CHAPTER 4 - ENVIRONMENTAL CONSEQUENCES

4.1 IMPACT CRITERIA AND ASSESSMENT

Impacts identified for each issue analyzed in the chapter are based on the intensity, duration, and extent of the impact. Summary impact levels are characterized as negligible, minor, moderate, or major. Impact level thresholds are defined in Table 4-1.

Table 4-1 Resource Assessment Impact Level Guidelines

Negligible	Minor	Moderate	Major
Little or no impact to the resource would occur; any change that might occur may be perceptible but difficult to measure.	Change in a resource would occur, but no substantial impact would result. The change would be perceptible & measurable but not alter resource condition.	Noticeable & measurable change in a resource would occur & would alter resource condition, but the integrity of the resource would remain.	Substantial impact to a resource would occur that is easily defined, highly noticeable, & would measurably alter the integrity of the resource.

4.2 ASSUMPTIONS FOR THE CUMULATIVE EFFECTS ANALYSIS

Existing OHV trails and routes, commercial fishing structures, NPS facilities, lodges, and airstrips contribute to cumulative effects in the Dry Bay Area (Figs. 3-9, 3-10, & 3-11). These facilities are likely to affect several or all resources evaluated in this EA.

- Existing OHV trails and routes: Existing trails in the Dry Bay area of the Glacier Bay National Preserve developed primarily as a result of commercial fishing activities. Existing trails and routes provide access to commercial fishing areas on the Alsek and East Alsek Rivers, commercial fish camps, boat haulout areas, fish processing plant, airstrips and permitted lodges. The 83.5 miles of trail in the Dry Bay area of the Preserve cover about 117.25 acres.

- Temporary fish camp (TFC): Each camp is sited on a 1/4 acre parcel. The camp can be a soft or hard sided structure no bigger than 400 sq. ft. in size. The structure must be sited on skids or blocks rather than a foundation. The structure must be collapsed for onsite winter storage. An outhouse is included in the total structure size. Between 10 to 45 temporary fish camps have existed depending on the season in the temporary camp zone (NPS, 2005). Temporary fish camps can cover up to about 11 acres depending on the year.

- Commercial (permanent) fish camp (cabin): Each cabin is sited on a 1/4 acre parcel. Each cabin must be a single story hard sided, roofed structure under 16 feet in height and up to 576 sq. ft. in size. The structure must be sited on skids or blocks rather than a foundation. An outhouse is included in the total structure size. The number of camps is capped at 21. Currently there are 17 camps in the preserve. About 5 acres of land could be covered by commercial fish camps.

- Seafood processing facility: The facility consists of a hard-sided building located on a 3,600 foot airstrip with a state-permitted water and septic system, 2 generators, ice makers, and fish processing equipment. The plant also provides fuel and groceries to commercial fishers operating in the Preserve. The facility operates under a commercial business permit from NPS. The Alaska Department of Fish and Game maintains a small administrative camp near the plant. There is also a small fish buying station located on the airstrip that brings in ice and carries whole fish out to market. The permittee operates under an annual permit through NPS. The past facility operator, Sitka Sounds Seafoods, dumped fish processed waste into the Alsek River under an EPA NPDES permit. The current Wild Alaska Seafood processor (there since 2005) is not allowed to process any seafood on site under their current permit. The seafood processing facility covers a total of 1 acre.

- NPS Facilities: The NPS maintains a Ranger Station consisting of a 2 story hard-sided cabin, 2 hard-sided bunkhouses for seasonal employees, an open workshop and ATV shed, a hard sided fuel cache, and small storage building located near the Alsek River rafter take out point and the seafood processing plant airstrip. There is also a DEC compliant sewage dump station, wastewater system and accessible outhouse that serves rafting groups. The NPS also maintains a public use cabin and accessible outhouse near the East Alsek River that is available on a first come first served basis. The NPS facilities in Dry Bay cover a total of 2.45 acres.

- Commercial Lodges: Three commercial lodges provide lodging, meals and sightseeing and/or fishing guide opportunities. The Alsek River Lodge is on the Alsek River while the Northern Lights Haven Lodge and Johnny's East River Lodge are on the lower East Alsek River (NPS, 2005). The lodges have state approved water and septic systems. The three lodges cover a total of 4.3 acres.

- Airstrips: Eleven airstrips exist in the Dry Bay Area. Airstrips cover a total of 38.8 acres.

Table 4-2 provides a summary of facilities to be considered in the cumulative effects analysis.

Table 4-2 Summary of Facilities Considered in the Cumulative Effects Analysis

Facilities	Number of Facilities	Acreage
Existing Trails and Routes	83.5 miles	117.25
Temporary fish camps	Up to 45 (1/4 acre each)	11.
Commercial fish camp (cabin)	21 (1/4 acre each)	5.
Seafood processing facility	1	1.
NPS Facilities	2 (ranger station & cabin)	2.45
Commercial Lodges	3	4.3
Airstrips	11	38.8
		Total 179.8

4.3 ALTERNATIVE 1: NO ACTION

Under the no-action alternative 83.5 miles of trails and routes in Glacier Bay National Preserve would be open to off-highway vehicle use. OHVs would be allowed with a permit only on the existing trails. Commercial fishers would be allowed to camp anywhere in the Temporary Fish Camp Zone and use existing trails/routes in this zone, whenever possible, to access campsites.

Table 4-3 lists the condition rating of 83.5 miles of trail assessed in the Dry bay area of the Preserve. About 95 percent of the trails were rated as good/fair while only about 5 percent were rated as degraded or very degraded.

Table 4-3 Summary of Trail Condition Classes for Existing Trails

Classification	Miles (%)	Acres (max)[1]	Acres (min)[1]
Good	58.6 (70.2)	61.10	30.94
Fair	20.4 (24.5)	39.03	23.49
Degraded	2.9 (3.3)	10.05	6.10
Very Degraded	1.6 (1.9)	7.06	3.84
Totals:	83.5	117.25	64.37

[1]Acres (max) and Acres (min) are the maximum and minimum acreage of the trail or trail segment. Acres (max) & Acres (min) are calculated by multiplying the maximum and minimum trail width for each trail segment in the same trail condition assessment inventory class. The segment acreages are added together to calculate the total acreage for the condition class.

4.3.1 Effects on Water Quality

ORV effects on water quality are likely to be most significant at stream crossings along the most frequently traveled routes. Historically, most ORV traffic occurred between the temporary commercial fishery camp and the fish processing facility near the main airstrip. Currently, most traffic occurs between permanent fishing camps and fishing sites and between dwellings or lodges and the main airstrip near the fish processing facility where people and supplies are transported in and out of Dry Bay.

ORV passage can directly affect water quality in two main ways. These include the erosion, suspension (turbidity,) and deposition of fine sediment as a consequence of ORV passage and/or leakage of petroleum products and other fluids from ORVs at stream crossings. Fine sediments suspended in water create turbidity, which is a quantifiable water quality characteristic affecting aquatic biota (Lloyd et al., 1987). Hydrocarbon or other fluid contaminants are often washed directly from ORVs and can be directly injected into water through submerged exhaust or combusted fuel can be precipitated from the atmosphere (Stoker and Seager, 1976). Heavy metals and nitrogen oxides accumulate along ATV trails and may be mobilized to aquatic systems during precipitation events (Trumbulak and Frissell, 2000). Of course the size and volume of receiving waters (the “dilution factor”) in comparison with input quantities of sediment or contaminants is a major determinant of the level of the effect. In many cases, sediments and contaminants would likely be diluted to undetectable levels.

State standards for sediment deposition, turbidity, petroleum hydrocarbons, oils and grease exist in Alaska Administrative Code (18 AAC 70). Standards for water quality affecting aquatic life (anadromous and resident fish) prohibit accumulation of fine sediments (0.1-0.4 mm diameter) in gravel beds by more than 5% (by weight) above natural conditions. Similarly, turbidity may not exceed 25 nephelometric turbidity units (NTUs) above natural conditions. Total aqueous hydrocarbons and total aromatic hydrocarbons in the water column may not exceed 15 and 10 µg/l, respectively. Concentrations of petroleum products along shorelines or on bottom substrates having a deleterious effect on aquatic life are prohibited.

ORVs can contribute large suspended sediment loads to receiving waters and some erosion rate estimates have ranged 5-50 times higher than natural rates (Hinckley et al., 1984) although these calculations are typically for arid climates. ORV passage at stream crossings disturbs and resuspends sediments and generates waves that undercut banks and cause erosion. But vegetation cover, substrate type, approach steepness, water conditions and traffic levels all influence the degree of the effect.

Disturbed or resuspended sediments would continue to be transported for short distances (meters or tens of meters) downstream (Rinella and Bogan, 2003) as bedload[1] or suspended sediment after ORV passage where they would accumulate in pools or along channel margins where current slows. In a comparison of watersheds subject to ORV traffic and those without, Chin et al. (2004) found that watersheds with ORV trails have pools with higher percentages of sands and fines, decreased depth, and pool volume.

Suspended silt and clay are typical causes of turbidity although fine organic material and microscopic organisms can also contribute (APHA, 1998). Finer materials are more easily disturbed and transported than courser materials although particles < 0.1 mm in diameter are typical for Alaska (MacDonald et al., 1991). Accumulated sediment downstream of ORV stream and estuary crossings would subsequently be scoured, resuspended, and transported on a much wider spatial scale as a result of fall flooding events.

ORV deposited sediment would continue to be periodically transported downstream during annual or less frequent flooding events. Flooding events in the Dry Bay area capable of resuspending and transporting deposited sediments typically occur during the wet season from September through November. The extent of sediment movement and transport is dependant on sediment particle size and composition, gradient or channel slope, stream velocity, and magnitude of precipitation and discharge events. Eventually, accumulated sediment would move through the watershed (stream-delta-estuary) and ultimately be carried offshore to the Gulf of Alaska during larger-magnitude, flood-associated storm events affecting estuary/delta morphology.

ORVs can also alter or affect drainages and wetlands in ways that can significantly change runoff patterns and amounts. Physical impact of tire treads strip surface vegetation and compact

[1] Bedload is substrate particles, typically to large or heavy to be transported in suspension, which are transported downstream by current along or just above the stream bottom.

soils resulting in less porous soils, incised trails (ditching), and reduced infiltration capacity[2]. Incised trails entrain surface flow and enhance runoff effectiveness (Meyer, 2002). Moreover, they can compromise wetland structure and function by channelling water from surrounding landforms. Incised trails often exist as pools during the wet season and form isolated ponds during drier periods.

State of Alaska and NPS staff conducted a very cursory inventory of selected Dry Bay ORV water crossings during July of 2006. Both active and passive fishing gear were used to determine fish species presence and relative abundance along a suite of water crossings. Sites were also assessed for effects of ORV passage. Results are detailed in Appendix H and summarized and discussed under each alternative.

Site Specific Effects

No trails or routes would be designated and all 83.5 miles of existing trails and routes would remain open to ORV use under the no-action alternative (Fig. 2-1 and 2-2). Impacts to water quality would continue at all fifteen water crossings (Table 2-1). ORVs would periodically continue to use the deepwater estuary crossing southeast of Dog Salmon Creek (Fig. 3-9). However, infrequent use of this crossing would continue as a consequence of an alternative route along the Doame Trails complex.

Relatively frequent ORV passage at upper Dog Salmon Creek (DSC) along Main Trail East (Fig. 3-9, Site 8) has primarily caused bank undercutting, erosion, and downstream sedimentation (Appendix H). An estimated sediment accumulation area of approximately 10 cubic yards was observed and documented 30 m downstream of this crossing in July of 2006 (NPS unpublished data). However, it is not possible to determine whether accumulated sediment is the result of ORV passage or natural processes. Despite relatively frequent ORV use, past crossing hardening efforts combined with relatively voluminous stream discharge at this site would mitigate effects of ORV passage on water quality.

Similarly, water crossings along the five DSC Estuary Routes (Fig. 2-1 and 2-2) and deepwater estuary crossing area are thought to have minimal impacts on water quality because extremes in physical (i.e. temperature, mixing) and chemical (i.e., salinity and dissolved oxygen) conditions as a consequence of tide likely overshadow any ORV passage effect. Moreover, little evidence of ORV passage is detectable after tidal inundation as a result of the lack of vegetation and relatively resistant sand and small gravel substrate present at these crossings. Impacts along the deepwater estuary crossing area would be even less likely due to relatively infrequent and dispersed use in this area. ORV passage effects across the Doame River delta (See Fig. 2-1, Doame West and East trail crossings) would likely have comparable limited impacts on water quality at these sparsely vegetated and primarily sandy crossings. Relatively voluminous discharge at these two crossings would also likely mitigate ORV passage effects on water quality.

[2] Infiltration capacity is the rate at which water is absorbed by soil and ultimately contributes to groundwater.

ATV traffic along the East Access Trail would continue undercutting banks at the lake outlet water crossing (Fig. 3-9, Site 4) and passage would likely generate some small amount of turbidity and downstream sediment deposition. Sediment supply at the water crossing would be limited to only that produced by ORV passage because the lake functions as an upstream sediment trap for natural sediment sources. Moreover, gravel and sand substrate at the crossing likely mitigates the effect of ORV passage on water quality at this location.

Limited impacts to water quality along the East Alsek River crossing (Fig. 2-1) would continue under this alternative. Bank erosion would continue at both banks as a result of ORV use although substrate impacts and sediment resuspension during ATV passage would be somewhat mitigated by the relatively stable rock substrate along the crossing (Appendix H). Some small amount of suspended sediment and downstream deposition would likely occur as a result of ATV passage. However, relatively voluminous discharge would tend to mitigate ORV passage effects on water quality at this location.

In contrast to minimal impacts at some water crossings, continued ORV passage at other water crossings, even at current use levels, would likely cause measurable impacts to water quality. However, actual quantitative assessment of water quality effects would necessitate monitoring of pertinent water quality parameters as part of a well-planned and carefully controlled before/after ORV passage study design. Although ORV passage at stream crossings along DSC Trail is infrequent, incised trail conditions along the eastern approach to Dog Salmon Creek (Fig. 3-9, Site 9) and associated bank and trail erosion at this and other crossings along the trail (Sites 10-12) are evident (Appendix H). ORV passage, even at current low levels, would continue to sustain incised trails, enhance erosion, and increase suspended sediment and deposition. ORV passage would likely cause detectable impacts to water quality as a consequence of relatively low volumes of discharge along these water crossings.

ORV passage along the Varni East Trail (Fig. 3-9, Site 7) water crossing would continue to have significant effects on water quality. Bank undercutting and erosion as well as a deeply incised trail have been documented at this location (Appendix H). Turbidity levels after ORV passage would likely exceed state standards as a result of abundant fine organic sediment present along this crossing with likely significant downstream suspended and deposition effects. ORV passage at this water crossing would likely contribute to a measurable decline in water quality as a consequence of relatively low stream volume and discharge.

ORV passage along the east end of Main Trail East would continue to impact water quality in isolated ponds (Fig. 3-9, Sites 5 and 6). ATV traffic would maintain the incised trail/isolated pond at Site 5 and passage would likely generate suspended sediment concentrations or turbidity exceeding state standards as a consequence of small pool volume at both locations.

The Doame Trail complex (Fig. 3-9, Site 1) would continue to channel or entrain runoff from the wetland area along the trail. Continued ORV activity at this location, particularly during high water periods, would maintain or enhance this entrenched trail feature. The continued existence and functionality of this feature would perhaps shunt surface water away from this area at a higher rate than if this feature did not exist. Moreover, the entrenched trail feature would continue to exist as isolated pools during low water periods. ORV passage would generate

turbidity and suspended sediment when the trail is inundated during high water conditions. Because of the considerable length of this water crossing, it is quite likely that ORV passage would cause turbidity and suspended sediment levels that would exceed state standards even with the relatively high volume of flow occurring through this area during high water conditions.

Cumulative Effects

Erosion and sedimentation rates have been exacerbated since the establishment of human ORV use in this area. Effects were likely greatest during initial trail development and during the commercial fishery heyday (mid 1980s to mid 1990s) when over 90 permit holders employed ORVs for transporting their catch and supplies between fishing camps, fishing sites, fish processors, and airstrips. However, strong winds associated with winter storms in the Gulf of Alaska transport large volumes of sand and fine sediment inland from the beach, dunes and estuary/delta areas. These materials are deposited over the landscape and ultimately entrained and transported by natural erosion processes. Although no quantitative information exists, it is likely that the amount of sediment redistributed inland during winter storms and subsequent scouring and redistribution of this material during stream flooding exceeds that generated by ORV traffic.

In addition to ORVs, motorized watercraft can affect water quality. Over 90 permit holders fished the East Alsek River during its heyday and many permittees used motorized dories to set, tend and retrieve their nets. Most outboard engines used in this area have been two-stroke which produce 12 times more aromatic hydrocarbons and five times as much oil and grease in their exhaust than four-stroke engines (Environment Canada, 2000). In contrast, most ATV engines have been cleaner burning four-stroke designs since their initial development in the 1970s. Thus motorized watercraft has likely accounted for the vast majority of hydrocarbon contaminant effects on area water quality. However, these effects would have been likely negligible and undetectable given the large volume and magnitude of daily flux in the estuary/delta as a result of stream discharge and tidal influence.

Some small amount of surface water contamination by sewage facilities or through fuel or other contaminant spills has probably occurred periodically at or near human facilities and developments over the history of area human occupation in Dry Bay. A total of 28 to 67 outhouses and up to six state approved septic systems (see section 4-2) are currently dispersed across approximately 24 total acres of facility-associated developments. However, past facilities were probably less well designed and engineered and some leakage to surface waters may have occurred. Similarly, small amounts of environmental contaminants including hazardous and/or toxic compounds and fuel have likely leaked into the environment as a result of human use and occupation. Although contaminants are likely dispersed and undetectable, some areas in close proximity to human habitations (i.e., lodges, commercial fishing camps, fish processing facility) may exhibit higher than background level concentrations depending upon past contaminant disposal, dispensing methods, and containment or storage facilities. However, no measurable human-caused effects on water quality have ever been documented and effects are likely negligible.

