3

Affected Environment

INTRODUCTION

This chapter describes the environment that could be affected by actions proposed in the alternatives for the Brooks Camp area. This chapter includes the specific topics identified in chapter 1 that are analyzed to determine the environmental impacts of implementing the alternatives. The focus is on those key natural and cultural resources, visitor uses and experiences, and the socioeconomic environment that could be affected by implementing the alternatives. The conditions described herein provide a baseline for the analyses in chapter 4.

NATURAL RESOURCES

GENERAL DESCRIPTION

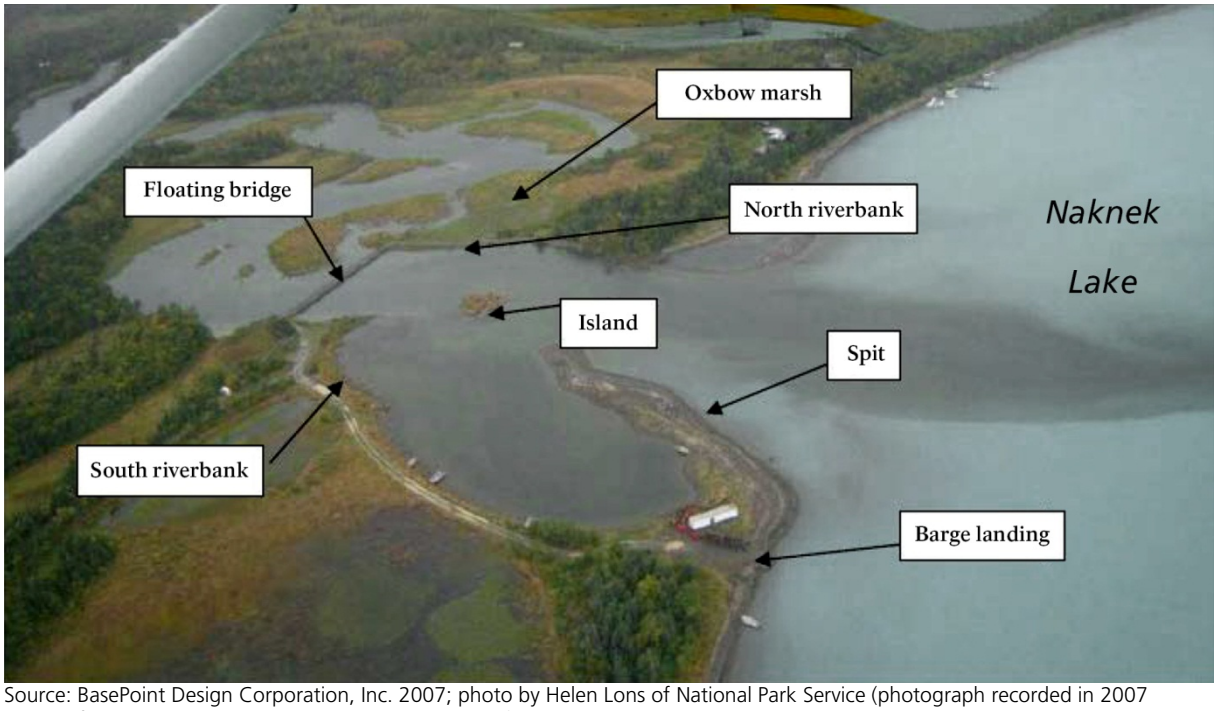
Brooks Camp is in the interior lakes region of Katmai National Park and Preserve, about 35 miles southeast of King Salmon, Alaska. Most of the camp infrastructure is at the mouth of Brooks River where it empties into Naknek Lake.

The project area includes Brooks Camp, its vicinity on both the north and south sides of Brooks River, and the adjacent shores of Naknek Lake where NPS barge landings occur (see figure 8). Although the alternative bridge locations are focused near the mouth of Brooks River, this project area is ecologically connected to the upstream stretches of the river, which extend more than a mile to the west (as the river flows out of Lake Brooks and meanders downstream). The seasonal salmon runs through Naknek Lake to Lake Brooks, and the associated brown bear feeding patterns along Brooks River, contribute to a complex natural system in this area.

The landscape in the vicinity of the project area consists of gradual rolling terrain that flattens out in the lower areas of the drainage basin (along the floodplain of Brooks River and near the shores of Naknek Lake). The elevation in the project area generally ranges from about 40 ft to 90 ft above mean sea level. Wet meadows, willow thickets, and floodplain marshes are common features of the lowland portions of the project area. These wetland areas are primarily found in the low-lying oxbow floodplains of Brooks River. The upland portions on the south side of the river are generally covered with a white spruce forest, with interspersed balsam poplar and Kenai birch near perimeters of open wet meadow areas. On the north side of the river, the upland areas include more open grassy areas, with pockets of mixed forest that include Kenai birch, balsam poplar, and white spruce (NPS 1996; URS Group, Inc. 2009a).

The wildlife habitat provided by this mosaic of uplands and lowlands around the mouth of Brooks River serve many small and large mammal species, as well as a wide variety of birds. Mammals that inhabit the project area include brown bear, moose, wolf, wolverine, mink, short-tailed weasel, river otter, beaver, porcupine, snowshoe hare, lynx, arctic ground squirrel, red squirrel, red-backed vole, northern jumping mouse, little brown bat, and several species of shrews (NPS 1996). Given their high seasonal concentration and activity, and their appeal to park visitors, brown bears are the most prominent wildlife species in the Brooks Camp area.

The brown bear activity in the vicinity of the project area primarily coincides with sockeye salmon runs in Brooks River during the summer and early fall. The bears tend to concentrate along the Brooks River corridor through the month of July when the sockeye salmon make their migration from Naknek Lake up to Lake Brooks. Although the numbers vary from year to year, typically 40–60 brown bears arrive in the area to feed on the migrating salmon (NPS 1996; URS Group, Inc. 2009a).

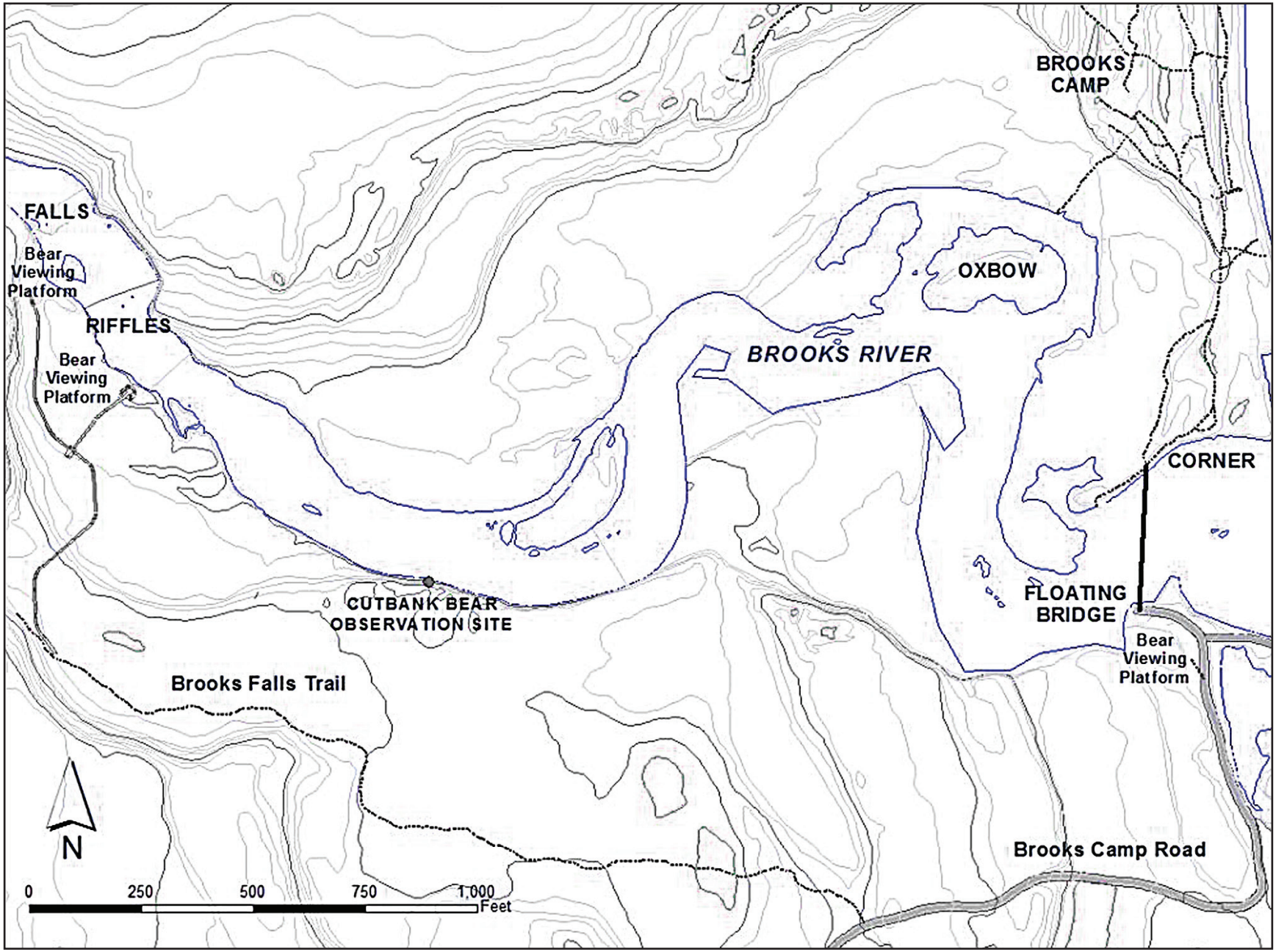


Source: BasePoint Design Corporation, Inc. 2007; photo by Helen Lons of National Park Service (photograph recorded in 2007 prior to floating bridge relocation to its current location)

FIGURE 8. AERIAL IMAGE OF PROJECT AREA

In addition to the sockeye salmon, several other fish species occupy the waters of Brooks River and adjacent Lake Brooks and Naknek Lake. These fish include coho salmon, Chinook salmon, pink salmon, chum salmon, grayling, arctic char, Dolly Varden, lake trout, rainbow trout, arctic lamprey, humpback whitefish, least cisco, pygmy whitefish, round whitefish, pond smelt, northern pike, longnose sucker, burbot, threespine and ninespine sticklebacks, and coast range and slimy sculpins. Of these fish, the rainbow trout plays an important role in the Brooks River ecology by feeding on the high concentrations of salmon eggs and juvenile salmon in the river. Rainbow trout numbers in Brooks River are the highest in late September when the trout enter the river from Lake Brooks and Naknek Lake to feed on the recently laid sockeye salmon eggs (NPS 1996).

Bird species that commonly inhabit the project area include bald eagles, common ravens, black-billed magpies, tree swallows, ospreys, mallards, and common mergansers. Sea birds such as Bonaparte's gulls, arctic terns, glaucous-winged gulls, and mew gulls visit the area during salmon runs and die-offs and when salmon fry and smolt numbers are high (NPS 1996). The boreal forests in the project area host several songbird species such as the dark-eyed junco, gray jay, American robin, varied and hermit thrushes, and black-capped and boreal chickadees. Tundra swans and diving birds, such as the greater scaup, and the common golden-eye are also known to use the beaver ponds in the area for feeding (NPS 1996). A bald eagle nest also exists south of the project area on the fringe of the small lake known as Beaver Pond.



Map 8. Middle Portion of the Brooks River

Katmai National Park and Preserve

United States Department of the Interior • National Park Service

WILDLIFE

Brown Bear

General Species Summary. The brown bear (*Ursus arctos*) is a common and vital member of the overall Alaska ecosystem. The brown bear is the same species as the grizzly bear, but it is different in that it resides in or near coastal areas and has a more abundant food supply, particularly salmon. Grizzly bears are listed as threatened under the Endangered Species Act for the Lower 48. However, given their higher population numbers in Alaska, the brown/grizzly bear is classified as a game animal in the state and there are established regional regulations. Today, population estimates indicate that more than 30,000 brown/grizzly bears live in Alaska (USFWS 2007b). Meanwhile, more than 25,000 brown/grizzly bears live in Canada. Of this large Alaskan population, a 2007 aerial survey estimated that nearly 2,200 brown bears live in Katmai National Park and Preserve, making the area the largest single concentration of protected brown bears on the continent (Olson and Putera 2007; DeBruyn 1999). The brown bears at the park are dependent on salmon, including those in Brooks River. In 2008, monitoring efforts identified at least 70 individual bears fishing for sockeye in June and July, and at least 52 bears feeding on spawned-out sockeye salmon in late summer and fall (Olson 2009).

The brown bear has a large overall range of 50 to 300 square miles for females and 200 to 500 square miles for males. The average lifespan of a brown bear is 15 to 20 years, with some living more than 30 years (USFWS 2007b). Some of the brown bears that frequent Brooks River return year after year. Brown bears usually spend spring and summer at the lower elevations of their range and return to higher elevations in autumn to search for dens on isolated mountain slopes for winter hibernation. The bears typically enter the dens in October or November. When brown bears emerge from their dens in spring (males in March or April, females in April and May), they often immediately seek carrion of other animals that succumbed to the winter. The bears then travel to the lower elevations of their range to areas that are wet, with greening herbaceous cover, such as the Brooks River basin (USFWS 2007b).

Brown bears are primarily solitary animals. Most of their time is spent foraging, independently of other bears. With the exception of interacting with other bears in concentrated feedings areas like Brooks Falls, the only times brown bears associate closely with other bears are during mating season and when females are tending to their young. The brown bear mating season is typically from June through July, which coincides with the time when the bears congregate along Brooks River for the July salmon run. Brown bear cubs rely primarily on their mother's milk for up to a year, and stay with their mother for nearly three years. Thus, the cubs that accompany female bears to Brooks River may be anywhere from six months to three years old (USFWS 2007b).

The diet of the brown bear consists of both plants and animals, making it the largest omnivore in North America. More than 80 percent of the brown bear diet is plant-based (e.g., roots, fruits, nuts, and green vegetation). Adult insects or insect larvae are another common source of food for brown bears (USFWS 2007b). However, in the case of Katmai National Park and Preserve, the brown bear's animal-based meat diet is quite pronounced. In addition to feeding on carrion, small mammals, or occasionally preying on young or weak moose, the brown bears at the park rely heavily on salmon as a key component of their diet. The sockeye salmon that migrate through Brooks River are a prime example of this dependence.

Brown Bear Activity in Summer and Fall along Brooks River. The sockeye salmon migrating up and spawning in Brooks River

attract brown bears to the project area twice each year. Brown bears first occupy the Brooks River corridor after leaving their dens in spring when they sporadically pass through the area (prior to the salmon run). Greater numbers of bears begin to congregate and stay in the corridor from late June through July, when sockeye salmon migrate upstream through the Brooks River. These energetic salmon are targeted by brown bear predation primarily at Brooks Falls or in downstream pools. During August, the bear activity along Brooks River decreases as the bears move out to other rivers and streams in the area to feed on subsequent salmon runs or upslope to browse on berry patches. By the last week of August or the first week of September, brown bear activity returns to Brooks River because bears come to feed on spawned-out or dead sockeye salmon in the river. At this time, some bears also fish for coho salmon on Brooks Falls as the coho salmon migrate upstream as part of a smaller coho salmon run in September. The autumn bear activity along Brooks River typically continues through mid-October. Salmon occupy Brooks River for a longer period than any other river drainage in Katmai National Park and Preserve, with the exception of the Savonoski River (DeBruyn 1999; Troyer 1980; Smith 2002).

During the past few decades, the number of brown bears feeding on salmon in Brooks River has risen considerably. In the 1970s, a Brooks River study estimated that only 6 to 8 individual brown bears fished on Brooks River in July, while 8 to 24 bears foraged for dead or dying salmon in autumn (Troyer 1980). In the mid-1980s, a subsequent survey estimated 20 to 21 bears in July and 18 to 24 in autumn (Jope 1985). In the late 1980s and early 1990s, surveys indicated 19 to 32 bears in July and 32 to 44 bears in autumn (Olson et. al. 1997). In 2008, NPS staff identified at least 70 individual brown bears in July and 50 bears in autumn—several times more than the Brooks River bear counts in past decades (Olson 2009).

Because notable variations in bear activity can occur from year to year, it is best to look at average numbers over multiple years. The shifts in bear activity numbers and timing (i.e., July compared to September) during the past 20 years can been seen by looking at four-year averages from 1988 to 1991 and from 2005 to 2008. Two decades ago, from 1988 through 1991, an average of 22 bears were regularly active along Brooks River in July each summer, and 26 bears were active in the autumn. Whereas, in the four years from 2005 through 2008, an average of 68 bears were regularly active in July each year, and 54 bears were active in the autumn (Olson 2009). These averages reveal a tripling and doubling of brown bear numbers over the past 20 years in July and autumn, respectively.

Not only are the recent total bear numbers more than those of the past, but also the July sockeye salmon run is now attracting more bears than the September salmon spawning and die-off. In past decades, the autumn feeding period attracted more bears than the summer feeding period.

The increase in brown bear activity along Brooks River may be explained by a wide variety of factors. First, the overall population of brown bears on the Alaska Peninsula has increased over the past few decades (DeBruyn 1999; Sellers and McNay 1984). Secondly, NPS land acquisitions and boundary adjustments to Katmai National Park and Preserve over the years have provided additional protection to the habitat (and bears) around Brooks River. Next, the size of the July sockeye salmon run has also been healthy and strong during the past 20 years (Olson 2009). Another important factor may be the fact that more bears have become habituated to human activity over the years. More specifically, many cubs have experienced benign contacts with humans along Brooks River while being accompanied by adult bears over the years, which may habituate them as they grow older (Olson 2009). Simultaneously, more

NPS staff and active NPS management provides more bear protection than in decades past (DeBruyn 1999). Lastly, since bear hunting in the area ended in the mid-20th century due to an increased NPS presence, the Katmai National Park and Preserve bear population has increased slowly but steadily. Compared to other mammals, brown bears have a relatively slow population growth rate. Therefore, the noted increases in the park's bear population may be the continuing result and progression that followed the cessation of bear hunting that occurred several years ago (Troy Hamon, pers. comm., August 2010).

