Environmental Assessment

Plate Boundary Observatory Global Positioning System Network Installation and Maintenance in Alaska

in

Denali National Park and Preserve
Lake Clark National Park and Preserve
Katmai National Park and Preserve

U.S. Department of the Interior
National Park Service
Alaska Regional Office
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Glossary of Scientific Terms

Term	Definition
Active boundary zone	An area that is likely to have another earthquake.
Azimuthal coverage	The horizontal angular distance from a reference direction, usually the northern point of the horizon, to the point where a vertical circle through a celestial body intersects the horizon, usually measured clockwise.
BP	before present
Bedrock	The unweathered rock below the soil surface.
CGPS	continuous global positioning system
Deformation	Any change in attitude, shape, or volume of a bed or layer, after its formation. Deformation from earthquakes is the result of stress and strain.
Fault	A planar or gently curved fracture in the Earth's crust across which there has been relative displacement.
Geodetics	The scientific discipline that deals with the measurement and representation of the Earth, its gravitational field, and other geodynamic phenomena, such as crustal motion.
Geophysics	The study of the Earth by quantitative physical methods, especially by seismic, electromagnetic, and radioactivity methods.
Hypocenter	The site of an earthquake.
Lock faults	A locked fault is a fault that is not slipping because frictional resistance on the fault is greater than the shear stress across the fault (it is stuck). Such faults may store strain for extended periods that is eventually released in an earthquake when frictional resistance is overcome.
Metamorphic rock	Metamorphism: The changes of mineralogy and texture imposed on a rock by pressure and temperature in the Earth's interior.
Plate motions / sliding	Lateral movement of the major architectural features of the Earth’s crust.
Pyroclastic	Pertaining to fragmented (clastic) rock material formed by a volcanic explosion or ejection from a volcanic vent.
Kinematics	The branch of mechanics concerned with objects in motion.
Seismicity	The world wide or local distribution of earthquakes in space and time; a general term for the number of earthquakes in a unit of time.
Seismology	The behavior of earthquakes and the shock waves which they produce.
Seismometer	An instrument that measures motion of the ground caused by earthquake waves.
Strain	The deformation of rocks caused by stress.
Subduction zone	A dipping planar zone descending away from a trench and defined by high seismicity, interpreted as the shear zone between a sinking oceanic plate and an overriding plate.
Tectonics	The study of the major structural features of the Earth’s crust or the broad structure of a region.

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Chapter 1: PURPOSE AND NEED

1.1 Purpose of and Need for Proposed Action

The National Park Service (NPS) is considering a request from the University NAVSTAR Consortium Inc. (UNAVCO) to authorize construction and operation of its Plate Boundary Observatory (PBO) Project on land administered by the U.S. Department of the Interior (USDI). The NPS-administered lands are in Denali National Park and Preserve, Lake Clark National Park and Preserve, and Katmai National Park and Preserve in Alaska (Figure 1-1). The complete Proposed Action and alternatives considered are described in Chapter 2.

PBO is part of the EarthScope Program, which is comprised of the PBO, USArray, and the San Andreas Fault Observatory at Depth. It is a congressionally funded National Science Foundation (NSF) Major Research Equipment and Facilities Construction (MREFC) project. The MREFC account supports the acquisition, construction, and commissioning of major research facilities and equipment that provide unique capabilities at the frontiers of science and engineering. The PBO is being constructed by UNAVCO, an NSF funded science support facility consisting of the construction and operation of a geodetic observatory for the purpose of studying the Earth's surface deformation across the active boundary zone between the Pacific and North American plates in the western United States and Alaska. UNAVCO's EarthScope partner, the USGS is the lead federal agency with responsibility under the Stafford Act to provide notification and warnings for earthquakes, volcanoes, and landslides. EarthScope/PBO instrumentation proposed in the National Parks in Alaska would augment and enhance the USGS' ability to fulfill their federal mandate.

The EarthScope Program was funded as a national science initiative to explore the structure and evolution of the North American continent and the physical processes controlling earthquakes and volcanoes. EarthScope is taking an integrated, interdisciplinary approach to study the active earthquake zones, individual faults and volcanoes, deformation along plate boundaries, continental geodynamics and plate tectonic motion, fluids in the crust, and volcanic and seismic hazards. It will image Earth structure and measure deformation across the contiguous United States and Alaska with a level of detail and data accessibility never seen before. A clearer understanding of the forces that shape the environment will translate into better assessment of earthquake and volcanic hazards.

Currently, a very sparse geodetic network exists in the western continental U.S. and Alaska. Alaska had only 16 continuous global positioning system (CGPS) stations at the start of the PBO Project. Compared to the PBO network, this limited coverage contributes to a lack of

understanding of basic Earth processes, (i.e., active faulting and earthquakes and volcanic hazards) resulting in public safety risks and gaps in human understanding of fundamental Earth processes. In all, the PBO network will have 142 new CGPS stations in Alaska. This proposal for six new CGPS stations is designed specifically to fill the gaps in, and thus increase the accuracy of, the existing geodetic network by installing the new CGPS stations in a carefully designed and integrated network.

Denali National Park and Preserve is a high-risk area lacking adequate monitoring for potentially dangerous lock faults and strain accumulation. Katmai and Lake Clark National Parks and Preserves are in a very active subduction zone with a history of strong earthquakes and volcanic activity in historic times, including recent years. Very little is known about plate motions in this area. The United States Geological Survey Open File Report 95-624 indicates numerous earthquakes have occurred in the subject area since the 1964 Great Alaska Earthquake, and many of these contributed to the ongoing deformation in the region. No PBO stations are currently located in any of the national parks in Alaska.

Stations AC08 (Cape Douglas-Katmai National Park and Preserve) (Figure 1-2), AC37 (Lake Clark NPS Radio Hut-Lake Clark National Park and Preserve) (Figure 1-3), and AC47 (Slope Mountain-Lake Clark National Park and Preserve) (Figure 1-3) would be located within the Cook Inlet Region of southcentral Alaska. Permanent CGPS stations in these locations would be used by researchers at the University of Alaska-Fairbanks Geophysical Institute (UAF/GI) to detect and monitor ongoing regional deformation associated with the 1964 Good Friday magnitude (M) 9.0 earthquake, which was caused when the North American plate slid over the top of the Pacific plate after centuries of building pressure. The Denali Fault (DF) lies to the north of Lake Clark National Park and Preserve. The Castle Mountain Fault (CMF) traverses west-southwestward and then becomes the Lake Clark Fault (LCF). There are splays off the CMF that likely reduce the slip rate on the LCF, but essentially they are the same faults. The proposed GPS stations in Lake Clark National Park and Preserve are vital to understanding how much strain is transferred from the CMF onto the LCF. This is a primary reason for the PBO site. There is, in addition, an indirect, but important, connection between the DF and the LCF. The crust south of the DF is rotating counterclockwise and pushing westward. It is not clear how much of the DF strain makes its way onto the LCF system versus what is taken up in the north-south trending part of the western Alaska Range (Haeussler 2007)

Station AC26 (Cape Gull-Katmai National Park and Preserve) (Figure 1-2) would be used to identify and detect both 1964 postseismic deformation and help to define slip rates on the eastern end of the Aleutian Subduction Zone. UNAVCO chose the old Coast Guard/Federal Aviation

Administration (FAA) Cape Gull site as opposed to the new Coast Guard/FAA Cape Gull site because the rock at the latter station is highly fractured sandstone that would not support a short drill-based monument (SDBM). To reach solid rock, UNAVCO would have to excavate several feet of the top layers of the fractured rock. The rock at the old Coast Guard/FAA Cape Gull site is solid at the surface, ideal for drilling, and most suitable for a SDBM.

Stations AC33 (N. Denali Tokosha Comm) and AC56 (Wickersham Dome) (Figure 1-4) are located in Denali National Park and Preserve on the western end of the Denali Fault Zone and would be used to measure and detect slip rates on the western end of the fault as well as detect and measure postseismic deformation associated with the 2002 M7.9 Denali Earthquake. Lack of data on the western end of the fault has prevented researchers from determining slip rates on this portion of the fault.

PBO station locations were chosen by a consortium of academic and government scientists during the early planning stages (ca. 2002-2003) of the Plate Boundary Observatory (PBO) Project in a series of siting workshops. Siting committees are a formal part of the PBO siting process and stations are the subject of intense discussions that allocate finite resources (available PBO GPS stations) to answer as many important scientific questions as possible. The PBO Tectonic Committee, the USGS-Alaska Volcano Observatory (AVO), and the University of Alaska-Fairbanks/Geophysical Institute (UAF/GI) endorsed the proposed station locations. Subsequent meetings of the siting committee, held in 2004 and 2005, further refined target stations with consideration for permitting and logistical constraints. These early siting meetings, attended by many highly respected groups working together over several years, were critical to the careful planning and consideration of PBO sites.

For Station AC33 (N. Denali Tokosha Comm), the Tectonics Committee recommended that the station be located on the southwestern side of the fault. The station also needed a line of sight to the existing PBO station, AC46, located on Shell Hill in State of Alaska Department of Natural Resources managed land, not park land. During the site reconnaissance for Station AC33 (N. Denali Tokosha Comm), suitable rock was not found at other locations outside the park that had a line of sight to Station AC46 and that was also close to the desired location on the southwestern side of the fault. UNAVCO chose the existing N. Denali Tokosha Comm site because it has solid rock that would support a CGPS receiver and it had a line of sight to AC46 (Figure 1-4). In addition, the N. Denali Tokosha Comm station site was recommended by NPS because park goals include co-locating backcountry facilities wherever possible.

Continued monitoring of these areas is important because the largest earthquakes in Alaska are caused by subduction of the Pacific plate beneath Alaska. The three largest earthquakes in the

20th century occurred in Alaska in 1957, 1964, and 1965. Although it is generally believed that these great earthquakes are rare, five great underthrusting events have occurred in Alaska since 1938. In a recent evaluation of the seismic potential in Alaska, researchers indicated that several subduction zone segments may be ready to rupture soon. The Yakataga gap and the region between Kodiak Island and the Shumagin Islands are areas where M8 or greater events are expected. Smaller M6.8 to 8.0 earthquakes, which occur in many regions of central and southcentral Alaska, occur at more frequent intervals. On average, Alaska has a M7.0 or larger earthquake about every two years, which could cause major damage if they occurred in a populated or strategically sensitive area. Many smaller events often occur near populated areas, and thus pose a continuous threat to urban areas (AEIC, 2006).

Each PBO station produces a continuous stream of information about the horizontal and vertical movements of the Earth's plates and provides the information on the one-month to multidecade time scale. Any change in the long-term trend direction indicates that something has changed in the plate motion that would warrant further study. The PBO has three dedicated analysis centers that continually monitor every site in the PBO network, and over 200 distinct users that analyze the data as a part of their ongoing areas of research. With the addition of the proposed CGPS instruments, scientists would have a much better understanding of the earthquake risks along the known, and potentially unknown, fault systems in Alaska—information that is valuable to park managers who can use it to plan for the safety of park visitors and staff or begin activation of a safety plan.

The proposed PBO stations would also allow the U.S. Geological Survey (USGS) to discriminate between regional deformation and localized deformation on the active volcanoes in the Cook Inlet region during an eruption. PBO CGPS stations provide a different time scale and type of measurement than the existing USGS and UAF/GI seismometers. A good example of this use was the most recent Augustine eruption where all stations on the volcano recorded extensive deformation, but regional stations nearby did not detect deformation, which indicated that the signal was localized beneath the volcano.

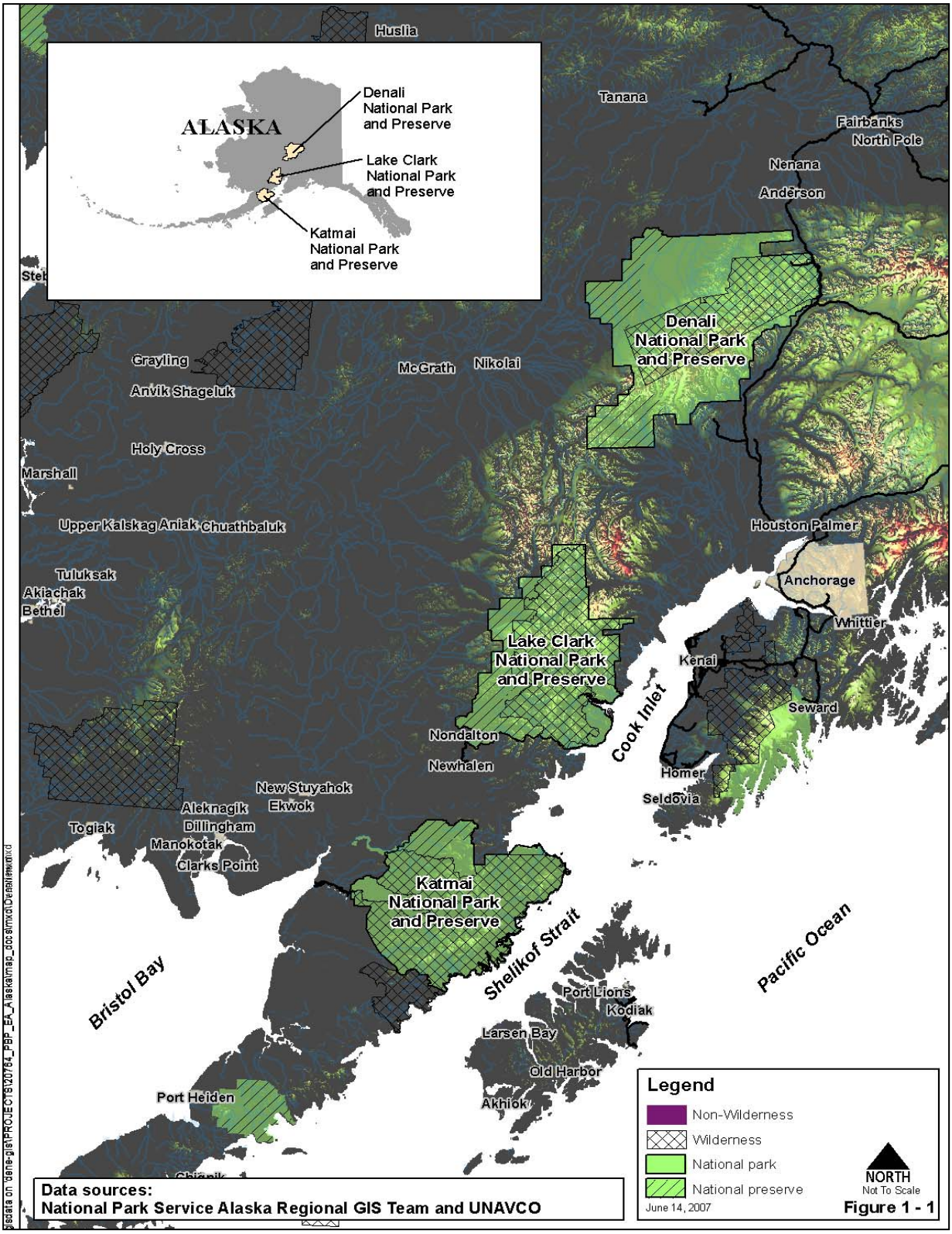


Figure 1-1. Location of national parks and preserves where PBO stations are being proposed. Denali, Lake Clark, and Katmai National Parks and Preserves are located in southcentral Alaska where volcanoes and seismic events have helped shape the dramatic landscapes and ecosystems.

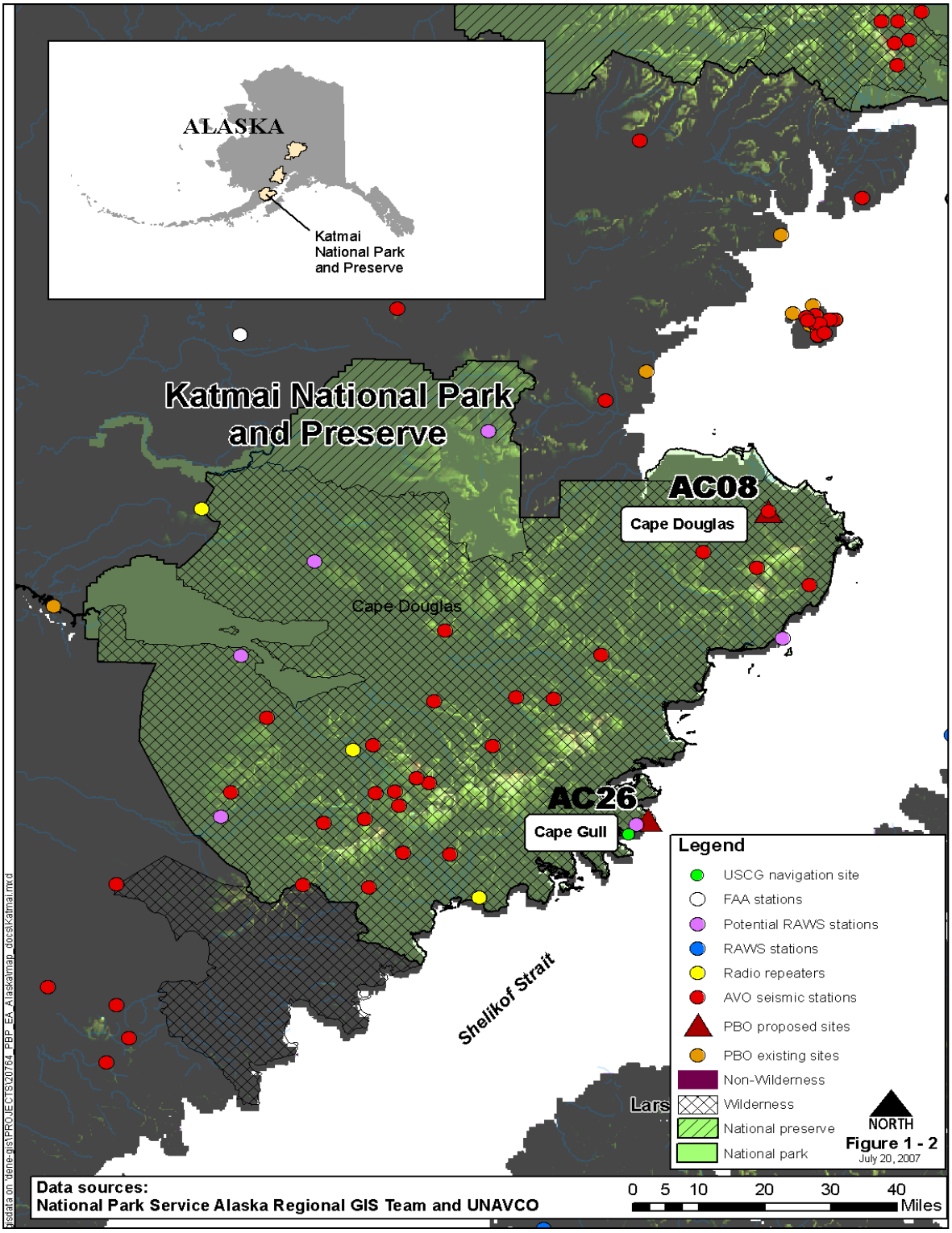


Figure 1-2. Location of proposed and existing seismic stations in Katmai National Park and Preserve. This park is known for its active volcanoes and is, therefore, the location of numerous other scientific, weather, and communication stations. New PBO stations in this park would be used to detect and monitor ongoing regional deformation from the 1964 Good Friday earthquake and help define slip rates in the eastern end of the Aleutian Subduction Zone.

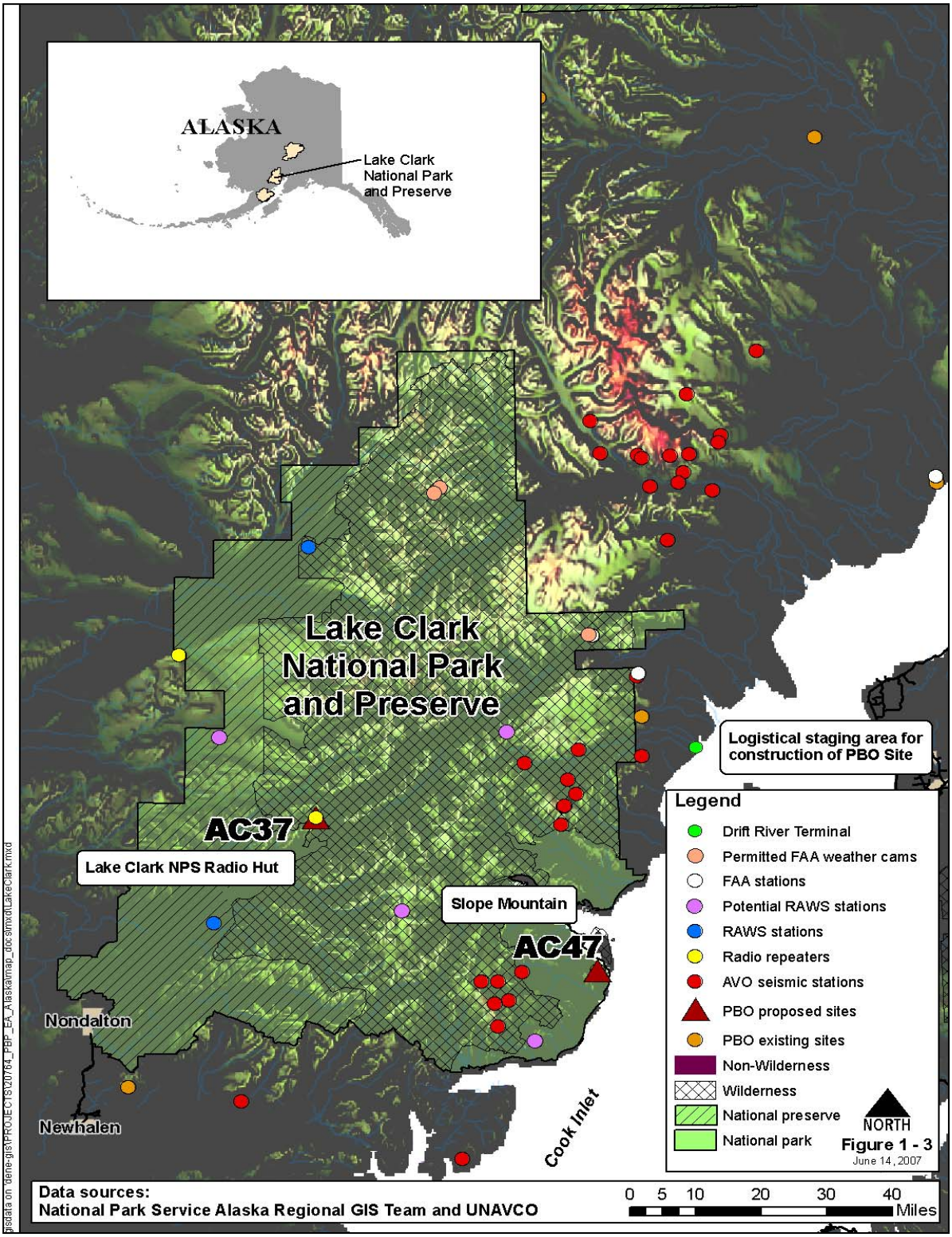


Figure 1-3. Location of proposed and existing seismic stations in Lake Clark National Park and Preserve. New PBO stations in this park would be used to detect and monitor ongoing regional deformation from the Castle Mountain and Lake Clark Faults, and those associated with active volcanoes in the Cook Inlet region.

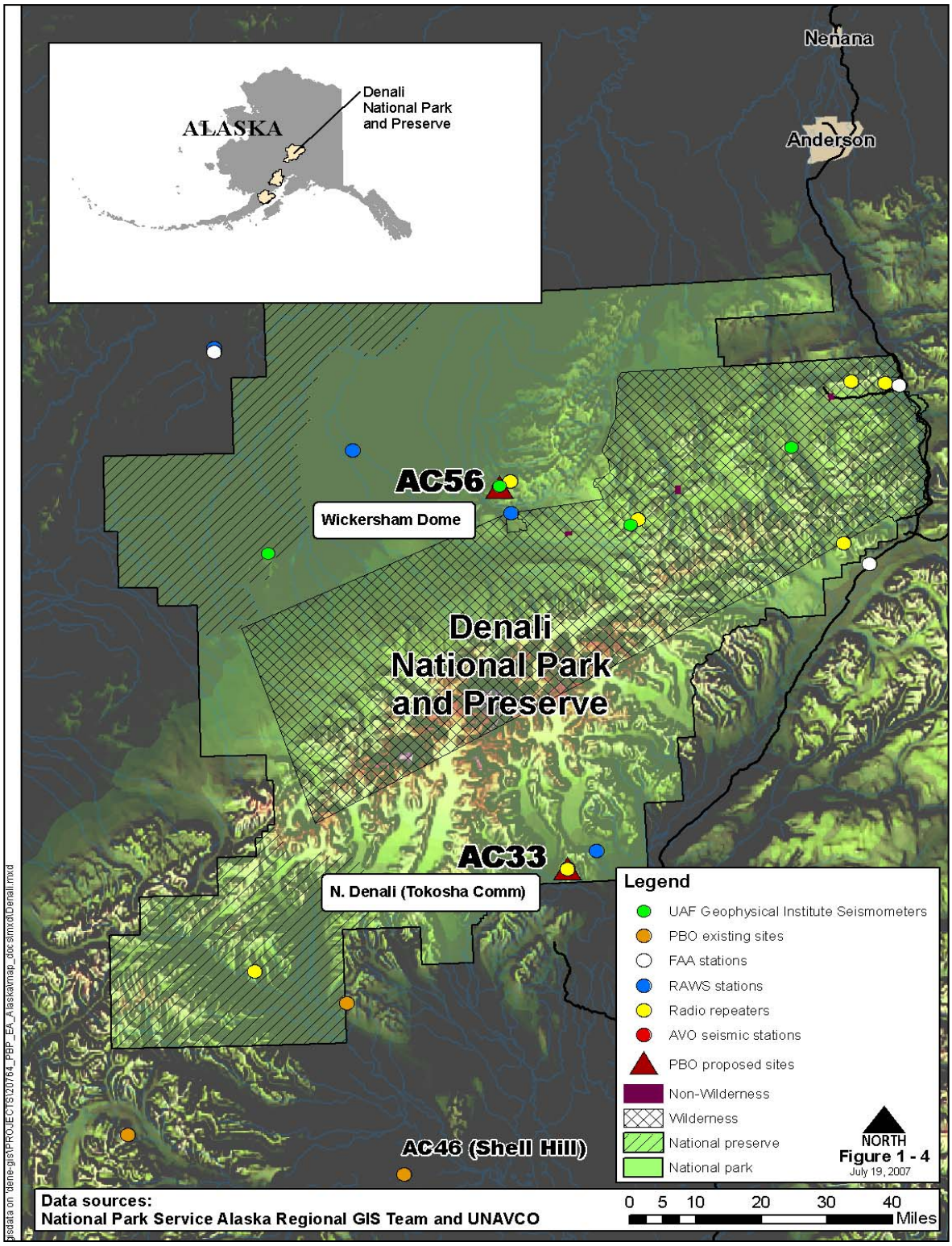


Figure 1-4. Location of proposed and existing seismic stations in Denali National Park and Preserve. The two new PBO stations would measure and detect slip rates on the western end of the Denali Fault Zone.

Through the use of modern geophysical observational and monitoring equipment and satellite telecommunications technology, the proposed geodetic network would provide round-the-clock observational data that describes the geophysical condition of Alaska as well as the western continental U.S. NPS scientists and resource personnel including archaeologists, historic landscape architects, and fire management personnel could use PBO CGPS data from sites in the parks to post-process GPS readings collected to map key resources. This could be done in real time with Real Time Kinematic (RTK) or in an office using the 24-hour data files available from the EarthScope data portal at http://www.earthscope.org/data/gps.php. In addition, the PBO CGPS sites are stable, permanent points of reference that could be used as survey control to define park boundaries and map all types of resources to a high degree of accuracy and repeatability.

Additional objectives of the PBO Project are to provide a foundation for fundamental and applied research throughout the western U.S. and Alaska that would help mitigate risks from geological hazards and contribute to the understanding of the dynamic nature of the Earth. For NPS, this provides an opportunity to develop education and outreach materials for park rangers who interpret the landforms resulting from the volcanic and seismic processes.

This Environmental Assessment (EA) analyzes the No Action and Proposed Action Alternatives and their respective impacts to the environment. This EA has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, regulations of the Council on Environmental Quality (CEQ) (40 CFR§§1500–1508), and USDI-NPS Directors Order #12 (NPS, 2001).

1.2 Background

1.2.1 Park Purpose and Significance

In 1980, the U.S. Congress (Congress) passed the Alaska National Interest Lands Conservation Act (ANILCA), of which Section 101 outlined the broad purposes of the expanded parks and preserves areas:

- Preserve lands and waters for the benefit, use, education, and inspiration of present and future generations.
- Preserve unrivaled scenic and geological values associated with natural landscapes.
- Maintain sound populations of, and habitat for, wildlife species.

- Preserve extensive, unaltered ecosystems in their natural state.
- Protect resources related to subsistence needs.
- Protect historic and archeological sites.
- Preserve wilderness resource values and related recreational opportunities.
- Maintain opportunities for scientific research in undisturbed ecosystems.
- Provide the opportunity for rural residents to engage in a subsistence way of life.

Section 701 of ANILCA, in accordance with subsection 3(c) of the Wilderness Act of 1964 (Public law 88-577, 78 Stat. 890 16 U.S.C. 113-1136), designated 1,900,000 acres as Denali Wilderness, 3,473,000 acres as Katmai Wilderness, and 2,470,000 acres as Lake Clark Wilderness. These designations are described further below.

1.2.1.1 Denali National Park and Preserve

Purpose. On February 26, 1917, Congress established Mount McKinley National Park as…

> …a public park for the benefit and enjoyment of the people…for recreation purposes by the public and for the preservation of animals, birds, and fish for the preservation of the natural curiosities and scenic beauties thereof…and said park shall be, and is hereby established as a game refuge. (39 Stat. 938)

In 1980 under passage of the ANILCA, Mount McKinley National Park was enlarged by approximately 3.8 million acres, and it was renamed Denali National Park and Preserve (Figure 1-1).

Section 202(3)(a) of ANILCA states that the park additions and preserve are to be managed for the following purposes, among others:

> to protect and interpret the entire mountain massif, and additional scenic mountain peaks and formations; and to protect habitat for, and populations of fish and wildlife including, but not limited to, brown/grizzly bears, moose, caribou, Dall sheep, wolves, swans and other waterfowl; and to provide continued opportunities, including reasonable access, for mountain climbing, mountaineering and other wilderness recreational activities.

Subsistence uses by local residents is permitted in the additions to the park, where such uses are traditional, in accordance with the provisions in Title VIII of ANICLA.

Significance. Denali National Park and Preserve encompasses a vast 6 million-acre area. Most of the 2 million acres of the original park have been in protected status since 1917. This large size enables a spectacular array of flora and fauna to live together in a healthy natural ecosystem and provides excellent opportunities to study subarctic ecosystems in settings largely undisturbed by humans. Because of these values, the United Nations Man and the Biosphere Program designated the park and preserve to be an International Biosphere Reserve (NPS, 2005).

The park contains a major portion of the Alaska Range, one of the great mountain uplifts in North America. The Alaska Range is dominated by North America's highest peak, Mount McKinley, with a summit of 20,320 feet (6,193.5 meters) above sea level.

Known cultural resources include archeological and historic sites associated with Athabascan Indian groups, early explorers, mining history, and the early days of the park. Major prehistoric sites in the park include the Teklanika Archeological District, a property listed on the National Register of Historic Places. Many historic structures are in the park headquarters area, which is listed on the National Register of Historic Places as a district. Another Historic District is made up of patrol cabins built along the park road and boundary of the Denali Wilderness (NPS, 2006b).

1.2.1.2 Lake Clark National Park and Preserve

Purpose. Section 201(7)(a) of ANILCA provided for the establishment of Lake Clark National Park as follows:

> Lake Clark National Park, containing approximately two million four hundred thirty-nine thousand acres of public lands and Lake Clark National Preserve, containing approximately one million two hundred and fourteen thousand acres of public lands… The park and preserve shall be managed for the following purposes, among others: To protect the watershed necessary for perpetuation of the red salmon fishery in Bristol Bay; to maintain unimpaired the scenic beauty and quality of portions of the Alaska Range and the Aleutian Range, including active volcanoes, glaciers, wild rivers, lakes, waterfalls, and alpine meadows in their natural state; and to protect habitat for and populations of fish and wildlife including but not limited to caribou, Dall sheep, brown/grizzly bears, bald eagles, and peregrine falcons.

Subsistence uses by local residents is permitted in the park where such uses are traditional in accordance with the provisions of Title VIII of the ANICLA.

Significance. Lake Clark National Park and Preserve protects approximately 4 million acres of undisturbed public land representing a microcosm of Alaskan ecological resources characterized by rugged mountain peaks and spires, glaciers, coastal areas, deep valleys and lakes, high tundra, wild rivers, and a wide cross-section of flora and fauna.

Two active volcanoes within the park and preserve are listed on the National Register of Natural Landmarks: Mt. Iliamna and Mt. Redoubt with elevations above 10,000 feet (3,048 meters).

Lake Clark National Park and Preserve contains portions of three designated Wild and Scenic Rivers (Chilikadrotna, Mulchatna, and Tlikakila) that are maintained in their entirety free of impoundments and diversions, and are inaccessible by road. Their shorelines are kept primitive, and their waters remain unpolluted. In addition, Lake Clark National Park and Preserve contains the upper reaches of the Kvichak River system, which is the world's most productive spawning and rearing habitat for sockeye salmon. This river system contributes approximately 50 percent of the sockeye salmon caught in Bristol Bay, 33 percent of the entire U.S. catch, and 16 percent of the total world catch.

Within Lake Clark National Park and Preserve, a significant complex of late prehistoric and historic Dena'ina sites is within the Kijik Archeological District National Historic Landmark. Radiocarbon analysis indicates that this district was first occupied during the period AD 1170—1415. The district continued to be occupied until the turn of the nineteenth century, and includes the largest-known Athabascan archeological site complex in Alaska. “The lands and resources encompassed by the park and preserve continue to be significant to the Dena’ina people who now reside in villages such as Nondalton, Lime Village, Pedro Bay, Iliamna, Stony River and Tyonek” (NPS, 2004a).

1.2.1.3 Katmai National Park and Preserve

Purpose. Katmai National Park and Preserve (Figure 1-1) was originally established as Katmai National Monument in 1918 to preserve geological features related to the June 6, 1912 eruptions of the Mt. Katmai and Novarupta volcanoes. Section 202(2)(a) of the ANICLA of 1980 added land and redesignated the area as a national park and preserve. The implementing language stated that the area is to be managed for the following purposes, among others: to protect habitats for, and populations of, fish and wildlife, including, but not limited to, high concentrations of brown/grizzly bears and their denning areas; to maintain unimpaired the water habitat for significant salmon populations; and to protect scenic, geological, cultural and recreational features.

Significance. Katmai National Park and Preserve protects approximately 4 million acres of public land, which contains unique volcanic resources, lakes and streams, a coastline, and important wildlife species and habitat to be managed in a natural state. The park and preserve protects the site of the world's second most powerful eruption in historic times. It is an active volcanic region encompassing the Valley of Ten Thousand Smokes, and is home to the largest protected population of brown bears in North America.