Overall, human occupation and associated vessel and ORV use over time in the Dry Bay area has undoubtedly had some effect on water quality. Although very little quantitative information exists, cumulative effects on water quality are likely moderate and, in the case of erosion and sedimentation, are likely overshadowed by natural processes. However, ORV trails have clearly affected and entrained natural patterns of runoff and these effects are still visible today. Current ORV use and associated impacts are likely incrementally less than those that occurred during the commercial fishery heyday and likely significantly less than the sum of all cumulative effects.

Conclusion: ORV effects on water quality under the no-action alternative would be minor despite 83.5 miles of trails and 14 water crossings (plus the deepwater estuary route) remaining open. While water quality effects would be minimal at some water crossings, measurably greater effects would continue at specific crossing locations (i.e., DSC Trail, Varni East Trail, Doame Trail complex).

The level of impact on water quality would not result in any impairment to preserve resources, thereby fulfilling specific purposes identified in enabling legislation and maintaining the cultural integrity of the park and preserve.

4.3.2 Effects on Vegetation (Including Wetlands)

Under the no-action alternative, the continued use of vehicles on all of the vehicle trails throughout the Dry Bay area of Glacier Bay National Preserve would keep out or depress vegetation on the existing trails. Along some trails, the impacts to wetland and upland vegetation would enlarge because parts of trails would continue to be widened or relocated due to vehicle traffic abrading vegetation (leaves, branches, stems, roots), surface soils, sediments, and creating low flooded areas or mud holes (see Photo 2-1). In one such location along the Inside Trail, a couple deep holes were created and widened such that most travelers use alternative routes around this trail (Photo 4-1). Due to poorly bonded soils, widening is also created by wave action from vehicle passage washing ponded area perimeters. This is evident in many ponded areas and occurs from passage of ATVs and larger vehicles.

Photo 4-1 Deep mud hole along Inside Trail in closed alder-cottonwood forest.

Vegetation types likely to receive the greatest impacts from continued uses of existing trails would be palustrine wetlands areas, particularly where emergent wetland vegetation occurs along small streams and creeks (see Photo 2-2). Trails receiving light use or discontinued use would tend to show recovering vegetation, such as the Tractor Trail North and Bear Island Trail (Photos 4-2 and 4-3).


Photo 4-2 Tractor Trail North


Photo 4-3 Bear Island Trail

Trails in sandy, nearly barren areas are often widened or relocated because of blowing sediments or flooding. This would further impede natural vegetative succession from occurring in some locations adjacent to existing travel corridors. This type of phenomena occurs in the Maze and Dunes routes areas (see Photos 4-4 and 4-5).


Photo 4-4 Maze Central Route


Photo 4-5 Dunes South Route

A small percentage of the existing trails traverse riverine or estuarine wetlands areas, and these areas tend to be sandy or gravelly with sparse or hardy vegetation. Trails in riverine areas may experience massive periodic floods, which would tend to remove vegetation in and near the trails over time (see Photo 3-17). Trails in estuarine areas are flooded with brackish waters once or twice a day, depending on the season, and vehicle tracks are often erased (see Photo 3-16).

Table 3-3 summarizes existing trail conditions by wetland type and upland vegetation. Trails on good substrate (gravel) generally stay within the original footprint, have minimal effect on adjacent area vegetation and are ranked in good or fair condition (see Photos 3-1 and 3-2). Trail segments in degraded or very degraded condition are located on poor quality substrate (sand or silt), are generally wider than the original footprint due to deteriorating conditions, and are likely to continue to widen and adversely affect vegetation with continued use (see Photos 3-3 and 3-4). The miles and acreage of vegetation displaced by ORV trails are provided in Table 3-3 and the

percentages by vegetation class are derived from these numbers. The actual acreage of trail impacts to vegetation lie somewhere between the minimum and the maximum area calculations.

Upland Vegetation

Trails in upland vegetation types occupy 66.8 miles (80.1%) of the total existing trail length and 86 acres (about 73%) of the total acres of trails. Of the 66.8 miles of trail in upland vegetation types, 2.1 miles (3.2%) is either degraded or very degraded, generally meaning these trail segments are wider, more deeply eroded, and adversely affect greater areas of vegetation than segments not degraded. This is proven by the area calculations. Degraded trails traversing upland vegetation would effect between 4.2 and 7.2 acres depending on trail width. Though only 3.2 percent of the trail miles through upland vegetation are degraded to some degree, about 8.7 percent of trail area is degraded. Of the total acres of degraded (wider) trail segments in all vegetation classes, about 42 percent occurs in upland vegetation. An estimated 3 to 5 acres of upland vegetation area in the Preserve could be damaged or retarded by vehicles over the next couple decades, particularly where routes are not easily followed in the Maze and Dunes areas.

Palustrine Wetlands

Trails in palustrine wetland areas traverse about13.1 miles (15.7% of the total trail miles). The degraded trails cover between 5.7 and 9.9 acres (36% of the area through palustrine vegetation). About 58 percent of all 9.9 to 17.1 acres of degraded trails traverse palustrine vegetation. A disproportionate percent of degraded trails occur in palustrine vegetation types because the fine-grained and poorly bonded soil particles are easily sheared and eroded by vehicle passage and perimeter washing during saturated periods. These areas are likely to see additional future degradation under the existing trail management scheme because travelers generally circumnavigate deepened muddy/silty sections of trail where possible. Low growing wetland vegetation is easily traversed by ORVs. These statements correlate with a statement that wetlands are particularly susceptible to damage by ORVs (Meyer, 2002; Rickard and Brown, 1974). Without management intervention, it is conceivable another 5 to 10 acres of palustrine wetlands could be adversely affected over the next 20 years.

Riverine and Estuarine Wetlands

Trails across riverine and estuarine wetland areas occupy 1.44 miles (1.7%) and 2.15 miles (2.6%), respectively. Of trails across these vegetation types, small portions are degraded (0.4 miles or 2.8% for riverine wetlands areas and 0.02 miles or 0.9% for estuarine wetland areas). Of the total acres of degraded trail segments through these vegetation types, less than 1 percent occurs in either type. Because of the sandy/gravelly surfaces and sparse or hardy vegetation in these areas, impacts from vehicle trails are minimal and would continue to be so.

Invasive Plants

Invasive exotic plants occur along over half of the trail segments in the Dry Bay area (Fig. 3-8). Invasive plants generally take hold where disturbance to the land surface and existing vegetation occurs. Invasive plant species commonly disperse via seeds or plant material that attach to

clothing, gear, and vehicles, including airplanes, ORVs and heavy equipment. Where human travel is very light or where silty and sandy conditions occur with virtually no soil development (dunes and the Maze), invasive plants have not yet been found. The ubiquitous common dandelion is showing up along most of the main trails, as is the bigleaf lupine, which is also spreading off the major trails into the surrounding vegetation. Some invasive species, such as the oxeye daisy, are planted or sown near lodges and cabins and are spreading from those locations. Oxeye daisies are in early stages of establishment in most locations, but they are well-established at the fish plant and Hazen cabin (Rapp, 2006). ORV traffic is a likely disperal mechanism in Dry Bay. Under the no-action alternative with no change in management at Dry Bay, invasive plants could spread from current locations and infest newly or continually disturbed areas. Invasive plants, including new species, would be expected to infest more of the existing trail-side vegetation and colonize newly degraded trail segments as they occur, particularly in upland vegetation types. This could easily amount to an estimated 10 to 20 acres of new infestations over the next 20 years, however, the NPS proposed Invasive Plant Management Plan should address and control new infestations. Control of the bigleaf lupine under this plan is not likely because it is so well established and has spread beyond trail side areas. Therefore, we estimate 5 acres of new invasive plant infestation in the Dry Bay area over the next couple decades, primarily from uncontrolled spread of bigleaf lupine.

Cumulative Effects

Other existing facilities cover about 62.55 acres [temporary fish camps (11 acres), commercial fish camps (5 acres), seafood processing facility (1 acre), NPS facilities (2.45 acres), commercial lodges (4.3 acres), and airstrips (38.8 acres)]. Native vegetation has been totally displaced on at least 40 acres of these areas, and the remaining area has had the native vegetation disturbed. Some remaining portions of these facilities have seen some re-growth of native vegetation, and other portions have invasive plants growing on the disturbed sites. It is reasonable to assess that about 50 acres of native vegetation has been lost to other facilities and invasive plants. Essentially all of these facilities are located entirely in upland vegetation types. Future additional impacts to vegetation from other facilities (not trails) under the no-action alternative are unlikely and so would remain at about 50 acres except for the possible spread of invasive plants into these disturbed areas. Combined with the total 117.25 acres of impacts to native vegetation with existing trails and the potential for an estimated 20 acres of additional lost wetland and upland vegetation from trail widening and invasive plant infestation over the next two decades, about 187 acres of native vegetation would be lost from human activities under the no-action alternative. Overall these impacts would result in long-term (decades), noticeable, and widespread, moderate impacts to vegetation in the Preserve, the no-action alternative would account for almost 10 percent of the total adverse effect on vegetation and wetlands.

Conclusion: Impacts to vegetation and wetland resources under the no-action alternative would be minor. About 20 acres of new impacts to vegetation would occur along newly disturbed trail segments and persist for decades, but the overall integrity of vegetation in the Preserve would remain.

The level of impacts on vegetation and wetlands would not result in any impairment of preserve resources fulfilling specific purposes identified in enabling legislation, or that are essential to the cultural integrity of the park and preserve.

4.3.3 Effects on Aquatic Biota and Habitat

ORV effects on aquatic biota and habitat occur primarily at and downstream of stream crossings. ORVs are not likely to impose population level effects on fish or invertebrates. They can however; affect segments of a population and can have very real effects (both direct and indirect) on individual aquatic animals and habitat. Physical impacts to fish and habitat can occur through direct physical contact during vehicle passage or by ORV stream crossing associated wave wash and stranding of individual fish. ORV passage can also resuspend and entrain sediments which are often flushed downstream to more indirectly impact biota and habitat. Suspended sediment can have both lethal and sublethal effects on biota while deposited sediment can have significant and lethal effects on both aquatic habitat and biota.

Some species and life stages of aquatic biota are more sensitive to sedimentation than others. Salmonid species that spend significant components of their life cycle in fresh waters (i.e., coho, sockeye, Chinook, Dolly Varden, steelhead and cutthroat trout) are probably more sensitive to turbidity effects than other species. Eggs, embryos and early juvenile salmonids are typically more sensitive to suspended sediment than adults (Lloyd, 1987, Newcombe and Jensen, 1996). Blackflies, stoneflies and mayflies were most sensitive to sediment deposition as evidenced by downstream drift during experimental sedimentation of a Northwest Territories stream (Rosenberg and Wiens, 1979).

Small numbers of fish and invertebrates can suffer mortality at water crossings and isolated ponds as a result of direct physical impact or wave wash and subsequent stranding. Physical injury or mortality results when vehicles physically impact or crush invertebrates, eggs, embryos, juveniles or adult fish during passage at stream crossings. Salmonid eggs and embryos are particularly susceptible to physical disturbance during early development (after fertilization and before the eyed stage) and due to inability to avoid such impacts. Stranding can ultimately result in mortality due to suffocation or predation. Mortality effects would likely be high for fish stranded in isolated pools due to their more limited ability to avoid ORVs as a consequence of small relative habitat size and lack of connectivity with other habitat.

Bank erosion and undercutting also occur at and adjacent to water crossings as a consequence of ORV generated wave action. While eroded sediments are often resuspended and transported downstream, undercutting can also create important habitat.

The effect of suspended sediment on aquatic biota depends on the concentration of suspended sediment and duration of exposure (Newcombe and Jensen, 1996). Relatively low levels of suspended sediment can kill, stress, and alter fish behavior (Lloyd, 1987). Direct salmonid mortality at suspended sediment concentrations of around 100 g/l has been observed (McLeay et al., 1987, Lake and Hinch, 1999). But this concentration is about an order of magnitude higher than natural stream levels. Some salmonid species are displaced at turbidity levels of 25-50

NTUs (Sigler et al., 1984; Harvey, 1989). Bisson and Bilby (1982) documented that juvenile coho salmon avoided 70 NTUs.

Suspended sediment concentrations greater than 40 g/l have been documented to cause a stress response through erosion of coho salmon gill filament tips (Lake and Hinch, 1999). Suspended sediments have also been implicated in gill trauma in juvenile sockeye salmon and lethality increased with increasing particle size (Servizi and Martens, 1987). Yearling coho salmon and steelhead can survive high suspended solids concentrations but may undergo sublethal physiological stress that can potentially reduce individual fitness (Redding et al., 1987). Stress response can affect an organism's immune system ultimately leading to increased mortality or at least reduced growth.

Salmonid feeding and growth is negatively affected by high turbidity. Sedimentation can also affect macroinvertebrate abundance and distribution. Fine silt clogs collecting or feeding apparatus of some macroinvertebrates resulting in reduced feeding efficiency and growth rates. But most macroinvertebrates that are able will avoid high turbidity and suspended sediment. Salmonid prey detection and capture is impaired at 25-70 NTUs (Lloyd et al., 1987, Wilber, 1983) and Sigler et al. (1984) documented reduced juvenile coho and steelhead growth after exposure to turbidity levels of 25 NTU. Because fish are visual predators, they typically avoid highly turbid conditions where prey may be difficult to detect or intercept. But since invertebrates also avoid these conditions it is difficult to know whether fish avoidance is a direct or indirect consequence of turbidity. In contrast, turbidity can also function to hide fish from visual predators.

Sedimentation in streams effectively reduces light penetration reducing algal abundance and primary production (Lloyd et al., 1987). Sediment can also scour and smother periphyton and benthic algae (Van Nieuwenhuyse and LaPerriere, 1986). Substrate pore space serves as important habitat for benthic macroinvertebrates and developing salmon eggs. Fine sediment deposition reduces substrate permeability resulting in decreased dissolved oxygen exchange across the sediment water interface (MacDonald et al., 1991).

Sediment deposition in spawning gravels and around egg membranes can affect oxygen exchange and suffocate eggs and embryos (Bash et al., 2001). Reiser and White (1988) found that sediment particles < 0.84 mm were most detrimental to incubating steelhead and chinook salmon eggs. Phillips et al. (1975) determined that substrates containing 20 percent fines reduced coho salmon and steelhead fry emergence success by 30-40 percent. Sedimentation can also trap or prevent fry emergence. Salmonid alevins need to reenter rearing gravels after emergence to avoid predators and unfavorable water column environmental conditions; fine sediment deposition can slow or prohibit reentry.

Hyporheic[3] inputs to streams can contribute upwelling, increase oxygen concentration, and cool temperatures. In fact, upwelling is important for enhancing oxygen exchange and waste removal

[3] The Hyporheic zone is defined as the spatially fluctuating ecotone between stream waters and groundwater where ecological processes are influenced at various scales by water movement,

in salmon redds. However, increased sediment loads can clog hyporheic connectivity. Because salmonids can detect and often spawn selectively in upwelling areas, clogging effects and loss of upwelling functionality may cause salmonids to avoid or abandon affected areas.

Fine sediment would continue to be resuspended and accumulate downstream of stream crossings as a result of ORV passage. The amount and quality of accumulated sediment would depend on the number of vehicles crossing, crossing vehicle speed and the type of substrate and water conditions (i.e., depth and velocity) at the crossing. Accumulated fine sediment at or within close proximity to water crossings would likely be transported further downstream during flood events especially during periods of fall flooding to potentially accumulate in the estuary or be transported into the Gulf of Alaska. Aquatic biota in freshwater and brackish environments would either avoid or be exposed to different turbidity levels depending on habitat characteristics and ability to seek refuge.

Sediment deposition would affect primary and secondary production, egg and embryo survival, substrate porosity, hyporheic exchange, and invertebrate diversity and abundance but only in those downstream areas subject to these effects and only when these life history stages or habitats are present. The timing of sediment deposition is all important because spawning salmon sort and coarsen stream-bed materials through spawning activity (Montgomery et al., 1996).

A very small number of watersheds and only limited stream reaches within water courses would actually be subject to these effects. Immediate, initial effects would occur primarily within a relatively well defined, localized reach within perhaps meters or tens of meters of each crossing (Rhinella and Bogan, 2003; Unpublished NPS data). Direct mortality, habitat loss, and loss of habitat functionality would affect only a very small component populations and available habitats. Sediment accumulation downstream of stream crossings would likely occur during most of the summer season but be resuspended and transported to the estuary and eventually the Gulf of Alaska during flooding events in the fall.

Aquatic animals would continue to be temporarily displaced from stream crossing locations during and for short periods after ORV crossings. These behavioral avoidance effects, although potentially affecting growth rates or individual fitness, are likely to be negligible because of low duration (seconds to minutes) and frequency (a few passages each day). Effects would generally occur over six or seven months each year from April or May through October. Again, effects would likely be more significant resulting in reduced condition, reduced growth, and increased probability of mortality for aquatic biota in small, seasonally isolated pools.

State of Alaska and NPS staff conducted a very cursory inventory of selected Dry Bay ORV water crossings during July of 2006. Both active and passive fishing gear were used to determine fish species presence and relative abundance along a suite of water crossings. Sites

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permeability, substrate particle size, resident biota, and the physiochemical features of the overlying stream and adjacent aquifers.

were also assessed for effects of ORV passage. Results are detailed in Appendix H and summarized and discussed under each alternative.