Many of the bears seen along Brooks River in summer and fall are repeat visitors from past years. In 2008, for example, 59 of the 70 individual bears observed in July were recognized from previous years, and 35 of the 52 individual bears observed in autumn of that same year were recognized from previous years (Olson 2009). Given the challenge of identifying bears as they grow and change in appearance each year (e.g., changes in fur), these observations should be considered minimum numbers. Similarly, in any given year, a number of bears visiting Brooks River in September are the same bears that fished in the river a couple months earlier in July of the same year.

Interestingly, although the numbers of bears coming to Brooks River in both July and September have increased over past decades, the bears continue to focus their activity on the same specific fishing sites and foraging locations along the river from year to year. Despite the year-to-year spatial consistency, the differences in activity locations and bear behavior between the July aggregation and the autumn aggregation require NPS staff to administer different levels, types, and locations of management actions to avoid human-bear conflicts (Olson et. al. 2009; Olson 2009).

This management continues to become more and more challenging because, along with this increase in bears at Brooks River, the number of visitors coming to the area has also increased substantially. NPS staff is managing more bears and more people in the same small space. Over recent years, the frequency of ground level human-bear interaction incidents has increased when compared to incident records from past decades (Troy Hamon, pers. comm., August 2010).

Ground surveys conducted during August 2009 indicate that heavy concentrations of bear trails and bedding sites exist in the vicinity of the proposed elevated bridge and walkways on both sides of Brooks River (Olson 2009).

Summer Bear Activity: Behavior and Patterns from Late June through July. As previously described, brown bears start arriving in the Brooks River corridor in late June or early July to feed on migrating sockeye salmon. At least 70 individual bears fished for salmon in this area in the summer of 2008 (Olson 2009). The bears usually remain in the area through July. One of the reasons for this high concentration of bears in July is because Brooks River has a waterfall that creates a migration challenge for salmon. Sockeye salmon seeking to pass over the falls gather below it and are more concentrated and available for capture than salmon in other rivers that lack such migration challenges (Troy Hamon, pers. comm., August 2010). In other words, this is one of the first good opportunities for brown bears to pursue a consistent, high volume of food and calories after emerging from dens in springtime (Olson et. al. 2009).

By late June, bears are still in their weight loss stage after emerging from dens and are in a courting period. In addition, the adult females with spring cubs are very protective of their cubs at this time early in the season. Given this combination of factors, the July aggregation is characterized by more bear movement and

more energetic bear activity than the autumn aggregation. To compound matters, the sockeye salmon are much more active in July because they still have extensive energy reserves (e.g., faster swimming, jumping, splashing) from feeding in the ocean. This strong fish activity also tends to trigger more bear activity (e.g., bears diving for fish) because the sockeye salmon are more difficult to catch during this stage of the migration (Olson et. al. 2009).

During the summer aggregation, the most productive fishing area for bears on Brooks River is the area immediately below and on top of Brooks Falls (roughly halfway up Brooks River between Naknek Lake and Lake Brooks). In most cases, the best fishing sites at this waterfall go to the most dominant bears, which tend to be larger and older male bears (DeBruyn 1999). Other more submissive or subordinate bears typically fish for salmon in the shallow riffle area below Brooks Falls or forage for injured salmon that were unsuccessful in making the leap over Brooks Falls (DeBruyn 1999). As a consequence of the location and activity at Brooks Falls, in July the most active and concentrated bear fishing occurs in reaches of the river that are upstream of and somewhat removed from Brooks Camp and the project area.

Autumn Bear Activity: Behavior and Patterns from Late August through Mid-October. After the lull in August, brown bear activity typically returns to Brooks River by the last week of August, as bears seek salmon carcasses or dying, spawned-out salmon in the river. As previously noted, some of the bears return to Brooks Falls to fish for coho salmon that are migrating upstream as part of a smaller September coho salmon run (DeBruyn 1999). At least 52 individual brown bears foraged for salmon along Brooks River during the 2008 autumn activity period (Olson 2009). The autumn aggregation along Brooks River usually lasts through mid-October.

Unlike July, for the most part, this autumn aggregation focuses on areas where sockeye salmon carcasses pile up and on areas where bears can easily swim and dive for carcasses along the river bottom (Olson et. al. 2009). In this case, the primary bear activity areas are a result of river current patterns and river morphology. Important locations for autumn foraging are in the middle portion of Brooks River down through the oxbow, as well as along the Naknek Lake shoreline north of the river mouth (DeBruyn 1999).

The availability of multiple locations where dying salmon and salmon carcasses amass most likely explains why only a few bears aggregate at Brooks Falls in the autumn (Olson 2009; Olson and Gilbert 1994; Olson et. al. 1997). Thus, in the autumn the downstream flow of carcasses bring the bears much closer to the human activity zones of Brooks Camp when compared to the July run (Olson et. al. 2009; Braaten and Gilbert 1987).

The area upstream of the existing floating bridge (from the river's mouth upstream approximately 0.75 miles, including the area known as the oxbow) has been documented as an important autumn feeding area for family groups that are more intolerant of the human activity common at the lower/mouth area of the river near Brooks Camp (Olson et. al. 2009; Olson 1993; Olson and Gilbert 1994; Olson et al. 1997). A 1980s study noted that brown bears arriving at Brooks River in autumn appeared shyer than the bears that fished there in July. The study concluded that the autumn bears generally had a low tolerance for human activity, particularly the female bears with cubs (Braaten and Gilbert 1987).

Other areas and natural features near the mouth of Brooks River (and downstream of the floating bridge) are also important for bears during the autumn feeding period. For example, the island, the spit, and adjacent riverbanks near the mouth of the river often provide areas for bears to

rest between feeding activities in the river (see figure 8). These features also serve as safe havens for cubs or other bears when trying to avoid or escape larger, male bears that are feeding in the area.

Human Habituation of Brown Bears. In the area of Brooks River, the goal of NPS managers is to protect the brown bears and their habitat (which includes their access to seasonal salmon runs) while also providing opportunities for park visitors to observe the salmon run and bear feeding cycle. Given this goal and the annual concentration of both people and bears along Brooks River, it is inevitable that some bears will grow somewhat accustomed and adapted to certain levels and locations of human activity. *Human habituation* is the term used to describe this adaptation of certain brown bears to humans. *Habituation* is defined as "a waning of response to a repeated neutral stimulus" (DeBruyn 1999; Whittaker and Knight 1998). In this case, it applies to brown bears that experience repeated benign interactions with humans (over months or years) to a point where the bears' responses to nearby human activity are muted or minimized (Herrero et. al. 2005).

Many consider it desirable to allow bears to become habituated to humans at Brooks River, as habituation may reduce the risk associated with close human-bear encounters because habituated bears are more tolerant of humans in close proximity. Not only does this provide safer opportunities for park visitors to observe bears at close range, but it also allows bears to access a critical food source (i.e., salmon) that exists near human activity centers.

However, human habituation in bears also has possible risks, for both bears and humans. For example, habituated brown bears may have a greater tendency to approach people, which may occasionally lead to dangerous interactions. Similarly, habituated bears may be less cautious when approaching roadways, which could lead to traffic delays or collisions. In addition, habituated bears are at much greater risk if they wander beyond protected lands, because they are more prone to be killed or victims of ignorant or illegal human behavior (Herrero et. al. 2005). In other words, while habituation may improve safety for humans and bear access to salmon at Brooks River, it may leave bears and humans vulnerable in other situations and locations.

Another risk of habituation relates to the reaction distance of bears. When humans and bears are regularly near each other, the reaction distance in the event of a serious confrontation is so close that the response options and time are very limited (Troy Hamon, pers. comm., August 2010). This can increase the potential for a dangerous situation for both bear and human.

Even though some bears may become habituated to humans at Brooks River, it is very important to note that some bears do not become habituated. The bears that become habituated may have a competitive edge over nonhabituated bears because the habituated bears will likely have better access to prime salmon fishing/feeding areas (which are also in vicinity of humans). Bears that never become habituated to humans may be forced to seek salmon at less productive locations and/or during less productive times. Some of these bears may choose to avoid the Brooks River salmon run entirely.

One example of this variation in behavioral response of individual bears has been documented near the existing elevated boardwalk that accesses the Brooks Falls viewing platforms. While a large number of bears have not been notably affected by the elevated boardwalks, observations indicate that some individual bears adjust their behavior because of the presence of overhead human activity (DeBruyn et. al. 2004). For example, the location where some bears cross under the boardwalk may depend on where humans are present on

the boardwalk. Other bears may avoid crossing under the boardwalk entirely due to being intimidated by overhead activity. Thus, the value of the Brooks Falls area for fishing and resting to some bears may be adversely affected by the presence of overhead human activity on the boardwalks.

There are also examples of both habituated and nonhabituated bears being involved in a disproportionate number of negative human-bear interactions (DeBruyn 1999; Herrero 1985; Squibb and Holmes 1992). Regardless of how habituated a bear is, this variation is most likely because of the fact that each bear possesses a different level of individual tolerance and may behave in its own unique way (DeBruyn 1999). Furthermore, because of dominance hierarchies that form at feeding aggregation areas, bears that are subordinate or submissive to other more dominant bears may be more cautious of other dominant bears than they are humans. Thus, it may be difficult to determine why a particular bear is behaving in a "skittish" manner (i.e., whether the skittish behavior is a result of the bear's intolerance of humans or its hesitation with more dominant bears in the area) (DeBruyn 1999).

Human-Bear Interactions at Brooks River. For apparent reasons, most human-bear encounters in areas along Brooks River typically occur in areas where, and at times when, concentrated bear activity overlaps with concentrated human activity. To help minimize these interactions, park visitors are asked to keep distances between themselves and bears (a minimum of 50 yards from individual bears and more distance if the bear appears to want more space). Bear-watchers are also asked to minimize time spent on the boardwalks on the south side of the river and use them only as access routes to/from viewing platforms (i.e., not use them as viewing platforms) (Olson 2009). Regardless of these regulations, human-bear interactions and confrontations still occur.

One area that requires some of the most vigilance from park staff and visitors is the area in and around Brooks Camp at the mouth of Brooks River. The location of Brooks Camp, with the Brooks River oxbow to the west, the Brooks River mouth to the south, and Naknek Lake to east, and the concentration of bears around Brooks Camp during the salmon runs in the summer and fall substantially increase the potential for human-bear interactions. NPS records of human-bear interactions from 1989 through 2009 show the highest number of interactions at Brooks Camp occurring in July followed by September

A bear behavior researcher described Brooks Camp, in the autumn, as being, "surrounded on three sides by bears feeding on salmon" (Braaten and Gilbert 1987). Bears move back and forth to/from salmon carcass areas along the Naknek Lake shoreline and other areas along the river mouth and oxbow (as well as to/from bedding sites in this area). This bear activity is in the same area as Brooks Camp human movement areas. For example, the campground trail that connects the campground to the main Brooks Camp area is quite problematic because both people and bears are trying to use the same north to south corridor along the shore of Naknek Lake in the fall (Olson et. al. 2009).

The trail that connects Brooks Camp to the existing floating bridge running along the north shore of Brooks River is another common site of human-bear encounters in the summer and fall. Human-bear encounters often occur in this area when bears are feeding on salmon or resting along the river shoreline while people are trying to access the bridge from the camp (or the camp from the bridge). Given this conflict, in August 2008 NPS staff moved the camp-side bridge access point about 65 meters (approx. 215 ft) downstream from its previous location to minimize the riverside travel distance from Brooks Camp to the bridge (Olson 2009).

When bears cause substantial delays along pedestrian travel routes, NPS staff resorts to the use of hazing techniques (e.g., yelling, air horns, bird scare devices, rubber bullets). Since 1998, the park's bear management plan has included the option of hazing resting bears if human traffic movements are delayed more than 30 minutes (Olson et. al. 2009). This hazing policy is particularly important for the area near Brooks Camp in the fall, when the primary trail from camp to the floating bridge is often impassable because of bears resting in the area near the river mouth (Olson et. al. 2009). In recent years, the number of times hazing is used near the camp and along the shores of Naknek Lake has increased (to allow human passage).

However, sometimes NPS staff is not available to monitor these human-bear encounters. For example, a large amount of bear feeding activity takes place in the evening (generally from 6:00 p.m. to 10:00 p.m.). However, in past years, little or no NPS staff was present along the river during evening hours in September when the bears were active, and the actions of both park visitors and bears were generally unsupervised (Olson et. al. 2009; Olson et. al. 1998; Bentley et al. 2007). In 2009 and 2010, NPS staff hours in September were lengthened to 7:00 p.m. to provide more staff presence during this high activity period.

Another challenge with human-bear interaction results from a large number of anglers accessing Brooks River during heavy bear use in the area. Brooks River is a popular sportfishing area because of the salmon runs and presence of large rainbow trout feeding on salmon eggs or juveniles. Fishing is allowed anywhere on the river, with the exception of within 100 yards of the Brooks Falls fish ladder. Like all other visitors, anglers too must maintain the 50-yard separation from bears.

Because anglers and bears are pursuing the same fish, encounters do occur. For example, during the July salmon run, the bears are particularly tuned in to splashing of fish in the river. Concurrently, there tends to be more anglers in the river in July, with focus on catching the energetic, migrating rainbow trout. Thus, bears occasionally chase fish that are hooked on angler lines. Bears associating anglers with fish is a notable concern for the park (Olson et. al. 2009). In the late 1990s, the National Park Service restricted any fish retention by anglers in the river upstream of the floating bridge in an attempt to minimize the bears "stealing" fish from anglers and associating anglers with the food source. This policy change appears to have been somewhat successful, though fish stealing still occurs from time to time (Olson et. al. 2009). Anglers are allowed to keep one fish downstream of the bridge, but they must immediately place any kept fish in a plastic bag and store it whole in the fish freezing building in Brooks Camp (Olson 2009). Anglers are also required to cut the line if a bear begins pursuing the hooked fish.

Despite these regulations, human-bear interactions are still triggered when anglers do not abide by the 50-yard separation rule and/or continue reeling in fish near bears. Park staff has documented problems with some anglers affecting bear access to the river by hazing bears or not allowing bears to fish in the stretch of river the anglers are using (Olson et. al. 2009).

Other documented incidents of bears being negatively affected are from noise from motorboats and floatplanes near the mouth of Brooks River. However, some bears have become habituated to boat and plane noise and are not notably affected (Olson et. al. 2009). The impact of floatplanes and boats near the mouth of Brooks River is greatest during the autumn when the bear aggregation follows the salmon carcasses to areas near the river mouth and Naknek Lake shoreline. All floatplane activities along the lakeshore near Brooks Camp can be disturbing to some bears (i.e., floatplane landing, taking off, loading, and unloading). In some cases, staff members

have observed human activity near the plane landing/loading area pushing bears away from the shoreline and into Brooks Camp (Olson et. al. 2009). Human activity in one area is capable of spurring human-bear encounters in another area. To help minimize such impacts, all floatplane pilots are prohibited from inadvertently disturbing bears within 50 yards. However, this policy is sometimes ignored and bear behavior is affected.

The attraction of food brought by humans to the area can also generate human-bear interactions. However, only a few instances in recent years of bears accessing human food or garbage have been documented. This low number may be a result of both preventive measures taken by the park staff and park visitors, as well as the ample availability of another, better food source for the bears (salmon) (Olson et. al. 2009).

Lastly, mainly during the autumn aggregation, some instances of bears damaging items such as boats, viewing platforms, the floating bridge, floatplanes, and bicycles have been noted. Hazing these bears with noise has proven to be important and effective in providing negative reinforcement for such behavior (Olson et. al. 2009). However, periodic damage continues to occur.

Bald Eagle

General Species Summary. The bald eagle (*Haliaeetus leucocephalus*) is both an important predator and an important scavenger in the ecosystem of southern Alaska. The bald eagle is protected by the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act.

Alaska contains an estimated 30,000 bald eagles (including fledglings). Although most bald eagles winter in southern Alaska, some are known to migrate southward along the coast during cold months (ADF&G 2008b; NPS 2010c).

Given its dependence on water bodies throughout its life cycle, bald eagles are most common in Alaska's southern coastal regions, as well as on offshore islands and around inland freshwater rivers and lakes (ADF&G 2008b). The vast complex of freshwater lakes and rivers of the Naknek drainage in Katmai National Park and Preserve provide ample habitat for bald eagles. Katmai National Park and Preserve has a large breeding population of bald eagles. Wooded areas or individual trees immediately along the edge of water bodies typically provide the necessary perching, roosting, and nesting areas for the eagles (USFWS 2007a). The bald eagle's association with water bodies is related to its primary food source—fish. Coastal bald eagles prey on herring, pollock, flounder, salmon, and other small shoreline sea life, and the inland bald eagles rely most heavily on salmon and other freshwater fish. They can also be opportunistic predators of waterfowl and small mammals. Equally important, bald eagles often rely on carrion for food when not preying on fish or wildlife. This dependence on carrion is particularly common in areas such as Brooks River, where bald eagles feed on dead, spawned-out salmon or salmon remnants left behind by brown bears (ADF&G 2008b).

Unlike many other avian species, bald eagles are known to mate for life. The mating pair typically nests in tall trees that are near water, with open views and little cover above the nest. Both the male and female participate in nest building, which typically begins in April in Alaska (ADF&G 2008b). The completed nest can be as large as 10 ft in diameter (USFWS 2007a). Generally, bald eagles use nests year after year, enlarging them or rebuilding them. However, the breeding pair may have alternate nests available in the same breeding area each year (USFWS 2007a).

Once the nest is ready, breeding bald eagles typically produce one to three eggs each year (USFWS 2007a). The eggs usually incubate for about 35 days before hatching.

In many cases, the stronger eaglets take most or all of the food and/or kill the weakest or youngest eaglet in the nest (USFWS 2007a). Human disturbances, disease, lack of food, and severe weather can also lead to eaglet mortality (ADF&G 2008b). The surviving eaglets usually fledge from the nest after 75 days. Even after breeding season, the adults and fledglings may continue to roost near the nest site (USFWS 2007a).

The primary threats to the bald eagle populations in southwestern Alaska continue to involve human-related actions such as ecotourism, sport and commercial fishing, timber harvest and mining activities adjacent to parks, and potential oil spills or other coastal accidents (NPS 2010c). Given the very limited human activities within Katmai National Park and Preserve (relative to the size of the area), the effects on bald eagle population in the park are also relatively limited.

