



2009 ORV Monitoring Results: Pyramid Peak Trail, Windy Creek Trail, and Cantwell Creek Floodplain Route

Cantwell Traditional Use Area, Denali National Park and Preserve

Natural Resource Data Series NPS/CAKN/NRDS—2010/092



ON THE COVER

A photo of ORV tracks along Cantwell Creek in the Cantwell Traditional Use Area, Denali National Park and Preserve. NPS photo.

2009 ORV Monitoring Results: Pyramid Peak Trail, Windy Creek Trail, and Cantwell Creek Floodplain Route

*Cantwell Traditional Use Area, Denali National Park and
Preserve*

Natural Resource Data Series NPS/CAKN/NRDS—2010/092

Ashley Bembenek
ORV Monitoring Technician

Carl A. Roland
Plant Ecologist

Denali National Park and Preserve
PO Box 9
Denali Park, AK 99755

October 2010

U.S. Department of the Interior
National Park Service
Natural Resource Program Center
Fort Collins, Colorado

The National Park Service, Natural Resource Program Center publishes a range of reports that address natural resource topics of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Data Series is intended for timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner. This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data. Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

This report is available from Denali National Park and Preserve and the Natural Resource Publications Management website (<http://www.nature.nps.gov/publications/NRPM>).

Please cite this publication as:

Bembenek, A., and C. Roland. 2009. 2009 ORV monitoring results: Pyramid Peek Trail, Windy Creek Trail, and Cantwell Creek Floodplain Route, Cantwell Traditional Use Area, Denali National Park and Preserve. Natural Resource Data Series NPS/CAKN/NRDS—2010/092. National Park Service, Fort Collins, Colorado.

Contents

	Page
Figures.....	v
Tables.....	vii
Executive Summary	ix
Acknowledgments.....	x
Introduction.....	1
Methods.....	1
Aerial Reconnaissance	1
Linear Trail Mapping.....	1
Repeat Photography.....	3
Magnetic ORV Counters	3
Data Management and Analysis	4
Trail Characteristics.....	4
Geo-referenced Photos.....	5
Study Areas.....	5
<i>Windy Creek Trail</i>	5
<i>Pyramid Peak Trail</i>	5
<i>Cantwell Creek Floodplain Route</i>	8
Results.....	9
Windy Creek	9
<i>Linear Trail Mapping</i>	9
<i>Trail Characteristics</i>	9
<i>Repeat Photography</i>	13
<i>Magnetic ORV Counters</i>	13

Pyramid Peak Trail	15
<i>Linear Trail Mapping</i>	15
<i>Trail Characteristics</i>	16
<i>Repeat Photography</i>	20
<i>Magnetic ORV Counters</i>	20
Cantwell Creek Floodplain Route	21
<i>Linear Trail Mapping</i>	21
<i>Trail Characteristics</i>	21
<i>Repeat Photography</i>	26
Summary	27
Windy Creek	27
Pyramid Peak	27
Cantwell Creek Floodplain Route	27
References	29
Appendix A Repeat Photography for Windy Creek Trail	31
Appendix B Repeat Photography for Pyramid Peak Trail	38
Appendix C Repeat Photography for Cantwell Creek Floodplain Route	42

Figures

	Page
Figure 1. ORV trails in the Cantwell Traditional Use Area of Denali National Park and Preserve.....	2
Figure 2. Windy Creek ORV Trail.	6
Figure 3. Pyramid Peak ORV Trail.....	7
Figure 4. Cantwell Creek Floodplain ORV Route.....	8
Figure 5. Trail type classification on Windy Creek Trail.	10
Figure 6. Locations where vegetation stripping exceeds 50 percent on Windy Creek Trail.	11
Figure 7. Degree of rutting by year on Windy Creek Trail.	12
Figure 8. Total trail depth by year on Windy Creek Trail.	13
Figure 9. 2009 ORV counter data from counters WC Counter 2 and WC Counter 3 on Windy Creek Trail.	15
Figure 10. Trail type classification on Pyramid Peak Trail.	16
Figure 11. Locations where vegetation stripping exceeds 50 percent on Pyramid Peak Trail.	17
Figure 12. Degree of rutting by year on Pyramid Peak Trail.....	18
Figure 13. Total trail depth by year on Pyramid Peak Trail.	19
Figure 14. ORV counter data from Pyramid Peak Counters 1 and 2.....	21
Figure 15. Trail type classification on Cantwell Creek Floodplain Route.	23
Figure 16. Locations where Vegetation Stripping Exceeds 50 Percent on Cantwell Creek Floodplain Route.....	24
Figure 17. Degree of rutting by year on Cantwell Creek Floodplain Route.....	25
Figure 18. Total trail depth by year on Cantwell Creek Floodplain Route.....	26
Figure A1. Windy Creek Repeat Photo Point 1.	31
Figure A2. Windy Creek Repeat Photo Point 2.	32

Figure A3. Windy Creek Repeat Photo Point 3.....	32
Figure A4. Windy Creek Repeat Photo Point 4.....	33
Figure A5. Windy Creek Repeat Photo Point 5.....	34
Figure A6. Windy Creek Repeat Photo Point 6.....	35
Figure A7. Windy Creek Repeat Photo Point 7.....	36
Figure A8. Windy Creek Repeat Photo Point 8.....	37
Figure B1. High Impact Point near the trailhead of Pyramid Peak Trail.....	38
Figure B2. Pyramid Peak Repeat Photo Point 2.	39
Figure B3. Pyramid Peak Repeat Photo Point 3.	39
Figure B4. Pyramid Peak Repeat Photo Point 4.	40
Figure B5. Pyramid Peak Repeat Photo Point 5.	40
Figure B6. Pyramid Peak Repeat Photo Point 6.	41
Figure C1. Cantwell Creek Floodplain High Impact Point 1.....	42
Figure C2. Cantwell Creek Floodplain Repeat Photo Point 4.	43
Figure C3. Cantwell Creek Floodplain Repeat Photo Point 5.	43
Figure C4. Cantwell Creek Floodplain Repeat Photo Point 6.	44
Figure C5. Cantwell Creek Floodplain Repeat Photo Point 7.	45
Figure C6. Cantwell Creek Floodplain Repeat Photo Point 9.	45
Figure C7. Cantwell Creek Floodplain Repeat Photo Point 10.	46
Figure C8. Cantwell Creek Floodplain Repeat Photo Point 11.	46
Figure C9. Cantwell Creek Floodplain Repeat Photo Point 12.	47
Figure C10. Cantwell Creek Floodplain Repeat Photo Point 14.	47
Figure C11. Cantwell Creek Floodplain Repeat Photo Point 15.	48

Tables

	Page
Table 1. Overall trail length on Windy Creek Trail by year.	9
Table 2. Trail type classification by year on Windy Creek Trail.....	9
Table 3. Percent vegetation stripping by year on Windy Creek Trail.	10
Table 4. Degree of rutting by year on Windy Creek Trail.....	11
Table 5. Total trail depth by year on Windy Creek Trail.....	13
Table 6. Summary of ORV counter data by year.....	14
Table 7. Trail length on Pyramid Peak by year.	15
Table 8. Trail type classification by year on Pyramid Peak Trail.....	16
Table 9. Percent vegetation stripping by year on Pyramid Peak Trail.....	17
Table 10. Degree of rutting by year on Pyramid Peak Trail.....	18
Table 11. Total trail depth by year on Pyramid Peak Trail.....	19
Table 12. ORV counter data by year on Pyramid Peak Trail.	20
Table 13. Trail length on Cantwell Creek Floodplain Route by year.	21
Table 14. Trail type classification by year on Cantwell Creek Floodplain Route.....	22
Table 15. Percent vegetation stripping by year on Cantwell Creek Floodplain Route.....	23
Table 16. Degree of rutting by year on Cantwell Creek Floodplain Route.	24
Table 17. Total trail depth by year on Cantwell Creek Floodplain Route.....	25

Executive Summary

The Final Determination for the Cantwell Traditional Use Area (TUA) allows subsistence users to operate off-road vehicles (ORV) within the Cantwell TUA for subsistence hunting purposes. Following this decision, Denali National Park and Preserve (DNP&P) established an ORV monitoring program to determine annual ORV use levels, track damage to resources and monitor the condition of open trails and routes within the Traditional Use Area. Of particular interest were identifying any severe impacts affecting trail sustainability or incursions beyond open established trails, as well as the amount of use on the open trails. We also seek to monitor the recovery of areas previously disturbed by ORVs upon closure to determine the rates of recovery of native vegetation in selected areas.

Since 2005, annual monitoring has occurred on three ORV routes: the Windy Creek Trail, the Pyramid Creek Trail, and the Cantwell Creek Floodplain Route. Methods used include aerial survey, GPS mapping of trail segments and characteristics (trail type, vegetation stripping class, degree of rutting and total trail depth), photography at repeat photo points, and the use of ORV traffic counters.

This report presents our 2009 monitoring results. ORV monitoring continues to provide data to support timely and appropriate management decisions for the Cantwell TUA.

Acknowledgments

The authors would like to thank Joe Van Horn for his valuable assistance and guidance in carrying out this study and also throughout the process of establishing a program for managing and monitoring the impacts of ORVs in Denali National Park and Preserve. Also, we thank former ORV monitoring staff Rob Liebermann and Heather Wetherbee for their contributions to the program in past years.

Introduction

The Final Determination for the Cantwell Traditional Use Area (TUA) allows subsistence users to operate off-road vehicles (ORV) within the Cantwell TUA for subsistence hunting purposes (Denali National Park and Preserve, 2005). Following this decision, Denali National Park and Preserve (DNP&P) established an ORV monitoring program to document ongoing issues with ORV use in the TUA including tracking additional incursions, mapping trail extent and documenting trail conditions. Of particular interest were severe impacts affecting trail sustainability or incursions beyond open established trails, as well as the amount of use on the open trails. ORV monitoring continues to provide data to support timely and appropriate management decisions for the Cantwell TUA.