Site Specific Effects

No trails or routes would be designated and all 83.5 miles of existing trails and routes would remain open to ORV use under the no-action alternative (Fig. 2-1 and 2-2). ORV effects on biota and habitat would continue at all fifteen water crossings (Table 2-1). ORVs would periodically continue to use the deepwater estuary crossing southeast of Dog Salmon Creek (Fig. 3-9). However, use would be infrequent as a consequence of an alternative route along the Doame Trails complex. Direct physical impacts, suspended sediment and deposition effects, and behavioral avoidance by aquatic biota would continue as a result of ORV passage under this alternative.

Impacts to biota and habitat would continue at water crossings and downstream areas under this alternative. Effects are anticipated to be minor where water crossings have been gravel hardened or occur in relatively resistant estuarine or delta habitat. In contrast, continued ORV passage at other water crossings, even at current use levels, would likely continue to degrade habitat and impact biota. Trail and water crossing conditions, level of crossing use, habitat type and condition, and animal distribution and abundance would all affect the level of ORV crossing effects.

ORV passage at some water crossings would continue to have minimal impacts on aquatic biota and habitat due to relatively resistant trail and crossing conditions. Relatively frequent ORV passage at upper Dog Salmon Creek along Main Trail East (Fig. 3-9, Site 8) has primarily caused bank undercutting, erosion, and downstream sedimentation (Appendix H). An estimated sediment accumulation area of approximately 10 cubic yards was observed and documented 30 m downstream of this crossing in July of 2006 (NPS unpublished data). However, it is not possible to determine whether accumulated sediment is the result of ORV passage or natural processes. Juvenile coho and sockeye salmon and threespine stickleback have been documented to occur here but at reduced abundance compared to other sampled locations (Appendix H). Yet despite its relatively frequent use and as a result of past crossing hardening efforts, effects on biota and habitat function appear minimal under current use levels.

Similarly, water crossings along the DSC Estuary Routes (Fig. 2-1 and 2-2) and deepwater estuary crossing area are thought to have minimal impacts on aquatic biota and habitat because extremes in physical (i.e. temperature, mixing) and chemical (i.e., salinity and dissolved oxygen) conditions as a consequence of tide and associated effects on biota likely overshadow any ORV passage effect. Little evidence of ORV passage is detectable after tidal inundation as a result of the lack of vegetation and relatively resistant sand and small gravel substrate present at these crossings. Impacts along the deepwater estuary crossing area would be even less likely due to relatively infrequent and dispersed use in this area. ORV passage effects across the Doame River delta (See Fig. 2-1, Doame West and East trail crossings) would likely have comparable limited impacts on biota and habitat at these sparsely vegetated and primarily sandy crossings.

ATV traffic along the East Access Trail would continue undercutting banks at the lake outlet water crossing (Fig. 3-9, Site 4) causing some small amount of downstream sediment deposition. Sediment supply at the water crossing would be limited to only that produced by ORV passage because the lake functions as a sediment sink for upstream (natural) sediment sources. The lake also undoubtedly functions as important rearing habitat for juvenile coho and sockeye salmon despite moderate catch rates documented at this site in 2006 (Appendix H). Continued ORV passage, despite past attempts to harden the crossing, would continue to maintain undercut banks and cause some small amount of erosion and sedimentation which would continue to impact juvenile fish and habitat.

Limited impacts to aquatic biota and habitat along the East Alsek River crossing (Fig. 2-1) would continue under this alternative. Bank erosion would continue at both banks as a result of ORV use although substrate impacts and sediment resuspension during ATV passage would be somewhat mitigated by the relatively stable rock substrate along the crossing (Appendix H). Migrating and spawning adult as well as rearing juvenile salmon would be temporarily displaced or disturbed with ORV passage and some small amount of sediment deposition would probably occur downstream. Sedimentation effects could affect small numbers of sockeye salmon spawning downstream of this area. Any increase in ORV traffic and associated impacts should be monitored closely at this crossing because of the inherent value of the diverse and abundant fisheries resources in this river system (Table 3-4).

In contrast to minimal impacts at some water crossings, continued ORV passage at other water crossings, even at current use levels, would likely continue to degrade habitat and impact biota under this alternative. Although ORV passage at stream crossings along DSC Trail is infrequent, incised trail conditions along the eastern approach to Dog Salmon Creek (Fig. 3-9, Site 9) and associated bank and trail erosion at this and other crossings along the trail (Sites 10-12) are evident (Appendix H). Field sampling results documented five different fish species (i.e., juvenile coho and sockeye salmon, threespine stickleback, starry flounder and staghorn sculpin) here during 2006 (Appendix H). In fact, seine and minnow trapping catch rates for juvenile coho salmon at this site were some of the highest documented. Sampling results suggest these crossings function as important juvenile salmonid rearing habitat. ORV passage, even at current low levels, would continue to degrade habitat, cause some small amount of direct mortality, or at least temporarily displace biota during ATV passage.

ORV passage along the Varni East Trail (Fig. 3-9, Site 7) water crossing would continue to have significant effects on aquatic habitat and biota. Bank undercutting and erosion as well as a deeply incised trail have been documented at this location (Appendix H). Four different fish species were captured at this sampling location including juvenile coho and sockeye salmon, threespine stickleback and starry flounder. Catch rates at this location during 2006 were some of the highest for juvenile sockeye and moderate for coho suggesting important rearing habitat at this location. Turbidity levels after ORV passage would likely exceed state standards as a result of the abundant fine organic sediment present along this crossing with likely significant downstream deposition effects. At minimum, high turbidity levels following ATV passage at this site would certainly displace and stress biota with deposition effects in downstream areas. ORV passage at this water crossing would continue to significantly degrade habitat and affect biota.

ORV passage along the east end of Main Trail East would continue to impact habitat and fish in isolated ponds (Fig. 3-9, Sites 5 and 6). ATV traffic would maintain the incised trail/isolated pond at Site 5 and associated wave wash and direct physical impact would continue to cause mortality to high densities of stressed and stranded juvenile coho and sockeye salmon and stickleback at this site (Appendix H). Low rainfall and drying conditions would further exacerbate marginal habitat conditions and ATV passage mortality effects.

ORV passage along the Doame Trail would continue to maintain a deeply incised track and sediment erosion effects through this wetland area with subsequent impacts to aquatic habitat and biota. Sections of this trail (Fig. 3-9, Site 1) would capture and reroute water flow and sediment throughout this area potentially affecting wetland structure and function. Incised tracks would continue to persist as shallow, isolated ponds during low water periods. Juvenile coho salmon and stickleback would continue to be trapped within these isolated ponds (Appendix H) and suffer increased mortality particularly during dry periods.

Cumulative Effects

ORVs have undoubtedly disturbed aquatic biota and had some small mortality effect over the years. Mortality effects have probably been greatest at isolated pools containing fish and secondarily through sedimentation effects on salmonid eggs and embryos. These effects have likely occurred on an individual basis rather than as population level effects. In contrast, direct mortality to and disturbance of target and bycatch species as a result of area fisheries activity has undoubtedly been far greater than any mortality effects caused by ORV traffic.

Erosion and sedimentation rates have been exacerbated since the establishment of human ORV use in this area. Effects were likely greatest during initial trail development and during the commercial fishery heyday (mid 1980s to mid 1990s) when over 90 permit holders used ORVs for transporting their catch and supplies between fishing camps, fishing sites, fish processors, and airstrips. Enhanced erosion and sedimentation rates associated with ORV use could at least partly account for a small reduction in the quantity and quality of fish habitat at or downstream of water crossings. However, strong winds associated with winter storms in the Gulf of Alaska transport large volumes of sand and fine sediment inland from the beach, dunes and estuary/delta areas. Although no quantitative information exists, redistributed sand and sediment scoured and transported downstream during flooding events likely exceeds amounts generated by ORV traffic along a limited number of water crossings.

Uplift rates approaching 2 cm per year (Larsen et al. 2004) and associated physical and ecological change may well overshadow ORV effects on aquatic habitat and biota. Because the land surface is rising about a foot a decade, streams are apparently becoming more entrenched and groundwater sources are deepening. Based on preliminary evidence available from an aerial photo series for the Dry Bay area (1948-1996) and photo interpreted vegetation land cover changes, the East Alsek River is apparently drier now than in the past. This phenomenon could affect stream discharge throughout the preserve and may perhaps influence the quantity and quality of aquatic habitat.

Cumulative effects of both natural phenomena and human-caused change have had a moderate effect on aquatic biota and habitat in the Dry Bay area. Fisheries associated mortality and disturbance effects are much more significant compared with ORV effects. Natural wind driven sediment transport as well as channel scouring and deposition during flood events have likely exceeded erosion and sedimentation effects at water crossings by ORV passage. High uplift rates may have considerable consequences for aquatic habitat and biota. Moreover, these effects would occur over a much larger area than those caused by ORVs. Continued ORV use under Alternative 1 would have an incrementally reduced effect on aquatic biota and habitat compared with past ORV effects and a very small to negligible effect when compared with the sum of all cumulative effects.

Conclusion: ORV effects on aquatic biota and habitat at fifteen water crossings and the deepwater estuary crossing area under the no-action alternative would be minor, despite more obvious negative effects at specific stream crossing locations (i.e., DSC Trail, Varni East Trail, isolated pools along west end of Main Trail East, and Doame Trails complex.).

The level of impact on aquatic biota and habitat would not result in any impairment to preserve resources, thereby fulfilling specific purposes identified in enabling legislation and maintaining the cultural integrity of the park and preserve.

4.3.4 Effects on Wildlife

ORV Effects on Wildlife: Overview

The majority of ORV impact research investigates the effect on soils and vegetation with general and indirect conclusions about the wildlife that depends upon them. ORV effects on some species have been investigated in the desert southwest, permafrost tundra, western coniferous forest, and barrier beach habitats (Berry, 1980; Trombulak and Frissell, 2000; Stokowski and LaPointe, 2000).

Most ORV impact studies took place where vehicles were not restricted to established trails and riders created new tracks anywhere the terrain allowed. Generally, the number of vehicles, frequency of use, and resulting damaged habitat was expanding over the term of the study. Other studies focus on wildlife responses to established maintained roads with higher speeds and relatively large traffic volumes.

Few studies document specific ORV effects to birds or large game animals other than barrier beach nesting shorebirds, scrub desert songbirds, desert bighorn sheep and caribou (Taylor, 2002). Some wildlife avoids areas where ORVs are present, relocating to areas that may be lower quality habitats. Some wildlife becomes tolerant to road traffic (notably deer) or is attracted to the corridors created by roads because they offer easier movement in winter, road maintenance provides annual forbe and grass grazing, abundant seed foods, roadkills provide carrion, or the open terrain makes hunting small mammal and insect prey easier (Trombulak and Frissell, 2000; Stokowski and LaPointe, 2000).

Male and female grizzly bears tolerate roads differently by season and level of traffic. Adults avoid high traffic roads more than juveniles. Females stay farther from vehicle traffic and noise than males, yet are found closer to human settlements and activity. Adult females chose to avoid humans rather than find high quality habitat (Gibeau et al., 2002).

Direct impacts to wildlife include physical injury or death from collisions or crushing, increase in metabolic stress from startling and fleeing, hearing damage resulting from engine noise, and increased exposure to hunting, harassment, or poaching. Beach nesting birds such as least tern and piping plover have declined throughout their range partially due nest and fledgling losses caused by ORVs. Incubating adults, eggs, and nests are crushed by ORV tires, adults flushed repeatedly off nests by ORV disturbances lose eggs and chicks to chilling or predation. Foraging chicks can become trapped in ruts in soft sand when attempting to reach the intertidal zone. Migrating shorebirds that are flushed repeatedly by ORVs in critical stopover habitats have less opportunity to restore fat reserves needed for migration or breeding (USFWS, 1994).

Havlick (2002) cites studies showing birds, reptiles, and large ungulates respond to vehicles with accelerated heart rates, increased levels of stress hormones, and reproductive failure sometimes regardless of how often the events occur. MacArthur et. al. (1979) recorded an increase in heart rate and energy consumption of female bighorn sheep near roads regardless of the level of vehicle use. Some migrating waterfowl and shorebirds are more easily disturbed, flush at greater distances, and flee farther when using habitats near roads (Trombulak and Frissell, 2000).

ORV noise has been shown to damage hearing sensitivity and predator detection in kangaroo rats and fringe-toed lizards. Noise can also interfere with songbird breeding and territorial display by masking calls and interrupting song (Berry, 1980).

Indirect effects include declines in fitness, reproduction or survival due to loss of habitat or prey species or declines in the quality of habitat due to vegetation damage, stream sedimentation, or spread of invasive plants. Several studies demonstrated measurable declines in small mammal diversity in areas where ORV use occurs compared to areas with no ORV use. Many small mammal, reptile, and insect species show reluctance or refusal to cross a road, even if it is narrow and gravel surfaced. This could lead to genetic isolation or failure to breed (Merriam et al., 1989).

Wildlife Responses to ORVs in Dry Bay

Some wildlife species such as bear, wolf, lynx, wolverine, bald eagle, and some passerine birds range through many habitats in the Preserve while others including moose, parasitic jaeger, meadow jumping mouse, boreal toad, and migratory waterbirds are found in specific areas. The effect ORVs have upon these species may depend upon which habitat the particular disturbance occurs in and the time of year. Wide ranging species sensitive to vehicle disturbance such as wolves may leave the Dry Bay area completely. Others such as bald eagle may become tolerant and move away from a trail only temporarily, and some species such as bear and moose will begin using the trail itself. Populations restricted to a specific habitat may not be able to move away from trails developing within their range but decline in fitness and survival.

Pyare et al. (2005) found that ORV routes did affect which favored willow habitat moose used in the Yakutat Forelands. Most individual moose selected willow habitat located farther from a trail however whether this was due to the traffic level on a particular trail, the presence of the trail itself, or exposure to hunting in late fall is still being investigated.

For some habitats in Dry Bay the effects of ORV trails are more comparable to effects of established stable roads and in other habitats they are more comparable to the effects of pioneering cross country track formation. For purposes of discussion and consistency effects to wildlife will be categorized by the 4 physiographic regions described in Chapter 3 Section 3.1.2. These are the Alsek River Corridor, Uplands, Dunes and Plains, and Estuary/Delta.

Site Specific Effects

Under Alternative 1 no trails would be closed. All 83.5 miles of existing trails and routes would remain open to ORV use under permit. No maintenance, improvements, or restoration of trails would be performed by NPS. No new trails would be constructed and ORVs would still be required to use existing trails. The amount of ORV use would not change so the frequency and types of encounters would remain generally at the current level. The types of effects ORVs impose on wildlife will also occur at the same intensity and in the same areas.

In the Alsek River Corridor and Upland regions moose, bear, and wolf may be disturbed by an ORV as they use the corridors for travel. Large mammals using the trail or habitat on either side would be exposed to hunters more frequently than those that stay farther away from a trail. Small mammals, boreal toad, and passerine birds foraging or nesting in trail side brush may be injured or killed by a vehicle.

Where trails cross riparian corridors and wetlands along the Main Trail East habitat damage would continue as vehicles detour around ponds and mudholes. Habitat damage would expand in specific places as degraded trail segments widen or become braided. The amount of quality wetland habitat available to moose, ducks, common snipe, warblers, thrushes, voles, shrews, meadow jumping mouse and boreal toad would decrease slowly. ORV trail crossings at anadromous streams and riparian corridors would not be hardened, and vehicles may be forced to create new fording points as channels shift. The amount of riparian habitat in good condition available to moose, waterfowl, and bears may be reduced.

In the Temporary Camp Zone portions of the Dunes and Plains and the Estuary/Delta regions permittees could drive their vehicles anywhere necessary to reach campsites. Route locations would not be defined or marked so ORV users may still stray when the area is flooded or tracks are erased. Arctic tern, parasitic jaeger, and glaucous-winged gull nesting in this region may still lose nests or chicks to crushing, predation, or abandonment. Moose calving in the dunes would probably not be disturbed by an ORV as they are present for a short time early in the season.

The Dog Salmon Cutoff Trail, DSC Trail, Varni West and Varni East Trails, Schumacher Trail, Doame West Route, Doame East Trail, and the Ranney Route all cross or reach into the estuary delta region. Segments of the DSC Trail, Varni East, and the Doame River route/trail complex have caused significant habitat damage including vegetation loss, stream sedimentation, erosion,

large areas of braided tracks and deep ruts. Some segments of trails and routes in the Doame River area have become stream channels damaging aquatic vegetation and potentially stranding aquatic invertebrates. Waterfowl and moose feeding on aquatic plants and invertebrates may be attracted to these trail segments only to be disturbed as ORVs approach. The amount of channelized trail would probably increase resulting in further degradation or loss of wetland habitats. Under this alternative degraded trails would not be closed or repaired and stream crossings would not be stabilized.

Habitat damage in specific areas would continue as trails degrade reducing the amount of wetland, riparian, and estuarine habitat available to waterfowl, shorebirds, moose, bear, and passerine birds. Continuing stream sedimentation and turbidity would reduce production of aquatic plant and invertebrate foods for migratory waterbirds. ORV users would still cross the estuaries at multiple points to fish and hunt disturbing bears, wolverine, mink, otter, gulls and terns, bald eagle, flocking shorebirds and waterfowl at the time they are building critical fat reserves for migration and winter denning. Game species such as bear, waterfowl, otter, wolf, wolverine and mink foraging on spawning salmon would be exposed to hunting and trapping more frequently than individuals farther from trails.

