



ENVIRONMENTAL ASSESSMENT

Snag Creek/Kuskulana Land Exchange

Wrangell-St. Elias National Park & Preserve, Alaska

February, 2017

Photo: Kuskulana Property looking south



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Environmental Assessment

February, 2017

Note to Reviewers

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CHAPTER 1: PURPOSE AND NEED

1.1 Purpose and Need

Mr. Mat Worker is the owner of two private parcels within WRST. Mr. Worker has proposed to trade one of those parcels for land of equal value adjacent to the other parcel. The two parcels he owns are at the Kuskulana Glacier in designated wilderness and in the Snag Creek drainage northeast of Chisana (Figure 1). Mr. Worker proposes to exchange the Kuskulana parcel for land adjacent to his Snag Creek parcel. Under the proposal, National Park Service (NPS) would acquire the mineral estate to the Kuskulana parcel and retain the mineral estate on the Snag Creek parcel.

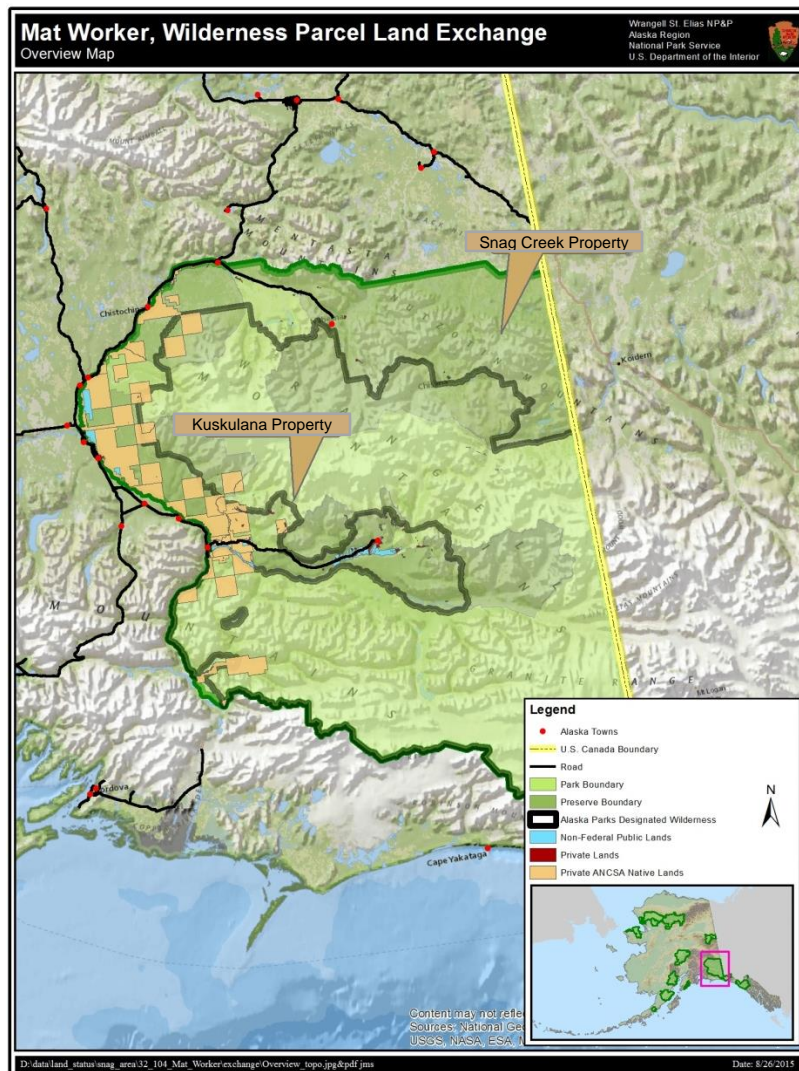


Figure 1. Parcels owned by Mr. Worker in WRST.

The Kuskulana parcel (tract WRST 20-119, 39.93 acres) is at a location where the Kuskulana Glacier splits and is about one mile inside the designated wilderness boundary (see Figure 3). Access is via walking approximately three miles from an off-road vehicle (ORV) trail or from the Nugget Creek airstrip

(approximately 4 miles). This parcel was recently purchased by Mr. Worker and is a patented mining claim. There are historic items and old mining adits located on this property. No modern structures are present. There was an old airstrip below the property and adjacent to the glacier, but it has become overgrown and unusable.

The Snag Creek parcel (tract# WRST 32-109, 35.91) is in the upper Snag Creek drainage (see Figure 2). The property is about 20 miles to the northeast of Chisana and about 16 miles west of the U.S.-Canada border. The closest road is about 35 miles away. Mr. Worker has built a small cabin and a few outbuildings on the property. The sole access to the property is via small airplane. Current access is via an existing airstrip located on NPS lands on upper Snag Creek. The airstrip is in the floodplain and was partially washed out in 2013. There has been a long documented history of the airstrip within the floodplain washing out and having to be constantly moved or adjusted. The airstrip is characterized by the landowner as unstable, unsafe, and not a reasonable means of access. NPS park pilots will not fly into this strip due to safety concerns. There is an alternative airstrip available to the public at the McDonald airstrip, approximately 4 miles upstream.

The purpose of the proposed land exchange is to provide Mr. Worker sufficient space to construct an airstrip on the Snag Creek parcel. Mr. Worker has indicated that the airstrip would be approximately 1,200 feet in length and constructed as follows: Vegetation would be cleared to ground level in a 20 foot swath using a chainsaw and a walk-behind, motorized brush-cutter. Within this area, low spots would be filled in using hand tools with material from on site. Brush within 30 to 40 feet on either side of the main landing area would be cut to 18 inches or less. The constructed airstrip would be on private land and would not be available for public use. See Figure 4 for the location of the existing airstrip as well as the location of the acquired land parcel where the new airstrip would be constructed.

There is a need to provide adequate and feasible access to inholdings per Section 1110(b) of the Alaska National Interest Lands Conservation Act (ANILCA) of 1980. Additionally, isolated patented mining claims in wilderness were identified in the park's 1986 Land Protection Plan as a top priority for acquisition, contingent on a willing seller. Acquisition of such properties prevents the potential for possible future development within designated wilderness. Additionally, ANILCA §1302(a) authorizes the Secretary to acquire (by purchase, donation, exchange, or otherwise) any lands or interests in lands within the boundaries of a conservation unit system. ANILCA §1302(h) specifically authorizes the Secretary to exchange lands or interests with the State, Native Village or Regional Corporations, or individuals. An exchange is based on "equal value," with the option of using cash to equalize values as needed. However, if the parties agree and the exchange is in the public interest, the exchange could be made for other than equal value.

This environmental assessment (EA) analyzes the potential environmental impacts which could result from the alternatives considered, including the No Action alternative. This EA has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, regulations of the Council of Environmental Quality (CEQ) (40 Code of Federal Regulations 1508.9), and the NPS NEPA compliance guidance handbook (Director's Order [DO]-12, Conservation Planning, Environmental Impact Analysis, and Decision Making) (NPS 2001).