NPS believes there are more than nine active or dormant volcanoes; often twelve are cited: Mt. Douglas, Four-Peaked Volcano, Kaguyak, Kukak Volcano, Mt. Steller, Snowy Mountain, Mt. Katmai, Mt. Griggs, Novarupta, Mt. Mageik, Trident Volcano, and Mt. Martin. The landscape was dramatically altered by the 1912 eruption of the Novarupta volcano (NPS, no date-e).

Katmai National Park and Preserve contains approximately 3.4 million acres of designated wilderness for management under the provisions of the Wilderness Act of 1964 in accordance with applicable ANILCA provisions. Significant prehistoric and historic sites are scattered across the 4.7 million acres within Katmai/Alagnak and Aniakchak National Parks (NPS, 2004b).

1.2.2 The Wilderness Act of 1964

The Wilderness Act of 1964 (Public Law 88-577, 78 Stat. 890 16 U.S.C. 1131-1136) was enacted "to establish a National Wilderness Preservation System for the good of the whole people, and for other purposes." It provided for the review of every roadless area of 5,000 or more acres and every roadless island within National Wildlife Refuge and National Park Systems, and for recommendations about the suitability of these areas for inclusion in the National Wilderness Preservation System. The Act lists criteria for determining suitability of lands for wilderness designation and provides restrictions on activities within a designated wilderness area. Under authority of this Act over 25 million acres of land and water in the National Wildlife Refuge System were reviewed. In addition, of the some 7 million acres found suitable for wilderness designation, the Alaska National Interest Lands Conservation Act (P.L. 96-487) established seven designated wilderness areas in Alaska and required the study of nondesignated land for wilderness suitability, comprising 18,560,000 acres. Wilderness was designated in Denali, Katmai and Lake Clark National Parks and Preserves under ANILCA. Section 4(c) of the Wilderness Act defines prohibited uses as:

> Except as specifically provided for in this Act, and subject to existing private rights, there shall be no commercial enterprise and no permanent road within any wilderness area designated by this Act and, except as necessary to meet

> minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area.

1.2.3 Pertinent National Park Service Management Policies

The 2006 NPS Management Policies (NPS, 2006a) address geologic hazards in Section 4.8.1.3:

> Naturally occurring geologic processes, which the Park Service is charged to preserve unimpaired, can be hazardous to humans and park infrastructure. These include earthquakes, volcanic eruptions, mudflows, landslides… The Service will work closely with specialists at the U.S. Geological Survey and elsewhere, and with local, state, and federal disaster management officials, to devise effective geologic hazard identification and management strategies. Although the magnitude and timing of future geologic hazards are difficult to forecast, park managers will strive to understand future hazards and, once the hazards are understood, minimize their potential impact on visitors, staff and developed areas. …

The 2006 NPS Management Policies (NPS, 2006a) address scientific activities in wilderness in Section 6.3.6:

> The statutory purposes of wilderness include scientific activities, and these activities are encouraged and permitted when consistent with the Service's responsibilities to preserve and manage wilderness.

Section 6.3.6.1 further states:

> …Even those scientific activities (including inventory, monitoring, and research) that involve potential impact to wilderness resources or values (including access, ground disturbance, use of equipment, and animal welfare) should be allowed when the benefits of what can be learned outweigh the impacts on wilderness resources or values…The project will not significantly interfere with other wilderness purposes (recreational, scenic, educational, conservation, or historical) over a broad area or for a long period of time.

The following NPS policies (NPS, 2006a) also apply.

- Section 6.3.1 General Policy states:

  > For the purposes of applying these policies, the term "wilderness" will include the categories of eligible, study, proposed, recommended, and designated wilderness…. The policies apply regardless of category…. In addition to managing these areas for the preservation of the physical wilderness resources, planning for these areas must ensure that the wilderness character is likewise preserved. This policy will be applied to all planning documents affecting wilderness…. The National Park Service will take no action that would diminish the wilderness eligibility of an area possessing wilderness characteristics until the legislative process wilderness designation has been completed. Until that time, management decisions will be made in expectation of eventual wilderness designation. This policy also applies to potential wilderness, requiring it to be managed as wilderness to the extent that existing nonconforming conditions allow…

- Section 6.3.5 Minimum Requirement states:

  > All management decisions affecting wilderness must be consistent with the minimum requirements concept.

Appendix A contains a Minimum Requirements/Minimum Tools Analysis for each park.

Although the primary focus of the proposed CGPS installations in the parks and preserves is on geologic hazards (Management Policies 2006 Section 4.8.1.3), visitor safety would also benefit.

- Section 8.2.5.1 Visitor Safety states:

  > The saving of human life will take precedence over all other management actions as the Park Service strives to protect human life and provide for injury-free visits…

- Section 8.2.5.2 Emergency Preparedness and Emergency Operations states:

  > The National Park Service will develop a program of emergency preparedness…This program will include a systematic method for alerting visitors about potential disasters and evaluation procedures.

1.2.4 Applicable Department of the Interior and Park Service Regulations

Pursuant to ANILCA the Department of the Interior issued special access regulations at 43 CFR Part 36. Helicopter use is addressed in 43 CFR 36.11(f)(4):

> The use of a helicopter in any area, other than at designated landing areas or pursuant to the terms and conditions of a permit issued by the appropriate Federal agency, or pursuant to a memorandum of understanding between the appropriate Federal agency and another party, or involved in emergency or search and rescue operations is prohibited.

1.2.5 The NPS Organic Act and General Authorities Act

The NPS Organic Act (NPS, 1916) and the General Authorities Act (NPS, 1970) prohibit impairment of park resources and values. The 2006 NPS Management Policies (NPS, 2006a) uses the terms "resources and values" to mean the full spectrum of tangible and intangible attributes for which the park is established and managed, including the Organic Act's fundamental purpose and any additional purposes, as stated in the parks' establishing legislation. The impairment of park resources and values may not be allowed unless directly and specifically provided by statute. The primary responsibility of the NPS is to ensure that park resources and values will continue to exist in a condition that will allow the American people to have present and future opportunities for enjoyment of them.

The evaluation of whether impacts of a Proposed Action would lead to an impairment of park resources and values is included in this EA. Impairment is more likely when there are potential impacts to a resource or value whose conservation is:

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

The National Park Service Omnibus Management Act of 1998 (P.L. 105–391, 112 Statute 3497) addresses resources inventory and management in Title II. Section 201 defines the purposes of this title to enhance and encourage scientific study in NPS units. Section 202 authorizes and directs the Secretary of the Interior to assure management is

enhanced in NPS units by a broad program of high quality science and information. Section 205 states the Secretary may solicit, receive, and consider requests from Federal and non-Federal public or private entities for the use of NPS units for scientific study. Such proposals must be: 1) consistent with applicable laws and the NPS Management Policies, and 2) the study would be conducted in a manner as to pose no threat to park resources or public enjoyment of those resources.

1.2.6 Applicable National Park Service Plans

Denali National Park and Preserve 1986 General Management Plan (NPS, 1986a) states:

> South-central Alaska is one of the most seismically active areas in North America. …Numerous small faults which are part of the Denali fault complex occur on the south side of the Alaska Range. While these small faults themselves may not cause major earthquake activity, activity in other areas could trigger subsidiary movements in this area (p. 120).

The *Denali National Park and Preserve Backcountry Management Plan* (NPS, 2006) states:

> Within three years, the NPS will complete a plan for administrative and research use of aircraft in the wilderness, park additions, and preserve, which includes goals and specific objectives for minimizing helicopter and airplane use; specifies a methodology for accounting for NPS administrative and research air traffic; and provides criteria for determining when the use of aircraft meets the minimum requirement/minimum tool test (p. 53).

The *Lake Clark National Park and Preserve 1984 General Management Plan* (NPS 1984) states:

> Lake Clark is a large park and preserve area formed by volcanic activity, tectonic movement, and the constant forces of erosion. It contains may of the resources considered to be typical of Alaska—the coast, high mountains, active volcanoes… (p. 8)

and

> While most of the area of the Lake Clark Wilderness is an extremely rugged and glaciated portion of the Alaska and Aleutian ranges, …helicopter landings are prohibited on park and preserve lands except in compliance with a permit issued by the superintendent (p. 24).

The *Katmai National Park and Preserve 1986 General Management Plan* (NPS, 1986b) states:

> Volcanism is one of the principal geologic processes in Katmai. The high peaks of the park were formed by volcanic activity, and many are still active, occasionally emitting steam, smoke, ash, or lava. A major eruption or earthquake may occur at any time (p. 103).

The plan also states:

> The superintendent may permit the use of helicopters for research activities and may prescribe terms and conditions in accordance with federal regulations (p. 21),

and

> …there are no designated landing areas for helicopters in Katmai National Park and Preserve. Annual permits may be issued for NPS-approved research projects (p. 27).

1.3 Issues

To focus the EA, the NPS selected specific issues for further analysis and eliminated others from evaluation. Impacts to wilderness and wildlife habitat have been identified as key issues.

1.3.1 Issues Selected for Detailed Analysis

Discussions of the affected environment and environmental consequences related to each alternative focus on the selected issue topics. A brief rationale for the selection of each issue is provided below.

Geo-hazard Monitoring and Human Safety: The Plate Boundary Observatory is being constructed by UNAVCO and their EarthScope partner, the USGS. The PBO network uses CGPS instruments that measure relative horizontal and vertical motion rather than the shaking motions detected by ordinary seismometers. The EarthScope Program includes the study of active earthquake zones, individual faults and volcanoes, deformation along plate boundaries, continental geodynamics and plate tectonic motion, fluids in the crust, and volcanic and seismic hazards. EarthScope/PBO instrumentation proposed in the national parks in Alaska would

augment and enhance the USGS's ability to fulfill their federal mandate to provide notification and warnings for earthquakes, volcanoes, and landslides.

The EarthScope Program explores the structure and evolution of the North American continent and the physical processes controlling earthquakes and volcanoes with an integrated, interdisciplinary approach. It will provide an image of the Earth's structure and measure deformation across the contiguous United States and Alaska with a level of detail and data accessibility never available before.

For scientists and NPS managers, the Earthscope Program, which includes the PBO installations in the national parks in Alaska, could provide a clearer understanding of the forces that shape the parks' environment. Data from these PBO installations would improve assessment of earthquake and volcanic hazards, and because of real time data relay, tsunami warnings.

Natural Sound Environment: Helicopters would be used for PBO equipment installation and equipment maintenance. Helicopter noises would disrupt natural sounds in the parks.

Soils: Small holes would be excavated during the installation of each new CGPS station. Although the PBO station sites were selected so that the CGPS equipment could be installed on bedrock, small areas of soil, where it exists, may be compacted by the installation activities. This compaction, if any, would be negligible.

Vegetation: Although the PBO station sites were selected so that the CGPS equipment could be installed on bedrock, small plots of tundra vegetation may be removed during installation and maintenance. In addition, the potential exists for the transfer of invasive or exotic species by way of helicopter, tools, and clothing during station installation and it is possible that species of special concern could be affected.

Wildlife and Habitat: Some wildlife habitat would be removed or disturbed at new PBO station sites. Nesting eagles, Dall sheep, caribou, moose and/or bears could be disturbed by helicopter use for construction and maintenance of PBO stations.

Visual Quality: During the summer months, a few hikers and climbers, and pilots and passengers of small aircraft (private pilots and commercial sightseeing and transport operators) that frequently fly over the parks and preserves would see the new PBO stations and existing seismic monitoring stations. The PBO stations could be considered visual intrusions on the scenic integrity of the backcountry and designated wilderness areas.

Cultural Resources: Although all but one of the new PBO stations would be co-located with existing seismic or communication equipment, presently unknown cultural resources may be

affected by the project. Station AC47 (Slope Mountain) would be on a previously undisturbed site.

Wilderness: Sights and sounds of helicopters transporting equipment to mountainous sites for installation and maintenance of PBO stations in these areas could temporarily affect the wilderness values of the parks and preserves. Equipment at the selected sites would remain within the wilderness at least until the year 2018. The equipment and installation and maintenance disturbances could be considered breaks in the character of designated wilderness areas.

Cumulative Effects: The installation and maintenance of the proposed PBO stations would cause an incremental increase in helicopter activity and the number of long-term facilities on the ground. These activities could contribute to resource impacts to the parks and preserves.

1.3.2 Issues Dismissed from Detailed Analysis

The following issues have been eliminated from detailed analysis and are not being addressed further in this EA.

Floodplains and Wetlands: The PBO stations would not be located in floodplains or wetland areas.

Threatened and Endangered Species: No threatened or endangered wildlife or plants that would be affected by the proposed activities are known to be located within the project areas. Four proposed PBO stations would be co-located with other facilities that have been previously assessed.

Minority and Low-Income Populations: Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations, requires all federal agencies to identify and address disproportionately high and adverse human health or environmental effects of their programs and policies on minority and low-income populations and communities. This project would not result in any significant changes in the socioeconomic environment of the parks and preserves, and therefore is not expected to have a direct or indirect impact on minority or low-income populations or communities.

Subsistence: Research activities would be conducted within areas of customary and traditional subsistence uses by local rural residents as allowed in Denali National Park and Preserve and Lake Clark National Park and Preserve. Subsistence activities are prohibited in Katmai National Park (Part 242, 36 CFR Ch. II (7-1-02 Edition). Research activities would

be conducted in a manner so as not to restrict subsistence uses (Appendix A: ANILCA Section 810(a) Subsistence Evaluation).

1.4 Permits and Approvals Needed to Complete the Project

The NPS would issue UNAVCO the appropriate permits to ensure the long-term, continuous operation of the CGPS stations. Under the National Park Service Research Permitting and Reporting System (RPRS), research permits would detail the permitted station locations and limits of installation, use of the NPS facilities and other locations to safely manage fuel and landing of helicopters in the NPS units.

Research permits would be issued for each PBO station according to the preferences of each park's superintendent:

- Stations AC56 (Wickersham Dome) and AC33 (N. Denali Tokosha Comm) in Denali National Park and Preserve: 10-year research permits or 5-year renewable permits.
- Stations AC37 (Lake Clark NPS Radio Hut) and AC47 (Slope Mountain) in Lake Clark National Park and Preserve: one initial permit, renewable on an annual basis.
- Stations AC26 (Cape Gull) and AC08 (Cape Douglas) in Katmai National Park and Preserve: one initial permit, renewable on an annual basis.

A travel permit would be needed to traverse Denali Park Road and a portion of the Skyline Drive with the truck and trailer needed to install and maintain the Station AC56 (Wickersham Dome) in Denali National Park and Preserve.

Investigator's Annual Reports (IARs) would be submitted to the NPS to assess the progress and effectiveness of the volcano monitoring program.

Each research permit application (initial and annual renewal) would undergo a brief internal park review, during which time park personnel would discuss specific fieldwork schedules and plans for the upcoming UNAVCO field season. Park personnel would monitor environmental effects and contact UNAVCO personnel for assistance in resolving any problems should they arise. The monitoring program would be evaluated annually and, at that time, it would be determined whether further NEPA EA documentation is needed.

Applications for other scientific research projects, involving specific geodetic and geological investigations, would be processed separately with individual project NEPA reviews and issuance of separate Research Permits.

The equipment for each station would be removed by the year 2018. A removal bond would be provided in the amount of $4,000 for each station. The bond would remain with the station permit in the event that the station is turned over to another research institution.

Chapter 2: ALTERNATIVES

2.1 Introduction

This chapter describes the range of reasonable alternatives, including the Proposed Action Alternative, the No Action Alternative, and those alternatives and actions that are not being considered further.

As part of the development of the Proposed Action Alternative, individual PBO station locations were selected using a systematic siting process to maximize operational capability and to minimize adverse environmental impacts. The siting process consisted of three phases that progressively eliminated from consideration infeasible and less desirable sites. The three phases were network definition, regional screening, and individual site evaluation. Most potential environmental impacts were minimized by siting the PBO stations such that they would avoid sensitive areas and resources. Potential siting areas were assessed based on the network's technical constraints and capabilities, geographic and environmental constraints, and other considerations such as the concerns of government agencies or local officials. For example, of the 14 sites originally identified in Denali National Park and Preserve, only two sites now remain because other suitable sites on bedrock were found outside, but adjacent to the park's boundary minimizing impacts to wilderness and areas eligible for wilderness designation. The two sites remaining within Denali National Park and Preserve were selected in consultation with NPS, in part, because NPS park goals include co-locating backcountry facilities wherever possible.

Each PBO station has a siting tolerance of 2 to 24 km (1.2 to 15 mi) from the center point of the ideal location. Thus, the CGPS monument can be located anywhere within a 2- to 24-km (1.2- to 15-mi) radius around a center point and still function as an integrated part of the proposed PBO network. The siting process and criteria are described in detail in Appendix B.

2.2 Alternative A: No Action

Under the No Action Alternative, installation of PBO stations would not occur on NPS-administered lands in Denali National Park and Preserve, Lake Clark National Park and Preserve, or Katmai National Park and Preserve. Implementation of this alternative would not meet the stated purpose of and need for the project. The existing network and its permitted maintenance schedule would remain in place, and no improvement of seismic data collection and interpretation would result.

This alternative represents a continuation of the existing situation and provides a baseline for evaluating the changes and impacts of the Proposed Action. The existing situation is described in the following paragraphs:

Denali National Park and Preserve. Use of existing analog instruments would continue at two stations outside and three stations inside Denali National Park and Preserve (Wickersham Dome, Thorofare, and Castle Rocks), along with two relay stations at Double Mountain and Mt. Healy (Figure 1-2). The AEIC may propose seismic monitoring stations at Double Mountain, Eagle Gorge, and between Birch Creek and Cache Creek, but no applications for any of these stations have been made and they are not foreseeable. Three radio repeater stations exist in the Denali National Park and Preserve Wilderness.

Lake Clark National Park and Preserve. Thirteen seismic stations are currently located within Lake Clark National Park and Preserve (Figure 1-3). New NPS Remote Automated Weather Stations (RAWS) are being proposed for installation in 2008. Of the four sites recommended (shown in Figure 1-3), two would be located in wilderness. NEPA documentation for the new RAWS is not yet complete. Twelve seismic stations and one radio repeater station in Lake Clark National Park and Preserve are located in designated wilderness.

Katmai National Park and Preserve. Twenty-three seismic stations are currently within Katmai National Park and Preserve (Figure 1-4). Six new RAWS (five in wilderness) are proposed for installation in 2008. The locations for the RAWS are shown in Figure 1-4. NEPA documentation for the new RAWS is not yet complete. Twenty seismic stations in Katmai National Park and Preserve are located in designated wilderness.

2.3 Alternative B: Proposed Action – Install New PBO Stations in Denali National Park and Preserve, Lake Clark National Park and Preserve, and Katmai National Park and Preserve

UNAVCO would install six CGPS stations in national parks in Alaska. These stations would help to fill gaps in, and increase the accuracy of, the existing geodetic network, and would provide the best possible detection of seismic signals.

Of the six stations proposed for the network, two are proposed for installation in Denali National Park and Preserve, two are proposed for installation in Lake Clark National Park and Preserve,

and two are proposed for installation in Katmai National Park and Preserve. The locations of these stations are described in Table 2-1 and shown in Figures 2-1 through 2-6.

Table 2-1. Alternative B Summary: Proposed PBO Station sites in Denali, Lake Clark, and Katmai National Parks and Preserves

Station	Name	National Park and Preserve	Latitude	Longitude	Elevation (feet)
AC56	Wickersham Dome	Denali	63.55275	150.92282	3,724
AC33	N. Denali (Tokosha Comm)	Denali	62.67113	150.6846	4,825
AC37	Lake Clark NPS Radio Hut	Lake Clark	60.439683	153.865367	5,231
AC47	Slope Mountain	Lake Clark	60.08147	152.62395	3,024
AC26	Cape Gull	Katmai	58.21458	154.15031	583
AC08	Cape Douglas	Katmai	58.928433	153.6448	2,093

2.3.1 Actions Associated with the Proposed Action

Under the Proposed Action Alternative, UNAVCO would use helicopters to gain access to all but one of the proposed PBO stations. Station AC56 (Wickersham Dome) would be accessible by truck and trailer pursuant to the conditions of a road travel permit for the restricted portion of the Denali Park Road and the part of Skyline Drive used to access the site. Helicopters are needed to reach the other station sites because they are in remote, rugged terrain where bedrock is protruding. These sites are inaccessible by vehicles or unsuitable for landing fixed-wing airplanes, and transport of heavy equipment and supplies such as seismic monitors, deep cycle batteries, equipment shelters, solar panels, and supporting frames is required. Further, maintenance of the stations requires the replacement of batteries, which are too cumbersome to be hand-carried to the sites. After the stations are operational, UNAVCO would conduct site visits only to replace back-up batteries and conduct routine maintenance. Site visits would occur approximately once every three years for each station unless equipment malfunctions. Occasionally, system malfunctions may require a visit to make repairs. Thus, with the exception of Station AC56, helicopters would likely be used for access to one or more stations in each park every three years. See Appendix C (Wilderness Minimum Requirements/Minimum Tool Analysis) for further discussion on the need for helicopters.

Helicopters would maintain a minimum altitude of 2,000 feet above ground surface when visibility and conditions allow, other than during landing and takeoff, pursuant to Federal Aviation Administration (FAA) Advisory Circular (AC) 91-36C, “Visual Flight Rules (VFR) Near Noise Sensitive Areas.” Maintaining this altitude from the ground surface is expected to

reduce adverse impacts to wildlife and recreational visitors to the parks. All flight plans would be designed to avoid high use visitor areas such as Brooks Camp and Three Forks overlook in Katmai National Park. UNAVCO personnel would consult with NPS each season so that flight paths would accommodate park resource and management needs.

2.3.1.1 Denali National Park

For Station AC33 (N. Denali Tokosha Comm) in Denali National Park, UNAVCO would use the Talkeetna airport to stage supplies and refuel the helicopter, as needed. Permission must be granted by the Denali NPS Chief Ranger for access at all times. Station AC56 (Wickersham Dome) would be accessible by truck and trailer.

2.3.1.2 Lake Clark National Park and Preserve

In Lake Clark National Park and Preserve, the airport in Port Alsworth would be used for Station AC37, Lake Clark NPS Radio Hut. UNAVCO would arrange for helicopter landing permission at the Wilder B&B located on the air strip.

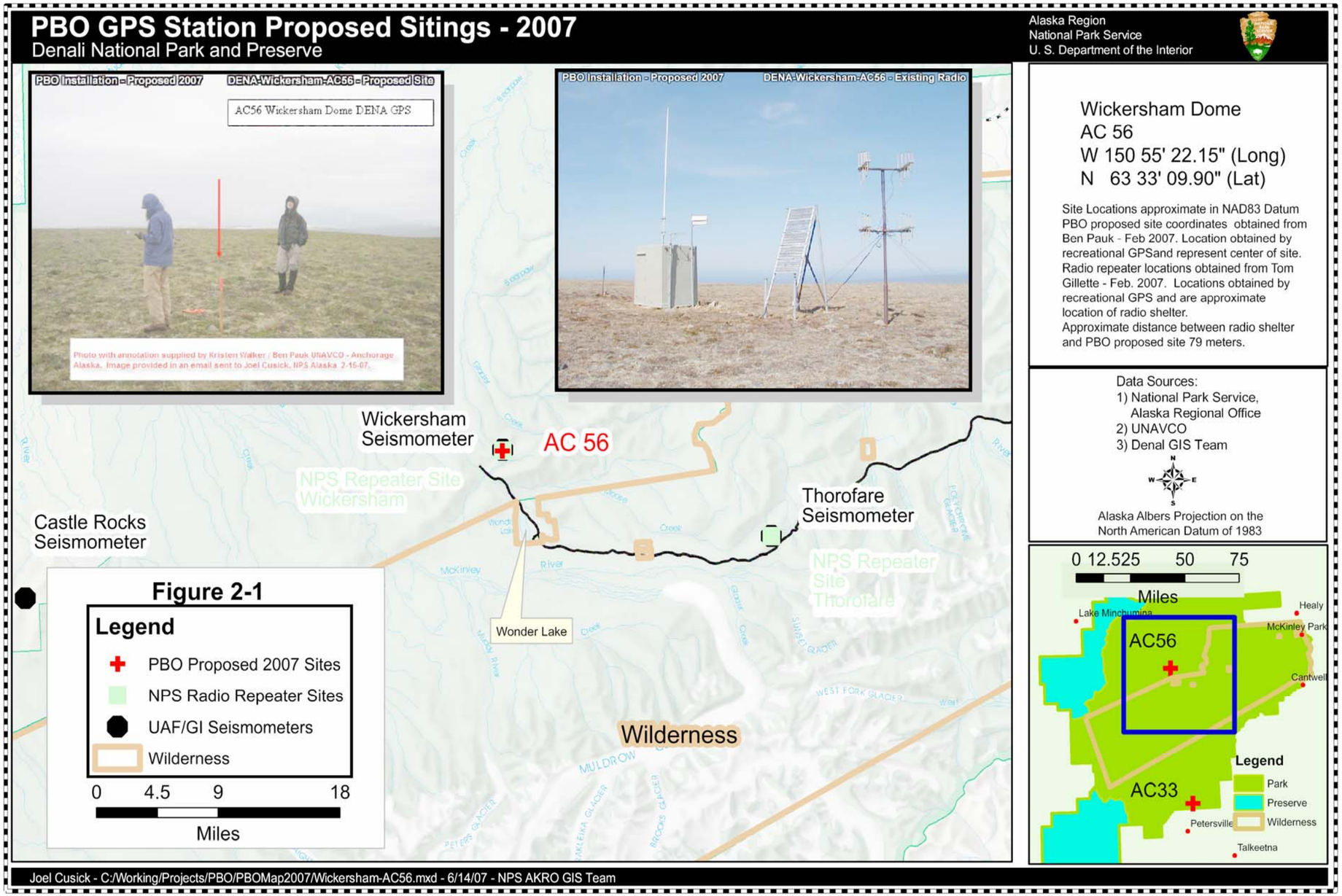
For Station AC47, Slope Mountain, UNAVCO would stage out of the Drift River Oil Terminal airstrip, which is located to the north where fuel and lodging are available. This airport and fueling facility was used during the construction of a PBO station near Double Glacier.

2.3.1.3 Katmai National Park

For Station AC26 (Cape Gull), all helicopter work would be conducted out of the Kodiak airport. UNAVCO has contacted the Katmai Wilderness Lodge located near Cape Gull as a potential staging area for the PBO equipment. Staging the gear from the Lodge would reduce the number of helicopter trips to and from Kodiak airport. UNAVCO would transport gear from the lodge to the PBO station site one day, install the PBO equipment for two days, depending on weather conditions, then load the construction gear and fly back to the lodge on the fourth day.

For Station AC08 (Cape Douglas), UNAVCO would use the airport at Homer (a one hour flight to the station site) and use AVO base camp on Augustine Island (a 20 minute flight from the station site) for refueling.

All monitoring equipment left in the field would be tagged to identify the agency, permit number, the purpose of the equipment, and the permittee’s name and contact information. Tagged equipment would facilitate follow-up for lost or abandoned equipment and may reduce vandalism by informing people of the reasons for installing the equipment in wilderness.



Photographs and map showing the location of proposed PBO Station AC56 (Wickersham Dome) within Denali National Park and Preserve. Figure 2-1.

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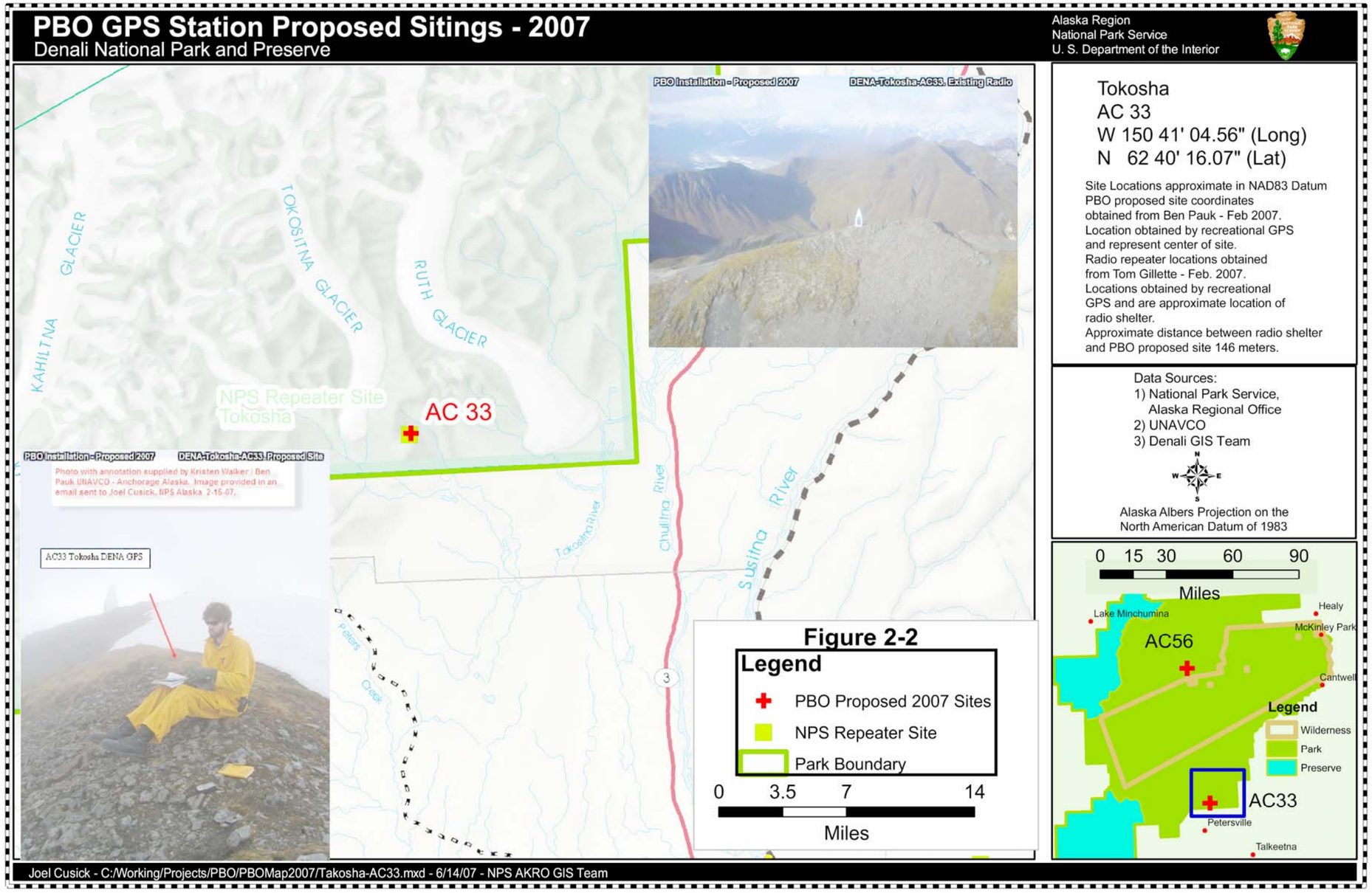

Photographs and map showing the location of proposed PBO Station AC33 (N. Denali Tokosha Comm) within Denali National Park and Preserve. Figure 2-2.

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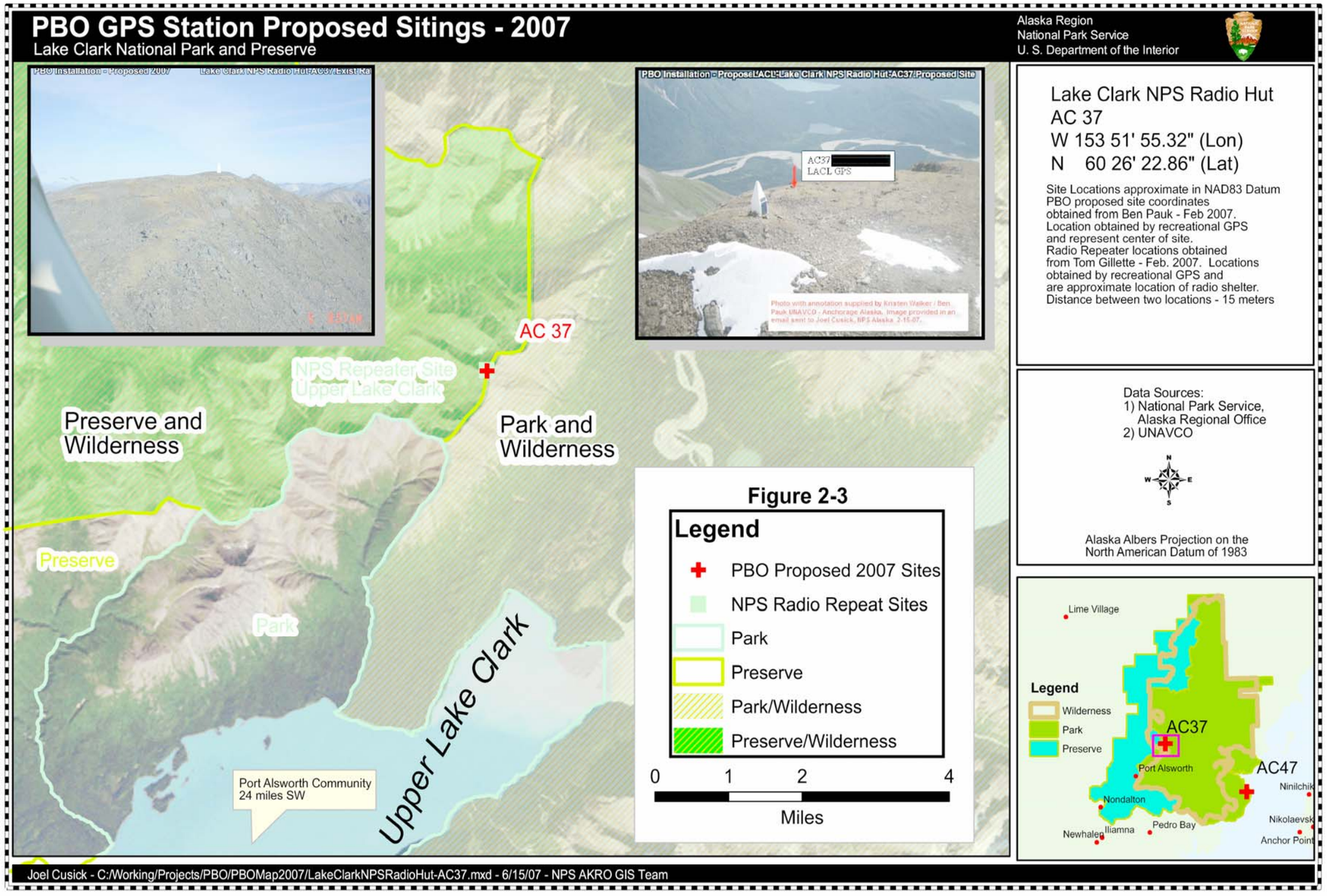

Photographs and map showing the location of proposed PBO Station AC37 (Lake Clark NPS Radio Hut) within Lake Clark National Park and Preserve. Figure 2-3.