Cumulative Effects

Migratory songbirds, shorebirds, colonial waterbirds, waterfowl, moose, bear, wolf, and other game species, raptorial birds, small mammals, and amphibians present in the Preserve have been disturbed by land-based commercial fishing since World War II. Seismic petroleum exploration activity established several roadways consequently used by commercial fishers, hunters and for subsistence use. As the set net fishery expanded in the 1940s the number of cabins and trails spread from the Alsek River east towards the East Alsek River. Human disturbance peaked during the 1980s and 1990s resulting from large East Alsek River sockeye salmon runs. Camps, cabins, boat launches, net sites, and access trails appeared along the estuary toward the Doame River delta. Trails and roads were also used for hunting and subsistence activity exposing more and more wildlife to harvest pressure and disturbance. The East Alsek River salmon fishery has declined significantly since, and human activity has declined along with it. Habitat at some sites previously used by humans has recovered.

About 180 acres of wildlife habitat has been converted to trails, airstrips, cabins and campsites. Disturbance and displacement of wildlife sensitive to ORV activity would have been most significant as each new trail or cabin site was established. Some trails and routes disappear as river channels shift and isostatic rebound alters wetland and shoreline margins. Plant succession is rapid in Dunes and Plains and Estuary/Delta habitats erasing routes in a few years if use is low. As upland trails stabilized and use patterns became more predictable some wildlife including moose, bear and woodland passerine birds began taking advantage of trail corridors or becoming tolerant of human presence and vehicles. The added effects from the No Action alternative would be minor, localized, and occur over an indefinite period of time.

Conclusion: The effect of the no-action alternative on wildlife as a result of ORV induced habitat loss and disturbance would be minor. The level of human use would occur in the same basic locations and at the same level. Disturbance related effects would be temporary and localized.

The level of impact on wildlife would not result in any impairment of park resources fulfilling specific purposes identified in enabling legislation, or that are essential to the cultural integrity of the park and preserve.

4.3.5 Effects on Visitor Use

Under Alternative 1 all 83.5 miles of existing trails and routes would remain open to currently authorized uses. The level and distribution of ORV use in the Preserve would not change significantly. Visitors could encounter sounds and sights of ORVs on existing trail throughout Dry Bay at the same locations and frequencies they do now. No trails or routes would be closed, and no trails or routes would be maintained or repaired by NPS. Visitors hoping to avoid noise, sights, or evidence of ORVs would need to hike away from the trail for some distance.

This alternative would provide the most extensive trail and route network around Dry Bay, with the overall condition of trails ranging from good to very degraded. Segments of the DSC Trail, the Doame River West and East Trail, Varni East, and the Main Trail East are ponded, rutted and muddy. Some segments may become impassable during wet periods as degradation continues.

Trails in upland areas such as the Inside Trail, Airport Cutoff, and Tractor North Trail may become too overgrown for vehicles to use. No stream crossings would be hardened or maintained so existing trails crossing Dog Salmon Creek or other streams could become impassable due to changes in the channel bottom, magnitude of stream discharge, or bank erosion. Rough trail conditions may also lead to vehicle damage and increased ORV maintenance costs for owners.

As OHV users attempt to avoid obstructions in ponded areas along the Main Trail East new tracks may form. Vehicles could become stranded resulting in traffic hazards or injury to riders. Routes in dune and estuarine areas would still be affected primarily by water, wind, and shifting sand. Lack of maintenance would have little effect. However, routes through the Dunes and Plains and Estuary/Delta regions would not be marked. When water and sand cover existing routes ORV users may create more and more new tracks. The visual impact of expanding trail braids, rutted and muddy wetlands may diminish the quality of experience sought by some visitors.

This alternative is not likely to affect Alsek River rafting groups as very few if any use ORV trails outside the immediate area of the take out point. Hikers and campers staging for trips to the outer coast and the Fairweather Range would have the same existing opportunities and access options.

Big game and waterfowl hunters and trappers would have ORV access to the East Alsek River corridor using the North Tractor, East Cabin and East Cabin North Trails. The extent of game species habitat accessible within 1 mile of a trail would remain the same. There may be conflicts between user groups along the East Cabin and East Cabin North Trails, the East Alsek River estuary, and the Doame River delta. Sport anglers, waterfowl hunters, and big game hunters accessing these trails at different times may interfere with each other due to vehicle noise and human activity from boat and raft launchings. ORV users wishing to reach the Doame River

delta to trap, hunt, fish, view wildlife, and hike toward the Deception Hills or Grand Plateau Glacier could use either the Doame Trail, cross the East Alsek River estuary by vehicle at low tide or load vehicles on boats to reach state intertidal lands.

Cumulative Effects

Human use, vehicle presence and associated trail development in the Preserve has occurred from land-based commercial fishing since World War II. Seismic petroleum exploration activity established several roadways consequently used by commercial fishers, hunters and for subsistence use. As the set net fishery expanded in the 1940s the number of cabins and trails spread from the Alsek River east towards the East Alsek River. Human use peaked during the 1980s and 1990s resulting from large East Alsek River sockeye salmon runs. Camps, cabins, boat launches, net sites, and access trails appeared along the estuary toward the Doame River delta. The East Alsek River salmon fishery has declined significantly since, and human activity has declined along with it. Some trails and campsites previously abandoned have been reclaimed by sand, grassland, shrubs and trees resulting in localized loss of access.

Under the No Action alternative degraded or overgrown trails and routes would continue to decline reducing access in specific areas. The added effects from the No Action alternative would be minor, localized, and occur over an indefinite period of time.

Conclusion: The no action alternative would have a minor negative impact on visitor use primarily due to localized trail deterioration. Public access across the Preserve would remain generally the same. The quality of experience for some visitors could decline because of the visual impacts of degraded trails and expanding habitat damage limiting opportunities to view wildlife.

4.3.6 Effects on Commercial Fishing

Under the no-action alternative 83.5 miles of trails and routes would be open to off-road vehicle use. The existing trail network would continue to allow commercial fisherman access to fishing sites, fish processing plant, campsites, cabins, boat haulouts, and airstrips which are directly incident to the exercise of valid commercial fishing rights and privileges. There would be no changes to existing commercial fishing infrastructure.

Because trail maintenance activities would generally not be under taken under the no-action alternative some trails could become degraded forcing commercial fishermen to develop alternative routes of access. This could cause an increase to travel times and have greater wear on ORVs used for commercial fishing purposes.

The continued use of 15 stream crossings by ORVs could affect fish and aquatic biota at and downstream of stream crossings. The impacts of ORV passage on biota and habitat would be minor (See Section 4.3.3 Effects on Aquatic Biota and Habitat). This level of impact would not likely affect sockeye salmon populations or affect commercial fishing harvest in the East Alsek or Alsek River commercial fishing area.

Cumulative Effects

Regardless of any action in this alternative, commercial fishing effort is primarily affected by natural variations in salmon populations. A large majority of the existing trails and infrastructure in the Dry Bay area were primarily established to support commercial fishing purposes and are a benefit to this activity. Other uses, such as river floating, sport fishing, wildlife viewing, hunting, trapping, and subsistence uses would have a minimal effect on commercial fishing, as those uses often do not occur in the same areas and at the same times. In addition, most of the subsistence users in Dry Bay are also commercial fishing permittees. Natural variability in salmon population has the greatest affect on commercial fishing in the commercial fishing areas. The continued use of the 83.5 miles of ORV trail and routes open under the no-action alternative would provide access to all fishing areas and commercial fishing infrastructure and benefit the activity. The deterioration of unmaintained trails, routes, and stream crossings would be a hindrance to the commercial fishing effort but would not affect the commercial harvest.

Conclusion: The no-action alternative would have a negligible long-term impact on commercial fishing in the Dry Bay area. The existing trail network would continue to provide access to commercial fishing areas and infrastructure with unmaintained trails, routes and ORV stream crossings being a slight impediment to the overall commercial fishing effort.

4.4 ALTERNATIVE 2: DESIGNATE TRAILS/ROUTES DIRECTLY INCIDENT TO COMMERCIAL FISHING AND AUTHORIZED UNDER CONCESSION CONTRACTS

This alternative would authorize ORV use on 58.7 miles (70.3%) of trails/routes and close 24.8 miles (29.7%) of existing trails/routes to ORV use. Table 4-4 lists the condition rating of 58.7 miles of trail open for ORV use under Alternative 2. Table 4-5 lists the condition rating of 24.8 miles of trail closed under Alternative 2.

Table 4-4 Summary of Trail Condition Classes for Trails Open to ORV Use in Alternative 2

Classification	Miles	Acres (max)[1]	Acres (min.)[1]	Percent Open by Classification
Good	44.1	48.5	24.6	75.2
Fair	12.1	24.9	15.3	20.7
Degraded	2.0	7.6	4.4	3.4
Very Degraded	0.5	2.3	1.3	0.8
Total Open:	**58.7**	**83.3**	**45.6**	

[1]Acres (max) and Acres (min) are the maximum and minimum acreage of the trail or trail segment. Acres (max) & Acres (min) are calculated by multiplying the maximum and minimum trail width for each trail segment in the same trail condition assessment inventory class. The segment acreages are added together to calculate the total acreage for the condition class.

Table 4-5 Summary of Trail Condition Classes for Trails Closed to ORV Use in Alternative 2

Classification	Miles	Acres (max)[1]	Acres (min.)[1]	Percent Closed by Classification
Good	14.5	12.6	6.4	58.3
Fair	8.3	14.1	8.1	33.5
Degraded	0.9	2.5	1.7	3.7
Very Degraded	1.1	4.8	2.6	4.5
Total Closed:	**24.8**	**34.0**	**18.8**	

[1]Acres (max) and Acres (min) are the maximum and minimum acreage of the trail or trail segment. Acres (max) & Acres (min) are calculated by multiplying the maximum and minimum trail width for each trail segment in the same trail condition assessment inventory class. The segment acreages are added together to calculate the total acreage for the condition class.

4.4.1 Effects on Water Quality

Under Alternative 2, trails not essential to commercial fishing and authorized concessions would be closed. Nearly 25 linear miles of preexisting ORV trail representing 30% of total trail length under Alternative 1 would be closed. Eleven stream crossings would be closed while only four would remain open (Fig. 2-3 and 2-4). The upper Dog Salmon Creek stream crossing along the western end of the Main Trail East would be stabilized and improved. The deepwater estuary crossing southeast of Dog Salmon Creek (Fig. 3-9) would be more frequently used due to closure of the Doame Trails complex. Trail closures associated with this alternative and the upper Dog Salmon Creek stream crossing improvement would have a net positive benefit on water quality.

The general effects of ORV passage on water quality are discussed at the beginning of section 4.3.1 under Alternative 1. Please see this section for a review of these effects.

Relatively frequent ORV passage at upper Dog Salmon Creek (DSC) along Main Trail East (Fig. 3-9, Site 8) has primarily caused bank undercutting, erosion, and downstream sedimentation (Appendix H). An estimated sediment accumulation area of approximately 10 cubic yards was observed and documented 30 m downstream of this crossing in July of 2006 (NPS unpublished data). However, it is not possible to determine whether accumulated sediment is the result of ORV passage or natural processes. Despite relatively frequent ORV use, proposed crossing stabilization combined with relatively voluminous stream discharge at this site would further mitigate effects of ORV passage on water quality.

ORV water crossing effects under Alternative 2 would cease along the DSC Trail (3 stream crossings), upper DSC estuary (2 crossings), Varni East Trail, East Access Trail, East Alsek River crossing, and the Doame Trails complex (3 crossings)(Fig. 2-3 and 2-4). Trail closures and stabilization of the upper Dog Salmon Creek crossing would result in the immediate cessation of ORV passage effects on water quality at these crossings. Degraded stream crossing and wetland habitats would be allowed to recover naturally following trail closure.

Trail and associated water crossings closures would protect water quantity and quality. However, it would take some time (e.g., years to decades) for these areas to revegetate naturally and for stream crossings to become stabilized.

DSC Trail closure would mitigate ORV water quality effects at three stream crossings. ORV passage effects would cease along lower Dog Salmon Creek (Fig. 3-9, Site 9) and at the two unnamed stream crossings (Sites 10-12) along the west end of this trail. Continued trail incision, bank undercutting, erosion, sedimentation and hydrocarbon leakage and emissions would cease along these stream crossings.

Closure of the two upper DSC estuary trail water crossings would alleviate water quality impacts as a result of ORV passage at these sites (Fig 2-4). Three estuary crossings (2 middle and 1 lower) through largely sandy substrate would remain open. However, water quality impacts would be naturally mitigated due to tidally regulated physicochemical variability and tidal dilution effects. Impacts along the deepwater estuary crossing area would be similar due to relatively infrequent and dispersed use in this area. Moreover, crossings would not be accessible at some tides and evidence of ORV passage at estuary crossings is typically washed away with each tidal cycle.

Varni East Trail (Fig. 3-9, Site 7) closure would alleviate ORV effects on water quality at this water crossing. This particular crossing is sensitive to ORV passage as a consequence of abundant fine, organic sediments and closure would mitigate or prevent effects of trail incision, bank undercutting, erosion, sedimentation, and hydrocarbon leakage.

Closure of the East Access Trail would eliminate ORV passage effects on water quality at the lake outlet crossing (Fig. 3-9, Site 4). Bank undercutting and erosion by ORV traffic would cease. The cessation of ORV passage across the East Alsek River (Fig. 3-9, Site 2) would

similarly alleviate any erosion, turbidity, sedimentation, or hydrocarbon leakage at this location. Organic debris and silt would no longer be resuspended and transported downstream at these sites.

Doame Trails complex closure (Fig. 2-3) would mitigate adverse ORV effects on natural wetland drainage structure and function along this trail (Fig. 3-9, Site 1) as well as other water quality effects. Deeply incised, ATV trails that have captured and rerouted water flow throughout this area would probably persist as pools or isolated ponds depending on water level for quite some time (e.g., decades). However, they would likely also trap and fill with sediment over time. Although ORV crossing effects along the Doame River delta (2 crossings) have likely been much more limited in comparison with effects at Site 1 partly as a consequence of discharge volume, any impact on water quality at these sites would cease with trail closure.

Cumulative Effects

Erosion and sedimentation rates have been exacerbated since the establishment of human ORV use in this area. Effects were likely greatest during initial trail development and during the commercial fishery heyday (mid 1980s to mid 1990s) when over 90 permit holders employed ORVs for transporting their catch and supplies between fishing camps, fishing sites, fish processors, and airstrips. However, strong winds associated with winter storms in the Gulf of Alaska transport large volumes of sand and fine sediment inland from the beach, dunes and estuary/delta areas. These materials are deposited over the landscape and ultimately entrained and transported by natural erosion processes. Although no quantitative information exists, it is likely that the amount of sediment redistributed inland during winter storms and subsequent scouring and redistribution of this material during stream flooding exceeds that generated by ORV traffic.

In addition to ORVs, motorized watercraft can affect water quality. Over 90 permit holders fished the East Alsek River during its heyday and many permittees used motorized dories to set, tend and retrieve their nets. Most outboard engines used in this area have been two-stroke which produce 12 times more aromatic hydrocarbons and five times as much oil and grease in their exhaust than four-stroke engines (Environment Canada, 2000). In contrast, most ATV engines have been cleaner burning four-stroke designs since their initial development in the 1970s. Thus motorized watercraft has likely accounted for the vast majority of hydrocarbon contaminant effects on area water quality. However, these effects would have been likely negligible and undetectable given the large volume and magnitude of daily flux in the estuary/delta as a result of stream discharge and tidal influence.

Some small amount of surface water contamination by sewage facilities or through fuel or other contaminant spills has probably occurred periodically at or near human facilities and developments over the history of area human occupation in Dry Bay. A total of 28 to 67 outhouses and up to six state approved septic systems (see section 4-2) are currently dispersed across approximately 24 total acres of facility-associated developments. However, past facilities were probably less well designed and engineered and some leakage to surface waters may have occurred. Similarly, small amounts of environmental contaminants including hazardous and/or toxic compounds and fuel have likely leaked into the environment as a result of human use and

occupation. Although contaminants are likely dispersed and undetectable, some areas in close proximity to human habitations (i.e., lodges, commercial fishing camps, fish processing facility) may exhibit higher than background level concentrations depending upon past contaminant disposal, dispensing methods, and containment or storage facilities. However, no measurable human-caused effects on water quality have ever been documented and effects are likely negligible.

Overall, human occupation and associated vessel and ORV use over time in the Dry Bay area has undoubtedly had some effect on water quality. Although very little quantitative information exists, cumulative effects on water quality are likely moderate and, in the case of erosion and sedimentation, likely overshadowed by natural processes. However, ORV trails have clearly affected and entrained natural patterns of runoff or caused erosion effects. Many of these effects are still visible today. ORV use and associated impacts under Alternative 2 would be measurably less than those under Alternative 1 and, in consequence, would be considerably less than those that occurred recently during the commercial fishery heyday. As a result, ORV impacts on water quality under this alternative would have a very limited or negligible effect when compared with the sum total of cumulative effects.

Conclusion: ORV effects on water quality under Alternative 2 would be negligible because 30 percent of trails would be closed including 11 water crossings. Closure of key trails across more heavily impacted water crossings would have a measurable and net positive benefit on water quality. Only four stream/estuary crossings and the deepwater route across the estuary would remain open. The Main Trail East stream crossing on upper Dog Salmon Creek would be stablized to mitigate ORV crossing effects on water quality.

The level of impacts on water quality would not result in any impairment of preserve resources fulfilling specific purposes identified in enabling legislation, or that are essential to the cultural integrity of the park and preserve.

4.4.2 Effects on Vegetation (Including Wetlands)

Under alternative 2 the NPS would designate 58.7 miles of the existing 83.5 miles of trails (or 70.3%) for ORV use. Metrics in terms of distances and areas of effects by vegetation class and trail condition are provided in Tables 7a and 7b of Appendix D, and calculations of the percent of effects are derived from these numbers.