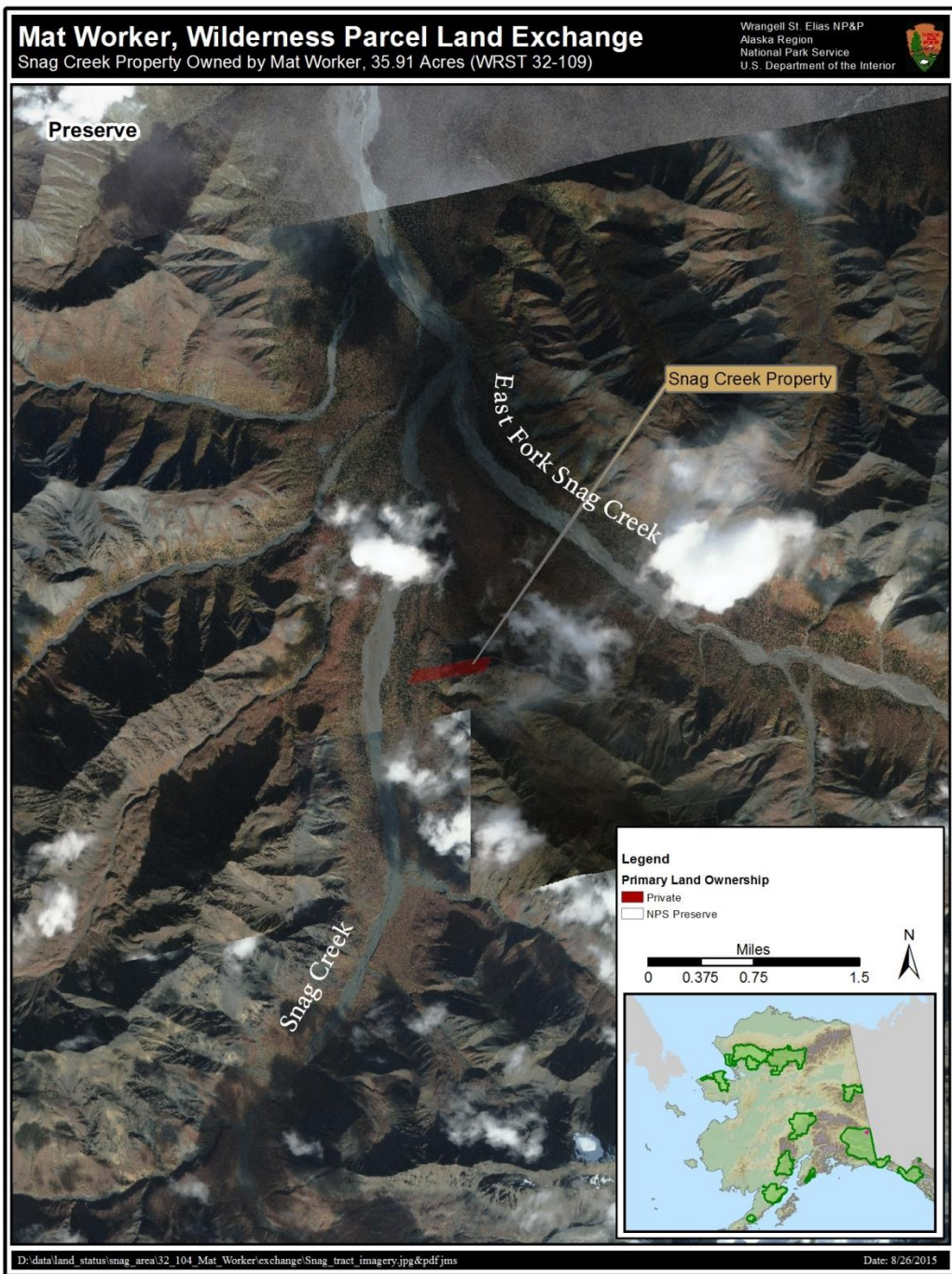


Figure 2. Location of Snag Creek parcel.

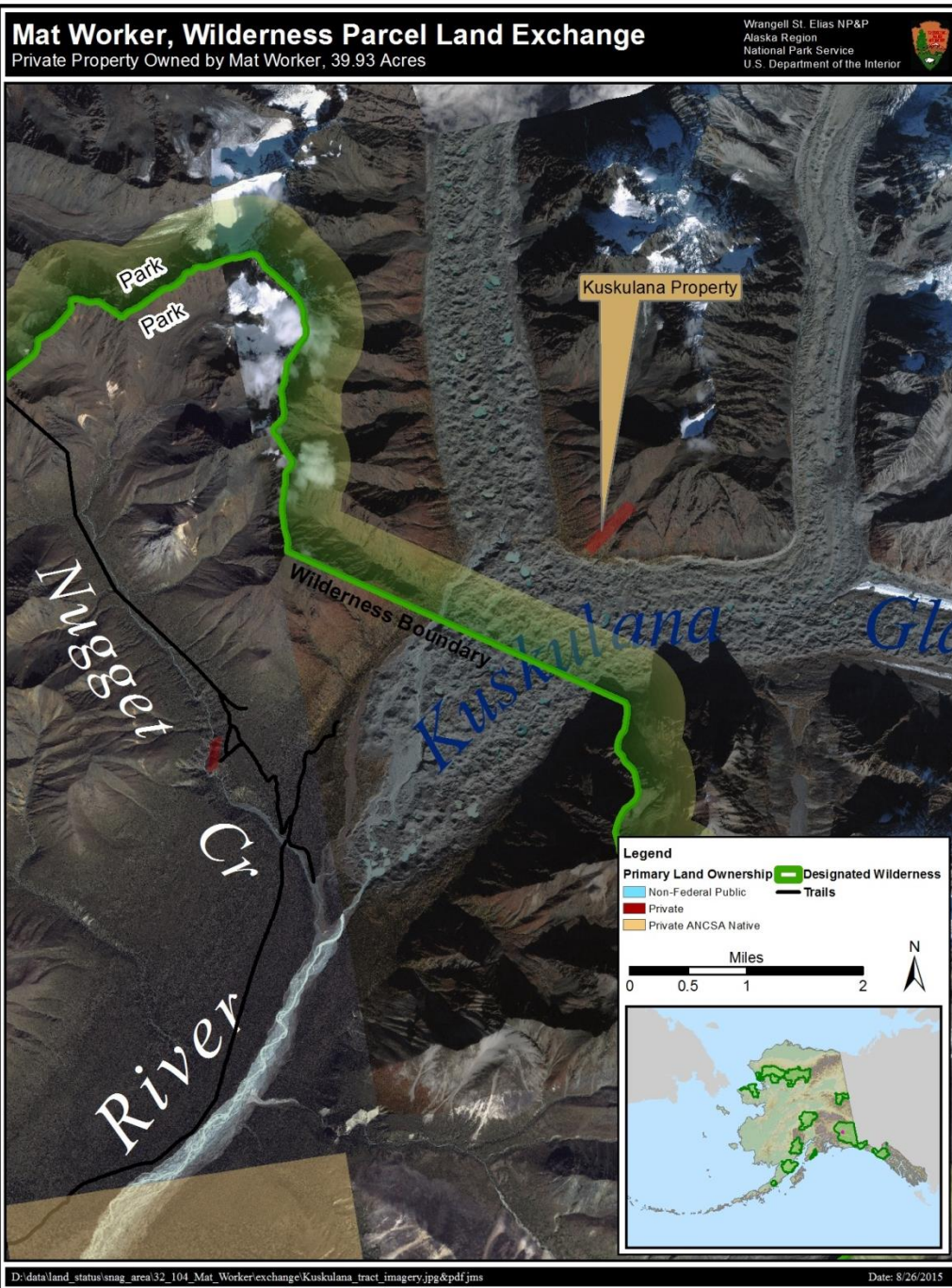


Figure 3. Location of Kuskulana parcel.