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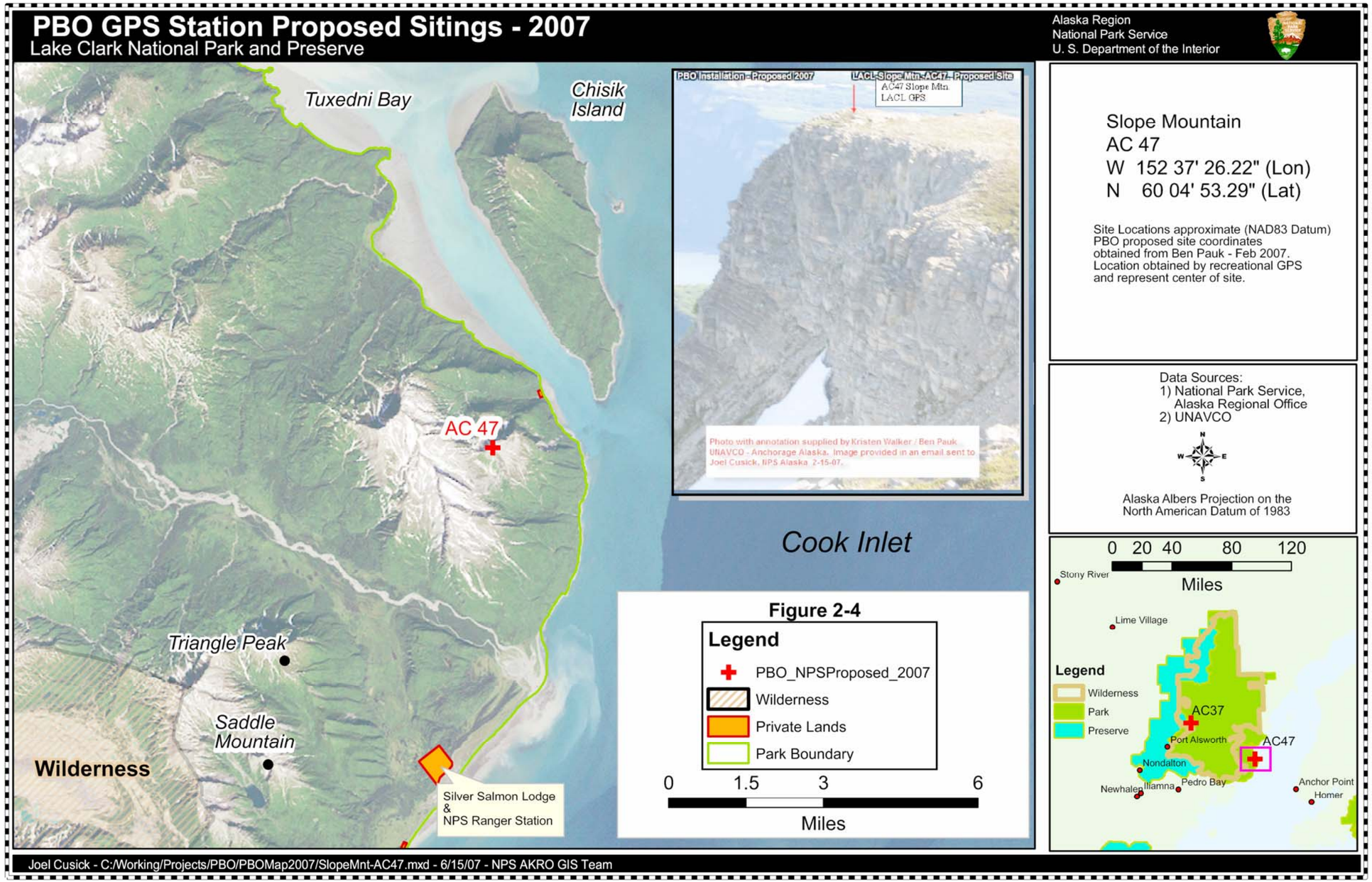

Photograph and map showing the location of proposed PBO Station AC47 (Slope Mountain) within Lake Clark National Park and Preserve. Figure 2-4.

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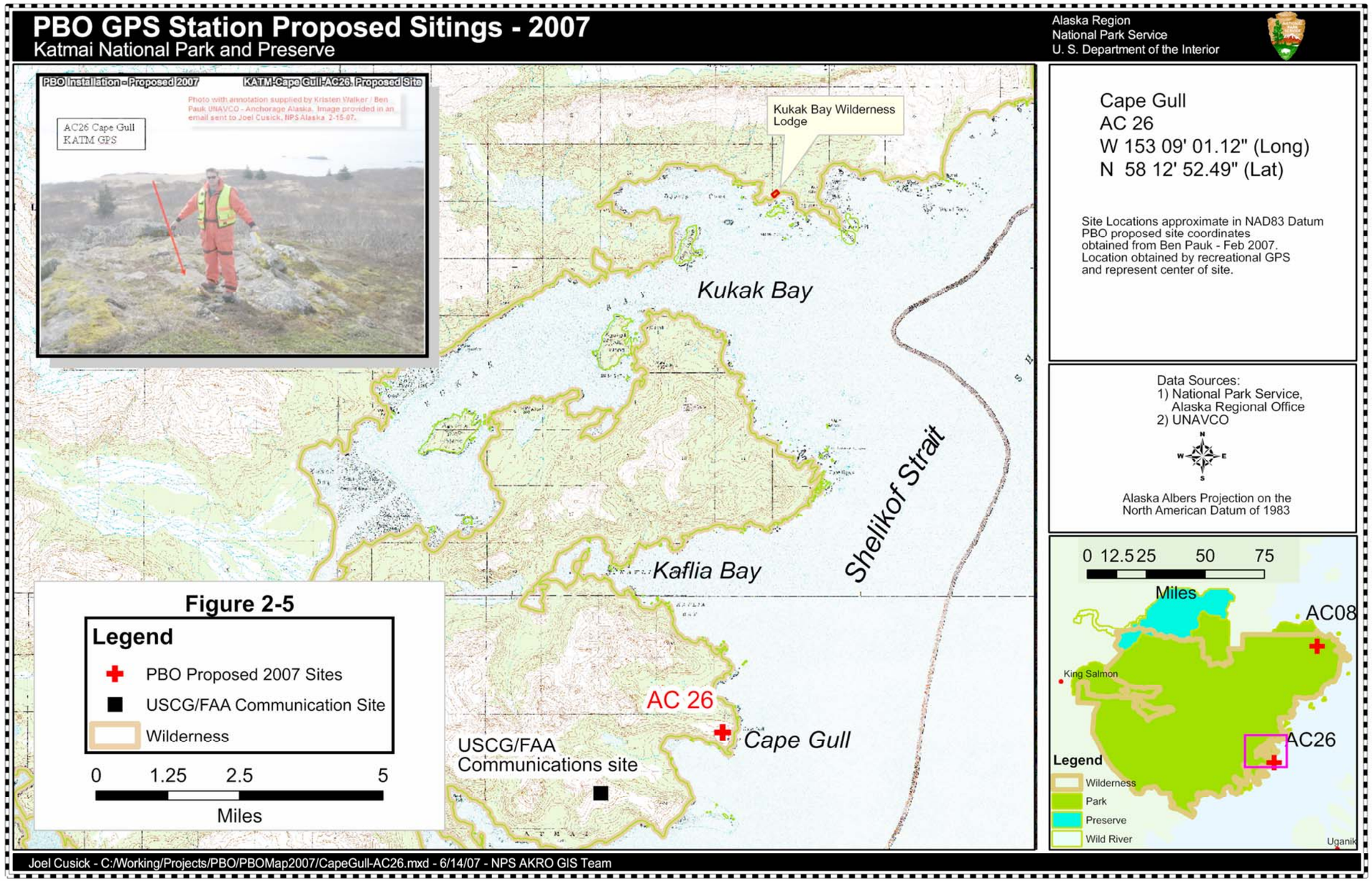

Photograph and map showing the location of proposed PBO Station AC26 (Cape Gull) within Katmai National Park and Preserve. Figure 2-5.

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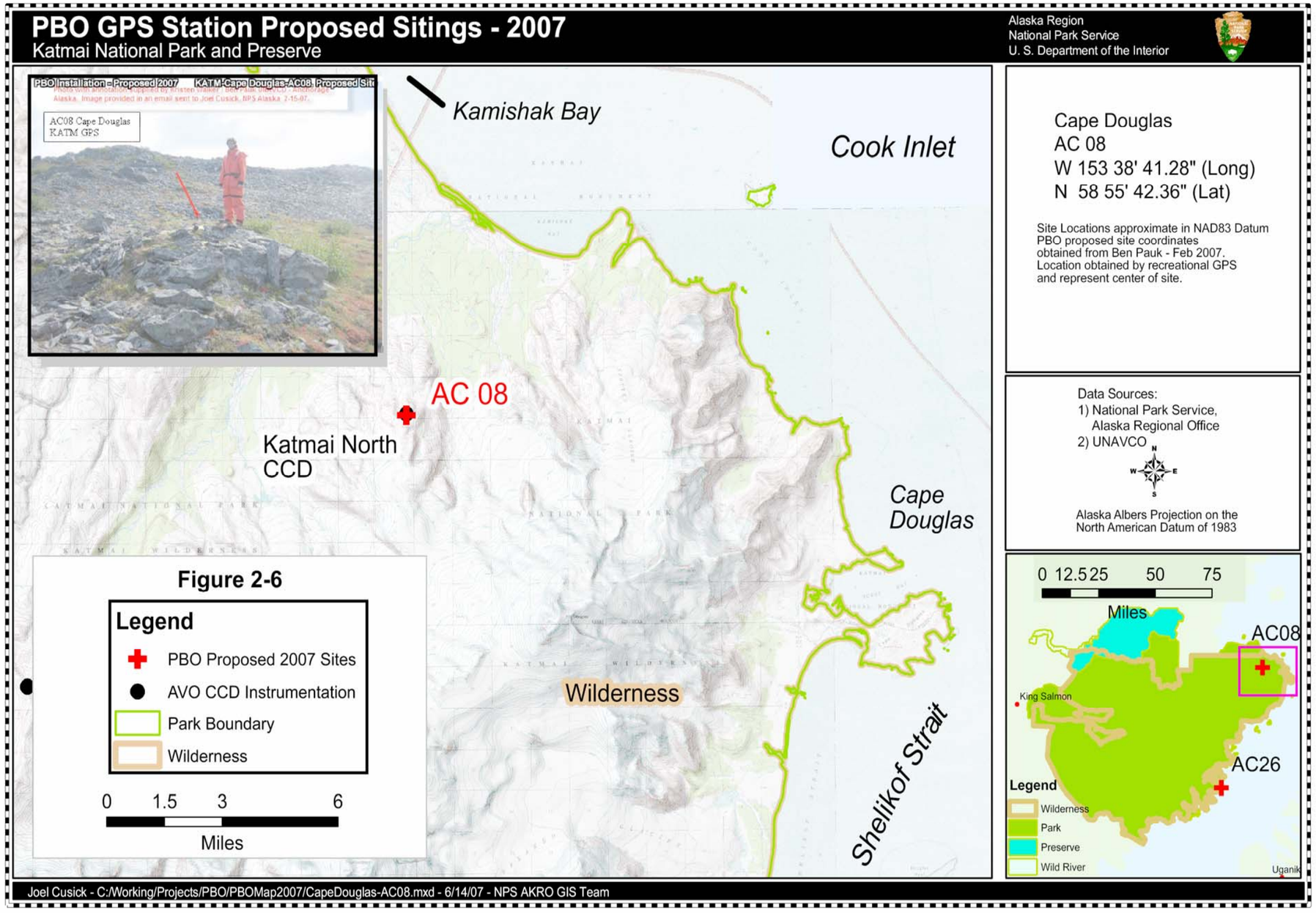

Photograph and map showing the location of proposed PBO Station AC08 (Cape Douglas) within Katmai National Park and Preserve. Figure 2-6.

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2.3.2 PBO Station Components

UNAVCO is proposing to install six short drill-braced monuments. As shown in Figures 2-7 through 2-11, these continuously operating GPS (CGPS) reference stations are composed of a monument assembly, solar panel array, a communication antenna, and equipment enclosure.

2.3.2.1 Short Drill Braced Monuments

Short drill-braced monuments are small, hand-drilled geodetic designs that can be installed quickly. They are well-suited for environmentally sensitive areas or extremely remote locations. Figure 2-7 is a schematic drawing of a typical short drill-braced monument (SDBM) installation with a solar panel array. Figure 2-8 shows a photograph of a completed station installation with a solar panel array. Figure 2-9 is a plan view schematic drawing (foot print) of a typical SDBM, and Figure 2-10 is a photograph showing how the footprint would look from the air.

As illustrated in Figure 2-8, a center hole and four perimeter holes are drilled at approximately a 55 degree angle 1.5–1.8 meter (m) [5-6 feet (ft)] into bedrock using a hand held, generator-powered rotary hammer. Five, 2.5 centimeter (cm) [1 inch (in)] diameter stainless steel rods that extend 1–1.4 m (3.3 to 4.5 ft) above the ground surface are inserted into the drilled holes to support the unit. A leveling adapter, geodetic grade CGPS antenna and radome [40 cm (16 in) diameter] are attached to the threaded top of the vertical leg. The total height of the monument is approximately 2 m (6.6 ft) including the CGPS antenna and radome.

These installations use portable equipment that can be packed on animals, delivered by a helicopter or driven by vehicle on four-wheel drive roads. This type of monument is only suitable where bedrock is within 0.3 m (1 ft) of the surface. Installation time is approximately one to two days. In Alaska, it may, more typically, take two to four days to complete the installation because of the greater possibility of poor weather conditions.

2.3.2.2 Data Relay

The CGPS data may be transmitted to a central database using a Code Division Multiple Access (CDMA, a digital cellular technology) modem on-site or to a data relay station. Two types of data relay stations are typically used—a radio network repeater station which uses CDMA technology or a Very Small Aperture Terminal (VSAT), satellite phone. Figure 2-11 shows a VSAT installed on an equipment hut. Table 2.2 lists details of the data relay for each PBO station.

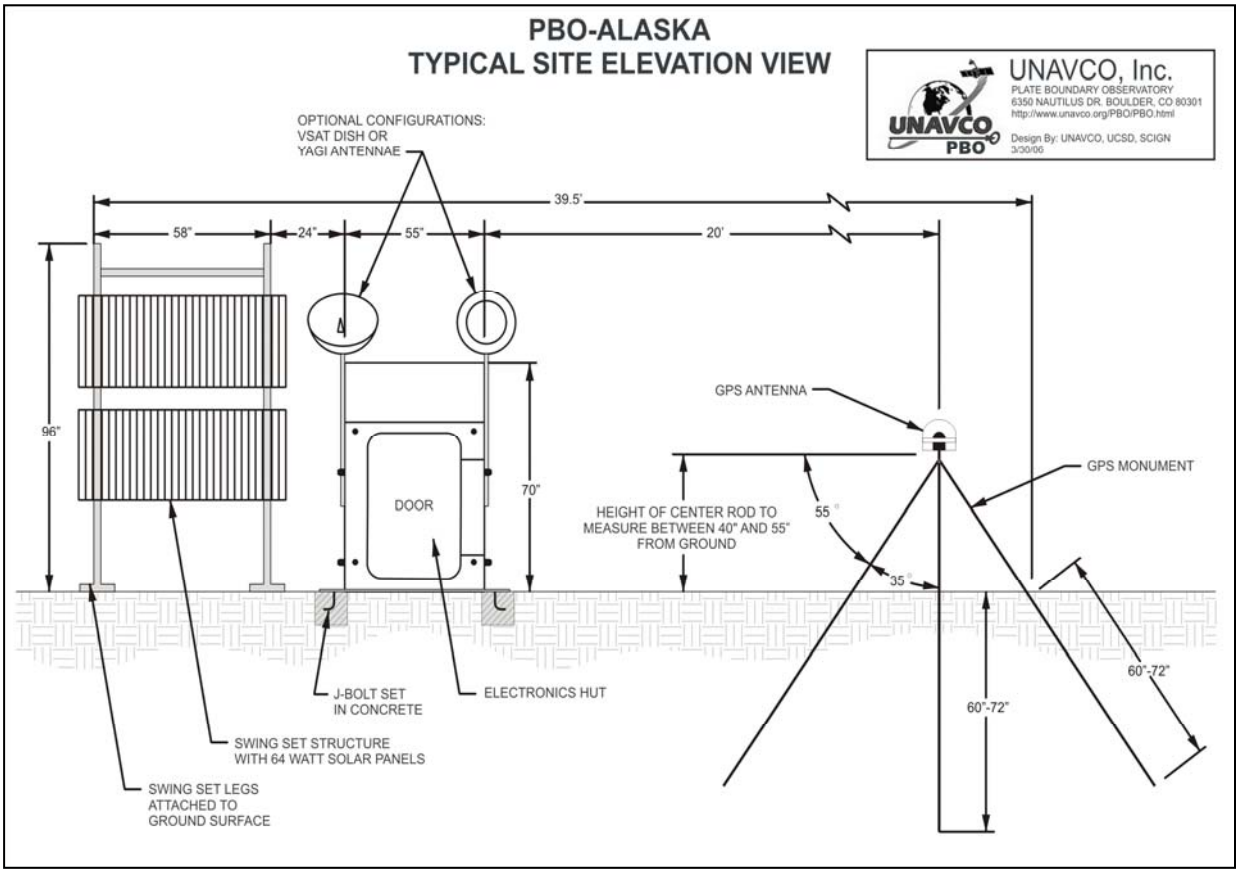

Figure 2-7. Schematic drawing of a typical short drill-braced monument (SDBM), equipment enclosure, and solar panel support structure installation.

Figure 2-8. Photograph showing installed short drill-braced monument, equipment enclosure, and solar panel support structure.

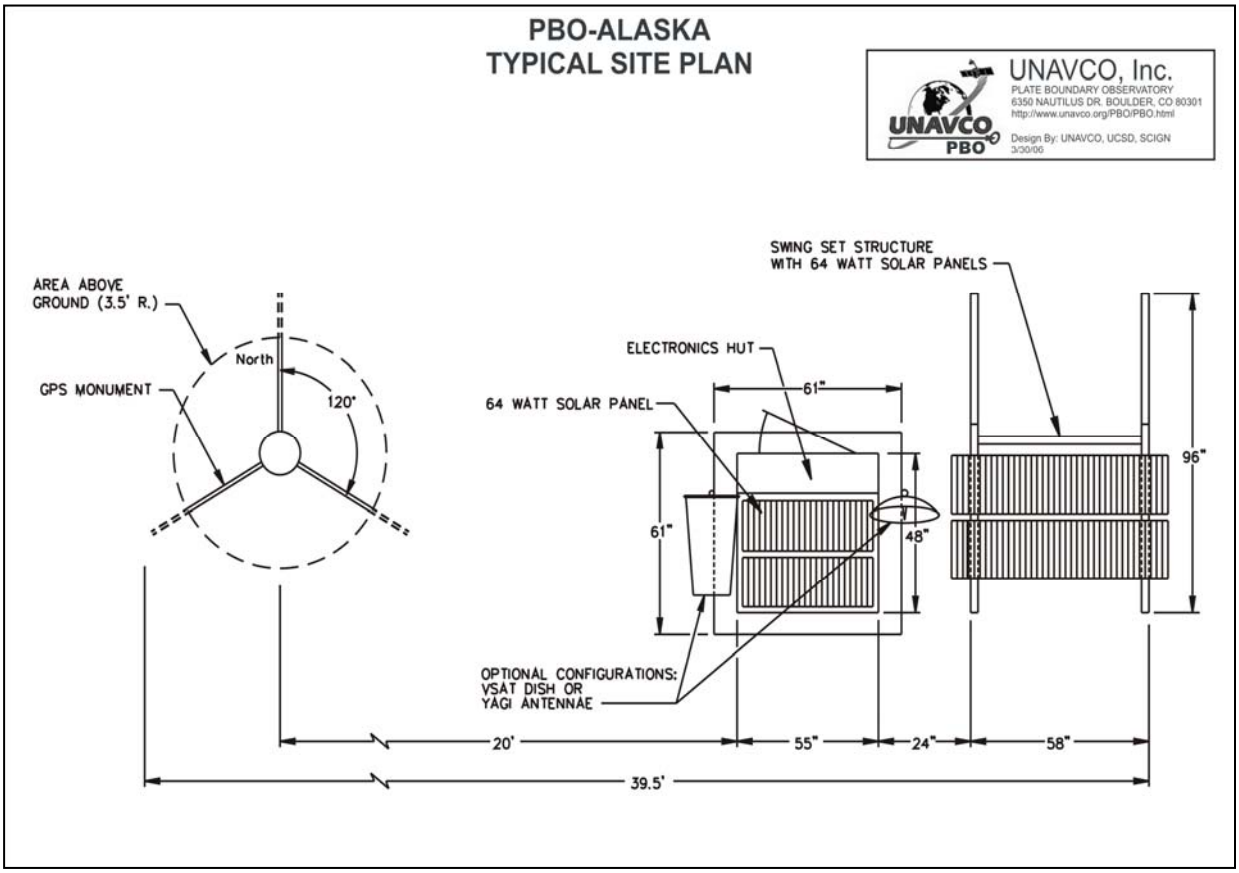

Figure 2-9. Schematic plan view (foot print) of a typical short drill-braced monument (SDBM), equipment enclosure, and solar panel support structure installation.

Figure 2-10. Photograph taken from approximately 500 feet above a typical SDBM station in Alaskan terrain showing the placement of equipment in a rugged landscape.

2.3.2.3 Electronics Hut

All electronic equipment would be placed in weatherproof enclosures (Figures 2-7, 2-8, 2-9, 2-10, and 2-11). Communications devices would be mounted to the top of the equipment enclosure. As shown in Figure 2-7, a VSAT antenna or a Yagi dish antenna would be used to transmit data, which would be downloaded and processed daily by the PBO Operations Center in Boulder, Colorado. Table 2-2 lists the overall communication detail for each proposed PBO station.

Figure 2-11. Photograph showing installed short drill-braced monument, with VSAT relay antenna, equipment enclosure, and solar panel support structure.

2.3.2.4 Solar Panels

Two solar panels would be mounted on the equipment enclosure (Figures 2-7, 2-8). The solar panels would be installed to a height that accounts for the expected snow accumulation levels at a given station site. The equipment enclosure would be connected to the CGPS by cable within conduit. Because these station sites are located at high elevations and on rocky outcrops, trenching is difficult. The conduit and cable would instead lie on the ground surface and be covered with small rocks.

Table 2-2. Alternative B Summary: Proposed PBO station communications detail

Station	Station Name	National Park	Previous disturbance	Overall Communication Strategy
AC56	Wickersham Dome	Denali	Pre-existing instrumentation for AEIC and a park repeater are at this site.	Intuicom 900 megahertz (MHz) spread spectrum radios to telemeter the data to a UAF/GI repeater station located at Lake Minchumina to the north of and outside the park where it would be repeated to an existing Internet connection at the UAF/GI. From radio shack to PBO station site – 79 meters – SW (Azimuth 210 deg. T)
AC33	N. Denali (Tokosha Comm)	Denali	Co-located with an existing Denali National Park radio communications hut at the peak of a ridge.	Intuicom 900 MHz spread spectrum radio to telemeter data to an existing radio repeater at an existing GPS station (AC46) located south of Denali National Park on Shell Hill, which is located on State of Alaska Department of Natural Resource Land (not park land). From radio shack location to PBO station site – 146 meters – NE (Azimuth 45 deg. T.) The proposed PBO station and associated equipment would not have any effect on the existing NPS equipment or vice versa.
AC37	Lake Clark NPS Radio Hut	Lake Clark	Below existing LCNP Communications station north of Port Alsworth. Station site is 50–60 feet east of existing hut on bedrock outcrop.	Intuicom 900 MHz spread spectrum radio to telemeter to an AC-powered VSAT to be located at an undermined location in the village of Port Alsworth. One potential location would be at the NPS headquarters or tool shed/gear shed near the NPS headquarters building in Port Alsworth. An alternative would be to locate StarBand VSAT at Lake Clark NPS Communications station. From radio shack to PBO station site – 15 meters – SE (Azimuth 175 deg. T).
AC47	Slope Mountain	Lake Clark	Previously undisturbed.	Intuicom 900 MHz spread spectrum radio to telemeter data to another master Intuicom radio to be located at the Ninilchik Volunteer Fire Department. A back-up would be a radio shot to Anchor Point (AC03) and Ugashat Islands.
AC26	Cape Gull	Katmai	Site of the “old” Coast Guard and FAA tower, which have been removed.	VSAT with either Hughes or StarBand to telemeter the data. Options for powering the VSAT: 1) DC power for a VSAT on-site, or 2) to minimize visual and wilderness impacts the NPS prefers a radio link to a VSAT at the “new” Coast Guard/FAA tower location where there is AC power for the VSAT, and an extra battery bank at AC26 (NPS permit needed).
AC08	Cape Douglas	Katmai	Existing USGS AVO seismometer on site.	DC powered Hughes VSAT to be installed on-site and mounted to the hut. Two 64 watt solar panels would be used to power a NetRS® and radio for data telemetry.

2.3.3 PBO Station Installation

The majority of the SDBM stations would be constructed within a 74 square meter (m^2) [800 square feet (ft^2) or 0.02 acre (ac)] construction area.

Some proposed PBO station sites are located in extremely rugged terrain. While the SDBM can be constructed on rugged terrain, the equipment support structures must be placed on relatively level terrain. In areas of rugged terrain, the SDBM and equipment support structures may be placed greater than nine meters [30 feet (ft)] apart. For these station sites, two separate construction areas would be utilized—one for construction of the SDBM and one for construction of the equipment support structures. Each construction zone would consist of a nine meter (30 ft) radius circle around the equipment. Table 2-3 lists the size of the construction areas for these installations.

Table 2-3. Construction area required for various PBO station installations

Type of installation	Construction area
SDBM (level terrain)	800 ft^2 (74 m^2) 0.02 acre (0.007 ha)
SDBM (rugged terrain)	5,655 ft^2 (525 m^2) 0.1 acre (0.05 ha)

All drill cuttings, grout, and other waste would be transported from the station site for disposal. Revegetation would be conducted, as needed, pursuant to NPS guidelines. Maintenance visits to the station sites would be conducted by helicopter except at Station AC56 (Wickersham Dome), where vehicular access is possible. Batteries used to power the instruments are gel cell types with no risk of spillage. Spent batteries would be removed from the station sites.

The completed SDBM stations occupy a relatively small footprint of 64 ft^2 (6 m^2) or 0.001 ac (0.0006 ha). Installation time is approximately two to four days depending on weather conditions.

2.3.4 Mitigation Associated with the Proposed Action

Traditional best management practices (BMPs) that are always used during the construction and installation of PBO stations include the following:

- UNAVCO would follow “Leave No Trace” principles while operating on National Park Service lands.

- UNAVCO would not damage or remove any natural feature.
- UNAVCO would not remove, dig, excavate, disturb, injure, destroy, or in any way damage a historic or archeological resource, site, artifact or property.
- If any archeological or historical resources are discovered during installation at any of the new stations, the installation would be halted and the NPS superintendent and park archaeologists would be notified as soon as practicable. No further action would take place until the NPS provides clearance, which would occur sometime after consultation with the State Historic Preservation Office and affected Native communities.
- After the stations are operational, UNAVCO would conduct station site visits only to replace back-up batteries and to conduct routine maintenance. Station site visits would occur approximately once every three years for each station unless equipment malfunctions.
- All drill cuttings, grout, and other waste would be transported from the station site for disposal.
- Batteries used to power the instruments would be gel cell types with no risk of spillage. Used batteries would be removed from the station site following replacement.

In addition, the following specific actions would be part of project design:

- To comply with the Migratory Bird Treaty Act, helicopter activity would be scheduled in consultation with NPS personnel to avoid sensitive bird migration or nesting periods in the project areas, including typical seabird and raptor nesting and crane migration periods. Known seabird colony areas, especially along the Pacific coastline of Lake Clark and Katmai national parks and preserves would be avoided.
- To reduce adverse impacts to wildlife and recreational users in the parks, helicopters would maintain a minimum altitude of 2,000 to 2,500 feet above ground surface, other than during landing and takeoff, or when visibility and conditions allow, pursuant to FAA Advisory Circular (AC91-36C), “Visual Flight Rules (VFR) Near Noise Sensitive Areas.”
- Consultations with USFWS would be made prior to installation and maintenance activities to determine flight routs and approaches (especially to Cape Gull, Cape Douglas, and Slope Mountain) so that murres, cormorants, kittiwakes, and other birds

and animals with sensitivity to sound are not disturbed during times of vulnerability (Squibb 2007).

- All flight plans would be designed to avoid high use visitor areas such as Brooks Camp and Three Forks overlook in Katmai National Park.

- UNAVCO personnel would consult with NPS each season, prior to issuance of research permits, so that flight paths would accommodate park resources and management needs.

- Vegetation disturbance would be limited to that necessary to implement the project and impacts to sensitive plant species would be avoided or minimized to the maximum extent practicable. In particular, sensitive plant species may be found at AC47 (Slope Mountain). UNAVCO would make a site visit to the AC47 site with NPS designee Dr. Matt Carlson of the UAA Alaska Heritage Program (scheduled for late July 2007) to determine if any rare plant species could be adversely affected by the proposed installation, and if found, consult with Dr. Carlson and NPS to avoid or minimize such adverse effects.

- Research activities would be conducted in a manner that would not restrict permitted subsistence uses.

- Although areas disturbed during installation would be kept to an absolute minimum and would be revegetated according to NPS guidelines, revegetation with native species is not considered feasible in some areas. Where revegetation with native species is not feasible, non-native species would not be used.

- To prevent the transportation and introduction of invasive plant species to these remote locations, helicopters, installers' clothing and footwear, and installation equipment would be cleaned before and after each CGPS installation.

- Installations would be small and, except for the solar panels, colored to match the surroundings. Four weeks prior to the scheduled installation of equipment and as part of the logistics coordination and consultation process for each individual site, UNAVCO would provide plans and colors to NPS officials.

- The equipment at each station site would be removed by the year 2018. In lieu of a removal bond, a certificate of deposit would be provided for each station in the amount of $4,000 that would accrue interest at a market rate, payable to the Department of

Interior/National Park Service. The certificate would remain with the station permit in the event that the station is turned over to another research institution.

2.4 Environmentally Preferred Alternative

The No Action Alternative is the environmentally preferred alternative because no new impacts to park resources and values would occur from the installation of new PBO stations in Denali National Park and Preserve, Lake Clark National Park and Preserve, and Katmai National Park and Preserve. This alternative represents a continuation of the existing situation.

2.5 Description of Alternatives and Actions Considered but Eliminated from Detailed Study

2.5.1 Outside-the-parks Alternative

Fourteen sites were originally identified within Denali National Park and Preserve, but other suitable locations on bedrock were found outside the park to avoid impacts to wilderness or areas eligible for wilderness designation. Now, only two sites are proposed within the park's boundaries, and these were carefully selected in cooperation with NPS to minimize impacts. The remaining six stations are located within the parks because the distance from the stations to the faults and volcanoes to be studied would be too far to yield meaningful data if located outside park boundaries. The configuration of the geodetic network (i.e. location of PBO station sites on bedrock in the parks) is dictated by the volcanic and tectonic structure of the Earth's crust in Alaska. The most seismically active areas are located within the parks and preserves. Although it is possible to install the six PBO stations outside of the parks, doing so would not allow the network to provide scientifically optimal data.

2.5.2 Substitute Technology Alternative

No comparable technology is currently available for monitoring the geologic hazards that are the subject of the PBO Project.

2.6 Summary Comparison of Environmental Impacts

Table 2-4 provides a summary comparison of Alternative A (No Action) and Alternative B (Proposed Action—Install New PBO Stations). The environments within which the proposed PBO stations would be installed are discussed in detail in Chapter 3, Affected Environment and the potential impacts to the environment are discussed in detail Chapter 4, Environmental Effects. A table defining the relative effects to physical and biological resources is included in the introduction to Chapter 4.

Table 2-4. Summary Comparison of the Alternatives

Resource Issues	Alternative A: No Action	Alternative B: Install New PBO Stations
Geo-hazard Monitoring and Human Safety	No new impacts	Improved geo-hazard data gathering and information to enhance public safety and interpretation of park resources at the most geologically active sites.
Natural Sound Environment	No new impacts	Negligible impact from installation and maintenance activities (every three years) including access by helicopter to five sites and by truck to one site.
Soils	No new impacts	Minor impacts to soils would occur at the new seismic stations in each park. PBO station AC26 (Cape Gull) would be located at a site formerly occupied by the Coast Guard and FAA. Site was previously disturbed.
Vegetation	No new impacts	Minor impacts to vegetation would occur at two new seismic station sites in each park. PBO Station AC26 (Cape Gull) would be located at a site formerly occupied by the Coast Guard and FAA. Site was previously disturbed.
Wildlife Habitat	No new impacts	Negligible impacts to wildlife habitat or populations from helicopter activity at five sites because of the remote locations of seismic stations and limited periods of helicopter use. A truck and trailer would be used at Station AC56 (Wickersham Dome); the effect would be negligible.
Visual Quality	No new impacts	Minor impacts to visual resources in remote locations.
Cultural Resources	No new impacts	No new impacts expected.
Wilderness	No new impacts	Minor impacts to wilderness character from helicopter access to install and maintain five of the proposed stations would occur. Three proposed PBO stations would be in designated wilderness areas (AC 26 Cape Gull, AC08 Cape Douglas, and AC37 Lake Clark NPS Radio Hut). AC47 Slope Mountain and AC33 N. Denali Tokosha Comm are in areas eligible for wilderness designation. Five stations would require maintenance once every three years including access by helicopter. Minor impacts to wilderness character would occur. AC 26 (Cape Gull), AC08 (Cape Douglas), AC37 (Lake Clark NPS Radio Hut), AC47 (Slope Mountain) and AC33 (N. Denali Tokosha Comm) stations would adversely affect wilderness character by remaining in the proposed locations until at least 2018.

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Chapter 3: AFFECTED ENVIRONMENT

3.1 Geo-hazard Monitoring and Human Safety

Currently, there is a seismic station array that provides a moderate level of geo-hazards information and monitoring associated with earthquakes and volcanic activity in Alaska. Park managers receive hazard forecasts and warnings from the USGS and FAA.

3.2 Natural Sound Environment

The NPS is concerned about the quality of a visitor's experience in the parks, including the variety and intensity of sounds. The total acoustic environment of an area is called the "soundscape." Protection and management of park soundscapes are guided by several important laws and regulations, which form the foundation of the NPS Natural Sounds Program. Among them are the 1916 NPS Organic Act, the Redwoods Act of 1978, NPS Management Policies (Section 4.9), and the 1987 National Parks Overflights Act (Public Law 100-91). The NPS web site entitled Park Soundscapes (NPS, No date-c) describes the importance of sounds in the parks as follows:

> Both natural and human sounds may be desirable and appropriate in a soundscape, depending on the purposes and values of the park. For example, the sound of canon fire and muskets may be appropriate and desirable at Gettysburg National Military Park but not in the wilderness of Yellowstone. Soundscapes often vary in their character from day to night and from season to season and can be affected by changes in numbers of visitors who introduce human-caused sound into the environment. The soundscape of a national park, like water, scenery, or wildlife, is a valuable resource that can easily be degraded or destroyed by inappropriate sounds or sound levels. As a result, soundscapes require careful management if they are to remain unimpaired for future generations (NPS, No date-c).

