

Uplands

Uplands include dwarf-low scrub and open white spruce forest vegetation types found on the adjacent terrace slopes. Species composition of the dwarf and low scrub communities is similar to those described for other sites. The open white spruce forest vegetation contains small white spruce (*Picea glauca*) and dwarf or small shrubs common in the wetlands types. These steep alluvial slopes are characterized by apparently relatively well-drained, coarse mineral soils.

Wetlands

The entire top of the terrace on the site (about 5.7 acres) is an isolated, saturated palustrine scrub-shrub broad-leaved deciduous and broad-leaved evergreen (PSS1/4B) wetland. Dwarf scrub vegetation is dominated by dwarf birch and several ericaceous shrubs, including bog blueberry, Labrador tea, lowbush cranberry, and crowberry. A sedge species, cloudberry, polar grass, and Arctic sweet coltsfoot were among the associated species. Silt loam mineral soils appear to be permanently saturated because of combination of shallow permafrost and subsurface drainage from the mountain slopes to the southwest.

Apparent wetland functions are similar to those provided by other previously described scrub-shrub wetlands. Natural biological support functions, hydrologic support, storm and floodwater storage, groundwater recharge and water quality protection range from low to moderate because of the wetlands landscape position, isolated nature, and relatively simple vegetation structure.

Wetland Impacts

Expansion of the existing mining operations at this site would remove approximately 3.1 acres of PSS1/4B wetlands. Existing operations and relatively high levels of human activity have already reduced the natural biological support functions of these wetlands to some degree. These wetlands are extensive throughout the park and loss of functions from their removal is expected to be moderate. Proposed reclamation might result in the creation of new wetlands assuming the permafrost and hydrology can be restored. Mining might result in changes in the hydrology of wetlands adjacent to Moose Creek that are downslope and to the west of mining area. Removal of the insulating layer is likely to increase the depth of thaw and translate to increased subsurface flows and increased groundwater discharge near the toe of the slope. Changes in hydrology might result in increased nutrient export and mineralization rates and increased forage potential for moose and beavers as willows grow in response to increased nutrient availability.

Moose Creek Terrace

Moose Creek Terrace consists of three different potential operations areas on different old alluvial terraces. The series of alluvial terraces range from about 40 to more than 80 feet above Moose Creek. The steep north-facing slopes of the mountain to the south and relatively flat 1 to 2 percent slopes of the terraces (not including the steep side slopes) appear to drain north toward Moose Creek.

Uplands

Upland vegetation adjacent to wetlands includes dwarf scrub types similar to those described above and an open needleleaf forest type. The latter appears to be an early seral phase of a white spruce forest type. White spruce forms an open canopy (~20 percent cover). In addition to white spruce, the dominant species include willow, dwarf birch, bog blueberry, crowberry, and lowbush crowberry.

Other plants that are present but not dominant included Labrador tea, mosses, and lichens. Upland plant communities were growing in coarser alluvial soils that appeared to be relatively well drained.

Wetlands

There are two wetlands at the Moose Creek Terrace site. These cover a total area of about 4.0 acres. Both are a mixture of palustrine scrub-shrub broad-leaved evergreen and broad-leaved deciduous (PSS1/4B) wetlands characterized by dwarf scrub vegetation types dominated by species similar to those described on other sites. Soils are apparently permanently saturated mineral soils. Shallow subsurface drainage from the slopes to the south appears to be the primary source of wetland hydrology to both wetlands. Because there is no direct surface water connection to Moose Creek, it appears that these are isolated and non-jurisdictional wetlands.

Functions for the PSS1/4B wetlands are similar to those previously discussed. Natural biological support functions may be somewhat higher than most other wetlands given the moderate structural complexity and proximity to the Moose Creek riparian corridor that provide habitat and travel corridor opportunities to fish and wildlife. Hydrologic support, storm and floodwater storage, groundwater recharge, and water purification or protection range from low to moderate.

Wetland Impacts

An estimated 4.0 acres of PSS1/4B wetlands would be temporarily altered by proposed mining. These wetlands appear to be isolated and non-jurisdictional wetlands. Proposed topsoil/overburden areas 1-3 are located in wetlands, as are the proposed stockpile/reject area and crusher/screenplant. Temporary alterations could be reduced by minimizing the footprint of topsoil and overburden stockpiles, stockpile/reject, and crusher/screenplant areas. There would be a temporary loss of some wetland functions during mining, such as some of the biological support functions as habitat would be unusable. Because of their temporary nature, these impacts are expected to be negligible. Assuming that wetlands would be restored upon removal of the topsoil and overburden, wetland functions would be restored as the wetlands recovered from this disturbance.

Camp Ridge

The Camp Ridge terrace is more than 100 feet above Moose Creek on the north side of the park road. Site drainage is WNW and W towards Moose Creek. Much of the site is characterized by gentle, 2 to 4 percent slopes. A small segment of the site, which is west of a small drainage, contains steeper forested slopes.

Uplands

An apparently older seral-phase needleleaf forest community type covers the steeper slopes (25 to 30 percent) on the western side of the small drainage. This community contained denser stands of white spruce (about 40 to 45 percent cover) that were considerably larger than elsewhere on the site. Dominant plants in this species-rich community included many of the same species observed elsewhere on the site, and also netleaf willow and rough fescue. Other plants present but not dominant included lichens and shrubby cinquefoil. Coarser-textured, better drained soils support this forest type.

Wetlands

Much of the site is wetland (1.5 acres) consisting of a mosaic of PSS1/4B and PEM1B wetlands. Wetlands consist of an open needleleaf forest type, dwarf scrub, and tussock tundra community types. Tree cover is generally less than 30 percent in the open needleleaf forest, so it is not considered a forested wetland according to the USFWS wetland classification system (Cowardin et. al. 1979). In addition, a portion of the site is characterized by a tussock tundra vegetation type that is classified as PEM1B wetland. White spruce and ericaceous shrubs similar to previously described scrub-shrub wetlands are dominant. Tussock tundra vegetation includes dwarf ericaceous shrub species similar to other wetlands as well as scattered black spruce (*Picea mariana*) and tussocks formed by cottongrass and sedges. Soils appear to be permanently saturated as a result of shallow permafrost and subsurface drainage patterns and range from mineral to organic (sphagnum peat). These palustrine scrub shrub and emergent wetlands appear to provide low to moderate levels of all functions, similar to previously described isolated wetlands.

Wetland Impacts

Approximately 1.5 acres of an apparently isolated, non-jurisdictional wetland complex composed of PSS1/4B and PEM1B classes would be removed by gravel mining. Although these types of wetlands are common in the park, this was the lone example of tundra and open forested/scrub-shrub wetland observed at the proposed gravel extraction sites being considered. Assuming this is representative of the overall distribution of this wetland type, it is less common than the other types encountered. Loss of these wetlands would likely not result in a major loss of functions. However, organic (peat) soils and the tundra (PEM1B) wetland vegetation class takes the most time to develop of all of the wetland types observed at the investigated sites, and cannot be easily restored or replaced. Potential impacts could be reduced by minimizing the mining footprint and replacing topsoil/overburden following completion of gravel mining.

Downtown Kantishna

This site is relatively flat and located in the floodplain of Moose Creek. Elevations on the site range from about 5 to 10 feet above the ordinary high water mark of Moose Creek. Much of the site has been disturbed by historic placer mining and contains tailings piles, abandoned channels, trails, and settling ponds. There are a couple of small tributary channels to Moose Creek near the northeast end of the site.

Uplands

Much of the site is unvegetated mine tailings. There is relatively sparse vegetation that includes some regrowth of alder, cottonwood, and willow.

Wetlands

The NWI map shows relatively extensive PSS1/4B wetland along the southwest boundary of the site. In addition to the palustrine wetlands, there are three riverine wetlands, Moose Creek (R3UBH) Eldorado Creek (R3UBHx) and a seasonally flooded, excavated unconsolidated shore (R3USCx) wetland in the northeast corner. Palustrine scrub-shrub wetlands appear to be associated with a lower lying area and small tributary drainages or side channels of Moose Creek. Dominant plants in this wetland include willows and dwarf evergreen shrubs similar to those for other wetlands with this classification. Soils are likely relatively shallow and permanently saturated. Both riverine wetlands have been disturbed by historic placer mining activities. These wetlands are generally unvegetated braided channels or sparsely vegetated gravel bars. Where vegetation exists, it consists primarily of pioneer species, including willows, alder and cottonwood.

Because of the disturbed nature of much of the site, wetland functions are relatively low for all categories except flood storage and attenuation for the R3USC_x wetlands. Because the site is in the floodplain, this function appears to be moderate. PSS1/4B wetlands appear to provide higher functions, as shown in Table 4.4, because of their size and less disturbed nature.

Wetland Impacts

An estimated 13.1 acres of PSS1/4B wetlands could be affected by gravel extraction along the southwest boundary of the proposed site, unless the mining and reclamation activity were limited to the previously disturbed areas of the site. In addition, 1.6 acre of R3USC_x wetland, which is likely a feature of historic placer mining, would be affected by gravel extraction. These wetlands appear to be associated with a small tributary drainage or side channel of Moose Creek and likely would be considered jurisdictional wetlands. It is assumed that impacts to riverine wetlands would be avoided or minimal, considering the proposed reclamation plans for the site. Impacts to palustrine wetlands at the north end of the site could likely be avoided or reduced by concentrating extraction and related operations over the rest of the site.

Kantishna Airstrip

The Kantishna Airstrip terrace is about 10 to 15 feet above the beaver pond wetland complex to the northwest and more than 30 feet above Moose Creek. There are two tiers to the terrace, a higher elevation tier to the south and a lower tier to the north. Water tracks that appear to carry seasonal flow to the beaver ponds occur at the base of the steep forested southwest slopes of Wickersham Dome that abut the site to the north. Site drainage, based on surface topography, appears to be NNW and WNW towards the beaver ponds and Moose Creek. Slopes on the top of the terrace are 1 to 2 percent. Side slopes are steeper (~15 to 20 percent). The southwest slopes of Wickersham Dome are very steep (~30 to 40 percent).

Uplands

Adjacent uplands are similar to those at other sites. Dwarf scrub communities are found on the side slopes of the terrace. Soils on the slopes appear to be relatively well drained.

Wetlands

The entire top of the terrace (about 9.1 acres) at this site is a mixed PSS1/4B wetland. The dwarf scrub vegetation is dominated by plants similar to those at wetlands described previously. Other plants that were common but not dominant included woodland horsetail (*Equisetum sylvaticum*), black spruce, sedges, and lichens.

This wetland appears to provide similar functions as the other PSS1/4B wetlands. Functions range from low to moderate.

Wetland Impacts

About 9.1 acres of apparently isolated, non-jurisdictional PSS1/4B wetlands could be removed by gravel mining, depending on the extent of activity at this location. This wetland type is common throughout the park and this impact would be unlikely to result in a major loss of wetland functions. Removal of wetlands could alter hydrology and water quality in wetlands to the northwest and west that are between the road and the toe of slope of the terrace where this site is located. Potential

impacts could be reduced by reducing the size of the proposed operation and through implementation of the proposed reclamation.

Proposed Mitigation

The proposed action includes a variety of measures in all alternatives to mitigate and monitor impacts of the actions on wetlands and other environmental resources. Measures used to mitigate impacts include avoidance, minimization through modification of proposed mining plans and, lastly, compensation for unavoidable impacts. The process to be followed for development and operation of upland and floodplain extraction and processing sites (described in detail in Chapter 2 of the EA) include specific prescriptions for identifying the area to be included in the active operations and installing erosion and sedimentation control measures. Sites would be designed so that restoration of the extraction area could occur quickly and return natural functions and processes to the sites. Operational monitoring, sediment monitoring and project documentation common to all sites and alternatives would include monitoring and records pertinent to wetland conditions before and after extraction activities. Restoration of the gravel source sites operated through this plan will, in general, not be considered to provide the compensation necessary for new wetland impacts.

The Downtown Kantishna site represents an exception to this condition. Wetland and floodplain resources at the Downtown Kantishna site have been considerably disturbed by past placer mining activity at the site, and the NPS has identified this site as a high priority for reclamation. While this site would be used for gravel extraction, the gravel removal would occur as an integral and necessary component of site reclamation. Because of the current degraded status of the Downtown Kantishna site, the serious need for reclamation of a functional stream/wetland/riparian system, and the need to recontour the floodplain to accomplish the reclamation, the Downtown Kantishna site would serve both purposes of gravel supply and compensation for wetland impacts.

Compensation, by restoration of previously degraded wetlands, is required under the NPS no-net-loss policy for projects involving disturbance or loss of wetlands. Gravel extraction and processing operations are not exempt from this requirement. Compensation will occur for the unavoidable loss or disturbance of wetland area at gravel source sites over the next 10 years. Compensation requirements and corresponding restoration plans have not yet been developed, pending NPS selection of a GAP alternative to be implemented, confirmed determination of the jurisdictional character of the affected wetlands, and final determination of the affected wetland acres and functions. However, the NPS has identified two sites as priority candidate locations for restoration of previously disturbed wetland areas. The sites are the Little Audrey and Yellow Pup mining claims, located in the Glacier Creek drainage northeast of Kantishna (see Maps D.1 and D.2). Wetland and riparian areas at both sites were disturbed by historic placer mining activities. The NPS estimates that the restoration areas for these sites could be approximately 10 acres at the former Little Audrey claims on Glacier Creek and 7.5 acres at the former placer claims on Yellow Pup Creek, a tributary to Glacier Creek. Restoration work would begin at these sites in 2004, and would follow an approach similar to NPS restoration of comparable disturbed areas along Caribou Creek in 2002.

Impacts by Alternative

The maximum total estimated wetland impact for each site and alternative is described in this section. Table 4.7 provides a summary of potentially affected wetland acreage by site, wetland type and alternative; these figures are based on the estimated wetland acreage within the mining plan envelope for each site, as displayed in Appendix C. To put the potential impacts in some sort of context, they are discussed by the type of wetlands affected, their apparent functions, and the potential ability for

the affected wetlands to be restored or recreated by proposed reclamation. Appendix D contains a summary of wetland evaluations and findings.

TABLE 4.8 SUMMARY OF POTENTIAL WETLAND IMPACTS BY ALTERNATIVE (ACRES)

| Site | Wetland Classification ¹ | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 | Alternative 5 |
|-----------------------------|--|---------------|------------------|------------------|------------------|------------------|
| TP | PSS1B ² | 0.8 | 1.2 | 1.2 | 1.2 | 1.2 |
| EFR | R3US/UB | | 2.3 ³ | | 2.3 ³ | 2.3 ³ |
| TR | R3US/UB | 2.2 | 3.3 ³ | 3.3 ³ | 3.3 ³ | 3.3 ³ |
| BP | PSS/EM1B | | | | | |
| B | PSS/EM1C ² | | 0.4 | | | |
| NFC | PSS1/4B ² | | | | | 3.1 |
| MCT | PSS1/4B ² | | | 4.0 | 4.0 | |
| CR | PSS1/4B ² and PEM1B ² | | 0.7 0.8 | | | |
| DK ⁴ | PSS1/4B | | | | | |
| | R3USC _x | | 1.6 | | 1.6 | 1.6 |
| KA | PSS1/4B ² | | 9.1 | | | |
| Total Impact (acres) | | 3.0 | 19.4 | 8.5 | 12.4 | 11.5 |

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

² Appear to be isolated, non-jurisdictional wetlands. The Alaska District, U.S. Army Corps of Engineers will make the final jurisdictional determination.

³ Including up to an acre of impacts from the temporary (seasonal) access road.

⁴ It is assumed that potential impacts to riverine wetlands (Moose Creek and Eldorado Creek) would be avoided or negligible. Gravel removal, processing and storage would be limited to previously disturbed areas.

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.

Alternative 1: No Action

The no-action alternative would impact about 3 acres of wetlands, the lowest impact of any alternative. Only those wetlands at the Teklanika Pit (PSS1B), Toklat River (R3US/UB), and North Face Corner (PSS1/4B) would potentially be affected. The river bottom wetlands along the Toklat River are periodically disturbed gravelly floodplain areas. There would be very little new impacts from continuing these existing gravel extraction operations.

Cumulative Impacts: Ongoing impacts to wetlands are from park projects to construct new visitor and administrative facilities and from pollution from vehicular use on the park road. Past impacts to wetlands are from construction of the park road and other infrastructure, and from placer mining in the Kantishna Hills. Future impacts to wetlands are expected to be limited to a few acres, at most, from trail construction. Restoration projects on wetlands and floodplains adjacent to placer-mined creeks in the Kantishna Hills would be expected to continue on tens of acres of regulatory wetland. The major increase in vehicle mileage on the park road from gravel hauling activity from this alternative would cause an incremental increase in the volume of dust and other airborne pollutants that would not result in noticeable change to wetland functioning along the road corridor. Destruction of about 1 acre of wetlands at Teklanika Pit under this alternative would have a very small impact on wetland resources along the road corridor. The cumulative impacts to wetlands in the park has been moderate, with a minor impact due to visitor facility construction and a moderate impact from 80 years of placer-mining in the Kantishna Hills.

Conclusion: Alternative 1 would result in negligible new direct and indirect impacts to wetlands. The overall level of wetland 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 affect the largest amount of wetland area (up to 19.4 acres), the most types of wetlands, and the least common wetland type observed at all of the sites (palustrine emergent wetlands at Boundary and Camp Ridge). Both jurisdictional and non-jurisdictional wetlands would be affected by this alternative, including 7.2 acres of jurisdictional riverine wetlands, 9.8 acres of isolated PSS1/4B wetlands, 0.4 acres of isolated PSS/EM1C wetlands, 1.2 acres of isolated PSS1B wetlands and 0.8 acres of isolated PEM1B wetlands (Table 4.7). Because loss of wetland functions would be proportional to loss of wetland area, this alternative also would contribute to a greater loss of functions compared to other alternatives and require the most compensatory mitigation. Even if tundra type (PEM1B) plants, topsoil and overburden are stockpiled, wetlands with peat (organic) soils are unlikely to be successfully restored or recreated. Organic soils, tussocks, and processes in these systems are not replicable at this time. There might be some risk of subsidence and thermokarst from thawing of permafrost, also reducing the potential to restore or recreate wetlands at the North Face Corner and Camp Ridge sites. This alternative would have the greatest losses of wetland acres and functions of all the action alternatives. Overall wetland impacts would be moderate, and would be greater than the other action alternatives.

Cumulative Impacts: Other considerations for cumulative impacts to wetlands would be similar as described for Alternative 1. The cumulative impacts to wetlands in the park has been moderate, with a minor impact due to visitor facility construction and a moderate impact from 80 years of placer-mining in the Kantishna Hills. This alternative would add up to 19 acres of direct impacts to wetlands, but these effects would be mitigated in part with compensatory wetland restoration at previously disturbed sites in the Glacier Creek drainage and Downtown Kantishna site. The overall cumulative impacts to wetlands would remain moderate.

Conclusion: Alternative 2 would result in moderate overall direct and indirect impacts to wetlands habitat along the park road corridor. The overall level of wetland 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

Fewer potential wetland impacts would occur from this alternative, compared to Alternatives 2, 4, or 5, an estimated maximum of 8.5 acres. Only those wetlands most commonly found along the park road corridor and at potential extraction sites would be affected and most of these would be jurisdictional riverine wetlands (3.3 acres) that would result in temporary impacts on wetland functions. In addition, approximately 1.2 acres of isolated and non-jurisdictional PSS1B wetlands and 1.4 acres of isolated and non-jurisdictional PSS1/4B wetlands would be affected. Potential losses of wetland acres and functions would be the lowest among the action alternatives, but greater than for Alternative 1. Overall wetland impacts would be minor.

Cumulative Impacts: Other considerations for cumulative impacts to wetlands would be similar as described for Alternatives 1 and 2. The cumulative impacts to wetlands in the park has been

moderate, with a minor impact due to visitor facility construction and a moderate impact from 80 years of placer-mining in the Kantishna Hills. Proposed placer mining restoration at Glacier Creek would reduce the overall adverse impacts to wetlands in the park. This alternative would result in up to 8.5 acres of impacts to wetlands (the least of all the action alternatives), but the overall cumulative impacts to wetlands would remain moderate.

Conclusion: Alternative 3 would result in minor overall direct and indirect impacts to wetlands habitat along the park road corridor. The overall level of wetland 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 would affect a combined total of up to 12.4 acres of jurisdictional and non-jurisdictional wetlands. Alternative 4 would affect the same amount of jurisdictional wetlands (5.6 acres of R3US/UB) as Alternative 2 or Alternative 5. Approximately 1.2 acres of isolated and non-jurisdictional PSS1B and 4.0 acres of isolated and non-jurisdictional PSS1/4B wetlands also would be affected. This alternative would have greater potential impacts on wetland acres and functions than Alternative 3, but lower potential impacts of both wetland acreage and functions compared to Alternative 2. All of the wetlands impacted by this alternative are common throughout the park and the surrounding region. Overall wetland impacts would be less than with Alternative 2, but potential impacts are higher than Alternative 3 and slightly higher than Alternative 5. Direct impacts to wetlands at the Moose Creek Terrace site could be reduced by moving processing and stockpiling activities onto newly excavated upland areas as the site is developed. Direct and indirect wetlands impacts would be long-term in a few small isolated locations, or moderate.

Cumulative Impacts: Considerations for cumulative impacts to wetlands would be similar as described for Alternatives 1 and 2. The cumulative impacts to wetlands in the park has been moderate, with a minor impact due to visitor facility construction and a moderate impact from 80 years of placer-mining in the Kantishna Hills. Proposed placer mining restoration at Glacier Creek and Downtown Kantishna would reduce the overall adverse impacts to wetlands in the park. This alternative would result in up to 12.4 acres of additional impacts to wetlands, but the overall cumulative impacts to wetlands would remain moderate.

Conclusion: Alternative 4 would result in moderate overall direct and indirect impacts to wetlands habitat along the park road corridor. The overall level of wetland 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 total affected wetland area for this alternative is estimated at a maximum of 11.5 acres. Alternative 5 would result in similar impacts to jurisdictional riverine and jurisdictional PSS1/4B wetlands compared to Alternative 2 and Alternative 4, and slightly lower impacts on jurisdictional riverine wetlands compared to Alternative 3. Compared to Alternative 4, total impacts to isolated and non-jurisdictional PSS1/4B wetlands for this alternative would be approximately 0.9 acres less. Alternative 5 would involve the same amount of impacts (about 1.2 acres) to isolated and non-jurisdictional PSS1B wetlands as all other action alternatives. Potential for wetland losses and associated functions for Alternative 5 are higher than for Alternative 3, but lower than for Alternative

2 and Alternative 4 (by a small margin). As with alternative 4, the overall direct and indirect impacts to wetlands would be moderate.

Cumulative Impacts: Considerations for cumulative impacts to wetlands would be similar as described for Alternatives 1, 2, and 4. The cumulative impacts to wetlands in the park have been moderate, with a minor impact due to visitor facility construction and a moderate impact from 80 years of placer mining in the Kantishna Hills. Proposed placer mining restoration at Glacier Creek and Downtown Kantishna would reduce the overall adverse impacts to wetlands in the park. This alternative would result in up to 11.5 acres of additional impacts to wetlands, and the overall cumulative impacts to wetlands would remain moderate.

Conclusion: Alternative 5 would result in moderate direct and indirect impacts to wetlands habitat along the park road corridor. The overall level of wetland 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.

FLOODPLAINS

The current Gravel Acquisition Plan considers five alternatives to acquire sufficient gravel over a 10-year period to maintain and repair the park road. Within the alternatives there are 10 total sites considered as potential gravel sources, 3 of which lie within a floodplain. East Fork River and Downtown Kantishna are new potential sites and Toklat River is currently operating.

Executive Order 11988 (Floodplain Management) requires the NPS, and other federal agencies, to evaluate the impacts its actions are likely to have on floodplains. This executive order requires that short and long-term adverse impacts associated with occupancy, modification or destruction of floodplains be avoided whenever possible. Indirect support of development and new construction in such areas should be avoided wherever there is a practicable alternative. To comply with these orders, the NPS has developed a set of agency policies and procedures, which can be found in Special Directive: 93-4: Floodplain Management Guideline. Compliance with Executive Order 11988 and Special Directive 93-4 is addressed in a Statement of Findings (SOF) presented as Appendix E to this EA.

Methods to minimize damage from a 100-year flood, as described in the National Flood Insurance Program (NFIP) "Floodplain Management Criteria for Flood Prone Areas" (44 CFR 60.3), do not apply to this project.

No significant risk to human health or safety would occur as a result of this project. The gravel extraction and processing work would take place during periods of low visitation. No downstream activities or development would be affected.

Summary of Site-Specific Impacts

All five of the alternatives evaluated in the EA would result in temporary physical disturbances to floodplains in Denali National Park. Table 2.1 indicates which of the floodplain sites would be included in which GAP alternatives. Alternative 1 and Alternative 3 would continue to extract and processes borrow material from the Toklat River site, but would not involve use of other floodplain sites. Alternative 2 would utilize material from the Toklat River, the East Fork River, and the Downtown Kantishna sites. Alternatives 4 and 5 both use material extracted from the Toklat River, East Fork River, and Downtown Kantishna sites.

Toklat River

The Toklat River site is positioned in the floodplain of the Toklat River about 0.75 miles north of Mile 53.4 of the park road. A 14- to 20-foot-wide, 0.75-mile-long gravel spur road from the park road to the Toklat Camp provides access to the edge of the floodplain and processing area. To acquire additional gravel from this site, heavy equipment would drive out onto the floodplain from a ramp at the end of the Toklat Camp access road. Extraction and processing activities would occur mostly before or after the bulk of the summer visitation season, because this site is visible from the park road. Studies of Toklat River bed-load transport (Karle 1989 and Emmet 2000) indicate that an annual average of 11,100 cy per year could be safely removed from the floodplain without adversely affecting river processes. The NPS (1999) previously concluded that the operation proposed for the Toklat River site could be conducted without significant effects to the floodplain.

East Fork River

This site is positioned in the floodplain of the East Fork of the Toklat River south of Mile 43.6 of the park road. A 10- to 12-foot-wide, 0.25-mile-long gravel spur road from the park road to the East Fork Cabin provides access to the edge of the flood plain. As with the Toklat River site, heavy equipment would drive out onto the floodplain from a ramp at the end of the East Fork Road to access the floodplain gravel source. Studies of East Fork River bed-load transport (Emmet 2002) indicate up to 5,400 cy/yr could safely be removed from the floodplain without adversely affecting river processes. Similar to the Toklat River situation, gravel could be extracted from the East Fork River site without significant impacts to the floodplain.

Extraction activities at the East Fork River would occur during September or in emergency situations. Extraction and processing would occur mostly before or after the bulk of the summer visitation season, because this site is highly visible from the park road. The East Fork River would be utilized under Alternatives 2, 4, and 5. In all three cases, the site would be reserved for emergency road repairs on the park road between the Teklanika Pit (Mile 27) and the Toklat River site (Mile 53).