Of the open trails, about 49.2 miles would traverse upland vegetation, and 8.2 miles would be across wetland areas with 75 percent as palustrine wetlands. About 2.5 miles of these trails or about 12 percent of the trail area is in a degraded or very degraded condition with about 45 percent of the degraded widened trails in palustrine wetlands and 55 percent of the degraded areas in upland vegetation. A reduction in degraded areas across wetlands and upland vegetation could be expected over the next decade with trail hardening and marking of designated routes. These measures would help contain trails within existing foot prints and mitigate impacts to vegetation, soils, and stream banks. These measures would help prevent trail widening, stream bank erosion, concomitant loss of vegetation and in some cases the trail width could be reduced.

Trails in good or fair condition would not likely be treated and trail widths would not change, so effects on (recovery of) vegetation along these trail segments would not change.

Of the 24.8 miles of trail to be closed under alternative 2, about 17.7 miles would be over upland vegetation types and 8.5 miles would be over wetland areas. Based on minimum and maximum trail widths for the segments, the total area to be closed would be between 19 and 35 acres. These areas would be expected to recover naturally over time. Key variables affecting duration of ORV trail effects are slope, aspect, soil moisture, hydrological regime, soil morphology, and vegetation type (Meyer, 2002). The impacts to vegetation groups are discussed below.

Upland Vegetation

A total of 17.7 miles (10.4 to 19.4 acres) of trail through upland vegetation would be closed. Trails to be closed with mostly upland vegetation are East Cabin North Trail, Tractor Trail North, Upper Alsek North Trail, Smitty's Spur, Towers Trail, Airport Cutoff, and Plains Cutoff. These areas would recover in time, but may not have the diversity or same composition as adjacent natural vegetation for some time. Vegetation recovery is highest, however, in upland areas with spruce woodland and low shrub communities (Happe et. al., 1998). Cottonwood and alder shrub vegetation types are also resilient and would recover quickly. Abandoned seismic trails through upland vegetation in the Dry Bay area have taken about 10-20 years to recover to a composition similar to surrounding vegetation, except it is younger overall (Capra, pers. com.). Upland vegetation impacted by ORVs in sand dunes and similar sandy areas take 1-3 years to fully recover after use ceases (Capra, pers. com.), primarily because of the deep-rooted, fast-growing adaptations of plant forms in these areas.

Open trails in upland vegetation would cover about 49.2 miles (36 to 66.6 acres) or about 80 percent of the calculated area of trails. Between 3.1 and 5.5 acres in upland vegetation is degraded or very degraded trail, accounting for about 55 percent of degraded open trail. As noted above, mitigating measures are expected to reduce this area over time, perhaps leading to recovery of an estimated 2 acres of impacted upland vegetation.

Palustrine Wetlands

About 6.9 miles of the 24.8 miles of trails to be closed under Alternative 2 would include those with the greatest existing adverse effects on palustrine wetland vegetation. These are the Doame Trail, Doame East and Doame West Trails, Varni East Trail, Dog Salmon Creek Trail, East Access Trail, Slue Cutoff, southerly parts of the Inland Trail, and parts of the Maze routes. Between 8.4 and 14.6 acres of trail traversing palustrine wetlands would be abandoned and allowed to recover. Some literature indicates wetland areas are less resistant to impacts but more resilient in terms of recovery. A functional recovery of a wetland area is more likely than a identical replication of the ecosystem prior to disturbance (Walker et al., 1987). Grasses and sedges are the most resistant species to ORV impacts and may recover quickest in an abandoned trail because of the rhizomes and ability of these plants to spread vegetatively (Happe et al., 1998). Because of the loss of other growth forms like forbs and shrubs, the total number of plant species would likely be less in a recovered location than in a non-disturbed location (Chapin and Shaver, 1981). Judging from past seismic trails and military trailing vehicles in the Dry Bay

area, however, palustrine wetland areas take two to six decades to fully recover (Capra, pers. com.).

A total of about 6.15 miles (7.5 to 13 acres) of trail through palustrine wetlands would remain open. Between 2.5 and 4.3 acres of the open trails would be over degraded or very degraded palustrine wetlands, accounting for about 45 percent of the degraded vegetation under Alternative 2. Segments of trail over degraded palustrine wetlands would be treated to be sustainable and eliminate widening. As noted above, mitigating measures are expected to reduce this area over time, perhaps leading to recovery of an estimated 2 acres of impacted palustrine wetlands.

Riverine and Estuarine Wetlands

A total of 1.3 miles of trail over riverine wetlands and 0.22 miles of estuarine wetlands (3.5% of the total trail area/1.2 acres) would be closed. Of closed trails across these vegetation types, small portions are degraded (0.04 miles or 0.4% for riverine wetlands areas and none for estuarine wetland areas). Of the total acres of degraded trail segments through these vegetation types, less than 0.5 percent occurs in these types. Again, because of the sandy/gravelly surfaces and sparse or hardy vegetation in these areas, impacts from vehicle trails are minimal and full recovery would likely occur within a decade or less.

About 0.1 miles of trail over riverine wetlands and 1.9 miles over estuarine wetlands (3.2% of the total trail area/2.5 acres) would remain open. A negligible portion of estuarine wetlands is classified as degraded, and no riverine wetlands fall within a degraded trail condition. Continuing impacts to riverine and estuarine wetlands along open trails would occur along 2.0 miles of existing trail.

Invasive Plants

Many of the trails to be closed do not yet have documented invasive plant species: Doame Trail, Doame East and West Trails, Maze Routes, Plains Cutoff, western half of Towers Trail, and duplicative Dunes Routes. There would be minimal risk of invasive plants taking over these areas if ORVs, their primary dispersal mechanism, would be cut off from these disturbed areas. Closed trails with invasive plants could see invasive plants infest and compete with native vegetation. These areas would likely be targeted for invasive plant eradication under guidance of the NPS Alaska Region Invasive Plant Management Plan before they take over large natural areas and while access to these areas is available. Examples of trails to be treated for invasive plants while accessible include: Alsek River North Trail, East Cabin North Trail, Towers Trail, East Access Trail, Varni East Trail, Airport Cutoff Trail, lower part of Inland Trail, and DSC Trail.

Trails remaining open to ORV use would harbor the greatest concentrations of invasive plants, probably because of dispersal of seeds and plant material on clothing, gear, and vehicles. Some plants could be controlled, however, the widely spread bigleaf lupine is not likely to be controlled and could result in additional newly infested vegetation over the next couple of decades.

Cumulative Effects

Existing facilities cover about 62.55 acres [temporary fish camps (11 acres), commercial fish camps (5 acres), seafood processing facility (1 acre), NPS facilities (2.45 acres), commercial lodges (4.3 acres), and airstrips (38.8 acres)]. Native vegetation has been totally displaced on at least 40 acres of these areas, and the remaining area has had the native vegetation disturbed. Some remaining portions of these facilities have seen some re-growth of native vegetation, and other portions have invasive plants growing on the disturbed sites. It is reasonable to assess that about 50 acres of native vegetation has been lost to other facilities and invasive plants. Essentially all of these facilities are located entirely in upland vegetation types. Future additional impacts to vegetation from other facilities (not trails) under the no-action alternative are unlikely and so would remain at about 50 acres, except for the possible spread of invasive plants into these disturbed areas. Combined with an estimated continuing 78.1 acres of impacts to native vegetation for open trails and routes (82.1 acres minus the potential for 4 acres of recovered vegetation from mitigating measures) about 128 acres of native vegetation would continue to be displaced from human activities. About 40 acres of wetland and upland vegetation could be recovered within a decade or two after: 1) closing trails that cover up to 34 acres, 2) controlling up to 2 acres of invasive plants, and 3) mitigating impacts to about 4 acres of existing widened trails, resulting in a counterbalancing beneficial effect to native vegetation. Overall these impacts would result in long-term (decades), noticeable, and widely distributed, beneficial effects to about 40 acres of native vegetation in the Preserve, or eventual recovery of about a fourth of the current impacted vegetation.

Conclusions: Alternative 2 would have a moderate, long-term, beneficial impact on vegetation and wetlands. The continued use of ORVs on trails open under this alternative would not result in any additional loss of vegetation while trail/route closures would allow for the natural recovery of about 40 acres of previously disturbed vegetation, including up to 18 acres of wetlands.

The level of impacts on vegetation and wetlands would not result in any impairment of preserve resources fulfilling specific purposes identified in enabling legislation, or that are essential to the cultural integrity of the park and preserve.

4.4.3 Effects on Aquatic Biota and Habitat

ORV passage effects on biota and habitat under Alternative 2 would be measurably reduced compared to Alternative 1 because trails not essential to commercial fishing and authorized concessions would be closed. Nearly twenty-five linear miles of ORV trail representing 30 percent of total trail length under Alternative 1 would be closed. Eleven stream crossing would be closed while only four crossings (Fig. 2-3 and 2-4) and the deepwater estuary crossing area would remain open. The upper Dog Salmon Creek stream crossing along the western end of the Main Trail East would be stabilized and improved. The deepwater estuary crossing southeast of Dog Salmon Creek would be more frequently used due to closure of the Doame Trails Complex. Trail closures and the upper Dog Salmon Creek stream crossing improvement would have a net positive effect on aquatic biota and habitat.

The general effects of ORV passage on aquatic biota and habitat are discussed at the beginning of section 4.3.3. under Alternative 1. Please see this section for a review of these effects.

ORV water crossing effects under Alternative 2 would cease along DSC Trail (3 crossings), upper DSC estuary (2 crossings), Varni East Trail, East Access Trail, East Alsek River crossing, and the Doame Trails complex (3 crossings)(Fig. 2-3 and 2-4). Trail closures would result in the immediate cessation of ORV passage effects on biota and habitat at these more heavily impacted stream crossings. Degraded water crossing and wetland habitats would be allowed to naturally recover following trail closure. Stabilization and improvement of the upper Dog Salmon Creek water crossing (Fig. 3-9, Site 8) would mitigate bank undercutting and erosion effects at this site.

Closure of these trail sections and associated water crossings would protect aquatic biota and habitat. However, it would take some time (e.g., years to decades) for these areas to naturally revegetate and for water crossings to become stabilized.

DSC Trail closure would mitigate ORV impacts to biota and habitat at three stream crossings. ORV passage effects would cease along lower Dog Salmon Creek and at the two unnamed stream crossings along the west end of this trail (Fig. 2-3 and 2-4). Incised trail conditions along the eastern approach to Dog Salmon Creek (Fig. 3-9, Site 9) would be allowed to recover and ORV effects on biota and habitat at this and other crossings along the trail (Sites 10-12) would cease thereby ensuring future protection of important salmonid rearing habitat.

Closure of the two upper DSC estuary trail water crossings would alleviate impacts at these sites (Fig. 2-4). Three estuary crossings (2 middle and one lower) through sand and small gravel substrate would remain open along with the deepwater estuary crossing area. The deepwater estuary crossing would likely experience greater use as a consequence of the alternate Doame Trails complex route closure. These crossings would not be accessible at high tide. Extreme variation in physicochemical and ecological conditions plus infrequent or dispersed use at these locations would likely result in few or negligible impacts to biota and habitat.

Varni East Trail (Fig. 3-9, Site 7) closure would halt further ORV passage effects on aquatic habitat and biota at this stream crossing. Trail incision, bank undercutting, erosion, sedimentation and disturbance effects at this degraded water crossing would no longer occur. Important rearing habitat for juvenile sockeye and coho salmon and several other species would be protected.

ORV passage along the east end of Main Trail East would continue to impact habitat and fish in isolated ponds (Fig. 3-9, Sites 5 and 6). ORV traffic would maintain the incised trail/isolated pond at Site 5 and associated wave wash and direct physical impact would continue to cause mortality to high densities of stressed and stranded juvenile coho and sockeye salmon and stickleback at this site (Appendix H). Low rainfall and drying conditions would further exacerbate marginal habitat conditions and ORV passage mortality effects.

East Access Trail closure would eliminate ORV passage effects on aquatic biota and habitat at the lake outlet crossing (Fig. 3-9, Site 4) and downstream areas. Bank undercutting, erosion and sedimentation would cease along with downstream sediment transport. ATV crossing effects

along the East Alsek River Trail would similarly cease under this alternative. Fish would no longer be disturbed or displaced, bank erosion would cease, and no downstream sedimentation effects would occur.

Closure of the Doame Trails complex (Fig. 3-9, Site 1) would mitigate adverse ORV effects on natural wetland drainage structure and function and minimize effects on habitat and biota. Although incised tracks would likely persist and trap fish for some time these features would diminish over time as a result of sediment accumulation and vegetative recolonization. Although ORV crossing effects along the Doame River delta are likely much more limited in comparison with effects at Site 1, any impact on aquatic habitat or biota at these sites (2 crossings) would also cease with trail closure.

Cumulative Effects

ORVs have undoubtedly disturbed aquatic biota and had some small mortality effect over the years. Mortality effects have probably been greatest at isolated pools containing fish and secondarily through sedimentation effects on salmonid eggs and embryos. These effects have likely occurred on an individual basis rather than as population level effects. In contrast, direct mortality to and disturbance of target and bycatch species as a result of area fisheries activity has undoubtedly been far greater than any mortality effects caused by ORV traffic.

Erosion and sedimentation rates have been exacerbated since the establishment of human ORV use in this area. Effects were likely greatest during initial trail development and during the commercial fishery heyday (mid 1980s to mid 1990s) when over 90 permit holders used ORVs for transporting their catch and supplies between fishing camps, fishing sites, fish processors, and airstrips. Enhanced erosion and sedimentation rates associated with ORV use could at least partly account for a small reduction in the quantity and quality of fish habitat at or downstream of water crossings. However, strong winds associated with winter storms in the Gulf of Alaska transport large volumes of sand and fine sediment inland from the beach, dunes and estuary/delta areas. Although no quantitative information exists, redistributed sand and sediment scoured and transported downstream during flooding events likely exceeds amounts generated by ORV traffic along a limited number of water crossings.

Uplift rates approaching 2 cm per year (Larsen et al. 2004) and associated physical and ecological change may well overshadow ORV effects on aquatic habitat and biota. Because the land surface is rising about a foot a decade, streams are apparently becoming more entrenched and groundwater sources are deepening. Based on preliminary evidence available from an aerial photo series for the Dry Bay area (1948-1996) and photo interpreted vegetation land cover changes, the East Alsek River is apparently drier now than in the past. This phenomenon could affect stream discharge throughout the preserve and may perhaps influence the quantity and quality of aquatic habitat.

Cumulative effects of both natural phenomena and human-caused change have had a moderate effect on aquatic biota and habitat in the Dry Bay area. Fisheries associated mortality and disturbance effects are probably significant compared with ORV effects. Natural wind driven sediment transport as well as channel scouring and deposition during flood events have likely

exceeded erosion and sedimentation effects at water crossings by ORV passage. High uplift rates may have considerable consequences for aquatic habitat and biota. Moreover, these effects would occur over a much larger area than those caused by ORVs. ORV effects on biota and habitat under Alternative 2 would be measurably less than those under Alternative 1 and, in consequence, would be considerably less than those that occurred during the commercial fishery heyday. As a result, ORV impacts under this alternative would have a very small to negligible effect when compared with the sum total of cumulative effects.

Conclusion: ORV effects on aquatic biota and habitat would be negligible because 30 percent of trails would be closed including 11 stream crossings. Several of the stream crossing closures under this alternative would have a measurable and net positive effect on biota and habitat. Only 4 water crossings plus the deepwater estuary crossing would remain open. The Main Trail East crossing on upper Dog Salmon Creek would be stabilized and improved to mitigate ORV passage effects on biota and habitat.

The level of impacts on aquatic biota and habitat would not result in any impairment of preserve resources fulfilling specific purposes identified in enabling legislation, or that are essential to the cultural integrity of the park and preserve.

4.4.4 Effects on Wildlife

Under Alternative 2 ORV use would continue on 58.7 miles of designated trails and routes throughout the Preserve. The amount and type of ORV use in Dry Bay would not change significantly supporting commercial fishing and concession permit activities. Designated trails would be maintained and repaired where necessary. Maintenance including brushing, stream crossing stabilization, route marking, and trail surface leveling would occur on some trail segments and routes annually. About 29 percent of Dry Bay habitats currently altered by ORV trails and routes would eventually re-establish themselves.

The general effects of ORV passage on wildlife are discussed at the beginning of section 4.3.4. under Alternative 1. Please see this section for a review of these effects.

Closed trails in upland habitats would include the Tractor North Trail, Towers Trail, Airport Cutoff, Smitty's Spur, East Cabin North Trail, Doame Trail, Varni East Trail and East Access Trail. In upland habitats where trails would require periodic brushing, maintenance activity would temporarily damage trail side passerine bird and small mammal foraging or nesting habitat. Noise from chainsaws, motorized brushers, and the presence of work crews would disturb wildlife directly along some trail segments each year.

Passerine birds and small mammals nesting or foraging along closed trails would no longer encounter vehicles. Trails in uplands are well defined and surrounded by stable woodland habitats. The trails could persist as narrow clearings for decades. Wildlife would probably continue to use closed trails for many years as they provide movement corridors, foraging areas for moose and raptors, seeds and forbs for birds and small mammals, and a variety of invertebrates in ponded segments.

Visitors could still traverse closed trails to reach the East Alsek River corridor and the Doame River though hunters and trappers would probably shift to areas closer to designated trails. Large mammal such as bear and moose would be exposed to lower hunting pressure along closed trails, particularly the Tractor North Trail and East Cabin North Trail. Less big game and waterfowl hunting, sport fishing would occur along the East Alsek River drainage and wildlife along the upper portions of the river would see less use by canoes or rafts. As hunters and trappers shift to areas accessible from designated trails hunting pressure on game animals along open trails may increase.