3.2.1 Denali National Park and Preserve

Because the soundscape of Denali National Park and Preserve is becoming increasingly affected by human-generated noise, a soundscape program is underway at the park. Park scientists are documenting natural and human-generated sounds at numerous locations throughout the park including high in the mountains, on glaciers, along rivers, in remote areas, and along Park Road.

Station AC56 (Wickersham Dome) would be above the air traffic landing area at Kantishna. *Denali National Park and Preserve Draft Backcountry Management Plan* notes that this is an area of "frequent noise from air traffic landing at Kantishna…" (NPS, 2003b). Station AC56 is also bordered on the north and south by a "summer corridor," which provides for "high-use travel routes via ground or water that provide access to remote parts of the park and preserve." Natural sound disturbance in a corridor is rated as "high" (NPS, 2006b).

Station AC33 (N. Denali Tokosha Comm) is above the Tokositna River, which, as noted in *Denali National Park and Preserve Draft Backcountry Management Plan,* is a main flight path for air taxis going to and from the Denali base camp and for air tours of Mount McKinley, and which has increasing use of snowmachines and motorboats (NPS, 2003c). AC33 is also within the Ruth Glacier Special Use Area (NPS, 2006b). This area provides for "high use of transportation services during the season when large numbers of day users are accessing the Ruth Amphitheater." The season is from May through September. The natural sound disturbance in the Ruth Glacier Special Use area is rated as "Very High" (NPS, 2006b). Large numbers of scenic air tour overflights produce high intensity levels of noise in this vicinity (NPS, 2006b).

Both CGPS stations would be in a Soundscape zone proposed to be designated "Primitive" where:

> Natural sounds are undisturbed the greater part of every hour over the entire area, but depending on the season, weather, and proximity to travel corridors there may be infrequent intrusions of human noise from snowmachines, aircraft, or other sources, a few of which may be loud (NPS 2005).

3.2.2 Lake Clark National Park and Preserve

The natural soundscape of the proposed stations within Lake Clark National Park and Preserve is relatively free from motorized vehicles. Typical vehicle sounds, depending on the season, would include motor boats and snowmobiles. Aircraft noise, however, is frequent, especially during good weather. These sounds include private aircraft navigating though the mountains, commercial airlines at high altitudes, authorized helicopters transporting people and equipment to authorized scientific installations, and aircraft used for park management and operations (NPS and FAA, 2006). The Port of Alsworth is located at the west end of Lake Clark Pass, which is the major air thoroughfare through the southern Alaska Range. Station AC37 (Lake Clark NPS Radio Hut) would be within designated wilderness along this flight path. In the summer months, daily flights over this area are estimated to range from several dozen to more than one hundred. Tuxedni Bay, west of the proposed Station AC47 (Slope Mountain), is a side trip for air tours along the Cook Inlet Coast. NPS reports that 50 low level flights were recorded

along the south side of Tuxedni Bay during a period of less than two months (June–July) in 2001, and over 350 other flights were audible (Spencer 2007).

3.2.3 Katmai National Park and Preserve

The natural soundscape of the proposed station sites within Katmai National Park and Preserve is relatively free from motorized vehicles because both sites, AC08 (Cape Douglas) and AC26 (Cape Gull), are within designated wilderness. Helicopters, however, are used for access to U.S. Coast Guard (USCG) and AVO stations for annual or biannual maintenance.

3.3 Soils and Geology

Denali, Lake Clark, and Katmai national parks and preserves are located in the Alaska Range Transition Division. This landscape is described as a "complex mix of folded, fractured, and deformed sedimentary and metamorphic rock with intrusions of granite." Soils in the mountains of this ecoregion are "generally thin, rocky, and coarse, with scattered pockets of permafrost" (Spencer et al, 2002).

3.3.1 Denali National Park and Preserve

The park contains a major portion of the Alaska Range, which is one of the great mountain uplifts in North America (NPS, 2006). Soil types within Denali National Park and Preserve can be generally classified as mountain and tundra soils, bog soils, and forest soils. Mountain and tundra soils form directly from bedrock and the slow accumulation of organic matter (NPS, 1986a). The *Soil Survey of Denali National Park Area, Alaska* was issued in July 2006 (Clark and Duffy, 2006). According to the survey, Stations AC56 (Wickersham Dome) has soil and geology associated with Alpine Schist Mountain Ridges with Discontinuous Permafrost and AC33 (N. Denali Tokosha Comm) is in an area of Nonvegetated Mountains, South Central Mountains.

3.3.2 Lake Clark National Park and Preserve

Currently, no comprehensive soil surveys have been conducted in Lake Clark National Park and Preserve (Natural Resources Conservation Service, 1998). In general, soils in Lake Clark National Park and Preserve are young, poorly developed, extremely variable, and are derived from glacial or volcanic processes (Racine and Young, 1978). The land surface below the 1,500–2,000-foot mean sea level (msl) elevation has been scoured by Pleistocene glaciations. The topography above approximately 2,000 feet (msl) is either too steep to retain soils, covered by snow and ice, or at too high an elevation for soil-forming vegetation to grow. Station AC37 (Lake Clark NPS Radio Hut) would be located on a bedrock outcrop, and AC47 (Slope

Mountain) would be located on bedrock that is highly competent metamorphic rock with little fracturing.

3.3.3 Katmai National Park and Preserve

Currently, no comprehensive soil surveys have been conducted in Katmai National Park and Preserve (Natural Resources Conservation Service, 1998). One limited study in the park evaluated soil properties in the Valley of the Ten Thousand Smokes (Cameron, 1970), but that study does not cover the area of the proposed PBO stations. The eastern side of the Alaska Peninsula and the Pacific coast are mountainous and rugged. In general, about 30 percent of the Aleutian Oceanic Meadow province, where the Katmai National Park stations would be located, consists of high mountains without soil cover. Dominant soils are formed from volcanic ash or pumice, with large components of pyroclastic materials. Permafrost is generally absent (Bailey, 1995). Station AC26 (Cape Gull) would be located at the former location of a Coast Guard/FAA tower, which is considered an ideal location for a seismic monitor because it has exposed competent bedrock. Station AC08 (Cape Douglas) would be constructed on similar exposed competent bedrock.

3.4 Vegetation

Denali, Lake Clark, and Katmai national parks and preserves are located in the Alaska Range Transition Division. The lower slopes of this ecoregion support “dense thickets of alder that transition to low shrubs in the subalpine and blueberry-rich alpine tundra.” Above 4,000 feet, however, the harsh conditions leave the rock and talus (broken rock) bare (Spencer et al, 2002).

3.4.1 Denali National Park and Preserve

The park is significant for its rich and varied vegetation, which includes alpine tundra, shrub-scrub tundra, mixed spruce-birch and spruce-tamarack woodlands, taiga, wetlands, and extensive riparian and lowland forest areas (NPS, 2006b). Denali National Park and Preserve station, AC56 (Wickersham Dome), (Figure 2-1) would be located in an area with dry alpine tundra, dwarf shrub, and rocky ground. The Lower Ruth Management Unit, in which AC33 (N. Denali Tokosha Comm) (Figure 2-2) would be located contains diverse vegetation including plant species that have not yet been found anywhere else in the park (NPS, 2003a). Station AC33, however, would be located on a peak in an area with dry alpine tundra, dwarf shrub, and rocky ground. As shown in Figures 2-1 and 2-2, Station AC56 has more vegetation than Station AC33.

3.4.2 Lake Clark National Park and Preserve

Lake Clark National Park and Preserve is located in the Subartic Regime (Mountains) Alaska Range Humid Taiga-Tundra-Meadow Province and is a continuation of the Alaska Range (Bailey, 1995). Station AC37 (Lake Clark NPS Radio Hut) (Figure 2-3) and Station AC47 (Slope Mountain) (Figure 2-4) would be within areas of sparse alpine tundra, with patches of prostrate shrub tundra and bare ground (broken rock). These station sites are above the tree line, where typically the plants form discontinuous mats among the rocks and rubble (Bailey, 1995). The NPS vascular plant inventory (Miller, et al, 2006) identified a rare pant *Arabis lemmonnii* (Demonstrably secure globally, but critically imperiled in the state) as well as four other species of conservation concern on Saddle Mountain[1], which is approximately 6 miles to the south of Slope Mountain. Slope Mountain is similar uptilted Jurassic sediments and may also support a population of *Arabis lemmonnii.* This plant grows on unstable, eroding steep terrain. NPS reviewers report that Slope Mountain has not been inventoried by a professional botanist surveying for unusual species.

3.4.3 Katmai National Park and Preserve

Katmai National Park and Preserve is within the Tundra Regime (Mountains) Aleutian Oceanic Meadow-Heath Province (Bailey, 1995). In the proposed CGPS station locations, trees are absent except for a few shrubs, chiefly dwarf willows. Large spruce, birch, and cottonwood forests, however, cover a substantial portion of the park and preserve to the west and east of the coastal areas. The southern extent of Sitka Spruce is found along the coast of Katmai National Park and Preserve. Boreal forest and coastal rainforest are slowly encroaching from the east of this province (Bailey, 1995). Station AC26 (Cape Gull) (Figure 2-5) would be in an area of tall alder shrub vegetation types with a scattering of small spruce nearby, while Station AC08 (Cape Douglas) (Figure 2-6) would be in an area of sparse alpine tundra and bare ground (i.e. broken rock).

3.5 Wildlife and Habitat

3.5.1 Denali National Park and Preserve

The park was originally established as a refuge for large mammals such as Dall sheep, caribou, wolves, grizzly bear, moose, and fox (NPS, 2006). The site proposed for Station AC56 (Wickersham Dome) is in an area of grizzly bear habitat, with black bears on the forested slopes

[1] The four other species of conservation concern: *Arnica diversifolia, Carex phaeocephala, Papaver alboroseum, and Thlaspi arcticum* (Miller et al, 2006).

below, and scattered raptor stations (NPS, 2003b). The proposed site for Station AC33 (N. Denali Tokosha Comm) is in an area, between the Tokositna River and Ruth Glacier, that has important wildlife habitat (NPS, 2003a), particularly for moose (NPS, 2005), however its location on a rocky peak may limit its habitat value (see Table 2-1 for CGPS station elevations).

3.5.2 Lake Clark National Park and Preserve

Lake Clark National Park and Preserve Station AC37 (Lake Clark NPS Radio Hut) would be within an area of known habit for large mammals including caribou, wolf, moose, Dall sheep, brown bear, and black bear (NPS, 1984). Station AC47 (Slope Mountain) would be within an area of known habitat for small mammals such as marmots and ground squirrels. Creeks and rivers far below the station site are salmon habitat, and seal and whale habitat is present in the Tuxedni Bay east of the station (NPS, 1984). In addition, the coastline south of the proposed site of Station AC47 (Slope Mountain) is home to a colony of glaucous-winged gulls, and Chisik Island, which is northeast of the site, supports colonies of at least nine seabird species (USFWS, 2006). NPS geographic information system (GIS) data for Lake Clark National Park and Preserve (NPS, no date-b) did not reveal any sensitive habitat, threatened, or endangered species near the proposed Slope Mountain station site.

3.5.3 Katmai National Park and Preserve

The site for Station AC26 (Cape Gull) is in an area of habitat for wolves, red fox, wolverines, river otters, porcupines, marmots, and brown bears. These mammals are common near coastal and lake areas in Katmai National Park and Preserve, and may also occur in alpine areas. Falcons, hawks, and eagles, and upland shorebirds may also be of concern in coastal, lakeside, and alpine-cliff areas. Seabirds and waterfowl are present close to coastal areas: At least six species of seabirds have colonies in the vicinity of Cape Gull (USFWS, no date). In addition, along the coast are sea lions, sea otters, and hair seals. Porpoise and Minke, killer, and gray whales sometimes use the Shelikof Strait, which is just below Cape Gull (NPS, No date-d). USFWS was contacted about threatened and endangered species in the vicinity of this site. They report that Steller's eider, Short-tailed albatross, Kittlitz's murrelets, and Northern sea otters occur in the vicinity. The proposed station site, however, does not provide habitat for any of these species (Baloug 2007).

Station AC08 (Cape Douglas) would be in an area of habitat for brown bears, which live throughout the coastal and lake regions of Katmai National Park and Preserve. (NPS, No date-d). The bears are most commonly encountered along fishing streams and the coast, and often den on mountain slopes. At least three species of seabirds have colonies that should be avoided when approaching Cape Douglas (USFWS, 2006).

3.6 Visual Quality

3.6.1 Denali National Park and Preserve

Station AC 56 (Wickersham Dome) would be located above the treeline at the west end of Denali National Park Road (Figure 2-1). The site overlooks Moose Creek and the Kantishna airplane landing station. It is also in an area that experienced mining, and the station may be visible from the mines located on ridge tops, such as Little Annie Mine and Red Top Mine. Each summer Wickersham Dome is visited by several hikers from the three lodges in the Wonder Lake area for the expansive views, and by some NPS employees for recreation (Rice 2007).

Station AC33 (N. Denali Tokosha Comm) is in Denali National Park and would be co-located with an existing communications hut on a ridge between the toes of the Ruth Glacier and the Tokositna Glacier (Figure 2-2). The PBO station site overlooks the Tokositna River. Mount Goldie can be seen in the west and Mount Church in the north. It is likely that the completed PBO station would be visible from airplanes following the Tokositna River on the way to Mount McKinley.

3.6.2 Lake Clark National Park and Preserve

Station AC37 (Lake Clark NPS Radio Hut) would be located on a flat shelf below existing LCNP Communications station north of Port Alsworth. The site is located 50–60 feet east of the existing hut on a bedrock outcrop (Figure 2-3). From this station, Lake Clark, Little Lake Clark, and the Tlikakila River would easily be seen to the south and southwest, with the Chigmit Mountains, within the park boundary, in the background. The Port of Alsworth is located at the west end of Lake Clark Pass, which is the major thoroughfare through the southern Alaska Range. During good weather, daily flights over this area are estimated to range from several dozen to more than one hundred. Thus, while Station AC 37 (Lake Clark NPS Radio Hut) would seldom be encountered by hikers, the CGPS station would be visible to the many pilots and passengers using this air corridor.

Station AC47 (Slope Mountain) would be located on flat bedrock some 3,000 feet above the Tuxedni Channel (Figure 2-4). From this barren station, Slope Mountain, and farther to the southwest, Triangle Peak and Saddle Mountain could be seen. Chisisk Island could be seen to the northeast, and Tuxedni Bay could be seen in the east and southeast. Tuxedni Bay, west of the proposed CGPS station site, is a side trip for air tours along the Cook Inlet Coast. NPS reports that 50 low level flights were recorded along the south side of Tuxedni Bay during a period of less than two months (June 19–July 28) in 2001, and over 350 other flights were audible. Although only a few hikers would be expected to see Station AC47 (Slope Mountain), it is likely

that many pilots and passengers would see it in an average summer month as they fly past Slope Mountain.

3.6.3 Katmai National Park and Preserve

Station AC26 (Cape Gull) would be located on a bedrock outcrop near Cape Gull on the Alaska Peninsula (Figure 2-5). This is the former site of a U.S. Coast Guard FM repeater tower and an FAA transponder/repeater tower, which were removed in 2000 and relocated to a higher location on a ridge to the northwest. Both sites are located within designated wilderness of Katmai National Park and Preserve. The Cape Gull site is near a cliff that is surrounded by the waters of Shelikof Straight. Kodiak Island is visible to the east and Kaflia Bay and Kukak Bay are visible to the northeast, with the high peaks around Fourpeaks Mountain visible beyond. On a clear and sunny day, Station AC26 (Cape Gull) would be visible to an airplane pilot and passengers from an elevation of 1,000 feet above ground level about two miles out in the east, south or west. The station would also be visible to a hiker if they were north of the site, at a higher elevation, and within one to two miles of it. If someone was hiking along the beach below or at lower elevations to the east or west, they would not likely see it. Someone kayaking below the cliffs would not see the site from the water in the east, south or west.

Station AC08 (Cape Douglas) would be located on the north flank of Mount Douglas Volcano, near the existing USGS Alaska Volcano Observatory seismometer (Figure 2-6). From this site, the mouth of the Douglas River and Kamishak Bay are visible to the north with Augustine Island and the Kenai Peninsula beyond. To the south it is possible to see Spotted Glacier and the peaks north of Mount Douglas. It would be possible to see the installation from the ridge line west of Spotted Glacier.

3.7 Cultural Resources

3.7.1 Denali National Park and Preserve

Two new PBO stations would be located in Denali National Park and Preserve. Station AC56 (Wickersham Dome) would be located above the treeline at the west end of Denali National Park Road (Figure 2-1) and would be in the general vicinity of the Kantishna/Old Eureka Historic Mining District. Station AC33 (N. Denali Tokosha Comm) would be co-located with an existing communications hut at the peak of a ridge between the toes of the Ruth Glacier and the Tokositna Glacier (Figure 2-2).

- Denali National Park and Preserve has a number of archaeological and historic sites. The Mount McKinley National Park Headquarters Historic District, listed on the National Register of Historic Places in 1987.

- The Patrol Cabin Historic District is comprised of patrol cabins constructed between 1924 and 1935 along the park road and boundary of the Denali Wilderness. The cabins are significant for the development of a transportation system in a remote area of interior Alaska and the early efforts of the NPS to practice wildlife conservation in the first national park in Alaska. Six of the cabins are located on the 90-mile Park Road at intervals of 10-15 miles apart.

- Kantishna/Old Eureka Historic Mining District, determined eligible for listing in the National Register of Historic Places in 1993, is comprised of six buildings, three sites, and two structures constructed between 1904 and 1942. The district is significant for its representation of prospecting and mineral exploration and mining settlement patterns in the Denali region. The building sites and landscape features are important interpretive elements tracing the history of settlement and mining technology (NPS, 2002).

- Two archaeological sites are within the southeast corner of the Lower Ruth Management Unit (Unit 75), however the proposed Station AC33 (N. Denali Tokosha Comm) would be far from that area.

3.7.2 Lake Clark National Park and Preserve

Station AC37 (Lake Clark NPS Radio Hut) would be co-located with a park telecommunications facility (Figure 2-3). Station AC47 (Slope Mountain) would be located on an undisturbed site on the north flank of Slope Mountain (Figure 2-4). A World War II period military observation post reported on Slope Mountain would be avoided if encountered.

A limited amount of archeological work has been done within Lake Clark National Park and Preserve. Although it is one of the largest parks in Alaska, its archaeological resources may be the least known. With one recognized National Historic Landmark and a viable Native community with a subsistence lifestyle, this park and preserve has the potential to contain extensive archaeological resources. Indications are that a full range of archeological resources, from early prehistoric to late prehistoric and historic, can be expected to occur in the park and preserve. The earliest archaeological investigation entailed the excavation of the Kijik Village site on the north shore of Lake Clark. The Kijik Archaeological District has been elevated to a National Register of Historic Landmark in recognition of its national significance (NPS, No date-a).

The early prehistory of Cook Inlet, which forms the eastern boundary of the park, is not very well known. The main cultural sequence is the Kachemak Bay sequence (I-IV), which runs from 4,000 before present (BP) to late prehistoric times. Kachemak settlements were located along

rugged coastlines with deep water offshore and mountains inland, especially in the southern portion of the Cook Inlet.

3.7.3 Katmai National Park and Preserve

Station AC26 (Cape Gull) would be located on the site formerly occupied by a U.S. Coast Guard FM repeater tower and FAA transponder/repeater tower (Figure 2-5). Station AC08 (Cape Douglas) would be co-located with a USGA AVO seismometer (Figure 2-6).

Katmai National Park and Preserve protects a rich archaeological record including National Historic landmarks at Brooks Camp and Amalik Bay on the coast. Current archaeological evidence suggests that people first inhabited the Pacific coast as early as 7,200 years ago and continued living there until forced to flee by the 1912 Katmai Eruption. Coastal peoples endured and adapted to rough seas, strong winds, earthquakes, and volcanic eruptions. The native inhabitants of the Upper Alaska Peninsula coast were typically dependent on the sea, and little evidence exists of settlements more than a short distance from the beach unless they are associated with freshwater streams that support migrating fish. Archaeological evidence shows that native inhabitants of the Katmai area subsisted on saltwater fish species, sea mammals (seals and whales), and limited amounts of bird species and terrestrial mammals. Recent excavations on Mink Island recovered artifacts from the Late Kachemak Period that are considered to be the highest in technical and artistic accomplishments in the precontact Upper Alaska Peninsula (Hilton, 1998). Some looting and vandalism of archaeological sites has occurred along the outer coast of Katmai and other locations.

3.8 Wilderness

As defined in The Wilderness Act of 1964,

> A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in

> an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value (16 U.S.C. 1131-1136).

Section 701 of ANICLA (1980) designates wilderness areas in the affected parks.

3.8.1 Denali National Park and Preserve

Denali Wilderness contains approximately 1.9 million acres (798,210 ha). Station AC56 (Wickersham Dome) would be in an area that is considered not eligible for wilderness (NPS, 2005). The site for Station AC56 is also bordered on the north and south by a "summer corridor," which provides for "high-use travel routes via ground or water that provide access to remote parts of the park and preserve." Natural sound disturbance in the corridor is rated as "high" (NPS, 2006b).

Although Station AC33 (N. Denali Tokosha Comm) would be located in an area considered eligible for wilderness designation, it would be above the Tokositna River, which, as noted in *Denali National Park and Preserve Draft Backcountry Management Plan,* is a main flight path for air taxis going to and from the Denali base camp and for air tours of Mount McKinley, and which has increasing use of snowmachines and motorboats (NPS, 2003c). Station AC33 would also be within the Ruth Glacier Special Use Area (NPS, 2006). This special area provides for "high use of transportation services during the season when large numbers of day users are accessing the Ruth Amphitheater." The season is from May through September. The natural sound disturbance in the Ruth Glacier Special Use area is rated as "Very High" (NPS, 2006). Large numbers of scenic air tour overflights produce high intensity levels of noise in this vicinity (NPS, 2006), but the Tokosha radio repeater site is seldom visited (Rice 2007).

3.8.2 Lake Clark National Park and Preserve

Lake Clark Wilderness contains approximately 2.47 million acres (999,573 ha). Proposed Station AC37 (Lake Clark NPS Radio Hut) would be within the designated wilderness of Lake Clark National Park and Preserve. The proposed site for Station AC47 (Slope Mountain) is managed as wilderness.

3.8.3 Katmai National Park and Preserve

Katmai Wilderness contains approximately 3.47 million acres (1,202,259 ha). Stations AC08 (Cape Douglas) and AC26 (Cape Gull) would be within the designated wilderness of Katmai National Park and Preserve.

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Chapter 4: ENVIRONMENTAL CONSEQUENCES

This EA evaluates the environmental, social, and economic effects from the proposed PBO stations within Denali National Park and Preserve, Lake Clark National Park and Preserve, and Katmai National Park and Preserve. The chapter is organized by alternative and, where applicable, the environmental effects of the Proposed Action Alternative are discussed by national park. This information is based on readily available environmental information, information from NPS resource specialists, and field reconnaissance. Adhering to the site selection criteria, Appendix B, ensured that several resources would not be affected at all, and the remaining resources would be affected very minimally. Construction best management practices would be implemented as part of the Proposed Action to further minimize impacts. The potential environmental consequences of installing the proposed PBO stations may be characterized as having major, moderate, minor, or negligible impacts on the physical and biological features of the existing environment. Table 4.1 briefly defines these levels of impact.

Table 4-1. Definitions of environmental impacts

	Major	Moderate	Minor	Negligible
Physical resources	Regional change of considerable severity in landforms, surface appearance, availability, or impairment of wilderness character lasting for the duration of the project or longer.	Localized changes of considerable severity in landform, surface appearance, availability, or impairment of wilderness character occurring for the duration of the project, or widespread changes generally limited to the period of construction.	Localized change(s) in surface appearance, distribution, availability, impairment of wilderness character, or other characteristics of physical resources with no observable residual modification.	Little or no change in surface appearance, distribution, availability, impairment of wilderness character, or other characteristics occurring as the result of this project, or if any change does occur, it would be extremely localized and temporary.
Biological resources	Regional change in habitat availability or quality that would likely modify the natural abundance or distribution of a species potentially through the life of the project or longer.	Regional change in habitat availability or quality that would likely modify the natural abundance or distribution of a species, or localized modification in habitat availability or quality that would likely modify the abundance or distribution of species potentially lasting through the life of the project or longer.	Localized change of species abundance, distribution, habitat availability or habitat quality.	No measurable change in abundance or distribution, habitat availability, or habitat quality.

4.1 Alternative A: No Action

The No Action Alternative is described in Section 2.2, Alternative A No Action.

4.1.1 Effects on Geo-Hazard Monitoring and Human Safety

NPS management policies Section 4.8.1.3 Geologic Hazards and the Visitor Safety policy are discussed on pages 14 and 15 of this EA.

The existing seismic station array would continue to provide a reasonable level of monitoring and geo-hazards information associated with volcanic activity and earthquakes. Without the Proposed Action, park managers would continue to receive hazard forecasts and warnings from the USGS and FAA, but without the state-of-the-art accuracy and improved sensitivity that the additional monitors would provide. Accurately identifying an earthquake location is highly dependent on a number of parameters (e.g. distance to nearest station, azimuthal coverage of seismic stations, depth to the hypocenter, and number of sensors).

Without the Proposed Action, however, the density of the existing seismic array would remain insufficient. The ideal network would have uniform 30-km spacing (density) over the area where significant deformation is expected. The density being proposed, however, takes advantage of what is already known from extensive GPS survey work, the topographic and climatic conditions of the subject area, and realistic assessment of the local infrastructure and terrain. The proposed network is conservative, and the number of sites has been reduced from the ideal uniform distribution to the minimum number needed to address scientific questions while maintaining acceptable resolution of the entire area where time-dependent deformation is expected to occur. The proposed CGPS locations would increase density in areas that are suitable for long-term sites (at least 10 years). (Freymueller et al, 2002).

4.1.1.1 Cumulative Effects

The existing seismic network helps the NPS and other federal agencies warn park visitors and area mariners of impending disasters from volcanic activity and earthquakes in the remote areas.

Existing seismic installations and proposed new RAWS are described below:

- Denali National Park and Preserve. Use of existing analog instruments would continue at two stations outside and three stations inside Denali National Park and Preserve (Wickersham Dome, Thorofare, and Castle Rocks), along with two relay stations at Double Mountain and Mt. Healy (Figure 1-2).

- Lake Clark National Park and Preserve. Thirteen seismic stations are currently located within Lake Clark National Park and Preserve (Figure 1-3). Four new NPS RAWS are being proposed for installation in 2008. The locations are shown in Figure 1-3. NEPA documentation for the new RAWS is not yet complete.

- Katmai National Park and Preserve. Twenty-three seismic stations are currently within Katmai National Park and Preserve (Figure 1-4). Six new RAWS are proposed for installation in 2008. The locations for the RAWS are shown in Figure 1-4. NEPA documentation for the new RAWS is not yet complete.

The cumulative impacts of these remote seismic monitoring and weather systems result in a benefit to park management and increase public safety.

4.1.1.2 Conclusions

The No Action Alternative would have no new effect on geo-hazard monitoring, forecasting, and human safety in the three parks and preserves. Geohazard forecasting would not be improved.

4.1.2 Effects on the Natural Sound Environment

With the exception of the installation and maintenance activities associated with the proposed climate station installations (Figures 1-3 and 1-4), the No Action Alternative would have no new impact on the natural soundscapes of the parks and preserves. Maintenance of existing seismometers, RAWS installations, and data repeaters with truck-and-trailer and helicopter support would continue as currently permitted.

4.1.2.1 Cumulative Effects

Cumulative effects to the natural soundscapes of the parks and preserves include the occasional military aircraft, and the more common passenger jets, small aircraft overflights, and helicopters operating in the area during firefighting season or for park inventory and monitoring activities. Aircraft noise disturbances at Wickersham Dome, Tokosha Mountain, Lake Clark Pass, and Slope Mountain are, however, much more frequent during the summer months.

The No Action Alternative would not incrementally increase noise in the three parks.

4.1.2.2 Conclusions

The No Action Alternative would result in no new impacts to the natural sounds in the parks and preserves. It would not result in the impairment of the natural purposes and values for which the parks and preserves were established.

4.1.3 Effects on Soils and Geology

With the exception of the installation and maintenance activities associated with the proposed climate station installations (Figures 1-3 and 1-4) the No Action Alternative would have no impact on soils or geology.

4.1.3.1 Cumulative Effects

The seismic stations and other remote radio communications and RAWS installations in the parks impact small areas of soil, but these areas amount to less than one acre of effect, which has a measurable, but minor, effect on the hundreds of thousands of acres of undisturbed soils in the parks and preserves.

4.1.3.2 Conclusions

The No Action Alternative would result in no new effects on soils and geology. It would not result in impairment of the natural purposes and values for which the parks were established.

4.1.4 Effects on Vegetation

With the exception of the installation and maintenance activities associated with the proposed climate station installations (Figures 1-3 and 1-4), the No Action Alternative would have no new impacts to vegetation.

4.1.4.1 Cumulative Effects

The projected impacts to vegetation under the No Action Alternative would be similar to the present maintenance activities at the existing stations.

The seismic monitoring stations, combined with other remote radio communications, and RAWS installations in the parks, impact small areas of vegetation. These impacts amount to less than one acre of affected area, which has a measurable, but minor, effect on the hundreds of thousands of acres of vegetation in the parks and preserves.

The No Action Alternative would not incrementally increase effects to vegetation in the three parks.

4.1.4.2 Conclusions

No new impacts to vegetation would occur with the No Action Alternative. This alternative would not result in impairment of the natural purposes and values for which the parks were established.

4.1.5 Effects on Wildlife and Habitat

The No Action Alternative would have no new impacts to wildlife and habitat.

4.1.5.1 Cumulative Effects

With the exception of the installation and maintenance activities associated with the proposed climate station installations (Figures 1-3 and 1-4), the projected impacts to wildlife and habitat would be similar to the present maintenance activities at the existing stations in the past.

The seismic stations, combined with other remote radio communication, and RAWS installations in the parks, impact small areas of habitat. These impacts amount to less than one acre of affected area, which has a measurable, but minor, effect on the millions of acres of habitat in the parks and preserves. The No Action Alternative would not incrementally increase effects to wildlife and habitat in the three parks.

4.1.5.2 Conclusions

No new effects to wildlife and habitat would occur with the No Action Alternative. It would not result in impairment of the natural purposes and values for which the parks were established.

4.1.6 Effects on Visual Quality

With the exception of the installation and maintenance activities associated with the proposed climate station installations (Figures 1-3 and 1-4), no new impacts would occur to visual quality with the No Action Alternative.

4.1.6.1 Cumulative Effects

A few hikers and climbers view existing seismic and communications stations, which continue to have a minor impact on the pristine visual quality of the areas. During the summer months, however, many pilots and passengers would continue to see the existing seismic and communications stations located in the vicinity of Wickersham Dome, Lake Clark Pass, and Slope Mountain. The new climate installations would also be visible.

The No Action Alternative would not incrementally increase effects to visual quality in the three parks.

4.1.6.2 Conclusions

The No Action Alternative would cause no new effects to visual quality. It would not result in impairment of the natural purposes and values for which the parks were established.

4.1.7 Effects on Cultural Resources

No new impacts are likely to occur to cultural resources with the No-Action Alternative.

4.1.7.1 Cumulative Effects

With the exception of the installation and maintenance activities associated with the proposed climate station installations (Figures 1-3 and 1-4), the No Action Alternative would only maintain the existing seismic, communications, and weather stations, and would be unlikely to result in new impacts to cultural resources in the parks.

When taking into account past actions and the resulting impacts, the overall impact to cultural resources would be moderate. The No Action Alternative would not incrementally increase effects to cultural resources in the three parks.

4.1.7.2 Conclusions

The No Action Alternative would not result in new impacts to cultural resources. It would not result in impairment of the natural purposes and values for which the parks were established.

4.1.8 Effects on Wilderness

With the exception of the installation and maintenance activities associated with the proposed climate station installations (Figures 1-3 and 1-4), the No Action Alternative would not have new impacts to designated wilderness or areas eligible for wilderness designation. Three radio repeater stations exist in the designated wilderness of Denali National Park and Preserve. Twelve seismic stations and one radio repeater station in Lake Clark National Park and Preserve are located in designated wilderness, and two of the four new RAWS sites under consideration would be within designated wilderness. Twenty seismic stations in Katmai National Park and Preserve are located in designated wilderness, and five of the six new RAWS sites would be in designated wilderness.

4.1.8.1 Cumulative Effects

Wilderness in the parks is affected by existing remote installations. These human developments are small and the cumulative effects on the resources and values of the vast area of wilderness in Denali, Lake Clark, and Katmai National Parks and Preserves are considered to be minor. The No Action Alternative would not incrementally increase effects on wilderness in the three parks.

4.1.8.2 Conclusions

The No Action Alternative would result in no new impacts to designated or eligible wilderness areas and would not impair the purposes and values for which the parks were established.

4.2 Alternative B: Proposed Action – Install PBO Stations in Denali National Park and Preserve, Lake Clark National Park and Preserve, and Katmai National Park and Preserve

A total of six PBO stations are proposed—two PBO stations in each of the following NPS-administered lands: Denali National Park and Preserve, Lake Clark National Park and Preserve, and Katmai National Park and Preserve (Figures 1-1 through 1-4). All of the proposed PBO stations would use SDBM equipment (Figures 2-7 through 2-11).

4.2.1 Effects on Geo-Hazard Monitoring and Human Safety

NPS management policies Section 4.8.1.3 Geologic Hazards and the Visitor Safety policy are discussed on pages 14 and 15 of this EA.

As discussed in Section 1.1 of this EA, there is a very sparse GPS network in Alaska, and although many conventional seismometers are located in the parks, no CGPS stations are located in any of the national parks in Alaska. The ideal network would have uniform 30-km spacing over the area where significant deformation is expected. The density being proposed, however, takes advantage of what is already known from extensive GPS survey work, the topographic and climatic conditions of the subject area, and realistic assessment of the local infrastructure and terrain (Freymueller et al, 2002).

Denali National Park and Preserve is a high risk area that lacks adequate monitoring for potentially dangerous locked faults and strain accumulation. Katmai and Lake Clark national parks and preserves are near an active subduction zone with a history of strong earthquakes and volcanic activity in historic times, including recent years. Yet very little is known about plate motions in these areas. The proposed network is conservative, and the number of sites has been reduced from the ideal uniform distribution to the minimum number needed to address the scientific questions while maintaining acceptable resolution of the entire area where time-dependent deformation is expected to occur. The proposed CGPS locations would increase density in areas that are suitable for long-term sites (at least 10 years) (Freymueller et al, 2002). Each of the six additional CGPS stations proposed for these parks would greatly improve

scientists' ability to directly measure the active fault systems within the parks, the interaction of the active faults, and the understanding of long-term hazards associated with them. Each proposed station is integral to the precision and accuracy of the network within the parks (Freymueller 2007).