Currently, ORV use is permitted on two trails in DNP&P (Windy Creek and Pyramid Peak Trails) and also the route on the Cantwell Creek Floodplain in the Cantwell TUA (Figure 1). Monitoring occurs annually on each of the trails. Each year, monitoring results are documented in a report.

This report presents our 2009 monitoring results from the Pyramid Peak Trail, the Windy Creek Trail, and the Cantwell Creek Floodplain Route. The methods discussed below are used for ORV monitoring throughout the Cantwell TUA. The methods section closes with a description of the entire study area. From that point forward, the information presented is specific to each study area.

Methods

In 2005, a comprehensive inventory of ORV impacts in the Cantwell TUA was completed (Liebermann and Roland, 2006). The inventory identified trails that required monitoring and developed the set of field methods for ORV monitoring in DNP&P. During each of the subsequent ORV monitoring seasons, technicians used these methods to complete the tasks described below.

Aerial Reconnaissance

Prior to field work, the ORV technician and Denali Wilderness Coordinator Joe Van Horn completed a brief aerial survey of the Cantwell TUA. The aerial survey familiarizes the technician with the study area, allows for a brief assessment of trail conditions and assists in identifying new ORV incursions, if any, in the project area. During the flight, data and maps from previous ORV monitoring events are used to assess current trail conditions and ORV impacts. A GPS unit is used to map relevant features, as needed. Observations from the aerial survey are used to plan field work.

Linear Trail Mapping

Ground-based trail mapping is the principle monitoring technique for this project. A Trimble GeoExplorer (2008 series) GPS unit was used to map all trail segments and other features collected for this project. Satellite reception was excellent in the project area in 2009. The GPS

unit was equipped with a data dictionary to document attributes for point, line and polygon features. The data dictionary, ORV_Monitoring_2009.ddf, was updated to reflect personnel changes from 2008 to 2009. Additional modifications were not necessary and the data dictionary remains consistent with the original ORV monitoring data dictionary (Liebermann and Roland, 2007).

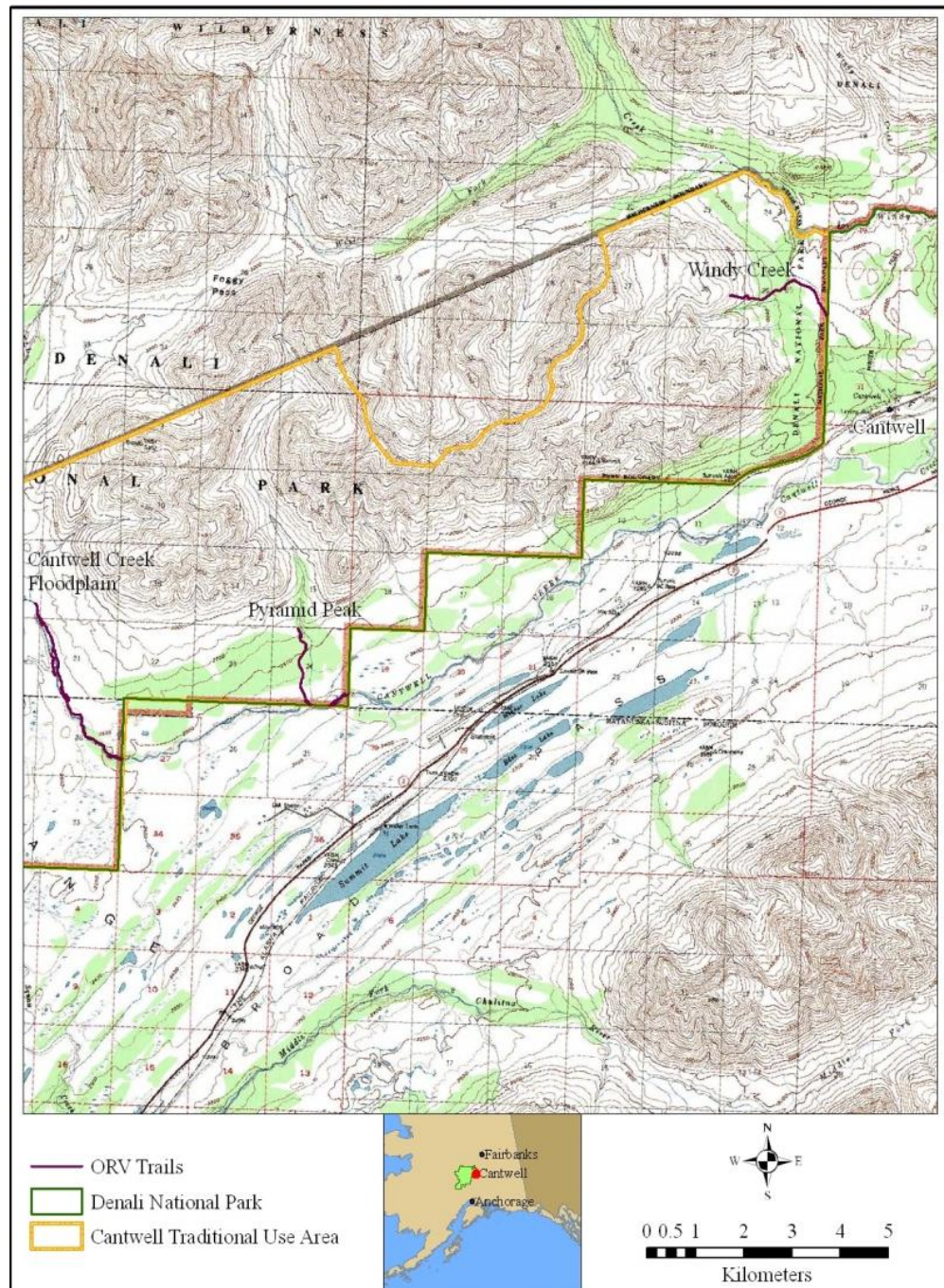


Figure 1. ORV trails in the Cantwell Traditional Use Area of Denali National Park and Preserve.

Trail mapping occurred when a distinguishable trail was present. Both open and closed trail sections were mapped. For each trail segment, trail characteristics were recorded in the data dictionary. Trail segments continued as long as the trail characteristics did not vary. When one of the trail characteristics changed, a new segment was created. Trail segments were a minimum of five meters long. Mapping ceased when the trail was no longer discernable. To assure that the trail did not continue, a brief survey was conducted beyond the terminus.

Repeat Photography

Over the course of the project, several repeat photo points have been established on each trail. Originally, each repeat photo point was established by creating a GPS point at the location and recording the photo's azimuth and other characteristics as prompted by the data dictionary. In subsequent renditions, the photographer used a GPS unit to relocate the photo point. The original photo(s) and photo azimuth were used to frame the scene, as closely as possible to the original orientation. A photo point is recorded with the GPS to document photo characteristics and note any changes. In general, 1 to 3 photos were taken at each repeat photo point. Technicians may establish additional repeat photo points, as needed. Supplemental photos may be used to document other information (i.e. high impact sites, campsite locations, wildlife sightings, etc.). A Cannon PowerShot SD900 Digital Elph camera was used to take all photos. The photo resolution was set to high.

Magnetic ORV Counters

Trafx® brand magnetic ORV counters monitor use on the trails. When the counter's magnet detects a significant amount of metal, a count with the date and time is created and stored in the counter's memory. Unlike other methods such as infrared, pressure sensors, etc., the magnetic counter provides a simple record of trail use that is free of unnecessary counts that may be created by other activity (i.e. animal traffic, ground tremors, etc.). Testing of these sensors was performed in 2008 to determine the appropriate level of sensitivity for the magnetic counters.

ORV counter use includes five relatively simple steps; all of which are well documented in the Trafx counter manual (Trafx Research, Ltd, 2008). Briefly, the ORV counters are configured in the office with the interface software (Trafx Research, Ltd, 2008). The counter settings used for this project are as follows: a delay of 024 and a threshold of 012. The settings were established during field trials and tests completed during 2007 and 2008; the results have been satisfactory. ORV counters were installed at key locations on the trail that satisfy the following requirements. The trail segment is the primary route, in an area with few obstacles to assure that all ORV traffic is captured and properly recorded. The location is well-drained to prevent damage to the counter electronics. The counter must be discreetly buried approximately 15 cm below the surface in the center of the trail perpendicular to the direction of travel. Ideally, counters will be buried in the same location each year so the data is comparable through time. When a location is selected, a GPS point, photos and notes are used to document the location for counter retrieval.

After hunting season, the counters are collected from the field. During counter retrieval, the technician notes any significant or unusual circumstances about the site or counter (i.e. evidence of ground disturbance, moisture accumulation, etc.). Data collected during retrieval, due to transport or other activities, is excluded from the data set.

Following counter retrieval, the data from the counter were downloaded using the interface software. The data were managed and analyzed with an Excel add-on macro that is supplied by TrafX Research, Ltd (2008).

Data Management and Analysis

All GPS data were downloaded and differentially-corrected using GPS Pathfinder Office (version 4.10) software. Differential correction was completed with the Talkeetna, AK CORS base station. The data was exported to ArcGIS. A geodatabase, 2009_ORV_Monitoring.gdb, was created to manage all of the 2009 data (data from previous seasons is stored in similar formats). The geometry of each shape file was repaired and metadata was created. ArcGIS editing tools were used to modify line features as needed (i.e. remove loops, zigzags and other inconsistencies). Additional analysis and map generation occurred in ArcGIS; Microsoft Excel was also used to analyze data.