Bald Eagle Activity along Brooks River, Naknek Lake, and on Beaver Pond. Given the robust fishery in Brooks River, various slow water stretches of Brooks River (including the mouth near Naknek Lake) provide quality foraging habitat for the bald eagle. Trees along this corridor also provide roosting opportunities near feeding areas. In addition to the Brooks River fishery, bald eagles are also known to forage for fish and other food sources in other water bodies near the project area. Beaver Pond, to the south of Brooks River, is one prime example. The tall trees that ring Beaver Pond also provide quality roosting habitat for eagles very near the food sources of the small lake.

An active nest site exists near the project area along the north shore of Beaver Pond, immediately west and south of the proposed barge landing and proposed access road, respectively (under action alternatives 2, 4, and 5). According to NPS staff, this bald eagle nest was active in 2000, and again in 2009 and 2010 (Troy Hamon, pers. comm., August 2010). Because Beaver Pond and the nest site are relatively offset from the developed areas of Brooks Camp to the north, ground level human activity near the existing nest is generally uncommon. However, it should be noted that floatplane flight paths between Brooks Camp and King Salmon are often routed directly over Beaver Pond and the adjacent nest site (while the nest is both active and inactive). These flights generate noise and aircraft presence at relatively low altitudes near the nest site. Any correlation between the floatplane disturbances and nesting activity and success is unknown.

Bald Eagle Nest Site Near North Shore of Beaver Pond

SALMON AND OTHER FISH

The fish that inhabit Brooks River, Lake Brooks, Naknek Lake, and their tributaries are vital resources in the park's ecology. One example of this importance is the sockeye salmon run in Brooks River. Given the size and concentration of the annual sockeye salmon run and its direct relation to the brown bear feeding activities in the park, sockeye salmon directly contribute to the significance, purpose, and value of the park. As a result, sockeye salmon runs are included in the park's significance statements. The significance statement reads as follows:

> Katmai National Park and Preserve protects the Naknek Lake drainage, an

important spawning and rearing ground for Bristol Bay sockeye salmon, sustaining one of the largest salmon runs in the world.

The salmon run and brown bears feeding are just two of the reasons why the Brooks River area is internationally recognized for its unique and outstanding wildlife and fish resources. The State of Alaska also formally recognizes Brooks River, Naknek Lake, and Lake Brooks as waters important for anadromous fish. In addition to anadromous fish, several other fish species occupy these waters and are integral components of the natural system.

The Ecology of Salmon

In addition to being important to the individual fish species, these waters are also critical because they support and host the many interconnected biological processes that tie the local and regional ecology together. The biological processes that occur in Brooks River, such as fish migrations and spawning, have ecological value that extends well beyond feeding bears on Brooks Falls.

One of the most important roles of fish, particularly anadromous salmon, is being the catalyst for nutrient cycling in the natural system. For example, anadromous salmon spend multiple years in ocean waters feeding and growing before returning to their natal waters to spawn. While growing in ocean waters, the salmon accumulate large amounts of nitrogen in their tissues, as most of the world's stored nitrogen exists on the ocean floor (Kozlowski 2007).

The seasonal concentration of salmon in places like Brooks River also directly affects the seasonal distribution of salmon consumers, such as resident fish, birds, and mammals. The ecology of the Brooks River area is a prime example of this trend. The inland ecosystems (both aquatic and upland ecosystems) at Katmai National Park and Preserve are dependent on seasonal influx of ocean-derived nutrients brought by anadromous salmon (Bartz 2002; Naiman 2002; Helfield 2001; Helfield and Naiman 2001, 2002). Some researchers suggest that salmon should be considered as keystone species because the health of the entire ecological community and its food web in these areas are so dependent on salmon (Naiman 2002; Wilson and Halupka 1995; Cederholm et al. 2000). A study in Washington and Oregon noted that 138 species were predators or scavengers of salmon at one or more stages of a salmon's life (Cederholm et al. 2000).

These ecological cycles and delicate interdependencies emphasize the importance of assessing both the direct and indirect effects of human-related disturbances on terrestrial and aquatic ecosystems at Katmai National Park and Preserve. Altering one minor component of the system's metabolism may have substantial effects on the overall health of the natural system.

Fish Species Common to Naknek Lake and Brooks River

Brooks River, Naknek Lake, and Lake Brooks provide spawning, rearing, and/or migration habitat for anadromous fish and resident fish. The following section includes brief descriptions of the most prevalent fish species in these waters near the project area, mainly Brooks River and the shallows of Naknek Lake. The section focuses on the sockeye salmon, rainbow trout, and arctic grayling given their significance to the local ecology and park visitation (i.e., attracting anglers, bears, and bear-watchers). The various salmon species all have similar basic habitat requirements and life/migration patterns, although these patterns may vary temporally and spatially.

Sockeye Salmon (*Oncorhynchus nerka*). Every June, sockeye salmon return from the sea to enter the Naknek drainage and

eventually work their way up to the mouth of Brooks River. Each July, roughly 100,000 or more sockeye salmon return from the sea to spawn in Brooks River, Lake Brooks, and surrounding tributaries (NPS 1996). This is the largest and most notable salmon run in the project area and is responsible for attracting brown bears to Brooks River during summer months. In addition to bears, salmon also attract many anglers to Brooks River every summer. These salmon are the primary summer food source for many brown bears. The bear activity, in turn, attracts many park visitors to watch the bears in July.

After a brief lull in sockeye salmon migration and associated bear activity in Brooks River in August, another salmon run occurs in Brooks River from late August through September. Fishery records from the mid-20th century also indicated that some sockeye salmon migrate through Brooks River into Lake Brooks during July and return back downstream to spawn in Brooks River in September. However, the majority of salmon that spawn in Brooks River enter from Naknek Lake and do not leave the river (NPS 1996; Troy Hamon, pers. comm., August 2010). This abundance of sockeye salmon in the river in September once again attracts brown bears back to the project area. The spawned eggs also provide a reliable and robust food source for other Brooks River fish, such as rainbow trout. The concentration of rainbow trout in the river in late summer, in turn, attracts many anglers to the project area. During the following year, the juvenile salmon serve as an important food source for several species of fish as they work their way to the sea via the rivers and lakes of Katmai National Park and Preserve. Most juvenile sockeye salmon spend one to three years in lakes to develop and grow. Smaller numbers rear in streams or immediately migrate to the sea after emerging from the gravel spawning beds, such as those in Brooks River (Burgner 1991). Once the juveniles reach the sea, they grow there for another one to four years, where they will increase their body weight anywhere from 10 to 100 times (Hartman and Burgner 1972; Kozlowski 2007).

After developing in ocean waters, adult sockeye salmon migrate from the sea back into freshwater rivers and lakes, including Naknek Lake and Brooks River. On average, sockeye salmon that return to spawn are roughly five years old (Kozlowski 2007). During this migration back to the freshwater spawning grounds, the adult sockeye swim upstream in schools along the river edge and through the lakes. This allows the salmon to conserve energy because the current speed is generally lower at the river edge and bottom. During the entire journey and through the entire spawning process, the salmon rely solely on their own fat and protein reserves for energy (Kozlowski 2007).

Good water quality and flow conditions are essential for the salmon as they travel upstream to and through their natal rivers. For example, an adequate water current is necessary to signal direction to the fish (i.e., guide them to swim against the current). Low flows, weak currents, and occasionally turbidity can impact the chances of the salmon reaching their spawning grounds (Brannon 1972). The sockeye salmon that are successful at reaching their natal rivers begin spawning behaviors that are common to all salmon species. First, the female sockeye brushes out a depression (bed) in the streambed gravel. Then, just as she deposits her eggs in the bed, the male sockeye releases his sperm. The female then immediately covers the eggs with gravel (Kozlowski 2007).

Ideal spawning habitat for sockeye salmon is often associated with groundwater springs along river bottoms, which provide clear, cool, oxygen-rich water to the developing embryos. In addition, the sockeye spawning habitat in rivers and streams is usually associated with an

adjacent lake that is used for juvenile rearing (Burgner 1991). Naknek Lake is a prime rearing area for young salmon but has less shoreline spawning habitat. Thus, in the vicinity of the project area, most of the sockeye spawning occurs in Brooks River (Kozlowski 2007).

Most fish spawning in Brooks River occurs upstream of the existing floating bridge. However, a limited number of fish spawn beneath and downstream of the bridge (Troy Hamon, pers. comm., August 2010). This number is just a small fraction of the overall annual Brooks River spawning fish population.

The spawned salmon eggs and the yolk-sac fry that remain in the gravel after hatching are quite vulnerable to environmental disturbances in river water quality. For example, river siltation can result in poor water circulation around the gravel-covered eggs, which may cause the eggs to hatch prematurely (Kozlowski 2007). Although the yolk-sac fry have mechanisms that help them cope with poor water conditions, these mechanisms burn important energy reserves and alter the fry development. This can result in fully formed yet smaller fry (Bams 1969). Smaller fry are more vulnerable to predation by fish such as rainbow trout (Burgner 1991).

The newly emerged sockeye fry occupy the shallow waters or limnetic zones of nearby lakes from early June through mid-July. The limnetic zones of Naknek Lake serve as the initial rearing ground for Brooks River sockeyes. In mid-July, the fry begin moving into the deeper, open water or littoral zones of the lakes to feed (Kozlowski 2007). While in the limnetic areas, the fry primarily feed on aquatic insects when adequate light conditions exist. After reaching the littoral zone, they tend to feed on zooplankton. When sockeye fry populations are large, littoral habitat overlap with other Naknek Lake resident species and may cause food source competition (Burgner et al. 1969). Other fish species that often compete for the same food source include threespine sticklebacks, ninespine sticklebacks, pond smelt, and pygmy whitefish. Several other large fish species prey on the sockeye fry in the rivers, lakes, and migration corridors. These predators include rainbow trout, coho salmon, lake trout, arctic char, Dolly Varden char, and northern pike (Buck et al. 1978). If the sockeye fry survive their time in the lake rearing grounds, they eventually transform into smolt and begin their migration to the sea (Kozlowski 2007).

Coho Salmon (*Oncorhynchus kisutch*). During the time of sockeye spawning in Brooks River, a smaller coho salmon run (several hundred) occurs in the river (NPS 1996). The peak spawning period for the coho salmon is usually in early September (Kozlowski 2007). The coho salmon are an important sport fish for anglers in Brooks River. Juvenile coho salmon are also a predator of sockeye salmon fry in lake waters.

Chinook Salmon (*Oncorhynchus tshawytscha*), Chum Salmon (*Oncorhynchus keta*), and Pink Salmon (*Oncorhynchus gorbuscha*). Chinook salmon, chum salmon, and pink salmon are much less abundant in Brooks River than the coho or sockeye salmon (Kozlowski 2007, Buck et al. 1978). However, past fish migration monitoring in the 1960s indicated that a small number of Chinook, chum, and pink salmon migrate up Brooks River to spawn (USFWS 1964). Although the Chinook is not a common species in the Naknek system, they are one of the main sport and subsistence fish taken in Naknek River (Kozlowski 2007).

Rainbow Trout (*Salmo gairdneri*). Rainbow trout is an important species of fish in Brooks River. Their large size and high numbers support a world-class sport fishery and attract many anglers to Brooks Camp in late summer. Rainbow trout are slow growing, freshwater, resident fish that inhabit the large lakes and rivers in the Naknek drainage, including Brooks River

(Kozlowski 2007). In most cases, rainbow trout remain in Naknek Lake in the winter and migrate to Brooks River to feed and spawn from March to July, as spring warming allows. However, some rainbow trout permanently reside in rivers (NPS 1999b; ADF&G 2008a). Most of the rainbow trout spawning in Brooks River occurs from mid-May through mid-June, in both the upper and lower reaches of the river. After spawning, most rainbow trout return to Naknek Lake or Lake Brooks. Very few rainbow trout stay in Brooks River during the main sockeye salmon migration in July; the sockeye are known to harass rainbow trout in the river (NPS 1996). However, in late August when the salmon spawning starts to increase, rainbow trout return to Brooks River from Lake Brooks and Naknek Lake to feed on the abundant freshly laid salmon eggs. Rainbow trout concentrations in Brooks River tend to be concurrent with the peak of the sockeye salmon spawning in later September.

Arctic Grayling (*Thymallus arcticus*). The arctic grayling are freshwater residents of the Naknek system and are considered an important sport fish. Important grayling spawning habitat exists in the lower Brooks River from the river's mouth to approximately 0.75 miles upstream (ADF&G 2007). The floating bridge is in the middle of this spawning area. Typically, the grayling begin spawning in Brooks River in early May. In a 1980 Brooks River fish survey, an estimated 300–500 arctic grayling were documented in the river. arctic grayling feed on drifting aquatic and terrestrial insects, salmon eggs, salmon smolt, and occasionally on small mammals swimming on the water surface (e.g., shrews (Kozlowski 2007).

Other Fish Species. Several other freshwater fish species occupy Brooks River, including, but not limited to, Dolly Varden char (*Salvelinus malma*), round whitefish (*Prosopium cylindraceum*), pygmy whitefish (*Prosopium coulteri*), humpback whitefish (*Coregonus pidschian*), least cisco (*Coregonus sardinella*), arctic lamprey (*Lampetra japonica*), Alaskan brook lamprey (*Lampetra alaskense*), threespine stickleback (*Gasterosteus aculeatus*), ninespine stickleback (*Pungitius pungitius*), rainbow smelt (*Osmerus mordax*), pond smelt (*Hypomesus olidus*), and longnose sucker (*Catostomus catostomus*). Some of these are resident species of the river and others are migrants to the river from other areas of the Naknek drainage system. However, most of these species use Brooks River to spawn at various times during the summer months.

VEGETATION AND WETLANDS

Vegetation

The vegetation cover in the vicinity of the project area consists of a variety of plant associations, ranging from upland communities to wetland communities. In addition to the portions of the project area being dictated by the hydrology of Brooks River and adjacent wetlands, the project area also lies along the southern and western extent of the Alaska Peninsula boreal forest. In Katmai National Park and Preserve, roughly 128,000 acres of open- and closed-canopy white spruce forest exists. About 31,000 acres of this forest is within a 12-mile radius of the project area (NPS 1996). These upland areas of the project area are characterized by closed and open mixed needleleaf and deciduous forest of white spruce (*Picea glauca*), Kenai birch (*Betula papyrifera* var. *kenaica*), and balsam poplar (*Populus balsamifera*). The understory consists of various willow species (*Salix* spp.) and alder (*Alnus* spp.), as well as high bush cranberry (*Virburnum edule*), Labrador tea (*Ledum* spp.), and other low shrubs (URS Group, Inc. 2009b; Viereck et al. 1992). The Brooks Camp campground is in a prominent stand of balsam poplar. As the elevation increases while moving up Dumpling Mountain (northwest of the project area), the dominant spruce forest transitions to a tall

shrub community, which eventually gives way to tundra (NPS 1996).

The Brooks River riparian corridor and adjacent wetland complexes near the project area have a mosaic of dense alder thickets and tall grass meadows interspersed with bogs and marshes that are dominated by wetland vegetation such as various sedges, reedgrasses, and willows. Most of the herbaceous meadows are dominated by bluejoint reedgrass (*Calamagrostis canadensis*), field horsetail (*Equisetum arvense*), and fireweed (*Epilobium angustifolium*) (URS Group, Inc. 2009b).

Nonnative, invasive plant species found in the area include shepherd's purse (*Capsella bursa-pastoris*), narrowleaf hawksbeard (*Crepis tectorum*), pineapple weed (*Matricaria discoidea*), common plantain (*Plantago major*), prostrate knotweed (*Polygonum aviculare*), white clover (*Trifolium repens*), dandelion (*Taraxacum officinale*), annual bluegrass (*Poa annua*), and bird vetch (*Vicia cracca*). Most of the invasive plant species populations found near the project area may have originated from inadvertent importation by visitors' footwear and other soil-disturbing NPS projects (URS Group, Inc. 2009a).

In addition to invasive plants, the spruce bark beetle has altered vegetation in the area, despite being a native species. Many large spruce trees between employee housing units have been killed by the beetle in recent years, and there are also many dead spruce trees standing throughout the project area (Coffman Engineers 2009). Hazard trees are removed by NPS staff each spring (URS Group, Inc. 2009a).

Wetlands Overview

A substantial portion of Alaska's 175 million acres of wetlands is on the Alaska Peninsula, in areas such as Katmai National Park and Preserve, particularly on the Bristol Bay side of the peninsula (Hall and Frayer 1994; Kozlowski 2007). Wetlands in this region are maintained by surface and groundwater flows from heavy rainfall, glacial melt water, river flooding, beaver activity, snowmelt, impermeable soils, and bedrock.

Katmai wetlands include marine, estuarine, riverine, palustrine, and lacustrine environments, with estimates exceeding 1 million acres of Katmai wetlands in total (Kozlowski 2007). The park's wetlands typically represent transitional zones between uplands and water bodies. The spatial variability of plant species in Katmai wetlands is high because slight changes in elevation yield substantial changes in vegetation type. Similarly, the temporal variability is also high because of the constantly changing surface water depth and groundwater levels, which are tied to precipitation, evaporation, infiltration, and thermokarst activity (Kozlowski 2007).

Most of the wetlands in the project area are palustrine wetlands that occupy low-lying areas near and along Brooks River. Palustrine wetlands are known to have several ecological functions. Some of the major functions of wetlands include the following: (1) discharge of groundwater; (2) flood control; (3) water quality control; (4) stabilization of sediments and retention of nutrients; (5) fish and wildlife habitat; and (6) biomass production and export (URS Group, Inc. 2009b; Larson et al. 1989).

In terms of social or human values, wetlands also provide benefits such as aesthetic open space and places for recreational activities such as birding, wildlife watching, photography, and nature appreciation. The wetlands adjacent to the Brooks River project area provide a high level of these social values given their location near a very popular park visitation area (i.e., Brooks Camp, bear watching areas, and launching point for trips to Valley of Ten Thousand Smokes).

Delineated Wetlands in Project Area

A preliminary wetlands delineation was conducted on August 19–21, 2009 (URS Group, Inc. 2009b). The survey documented jurisdictional wetlands within the project area, which included the following:

- Brooks Camp and surrounding area
- northern shoreline of Brooks River and east of Brooks Camp
- southern shoreline of Brooks River near the existing floating bridge
- existing barge landing site and access road
- the proposed barge landing site and access road to the south of the river.

Twelve individual wetlands were delineated in the project area (figure 9) and descriptions are provided below. The functional values of each of the 12 individual wetlands are provided in table 5. (See also the functional assessment of wetlands in appendix B.) The wetland identification letters and descriptions correspond directly to the identification letters in the August 2009 report by URS Group, Inc. (2009b). The classification system in this report and following table applies the Cowardin system (Cowardin et. al. 1979).