Downtown Kantishna

This large area lies on the western side of Moose Creek, immediately north of the Kantishna Roadhouse, and across Moose Creek beginning at Mile 91 of the park road. Access to the site is currently available by a gravel road with a ford at Moose Creek, but a bridge would be needed in the future to facilitate access by heavy equipment. The site dimensions are about 3,700 feet long by about 1,000 feet wide, with an estimated deposit thickness of 5 to 10 feet. The site covers about 55 acres. The site is estimated to produce a maximum yield of 59,000 cy of material. Though most of the area was previously disturbed, much of the area has already been colonized with alders, willows, cottonwood, and white spruce trees. Very little overburden occurs on the site.

This site would be operated throughout the summer season as needed. The process and storage area would be in the middle of the extraction area, to minimize visibility of the operations from the park road, Kantishna Roadhouse and Denali Backcountry Lodge. Operations at this site would necessarily involve equipment activity within and between the stream channels existing at this site, and there would be physical disturbance of the floodplain over a rather extensive area. The residual level of impact to the floodplains of Moose Creek and Eldorado Creek would depend largely upon the success of the reclamation plans for the site. Successful restoration would be able to reverse floodplain impacts from historic mining activities, including the loss of a substantial length of the original Eldorado Creek channel. Following restoration, NPS management of the site would be to protect the natural values and functions of the site.

Mitigation Measures

At both the East Fork and Toklat River sites, mirror channels would be excavated with a front-end loader from a downstream position to an upstream position beside an active river channel. Gravel from these mirror-channel cuts would be immediately loaded into dump trucks. Each mirror channel would be reclaimed within 5 years by natural stream flow processes, as the river dropped bed load to fill the cuts. Because no vegetation survives in the active floodplain, vegetative recovery would not be needed. The NPS would make annual level surveys across, above, and below the extraction area to assure natural river processes were not adversely affected.

Restoration plans for the Downtown Kantishna site have to date not been developed beyond the conceptual level. In general, those plans indicate that following removal of the planned gravel volume, the surface of the site would be contoured to match surrounding grades and to produce adequate meandering channels in Eldorado and Moose Creeks to facilitate fish passage. The final site contours would also provide for natural floodplain development on the site, rather than defining narrow channels for the creeks. The NPS may employ similar re-vegetation techniques to this area as were used to restore mining claims on Glen Creek.

General Impact Conclusion

With implementation of mitigation measures and successful reclamation of the sites, there would be minimal adverse impacts on floodplain values associated with any of the alternatives considered for this project. Use of the Toklat site is common to all five alternatives evaluated in the EA. Previous NPS EAs prepared in 1992 and 1999 (the latter specifically for the Toklat Borrow Material Processing Site) found that operations taking place in the Toklat River floodplain would not have significant effects on floodplain values. Impacts on the East Fork River from gravel mining would be essentially the same as those at the Toklat River site; removing material at the proposed rates would allow either site to be reclaimed within 5 years by natural stream processes.

Gravel acquisition is proposed for the Downtown Kantishna site under Alternatives 2, 4, and 5. In each the NPS objective is to mine material and reclaim the site during the life of the plan. Because this area has been substantially disturbed by mining activities in the past 50 years, reclamation of the site is a necessary activity in any event. All three alternatives that include Downtown Kantishna incorporate reclamation at the site after gravel extraction operations have been completed. Assuming the reclamation plan would be successful, the natural function of the floodplain would be restored and long-term effects on the floodplain would be minimal.

Based on these expected outcomes, none of the alternatives under consideration would be likely to have more than a minor adverse effect upon the integrity of floodplain resources in the park. With reclamation of the Downtown Kantishna site, natural floodplain functions that had been modified by cumulative mining impacts would actually be improved relative to the current condition.

Impacts by Alternative

Alternative 1: No Action

Alternative 1 would continue to remove the same amount of gravel from the floodplain at the Toklat River site, which would be reclaimed by natural processes within 5 years. This would result in little or no change from past practices.

Cumulative Impacts: Ongoing impacts to floodplains are from gravel extraction at Toklat River. Past impacts to floodplains are from construction of the park road, walling-off 4.77 acres of the Toklat floodplain as a gravel-processing site, and from 80 years of placer mining in the Kantishna Hills. Future impacts to floodplains are not expected at this time. Restoration projects on floodplains adjacent to placer-mined creeks in the Kantishna Hills are expected to continue on tens of acres of floodplains. Continued excavation at Toklat River would have a negligible effect on floodplain functioning. The cumulative impacts to floodplains in the park have been moderate, with a minor impact due to administrative facility construction and a moderate impact from 80 years of placer mining in the Kantishna Hills.

Conclusion: Alternative 1 would result in negligible direct and indirect impacts to floodplains. The overall level of floodplain 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 extract gravel from two new sites (East Fork River and Downtown Kantishna), and would extract gravel at a greater rate from the Toklat River (11,100 cy versus 7,500 cy.)

Cumulative Impacts: As described for Alternative 1, cumulative impacts to floodplains in the park have been moderate, with a minor impact due to administrative facility construction and a moderate impact from 80 years of placer-mining in the Kantishna Hills. The small but inconsequential effects of gravel extraction in the East Fork River and increased extraction at Toklat River would result in small additive effects to floodplains. Extraction with restoration at Downtown Kantishna and restoration at Glacier Creek would improve overall floodplain functions at these locations by grading out tailing piles, increasing stream sinuosity, and reintroducing vegetation in the floodplains. The overall cumulative effects to floodplains would remain moderate.

Conclusion: Alternative 2 would result in minor direct and indirect impacts to floodplains. The overall level of floodplain 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

Alternative 3 would result in a small increase in the extraction of gravel from the floodplain at the existing Toklat River site compared to the no-action alternative (from 7,500 cy to 11,100 cy.)

Cumulative Impacts: Cumulative impacts to floodplains would be similar as described for Alternative 1. The cumulative impacts to floodplains in the park have been moderate, with a minor impact due to administrative facility construction and a moderate impact from 80 years of placer mining in the Kantishna Hills.

Conclusion: Alternative 3 would result in negligible direct and indirect impacts to floodplains. The overall level of floodplain 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*)

Alternative 4 is virtually identical to Alternative 2 with respect to floodplain actions and potential impacts. Therefore, Alternative 4 would have short-term effects on small areas in the floodplains at Toklat River, East Fork River, and Downtown Kantishna. Effects at Downtown Kantishna may actually be beneficial to floodplain functions.

Cumulative Impacts: Cumulative impacts to floodplains would be the same as described for Alternative 2. Impacts to floodplains in the park have been moderate, with a minor impact due to administrative facility construction and a moderate impact from 80 years of placer mining in the Kantishna Hills. The small, inconsequential effects of gravel extraction in the East Fork River and increased extraction at Toklat River would result in small additive effects to floodplains. Extraction with restoration at Downtown Kantishna and restoration at Glacier Creek would improve overall floodplain functions at these locations. The overall cumulative effects to floodplains would remain moderate.

Conclusion: Alternative 4 would result in minor direct and indirect impacts to floodplains. The overall level of floodplain 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 identical to Alternative 4 with respect to floodplain actions and potential impacts. Therefore, Alternative 5 would have minor long-term effects on the floodplain at the Toklat River, East Fork River or Downtown Kantishna sites. Effects at Downtown Kantishna may actually be beneficial to floodplain functions.

Cumulative Impacts: Cumulative impacts to floodplains would be the same as described for Alternative 4. Impacts to floodplains in the park have been moderate, with a minor impact due to administrative facility construction and a moderate impact from 80 years of placer mining in the Kantishna Hills. Overall cumulative impacts to floodplains would remain moderate, but slightly improved.

Conclusion: Alternative 5 would result in minor direct and indirect impacts to floodplains. The overall level of floodplain 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.

CULTURAL RESOURCES

None of the candidate gravel sites evaluated in this EA, except for Downtown Kantishna, are located close to known existing archeological or historical resource sites. As discussed in Chapter 1, one of the criteria the NPS used to identify potential material source sites within the park is that development of the source would not impact known or suspected important historical or archeological resources or their settings. The excavation/reclamation plan for Downtown Kantishna would not include work closer than 100 feet from the Busia Cabin on the southern part of the Moose #1 claim. The Busia Cabin was declared eligible for the National Register of Historic Places in 1983 by the State Historic Preservation Officer.

As reported in Chapter 3, the NPS has evaluated all of the candidate material sites as having negligible potential for the presence of an unrecognized significant historic or archeological resource. This conclusion is based on negative findings from surveys for the presence of significant historic properties or archeological resources, and on the observed attributes of site geomorphology and environmental setting. The NPS has determined there is not a need for further archeological survey or monitoring during source development. If cultural resources were uncovered during excavation at any of the material sites, however, work would be stopped and appropriate mitigation would be undertaken prior to resumption of borrow operations.

The status of prior archeological investigations for individual alternate material sources located outside the park is unknown. Collectively, these external material sources are situated within the upper Nenana River valley. This geographic region is distinguished by relict river terraces upon which are numerous archeological sites representing some of the earliest known human occupations in Alaska. Consequently, in lieu of area-specific archeological survey data, the inferred cultural resource potential of these material sources is presumed to be high. Archeological surveys would likely need to be completed before any of these existing sources could be significantly expanded, if that were necessary to meet the volume requirements for external gravel sources, or if any new sources outside the park were to be developed to meet park gravel needs.

Section 101(d)(6)(B) of NHPA requires consultation with federally recognized Indian tribes - basically, an invitation to be consulting parties in the identification and evaluation process. This provision is included to address properties that may be of traditional religious and cultural significance to Alaska Natives (i.e., Traditional Cultural Properties). Such properties may not be represented by the presence of tangible physical remains, but may exist as a geographic or landscape feature. This formal consultation process has not yet been initiated for any of the potential material sources.

Alternative 1: No Action

The NPS has already received cultural resource clearances for gravel extraction operations at the Teklanika Pit, Toklat River and North Face Corner sites. Future discoveries of cultural resources from operations at these sites are not anticipated. The potential for cultural resource finds at material sites outside the park is unknown, because the location and degree of disturbance cannot be determined. Alternative 1 requires by far the largest volume of material (over 200,000 cy) from external sources, however, so this alternative would involve the highest indirect disturbance to cultural resources not yet inventoried external to the park.

Cumulative Impacts: No adverse impacts have occurred to historic or archeological sites on public property along the park road or in the Kantishna area. In fact the NPS has restored historic log structures in the headquarters area and the Quigley cabin in Kantishna. The old Kantishna Roadhouse and other structures are being preserved at the lodge. No known listed cultural properties would be affected by this alternative. The overall cumulative impacts would be negligible.

Conclusion: Alternative 1 would result in negligible direct and indirect impacts to cultural resources in the park. The overall level of potential cultural 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

The NPS has already received cultural resource clearances for gravel extraction operations at three existing sites inside the park, and has determined that the remaining six sites included in this alternative have negligible potential for the presence of unrecognized significant historic or archeological resources. New development at any of the latter six sites would not adversely affect known significant cultural resources or their settings. The listed Busia Cabin near the Downtown Kantishna extraction area would be avoided as described above. Therefore, operations under Alternative 2 would have negligible impacts on identified cultural resources and would not be likely to damage the integrity of undiscovered cultural resources within the park. The potential for cultural resource impacts at external material sites is unknown, but Alternative 2 requires a relatively small volume of material (projected at 12,500 cy in the cost analysis; see Appendix B) from external sources, and therefore would involve low potential for disturbance of resources not yet inventoried.

Cumulative Impacts: As described for Alternative 1, negligible and positive effects have occurred to cultural properties along the park road and no known cultural sites would be affected by this alternative. The overall cumulative impacts to cultural resources would be negligible.

Conclusion: Alternative 2 would result in negligible direct and indirect impacts to cultural resources in the park. The overall level of potential cultural 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 NPS has already received cultural resource clearances for gravel extraction operations at three existing sites inside the park (including North Face Corner that would only be restored under this alternative). The NPS has determined that the remaining site (Moose Creek Terrace) included in this alternative has negligible potential for the presence of unrecognized significant historic or archeological resources. New development at the latter site would not adversely affect known significant cultural resources or their settings. Therefore, operations under Alternative 3 would have negligible impacts on identified cultural resources and would not be likely to damage the integrity of undiscovered cultural resources within the park. The potential for cultural resource impacts at material sites outside the park is unknown, but Alternative 3 requires a relatively large volume of material (approximately 120,000 cy) from external sources, and therefore would involve a relatively higher potential for disturbance of resources not yet inventoried. Overall, the impacts from Alternative 3 would be virtually the same as those for Alternative 1.

Cumulative Impacts: The overall cumulative impacts would be negligible and nearly identical to those described for Alternative 1.

Conclusion: Alternative 3 would result in negligible direct and indirect impacts to cultural resources in the park. The overall level of potential cultural 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 a Moderate Number of Sites (*NPS Preferred*)

The NPS has already received cultural resource clearances for gravel extraction operations at three existing sites inside the park, and has determined that the remaining three sites included in this alternative have negligible potential for the presence of unrecognized significant historic or archeological resources. New development at any of the latter sites would not adversely affect known significant cultural resources or their settings. Therefore, operations under Alternative 4 would have negligible impacts on identified cultural resources and would not be likely to damage the integrity of undiscovered cultural resources within the park. The potential for cultural resource impacts at material sites outside the park is unknown, but Alternative 4 requires a relatively small volume of material (estimated at 12,500 cy) from external sources, and therefore would involve low potential for disturbance of resources not yet inventoried. Overall, the impacts from Alternative 4 would be very similar to (but slightly less than) those for Alternative 2.

Cumulative Impacts: As described for Alternative 1, negligible and positive effects have occurred to cultural properties along the park road and no known cultural sites would be affected by this alternative. The overall cumulative impacts to cultural resources would be negligible.

Conclusion: Alternative 4 would result in negligible direct and indirect impacts to cultural resources in the park. The overall level of potential cultural 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*)

Alternative 5 involves essentially the same actions and impacts as Alternative 4, except for the substitution of the North Face Corner site for Moose Creek Terrace. Overall, the impacts from Alternative 5 would be virtually identical to those for Alternative 4 and would be negligible.

Cumulative Impacts: As described for Alternative 1, negligible and positive effects have occurred to cultural properties along the park road and no known cultural sites would be affected by this alternative. The overall cumulative impacts to cultural resources would be negligible.

Conclusion: Alternative 5 would result in negligible direct and indirect impacts to cultural resources in the park. The overall level of potential cultural 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.

VISITOR USE AND EXPERIENCE

Park visitors in the vicinity of gravel acquisition operations would potentially be exposed to direct and indirect effects associated with those operations. In 1972 the NPS instituted its shuttle bus service and restricted private vehicles traveling past Savage River. Only visitors camping at Teklanika for a three-night minimum stay, Kantishna property owners, NPS staff, and individuals with special use permits are allowed to drive beyond the Savage River Check Station. There are three bus options for visitors who wish to drive into the park interior. The NPS shuttle, or visitor transportation service (VTS), travels between the park entrance and either Wonder Lake or the Eielson Visitor Center. The Tundra Wilderness Tour (TWT) travels to Mile 53. The Denali Natural History Tour (DNHT) makes

daily roundtrips to Mile 17 on the park road. (Because the DNHT trips only go a short distance beyond the Savage River check station, they are not counted against the 10,512-vehicle limit for the park road allocation period.) These transportation patterns largely determine the numerical distribution of visitors along the road corridor, and the number of visitors that might experience project activity at any given location.

According to the 1999 Park Road Traffic Report (NPS 2000) a total of 14,217 vehicles and 308,112 passengers traveled the park road in that year. Both were the highest numbers recorded to date. The GMP limits the number and types of vehicles allowed to transit the park road during the allocation period, which is from late May to mid-September. During the 1999 allocation period 12,649 vehicles and 289,916 passengers traveled the park road. Of those vehicles 36% were shuttle busses, 23% were tour buses, 26% were private vehicles, and 12% were NPS vehicles. The proportion of vehicles on the road during the GMP allocation period is roughly even by month during June (25% of the total), July (28%) and August (28%).

Table 4.9 provides the numbers of trips and passengers for each vehicle type, for both the entire year and the allocation period. Because no significant physical or management changes have occurred in the park since 1999, these data can be assumed to reflect current conditions on the park road. Furthermore, while no specific data are available on the distribution of visitor use along the park road beyond the Savage River Check Station, the distribution of the bus trips themselves provide a basic idea of visitor use patterns along the park road corridor. Most visitors taking a bus tour tend not to travel very far from designated bus stops. Therefore, because the three types of buses travel to various locations their frequency can be used as a key measure of most visitor use patterns in the park interior.

TABLE 4.9. NUMBERS OF VEHICLES AND PASSENGERS ON THE DENALI PARK ROAD

| | VTS | TWT | DNHT | Private | NPS | Total |
|---|--------|---------|--------|---------|-------|---------|
| Total number of vehicles on the park road 1999 | 3,507 | 2,409 | 2,099 | | | 14,217 |
| Total number of passengers on the park road 1999 | 97,350 | 107,930 | 17,308 | | | 308,112 |
| Number of vehicles on the park road during the GMP allocation period 1999 | 3,507 | 2,214 | 1,893 | 2,519 | 1,443 | 11,576 |
| Number of passengers on the park road during the GMP allocation period 1999 | 97,350 | 101,076 | 77,791 | 13,699 | | 276,217 |

Table 4.9 does not include data for Kantishna lodge operations. Businesses in the Kantishna area typically run an average of less than two round trips per lodge per day for administrative and other purposes (NPS 1996). Kantishna lodge bus passengers were estimated at 9,814 in the same report. According to a 1999 EIS for the Spruce Creek Access, a conservative estimate of 7,000 people visit or reside in Kantishna from June to mid-September (NPS 1999). However, NPS staff report that Kantishna visitor numbers have increased in recent years to 9,000 or more per year.

Backcountry users must camp at least one-half mile away, and out of view, from the park road or any other developed area (including gravel extraction sites). According to 2001 NPS visitor statistics, more than 90% of the backcountry use occurred from May through August. The average backcountry visitor season is approximately 100 days. Based on this 100 day season and assuming 100% capacity,

most of the backcountry zones in which gravel acquisition, processing, and storing sites are proposed could expect an absolute maximum of 400 to 600 (depending on the zone-specific quota) backcountry users throughout the season.

In a visitor survey completed in 1998 (Miller and Wright 1998), park visitors were asked a number of questions regarding their experience using the parks transportation system and the impact of the system on enjoying the park resources. A majority of the visitors indicated that seeing wildlife was an important part of their trip. Approximately 70% of the visitors sampled rated the bus as a place for viewing wildlife as good or excellent. A minority of visitors thought that seeing other busses detracted from their enjoyment of the park. The overwhelming response of the visitors indicated that existing traffic levels on the road did not pose a problem. Visitors further indicated that they did not perceive the traffic as an interference with their wildlife viewing experience. These survey responses are applicable to consideration of the cumulative impacts of the gravel acquisition activities on the visitor experience, particularly in relation incremental changes in park road traffic as a result of gravel hauling activity.

Alternative 1: No Action

Under this alternative, Teklanika Pit, Toklat River, and North Face Corner would remain the only approved material extraction sites along the park road. Neither the Teklanika nor Toklat River sites are visitor destinations or are part of exceptional viewsheds (NPS 1992). Visitors rarely venture close enough to the Toklat site to be adversely affected by work there. The Teklanika Pit area does not offer highly valued scenic attractions and is not frequently used as a hiker route. Based on these conditions, the NPS (1992) previously found that operations at these two sites would have negligible impacts on visitor use patterns in the areas of operation. The 1999 EA on expanding operation at the Toklat River site likewise concluded that the operations would have not have significant impacts on visitor use patterns in the area of operations.

The NPS (1999) EA for gravel acquisition at the North Face Corner site noted that operations at the screening plant would occur before the park road is open to bus traffic and before guests arrive at the Kantishna lodges. This would significantly reduce the impact of the noise generated during operations. Because of the timing of the proposed operations, the EA concluded that fewer than 100 visitors would be exposed to gravel processing operations in any season. The needs of the material crushing contract, however, mandated that the gravel pit operation started on August 19, and a much larger number of visitors were affected. Gravel extraction at North Face Corner would end by September 2003, so these effects would be short term.

The prior NPS environmental documents did conclude, however, that the proposed acquisition, processing and storage sites would increase the number of trucks on the park road needed to haul material to either storage sites or work sites along the road. These additional trips would increase noise and dust near the road and might contribute to lowered visitor satisfaction with the park. According to the cost analysis documented in Appendix B, the no-action alternative would generate an average of approximately 228,000 truck miles per year for hauling gravel. This represents the equivalent of approximately 16 percent of the vehicle miles generated on the park road by existing visitor and administrative traffic. This alternative would have the highest level of trucking activity among the five GAP alternatives. The machinery for both extracting and processing gravel would also be a source of noise and would occur at three existing extraction locations during hours of operation.

This alternative would likely produce about a 16 % increase in noise, exhaust, and dust production along the road corridor relative to current levels. The corresponding impacts to visitor use and

experience would be considered moderate. The effects of this activity on the visitor experience could be mitigated considerably by hauling gravel at night and/or during the shoulder seasons, to the extent practicable. Expanded use of dust palliatives on the park road could also reduce the amount of dust produced by the trucking activity.

Cumulative Impacts: The 228,000 miles of trucking activity with its noise and dust emissions would be added to the ongoing 1,481,000 miles of visitor bus and administrative vehicle travel. The 16 % increase in large vehicle travel on the park road would have periodic short term but widespread impacts to visitor experiences. The overall cumulative impacts would be moderate.

Conclusion: Alternative 1 would result in moderate direct and indirect impacts to visitor use and experience in the park.

Alternative 2: Maximum Flexibility/Short Hauls

This alternative would authorize extraction of mineral material from up to eight sites and the use of North Face corner for stockpiling and processing material. Two of the proposed sites, Teklanika Pit and Toklat River, are currently authorized for borrow production. The six new sites would be East Fork River, Beaver Pond, Boundary, Camp Ridge, Downtown Kantishna, and Kantishna Airstrip.

Increased dump truck and heavy equipment activity near the extraction sites and/or along the park road could affect the perception visitors have of the park and their recreational experience. Gravel hauling might occur at any time during the summer months. A slight degradation of visitor experience from these trucks might be expected. Under this alternative, however, the number of proposed sites would minimize haul distances and truck traffic. This alternative would generate approximately 110,000 truck miles a year, equivalent to 7 percent of total current annual vehicle miles generated by visitor and administrative traffic on the park road.

The gravel sites themselves would increase the distribution of human and industrial activity along the park road, particularly in the Kantishna area (see the Scenic Values section). Alternative 2 has the most proposed sites and it also has the most proposed sites that could be operating simultaneously during the summer season, creating human disturbance at more locations along the road corridor. The potential effects on wildlife viewing from the park road would probably be transient, however, and would be felt locally only when work was in progress.

Campers in the park campgrounds would be negatively affected only if the proposed sites were in sufficient proximity to campgrounds. The Teklanika campground is approximately 2 miles from the Teklanika Pit. Campers at Teklanika would be unlikely to experience additional noise from site operations, but they might notice increased traffic from trucks hauling material to repair sites along the road. The other proposed site that is relatively close to a campground is the Boundary site, which is located approximately 1,500 feet north of Wonder Lake. The Wonder Lake campground is located at the southern end of the lake, an additional 1.5-mile distance and lower in elevation. Noise from operations at the site might reach campers, but more likely the presence of trucks and the visual intrusion when entering and leaving the area would be the primary influence on their experience.

This alternative would not significantly affect backcountry users of the park. The draft backcountry management plan for the park allows few people per night per backcountry unit, and regulations require users to camp at least a half mile away, and out of view, from the road corridor and development sites. Given the size of each unit and the number of people allowed, backcountry users

should have no difficulty dispersing to pristine areas, away from the road corridor, that offer a quality wilderness experience.

Day hikers in the park should be minimally affected by this alternative. Most of the developed trails in the park are in the entrance area and are far away from any of the proposed gravel sites. There are also short trails near the Eielson Visitor Center, but operations noise at the proposed Beaver Pond site should not be audible from the center and the trail. Visitors who day hike off trail near one of the proposed sites may be subjected to noise or visual intrusions. The size of the park and park road, however, would make it easy for visitors to hike without encountering any of the proposed sites.

Processing and stockpiling activities at the North Face Corner pit would be visible and audible to users of the park road in that area, including all visitors to Kantishna. Gravel mining and reclamation activity at the Downtown Kantishna site would be evident to visitors at the Kantishna Roadhouse and Denali Backcountry Lodge. Noise, work at the sites, vehicle activity and fugitive dust associated with gravel acquisition work could affect the way these visitors perceive the character of the park.

Alternative 2 would affect more visitor experiences than Alternatives 3 through 5. This alternative includes the highest number of sites to be operated (9) and would create more gravel extraction activities that would be audible to campers and hikers. However, Alternative 2 would generate fewer truck miles on the park road than Alternatives 1 and 3 and approximately the same amount as Alternatives 4 and 5.

Alternative 2 would not affect visitor use patterns within the park and the effects on visitor experiences would likely be short-term and transitory over small areas, except for those staying at Kantishna area lodges. The overall impacts on visitor use and experience with this alternative would be minor. The effects of this alternative on visitor use and experiences could be mitigated considerably by hauling gravel at night and/or during the shoulder seasons, to the extent practicable. Expanded use of dust palliatives on the park road could also reduce the amount of dust produced by the trucking activity.

Cumulative Impacts: The 110,000 miles of trucking activity with its noise and dust emissions would be added to the ongoing 1,481,000 miles of visitor bus and administrative vehicle travel. The 7 % increase in large vehicle travel on the park road would have periodic short term but widespread impacts to visitor experiences. Alternative 2 would create a small incremental increase to the number and extent of developed sites within the park road corridor. The overall cumulative impacts are judged to be minor.

Conclusion: Alternative 2 would result in minor direct and indirect impacts to visitor use and experience along the park road corridor.

Alternative 3: Minimum Visual Intrusion/Long Hauls

This alternative involves maintaining two of the current three approved material extraction sites and adding one new site, at Moose Creek Terrace, to produce material for use on the western end of the road. Truck traffic and noise would be the feature of this alternative most evident to visitors. Because this alternative proposes only three sites within the park and requires a substantial amount of gravel to be brought in from outside the park, total gravel hauling activity would be highest among the four action alternatives. The potential effects on wildlife viewing from the park road would probably be transient and would be felt locally only when work was in progress.

Alternative 3 would generate an average of approximately 175,000 truck miles per year for gravel hauling. This represents the equivalent of approximately 12 percent of the total vehicle miles currently produced on the park road by visitor and administrative traffic. Truck traffic would be greater for this alternative than Alternatives 2, 4 or 5, but less than Alternative 1. The incremental change would likely be minor relative to the current volume of traffic, however, and would likely not be noticeable to park visitors. Furthermore, a 1998 visitor survey indicated that bus passengers did not, in general, perceive a problem with the amount of road traffic.

Under this alternative, material for road segments 1 through 4 would come mostly from external sources. Because of this the number of trucks hauling the material would increase substantially. There is a smaller visitor presence at the western end of the road and a larger presence at the east end. Because of this, increased truck traffic in the first four road segments would have a larger impact relative to road segments further west, as more visitors are present in the eastern part of the road corridor.