Trail Characteristics

During each mapping event (2007, 2008 and 2009), technicians recorded trail conditions using a GPS data dictionary. Several characteristics were recorded for each trail, requiring simultaneous evaluation of multiple trail attributes on the part of the technician. It appears that for some characteristics these evaluations may not be entirely consistent among technicians and the interpretation of the data among years is thus complicated for these potentially less repeatable attributes. However, some of this variation is likely attributable to variation among years in environmental conditions such as rainfall and snowmelt. The detailed monitoring results presented here focus on the four trail characteristics that were apparently most consistent among observers. These characteristics are trail type, vegetation stripping class, degree of rutting and total trail depth. Also note, the categories included for trail type, vegetation stripping class and degree of rutting have been lumped (i.e. low rutting includes segments where rutting was characterized as intermittent, faint or low) to reduce subjectivity and ambiguity among iterations. Total trail depth was not simplified. Each characteristic is expressed as a percent of the trail length to account for variations in trail length through time.

The following characteristics were not included in the detailed analysis: trail visibility, trail width, number of paths, surface grade, surface character, soil damage depth, drainage, muddiness and erosion. Trail visibility was not included in the analysis because the parameter was not collected for all trail segments, is dependent upon plant phenology, and the classification appeared to vary widely among technicians. Trail segments that were significantly wider than one vehicle were mapped as two trail segments, thus nearly all segments are in the same width category (single vehicle). The number of paths was not included because areas with multiple paths are mapped as several single paths and technicians do not consistently mark each of the segments as a "multiple path" segment. Further, all segments were mapped and the number of paths is easily viewed on a map. Surface grade and surface character remain stable through time and thus did not require analysis to compare values among years. The surface grade and surface character were incorporated into the site description. In general, soil damage depth parallels total trail depth; thus reporting on both characteristics was considered somewhat redundant for this report. Total trail depth was selected over soil damage depth because total trail depth includes all surface disturbance (i.e. organic material), as opposed to only soil disturbance. Both drainage

and muddiness appeared to be dependent on recent and annual weather patterns, so the influence of ORV use cannot be isolated within such a small dataset (three years with very different weather conditions). Erosion was included in the general results.

Geo-referenced Photos

Following download, all photos from the project were geo-tagged to include the GPS position and other critical information in the photo display. GPS Photo-Link software (Geospatial Experts, 2006) was used to geo-tag all photos. Prior to 2009, photos were not geo-tagged; however, the GPS position and photo number are stored in the GIS shape file for each photo.

Study Areas

Windy Creek Trail

The Windy Creek Trail is immediately north of Cantwell (Figure 2). This trail begins on the edge of town and passes through a 17B land easement on property owned by Mike Santos. After approximately 2.3 km, the trail enters the park. From the park boundary, the trail continues to the northwest for roughly 1.1 km. The vegetation adjacent to the trail is primarily dwarf birch scrub; the surrounding area includes sections of open spruce forest. At this point the trail passes through a junction and turns to the west. The trail continues for an additional 1.7 km; the total length within the park is 2.8 km. As the elevation increases beyond the trail junction, the vegetation shifts to alpine dwarf scrub and alpine meadow. The elevation ranges from approximately 770 m at the park boundary to 970 m at the trail terminus.

Pyramid Peak Trail

The Pyramid Peak Trail is about 14 km southwest of Cantwell. This trail begins outside of the park at a railroad overpass at milepost 201 on the George Parks Highway. The approach trail outside of the park boundary is roughly 6 km. The southeast section of the trail (0.7 km) passes through a small corner of the Cantwell TUA and approaches Cantwell Creek (Figure 3). The trail heads north from Cantwell Creek for 2.0 km (Figure 3). The southeast section is on the Cantwell Creek floodplain and the surface material is gravel or cobbles, with little or no soil development. Adjacent vegetation cover is low floodplain willows and other early seral species. Vegetation cover near the remainder of the trail includes open spruce forests, herbaceous meadows and wet alder-willow communities. The elevation ranges from approximately 730 m at the park boundary to 900 m at the trail terminus.

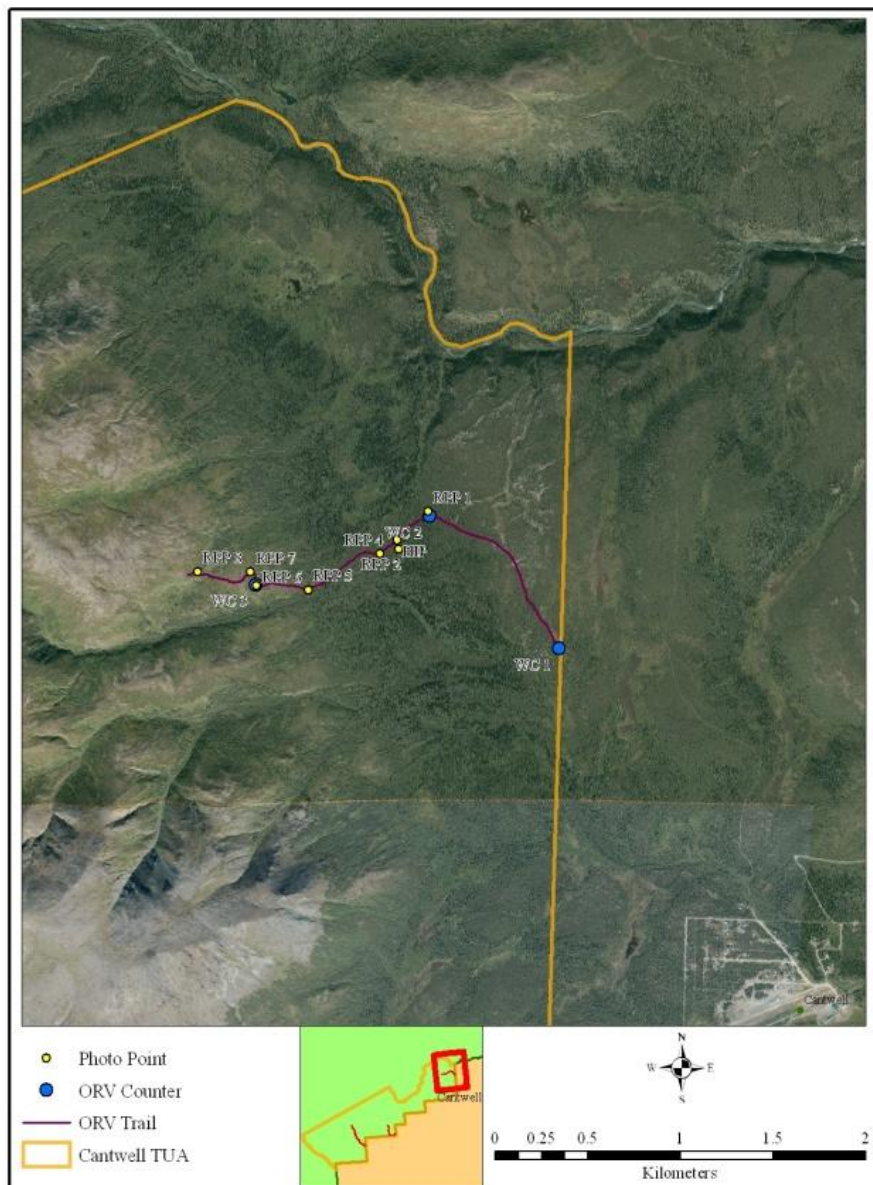


Figure 2. Windy Creek ORV Trail.

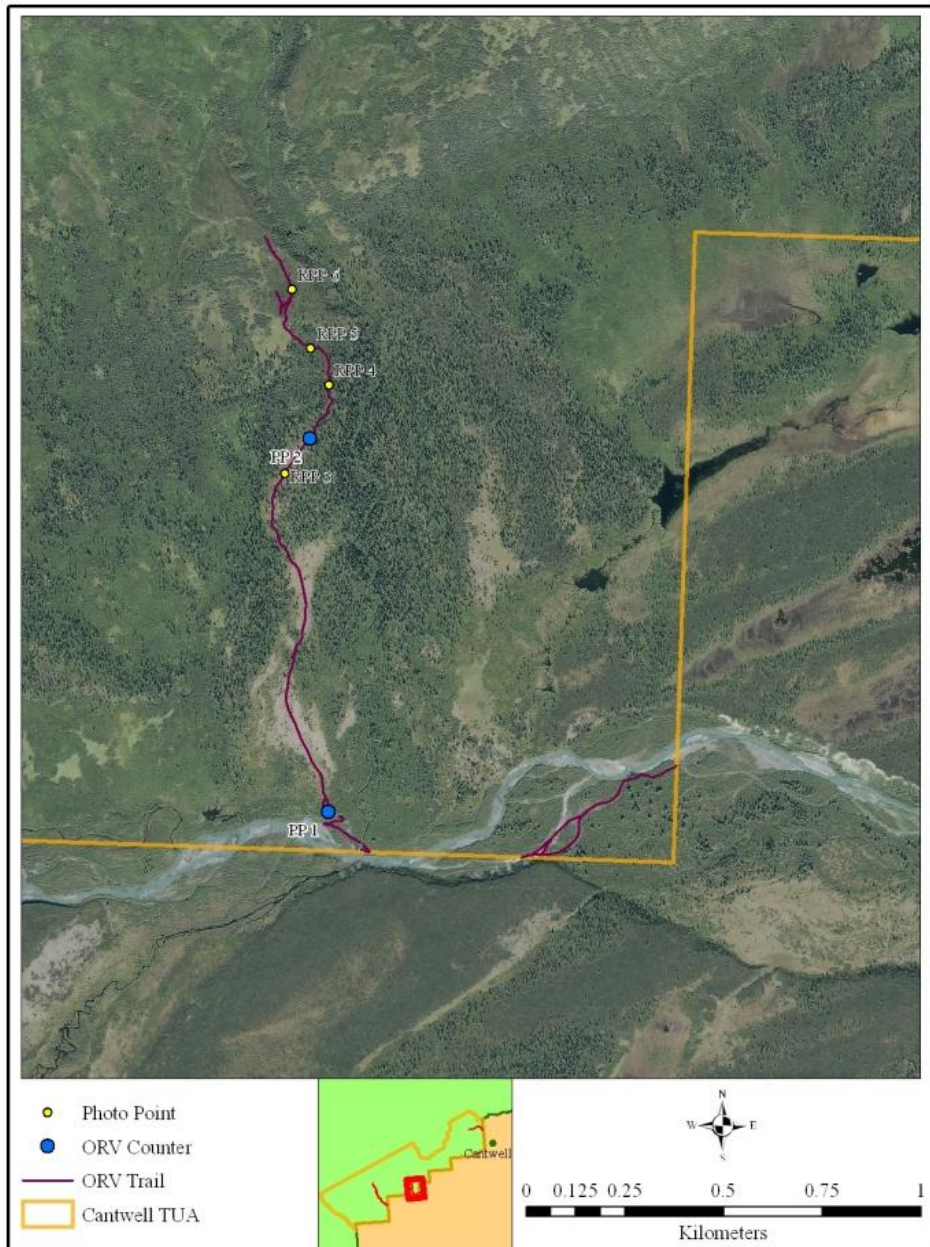


Figure 3. Pyramid Peak ORV Trail.