TABLE 5. ECOLOGICAL FUNCTION OF WETLANDS DELINEATED IN PROJECT AREA

Ecological Functions	Delineated Wetland in the Project Area (A through L)											
	A	B	C	D	E	F	G	H	I	J	K	L
Wildlife habitat for waterfowl, shorebirds, moose, brown bear, and a variety of small mammals	x	x	x	x	x	x	x	x	x	x	x	x
Feeding and brood-rearing habitat for waterfowl such as the common merganser (in open water							x		x	x		
Fish habitat									X[2]			
Biomass production and export	x	x	x	x	x	x	x	x	x	x	X	x
Flood control or moderation					x	x	x	x	x	x		
Discharge of groundwater							X[1]					
Water quality control, stabilization of sediments and retention of nutrients					x	x	x		x			

Source: URS Group 2009

1. Wetland G may provide this function to some degree, but the lack of an outlet suggests discharge is not substantial.
2. The open water of wetland I is the only wetland that provides any substantial functions as habitat for fish. The southern portions of this wetland are at the normal flow level of Brooks River and provide food and cover for small fish in the river. This wetland also provides the function of bank stabilization, which protects habitats in other areas of the river.

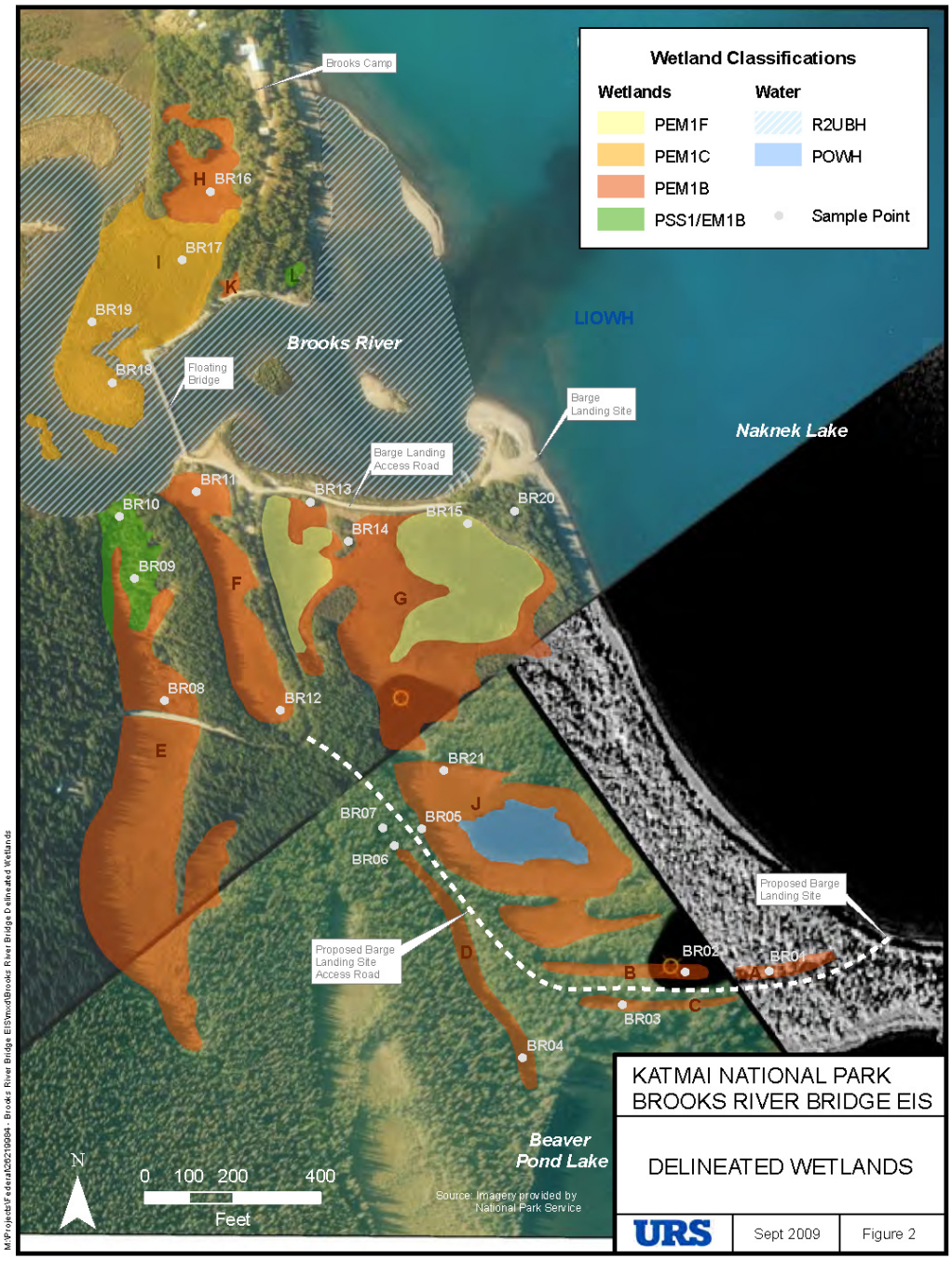
Vicinity of Southernmost Proposed Barge Landing Site and Access Road. No wetlands were delineated along the Naknek Lake shoreline in vicinity of the proposed barge landing site (see figure 9). However, wetlands A, B, C, D, and J are all immediately adjacent to the proposed access road route (see figure 9).

Wetland A—This wetland is a wet herbaceous meadow in a long, narrow (22 ft) depression between two forested ridges paralleling the proposed access road route. The area has been classified as a palustrine, emergent persistent, saturated wetland (PEM1B) (see Cowardin et. al. 1979 for all subsequent classifications in this section). The vegetation is dominated by bluejoint reedgrass (*Calamagrostis canadensis)*. Bebb willow (*Salix bebbiania*) is the only shrub found in this wetland. Individual balsam poplar and white spruce also exist in the slightly elevated areas in the wetland, but are not indicative of the wetland vegetation. During the delineation survey, saturated soils were found 8 inches below the surface, with standing water found at 16 inches below the surface.

Wetland B—This wetland lies along the proposed access road route to the proposed barge landing and is in the same long, narrow depression as wetland A (but is separated from wetland A by a narrow stretch of uplands). Like wetland A, this area has been classified as a palustrine, emergent persistent, saturated wetland (PEM1B). The dominant vegetation species include bluejoint reedgrass and Northwest Territory sedge (*Carex utriculata*). No trees or shrubs are in this wetland. During the delineation survey, the primary indicator of wetlands hydrology was saturation of the soil within 12 inches of the surface.

Wetland C—This wetland is another narrow depression in the landscape that parallels the south side of the proposed barge landing access road alignment. It is also immediately adjacent to Beaver Pond Lake and the active eagle nest that exists along the lake. Wetland C has been classified as a palustrine emergent persistent, saturated wetland (PEM1B). The vegetation in this wetland is dominated by Northwest Territory sedge and water-hemlock (*Cicuta mackenziena*), both hydrophytic vegetation. Saturation to the surface and standing water in low areas was also noted on the delineation survey, which are primary indicators of wetland hydrology.

Wetland D—Wetland D is a long, narrow depression immediately west of and parallel to the proposed access road alignment. Although the southern tip of this linear wetland nears Beaver Pond Lake, the survey indicates that the depression does not appear to connect directly with the lake. The majority of this depression has been classified as a combination of palustrine, emergent persistent, semipermanently flooded wetland (PEM1F) and saturated wetland (PEM1B). However, the very northern edge of the linear depression lacked one or more of the jurisdictional wetland criteria, and thus this area has been classified as uplands. The vegetation around the perimeter of this wetland consists of thick emergent vegetation, with open water and aquatic vegetation in the center. Vegetation at the southern end of this linear wetland is dominated by longawn sedge (*Carex machrochaeta*), Northwest Territory sedge, and marsh fivefinger (*Comarum palustris*). Aquatic vegetation in areas of open water consisted mostly of burreed (*Sparganium angustifolium*). Other vegetation in this wetland includes water horsetail (*Equisetum fluviatile*) and water-hemlock. At the northern end of this wetland, vegetation includes dense bluejoint reedgrass in the lower areas, with interspersed Bebb willow and birch. During the delineation survey, standing water was also noted in several noncontinuous low areas along the length of the wetland.



Source: URS Group, Inc. 2009b
Note: Aerial photograph was recorded in 2002, before the floating bridge was relocated to its current location; the location of the barge landing access road in this figure is approximate.

FIGURE 9. DELINEATED WETLANDS IN PROJECT AREA

Wetland J—This wetland is in a large depression in the landscape to the east of the proposed access road route. The wetland consists of a large emergent marsh around the perimeter with an area of open water in the center. The perimeter marsh has been classified as a palustrine, emergent persistent, saturated wetland (PEM1B), and the center of the wetland has been classified as palustrine, open water, and permanently flooded wetland (POWH). Although it lies immediately south of wetland G, this wetland is not directly connected to wetland G. The emergent vegetation around the wetland perimeter is dominated by bluejoint reedgrass, longawn sedge, and Northwest Territory sedge. Standing water in the center of the wetland and saturation to the surface along the perimeter marsh were the primary indicators of wetlands hydrology during the delineation survey.

Vicinity of Existing Barge Landing Site and Access Road. One wetland was delineated in this area.

Wetland G—This wetland lies along and immediately south of the existing access road to the existing barge landing. The road parallels the southern shoreline of the Brooks River and acts as a dike to wetland G, which would otherwise drain more to the river. This wetland complex consists of both emergent wetlands and open water areas with aquatic vegetation. The open water areas have been classified as palustrine, open water, permanently flooded (POWH) wetland, and the wettest areas with emergent vegetation have been classified as palustrine, emergent persistent, semi-permanently flooded wetland (PEM1F). The remainder of the marsh has been classified as palustrine, emergent persistent, and saturated wetland (PEM1B). The dominant vegetation in the northwest portion of this wetland includes Northwest Territory sedge and bluejoint reedgrass. Other emergent species include pendent grass (*Arctophylla fulva*), water hemlock, common mare's tail (*Hippuris vulgaris*), and longawn sedge. Aquatic vegetation in the open water in this area primarily consisted of burreed (*Sparganium* spp.).

Vegetation in the northeast portion of this wetland is also heavily dominated by Northwest Territory sedge, with a very small amount of longawn sedge and bluejoint reedgrass. Vegetation in the north central portion of this wetland included the dominant bluejoint reedgrass and two species of willow [diamondleaf willow (*Salix planifolia*) and Barclay's willow (*Salix barclayi*)]. Other species in this area included field horsetail and longawn sedge. The northeast, upland edge of this wetland is dominated by white spruce, paper birch, and Bebb willow, with an understory of bluejoint reedgrass. During the delineation survey, standing water was noted throughout most of this wetland. Thus, the hydrology criteria of wetland delineation was met.

Vicinity of the Brooks River Bridge—South Shoreline. Two wetlands were delineated along the south shoreline.

Wetland E—Wetland E is in a large, low depression extending from the edge of Brooks River near the bear observation platform, southward beyond Valley Road. The southern portion of this wetland has been classified as a palustrine, emergent persistent, saturated (PEM1B) wetland. The northern portion has been classified as a palustrine, scrub-shrub / emergent persistent, saturated wetland (PSS1/EM1B). The vegetation that is common to the central and southern portions of this wetland is dominated by bluejoint reedgrass. Longawn sedge made up only 5 percent of the total, and Northwest Territory sedge was only 1 percent of the cover in this area. A few interspersed diamondleaf willows also exist in this area. The vegetation in the northern portions of this wetland include a fair amount of shrub cover such as Bebb willow, diamondleaf willow, and Barclay's willow, with an understory dominated by

bluejoint reedgrass. A few interspersed white spruce and paper birch are also present in the slightly elevated areas of this wetland. The primary indicator of wetland hydrology in much of this wetland is saturation within 7 12 inches of the surface. Other secondary indicators of wetland hydrology include oxidized rhizospheres on living roots and stunted/stressed facultative or upland plants.

Wetland F—This wetland is a large wet meadow in a long, narrow depression that extends south from Brooks River near the elevated observation platform and parallels the west side of Valley Road. The area has been classified as a palustrine, emergent persistent, saturated wetland (PEM1B) with small fringe scrub-shrub wetlands. The vegetation in this wetland is mainly herbaceous. Dominant plants include longawn sedge and bluejoint reedgrass. The only other common species is the Northwest Territory sedge. The soil in the northern portion of this wetland consists of a 4-inch layer of fibrous organics over a 7-inch horizon of volcanic ash. A dark brown sandy loam mixed with fibrous organics lies below the horizon of ash, which transitions down to a dark grey sand and gravel matrix. The soil profile in the southern portion of Wetland F includes a 3-inch organic mat over a 7-inch ash horizon. Beneath the ash layer, a thin 1-inch layer of fibrous peat was found, followed by a horizon of gravel. During the delineation survey, no sizable areas of standing water were noted in this wetland. However, about 1 inch of surface water was noted in some areas of the northern edge of the wetland, with standing water found at 5 inches below the surface in other areas. At the south end of the wetland, the survey noted saturation at 10 inches from the surface and standing water at 20 inches from the surface.

North Side of Brooks River. Four wetlands were delineated on the north side of Brooks River.

Wetland H—This wetland is a large grass/sedge wet meadow in a depression on an elevated river terrace just west of Brooks Camp. Wetland H has been classified as a palustrine, emergent persistent, saturated wetland (PEM1B). The 2008 NPS wetland survey near Brooks Camp also classified this area as wetland (Rice 2008). The vegetation in this wetland is uniform over most of the wetland and is dominated by bluejoint reedgrass with only a small amount of Northwest Territory sedge. The plant cover transitions up to shrub habitat on three sides. The hydrology of this wetland at the time of the delineation can be described as saturation to the surface, with small areas of shallow standing water.

Wetland I—Wetland I is a large emergent marsh on the northern shoreline of Brooks River, between Brooks Camp and the oxbow of Brooks River. The area has been classified as a palustrine, emergent persistent, seasonally flooded, wetland (PEM1C). The two small islands separated from the main wetland were not sampled but had similar emergent vegetation and were included in Wetland I. Much of this wetland is flooded during high water periods in spring and summer, and the lower portions of the marsh were inundated at the time of the delineation survey. A portion of this marsh was filled in the past to create the northern access to the floating bridge on Brooks River.

The vegetation in the higher portions of this wetland is dominated by bluejoint reedgrass. Other minor species include water horsetail, yellow willowherb (*Epilobium luteum*), bog yellowcress (*Rorippa palustris*), Northwest Territory sedge, and longawn sedge. The slightly lower portions of this wetland in the central areas of this wetland are dominated by the same species. The vegetation in the lowest areas of this wetland only includes bluejoint reedgrass and pendant grass (*Arctophylla fulva*) emerging from the standing water. As previously noted, the

southern portion of this wetland was inundated at the time of the survey.

Wetlands K and L—Two small wetlands were delineated by NPS staff in a 2008 between Brooks Camp and the northern shoreline of Brooks River (Rice 2008). Wetland K has been classified as a palustrine, emergent persistent, saturated wetland (PEM1B). Wetland L has been classified as a palustrine, scrub-shrub / emergent persistent, saturated wetland (PSS1/EM1B).

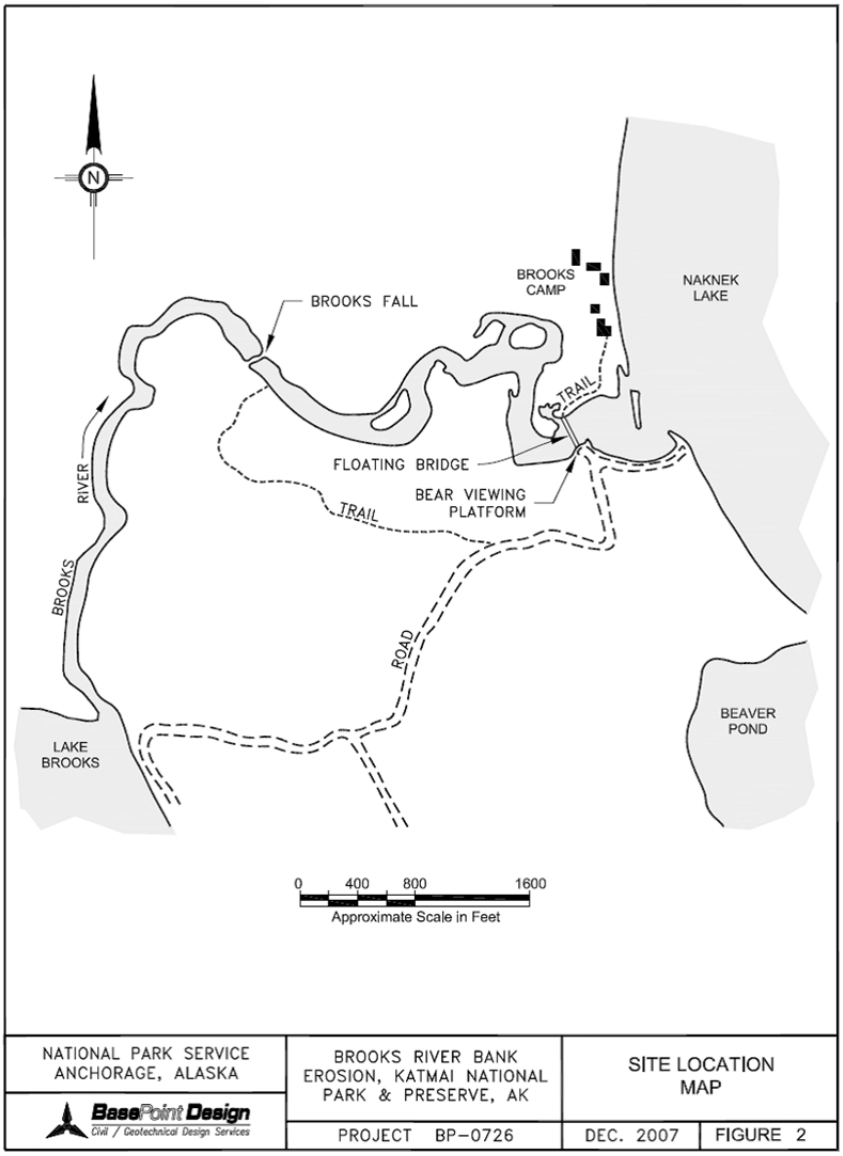
HYDROLOGY AND FLOODPLAINS

Naknek Lake and Lake Brooks

In the project area, Naknek Lake receives tributary drainage from the outflow of Brooks River. In turn, Brooks River is primarily fed by Lake Brooks and its subbasin. These are three primary hydrologic features that affect the local hydrology around the project area. Figure 10 provides a map of these features.