PBO instrumentation proposed in the national parks in Alaska would augment and enhance the USGS' ability to fulfill their federal mandate to provide notification and warnings for earthquakes, volcanoes, and landslides. The PBO network uses CGPS instruments that measure relative horizontal and vertical motion rather than the shaking motions detected by seismometers. The EarthScope Program, of which the PBO installations in the national parks in Alaska are a part, includes the study of active earthquake zones, individual faults and volcanoes, deformation along plate boundaries, continental geodynamics and plate tectonic motion, fluids in the crust, and volcanic and seismic hazards. For scientists and NPS managers, the PBO installations of the Earthscope Program could provide a clearer understanding of the forces that shape the parks' environment that could translate into better assessment of earthquake and volcanic hazards and improved knowledge of the parks' natural resources.

Park managers have an interest in the data that this system would generate, largely in preparing for and reacting to a seismic or volcanic event in their area (evacuating people, etc.), and in learning more about the earth processes affecting the parks. Using the geologic hazard data to avoid placing new visitor and other facilities in geologically hazard areas and in planning emergency preparedness would be consistent with NPS management priorities to protect human life and property. Improved monitoring and the virtual real-time posting of seismic readings within the parks could also provide the public the capability to interpret volcanic activity, associated hazards, and the value of the seismic monitoring array in the national parks.

4.2.1.1 Cumulative Effects

The existing seismic station array would continue to provide a moderate level of geo-hazards information and volcanic activity and earthquake monitoring**.** Existing use of analog instruments would continue at two stations outside and three stations inside Denali National Park and Preserve (Wickersham Dome, Thorofare, and Castle Rocks, along with two relay stations at Double Mountain and Mt. Healy) (Figure 1-2). Thirteen stations are currently located within Lake Clark National Park and Preserve (Figure 1-3), and 23 stations within Katmai National Park and Preserve (Figure 1-4). The existing seismic network helps the NPS and other federal agencies warn park visitors and area mariners of impending disasters from volcanic activity and earthquakes in remote areas, and to help NPS find the geologically safest sites for new park facilities.

Park managers would continue to receive hazard information from the USGS and FAA, but the new PBO stations would provide state-of-the-art accuracy and enhanced sensitivity. Because they use technology that measures relative horizontal and vertical motions, siting the CGPS instruments in increased density on bedrock along the fault systems would significantly augment the existing network and provide more thorough understanding of geologic activity in the parks and preserves. The accuracy of data retrieved is highly dependent on the following parameters: distance to nearest station, azimuthal coverage of seismic stations, depth to the hypocenter, and number of sensors. By using the improved CGPS station array, the USGS, FAA and NPS would be able to give more accurate and timely warning to park visitors, aviators, and mariners in the affected areas. The cumulative impacts of this remote seismic monitoring system would be beneficial to park managers and increase visitor safety.

4.2.1.2 Conclusions

The Proposed Action would result in a moderate improvement in geo-hazard data gathering and information to enhance public safety and interpretation of park resources at the most geologically active sites.

4.2.2 Effects on the Natural Sound Environment

Helicopter and truck visits required for initial installation of the stations would intrude upon the natural soundscape for two to four days (depending on weather conditions), with the potential for multiple flights in and out each day.

The exception would be at Station AC26 (Cape Gull), which would be staged from the Katmai Wilderness Lodge located near Cape Gull. UNAVCO would transport gear from the lodge to the station site one day, build the station for two days, and then pick up and fly all gear back to the lodge on the fourth day depending on weather conditions.

Subsequent to the initial PBO station installation, UNAVCO would conduct site visits only to replace back-up batteries and conduct routine maintenance. Maintenance of the stations would likely involve only one flight in and one flight out per day approximately once every three years for each station. Station AC56 (Wickersham Dome) would be maintained using a truck and trailer as permitted along established roads.

4.2.2.1 Cumulative Effects

Effects to the natural soundscapes of the parks and preserves include the occasional military aircraft, and the more common passenger jets, small aircraft overflights, and helicopters

operating in the area during firefighting season or for park inventory and monitoring activities. Aircraft noise disturbances at Wickersham Dome, Tokosha Mountain, Lake Clark Pass, and Slope Mountain are, however, much more frequent during the summer months.

Up to ten new RAWS are proposed for installation in 2008. Of these, six would be in Katmai National Park and Preserve, and four would be in Lake Clark National Park and Preserve. Section 2.2 describes the locations and status of these RAWS, and their locations are shown in Figures 1-3 and 1-4. These stations would have installation and maintenance requirements similar to those of the PBO stations that include the use of helicopters and trucks with trailers—vehicles that produce noise.

The additional noise intrusions, particularly from helicopters, to these remote areas would likely add a small amount of noise that exceeds ambient natural sound conditions for short periods of time during transport to and from the sites for installation and maintenance.

4.2.2.2 Conclusions

The proposed installation and maintenance of the PBO stations with helicopters and trucks would have a negligible adverse impact to the natural sound environment in the parks; however, it would not result in the impairment of the natural purposes and values for which the parks were established.

4.2.3 Effects on Soils and Geology

Developing the PBO station network would not require the excavation or use of local sand, gravel, or rock resources for installation. Seismic and volcanic activities are not a concern because these are the hazards that would be observed by the PBO stations. Detailed reviews of the local geology and seismic setting were completed as part of designing the network configuration (Appendix B). No geologic hazards such as land slides, rock falls, or soil subsidence are present at any of the proposed station sites.

When the stations are installed, limited surface and subsurface disturbance would occur during the two- to four-day construction period, depending on weather conditions, for each station. It is conceivable, however, that the surface disturbance from construction activities could last much longer than a few days, depending on site conditions. Six PBO stations would be installed on NPS-administered lands and each installed SDBM station would occupy a relatively small footprint. As shown in Table 4-2, station equipment impacts would be restricted to the area drilled for installation of the stainless steel rods and the foundation for the equipment hut.

Table 4-2. Construction area and station equipment disturbance area for PBO station installations

	Construction surface disturbance	Station equipment surface disturbance
Each CGPS station (6 stations)		
Square feet	800.00	64.00
Square meters	74.00	6.00
Acres	0.02	0.001
Hectares	0.007	0.0006
Each national park (3 parks)		
Square feet	1,600.00	128.00
Square meters	145.00	12.00
Acres	0.04	0.002
Hectares	0.014	0.0012
Total for NPS administered lands (6 parks)		
Square feet	4,800.00	384.00
Square meters	444.00	36.00
Acres	0.12	0.006
Hectares	0.042	0.0036

Maintenance activities would include helicopter landings and foot traffic around the installations once every three years, depending on battery life. This measurable, but minor, ground disturbance would not have any substantive negative impact on soils or geological resources.

4.2.3.1 Cumulative Effects

In addition to the proposed PBO stations, up to ten new RAWS are proposed for installation in 2008. Of these, six would be in Katmai National Park and Preserve, and four would be in Lake Clark National Park and Preserve. Section 2.2 describes the locations and status of these RAWS, and their locations are shown in Figures 1-3 and 1-4. These stations would have installation and maintenance requirements similar to those of the PBO stations that would include limited surface and subsurface disturbance would occur during the construction period for each station. As with the PBO stations, it is conceivable that the surface disturbance from construction activities could last much longer than a few days, depending on site conditions.

Maintenance activities that could affect soils would continue at two stations outside and three stations inside Denali National Park and Preserve (Wickersham Dome, Thorofare, and Castle Rocks, along with two relay stations at Double Mountain and Mt. Healy) (Figure 1-2). Thirteen stations are currently located within Lake Clark National Park and Preserve (Figure 1-3), and 23 stations within Katmai National Park and Preserve (Figure 1-4). Impacts to soils at the

proposed PBO stations and the new NPS RAWS would be similar to those that occur during maintenance activities at existing seismic monitoring and communication equipment stations.

The total cumulative impacts to soils at the proposed PBO station sites (in addition to the existing seismic stations and the proposed RAWS) would affect a small percentage of soils within millions of acres of the affected park units and the impacts would be minor.

4.2.3.2 Conclusions

The direct, indirect and additive impacts to soils from this alternative would be minor and would not result in the impairment of park resources that fulfill specific purposes identified in the enabling legislation or to the fundamental natural integrity of the affected parks.

4.2.4 Effects on Vegetation

Table 4-2 presents areas of construction and permanent disturbance for the proposed stations. The footprint of each PBO station is approximately 64 ft^2 (6 m^2) or 0.001 ac (0.0006 ha). The installation would require covering or removing up to 64 ft^2 (6 m^2) or 0.001 ac (0.0006 ha) of tundra vegetation. Vegetation would be lost beneath the seismometer and hut.

These station sites are above the tree line, where typically the plants form discontinuous mats among the rocks and rubble (Bailey, 1995). The NPS vascular plant inventory identified a rare plant *Arabis lemmonnii* (G5-S1), as well as four other species of conservation concern on Saddle Mountain, which is approximately six miles to the south of Slope Mountain. This plant grows on unstable, eroding steep terrain (Miller, et al, 2006). Slope Mountain is similar uptilted Jurassic sediments and may also support a population of *Arabis lemmonnii.* NPS reviewers report that Slope Mountain has not been inventoried by a professional botanist surveying for unusual species.

Although the PBO station sites were selected so that the CGPS equipment could be installed on bedrock, small plots of tundra vegetation may be removed during installation and maintenance. Vegetation disturbance would be limited to that necessary to implement the project. This removal of tundra plants, if any, would be minor within the millions of acres of vegetation within the parks.

Because of the sensitivity of alpine plants, however, areas disturbed during installation would be kept to an absolute minimum and would be revegetated according to NPS guidelines. Where revegetation with native species is not feasible, non-native species would not be used. In addition, to prevent the transportation and introduction of invasive plant species to these remote

locations, helicopters, installers' clothing and footwear, and installation equipment would be cleaned before and after each CGPS installation.

4.2.4.1 Cumulative Effects

In addition to the proposed CGPS stations, up to ten new RAWS are proposed for installation in 2008. Of these, six would be in Katmai National Park and Preserve, and four would be in Lake Clark National Park and Preserve. Section 2.2 describes the locations and status of these RAWS, and their locations are shown in Figures 1-3 and 1-4. These stations would have installation requirements similar to those of the PBO stations, and would include limited disturbance of vegetation at each site that would occur during the construction. As with the PBO stations, vegetation disturbance would be limited to that necessary to implement the project. This removal of tundra plants, if any, would be measurable, but minor.

The projected additional impacts to vegetation would be slightly more than for maintenance activities at existing stations in the past. Maintenance activities that could affect vegetation would continue at two stations outside and three stations inside Denali National Park and Preserve (Wickersham Dome, Thorofare, and Castle Rocks, along with two relay stations at Double Mountain and Mt. Healy) (Figure 1-2). Thirteen stations are currently located within Lake Clark National Park and Preserve (Figure 1-3), and 23 stations within Katmai National Park and Preserve (Figure 1-4).

The total cumulative impacts to vegetation at these sites and the existing and proposed seismic station array would affect a small percentage of vegetation within the millions of acres of the affected parks and the cumulative impacts would be minor.

4.2.4.2 Conclusions

Minor impacts to vegetation would occur at the six new PBO stations because of the general scarcity of vegetative cover at the proposed stations. These small, but measurable, impacts would not result in the impairment of park resources that fulfill specific purposes identified in the enabling legislation or to the fundamental natural integrity of the parks.

4.2.5 Effects on Wildlife and Habitat

Although wildlife habitat is known to be present throughout the parks, the proposed station sites do not provide suitable habitat for bears, wolves, wolverines, or ungulates such as moose or caribou. Falcons, hawks, and eagles, and upland shorebirds may also be of concern in coastal, lakeside, and alpine-cliff areas. Seabirds and waterfowl are present close to coastal areas: At least six species of seabirds have colonies in the vicinity of Cape Gull (USFWS, no date). Station

AC08 (Cape Douglas) At least three species of seabirds have colonies that should be avoided when approaching Cape Douglas (USFWS, 2006). In addition, the coastline south of the proposed site of Station AC47 (Slope Mountain) is home to a colony of glaucous-winged gulls, and Chisik Island, which is northeast of the site, supports colonies of at least nine seabird species (USFWS, 2006).

Small mammals such as marmots and ground squirrels, however, occur in such areas. During installation of the proposed stations, the potential exists for minor, temporary disturbance to wildlife as helicopters, trucks, and people travel to and from the station sites. Helicopter activity would be scheduled in consultation with USFWS and NPS personnel to avoid sensitive bird migration or nesting periods in the project areas, including typical seabird and raptor nesting and crane migration periods (Squibb 2007). Particular attention would be given to the scheduling and routing of installation and maintenance flights along the Pacific Coast of Lake Clark and Katmai national parks and preserves where seabird colonies are known to exist (Savage 2007, Stephensen 2007, USFWS, 2006). As described in Table 4-2, the area of affected habitat for each of the stations would be small.

At the AC26 (Cape Gull) site, bald eagles are known to occur in the area. During a 1994 survey, NPS noted a bald eagle next approximately 0.7 mile from the proposed PBO station site. Bald eagles are not on the list of endangered or threatened species for Alaska. The site is technically within a critical habitat area for the endangered Steller sea lion, but at an elevation of 489 feet above a steep cliff, it has not been occupied by these animals. The site is, however, frequented by brown bears and sea birds. No other threatened or endangered species were found at the site (U.S. Coast Guard, 1998). USFWS was contacted about threatened and endangered species in the vicinity of this site. They report that Steller's eider, Short-tailed albatross, Kittlitz's murrelets, and Northern sea otters occur in the vicinity. The proposed station site, however, does not provide habitat for any of these species. The USFWS would consider the installation as "not likely to adversely affect" the threatened and endangered species because the use of a helicopter to install the equipment would temporarily affect wildlife in the area. Mitigation would include an approach altitude of between 2,000 and 2,500 feet above ground level (Baloug 2007).

4.2.5.1 Cumulative Effects

The projected impacts to wildlife would be similar to impacts from current seismic stations during maintenance activities, but it would be greater during installation of the new stations. In addition, up to ten new RAWS are proposed for installation in 2008. Of these, six would be in Katmai National Park and Preserve, and four would be in Lake Clark National Park and Preserve. Section 2.2 describes the locations and status of these RAWS, and their locations are

shown in Figures 1-3 and 1-4. These stations would have installation and maintenance activities similar to those of the PBO stations that would include temporary disturbance to wildlife by trucks, helicopters, and installation crews.

Maintenance activities that could affect wildlife would continue at two stations outside and three stations inside Denali National Park and Preserve (Wickersham Dome, Thorofare, and Castle Rocks, along with two relay stations at Double Mountain and Mt. Healy) (Figure 1-2). Thirteen stations are currently located within Lake Clark National Park and Preserve (Figure 1-3), and 23 stations within Katmai National Park and Preserve (Figure 1-4).

The overall cumulative impacts to wildlife from the existing and proposed stations would be negligible.

4.2.5.2 Conclusions

Negligible impacts to wildlife would occur at the six new seismic stations from helicopter and truck visits related to installation and maintenance activities. These impacts would not result in the impairment of park resources that fulfill specific purposes identified in the enabling legislation or to the fundamental natural integrity of the parks.

4.2.6 Effects on Visual Quality

The new CGPS stations would have a minor impact on the pristine visual quality of the areas. A few hikers and climbers would see the proposed PBO stations when they are within one to two miles to the installations depending on the vantage point. During the summer months, however, many pilots and passengers see the existing seismic, communications, and RAWS located in the vicinity of Wickersham Dome, Lake Clark Pass, and Slope Mountain, and would see the proposed CGPS stations from low-flying aircraft. The colors and materials used for each installation, with the exception of the solar panels, would be chosen in consultation with NPS at the same time installation logistics are coordinated to ensure they would blend in with the environment. The overall impacts to visual quality would be minor because installations would be small, colored to match the surroundings, and visible only from short distances except for reflections from solar panels.

4.2.6.1 Cumulative Effects

The pristine quality in backcountry areas is also affected by other remote installations. Visual impacts would continue at two stations outside and three stations inside (Wickersham Dome, Thorofare, and Castle Rocks, along with two relay stations at Double Mountain and Mt. Healy) Denali National Park and Preserve (Figure 1-2). Thirteen stations are currently located within

Lake Clark National Park and Preserve (Figure 1-3), and 23 stations within Katmai National Park and Preserve (Figure 1-4).

Up to ten new RAWS are proposed for installation in 2008. Of these, six would be in Katmai National Park and Preserve, and four would be in Lake Clark National Park and Preserve. Section 2.2 describes the locations and status of these RAWS, and their locations are shown in Figures 1-3 and 1-4. These stations could be encountered by hikers and climbers, and especially during the summer months, would be visible from low-flying aircraft.

The combined impacts of the existing and proposed installations would be minor.

4.2.6.2 Conclusions

The overall impacts to visual quality in the parks from the Proposed Action would be minor and would not result in the impairment of park resources that fulfill specific purposes identified in the enabling legislation or to the fundamental natural integrity of the parks.

4.2.7 Effects on Cultural Resources

No new impacts to cultural resources at the six station sites are anticipated because of the remote locations and high elevations, and five of the new PBO stations would be located with existing seismic stations or communications facilities at sites that have been previously disturbed.

4.2.7.1 Denali National Park and Preserve

Station AC56 (Wickersham Dome) would be co-located with existing instrumentation for AEIC and an NPS repeater. This station would be located in the vicinity of the Kantishna/Old Eureka Historic Mining District, and access to the site would be by way of Denali Park Road, along which several of the Mount McKinley National Park Headquarters Historic District patrol cabins are located. It is unlikely, however, that any new impacts would occur along the existing roadway and tracks leading to the station site. AC33 (N. Denali Tokosha Comm) would be co-located with an existing NPS radio communications hut, and it is unlikely that any new impacts would occur.

4.2.7.2 Lake Clark National Park and Preserve

Station AC47 (Slope Mountain) would be on an undisturbed site. The potential for the occurrence of cultural resources at Station AC47 (Slope Mountain) is low. The project, as described, has little potential to affect unidentified cultural resources that might occur at

Station AC47. Station AC37 (Lake Clark NPS Radio Hut) would be located within 60 feet of an existing NPS communications hut, and it is unlikely that any new impacts would occur.

4.2.7.3 Katmai National Park and Preserve

AC26 (Cape Gull) would be located on the site formerly occupied by a U.S. Coast Guard FM repeater tower and an FAA transponder/repeater tower. An archaeological survey of the site proposed for Station AC26 (Cape Gull) was conducted on October 24, 1997. No cultural resources were identified on the site at that time, and test pits on the site demonstrated that bedrock is located within 50 centimeters of the ground surface. No new impacts to any cultural resource are likely to occur (U.S. Coast Guard, 1998). Station AC08 (Cape Douglas) would be located with an existing USGS AVO seismometer, and it is unlikely that any new impacts would occur.

If any archeological or historical resources are discovered during installation at any of the new stations, the installation would be halted and the NPS superintendent and park archaeologists would be notified as soon as practicable. No further action would take place until the NPS provides clearance, which would occur sometime after consultation with the State Historic Preservation Office and affected Native communities.

4.2.7.4 Cumulative Effects

Existing stations include two stations outside and three stations inside Denali National Park and Preserve (Wickersham Dome, Thorofare, and Castle Rocks, along with two relay stations at Double Mountain and Mt. Healy) (Figure 1-2). Thirteen stations are currently located within Lake Clark National Park and Preserve (Figure 1-3), and 23 stations within Katmai National Park and Preserve (Figure 1-4).

Up to ten new RAWS are proposed for installation in 2008. Of these, six would be in Katmai National Park and Preserve, and four would be in Lake Clark National Park and Preserve. Section 2.2 describes the locations and status of these RAWS, and their locations are shown in Figures 1-3 and 1-4. As with the PBO stations, it is unlikely that any new impacts would occur.

Some vandalism and looting has occurred at remote archaeological sites in Katmai and other parks. The Proposed Action Alternative, to maintain the existing seismic station array and install six new stations in each of the affected parks and preserves, is expected to have negligible additional new impacts, if any, to cultural resources in the parks. The overall cumulative impacts to cultural resources in the affected parks would remain moderate.

4.2.7.5 Conclusions

The Proposed Action would not result in new impacts to cultural resources. It would not result in impairment of the natural purposes and values for which the parks were established.

4.2.8 Effects on Wilderness

Section 701 of ANICLA (1980) designates wilderness areas in the affected parks. Three of the six proposed PBO stations, AC08 (Cape Douglas) and AC26 (Cape Gull) in Katmai National Park and Preserve, and AC37 (Lake Clark NPS Radio Hut) in Lake Clark National Park and Preserve, would be in designated wilderness. Two of the other proposed PBO stations would be in areas that are eligible wilderness. Proposed PBO station AC56 (Wickersham Dome) would be located in an area that is considered ineligible for wilderness designation (NPS, 2005).

Wilderness resource values would experience impacts from helicopter visits to install and maintain the PBO stations, and these small human facilities would remain in the wilderness until at least 2018, depending on whether research permits are renewed to continue the sites longer. A Wilderness Minimum Requirements and Minimum Tool Analysis (MRMT) for each park is included in Appendix C.

Wilderness characteristics, as analyzed in the MRMTs, include untrammeled, undeveloped, naturalness of the areas, and opportunities for solitude or unconfined recreation. Wilderness in the parks is currently affected by existing remote installations.

The footprints of the impacts would be small and inconspicuous, but the stations would affect the intrinsic value of large, untrammeled and undeveloped, wilderness landscapes. In all but one case, AC56 (Wickersham Dome), the equipment would introduce a new long-term installation in designated or eligible wilderness, which would affect the untrammeled and undeveloped wilderness character. Of the five stations proposed in wilderness, four would be co-located or near existing seismic or communication installations; one of the proposed CGPS stations, Station AC47 (Slope Mountain), would be located on a previously undisturbed site.

The proposed action is unlikely to have any significant negative impact on natural resource values due to the small size of the installation and the infrequent helicopter visits, but these visits and the proposed CGPS installations would not contribute to the naturalness of the wilderness character.

The proposed station sites are remote and the footprints are small, but no improvement to opportunities for solitude and unconfined recreations would be added from the Proposed Action because new structures would be built and helicopter activity would occur.

4.2.8.1 Cumulative Effects

Up to ten new RAWS are proposed for installation in 2008. Of these, six would be in Katmai National Park and Preserve (five in wilderness), and four would be in Lake Clark National Park and Preserve (two in wilderness). Section 2.2 describes the locations and status of these RAWS, and their locations are shown in Figures 1-3 and 1-4. These stations would have installation requirements similar to those of the PBO stations, including helicopter transport of people and equipment. As with the PBO stations, disturbance would be limited to that necessary to implement the project.

Wilderness in the parks is currently affected by existing remote installations. The new PBO stations would have impacts similar to the 5 communications stations that already exist in the designated wilderness of Denali National Park and Preserve, the 12 stations in Lake Clark National Park and Preserve that are located in designated wilderness, and the 20 stations in Katmai National Park and Preserve that are located in designated wilderness.

Wilderness resource values would experience impacts from helicopter access during installation and maintenance of the proposed PBO stations and the proposed RAWS, and because these are long-term installations—the PBO stations would be in place for at least 10 years. These human developments are small, and the cumulative effects to the resources and values of the vast area of wilderness in Denali, Lake Clark, and Katmai National Parks and Preserves are considered to be minor.

4.2.8.2 Conclusions

The overall impacts to wilderness resources and values in the parks from the Proposed Action would be minor and would not result in the impairment of park resources that fulfill specific purposes identified in the enabling legislation or to the fundamental natural integrity of the park.

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Chapter 5: CONSULTATION AND COORDINATION

5.1 Site Visit

5.1.1 Denali National Park and Preserve

Station AC56 (Wickersham Dome) was visited on July 17, 2005, by Brian Coyle, Northern California (NCAL) Regional Engineer UNAVCO, and Laura Smith, UNAVCO Summer Field Engineer.

Station AC33 (N. Denali Tokosha Comm) was visited on July 2, 2006, by Katrin Hafner, Pacific NW Regional Engineer UNAVCO, and Austin Baldwin, UNAVCO Summer Student Intern.

5.1.2 Lake Clark National Park and Preserve

Station AC37 (Lake Clark NPS Radio Hut) was visited on July 4, 2006, by Ben Pauk, Alaska Regional Engineer UNAVCO.

Station AC47 (Slope Mountain) was visited July 12, 2006, by Kelly (Kore) Fournier, UNAVCO Field Engineer, and Ally Marzulla, UNAVCO Summer Student Intern.

Station AC 47 (Slope Mountain) was visited in late July 2007, by Dr. Matthew L. Carlson, Alaska Natural Heritage Program Environment and Natural Resources Institute, and Page Spencer, National Park Service Southwest Alaska Network.

5.1.3 Katmai National Park and Preserve

Station AC26 (Cape Gull) was visited April 11, 2006, by Ben Pauk, AK Regional Engineer UNAVCO, and Brian Coyle, NCAL Regional Engineer UNAVCO.

Station AC08 (Cape Douglas) was visited September 6, 2006, by Ben Pauk, AK Regional Engineer UNAVCO, and Austin Baldwin, UNAVCO Summer Student Intern.

5.2 NPS Consultation

The following persons were consulted and served as points of contact in preparing this environmental assessment:

- William ‘Bud’ Rice, Environmental Resource Specialist, Alaska Regional Office

- Joel Cusick, GIS Specialist, Alaska Regional Office
- Judy Alderson, Regional Wilderness Coordinator, Alaska Regional Office

Since the start of the PBO project, UNAVCO has conducted informal meetings with the NPS, U.S. Forest Service, U.S. Fish and Wildlife Service, and Bureau of Land Management to introduce the project and to determine the most appropriate and efficient methods of NEPA compliance.

5.3 List of Preparers

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APPENDICES

APPENDIX A: ANILCA Section 810(a) Analysis

APPENDIX B: CGPS Station Siting Criteria

APPENDIX C: Wilderness Minimum Requirements/Minimum Tool Analysis

C1: Wilderness Minimum Requirements/Minimum Tool Analysis Denali National Park and Preserve

C2: Wilderness Minimum Requirements/Minimum Tool Analysis Lake Clark National Park and Preserve

C3: Wilderness Minimum Requirements/Minimum Tool Analysis Katmai National Park and Preserve

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APPENDIX A: ANILCA Section 810(a) Analysis

Alaska National Interest Land Conservation Act (ANILCA) Section 810(a) Summary Evaluations and Findings

I. INTRODUCTION

This section was prepared to comply with Title VIII, Section 810 of the Alaska National Lands Conservation Act (ANILCA). It evaluates the potential restrictions to subsistence activities which could result from the installation of UNAVCO seismic monitoring stations in Denali National Park and Preserve, Lake Clark National Park and Preserve, and Katmai National Park and Preserve.

II. EVALUATION PROCESS

Section 810(a) of ANILCA states:

> In determining whether to withdraw, reserve, lease, or otherwise permit the use, occupancy, or disposition of public lands…the head of the Federal agency…over such lands…shall evaluate the effect of such use, occupancy, or disposition on subsistence uses and needs, the availability of other lands for the purposes sought to be achieved, and other alternatives which would reduce or eliminate the use, occupancy, or disposition of public lands needed for subsistence purposes. No such withdrawal, reservation, lease, permit, or other use, occupancy or disposition of such lands which would significantly restrict subsistence uses shall be affected until the head of such Federal agency:
>
> 1. gives notice to the appropriate State agency and the appropriate local committees and regional councils established pursuant to section 805;
>
> 2. gives notice of, and holds, a hearing in the vicinity of the area involved; and
>
> 3. determines that (A) such a significant restriction of subsistence uses is necessary, consistent with sound management principles for the utilization of the public lands, (B) the proposed activity would involve the minimal amount of public lands necessary to accomplish the purposes of such use, occupancy, or other disposition, and (C) reasonable steps would be taken to minimize adverse impacts upon subsistence uses and resources resulting from such actions.

ANILCA Section 203 states in part:

> …Hunting shall be permitted in areas designated as national preserves under the provision of this Act. Subsistence uses by local residents shall be allowed in national preserves and, where specifically permitted by this Act, in national monuments and parks…

ANILCA Section 1313 states in part:

> A National Preserve in Alaska shall be administered and managed as a unit of the National Park System in the same manner as a national park except as otherwise provided in this Act and except that the taking of fish and wildlife for sport purposes and subsistence uses, and trapping shall be allowed in a national preserve under applicable State and Federal law and regulation.

When Congress passed ANILCA in 1980, it expanded the national park system in Alaska by creating new parks, monuments, and preserves and making additions to existing units. In establishing these new park areas, ANILCA Title II states the purposes for which Congress created each unit and the outlines the human uses and activities that may be permitted. ANILCA Title II states the following:

Mount McKinley National Park was expanded by the addition of an area containing approximately 2,426,000 acres of public land, and approximately 1,330,000 acres of additional public land was established as Denali National Preserve. The whole area was redesignated as Denali National Park and Preserve. The park and preserve were created by ANILCA, section 202(3)(a), for the following purposes:

> The park additions and preserve shall be managed for the following purposes, among others: To protect and interpret the entire mountain massif, and additional scenic mountain peaks and formations; and to protect habitat for, and populations of fish and wildlife including, but not limited to, brown/grizzly bears, moose, caribou, Dall sheep, wolves, swans and other waterfowl; and to provide continued opportunities, including reasonable access, for mountain climbing, mountaineering and other wilderness recreational activities.

ANILCA and NPS regulations authorize subsistence uses within Denali National Park and Preserve.

Lake Clark National Park, containing approximately 2,439 acres of public lands and Lake Clark National Preserve, containing approximately 1,214 acres of public lands, was created by ANILCA Section 207(7)(a) for the following purposes:

> The park and preserve shall be managed for the following purposes, among others: To protect the watershed necessary for perpetuation of the red salmon fishery in Bristol Bay; to maintain unimpaired the scenic beauty and quality of portions of the Alaska Range and the Aleutian Range, including active volcanoes, glaciers, wild rivers, lakes, waterfalls, and alpine meadows in their natural state; and to protect habitat for and populations of fish and wildlife including but not limited to caribou, Dall sheep, brown/grizzly bears, bald eagles, and peregrine falcons.

ANILCA and NPS regulations authorize subsistence uses within Lake Clark National Park and Preserve.

Katmai National Monument was expanded by the addition of an area containing approximately 1,037,000 acres of public land. Approximately 308,000 acres of additional public land was established as Katmai National Preserve. The monument was re-designated as "Katmai National Park." The park and preserve were created by ANILCA, section 202(2), for the following purposes:

> To protect habitats for, and populations of, fish and wildlife including, but not limited to, high concentrations of brown/grizzly bears and their denning areas; to maintain unimpaired the water habitat for significant salmon populations; and to protect scenic, geological, cultural and recreational features.

ANILCA and NPS regulations authorize subsistence uses within Katmai National Preserve and prohibit subsistence uses on federal lands within Katmai National Park.

ANILCA Section 810(a) further requires that the potential for significant restriction of subsistence uses by a propose action be evaluated on:

> …the availability of other lands for the purposes sought to be achieved and other alternatives which would reduce or eliminate the use, occupancy, or disposition of public lands needed for subsistence purposes.

III. PROPOSED ACTION ON FEDERAL PUBLIC LANDS

UNAVCO proposes to install six PBO stations in the affected parks. Of the total stations proposed, two are proposed for installation in Denali National Park and Preserve, two are proposed for installation in Lake Clark National Park and Preserve, and two are proposed for installation in Katmai National Park and Preserve. The seismographic networks are designed to monitor volcanic activity and are used to formulate public warning for potentially hazardous eruptions. Helicopters would be used to transport equipment and staff into the project locations. Once the stations are operational, UNAVCO would use helicopters to visit them and conduct routine maintenance. Comprehensive descriptions of and locations of each seismic station can be found in the Environmental Assessment in Section 2.3.

IV. AFFECTED ENVIRONMENT

Subsistence uses, as defined by ANILCA, means

> The customary and traditional use by rural Alaska residents of wild, renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of non-edible byproducts of fish and wildlife resources taken for personal or family consumption; for barter, or sharing for personal or family consumption; and for customary trade.

Subsistence activities include hunting, fishing, trapping, and collecting berries, edible plants, and wood or other materials.

Regional subsistence activities include seasonal gathering of wild edible plants and berries, hunting, trapping and fishing. The main subsistence species are moose, caribou, furbearers, and fish. Varieties of subsistence fish include Coho salmon, king salmon, sockeye salmon, and northern pike, but Burbot, Dolly Varden, Arctic grayling, lake trout, rainbow trout, and whitefish are also used by local people. Beaver, coyote, land otter, weasel, lynx, marten, mink, muskrat, red fox, wolf, and wolverine are important furbearer resources. Rock and willow ptarmigan, grouse, ducks, and geese complete the park/preserve subsistence small game list.

The NPS recognizes that patterns of subsistence use vary from time to time and from place to place depending on the availability of wildlife and other renewable natural resources. A subsistence harvest in a given year may vary considerably form previous years because of weather, migration patterns, and natural population cycles.

V. SUBSISTENCE USES AND NEEDS EVALUATION

Potential Impacts to Subsistence Users

To determine the potential impacts on existing subsistence activities for the Proposed Action, three evaluation criteria were analyzed relative to existing subsistence resources.

- The potential to reduce important subsistence fish and wildlife populations by (a) reductions in number, (b) redistribution of subsistence resources, or (c) habitat losses;
- What effect the action might have on subsistence fisherman or hunter access;
- The potential for the action to increase fisherman or hunter competition for subsistence resources.

1. The potential to reduce populations:

(a) Reduction in Numbers:

The Proposed Action is not expected to reduce wildlife species in the study area. The slight disturbances to wildlife would be highly localized, temporary (during construction) and not effect the species populations as a whole. Any population redistribution would be so small that no change would occur to the ongoing regional subsistence pattern. Natural cycles would continue.

(b) Redistribution of Resources:

The Proposed Action is not expected to redistribute or displace or stress subsistence wildlife resources.

(c) Habitat Loss:

The Proposed Action is not expected to cause the loss of beneficial or critical habitat for subsistence species such as salmon, caribou, moose, furbearers, and waterfowl. The Proposed Action would not manipulate subsistence habitats or result in development of a scale that would have any measurable impacts on subsistence resources.

The Superintendent may enact closures and/or restrictions if necessary to protect subsistence opportunities or to assure the continued viability of a particular fish or wildlife population.

2. Restriction of Access:

The Proposed Action is not expected to change current subsistence use patterns. Access for subsistence uses within NPS areas is granted pursuant to ANILCA, sections 811(a)(b) and 1110(a). ANILCA allows access within Alaska conservation system units by certain specified means, including motorboats, for traditional activities.

3. Increase in Competition:

The Proposed Action is not anticipated to result in increased competition for subsistence resources on Federal public lands in the study area. Provisions of ANILCA, the Federal Subsistence Board, and NPS regulations provide the tools for adequate protection of fish and wildlife populations while ensuring a subsistence priority for local rural residents.

VI. AVAILABILITY OF OTHER LANDS

Other lands outside the NPS have been considered and incorporated into the seismic station monitoring network. The Proposed Action is consistent with NPS mandates.