Cantwell Creek Floodplain Route

The Cantwell Creek Floodplain ORV Route is about 18 km southwest of Cantwell (Figure 4). The route begins outside of the park at a railroad overpass at milepost 201 on the George Parks Highway. The approach to the Park boundary is roughly 10 km. The vegetation adjacent to the route is floodplain willows and other early seral species. In many areas the trail surface is floodplain gravel or cobbles. The elevation ranges from approximately 760 m at the park boundary to 900 m at the route terminus near the wilderness boundary.

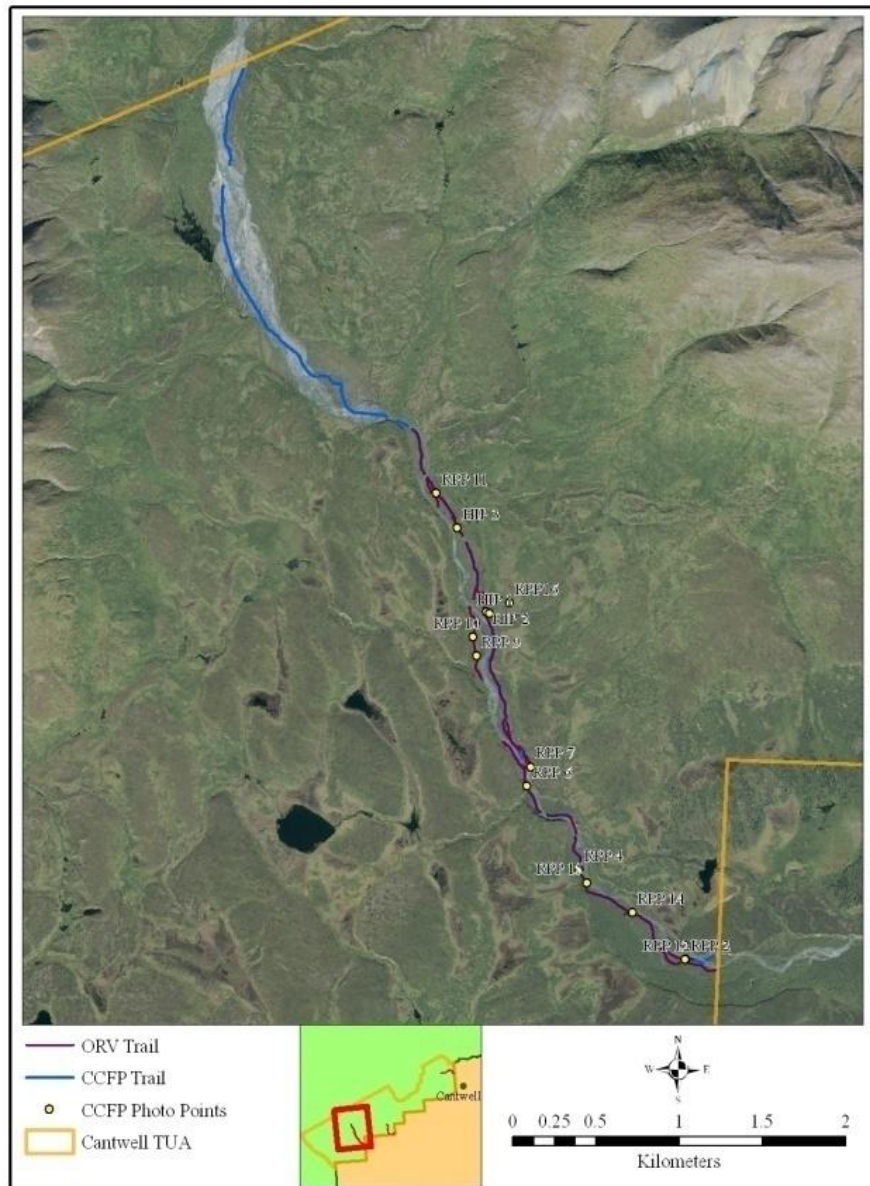


Figure 4. Cantwell Creek Floodplain ORV Route.

Results

Windy Creek

We surveyed the Windy Creek Trail on June 21 and 22, 2009. In addition to recording the conditions in this area, capturing repeat photographs, using a GPS to map and monitoring trail conditions, we installed three ORV counters in this area (Figure 2).

Linear Trail Mapping

The trail length was 2.8 km; which is approximately 0.3 km less than the 2008 trail length, 3.1 km (Table 1). The trail length has also decreased relative to the 2007 extent, 4.0 km (Table 1). The decrease in trail length has occurred on the western and southern extents of the trail (Figure 5). The western extent has decreased in length due to recovery on what was likely a one-time incursion. The western extent is an animal trail that is faint and discontinuous near the trail terminus (Figure 5). Decreases on the southern extent may be attributed to recovery, i.e. historic incursions are no longer used and vegetation has recovered. Erosion was not observed on the trail.

Table 1. Overall trail length on Windy Creek Trail by year.

Year	Length (km)
2007	4.0
2008	3.1
2009	2.8

Trail Characteristics

Based on the limited data set presented here, we have observed that the proportion primary trail type has apparently increased and the secondary trail length has decreased (Table 2). This may be attributed to concentrated use on established routes and decreased use and recovery on historic incursions. The western extent is an animal trail that is faint and discontinuous near the trail terminus. During each mapping event, a shorter segment of the west terminus trail was mapped and it was classified as a secondary route (Figure 5). Decreases on the southern extent may be attributed to recovery, i.e. historic incursions are no longer used and vegetation has recovered (Figure 5).

Table 2. Trail type classification by year on Windy Creek Trail.

Year	Primary	Secondary
2007	59%	41%
2008	65%	35%
2009	83%	17%

Note: Trail type is expressed as a percentage of total trail length.

In general, it appears that vegetation stripping may have decreased somewhat over time on the Windy Creek Trail. In 2007, a moderate portion, 45 percent, had 20 to 50 percent vegetation stripping (Table 3). Over time, that value has declined and concomitant increases in the >20 percent category have been recorded (Table 3). This suggests increased vegetation cover on the trail surface. However, short segments with greater than 50 percent vegetation stripping exist on the trail, as shown in Figure 6.

Table 3. Percent vegetation stripping by year on Windy Creek Trail.

Year	None	20-50%	> 50%
2007	6 %	45 %	0 %
2008	30 %	14 %	9 %
2009	0 %	0 %	1 %

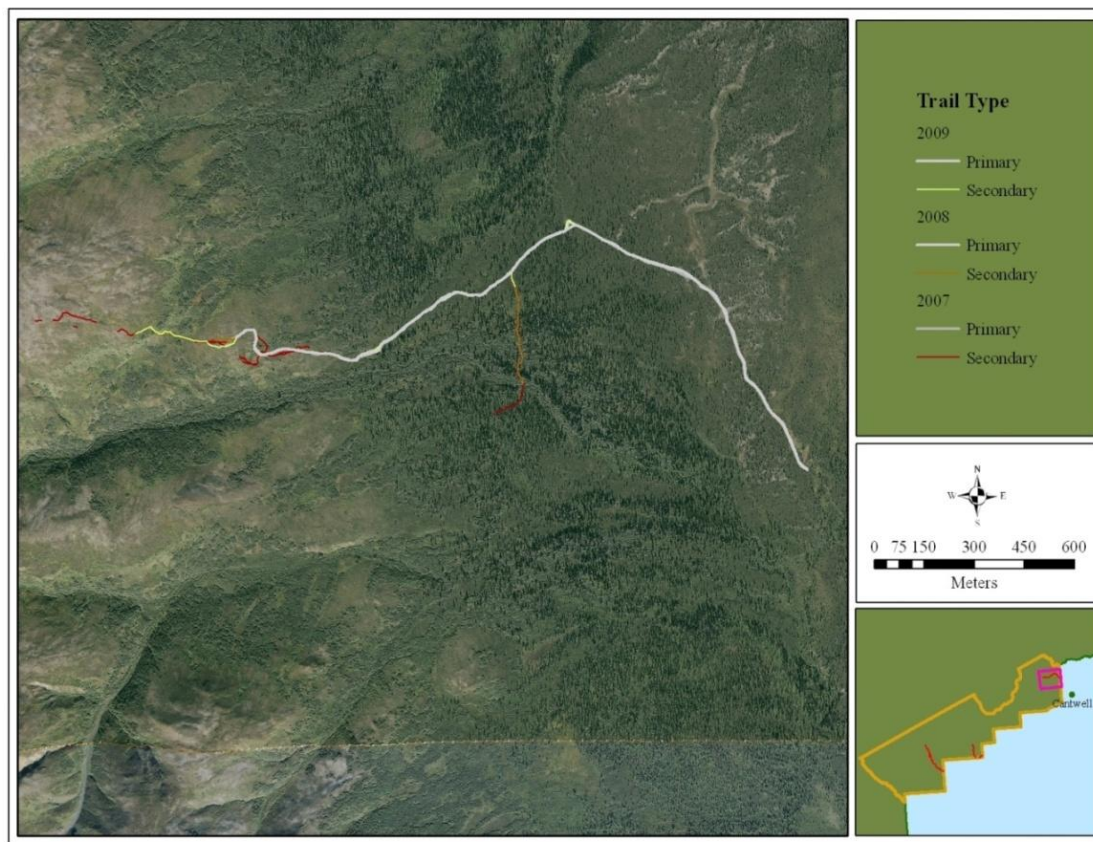


Figure 5. Trail type classification on Windy Creek Trail.