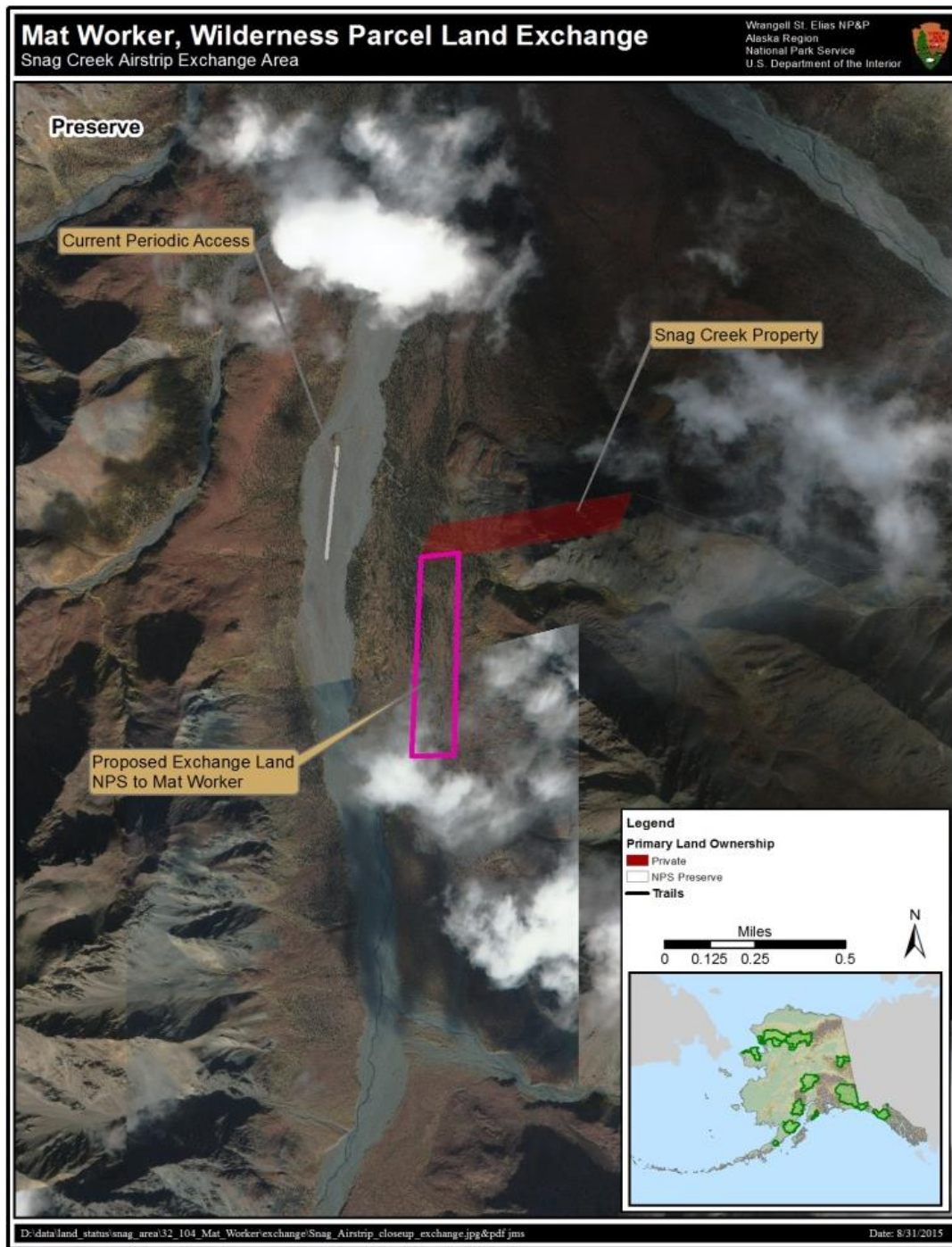


Figure 4. Proposed land conveyance and existing airstrip at Snag Creek.

1.2 Issues

To focus this environmental assessment, the NPS selected specific impact topics for analysis and eliminated others from further evaluation. Impact topics are defined as any resources in WRST that may be affected by the proposed action. A brief rationale for the selection of each topic is given below, as well as the rationale for dismissing specific topics from further consideration.

1.2.1 Issues Selected for Detailed Analysis

Cultural Resources

The land at Snag Creek proposed to be conveyed to Mr. Worker was surveyed by NPS cultural resource staff, pursuant to NHPA, Section 106. No cultural resources were identified. Retention of the Kuskulana property in private ownership could result in loss or damage of the cultural resources on and around the property.

Floodplains

The proposed land exchange would have no impact on floodplains, given that the new airstrip would be constructed on uplands and away from Snag Creek. However, Alternative B would involve reconstruction of the washed-out airstrip in the Snag Creek floodplain. Reconstruction of this strip would involve disturbance within the floodplain.

Soils

The proposed land exchange and airstrip construction would impact some previously undisturbed soils on the Snag Creek parcel. Impacts would be primarily confined to the construction of the airstrip as a suitable landing surface by clearing brush and trees to expose bare ground and create a suitable landing surface.

Vegetation

Construction of an airstrip would include removal of vegetation where the airstrip is constructed. Vegetation in the area is dominated by open white spruce and low birch shrubs. Felling of black spruce and poplar trees, including some up to 5" in diameter, and removal of brush in a previously undisturbed area would directly affect vegetation resources in this area.

The Federal Noxious Weed Control Act and Executive Order 13112 require federal agencies to analyze the potential to contribute to the introduction, continued existence, or spread of noxious weeds or non-native species or actions that may promote the introduction, growth, or expansion of the range of such species. Construction of a new airstrip would be considered for any effects on noxious weeds or non-native species.

Visual Resources

Some components of the natural landscape would be affected by the proposed land exchange and airstrip construction. In particular, development of the airstrip would introduce a linear feature into a landscape that is otherwise virtually devoid of human-made developments. The airstrip would be more noticeable

than other human-made features (such as the cabins that already exist on the Worker property) because of the size and linearity of the airstrip.

Visitor Use and Experience

Visitor use and recreation at the Snag Creek and Kuskulana areas is relatively low due to their remote location and difficult access. As a result, opportunities for solitude and primitive recreation by visitors abound, including use by backpackers and hunters. Changes in land ownership, the construction of additional modern developments, and new means of access may impact visitor use and experience in areas near the land exchange.

Wilderness

The WRST 1986 General Management Plan classified the Snag Creek area as eligible for inclusion in the National Wilderness Preservation System. The proposed land exchange would result in the loss of approximately 40 acres of eligible wilderness but the gain of approximately 40 acres of designated wilderness. The proposed airstrip construction would have an impact on the undeveloped character of the Snag Creek area. The Kuskulana parcel is located in designated wilderness.

1.2.2 Issues Dismissed from Further Analysis

Air Resources

WRST is considered a Class II airshed under the Clean Air Act, which requires consideration of impacts on air resources. Proposed airstrip construction activities use hand tools and would have no effect on local air quality. If the airstrip is constructed, negligible impacts to air quality would occur from its use via airborne dust and exhaust emissions.

Aquatic and Water Resources

The proposed land exchange and airstrip construction are located in areas that do not affect aquatic or water resources. While current access to the Snag Creek parcel is provided via an airstrip in the riverbed, this airstrip is generally considered unsafe and unstable, and is correspondingly not used. Impacts to aquatic and water resources are negligible.

Environmental Justice

This action would not result in changes to human health or the environment with disproportionately high and adverse effects on minority or low-income populations or communities.

Subsistence

ANILCA Section 810 requires federal agencies to analyze the impacts of federal actions on subsistence resources and lifestyles. Some local rural residents conduct subsistence activities including hunting, trapping and gathering within the general vicinity of this proposed action. This action has no potential to result in any additional subsistence restrictions. The ANILCA 810 analysis for this project is attached as Appendix A.

Threatened and Endangered Species

The Endangered Species Act requires analysis of impacts on all federally listed, threatened, and endangered species, as well as species of special concern listed by the State of Alaska. There are no listed, threatened, or endangered species within the Snag Creek or Kuskulana areas. Therefore, no Endangered Species Act section 7 consultation with the U.S. Fish and Wildlife Service is required.

Wetlands

The proposed land exchange would not have an impact on wetlands or wetland values as the project area does not include any wetland areas. A statement of findings is not required because no impacts to wetlands will occur.

Wildlife

Moose, bear, caribou, and Dall's sheep use or travel through the Snag Creek and Kuskulana areas. The land exchange and airstrip construction activities would potentially impact small amounts of wildlife habitat. The proposed airstrip could indirectly affect wildlife using nearby lands during the summer months because of noise and human activity. Some human activity is already present in the area, but is very limited in scope and has not resulted in any documented displacement of wildlife. Because of the anticipated minor effects to wildlife and wildlife habitat, this topic will not be analyzed in detail.

CHAPTER 2: ALTERNATIVES

2.1 Alternative A – No Action

Under this alternative, the NPS would not proceed with the land exchange and Mr. Worker would own one parcel of land at Snag Creek and one at the Kuskulana. No airstrip would be constructed in the uplands at Snag Creek. The existing airstrip at Snag Creek would continue to be the sole means of access to Mr. Worker's Snag Creek property. The Kuskulana property would remain in private ownership, and access would remain the same (ORV trail and foot). This alternative provides a baseline for evaluating the changes and impacts of the proposed alternative.

2.2 Alternative B – Improvement of Existing Airstrip at Snag Creek

Under this alternative, the NPS would not proceed with the land exchange and Mr. Worker would own one parcel of land at Snag Creek and one at the Kuskulana. NPS would permit Mr. Worker to clear the old airstrip on NPS land adjacent to the Kuskulana property in order to provide reasonable access to his property. No airstrip would be constructed in the uplands at Snag Creek. However, NPS would permit Mr. Worker to make improvements to the existing airstrip in the floodplains of Snag Creek. These improvements would consist of a lengthening of the existing washed-out airstrip and diversion structures to minimize the potential for future flooding.

2.3 Alternative C – Proposed Action (NPS Preferred Alternative)

Under this alternative, the NPS would exchange a 39.93 acre parcel of land adjacent to Mr. Worker's Snag Creek parcel in exchange for acquisition of the Kuskulana parcel (see Figures 3 and 4). Mr. Worker would likely proceed to construct an airstrip on the conveyed land at Snag Creek. Mr. Worker has indicated that the airstrip would be approximately 1,200 feet in length and constructed as follows: Vegetation would be cleared to ground level in a 20 foot swath using a chainsaw and a walk-behind, motorized brush-cutter. Within this area, low spots would be filled in using hand tools with material from on site. Brush within 30 to 40 feet on either side of the main landing area would be cut to 18 inches or less. Figure 5 shows the area in which the airstrip would be constructed. If Mr. Worker constructs the airstrip on private land, it would not be open for public use. The existing airstrip on NPS lands would remain unmaintained but open for public use, as well as the McDonald airstrip on NPS lands approximately 4 miles upstream.