The potential for impacts on camping and hiking due to noise and visual intrusion (see impacts on viewshed) near the extraction sites would be lowest under this alternative, because only three sites would be used for gravel extraction.

Noise from equipment operating at the proposed Moose Creek Terrace site would probably reach visitors at Camp Denali and North Face Lodge. People hiking along Moose Creek would hear the equipment operation because they follow the Moose Creek mining access road from North Face Lodge. Hikers could hear the gravel operation all the way from North Face Lodge for the mile to the site and at least a mile farther upstream. Hikers on the popular Moose Creek route would be exposed to views of the operation as they approached the site.

The effects of this alternative on the visitor experience could be mitigated considerably by hauling gravel at night and/or during the shoulder seasons, to the extent practicable. Expanded use of dust palliatives on the park road could also reduce the amount of dust produced by the trucking activity.

Cumulative Impacts: The 175,000 miles of trucking activity with its noise and dust emissions would be added to the ongoing 1,481,000 miles of visitor bus and administrative vehicle travel. The 12 % increase in large vehicle travel on the park road would have periodic short term but widespread impacts to visitor experiences. Considering the ongoing and additional vehicular traffic under this alternative, the overall cumulative impacts to visitors would be moderate.

Conclusion: Alternative 3 would result in moderate direct and indirect impacts to visitor use and experience along the park road corridor.

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

This alternative would distribute the operation of the permitted sites temporally as well as spatially. Extraction at the East Fork River and Toklat River sites is scheduled for operation only in the spring and fall, before and after the bulk of summer visitation. Because Moose Creek Terrace would only be developed after the Downtown Kantishna site has been exhausted, only one gravel operation would be evident to visitors in the Kantishna area at any given time. The other sites would operate during the summer season as needed.

Noise from equipment at the proposed Moose Creek Terrace site might reach visitors at Camp Denali and North Face Lodge. People hiking along Moose Creek would hear the equipment operation because they follow the mining access road from North Face Lodge. All hikers heading up Moose Creek would hear the operation all the way from North Face Lodge for the mile to the site and at least a mile farther upstream. As discussed for Alternative 2, gravel mining and reclamation activity at the Downtown Kantishna site would be evident to visitors at the Kantishna Roadhouse and Denali Backcountry Lodge.

Potential impacts to visitors camping, hiking and backpacking would be the same as reported for Alternatives 2 and 3. Because the proposed sites would not all be operating simultaneously, however, impacts in this case would be of less magnitude than Alternative 2.

This alternative would generate approximately 106,000 truck miles per year for gravel hauling, equivalent to 7 percent of the current total vehicles miles from visitor and administrative traffic on the park road. This presence would be considerably less than Alternatives 3 and 1. The effects of this alternative on visitor use and experiences could be mitigated considerably by hauling gravel at night and/or during the shoulder seasons, to the extent practicable. Expanded use of dust palliatives on the park road could also reduce the amount of dust produced by the trucking activity.

Cumulative Impacts: The 106,000 miles of trucking activity with its noise and dust emissions would be added to the ongoing 1,481,000 miles of visitor bus and administrative vehicle travel. The 7 % increase in large vehicle travel on the park road would have periodic short-term impacts to visitor experiences that would be commensurate with existing levels of truck traffic. Alternative 4 would create a small incremental increase (3 new sites) to the number and extent of developed sites within the park road corridor. The overall cumulative impacts to visitor uses and experiences are judged to be minor.

Conclusion: Alternative 4 would result in minor direct and indirect impacts to visitor use and experiences in the park.

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

The impacts of Alternative 5 on visitor use and experience would be very similar to those identified for Alternative 4. The primary difference in impacts would be due to the use of North Face Corner instead of Moose Creek Terrace in the second phase of Alternative 5. This alternative would generate approximately 105,000 vehicle miles per year for hauling gravel, equivalent to 7 percent of the total annual vehicle miles generated by visitor and administrative traffic on the park road. The level of gravel hauling activity would be virtually the same as for Alternative 4.

Utilizing North Face Corner instead of Moose Creek Terrace would result in exposure to gravel operations for a greater number of Kantishna area visitors. The North Face Corner pit would be visible and audible to all users of the park road in that area, including all visitors to Kantishna. As

discussed for Alternatives 2 and 4, gravel mining and reclamation activity at the Downtown Kantishna site would be evident to visitors at the Kantishna Roadhouse and Denali Backcountry Lodge. Noise, work at the sites, and vehicle activity and fugitive dust associated with these operations would affect the way visitors perceive the character of that portion of the park.

Because of the greater exposure of the North Face corner site to Kantishna visitors, impacts on visitor use and experience from this alternative would be slightly greater than those impacts for Alternative 4. Overall, however, based on the balance between impacts at the specific source sites and along the road corridor, the level of impacts would likely be considered minor. The effects of this alternative on visitor use and experiences could be mitigated considerably by hauling gravel at night and/or during the shoulder seasons, to the extent practicable. Expanded use of dust palliatives on the park road could also reduce the amount of dust produced by the trucking activity.

Cumulative Impacts: The 105,000 miles of trucking activity with its noise and dust emissions would be added to the ongoing 1,481,000 miles of visitor bus and administrative vehicle travel. The 7 % increase in large vehicle travel on the park road would have periodic short-term impacts to visitor experiences that would be commensurate with existing levels of truck traffic. Alternative 5 would create a small incremental increase to the number and extent of developed sites (2 new sites) within the park road corridor. The overall cumulative impacts to visitor uses and experiences are judged to be minor.

Conclusion: Alternative 5 would result in minor direct and indirect impacts to visitor use and experience in the park.

SCENIC VALUES

Visitors to the park would potentially be exposed to views of land disturbance and operations activities at the gravel extraction and processing sites. The physical changes to the landscape could affect the scenic quality of the landscape as perceived by visitors. Evidence of human industrial activity, such as equipment operations at the gravel sites and increased truck traffic along the park road, could also intrude on visitors' experience and their perception of the scenery and wildlife viewing opportunities. The extent and intensity of the potential effects on scenic values would depend largely on the degree of additional disturbance introduced by the gravel operations. It would also depend upon the number and sensitivity to change of the visitors exposed to those conditions, which would vary among the park users groups and their distribution within the park. This section of the EA provides an assessment of the potential visual effects of the gravel acquisition plan on the scenic values of the park. A discussion of site-specific effects at the candidate gravel sites is followed by a summary of potential effects on scenic values for each plan alternative. As a key measure of potential effects on scenic values, Table 4.10 provides estimates of the approximate linear distances along the park road from which each site would likely be visible.

TABLE 4.10 EXTENT OF EXTRACTION SITE VISIBILITY FROM THE PARK ROAD

| Extraction Site | Approximate Length of Park Road with Visual Access to Site | | | | |
|---|--|-----------------------------|-----------------------------|-----------------------------|------------------|
| | Alternative 1 No Action | Alternative 2 | Alternative 3 | Alternative 4 | Alternative 5 |
| Teklanika MP 27.2: Visible from park road; transitory view from bridge; not visible from pullout/rest stop overlooking Teklanika River or from Teklanika Campground. | 27.0-27.7=0.7 | 27.0-27.7=0.7 | 27.0-27.7=0.7 | 27.0-27.7=0.7 | 27.0-27.7=0.7 |
| East Fork MP 43: Visible from park road due topography and downward travel directed toward site; not visible from Polychrome Pass. | | 42.5-44.5=2.0 | | 42.5-44.5=2.0 | 42.5-44.5=2.0 |
| Toklat MP 53.4: Visible from park road; views from the Toklat rest stop are blocked by topography; also, visible from the Toklat Bridge. | 52.9-53.06=0.7 | 52.9-53.06=0.7 | 52.9-53.06=0.7 | 52.9-53.06=0.7 | 52.9-53.06=0.7 |
| Beaver Pond MP 70: Visible at various points along the park road; not visible from the Eielson Visitor Center. | | 68.5-72.=3.5 | | 68.5-72.0=3.5 | 68.5-72.0=3.5 |
| Boundary MP 88: Visible from park road; the design would eliminate visibility from Camp Denali and North Face Lodge. | | 87.8-88.2=0.4 | | | |
| Moose Creek Terrace MP 89: Not visible from the park road, but visible from side roads in Moose Creek Valley, which is frequented by hikers and North Face Lodge and Camp Denali guests. | | | Not visible from park road. | Not visible from park road. | |
| North Face Corner MP 89: Visible from the park road, Camp Denali and North Face Lodge. | 88.8-89.6=0.8 | | | | 88.8-89.6=0.8 |
| Camp Ridge MP 90: Visible from the park road, Camp Denali and North Face Lodge. | | 89.4-90.2=0.8 | | | |
| Downtown Kantishna MP 91: Visible from the Park Road, Camp Denali, and North Face Lodge. | | 90.5-92.0=1.5 | | 90.5-92.0=1.5 | 90.5-92.0=1.5 |
| Kantishna Airstrip MP 93: Visible from Lower Moose Creek Trail, Jauhola Road, and residences on hillside to south. | | Not visible from park road. | | | |
| TOTAL | 2.2 miles | 9.6 miles | 1.4 miles | 8.4 miles | 9.2 miles |

As discussed previously in the Visitor Use and Experience section, the primary park user groups include people riding shuttle buses or tour buses along the park road, visitors staying in park campgrounds, backcountry users (primarily backpackers), day hikers in the front country, and visitors staying at the Kantishna lodges. In number, bus riders comprise by far the largest group. A relatively small portion of this group travels to the west end of the park road, or at least to the Wonder Lake area near the west end. Based on the configuration of the park shuttle and tour bus systems, most riders travel no farther than the Eielson Visitor Center at Mile 66, and many remain within the eastern 17 miles of the road corridor.

Backcountry campers are regulated by limits on the number of visitors allowed in backcountry zones (see Visitor Use section of this EA). Most of the zones near the park road have a daily quota of four to six visitors, which would serve to minimize viewer exposure to gravel extraction sites among this user group. In addition, backcountry visitors must camp at least one-half mile and out of view from the park road or any other developed area, including gravel extraction sites. Therefore, it is not likely that any gravel sites would be visibly exposed to backcountry camps. Most hiking trails are located near the park entrance, where no gravel sites are proposed, and most hiking is done across open terrain where hikers can choose to avoid the vicinity of gravel extraction areas.

In a visitor survey completed in 1998 (Miller and Wright 1998), visitors were asked a number of questions regarding their experience using the park transportation system and the impact of the system on enjoying the park resources. The majority of the visitors indicated that viewing wildlife was an important part of their trip and that traffic on the road did not adversely affect their viewing experience. Visitors also indicated that traffic did not interfere with their wildlife viewing experience.

Potential Effects at Gravel Source Sites

Teklanika Pit

Currently, a portion of this site is in use as a borrow pit and a portion has been abandoned. Because the terrain rises from the park road to the site, the pit area is not evident from the road, although the top of a pit wall can be distinguished. Bulldozers push overburden material toward the southeast side of the site for use in revegetation of previously disturbed areas and to screen views of the site from the road.

Under Alternative 2, 4 or 5, excavation at this site would be expanded to the north and west, toward the park road. Views to the south from the road could include scars from excavation, as well as heavy equipment and dust during times of active pit operations. Most of the processing and stockpiling would continue to occur during the summer (the main visitor season), as needed. The south and north pit walls would be reclaimed as excavation progressed to the northeast. Priority would be placed on the north wall because it is slightly visible from the road through a partial screen of spruce trees. Slopes would be recontoured and organic overburden would be spread to hasten natural recovery.

It is not common for vehicles to stop for viewing opportunities at this location, and this site is not near any park visitor facilities. A pullout overlooking the Teklanika River is 1.4 miles east of the pit site and the Teklanika Campground is 1.8 miles west of the site; the pit is not visible from either location. While landscape disturbance and operations activity at the Teklanika Pit could be visible in the foreground to a large portion of park road travelers during the long-term operating period for this site, their view of the pit site would be quite brief and transitory. Moreover, the evidence of human disturbance would represent a small change in an expansive landscape. With restoration of the site following closure, the changes to the landscape would not be permanent. Based on these

considerations, expanded operations at the Teklanika Pit would have a subtle and minor temporary effect on scenic values in the adjacent area or the road corridor in general.

Toklat River

The Toklat River site is currently used for excavation of accumulated gravel from within the existing river channel. Natural stream processes eliminate visible evidence of the excavations within a relatively brief period. Processing and stockpiling occurs north of the NPS Toklat Camp housing equipment and storage area, which has introduced evidence of human modification into the local landscape. The Toklat rest area is adjacent to the park road on the west bank of the river, approximately 0.75 mile to the south of the site, but views from the rest area toward the extraction site are blocked by topography. This site is visible in the distance from the park road and the Toklat River bridge. As a result, viewing experiences (natural vista and foreground view) would continue to be altered by ongoing operation at this site. Extraction activities would occur mostly before or after the main visitor season to minimize visual impacts during high-use periods. In addition, the site is not a visitor destination area or part of an exceptional viewshed (NPS 1999). Material processing could occur at any time during the season, either by contractor or NPS staff. Based on the typical viewing distance to this site, the existing degree of landscape modification, the proposed timing of gravel operations and the ability of the river to remove evidence of the mirror-channel cuts, scenic values in the vicinity of the Toklat River site would not be changed by continued gravel operations.

East Fork River

To the west of the East Fork site the park road climbs away from the river and crosses the lower portion of an open slope before turning west toward Polychrome Pass. Excavation activities and equipment would be visible in middleground views for travelers along the park road. Views of operations at the East Fork site would be more prominent for eastbound viewers than for westbound traffic, as their direction of travel would be downward and directed toward the site. Excavation would occur in accumulated gravel near the east bank of the river, and the mirror-channel cuts would be reclaimed through natural stream flow processes. Scenic values along a portion of the park road would be diminished during intermittent periods of active operations at this site. However, extraction activities would occur mostly before or after the main visitor season to avoid viewshed impacts during high-use periods, unless the need was during a road emergency. Based on the expected timing of the proposed operations and the limited numbers of viewers likely to be present, impacts on scenic values in the vicinity of the East Fork River site are expected to be minor.

Beaver Pond

The Beaver Pond site is the location of a former borrow pit. Some excavated areas are now covered in shrubs and grasses. The existing surface disturbance at this site is not highly visible from the park road. The new extraction area would be visible from various points along the road, primarily at distances of about one-half mile or more. Processing and storage would occur in the middle of the lower end of the extraction area to minimize visibility from the road. Overburden would be pushed toward the east side of the pit to obstruct views of the extraction area from the road. The Beaver Pond site would be operated as needed, although most of the processing and stockpiling would occur in the spring or fall when visitor use of the park is low. Following closure of the site, reclamation would be accomplished by contouring the pit slopes to a 2:1 grade to blend with the surrounding topography and spreading organic overburden to hasten natural recovery. With restoration of the site, the changes to the landscape would eventually be difficult to identify.

Thorofare Cabin, used by NPS patrol staff, is below the site to the west. However the site is not visible from the cabin. The site is also about 3 miles from a common route that provides access to Green Point and the Anderson Pass backcountry area. The Beaver Pond site would be slightly visible in the midground vistas of hikers in the backcountry, as would the park road in this area. This site is west of the Eielson Visitor Center, and most park visitors do not travel this far west on the park road. While the periods of excavation and processing are expected to be short and transitory at the site, stockpiling and project uses are expected to be continuous over the period of the plan. Based on the transitory nature of views to the Beaver Pond site for park road travelers, operating measures that would be employed to screen views, and the temporary period of continuous excavation and processing operations at this site, impacts on scenic values in this area of the road corridor are expected to be minor to moderate.

Boundary

The Boundary site is also a former borrow pit. Some formerly excavated areas are now covered in shrubs and grasses. A bus parking area and gravel stockpiles are near the entry to the former pit access road. The new extraction area would be defined and developed to minimize visual impacts from the park road. The design would eliminate visibility from Camp Denali and the North Face Lodge. Overburden would be pushed to the north side of the pit to obstruct views onto the extraction and processing area. During the reclamation process, slopes would be contoured to a 2:1 grade, blended with the surrounding topography, and organic overburden would be spread to hasten natural recovery. This site would be operated as needed, although most of the processing and stockpiling would occur in the spring or fall when visitor use of the park is low. Based on the relatively low number of potential views of the Boundary site, operating measures that would be employed to screen views, and the temporary period of operation for this site, impacts on scenic values in this area of the road corridor are expected to be minor.

Moose Creek Terrace

The Moose Creek Terrace site is above the south banks of Moose Creek and is not visible from the park road, although it is clearly visible from a secondary road that winds through the Moose Creek valley. Guests of the North Face Lodge, Camp Denali, Denali Backcountry Lodge and/or Kantishna Roadhouse walk through this area daily, including participation on guided hikes. Processing and stockpiling would be on a lower terrace to reduce visibility to hikers. The site would be operated throughout the main visitor season as needed, although most of the processing and stockpiling would occur in the spring or fall when visitor use of the park is low. Use of the site would require upgrading the road to the site and a new visitor parking area and trail may be constructed on the east side of the processing area. The quality of views experienced by visitors using the Moose Creek valley would be diminished on a long-term basis by the evidence of gravel extraction and processing at this site. Because visitors typically access this area on foot, the duration of those views would be relatively long. However, based on the relatively low number of affected viewers and the proposed seasonal operating patterns for the major excavation and processing work, impacts on scenic values in the Moose Creek area are expected to be minor to moderate.

North Face Corner

The North Face Corner site is adjacent to the south side of park road and is part of the gravel benches lining the south side of Moose Creek. The site is about 400 feet northwest of the North Face Lodge and about 1,400 feet southwest of Camp Denali. This site is an active pit and has been developed by cutting away at the slope adjacent to the uphill side of the Denali Park Road. The park road would be realigned to eliminate a safety corner after reclamation.

The site would continue to be fully visible from the park road, the North Face Lodge, and the Camp Denali cabins. Processing and vehicle activity, including fugitive dust, would affect the visual experience of park visitors on the road and at the lodge and cabins. Views of overburden stockpiles would continue to detract from the natural visual character of the landscape. Extraction activities would continue to impose on viewsheds and alter natural vistas, adversely affecting the visitors' perception of the park as a "wilderness." Processing and storage would be located at the western portion of the site to reduce their visibility. The site would continue to have an industrial look, including a screening plant and rock crusher, until final recontouring and revegetation work established a terraced edge profile and connection to the rest of the landscape. The site would be operated throughout the main visitor season as needed, although most of the processing and stockpiling would occur in the spring or fall when visitor use of the park is low.

While the North Face Corner site is now an active gravel pit, expanded operation would further degrade visual conditions near this site. Based on the visual presence of site disturbance and operations in the immediate foreground for all travelers on the park road in this area and the proximity to two lodges, impacts on scenic values in this area are expected to be moderate.

Camp Ridge

The Camp Ridge site is adjacent to the eastern side of the park road near the crossing of Moose Creek. This site is plainly visible from vehicles traveling on the park road and by guests of the North Face Lodge and Camp Denali, who often walk along this section of road. Extraction and processing activities at Camp Ridge would be fully visible from the park road. Most views from the road would be quite brief, limited to the time required for a vehicle to pass by the site, although this would not be the case for lodge visitors walking along the road. Processing and vehicle activity, including fugitive dust, would detract from the natural visual character of the landscape. Evidence of human development in the Kantishna area is common, although the local viewshed has a predominantly natural appearance. A key impact factor for this location is that relatively few park visitors travel this far west; only two park shuttle buses per day travel beyond Wonder Lake, so most potential viewers of the Camp Ridge site would be Kantishna-area lodge guests. In addition, most of the processing and stockpiling activity at this site would occur in the spring or fall, when visitor use of the park is low. Based on consideration of visitor numbers and seasonal timing of operations, impacts on scenic values in the area surrounding Camp Ridge are expected to be minor.

Downtown Kantishna

The Downtown Kantishna site is composed of several former placer mining claims that are bounded by Moose Creek to the east, the Kantishna Roadhouse and Denali Backcountry Lodge to the south and north, and steep slopes to the west. Processing and storage would be in the middle of the pit area to reduce visibility from park road and the lodges. In addition, berms or gravel stockpiles would be created on the south and north sides of the pit to screen views. After the mining process is completed, slopes would be contoured to match surrounding grades and to produce meandering channels in Eldorado Creek and Moose Creek.

This site would be operated as needed. However, most of the processing and stockpiling would occur in the spring or fall, when visitor use of the park is low. Gravel processing operations, including heavy equipment and stockpiles, would be visible from the park road, the Kantishna Roadhouse, and the Denali Backcountry Lodge. Dust would be generated during periods of gravel crushing and hauling. A bridge over Moose Creek would be needed to allow heavy equipment access to the site. Bridge construction would temporarily disturb views along the creek, and the bridge would be visible from the local lodges. Viewing experiences would be adversely affected and the visitors' perception

of the park as a "wilderness" would be degraded. However, the visual effect would be limited to foreground views of a site that is commonly known to have been previously disturbed by placer mining. Because the site would be so visible to visitors traveling above it on the park road, however, impacts on scenic values near the Downtown Kantishna site are expected to be moderate,

Kantishna Airstrip

This site is parallel to the Kantishna Airstrip, the Lower Moose Creek Trail, and historic Jauhola Road. The site is not visible from the park road, which ends a short distance to the south, or the Kantishna Airstrip. However, it is visible from the trail, Jauhola Road, and a residence on hillside about three-quarters of a mile to the south. To reduce visibility, processing and storage would be in the middle of the pit area or near the south edge. This site would be operated as needed, although most of the processing and stockpiling would occur in the spring or fall, when visitor use of the park is low. Views that include this site would be adversely affected by the evidence of disturbance. However, the adjacent portions of this viewshed contain a number of existing development features, including the airstrip, the airstrip access road and an historic cabin. Based on the relatively low numbers of potential viewers present near this site and the degree of landscape modification, impacts on scenic values near the Kantishna Airstrip are expected to be minor.

Alternative 1: No Action

Continued use of the approved material extraction sites at Teklanika and the Toklat River, and minimal extraction at the North Face Corner site would continue to alter natural viewsheds and create dust that could slightly degrade the viewing experience of major visitor groups. All three of the existing sites are visible to some degree from the park road, for a combined distance of approximately 2 miles. The North Face Corner site would be restored, however, after 2003. Truck and heavy equipment traffic on the park road would also detract from the viewing experience. However, only three sites would be in use and they are located away from the highest-use areas of the park. Impacts to scenic values resulting from reliance on external gravel sources, and the associated increase in truck activity, might be similar to those discussed above, although they would likely occur within a landscape that has more evidence of existing development. Under Alternative 1, visual impacts would be low and impacts on scenic values along the road corridor are expected to be minor.

Cumulative Impacts: Opportunities to view scenery and wildlife from the Denali Park Road are generally recognized to be excellent because few visible developments occur along the park road corridor. The limited change in scenic values would not represent a new type of landscape modification and would be a negligible impact in the context of existing landscape modification. The overall cumulative impacts on scenic values would be minor.

Conclusion: Alternative 1 would result in minor direct and indirect impacts to scenic values in the park. The overall level of potential impacts to scenic values 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

Use of eight extraction sites (Teklanika, East Fork River, Toklat River, Beaver Pond, Boundary, Camp Ridge, Downtown Kantishna and Kantishna Airstrip) and the North Face Corner site for processing and stockpiling gravel would alter natural viewsheds and create dust that could degrade

the viewing experience of major viewer groups. Seven of the extraction sites and North Face Corner are at least partially visible from the park road; the combined distance of potential view exposure along the road is estimated at 9.6 miles. Truck and heavy equipment traffic on the park road would also detract from the viewing experience. This alternative represents the greatest degree of incremental intrusion to viewsheds along the park road. However, this alternative would minimize gravel hauling, and would thereby result in less impact of this type to viewing experiences. No new proposed gravel sites would be located in the eastern end of the road corridor, where the concentration of visitors is greatest.

Visual impacts resulting from the use of external gravel sources would be similar in nature to those discussed above for Alternative 1, although Alternative 2 would have minimal reliance on external material sources. Overall, Alternative 2 would likely result in long-term, localized landscape changes at a relatively high number of sites. Based on the distribution of the sites and their location within the developed area of the park, overall impacts on scenic values within the road corridor or the park in general are expected to be moderate.

Cumulative Impacts: Opportunities to view scenery and wildlife from the Denali Park Road are generally recognized to be excellent because few visible developments occur along the park road corridor. The addition of six new gravel extraction sites, five along the western end of the park road, would result in long-term, local impacts to scenic values, or moderate impacts. For these reasons the overall cumulative impacts of Alternative 2 on scenic values are expected to be moderate.

Conclusion: Alternative 2 would result in moderate direct and indirect impacts to scenic values in the park. The overall level of potential impacts to scenic values 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

This alternative would result in new development at the Moose Creek Terrace site, which would be considered a major extraction site, and continued operation of two existing sites. At all three sites, gravel processing would alter the natural viewshed and create dust that could slightly degrade the viewing experience of major viewer groups. However, only three sites would be in use and all are located away from the highest park use areas. In addition, the Moose Creek site is not visible from the park road. The other two sites are visible from the park road for a combined distance of about 1 mile. The relatively long haul distances for this alternative would result in a comparatively large increase in truck and heavy equipment traffic on the park road for a longer duration, which could detract from the viewing experience of major viewer groups. Overall, visual impacts from Alternative 3 are expected to be minor.

Cumulative Impacts: Alternative 3 would have similar cumulative effects to scenery as Alternative 1, except this alternative would have one new site at Moose Creek Terrace. The overall cumulative impacts on scenic values would be minor.

Conclusion: Alternative 3 would result in minor direct and indirect impacts to scenic values in the park. The overall level of potential impacts to scenic values 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*)

Visual impacts under Alternative 4 would be similar to those described above for Alternative 2, although gravel operations would occur at two fewer sites. Use of six extraction sites would alter the natural viewshed and create dust that could slightly degrade the viewing experience of major viewer groups. However, no sites would be located in the eastern end of the road corridor, where the concentration of visitors is greatest. Phased development would minimize viewshed impacts because fewer sites would be operational at any one time. Five of the proposed extraction sites in Alternative 4 are visible from the park road, for a combined distance estimated at approximately 8.4 miles. Alternative 4 would generate a relatively small increase in truck traffic on the park road, with corresponding minor effects on viewers. Overall visual impacts from Alternative 4 would be slightly less than those discussed for Alternative 2. Based on the distribution of the sites and their location within the developed area of the park, impacts on scenic values within the road corridor or the park in general are expected to be moderate.

Cumulative Impacts: Opportunities to view scenery and wildlife from the Denali Park Road are generally recognized to be excellent because few visible developments occur along the park road corridor. The addition of three new gravel extraction sites would result in long-term, local impacts to scenic values. For these reasons the overall cumulative impacts of Alternative 2 on scenic values are expected to be moderate.