Naknek Lake is the largest freshwater lake in Katmai National Park and Preserve, as well as the largest lake within a national park system unit boundary (Kozlowski 2007). A 1969 study by the Alaska Bureau of Commercial Fisheries indicated that Naknek Lake has a maximum depth of 568 ft and an area of 235 square miles, with a surface elevation of about 33 ft above mean sea level. Meanwhile, the smaller and shallower Lake Brooks has a maximum depth of 259 ft and an area of 29 square miles, with a surface elevation of 62 ft above mean sea level (Alaska Bureau of Commercial Fisheries et. al. 1964; Burgner et. al. 1969; Kozlowski 2007).

Naknek Lake is routinely used by floatplanes and boats near the mouth of Brooks River during the summer months of park visitation. Floatplanes also use Lake Brooks as well.



Source: BasePoint Design Corporation, Inc. 2007

FIGURE 10. WATER FEATURES IN VICINITY OF PROJECT AREA

Each year, a limited amount of diesel and gasoline fuels escape into Naknek Lake by leakage or spillage from engines of floatplanes and boats anchored or beached adjacent to Brooks Camp (NPS 2009). Because water quality protection throughout Katmai National Park and Preserve is a high priority, the National Park Service strives to minimize these pollutant sources as much as possible. Maintaining the pristine water quality in the park is one the main reasons given in executive orders that expanded the park since its establishment (NPS 1996).

Brooks River

Brooks River flows from the outlet of Lake Brooks for about 1.5 miles until it empties into Naknek Lake at its mouth. Brooks Camp and the project area are located here. For about a third of its length, Brooks River flows in a south to north direction from Lake Brooks. For the remainder of its

length, the river generally flows west to east all the way to Naknek Lake. The velocity of the flow is generally slowing from a relatively swift, turbulent flow condition in the upstream portion of the reach to a relatively slower and more tranquil condition near the mouth. A prominent feature of Brooks River is the fault line that cuts across the river at its approximate midpoint between the two lakes. This fault line creates Brooks Falls, the 6-foot waterfall that is a focal point during the July sockeye salmon run and bear feeding.

Most of the water that feeds the river from Lake Brooks drains from the mountains and tundra that surround Lake Brooks, mainly from spring snowmelt (Kozlowski 2007). Brooks River is a dynamic, alluvial river that transitions from a relatively steep boulder- and cobble-bedded river to a meandering sand/gravel/cobble river as it flows into Naknek Lake (BasePoint Design Corporation, Inc. 2007). As the river nears its outfall into Naknek Lake, it meanders through a low alluvial plain. Low banks are common in this stretch, which make the river susceptible to continued meandering processes because of hydrologic and geomorphic processes.

The gradual meandering in the lower stretches of Brooks River is the result of several natural forces. Three primary hydrologic and geomorphic processes are responsible for the river's ever-changing shape and alignment. First, hydraulic forces from the high snowmelt run-off flows each spring and summer cause erosion of the riverbanks and riverbed. Secondly, springtime ice breakage and shifting, as well as freeze/thaw cycles, are capable of eroding riverbanks along the length of the river. Ice dams are also capable of causing channel rerouting and flooding. Lastly, the wind and wave action of Naknek Lake alters and erodes the lake's shoreline and riverbanks near the mouth of Brooks River (BasePoint Design Corporation, Inc. 2007). For example, the mouth of Brooks River has shifted a notable amount in the past 20 years. The combined effect of the meandering and sustained winds from Naknek Lake generate a longshore drift that changes the channel configuration and sediment deposition areas near the river mouth (NPS 1996).

Changes in the river's alignment generally happen over a long period of time because the various natural forces slowly cut riverbank material from one area and deposit it in another. Meandering typically progresses as the force from the current and flow are greater on the outside edge of river bends (i.e., near the bank) causing greater erosion in this part of the channel. Meanders become more pronounced and shift downstream until a geologic or hydrologic cutoff occurs, redirecting the river flows (BasePoint Design Corporation, Inc. 2007). This process results in shifting cutbanks and evolving oxbows along the river's alignment. Large storms or substantial spring run-off flows are capable of causing instantaneous changes in the river alignment.

The speed and degree of the river's geomorphic changes are dependent on climatic conditions and events, which can vary considerably and become extreme at times. For example, water levels at Naknek Lake and Brooks River can rise as much as 7 ft between spring and late summer, and local flooding around the mouth of Brooks River has occurred up to the elevation of the fish freezing building in Brooks Camp (NPS 1996).

Brooks River Floodplain in the Project Area

Floodplains play an essential role in the overall function of a river system. Floodplains influence the hydrology of a watershed by dissipating floodwater energy and serve as a temporary storage area for floodwaters and a deposition area for sediment eroded from the watershed. The flooding that occasionally occurs

along Brooks River can result from heavy precipitation, ice buildup in the river, rapid snowmelt in the watershed, or a combination of these factors. Because the lower end of Brooks River flows through an alluvial valley with more gradual (flatter) topography, flooding in this area generally covers a wider area than the upper reaches of Brooks River.

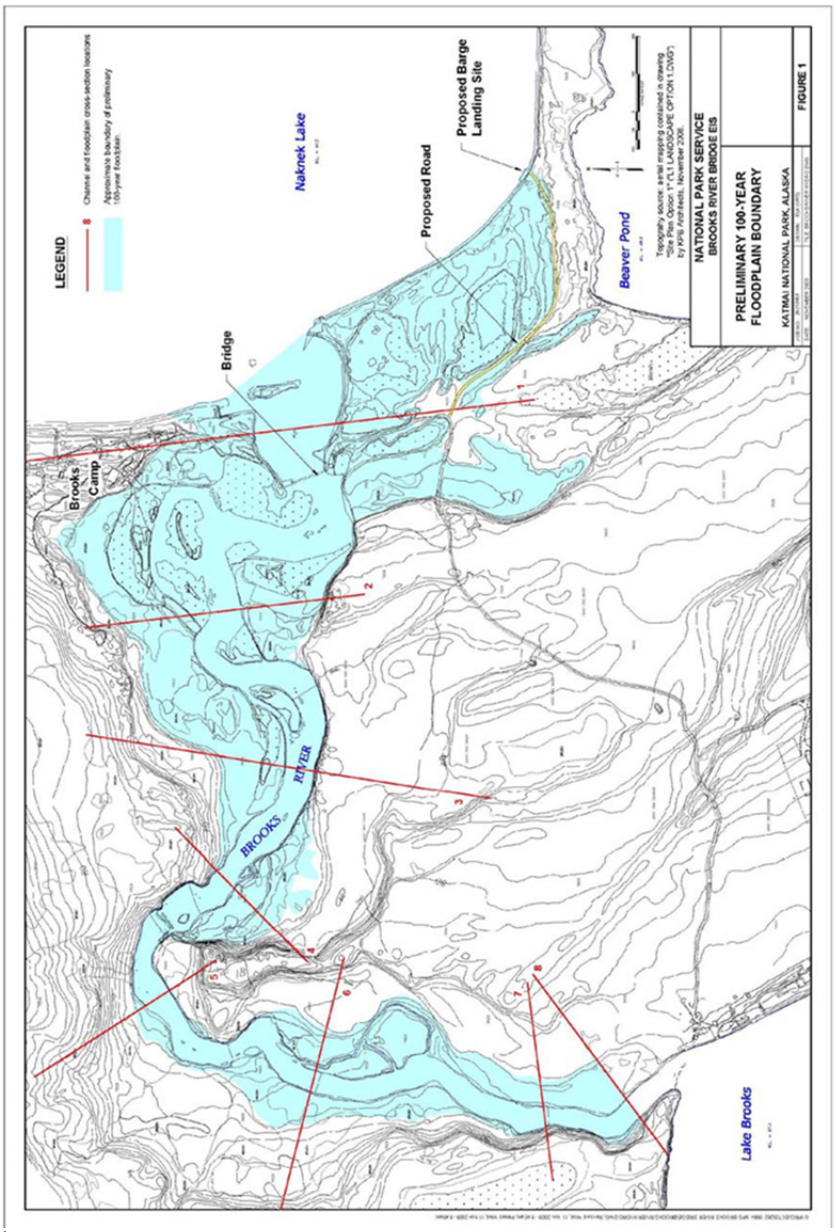
A 100-year floodplain is the elevation to which the river rises during a storm that occurs on average every 100 years. To put it another way, a 100-year floodplain is the flood elevation that has a 1 percent chance of being reached by river floodwater in any given year. Most of the lower Brooks River valley lies within the 100-year floodplain. Although most of Brooks Camp appears to be situated above the 100-year floodplain elevation, the proposed improvements in the project area would all be within the estimated 100-year floodplain (i.e., Brooks River bridge and boardwalk, barge landing sites, and landing access roads). Regardless, storm flooding along Brooks River is somewhat eased because of the size of Lake Brooks and associated water storage above the river. Lake Brooks accounts for about 20 percent of the total Brooks River watershed area. Refer to figure 11 for an illustration of the estimated 100-year floodplain in the project area. To help identify the flood flows and extents, NPS staff modeled a 100-year flood in the entire Brooks River, from Lake Brooks to Naknek Lake. Eight modeled cross sections were established, where flow velocities and elevations could be estimated. The locations of these eight modeled cross sections are identified in figure 11. Figure 11 also shows the estimated inundation area of the 100-year flood.

The floodwater surface elevation at each cross section, as well as main channel and average floodplain velocities associated with a 100-year event, are summarized in table 6. Because of the surface roughness (trees, brush, surface undulations) of the floodplain, the model predicts that floodplain flow velocities will be less than 1 foot/second in most areas. However, the velocity of the storm flows in the main Brooks River channel are likely to be notably higher (as much as 8 ft/s in the upper portion of the river, and roughly 2 ft/s near Naknek Lake).

TABLE 6. SUMMARY OF ESTIMATED WATER SURFACE ELEVATIONS AND VELOCITIES ASSOCIATED WITH 100-YEAR RECURRENCE INTERVAL

Cross Section	Minimum Channel Elevation (ft)	Water Surface Elevation (ft)	Main Channel Velocity (ft/s)	Floodplain Average Velocity (ft/s)	
				Left Overbank	Right Overbank
8	68.0	73.1	4.3	0.7	1.0
7	66.0	71.0	6.2	0.8	1.7
6	62.0	67.3	4.0	0.8	1.3
5	58.0	60.8	8.8	1.1	0.9
4	48.6	53.9	4.8	0.6	1.2
3	46.9	51.8	4.3	1.2	1.3
2	45.4	50.4	2.4	0.7	0.7
1	46.0	48.3	2.8	0.4	1.0

Source: NPS 2009(c)



Source: NPS 2009(c)

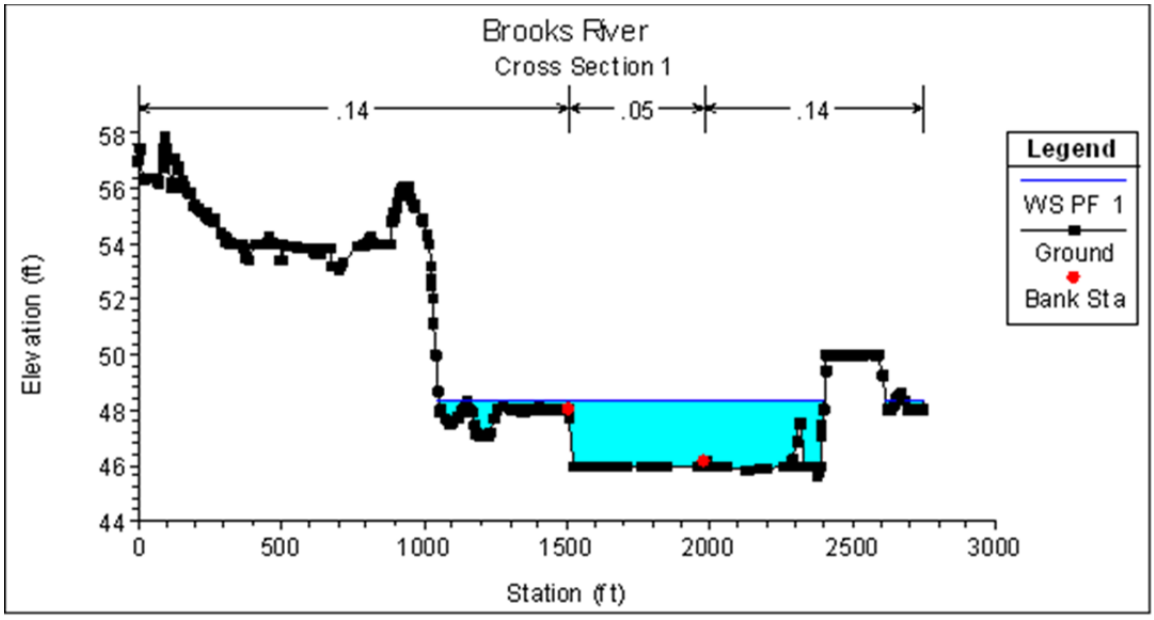
FIGURE 11. ESTIMATED 100-YEAR FLOODPLAIN OF BROOKS RIVER NEAR PROJECT AREA

The minimum channel elevations and the water surface elevations listed in table 6 indicate the expected water depth in the channel during a 100-year flood. Figure 12 shows the estimated flood flow elevations at the cross section near the proposed bridge.

As shown in table 6 and figure 11, the estimated floodwater depths in the vicinity of near the proposed elevated Brooks River bridge and boardwalk range from about 2 ft to 5 ft. Floodplain water depths in the vicinity of near the proposed road and barge

landing site are likely to be less than 2 ft. In figure 12, the "WS PF 1" in the legend refers to the water surface elevation for a 100-year flood, represented by the solid, continuous line; "Ground" refers to the upland and riverbed ground elevation; "Bank St a" refers to the top of the main channel banks, represented by two dots.

In addition to these anticipated flow velocities and inundation depths and areas, Brooks River would also have bank erosion, channel migration, and riverbed scouring during a 100-year storm. The degree of erosion and channel migration would depend on the severity of the storm, its hydrograph, and other physical factors at the time.



Source: NPS 2009(c)

FIGURE 12. ESTIMATED FLOOD FLOW ELEVATIONS OF CROSS SECTION NEAR PROPOSED BRIDGE

Hydrology and Geomorphology in Vicinity of the Project Area

The project area is near the mouth of Brooks River, adjacent to Brooks Camp on the north side of the river and near the existing bear viewing platform on the south side. The existing floating bridge also demarks the approximate alignment of the proposed permanent bridge. The following discussion focuses on hydrological conditions and processes in the vicinity of the project area.

In a 2007, hydrologic assessment of the project area, the National Park Service and BasePoint Design Corporation noted that the riverbanks on the north and south sides of the river had wave erosion and bank scouring damage near the floating bridge site, with the worst erosion occurring along the north bank. Because the eastern portion of the north bank is wooded, the wave erosion along this area has resulted in some downed trees along the riverbank (BasePoint Design Corporation, Inc. 2007). The Corner trail that connects Brooks Camp and the floating bridge runs along this stretch of eroded riverbank. The ongoing bank erosion near the floating bridge site necessitates annual maintenance to restore and stabilize the shoreline in this area. These annual bank stabilization and sediment removal efforts are needed to mitigate the hydraulic effects

of anchoring the floating bridge to the shorelines.

An alluvial peninsula known as the "spit" extends from the south bank of the river near the mouth. The spit was formed by sediment deposition as river flow velocity dropped as the water flows out into Naknek Lake. The National Park Service currently uses the base of the spit as a loading area for barges that take supplies and materials to and from Brooks Camp. In addition to the spit, a small alluvial island also exists in the middle of the river just east of the floating bridge. The 2007 hydrologic assessment indicates that the locations and dimensions of the alluvial spit and island at the mouth of the river are constantly changing from geomorphic processes (BasePoint Design Corporation, Inc. 2007).

Just upstream of and around the bend from the floating bridge crossing, a series of large oxbows exist. These oxbow channels are just northwest of the Brooks Camp area. By inspecting aerial imagery, it is apparent that the size and curvature of the river oxbows in this area have changed considerably over the years as a result of river flow dynamics (as previously described). The current result is a pair of river channel oxbows, with wet meadow areas along the shorelines as well as on islands between the series of oxbows channels.

River geomorphology is quite unpredictable because of its direct correlation to climate conditions and storms. Thus, predicting the future conditions, configuration, and alignments of Brooks River and its associated features is also difficult. However, given past data and knowledge of the dynamic river processes under normal conditions, some limited predictions can be made.

Assuming nonflooding scenarios, the 2007 hydrologic assessment highlighted the following six anticipated geomorphic changes that might be expected in the project area (BasePoint Design Corporation, Inc. 2007). However, it should be noted that the potential implementation of an action alternative in this document may modify the river and riverbank features and/or management needs of the area.

Oxbow channels and wet meadows west and northwest of Brooks Camp— This area is on the outside of a river bend that has potential to erode more rapidly than the inside of a bend. As a result, the river could erode soil and migrate into the marshy area west and northwest of the existing trail, and could eventually encroach on the trail itself. If such erosion occurs near the trail, then bank erosion protection may be needed in this area.

Corner trail (connects Brooks Camp with the floating bridge)—This area is on the outside of a slight river bend, with considerable bank erosion already occurring. Continued bank erosion and river migration could be expected over time.

River main channel—Substantial bank erosion would continue to be expected along the outer banks of the river bends. Some sedimentation and bank buildup would be expected on the inside of bends. These river bends tend to erode banks and move laterally and downstream over time.

The spit—The spit at the mouth of Brooks River results from the complex interaction between hydraulic processes of the river and Naknek Lake as the river flows into the lake. The river transports sediment in the downstream direction until sediment deposition occurs from reduced river flow velocities at the mouth. Heavy wind and wave action in the lake then pushes and spreads these sediment deposits into a spit formation. Over time, additional sediment deposition and wind/wave action continue to shift, build, and erode the spit. Its location, size, and shape continually changes.