In the Dunes and Plains region trails and routes closed to ORVs would include the Inside Trail, Dunes, Maze West, and sections of the Maze Central Routes. Designated routes would be marked annually which may reduce the number of ORV tracks as it will be easier for users to find their way. Ground nesting birds particularly parasitic jaegers in the vicinity of designated routes would be less exposed to disturbance, inadvertent crushing of nests and loss of chicks. It would still be unlikely that moose calving in the dunes would be disturbed by an ORV as little vehicle activity occurs early in spring.

Temporary access trails in the Temporary Camp Zone would take the least environmentally disturbing, shortest, and most direct route from an authorized/existing trail or route to a camp or fishing site. Arctic tern, shorebirds, waterfowl, and glaucous-winged gull nesting in this zone may lose nests or chicks to crushing, predation, or abandonment.

One stream crossing on the Main Trail East (upper Dog Salmon Creek) would be hardened which would reduce ongoing riparian habitat damage in that immediate area. Initial stabilization activity would disturb wildlife temporarily and there may be periodic short term disturbance when the crossing needs repair.

Where trails cross unimproved riparian corridors and wetlands habitat damage would continue as vehicles detour around ponds and rutted segments. Habitat damage would expand in specific areas as degraded trail segments widen or become braided. The amount of quality wetland habitat available to moose, ducks, common snipe, warblers, thrushes, voles, shrews, meadow jumping mouse and boreal toad would decrease locally.

Under this alternative habitats east of the East Alsek and Doame River drainages would no longer be accessible by vehicle reducing disturbance to moose, bear, waterfowl, small mammals and passerine birds. Riparian and wetland habitats in the Doame River area would slowly restore themselves once vehicle traffic is absent. ORV users traveling to the Ranney airstrip and Doame River area would cross the East Alsek River estuary which may increase the local disturbance to shorebirds and waterfowl.

Cumulative Effects

Migratory songbirds, shorebirds, colonial waterbirds, waterfowl, moose, bear, wolf, and other game species, raptorial birds, small mammals, and amphibians present in the Preserve have been disturbed by land-based commercial fishing since World War II. Seismic petroleum exploration activity established several roadways consequently used by commercial fishers, hunters and for

subsistence use. As the set net fishery expanded in the 1940s the number of cabins and trails spread from the Alsek River east towards the East Alsek River. Human disturbance peaked during the 1980s and 1990s resulting from large East Alsek River sockeye salmon runs. Camps, cabins, boat launches, net sites, and access trails appeared along the estuary toward the Doame River delta. Trails and roads were also used for hunting and subsistence activity exposing more and more wildlife to harvest pressure and disturbance. The East Alsek River salmon fishery has declined significantly since, and human activity has declined along with it. Habitat at some sites previously used by humans has recovered.

About 180 acres of wildlife habitat has been converted to trails, airstrips, cabins and campsites. Disturbance and displacement of wildlife sensitive to ORV activity would have been most significant as each new trail or cabin site was established. Some trails and routes disappear as river channels shift and isostatic rebound alters wetland and shoreline margins. Plant succession is rapid in Dunes and Plains and Estuary/Delta habitats erasing routes in a few years if use is low. As upland trails stabilized and use patterns became more predictable some wildlife including moose, bear and woodland passerine birds began taking advantage of trail corridors or becoming tolerant of human presence and vehicles. The added effects from Alternative 2 would be beneficially minor, localized, and occur over an indefinite period of time.

Conclusion: Under Alternative 2 the effects on wildlife from ORV induced habitat loss and disturbance would be minor as the level of human use would occur in the same basic locations and at the same frequency. Disturbance related effects would be temporary and localized. Wildlife using habitats in the East Alsek River corridor and Doame River area would benefit from reduced disturbance by ORVs.

The level of impact on wildlife would not result in any impairment of park resources fulfilling specific purposes identified in enabling legislation, or that are essential to the cultural integrity of the park and preserve.

4.4.5 Effects on Visitor Use

Under Alternative 2 about 58.7 miles of trails and routes would remain open to ORV use in support of commercial fishing purposes and/or authorized under concession contracts. Other uses such as sport fishing, hunting under state regulations, trapping, wildlife viewing, and hiking would continue to occur incidentally. Approximately 24.8 miles of trails and routes would be closed to ORV use. Trails and routes that would be closed include Smitty's Spur, Towers, Tractor North, East Cabin North, Varni East, East Access, Doame, Doame West Routes and Doame East, Plains Cutoff, DSC, the Dog Salmon Creek estuary routes, and the Inside Trail.

Visitors could encounter sounds, sights, and evidence of ORVs on all designated trails or routes in Dry Bay. There may be an increase in the amount of traffic on designated trails and routes due to closures. Visitors wishing to travel on foot and avoid vehicles would have the option to use closed routes. Closed trails would eventually vanish as soils and vegetation reclaim the footprint. Depending on the location of closed trails foot traffic may keep narrow paths clear for a few years or decades. Trails in the Uplands and Alsek River Corridor may persist for 10 to 20

years while trails and routes in the Dunes and Plains and Estuary/Delta regions may disappear entirely within a few years.

The overall condition of designated trails would improve over time due to cyclic maintenance and repair by NPS. Trails in the Alsek Corridor and Upland regions such as the Flowers, Rohloff, Alsek North, Bear Island, Dog Salmon Cutoff, and East Cabin Trails would remain accessible for ORVs as a result of regular brush clearing and leveling of rough or ponded segments. One stream crossing on the Main Trail East (upper Dog Salmon Creek) would be hardened which would maintain reliable ORV access across this stream.

Because of regular maintenance, OHV users may need to detour around fewer and fewer areas along the Main Trail East. Fewer hazards for ORV riders may exist. Routes in dune and estuarine areas would continue to be affected primarily by water, wind, and shifting sand. Trail maintenance would have little effect in these areas. However, routes through the Dunes and Plains and Estuary/Delta regions would be marked annually making it easier for ORV users to keep to the designated routes when water and sand cover the tracks. The number and expanse of new tracks, ruts, ponded areas, and braiding would be reduced enhancing the quality of experience for visitors.

This alternative would not likely affect Alsek River rafting groups as very few if any use ORV trails outside the immediate area of the take out point. Hikers and campers staging for trips to the outer coast and the Fairweather Range would have the same existing opportunities and access options.

Big game and waterfowl hunters and trappers would have less ORV access to the East Alsek River corridor due to the closure of the North Tractor and East Cabin North Trails. Until closed trail corridors fill with alder and willow brush they may provide improved hunting or trapping opportunities for visitors on foot as wildlife may travel these corridors undisturbed by vehicles. However, the noise of a vehicle does alert wildlife to human approach. Visitors hiking closed trails may have an increased chance of getting closer to wildlife. Some visitors may not take advantage of trails closed to ORV use.

Hunting activity may increase along designated routes resulting in a sense of crowding and competition as a result of trail closures in the Doame River area. Fewer hunters or trappers may choose to hike long distances on closed trails in search of game.

Because the East Access and Doame Trails would be closed to vehicles, visitors wishing to reach the Doame River delta to trap, hunt, fish, view wildlife, and hike toward the Deception Hills or Grand Plateau Glacier using an ORV would need to cross the East Alsek River estuary by vehicle at low tide or load vehicles on boats to reach state intertidal lands. ORV operators would need to time their trips based on current tides and may need to wait several hours to make a return crossing. Closing the northern most Dog Salmon Creek estuary route and DSC trail would reduce access between the Temporary Camp Zone and Dog Salmon airstrip when high tides make the lower DSC estuary routes impassable.

Under this alternative some visitors may feel the amount of public access necessary to continue authorized uses in the Preserve is being restricted. Closing the Varni East Trail would inconvenience lodge clients arriving at the Varni airstrip. Visitors on foot would have more opportunities to avoid ORV traffic and observe wildlife. Others may feel that the NPS recognizes how essential ORVs are to permittees in Dry Bay because maintenance and repair of important access trails and stream crossings would now occur.

Cumulative Effects

Human use, vehicle presence and associated trail development in the Preserve because of land-based commercial fishing activity has occurred since World War II. Seismic petroleum exploration activity established several roadways consequently used by commercial fishers, hunters and for subsistence use. As the set net fishery expanded in the 1940s the number of cabins and access trails spread from the Alsek River east towards the East Alsek River. Visitors could reach more of the Preserve using a vehicle. Human use peaked during the 1980s and 1990s resulting from large East Alsek River sockeye salmon runs. Camps, cabins, boat launches, net sites, and access trails appeared along the estuary toward the Doame River delta. The East Alsek River salmon fishery has declined significantly since, and human activity has declined along with it. Some trails and campsites previously abandoned have been reclaimed by sand, grassland, shrubs and trees resulting in localized loss of access.

Under Alternative 2 annual maintenance on degraded or overgrown trails would have a minor positive effect resulting in improved visitor experiences. Access east of the East Alsek and Doame would be moderately reduced due to trail closures and occur over an indefinite period of time. Access for visitors traveling on foot would increase particularly for those wishing to avoid presence of vehicles.

Conclusion: Alternative 2 would have moderate negative effect on visitor use due to the closure of 24.8 miles of trails and routes. ORV access across the western portion of the Preserve would benefit from regular trail maintenance. Access to the eastern portions of the Preserve would be reduced due to trail closures in the Doame River area. Hikers would have slightly increased opportunities to access areas without ORV disturbance.

4.4.6 Effects on Commercial Fishing

Alternative 2 would designate 58.7 miles of trails and routes for ORV use and close 24.8 miles of existing trails. The resulting trail network would provide commercial fisherman access to fishing sites, the fish processing plant, campsites, cabins, boat haulouts, and airstrips which are directly incident to the exercise of valid commercial fishing rights and privileges.

The closure of duplicate trails in the maze area would not affect access between the main airstrip and the East Alsek commercial fishing area. The Maze Central and Maze West routes would to open under this alternative and continue to be the main transportation routes between these two important commercial fishing destinations. Access between the Temporary Camp Zone in the East Alsek river estuary and boat haulouts in the Alsek River mouth area would continue under

this alternative. The NPS would mark a single route early each year to facilitate travel between these destinations.

Closure of the northern most DSC estuary route and DSC Trail would limit access between the Temporary Camp Zone and the Dog Salmon airstrip when high tides make the lower DSC estuary routes impassable. This would be an inconvenience to commercial fishermen causing an increase in travel distance and a loss in time to reach the same destination.

The closure of the Doame Trail complex would not affect access to the Ranney Fish camp and air strip. This area can be accessed by aircraft or by transporting an ORV across the East Alsek River estuary and traveling across state tidelands to reach the camp.

Others trails (East Cabin North, Tractor North, Towers, Varni East and East Access) closed under this alternative would not affect commercial fishing activities.

Trail maintenance activities would improve the quality of trails and routes designated for ORV use in Alternative 2. Trail maintenance would marginally improve the transportation network used by commercial fishermen. Marking and brushing trails/routes as well as trail bed improvements could shorten travel times and limit mechanical impacts to ORVs

The closure of 11 stream crossing would reduce effects on aquatic biota and habitat. The impacts resulting from ORV passage at 4 stream crossing open under Alternative 2 would be negligible (See Section 4.4.3 Effects on Aquatic Biota and Habitat). These impacts would not likely affect sockeye salmon populations or affect commercial fishing harvest in the East Alsek or Alsek River commercial fishing area.

Cumulative Effects

Regardless of any action in this alternative, commercial fishing effort is primarily affected by natural variations in salmon populations and market forces. A large majority of the trails and infrastructure in the Dry Bay area were primarily established to support commercial fishing purposes and are a benefit to this activity. Other uses, such as river floating, sport fishing, wildlife viewing, hunting, trapping, and subsistence uses would have a minimal effect on commercial fishing, as those uses often do not occur in the same areas and at the same times. In addition, most of the subsistence users in Dry Bay are also commercial fishing permittees. The designation of 58.7 miles of trail and routes open to ORV use under Alternative 2 would provide access to all fishing areas and commercial fishing infrastructure and benefit the activity.

Conclusion: Alternative 2 would have a negligible long-term impact on commercial fishing in the Dry Bay area. The trail network under Alternative 2 would provide access to commercial fishing areas and infrastructure. Trail/route maintenance would improve the transportation network used by commercial fisherman.

4.5 ALTERNATIVE 3: DESIGNATE TRAILS/ROUTES DIRECTLY INCIDENT TO COMMERCIAL FISHING, AUTHORIZED UNDER CONCESSION CONTRACTS, AND FOR OTHER PURPOSES

This alternative would authorize ORV use on 62.9 miles (75.3%) of trails or routes and close 20.6 miles (24.7%) of existing trails and routes to ORV use. Table 4-6 lists the condition rating of 62.9 miles of trail authorized for ORV use under this alternative. Table 4-7 lists the condition rating of 20.6 miles of trail closed under Alternative 2.

Table 4-6 Summary of Trail Condition Classes for Trails Open to ORV Use in Alternative 3

Classification	Miles	Acres (max.)[1]	Acres (min.)[1]	Percent Open by Classification
Good	48.0	51.2	25.9	76.3
Fair	12.3	25.1	15.4	19.6
Degraded	2.1	7.6	4.5	3.3
Very Degraded	0.5	2.3	1.3	0.7
Total Open:	**62.9**	**86.2**	**47.1**	

[1]Acres (max) and Acres (min) are the maximum and minimum acreage of the trail or trail segment. Acres (max) & Acres (min) are calculated by multiplying the maximum and minimum trail width for each trail segment in the same trail condition assessment inventory class. The segment acreages are added together to calculate the total acreage for the condition class.

Table 4-7 Summary of Trail Condition Classes for Trails Closed to ORV Use in Alternative 3

Classification	Miles	Acres (max.)[1]	Acres (min.)[1]	Percent Closed by Classification
Good	10.6	9.9	5.0	51.4
Fair	8.1	14.0	8.1	39.3
Degraded	0.8	2.4	1.6	4.0
Very Degraded	1.1	4.8	2.6	5.3
Total Closed:	**20.6**	**31.0**	**17.3**	

[1]Acres (max) and Acres (min) are the maximum and minimum acreage of the trail or trail segment. Acres (max) and Acres (min) are calculated by multiplying the maximum and minimum trail width for each trail segment in the same trail condition assessment inventory class. The segment acreages are added together to calculate the total acreage for the condition class.

4.5.1 Effects on Water Quality

Effects under the preferred alternative would be similar to Alternative 2 except that 4.2 miles of additional trails would remain open (Fig. 2-5). Nearly 21 linear miles of preexisting ORV trail representing 25% of total trail length under Alternative 1 would be closed. Ten stream crossings would be closed while five would remain open (Fig. 2-5). A single stream crossing at the East Access Trail lake outlet (Fig. 3-9, Site 4) would allow access to the lower East Alsek River and this crossing accounts for the single additional stream crossing over Alternative 2. The upper Dog Salmon Creek stream crossing along the western end of the Main Trail East (Fig. 3-9, Site 8) and the East Access Trail lake outlet stream crossing (Fig. 3-9, Site 4) would both be stabilized and improved. Similar to Alternative 2, the deepwater estuary crossing southeast of

Dog Salmon Creek (Fig. 3-9) would be frequently used due to closure of the Doame Trails complex.

The general effects of ORV passage on water quality are discussed at the beginning of section 4.3.1 under Alternative 1. Please see this section for a review of these effects.

The trail closures and two stream crossing improvements would have a net positive benefit on water quality. This net positive benefit would be slightly less than under Alternative 2 because 4.2 fewer miles of trails would be closed and the East Access Trail including the lake outlet stream crossing would remain open. However, this crossing would be stabilized and improved which would mitigate, at least to some extent, the effect of this section of trail and stream crossing remaining open.

Relatively frequent ORV passage at upper Dog Salmon Creek (DSC) along Main Trail East (Fig. 3-9, Site 8) has primarily caused bank undercutting, erosion, and downstream sedimentation (Appendix H). An estimated sediment accumulation area of approximately 10 cubic yards was observed and documented 30 meters downstream of this crossing in July of 2006 (NPS unpublished data). However, it is not possible to determine whether accumulated sediment is the result of ORV passage or natural processes. Despite relatively frequent ORV use, proposed crossing stabilization combined with relatively voluminous stream discharge at this site would further mitigate effects of ORV passage on water quality.

Similar to Alternative 2, the DSC Trail (3 stream crossings), upper DSC estuary (2 crossings), Varni East Trail, East Alsek River crossing, and Doame Trails complex (3 crossings) closures would result in the immediate cessation of ORV passage effects on water quality at these stream crossings. Degraded stream crossing and wetland habitats would be allowed to recover naturally following trail closure.

Trail and associated water crossings closures would protect water quantity and quality. However, it would take some time (e.g., years to decades) for these areas to revegetate naturally and for stream crossings to become stabilized.

Similar to Alternative 2, closure of the DSC Trail would mitigate ORV water quality effects at three stream crossings. ORV passage effects would cease along lower Dog Salmon Creek (Fig. 3-9, Site 9) and at the two unnamed stream crossings (Sites 10-12) along the west end of this trail. Continued trail incision, bank undercutting, erosion, sedimentation and hydrocarbon leakage and emissions would cease along these stream crossings.

Similarly, closure of the two upper DSC estuary trail stream crossings would alleviate water quality impacts as a result of ORV passage at these sites (Fig 2-4). Three estuary crossings (2 middle and 1 lower) through largely sandy substrate would remain open. However, water quality impacts would be naturally mitigated due to tidally regulated physicochemical variability and tidal dilution effects. Impacts along the deepwater estuary crossing area would be similar due to relatively infrequent and dispersed use in this area. Moreover, crossings would not be accessible at some tides and evidence of ORV passage at estuary crossings is typically washed away with each tidal cycle.

Varni East Trail (Fig. 3-9, Site 7) closure would alleviate ORV effects on water quality at this water crossing. This particular crossing is sensitive to ORV passage as a consequence of abundant fine, organic sediments and closure would mitigate or prevent effects of trail incision, bank undercutting, erosion, sedimentation, and hydrocarbon leakage.