Conclusion: Alternative 4 would result in moderate direct and indirect impacts to scenic values in the park. The overall level of potential impacts to scenic values 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*)

Under Alternative 5, viewshed impacts would be similar to those discussed under Alternative 4 because the major difference would be use of the North Face Corner site instead of the Moose Creek Terrace site. Visual impacts in this case would include the continued high visibility of the North Face Corner site. Based on the previous reasoning, Alternative 5 would be expected to result in moderate overall impacts on scenic values.

Cumulative Impacts: Opportunities to view scenery and wildlife from the Denali Park Road are generally recognized to be excellent because few visible developments occur along the park road corridor. The addition of two new gravel extraction sites would result in long-term, local impacts to scenic values. For these reasons the overall cumulative impacts of Alternative 2 on scenic values are expected to be moderate.

Conclusion: Alternative 5 would result in moderate direct and indirect impacts to scenic values in the park. The overall level of potential impacts to scenic values 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.

PUBLIC ACCESS AND SAFETY

The currently approved in-park gravel sources are inadequate in volume to support maintenance and rehabilitation needs for the park road and the development projects identified in the Frontcountry Plan. There is concern that poor roadway conditions at many locations in the western part of the park road represent potential safety risks for park visitors and administrative employees. Consequently, a key issue for the evaluation of the alternative gravel acquisition plans is their ability to support public access and safety needs, specifically in relation to the continued ability to provide for comfortable and safe access to the interior of the park along the park road. In general, the four action alternatives for the plan would adequately support maintenance and rehabilitation needs for the park road, and would thereby contribute to meeting public access and safety needs.

As discussed in Chapter 1, potential safety hazards from gravel extraction, processing and hauling operations are also a pertinent concern for this topic area. All of the GAP alternatives would involve various types of risks to workers and (in some cases) the visiting public associated with development of high walls at upland extraction sites, operation of heavy equipment for gravel extraction and processing, fuel storage at extraction and processing sites, and operation of heavy trucks for hauling gravel from source sites to places of use along the park road corridor. While the risks to workers would be somewhat variable among alternatives based on location and organization (i.e., NPS or contractor/supplier personnel) the overall worker-safety risk should be approximately equal among alternatives because the total volume of material would be the same. Furthermore, it is expected that risks to workers would be minimized through standard NPS and private-sector safety practices and worker-safety regulations. Consequently, the following discussion addresses potential operational safety issues only to the extent that they are specific to a given alternative or site.

Alternative 1: No Action

Under Alternative 1, in-park gravel production would be insufficient to meet the material demand for road maintenance and construction over the next 10 years. The result would be reliance on external sources for nearly two-thirds of the gravel needs and likely a 16 % increase in annual vehicle miles traveled on the park road. This alternative would have a higher potential for continued degradation of the roadway surface throughout the road corridor, and particularly in the west end where the North Face Corner pit cannot supply enough material to meet the identified 10-year needs. Lack of adequate maintenance on the park road could, at some point, make it unsafe and difficult for visitors to travel through the park and enjoy its resources. It could also limit access for Kantishna-area visitors, and/or make that access more difficult and less comfortable. Short-term completion of gravel extraction at the North Face Corner site, and reclamation of that site, would eliminate potential traffic-safety risks associated with the proximity of gravel operations to public traffic on the park road and the existence of a relatively sharp curve on the park road at this location. Alternative 1 could lead to major impacts to visitor access and safety along the park road.

Cumulative Impacts: Visitor access and safety has been steadily improved along the Denali Park Road since the Front Country EIS and identification and funding from the Federal Highways Administration to correct problem areas. The lack of a reliable gravel source site at the western end of the park road and the increase in heavy dump truck traffic would likely reverse this trend and result in long-term degradation of the park road and safe conditions for visitor access. Alternative 1 could result in major cumulative impacts to the visitor access and safety.

Conclusion: The no-action alternative would lead to major impacts to visitor access and safety if identified problem areas are not corrected and sections of the park road fail and routine road maintenance falls behind schedule. .

Alternative 2: Maximum Flexibility/Short Hauls

This alternative would produce a sufficient volume and quality of material to meet the identified needs for maintaining and repairing the park road. Maintenance of the park road to the level defined in the applicable standards is the basic requirement to provide safe travel for visitors and safe and effective access for NPS personnel and lodge guests and owners. Park shuttle buses and tour buses are the methods most commonly used by visitors for travel to the park's interior to view wildlife and scenery. Alternative 2 might improve the experience of bus users by increasing the comfort and safety of bus trips on the park road.

Assuming standard safety plans are followed in gravel extraction, processing and hauling operations, this alternative would create negligible increases in safety hazards for park visitors or employees. Alternative 2 would entail potential interaction between park visitor traffic (on foot and in vehicles) and operations activities at the North Face Corner and Camp Ridge sites, which are immediately adjacent to the park road in the Kantishna area. Based on the relatively low volume of traffic in the western end of the road corridor and the fact that virtually all of the vehicles would be operated by NPS, lodge or concessioner personnel, it is expected that the increased safety risk would be minor.

Cumulative Impacts: Visitor access and safety has been steadily improved along the Denali Park Road since the Front Country EIS and identification and funding from the Federal Highways Administration to correct problem areas. This alternative would continue that trend. Short-term safety concerns at the western end of the park road between North Face Corner and Camp Ridge would result in overall minor cumulative impacts to visitor access and safety.

Conclusion: Alternative 2 would result in minor public access and safety risks, mostly at the western end of the park road.

Alternative 3: Minimum Visual Intrusion/Long Hauls

Alternative 3 would support maintenance objectives for the park road to the same degree as Alternative 2, and would help to provide safe travel and effective access for all users of the park road. This alternative would produce a relatively high volume of truck traffic associated with gravel hauling, which could translate into an increased level of traffic safety concern. Based on the incremental change compared to the baseline traffic level, however, potential traffic safety effects should be minor to negligible. As discussed for Alternative 1, reclamation of the North Face Corner site would eliminate potential traffic-safety risks associated with gravel operations adjacent to the park road and the relatively sharp curve on the park road at this location. Assuming standard safety plans are followed in gravel extraction, processing and hauling operations, this alternative would result in minor increases in safety hazards for park visitors or employees.

Cumulative Impacts: Visitor access and safety has been steadily improved along the Denali Park Road since the Front Country EIS and identification and funding from the Federal Highways Administration to correct problem areas. This alternative would continue that trend. Short-term safety concerns at the eastern end of the park road would result from increased gravel truck traffic from external sources. This would in result minor cumulative impacts to visitor access and safety.

Conclusion: Alternative 3 would result in minor public access and safety impacts, mostly at the eastern end of the park road from increased gravel truck traffic.

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

Alternative 4 would support maintenance objectives for the park road to the same degree as discussed previously for Alternative 2, and would help to provide safe travel and effective access for all users of the park road. Gravel production in the Kantishna area would not be located immediately adjacent to the park road (unlike Alternative 2), and there would be a negligible increase in safety risks from traffic interactions. Assuming standard safety plans are followed in gravel extraction, processing and hauling operations, this alternative would result in negligible increases in safety hazards for park visitors or employees.

Cumulative Impacts: Visitor access and safety would continue to be improved along the Denali Park Road since the Front Country EIS and identification and funding from the Federal Highways Administration to correct problem areas. Road conditions would continue to be improved and less truck traffic in visitor concentration areas would result in negligible cumulative impacts to visitor access and safety.

Conclusion: Alternative 4 would result in negligible public access and safety impacts with overall improving conditions in the next 10 years.

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

Alternative 5 would support maintenance objectives for the park road to the same degree as discussed previously for Alternatives 2 and 4, and would help to provide safe travel and effective access for all users of the park road. As discussed for Alternative 2, expanded operations at the North Face Corner site would involve minor increased safety risks associated with gravel operations adjacent to the park road in this location. Assuming standard safety plans are followed in gravel extraction, processing and hauling operations, this alternative would result in minor increases in safety hazards for park visitors near the North Face Corner for a short period of time.

Cumulative Impacts: Visitor access and safety would continue to be improved along the Denali Park Road since the Front Country EIS and identification and funding from the Federal Highways Administration to correct problem areas. Road conditions would continue to be improved and less truck traffic in visitor concentration areas would result in negligible cumulative impacts to visitor access and safety.

Conclusion: Alternative 5 would result in minor public access and safety impacts with overall improving conditions in the next 10 years.

PARK MANAGEMENT

The NPS is concerned that gravel source sites for park road maintenance and special projects must be adequate to provide the material requirements estimated for the next 10 years. The sources should be spaced in such a manner as to be efficient and cost-effective without causing unreasonable adverse impacts to park resources and values. The NPS is also concerned that frequent trips with heavy gravel trucks over long haul distances would accelerate wear and tear on the park road. These concerns overlap to a considerable degree with other topics addressed in this EA, including Public Access and Safety.

The NPS has estimated a need for approximately 375,000 cy of borrow material over the next 10 years. All of the alternatives evaluated would be able to provide enough material to accomplish the maintenance and repair goals of the gravel acquisition plan, although the alternatives differ considerably in their reliance on in-park versus external material sources. The park management concerns for which the alternatives could produce variable results include cost, impacts to the road character and condition through wear and tear, and the level of increased traffic on the park road.

Alternative 1: No Action

Under this alternative, Teklanika Pit, Toklat River and North Face Corner would remain the only approved material extraction sites along the park road. The gravel needs at the western end of the road for maintenance, repairs, and construction exceed 10,000 cy per year. Under this alternative, material would have to be hauled to the western end from the Toklat River site at Mile 53 after the North Face Corner supply is exhausted. The NPS could choose to haul the material this distance, haul material from outside sources to the western end or lower the design or maintenance standards for the west end of the road.

Hauling gravel from Toklat to the western end would cause excessive hauling costs and would limit the ability to use gravel from Toklat in other areas of the park. Hauling gravel from external sources to the western end of the road would be prohibitively expensive and would further degrade the road surface. Lowering the standards for road performance would decrease the ability of the road to function as a safe and accessible way for the public to visit the park and view its resources. Any of these options would inhibit proper management of the park road, as directed in the GMP. Lastly, the NPS may need to count gravel trucks against the GMP seasonal road limits, thereby reducing the number of visitor vehicles and creating management controversy.

Cumulative Impacts: The existing road maintenance efforts would be incrementally increased over existing levels with this alternative because the additional heavy vehicle traffic over the road would accelerate wear and tear. Mostly larger 18-yard belly dump gravel trucks would be used to transport gravel from external source sites, exacerbating the impacts to the park road. Road maintenance costs would be increased dramatically because gravel would need to be hauled longer distances, and hauling costs are the major component of the overall costs. In addition, the NPS record of decision for the Front Country EIS calls for the reduction of photographer permits by 50 % to allow for a reallocation to buses under the 10,512 annual vehicle limit, which replaces lighter vehicles with heavier buses and increases road impacts. These combined effects would result in major cumulative impacts to park management.

Conclusion: Alternative 1 would result in major impacts to park operations and management.

Alternative 2: Maximum Flexibility/Short Hauls

This alternative is capable of producing more borrow material than is required over the next 10 years. It would also decrease (compared to Alternative 1) gravel hauling mileage by distributing extraction sites throughout the road corridor. Accordingly, it would reduce road degradation by decreasing haul distances and truck trips. Total gravel vehicle mileage under Alternative 2 would be equivalent to 7 percent of the existing level for visitor and administrative activity. The authorized gravel sites would not all be active simultaneously, which would lessen the impact on the road character due to truck traffic and the visual presence of industrial equipment and human activity. Park maintenance staff could adjust to the change in gravel source sites in a year or two. This alternative would require park management to acquire and install a temporary bridge over Moose Creek to extract gravel from Downtown Kantishna.

Cumulative Impacts: The amount of gravel truck traffic and impacts to the park road would be slightly increased over recent years and gravel production and hauling costs would be commensurate with recent years. The NPS record of decision for the Front Country EIS calls for the reduction of photographer permits by 50 % to allow for a reallocation to buses under the 10,512 annual vehicle limit, which replaces lighter vehicles with heavier buses and increases road impacts. Few dump trucks would transport external source gravel into the park and no reallocations of vehicles under the 10,512 limit would be contemplated. These effects would result in minor cumulative impacts to park management.

Conclusion: The overall impacts of Alternative 2 on park operations and management would be minor.

Alternative 3: Minimum Visual Intrusion/Long Hauls

This alternative would have the capability to produce more than enough material to meet park road maintenance needs over the next 10 years. Other than the no-action alternative (Alternative 1), this alternative is scheduled to produce the smallest amount of borrow material from sources within the park. The consequence of this would be a heavy reliance on external sources that would likely cause both increased truck traffic on the road and increased cost due to purchase and transport of material from outside the park. These long haul distances would measurably increase the expense of road maintenance relative to Alternatives 2, 4 or 5. The 12 percent increase in trucks hauling gravel would also be more frequently visible to visitors along the park road, thereby altering the road's character, and would cause increased wear and tear on the road. In turn, this effect would require increased maintenance and gravel requirements, along with increased hauling costs and decreased usability of the park road for visitors. Both of these impacts would adversely affect the character of the road. The NPS may need to count gravel trucks against the GMP seasonal road limits, thereby reducing the number of visitor vehicles and creating management controversy. This alternative would, however, be more consistent with NPS policies to produce mineral materials from external sources when feasible.

Cumulative Impacts: The cumulative impacts of Alternative 3 on park operations and management would be similar to but less than those described for alternative 1 because less gravel from external sources would need to be imported and a western source of gravel would reduce overall hauling distances. Larger 18-yard belly dump gravel trucks would be used to transport gravel from external source sites, exacerbating the impacts to the eastern part of the park road. Road maintenance costs would be moderately increased because gravel would need to be hauled long distances, and hauling costs are the major component of the overall costs. These effects would result in moderate cumulative impacts to park management.

Conclusion: The impact of Alternative 3 on park operations and management would be moderate.

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

This alternative would be able to produce more than enough material to meet projected needs over the next 10 years. Alternative 4 would require only an estimated 12,500 cy from external sources, which would be used in repairs on road sections 1 through 3. The distribution of extraction, processing and stockpiling sites along the park road under Alternative 4 would reduce hauling distances and cost relative to Alternative 3. The decreased need for long haul distances would also reduce the number of trucks seen by visitors, dust created by the trucks and noise, thereby reducing the impacts on park road character relative to Alternative 3. Overall, impacts from this alternative on park operations and management would be virtually the same as for Alternative 2, and would be minor.

Cumulative Impacts: The cumulative impacts of Alternative 4 would be similar to those described for alternative 2 and would be minor.

Conclusion: Overall, impacts from Alternative 4 on park operations and management would be virtually the same as for Alternative 2, and would be minor.

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

Similar to Alternative 4, Alternative 5 could produce more than enough material to meet gravel requirements for the next 10 years. Compared to Alternative 4, gravel hauling activity from Alternative 5 would be very slightly less and would likely have no differential effect on the character of the park road.

Cumulative Impacts: The cumulative impacts of Alternative 5 would be similar to those described for Alternatives 2 and 4, and would be minor.

Conclusion: Impacts on park operations and management from Alternative 5 would be essentially the same as Alternatives 2 or 4, and would be minor.

LOCAL ECONOMY

Purchases of gravel from sources outside the park could provide economic benefits to private-sector mineral material owners and contractors. The extent to which this would occur would depend upon the amount of material purchased from outside sources and the haul distances from those sources to points of use in the park. Gravel purchases represent the primary way in which the gravel acquisition plan could have a direct impact on the local economy. A potential means of indirect impact involves the relationship between maintenance of the park road and the economic interests of lodge operators and concessioners. Businesses in the Kantishna area depend upon adequate maintenance of the park road for access by their customers. Gravel acquisition alternatives that would support adequate maintenance of the road would help to sustain those businesses, while failure to adequately maintain the road would be an economic threat to west-end commercial operations.

The cost of purchasing and transporting gravel produced outside the park represents a substantial element of the total cost of each alternative. In 2000, the NPS purchased 15,150 cy of material from

external sources at a cost of \$790,000 (see Appendix A). In 2001, 3,588 cy were purchased for \$650,000, and projects implemented in 2002 included 3,200 cy of external gravel were purchased for \$500,000. The differences in cost reflect differences in type of gravel as well as differences in project scopes. These costs represent revenues to the local economy; they directly and indirectly help to support employment and payrolls in communities outside the park.

Alternative 1: No Action

Under this alternative 220,000 to 240,000 cy of gravel are expected to be purchased from external material sources over the next 10 years. The prices that would be paid for this gravel would vary for a number of reasons, and do not readily translate into a specific revenue stream to the local economy. Based on the assumptions used in the cost analysis of material sources performed for this study (see Appendix B), Alternative 1 was calculated to cost over \$8.5 million for external gravel purchases over 10 years, or an average of \$850,000 per year if contractor crews transported the purchased material. Gravel purchases at this level would represent a substantial increase over what the NPS has spent locally for gravel in the past 3 years. Consequently, Alternative 1 would produce a larger impact in the local economy and a benefit for external gravel producers. It is possible that the increased expenditures could support increased employment locally in the mining sector, although any change in employment would likely be small.

As discussed under Park Management, Alternative 1 would not provide sufficient in-park gravel for adequate maintenance of the park road. The reliance on external gravel resources to maintain and repair the road and increased haul mileage under this alternative would create a higher potential that the condition of the road would degrade. Over time, this could cost the Kantishna area lodges more to maintain and operate their fleet of vehicles and they might have to charge visitors more.

Other possible types of economic changes would not be expected under this alternative. Visitor patterns in the entrance area of the park would not likely change, so commercial businesses outside the entrance area would not likely be affected. Because this alternative would not result in expanded in-park material extraction, processing, or storage activities, the Park Service would not need to increase its number of employees to accommodate the alternative.

Cumulative Impacts: Compared to the existing level of influence of park visitation and operations on the local economy, the cumulative impacts of Alternative 1 would be minor.

Conclusion: Overall, the impacts of Alternative 1 on the local economy would likely be minor. There is some potential for offsetting impacts, with positive economic effects from gravel and possible negative effects if costs were increased for lodge operators.

Alternative 2: Maximum Flexibility/Short Hauls

The increase in gravel extraction sites and volumes within the park proposed for Alternative 2 could result in an increase in park employment to support these activities. However, because most of the sites would operate in the summer season and the rest in the shoulder season, any new employees would most likely be seasonal. The impact of such an increase is likely to be negligible within the local economy.

Alternative 2 involves purchase of an estimated 12,500 cy of material from external material sources. On an annual basis, this could represent a smaller volume of external purchases than in recent years.

Truck operators and gravel producers outside the park might experience a decrease in revenues from the NPS, but the effects would not likely be significant based on the potential magnitude of change.

This alternative would provide sufficient gravel to meet the material needs for maintenance and improvement of the park road. This would not change the number of visitors traveling to the Kantishna lodges, but would continue a service level that is important to those businesses. Alternative 2 would be unlikely to promote changes in park use patterns that would influence the local service economy outside the park.

Cumulative Impacts: Compared to the existing level of influence of park visitation and operations on the local economy, the cumulative impacts of Alternative 2 would be negligible.

Conclusion: Overall, based on the types and magnitude of potential economic effects identified, impacts to the local economy from Alternative 2 would be negligible.

Alternative 3: Minimum Visual Intrusion/Long Hauls

The impacts of this alternative would be very similar to those from Alternative 1. A substantial amount of material (120,000 to 130,000 cy) would be imported from external sources, which would generate nearly \$3.7 million in revenue for road work contractors, local gravel suppliers, and trucking sub-contractors over 10 years. Total vehicle miles generated by gravel hauling would also increase, relative to Alternative 2, because of the limited distribution of proposed sites along the road corridor.

Alternative 3 would provide sufficient gravel to meet the material needs for maintenance and improvement of the park road. The effects of this alternative on local-area businesses would be beneficial because of the large amount of material needed from external sources and the level of truck activity needed to transport the material.

Cumulative Impacts: Compared to the existing level of influence of park visitation and operations on the local economy, the cumulative impacts of Alternative 3 would be minor.

Conclusion: As discussed for Alternative 1, the overall impacts of Alternative 3 on the local economy would likely be minor.

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

As with Alternative 2, the increase in proposed gravel extraction sites and volumes within the park might require an increase in NPS employment. If so, the employees would likely be seasonal. It is unlikely that this alternative would require more than a small increase in NPS employment.

Under Alternative 4, the volume of material purchased from external sources and the amount of revenue to those sources would be the same as for Alternative 2. Alternative 4 would, like Alternative 2, provide sufficient gravel to meet the material needs for maintenance and improvement of the park road. The effects of this alternative on conditions for businesses in the Kantishna area and outside the park entrance would be the same as described for Alternative 2.

Cumulative Impacts: Compared to the existing level of influence of park visitation and operations on the local economy, the cumulative impacts of Alternative 4 would be negligible.

Conclusion: Overall, based on the types and magnitude of potential economic effects identified, impacts to the local economy from Alternative 4 would be negligible.

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

The effects of Alternative 5 on the local economy would be virtually the same as those described for Alternative 4. The volume of material purchased from external sources and the amount of revenue to those sources would be small, and the same as for Alternatives 2 and 4. Alternative 5 would, like Alternatives 2-4, provide sufficient gravel to meet the material needs for maintenance and improvement of the park road. The effects of this alternative on businesses in the Kantishna area and outside the park entrance would be the same as described for Alternative 2.

Cumulative Impacts: Compared to the existing level of influence of park visitation and operations on the local economy, the cumulative impacts of Alternative 5 would be negligible.

Conclusion: Overall, based on the types and magnitude of potential economic effects identified, impacts to the local economy from Alternative 5 would be negligible.

SUBSISTENCE

There are approximately 320 local rural residents who qualify for subsistence use within Denali National Park and Preserve (see Appendix G). Since 1980, the overall populations for most communities surrounding Denali have increased, but the relative number of subsistence users actively involved in subsistence at Denali has remained about the same.

Subsistence community profile studies were conducted for most of Denali's subsistence communities in the early 1980s. The studies indicated that the region's main subsistence species were moose, caribou, ptarmigan, spruce grouse, hare, and a few species of fresh water fish. Large mammals accounted for 70% of the resources used, and fish accounted for 21%.

The subsistence region in the park/preserve provides only a small portion of the estimated subsistence harvest by the people of the resident zone communities of Cantwell, Minchumina, Nikolai, Telida, and by other eligible people. A significant portion of the subsistence use area for these communities is adjacent to the eastern and western boundaries of the Denali National Park and Preserve. In general, the NPS estimates that subsistence harvest from the park/preserve, for certain species, constitutes slightly more than 25% of total harvests in the entire subsistence region.

Common patterns of local use include traveling to the park/preserve by traditional means, such as on foot, by dog sled, motorboat, snowmobile, and occasionally by airplane. Access to the Kantishna Hills for subsistence is by vehicles via the park road during summer and by snowmobile during the winter. Snowmobile use in the Kantishna Hills by subsistence users is rare.

There are no subsistence users who currently reside in the Kantishna area. A limited amount of hunting, fishing, and trapping occurs in the Kantishna Hills because of its distance to resident zone communities. At present up to 10 persons may be expected to hunt or trap annually in the Kantishna Hills area. Current subsistence use of the Kantishna Hills has been primarily for hunting moose and berry picking. Users were primarily from McKinley Village and Cantwell. The caribou-hunting season has been closed in this area since 1977 due to the significant decline of the Denali caribou

herd. Past subsistence use of the Kantishna Hills area was primarily for hunting moose and caribou in the fall and for trapping during the winter. Occasionally, subsistence users would use ptarmigan, fish, or berries.

Based on existing and authorized subsistence use patterns relative to the proposed distribution of gravel sites, none of the gravel acquisition plan alternatives is likely to have an effect on the availability or distribution of subsistence resources, access to the resources by subsistence users, or competition among users for subsistence resources. A detailed assessment of the effects of the proposal on subsistence use pursuant to Section 810 of ANILCA is provided as Appendix F to this EA, and provides support for the conclusions summarized below.

Alternative 1: No Action

This alternative would have no direct or indirect effects on subsistence activities in the Kantishna area because no gravel sources would be developed there. Gravel would be imported from the Toklat River after the North Face Corner is restored.

Cumulative Impacts: At present a one-mile firearms discharge closure exists around the Denali Park Road in the Kantishna area (10 square miles) for the summer season and until the lodges are vacated around September 15. These effects were judged to have a minor and insignificant effect on subsistence uses in the area. Alternative 1 would have no additional effects on subsistence.

Conclusion: Alternative 1 would have negligible effects on subsistence uses in Denali National Park and Preserve. 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 involve the development and use of 4 gravel source sites in the Kantishna subsistence area: North Face Corner, Camp Ridge, Downtown Kantishna, and Kantishna Airstrip. All of these sites lie within the firearms closure area, but development and use of these sites after September 15 (when processing and stockpiling activities would be most intensive) could have a minor effect on subsistence moose hunting in fall. The firearms closure would likely not be extended area wise, but the period of closure could be lengthened to protect workers in the area after September 15. Most subsistence hunters travel up Moose Creek, however, so the geographic effects would be small and the temporary.

Cumulative Impacts: At present a one-mile firearms discharge closure exists around the Denali Park Road in the Kantishna area for the summer season (10 square miles) and until the lodges are vacated around September 15. These effects were judged to have a minor and insignificant effect on subsistence uses in the area. Alternative 2 would have minor additional effects on subsistence uses in the area.

Conclusion: Alternative 2 would result in minor direct and indirect impacts on subsistence uses in Denali National Park and Preserve. The overall level of subsistence 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

Minor effects to access for subsistence use could occur near the Moose Creek Terrace site. The firearms use restriction may need to be extended both in space and time to protect park maintenance workers in the area after September 15, but the geographic area would be small and the period of time would be a few weeks at most.

Cumulative Impacts: At present a one-mile firearms discharge closure exists on both sides of the Denali Park Road in the Kantishna area (10 square miles) for the summer season and until the lodges are vacated around September 15. These effects were judged to have a minor and insignificant effect on subsistence uses in the area. Alternative 3 would result in less than one square mile and a few weeks additional firearms closure, which would have minor additional effects on subsistence uses in the area.

Conclusion: Alternative 3 would result in minor direct and indirect impacts to subsistence resources or uses within the park. The overall level of subsistence 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 with Moderate Number of Sites (*NPS Preferred*)

As discussed in Alternatives 2 and 3, small geographic and temporal restrictions on firearms discharge for subsistence uses could be extended to protect gravel workers near the Downtown Kantishna and the Moose Creek Terrace sites.

Cumulative Impacts: At present a one-mile firearms discharge closure exists around the Denali Park Road in the Kantishna area (10 square miles) for the summer season and until the lodges are vacated around September 15. These effects were judged to have a minor and insignificant effect on subsistence uses in the area. Alternative 4 would result in less than one square mile and a few weeks additional closure, which would have minor additional effects on subsistence uses in the area.

Conclusion: Alternative 4 would result in minor direct and indirect impacts to subsistence resources or uses in the park. The overall level of subsistence 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: Most Economic Alternative with Moderate Hauls

This alternative would have similar effects on subsistence uses in Denali National Park and Preserve as described for alternative 2, except just two gravel source sites would be involved in the Kantishna area: Downtown Kantishna and North Face Lodge.