The island in the river mouth—The dynamic nature of the island is similar to that of the spit.

Roadway parallel to the south side of the river mouth (existing barge landing access road)—The portion of the road on the spit would experience change that is similar to that of the spit. The portion of the road along the riverbank is located along a portion of the river that is relatively shallow and has a relatively low current. As a result, this riverbank area would likely continue to be relatively stable. Some instability could result from the lake's wave activity. However, the narrow strip of vegetation that exists between the road and the water would continue to provide bank stability. If erosion becomes evident in this area, some additional bank protection may be necessary, such as planting erosion-resistant shrubs.

SOUNDSCAPE

The natural soundscape of an area is often described from an anthropocentric perspective, which not only identifies what humans hear, but also captures how humans appreciate or respond to the soundscape. For example, the quiet natural soundscape near Brooks Camp provides a sense of solitude and serenity to park visitors. However, a natural soundscape is also essential from a biological perspective because it can provide the conditions that allow for the continuation of important natural processes. Wildlife that depend on audio communication and quiet surroundings to accommodate this communication are one example of this importance.

According to NPS policy, the natural soundscape in a park unit is defined as

> . . . all natural sounds that occur in a park, including the physical capacity for transmitting those natural sounds and the interrelationships among park natural sounds of different frequencies and volumes. Natural sounds occur within and beyond the range of sounds that humans can perceive, and they can be transmitted through air, water, or solid materials. . . . Some natural sounds in the natural soundscape are also part of the biological or other physical resource components of the park (NPS 2006).

A natural soundscape also includes "natural quiet," which is what occurs in the absence of natural and human-caused sound.

The following discussion about the soundscape in vicinity of the project area is presented primarily in a qualitative fashion because limited quantitative data exist for characterizing the Brooks River soundscape. However, in the summer of 2010, a soundscape inventory was conducted in the Brooks Camp area (NPS 2010e).

In general, the Brooks Camp area can be considered a rather quiet place. Near the project area, the natural soundscape is not disturbed by unnatural sounds for roughly half of the year (generally from November to April). During this period, little or no human activities occur along Brooks River and the high quality conditions of the natural soundscape are maintained. During this time, the only sounds one would hear in the area are natural sounds, including sounds produced by wind, flowing water, rain, and wildlife.

For approximately five months of the year, when people are generally present from May through October, unnatural sounds (or noises) foreign to the natural soundscape occur. Noise is generated by park staff, concession employees, and visitors. Human-caused sound from sources such as floatplanes, motor boats, motorized vehicles, power generators at Brooks Camp and Lake Brooks, trail maintenance chainsaws, electronic devices,

bear hazing devices, and park visitors can degrade the natural soundscape.

During times of high levels of human activity, the Brooks Camp area can be noisy relative to many other areas in the park. The peak disturbance period to the natural soundscape typically occurs in July when large volumes of salmon, bears, and people converge on the Brooks River corridor. During this time, noises are frequently generated by motorized vehicles, floatplanes, and boats, as well as by anglers, guides, bear-watchers, park staff, and concession employees.

The loudest and most frequently heard noise near the project area is from floatplanes that are landing, taking off, or taxiing to/from the Naknek Lake shoreline near Brooks Camp. Because different types of planes access Brooks Camp (e.g., turbine engines, piston engines), the sound quality of the noises generated by airplanes varies from plane to plane. At the lower viewing platform, noise from aircraft constituted an average of 32 percent of total noise during the 2010 monitoring period and 55 percent of total noise at the Brooks Camp visitor center (NPS 2010e).

Motorized all-terrain vehicle (ATV) use associated with park operations and concessions is another major contributor to unnatural sounds at Brooks Camp. Vehicles regularly cross the floating bridge 6 to 10 times per day. Noise from heavy equipment being used at the barge landing area also can be heard near the bridge, depending on wind direction, two to three times per week when barges are unloading supplies. Other noise sources that were audible at the lower river platform included voices of people (77 percent of the time audible), motors (16 percent of the time audible), and heavy equipment (5 percent of the time audible). Total noise levels were as high as approximately 70 decibels adjusted (dBA) (L_{max}) and almost 50 dBA (L_{eq}) during the middle of the day (NPS 2010e). (L_{max} is the loudest sound level generated in an area. L_{eq} is the average squared sound pressure level (A weighted) expressed in decibels.)

CULTURAL RESOURCES

ARCHEOLOGICAL RESOURCES

The Brooks River Archeological District (designated a national historic landmark in 1993) is comprised of at least 22 well-preserved archeological sites along the beach ridges and river terraces of the approximately 1.5 mile-long Brooks River and adjacent portions of Lake Brooks and Naknek Lake. The archeological resources date from about 2500 BC to historic times and represent nine primary cultural phases. Surface archeological resources include more than 900 recorded depressions that have been documented, in some instances, to represent semisubterranean house sites. Archeological research has demonstrated that surface features likely represent a fraction of the houses preserved beneath the surface. Hearths, storage pits, house floors, human burials, and faunal remains have also been identified. For much of the time that humans have occupied the area, the seasonal salmon runs in Brooks River have served as a primary component of their subsistence base (NPS 1992).

The following cultural traditions, periods, and phases are represented in the district's archeological record (from Dumond 1981). Individual sites frequently contain evidence of multiple phases and occupation periods:

Northern Archaic Tradition—Kittewick Period, Brooks River Beachridge Phase *(ca. 2500 BC to 1900 BC)*—Primary features associated with this hunting-focused phase include temporary campsites along a ridgeline formed by Naknek Lake. Leaf-shaped knife and lance points of percussion-chipped igneous rock are characteristic artifacts of the phase.

Kodiak Tradition—Kittewick Period, Brooks River Strand Phase *(ca. 2500 BC to 1900 BC)*—People associated with this early phase of the Kodiak tradition are thought to have seasonally hunted caribou in the interior Alaska Peninsula. Among the associated resources are temporary campsites, subcircular dwellings, polished slate knife and lance blades, and D-shaped stone oil lamps.

Arctic Small Tool Tradition—Gomer Period, Brooks River Gravels Phase *(ca.1800 BC to 1100 BC)*—Notable features associated with this period are square, semisubterranean houses with central hearths, passageways, and campsites. Sites have been found on ridges overlooking both sides of Brooks River. Characteristic artifacts include well-fashioned end blades and scrapers, but ceramics are not among the assemblage. The district is thought to contain the largest concentration of cultural material from this phase in Alaska and possibly North America.

Norton Tradition—Brooks River Period, Smelt Creek Phase *(ca. 300 BC to AD 100)*. This phase is characterized by small, semisubterranean houses on the lower Naknek River and campsites without constructed hearths along Brooks River. The earliest appearance of ceramic vessels in the area is associated with this phase. Other distinguishing artifacts include asymmetrical side blades, drills, and projectile points with long contracting stems/bases.

Norton Tradition—Brooks River Period, Weir Phase *(ca. AD 100 to AD 600)*—Distinguishing features from this phase include semisubterranean houses and temporary campsites placed in existing depressions. Cylindrically shaped pottery, stemmed projectile points with rounded shoulders, and

notched pebble sinkers (used for fishing) are distinguishing artifacts.

Norton Tradition—Brooks River Period, Brooks River Falls Phase *(ca. AD 600 to AD 1050)*—Short-term campsites associated with this fishing-focused phase are concentrated near Brooks Falls. No distinctive house sites have been identified, although these may have been obscured by subsequent occupations. Clay and bark-lined pits have been identified. Ceramics, small chalcedony projectile points, and polished lance blades are among the artifact assemblage.

Thule Tradition—Naknek Period, Brooks River Camp Phase *(AD 1050 to AD 1450)*—A large concentration of sites from this phase is found on the north side of Brooks River, east of the falls. Temporary campsites, clay-lined pits, burials, and house sites (some with evidence of year-round habitation) have been identified. The phase is characterized by gravel-tempered pottery, clay lamps, cold-trap house entryways, and an extensive use of polished slate for making tools (e.g., barbed dart blades).

Thule Tradition—Naknek Period, Brooks River Bluffs Phase *(ca. AD 1450 to AD 1800)*—A wide variety of features have been identified from this phase, including multiroom houses(suitable for winter habitation), sweathouse, fish-drying rack, and temporary campsites. Defining artifacts include smoothly polished adze blades, projectile insert blades, barbed arrowheads, harpoon dart heads, and ceramics. European trade items are not found among the artifacts.

Thule Tradition—Naknek Period; Pavik Phase *(ca. AD 1450 to AD 1800)*—This phase is differentiated from the Brooks River Bluffs Phase by the presence of a small number of European American trade items; the phase otherwise retains the same traditional cultural items among the artifact assemblage. Scant archeological evidence for the Pavik Phase has been identified in the Brooks River Archeological District.

The district's archeological sites incorporate a large concentration of stratified cultural deposits that significantly enhance understanding of the lifeways of indigenous populations, including the late prehistoric Thule tradition (Brooks River Bluffs Phase) and all preceding cultural phases beginning with prehistoric Northern Archaic peoples. The archeological record indicates that the Brooks River area sustained both seasonal and year-round occupations, supported by a stable and plentiful resource base of caribou (the primary focus of the area's earliest hunters), seasonal salmon runs, other marine and terrestrial fauna, and edible plants. A series of volcanic eruptions during the past 6,500 years have deposited layers of ash that serve as reliable stratigraphic markers, assisting archeologists with site dating and comparative analysis. The primary prehistoric resources are below the ash layer of the 1912 Novarupta Volcano eruption. The district retains the potential to yield further important information regarding cultural history, prehistoric subsistence strategies, settlement systems, and cultural ecology (among other research topics) (NPS 1992).

Areas of anticipated ground disturbance associated with proposed construction activities (i.e., bridge, boardwalks, ramps, and new barge landing site and administrative road) were archeologically surveyed and tested in 2008, 2009, and 2010 by NPS staff. The 2008 work consisted of preliminary investigations of the north side of Brooks River at the Corner and evaluation of archeological remains of the original Northern Consolidated Airlines fish camp. No national register-eligible archeological resources were identified. The 2009

investigations were conducted along possible boardwalk alignment in wetlands on the south side of the river. No archeological resources were identified.

In 2010, archeological shovel testing was completed in advance of geotechnical drilling required to determine the depth of suitable bedrock capable of supporting the bridge and platform footings. Testing conducted in the Brooks Camp area uncovered charcoal, charred bone fragments, ceramic shards, and lithic material likely associated with a previously recorded prehistoric site (XMK-044). The findings demonstrated that although the area had been previously impacted by modern development and construction activities, the site's buried prehistoric resources continue to retain archeological integrity (Vinson 2010a).

Archeological testing along the proposed route of the proposed access road to the barge landing led to the discovery of at least one prehistoric component associated with previously recorded site XMK-037. The site is comprised of three clusters of historic house depressions. The investigations greatly expanded the site boundaries, and lithic artifacts uncovered at the site are anticipated to enhance understanding of prehistoric workshop activities and household economies associated with habitation on Naknek Lake (Vinson 2010b).

ETHNOGRAPHIC RESOURCES

The National Park Service defines *ethnographic resources* as "a site, structure, object, landscape, or natural resource feature assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it" (NPS 28: *Cultural Resources Management Guideline*). Ethnographic resources typically hold significance for traditionally associated peoples whose shared sense of purpose, existence as a community, and identity as an ethnically distinct people are closely linked to particular resources and places.

Brooks River Archeological District National Historic Landmark, or portions thereof, has also been identified as a potential ethnographic landscape and potential traditional cultural property (i.e., an ethnographic resource meeting the criteria of eligibility for the National Register of Historic Places). The draft traditional cultural property inventory for the Brooks River area (Agli 2006) recognizes the district by its traditional Sugpiat/Alutiiq name, *Kittiwick*, which translates to mean a sheltered place behind a lookout point. For thousands of years, according to oral history and traditions, the Alaska Peninsula Sugpiat people used the area for subsistence hunting, fishing (primarily for redfish/salmon), and plant gathering. These people traditionally built semisubterranean houses using wooden posts and log cribbed roofs. The structures were covered with mud and sod. Related to the Kodiak Island people, the Sugpiat developed a widely diversified subsistence strategy based on land and sea resources. Substantial permanent settlements were established near the mouth of Brooks River and the vicinity of Brooks Camp that persisted until early historic times. Permanent settlement then shifted east to the Savonoski River and the lower Naknek River (Agli 2006; NPS 1999a; URS Group Inc. 2009a).

The Brooks River area is considered the ancestral homeland for many indigenous Sugpiat people who continue to use and revere the area as a place of shared traditions, kinship ties, and other spiritual/cultural connections. The Council of Katmai Descendants, formed in 1994, represents those peoples with cultural ties to the area. The council also serves as an advisory group and source of traditional knowledge for the native descendants (Agli 2006).

Information provided by the Council of Katmai Descendants and identified in published ethnographic and historical sources include several places, resources, and activities contributing to the area's significance as an ethnographic landscape. These include the following:

- water bodies and associated features (e.g., Brooks River, Naknek Lake, Lake Brooks, the spit at the mouth of Brooks River, Beaver Pond).
- archeological sites and burial locations on the north and south sides of Brooks River.
- Dumpling Mountain and the trail leading to the top of the mountain.
- habitation features located in the protected property (conservation easement area as follows: fish racks, net anchors, tents, meat caches, sheds, outhouses, smokehouses, gardens, and boat launching areas
- transit routes from winter homes to seasonal use sites (e.g., from Old Savonoski down Iliuk Arm (pre-1912); from South Naknek and New Savonoski up Naknek River and across Naknek Lake to Brooks River (post-1912); former trails along the shore of Naknek Lake leading from the river mouth to Dumpling Mountain and to the entrance of Iliuk Arm).
- plants and berries traditionally consumed and/or used for medicinal and other purposes.
- the annual harvesting of redfish from Brooks River remains a traditionally important activity.

The 1912 eruption of Novarupta Volcano resulted in the widespread displacement of the area's traditionally associated people from their former villages and forced Sugpiat inhabitants of Savonoski to abandon their village at the east end of Naknek Lake. The Sugpiat returned to the region after the effects of the eruption diminished, but shifted their traditional redfish harvest to Brooks River where they seined redfish from the north and south banks and established camps, cabins, and boat launching points at the river mouth. The National Marine Fisheries Agency operation at the head of the river and growing numbers of fly-in sports anglers had little effect on the Sugpiat people's ability to conduct traditional activities.

Beginning in the 1950s, development associated with operations of the park concessioner and the National Park Service at Brooks Camp presented greater disturbance to sites and resources and disrupted the traditional use activities of the Sugpiat people. Impacts were compounded by increasing numbers of anglers and visitors to the area. Development actions (e.g., completion of the Valley Road linking Brooks Camp with Valley of Ten Thousand Smokes, NPS use of the spit road and loading ramp, installation of the floating bridge over the river, and construction of the bear viewing platform and boardwalk on the south side of the river) have impinged on the ability of the Sugpiat to conduct activities on Brooks River in a manner and setting to which they were traditionally accustomed.

In 1981, the National Park Service closed Naknek Lake to gill net fishing including the harvest of redfish at Brooks Camp. Although federal law changed in 1996 to allow the harvest of redfish, high numbers of bears and visitors, later closing dates for Brooks Camp, and other regulations continue to discourage the traditional late season redfish harvest.

A land parcel on the south side of the river was originally part of a 160-acre Alaska Native allotment filed by Sugpiat elder Mrs. Palakia Melgenak in 1971. The application was contested for several years and finally settled in 1997 with a court ruling that granted 80 acres to the heirs of Palakia Melgenak. The National Park

Service purchased the western two-thirds of the allotment in fee simple and purchased a conservation easement on the eastern one-third of the allotment ("protected property," figure 3). No new development by the National Park Service shall occur on the protected property without the National Park Service first consulting, obtaining, and considering the views of the heirs. The family retained a 7.97-acre "exclusive use area" along the shore of Naknek Lake between the mouth of Brooks River and Beaver Pond. A cluster of log cabins were constructed in this area during the 1920s/1930s. Ten acres on the east end of the Iliuk Arm of Naknek Lake near the mouth of Savonoski River were also conveyed to the heirs of Palakia Melgenak (Agli 2006; NPS 1999a).

No systematic ethnographic investigations of the Brooks River area have been completed to date. The National Park Service initiated an ethnographic resource survey of the area in 2010 that is anticipated to further identify and document sites, resources, and customary uses that have cultural importance to the area's traditionally associated people.

HISTORIC BUILDINGS, STRUCTURES, AND CULTURAL LANDSCAPES

During the first half of the 20th century (particularly from the 1920s through the 1940s), a number of self-sufficient individuals trapped beaver, fox, and other fur-bearing animals in the Katmai area. In common with trappers throughout Alaska, they built subsistence cabins and other structures near lakes and rivers. They typically supplemented the income they made from trapping during the long winters by working at various Bristol Bay fish canneries during the summer. An expansion of the Katmai National Monument boundaries in 1931 brought those trapping within the monument boundaries into conflict with NPS resource protection policies. This effectively ended the trappers' lifeway in the Katmai area, and only a few instances of illegal trapping have occurred since 1950 when the National Park Service established a management presence at Brooks Camp (NPS 1999a).

Among the historic structures associated with trapping in the general project vicinity is Scott's cabin and associated outbuildings. These were constructed in the late 1920s by trapper Stephen M. Scott (nicknamed "Portland Packer Scotty"). The small log/earthen cabin, caches, and other structures are about midway between Naknek Lake and Lake Brooks, on the south side of Brooks River. The cabin complex has been determined eligible for the National Register of Historic Places (NPS 1999a).

In 1941, the U.S. Fish and Wildlife Service began construction of the National Marine Fisheries Research Station at the eastern end of Lake Brooks near the head of Brooks River. The rustic log research station and field laboratory supported a successful fish research and management program at the site for more than 30 years. The U.S. Fish and Wildlife Service also constructed a salmon-counting weir, a concrete fish ladder bypassing Brooks Falls, and a road linking Brooks and Naknek Lakes. The National Park Service acquired the research station in 1979 and adapted it for employee housing. The research station has been determined eligible for the National Register of Historic Places (NPS 1999a).