In contrast with Alternative 2, the East Access Trail would remain open and ORV passage effects on water quality at the lake outlet crossing (Fig. 3-9, Site 4) and downstream areas would continue. However, these effects would be mitigated by stream crossing improvements and stabilization at this location.

The cessation of ORV passage across the East Alsek River (Fig. 3-9, Site 2) would alleviate any erosion, turbidity, sedimentation, or hydrocarbon leakage at this location. Organic debris and silt would no longer be resuspended and transported downstream at this site.

Similar to Alternative 2, closure of the Doame Trails complex would mitigate adverse ORV effects on natural wetland drainage structure and function along this trail (Fig. 3-9, Site 1) as well as other water quality effects. Deeply incised, ATV trails that have captured and rerouted water flow throughout this area would probably persist as pools or isolated ponds depending on water level for quite some time (e.g., decades). However, they would likely also trap and fill with sediment over time. Although ORV crossing effects along the Doame River delta (2 crossings) have likely been much more limited in comparison with effects at Site 1 partly as a consequence of discharge volume, any impact on water quality at these sites would cease with trail closure

Cumulative Effects

Erosion and sedimentation rates have been exacerbated since the establishment of human ORV use in this area. Effects were likely greatest during initial trail development and during the commercial fishery heyday (mid 1980s to mid 1990s) when over 90 permit holders employed ORVs for transporting their catch and supplies between fishing camps, fishing sites, fish processors, and airstrips. However, strong winds associated with winter storms in the Gulf of Alaska transport large volumes of sand and fine sediment inland from the beach, dunes and estuary/delta areas. These materials are deposited over the landscape and ultimately entrained and transported by natural erosion processes. Although no quantitative information exists, it is likely that the amount of sediment redistributed inland during winter storms and subsequent scouring and redistribution of this material during stream flooding exceeds that generated by ORV traffic.

In addition to ORVs, motorized watercraft can affect water quality. Over 90 permit holders fished the East Alsek River during its heyday and many permittees used motorized dories to set, tend and retrieve their nets. Most outboard engines used in this area have been two-stroke which produce 12 times more aromatic hydrocarbons and five times as much oil and grease in their exhaust than four-stroke engines (Environment Canada 2000). In contrast, most ATV engines have been cleaner burning four-stroke designs since their initial development in the 1970s. Thus motorized watercraft has likely accounted for the vast majority of hydrocarbon contaminant effects on area water quality. However, these effects would have been likely negligible and

undetectable given the large volume and magnitude of daily flux in the estuary/delta as a result of stream discharge and tidal influence.

Some small amount of surface water contamination by sewage facilities or through fuel or other contaminant spills has probably occurred periodically at or near human facilities and developments over the history of area human occupation in Dry Bay. A total of 28 to 67 outhouses and up to six state approved septic systems (see section 4-2) are currently dispersed across approximately 24 total acres of facility-associated developments. However, past facilities were probably less well designed and engineered and some leakage to surface waters may have occurred. Similarly, small amounts of environmental contaminants including hazardous and/or toxic compounds and fuel have likely leaked into the environment as a result of human use and occupation. Although contaminants are likely dispersed and undetectable, some areas in close proximity to human habitations (i.e., lodges, commercial fishing camps, fish processing facility) may exhibit higher than background level concentrations depending upon past contaminant disposal, dispensing methods, and containment or storage facilities. However, no measurable human-caused effects on water quality have ever been documented and effects are likely negligible.

Overall, human occupation and associated vessel and ORV use over time in the Dry Bay area has undoubtedly affected water quality. Although very little quantitative information exists, cumulative effects on water quality are likely moderate and, in the case of erosion and sedimentation, likely overshadowed by natural processes. However, ORV trails have clearly affected and entrained natural patterns of runoff and these effects are still visible today. ORV use and associated impacts under the preferred alternative would be measurably less than those under Alternative 1 and slightly greater than those under Alternative 2 and, in consequence, would be considerably less than those that occurred during the commercial fishery heyday. As a result, ORV impacts on water quality under this alternative would have a very limited or negligible effect when compared with the sum total of cumulative effects.

Conclusion: ORV effects on water quality under Alternative 3 would be slightly greater than under Alternative 2 but still negligible because 25 percent of trails would be closed including 10 water crossings. Closure of key trails across more heavily impacted water crossings would have a measurable and net positive benefit on water quality. Five stream/estuary crossings and the deepwater route across the estuary would remain open. In contrast with Alternative 2, the lake outlet stream crossing along the East Access trail would remain open. The Main Trail East stream crossing on upper Dog Salmon Creek and the East Access trail lake outlet crossing would be stabilized to mitigate ORV crossing effects.

The level of impacts on water quality would not result in any impairment of preserve resources fulfilling specific purposes identified in enabling legislation, or that are essential to the cultural integrity of the park and preserve.

4.5.2 Effects on Vegetation (Including Wetlands)

Under alternative 3 the NPS would designate 62.9 miles of the existing 83.5 miles of trails (or 75.3%) for ORV use. Metrics in terms of distances and areas of effects by vegetation class and trail condition are provided in Tables 8a and 8b of Appendix D, and calculations of the percent of effects are derived from these numbers.

Of the open trails, 54.0 miles would be across upland vegetation, and 9.4 miles would be across wetland areas with 66 percent as palustrine wetlands. About 2.6 miles of these trails or about 12 percent of the trail area would be in degraded or very degraded condition with about 44 percent of the degraded widened trails in palustrine wetlands and 56 percent of the degraded areas in upland vegetation. As in alternative 2, measures to contain trails within existing foot prints would mitigate impacts to vegetation, soils, and stream banks along the designated routes. These measures would help prevent the widening of actively used trails and erosion of stream banks, and in some cases the trail width could be reduced. Recovery of degraded areas across wetlands and upland vegetation could be expected over the next decade with trail hardening and marking of designated trails.

Of the 20.2 miles of trail to be closed under alternative 3, about 12.9 miles would be over upland vegetation types and 7.3 miles would be over wetland areas. Based on minimum and maximum trail widths for the segments, the total area to be closed would be between 17 and 31 acres. These areas would be expected to recover naturally over time. Key variables affecting duration of ORV trail effects are slope, aspect, soil moisture, hydrological regime, soil morphology, and vegetation type (Meyer, 2002). The impacts to vegetation groups are discussed below.

Upland Vegetation

About 12.9 miles (8.6 to 15.75 acres) of trail through upland vegetation would be closed. Trails to be closed with mostly upland vegetation are Smitty's Spur, Towers Trail, Airport Cutoff, and Plains Cutoff. These areas would recover in time, but may not have the diversity of adjacent natural vegetation for some time. Vegetation recovery is highest, however, in upland areas with spruce woodland and low shrub communities (Happe et. al., 1998). Cottonwood and alder shrub vegetation types are also resilient and would recover quickly. Abandoned seismic trails through upland vegetation in the Dry Bay area have taken about 10-20 years to recover to a composition similar to surrounding vegetation, except it is younger overall (Capra, pers. com.). Upland vegetation impacted by ORVs in sand dunes and similar sandy areas take 1-3 years to fully recover after use ceases (Capra, pers. com.), primarily because of the deep-rooted, fast-growing adaptations of plant forms in these areas.

Trails to remain open that mostly traverse upland vegetation would be East Cabin North Trail, Tractor Trail North, Upper Alsek North Trail. Open trails traversing upland vegetation would cover 54.0 miles (37.8 to 70.2 acres) or about 80 percent of the calculated area of trails. Between 3.2 and 5.6 acres in upland vegetation would be degraded or very degraded trail, accounting for about 55 percent of degraded open trail area under Alternative 3. As noted above, mitigating measures are expected to reduce this area over time, perhaps leading to recovery of an estimated 2 acres of impacted upland vegetation.

Palustrine Wetlands

About 6.8 miles of the 20.2 miles of trails to be closed under alternative 3 would include those with the greatest existing adverse effects on palustrine wetland vegetation. These are the Doame Trail, Doame East and Doame West Trails, Varni East Trail, Dog Salmon Creek Trail, East Access Trail, Slue Cutoff, southerly parts of the Inland Trail, and parts of the Maze routes. Between 8.4 and 14.5 acres of trail traversing palustrine wetlands would be abandoned and allowed to recover. Some literature indicates wetland areas are less resistant to impacts but more resilient in terms of recovery. A functional recovery of a wetland area is more likely than a complete recovery to the ecosystem as it was before disturbance (Walker et al., 1987). Grasses and sedges are the most resistant species to ORV impacts and may recover quickest in an abandoned trail because of the rhizomes and ability of these plants to spread vegetatively (Happe et al., 1998). Because of the loss of other growth forms like forbs and shrubs, the total number of plant species is likely to be less in a recovered location than in a non-disturbed location (Chapin and Shaver, 1981). Judging from past seismic trails and military training vehicles in the Dry Bay area, however, palustrine wetland areas take two to six decades to fully recover (Capra, pers. com.).

About 6.2 miles (7.6 to 13 acres) of trail crossing palustrine wetland areas would remain open. Between 2.5 and 4.3 acres of the open trails would be over degraded or very degraded palustrine wetlands, accounting for about 44 percent of the degraded vegetation under Alternative 3. As noted above, mitigating measures are expected to reduce this area over time, perhaps leading to recovery of an estimated 2 acres of impacted palustrine wetlands.

Riverine and Estuarine Wetlands

About 0.45 miles of trail crossing riverine and estuarine wetlands would be closed (2.2% of the total closed trail area/0.4 acres). The primary difference between this alternative and alternative 2 is a result of keeping the Alsek River North Trail open, which traverses riverine wetlands. Of closed trails across these vegetation types, small portions are degraded (0.04 miles or 0.4% for riverine wetlands areas and none for estuarine wetland areas). Of the total acres of degraded trail segments through these vegetation types, less than 0.5 percent occurs in either type. (This is the same as in alternative 2, indicating none of the Alsek River Trail riverine wetlands would be degraded.) Again, because of the sandy/gravelly surfaces and sparse or hardy vegetation in these wetland areas, impacts from vehicle trails are minimal and full recovery would likely occur within a decade or less.

About 1.2 miles of riverine wetlands and 1.9 miles of estuarine wetlands would remain open (about 5.0% of the open trail area/3.3 acres). A negligible portion of estuarine wetlands is classified as degraded, and no riverine wetlands fall within a degraded trail condition. Continuing minor impacts to riverine and estuarine wetlands along open trails would occur along 3.1 miles of existing trail.

Invasive Plants

Many of the trails to be closed do not yet have documented invasive plant species: Doame Trail, Doame East and West Trails, Maze Routes, Plains Cutoff, western half of Towers Trail, and duplicative Dunes Routes. There would be minimal danger of invasive plants taking over these areas if ORVs, their primary dispersal mechanism, are cut off from these disturbed areas. Closed trails with invasive plants could see invasive plants infest and compete with native vegetation. These areas would likely be targeted for invasive plant eradication under guidance of the NPS Alaska Region Invasive Plant Management Plan before they take over large natural areas and while access to these areas is available. Examples of trails to be treated for invasive plants while accessible include: Towers Trail, East Access Trail, Varni East Trail, Airport Cutoff Trail, lower part of Inland Trail, and DSC Trail. The Alsek North Trail, East Cabin North Trail, and East Alsek Access Trail would remain open in this alternative compared to alternative 2, and these trails have some invasive plant infestations. Trails to remain open would harbor the greatest concentrations of invasive plants due to dispersal of seeds and plant material on clothing, gear, and vehicles. Some plants could be controlled, however, the widely spread bigleaf lupine is not likely to be controlled.

Cumulative Effects

Other existing facilities cover about 62.55 acres [temporary fish camps (11 acres), commercial fish camps (5 acres), seafood processing facility (1 acre), NPS facilities (2.45 acres), commercial lodges (4.3 acres), and airstrips (38.8 acres)]. Native vegetation has been totally displaced on at least 40 acres of these areas, and the remaining area has had the native vegetation disturbed. Some remaining portions of these facilities have seen some re-growth of native vegetation, and other portions have invasive plants growing on the disturbed sites. It is reasonable to assess that about 50 acres of native vegetation has been lost to other facilities and invasive plants. Essentially all of these facilities are located entirely in upland vegetation types. Future additional impacts to vegetation from other facilities (not trails) under the no-action alternative are unlikely and so would remain at about 50 acres except for the possible spread of invasive plants into these disturbed areas. Combined with an estimated continuing 81.6 acres of impacts to native vegetation (82.1 acres minus the potential for 4 acres of recovered vegetation from mitigating measures) about 133 acres of native vegetation would continue to be displaced from human activities under alternative 3. An estimated total of 36 acres of wetland and upland vegetation would be recovered within a few decades after: 1) closing trails, 2) controlling invasive plants, and 3) mitigating impacts to existing widened trails, resulting in a counterbalancing beneficial effect to native vegetation. Overall these impacts would result in long-term (decades), noticeable, and widely distributed, moderate beneficial effects to 36 acres of native vegetation in the Preserve, or eventual recovery of about a fifth of the currently impacted vegetation.

Conclusions: Alternative 3 would have a moderate, long-term, beneficial impact on vegetation and wetlands. The continued use of ORVs on trails open under this alternative would not result in any additional loss of vegetation while trail/route closures would allow for the natural recovery of about 36 acres of previously disturbed vegetation, including up to 17 acres of wetland.

The level of impacts on vegetation would not result in any impairment of preserve resources fulfilling specific purposes identified in enabling legislation, or that are essential to the cultural integrity of the park and preserve.

4.5.3 Effects on Aquatic Biota and Habitat

Effects under the preferred alternative would be similar to Alternative 2 except that 4.2 miles of additional trails would remain open (Fig. 2-5). Nearly 21 linear miles of preexisting ORV trail representing 25 percent of total trail length under Alternative 1 would be closed. Ten stream crossings would be closed while five would remain open. A single stream crossing at the East Access Trail lake outlet (Fig. 3-9, Site 4) would allow access to the lower East Alsek River and this crossing accounts for the single additional stream crossing over Alternative 2. The upper Dog Salmon Creek stream crossing along the western end of the Main Trail East (Fig. 3-9, Site 8) and the East Access Trail lake outlet crossing (Fig. 3-9, Site 4) would both be stabilized and improved. Similar to Alternative 2, the deepwater estuary crossing southeast o Dog Salmon Creek (Fig. 3-9) would be frequently used due to closure of the Doame Trails complex. The trail closures and two stream crossing improvements would have a net positive effect on aquatic biota and habitat that would be slightly less than under Alternative 2.

The general effects of ORV passage on aquatic biota and habitat are discussed at the beginning of section 4.3.3. under Alternative 1. Please see this section for a review of these effects.

Similar to Alternative 2, the DSC Trail (3 stream crossings), upper DSC estuary (2 crossings), Varni East Trail, East Alsek River Crossing, and Doame Trails complex (3 crossings) closures would result in the immediate cessation of ORV passage effects on aquatic biota and habitat at these water crossings (Fig. 2-5 and 2-4). Degraded water crossing and wetland habitats would be allowed to naturally recover following trail closure. Stabilization and improvement of both the upper Dog Salmon Creek (Fig. 3-9, Site 8) and East Access Trail (Site 4) would mitigate bank undercutting and erosion effects at these sites.

Closure of these trail sections and associated water crossings would protect aquatic biota and habitat. However, it would take some time (e.g., years to decades) for these areas to naturally revegetate and for water crossings to become stabilized.

DSC Trail closure would mitigate ORV impacts to biota and habitat at three stream crossings. ORV passage effects would cease along lower Dog Salmon Creek and at the two unnamed stream crossings along the west end of this trail (Fig. 2-5 and 2-4). Incised trail conditions along the eastern approach to Dog Salmon Creek (Fig. 3-9, Site 9) would be allowed to recover and ORV effects on biota and habitat at this and other crossings along the trail (Sites 10-12) would cease thereby ensuring future protection of important salmonid rearing habitat.

Closure of the two upper DSC estuary trail water crossings would alleviate impacts at these sites (Fig. 2-4). Three estuary crossings (2 middle and one lower) through sand and small gravel substrate would remain open along with the deepwater estuary crossing area. The deepwater estuary crossing would likely experience greater use as a consequence of the alternate Doame Trails complex route closure. These crossings would not be accessible at high tide. Extreme

variation in physicochemical and ecological conditions plus infrequent or dispersed use at these locations would likely result in few or negligible impacts to biota and habitat.

Varni East Trail (Fig. 3-9, Site 7) closure would halt further ORV passage effects on aquatic habitat and biota at this stream crossing. Trail incision, bank undercutting, erosion, sedimentation and disturbance effects at this degraded water crossing would no longer occur. Important rearing habitat for juvenile sockeye and coho salmon and several other species would be protected.
ORV passage along the east end of Main Trail East would continue to impact habitat and fish in isolated ponds (Fig. 3-9, Sites 5 and 6). ATV traffic would maintain the incised trail/isolated pond at Site 5 and associated wave wash and direct physical impact would continue to cause mortality to high densities of stressed and stranded juvenile coho and sockeye salmon and stickleback at this site (Appendix H). Low rainfall and drying conditions would further exacerbate marginal habitat conditions and ATV passage mortality effects.

The East Access Trail would remain open and ORV passage effects on aquatic biota and habitat at the lake outlet crossing (Fig. 3-9, Site 4) and downstream areas would continue. However, these effects would be mitigated by stream crossing improvements and stabilization at this location.

ATV crossing effects along the East Alsek River Trail would similarly cease under this alternative. Fish would no longer be disturbed or displaced, bank erosion would cease, and no downstream sedimentation effects would occur.