VII. OTHER ALTERNATIVES

A “No Action Alternative” to not construct the seismic monitoring stations was considered in preparing this analysis. This alternative would improve predictive capabilities for identifying potential volcanic eruptions nor result in improved public safety. No other alternative was considered in this analysis since the Proposed Action is both site and project-specific.

IX. FINDINGS

This analysis concludes that the Proposed Action would not result in a significant restriction of subsistence uses.

APPENDIX B: CGPS Station Siting Criteria

Siting Process

Overview

Individual PBO stations would be selected using a systematic siting process to maximize operational capability and minimize adverse environmental impacts. It is assumed that all potential environmental impacts would be minimized by siting to avoid sensitive areas. The best location is selected by progressively eliminating from consideration infeasible and less desirable sites. Through the use of siting criteria, the network's technical constraints and capabilities and environmental constraints are considered in identifying locations for the PBO stations. The siting process for the PBO network consists of three distinct phases: network definition, regional screening, and individual site evaluation.

During network definition, the specific needs of the network users and the operational capability and constraints of the equipment would be used to define an integrated network of monitoring locations. This phase would determine the geographic extent of the network and identify nominal locations for CGPS receivers. Nominal locations are defined as geographic coordinates at which the performance of the network would theoretically be optimal. However, surrounding each of these nominal locations, there is a zone of tolerance where the operational needs of the PBO network would still be met. Because it would be acceptable to place a PBO station anywhere in this zone, sensitive environmental resources can be avoided by moving the PBO station to a location in the zone where the sensitive resources do not exist. During this first phase of the siting process, an overall environmental review would be conducted to avoid obvious significant environmental impacts and to recommend any adjustments to the network siting locations.

The second phase of the siting process is the regional screening phase. Optimal geographic network locations would be narrowed to potential area-wide sites through the use of exclusionary and evaluative siting criteria, which are described in more detail in the next section. During this phase, the applicant would notify and consult with the appropriate federal, state, and local agencies to identify their concerns and incorporate their suggestions into the siting process. The agencies would review the tolerance zone to help identify where resources may exist that would be subject to exclusionary or evaluative siting criteria. After area-wide potential sites are screened, specific sites are selected for individual site investigation.

The third phase of the siting process would be the individual site evaluation, for which field investigations would be conducted to determine the relative suitability of the candidate sites and to select a preferred site for the PBO station. This phase would involve analyzing the candidate sites for site-specific environmental impacts and operational suitability, using exclusionary and evaluative criteria. It is during this phase that biological and cultural surveys would be conducted, if necessary.

Siting Criteria

Site screening and evaluation would be conducted by applying a set of siting criteria that reflects the full range of siting considerations for the project. The siting criteria for the PBO project are designed to achieve the following primary project goals:

- Optimize the operational capability of the PBO network.
- Identify sites that are suitable for development as PBO network locations.
- Optimize right-of-way/easement acquisition conditions.
- Minimize conflicts with public use for areas in which PBO stations are deployed.
- Minimize adverse environmental impacts.

To achieve each goal, exclusionary and evaluative siting criteria have been developed. Exclusionary criteria are operational goals that must be met or resources that must not be disturbed when siting the PBO stations. Evaluative criteria, on the other hand, are not absolute but are used to make tradeoffs between or among conflicting goals and resources.

Exclusionary Siting Criteria

Except for operational exclusions used in the network development phase, exclusionary criteria would be applied to eliminate highly sensitive areas (e.g., wetlands, wilderness areas, etc.) from consideration. This would be accomplished using published maps and data. Some exclusionary criteria would require site-specific data and field analysis, including cultural resources and threatened and endangered species. Therefore, exclusionary criteria would be used throughout the siting process.

Table 1 lists exclusionary criteria to be used in siting PBO stations. Other exclusions may be added as a result of operational testing or pursuant to consultation with government officials and agencies. Once applied, exclusionary criteria would eliminate from further consideration areas that do not meet the standards of acceptable performance.

Table 1 Exclusionary Siting Criteria

Resource	Criteria
Operational Suitability	Exclude areas where sources of radio frequency interference, such as power transmission lines, unacceptably impair system performance.
Construction Suitability	Exclude areas with known past slope instability or potential technical risk of instability.
	Exclude areas prone to collapse.
Geology	Exclude areas where station installation would conflict with mineral rights, oil and gas leases, and known mineral deposits.
Biology	Where siting is allowed within areas managed for wildlife protection (e.g., refuges, preserves or sanctuaries), exclude sensitive areas such as known wildlife movement corridors, breeding or nesting areas, etc., as determined by managing agency(s).
Land Use	Exclude areas protected by the Wild and Scenic Rivers Act.
	Exclude prime and unique farmlands, as identified by the Natural Resource Conservation Service (formerly U.S. Soil Conservation Service).
	Exclude national and state parks and designated recreation areas.
	Exclude natural landmarks designated through the National Natural Landmarks Program.
	Exclude wilderness areas designated under the Wilderness Act.
Visual Resources	Exclude areas within the defined corridor of a designated scenic highway.
Safety	Exclude areas that encroach into FAA airport standoff distances.
	Exclude areas within 259 meters (850 feet) of quarries where blasting occurs.

Evaluative Siting Criteria

Most siting criteria are evaluative rather than exclusionary. Evaluative criteria are used to compare area-wide sites within the tolerance zone and choose the individual sites that best meet the operational criteria of the PBO network while avoiding or minimizing environmental impacts to the greatest extent possible. Evaluative criteria would be applied to those locations not excluded by exclusionary criteria. Evaluative criteria may be used to further eliminate locations if there are sufficient alternative siting opportunities or may be used to compare siting locations. The evaluative criteria to be used in siting PBO stations are listed in Table 2. The criteria would be used to avoid locations or conditions with the potential for high environmental impact. In cases where avoidance of locations with the potential for sizeable impacts would not be feasible, field investigations would be conducted to determine the extent of actual environmental impacts.

The importance of each evaluative criterion would vary from site to site as resources and their relative importance vary from site to site. Depending on the resources present, one criterion may be given precedence over another criterion in siting the PBO station to decrease overall impacts or impacts to a sensitive resource. Concerns of government agencies and local officials could also affect the importance of a criterion at any given PBO station.

Table 2 Evaluative Siting Criteria

Resource	Criteria
General Site Requirements	Sky view down to ~10° above the horizon.
	Sites on or near bedrock.
	Sites near AC power and internet, or sites where solar panels and data communications links (radio, VSAT, wireless, phone) can be installed.
	For sites located on municipal, county, state and federal land, obtain permit and NEPA compliance for a UNAVCO, Inc.-supported, continuously operating GPS station with a high stability monument, 12-channel geodetic quality receiver and antenna, and unrestricted access to the sites.
	For sites on private property, lease agreements and easements would be negotiated on a case-by-case basis.
Operational Suitability	Avoid areas where the required signal strength could not be achieved.
	Avoid areas developed, zoned, or planned for industrial uses where potential sources of radio frequency interference exist.
	Avoid areas where power line corona effects could interfere with signal propagation.
	Avoid sites in proximity to metal towers or buildings that would interfere with system performance.
	Avoid sites where measured ground conductivity is below that required for adequate antenna performance.
Construction Suitability	Avoid areas requiring new access roads for PBO station installation or maintenance.
Geology and Soils	Avoid areas highly prone to erosion.
	Avoid areas with known paleontological resources.
Water Resources	Avoid areas within surface water body setbacks.
	Avoid floodplains where PBO stations cannot be constructed at least two feet above the 100-year flood level.
Biology	Avoid habitats of threatened and endangered species, as defined by the U.S. Fish and Wildlife Service (USFWS).
	Avoid critical wildlife habitats, as identified by the USFWS and state wildlife agencies.
	Avoid habitats of state and locally listed rare, threatened, endangered, or sensitive species, as identified by state and local wildlife agencies.
	Avoid critical avian habitats, as defined by the USFWS and state wildlife agencies.
	Avoid rare native plant communities, as defined by state and local agencies.

Resource	Criteria
	Avoid habitats of high value to plant and animal populations, as determined by state fish and wildlife agencies.
	Avoid wetlands and riparian areas that have been designated by the U.S. Army Corps of Engineers or identified by USFWS or state agencies in accordance with state laws and regulations, and where construction of proposed PBO stations would affect the properties critical to designation and viability.
Noise	Avoid sensitive land uses located near PBO stations where day-night average noise level (L_{dn}) would exceed 75 dBA.
Land Use	Avoid areas where existing residential development, or existing residential zoning in combination with development plans, indicate that there may be visual, noise, or safety concerns or other conflicts with residential uses.
	Avoid designated coastal zones where construction of PBO stations would adversely affect coastal resources or where the objectives of applicable coastal plans and programs could not be satisfied.
	Avoid locally designated preservation and conservation areas where the purposes of such areas or the objectives of their designation would be adversely affected.
Cultural Resources	Avoid known cultural resources listed or determined to be eligible for listing on the National Register of Historic Places.
	Avoid resources and locations determined to have importance to the free expression or practice of the Native American religion, in accordance with the American Indian Religious Freedom Act.
	Avoid areas that contain cultural resources of value at the state or local level but which are not considered eligible for National Register listing (e.g., cultural properties listed on state of local registers or identified by state historians, state archaeologists, or other appropriate state and local agency personnel).
Safety	Maintain a standoff distance between the base of the monument or strainmeter and inhabited structures.

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APPENDIX C: Wilderness Minimum Requirements / Minimum Tool Analysis

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Appendix C1:

Wilderness Minimum Requirements/Minimum Tool Analysis Denali National Park and Preserve

Step 1, Determine if it is necessary to take action.

Description: Briefly describe the situation that may prompt action.

The University NAVSTAR Consortium Inc. (UNAVCO) proposes to construct and operate two new stations for its Plate Boundary Observatory (PBO) Project on land administered by the U.S. Department of the Interior (USDI), National Park Service (NPS) in Denali National Park and Preserve in Alaska. The UNAVCO PBO Project consists of the construction and operation of a geodetic observatory for the purpose of studying the Earth's surface deformation across the active boundary zone between the Pacific and North American plates in the western United States and Alaska. To accomplish the scientific objectives of the PBO Project, the observatory consists of a carefully designed and integrated network of continuous Global Positioning System (CGPS) receivers.

Currently, a very sparse geodetic network exists in the western continental U.S. and Alaska. The limited geographic coverage of this network contributes to a lack of understanding of basic Earth processes,
(i.e., active faulting and earthquake and volcanic hazards) resulting in public safety risks, and gaps in human understanding of fundamental Earth processes. Denali National Park and Preserve is a high risk area lacking adequate monitoring for potentially dangerous locked faults and strain accumulations.

A complete description of the Proposed Action can be found in Section 2.3 of the EA.

A. Describe Valid Existing Rights or special Provisions of Wilderness Legislation

Are there valid existing rights or is there a special provision in wilderness legislation (the Wilderness Act of 1964 or subsequent wilderness laws) that allows consideration of action involving Section 4(c) uses? Cite law and section.

Yes: x No: Not Applicable:

Explain:

The Wilderness Act of 1964 (Public Law 88-577, 78 Stat. 890 16 U.S.C. 1131-1136) was enacted "to establish a National Wilderness Preservation System for the good of the whole people, and for other purposes." It provided for the review of every roadless area of 5,000 or more acres and every roadless island within National Wildlife Refuge and National Park Systems, and for recommendations about the suitability of these areas for inclusion in the National Wilderness Preservation System. The Act lists criteria for determining suitability of lands for wilderness designation and provides restrictions on activities within a designated wilderness area. Under authority of this Act over 25 million acres of land and water in the National Wildlife Refuge System were reviewed. In addition, of the some 7 million acres found suitable for wilderness designation, the Alaska National Interest Lands Conservation Act (P.L. 96-487) established seven designated wilderness areas in Alaska and required the study of nondesignated land for wilderness suitability, comprising 18,560,000 acres. Wilderness was designated in Denali, Katmai and Lake Clark National Parks and Preserves under ANILCA.

Section 4(c) of the Wilderness Act defines prohibited uses as:

> Except as specifically provided for in this Act, and subject to existing private rights, there shall be no commercial enterprise and no permanent road within any wilderness area designated by this Act and, except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area.

In 1980, Congress passed, and President Carter signed, the Alaska National Interest Lands Conservation Act (ANILCA). Although Section 1310 of ANCILA provides some exceptions for certain types of navigational aids and other weather and climate facilities in wilderness, no

specific exceptions are provided for seismic monitoring stations. It is the intent of Congress to "…maintain opportunities for scientific research and undisturbed ecosystems."

B. Describe Requirements of Other Legislation

Do other laws require action?

Yes:	**No:**	**x**	**Not Applicable:**

Explain:

No other laws require action, but the importance of geologic resources and processes were mentioned in ANILCA for the area of this proposed project. Section 202(3)(a) of ANILCA added about 3.8 million acres to Mount McKinley National Park and renamed it Denali National Park and Preserve. The park and preserve additions are to be managed for the following purposes:

> To protect and interpret the entire mountain massif, and additional scenic mountain peaks and formations; and to protect habitat for, and populations of fish and wildlife including, but not limited to, brown/grizzly bears, moose, caribou, Dall sheep, wolves, swans and other waterfowl; and to provide continued opportunities, including reasonable access, for mountain climbing, mountaineering and other wilderness recreational activities. Subsistence uses by local residents shall be permitted in the additions where such uses are traditional.

ANILCA Title I recognizes that the purposes for the new conservation system units include their preservation "for the benefit, use, education, and inspiration of present and future generations… that contain nationally significant natural, scenic,… geological, scientific, wilderness, and recreational values…." It is also the intent of Congress to "…maintain opportunities for scientific research and undisturbed ecosystems."

C. Describe Other Guidance

Does taking action conform to and implement relevant standards and guidelines and direction contained in agency policy, unit and wilderness management plans, species recovery plans, tribal government agreements, state and local government and interagency agreements?

Yes: x **No:** **Not Applicable:**

Explain:

National Park Service Management Policies (2006) state that wilderness policy directives apply regardless of the category of wilderness, and all management decisions which affect wilderness must be consistent with the minimum requirement concept. These policies require that the management action must be appropriate or necessary for administration of the area as wilderness.

6.3.1 General Policy

For the purposes of applying these policies, the term "wilderness" will include the categories of suitable, study, proposed, recommended, and designated wilderness. Potential wilderness may be a subset of any of these five categories. **The policies apply regardless of category** except as otherwise provided herein.

In addition to managing these areas for the preservation of the physical wilderness resources, planning for these areas must ensure that the wilderness character is likewise preserved. This policy will be applied to all planning documents affecting wilderness.

6.3.5 Minimum Requirement

All management decisions affecting wilderness must be consistent with the minimum requirement concept. This concept is a documented process used to determine if administrative actions, projects, or programs undertaken by the Service or its agents and affecting wilderness character, resources, or the visitor experience are necessary, and if so how to minimize impacts. The minimum requirement concept will be applied as a two-step process that determines

- **whether the proposed management action is appropriate or necessary for administration of the area as wilderness and does not cause a**

significant impact to wilderness resources and character, in accordance with the Wilderness Act; and

- the techniques and types of equipment needed to ensure that impacts on wilderness resources and character are minimized.

In accordance with this policy, superintendents will apply the minimum requirement concept to the context of wilderness management planning, as well as to all other administrative practices, proposed special uses, scientific activities, and equipment use in wilderness. The only exception to the minimum requirement policy is for eligible areas that the Service has not proposed for wilderness designation. However, those lands will still be managed to preserve their eligibility.

When determining minimum requirements the potential disruption of wilderness character and resources will be considered before, and given significantly more weight than, economic efficiency and convenience. If a compromise of wilderness resources or character is unavoidable, only those actions that preserve wilderness character and/or have localized, short-term adverse impacts will be acceptable.

The policies recognize scientific research as an important use of wilderness, but like any other use of wilderness, the negative impacts of the use must be weighed against the public benefits of providing enduring wilderness resources.

The policies provide more specific guidance for those scientific activities which involve prohibitions identified in Section 4(c) of the Wilderness Act. The research must either (1) provide essential information for the understanding, health, management, or administration of wilderness, or (2) if it has no direct relationship to wilderness, it must not compromise wilderness resources or character. Additionally, scientific monitoring devices that are operated in wilderness must provide information that is essential for the administration and preservation of wilderness.

6.3.6 Scientific Activities in Wilderness

The statutory purposes of wilderness include scientific activities, and these activities are encouraged and permitted when consistent with the Service's responsibilities to preserve and manage wilderness.

6.3.6.1 General Policy

… Scientific activities involving prohibitions identified in Section 4(c) of the Wilderness Act [16 USC 1133(c)] may be conducted within wilderness when the following occur:

- **The desired information is essential for the understanding, health, management or administration of wilderness,** and the project cannot be reasonably modified to eliminate or reduce the nonconforming wilderness use(s); **or if it increases scientific knowledge, even when this serves no immediate wilderness management purposes, provided it does not compromise wilderness resources or character.** The preservation of wilderness resources and character will be given significantly more weight than economic efficiency and/or convenience.

… Research and monitoring devices (e.g., video cameras, data loggers, meteorological stations) may be installed and operated in wilderness if (1) **the desired information is essential for the administration and preservation of wilderness, and cannot be obtained from a location outside of wilderness without significant loss of precision and applicability;** and (2) the proposed device is the minimum requirement necessary to accomplish the research objective safely.

… Devices located in wilderness will be removed when determined to be no longer essential. Permanent equipment caches are prohibited within wilderness. Temporary caches must be evaluated using the minimum requirement concept.

All scientific activities, including the installation, servicing, removal, and monitoring of research devices, will apply minimum requirement concepts and be accomplished in compliance with *Management Policies*, director's orders, and procedures specified in the park's wilderness management plan.

D. Describe Options Outside of Wilderness

Can this situation be resolved by action outside of wilderness?

Yes: **No:** **x** **Not Applicable:**

Explain:

Currently, a very sparse geodetic network exists in the western continental U.S. and Alaska. Alaska had only 16 CGPS stations at the start of the PBO Project. Compared to the PBO

network, this limited coverage contributes to a lack of understanding of basic Earth processes, (i.e., active faulting and earthquakes and volcanic hazards) resulting in public safety risks and gaps in human understanding of fundamental Earth processes. In all, the PBO network will have 142 new CGPS stations in Alaska. Denali National Park and Preserve is a high risk area that lacks adequate monitoring for potentially dangerous locked faults and strain accumulation. This proposal for two new CGPS stations in Denali National Park and Preserve is designed specifically to fill the gaps in, and thus increase the accuracy of, the existing geodetic network by installing the new CGPS stations in a carefully designed and integrated network. Other PBO stations have been installed outside of the park, and this option was considered for the CGSP stations proposed within Katmai National Park and Preserve. The distance from the station to the faults, however, would be too great to yield meaningful data. The configuration of the geodetic network is dictated by the volcanic and tectonic structure of the Earth's crust in Alaska. Existing seismic equipment technology does not provide enough sensitivity to detect subtle magma movements and associated seismic activity at distances beyond the proposed areas. In addition, there is no comparable technology currently in existence for monitoring seismic and volcanic activities.

It is also important to install the PBO stations on or near exposed bedrock with a clear path for data telemetry to other points in the PBO network. A location on bedrock is of critical importance because the quality of seismic signals detected by a seismometer is directly related to the amount of signal attenuation caused by any soils or unconsolidated materials overlying the bedrock in a given area. A seismometer located on bedrock would encounter little or no attenuation of seismic signals, thus allowing significantly greater accuracy in the analysis of volcanic activity and earthquake mechanisms, location, depth, and magnitude. Stations located on bedrock tend to be more accurate than those located on unconsolidated materials.

The scarcity of locations with bedrock at or near the surface naturally limits UNAVCO's ability to achieve these objectives. The placement of PBO stations at the sites described in the park is considered part of the minimum necessary to achieve the desired increase in seismic monitoring and accuracy. Without the installation of the two new PBO stations to increase the precision of the AVO, AEIC and PBO seismic network, scientists conclude they could not accurately detect and locate micro-earthquakes on and near the Denali Fault. Adding the proposed PBO stations would enable researchers to identify and detect both 1964 post-seismic deformations and help to define slip rates on the eastern end of the Aleutian Subduction zone, and detect and monitor ongoing regional deformation associated with the 1964 Good Friday M9.0 earthquake. In addition, these stations would allow the USGS to discriminate between regional deformation and localized deformation on the active volcanoes in the Cook Inlet region during an eruption.

Each PBO station produces a continuous stream of information about the horizontal and vertical movements of the Earth's plates and provides the information on the one-month to multidecade time scale. Any change in the long-term trend direction indicates that something has changed in the plate motion that would warrant further study. The PBO has three dedicated analysis centers that continually monitor every site in the PBO network, and over 200 distinct users that analyze the data as a part of their ongoing areas of research. With the addition of the proposed CGPS instruments, scientists would have an incrementally better understanding of the earthquake risks along the known, and potentially unknown, fault systems in Alaska—information that is valuable to park managers who can use it to plan for the safety of park visitors and staff, site new facilities, update a safety program, or begin activation of a safety plan. Not placing these two new stations in Denali National Park and Preserve would severely limit scientists' ability to directly measure the park's active faults, the interaction of these active faults, and the understanding of the park's long-term hazards (Freymueller 2007).

Existing seismic stations include at two stations outside and three stations inside Denali National Park and Preserve (Wickersham Dome, Thorofare, and Castle Rocks, along with two relay stations at Double Mountain and Mt. Healy) (see Figure 1-2 in the EA). The AEIC may propose seismic monitoring stations at Double Mountain, Eagle Gorge, and between Birch Creek and Cache Creek, but no application has been submitted. Park wilderness surrounds the volcanic and seismically active regions. Five communications stations already exist in the designated wilderness of Denali National Park and Preserve. The result of the new stations would be that the park manager receives significant hazard forecasts and warnings from the USGS and the FAA. The new PBO stations would be installed on bedrock and would have state-of-the-art accuracy and sensitivity thus enhancing the efficacy of the existing seismic monitoring network.

E. Wilderness Character

How would action contribute to the preservation of wilderness character, as describe by the components listed below.

Untrammeled:

No contribution. Station AC56 (Wickersham Dome) would be located in an area that is not designated and is not eligible for wilderness designation, therefore, it will not be further evaluated in this section. Station AC33 (N. Denali Tokosha Comm) would be in an area that is not designated as wilderness, but that is eligible for wilderness designation. It would be

collocated with existing communication equipment and would have no additional effect on designated wilderness. Travel to this site would not be through areas currently designated wilderness.

The Tokosha radio repeater site is seldom visited (Rice 2007). Commercial and Private pilots and their passengers, however, frequently fly over this area in the summer months, and the station is likely to be seen from the air.

The footprint of the impacts would be small and inconspicuous. The CGPS station could affect individuals who value the intangible aspects of wilderness such as knowing the area is untrammeled and undeveloped. The intrinsic value of large wilderness landscapes is a special characteristic of national parks and high quality wilderness lands in Alaska, and is important to many members of the public who may (or may not) visit the area.

Undeveloped:

No contribution. Station AC33 (N. Denali Tokosha Comm) would be located within an area disturbed by installation of existing communication equipment. It would be above the Tokositna River, which, as noted in *Denali National Park and Preserve Draft Backcountry Management Plan,* is a main flight path for air taxis going to and from the Denali base camp and for air tours of Mount McKinley, and which has increasing use by snowmachines and motorboats (*Denali National Park and Preserve Draft Backcountry Management Plan*, 2003). AC33 is also within the Ruth Glacier Special Use Area (*Denali National Park and Preserve Final Backcountry Management Plan*, January 2006). The NPS, however, can directly benefit from the new PBO CGPS station in their cadastral boundary survey work. PBO stations are stable, permanent points of reference that can be used as survey controls to define park boundaries with a high degree of accuracy and repeatability. Mapping accuracy for all types of resources would improve using the proposed PBO CGPS station as a base: the precision and accuracy of mapping and collecting data from research plots would improve. Resource studies and mapping that could benefit range from wetland identification, to archaeological and historic, to wildlife tracking, and fire management.

Natural:

Neutral to minor contribution. Installation of Station AC33 (N. Denali Tokosha Comm) is unlikely to have any negative impact on natural resource values due to the small size of the installation and the infrequent helicopter visits. A beneficial contribution would be possible from a greater understanding of the effects of earthquake and volcanic events on other contributing processes in the natural environment. The results of the action could include increased public and park management understanding of changes to the ecosystems from landslides, ground surface ruptures, and slope failures from earthquakes. These events could alter the annual discharge of water into glacial-fed rivers and streams, change the long-term response of glaciers to climate, alter stream flow and turbidity, change glacier mass balance and impoundments, and create hazardous downstream flooding zones. Habitat for species that reside in steep mountainous terrain may be altered or eliminated by seismic or volcanic events.

Scientists who study the volcanic and seismic processes of the Earth are not the only people who would realize the benefit of installing the Station AC33 (N. Denali Tokosha Comm) in the park's wilderness. Improvements to the seismic network with the proposed PBO station installation would improve the park's ability to understand and appreciate long-term ecological change. Data are collected by the stations seven days a week and 24 hours a day. NPS scientists and resource personnel including archaeologists, historic landscape architects, and fire management rangers can use PBO CGPS data from sites in the park to map the park's key resources. This can be done in "real time" with Real Time Kinematic (RTK) or in an office using the 24-hour data files available from the EarthScope data portal, which is at http://www.earthscope.org/data/gps.php.

The new permanent Station AC33 (N. Denali Tokosha Comm) in Denali National Park and Preserve would be used to detect and monitor ongoing regional deformation associated with the 1964 Good Friday M9.0 earthquake, which was caused when the North American plate slid over the top of the Pacific plate after centuries of building pressure. Continued monitoring is important because the largest earthquakes in Alaska are caused by subduction of the Pacific plate beneath Alaska. Three of the largest earthquakes in the 20th century occurred in Alaska (1957, 1964, and 1965). Although it is generally believed that these great earthquakes are rare, five great underthrusting events have occurred in Alaska since 1938. A recent evaluation of the seismic potential in Alaska indicated that several subduction zone segments may be ready to rupture soon. The Yakataga gap and the region between Kodiak Island and the Shumagin Islands are areas where magnitude 8+ events are expected. Smaller magnitude 6.8 to 8.0 earthquakes, which occur in many regions of central and southcentral Alaska, occur at more frequent intervals, and in locations that cannot always be predicted. On average, Alaska has a

magnitude 7.0 or larger earthquake about every two years, which could cause major damage if they occurred in a populated or strategically sensitive area. Many smaller events often occur near populated areas, and thus pose a continuous threat to urban areas (AEIC, 2006).

Improvements to the seismic network, and a corresponding improvement in data accuracy, with the proposed Station AC33 (N. Denali Tokosha Comm) installation would improve the park's ability to understand, appreciate, and interpret long-term ecological changes caused by major and minor seismic and volcanic events. All PBO CGPS stations have yearly velocity vectors that are important when defining and recovering boundaries in tectonically active areas. Land status issue resolution would be improved with the increased accuracy and density of the geodetic network. This is especially useful where easement and trails cross the boundaries between NPS- and BLM-managed lands (Cusick 2007).

Outstanding opportunities for solitude or a primitive and unconfined type of recreation:

No contribution. The Station AC33 (N. Denali Tokosha Comm) site is co-located with existing communication equipment and is so remote that few park visitors would ever encounter it.

Other unique components that reflect the character of this wilderness:

Minor contribution: The faults, volcanoes, and their related processes are the source for many distinct landforms and features in the park, are the primary reason for the park's establishment, and are closely associated with the public's impressions of the area as wilderness. These underlying geologic processes are of interest to the public and information on them is regularly presented to the public by the NPS. Scientific research, public education, and interpretation of these important geologic processes are directly associated with the character of the wilderness landscape in the park and would be enhanced, to some degree, with the more accurate data from the proposed Station AC33 (N. Denali Tokosha Comm). New information that could be shared with the public can be derived from the results of the more detailed monitoring that the new station would provide. The PBO Project includes an educational outreach program that uses the data collected by the CGPS network to explain how the dynamics of past, current, and future tectonics have helped shape the landscape seen in the park today, and how that landscape can be expected to evolve. Gathering this information allows NPS staff to better manage today's recourses for future generations, and provides a net benefit to the public's general understanding of the processes and features associated with the wilderness landscape. The highly specialized nature of the information, however, may reduce the likelihood that a measurable increase would occur.

F. Describe Effects to the Public Purposes of Wilderness

How would action support the public purposes for wilderness (as stated in Section 4(b) of the Wilderness Act) of recreation, scenic, scientific, education, conservation, and historical use?

Scientific

Major contribution. The primary and unique benefit of this action is an improved scientific understanding of the volcanic and earthquake processes with minor support for other management actions such as accurate GPS data more directly related to the preservation and enjoyment of the area as wilderness. Without these installations, readings of plate boundary movements in the park would remain limited because the existing seismometers are not arrayed in sufficient density. PBO CGPS stations provide a different time scale and type of measurement than the existing USGS and UAF/GI seismometers. CGPS instruments provide information about ground movement direction and velocity on the one-month to multidecade time scale, while the existing seismometers provide information about ground shaking in seconds. With the addition of CGPS instruments, scientists would have a much better understanding of the earthquake risks along the known and potentially unknown fault systems in Alaska.

The PBO Project is designed specifically to increase the accuracy of the existing geodetic network. Improvements to the seismic network, and a corresponding improvement in data accuracy, with the proposed PBO station installations would improve the park's ability to understand, appreciate, and interpret long-term ecological changes caused by major and minor seismic and volcanic events. All PBO CGPS stations have yearly velocity vectors that are important when defining and recovering boundaries in tectonically active areas. Land status issue resolution would be improved with the increased accuracy and density of the geodetic network. This is especially useful where easement and trails cross the boundaries between NPS- and BLM-managed lands (Cusick 2007). Easements may also cross NPS lands providing access to State and Private lands and 17b easements across Native Corporation lands may feed across private lands to park and other public lands, which are recorded by BLM. Using corrected and more accurate GPS for accurate locations of these easements and rights-of-way are an important land management issue.

Other scientific benefits for the park include communication improvements. For example, because the CGPS equipment transits communication signals in the 900 MHz frequency, NPS staff can easily utilize their existing survey equipment to more accurately survey the existing condition of wetland resources and monitor their changes over time.

The NPS can also benefit from the new PBO CGPS stations in their cadastral boundary survey work. PBO stations are stable, permanent points of reference that can be used as survey controls to define park boundaries with a high degree of accuracy and repeatability. Mapping accuracy for all types of resources would improve using the proposed PBO CGPS stations as bases: the precision and accuracy of mapping and collecting data from research plots would improve. Resource studies and mapping that could benefit range from wetland identification, to archaeological and historic, to wildlife tracking, and fire management.

The largest earthquakes in Alaska are caused by subduction of the Pacific plate beneath Alaska. Although it is generally believed that these great earthquakes are rare, five great underthrusting events have occurred in Alaska since 1938. In a recent evaluation of the seismic potential in Alaska, researchers indicated that several subduction zone segments may be ready to rupture soon. Stations AC33 and AC56 would be located on the western end of the Denali Fault Zone and would be used to detect and measure slip rates on the western end of the fault, as well as detect and measure post-seismic deformation associated with the 2002 M7.9 Denali Earthquake. On average, Alaska has a magnitude 7.0 or larger earthquake about every two years, and could cause major damage if they occurred in a populated or strategically sensitive area (AEIC, 2006).Lack of data on the western end of the fault has prevented researchers from determining slip rates on this portion of the fault.

Installation of these CGPS stations, on bedrock, contributes significantly to the overall mission of the PBO project. Through the use of modern geophysical observational and monitoring equipment and satellite telecommunications technology, the proposed PBO geodetic network would provide round-the-clock observational data that describes the geophysical condition of Alaska, as well as the western continental U.S. Additional objectives of the PBO Project are to provide a foundation for fundamental and applied research throughout the western U.S. and Alaska that would help mitigate risks from geological hazards and contribute to the public's understanding of the dynamic nature of the Earth.

Educational

Minor contribution. Scientists who study the volcanic and seismic processes of the Earth are not the only people who would realize the benefit of installing the PBO CGPS stations in the park's wilderness. Improvements to the seismic network with the proposed PBO station installations would improve the park's ability to understand and appreciate long-term ecological change. Data are collected by the stations seven days a week and 24 hours a day. NPS scientists and resource personnel including archaeologists, historic landscape architects, and fire management rangers can use PBO CGPS data from sites in the park to map the park's key resources. This can be done

in "real time" with Real Time Kinematic (RTK) or in an office using the 24-hour data files available from the EarthScope data portal, which is at http://www.earthscope.org/data/gps.php.

Having these PBO CGPS stations in the park provides an opportunity to develop educational and outreach materials for the park rangers who interpret the landforms resulting from the volcanic and seismic processes, including how the data are collected and what the data are used for. The public, in general, and park visitors in particular, are curious about how the plates are moving, how active faults are studied, and how that relates to earthquakes and volcanoes that formed the park landscape. New information that could be shared with the public can be derived from the results of the more detailed monitoring that the new stations would provide. The PBO Project includes an educational outreach program that uses the data collected by the CGPS network to explain how the dynamics of past, current, and future tectonics have helped shape the landscape seen in the park today, and how that landscape can be expected to evolve. Gathering this information allows NPS staff to better manage today's recourses for future generations, and provides a net benefit to the public's general understanding of the processes and features associated with the wilderness landscape. The highly specialized nature of the information, however, may reduce the likelihood that a measurable increase would occur.

Recreation, Conservation, Historical

Minor Contribution. NPS easements and rights-of-way have been mapped in Geographic Information systems and NPS has already benefited from GPS control that offers on-ground mapping accuracy of one meter or less. This is important because accuracy degrades with distance from base stations at the rate of 10 cm of error for each 100 km of baseline distance, thus improving the GPS network in Alaska parks would add a significant level of accuracy the park's GIS data (Cusick 2007).

Step 1 Decision: Is it necessary to take action?

Yes: x No: Not Applicable:

Explain

The project must satisfy one of the following three criteria that were previously described in NPS policy to be allowed in wilderness:

1. **Research and monitoring devices (e.g., video cameras, data loggers, meteorological stations) may be installed and operated in wilderness if (1) the**

desired information is essential for the administration and preservation of wilderness, and cannot be obtained for a location outside of wilderness without significant loss of precision and applicability; and (2) the proposed device is the minimum requirement necessary to accomplish the research objective safely.

Though the PBO plate movement information may not be critical to managing wilderness areas, the accurate location of easements and ROWs guaranteed by ANILCA may be enhanced with CGPS capabilities and, therefore, is of interest to park managers. It is possible to see how incrementally better information would help improve the ability of park managers to distinguish natural effects on the resources of the wilderness from those that might be anthropogenic in nature and, therefore, require management intervention to preserve wilderness resource conditions. The new PBO stations, with which data accuracy would be improved, can be used to pinpoint Earth movements and potential hazards for wilderness users. These hazards include eruptions, land slides, lahars, impoundments, unstable ground, and ruptures.

The placement of PBO stations at the sites described in the park is considered part of the minimum necessary to achieve the desired increase in seismic monitoring and accuracy. It is possible to install the two PBO stations outside of the park, but the distance from the station to the fault would be too great to yield meaningful data. The configuration of the geodetic network is dictated by the volcanic and tectonic structure of the Earth's crust in Alaska. Existing seismic equipment technology does not provide enough sensitivity to detect subtle magma movements and associated seismic activity at distances beyond the proposed areas. In addition, there is no comparable technology currently in existence for monitoring seismic and volcanic activities.