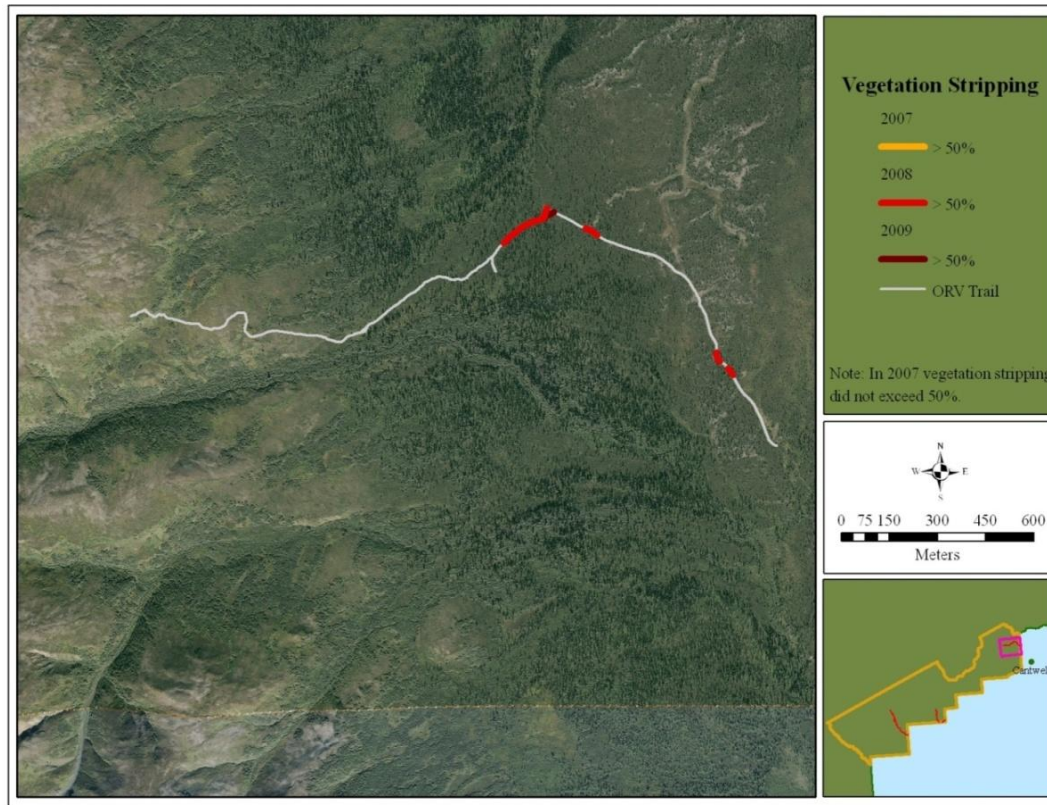


Figure 6. Locations where vegetation stripping exceeds 50 percent on Windy Creek Trail.

In 2009 a greater proportion of the trail was classified as “moderately rutted” than in 2008, 85 to 44 percent, respectively (Table 4). In 2008, 15 percent of the trail was classified as heavily rutted (Table 4) whereas heavy rutting was not observed in 2009. In general, heavily rutted areas declined in 2009 relative to 2008, and moderately rutted areas were more common (Figure 7).

Table 4. Degree of rutting by year on Windy Creek Trail.

Year	None	Low	Moderate	Heavy	Unclassified
2007	0 %	0 %	0 %	0 %	100 %
2008	21 %	20 %	44 %	15%	0 %
2009	15 %	0 %	85 %	0 %	0 %

Note: Degree of rutting is expressed as a percent of trail length.

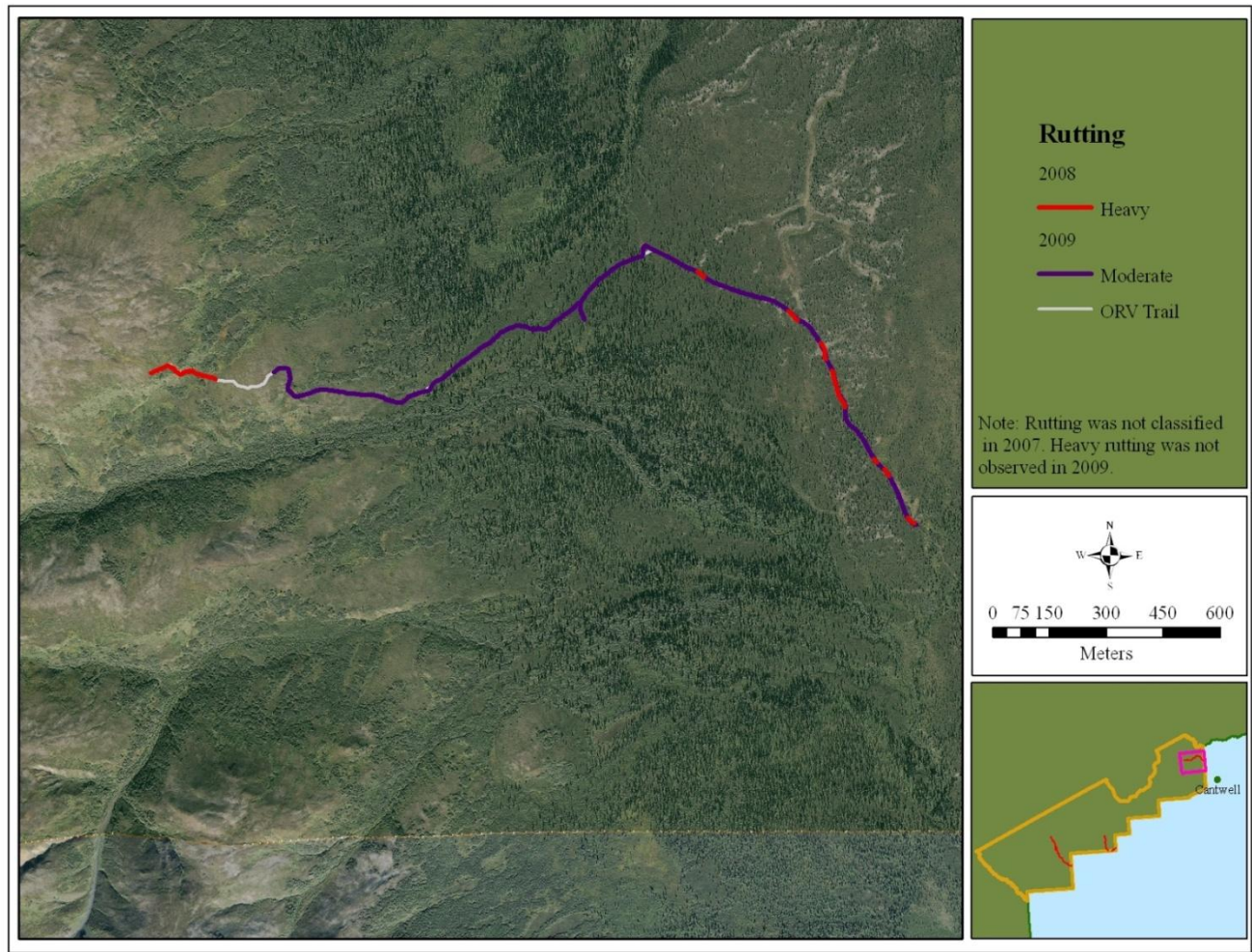


Figure 7. Degree of rutting by year on Windy Creek Trail.

Over the three-year period of this study, it appears that the total trail depth may have declined somewhat over time. In 2007, the bulk of the trail, 61 percent, was classified as 12 to 24 inches deep (Table 5). In 2008, 52 percent of the trail was 6 to 12 inches deep and 33 percent was wheel tracks only (Table 5). In 2009, nearly the entire trail, 96 percent, was classified as wheel tracks only. Field notes from 2009 indicate the wheel tracks were 4 to 6 inches deep, in most areas; which is consistent with 2008 observations. The reduction in total trail depth may be due to variation among observers, or compaction adjacent to the main wheel tracks, or erosion of the trail center. Regardless of the trail depth observed, the trail depth was consistent on the main stem of the trail (Figure 8). Areas with increased trail depths occur early in the route in rocky areas, with relatively shallow soils (Figure 8).

Table 5. Total trail depth by year on Windy Creek Trail.

Year	< 6" Wheel Tracks Only	<6"	6-12"	12-24"	>24"
2007	1 %	16 %	22 %	61 %	0 %
2008	33 %	11 %	52 %	3 %	1 %
2009	96 %	4 %	0 %	0 %	0 %

*Total trail depth is expressed as a percent of trail length.