In the exchange, the NPS would include a deed restriction on the Snag Creek parcel conveyed to Mr. Worker. The deed restriction includes provisions for prevention of future subdivision as well as restrictions to protect visual resources. The deed restriction is described in detail in section 2.4 of this document.

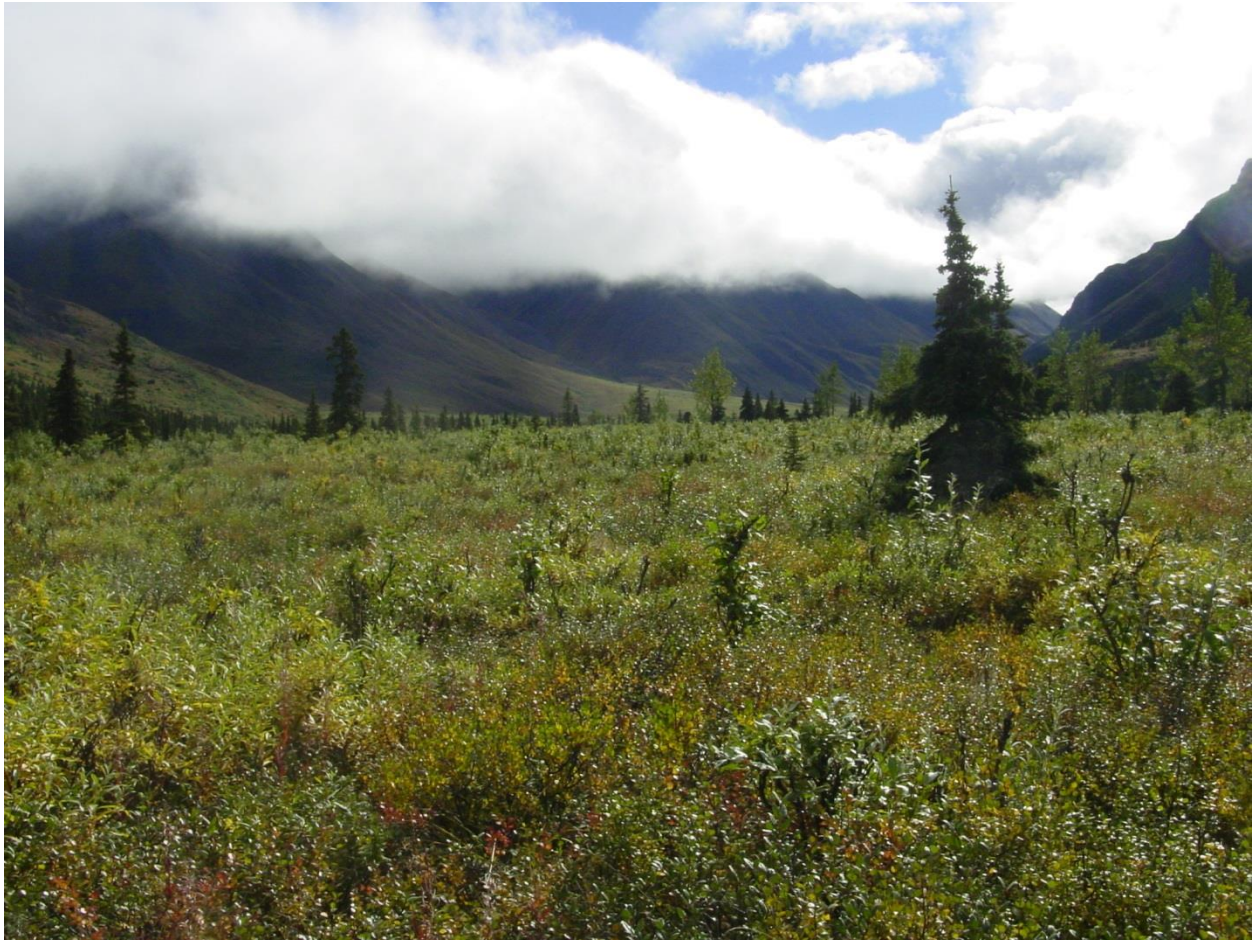


Figure 5: Location of proposed airstrip at Snag Creek

2.4 MITIGATING MEASURES

A complete description of the deed restrictions for the conveyed land is provided below:

1. The property shall not be divided, subdivided, or defacto subdivided and shall be sold, leased, or otherwise conveyed only in its entirety.
2. Structures (excluding antennas) shall not exceed a height of 35 feet measured from the natural grade of the land to the highest point of the structure. Antennas or wind turbines shall not exceed a height of 50 feet as measured from the natural grade of the land to the highest point of the structure.
3. Roofs, exterior siding, plumbing vent pipes, chimneys, drain gutters, downspouts, and other exterior materials and fixtures, except windows, shall be constructed of nonreflective material and painted or maintained with earth-tone colors found in the surrounding environment. Use of

native materials such as wood and stone is encouraged. Solar panels, photovoltaic cells, wind turbines and other forms of alternative energy production/collection would not be subject to this restriction.

2.5 COMPARISON OF ENVIRONMENTAL EFFECTS

Impact Topic	Alternative A, No Action	Alternative B, Improvement of Existing Snag Creek airstrip	Alternative C, Proposed Action (land exchange)
Cultural Resources	No effects.	Adverse effects because of potential increased access and development at Kuskulana property.	Benefits because of acquisition of Kuskulana property and protection of cultural resources on that property.
Floodplains	No effects.	The effects to floodplain function that would result from improvement of the existing airstrip would occur for only a short distance downstream and would not affect any improvements, buildings, or outbuildings in the area.	No effects.
Soils	No effects.	Minor effects from improvement of existing airstrip at Snag Creek and potential development at Kuskulana.	Minor effects from construction of new airstrip on private lands at Snag Creek.
Vegetation	No effects.	Adverse impacts from vegetation clearing on more than one acre needed at upper Snag Creek and Kuskulana.	Adverse impacts because of vegetation removal and clearing on 2.75 acres at previously undisturbed site.
Visual Resources	No effects.	Maintenance of linear features at both Snag Creek and Kuskulana result in adverse impacts.	Adverse effect because of creation of linear disturbance at previously undisturbed site.
Visitor Use and Experience	No effects.	Adverse and beneficial effect from improved access from development at Kuskulana. Access improved for pilots with high skill levels.	New improvement would be noticeable to very few visitors but not available to general public. Could increase hunting competition in the area.
Wilderness character	No effects.	Moderate effects on undeveloped character, mostly from development at Kuskulana.	Benefit from acquisition of Kuskulana parcel outweighs impacts of new airstrip at Snag Creek in eligible wilderness.

CHAPTER 3: AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

Introduction: This Chapter gives a brief description of the existing conditions for each of the impact topics listed in Chapter 1. It also discloses the anticipated direct, indirect, and cumulative impacts expected from the implementation of each alternative.

3.1 Project Area

The Snag Creek and Kuskulana parcels are shown in Figures 2 and 3. The project area is approximately 200 acres, including both parcels Mr. Worker currently owns and the adjacent existing airstrip on Upper Snag Creek; and the area of the lands proposed to be conveyed to Mr. Worker.

3.2 Cultural Resources

3.2.1 Current Condition of Cultural Resources

Literature review of the project area has resulted in the identification of two mining sites, the Kuskulana Glacier Cabin and the Sulzer Property (private Snag Creek parcel owned by Mr. Worker). The Kuskulana Glacier Cabin (XMC-00100) has been included in the Alaska Heritage Resources Survey (AHRS) database and is located on the north side of the Kuskulana Glacier on NPS-owned lands (McCollough and Elder 1988). The Kuskulana Glacier Cabin is associated with the historic Whistler Claim (located on the private parcel owned by Mr. Worker). Two mining-related adits are reported to be located on the Whistler Claim. Due to private ownership of the parcel, the claim has never received archeological survey. It is likely that numerous mining-related artifacts and features are present within the claim area. The Snag Creek parcel currently owned by Mr. Worker is a historic patented mining claim. The claim is also owned by Mr. Worker and used to have several mining-related structures. All evidence of these structures however, has been completely washed away by seasonal flooding events (Bleakley 2002).