Cumulative Impacts: At present a one-mile firearms discharge closure exists around the Denali Park Road in the Kantishna area for the summer season (10 square miles) and until the lodges are vacated around September 15. These effects were judged to have a minor and insignificant effect on subsistence uses in the area. Alternative 5 would have minor additional effects on subsistence uses in the area.

Conclusion: Alternative 5 would result in minor direct, indirect, and cumulative impacts to subsistence resources or uses within the park. The overall level of subsistence 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.

WILDERNESS

Nearly the entire Denali Park road runs through the former Mount McKinley National Park, 95% of which is currently designated wilderness. The wilderness exclusion zone consists primarily of the entrance area and a 300-foot-wide road corridor (150 feet on either side) with wider development nodes at certain locations along the 90-mile length of the road. Lands within the road corridor are designated Park Development Zones and are managed to accommodate major development and intensive use. Lands within Park Development Zones are to be managed to minimize human disturbance on adjacent park wilderness.

None of the proposed gravel acquisition sites, with the exception of a portion of the East Fork River site (see discussion below) are located on designated wilderness land. Impacts of the alternatives on wilderness would be limited to indirect auditory and visual intrusions. Visual intrusions are addressed in the Scenic Values section of this EA, and are not duplicated below. Auditory intrusions might affect either visitor experience or wildlife use within the affected area. Both would be limited to times of active gravel operations and would be temporary in nature. More specific impacts on wildlife are covered in the Wildlife Values and Habitat section of the EA.

Alternative 1: No Action

Under this alternative, Teklanika Pit, Toklat River and North Face Corner (for a limited time) would be the only approved material extraction sites along the park road. None of these three sites is located in designated wilderness areas. Both the Teklanika Pit and the Toklat River sites are located within non-wilderness development nodes along the park road corridor and the North Face Corner lies about 1 mile north of the wilderness boundary. The only possible impacts these sites might have on wilderness values would be auditory intrusions on the solitude of nearby wilderness lands. The potential impacts on wilderness from the existing authorized borrow sites were previously evaluated by the NPS (1992); none of these analyses found that operations at these sites would create significant adverse impacts on the adjacent wilderness. Given the projected increase in truck traffic along the park road, including at night, Alternative 1 would introduce additional noise disturbance to adjacent wilderness areas along the park road corridor, thereby decreasing the area where peace and solitude could be obtained.

Cumulative Impacts: Because Alternative 1 would result in additional disturbance to the peace and solitude in wilderness areas adjacent to the park road from dump truck traffic, including at night, the cumulative impacts of this alternative to wilderness would be minor.

Conclusion: Alternative 1 would result in minor indirect impacts to wilderness values in the park. The overall level of potential wilderness 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 authorize extraction of mineral material from up to eight sites and the use of North Face Corner for stockpiling and processing material. With one partial exception, all of the proposed sites lie outside the wilderness boundary, either in non-wilderness development nodes along the park road corridor or in the Kantishna area. The most likely adverse impact of this alternative would be auditory intrusions on adjacent wilderness land from gravel extraction and processing operations, and possible visual intrusion at some of the sites (see Scenic Values). The proposed East Fork River extraction site, as delineated in Appendix C, extends into designated wilderness. Because mechanized equipment cannot be operated within wilderness, the NPS would not fully implement the mining plan reflected in Appendix C. Consequently, the NPS would likely utilize the East Fork River site primarily in response to emergencies, such as road failures, or the area and volume of extraction would be limited.

This alternative includes the most new extraction, processing and storage sites. Relative to the other alternatives, this would create the most extensive noise impact around development sites. Alternative 2 would result in low overall hauling mileage, however, which would reduce noise impacts from hauling material.

Cumulative Impacts: Alternative 2 would result in additional noise disturbance to wilderness values of peace and solitude above existing road traffic and existing administrative sites along the road corridor from new extraction sites (East Fork River, Beaver Pond, and Boundary). Because the geographic extent of the additional noise impacts to wilderness values would be small, the cumulative impacts of this alternative to wilderness would be minor.

Conclusion: Alternative 2 would result in minor overall impacts to wilderness values in the park. The overall level of potential wilderness 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

This alternative would involve maintaining two of the current three material extraction sites and adding one new site located near the end of the park road and approximately 1 mile north of the wilderness boundary. As described for Alternative 1, the existing sites are located in road corridor development nodes and outside the wilderness boundary. The effects of operational noise from this alternative on wilderness values would be very similar to those discussed for Alternative 1. Alternative 3 would result in less noise in wilderness areas near the Teklanika Pit, but an offsetting increase in noise from truck traffic hauling gravel from outside sources along the eastern end of the road corridor.

Cumulative Impacts: Alternative 3 would result in additional noise disturbance to wilderness values of peace and solitude above existing road traffic and existing administrative sites along the road corridor from 175,000 miles of dump truck traffic. Because the additional noise impacts to wilderness values would be audible a short distance, the cumulative impacts of this alternative to wilderness would be minor.

Conclusion: As discussed for Alternative 1, Alternative 3 would result in minor indirect impacts to wilderness values in the park. The overall level of potential wilderness 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 with Moderate Number of Sites (*NPS Preferred*)

With the partial exception of the East Fork River site, as discussed above for Alternative 2, none of the proposed gravel sites included in Alternative 4 are within designated wilderness. Because part of the East Fork River site identified in Appendix C extends into designated wilderness, the NPS would utilize this site primarily in response to emergencies, such as road failures. As with the other alternatives, auditory and visual intrusions would be the only potential sources of change to wilderness values. Under this alternative it is likely that five in-park gravel sources could be used at the same time, which represents an increase of only two operating sites compared to the current condition. Vehicle noise effects to wilderness would not increase noticeably under this alternative.

Cumulative Impacts: In addition to existing noise impacts to wilderness values described in Alternatives 1-3, Alternative 4 would result in two new extraction areas adjacent to park wilderness (East Fork and Beaver Pond). Gravel extraction activities at these two sites would introduce additional localized noise impacts to surrounding designated wilderness, which would constitute minor cumulative impacts to the character of wilderness resources in the park.

Conclusion: Alternative 4 would create the potential for minor indirect impacts to wilderness values in the park. The overall level of potential wilderness 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 effects of this alternative on wilderness values would be essentially the same as those of Alternative 4.

Cumulative Impacts: As discussed for Alternative 4, Alternative 5 would result in overall minor cumulative impacts to the character of wilderness resources in the park.

Conclusion: Alternative 5 would result in minor indirect impacts to wilderness values in the park. The overall level of potential wilderness 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.

CHAPTER 5

CONSULTATION AND COORDINATION

The National Park Service consulted with the following agencies, organizations and individuals in the development and preparation of this environmental assessment:

U.S. Army Corps of Engineers, Alaska District, Regulatory Section
U.S. Fish and Wildlife Service, Threatened and Endangered Species Office
Wally Cole, North Face Lodge
Alan Cornelius, Denali Backcountry Lodge
Stan Peters, Doyon Corporation/ Kantishna Roadhouse
Greg Lahaie, Kantishna Air

This environmental assessment was prepared jointly by National Park Service staff and contractor personnel from Hart Crowser Inc. NPS staff were the primary authors for Chapter 1: Purpose and need, Chapter 2: Description of the Alternatives and Appendix C: Mining Plans. Hart Crowser personnel were assigned lead responsibility for preparing most of the remainder of the document. NPS and Hart Crowser staff consulted the following NPS specialists during the course of EA development (and their current position at the time of their involvement):

| | |
|-----------------|---|
| Nancy Swanton | NPS/DENA, Planning and Compliance Division, Chief |
| Bud Rice | NPS/AKSO, Environmental Protection Specialist |
| Phil Brease | NPS/DENA, Geologist |
| Steve Carwile | NPS/DENA, Compliance Officer |
| Elwood Lynn | NPS/DENA, Facilities Management, Chief |
| Tim Taylor | NPS/DENA, Roads Maintenance, Supervisor |
| Ann Kain | NPS/DENA, Cultural Resource Specialist |
| Joe Van Horn | NPS/DENA, Wilderness Coordinator |
| Brad Ebel | NPS/DENA, Roads Maintenance, Supervisor |
| Ken Karle | NPS/DENA, Hydrologic Engineer |
| Gordon Olson | NPS/DENA, Resource Management, Chief |
| Diane Chung | NPS/DENA, Park Superintendent, Acting |
| Pat Owen | NPS/DENA, Resource Management, Biologist |
| Shan Burson | NPS/DENA, Research and Resource Preservation |
| Phyllis Motsko | NPS/DENA, Concessions Management |
| Mike Tranel | NPS/DENA, Planning |
| Bruce Giffen | NPS/AKSO, Geologist |
| Mark Ziegenbein | NPS/GRO, Geologist |

CHAPTER 6

REFERENCES

- Adams, Leslie. 1997. Identifying Rural Development Opportunities in the Denali Borough. Master of Arts Thesis. University of Alaska Fairbanks.
- Brannen, K.M. and D.K. Swanson. 2001. Soil Survey of Kantishna Area, Alaska. Prepared by Natural Resources Conservation Service, U.S. Department of Agriculture.
- Cowardin, L. M., V. Carter, F. C. Golet and E. T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Fish and Wildlife Service, Office of Biological Services, Publication FWS/OBS-79/31. Washington, DC.
- Edwards, P.J. and M.J. Tranel. 1998. Physical and Chemical Characterization of Streams and Rivers within Denali National Park and Preserve. Unpublished Report to U.S. Department of the Interior, Denali National Park, Alaska.
- Edwards, P.J., M. Tranel, P. Brease and P. Sousanes. 2000. Stream and River Water Quality in Denali National Park and Preserve, Alaska. Bulletin of the American Water Resources Association, Water Resources in Extreme Environments. p. 203.
- Emmett, William W. 2000. Letter Report from William Emmett, Consulting Hydrologist, Littleton, Colorado to Ken Karle, NPS, Denali National Park and Preserve, Denali, Alaska on the results of the Toklat River gravel extraction study. September 15, 2000.
- Emmett, William. W. 2002. Letter to the National Park Service Describing the Estimate of Annual Bed Load Discharge of the East Fork Toklat River. On File at Denali National Park Headquarters. March 7, 2002.
- Follman, E.H. 1980. Gravel Removal Studies in Arctic and Subarctic Floodplains in Alaska. Technical report. Prepared by Woodward-Clyde Consultants, Anchorage, Alaska, for U.S. Fish and Wildlife Service. Anchorage, Alaska.
- Hart Crowser. 2002. Denali National Park Gravel Acquisition Plan Wetland Delineation. Prepared for Denali National Park by Hart Crowser, Inc.. Anchorage, Alaska.
- Hultén, E. 1968. Flora of Alaska and Neighboring Territories. Stanford University Press. Stanford, CA.
- Joyce, M.R., L.A. Rundquist and L.L Moulton. 1980. Gravel Removal Guidelines for Arctic and Subarctic Floodplains. U.S. Department of the Interior. Washington, D.C.
- Karle, K.F. 1989. Replenishment Potential for Gravel Removal Sites at the Toklat River. Unpublished Master's Thesis, University of Alaska. Fairbanks, Alaska.
- Karle, K. 2002. Analyses of Three Gravel Sites: Toklat River, East Fork River, and Downtown Kantishna. Unpublished Report Prepared for Denali National Park, Alaska.
- Karle, K. 2003. Reclamation and Mitigation Measures for Downtown Kantishna Gravel Pit. Unpublished report prepared for Denali National Park, Alaska.

- Miller, Craig A. and R. Gerald Wright. 1998. Visitor Satisfaction with Public Transportation Services and Wildlife Viewing Opportunities in Denali National Park and Preserve. University of Idaho, Cooperative Fish and Wildlife Research Unit. May 1998.
- National Park Service. 1990. Replenishment Potential for Gravel Removal Sites for the Toklat River, Denali National Park and Preserve. Unpublished Report, Denali National Park, Alaska.
- NPS. 1982. Environmental Assessment for Park Road Rehabilitation Program, Denali National Park and Preserve, Alaska. U.S. Department of the Interior, National Park Service, Denver Service Center. February 1982.
- NPS. 1986. General Management Plan, Land Protection Plan, Wilderness Suitability Review. U.S. Department of the Interior, National Park Service, Denali National Park and Preserve.
- NPS. 1990. Final Environmental Impact Statement, Cumulative Impacts of Mining, Denali National Park and Preserve. U.S. Department of the Interior, National Park Service, Denver Service Center. Denver, Colorado.
- NPS. 1992. Environmental Assessment for a Borrow Use Management Plan to Maintain the Denali Park Road. U.S. Department of the Interior, National Park Service, Denali National Park and Preserve. February 18, 1992.
- NPS. 1994. Road System Evaluation, Denali National Park and Preserve, Alaska. U.S. Department of the Interior, National Park Service, Denver Service Center. April 1994.
- NPS. 1995a. Denali National Park Road Design Standards. U.S. Department of the Interior, National Park Service, Denali National Park and Preserve.
- NPS. 1995b. Denali National Park Road Maintenance Standards. U.S. Department of the Interior, National Park Service, Denali National Park and Preserve.
- NPS. 1996a. Draft Entrance Area and Road Corridor Development Concept Plan/Environmental Impact Statement, Denali National Park and Preserve, Alaska. U.S. Department of the Interior, National Park Service, Denali National Park and Preserve. NPS D-244, June 1996.
- NPS. 1997a. Entrance Area and Road Corridor Development Concept Plan, Denali National Park and Preserve, Alaska. U.S. Department of the Interior, National Park Service, Denali National Park and Preserve. NPS D-275, July 1997.
- NPS. 1997b. Strategic Plan: Implementation of the Government Performance and Results Act. U.S. Department of the Interior, National Park Service, Denali National Park and Preserve. September 1997.
- NPS. 1999a. Draft Environmental Assessment for the Toklat Burrow Material Processing Site. U.S. Department of the Interior, National Park Service, Denali National Park and Preserve. September 8, 1999.

- NPS. 1999b. Draft Environmental Impact Statement, Spruce Creek Access, Denali National Park and Preserve, Alaska. NPS D-297. U.S. Department of the Interior, National Park Service, Denali National Park and Preserve. Anchorage, Alaska. July 1999.
- NPS. 1999c. Environmental Assessment for Gravel Acquisition at the North Face Corner, Denali Park Road. U.S. Department of the Interior, National Park Service, Denali National Park and Preserve. April 30, 1999.
- NPS. 2000. Park Road Traffic, 1999, Denali National Park and Preserve. U.S. Department of the Interior, National Park Service, Denali National Park and Preserve, Research and Resource Preservation Division. Denali Park, Alaska. July 2000.
- NPS. 2001a. Environmental Assessment, Reclamation of Mined Lands Program, Denali National Park and Preserve. U.S. Department of the Interior, National Park Service, Denali National Park and Preserve.
- NPS. 2001b. 2001 NPS Management Policies, Chapter 1: The Foundation. (printed from NPS website)
- NPS. 2002. Air Quality in the National Parks. Second edition. U.S. Department of the Interior, National Park Service Air Resources Division. D-2266
- Reid and Dunne. 1984. Sediment Production from Forest Road Surfaces. *Water Resources Research*. 20(11):1753-1761.
- Reppert, R.T., W. Sigleo, E. Stakhiv, L. Messman and C. Beyers. 1979. Wetland Values: Concepts and Methods for Wetland Evaluation. U.S. Army Corps of Engineers, Institute for Water Resources. Fort Belvoir, Virginia.
- Ritter, D.F.. 1978. Process Geomorphology. Dubuque, Iowa. Wm. C. Brown Co.; 603 p.
- Singer, F. J. and J. B. Beattie. 1986. The Controlled Traffic System and Associated Wildlife Responses in Denali National Park. *Arctic* 39(3): 195-203.
- Spat, P.D., and M.C. Miller. 1981. "Growth Conditions and Vitality of Sphagnum in a Tundra Community along the Alaska Pipeline Haul Road," *Arctic* 38:48-54.
- U.S. Army Corps of Engineers (Corps). 1987. Corps of Engineers Wetlands Delineation Manual. U.S. Army Corps of Engineers, Environmental Laboratory, Technical Report Y-87-1, Waterways Experiment Station. Vicksburg, Mississippi.
- U.S. Census Bureau. 2000. Census, 2000. Table DP-1. Profile of General Demographic Characteristics (Denali Borough, AK).
- U.S. Census Bureau. 2000. Census, 2000. Table DP-1. Profile of Selected Economic Characteristics (Denali Borough, AK).
- U.S. Census Bureau. 2000. Census, 2000. Table DP-1. Profile of General Demographic Characteristics (City of Healy, AK).

- U.S. Census Bureau. 2000. Census, 2000. Table DP-1. Profile of Selected Economic Characteristics (City of Healy, AK).
- USDA, NRCS. 2001. The PLANTS Database, Version 3.1 (<http://plants.usda.gov>). National Plant Data Center. Baton Rouge, LA 70874-4490 USA.
- Viereck L.A., C.T. Dyrness, A.R. Batten and K.J. Wenzlick. 1992. The Alaska Vegetation Classification. General Technical Report PNW-GTR-286. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Portland, OR.
- Walker, D. A. and K.R. Everett. 1987. "Road Dust and its Environmental Impact on Alaskan Taiga and Tundra," *Arctic and Alpine Research* 19:479-489.
- Walker, D. A. and P.J Webber. 1980. "Dust Impacts on Vegetation," in *Environmental Engineering and Ecological Investigations along the Yukon River-Prudhoe Bay Haul Road*, J. Brown and R. Berg (eds.). U.S. Army Cold Regions Research and Engineering Laboratory.

APPENDIX A
Denali National Park 10-Year Gravel Needs

| YEAR | | | ACTUAL PARK GRAVEL USE TOTALS | | | | | |
|------|----------------|---------------------------------------|-------------------------------|--------------------|---------------|------------------------|------------------|--------------|
| 2000 | | | | | | | | |
| | | | | | | | | |
| | SEGMENT | ACTIVITY TITLE | ACTIVITY TYPE/NEED | FUNDING | VOLUME | GRAVEL SOURCE | COST (16) | \$/cy |
| | 2 | Primrose, Phase 1 | Subgrade digout | FHWA Contract | 10650 | Outside | \$610,000 | 58/cy |
| | 3 | Igloo Forest Crowning | Build crown/topcourse | FLIP/Cyc/Fee | 4500 | Outside | \$180,000 | |
| | 4 through 10 | Road Safety/road maint | Road Safety Repair/Maint | Cyc,R/R, Fee, Base | 5808 | Tek, Toklat, Kantishna | | |
| | 2,3 | Crown prep for CACL/road mtnc | CACL | Cyc,R/R, Fee, Base | 4000 | Tek, Outside | | |
| | 10 | N. Face Crushing Contract | Build crown/topcourse | FHWA Contract | 8261 | Kantishna | | |
| | | Quigly Cabin/WLRS | Building rehab | | 127 | Tek, Toklat | | |
| | | | | | | | | |
| | | | | Total Used | 33346 | | | |
| 2001 | | | ACTUAL PARK GRAVEL USE TOTALS | | | | | |
| | | | | | | | | |
| | SEGMENT | ACTIVITY TITLE | ACTIVITY TYPE/NEED | FUNDING | VOLUME | GRAVEL SOURCE | COST (16) | \$/cy |
| | 10 | Kantishna Airstrip Bypass Road | Road construction | FLHP | 2517 | Kantishna | \$119,000 | 47/cy |
| | 10 | Replish Topcourse/Kant. Gravel | Build crown/topcourse | FHWA/RR | 11518 | Kantishna | | |
| | 4 | slumps, shoulders, culverts, sft spot | General road maint. (4) | Cyc,R/R, Fee, Base | 516 | Tek, Toklat, Kantishna | | |
| | 5 | " | " | " | 936 | Tek, Toklat, Kantishna | | |
| | 6 | " | " | " | 700 | Tek, Toklat, Kantishna | | |
| | 7 | " | " | " | 0 | | | |
| | 8 | " | " | " | 72 | | | |
| | 9 | " | " | " | 144 | | | |
| | 10 | " | " | " | 322 | | | |
| | 2 | Crown prep for CACL/road mtnc | CACL/maintenance (4) | Cyc,R/R, Fee, Base | 1576 | Tek, Outside | | |
| | 3 | Crown prep for CACL/road mtnc | CACL/maintenance (4) | Cyc,R/R, Fee, Base | 2363 | Tek, Outside | | |
| | | Tank yank | Under ground tank remove | | 360 | Outside | | |
| | | Primrose Rest Area Rehab | | Contract | 3588 | Outside | \$650,000 | 181/cy |
| | | Trails, WLRS, Other | | | 532 | Tek/Kant | | |
| | | | | | | | | |
| | | | | Total Used | 25144 | | | |

Denali National Park 10-Year Gravel Needs

| 2002 | | | PROJECTED PARK GRAVEL USE TOTALS | | (not included in 10 year estimate) | | | |
|--|---------|---------------------------------------|----------------------------------|--------------------|------------------------------------|-------------------------|-----------|--------|
| | SEGMENT | ACTIVITY TITLE | ACTIVITY TYPE/NEED | FUNDING | VOLUME | GRAVEL SOURCE | COST (16) | \$/cy |
| Normal Road Maintenance Related Work or Projects (1) | | | | | | | | |
| Maint | 1 | slumps, shoulders, culverts, sft spot | General road maint. | Cyc,R/R, Fee, Base | 500 | Tek, Outside | | |
| | 2 | " | " | Cyc,R/R, Fee, Base | | | | |
| | 3 | " | " | Cyc,R/R, Fee, Base | | | | |
| Maint | 4 | " | " | Cyc,R/R, Fee, Base | 450 | Tek, East Fork?, Toklat | | |
| Maint | 5 | " | " | " | 625 | Toklat, East Fork? | | |
| Maint | 6 | " | " | " | 250 | Toklat | | |
| Maint | 7 | " | " | " | 125 | 70 mile, Toklat | | |
| Maint | 8 | " | " | " | 250 | 70 mile | | |
| Maint | 9 | " | " | " | 350 | Kantishna, 70 mile | | |
| Maint | 10 | " | " | " | 450 | Kantishna | | |
| Project | 2 | Re-construct maintainable sfc (9) | Build maintainable surface | CyC, R/R, Fee | 3400 | Tek, Outside | | |
| Project | 3 | " | " | CyC, R/R, Fee | 5100 | Tek, Outside | | |
| | 4 | " | " | CyC, R/R, Fee | | | | |
| | 5 | " | " | CyC, R/R, Fee | | | | |
| | 6 | " | " | CyC, R/R, Fee | | | | |
| | 7 | " | " | CyC, R/R, Fee | | | | |
| | 8 | " | " | CyC, R/R, Fee | | | | |
| Project | 9 | " | " | RR | 11518 (6) | Kantishna | \$425,000 | |
| Project | 9 | Superelevation repairs | Road edge grade raise | RR | 1000 (6) | Kantishna | \$196,500 | |
| | 10 | " | " | CyC, R/R, Fee | | | | |
| Road Construction Specific or Specially Funded Projects (2) | | | | | | | | |
| Project | 1 | R/R Depot Bypass Construction | Road construction | | 10000 (7) | Outside | | |
| Project | 2 | Correct Savage Area Parking | Road construction | FHWA Contract | 3200 (5) | Outside | \$500,000 | |
| Project | 4 | East Fork Eroded Road Section | Digout and gabion wall (8) | FHWA Contract | 3000 (6) | Toklat, Tek | \$483,000 | 161/cy |
| Project | 8 | Rehab Grassy Pass | Subgrade digout (8) | FHWA Contract | 4500 (6) | Toklat, Kantishna | \$850,000 | 189/cy |
| Project | | Contaminated site rehab, Toklat | Site rehab | | 500 | Toklat | | |
| Facility, Trails or Other Maintenance/Projects (3) | | | | | | | | |
| Project | | Other (10) * | Trails, const, rehab, remed | | 3000 | Tek, Tok, Kant, Outside | | |
| | | *WL cabins, Savage Alpine Trl | | | | | | |
| | | | | | | | | |
| | | | | Total Need | 48218 | | | |

APPENDIX A
Denali National Park 10-Year Gravel Needs

| 2003 | | | PROJECTED PARK GRAVEL USE TOTALS | | | | | |
|--|----------------|---------------------------------------|---|--------------------|---------------|-------------------------|------------------|--------------|
| | SEGMENT | ACTIVITY TITLE | ACTIVITY TYPE/NEED | FUNDING | VOLUME | GRAVEL SOURCE | COST (16) | \$/cy |
| Normal Road Maintenance Related Work or Projects (1) | | | | | | | | |
| Maint. | 1 | slumps, shoulders, culverts, sft spot | General road maint. | Cyc,R/R, Fee, Base | 500 | Tek, Outside | | |
| | 2 | " | " | Cyc,R/R, Fee, Base | | | | |
| | 3 | " | " | Cyc,R/R, Fee, Base | | | | |
| Maint. | 4 | " | " | Cyc,R/R, Fee, Base | 450 | Tek, East Fork?, Toklat | | |
| Maint. | 5 | " | " | " | 625 | Toklat, East Fork? | | |
| Maint. | 6 | " | " | " | 250 | Toklat | | |
| Maint. | 7 | " | " | " | 125 | 70 mile, Toklat | | |
| Maint. | 8 | " | " | " | 250 | 70 mile | | |
| Maint. | 9 | " | " | " | 350 | Kantishna, 70 mile | | |
| Maint. | 10 | " | " | " | 450 | Kantishna | | |
| Project | 2 | Re-construct maintainable sfc (9) | Build maintainable surface | CyC, R/R, Fee | 3400 | Tek, Outside | | |
| Project | 3 | " | " | CyC, R/R, Fee | 5100 | Tek, Outside | | |
| | 4 | " | " | CyC, R/R, Fee | | | | |
| | 5 | " | " | CyC, R/R, Fee | | | | |
| | 6 | " | " | CyC, R/R, Fee | | | | |
| | 7 | " | " | CyC, R/R, Fee | | | | |
| Project | 8 | " | " | CyC, R/R, Fee | 3400 | Toklat/70 mile | | |
| Project | 9 | " | " | CyC, R/R, Fee | 3400 | Kantishna | | |
| | 10 | " | " | CyC, R/R, Fee | | | | |
| Road Construction Specific or Specially Funded Projects (2) | | | | | | | | |
| Project | 3 | Correct Tattler Creek Safety Prob | Digout and gabion wall (8) | FHWA Contract | 3700 (5) | Inside | \$583,000 | |
| Project | 3 | Rehab Igloo Canyon, Phase I | Subgrade digout (8) | FHWA Contract | 15000 (5) | Tek, Outside | \$850,000 | |
| Project | | Front Country development | Contract construction | | 2500 | Outside | | |
| Project | | Extend Kantishna Airstrip (13) | Digout and replace | | 5555 | Kantishna Area | | |
| Facility, Trails or Other Maintenance/Projects (3) | | | | | | | | |
| Project | | Other (10) * | Trails, const, rehab, remed | | 3000 | Tek, Tok, Kant, Outside | | |
| | | *Toklat Bunkhouse, EVC Alpine | | | | | | |
| | | | | | | | | |
| | | | | Total Need | 48055 | | | |