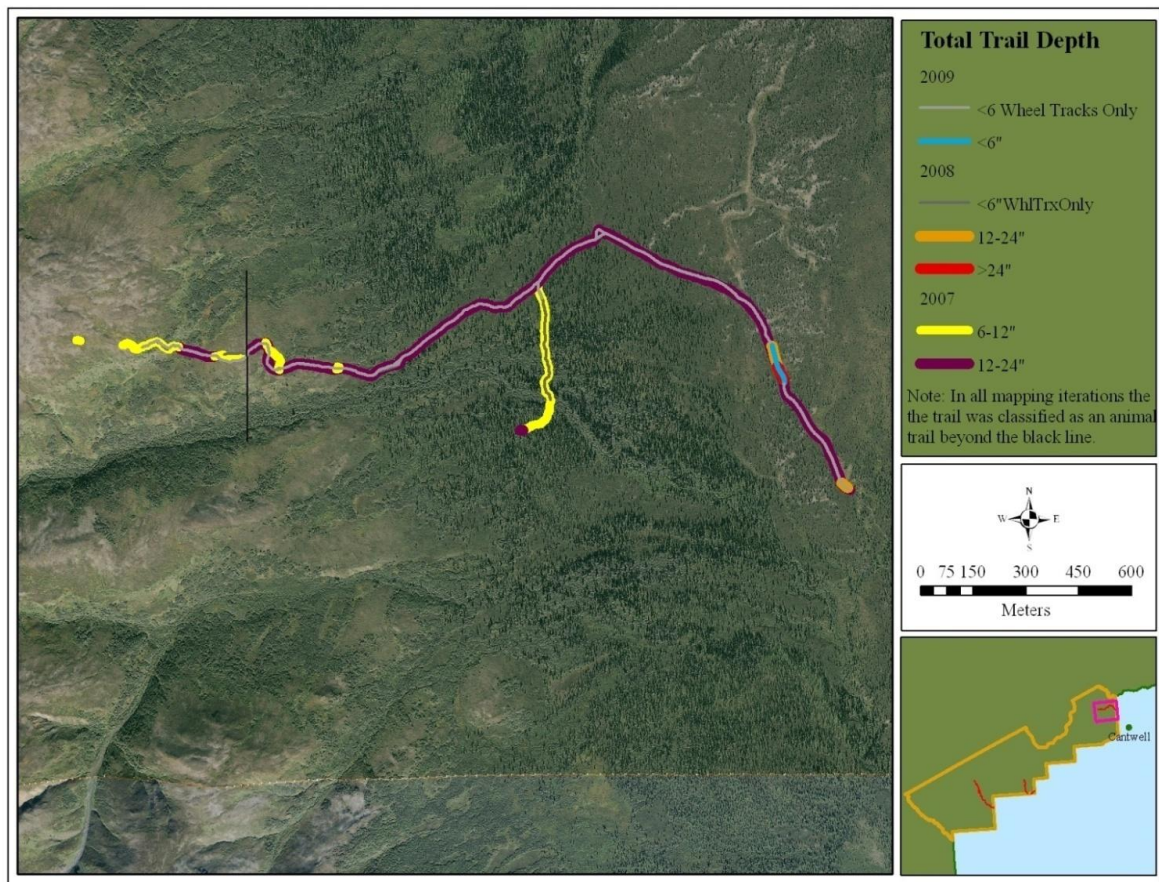


Figure 8. Total trail depth by year on Windy Creek Trail.

Repeat Photography

Repeat photos are used to visually assess trail conditions through time. Appendix A includes the repeat photo points on Windy Creek Trail.

Magnetic ORV Counters

ORV counters were installed at three locations on Windy Creek Trail (Figure 2). The first counter, referred to as WC Counter 1, was located just inside the park boundary (Figure 2). The

second counter, WC Counter 2, was installed on the recently designated route at the trail junction (Figure 2). The third counter was installed on a small plateau near the end of the primary route and beyond the trail closure sign (Figures 2 and 8).

WC Counter 1 failed to collect data in 2009 due to technician error. The “current date” was incorrectly programmed into the counter’s memory. The start date was not reached and the counter did not record data. Although the date and other settings were double-checked, the error was not noticed until after the counter was retrieved from the field. WC Counters 2 and 3 captured data throughout the summer (Table 6 and Figure 9).

Trail use decreased in 2009 (Table 6) as compared to 2008. At WC Counter 2 the counter recorded approximately half the hits recorded in 2008 (Table 6). Although the locations are different both counters, WC 2-2009 and WC 1-2008, should capture trail use on the first half of the trail. WC Counter 3 indicates an even greater reduction in trail use, 3 and 51 hits for 2009 and 2008, respectively (Table 6). Data from WC Counter 3 suggests the majority of ORV users were complying with trail closures, but that some entry into closed areas may be continuing during hunting season.

Table 6. Summary of ORV counter data by year.

Year	Dates Deployed		Counter	Total Counts	Counts Per Day
	Start	End			
2009	6/27/2009	9/21/2009	WC 1*	No data	-
			WC 2	55	0.63
			WC 3*	3	0.03
2008	7/6/2008	9/20/2008	WC 1*	97	1.28
	7/8/2008	9/17/2008	WC 3*	51	0.72

* Identically named counters were deployed in similar locations each year.

** WC2 was not deployed in 2008.

Most ORV use coincides with hunting season, August 1 to September 20 (Figure 9). Although trail use, as recorded at WC Counter 2, peaked on July 26 and 27 just prior to hunting season (Figure 9). This may be explained by trips made by hunters establishing camps and performing reconnaissance of favorite hunting spots in preparation for season opening. WC Counter 3 recorded data on two occasions, September 3 and 19 (Figure 9). These may represent unlawful incursions into closed areas by subsistence ORV users.

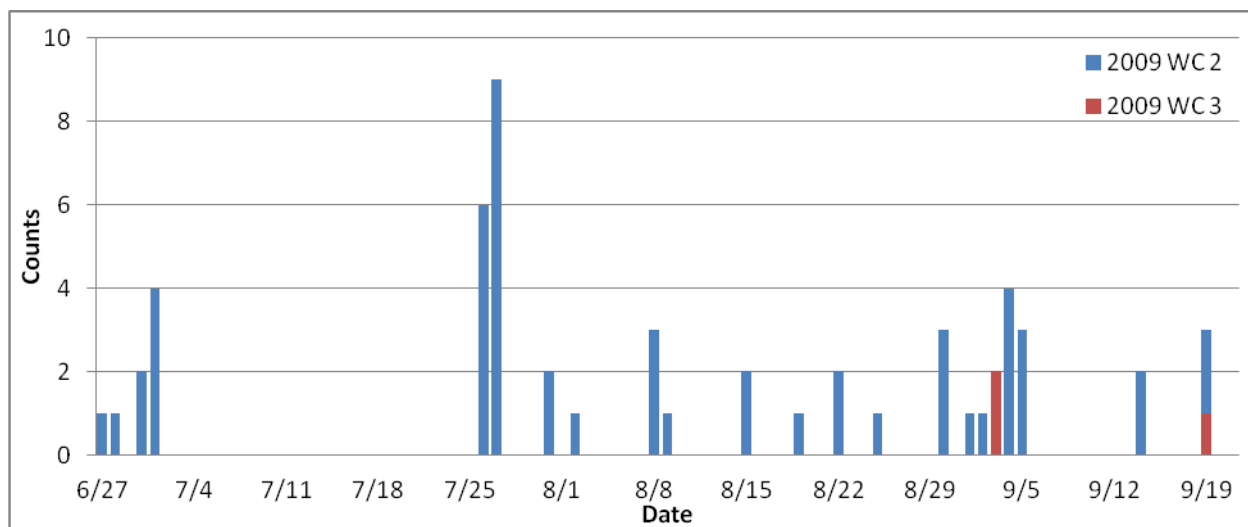


Figure 9. 2009 ORV counter data from counters WC Counter 2 and WC Counter 3 on Windy Creek Trail.

Pyramid Peak Trail

Monitoring on the Pyramid Peak Trail was completed on June 24, 2009. Two ORV counters were installed.

Linear Trail Mapping

The 2009 trail length is 2.8 km; which is 0.2 km longer than the 2008 trail length, 2.6 km (Table 7). The increase in trail length is from four new, or previously unmapped, trail segments on the south portion of the trail (Figure 10). One segment is on the southeast section of the trail near the park boundary to the south. The other segments are located just north of the park boundary and Cantwell Creek. The new segments are approximately 230 m in length. The segments are within the Cantwell Creek floodplain. These short trail sections are secondary spurs and not part of the newly-defined marked route.

Table 7. Trail length on Pyramid Peak by year.

Year	Length (km)
2007	1.8
2008	2.6
2009	2.8

Adjacent vegetation cover is low floodplain willows that are unevenly distributed due to frequent flooding and channel evolution. The trail length has also increased relative to the 2007 extent of 1.8 km (Table 7). The southern section of the trail near Cantwell Creek was not mapped in 2007, accounting for the increase in trail length. However, the trail terminus has receded since 2007

(Figure 10). The decrease in trail length near the terminus is likely attributed to vegetation recovery after a historic incursion.

Trail Characteristics

The ratio of primary to secondary trail has remained stable from 2008 to 2009 (Table 8). Both years suggest an increase in primary trail length over 2007, however this is due to the addition of the southeast section of the trail, not trail change. The trail terminus has receded over time and a greater portion of the north end of the trail has been classified as a secondary route (Figure 10). Field notes confirm this trend and recent travel, within the last two years, seems unlikely.

Table 8. Trail type classification by year on Pyramid Peak Trail.

Year	Primary	Secondary
2007	93 %	7 %
2008	65 %	35 %
2009	68 %	32 %

Note: Trail type is expressed as a percent of trail length.