The Area of Potential Affect (APE) for cultural resources for this project consists of a 40-acre area situated on upper Snag Creek (62.200288/-141.500338) adjacent to Mr. Worker's existing private parcel. The Kuskulana parcel (Whistler Claim) has not been included in the APE as the proposed project will result in federal ownership of the parcel. Aerial reconnaissance and pedestrian survey of the project area on upper Snag Creek was undertaken on July 16, 2016. No historic resources were identified during the survey.

3.2.2 Effects on Cultural Resources from Alternative A, No Action

Direct and Indirect Impacts: No new direct impacts to cultural resources would result from the ongoing private ownership of the Snag Creek and Kuskulana properties.

Cumulative Impacts: Since there are no direct or indirect effects associated with this alternative, there would be no contribution to cumulative impacts.

3.2.3 Effects on Cultural Resource from Alternative B, Improvement of the Existing Airstrip at Snag Creek

Direct and Indirect Impacts: Under this alternative, the Kuskulana parcel would remain in private ownership and it is reasonable to assume the old airstrip adjacent to private land would be maintained by the private landowner. This would require brushing of less than ½ an acre. No cultural resources are known to exist at the old airstrip site. For the Snag Creek area, NPS would permit Mr. Worker to re-construct the existing airstrip on Upper Snag Creek on NPS land. This would involve grading and leveling of approximately .45 acres of coarse gravels on the sparsely vegetated floodplain. The area has been surveyed for cultural resources and none were found. Therefore there would be no direct or indirect effects to cultural resources on or around the Snag Creek or Kuskulana properties.

Cumulative Impacts: Past mining and mining exploration have led to the existing condition of cultural resources on and adjacent to the Kuskulana property, as described in section 3.2.1. Increased access to the property and reasonably foreseeable development on the property, such as construction of a cabin, could result in some loss or displacement of cultural resources. For Snag Creek, improvement of the existing airstrip on NPS lands would improve the safety of the airstrip, but would not necessarily increase the level of access over the existing situation. No other developments on the existing private land that could potentially affect cultural resources would be reasonably foreseeable.

Conclusion: This alternative would result in negative impacts to cultural resources, for the following reasons:

- **Intensity:** There would be no effect to cultural resources on or adjacent to the Snag Creek property as a result of the improvement of the existing airstrip at Upper Snag Creek because surveys conducted in the area showed no cultural resources present. For the Kuskulana property, retention in private ownership would result, at the very least, in negative impacts from benign neglect. Brushing of the old airstrip or small-scale development of the property could result in loss or displacement of cultural resources.
- **Context:** Historic resources were identified as a “Fundamental Resource and Value” in the park Foundation Statement (2010). In addition, one purpose of ANILCA is “...to protect and preserve historic...sites...” (Section 101(b)). This alternative would not protect cultural resources on lands retained in private ownership.

3.2.4 Effects on Cultural Resources from Alternative C, Proposed Action

Direct and Indirect Impacts: Acquisition of the Kuskulana parcel would result in moderate positive, direct effects to the cultural resources of the area by facilitating increased stewardship of the historic resource. If conveyed to federal ownership, stewardship of cultural resources on the parcel would include surveys of existing resources and potential preservation and archival activities. No direct or indirect impacts to cultural resources would be incurred by conveyance of the 40-acre parcel in Snag Creek to Mr. Worker and the construction of a new airstrip, as no cultural resources have been identified in the area.

Cumulative Impacts: Past mining and mining exploration have led to the existing condition of cultural resources on and adjacent to the Kuskulana property, as described in section 3.2.1. Under NPS ownership, there would be no changes to the land in the reasonably foreseeable future, with no potential

effects to cultural resources. For the Snag Creek area, improvement of the existing airstrip in Upper Snag Creek would result in more small airplanes landing at the new airstrip, in support of private land access. Because of the lack of cultural resources in the area, this would have little to no effect on cultural resources.

Conclusion: The proposed land exchange would have beneficial effects to cultural resources, based on the following:

- **Intensity:** Beneficial effects to cultural resources would occur under this alternative, as the park would acquire land known to have historical artifacts. Acquisition of these cultural resources would allow increased stewardship of the historic resource.
- **Context:** Historic resources were identified as a “Fundament Resource and Value” in the park Foundation Statement (2010). In addition, one purpose of ANILCA is “...to protect and preserve historic ...sites...” (Section 101(b)), which would be furthered under this proposed land exchange.

3.3 Floodplains

3.3.1 Current Condition of Floodplains

Floodplains in Snag Creek consist of a perennial stream channel, intermittently flooded channels, and gravel bars. Floodplain bars contain scrub-shrub vegetation in various stages of development. The main channel of Snag Creek ranges from 10 to 20 feet in width in the area of the proposed land exchange. Periodic flooding increases the volume and size of the bed load and spreads it over the floodplain. This scours the stream bottom and riparian area, slows the establishment of aquatic and terrestrial vegetation, and often alters the physical characteristics of the stream channel. Aufeis frequently forms in the Snag Creek floodplain during winter months.

The existing airstrip in Snag Creek has affected approximately 1.5 acres of floodplains from the footprint of the airstrip and past actions to prevent the airstrip from being washed out. Disturbance of this floodplain has included excavation and movement of up to two feet of gravel and sand, and movement of surficial rock structures.

No floodplains are present in the Kuskulana area involved in this proposed land exchange.

3.3.2 Effect on Floodplains from Alternative A, No Action

Direct and Indirect Effects: Under this Alternative, no land exchange would take place. Both the existing Snag Creek parcel and the Kuskulana parcel would remain in private ownership. No improvements would occur to the existing airstrip on Upper Snag Creek. There would be no direct and indirect effects to floodplains under this alternative.

Cumulative Impacts: Since there are no direct or indirect effects associated with this alternative, there would be no contribution to cumulative impacts.

3.3.3 Effects on Floodplains from Alternative B, Improvement of the Existing Airstrip at Snag Creek

Direct and Indirect Effects: Under this alternative, the washed-out airstrip in the floodplain of Snag Creek would be re-constructed. Construction would likely involve disturbance of approximately .45 acres of floodplain to grade, level, and extend the washed-out airstrip. Additional construction would likely be done to reduce the likelihood of the airstrip washing out, potentially including water diversions on the up-stream end of the airstrip. Heavy machinery would likely be used in this construction. Grading, leveling, and lengthening the existing airstrip would not affect floodplain function or the ability of Snag Creek to dissipate energy through water spreading to adjacent channels in high water events. Construction of water diversions would contain high water to the primary existing channel, potentially increasing downstream energy during high water events.

There would be no effects to floodplains at the Kuskulana property under this Alternative.

Cumulative Impacts: For the Snag Creek floodplain, there would be no cumulative impact above what is described under direct and indirect effects. For the Kuskulana property, there are no reasonably foreseeable actions that would impact floodplains.

Conclusion: The proposed reconstruction of the existing airstrip in Upper Snag Creek would have minor adverse impacts to the Snag Creek floodplain, for the following reasons:

- **Intensity:** The effects to floodplain function that would result from improvement of the existing airstrip would occur for only a short distance downstream and would not affect any improvements, buildings, or outbuildings in the area.
- **Context:** The disturbed Snag Creek floodplain does not represent a rare or unusual resource in the area.

3.3.4 Effects on Floodplains from Alternative C, Proposed Action

Direct and Indirect Effects: No new direct or indirect impacts to floodplains would occur under this alternative. Floodplains in Snag Creek affected by the existing, defunct airstrip would undergo natural reclamation by Snag Creek as use of the airstrip is discontinued. Construction of the new airstrip on private land at Snag Creek would occur on uplands, not in the floodplain. The Kuskulana property would be acquired by NPS and no disturbance to floodplains would occur.

Cumulative Impacts: Since there are no direct or indirect effects associated with this alternative, there would be no contribution to cumulative impacts. There are no reasonably foreseeable actions, either at the Kuskulana property or the Snag Creek property, that would affect floodplains.

3.4 Soils

3.4.1 Current Condition of Soils

Regional climate strongly affects the character of upland soils in the Snag Creek and Kuskulana areas. Low soil temperature and discontinuous permafrost have limited soil development (Cook et al. 2007). Soils typically consist of a thin (typically 5 to 7 cm) surface organic layer covering gravelly sands and

sandy loams weathered variously from marine and volcanic and igneous bedrock, glaciofluvial deposits, and volcanic tephra. The depth of the seasonally active soil layer ranges from 30 to 60 cm in the Snag Creek area (Panda 2014). Soil moisture regimes range from mesic to hydric. Soil oxygen content is low in the hydric soils. Gravel till underlies the area of the proposed airstrip below the active soil layer.