APPENDIX A
Denali National Park 10-Year Gravel Needs

| 2004 | PROJECTED PARK GRAVEL USE TOTALS | | | | | | | |
|--|----------------------------------|---------------------------------------|-----------------------------|--------------------|--------------|-------------------------|-----------|-------|
| | SEGMENT | ACTIVITY TITLE | ACTIVITY TYPE/NEED | FUNDING | VOLUME | GRAVEL SOURCE | COST (16) | \$/cy |
| Normal Road Maintenance Related Work or Projects (1) | | | | | | | | |
| Maint. | 1 | Slumps, shoulders, culverts, sft spot | General road maint. | Cyc,R/R, Fee, Base | 500 | Tek, Outside | | |
| | 2 | " | " | Cyc,R/R, Fee, Base | | Tek, Outside | | |
| | 3 | " | " | Cyc,R/R, Fee, Base | | Tek, Outside | | |
| Maint. | 4 | " | " | Cyc,R/R, Fee, Base | 450 | Tek, East Fork?, Toklat | | |
| Maint. | 5 | " | " | " | 625 | Toklat, East Fork? | | |
| Maint. | 6 | " | " | " | 250 | Toklat | | |
| Maint. | 7 | " | " | " | 125 | 70 mile, Toklat | | |
| Maint. | 8 | " | " | " | 250 | 70 mile | | |
| Maint. | 9 | " | " | " | 350 | Kantishna, 70 mile | | |
| Maint. | 10 | " | " | " | 450 | Kantishna | | |
| Project | 2 | Re-construct maintainable sfc (9) | Build maintainable surface | CyC, R/R, Fee | 2550 | Tek, Outside | | |
| Project | 3 | " | " | CyC, R/R, Fee | 2550 | Tek, Outside | | |
| Project | 4 | " | " | CyC, R/R, Fee | 6800 | Toklat / East Fork? | | |
| | 5 | " | " | CyC, R/R, Fee | | | | |
| | 6 | " | " | CyC, R/R, Fee | | | | |
| | 7 | " | " | CyC, R/R, Fee | | | | |
| | 8 | " | " | CyC, R/R, Fee | | | | |
| | 9 | " | " | CyC, R/R, Fee | | | | |
| | 10 | " | " | CyC, R/R, Fee | | | | |
| Road Construction Specific or Specially Funded Projects (2) | | | | | | | | |
| Project | 3 | Rehab Igloo Canyon, Phase II | Subgrade digout (8) | FHWA Contract | 15000 (5) | Tek, Outside | \$850,000 | |
| Project | 4 | Correct 44 mile problem | Subgrade digout (8) | FHWA | 1400 | Toklat | \$51,455 | 36/cy |
| Project | 4 | Mile 41-48 super elevation rep. | Grade raise | FHWA | 1000 (6) | Tek, Toklat | | |
| Project | | Front Country development | Contract construction | | 2500 | Outside | | |
| Project | | Rehab Airstrips (12) | Airstrip rehab/safety work | R/R | 3000 | 1500 Outside, 1500 Kant | \$241,000 | |
| Facility, Trails or Other Maintenance/Projects (3) | | | | | | | | |
| Project | | Other (10) * | Trails, const, rehab, remed | | 3000 | Tek, Tok, Kant, Outside | | |
| | | * Eielson Visitor center | | | | | | |
| | | | | | | | | |
| | | | | Total | 40800 | | | |

APPENDIX A
Denali National Park 10-Year Gravel Needs

| 2005 | | | PROJECTED PARK GRAVEL USE TOTALS | | | | | |
|--|---------|---------------------------------------|----------------------------------|--------------------|-----------|-------------------------|-------------|-------|
| | SEGMENT | ACTIVITY TITLE | ACTIVITY TYPE/NEED | FUNDING | VOLUME | GRAVEL SOURCE | COST (16) | \$/cy |
| Normal Road Maintenance Related Work or Projects (1) | | | | | | | | |
| Maint. | 1 | Slumps, shoulders, culverts, sft spot | General road maint. | Cyc,R/R, Fee, Base | 500 | Tek, Outside | | |
| | 2 | " | " | Cyc,R/R, Fee, Base | | Tek, Outside | | |
| | 3 | " | " | Cyc,R/R, Fee, Base | | Tek, Outside | | |
| Maint. | 4 | " | " | Cyc,R/R, Fee, Base | 450 | Tek, East Fork?, Toklat | | |
| Maint. | 5 | " | " | " | 625 | Toklat, East Fork? | | |
| Maint. | 6 | " | " | " | 250 | Toklat | | |
| Maint. | 7 | " | " | " | 125 | 70 mile, Toklat | | |
| Maint. | 8 | " | " | " | 250 | 70 mile | | |
| Maint. | 9 | " | " | " | 350 | Kantishna, 70 mile | | |
| Maint. | 10 | " | " | " | 450 | Kantishna | | |
| Project | 2 | Re-construct maintainable sfc (9) | Build maintainable surface | CyC, R/R, Fee | 2550 | | | |
| Project | 3 | " | " | CyC, R/R, Fee | 2550 | | | |
| Project | 4 | " | " | CyC, R/R, Fee | 6800 | Toklat / East Fork? | | |
| Project | 5 | " | " | CyC, R/R, Fee | | | | |
| | 6 | " | " | CyC, R/R, Fee | | | | |
| | 7 | " | " | CyC, R/R, Fee | | | | |
| | 8 | " | " | CyC, R/R, Fee | | | | |
| | 9 | " | " | CyC, R/R, Fee | | | | |
| | 10 | " | " | CyC, R/R, Fee | | | | |
| Road Construction Specific or Specially Funded Projects (2) | | | | | | | | |
| Project | 4 | Rehab Sable Pass section | Subgrade digout (8) | FHWA Contract | 15000 (5) | Tek, Toklat | \$1,500,000 | |
| Project | | Front Country development | Contract construction | | 2500 | Outside | | |
| Facility, Trails or Other Maintenance/Projects (3) | | | | | | | | |
| Project | | Other (10) * | Trails, const, rehab, remed | | 3000 | Tek, Tok, Kant, Outside | | |
| | | *Includes Toklat Rest Stop | | | | | | |
| | | | | | | | | |
| | | | | Total Need | 35400 | | | |

APPENDIX A
Denali National Park 10-Year Gravel Needs

| 2006 | | | PROJECTED PARK GRAVEL USE TOTALS | | | | | |
|--|---------|---------------------------------------|----------------------------------|--------------------|--------------|----------------------------|-------------|--------|
| | SEGMENT | ACTIVITY TITLE | ACTIVITY TYPE/NEED | FUNDING | VOLUME | GRAVEL SOURCE | COST (16) | \$/cy |
| Normal Road Maintenance Related Work or Projects (1) | | | | | | | | |
| Maint. | 1 | slumps, shoulders, culverts, sft spot | General road maint. | Cyc,R/R, Fee, Base | 500 | Tek, Outside | | |
| Maint. | 2 | " | " | Cyc,R/R, Fee, Base | 900 | Tek, Outside | | |
| | 3 | " | " | Cyc,R/R, Fee, Base | | Tek, Outside | | |
| Maint. | 4 | " | " | Cyc,R/R, Fee, Base | 450 | Tek, East Fork?, Toklat | | |
| Maint. | 5 | " | " | " | 625 | Toklat, East Fork? | | |
| Maint. | 6 | " | " | " | 250 | Toklat | | |
| Maint. | 7 | " | " | " | 125 | 70 mile, Toklat | | |
| Maint. | 8 | " | " | " | 250 | 70 mile | | |
| Maint. | 9 | " | " | " | 350 | Kantishna, 70 mile | | |
| Maint. | 10 | " | " | " | 450 | Kantishna | | |
| | 2 | Re-construct maintainable sfc (9) | Build maintainable surface | CyC, R/R, Fee | | | | |
| Project | 3 | " | " | CyC, R/R, Fee | 2550 | | | |
| | 4 | " | " | CyC, R/R, Fee | | | | |
| Project | 5 | " | " | CyC, R/R, Fee | 6800 | Toklat / East Fork? | | |
| | 6 | " | " | CyC, R/R, Fee | | | | |
| | 7 | " | " | CyC, R/R, Fee | | | | |
| | 8 | " | " | CyC, R/R, Fee | | | | |
| | 9 | " | " | CyC, R/R, Fee | | | | |
| | 10 | " | " | CyC, R/R, Fee | | | | |
| Road Construction Specific or Specially Funded Projects (2) | | | | | | | | |
| Project | 9 | 70-72 Mile Repair | Subgrade digout (8) | FHWA Contract | 8000 (5) | Mile 70, Toklat, Kantishna | \$1,500,000 | |
| Project | 10 | Kantishna Road Repair, Phase 1 | Subgrade digout (8) | AKDOT | 12500 (14) | Kantishna | \$2,500,000 | 200/cy |
| Facility, Trails or Other Maintenance/Projects (3) | | | | | | | | |
| Project | | Other (10) * | Trails, const, rehab, remed | | 3000 | Tek, Tok, Kant, Outside | | |
| | | * Includes Savage Rest Stop | | | | | | |
| | | | | | | | | |
| | | | | Total Need | 36750 | | | |

APPENDIX A
Denali National Park 10-Year Gravel Needs

| 2007 | | | PROJECTED PARK GRAVEL USE TOTALS | | | | | |
|--|---------|---------------------------------------|----------------------------------|--------------------|------------|-------------------------|-------------|--------|
| | SEGMENT | ACTIVITY TITLE | ACTIVITY TYPE/NEED | FUNDING | VOLUME | GRAVEL SOURCE | COST (16) | \$/cy |
| | | | | | | | | |
| Normal Road Maintenance Related Work or Projects (1) | | | | | | | | |
| Maint. | 1 | Slumps, shoulders, culverts, sft spot | General road maint. | Cyc,R/R, Fee, Base | 500 | Tek, Outside | | |
| Maint. | 2 | " | " | Cyc,R/R, Fee, Base | 900 | Tek, Outside | | |
| Maint. | 3 | " | " | Cyc,R/R, Fee, Base | 1500 | Tek, Outside | | |
| Maint. | 4 | " | " | Cyc,R/R, Fee, Base | 450 | Tek, East Fork?, Toklat | | |
| Maint. | 5 | " | " | " | 625 | Toklat, East Fork? | | |
| Maint. | 6 | " | " | " | 250 | Toklat | | |
| Maint. | 7 | " | " | " | 125 | 70 mile, Toklat | | |
| Maint. | 8 | " | " | " | 250 | 70 mile | | |
| Maint. | 9 | " | " | " | 350 | Kantishna, 70 mile | | |
| Maint. | 10 | " | " | " | 450 | Kantishna | | |
| | 2 | Re-construct maintainable sfc (9) | Build maintainable surface | CyC, R/R, Fee | | | | |
| | 3 | | " | CyC, R/R, Fee | | | | |
| | 4 | | " | CyC, R/R, Fee | | | | |
| Project | 5 | | " | CyC, R/R, Fee | 3400 | Toklat | | |
| Project | 6 | | " | CyC, R/R, Fee | 5100 | Toklat | | |
| | 7 | | " | CyC, R/R, Fee | | | | |
| | 8 | | " | CyC, R/R, Fee | | | | |
| | 9 | | " | CyC, R/R, Fee | | | | |
| | 10 | | " | CyC, R/R, Fee | | | | |
| Road Construction Specific or Specially Funded Projects (2) | | | | | | | | |
| Project | 10 | Kantishna Road Repair, Phase 2 | Subgrade digout (8) | AKDOT | 12500 (14) | Kantishna | \$2,500,000 | 200/cy |
| | | | | | | | | |
| Facility, Trails or Other Maintenance/Projects (3) | | | | | | | | |
| | | Other (10) | Trails, const, rehab, remed | | 3000 | Tek, Tok, Kant, Outside | | |
| | | | | | | | | |
| | | | | Total Need | 29400 | | | |

APPENDIX A
Denali National Park 10-Year Gravel Needs

| 2008 | | | PROJECTED PARK GRAVEL USE TOTALS | | | | | |
|--|---------|---------------------------------------|----------------------------------|--------------------|----------|-------------------------|-------------|-------|
| | SEGMENT | ACTIVITY TITLE | ACTIVITY TYPE/NEED | FUNDING | VOLUME | GRAVEL SOURCE | COST (16) | \$/cy |
| Normal Road Maintenance Related Work or Projects (1) | | | | | | | | |
| Maint. | 1 | Slumps, shoulders, culverts, sft spot | General road maint. | Cyc,R/R, Fee, Base | 500 | Tek, Outside | | |
| Maint. | 2 | " | " | Cyc,R/R, Fee, Base | 900 | Tek, Outside | | |
| Maint. | 3 | " | " | Cyc,R/R, Fee, Base | 1500 | Tek, Outside | | |
| Maint. | 4 | " | " | Cyc,R/R, Fee, Base | 450 | Tek, East Fork?, Toklat | | |
| Maint. | 5 | " | " | " | 625 | Toklat, East Fork? | | |
| Maint. | 6 | " | " | " | 250 | Toklat | | |
| Maint. | 7 | " | " | " | 125 | 70 mile, Toklat | | |
| Maint. | 8 | " | " | " | 250 | 70 mile | | |
| Maint. | 9 | " | " | " | 350 | Kantishna, 70 mile | | |
| Maint. | 10 | " | " | " | 450 | Kantishna | | |
| | 2 | Re-construct maintainable sfc (9) | Build maintainable surface | CyC, R/R, Fee | | | | |
| | 3 | " | " | CyC, R/R, Fee | | | | |
| | 4 | " | " | CyC, R/R, Fee | | | | |
| | 5 | " | " | CyC, R/R, Fee | | | | |
| Project | 6 | " | " | CyC, R/R, Fee | 8500 | Toklat | | |
| | 7 | " | " | CyC, R/R, Fee | | | | |
| | 8 | " | " | CyC, R/R, Fee | | | | |
| | 9 | " | " | CyC, R/R, Fee | | | | |
| | 10 | " | " | CyC, R/R, Fee | | | | |
| Road Construction Specific or Specially Funded Projects (2) | | | | | | | | |
| Project | 5 | Polychrome Pass Rehab | Subgrade digout | FHWA Contract | 6300 (5) | Toklat/Teklanika | \$1,000,000 | |
| Project | | Construct Toklat Multifunction Bldg | Capital Construction | | 6800 | Toklat | | |
| Facility, Trails or Other Maintenance/Projects (3) | | | | | | | | |
| Project | | Other (10) | Trails, const, rehab, remed | | 3000 | Tek, Tok, Kant, Outside | | |
| | | | | | | | | |
| | | | | Total Need | 30000 | | | |

APPENDIX A
Denali National Park 10-Year Gravel Needs

| 2009 | | | PROJECTED PARK GRAVEL USE TOTALS | | | | | |
|--|---------|---------------------------------------|----------------------------------|--------------------|--------|-------------------------|-----------|-------|
| | SEGMENT | ACTIVITY TITLE | ACTIVITY TYPE/NEED | FUNDING | VOLUME | GRAVEL SOURCE | COST (16) | \$/cy |
| Normal Road Maintenance Related Work or Projects (1) | | | | | | | | |
| Maint. | 1 | Slumps, shoulders, culverts, sft spot | General road maint. | Cyc,R/R, Fee, Base | 500 | Tek, Outside | | |
| Maint. | 2 | " | " | Cyc,R/R, Fee, Base | 900 | Tek, Outside | | |
| Maint. | 3 | " | " | Cyc,R/R, Fee, Base | 1500 | Tek, Outside | | |
| Maint. | 4 | " | " | Cyc,R/R, Fee, Base | 450 | Tek, East Fork?, Toklat | | |
| Maint. | 5 | " | " | " | 625 | Toklat, East Fork? | | |
| Maint. | 6 | " | " | " | 250 | Toklat | | |
| Maint. | 7 | " | " | " | 125 | 70 mile, Toklat | | |
| Maint. | 8 | " | " | " | 250 | 70 mile | | |
| Maint. | 9 | " | " | " | 350 | Kantishna, 70 mile | | |
| Maint. | 10 | " | " | " | 450 | Kantishna | | |
| | 2 | Re-construct maintainable sfc (9) | Build maintainable surface | CyC, R/R, Fee | | | | |
| | 3 | " | " | CyC, R/R, Fee | | | | |
| | 4 | " | " | CyC, R/R, Fee | | | | |
| | 5 | " | " | CyC, R/R, Fee | | | | |
| | 6 | " | " | CyC, R/R, Fee | | | | |
| Project | 7 | " | " | CyC, R/R, Fee | 6800 | Toklat | | |
| | 8 | " | " | CyC, R/R, Fee | | | | |
| | 9 | " | " | CyC, R/R, Fee | | | | |
| | 10 | " | " | CyC, R/R, Fee | | | | |
| Road Construction Specific or Specially Funded Projects (2) | | | | | | | | |
| Project | | As yet unspecified project (15) | Unknown | | 14800 | Unknown | | |
| Facility, Trails or Other Maintenance/Projects (3) | | | | | | | | |
| Project | | Other (10) | Trails, const, rehab, remed | | 3000 | Tek, Tok, Kant, Outside | | |
| | | | | | | | | |
| | | | | Total Need | 30000 | | | |

APPENDIX A
Denali National Park 10-Year Gravel Needs

| 2010 | PROJECTED PARK GRAVEL USE TOTALS | | | | | | | |
|--|----------------------------------|---------------------------------------|-----------------------------|--------------------|--------------|-------------------------|-----------|-------|
| | SEGMENT | ACTIVITY TITLE | ACTIVITY TYPE/NEED | FUNDING | VOLUME | GRAVEL SOURCE | COST (16) | \$/cy |
| Normal Road Maintenance Related Work or Projects (1) | | | | | | | | |
| Maint. | 1 | blumps, shoulders, culverts, sft spot | General road maint. | Cyc,R/R, Fee, Base | 500 | Tek, Outside | | |
| Maint. | 2 | " | " | Cyc,R/R, Fee, Base | 900 | Tek, Outside | | |
| Maint. | 3 | " | " | Cyc,R/R, Fee, Base | 1500 | Tek, Outside | | |
| Maint. | 4 | " | " | Cyc,R/R, Fee, Base | 450 | Tek, East Fork?, Toklat | | |
| Maint. | 5 | " | " | " | 625 | Toklat, East Fork? | | |
| Maint. | 6 | " | " | " | 250 | Toklat | | |
| Maint. | 7 | " | " | " | 125 | 70 mile, Toklat | | |
| Maint. | 8 | " | " | " | 250 | 70 mile | | |
| Maint. | 9 | " | " | " | 350 | Kantishna, 70 mile | | |
| Maint. | 10 | " | " | " | 450 | Kantishna | | |
| | 2 | Re-construct maintainable sfc (9) | Build maintainable surface | CyC, R/R, Fee | | | | |
| | 3 | " | " | CyC, R/R, Fee | | | | |
| | 4 | " | " | CyC, R/R, Fee | | | | |
| | 5 | " | " | CyC, R/R, Fee | | | | |
| | 6 | " | " | CyC, R/R, Fee | | | | |
| Project | 7 | " | " | CyC, R/R, Fee | 5100 | Toklat/70 mile | | |
| | 8 | " | " | CyC, R/R, Fee | | | | |
| | 9 | " | " | CyC, R/R, Fee | | | | |
| | 10 | " | " | CyC, R/R, Fee | | | | |
| Road Construction Specific or Specially Funded Projects (2) | | | | | | | | |
| Project | | As yet unspecified project (15) | Unknown | | 11500 | Unknown | | |
| Facility, Trails or Other Maintenance/Projects (3) | | | | | | | | |
| Project | | Kantishna Admin Site Develop | Extra construction | | 5000 | Kantishna | | |
| Project | | Other (10) | Trails, const, rehab, remed | | 3000 | Tek, Tok, Kant, Outside | | |
| | | | | | | | | |
| | | | | Total Need | 30000 | | | |

APPENDIX A
Denali National Park 10-Year Gravel Needs

| 2011 | | | PROJECTED PARK GRAVEL USE TOTALS | | | | | |
|--|---------|---------------------------------------|----------------------------------|--------------------|--------------|-------------------------|-----------|-------|
| | SEGMENT | ACTIVITY TITLE | ACTIVITY TYPE/NEED | FUNDING | VOLUME | GRAVEL SOURCE | COST (16) | \$/cy |
| Normal Road Maintenance Related Work or Projects (1) | | | | | | | | |
| Maint. | 1 | Slumps, shoulders, culverts, sft spot | General road maint. | Cyc,R/R, Fee, Base | 500 | Tek, Outside | | |
| Maint. | 2 | " | " | Cyc,R/R, Fee, Base | 900 | Tek, Outside | | |
| Maint. | 3 | " | " | Cyc,R/R, Fee, Base | 1500 | Tek, Outside | | |
| Maint. | 4 | " | " | Cyc,R/R, Fee, Base | 450 | Tek, East Fork?, Toklat | | |
| Maint. | 5 | " | " | " | 625 | Toklat, East Fork? | | |
| Maint. | 6 | " | " | " | 250 | Toklat | | |
| Maint. | 7 | " | " | " | 125 | 70 mile, Toklat | | |
| Maint. | 8 | " | " | " | 250 | 70 mile | | |
| Maint. | 9 | " | " | " | 350 | Kantishna, 70 mile | | |
| Maint. | 10 | " | " | " | 450 | Kantishna | | |
| | 2 | Re-construct maintainable sfc (9) | Build maintainable surface | CyC, R/R, Fee | | Tek, Outside | | |
| | 3 | " | " | CyC, R/R, Fee | | Tek, Outside | | |
| | 4 | " | " | CyC, R/R, Fee | | | | |
| | 5 | " | " | CyC, R/R, Fee | | | | |
| | 6 | " | " | CyC, R/R, Fee | | | | |
| | 7 | " | " | CyC, R/R, Fee | | | | |
| | 8 | " | " | CyC, R/R, Fee | | | | |
| | 9 | " | " | CyC, R/R, Fee | | | | |
| Project | 10 | (WL CG Road) | " | CyC, R/R, Fee | 3400 | Kantishna | | |
| Project | 10 | WL Inlet road rehab (11) | Safety repair | | 3000 | Kantishna | | |
| Road Construction Specific or Specially Funded Projects (2) | | | | | | | | |
| Project | | As yet unspecified project (15) | Unknown | | 15200 | Unknown | | |
| Facility, Trails or Other Maintenance/Projects (3) | | | | | | | | |
| Project | | Other (10) | Trails, const, rehab, remed | | 3000 | Tek, Tok, Kant, Outside | | |
| | | | | | | | | |
| | | | | Total Need | 30000 | | | |

APPENDIX A
Denali National Park 10-Year Gravel Needs

| 2012 | PROJECTED PARK GRAVEL USE TOTALS | | | | | | | |
|--|----------------------------------|---------------------------------------|-----------------------------|--------------------|--------------|-------------------------|-----------|-------|
| | SEGMENT | ACTIVITY TITLE | ACTIVITY TYPE/NEED | FUNDING | VOLUME | GRAVEL SOURCE | COST (16) | \$/cy |
| Normal Road Maintenance Related Work or Projects (1) | | | | | | | | |
| Maint. | 1 | slumps, shoulders, culverts, sft spot | General road maint. | Cyc,R/R, Fee, Base | 500 | Tek, Outside | | |
| Maint. | 2 | " | " | Cyc,R/R, Fee, Base | 900 | Tek, Outside | | |
| Maint. | 3 | " | " | Cyc,R/R, Fee, Base | 1500 | Tek, Outside | | |
| Maint. | 4 | " | " | Cyc,R/R, Fee, Base | 450 | Tek, East Fork?, Toklat | | |
| Maint. | 5 | " | " | " | 625 | Toklat, East Fork? | | |
| Maint. | 6 | " | " | " | 250 | Toklat | | |
| Maint. | 7 | " | " | " | 125 | 70 mile, Toklat | | |
| Maint. | 8 | " | " | " | 250 | 70 mile | | |
| Maint. | 9 | " | " | " | 350 | Kantishna, 70 mile | | |
| Maint. | 10 | " | " | " | 450 | Kantishna | | |
| | 2 | Re-construct maintainable sfc (9) | Build maintainable surface | CyC, R/R, Fee | | Tek, Outside | | |
| | 3 | " | " | CyC, R/R, Fee | | Tek, Outside | | |
| | 4 | " | " | CyC, R/R, Fee | | | | |
| | 5 | " | " | CyC, R/R, Fee | | | | |
| | 6 | " | " | CyC, R/R, Fee | | | | |
| | 7 | " | " | CyC, R/R, Fee | | | | |
| | 8 | " | " | CyC, R/R, Fee | | | | |
| | 9 | " | " | CyC, R/R, Fee | | | | |
| Project | 10 | " | " | CyC, R/R, Fee | | | | |
| | | | | | | | | |
| | | | | | | | | |
| Road Construction Specific or Specially Funded Projects (2) | | | | | | | | |
| Project | | As yet unspecified project (15) | Unknown | | 21600 | Unknown | | |
| | | | | | | | | |
| Facility, Trails or Other Maintenance/Projects (3) | | | | | | | | |
| Project | | Other (10) | Trails, const, rehab, remed | | 3000 | Tek, Tok, Kant, Outside | | |
| | | | | | | | | |
| | | | | Total Need | 30000 | | | |

APPENDIX A
Denali National Park 10-Year Gravel Needs

| | | | | | | | | | |
|---|--|--|--|------------------------------------|---------------|--|--|--|--|
| | | | | | | | | | |
| | | | | TOTAL NEED 2003 - 2012 | 340405 | | | | |
| | | | | 10% emergency/contingency | 34040 | | | | |
| | | | | GRAND NEED TOTAL | 374445 | | | | |
| | | | | | | | | | |
| | | | | Average Yearly Need 03 - 12 | 37445 | | | | |
| Footnotes | | | | | | | | | |
| (1) These are activities or projects normally associated with the maintenance of the park road such as slump shims, shoulder repairs, culvert replacement, soft spot digouts, ditch repair, etc... Also included is the replacing of the gravel driving surface. Estimates are based on actual volumes previously used. | | | | | | | | | |
| (2) These are specific projects related to construction or special funding which may be normally outside the scope of the parks day labor force. | | | | | | | | | |
| (3) These are facility or trails related maintenance or projects or gravel needs which don't fit under roads use. | | | | | | | | | |
| (4) Material used to address the most immediate road repair/maint needs. Falls far short of actual need. In 2001 included palliative crown for 1 mile in seg. 5&6 | | | | | | | | | |
| (5) Estimate based on total project cost divided by material volumes of known similar type projects in the same general area. | | | | | | | | | |
| (6) Estimate based on previous years haul records or engineering estimates for an approved project. | | | | | | | | | |
| (7) Estimate based on experience and knowledge with the area/project. | | | | | | | | | |
| (8) Subgrade digouts for segments 3 through 10 result in nearly an equal volume being returned to the source pit for eventual pit rehab. | | | | | | | | | |
| (9) 1700 cys/mile used. This is actual average cys/mile experienced for this work. Though palliative will not be applied in all sections the road needs to be brought to a crowned, maintainable surface. Work may not be done in the order shown. | | | | | | | | | |
| (10) Trails 500-1000, Soil remediation 500-1000, building construction/foundation stabilization 500-1000, annual total 3000 cys. | | | | | | | | | |
| (11) Not funded or in PMIS yet | | | | | | | | | |
| (12) HQ/Kantishna airstrip rehab. Assumes \$80/yd average material costs. | | | | | | | | | |
| (13) Assumes 6' x 150' x 500' subgrade digout and replace with 2' of good gravel including topcourse. 10445 leftover digout waste for pit rehab. | | | | | | | | | |
| (14) This reflects 4500cys/mile. Figure taken from similar subgrade repair at Grassy Pass. This is expected to be mid-range gravel need for this repair. | | | | | | | | | |
| (15) This figure reflects anticipated but unspecified projects to make total needs 30000 cys. | | | | | | | | | |
| (16) All costs are in 2001 dollars. | | | | | | | | | |

APPENDIX B

COST ANALYSIS OF EXTERNAL AND IN-PARK MATERIAL SOURCES

Hart Crowser conducted an economic evaluation to compare the cost of using gravel from various source sites within and outside the park. The process for and results from this analysis are summarized in Chapter 1 of the EA. Appendix B includes two tables documenting the summary results of the cost analyses. The analysis estimated the cost of obtaining mineral material from external sources versus in-park sources based on the combined material cost and transportation distance. Whether the gravel would be transported by NPS personnel or by a contractor also affects the cost of using an external source. Consequently, the cost analysis included one set of tables reflecting costs with contractor transport of the material, and a second set showing costs with NPS transport. These results are provided as Tables B1 and B2; Table B1 summarizes the cost, miles traveled, and volume of gravel to be used for the various alternatives using outside contractors. Table B2 summarizes the cost, miles traveled, and volume of gravel to be used for the various alternatives using NPS personnel and equipment for hauling.