The first tourism-related structures at Brooks Camp were constructed in 1950 as part of a sportfishing camp developed by Northern Consolidated Airlines, the park's first concessioner. Most of the camp's original wall tents were later replaced with prefabricated wood cabins. Among the additional structures built by the concessioner during the 1950s and 1960s were a manager's quarters/store, cookhouse, bathhouse, powerhouse, guest cabins, and Brooks Lodge. The National

Park Service also undertook initial facility development at Brooks Camp in the 1950s with the construction of a rustic log ranger station (1955) and boathouse (1959). The ranger station was the first permanent NPS station in the park (NPS 1999a). Both the ranger station (currently used as a visitor center) and boathouse (currently used as a ranger station) were listed in the National Register of Historic Places in 2010.

The 22 mile-long Valley Road, constructed in 1962 as part of NPS Mission 66 improvements, linked Brooks Camp with Valley of Ten Thousand Smokes. The road substantially contributed to the growing popularity of Katmai National Park and Preserve as a tourist destination. Also in the 1960s, the National Park Service constructed additional facility buildings and employee housing at Brooks Camp. Existing trails and circulation pathways were expanded and improved during this period as well (NPS 1999a; NPS, Ferreira 2011).

The National Park Service is evaluating the Brooks Camp area as an historic district and cultural landscape with significance linked to its historical associations with the early period of tourism and park management.

Additional Investigations

All cultural resources within the project area will be inventoried, and potential effects will be assessed to avoid or minimize adverse effects. Archeological surveys including subsurface testing were conducted in July 2010 for areas of potential project ground disturbance within the national historic landmark district (e.g., geological testing for bridge foundations, new road alignment to the barge landing site, and boat storage area). The Brooks Camp Historic District Cultural Landscape Inventory was completed and the Alaska state historic preservation officer concurred that the Brooks Camp Historic District is eligible for listing on the National Register of Historic Places. An ethnographic resource survey was initiated in late summer 2010 to document the potential ethnographic cultural landscape comprising the lower Brooks River area. The survey would identify and document places of cultural importance to native Katmai area descendants. The ethnographic traditional use / cultural landscape information would be compiled and a determination of eligibility for listing in the National Register of Historic Places would be submitted to the state historic preservation officer along with a section 106 assessment of project effects on ethnographic resources.

VISITOR USE AND EXPERIENCE

VISITOR ACCESS AND TRANSPORTATION

Katmai National Park and Preserve is on the Alaska Peninsula. Park headquarters are in the town of King Salmon, about 290 air miles from Anchorage, Alaska. Brooks Camp is about 35 air miles from park headquarters in the western section of the park.

During the summer, Brooks Camp is only accessible by floatplane or boat. Most visitors fly into Anchorage or King Salmon and purchase a passage on a floatplane to Brooks Camp, which is approximately 30 air miles from King Salmon. Floatplanes can land on Naknek Lake, located directly adjacent to Brooks Camp, or on Lake Brooks, which is upriver from the camp. A park maintenance road south of the river connects Lake Brooks to the Brooks Camp area and provides bus tour access to Valley of Ten Thousand Smokes (southeast of Brooks Camp).

Boats can reach Brooks Camp via Naknek Lake from Lake Camp, which is connected by road to the villages of Naknek and King Salmon west of the park boundary. Several commercially authorized operators provide air taxi and boat access. Visitors must make their own arrangements to arrive to the Brooks Camp area.

Brooks Camp is on the north side of Brooks River. An 8-foot-wide, 320-foot-long floating bridge over the river provides essential access between Brooks Camp and areas on the south side of the river such as the bear viewing platforms, Valley of Ten Thousand Smokes bus parking area, and Lake Brooks floatplane arrival area. This is a seasonal bridge, installed every spring and removed in the fall. The bridge is a pontoon-style made of metal framing and wood coverings and railings. It is used by both pedestrians and light utility vehicles and is managed as a travel corridor, not a viewing platform. Once across the bridge visitors and staff alike must use a trail to access the camp area. This trail passes through a vegetated area on the north bank of the river—the Corner, which often creates a point of congestion for traffic flow during high use periods. The Corner is a site of high bear activity, and consequently "bear jams" occur frequently in this area.

Building materials, fuel, vehicles and equipment, and other supplies are brought to Brooks Camp on a barge. Currently, there is a barge landing at the mouth of Brooks River on the south side. An NPS administrative road connects the barge landing to the floating bridge and to the bus parking area to the south (see "Park Operations" section for more information).

BROOKS RIVER BRIDGE DURING HEIGHTENED VISITATION

VISITOR ACTIVITIES

Although Brooks Camp is now known primarily for viewing bears, it was originally established to accommodate sport fishing, which is still an important recreational use in the area (Sherwonit 1996). An elite group of fly anglers travel to Brooks River to hook trophy rainbow trout in the same waters as the bears that fish for salmon.

A study of Brooks Camp visitors conducted in July 2006 revealed that nearly all visitors came to the site to view bears (97 percent). Most visitors participated in multiple activities, however, which also include photography (80 percent), visiting the visitor center (75 percent), purchasing items in the bookstore (51 percent), dining (47 percent), day hiking (25 percent), attending ranger-led walks (20 percent), picnicking (20 percent), staying in lodging (16 percent), and camping (13 percent). Less common activities (less than 10 percent participation) include taking guided tours, fishing, backpacking, and boating. (Littlejohn and Hollenhorst 2007).

Although fishing is not represented as a common activity in this study, the July timing may have caused the anglers to be underrepresented in the survey sample, as fishing is most popular later in the summer. In 2009, user days spent sport fishing made up 15 percent of total user days at Brooks Camp, as reported by the concessioners (NPS 2009i). User days reflect one person for one day; therefore, if three people are on a trip for two days, this will be represented as six user days (NPS 2010f).

No retention of fish in Brooks River above the floating bridge is permitted due to the difficulty of safely removing fish without causing dangerous bear interactions. A small percentage (~2 percent) of visitors and residents do engage in catch-and-keep fishing downriver of the bridge (Littlejohn and Hollenhorst 2007).

VISITOR FACILITIES, SERVICES, AND AMENITIES

Bear viewing is the primary activity at Brooks Camp, and viewing platforms and elevated walkways have been installed to facilitate bear viewing while minimizing

human-bear interactions and associated impacts. Primary viewing areas include Brooks Falls platform, Riffles platform, and the Lower River platform on the south shore of Brooks River. These platforms rise nearly 10 ft above grade and were each designed to accommodate up to 40 people at one time.

A trail network exists, linking the Brooks Camp area to nearby attractions such as Brooks Falls, Valley of Ten Thousand Smokes, a reconstructed semisubterranean house exhibit, and Dumpling Mountain. This network includes an elevated walkway to the Brooks Falls viewing area. Anglers are the primary users of several social trails that are unmanaged and unmaintained by park staff, including one along the lakeshore from Brooks Camp to the mouth of the river, one from the north bridge access point west to a point along the river, and a social trail leading from Brooks Camp to the popular oxbow area. Most maintained trail sections in the Brooks River area are universally accessible; however, a few trail sections exceed the minimum grade for accessibility and/or contain uneven surfaces. During periods of low water in Brooks River, which usually occur in June and early July, the ramps and gates on each side of the floating bridge also tend to exceed the minimum grade for accessibility. In addition, persons with mobility impairments would need to be prepared to move from trails or other areas should a bear come into the vicinity. Although there are no data available as to the number of people with mobility impairments that come to Brooks Camp, the way in which visitors answered other questions in the July 2006 study imply that they are a small percentage (less than 5 percent) of visitors (Littlejohn and Hollenhorst 2007).

Overnight accommodations at Brooks Camp include Brooks Lodge and a walk-in campground. Brooks Lodge, operated by concessioner Katmailand, Inc. since 1982, is an overnight facility open between June and September. It has 16 rooms that can accommodate up to four people per room. The lodge also includes a dining area, bar, and visiting area with fireplace.

The Brooks Camp campground, operated by the National Park Service, can accommodate a maximum of 60 campers per night. Campground reservations must be made in advance either online or by phone. The campground includes potable water and two vault toilets. Campers can also purchase hot showers at Brooks Lodge. Three cooking shelters and picnic tables are provided for centralized cooking. Campers can also purchase hot meals from Brooks Lodge. There are not phone or Internet services provided. The campground is surrounded by an electric fence and food and gear storage caches are provided for bear safety. Additionally, all visitors must check in at the Brooks Camp Visitor Center and receive bear and campground orientations.

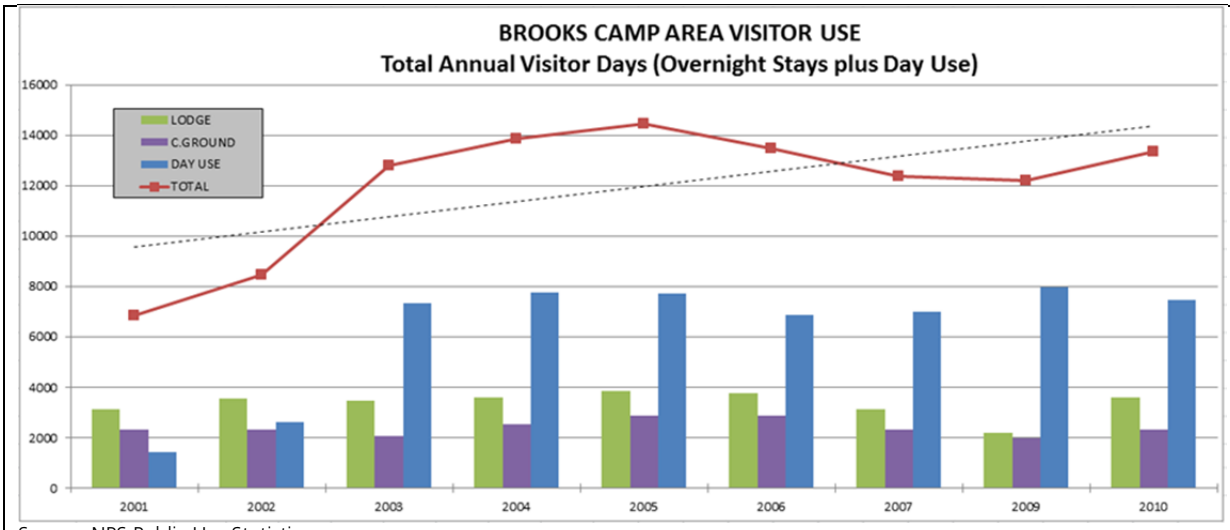
The Brooks Camp Visitor Center is a small log cabin with a modern addition on the shore of Naknek Lake near Brooks Lodge. It provides a central location for presenting the bear orientation program and contains a small gift shop managed as an outlet of the cooperating association, Alaska Geographic.

A variety of NPS interpretive programs are offered at Brooks Camp. According to the July 2006 visitor survey (Littlejohn and Hollenhorst 2007), about 36 percent of visitors reported participating in informational or interpretive programs. Each evening NPS interpretive rangers give illustrated talks at a small auditorium on topics such as the natural and cultural history of the area. Rangers also lead an interpretive program on the bus tours of Valley of Ten Thousand Smokes. Other interpretive programs, such as a cultural walk to the reconstructed semisubterranean house exhibit and hikes to Dumpling Mountain and other nearby sites, are offered on occasion.

Multiple commercial service providers, based outside of Katmai, but operating within the park, function in and around the Brooks Camp area, providing other guided services including bear viewing tours, fishing excursions, kayak trips, and transportation services. These activities are managed by the National Park Service under commercial use authorizations (CUAs).

VISITOR SEASON AND VISITOR USE LEVELS—OVERALL

Brooks Camp receives approximately between 12,000 to 14,000 visitors each summer (figure 13), reaching almost 300 visitors per day during peak use periods in July. It is the most popular area in Katmai National Park and Preserve (in July 2006, 61 percent of all park visitors reported visiting the Brooks Camp area).



Source: NPS Public Use Statistics
Note: Data from 2008 was not included due to recording inaccuracies.

FIGURE 13. ANNUAL VISITOR DAYS (OVERNIGHT STAYS PLUS DAY USE)

All arriving visitors must check in and receive an orientation on bears at the Brooks Camp Visitor Center (unless they are with a sport fishing guide, in which case the guide conducts the orientation). In 2010, the Brooks Camp Visitor Center had more than 13,000 visitors; most of them came in July (NPS 2011).

The July 2006 visitor study suggests that the most visitors to the Brooks Camp area come for the day only (Littlejohn and Hollenhorst 2007). Figure 13 shows the distribution of day versus overnight use. For the past eight years, overnight use has represented approximately 44 percent of visitor use at Brooks Camp. This use is split between the Brooks Camp campground, Brooks Lodge, and overnight backcountry users.

Although open from June 1 through September 17, the Brooks Camp campground is only at or near capacity from the last week of June through the entire month of July. The campground can accommodate up to 60 campers, and the 10-year average from 2001–2010 is 45 campers per night (total number of monthly visitors divided by the number of nights) in July. In 2010, the average number of visitors per night in July was 59 (NPS 2011). It is important to note, however, that group sizes and lengths of stay varied significantly over this period—groups as

large as 44 people and lengths of stay as long as 7 nights were reported.

Similar to the campground the Brooks Lodge is typically full during peak season. During the 2010 season, the lodge had a total of 1,404 (351/month average) room nights or 3,590 (898/month average) bed nights. July is typically the busiest month—in 2010, the lodge had more than 1,300 overnight visits. The operator of Brooks Lodge, the concessioner Katmailand, Inc., provided more than 1,000 Valley Tours, 19 guided wildlife viewing tours, and 22 guided fishing tours in 2010.

VISITOR USE LEVELS—CROWDING

Visitor use levels and crowding have been a topic of concern at Brooks Camp for several years (Womble and Studebaker 1981). In the July 2006 study, when compared to other areas of Katmai, Brooks Camp visitors reported the highest levels of perceived crowding. Forty percent of visitors rated the crowding as "moderate," 12 percent of visitors rated it as "very crowded," and 4 percent of visitors rated it as "extreme" (Littlejohn and Hollenhorst 2007).

Because of the popularity of the Brooks Falls viewing platform and resulting use levels, this platform's capacity is strictly managed. The platform can accommodate a maximum of 40 people simultaneously. When the platform fills to capacity a waiting line is formed and viewing times are restricted to one hour. During these access restriction times waiting visitors are encouraged to view bears on the Riffles platform until space is available.

Crowding also occurs at the Corner and on the lower river platforms during bear jams, when the bridge is closed due to bears blocking safe access. While foot traffic is halted, waiting for the bears to move, many visitors who would otherwise be spread out are directed by NPS staff to remain on the lower bear viewing platform or near the Corner for extended periods, which causes visitors to become bunched together. Visitation levels are highest in July, but data from a 2011 study found that the bridge was open more often than closed in July. In September, although visitation is lower than in July, the bridge was closed more often than it was open due to higher usage of the lower river by bears (NPS 2011b).

Despite the increased level of crowding, 48 percent of visitors reported that bridge closures "added to" their experience and only 7 percent reported that it detracted from their experience (Littlejohn and Hollenhorst 2007). Bear jams add to visitor experience by providing an intimate yet safe bear encounter. The presence of uniformed rangers provides reassurance of safety, while the proximity to wild bears gives visitors a sense of adventure.

VISITOR SAFETY

While bear viewing is the primary reason visitors come to Brooks Camp, it also presents the most significant visitor safety concerns (human-bear interactions are detailed in the "Natural Resources" section of this chapter).

Human-bear interactions are of primary concern in the lower Brooks River area during the salmon run and spawning seasons. In July and September, visitors regularly come into close proximity to bears when fishing in the river, walking around the Corner area, travelling along the trail connecting the campground to the lodge, and travelling along the trail from the lower river platform to the falls platform. The lower river area and location of the floating bridge coincides with an important feeding ground for bears. The fact that the floating bridge is at ground level also contributes to higher opportunities for human-bear interactions. Consequently, visitors are frequently prevented from crossing the river, often for

extended lengths of time, while waiting for the bears to move out of the area. As a result, NPS staff has posted an advisory notice on its website informing visitors to take these delays into consideration when planning their daily itinerary. Another major safety concern involves recreational anglers coming into contact with bears in the waters of Brooks River or on its banks. Human-bear interactions are also common on the beaches along the shores of Naknek Lake.

NPS staff, including interpretive, resources management, and law enforcement rangers, is stationed at Brooks Camp during the season to ensure visitor safety, among other duties. All visitors arriving at Brooks Camp must check in at the visitor center and the majority participate in a bear orientation program. This 20-minute program provides visitors with essential information on how to behave in bear country, e.g., storing food, fishing activities, what to do in case of wildlife encounters, and other important topics. The only excepted visitors are those who are guided sport fishing anglers; the sport fishing guides who are part of the Brooks River Guide Program are required under a commercial use authorization to attend a bear orientation and pass the information along to their clients. Guides are also responsible for staying within sight of their clients while at Brooks Camp.

Other bear safety measures include a designated cooking facility and food storage caches at the campground, which is also surrounded by an electrical fence to deter bear encroachment. Food storage caches and designated outdoor eating areas for day visitors are next to the Brooks Camp Visitor Center and at Lake Brooks. All backcountry users must carry and use bear-proof food storage containers.

Because of this management presence, the 10-year average from 2000–2009 of bear charges (including hop and bluff charges) is only two per year and of incidents involving bears accessing human food is only four per year. The average number of dominance interactions, defined as competition for space occurring between bears and humans when a bear is not surprised (NPS 2009g), per year is a higher number at twelve per year, which is still a remarkably good statistic based on the amount of opportunity for human-bear interactions (NPS 2009h). No fatalities and only a couple of mauling incidents have been recorded. It is important to note, however, that successfully protecting visitors from bears is contingent on an intensive visitor use and bear management program. Under current conditions, this program relies on significant staff time, proactive education and information efforts, and strict enforcement and monitoring.