2. **It increases scientific knowledge, even when this serves no immediate wilderness management purpose, provided it does not compromise wilderness resources or character.**

If the information does not serve any immediate wilderness management purpose or is not essential to understanding the wilderness area, policy still allows it to occur if it does not compromise wilderness resources or character. The information obtained from the PBO stations would increase scientific knowledge about the volcanoes, faults, and associated seismic features in the park. The PBO Project is designed specifically to increase the accuracy of the existing geodetic network. Improvements to the seismic network, and a corresponding improvement in data accuracy, with the proposed PBO station installations would improve the park's ability to understand, appreciate, and interpret long-term ecological changes caused by major and minor seismic and volcanic events.

All PBO CGPS stations have yearly velocity vectors that are important when defining and recovering boundaries in tectonically active areas. Land status issue resolution would be improved with the increased accuracy and density of the geodetic network. This is especially useful where easement and trails cross the boundaries between NPS- and BLM-managed lands, and for accuracy in defining research plots for the park's resource studies (Cusick 2007).

PBO CGPS stations provide a different time scale and type of measurement than the existing USGS and UAF/GI seismometers. CGPS instruments provide information about ground movement direction and velocity on the one-month to multidecade time scale, while the existing seismometers provide information about ground shaking in seconds. With the addition of the CGPS instruments, scientists would have a much better understanding of the earthquake risks along the known and potentially unknown fault systems in Alaska.

Although this information would not serve any immediate wilderness management purpose, better information would help improve the ability of park managers to distinguish natural effects on the resources of the wilderness from those that might be anthropogenic in nature and, therefore, require management intervention to preserve wilderness resource conditions. The project, however, would cause minor impacts to wilderness character in the park because (1) two long-term CGPS stations would be co-located with existing seismic and radio communications equipment, but proposed Station AC33 (N. Denali Tokosha Comm) would be in an area eligible to be designated wilderness; and (2) use of the helicopter needed to install and maintain AC33 (N. Denali Tokosha Comm) is also prohibited.

3. The desired information is essential for the understanding health, management or administration of wilderness and the project cannot be reasonably modified to eliminate or reduce the nonconforming wilderness use(s).

The justification for the action is that it is needed for the greater understanding of the wilderness areas. Understanding in this context would be broadly interpreted to mean an increase in understanding of a prominent aspect of the wilderness areas. According to NPS-77, Natural Resources Management Guideline, the NPS should seek to identify significant geologic features and processes.

Section 202 of ANILCA states that Denali National Park and Preserve additions are to be managed "…to protect and interpret the entire mountain massif and the additional scenic mountain peaks and formations." The Denali Fault is certainly an important feature of the Denali landscape and contributes greatly to the mountain scenery.

Although impacts to wilderness character could occur, primarily from the establishment of the PBO stations in areas that are notably free from signs of modern technology, they are generally minor. Given the fundamental role that the faults and volcanoes play in the landscape of Denali National Park and Preserve, the associated visitor experience, the long-term ecological processes of the areas, and the contribution the information can make to public health and safety, the proposed action can, on balance, meet the minimum requirement for the administration of the installation areas as wilderness. Because the PBO stations would be co-located with other seismic or communication stations, this project is neutral in terms of a cost to benefit analysis. The placement of PBO stations at the sites described is considered part of the minimum necessary to achieve the desired increase in seismic monitoring and accuracy.

This minimum requirement finding is made with the understanding that no other external equipment or other types of transmission equipment would be placed at these sites beyond the items described in the Environmental Assessment without additional review. The proposed transmission equipment has been authorized at the identified locations partly because of their extremely low profile nature. Any additional equipment could negate this assumption that was a critical element in the impact versus benefit decision to authorize the Proposed Action.

If action is necessary, proceed to Step 2 to determine the minimum tool for action.

Step 2: Determine the minimum tool.

Description of Alternative Actions

For each alternative, describe what methods and techniques will be used, when the action will take place, where the action will take place, what mitigation measures are necessary, and the general effects to wilderness character.

The selected alternative is:

Alternative B. A full description of Alternative B, the Proposed Action, can be found in Section 2.3 of the EA.

Describe the rationale for selecting this alternative:

The selected alternative provides the best mitigation for the impacts to visual and soundscape resources through the site-specific placement of the PBO stations and the restricted use of helicopters to the minimum number of trips necessary for installation and maintenance.

Reducing these impacts also reduces impacts to related wilderness resource values in Denali National Park and Preserve.

Describe any monitoring and reporting requirements:

The number of landings at the Station AC33 (N. Denali Tokosha Comm) would be monitored to confirm that the minimum necessary trips are being used.

Please check any Wilderness Act Section 4(c) uses approved in this alternative:

X mechanical transport
X motorized equipment
X motor vehicles
_ motorboats
X landing of aircraft
_ temporary road
X structure or installation

Be sure to record and report any authorizations of Wilderness Act Section 4(c) uses according to agency procedure.

Approvals	**Signature**	**Name**	**Position**	**Date**
Prepared by:				
Recommended:				
Approved by:				

Appendix C2:

Wilderness Minimum Requirements/Minimum Tool Analysis Lake Clark National Park and Preserve

Step 1, Determine if it is necessary to take action.

Description: Briefly describe the situation that may prompt action.

The University NAVSTAR Consortium Inc. (UNAVCO) proposes to construct and operate two new stations for its Plate Boundary Observatory (PBO) Project on land administered by the U.S. Department of the Interior (USDI), National Park Service (NPS) in Lake Clark National Park and Preserve, in Alaska. The proposed CGPS sites are Station AC37 (Lake Clark NPS Radio Hut), which is located in designated wilderness, and Station AC47 (Slope Mountain), which is in an area eligible for wilderness designation. The UNAVCO PBO Project consists of the construction and operation of a geodetic observatory for the purpose of studying the Earth's surface deformation across the active boundary zone between the Pacific and North American plates in the western United States and Alaska. To accomplish the scientific objectives of the PBO Project, the observatory consists of a carefully designed and integrated network of continuous Global Positioning System (CGPS) receivers.

Currently, a very sparse geodetic network exists in the western continental U.S. and Alaska. The limited geographic coverage of this network contributes to a lack of understanding of basic Earth processes, (i.e., active faulting and earthquake and volcanic hazards) resulting in public safety risks, and gaps in human understanding of fundamental Earth processes. The Lake Clark area is very near an active subduction zone with a history of strong earthquakes and very little is known about plate motions in this area.

A complete description of the Proposed Action can be found in Section 2.3 of the EA.

A. Describe Valid Existing Rights or special Provisions of Wilderness Legislation

Are there valid existing rights or is there a special provision in wilderness legislation (the Wilderness Act of 1964 or subsequent wilderness laws) that allows consideration of action involving Section 4(c) uses? Cite law and section.

Yes: x No: Not Applicable:

Explain:

The Wilderness Act of 1964 (Public Law 88-577, 78 Stat. 890 16 U.S.C. 1131-1136) was enacted "to establish a National Wilderness Preservation System for the good of the whole people, and for other purposes." It provided for the review of every roadless area of 5,000 or more acres and every roadless island within National Wildlife Refuge and National Park Systems, and for recommendations about the suitability of these areas for inclusion in the National Wilderness Preservation System. The Act lists criteria for determining suitability of lands for wilderness designation and provides restrictions on activities within a designated wilderness area. Under authority of this Act over 25 million acres of land and water in the National Wildlife Refuge System were reviewed. In addition, of the some 7 million acres found suitable for wilderness designation, the Alaska National Interest Lands Conservation Act (P.L. 96-487) established seven designated wilderness areas in Alaska and required the study of nondesignated land for wilderness suitability, comprising 18,560,000 acres. Wilderness was designated in Denali, Katmai and Lake Clark National Parks and Preserves under ANILCA.

Section 4(c) of the Wilderness Act defines prohibited uses as:

> Except as specifically provided for in this Act, and subject to existing private rights, there shall be no commercial enterprise and no permanent road within any wilderness area designated by this Act and, except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area.

In 1980, Congress passed, and President Carter signed, the Alaska National Interest Lands Conservation Act (ANILCA). Although Section 1310 of ANCILA provides some exceptions for certain types of navigational aids and other weather and climate facilities in wilderness, no specific exceptions are provided for seismic monitoring stations. It is also the intent of Congress to "…maintain opportunities for scientific research and undisturbed ecosystems."

B. Describe Requirements of Other Legislation

Do other laws require action?

Yes: **No:** **x** **Not Applicable:**

Explain:

No other laws require action, but the importance of geologic resources and processes were mentioned in ANILCA for the area of this proposed project. ANILCA established a Lake Clark Wilderness [Section 201(7)(a)] for management under the provisions of the Wilderness Act of 1964. ANILCA specifies that Lake Clark National Park and Preserve be managed, in part, to "…maintain unimpaired the scenic beauty and quality of portions of the Alaska Range and the Aleutian Range, including volcanoes,…"

Lake Clark National Park and Preserve's ecosystem, scenic, and wilderness values were largely formed by volcanic activity and tectonic movements.

ANILCA Title I recognizes that the purposes for the new conservation system units include their preservation "for the benefit, use, education, and inspiration of present and future generations… that contain nationally significant natural, scenic,… geological, scientific, wilderness, and recreational values…." It is also the intent of Congress to "…maintain opportunities for scientific research and undisturbed ecosystems."

C. Describe Other Guidance

Does taking action conform to and implement relevant standards and guidelines and direction contained in agency policy, unit and wilderness management plans, species recovery plans, tribal government agreements, state and local government and interagency agreements?

Yes: **x** **No:** **Not Applicable:**

Explain:

National Park Service Management Policies (2006) state that wilderness policy directives apply regardless of the category of wilderness, and all management decisions, which affect wilderness, must be consistent with the minimum requirement concept. These policies require that the management action must be appropriate or necessary for administration of the area as wilderness.

6.3.1 General Policy

For the purposes of applying these policies, the term "wilderness" will include the categories of suitable, study, proposed, recommended, and designated wilderness. Potential wilderness may be a subset of any of these five categories. **The policies apply regardless of category** except as otherwise provided herein.

In addition to managing these areas for the preservation of the physical wilderness resources, planning for these areas must ensure that the wilderness character is likewise preserved. This policy will be applied to all planning documents affecting wilderness.

6.3.5 Minimum Requirement

All management decisions affecting wilderness must be consistent with the minimum requirement concept. This concept is a documented process used to determine if administrative actions, projects, or programs undertaken by the Service or its agents and affecting wilderness character, resources, or the visitor experience are necessary, and if so how to minimize impacts. The minimum requirement concept will be applied as a two-step process that determines

- **whether the proposed management action is appropriate or necessary for administration of the area as wilderness and does not cause a significant impact to wilderness resources and character, in accordance with the Wilderness Act;** and

- the techniques and types of equipment needed to ensure that impacts on wilderness resources and character are minimized.

In accordance with this policy, superintendents will apply the minimum requirement concept to the context of wilderness management planning, as well as to all other administrative practices, proposed special uses, scientific activities, and equipment use in wilderness. The only exception to the minimum

requirement policy is for eligible areas that the Service has not proposed for wilderness designation. However, those lands will still be managed to preserve their eligibility.

When determining minimum requirements the potential disruption of wilderness character and resources will be considered before, and given significantly more weight than, economic efficiency and convenience. If a compromise of wilderness resources or character is unavoidable, only those actions that preserve wilderness character and/or have localized, short-term adverse impacts will be acceptable.

The policies recognize scientific research as an important use of wilderness, but like any other use of wilderness, the negative impacts of the use must be weighed against the public benefits of providing enduring wilderness resources.

The policies provide more specific guidance for those scientific activities which involve prohibitions identified in Section 4(c) of the Wilderness Act. The research must either (1) provide essential information for the understanding, health, management, or administration of wilderness, or (2) if it has no direct relationship to wilderness, it must not compromise wilderness resources or character. Additionally, scientific monitoring devices that are operated in wilderness must provide information that is essential for the administration and preservation of wilderness.

6.3.6 Scientific Activities in Wilderness

The statutory purposes of wilderness include scientific activities, and these activities are encouraged and permitted when consistent with the Service's responsibilities to preserve and manage wilderness.

6.3.6.1 General Policy

… Scientific activities involving prohibitions identified in Section 4(c) of the Wilderness Act [16 USC 1133(c)] may be conducted within wilderness when the following occur:

- **The desired information is essential for the understanding, health, management or administration of wilderness,** and the project cannot be reasonably modified to eliminate or reduce the nonconforming wilderness use(s); **or if it increases scientific knowledge, even when**

this serves no immediate wilderness management purposes, provided it does not compromise wilderness resources or character. The preservation of wilderness resources and character will be given significantly more weight than economic efficiency/and or convenience.

…Research and monitoring devices (e.g., video cameras, data loggers, meteorological stations) may be installed and operated in wilderness if (1) **the desired information is essential for the administration and preservation of wilderness, and cannot be obtained from a location outside of wilderness without significant loss of precision and applicability;** and (2) the proposed device is the minimum requirement necessary to accomplish the research objective safely.

…Devices located in wilderness will be removed when determined to be no longer essential. Permanent equipment caches are prohibited within wilderness. Temporary caches must be evaluated using the minimum requirement concept.

All scientific activities, including the installation, servicing, removal, and monitoring of research devices, will apply minimum requirement concepts and be accomplished in compliance with *Management Policies*, director's orders, and procedures specified in the park's wilderness management plan.

D. Describe Options Outside of Wilderness

Can this situation be resolved by action outside of wilderness?

Yes:	No:	x	Not Applicable:

Explain:

Currently, a very sparse geodetic network exists in the western continental U.S. and Alaska. Alaska had only 16 CGPS stations at the start of the PBO Project. Compared to the PBO network, this limited coverage contributes to a lack of understanding of basic Earth processes, (i.e., active faulting and earthquakes and volcanic hazards) resulting in public safety risks and gaps in human understanding of fundamental Earth processes. In all, the PBO network will have 142 new CGPS stations in Alaska. Lake Clark National Park and Preserve is very near an active subduction zone with a history of strong earthquakes, and very little is known about plate motions in this area. This proposal for two new CGPS stations in Lake Clark National

Park and Preserve is designed specifically to fill the gaps in, and thus increase the accuracy of, the existing geodetic network by installing the new CGPS stations in a carefully designed and integrated network. Other PBO stations have been installed outside of the park, and this option was considered. The distance from the station to the faults, however, would be too great to yield meaningful data. The configuration of the geodetic network is dictated by the volcanic and tectonic structure of the Earth's crust in Alaska. Existing seismic equipment technology does not provide enough sensitivity to detect subtle magma movements and associated seismic activity at distances beyond the proposed areas. In addition, there is no comparable technology currently in existence for monitoring seismic and volcanic activities.

Each PBO station produces a continuous stream of information about the horizontal and vertical movements of the Earth's plates and provides the information on the one-month to multidecade time scale. Any change in the long-term trend direction indicates that something has changed in the plate motion that would warrant further study. The PBO has three dedicated analysis centers that continually monitor every site in the PBO network, and over 200 distinct users that analyze the data as a part of their ongoing areas of research. With the addition of the proposed CGPS instruments, scientists would have an incrementally better understanding of the earthquake risks along the known, and potentially unknown, fault systems in Alaska—information that is valuable to park managers who can use it to plan for the safety of park visitors and staff, site new facilities, update a safety program, or begin activation of a safety plan. Not placing these two new stations in Lake Clark National Park and Preserve would severely limit scientists' ability to directly measure the park's active faults, the interaction of these active faults, and the understanding of the park's long-term hazards (Freymueller 2007).

It is also important to install the PBO stations on or near exposed bedrock with a clear path for data telemetry to other points in the PBO network. A location on bedrock is of critical importance because the quality of seismic signals detected by a seismometer is directly related to the amount of signal attenuation caused by any soils or unconsolidated materials overlying the bedrock in a given area. A seismometer located on bedrock would encounter little or no attenuation of seismic signals, thus allowing significantly greater accuracy in the analysis of volcanic activity and earthquake mechanisms, location, depth, and magnitude. Stations located on bedrock tend to be more accurate than those located on unconsolidated materials.

The scarcity of locations with bedrock at or near the surface naturally limits UNAVCO's ability to achieve these objectives. The placement of PBO stations at the sites described in the park is considered part of the minimum necessary to achieve the desired increase in seismic monitoring and accuracy.

The Denali Fault lies to the north of Lake Clark National Park and Preserve. The Castle Mountain Fault traverses westward (sort of west-southwestward) and then becomes the Lake Clark Fault. There are splays off the Castle Mountain Fault that likely reduce the slip rate on the Lake Clark Fault, but essentially they are the same faults. The proposed GPS stations in Lake Clark National Park and Preserve are vital to understanding how much strain is transferred from the Castle Mountain Fault onto the Lake Clark Fault. No one knows—this is a primary reason for the PBO site. There is, in addition, an indirect, but important, connection between the Denali Fault and the Lake Clark Fault. The crust south of the Denali Fault is rotating counterclockwise and pushing westward. It is not clear how much of the Denali Fault strain makes its way onto the Lake Clark Fault system versus what is taken up in the north-south trending part of the western Alaska Range (Haeussler 2007)

Without the installation of the two new PBO stations to increase the precision of the AVO, AEIC and PBO seismic network, scientists conclude they could not accurately detect and locate micro-earthquakes on and near the these faults. Adding the proposed PBO stations would enable researchers to identify and detect both 1964 post-seismic deformations and help to define slip rates on the eastern end of the Aleutian Subduction zone. In addition, these stations would allow the USGS to discriminate between regional deformation and localized deformation on the active volcanoes in the Cook Inlet region during an eruption. PBO CGPS stations provide a different time scale and type of measurement than the existing USGS and UAF/GI seismometers. CGPS instruments provide information about ground movement direction and velocity on the one-month to multidecade time scale, while the existing seismometers provide information about ground shaking in seconds. With the addition of the CGPS instruments, scientists would have a much better understanding of the earthquake risks along the known and potentially unknown fault systems in Alaska.

Thirteen seismic stations already exist within Lake Clark National Park and Preserve. Of these, 12 stations already exist in the designated Lake Clark National Park and Preserve Wilderness. As a result of this data collection, the park manager receives significant hazard forecasts and warnings from the USGS and the FAA. The new PBO stations would be installed on bedrock and would have state-of-the-art accuracy and sensitivity thus enhancing the existing seismic monitoring network.

E. Wilderness Character

How would action contribute to the preservation of wilderness character, as describe by the components listed below.

Untrammeled:

No contribution. Station AC47 (Slope Mountain) would be located in an area eligible for future wilderness designation, but installation of the station would have no effect on currently designated wilderness. Station AC37 (Lake Clark NPS Radio Hut) would be located near or collocated with existing NPS communications equipment and the equipment would introduce a new long-term installation in designated wilderness. The footprint of the impact, however, would be small and inconspicuous.

Although the locations of the stations are so remote that few park visitors would ever encounter them, commercial and private pilots and their passengers frequently fly over these areas in the summer months, and the stations are likely to be seen from the air.

The CGPS stations could affect individuals who value the intangible aspects of wilderness such as knowing the area is untrammeled and undeveloped. The intrinsic value of large wilderness landscapes is a special characteristic of national parks and high quality wilderness lands in Alaska, and is important to many members of the public who may (or may not) visit the area.

Undeveloped:

No contribution. Station AC47 (Slope Mountain) is the only proposed PBO station site within a previously undisturbed area. The footprint of the impact would be small and inconspicuous.

Station AC37 (Lake Clark NPS Radio Hut) would be co-located within an area disturbed by installation of Lake Clark NPS communications equipment.

Natural:

Neutral to minor contribution. The proposed action is unlikely to have any significant negative impact on natural resource values due to the small size of the installation and the infrequent helicopter visits. A beneficial contribution would be possible from a greater understanding of the effects of earthquake and volcanic events on other contributing processes in the natural environment. The results of the action could include increased public and park management understanding of changes to the ecosystems from landslides, ground surface ruptures, and slope failures from earthquakes. These events could alter the annual discharge of water into glacial-fed rivers and streams, change the long-term response of glaciers to climate, alter stream flow and turbidity, change glacier mass balance and impoundments, and create hazardous downstream flooding zones. Habitat for species that reside in steep mountainous terrain may be altered or eliminated by seismic or volcanic events. Improvements to the seismic network with the proposed PBO station installations on bedrock would improve the park’s ability to understand and appreciate long-term ecological change.

The new permanent CGPS stations in Lake Clark National Park and Preserve would be used to detect and monitor ongoing regional deformation associated with the 1964 Good Friday M9.0 earthquake, which was caused when the North American plate slid over the top of the Pacific plate after centuries of building pressure. Continued monitoring is important because the largest earthquakes in Alaska are caused by subduction of the Pacific plate beneath Alaska. Three largest earthquakes in the 20th century occurred in Alaska (1957, 1964, and 1965). Although it is generally believed that these great earthquakes are rare, five great underthrusting events have occurred in Alaska since 1938. In a recent evaluation of the seismic potential in Alaska, researchers indicated that several subduction zone segments may be ready to rupture soon. The Yakataga gap and the region between Kodiak Island and the Shumagin Islands are areas where magnitude 8+ events are expected. Smaller magnitude 6.8 to 8.0 earthquakes, which occur in many regions of central and southcentral Alaska, occur at more frequent intervals, and in locations that cannot always be predicted. On average, Alaska has a magnitude 7.0 or larger earthquake about every two years, and could cause major damage if they occurred in a populated or strategically sensitive area. Many smaller events often occur near populated areas, and thus pose a continuous threat to urban areas (AEIC, 2006).

Scientists who study the volcanic and seismic processes of the Earth are not the only people who would realize the benefit of installing the PBO CGPS stations in the park's wilderness. Improvements to the seismic network with the proposed PBO station installations would improve the park's ability to understand and appreciate long-term ecological change. Data are collected by the stations seven days a week and 24 hours a day. NPS scientists and resource personnel including archaeologists, historic landscape architects, and fire management rangers can use PBO CGPS data from sites in the park to map the park's key resources. This can be done in "real time" with Real Time Kinematic (RTK) or in an office using the 24-hour data files available from the EarthScope data portal, which is at http://www.earthscope.org/data/gps.php.

Improvements to the seismic network, and a corresponding improvement in data accuracy, with the proposed PBO station installations would improve the park's ability to understand, appreciate, and interpret long-term ecological changes caused by major and minor seismic and volcanic events. All PBO CGPS stations have yearly velocity vectors that are important when defining and recovering boundaries in tectonically active areas. Land status issue resolution would be improved with the increased accuracy and density of the geodetic network. This is especially useful where easement and trails cross the boundaries between NPS- and BLM-managed lands (Cusick 2007).

Outstanding opportunities for solitude or a primitive and unconfined type of recreation:

No contribution. Station AC47 (Slope Mountain) is the only PBO station site proposed in a previously undisturbed area, but the area is eligible for future wilderness designation. The Slope Mountain site is also within an area under application for a native village corporation. The Station AC37 (Lake Clark NPS Radio Hut) site is near an existing NPS communication installation. Although both station sites are remote, so that few park visitors would ever encounter them and the footprints of the installations would be small and inconspicuous, no benefit to solitude accrues from the proposed action because new structures and helicopter activity would occur.

Other unique components that reflect the character of this wilderness:

Very minor contribution: The faults, volcanoes, and their related processes are the source for many distinct landforms and features in the park, are the primary reason for the park's establishment, and are closely associated with the public's impressions of the area as wilderness. These underlying geologic processes are of interest to the public and information on them is regularly presented to the public by the NPS. Scientific research, public education, and interpretation of these important geologic processes are directly associated with the character of the wilderness landscape in the park and would be enhanced to some degree with the more accurate data from the proposed CGPS stations. New information that could be shared with the public can be derived from the results of the more detailed monitoring that the new stations would provide. The PBO Project includes an educational outreach program that uses the data collected by the CGPS network to explain how the dynamics of past, current, and future tectonics have helped shape the landscape seen in the park today, and how that landscape can be expected to evolve. Gathering this information allows NPS staff to better manage today's recourses for future generations. The highly specialized nature of the information, however, may reduce the likelihood that a measurable increase would occur.

F. Describe Effects to the Public Purposes of Wilderness

How would action support the public purposes for wilderness [as stated in Section 4(b)] of the Wilderness Act) of recreation, scenic, scientific, education, conservation, and historical use?

Scientific

Major contribution. The primary and unique benefit of this action is an improved scientific understanding of the volcanic and earthquake processes with minor support for other management actions such as accurate GPS data more directly related to the preservation and

enjoyment of the area as wilderness. Without these installations, readings of plate boundary movements in the park would remain limited because the existing seismometers are not arrayed in sufficient density. PBO CGPS stations provide a different time scale and type of measurement than the existing USGS and UAF/GI seismometers. CGPS instruments provide information about ground movement direction and velocity on the one-month to multidecade time scale, while the existing seismometers provide information about ground shaking in seconds. With the addition of CGPS instruments, scientists would have a much better understanding of the earthquake risks along the known and potentially unknown fault systems in Alaska.

The PBO Project is designed specifically to increase the accuracy of the existing geodetic network. Improvements to the seismic network, and a corresponding improvement in data accuracy, with the proposed PBO station installations would improve the park's ability to understand, appreciate, and interpret long-term ecological changes caused by major and minor seismic and volcanic events. All PBO CGPS stations have yearly velocity vectors that are important when defining and recovering boundaries in tectonically active areas. Land status issue resolution would be improved with the increased accuracy and density of the geodetic network. This is especially useful where easement and trails cross the boundaries between NPS- and BLM-managed lands (Cusick 2007).

Other scientific benefits for the park include communication improvements. For example, because the CGPS equipment transits communication signals in the 900 MHz frequency, NPS staff can easily utilize their existing survey equipment to more accurately survey the existing condition of wetland resources and monitor their changes over time.

The NPS can also benefit from the new PBO CGPS stations in their cadastral boundary survey work. PBO stations are stable, permanent points of reference that can be used as survey controls to define park boundaries with a high degree of accuracy and repeatability. Mapping accuracy for all types of resources would improve using the proposed PBO CGPS stations as bases: the precision and accuracy of mapping and collecting data from research plots would improve. Resource studies and mapping that could benefit range from wetland identification, to archaeological and historic, to wildlife tracking, and fire management.

Stations AC37 (Lake Clark NPS Radio Hut), and AC47 (Slope Mountain) are located within the Cook Inlet Region of South Central Alaska. Permanent CGPS stations in this location would be used by researchers at the UAF/GI to detect and monitor ongoing regional deformation associated with the 1964 Good Friday M9.0 earthquake. Although it is generally believed that these great earthquakes are rare, five great underthrusting events have occurred in Alaska since 1938. In a recent evaluation of the seismic potential in Alaska, researchers indicated that several

subduction zone segments may be ready to rupture soon. On average, Alaska has a magnitude 7.0 or larger earthquake about every two years, and could cause major damage if they occurred in a populated or strategically sensitive area (AEIC 2006). In addition, this data would allow the USGS to discriminate between regional deformation and localized deformation on the active volcanoes in the Cook Inlet region during an eruption. An example was best seen in the most recent Augustine eruption where all stations on the volcano recorded extensive deformation, but regional stations nearby did not show deformation, indicating the signal was localized beneath the volcano.

Installation of these CGPS stations, on bedrock, contributes significantly to the overall mission of the PBO project. Through the use of modern geophysical observational and monitoring equipment and satellite telecommunications technology, the proposed PBO geodetic network would provide round-the-clock observational data that describes the geophysical condition of Alaska, as well as the western continental U.S. Additional objectives of the PBO Project are to provide a foundation for fundamental and applied research throughout the western U.S. and Alaska that would help mitigate risks from geological hazards and contribute to the public's understanding of the dynamic nature of the Earth.

Educational

Minor contribution. Scientists who study the volcanic and seismic processes of the Earth are not the only people who would realize the benefit of installing the PBO CGPS stations in the park's wilderness. Improvements to the seismic network with the proposed PBO station installations would improve the park's ability to understand and appreciate long-term ecological change. Data are collected by the stations seven days a week and 24 hours a day. NPS scientists and resource personnel including archaeologists, historic landscape architects, and fire management rangers can use PBO CGPS data from sites in the park to map the park's key resources. This can be done in "real time" with Real Time Kinematic (RTK) or in an office using the 24-hour data files available from the EarthScope data portal, which is at http://www.earthscope.org/data/gps.php.

Having these PBO CGPS stations in the park provides an opportunity to develop educational and outreach materials for the park rangers who interpret the landforms resulting from the volcanic and seismic processes, including how the data are collected and what the data are used for. The public, in general, and park visitors in particular, are curious about how the plates are moving, how active faults are studied, and how that relates to earthquakes and volcanoes that formed the park landscape. New information that could be shared with the public can be derived from the results of the more detailed monitoring that the new stations would provide. The PBO Project includes an educational outreach program that uses the data

collected by the CGPS network to explain how the dynamics of past, current, and future tectonics have helped shape the landscape seen in the park today, and how that landscape can be expected to evolve. Gathering this information allows NPS staff to better manage today's recourses for future generations, and provides a net benefit to the public's general understanding of the processes and features associated with the wilderness landscape. The highly specialized nature of the information, however, may reduce the likelihood that a measurable increase would occur.

Recreation, Conservation, Historical

Minor Contribution. NPS easements and rights-of-way have been mapped in Geographic Information systems and NPS has already benefited from GPS control that offers on-ground mapping accuracy of one meter or less. This is important because accuracy degrades with distance from base stations at the rate of 10 cm of error for each 100 km of baseline distance, thus improving the GPS network in Alaska parks would add a significant level of accuracy the park's GIS data (Cusick 2007).

Step 1 Decision: Is it necessary to take action?

Yes: x No: Not Applicable:

Explain

The project must satisfy one of the following three criteria that were previously described in NPS policy to be allowed in wilderness:

1. **Research and monitoring devices (e.g., video cameras, data loggers, meteorological stations) may be installed and operated in wilderness if (1) the desired information is essential for the administration and preservation of wilderness, and cannot be obtained for a location outside of wilderness without significant loss of precision and applicability; and (2) the proposed device is the minimum requirement necessary to accomplish the research objective safely.**

   The information provided by the project is not essential for the administration and preservation of wilderness in the affected park. The information, however, is of interest to park managers. It is possible to see how incrementally better information would help improve the ability of park managers to distinguish natural effects on the resources of the wilderness from those that might be anthropogenic in nature and, therefore, require management intervention to preserve wilderness resource conditions. The new PBO stations, with which

data accuracy would be improved, can be used to pinpoint Earth movements and potential hazards for wilderness users. These hazards include eruptions, land slides, lahars, impoundments, unstable ground, and ruptures.

The placement of PBO stations at the sites described in the park is considered part of the minimum necessary to achieve the desired increase in seismic monitoring and accuracy. It is possible to install the two PBO stations outside of the park, but the distance from the station to the fault would be too great to yield meaningful data. The configuration of the geodetic network is dictated by the volcanic and tectonic structure of the Earth's crust in Alaska. Existing seismic equipment technology does not provide enough sensitivity to detect subtle magma movements and associated seismic activity at distances beyond the proposed areas. In addition, there is no comparable technology currently in existence for monitoring seismic and volcanic activities.

2. It increases scientific knowledge, even when this serves no immediate wilderness management purpose, provided it does not compromise wilderness resources or character.

If the information does not serve any immediate wilderness management purpose or is not essential to understanding the wilderness area, policy still allows it to occur if it does not compromise wilderness resources or character. The information obtained from the PBO stations would increase scientific knowledge about the volcanoes, faults, and associated seismic features in the park. The PBO Project is designed specifically to increase the accuracy of the existing geodetic network. Improvements to the seismic network, and a corresponding improvement in data accuracy, with the proposed PBO station installations would improve the park's ability to understand, appreciate, and interpret long-term ecological changes caused by major and minor seismic and volcanic events.

All PBO CGPS stations have yearly velocity vectors that are important when defining and recovering boundaries in tectonically active areas. Land status issue resolution would be improved with the increased accuracy and density of the geodetic network. This is especially useful where easement and trails cross the boundaries between NPS- and BLM-managed lands, and for accuracy in defining research plots for the park's resource studies (Cusick 2007).

PBO CGPS stations provide a different time scale and type of measurement than the existing USGS and UAF/GI seismometers. CGPS instruments provide information about ground movement direction and velocity on the one-month to multidecade time scale, while the existing seismometers provide information about ground shaking in seconds.

With the addition of the CGPS instruments, scientists would have a much better understanding of the earthquake risks along the known and potentially unknown fault systems in Alaska.

Although this information would not serve any immediate wilderness management purpose, better information would help improve the ability of park managers to distinguish natural effects on the resources of the wilderness from those that might be anthropogenic in nature and, therefore, require management intervention to preserve wilderness resource conditions. The project, however, would compromise wilderness character in the park because (1) a permanent or long-term installation is one of the major prohibitions in the Wilderness Act and this project would have two installations, and (2) use of motorized equipment in wilderness, such as the helicopter needed to install and maintain the PBO stations is further prohibited Section 6.4.3.3 of the *National Park Service 2006 Management Policies* (NPS, 2006a) and *Lake Clark National Park and Preserve 1984 General Management Plan* (NPS, 1984).

3. The desired information is essential for the understanding health, management or administration of wilderness and the project cannot be reasonably modified to eliminate or reduce the nonconforming wilderness use(s).

The justification for the action is that it is needed for the greater understanding of the wilderness areas. Understanding in this context would be broadly interpreted to mean an increase in understanding of a prominent aspect of the wilderness areas. According to NPS-77, Natural Resources Management Guideline, the NPS should seek to identify significant geologic features and processes.

ANILCA established a Lake Clark Wilderness [Section 201(7)(a)] for management under the provisions of the Wilderness Act of 1964. ANILCA specifies that the park and preserve be managed, in part, to "…maintain unimpaired the scenic beauty and quality of portions of the Alaska Range and the Aleutian Range, including volcanoes,…" Lake Clark National Park and Preserve's ecosystem, scenic, and wilderness values were largely formed by volcanic activity and tectonic movements, thus increased understanding of these important features would result from implementation of the PBO station installations.

Although impacts to wilderness character would occur, primarily from the establishment of the PBO stations in areas that are notably free from signs of modern technology, they are generally minor. Given the fundamental role that the faults and volcanoes play in the landscapes of the park, the associated visitor experience, the long-term ecological processes of the areas, and the contribution the information can make to public health and safety, the

proposed action can, on balance, meet the minimum requirement for the administration of the installation areas as wilderness. Because one PBO station would be co-located with other seismic or communication stations in designated wilderness, and the other station is in an undisturbed area eligible for wilderness designation pending resolution of Native lands selections, this project is, at best, a minor intrusion into wilderness. The placement of PBO stations at the sites described, however, is considered part of the minimum necessary to achieve the desired increase in seismic monitoring and accuracy.