Tables B1 and B2 are the summary worksheets from very large Excel workbooks that each include seven separate worksheets; each workbook also includes a worksheet for each alternative and a worksheet listing assumptions used in the analysis. The detailed tables for each alternative are not included in Appendix B because they include a large volume of information. The summary tables identify gravel volumes and costs by year, source site and alternative, however, and are sufficiently detailed for review of the EA. (The summary tables also identify the total vehicle miles required to transport material by truck for each year and alternative.) The complete set of cost analysis tables is available from the NPS by request.

Table B1
Cost Analysis Summary - Contractor Transportation

| Year | Source | Alternative 1 | | Alternative 2 | | Alternative 3 | | Alternative 4 | | Alternative 5 | |
|------|-----------------------------|---------------------|----------------|---------------------|----------------|---------------------|----------------|---------------------|----------------|---------------------|----------------|
| | | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost |
| 2003 | | | | | | | | | | | |
| | External (Parks Highway) | 29,500 | \$789,181 | 3,000 | \$47,626 | 30,200 | \$869,630 | 3,000 | \$47,626 | 3,000 | \$47,626 |
| | Teklanika - MP 27.2 | 3,700 | \$36,963 | 27,650 | \$296,144 | 450 | \$8,096 | 27,200 | \$288,048 | 27,200 | \$288,048 |
| | East Fork - MP 43 | | | | | | | 1,075 | \$11,239 | 1,075 | \$11,239 |
| | Toklat - MP 53.4 | 5,450 | \$158,948 | 3,875 | \$169,730 | 1,000 | \$23,140 | 3,250 | \$155,330 | 3,250 | \$155,330 |
| | Beaver Pond - MP 70 | | | 3,775 | \$38,112 | | | 3,775 | \$38,112 | 3,775 | \$38,112 |
| | Boundary - MP 88 | | | 4,200 | \$74,598 | | | | | | |
| | Moose Creek Terrace - MP 89 | | | | | 16,405 | \$654,047 | | | | |
| | North Face Corner - MP 89 | 9,405 | \$238,727 | | | | | | | | |
| | Camp Ridge - MP 90 | | | | | | | | | | |
| | Downtown Kantishna - MP 91 | | | | | | | 9,755 | \$246,339 | 9,755 | \$246,339 |
| | Kantishna Airstrip - MP 93 | | | 5,555 | \$105,767 | | | | | | |
| | 2003 Year End Totals | | | | | | | | | | |
| | Total Cubic Yards | 48,055 | | 48,055 | | 48,055 | | 48,055 | | 48,055 | |
| | Total Trucking Miles | 229,169 | | 77,390 | | 312,699 | | 80,836 | | 80,836 | |
| | Total Estimated Cost | | \$1,223,819 | | \$731,977 | | \$1,554,913 | | \$786,695 | | \$786,695 |
| 2004 | | | | | | | | | | | |
| | External (Parks Highway) | 24,000 | \$616,768 | 3,000 | \$26,676 | 32,300 | \$626,599 | 3,000 | \$26,676 | 3,000 | \$26,676 |
| | Teklanika - MP 27.2 | 7,500 | \$110,620 | 6,500 | \$91,910 | 450 | \$8,419 | 20,100 | \$184,121 | 20,100 | \$184,121 |
| | East Fork - MP 43 | | | 23,250 | \$366,358 | | | 9,650 | \$96,765 | 9,650 | \$96,765 |
| | Toklat - MP 53.4 | 8,850 | \$260,919 | 3,875 | \$64,199 | 1,000 | \$24,066 | 3,875 | \$64,199 | 3,875 | \$64,199 |
| | Beaver Pond - MP 70 | | | 375 | \$4,312 | | | 375 | \$4,312 | 375 | \$4,312 |
| | Boundary - MP 88 | | | 800 | \$11,140 | | | | | | |
| | Moose Creek Terrace - MP 89 | | | | | 7,050 | \$259,492 | | | | |
| | North Face Corner - MP 89 | 450 | \$10,034 | | | | | | | | |
| | Camp Ridge - MP 90 | | | | | | | | | | |
| | Downtown Kantishna - MP 91 | | | | | | | 3,800 | \$82,734 | 3,800 | \$82,734 |
| | Kantishna Airstrip - MP 93 | | | 3,000 | \$64,397 | | | | | | |
| | 2004 Year End Totals | | | | | | | | | | |
| | Total Cubic Yards | 40,800 | | 40,800 | | 40,800 | | 40,800 | | 40,800 | |
| | Total Trucking Miles | 203,525 | | 68,070 | | 152,375 | | 24,870 | | 24,870 | |
| | Total Estimated Cost | | \$998,341 | | \$628,993 | \$40,800 | \$918,576 | \$40,800 | \$458,807 | \$40,800 | \$458,807 |
| 2005 | | | | | | | | | | | |
| | External (Parks Highway) | 27,800 | \$1,132,235 | 3,000 | \$108,069 | 29,900 | \$1,203,270 | 3,000 | \$108,828 | 3,000 | \$108,828 |
| | Teklanika - MP 27.2 | 5,100 | \$68,345 | 11,900 | \$196,902 | 450 | \$8,756 | 5,100 | \$68,345 | 5,100 | \$68,345 |
| | East Fork - MP 43 | | | 15,450 | \$136,103 | | | 22,875 | \$221,751 | 22,875 | \$221,751 |
| | Toklat - MP 53.4 | 2,500 | \$82,829 | 875 | \$20,679 | 1,000 | \$25,028 | 250 | \$5,797 | 250 | \$5,797 |
| | Beaver Pond - MP 70 | | | 375 | \$4,366 | | | 375 | \$4,485 | 375 | \$4,485 |
| | Boundary - MP 88 | | | 800 | \$11,334 | | | | | | |
| | Moose Creek Terrace - MP 89 | | | | | 4,050 | \$208,091 | | | | |
| | North Face Corner - MP 89 | | | | | | | | | 3,000 | \$175,998 |
| | Camp Ridge - MP 90 | | | | | | | | | | |
| | Downtown Kantishna - MP 91 | | | 3,000 | \$181,409 | | | 3,800 | \$208,048 | 800 | \$24,262 |
| | Kantishna Airstrip - MP 93 | | | | | | | | | | |
| | 2005 Year End Totals | | | | | | | | | | |
| | Total Cubic Yards | 35,400 | | 35,400 | | 35,400 | | 35,400 | | 35,400 | |
| | Total Trucking Miles | 309,325 | | 86,130 | | 329,675 | | 73,045 | | 71,245 | |
| | Total Estimated Cost | | \$1,283,409 | | \$658,863 | | \$1,445,146 | | \$617,255 | | \$609,467 |

| Year | Source | Alternative 1 | | Alternative 2 | | Alternative 3 | | Alternative 4 | | Alternative 5 | |
|-----------------------------|-----------------------------|---------------------|----------------|---------------------|----------------|---------------------|----------------|---------------------|----------------|---------------------|----------------|
| | | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost |
| 2006 | External (Parks Highway) | 24,000 | \$282,654 | 500 | \$11,438 | 3,950 | \$150,420 | 500 | \$11,438 | 500 | \$11,438 |
| | Teklanika - MP 27.2 | 4,775 | \$70,464 | 3,450 | \$43,628 | 450 | \$9,106 | 6,450 | \$144,832 | 6,450 | \$144,832 |
| | East Fork - MP 43 | | | 450 | \$5,057 | | | 450 | \$5,057 | 450 | \$5,057 |
| | Toklat - MP 53.4 | 7,975 | \$225,652 | 10,675 | \$367,158 | 7,800 | \$202,264 | 7,675 | \$198,462 | 7,675 | \$198,462 |
| | Beaver Pond - MP 70 | | | 8,375 | \$576,905 | | | 375 | \$4,664 | 375 | \$4,664 |
| | Boundary - MP 88 | | | 800 | \$12,050 | | | | | | |
| | Moose Creek Terrace - MP 89 | | | | | 24,550 | \$2,418,809 | | | | |
| | North Face Corner - MP 89 | | | | | | | | | | |
| | Camp Ridge - MP 90 | | | | | | | | | | |
| | Downtown Kantishna - MP 91 | | | 12,500 | \$1,302,593 | | | 21,300 | \$2,161,485 | 21,300 | \$2,161,485 |
| | Kantishna Airstrip - MP 93 | | | | | | | | | | |
| 2006 Year End Totals | | | | | | | | | | | |
| Total Cubic Yards | | 36,750 | | 36,750 | | 36,750 | | 36,750 | | 36,750 | |
| Total Trucking Miles | | 68,510 | | 387,380 | | 456,945 | | 408,220 | | 408,220 | |
| Total Estimated Cost | | | \$578,770 | | \$2,318,828 | | \$2,780,598 | | \$2,525,938 | | \$2,525,938 |
| 2007 | External (Parks Highway) | 16,900 | \$1,045,610 | 500 | \$11,895 | 2,900 | \$110,231 | 500 | \$11,895 | 500 | \$11,895 |
| | Teklanika - MP 27.2 | 1,500 | \$17,530 | 2,400 | \$33,102 | 450 | \$9,471 | 2,400 | \$33,102 | 2,400 | \$33,102 |
| | East Fork - MP 43 | | | 3,850 | \$48,177 | | | 450 | \$5,259 | 450 | \$5,259 |
| | Toklat - MP 53.4 | 11,000 | \$309,147 | 5,975 | \$151,033 | 9,500 | \$246,630 | 9,375 | \$242,675 | 9,375 | \$242,675 |
| | Beaver Pond - MP 70 | | | 375 | \$4,851 | | | 725 | \$9,268 | 725 | \$9,268 |
| | Boundary - MP 88 | | | 800 | \$12,532 | | | | | | |
| | Moose Creek Terrace - MP 89 | | | 3,000 | \$190,359 | 16,550 | \$538,594 | | | | |
| | North Face Corner - MP 89 | | | | | | | | | 3,000 | \$190,359 |
| | Camp Ridge - MP 90 | | | | | | | | | | |
| | Downtown Kantishna - MP 91 | | | 12,500 | \$348,618 | | | 15,950 | \$559,950 | 12,950 | \$361,168 |
| | Kantishna Airstrip - MP 93 | | | | | | | | | | |
| 2007 Year End Totals | | | | | | | | | | | |
| Total Cubic Yards | | 29,400 | | 29,400 | | 29,400 | | 29,400 | | 29,400 | |
| Total Trucking Miles | | 293,925 | | 53,330 | | 63,595 | | 55,470 | | 53,670 | |
| Total Estimated Cost | | | \$1,372,287 | | \$800,587 | | \$904,924 | | \$862,151 | | \$853,728 |
| 2008 | External (Parks Highway) | 16,600 | \$506,626 | 500 | \$12,371 | 9,700 | \$199,523 | 500 | \$12,371 | 500 | \$12,371 |
| | Teklanika - MP 27.2 | 2,400 | \$34,426 | 2,400 | \$34,426 | 450 | \$9,849 | 2,400 | \$34,426 | 2,400 | \$34,426 |
| | East Fork - MP 43 | | | 6,750 | \$69,778 | | | 6,750 | \$69,778 | 6,750 | \$69,778 |
| | Toklat - MP 53.4 | 11,000 | \$314,894 | 16,175 | \$659,343 | 15,800 | \$357,108 | 16,175 | \$659,343 | 16,175 | \$659,343 |
| | Beaver Pond - MP 70 | | | 375 | \$5,045 | | | 375 | \$5,045 | 375 | \$5,045 |
| | Boundary - MP 88 | | | 800 | \$13,033 | | | | | | |
| | Moose Creek Terrace - MP 89 | | | | | 4,050 | \$234,074 | 800 | \$25,735 | | |
| | North Face Corner - MP 89 | | | | | | | | | 3,000 | \$197,974 |
| | Camp Ridge - MP 90 | | | | | | | | | | |
| | Downtown Kantishna - MP 91 | | | 3,000 | \$206,734 | | | 3,000 | \$206,734 | 800 | \$27,292 |
| | Kantishna Airstrip - MP 93 | | | | | | | | | | |
| 2008 Year End Totals | | | | | | | | | | | |
| Total Cubic Yards | | 30,000 | | 30,000 | | 30,000 | | 30,000 | | 30,000 | |
| Total Trucking Miles | | 131,865 | | 112,790 | | 78,415 | | 113,110 | | 111,630 | |
| Total Estimated Cost | | | \$855,947 | | \$1,000,730 | | \$800,555 | | \$1,013,431 | | \$1,006,229 |

| Year | Source | Alternative 1 | | Alternative 2 | | Alternative 3 | | Alternative 4 | | Alternative 5 | |
|-----------------------------|-----------------------------|---------------------|----------------|---------------------|----------------|---------------------|----------------|---------------------|----------------|---------------------|----------------|
| | | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost |
| 2009 | External (Parks Highway) | 18,300 | \$827,736 | 500 | \$12,866 | 2,900 | \$119,225 | 500 | \$12,866 | 500 | \$12,866 |
| | Teklanika - MP 27.2 | 2,400 | \$35,803 | 2,400 | \$35,803 | 450 | \$10,243 | 2,400 | \$35,803 | 2,400 | \$35,803 |
| | East Fork - MP 43 | | | 450 | \$5,688 | | | 450 | \$5,688 | 450 | \$5,688 |
| | Toklat - MP 53.4 | 9,300 | \$329,555 | 7,675 | \$257,659 | 22,600 | \$523,923 | 15,675 | \$286,990 | 15,675 | \$286,990 |
| | Beaver Pond - MP 70 | | | 375 | \$5,246 | | | 7,175 | \$118,735 | 7,175 | \$118,735 |
| | Boundary - MP 88 | | | | | | | | | | |
| | Moose Creek Terrace - MP 89 | | | 800 | \$25,954 | 4,050 | \$243,437 | 3,350 | \$223,030 | | |
| | North Face Corner - MP 89 | | | | | | | | | | |
| | Camp Ridge - MP 90 | | | 3,000 | \$165,466 | | | | | | |
| | Downtown Kantishna - MP 91 | | | 14,800 | \$1,060,682 | | | 450 | \$13,574 | 3,800 | \$243,387 |
| | Kantishna Airstrip - MP 93 | | | | | | | | | | |
| 2009 Year End Totals | | | | | | | | | | | |
| Total Cubic Yards | | 30,000 | | 30,000 | | 30,000 | | 30,000 | | 30,000 | |
| Total Trucking Miles | | 220,265 | | 186,030 | | 86,915 | | 66,850 | | 68,190 | |
| Total Estimated Cost | | | \$1,193,095 | | \$1,569,365 | | \$896,829 | | \$696,687 | | \$703,469 |
| 2010 | External (Parks Highway) | 20,000 | \$1,142,647 | 500 | \$13,380 | 2,900 | \$123,994 | 500 | \$13,380 | 500 | \$13,380 |
| | Teklanika - MP 27.2 | 2,400 | \$37,236 | 2,400 | \$37,236 | 450 | \$10,653 | 2,400 | \$37,236 | 2,400 | \$37,236 |
| | East Fork - MP 43 | | | 450 | \$5,916 | | | 450 | \$5,916 | 450 | \$5,916 |
| | Toklat - MP 53.4 | 7,600 | \$282,246 | 15,375 | \$292,946 | 12,500 | \$242,164 | 875 | \$26,003 | 875 | \$26,003 |
| | Beaver Pond - MP 70 | | | 5,475 | \$93,978 | | | 5,475 | \$93,978 | 5,475 | \$93,978 |
| | Boundary - MP 88 | | | 800 | \$14,096 | | | | | | |
| | Moose Creek Terrace - MP 89 | | | | | 14,150 | \$693,201 | 19,500 | \$1,217,605 | | |
| | North Face Corner - MP 89 | | | | | | | | | 15,300 | \$1,061,946 |
| | Camp Ridge - MP 90 | | | | | | | | | | |
| | Downtown Kantishna - MP 91 | | | 5,000 | \$156,859 | | | 800 | \$29,519 | 5,000 | \$156,859 |
| | Kantishna Airstrip - MP 93 | | | | | | | | | | |
| 2010 Year End Totals | | | | | | | | | | | |
| Total Cubic Yards | | 30,000 | | 30,000 | | 30,000 | | 30,000 | | 30,000 | |
| Total Trucking Miles | | 288,565 | | 42,490 | | 103,555 | | 152,430 | | 147,050 | |
| Total Estimated Cost | | | \$1,462,129 | | \$614,411 | | \$1,070,013 | | \$1,423,637 | | \$1,395,318 |
| 2011 | External (Parks Highway) | 18,700 | \$915,085 | 500 | \$13,916 | 2,900 | \$128,954 | 500 | \$13,916 | 500 | \$13,916 |
| | Teklanika - MP 27.2 | 2,400 | \$38,725 | 2,850 | \$49,804 | 450 | \$11,079 | 2,400 | \$38,725 | 2,400 | \$38,725 |
| | East Fork - MP 43 | | | | | | | 450 | \$6,152 | 450 | \$6,152 |
| | Toklat - MP 53.4 | 8,900 | \$455,796 | 19,075 | \$375,505 | 16,200 | \$322,692 | 19,075 | \$375,505 | 19,075 | \$375,505 |
| | Beaver Pond - MP 70 | | | 375 | \$5,674 | | | 375 | \$5,674 | 375 | \$5,674 |
| | Boundary - MP 88 | | | 800 | \$14,660 | | | | | | |
| | Moose Creek Terrace - MP 89 | | | | | 10,450 | \$451,091 | 7,200 | \$223,745 | | |
| | North Face Corner - MP 89 | | | | | | | | | 6,400 | \$187,790 |
| | Camp Ridge - MP 90 | | | | | | | | | | |
| | Downtown Kantishna - MP 91 | | | 6,400 | \$208,811 | | | | | 800 | \$30,700 |
| | Kantishna Airstrip - MP 93 | | | | | | | | | | |
| 2011 Year End Totals | | | | | | | | | | | |
| Total Cubic Yards | | 30,000 | | 30,000 | | 30,000 | | 30,000 | | 30,000 | |
| Total Trucking Miles | | 253,305 | | 43,850 | | 77,795 | | 40,710 | | 39,750 | |
| Total Estimated Cost | | | \$1,409,607 | | \$668,370 | | \$913,817 | | \$663,717 | | \$658,462 |

| Year | Source | Alternative 1 | | Alternative 2 | | Alternative 3 | | Alternative 4 | | Alternative 5 | |
|-----------------------------|-----------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| | | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost |
| 2012 | External (Parks Highway) | 25,100 | \$1,281,260 | 500 | \$14,472 | 2,900 | \$134,112 | 500 | \$14,472 | 500 | \$14,472 |
| | Teklanika - MP 27.2 | 2,400 | \$40,274 | 2,400 | \$40,274 | 450 | \$11,522 | 2,400 | \$40,274 | 2,400 | \$40,274 |
| | East Fork - MP 43 | | | | | | | 450 | \$6,398 | 450 | \$6,398 |
| | Toklat - MP 53.4 | 2,500 | \$108,997 | 25,925 | \$536,307 | 22,600 | \$463,037 | 25,475 | \$517,963 | 25,475 | \$517,963 |
| | Beaver Pond - MP 70 | | | 375 | \$5,901 | | | 375 | \$5,901 | 375 | \$5,901 |
| | Boundary - MP 88 | | | 800 | \$15,247 | | | | | | |
| | Moose Creek Terrace - MP 89 | | | | | 4,050 | \$273,834 | 800 | \$30,106 | | |
| | North Face Corner - MP 89 | | | | | | | | | 800 | \$29,195 |
| | Camp Ridge - MP 90 | | | | | | | | | | |
| | Downtown Kantishna - MP 91 | | | | | | | | | | |
| | Kantishna Airstrip - MP 93 | | | | | | | | | | |
| 2012 Year End Totals | | | | | | | | | | | |
| | Total Cubic Yards | 30,000 | | 30,000 | | 30,000 | | 30,000 | | 30,000 | |
| | Total Trucking Miles | 281,465 | | 46,320 | | 84,195 | | 45,830 | | 45,670 | |
| | Total Estimated Cost | | \$1,430,531 | | \$612,201 | | \$882,506 | | \$615,115 | | \$614,204 |
| 10-Year Totals | | | | | | | | | | | |
| | External (Parks Highway) | 220,900 | \$8,539,802 | 12,500 | \$272,709 | 120,550 | \$3,665,959 | 12,500 | \$273,468 | 12,500 | \$273,468 |
| | Teklanika - MP 27.2 | 34,575 | \$490,387 | 64,350 | \$859,230 | 4,500 | \$97,195 | 73,250 | \$904,913 | 73,250 | \$904,913 |
| | East Fork - MP 43 | | | 50,650 | \$637,077 | | | 43,050 | \$434,004 | 43,050 | \$434,004 |
| | Toklat - MP 53.4 | 75,075 | \$2,528,984 | 109,500 | \$2,894,561 | 110,000 | \$2,430,053 | 101,700 | \$2,532,268 | 101,700 | \$2,532,268 |
| | Beaver Pond - MP 70 | | | 20,250 | \$744,390 | | | 19,400 | \$290,175 | 19,400 | \$290,175 |
| | Boundary - MP 88 | | | 10,600 | \$178,689 | | | | | | |
| | Moose Creek Terrace - MP 89 | | | 3,800 | \$216,314 | 105,355 | \$5,974,671 | 31,650 | \$1,720,221 | | |
| | North Face Corner - MP 89 | 9,855 | \$248,761 | | | | | | | 31,500 | \$1,843,262 |
| | Camp Ridge - MP 90 | | | 3,000 | \$165,466 | | | | | | |
| | Downtown Kantishna - MP 91 | | | 57,200 | \$3,465,705 | | | 58,855 | \$3,508,383 | 59,005 | \$3,334,226 |
| | Kantishna Airstrip - MP 93 | | | 8,555 | \$170,164 | | | | | | |
| Total Miles Traveled | | 2,279,919 | | 1,103,780 | | 1,746,164 | | 1,061,371 | | 1,051,131 | |
| 10 Year Sums | | 340,405 | \$11,807,934 | 340,405 | \$9,604,304 | 340,405 | \$12,167,878 | 340,405 | \$9,663,432 | 340,405 | \$9,612,316 |
| 10 % Contingency | | 34,041 | \$1,180,793 | 34,041 | \$960,430 | 34,041 | \$1,216,788 | 34,041 | \$966,343 | 34,041 | \$961,232 |
| 10-Year Total | | 374,446 | \$12,988,728 | 374,446 | \$10,564,734 | 374,446 | \$13,384,666 | 374,446 | \$10,629,775 | 374,446 | \$10,573,548 |

| | | |
|------|--|-------|
| Cost | Per cubic yard per mile' round trip | 0.80 |
| | Processing cost for Teklanika in \$ per cubic yard | 7.59 |
| | Processing cost for North Face Corner in \$ per cubic yard | 19.04 |
| | Cost of Gravel External Park in \$ per cubic yard | 4.5 |
| | Inflation in % | 0.04 |
| | External D1 | 14 |