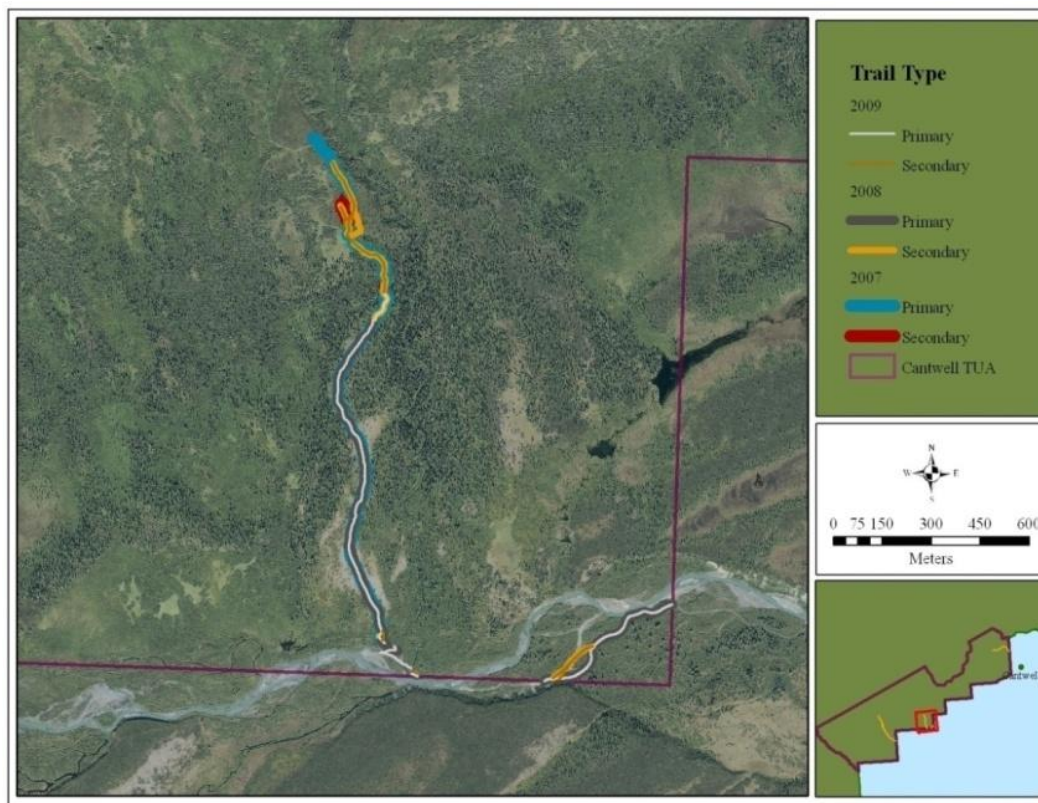


Figure 10. Trail type classification on Pyramid Peak Trail.

Vegetation stripping exceeded 50 percent on the south section of the trail (Figure 11). However, the southern section of the trail is on the Cantwell Creek floodplain and vegetation cover is intermittent due to the hydrologic regime. In such areas, ORVs generally travel in areas without vegetation cover. On the northern portion of the trail, areas with greater than 50 percent vegetation stripping may have decreased somewhat over time (Figure 11). Overall, the majority of the trail had less than 20 percent vegetation stripping (Table 9).

Table 9. Percent vegetation stripping by year on Pyramid Peak Trail.

Year	None	< 20%	20-50%	> 50%
2007	17 %	76 %	1 %	7 %
2008	51 %	40 %	1 %	7 %
2009	1 %	66 %	2 %	31 %

Note: Vegetation stripping is expressed as a percent of trail length.

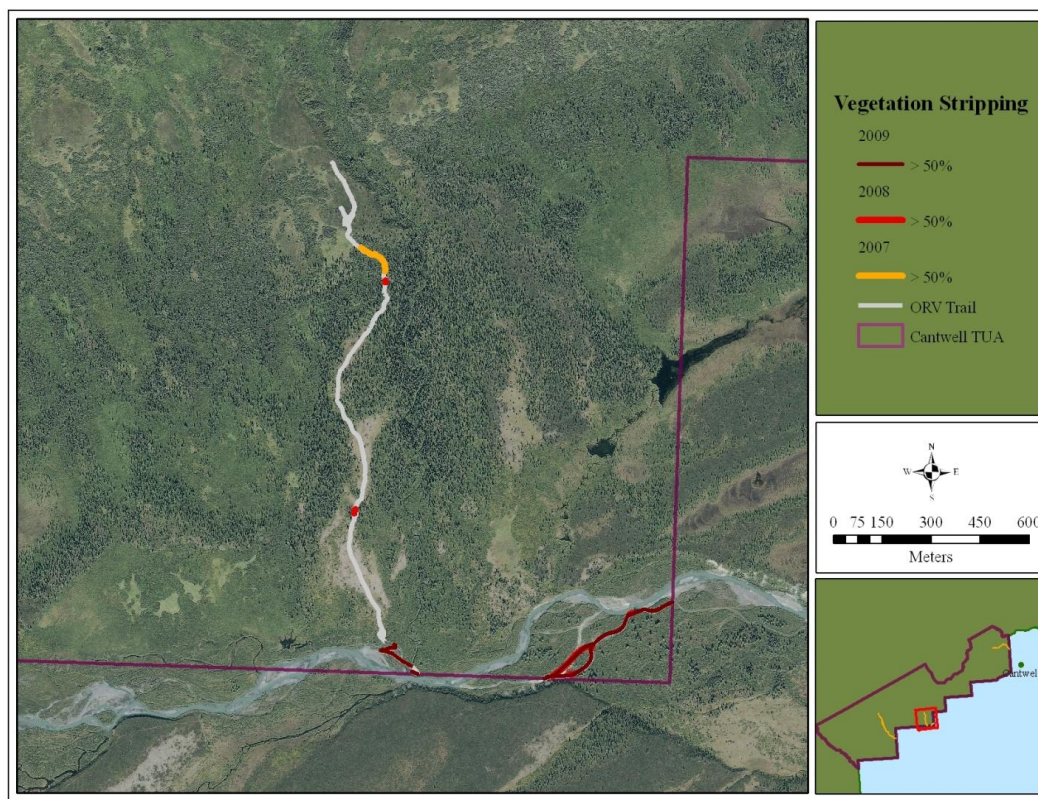


Figure 11. Locations where vegetation stripping exceeded 50 percent on Pyramid Peak Trail.

In 2009, a greater proportion of the trail was classified as “moderately rutted” than in 2008, 89 versus 47 percent, respectively (Table 10). In 2008, one percent of the trail was classified as heavily rutted (Table 10). Heavy rutting was not observed in 2009 (Table 10, Figure 12). In general, the trail is moderately rutted with heavily rutted sections. This may represent increased rut-formation along this trail during the wet hunting season of 2008, which occurred between these two measurement periods.

Table 10. Degree of rutting by year on Pyramid Peak Trail.

Year	None	Low	Moderate	Heavy	Unclassified
2007	0 %	0 %	0 %	0 %	100 %
2008	38 %	14 %	47 %	1 %	0 %
2009	1 %	10 %	89 %	0 %	0 %

Note: Degree of Rutting is expressed as a percent of trail length.

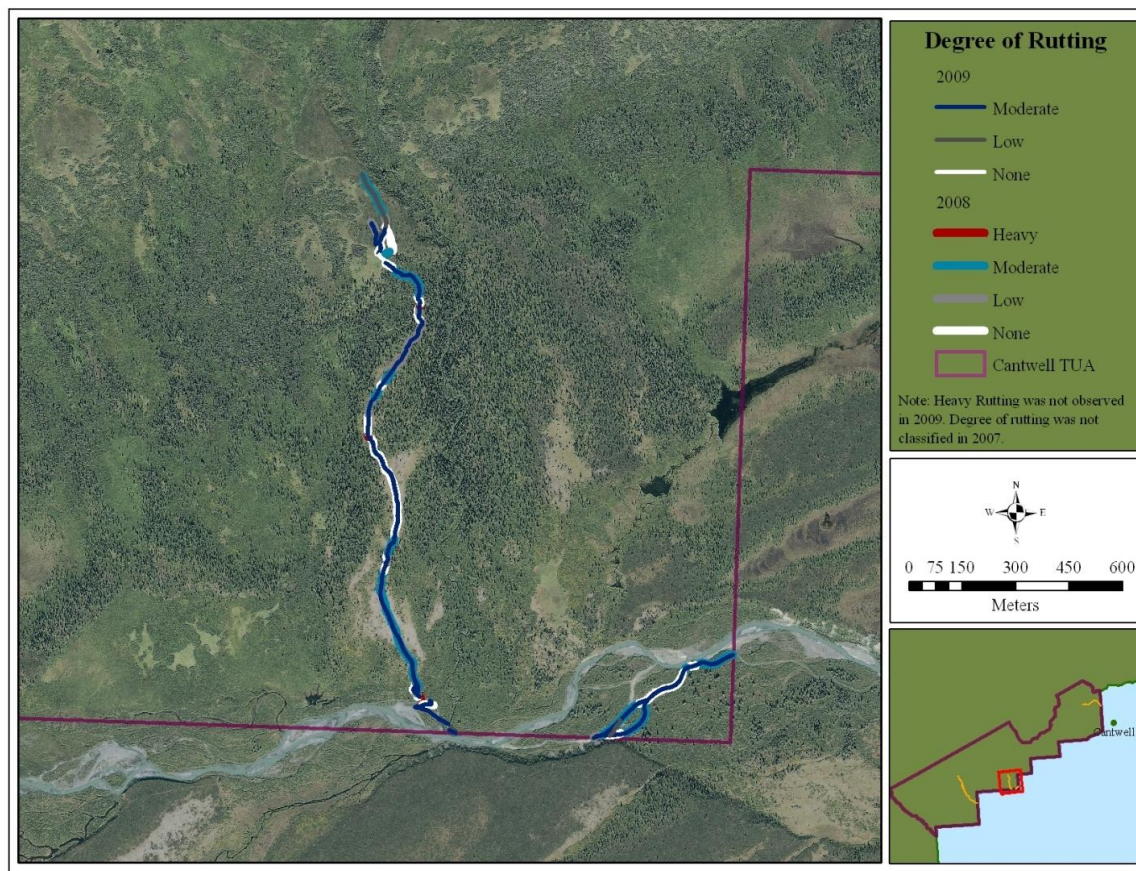


Figure 12. Degree of rutting by year on Pyramid Peak Trail.