Past mining activity on the Kuskulana parcel has disturbed some soils. The extent of disturbance is currently unknown as the land is private property.

3.4.2 Effects on Soils from Alternative A, No Action

Direct and Indirect Effects: Under this alternative, no land exchange would take place and access to both private land parcels would remain difficult. No further development of either properties would be expected. There would be no direct or indirect effects to soils in the Snag Creek or the Kuskulana areas.

Cumulative Impacts: There would be no anticipated past, present, or reasonably foreseeable actions at either parcel that would affect soils. Since there are no direct or indirect effects associated with this alternative, there would be no contribution to cumulative impacts.

3.4.3 Effects on Soils from Alternative B, Improvement of Existing Airstrip at Snag Creek

Direct and Indirect Effects: Improvement of the existing airstrip at upper Snag Creek would involve disturbance of approximately 0.45 acres. This disturbance would occur in the floodplain of Snag Creek, where soil development is extremely limited due to periodic natural disturbance. The disturbed substrate would consist of unconsolidated gravels mixed with a component of silt and sand. Disturbance of actual developed soils in this area would be minimal. Trailing from the improved airstrip at upper Snag Creek to the private inholding at Snag Creek would result in soil compaction on approximately 0.24 acres. At the Kuskulana site, brushing and spot leveling of the old airstrip would result in a disturbance to approximately 0.09 acres of soil.

Cumulative Impacts: At the Snag Creek parcel, access limited to the improved floodplain airstrip would limit reasonably foreseeable future development on that private land parcel. At the Kuskulana site, construction of a small cabin on the private land parcel is a reasonably foreseeable action that would result in loss or displacement of 0.02 acres of soil.

Conclusion: Impacts to soils would be minor, based on the following:

- Intensity: This alternative would result in potential disturbance of just under 1 acre of soils, some of which are minimally developed and already subject to periodic natural disturbance.
- Context: The impacts do not interfere with the park's ability to fulfill its purpose. Management for soils is not specifically identified as a specific purpose in the establishing legislation of the park, nor are soils specifically mentioned in the park's general management plan as being of significance. Soils are not a rare or unusual resource.

3.4.4 Effects on Soils from Alternative C, Proposed Action

Direct and Indirect Effects: Some soil disruption would occur as a result of constructing a new airstrip at the Snag Creek property. During construction, the surface of the airstrip would be leveled, including re-

arranging glacial till and rock with hand tools. Soils on the airstrip would receive higher levels of compaction, affecting soil oxygenation. Use of hand tools, per the proposed method of construction, will minimize these impacts during construction but ongoing use of the airstrip will reduce aeration and water filtration properties of the soil. Continued use of the airstrip will also reduce the amount of organic material from physical damage, increasing the likelihood of increased soil temperatures.

Airstrip construction is not anticipated to affect the discontinuous permafrost below the surface of the airstrip. Erosion is not anticipated to occur as a result of soil disturbance because of the upland nature of the site. A total of 0.5 acres of soil disturbance would occur in this alternative.

The Kuskulana property would be acquired by NPS and no direct or indirect effects to soils would occur.

Cumulative Impacts: No documentation is present of soil disturbance in the areas affected by this proposed land exchange. Additional soil disturbance in the foreseeable future is not anticipated, nor are activities known to disturb soils occurring in geographically adjacent areas.

Conclusion: The proposed land exchange would result in minor adverse impacts to soils, for the following reasons:

- Intensity: The small footprint of disturbance (less than one acre) results in minor impacts to soils. Outside of the area where the airstrip would be constructed, no direct or indirect impacts on soils would occur.
- Context: The impacts do not interfere with the park's ability to fulfill its purpose. Management for soils is not specifically identified as a specific purpose in the establishing legislation of the park, nor are soils specifically mentioned in the park's general management plan as being of significance. Soils are not a rare or unusual resource.

3.5 Vegetation

3.5.1 Current Condition of Vegetation

Vegetation in the Snag Creek area is primarily composed of open white spruce and lowland birch shrub landcover types (Jorgenson et al. 2008). The vegetation structure is generally needleleaf forest within dwarf willow meadow and boreal subalpine spruce woodland ecotypes. The bench where the proposed airstrip construction would occur is primarily covered by several species of willow (*Salix spp.*), with white spruce (*Picea glauca*) and poplar trees (*Populus balsamifera*) sporadically found throughout the area (see Figure 5). Sedge (*Carex spp.*), willow, and dwarf birch (*Betula nana*) predominate in mesic areas. Close ground cover consists mainly of mosses and lichens. Vegetation at the existing airstrip on upper Snag Creek consists of early growth willow, poplar, and alder, with some scattered white spruce (see Figure 6). To date, no invasive plant species have been documented at the sites included in the vicinity of the Snag Creek parcels.

Vegetation in the Kuskulana area is dominated by subalpine, alpine, low shrub, and barren vegetation structures (Jorgenson et al. 2008). Vegetation species are associated with that of a mesic soil regime, including willow species, dwarf birch, alder (*Alnus spp.*), and lichen species. Because the parcel is currently privately owned, limited data on vegetation cover is available. To date, no invasive plant species have been documented at the sites included in the vicinity of the Kuskulana parcel.

3.5.2 Effects on Vegetation from Alternative A, No Action

Direct and Indirect Effects: There would be no direct or indirect effects on vegetation at the Snag Creek or Kuskulana sites resulting from the No Action alternative.

Cumulative Impacts: No reasonably foreseeable development that would affect vegetation would be anticipated at either the Snag Creek or Kuskulana parcel. Since there are no direct or indirect effects associated with this alternative, there would be no contribution to cumulative impacts.

Figure 6: Existing Airstrip on upper Snag Creek



3.5.3 Effects on Vegetation from Alternative B, Improvement of Existing Airstrip at Snag Creek

Direct and Indirect Effects: Improvement of the existing airstrip at upper Snag Creek would involve cutting or removal of existing vegetation over approximately 0.45 acres. Floodplain vegetation is scattered and in a state of constant transition due to natural disturbance (see Figure 6). Removal of mature spruce or poplar trees would be minimal. Trailing from the improved airstrip at upper Snag Creek

to the private inholding at Snag Creek would result in the cutting or removal some scattered vegetation. At the Kuskulana site, the existing airstrip would be cleared to provide access to the private land. This would involve clearing of approximately 0.37 acres of vegetation consisting mostly of alder.

Cumulative Impacts: At the Snag Creek parcel, access limited to the improved floodplain airstrip would limit reasonably foreseeable future development on that private land parcel. At the Kuskulana site, construction of a small cabin on the private land parcel is a reasonably foreseeable action that would result in loss or displacement of 0.4 acres of vegetation.

Conclusion: Moderate adverse impacts to vegetation would occur for the following reasons:

- Intensity: This alternative would result in potential cutting or removal of over 1 acre of vegetation, with a long term intent of maintaining the improvements.
- Context: The impacts do not interfere with the park's ability to fulfill its purpose. Management for healthy vegetation is not specifically identified as a specific purpose in the establishing legislation of the park and vegetation is not specifically mentioned in the park's general management plan as being of significance. No rare or unusual vegetation species would be disturbed.

3.5.4 Effects on Vegetation from Alternative C, Proposed Action

Direct and Indirect Effects: Approximately 2.75 acres of vegetation would be directly impacted under this alternative at the Snag Creek private property, resulting from an airstrip approximately 1,200 feet in length and brushed 40 feet on either side of the main landing area. It is anticipated that a total of up to 62 mature trees would be removed, including white spruce and poplar species. Of these trees, 10 would be located on park lands not conveyed in the land exchange and would be cleared to provide for the approach to the airstrip. Additional vegetation within 40 feet on either side of the airstrip would be cut to 18 inches or less in height, though organic material and root systems would not be removed. The airstrip would require ongoing maintenance and brushing of vegetation after the initial construction.

Disturbance of organic material would occur on the landing area of the airstrip, including the pulverization of organic litter on the surface and potential disturbance of natural decay process. Erosion patterns may be affected by the vegetation disturbance. Indirect effects include trampling of vegetation and would likely result in the establishment of trails to and from the airstrip. Potential for the introduction of invasive plant species would not increase under this alternative, as Mr. Worker would land his aircraft in the Snag Creek drainage irrespective of specifically where the airstrip is located.

The Kuskulana property would be acquired by NPS and no vegetation disturbance would occur.

Cumulative impacts: No reasonably foreseeable impacts to vegetation are anticipated within the project area.