Table B2
Cost Analysis Summary - NPS Transportation

| Year | Source | Alternative 1 | | Alternative 2 | | Alternative 3 | | Alternative 4 | | Alternative 5 | |
|------|-----------------------------|---------------------|----------------|---------------------|----------------|---------------------|----------------|---------------------|----------------|---------------------|----------------|
| | | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost |
| 2003 | | | | | | | | | | | |
| | External (Parks Highway) | 29,500 | \$714,098 | 3,000 | \$43,763 | 30,200 | \$784,381 | 3,000 | \$43,763 | 3,000 | \$43,763 |
| | Teklanika - MP 27.2 | 3,700 | \$35,742 | 27,650 | \$284,280 | 450 | \$7,452 | 27,200 | \$276,828 | 27,200 | \$276,828 |
| | East Fork - MP 43 | | | | | | | 1,075 | \$10,816 | 1,075 | \$10,816 |
| | Toklat - MP 53.4 | 5,450 | \$151,361 | 3,875 | \$151,814 | 1,000 | \$22,576 | 3,250 | \$137,758 | 3,250 | \$137,758 |
| | Beaver Pond - MP 70 | | | 3,775 | \$36,812 | | | 3,775 | \$36,812 | 3,775 | \$36,812 |
| | Boundary - MP 88 | | | 4,200 | \$68,724 | | | | | | |
| | Moose Creek Terrace - MP 89 | | | | | 16,405 | \$607,064 | | | | |
| | North Face Corner - MP 89 | 9,405 | \$230,525 | | | | | | | | |
| | Camp Ridge - MP 90 | | | | | | | | | | |
| | Downtown Kantishna - MP 91 | | | | | | | 9,755 | \$238,006 | 9,755 | \$238,006 |
| | Kantishna Airstrip - MP 93 | | | 5,555 | \$105,767 | | | | | | |
| | 2003 Year End Totals | | | | | | | | | | |
| | Total Cubic Yards | 48,055 | | 48,055 | | 48,055 | | 48,055 | | 48,055 | |
| | Total Trucking Miles | 229,169 | | 77,390 | | 312,699 | | 80,836 | | 80,836 | |
| | Total Estimated Cost | | \$1,131,725 | | \$691,159 | | \$1,421,474 | | \$743,982 | | \$743,982 |
| 2004 | | | | | | | | | | | |
| | External (Parks Highway) | 24,000 | \$550,120 | 3,000 | \$24,707 | 32,300 | \$579,228 | 3,000 | \$24,707 | 3,000 | \$24,707 |
| | Teklanika - MP 27.2 | 7,500 | \$103,550 | 6,500 | \$86,327 | 450 | \$7,750 | 20,100 | \$180,620 | 20,100 | \$180,620 |
| | East Fork - MP 43 | | | 23,250 | \$341,219 | | | 9,650 | \$93,934 | 9,650 | \$93,934 |
| | Toklat - MP 53.4 | 8,850 | \$249,139 | 3,875 | \$61,010 | 1,000 | \$23,479 | 3,875 | \$61,010 | 3,875 | \$61,010 |
| | Beaver Pond - MP 70 | | | 375 | \$4,126 | | | 375 | \$4,126 | 375 | \$4,126 |
| | Boundary - MP 88 | | | 800 | \$10,477 | | | | | | |
| | Moose Creek Terrace - MP 89 | | | | | 7,050 | \$243,007 | | | | |
| | North Face Corner - MP 89 | 450 | \$9,879 | | | | | | | | |
| | Camp Ridge - MP 90 | | | | | | | | | | |
| | Downtown Kantishna - MP 91 | | | | | | | 3,800 | \$81,704 | 3,800 | \$81,704 |
| | Kantishna Airstrip - MP 93 | | | 3,000 | \$63,710 | | | | | | |
| | 2004 Year End Totals | | | | | | | | | | |
| | Total Cubic Yards | 40,800 | | 40,800 | | 40,800 | | 40,800 | | 40,800 | |
| | Total Trucking Miles | 203,525 | | 68,070 | | 152,375 | | 24,870 | | 24,870 | |
| | Total Estimated Cost | | \$912,688 | | \$591,576 | \$40,800 | \$853,465 | \$40,800 | \$446,101 | \$40,800 | \$446,101 |
| 2005 | | | | | | | | | | | |
| | External (Parks Highway) | 27,800 | \$1,010,993 | 3,000 | \$96,353 | 29,900 | \$1,080,922 | 3,000 | \$97,112 | 3,000 | \$97,112 |
| | Teklanika - MP 27.2 | 5,100 | \$64,705 | 11,900 | \$182,744 | 450 | \$8,060 | 5,100 | \$64,705 | 5,100 | \$64,705 |
| | East Fork - MP 43 | | | 15,450 | \$134,158 | | | 22,875 | \$217,081 | 22,875 | \$217,081 |
| | Toklat - MP 53.4 | 2,500 | \$78,519 | 875 | \$20,218 | 1,000 | \$24,418 | 250 | \$5,708 | 250 | \$5,708 |
| | Beaver Pond - MP 70 | | | 375 | \$4,173 | | | 375 | \$4,291 | 375 | \$4,291 |
| | Boundary - MP 88 | | | 800 | \$10,643 | | | | | | |
| | Moose Creek Terrace - MP 89 | | | | | 4,050 | \$190,947 | | | | |
| | North Face Corner - MP 89 | | | | | | | | | 3,000 | \$160,293 |
| | Camp Ridge - MP 90 | | | | | | | | | | |
| | Downtown Kantishna - MP 91 | | | 3,000 | \$164,634 | | | 3,800 | \$190,202 | 800 | \$23,192 |
| | Kantishna Airstrip - MP 93 | | | | | | | | | | |
| | 2005 Year End Totals | | | | | | | | | | |
| | Total Cubic Yards | 35,400 | | 35,400 | | 35,400 | | 35,400 | | 35,400 | |
| | Total Trucking Miles | 309,325 | | 86,130 | | 329,875 | | 73,045 | | 71,245 | |
| | Total Estimated Cost | | \$1,154,217 | | \$612,924 | | \$1,304,347 | | \$579,099 | | \$572,382 |

| Year | Source | Alternative 1 | | Alternative 2 | | Alternative 3 | | Alternative 4 | | Alternative 5 | |
|------|-----------------------------|---------------------|----------------|---------------------|----------------|---------------------|----------------|---------------------|----------------|---------------------|----------------|
| | | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost |
| 2006 | External (Parks Highway) | 24,000 | \$262,161 | 500 | \$10,969 | 3,950 | \$138,818 | 500 | \$10,969 | 500 | \$10,969 |
| | Teklanika - MP 27.2 | 4,775 | \$66,381 | 3,450 | \$41,680 | 450 | \$8,382 | 6,450 | \$132,490 | 6,450 | \$132,490 |
| | East Fork - MP 43 | | | 450 | \$4,890 | | | 450 | \$4,890 | 450 | \$4,890 |
| | Toklat - MP 53.4 | 7,975 | \$218,111 | 10,675 | \$342,798 | 7,800 | \$197,423 | 7,675 | \$193,776 | 7,675 | \$193,776 |
| | Beaver Pond - MP 70 | | | 8,375 | \$507,412 | | | 375 | \$4,463 | 375 | \$4,463 |
| | Boundary - MP 88 | | | 800 | \$11,332 | | | | | | |
| | Moose Creek Terrace - MP 89 | | | | | 24,550 | \$2,158,520 | | | | |
| | North Face Corner - MP 89 | | | | | | | | | | |
| | Camp Ridge - MP 90 | | | | | | | | | | |
| | Downtown Kantishna - MP 91 | | | 12,500 | \$1,160,297 | | | 21,300 | \$1,927,007 | 21,300 | \$1,927,007 |
| | Kantishna Airstrip - MP 93 | | | | | | | | | | |
| | 2006 Year End Totals | | | | | | | | | | |
| 2007 | Total Cubic Yards | 36,750 | | 36,750 | | 36,750 | | 36,750 | | 36,750 | |
| | Total Trucking Miles | 68,510 | | 387,380 | | 456,945 | | 408,220 | | 408,220 | |
| | Total Estimated Cost | | \$546,652 | | \$2,079,377 | | \$2,503,143 | | \$2,273,594 | | \$2,273,594 |
| 2008 | External (Parks Highway) | 16,900 | \$921,848 | 500 | \$11,408 | 2,900 | \$101,980 | 500 | \$11,408 | 500 | \$11,408 |
| | Teklanika - MP 27.2 | 1,500 | \$16,951 | 2,400 | \$31,481 | 450 | \$8,718 | 2,400 | \$31,481 | 2,400 | \$31,481 |
| | East Fork - MP 43 | | | 3,850 | \$46,253 | | | 450 | \$5,085 | 450 | \$5,085 |
| | Toklat - MP 53.4 | 11,000 | \$300,329 | 5,975 | \$148,566 | 9,500 | \$241,814 | 9,375 | \$238,020 | 9,375 | \$238,020 |
| | Beaver Pond - MP 70 | | | 375 | \$4,641 | | | 725 | \$8,879 | 725 | \$8,879 |
| | Boundary - MP 88 | | | 800 | \$11,785 | | | | | | |
| | Moose Creek Terrace - MP 89 | | | 3,000 | \$173,373 | 16,550 | \$515,224 | | | | |
| | North Face Corner - MP 89 | | | | | | | | | 3,000 | \$173,373 |
| | Camp Ridge - MP 90 | | | | | | | | | | |
| | Downtown Kantishna - MP 91 | | | 12,500 | \$338,967 | | | 15,950 | \$531,807 | 12,950 | \$351,169 |
| | Kantishna Airstrip - MP 93 | | | | | | | | | | |
| | 2007 Year End Totals | | | | | | | | | | |
| 2008 | Total Cubic Yards | 29,400 | | 29,400 | | 29,400 | | 29,400 | | 29,400 | |
| | Total Trucking Miles | 293,925 | | 53,330 | | 63,595 | | 55,470 | | 53,670 | |
| | Total Estimated Cost | | \$1,239,128 | | \$766,473 | | \$867,736 | | \$826,681 | | \$819,416 |
| 2009 | External (Parks Highway) | 16,600 | \$452,712 | 500 | \$11,864 | 9,700 | \$184,676 | 500 | \$11,864 | 500 | \$11,864 |
| | Teklanika - MP 27.2 | 2,400 | \$32,740 | 2,400 | \$32,740 | 450 | \$9,066 | 2,400 | \$32,740 | 2,400 | \$32,740 |
| | East Fork - MP 43 | | | 6,750 | \$68,754 | | | 6,750 | \$68,754 | 6,750 | \$68,754 |
| | Toklat - MP 53.4 | 11,000 | \$306,633 | 16,175 | \$607,179 | 15,800 | \$346,265 | 16,175 | \$607,179 | 16,175 | \$607,179 |
| | Beaver Pond - MP 70 | | | 375 | \$4,827 | | | 375 | \$4,827 | 375 | \$4,827 |
| | Boundary - MP 88 | | | 800 | \$12,257 | | | | | | |
| | Moose Creek Terrace - MP 89 | | | | | 4,050 | \$214,789 | 800 | \$24,744 | | |
| | North Face Corner - MP 89 | | | | | | | | | 3,000 | \$180,308 |
| | Camp Ridge - MP 90 | | | | | | | | | | |
| | Downtown Kantishna - MP 91 | | | 3,000 | \$187,863 | | | 3,000 | \$187,863 | 800 | \$26,087 |
| | Kantishna Airstrip - MP 93 | | | | | | | | | | |
| | 2008 Year End Totals | | | | | | | | | | |
| 2009 | Total Cubic Yards | 30,000 | | 30,000 | | 30,000 | | 30,000 | | 30,000 | |
| | Total Trucking Miles | 131,865 | | 112,790 | | 78,415 | | 113,110 | | 111,630 | |
| | Total Estimated Cost | | \$792,085 | | \$925,484 | | \$754,796 | | \$937,972 | | \$931,760 |

| Year | Source | Alternative 1 | | Alternative 2 | | Alternative 3 | | Alternative 4 | | Alternative 5 | |
|------|-----------------------------|---------------------|----------------|---------------------|----------------|---------------------|----------------|---------------------|----------------|---------------------|----------------|
| | | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost |
| 2009 | | | | | | | | | | | |
| | External (Parks Highway) | 18,300 | \$733,374 | 500 | \$12,339 | 2,900 | \$110,302 | 500 | \$12,339 | 500 | \$12,339 |
| | Teklanika - MP 27.2 | 2,400 | \$34,050 | 2,400 | \$34,050 | 450 | \$9,429 | 2,400 | \$34,050 | 2,400 | \$34,050 |
| | East Fork - MP 43 | | | 450 | \$5,500 | | | 450 | \$5,500 | 450 | \$5,500 |
| | Toklat - MP 53.4 | 9,300 | \$315,048 | 7,675 | \$247,656 | 22,600 | \$497,266 | 15,675 | \$269,971 | 15,675 | \$269,971 |
| | Beaver Pond - MP 70 | | | 375 | \$5,020 | | | 7,175 | \$111,884 | 7,175 | \$111,884 |
| | Boundary - MP 88 | | | | | | | | | | |
| | Moose Creek Terrace - MP 89 | | | 800 | \$25,036 | 4,050 | \$223,381 | 3,350 | \$203,461 | | |
| | North Face Corner - MP 89 | | | | | | | | | | |
| | Camp Ridge - MP 90 | | | 3,000 | \$146,676 | | | | | | |
| | Downtown Kantishna - MP 91 | | | 14,800 | \$963,864 | | | 450 | \$13,199 | 3,800 | \$222,509 |
| | Kantishna Airstrip - MP 93 | | | | | | | | | | |
| | 2009 Year End Totals | | | | | | | | | | |
| | Total Cubic Yards | 30,000 | | 30,000 | | 30,000 | | 30,000 | | 30,000 | |
| | Total Trucking Miles | 220,265 | | 186,030 | | 86,915 | | 66,850 | | 68,190 | |
| | Total Estimated Cost | | \$1,082,472 | | \$1,440,140 | | \$840,377 | | \$650,403 | | \$656,252 |
| 2010 | | | | | | | | | | | |
| | External (Parks Highway) | 20,000 | \$1,008,775 | 500 | \$12,832 | 2,900 | \$114,714 | 500 | \$12,832 | 500 | \$12,832 |
| | Teklanika - MP 27.2 | 2,400 | \$35,412 | 2,400 | \$35,412 | 450 | \$9,808 | 2,400 | \$35,412 | 2,400 | \$35,412 |
| | East Fork - MP 43 | | | 450 | \$5,720 | | | 450 | \$5,720 | 450 | \$5,720 |
| | Toklat - MP 53.4 | 7,600 | \$269,620 | 15,375 | \$275,594 | 12,500 | \$228,105 | 875 | \$25,442 | 875 | \$25,442 |
| | Beaver Pond - MP 70 | | | 5,475 | \$88,575 | | | 5,475 | \$88,575 | 5,475 | \$88,575 |
| | Boundary - MP 88 | | | 800 | \$13,257 | | | | | | |
| | Moose Creek Terrace - MP 89 | | | | | 14,150 | \$646,634 | 19,500 | \$1,117,364 | | |
| | North Face Corner - MP 89 | | | | | | | | | 15,300 | \$968,639 |
| | Camp Ridge - MP 90 | | | | | | | | | | |
| | Downtown Kantishna - MP 91 | | | 5,000 | \$152,516 | | | 800 | \$28,216 | 5,000 | \$152,516 |
| | Kantishna Airstrip - MP 93 | | | | | | | | | | |
| | 2010 Year End Totals | | | | | | | | | | |
| | Total Cubic Yards | 30,000 | | 30,000 | | 30,000 | | 30,000 | | 30,000 | |
| | Total Trucking Miles | 288,565 | | 42,490 | | 103,555 | | 152,430 | | 147,050 | |
| | Total Estimated Cost | | \$1,313,807 | | \$583,906 | | \$999,260 | | \$1,313,561 | | \$1,289,136 |
| 2011 | | | | | | | | | | | |
| | External (Parks Highway) | 18,700 | \$810,743 | 500 | \$13,345 | 2,900 | \$119,303 | 500 | \$13,345 | 500 | \$13,345 |
| | Teklanika - MP 27.2 | 2,400 | \$36,828 | 2,850 | \$47,027 | 450 | \$10,199 | 2,400 | \$36,828 | 2,400 | \$36,828 |
| | East Fork - MP 43 | | | | | | | 450 | \$5,949 | 450 | \$5,949 |
| | Toklat - MP 53.4 | 8,900 | \$418,548 | 19,075 | \$353,003 | 16,200 | \$303,615 | 19,075 | \$353,003 | 19,075 | \$353,003 |
| | Beaver Pond - MP 70 | | | 375 | \$5,430 | | | 375 | \$5,430 | 375 | \$5,430 |
| | Boundary - MP 88 | | | 800 | \$13,787 | | | | | | |
| | Moose Creek Terrace - MP 89 | | | | | 10,450 | \$426,508 | 7,200 | \$218,777 | | |
| | North Face Corner - MP 89 | | | | | | | | | 6,400 | \$184,899 |
| | Camp Ridge - MP 90 | | | | | | | | | | |
| | Downtown Kantishna - MP 91 | | | 6,400 | \$203,030 | | | | | 800 | \$29,345 |
| | Kantishna Airstrip - MP 93 | | | | | | | | | | |
| | 2011 Year End Totals | | | | | | | | | | |
| | Total Cubic Yards | 30,000 | | 30,000 | | 30,000 | | 30,000 | | 30,000 | |
| | Total Trucking Miles | 253,305 | | 43,850 | | 77,795 | | 40,710 | | 39,750 | |
| | Total Estimated Cost | | \$1,266,119 | | \$635,622 | | \$859,624 | | \$633,332 | | \$628,799 |

| Year | Source | Alternative 1 | | Alternative 2 | | Alternative 3 | | Alternative 4 | | Alternative 5 | |
|----------------|-----------------------------|---------------------|---------------------|---------------------|--------------------|---------------------|---------------------|---------------------|--------------------|---------------------|--------------------|
| | | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost | Cubic Yards Used | Estimated Cost |
| 2012 | | | | | | | | | | | |
| | External (Parks Highway) | 25,100 | \$1,134,792 | 500 | \$13,879 | 2,900 | \$124,075 | 500 | \$13,879 | 500 | \$13,879 |
| | Teklanika - MP 27.2 | 2,400 | \$38,301 | 2,400 | \$38,301 | 450 | \$10,607 | 2,400 | \$38,301 | 2,400 | \$38,301 |
| | East Fork - MP 43 | | | | | | | 450 | \$6,187 | 450 | \$6,187 |
| | Toklat - MP 53.4 | 2,500 | \$103,326 | 25,925 | \$504,043 | 22,600 | \$435,181 | 25,475 | \$486,545 | 25,475 | \$486,545 |
| | Beaver Pond - MP 70 | | | 375 | \$5,647 | | | 375 | \$5,647 | 375 | \$5,647 |
| | Boundary - MP 88 | | | 800 | \$14,338 | | | | | | |
| | Moose Creek Terrace - MP 89 | | | | | 4,050 | \$251,273 | 800 | \$28,947 | | |
| | North Face Corner - MP 89 | | | | | | | | | 800 | \$28,162 |
| | Camp Ridge - MP 90 | | | | | | | | | | |
| | Downtown Kantishna - MP 91 | | | | | | | | | | |
| | Kantishna Airstrip - MP 93 | | | | | | | | | | |
| | 2012 Year End Totals | | | | | | | | | | |
| | Total Cubic Yards | 30,000 | | 30,000 | | 30,000 | | 30,000 | | 30,000 | |
| | Total Trucking Miles | 281,465 | | 46,320 | | 84,195 | | 45,830 | | 45,670 | |
| | Total Estimated Cost | | \$1,276,419 | | \$576,209 | | \$821,135 | | \$579,507 | | \$578,721 |
| 10-Year Totals | | | | | | | | | | | |
| | External (Parks Highway) | 220,900 | \$7,599,614 | 12,500 | \$251,458 | 120,550 | \$3,338,400 | 12,500 | \$252,218 | 12,500 | \$252,218 |
| | Teklanika - MP 27.2 | 34,575 | \$464,659 | 64,350 | \$814,041 | 4,500 | \$89,470 | 73,250 | \$863,454 | 73,250 | \$863,454 |
| | East Fork - MP 43 | | | 50,650 | \$606,494 | | | 43,050 | \$423,917 | 43,050 | \$423,917 |
| | Toklat - MP 53.4 | 75,075 | \$2,410,634 | 109,500 | \$2,711,880 | 110,000 | \$2,320,141 | 101,700 | \$2,378,411 | 101,700 | \$2,378,411 |
| | Beaver Pond - MP 70 | | | 20,250 | \$666,663 | | | 19,400 | \$274,934 | 19,400 | \$274,934 |
| | Boundary - MP 88 | | | 10,600 | \$166,600 | | | | | | |
| | Moose Creek Terrace - MP 89 | | | 3,800 | \$198,409 | 105,355 | \$5,477,347 | 31,650 | \$1,593,293 | | |
| | North Face Corner - MP 89 | 9,855 | \$240,404 | | | | | | | 31,500 | \$1,695,674 |
| | Camp Ridge - MP 90 | | | 3,000 | \$146,676 | | | | | | |
| | Downtown Kantishna - MP 91 | | | 57,200 | \$3,171,172 | | | 58,855 | \$3,198,004 | 59,005 | \$3,051,536 |
| | Kantishna Airstrip - MP 93 | | | 8,555 | \$169,478 | | | | | | |
| | Total Miles Traveled | 2,279,919 | | 1,103,780 | | 1,746,164 | | 1,061,371 | | 1,051,131 | |
| | 10 Year Sums | 340,405 | \$10,715,312 | 340,405 | \$8,902,871 | 340,405 | \$11,225,358 | 340,405 | \$8,984,231 | 340,405 | \$8,940,143 |
| | 10 % Contingency | 34,041 | \$1,071,531 | 34,041 | \$890,287 | 34,041 | \$1,122,536 | 34,041 | \$898,423 | 34,041 | \$894,014 |
| | 10-Year Total | 374,446 | \$11,786,843 | 374,446 | \$9,793,158 | 374,446 | \$12,347,894 | 374,446 | \$9,882,654 | 374,446 | \$9,834,158 |

| | | |
|------|--|-------|
| Cost | Per cubic yard per mile' round trip | 0.69 |
| | Processing cost for Teklanika in \$ per cubic yard | 7.59 |
| | Processing cost for North Face Corner in \$ per cubic yard | 19.04 |
| | Cost of Gravel External Park in \$ per cubic yard | 4.5 |
| | Inflation in % | 0.04 |
| | External D1 | 14 |
| | 10 yd vs 18 yr conversion | 0.725 |

Appendix C

Mining Plans

Contents List

Teklanika Pit

Tek Pit Excavation – 12/8/02
Table of Dimensions, for Units 1, 2 and 3
Extraction Plan 12/9/02 (Color Topographic)

East Fork River

Figure 4 – East Fork River Gravel Extraction Site Map
Figure 5 – East Fork River Typical Cross-Section

Toklat River

Figure 2 – Toklat River Gravel Extraction Site Map
Figure 3 – Toklat River Typical Cross-Section

Beaver Pond

Extraction Plan (MP 70) (Color Topographic)
Beaver Pond Pit (MP 70) Cross-Section - 3/19/03
Volume Calculations (MP 70) and Cut and Fill Balance Chart

Boundary Pit

Volume Calculations
Aerial Topographic Photo with Cross Section Location Map

Moose Creek Terrace

Chronological Description
Moose Creek Terrace #3 Earthwork
Cross-Sections for Extraction/Reclamation
Moose Creek Terrace Extraction Plan (IR Aerial Photo)

North Face Corner

Volume Calculations Phase 1 through 6
Cross-Sections 1 through 6
B&W Aerial Topographic Photo of Mining Plan

Camp Ridge

Volume Calculations
Cross Sections 1 through 4
B&W Aerial Topographic Photo of Mining Plan

Kantishna Airstrip

B&W Topographic Photo of Mining Plan
Cross-Sections 1 through 7
Volume Calculations

Downtown Kantishna

Figure 6 – Gravel Extraction Area Map
Figure 7 – After Excavation and Reclamation
Figure 8 – Cross-Section Locations
Figure 9 - Cross Sections Showing Cut and Fill Amounts

Reclamation/Mitigation Measures for Downtown Kantishna Gravel Pit

HMM Report – March 2003

Tek Pit Excavation – 12/8/02

Area and volume calculations and spatial orientations were accomplished using Acad drawing Dar-27.dwg of 1996, and as updated (in the existing pit area) by GPS survey of 12/3/02. As of 12/3/02, the existing pit floor now extends 200 feet further north with an average GPS measured elevation of about 2509 feet. Three mining units are addressed in this plan. Two of these units (Unit 1 and Unit 2) are assumed to be authorized for extraction under the existing 1992 Environmental Assessment. The third unit (Unit 3) is a new proposal and constitutes the mining to be evaluated and analyzed under any new NEPA documents. The following excavation – restoration plan is provided assuming the units will be mined consecutively as numbered within the 10-year time frame as considered for the Gravel Acquisition Plan (GAP) and with a start year assumed to be the field season of 2003.

Unit 1 “Wedge” (see map for location)

Unit 1 is a cleared and partially excavated ramp (irregular slope at approximately 1 ½ :1) that is assumed to be currently authorized for excavation under the 1992 Environmental assessment. Unit 1 involves a surface area of approximately 21,860 square feet (0.50 acres). This area is in an irregular crescent shape, approximately 200 feet long, by 124 feet wide. The elevation at the top of the unit averages around 2535 feet while the floor elevation is around 2509 feet, giving a backwall thickness of 26 feet. The resultant wedge shape would yield around **10,500 bank cubic yards**.

Excavation would continue in a combination terrace-cut, cat push method using an ascending ramp on the west side of the pit floor to gain access to the upper reaches of Unit 1. Cuts would be in some configuration of expanding crescent shapes moving further east. Excavation would continue in this fashion moving the new cuts into the area of Unit 2, while processing, stockpiling and other operations would continue on the old existing pit floor. Oversize or other material reject should be placed as soon as possible along the south easterly corner and easterly backwall to “fill” the old cut for rehabilitation purposes.

Unit 2 “Cleared” (see map for location)

Unit 2 is an irregular polygon of cleared ground to the east of unit 1, with rough dimensions of 258 feet long by 192 feet wide. The existing cleared surface area involves some 41,075 square feet (0.94 acres). The extraction area, leaving a borderline buffer for topsoil storage and operational space, is roughly 193 feet long, by 145 feet wide, and involves some 27,182 square feet (0.62 acres), which is contained within the cleared 0.94 acres. Assuming a pit floor elevation at 2509 feet, an existing surface elevation averaging around 2530 feet, and an average thickness of 30 feet, unit 2 should yield about **30,200 bank cubic yards**.

Excavation would be continued as in unit 1, with terrace cuts and cat pushes to reach the pit floor for gravel processing and stockpiling. As excavation approaches the pit limits on the north and east walls, care should be taken to allow for appropriate access to the upper reaches for rehab purposes.

Unit 3 "GAP Proposal"

Unit 3 is an irregular rectangle of ground to the west of the existing pit, with rough dimensions of 621 feet long by 180 feet wide. The proposed area to be cleared involves some 97,375 square feet (2.24 acres). The extraction area, leaving a borderline buffer for topsoil storage and operational space, is roughly 598 feet long, by 131 feet wide, and involves some 76,742 square feet (1.76 acres), which is contained within the clearing limits (2.24 acres). Assuming a pit floor elevation at 2508 feet, an existing surface elevation averaging around 2537 feet, and an average thickness of 28 feet, unit 3 should yield about **79,500 bank cubic yards**.

Excavation would continue in terrace cuts and cat pushes in north-south segments, working both south and west. Reject and oversize material would be placed along the easterly backwall, building that backwall incrementally westerly. Additionally, waste material can be placed in the embayment of unit 2, filling in the existing excavation as much as possible. When Unit 3 is completely mined, the overall pit configuration should be similar to the existing pit of year 2002, but migrated approximately 150 feet further west.

Table of Dimensions for Units 1, 2, 3

| | <u>Length</u> | <u>Width</u> | <u>Depth</u> | <u>SQ FT</u> | <u>Acreage</u> | <u>Cu Ft</u> | <u>Cu Ft Adj</u> | <u>Cubic Yds</u> |
|----------------------------------|---------------|--------------|--------------|--------------|----------------|--------------|------------------|------------------|
| <u>Unit 1 "Wedge"</u> | | | | | | | | |
| Excavation | 200 | 124 | 26 | 24800 | 0.57 | 644800 | 322400 | 11941 |
| | | acad area | —————▶ | 21861 | 0.50 | 568386 | 284193 | 10526 |
| <u>Unit 2 "Cleared"</u> | | | | | | | | |
| Cleared Area | 258 | 192 | | 49536 | 1.14 | | | |
| | | acad area | —————▶ | 41075 | 0.94 | | | |
| Excavation | 193 | 145 | 30 | 27985 | 0.64 | 839550 | | 31094 |
| | | acad area | —————▶ | 27182 | 0.62 | 815460 | | 30202 |
| <u>Unit 3 "GAP Prop."</u> | | | | | | | | |
| Clearing | 621 | 180 | | | | | | |
| | | acad area | —————▶ | 97375 | 2.24 | | | |
| Excavation | 598 | 131 | 28 | 78338 | 1.80 | 2193464 | | 81239 |
| | | acad area | —————▶ | 76742 | 1.76 | 2148776 | | 79584 |