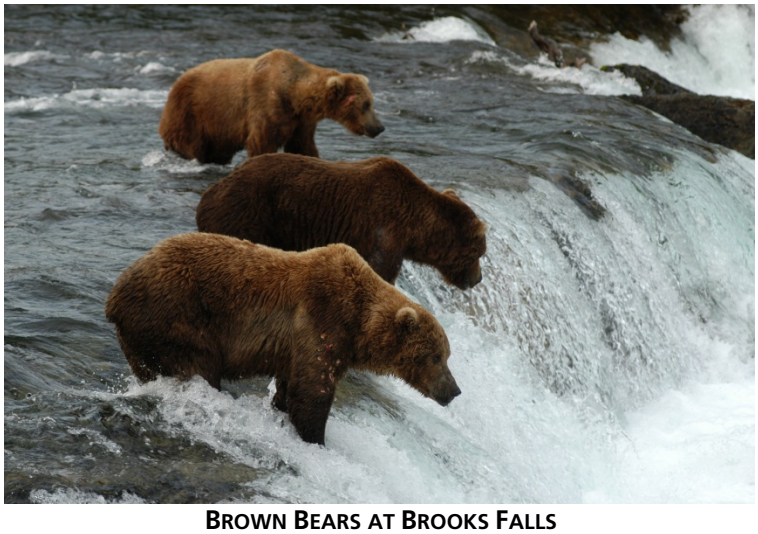
VISUAL RESOURCES/SCENERY

Nestled on the shores of Naknek Lake at the mouth of Brooks River among poplar trees and lush vegetation is the Brooks Camp area, known for its natural scenery. Naknek Lake is one of the largest lakes in the national park system. Its glacial waters frame the foreground for views of distant mountain peaks such as Mount Dumpling. Brooks River is surrounded by lush riparian vegetation, creating a superlative backdrop for bear viewing and other recreational activities. The combination of water, vegetation, and mountains produces a characteristically Alaskan backcountry scene that is integral to the Brooks Camp experience.

Most notably, Brooks Camp is known for its opportunity to view bears in their natural habitat. One of the most picturesque and popular areas for bear viewing is Brooks Falls, about 1 mile from Brooks Camp. At the falls, as well as along other segments of Brooks River, bears can be seen fishing for salmon during seasonal spawning runs.

There are several structures at Brooks Camp that facilitate access and bear viewing opportunities (which are presented earlier in this chapter). Existing buildings and structures are generally screened from view by the poplar stands, spruce forests, and low vegetation surrounding them. However, several structures, especially those near Brooks River and Naknek Lake shorelines, are noticeable in the otherwise natural and largely undeveloped landscape. The floating access bridge, made primarily of wood with a metal substructure, stands out and is clearly visible from both shorelines as it crosses Brooks River. In addition, one wooden viewing platform is near the river to facilitate bear viewing. Two other wooden viewing platforms and an elevated walkway in the Brooks Falls area are also present, with the structures rising nearly 10 ft above the ground in places. All of these structures are noticeable against the surrounding natural landscape.

Finally, human use affects visual resources in the Brooks Camp area. Crowds of up to 50 people at one time consistently form on and near the floating bridge during and immediately after bear jams.



BROWN BEARS AT BROOKS FALLS

SOCIOECONOMIC ENVIRONMENT

OVERVIEW

Katmai National Park and Preserve resides within the boundaries of four boroughs—Lake and Peninsula Borough, Kodiak Island Borough, Kenai Peninsula Borough, and Bristol Bay Borough. Bristol Bay Borough includes a small portion of the western tip of the park and includes the population centers nearest to the park and preserve. Therefore, the influence area for economic and social consideration associated with Katmai National Park and Preserve and this visitor access draft environmental impact statement would primarily focus on Bristol Bay Borough, which includes the communities of Naknek, South Naknek, and King Salmon, as well as connections to and relationships between Anchorage and the park and preserve.

The movement of most goods, supplies, commodities, and people in Alaska flow through Anchorage, and the city's transportation and economic ties to King Salmon and Katmai National Park and Preserve are strong. The park's transportation and economic connections to Anchorage are mentioned herein where appropriate. The communities of King Salmon and Naknek are also discussed given the economic links between these communities and Katmai National Park and Preserve. King Salmon is the community nearest the park, home to NPS headquarters and the King Salmon Visitor Center, and serves as the transportation hub for the region.

Bristol Bay Borough

The Bristol Bay Borough is southwest of Anchorage and is often referred to as the "Gateway to Katmai National Park and Preserve." This borough is on the Alaska Peninsula at the head of Kvichak Bay, an arm of Bristol Bay. This borough is one of 12 organized boroughs in the state that represents the more populated parts of the state and functions similar to a county in the Lower 48 (U.S. Census Bureau 2005).

Bristol Bay Borough was established in 1962, the first borough in the state. It is the official governing body for South Naknek, King Salmon, and Naknek (the borough seat). Naknek and South Naknek are situated on opposite sides of Naknek River on the western side of the borough, where the river meets Bristol Bay. South Naknek is a more traditional Alaskan community with no road between it and outside communities; the area's economy was and continues to be dominated by fishing and related industries-(Bristol Bay Borough 2010).

King Salmon

King Salmon serves as the regional transportation center. It is connected to the Naknek area via the Alaska Peninsula Highway. Although sparsely populated, King Salmon is directly connected to Anchorage via two commercial airlines.

The federal government has played a role in the community for decades—since the King Salmon Air Station was built at the beginning of World War II. The air station has been used as a fuel and support base, forward operating base, and as part of the nation's permanent air defense system. In 1959, the state acquired the airfield, which today serves as the commercial airport. The air station was placed in caretaker status in 1994, but daily military activities continue, including training missions and North American Air Defense missions. The Bristol Bay Borough, State of Alaska, and U.S. Fish and Wildlife Service use buildings

at the airfield (Bristol Bay Borough 2010 and Alaska Department of Commerce 2010).

Today, King Salmon's economy is driven by transportation, government jobs, and fishing-related employment (Alaska Department of Commerce 2010). A portion of the transportation, retail, and service industries in the community is supported by the many tourists and sportsmen visiting the region, including Katmai National Park and Preserve and Brooks Camp.

Naknek

Naknek is a fishing community about 15 miles west of King Salmon along the Alaska Peninsula Highway. It sits at the mouth of Naknek River where the river meets Kvichak Bay and Bering Sea. The population (552) was greater than King Salmon (409) as of 2008.

The economy is dominated by fishing and government employment. Salmon fishing and processing and the corresponding surge of people who come to fish each season is a major economic driver. Over 100 (approximately 25 percent) residents held commercial fishing permits in 2009 and several thousand people move to the area during fishing season. A cargo dock is located here, which is operated by Bristol Bay Borough and serves as the port of Bristol Bay. Naknek is the seat of Bristol Bay Borough and government employment is concentrated here (Alaska Department of Commerce 2010). In addition, most of the equipment and supplies for construction of the bridge and boardwalk would arrive by ocean barge to Naknek.

DEMOGRAPHICS

Population

Bristol Bay Borough's population was 1,410 in 1990 and was estimated to have decreased by 457 people by 2008. Each of the population centers in the borough also had a decrease in population between 1990 and 2008. King Salmon and South Naknek had the largest percentage decrease in population, 36 percent and 50 percent respectively (U.S. Census Bureau 1990b, 2000, 2008; Alaska Department of Labor and Workforce Development 2010a). See table 7.

TABLE 7. POPULATION OF BRISTOL BAY BOROUGH AND POPULATION CENTERS

	1990	2000	2008	Percent Change 1990–2000
Bristol Bay Borough	1,410	1,258	953	–11 percent
King Salmon	696	442	409	–36 percent
Naknek	575	678	552	–4 percent
South Naknek	136	137	68	–50 percent

Source: U.S. Census Bureau 1990b, 2000, and 2008 and Alaska Dept. of Labor & Workforce Development 2010a

Note: King Salmon, Naknek, and South Naknek data represents the respective census designated place.

ECONOMY AND EMPLOYMENT

The ability to earn a living in this area remains challenging because of its geographic isolation, lack of connectivity with major land transportation corridors, small population, and the seasonality of employment opportunities. The seasonal nature of employment is a direct result of the dominant industry in the area—

harvesting and processing wild sockeye salmon. The salmon fishing season typically runs from June to August, but differs depending on the species being fished (ADF&G 2007). Tax revenue is generated through property taxes, a raw fish tax, and a bed tax. There is no sales tax in the borough (Alaska Department of Commerce 2010).

The port of Bristol Bay is in Naknek and is the major cargo hub in southwest Alaska. Cargo destined for King Salmon is delivered to the Bristol Bay port and then trucked to King Salmon. The port, which is operated by the borough, is also the main location for offloading salmon from boat to shore. The Bristol Bay red salmon fishery is large and a critical source of employment and borough tax revenue, serving a critical role in the region's economy (Alaska Department of Commerce 2010). In 2007, there were 29.5 million fish harvested in Bristol Bay, with a preliminary estimated value of $106 million (Resource Development Council for Alaska, Inc. 2010).

The large salmon runs result in many people traveling to the area, for work and pleasure. Both commercial and sport fishing helps to support the air services industry, a large employer in King Salmon and the region. The salmon industry also helps to support the 34 residents of King Salmon and the 173 borough residents that held commercial fishing permits in 2008, as well as the many local residents that participate in net-fishing. The red salmon of this area not only impacts the economy through harvesting and processing, but tourists flock to the area, particularly to Brooks Camp in Katmai National Park and Preserve to watch bears feeding on salmon (Alaska Department of Commerce 2010). Spending at restaurants, bars, and hotels in King Salmon and the Bristol Bay area generate income for local business owners as well as tax revenue to provide government services.

Employment

The unemployment rate in Bristol Bay Borough decreased from 6.3 percent in 2004 to 4.3 percent in 2009, and was below that of Anchorage from 2006–2009. The unemployment rate has also been lower than that of the state as a whole since 2006 (Alaska Dept. of Labor and Workforce Development 2010c).

The average employment in Bristol Bay Borough for all industries, including the government, was 1,287 people per month in 2008. The borough's average monthly employment for all industries between 2004 and 2008 fluctuated from a low of 1,227 in 2005 to a high of 1,371 in 2007 (Alaska Dept. of Labor and Workforce Development 2010b.

Government also plays a role in the borough economy, employing 238 people, or more than 18 percent of the workforce (Alaska Dept. of Labor and Workforce Development 2010b. Government jobs also contribute to King Salmon's economy. State and local government employed 56 people in 2008. Total federal employment figures are unavailable for King Salmon, but the National Park Service and U.S. Fish and Wildlife Service are employers in King Salmon. The other industries with the most workers in 2008 were trade, transportation and utilities and educational and health services (Alaska Dept. of Labor and Workforce Development 2010a).

Economic Contributions of Katmai National Park and Preserve

Katmai National Park and Preserve serves an important role in the local and regional economy in the form of park operations, capital expenditures, federal payments in lieu of taxes, and visitor expenditures. The park and preserve contributes both directly and indirectly to economic activity locally, regionally, and statewide. Direct spending by the park and the indirect effect of employee spending in King Salmon

support local businesses and generate tax revenue. Visitor spending in King Salmon, Anchorage, and elsewhere benefits those respective economies. Much of the park's economic activity is related to Brooks Camp. The camp is a primary destination in the park and has many visitors as a result of wildlife watching and fishing opportunities.

The exact economic impact associated with visitation to Katmai National Park and Preserve is difficult to determine. The reasons for this are varied. Unique challenges to Katmai National Park and Preserve include the fact that the park is very geographically isolated and reaching it often involves purchasing flights or cruise packages outside of the park and outside of Alaska. For example, trips often originate in Homer, Soldotna, and Kenai. As a result, expenditure locations and amounts are difficult to isolate. The best available economic impact data try to account for the complexities unique to Alaska and is included below.

Data included in table 8 are based on the number of visitors to Katmai National Park and Preserve as a whole and are not isolated to Brooks Camp. Table 8 has three rows—the first row shows expenditures that were made within the Katmai National Park and Preserve boundary; the second row shows those expenditures made outside of the Katmai National Park and Preserve boundary; and the third row is weighted expenditures outside Katmai National Park and Preserve. Row 3 was calculated to more accurately "credit" Katmai National Park and Preserve visitor expenditures to better reflect the relative role Katmai National Park and Preserve played in overall Alaska trip plans. For example, if visitors came primarily to visit Katmai National Park and Preserve, then all of their expenditures in the state are credited to Katmai National Park and Preserve. If their trip to Katmai National Park and Preserve was unplanned, then fewer of their expenditures outside the park are credited to Katmai National Park and Preserve. Therefore, the weighted numbers are a conservative set of estimates (Fay and Christensen 2010).

TABLE 8. EXPENDITURES PER PERSON PER TRIP (2009 DOLLARS)

	Day Trip	Day Package	Overnight in Katmai NPP
Expenditures inside Katmai National Park and Preserve	$134	$501	$1,005
Expenditures outside Katmai National Park and Preserve	$1,046	$2,547	$1,701
Expenditures outside Katmai National Park and Preserve (weighted)	$455	$1,131	$1,081

Source: Fay and Christensen 2010

Visitor spending inside the park related to day trip and day packages was highest for transportation expenses (including airfare), followed by guide fees and charges. Overnight visitor spending inside the park and preserve was highest for transportation expenses (including airfare), followed by lodging and spending at restaurants and bars (Fay and Christensen 2010).

Table 9 shows that more than $51 million was spent in the state by visitors to the park and preserve and almost $32 million was spent in the five-borough region considered in the Fay and Christensen (2010) report, which includes the boroughs of Bristol Bay, Kodiak Island, Lake and Peninsula, and Kenai Peninsula as well as the Municipality of Anchorage. About 61 percent of the dollars spent in the five-borough region was outside the park and preserve, whereas, about 76 percent of expenditures in the state occurred outside the park and preserve. Visitor expenditures in the state by visitors to Katmai National Park and Preserve supported 647 jobs, generated $73 million in total industrial output, $23 million in labor income, and added a value of $37 million to the Alaska economy (Fay and Christensen 2010).

Concessions

As of 2008, Katmai National Park and Preserve had contracts with 10 concessioners to provide visitor services. The combined annual franchise fees for all contracts in 2008 were slightly less than $90,000. The services provided by these companies range from food and service operations to fishing guide services. By far the largest concessioner operating in the park is Katmailand, Inc., which operates the 64-bed Brooks Lodge and Grosvenor Lodge. The services they provide at Brooks Lodge include providing visitors with overnight accommodations, food services, showers, and restrooms. In addition, Katmailand, Inc. operates bus tours from the south side of the river at Brooks Camp to Three Forks Overlook at Valley of Ten Thousand Smokes.

Commercial Use Authorizations

Section 418 of the National Parks Omnibus Management Act of 1998, Public Law 105-391, authorizes the National Park Service, upon request, to issue commercial use authorizations to individuals, corporations, and other entities to provide commercial services to park and preserve area visitors. These commercial use authorizations are used to authorize commercial services to park and preserve area visitors, but they are not concession contracts. They are intended to provide a simple means to authorize suitable commercial services to visitors in park and preserve areas in the limited circumstances described in park and preserve establishing legislation. In 2008, there were 116 commercial use authorizations issued by Katmai National Park and Preserve. Of the 116, about 75 percent reported actual activity and therefore paid fees accordingly. In 2009, 123 applications for commercial use authorizations were received, and of those about 75 percent reported economic activity and paid fees accordingly. Of those that reported activity, the gross receipts for Brooks Camp commercial use authorizations in 2009 were about $482,000.

TABLE 9. EXPENDITURES IN FIVE-BOROUGH REGION AND ALASKA BY VISITORS TO KATMAI NATIONAL PARK AND PRESERVE IN 2007 (2009 DOLLARS)

Total Direct Expenditures inside Katmai National Park and Preserve	$12,335,897
Total Direct Expenditures outside Katmai National Park and Preserve in Alaska (weighted for Katmai National Park and Preserve influence)	$19,411,823
Subtotal (expenditures in the five-borough region)	$31,747,721
Total Direct Expenditures outside Katmai National Park and Preserve in Alaska (expenditures outside five-borough region)	$19,426,482
Total Expenditures in Alaska	**$51,174,203**

Source: Fay and Christensen 2010

KATMAI NATIONAL PARK AND PRESERVE OPERATING BUDGET

To fulfill the park and preserve mission to protect resources and provide for safe and memorable visitor opportunities, Katmai National Park and Preserve has an annual budget that supports NPS operations, including employees working in King Salmon and Brooks Camp. Tables 10 and 11 represent those funds and NPS staff authorized in each fiscal year budget for the park and preserve as a whole and Brooks Camp alone.

Table 10 includes the authorized park operating budget and full-time equivalent (FTE) employees for fiscal years 2006–2010. During the past five years, the authorized amount for the park and preserve has increased by almost $1 million to pay for additional staff hired to ensure visitor safety and pay for continued maintenance and operational needs.

Table 1Ĭ highlights the costs to operate Brooks Camp by division, as well as the number of FTE employees by division for the federal fiscal years 2006–2010. As shown in table 11, three of the approximately eight total FTE staff hired since fiscal year 2006 were additional interpretation staff at Brooks Camp (one full-time-equivalent employee could be two employees working part time). The interpretation staff was hired as full-time seasonal employees, replacing volunteers who had traditionally filled those positions.

In 2010, the operating cost of Brooks Camp comprised roughly 30 percent of the overall Katmai National Park and Preserve authorized budget and Brooks Camp FTE staff comprised about 42 percent of all NPS FTE employees working at the park. These figures only include the costs for direct operations at Brooks Camp and do not reflect the extensive amount of work done in the off-season related to planning work, hiring, procurement, training, repair, and maintenance of equipment, contracting, and aviation.

TABLE 10. KATMAI NATIONAL PARK AND PRESERVE OPERATING BUDGET

FY	Authorized Amounts	Park FTE
2006	$2,960,500.00	24.0
2007	3,024,100.00	27.0
2008	3,286,400.00	31.5
2009	3,596,100.00	33.2
2010	3,878,000.00	31.8

Source: National Park Service, Katmai National Park and Preserve

Note: FTE refers to full-time-equivalent staff.

TABLE 11. BROOKS CAMP OPERATING COSTS (2006–2010)

	Interpretation		Resource Management		Law Enforcement		Maintenance		Total	
FY	Cost	FTE	Cost	FTE	Cost	FTE	Cost	FTE	Cost	FTE
06	$76,218	2.0	$143,937	1.8	$101,606	1.6	$423,441	4.6	$745,202	10.0
07	110,017	1.9	132,299	1.4	107,592	1.7	461,545	4.7	811,452	9.7
08	254,009	5	121,451	1.5	143,751	1.5	523,345	5.1	1,042,555	13.0
09	229,464	4.8	121,938	1.8	158,882	1.6	543,273	4.9	1,053,558	13.2
10	254,826	5.0	102,500	1.7	147,787	1.5	630,890	5.0	1,136,002	13.2

Source: National Park Service, Katmai National Park and Preserve

Note: These are only costs for operations and do not reflect expenditures in the off-season.