The natural processes of the wilderness and the values of solitude or primitive and unconfined recreation experiences would not be threatened by this action, and park safety and knowledge of the processes that formed it would be enhanced. This minimum requirement finding is made with the understanding that no other external equipment or other types of transmission equipment would be placed at these sites beyond the items described in the Environmental Assessment without additional review. The proposed transmission equipment has been authorized at the identified locations partly because of their extremely low profile nature. Any additional equipment could negate this assumption that was a critical element in the impact versus benefit decision to authorize the Proposed Action.

If action is necessary, proceed to Step 2 to determine the minimum tool for action.

Step 2: Determine the minimum tool.

Description of Alternative Actions

For each alternative, describe what methods and techniques will be used, when the action will take place, where the action will take place, what mitigation measures are necessary, and the general effects to wilderness character.

The selected alternative is:

Alternative B. A full description of Alternative B, the Proposed Action, can be found in Section 2.3 of the EA.

Describe the rationale for selecting this alternative:

The selected alternative provides the best mitigation for the impacts to visual and soundscape resources through the site-specific placement of the PBO stations and the restricted use of helicopters to the minimum number of trips necessary for installation and maintenance.

Reducing these impacts also reduces impacts to related wilderness resource values in Lake Clark National Park and Preserve.

Describe any monitoring and reporting requirements:

The number of landings at the stations would be monitored under the (Research and Reporting System (RPRS)) to confirm that the minimum necessary trips are being used. This EA covers the NEPA requirements for installation and maintenance, but the RPRS renewals would be required on an annual basis to refine helicopter use and field schedules and activities.

Please check any Wilderness Act Section 4(c) uses approved in this alternative:

X mechanical transport
X motorized equipment
_ motor vehicles
_ motorboats
X landing of aircraft
_ temporary road
X structure or installation

Be sure to record and report any authorizations of Wilderness Act Section 4(c) uses according to agency procedure.

Approvals	**Signature**	**Name**	**Position**	**Date**
Prepared by:				
Recommended:				
Approved by:				

Appendix C3:

Wilderness Minimum Requirements/Minimum Tool Analysis Katmai National Park and Preserve

Step 1, Determine if it is necessary to take action.

Description: Briefly describe the situation that may prompt action.

The University NAVSTAR Consortium Inc. (UNAVCO) proposes to construct and operate two new stations for its Plate Boundary Observatory (PBO) Project on land administered by the U.S. Department of the Interior (USDI), National Park Service (NPS) in Katmai National Park and Preserve in Alaska. The UNAVCO PBO Project consists of the construction and operation of a geodetic observatory for the purpose of studying the Earth's surface deformation across the active boundary zone between the Pacific and North American plates in the western United States and Alaska. To accomplish the scientific objectives of the PBO Project, the observatory consists of a carefully designed and integrated network of continuous Global Positioning System (CGPS) receivers.

Currently, a very sparse geodetic network exists in the western continental U.S. and Alaska. Alaska had only 16 CGPS stations at the start of the PBO Project. Compared to the PBO network, this limited coverage contributes to a lack of understanding of basic Earth processes, (i.e., active faulting and earthquakes and volcanic hazards) resulting in public safety risks and gaps in human understanding of fundamental Earth processes. In all, the PBO network will have 142 new CGPS stations in Alaska. Katmai National Park and Preserve is very near an active subduction zone with a history of strong earthquakes and active volcanoes, but very little is known about plate motions in this area. This proposal for two new CGPS stations in Katmai National Park and Preserve is designed specifically to fill the gaps in, and thus increase the accuracy of, the existing geodetic network by installing the new CGPS stations in a carefully designed and integrated network. Many other PBO stations have been installed outside of the park, and this option was considered. The distance from the station to the faults, however, would be too great to yield meaningful data. The configuration of the geodetic network is dictated by the volcanic and tectonic structure of the Earth's crust in Alaska. Existing seismic equipment technology does not provide enough sensitivity to detect subtle magma movements and associated seismic activity at distances beyond the proposed areas. In addition, there is no comparable technology currently in existence for monitoring seismic and volcanic activities.

A complete description of the Proposed Action can be found in Section 2.3 of the EA.

A. Describe Valid Existing Rights or special Provisions of Wilderness Legislation

Are there valid existing rights or is there a special provision in wilderness legislation (the Wilderness Act of 1964 or subsequent wilderness laws) that allows consideration of action involving Section 4(c) uses? Cite law and section.

Yes: x No: Not Applicable:

Explain:

In 1980, Congress passed, and President Carter signed, the Alaska National Interest Lands Conservation Act (ANILCA). Although Section 1310 of ANCILA provides some exceptions for certain types of navigational aids and other weather and climate facilities in wilderness, no specific exceptions are provided for seismic monitoring stations. It is also the intent of Congress to "…maintain opportunities for scientific research and undisturbed ecosystems."

The Wilderness Act of 1964 (Public Law 88-577, 78 Stat. 890 16 U.S.C. 1131-1136) was enacted "to establish a National Wilderness Preservation System for the good of the whole people, and for other purposes." It provided for the review of every roadless area of 5,000 or more acres and every roadless island within National Wildlife Refuge and National Park Systems, and for recommendations about the suitability of these areas for inclusion in the National Wilderness Preservation System. The Act lists criteria for determining suitability of lands for wilderness designation and provides restrictions on activities within a designated wilderness area. Under authority of this Act over 25 million acres of land and water in the National Wildlife Refuge System were reviewed. In addition, of the some 7 million acres found suitable for wilderness designation, the Alaska National Interest Lands Conservation Act (P.L. 96-487) established seven designated wilderness areas in Alaska and required the study of nondesignated land for wilderness suitability, comprising 18,560,000 acres. Wilderness was designated in Denali, Katmai and Lake Clark National Parks and Preserves under ANILCA.

Section 4(c) of the Wilderness Act defines prohibited uses as:

> Except as specifically provided for in this Act, and subject to existing private rights, there shall be no commercial enterprise and no permanent road within any wilderness area designated by this Act and, except as necessary to meet minimum requirements for the administration of the area for the purpose of this

Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area.

B. Describe Requirements of Other Legislation

Do other laws require action?

Yes: **No:** **x** **Not Applicable:**

Explain:

No other laws require action, but the importance of geologic resources and processes were mentioned in ANILCA for the area of this proposed project. ANILCA established Katmai National Preserve in July 1980 and redesignated Katmai National Monument as "Katmai National Park". Section 202(2) of ANCILA states: “The monument addition and preserve shall be managed for the following purposes, among others: To protect habitats… and to protect scenic, geological, cultural and recreational features.” A significant feature of the park is the predominantly volcanic Aleutian Range. NPS believes there are more than nine active or dormant volcanoes; often twelve are cited: Mt. Douglas, Four-Peaked Volcano, Kaguyak, Kukak Volcano, Mt. Steller, Snowy Mountain, Mt. Katmai, Mt. Griggs, Novarupta, Mt. Mageik, Trident Volcano, and Mt. Martin. The landscape was dramatically altered by the 1912 eruption of the Novarupta volcano (NPS, no date-e). Mount Douglas, which is near AC08 (Cape Douglas), is considered an active volcano. Considering this history and present activity, increased understanding of these dynamic features would result from implementation of the PBO station installations.

ANILCA Title I recognizes that the purposes for the new conservation system units include their preservation “for the benefit, use, education, and inspiration of present and future generations… that contain nationally significant natural, scenic,… geological, scientific, wilderness, and recreational values….” It is also the intent of Congress to “…maintain opportunities for scientific research and undisturbed ecosystems.”

C. Describe Other Guidance

Does taking action conform to and implement relevant standards and guidelines and direction contained in agency policy, unit and wilderness management plans, species recovery plans, tribal government agreements, state and local government and interagency agreements?

Yes: x **No:** **Not Applicable:**

Explain:

National Park Service Management Policies (2006) state that wilderness policy directives apply regardless of the category of wilderness, and all management decisions, which affect wilderness, must be consistent with the minimum requirement concept. These policies require that the management action must be appropriate or necessary for administration of the area as wilderness.

6.3.1 General Policy

For the purposes of applying these policies, the term "wilderness" will include the categories of suitable, study, proposed, recommended, and designated wilderness. Potential wilderness may be a subset of any of these five categories. **The policies apply regardless of category** except as otherwise provided herein.

In addition to managing these areas for the preservation of the physical wilderness resources, planning for these areas must ensure that the wilderness character is likewise preserved. This policy will be applied to all planning documents affecting wilderness.

6.3.5 Minimum Requirement

All management decisions affecting wilderness must be consistent with the minimum requirement concept. This concept is a documented process used to determine if administrative actions, projects, or programs undertaken by the Service or its agents and affecting wilderness character, resources, or the visitor experience are necessary, and if so how to minimize impacts. The minimum requirement concept will be applied as a two-step process that determines

- **whether the proposed management action is appropriate or necessary for administration of the area as wilderness and does not**

cause a significant impact to wilderness resources and character, in accordance with the Wilderness Act; and

- the techniques and types of equipment needed to ensure that impacts on wilderness resources and character are minimized.

In accordance with this policy, superintendents will apply the minimum requirement concept to the context of wilderness management planning, as well as to all other administrative practices, proposed special uses, scientific activities, and equipment use in wilderness. The only exception to the minimum requirement policy is for eligible areas that the Service has not proposed for wilderness designation. However, those lands will still be managed to preserve their eligibility.

When determining minimum requirements, the potential disruption of wilderness character and resources will be considered before, and given significantly more weight than, economic efficiency and convenience. If a compromise of wilderness resources or character is unavoidable, only those actions that preserve wilderness character and/or have localized, short-term adverse impacts will be acceptable.

The policies recognize scientific research as an important use of wilderness, but like any other use of wilderness, the negative impacts of the use must be weighed against the public benefits of providing enduring wilderness resources.

The policies provide more specific guidance for those scientific activities which involve prohibitions identified in Section 4(c) of the Wilderness Act. The research must either (1) provide essential information for the understanding, health, management, or administration of wilderness, or (2) if it has no direct relationship to wilderness, it must not compromise wilderness resources or character. Additionally, scientific monitoring devices that are operated in wilderness must provide information that is essential for the administration and preservation of wilderness.

6.3.6 Scientific Activities in Wilderness

The statutory purposes of wilderness include scientific activities, and these activities are encouraged and permitted when consistent with the Service's responsibilities to preserve and manage wilderness.

6.3.6.1 General Policy

… Scientific activities involving prohibitions identified in Section 4(c) of the Wilderness Act [16 USC 1133(c)] may be conducted within wilderness when the following occur:

- **The desired information is essential for the understanding, health, management or administration of wilderness,** and the project cannot be reasonably modified to eliminate or reduce the nonconforming wilderness use(s); **or if it increases scientific knowledge, even when this serves no immediate wilderness management purposes, provided it does not compromise wilderness resources or character.** The preservation of wilderness resources and character will be given significantly more weight than economic efficiency and/or convenience.

… Research and monitoring devices (e.g., video cameras, data loggers, meteorological stations) may be installed and operated in wilderness if (1) **the desired information is essential for the administration and preservation of wilderness and cannot be obtained from a location outside of wilderness without significant loss of precision and applicability;** and (2) the proposed device is the minimum requirement necessary to accomplish the research objective safely.

… Devices located in wilderness will be removed when determined to be no longer essential. Permanent equipment caches are prohibited within wilderness. Temporary caches must be evaluated using the minimum requirement concept.

All scientific activities, including the installation, servicing, removal, and monitoring of research devices, will apply minimum requirement concepts and be accomplished in compliance with *Management Policies*, director's orders, and procedures specified in the park's wilderness management plan.

D. Describe Options Outside of Wilderness

Can this situation be resolved by action outside of wilderness?

Yes: **No:** **x** **Not Applicable:**

Explain:

Currently, a very sparse geodetic network exists in the western continental U.S. and Alaska. Alaska had only 16 CGPS stations at the start of the PBO Project. Compared to the PBO network, this limited coverage contributes to a lack of understanding of basic Earth processes, (i.e., active faulting and earthquakes and volcanic hazards) resulting in public safety risks and gaps in human understanding of fundamental Earth processes. In all, the PBO network will have 142 new CGPS stations in Alaska. Katmai National Park and Preserve is very near an active subduction zone with a history of strong earthquakes and active volcanoes, but very little is known about plate motions in this area. This proposal for two new CGPS stations in Katmai National Park and Preserve is designed specifically to fill the gaps in, and thus increase the accuracy of, the existing geodetic network by installing the new CGPS stations in a carefully designed and integrated network of continuous receivers. Many other PBO stations have been installed outside of the park, and this option was considered. The distance from the station to the faults, however, would be too great to yield meaningful data. The configuration of the geodetic network is dictated by the volcanic and tectonic structure of the Earth's crust in Alaska. Existing seismic equipment technology does not provide enough sensitivity to detect subtle magma movements and associated seismic activity at distances beyond the proposed areas. In addition, there is no comparable technology currently in existence for monitoring seismic and volcanic activities. Not placing these two new stations in Katmai National Park and Preserve would severely limit scientists' ability to directly measure the park's active faults, the interaction of these active faults, and the understanding of the park's long-term hazards (Freymueller 2007).

Each PBO station produces a continuous stream of information about the horizontal and vertical movements of the Earth's plates and provides the information on the one-month to multidecade time scale. Any change in the long-term trend direction indicates that something has changed in the plate motion that would warrant further study. The PBO has three dedicated analysis centers that continually monitor every site in the PBO network, and over 200 distinct users that analyze the data as a part of their ongoing areas of research. With the addition of the proposed CGPS instruments, scientists would have an incrementally better understanding of the earthquake risks along the known, and potentially unknown, fault systems in Alaska—information that is valuable to park managers who can use it to plan for the safety of park visitors and staff, site new facilities, update a safety program, or begin activation of a safety plan.

It is also important to install the PBO stations on or near exposed bedrock with a clear path for data telemetry to other points in the PBO network. A location on bedrock is of critical importance because the quality of seismic signals detected by a seismometer is directly related to the amount of signal attenuation caused by any soils or unconsolidated materials overlying the bedrock in a given area. A seismometer located on bedrock would encounter little or no attenuation of seismic signals, thus allowing significantly greater accuracy in the analysis of volcanic activity and earthquake mechanisms, location, depth, and magnitude. Stations located on bedrock tend to be more accurate than those located on unconsolidated materials.

The scarcity of locations with bedrock at or near the surface naturally limits UNAVCO's ability to achieve these objectives. The placement of PBO stations at the sites described in the park is considered part of the minimum necessary to achieve the desired increase in seismic monitoring and accuracy. Without the installation of the two new PBO stations to increase the precision of the AVO, AEIC and PBO seismic network, scientists conclude they could not accurately detect and locate micro-earthquakes on and near the Denali Fault. Adding the proposed PBO stations would enable researchers to identify and detect both 1964 post-seismic deformations and help to define slip rates on the eastern end of the Aleutian Subduction zone, and detect and monitor ongoing regional deformation associated with the 1964 Good Friday M9.0 earthquake. In addition, these stations would allow the USGS to discriminate between regional deformation and localized deformation on the active volcanoes in the Cook Inlet region during an eruption. PBO CGPS stations provide a different time scale and type of measurement than the existing USGS and UAF/GI seismometers. CGPS instruments provide information about ground movement direction and velocity on the one-month to multidecade time scale, while the existing seismometers provide information about ground shaking in seconds. With the addition of the CGPS instruments, scientists would have a much better understanding of the earthquake risks along the known and potentially unknown fault systems in Alaska.

Park wilderness surrounds the volcanic and seismically active regions, and 26 existing seismic or communication stations (including three new AVO seismometers) are within Katmai National Park and Preserve. All of the seismic stations in Katmai National Park and Preserve are located in designated wilderness. The result of these stations is that the park manager receives significant hazard forecasts and warnings from the USGS and the FAA. The new PBO stations, however, would be installed on bedrock and would have state-of-the-art accuracy and sensitivity, thus enhancing the existing seismic monitoring network.

E. Wilderness Character

How would action contribute to the preservation of wilderness character, as describe by the components listed below.

Untrammeled:

No contribution. The PBO stations would have little effect on the designated wilderness. AC26 (Cape Gull) would be located on a former USCG navigational aid site, and the new equipment would introduce a small long-term installation in designated wilderness. The footprint of the impact, however, would be small and inconspicuous. AC08 (Cape Douglas) would be located near an existing AVO seismometer and would have a negligible effect on the designated wilderness areas, and the area would retain nearly all of the qualities of wilderness it currently has.

The locations of the stations are so remote that few park visitors would ever encounter them by traveling on foot. Commercial and private pilots and their passengers, however, frequently fly over coastal areas during the summer months, and the stations are likely to be seen from the air. These visitors would experience a change in wilderness character, although at a negligible level. The CGPS stations could also affect individuals who value the intangible aspects of wilderness such as knowing the area is untrammeled and undeveloped. The intrinsic value of large wilderness landscapes is a special characteristic of national parks and high quality wilderness lands in Alaska, and is important to many members of the public who may (or may not) visit the area.

Undeveloped:

No contribution. Both station sites are located within areas disturbed by the installation of seismic or communication equipment. Station AC08 (Cape Douglas) would be co-located with an existing USGS AVO seismometer. Site AC26 (Cape Gull), is located at the former U.S. Coast Guard/FAA facilities site. The NPS, however, can directly benefit from the new PBO CGPS stations in their cadastral boundary survey work. PBO stations are stable, permanent points of reference that can be used as survey controls to define park boundaries with a high degree of accuracy and repeatability. Mapping accuracy for all types of resources would improve using the proposed PBO CGPS stations as bases: the precision and accuracy of mapping and collecting data from research plots would improve. Resource studies and mapping that could benefit range from wetland identification, to archaeological and historic, to wildlife tracking, and fire management.

Natural:

Neutral to minor contribution. The proposed action is unlikely to have any negative impact on natural resource values due to the small size of the installations and the infrequent helicopter visits. A beneficial contribution would be possible from a greater understanding of the effects of earthquake and volcanic events on other contributing processes in the natural environment. The results of the action could include increased public and park management understanding of changes to the ecosystems from landslides, ground surface ruptures, and slope failures from earthquakes. These events could alter the annual discharge of water into glacial-fed rivers and streams, change the long-term response of glaciers to climate, alter stream flow and turbidity, change glacier mass balance and impoundments, and create hazardous downstream flooding zones. Habitat for species that reside in steep mountainous terrain may be altered or eliminated by seismic or volcanic events. Volcanic eruptions such as the 1912 eruption of the Katmai volcano can affect worldwide climate and, as in the case of that eruption, cause the evacuation of local communities.

The new permanent CGPS station at Cape Douglas would be used to detect and monitor ongoing regional deformation associated with the 1964 Good Friday M9.0 earthquake, which was caused when the North American plate slid over the top of the Pacific plate after centuries of building pressure. Continued monitoring is important because the largest earthquakes in Alaska are caused by subduction of the Pacific plate beneath Alaska. Three of the largest earthquakes in the 20th century occurred in Alaska (1957, 1964, and 1965). Although it is generally believed that these great earthquakes are rare, five great underthrusting events have occurred in Alaska since 1938. In a recent evaluation of the seismic potential in Alaska, researchers indicated that several subduction zone segments may be ready to rupture soon. The Yakataga gap and the region between Kodiak Island and the Shumagin Islands are areas where magnitude 8+ events are expected. Smaller magnitude 6.8 to 8.0 earthquakes, which occur in many regions of central and southcentral Alaska, occur at more frequent intervals, and in locations that cannot always be predicted. On average, Alaska has a magnitude 7.0 or larger earthquake about every two years, and could cause major damage if they occurred in a populated or strategically sensitive area. Many smaller events often occur near populated areas, and thus pose a continuous threat to urban areas (AEIC, 2005).

Scientists who study the volcanic and seismic processes of the Earth are not the only people who would realize the benefit of installing the PBO CGPS stations in the park's wilderness. Improvements to the seismic network with the proposed PBO station installations would improve the park's ability to understand and appreciate long-term ecological change. Data are collected by the stations seven days a week and 24 hours a day. NPS scientists and resource personnel

including archaeologists, historic landscape architects, and fire management rangers can use PBO CGPS data from sites in the park to map the park's key resources. This can be done in "real time" with Real Time Kinematic (RTK) or in an office using the 24-hour data files available from the EarthScope data portal, which is at http://www.earthscope.org/data/gps.php.

Improvements to the seismic network, and a corresponding improvement in data accuracy, with the proposed PBO station installations would improve the park's ability to understand, appreciate, and interpret long-term ecological changes caused by major and minor seismic and volcanic events. All PBO CGPS stations have yearly velocity vectors that are important when defining and recovering boundaries in tectonically active areas. Land status issue resolution would be improved with the increased accuracy and density of the geodetic network. This is especially useful where easement and trails cross the boundaries between NPS- and BLM-managed lands (Cusick 2007).

Outstanding opportunities for solitude or a primitive and unconfined type of recreation:

No contribution. Both station sites are located within areas disturbed by the installation of seismic or communication equipment. Station AC08 (Cape Douglas) would be co-located with an existing USGS AVO seismometer. Site AC26 (Cape Gull), is located at the former U.S. Coast Guard/FAA facilities site. Although both sites are so remote that few park visitors would ever view them except from the air, the action would not benefit solitude because new structures would be present and helicopter visits would occur.

Other unique components that reflect the character of this wilderness:

Minor contribution: The faults, volcanoes, and their related processes are the source for many distinct landforms and features in the park, are the primary reason for the park's establishment, and are closely associated with the public's impressions of the area as wilderness. These underlying geologic processes are of interest to the public and information on them is regularly presented to the public by the NPS. Scientific research, public education, and interpretation of these important geologic processes are directly associated with the character of the wilderness landscape in the park and would be enhanced, to some degree, with the more accurate data from the proposed CGPS stations. New information that could be shared with the public can be derived from the results of the more detailed monitoring that the new stations would provide. The PBO Project includes an educational outreach program that uses the data collected by the CGPS network to explain how the dynamics of past, current, and future tectonics have helped shape the landscape seen in the park today, and how that landscape can be expected to evolve. Gathering this information allows NPS staff to better manage today's resources for future generations, and provides a net benefit to the public's general understanding of the processes and

features associated with the wilderness landscape. The highly specialized nature of the information, however, may reduce the likelihood that a measurable increase would occur.

F. Describe Effects to the Public Purposes of Wilderness

How would action support the public purposes for wilderness (as stated in Section 4(b) of the Wilderness Act) of recreation, scenic, scientific, education, conservation, and historical use?

Scientific

Major contribution. The primary and unique benefit of this action is an improved scientific understanding of the volcanic and earthquake processes with minor support for other management actions such as accurate GPS data more directly related to the preservation and enjoyment of the area as wilderness. Without these installations, readings of plate boundary movements in the park would remain limited because the existing seismometers are not arrayed in sufficient density. PBO CGPS stations provide a different time scale and type of measurement than the existing USGS and UAF/GI seismometers. CGPS instruments provide information about ground movement direction and velocity on the one-month to multidecade time scale, while the existing seismometers provide information about ground shaking in seconds. With the addition of CGPS instruments, scientists would have a much better understanding of the earthquake risks along the known and potentially unknown fault systems in Alaska.

The PBO Project is designed specifically to increase the accuracy of the existing geodetic network. Improvements to the seismic network, and a corresponding improvement in data accuracy, with the proposed PBO station installations would improve the park's ability to understand, appreciate, and interpret long-term ecological changes caused by major and minor seismic and volcanic events. All PBO CGPS stations have yearly velocity vectors that are important when defining and recovering boundaries in tectonically active areas. Land status issue resolution would be improved with the increased accuracy and density of the geodetic network. This is especially useful where easement and trails cross the boundaries between NPS- and BLM-managed lands (Cusick 2007).

Other scientific benefits for the park include communication improvements. For example, because the CGPS equipment transits communication signals in the 900 MHz frequency, NPS staff can easily utilize their existing survey equipment to more accurately survey the existing condition of wetland resources and monitor their changes over time.

The NPS can also benefit from the new PBO CGPS stations in their cadastral boundary survey work. PBO stations are stable, permanent points of reference that can be used as survey controls to define park boundaries with a high degree of accuracy and repeatability. Mapping accuracy for all types of resources would improve using the proposed PBO CGPS stations as bases: the precision and accuracy of mapping and collecting data from research plots would improve. Resource studies and mapping that could benefit range from wetland identification, to archaeological and historic, to wildlife tracking, and fire management.

The largest earthquakes in Alaska are caused by subduction of the Pacific plate beneath Alaska. Although it is generally believed that these great earthquakes are rare, five great underthrusting events have occurred in Alaska since 1938. In a recent evaluation of the seismic potential in Alaska, researchers indicated that several subduction zone segments may be ready to rupture soon. Stations AC33 and AC56 would be located on the western end of the Denali Fault Zone and would be used to detect and measure slip rates on the western end of the fault, as well as detect and measure post-seismic deformation associated with the 2002 M7.9 Denali Earthquake. On average, Alaska has a magnitude 7.0 or larger earthquake about every two years, and could cause major damage if they occurred in a populated or strategically sensitive area (AEI, 2006). Lack of data on the western end of the fault has prevented researchers from determining slip rates on this portion of the fault.

Installation of these CGPS stations, on bedrock, contributes significantly to the overall mission of the PBO project. Through the use of modern geophysical observational and monitoring equipment and satellite telecommunications technology, the proposed PBO geodetic network would provide round-the-clock observational data that describes the geophysical condition of Alaska, as well as the western continental U.S. Additional objectives of the PBO Project are to provide a foundation for fundamental and applied research throughout the western U.S. and Alaska that would help mitigate risks from geological hazards and contribute to the public's understanding of the dynamic nature of the Earth.

Educational

Minor contribution. Scientists who study the volcanic and seismic processes of the Earth are not the only people who would realize the benefit of installing the PBO CGPS stations in the park's wilderness. Improvements to the seismic network with the proposed PBO station installations would improve the park's ability to understand and appreciate long-term ecological change. Data are collected by the stations seven days a week and 24 hours a day. NPS scientists and resource personnel including archaeologists, historic landscape architects, and fire management rangers can use PBO CGPS data from sites in the park to map the park's key resources. This can be done

in “real time” with Real Time Kinematic (RTK) or in an office using the 24-hour data files available from the EarthScope data portal, which is at http://www.earthscope.org/data/gps.php.

Having these PBO CGPS stations in the park provides an opportunity to develop educational and outreach materials for the park rangers who interpret the landforms resulting from the volcanic and seismic processes, including how the data are collected and what the data are used for. The public, in general, and park visitors in particular, are curious about how the plates are moving, how active faults are studied, and how that relates to earthquakes and volcanoes that formed the park landscape. New information that could be shared with the public can be derived from the results of the more detailed monitoring that the new stations would provide. The PBO Project includes an educational outreach program that uses the data collected by the CGPS network to explain how the dynamics of past, current, and future tectonics have helped shape the landscape seen in the park today, and how that landscape can be expected to evolve. Gathering this information allows NPS staff to better manage today’s recourses for future generations, and provides a net benefit to the public’s general understanding of the processes and features associated with the wilderness landscape. The highly specialized nature of the information, however, may reduce the likelihood that a measurable increase would occur.

Recreation, Conservation, Historical

Minor Contribution. NPS easements and rights-of-way have been mapped in Geographic Information systems and NPS has already benefited from GPS control that offers on-ground mapping accuracy of one meter or less. This is important because accuracy degrades with distance from base stations at the rate of 10 cm of error for each 100 km of baseline distance, thus improving the GPS network in Alaska parks would add a significant level of accuracy the park’s GIS data (Cusick 2007). Easements may also cross NPS lands that provide access to state lands, private lands, and 17b easements across Native Corporation lands that may be across private lands to park and other public lands. These easements are recorded by BLM. Accurate locations of these easements and rights-of-way are an important land management issue.

Step 1 Decision: Is it necessary to take action?

Yes: x No: Not Applicable:

Explain

The project must satisfy one of the following three criteria that were previously described in NPS policy to be allowed in wilderness:

1. **Research and monitoring devices (e.g., video cameras, data loggers, meteorological stations) may be installed and operated in wilderness if (1) the desired information is essential for the administration and preservation of wilderness, and cannot be obtained for a location outside of wilderness without significant loss of precision and applicability; and (2) the proposed device is the minimum requirement necessary to accomplish the research objective safely.**

   Although the primary information provided by the project is not essential to the administration and preservation of wilderness, improved GPS capabilities could help with the management and administration of the area. It is possible to see how incrementally better information would help improve the ability of park managers to distinguish natural effects on the resources of the wilderness from those that might be anthropogenic in nature and, therefore, require management intervention to preserve wilderness resource conditions. The new PBO stations, with which data accuracy would be improved, can be used to pinpoint Earth movements and potential hazards for wilderness users. These hazards include eruptions, land slides, lahars, impoundments, unstable ground, and ruptures.

   The placement of PBO stations at the sites described in the park is considered part of the minimum necessary to achieve the desired increase in seismic monitoring and accuracy. It is possible to install the two PBO stations outside of the park, but the distance from the station to the fault would be too great to yield meaningful data. The configuration of the geodetic network is dictated by the volcanic and tectonic structure of the Earth's crust in Alaska. Existing seismic equipment technology does not provide enough sensitivity to detect subtle magma movements and associated seismic activity at distances beyond the proposed areas. In addition, there is no comparable technology currently in existence for monitoring seismic and volcanic activities.

   The natural processes of the wilderness and the values of solitude or primitive and unconfined recreation experiences would not be threatened by this action, and park safety and knowledge of the processes that formed it would be enhanced.

2. It increases scientific knowledge, even when this serves no immediate wilderness management purpose, provided it does not compromise wilderness resources or character.

If the information does not serve any immediate wilderness management purpose or is not essential to understanding the wilderness area, policy still allows it to occur if it does not compromise wilderness resources or character. The information obtained from the PBO stations would increase scientific knowledge about the volcanoes, faults, and associated seismic features in the park. The PBO Project is designed specifically to increase the accuracy of the existing geodetic network. Improvements to the seismic network, and a corresponding improvement in data accuracy, with the proposed PBO station installations would improve the park's ability to understand, appreciate, and interpret long-term ecological changes caused by major and minor seismic and volcanic events.

All PBO CGPS stations have yearly velocity vectors that are important when defining and recovering boundaries in tectonically active areas. Land status issue resolution would be improved with the increased accuracy and density of the geodetic network. This is especially useful where easement and trails cross the boundaries between NPS- and BLM-managed lands, and for accuracy in defining research plots for the park's resource studies (Cusick 2007).

PBO CGPS stations provide a different time scale and type of measurement than the existing USGS and UAF/GI seismometers. CGPS instruments provide information about ground movement direction and velocity on the one-month to multidecade time scale, while the existing seismometers provide information about ground shaking in seconds. With the addition of the CGPS instruments, scientists would have a much better understanding of the earthquake risks along the known and potentially unknown fault systems in Alaska.

Although this information would not serve any immediate wilderness management purpose, better information would help improve the ability of park managers to distinguish natural effects on the resources of the wilderness from those that might be anthropogenic in nature and, therefore, require management intervention to preserve wilderness resource conditions. The project, however, would compromise wilderness character in the park because (1) a permanent or long-term installation is one of the major prohibitions in the Wilderness Act and this project would have two installations, and (2) use of motorized equipment in wilderness, such as the helicopter needed to install and maintain both PBO stations, is further prohibited except as provided for in the Section 6.4.3.3 of the *National Park Service 2006*

Management Policies (NPS, 2006a) and *Katmai National Park and Preserve 1986 General Management Plan* (NPS, 1986).

3. The desired information is essential for the understanding health, management or administration of wilderness and the project cannot be reasonably modified to eliminate or reduce the nonconforming wilderness use(s).

The justification for the action is that it is needed for the greater understanding of the wilderness areas. Understanding in this context would be broadly interpreted to mean an increase in understanding of a prominent aspect of the wilderness areas. According to NPS-77, Natural Resources Management Guideline, the NPS should seek to identify significant geologic features and processes.

ANILCA established Katmai National Preserve in July 1980 and also redesignated Katmai National Monument as "Katmai National Park". Section 202(2) of ANCILA states: “The monument addition and preserve shall be managed for the following purposes, among others: To protect habitats… and to protect scenic, geological, cultural and recreational features.” A significant feature of the park is the predominantly volcanic Aleutian Range. NPS believes there are more than nine active or dormant volcanoes; often twelve are cited: Mt. Douglas, Four-Peaked Volcano, Kaguyak, Kukak Volcano, Mt. Steller, Snowy Mountain, Mt. Katmai, Mt. Griggs, Novarupta, Mt. Mageik, Trident Volcano, and Mt. Martin. The landscape was dramatically altered by the 1912 eruption of the Novarupta volcano (NPS, no date-e). Mount Douglas, which is near Station AC08 (Cape Douglas), is considered an active volcano. Given this history and present activity, increased understanding of these dynamic features would result from implementation of the PBO station installations.

While impacts to wilderness character would occur, primarily from the establishment of the PBO stations in areas that are notably free from signs of modern technology, they are generally minor. Given the fundamental role that the faults and volcanoes play in the landscapes of the park, the associated visitor experience, the long-term ecological processes of the areas, and the contribution the information can make to public health and safety, the proposed action can, on balance, meet the minimum requirement for the administration of the installation areas as wilderness. Because the PBO stations would be collocated with one other seismic station and one formerly disturbed communications site, the project would have minor additional impacts to wilderness. The placement of PBO stations at the sites described, however, is considered part of the minimum necessary to achieve the desired increase in seismic monitoring and accuracy.

The natural processes of the wilderness and the values of solitude or primitive and unconfined recreation experiences would not be threatened by this action, and park safety and knowledge of the processes that formed it would be enhanced.

This minimum requirement finding is made with the understanding that no other external equipment or other types of transmission equipment would be placed at these sites beyond the items described in the Environmental Assessment without additional review. The proposed transmission equipment has been authorized at the identified locations partly because of their extremely low profile nature. Any additional equipment could negate this assumption that was a critical element in the impact versus benefit decision to authorize the Proposed Action.

If action is necessary, proceed to Step 2 to determine the minimum tool for action.

Step 2: Determine the minimum tool.

Description of Alternative Actions

For each alternative, describe what methods and techniques will be used, when the action will take place, where the action will take place, what mitigation measures are necessary, and the general effects to wilderness character.

The selected alternative is:

Alternative B. A full description of Alternative B, the Proposed Action, can be found in Section 2.3 of the EA.

Describe the rationale for selecting this alternative:

The selected alternative provides the best mitigation for the impacts to visual and soundscape resources through the site-specific placement of the PBO stations and the restricted use of helicopters to the minimum number of trips necessary for installation and maintenance. Reducing these impacts also reduces impacts to related wilderness resource values in Katmai National Park and Preserve.

Describe any monitoring and reporting requirements:

The number of landings at the stations would be monitored under the (Research and Reporting System (RPRS) to confirm that the minimum necessary trips are being used. This EA covers the NEPA requirements for installation and maintenance, but the RPRS renewals would be required on an annual basis to refine helicopter use and field schedules and activities.

Please check any Wilderness Act Section 4(c) uses approved in this alternative:

X mechanical transport
X motorized equipment
_ motor vehicles
_ motorboats
X landing of aircraft
_ temporary road
X structure or installation

Be sure to record and report any authorizations of Wilderness Act Section 4(c) uses according to agency procedure.

Approvals	**Signature**	**Name**	**Position**	**Date**
Prepared by:				
Recommended:				
Approved by:				