Closure of the Doame Trails complex (Fig. 3-9, Site 1) would mitigate adverse ORV effects on natural wetland drainage structure and function and minimize effects on habitat and biota. Although incised tracks would likely persist and trap fish for some time these features would diminish over time as a result of sediment accumulation and vegetative recolonization. Although ORV crossing effects along the Doame River delta are likely much more limited in comparison with effects at Site 1, any impact on aquatic habitat or biota at these sites (2 crossings) would also cease with trail closure.

Cumulative Effects

ORVs have undoubtedly disturbed aquatic biota and had some small mortality effect over the years. Mortality effects have probably been greatest at isolated pools containing fish and secondarily through sedimentation effects on salmonid eggs and embryos. These effects have likely occurred on an individual basis rather than as population level effects. In contrast, direct mortality to and disturbance of target and bycatch species as a result of area fisheries activity has undoubtedly been far greater than any mortality effects caused by ORV traffic.

Erosion and sedimentation rates have been exacerbated since the establishment of human ORV use in this area. Effects were likely greatest during initial trail development and during the commercial fishery heyday (mid 1980s to mid 1990s) when over 90 permit holders used ORVs for transporting their catch and supplies between fishing camps, fishing sites, fish processors, and airstrips. Enhanced erosion and sedimentation rates associated with ORV use could at least

partly account for a small reduction in the quantity and quality of fish habitat at or downstream of water crossings. However, strong winds associated with winter storms in the Gulf of Alaska transport large volumes of sand and fine sediment inland from the beach, dunes and estuary/delta areas. Although no quantitative information exists, redistributed sand and sediment scoured and transported downstream during flooding events likely exceeds amounts generated by ORV traffic along a limited number of water crossings.

Uplift rates approaching 2 cm per year (Larsen et al. 2004) and associated physical and ecological change may well overshadow ORV effects on aquatic habitat and biota. Because the land surface is rising about a foot a decade, streams are apparently becoming more entrenched and groundwater sources are deepening. Based on preliminary evidence available from an aerial photo series for the Dry Bay area (1948-1996) and photo interpreted vegetation land cover changes, the East Alsek River is apparently drier now than in the past. This phenomenon could affect stream discharge throughout the preserve and may perhaps influence the quantity and quality of aquatic habitat.

Cumulative effects of both natural phenomena and human-caused change have had a moderate effect on aquatic biota and habitat in the Dry Bay area. Fisheries associated mortality and disturbance effects are probably significant compared with ORV effects. Natural wind driven sediment transport as well as channel scouring and deposition during flood events have likely exceeded erosion and sedimentation effects at water crossings by ORV passage. High uplift rates may have considerable consequences for aquatic habitat and biota. Moreover, these effects would occur over a much larger area than those caused by ORVs. ORV effects on biota and habitat under Alternative 3 would be only slightly greater than those under Alternative 2 and, in consequence, would be considerably less than those that occurred during the commercial fishery heyday. As a result, ORV impacts under this alternative would have a very limited effect when compared with the sum total of cumulative effects.

Conclusion: ORV effects on aquatic biota and habitat would be negligible because 25 percent of trails would be closed including 10 stream crossings. Several of the stream crossing closures under this alternative would have a measurable and net positive effect on biota and habitat. Only 5 water crossings plus the deepwater estuary crossing would remain open. Both the Main Trail East crossing on upper Dog Salmon Creek and the lake outlet crossing along the East Access Trail would be stabilized and improved to mitigate ORV passage effects on biota and habitat.

The level of impacts on aquatic biota and habitat would not result in any impairment of preserve resources fulfilling specific purposes identified in enabling legislation, or that are essential to the cultural integrity of the park and preserve.

4.5.4 Effects on Wildlife

Under Alternative 3 ORV use would continue on 58.7 miles of trails and routes throughout the Preserve. The amount and type of ORV use in Dry Bay would not change significantly supporting commercial fishing, concession permit activities, hunting, sport fishing, trapping, and other uses. The level of additional recreational use impacting wildlife would probably not increase significantly. The majority of use such as hunting and sport fishing would be incidental

to commercial fishing. Concession and commercial activity such as guiding and outfitting would require review and approval by NPS. Designated trails would be maintained and repaired where necessary. Maintenance including brushing, stream crossing stabilization, route marking, and trail surface leveling would occur on some trail segments and routes annually. About 29 percent of Dry Bay habitats currently altered by ORV trails and routes would eventually re-establish themselves.

The general effects of ORV passage on wildlife are discussed at the beginning of section 4.3.4. under Alternative 1. Please see this section for a review of these effects.

Closed trails in upland habitats would include the Towers Trail, Airport Cutoff, Smitty's Spur, Doame Trail, DSC and Varni East Trail. In upland habitats where trails would require periodic brushing, maintenance activity would temporarily damage trail side passerine bird and small mammal foraging or nesting habitat. Noise from chainsaws, motorized brushers, and the presence of work crews would disturb wildlife directly along some trail segments each year.

Passerine birds and small mammals nesting or foraging along closed trails would no longer encounter vehicles. Trails in uplands are well defined and surrounded by stable woodland habitats. The closed trails could persist as narrow clearings for decades. Wildlife would probably continue to use closed trails for many years as they provide movement corridors, foraging areas for moose and raptors, seeds and forbs for birds and small mammals, and a variety of invertebrates in ponded segments.

Visitors would have ORV access to the East Alsek River corridor by the Tractor Trail North, East Cabin, and East Cabin North trails. Large mammal such as bear and moose, passerine birds, waterfowl, small mammals, and furbearers would be exposed to hunting activity along these trails, particularly the Tractor North Trail and East Cabin North Trail. Waterfowl hunting and sport fishing would occur along the East Alsek River drainage and wildlife along the upper portions of the river would be disturbed by vehicles and canoe or rafting parties.

In the Dunes and Plains region closed trails and routes would include the Inside Trail, Dunes, Maze West, and sections of the Maze Central Routes. Designated routes would be marked annually which would make it easier for users to find their way when sand or water covers the track. Marking routes may reduce the number of new ORV tracks. Ground nesting birds particularly parasitic jaegers in the vicinity of designated routes would be less exposed to disturbance, inadvertent crushing of nests and loss of chicks. It would still be unlikely that moose calving in the dunes would be disturbed by an ORV as little vehicle activity occurs this early in spring.

Stream crossings on the Main Trail East (upper Dog Salmon Creek) and East Access Trail (lake outlet crossing) would be hardened which would reduce ongoing riparian habitat damage in those immediate areas. Initial stabilization activity would disturb wildlife temporarily and there may be periodic short term disturbance when the crossing needs repair.

Temporary access trails in the Temporary Camp Zone would take the least environmentally disturbing, shortest, and most direct route from an authorized/existing trail or route to a camp or

fishing site. Arctic tern, shorebirds, waterfowl, and glaucous-winged gull nesting in this zone may lose nests or chicks to crushing, predation, or abandonment.

Where trails cross unimproved riparian corridors and wetlands habitat damage would continue as vehicles detour around ponds and rutted segments. Habitat damage would expand in specific areas as degraded trail segments widen or become braided. The amount of quality wetland habitat available to moose, ducks, common snipe, warblers, thrushes, voles, shrews, meadow jumping mouse and boreal toad would decrease locally.

Under this alternative habitats east of the Doame Trail would no longer be accessible by ORVs reducing disturbance to moose, bear, waterfowl, small mammals and passerine birds. Riparian and wetland habitats in the Doame River area would slowly restore themselves once vehicle traffic is absent. ORV users accessing the state intertidal zone, Ranney airstrip and Doame River area would cross the East Alsek River estuary which may increase the local disturbance to shorebirds and waterfowl.

Cumulative Effects

Migratory songbirds, shorebirds, colonial waterbirds, waterfowl, moose, bear, wolf, and other game species, raptorial birds, small mammals, and amphibians present in the Preserve have been disturbed by land-based commercial fishing since World War II. Seismic petroleum exploration activity established several roadways consequently used by commercial fishers, hunters and for subsistence use. As the set net fishery expanded in the 1940s the number of cabins and trails spread from the Alsek River east towards the East Alsek River. Human disturbance peaked during the 1980s and 1990s resulting from large East Alsek River sockeye salmon runs. Camps, cabins, boat launches, net sites, and access trails appeared along the estuary toward the Doame River delta. Trails and roads were also used for hunting and subsistence activity exposing more and more wildlife to harvest pressure and disturbance. The East Alsek River salmon fishery has declined significantly since, and human activity has declined along with it. Habitat at some sites previously used by humans has recovered.

About 180 acres of wildlife habitat has been converted to trails, airstrips, cabins and campsites. Disturbance and displacement of wildlife sensitive to ORV activity would have been most significant as each new trail or cabin site was established. Some trails and routes disappear as river channels shift and isostatic rebound alters wetland and shoreline margins. Plant succession is rapid in Dunes and Plains and Estuary/Delta habitats erasing routes in a few years if use is low. As upland trails stabilized and use patterns became more predictable some wildlife including moose, bear and woodland passerine birds began taking advantage of trail corridors or becoming tolerant of human presence and vehicles. The added effects from Alternative 3 would be beneficially minor, localized, and occur over an indefinite period of time.

Conclusion: Under Alternative 3 effects on wildlife from ORV induced habitat loss and disturbance would be minor. The level of human use would occur in the same basic locations and at the same frequency except for habitats in the Doame River area would benefit from reduced ORV disturbance. Disturbance related effects would be temporary and localized.

The level of impact on wildlife would not result in any impairment of park resources fulfilling specific purposes identified in enabling legislation, or that are essential to the cultural integrity of the park and preserve.

4.5.5 Effects on Visitor Use

Under Alternative 3 about 62.9 miles of trails and routes would be designated for ORV use to provide access for commercial fishing purposes, use authorized under concession contracts, and other activities (hunting, sport fishing, trapping, etc.). About 20.6 miles of trails and routes would be closed. Trails and routes to be closed include Smitty's Spur, Towers, Varni East, Doame, Doame West Routes and Doame East, Plains Cutoff, DSC, and Inside Trails.

Visitors could encounter sounds, sights, and evidence of ORVs on all designated trails or routes in Dry Bay. There may be slight increases in the amount of traffic on designated trails and routes due to closures. Visitors wishing to travel on foot and avoid vehicles would have the option to use closed routes. Closed trails would eventually vanish as soils and vegetation reclaim the footprint. Depending on the location of closed trails foot traffic may keep narrow paths clear for a few years or decades. Trails in the Uplands and Alsek River Corridor may persist for 10 to 20 years while trails and routes in the Dunes and Plains and Estuary/Delta regions may disappear entirely within a few years.

The overall condition of designated trails would improve over time due to cyclic maintenance and repair by NPS. Trails in the Alsek Corridor and Upland regions such as the Alsek North Trail upstream of the Tractor Trail North, Tractor Trail North, Flowers, Rohloff, Alsek North, Bear Island, Dog Salmon Cutoff, East Access, East Cabin and East Cabin North Trails would remain accessible for ORVs as a result of regular brush clearing and leveling of rough or ponded segments. Stream crossings on the Main Trail East (upper Dog Salmon Creek) and East Access Trail (lake outlet crossing) would be hardened which would maintain reliable ORV access across these streams.

Because of regular maintenance, OHV users may detour around fewer ponded areas along the Main Trail East reducing the amount of braided, rutted, and widened segments. Fewer hazards for ORV riders may exist. Routes in dune and estuarine areas would continue to be affected primarily by water, wind, and shifting sand. Trail maintenance would have little effect in these areas. However, routes through the Dunes and Plains and Estuary/Delta regions would be marked annually making it easier for ORV users to keep to the designated routes when water and sand cover the tracks. The number and expanse of new tracks, ruts, ponded areas, and braiding would be reduced enhancing the quality of experience for visitors.

This alternative is not likely to affect Alsek River rafting groups as very few if any use ORV trails outside the immediate area of the take out point. Hikers and campers staging for trips to the outer coast and the Fairweather Range would have the same existing opportunities and access options.

Big game and waterfowl hunters and trappers would have ORV access to the East Alsek River corridor on the North Tractor, East Cabin North and East Access Trails. Visitors would be able to take ORVs or hike closer to Alsek Lake on the Alsek North Trail extension.

Because the Doame Trail complex would be closed to ORVs, visitors wishing to reach the Doame River delta to trap, hunt, fish, view wildlife, and hike toward the Deception Hills or Grand Plateau Glacier using an ORV would need to cross the East Alsek River estuary by vehicle at low tide or load vehicles on boats to reach state intertidal lands. ORV operators would need to time their trips based on current tides and may need to wait several hours to make a return crossing. Closing the northern most Dog Salmon Creek estuary route and DSC trail would reduce access between the Temporary Camp Zone and Dog Salmon airstrip when high tides make the lower DSC estuary routes impassable.

Hunting activity may increase slightly along designated routes resulting in a sense of crowding and competition as a result of trails closures in the Doame River area. Fewer hunters or trappers may choose to hike long distances on closed trails in search of game. Visitors hiking on closed trails would have an increased chance of getting closer to wildlife. Some visitors may not take advantage of trails closed to ORV use.

Until closed trail corridors fill with alder and willow brush they may provide improved hunting or trapping opportunities as wildlife may travel these corridors undisturbed by vehicles and they will provide easy foot access.

Some visitors may feel that the amount of public access necessary to continue authorized uses in the Preserve is being restricted. Closing the Varni East Trail would inconvenience lodge clients arriving at the Varni airstrip. Visitors on foot would have more opportunities to avoid ORV traffic and observe wildlife. Others may feel that the NPS recognizes how essential ORVs are to permittees in Dry Bay because maintenance and repair of important access trails and stream crossings would now occur.

Cumulative Effects

Human use, vehicle presence and associated trail development in the Preserve because of land-based commercial fishing activity has occurred since World War II. Seismic petroleum exploration activity established several roadways consequently used by commercial fishers, hunters and for subsistence use. As the set net fishery expanded in the 1940s the number of cabins and access trails spread from the Alsek River east towards the East Alsek River. Visitors could reach more of the Preserve using a vehicle. Human use peaked during the 1980s and 1990s resulting from large East Alsek River sockeye salmon runs. Camps, cabins, boat launches, net sites, and access trails appeared along the estuary toward the Doame River delta. The East Alsek River salmon fishery has declined significantly since, and human activity has declined along with it. Some trails and campsites previously abandoned have been reclaimed by sand, grassland, shrubs and trees resulting in localized loss of access.

Under Alternative 3 annual maintenance on degraded or overgrown trails would have a minor positive effect resulting in improved visitor experiences. Access east of the Doame would be

moderately reduced due to trail closures and occur over an indefinite period of time. Access for visitors traveling on foot would increase particularly for those wishing to avoid presence of vehicles.

Conclusion: Alternative 3 would have minor negative effect on visitor use due to the closure of 20.6 miles of trails and routes. ORV access across the western portion of the Preserve would benefit from regular trail maintenance. Access to the eastern portion of the Preserve would be reduced due to trail closures in the Doame River area. Hikers would have slightly increased opportunities to reach areas without ORV disturbance.

4.4.6 Effects on Commercial Fishing

Alternative 3 would designate 62.9 miles of trails and routes for ORV use and close 20.6 miles of existing trails. The resulting trail network would provide commercial fisherman access to fishing sites, the fish processing plant, campsites, cabins, boat haulouts, and airstrips which are directly incident to the exercise of valid commercial fishing rights and privileges.

The closure of duplicate trails in the maze area would not affect access between the main airstrip and the East Alsek commercial fishing area. The Maze Central and Maze West routes would to open under this alternative and continue to be the main transportation routes between these two important commercial fishing destinations. Access between the Temporary Camp Zone in the East Alsek river estuary and boat haulouts in the Alsek River mouth area would continue under this alternative. The NPS would mark a single route early each year to facilitate travel between these destinations.

Closure of the northern most DSC estuary route and DSC Trail could limit access between the Temporary Camp Zone and the Dog Salmon airstrip when high tides make the lower DSC estuary routes impassable. This would be an inconvenience to commercial fishermen causing an increase in travel distance and a loss in time to reach the same destination.

The closure of the Doame Trail complex would not affect access to the Ranney fish camp and air strip. This area can be accessed by aircraft or by transporting an ORV across the East Alsek River estuary and traveling across state tidelands to reach the camp.

Others trails (Towers, Varni East and East Access) closed under this alternative would not affect commercial fishing activities.

Trail maintenance activities would improve the quality of trails and routes designated for ORV use in Alternative 3. Trail maintenance would marginally improve the transportation network used by commercial fishermen. Marking and brushing trails/routes as well as trail bed improvements could shorten travel times and limit mechanical impacts to ORVs

The closure of 10 stream crossing would reduce effects on aquatic biota and habitat. The impacts resulting from ORV passage at 5 stream crossing open under Alternative 3 would be negligible (See Section 4.5.3 Effects on Aquatic Biota and Habitat). These impacts would not

likely affect sockeye salmon populations or affect commercial fishing harvest in the East Alsek or Alsek River commercial fishing area.

Cumulative Effects

Regardless of any action in this alternative, commercial fishing effort is primarily affected by natural variations in salmon populations and market forces. A large majority of the trails and infrastructure in the Dry Bay area were primarily established to support commercial fishing purposes and are a benefit to this activity. Other uses, such as river floating, sport fishing, wildlife viewing, hunting, trapping, and subsistence uses would have a minimal effect on commercial fishing, as those uses often do not occur in the same areas and at the same times. In addition, most of the subsistence users in Dry Bay are also commercial fishing permittees. The designation of 62.5 miles of trails and routes open to ORV use under Alternative 3 would provide access to all fishing areas and commercial fishing infrastructure and benefit the activity.

Conclusion: Alternative 3 would have a negligible long-term impact on commercial fishing in the Dry Bay area. The trail network under Alternative 3 would provide access to commercial fishing areas and infrastructure. Trail/route maintenance would improve the transportation network used by commercial fisherman.

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