Conclusion: The proposed land exchange would have moderate adverse impacts to vegetation, for the following reasons:

- Intensity: This alternative would result in potential cutting or removal of 2.75 acres of vegetation, with a long term intent of maintaining the improvements.

- Context: The impacts do not interfere with the park's ability to fulfill its purpose. Management for healthy vegetation is not specifically identified as a specific purpose in the establishing legislation of the park and vegetation is not specifically mentioned in the park's general management plan as being of significance. No rare or unusual vegetation species would be disturbed.

3.6 Visual Resources

3.6.1 Visual Resources Existing Condition

The Snag Creek and Kuskulana drainages exhibit expansive vistas that are primarily free from visual intrusions by modern human activity. Still, both areas possess some features in their viewshed created by modern human activity. Vegetation and rolling hills generally limit the viewshed in the Snag Creek area. The Kuskulana viewshed is dominated by high mountain peaks and rugged glaciers.

An existing cabin on Mr. Worker's current property is visible in the Snag Creek drainage. There are four temporary developments associated with the Snag Creek guided hunting concession area to the north. Because of vegetation screening and topography, the average visitor would be hard-pressed to see these structures on the ground. They are visible from the air if you know where to look.

The Kuskulana area shows evidence of mining history, as seen in old buildings and the linear features of old, unusable, overgrown historic roads that were once used in mineral exploration and development in the area. These developments contribute to the area's visual resources by providing evidence of the historical use of the area. A public use cabin is present approximately 3.5 miles from the Kuskulana parcel, but cannot be seen from the privately owned parcel.

3.6.2 Effects on Visual Resources from Alternative A, No Action

Direct and Indirect Effects: There would be no new direct or indirect effects to visual resources at either the Kuskulana or Snag Creek properties as a result of this alternative.

Cumulative Impacts: No reasonably foreseeable development that would affect visual resources would be anticipated at either the Snag Creek or Kuskulana parcel. Since there are no direct or indirect effects associated with this alternative, there would be no contribution to cumulative impacts.

3.6.3 Effects on Visual Resources from Alternative B, Improvements to the Existing Airstrip at Snag Creek

Direct and Indirect Effects: In the Snag Creek area, improvement of the existing airstrip on upper Snag Creek would result in disturbance of approximately 0.45 acres, some of which is already disturbed by the existing airstrip. Visually, the improvement would result in a linear feature that would be more evident from the air. The improvement would not be readily visible on the ground unless the visitor was at the improved airstrip and could see evidence of the recent work. Brushing and maintenance of the airstrip at Kuskulana would result in a long-term linear feature that would be visible from the air but most likely not visible to the rare visitor to this area on foot.

Cumulative Impacts: At the Snag Creek parcel, access limited to the improved floodplain airstrip would limit reasonably foreseeable future development on that private land parcel. At the Kuskulana site, construction of a small cabin on the private land parcel is a reasonably foreseeable action. This would result in a small area of land clearing and cabin construction that would be visible from the air but rarely seen by visitors on the ground.

Conclusion: Adverse impacts to visual resources would occur as follows:

- Intensity: Improvement and maintenance of the airstrip on upper Snag Creek and re-construction of the old airstrip at the Kuskulana property would create long-term linear features, visible from the air.
- Context: One purpose of WRST is to "...maintain unimpaired the scenic beauty and quality of high mountain peaks, foothills, glacial systems, lakes, and streams, valleys ...in their natural state" (ANILCA Section 201(9)). Because visual resources are one of the fundamental values of the park, impacts from this alternative are considered moderate.

3.6.4 Effects on Visual Resources from Alternative C, Proposed Action

Direct and Indirect Effects: This alternative would result in direct effects to visual resources at the Snag Creek parcel due to the construction of the 1200' airstrip and potential construction of buildings in a previously undisturbed area. Deed restrictions would require use of natural materials in building construction. The airstrip would be the most prominent visual intrusion and constitute the obvious evidence of modern human activity in the immediate area in Snag Creek. Benefits to visual resources would occur from the reclamation of the existing, defunct airstrip in Snag Creek as it grows in over time.

The proposed land exchange would transfer the Kuskulana property to the NPS and there would be no developments that would affect visual resources.

Cumulative Impacts: No additional activities affecting visual resources outside of those analyzed in this EA are anticipated to occur in the reasonably foreseeable future.

Conclusion: The proposed land exchange would have moderate effects to visual resources, for the following reasons:

- Intensity: Long term creation of a 1,200 foot linear feature in a previously undisturbed area. Any additional developments would be obscured by vegetation and mitigation measures specified by the deed restrictions that would accompany the land exchange.
- Context: One purpose of WRST is to "...maintain unimpaired the scenic beauty and quality of high mountain peaks, foothills, glacial systems, lakes, and streams, valleys ...in their natural state" (ANILCA Section 201(9)). Because visual resources are one of the fundamental values of the park, impacts from this alternative are considered moderate.

3.7 Visitor Use and Experience

3.7.1 Visitor Use and Experience Existing Condition

Visitor use of the Snag Creek area is primarily by hunters and backpackers. They can expect to see or hear few, if any, other visitors and evidence of their activities, though this likelihood increases during hunting season. Approximately 30-40 visitors pass through the Snag Creek area each year. Most of these access the area through an airstrip located approximately 3 miles north of the upper Snag Creek airstrip. Of these visitors, 20-30 are hunters who fly directly into the area via commercial air taxis. The remaining visitors access the Snag Creek area as part of longer routes and are primarily backpackers.

The Kuskulana area is primarily visited by backpackers, hunters, and mountaineers. Visitor access to the main Kuskulana drainage occurs by ATV, foot, or bike, with visitors accessing the area immediately around the Kuskulana parcel by foot. Since the NPS does not count visitors accessing the park by these methods, records on visitation in the Kuskulana area by the NPS are limited. It is estimated that less than 10 visitors pass through the area near where Kuskulana parcel is located (the peninsula of land surrounded by glaciers, north of the Kuskulana Glacier and east of an unnamed glacier). More visitors access the area near the Nugget Creek public use cabin to the west.

3.7.2 Effects on Visitor Use and Experience from Alternative A, No Action

Direct and Indirect Effects: There would be no change from the existing visitor experience condition at the Snag Creek or Kuskulana parcels as a result of this alternative.

Cumulative Impacts: No reasonably foreseeable development that would affect visitor use and experience would be anticipated at either the Snag Creek or Kuskulana parcel. Since there are no direct or indirect effects associated with this alternative, there would be no contribution to cumulative impacts.

3.7.3 Effects on Visitor Use and Experience from Alternative B, Improvement of Existing Airstrip at Snag Creek

Direct and Indirect Effects: An improved airstrip at upper Snag Creek would provide a visitor access point for those flying in, where one currently does not exist or is rarely used. Visitors to this airstrip would likely be sport hunters and would likely see sights, sounds or evidence of the nearby private land parcel. Brushing and maintenance of the small airstrip at Kuskulana could improve visitor access to that area.

Cumulative Impacts: At the Snag Creek parcel, access limited to the improved floodplain airstrip would limit reasonably foreseeable future development on that private land parcel. At the Kuskulana site, construction of a small cabin on the private land parcel is a reasonably foreseeable action. To most visitors to this remote area, the presence of a modern cabin would detract from a wilderness experience.

Conclusion: This alternative would result in beneficial and adverse effects on visitor use, for the following reasons:

- **Intensity:** This alternative would result in improved public access to the Snag Creek area by skilled pilots and could potentially result in improved access to the Kuskulana area. Improved access may be perceived as an opportunity by some visitors, but could detract from the experience of others, particularly those who are participating in guided sport hunting activities operated under a concession.

- Context: One purpose of WRST is to provide for “continued opportunities ... [for] wilderness recreational activities” (ANILCA Section 201(9)). Effects to these opportunities would be minor because of the small scale of disturbance and no net loss of acreage available for visitor use.

3.7.4 Effects on Visitor Use and Experience from Alternative C, Proposed Action

Direct and Indirect Effects:

Under this alternative, the human footprint in Snag Creek would grow, increasing the likelihood of visitors encountering sights and sounds of human activity, including motorized use and signs of modern human development. This activity would affect a small number of visitors’ experience and their opportunities for solitude and primitive or unconfined recreation. It is anticipated that Mr. Worker’s number of flights into the area will be reduced with access to a larger airstrip, as he will be able to safely land larger planes. Improved access may result in increased competition for wildlife resources. In an area where most visitors are focused on sport hunting, increased competition would result in a negative impact to visitor experience.

Opportunities for solitude and primitive or unconfined recreation in the Kuskulana area would increase from the park’s acquisition of this private land parcel. Private inholdings would no longer be present in a large area of wilderness, allowing visitors to travel throughout that area without concerns about trespassing on private property.

Cumulative Impacts: No activities affecting visitor use experience are anticipated to occur in the reasonably foreseeable future or in adjacent geographical areas.

Conclusion: The proposed land exchange would have beneficial and adverse effects to visitor use and experience, for the following reasons:

- Intensity: Impacts to visitor use and experience would be minor because of the size of WRST, wherein approximately 40 acres out of the park’s 13.2 million would be impacted. In addition, the relatively small scale of disturbance incurred from airstrip construction, low levels of visitation to the affected areas, and the availability of other areas for use by visitors, result in minor impacts to visitor use and experience.
- Context: One purpose of WRST is to provide for “continued opportunities ... [for] wilderness recreational activities” (ANILCA Section 201(9)). Effects to these opportunities would be negligible because of the small scale of disturbance and no net loss of acreage available for visitor use.

3.8 Wilderness

3.8.1 Current Condition of Wilderness

WRST currently possesses approximately 9.4 million acres of congressionally designated wilderness. NPS policy directs the purpose of wilderness “...to preserve[e] wilderness character and resources” and for these areas to be managed “...in such a manner as will leave them unimpaired for future use and enjoyment as wilderness” An additional 2 million acres are eligible wilderness, per the 1986 park GMP. Eligible wilderness is likewise managed to preserve the area’s wilderness character and so as not to

preclude the area's future designation as wilderness. WRST has identified the wilderness character of the park in a Wilderness Character Narrative (NPS 2013). In addition to the four qualities of wilderness character (untrammeled, natural, undeveloped, and solitude and primitive or unconfined recreation), WRST identified a fifth quality of "inhabited wilderness" to acknowledge the history of the park as a working wilderness, including subsistence uses.

Snag Creek is located in eligible wilderness and Mr. Worker's existing private parcel is located approximately 11 miles from the designated wilderness boundary. Natural processes in the area are intact and the area is free from modern human control or manipulations. Few developments are present on federal lands in the area and opportunities for solitude and primitive or unconfined recreation are abundant.

The Kuskulana parcel is an isolated inholding surrounded by designated wilderness. Some developments are present on or adjacent to the parcel, most notably the Big Horn Whistler cabin and infrastructure associated with past mining activities. These historical and cultural artifacts contribute to the inhabited quality of WRST's wilderness character.

3.8.2 Effects on Wilderness from Alternative A, No Action

Direct and Indirect Effects: There would be no change to the existing condition of wilderness character in the Snag Creek or Kuskulana areas as a result of the No Action alternative.

Cumulative Impacts: No reasonably foreseeable development that would affect visitor use and experience would be anticipated at either the Snag Creek or Kuskulana parcel. Since there are no direct or indirect effects associated with this alternative, there would be no contribution to cumulative impacts.

3.8.3 Effects on Wilderness from Alternative B, Improvement of the Existing Airstrip on Snag Creek

Direct and Indirect Effects: Direct impacts to wilderness character would include the continuation of existing impacts and uses occurring on private inholdings and affecting visitor opportunities for solitude on nearby federal lands. Additional impacts to wilderness character would be incurred through the re-construction of the airstrip in eligible wilderness at Snag Creek. Provision of this access would impact the undeveloped and solitude qualities of wilderness character. As the parcels at Snag Creek and the Kuskulana would continue to be privately owned, potential for additional modern human developments would persist, along with associated impacts to solitude on nearby wilderness.

Cumulative Impacts: At the Snag Creek parcel, access limited to the improved floodplain airstrip would limit reasonably foreseeable future development on that private land parcel. At the Kuskulana site, construction of a small cabin on the private land parcel is a reasonably foreseeable action. To most visitors to this remote area, the presence of a modern cabin would detract from a wilderness experience.

Conclusion: This alternative would result in moderate adverse impacts to the undeveloped character and to the opportunity for solitude and a primitive experience, for the following reasons:

- Intensity: Improvement of the existing airstrip on upper Snag Creek would result in a long-term development, but one that has already existed. Re-construction and long-term maintenance of the

airstrip at the Kuskulana parcel and construction of a new cabin would have a negative impact on the undeveloped quality of wilderness.

- Context: One purpose of ANILCA is to “...preserve wilderness resources values and related recreational opportunities...” (Section 101(b)). Wilderness resources are also at the core of the park’s establishing legislation, which include recreational opportunities, preservation of intact natural ecosystems, and the unimpaired scenic beauty and quality of natural features herein (Section 201(9)). Wilderness character and resources are identified in the park’s foundation statement and its General Management Plan as a key aspect of the park’s significance.

3.8.3 Effects on Wilderness from Alternative C, Proposed Action

Direct and Indirect Effects: Under this alternative, 39.93 acres of designated wilderness would be added in WRST in exchange for the elimination of approximately 39 acres of eligible wilderness. This land exchange would directly benefit wilderness resources in the Kuskulana area and would consolidate remote inholdings in eligible wilderness. Acquisition of a remote wilderness parcel and patented mining claim that is isolated from other developments would preclude future mining activities or modern developments.

Developments and/or activities that adversely affect wilderness character have the potential to expand on privately owned land the Snag Creek area under this alternative, as private ownership of land in that area would increase.

Cumulative Impacts: No activities affecting wilderness character and resources are anticipated to occur in the reasonably foreseeable future or in adjacent locations to the project area.

Conclusion: The proposed land exchange would have beneficial and adverse effects to wilderness, for the following reasons:

- Intensity: The benefits of obtaining a remote wilderness parcel and thus preventing future development outweigh the development of an airstrip on private lands, adjacent to existing developments, in eligible wilderness.
- Context: One purpose of ANILCA is to “...preserve wilderness resources values and related recreational opportunities...” (Section 101(b)). Wilderness resources are also at the core of the park’s establishing legislation, which include recreational opportunities, preservation of intact natural ecosystems, and the unimpaired scenic beauty and quality of natural features herein (Section 201(9)). Wilderness character and resources are identified in the park’s foundation statement and its General Management Plan as a key aspect of the park’s significance.

4.0 References and Supporting Documents

Bleakley, Geoff T. 2002. Assessment of Effects Form WRST-224-N. Wrangell-St. Elias National Park and Preserve. On file at WRST Cultural Resources Office.

Cook, M.B., C.A. Roland, and P. A. Loomis. 2007. An Inventory of the Vascular Flora of Wrangell-St. Elias National Park and Preserve, Alaska. Natural Resource Technical Report NPS/CAKN/NRTR-2007/067. National Park Service, Fort Collins, Colorado.

Eppinger, R.G., Briggs, P.H., Rosenkrans, D., and Ballestrazze, V., 2000, Environmental geochemical studies of select mineral deposits in Wrangell-St. Elias NP/P, Alaska: U.S. Geological Survey Professional Paper No. 1619.

Jorgenson, M. T., J. E. Roth, P. F. Loomis, E. R. Pullman, T. C. Cater, M. S. Duffy, W. A. Davis, and M. J. Macander, 2008. An ecological survey for landcover mapping of Wrangell-St. Elias National Park and Preserve. Natural Resource Technical Report NPS/WRST/NRTR—2008/094. National Park Service, Fort Collins, Colorado.

McCullough, M. and M. Elder. 1988. Mining Compliance Site inventory Form. Wrangell-St. Elias National Park and Preserve. On file at WRST Cultural Resources Office.

Moffit, F.H. 1954. Geology of the eastern part of the Alaska Range and adjacent area: USGS Bulletin 989-D, p. 65-218.

Panda, S. K., S. S. Marchenko, and V. E. Romanovsky. 2014. High-resolution permafrost modeling in Wrangell-St. Elias National Park and Preserve. Natural Resource Technical Report NPS/CAKN/NRTR—2014/861. National Park Service, Fort Collins, Colorado.

Viereck, L.A.; Dyrness, C.T.; Batten, A.R.; Wenzlick, K.J. 1992. The Alaska vegetation classification. Gen. Tech. Rep. PNW-GTR-286. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 278 p.

Winkler, Gary R., 2000, A geologic guide to Wrangell-Saint Elias National Park and Preserve, Alaska; a tectonic collage of northbound terranes, with contributions by MacKevett, E. M., Jr.; Plafker, George; Richter, D. H.; Rosenkrans, D. S.; Schmoll, H. R., U.S. Geological Survey Professional Paper 1616, 166 pp.