The total trail depth has been relatively consistent over time. In 2007, the bulk of the trail, 52 percent, was classified as wheel tracks only (Table 11). In 2008, 60 percent of the trail was less than 6 inches deep (Table 11). In 2009, nearly the entire trail, 94 percent, was classified as wheel tracks only (Table 11). Field notes from 2008 and 2009 indicate recent travel beyond the closure post (the sign is no longer present) is unlikely (Figure 13, see black line). Trail segments mapped beyond that point are historic ORV incursions. Trail depth has decreased over time on the northern extent beyond the black line.

Table 11. Total trail depth by year on Pyramid Peak Trail.

Year	< 6" Wheel Tracks Only	<6"	6-12"	12-24"	>24"
2007	52 %	22 %	25 %	2 %	0 %
2008	4 %	60 %	36 %	1 %	0 %
2009	94 %	0 %	6 %	0 %	0 %

*Total trail depth is expressed as a percent of trail length.

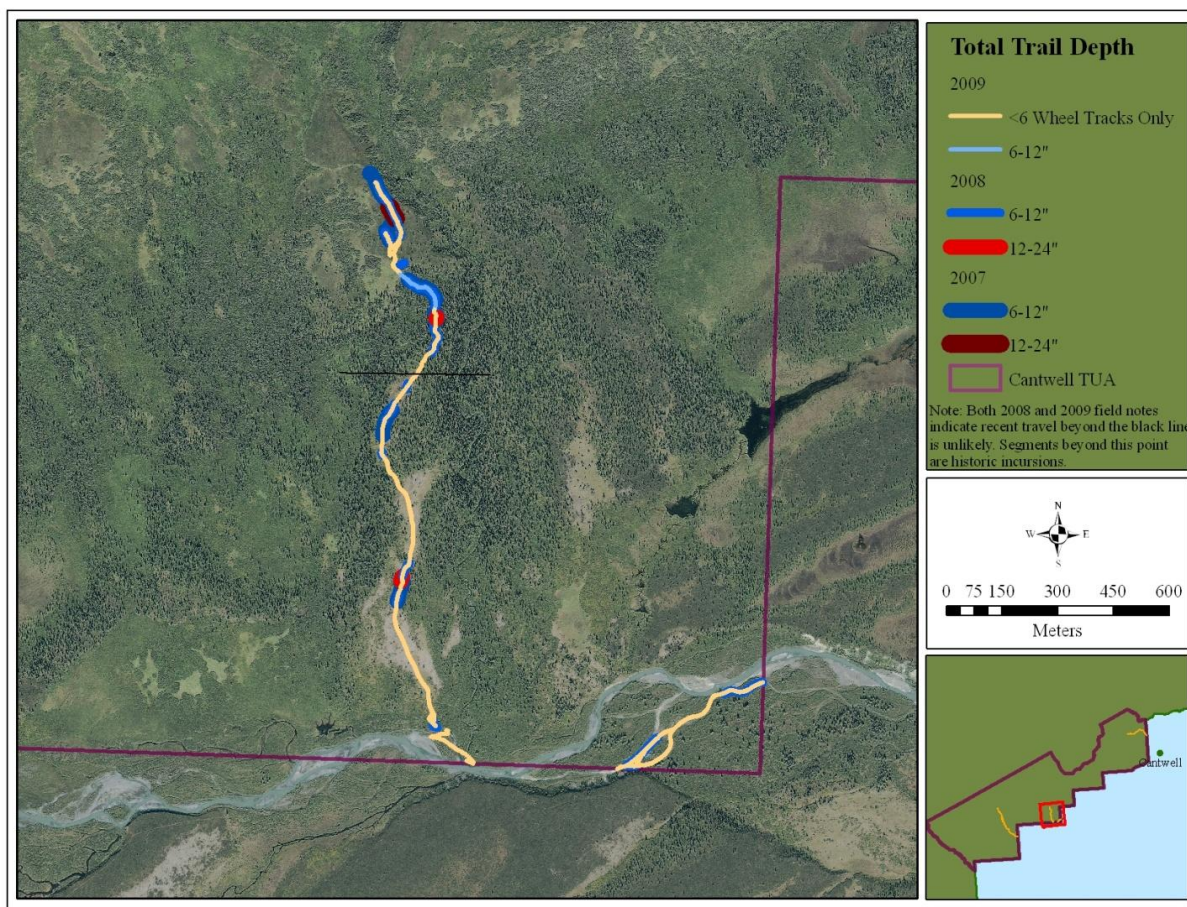


Figure 13. Total trail depth by year on Pyramid Peak Trail.

Repeat Photography

Repeat photos are used to visually assess trail conditions through time. Appendix B includes the repeat photos for Pyramid Peak Trail.

Magnetic ORV Counters

ORV counters were installed at two locations on the Pyramid Peak Trail (Figure 3). The first counter, referred to as PP Counter 1, was located north of Cantwell Creek just the past the high impact point (Figure 3 and Figure B1 in Appendix B). The second counter, PP Counter 2, was installed at the terminus of recent trail use (Figures 3 and 13). Both counters were properly installed and showed no evidence of disturbance. The counter settings reviewed during download are accurate and appropriate.

ORV use, as measured at PP Counter 1, was similar for both years with 36 passes in 2009 and 32 passes in 2008 (Table 12). However, data from PP Counter 2 indicates ORV travel was much higher at PP2 than at PP1, perhaps due to users camping along the trail and traversing the upper sections repeatedly (Table 12). PP Counter 1 recorded 7 hits that were not matched at PP Counter 2 for the same day, indicating a trip that terminated prior to the ORV reaching counter 2 (Figure 14). At PP Counter 2, 40 hits were recorded that were not registered, at PP Counter 1 on the same day (Figure 14). This suggests that users were camped along the trail and using ORVs to scout and to reconnoiter the area, without exiting past PP Counter 1. This represents a relatively large amount of traffic on this trail.

Table 12. ORV counter data by year on Pyramid Peak Trail.

Year	Dates Deployed		Counter	Total Counts	Counts Per Day
	Start	End			
2009	6/27/2009	9/21/2009	PP1*	36	0.41
			PP2	62	0.71
2008	7/13/2008	9/7/2008	PP1*	32	0.57

* Identically named counters were deployed in similar locations each year.
Note: PP 2 was not deployed in 2008.

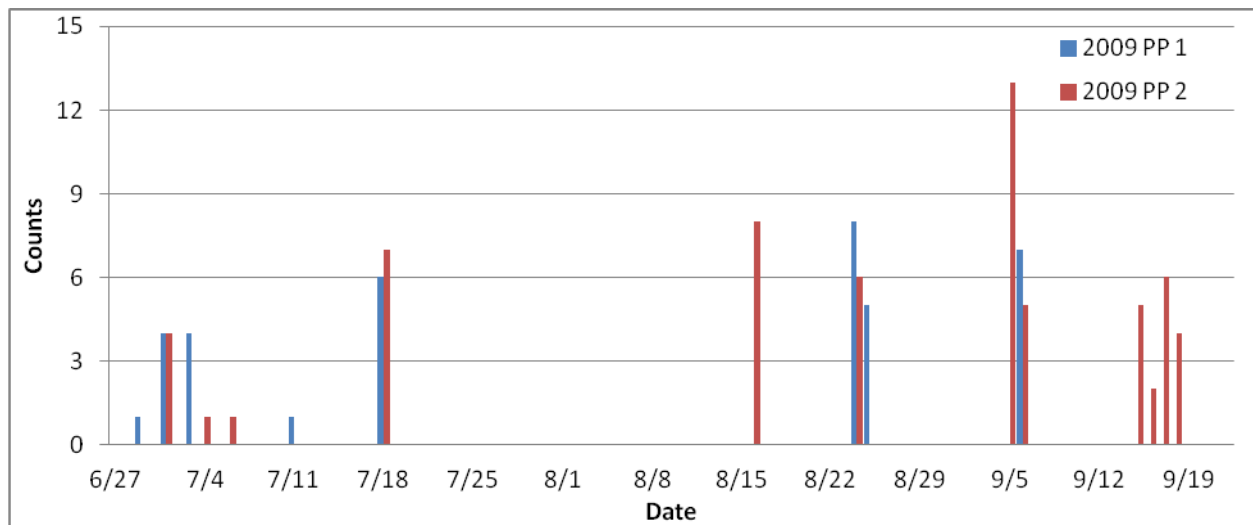


Figure 14. ORV counter data from Pyramid Peak Counters 1 and 2.

Cantwell Creek Floodplain Route

ORV monitoring on the Cantwell Creek Floodplain Route was completed on July 1 and 2, 2009. In late July, the DNP&P Trail Crew created a designated route on the Cantwell Creek Floodplain. The route is marked with orange posts and red flagging. On July 29, 2009 the final route alignment was mapped (Figure 4). The designated route is 6.5 km; the route begins at the park boundary and ends at the wilderness boundary (Figure 4). The designated route extends beyond the previously mapped trail by approximately 0.9 km. ORV counters were not installed in this area.

Linear Trail Mapping

The trail length in 2009 was 5.6 km; which is identical to the 2008 trail length (Table 13). The trail length has decreased relative to the 2007 extent of 6.3 km (Table 13). The decrease in length is due to a spur to the east of the route from a one-time incursion that was not mapped in 2008 and 2009 (Figure 3).

Table 73. Trail length on Cantwell Creek Floodplain Route by year.

Year	Length (km)
2007	6.3
2008	5.6
2009	5.6

Trail Characteristics

The proportion of the trail designated as “primary trail” has increased over time, and consequently the length of the trail designated as “secondary trail” has decreased (Table 14).

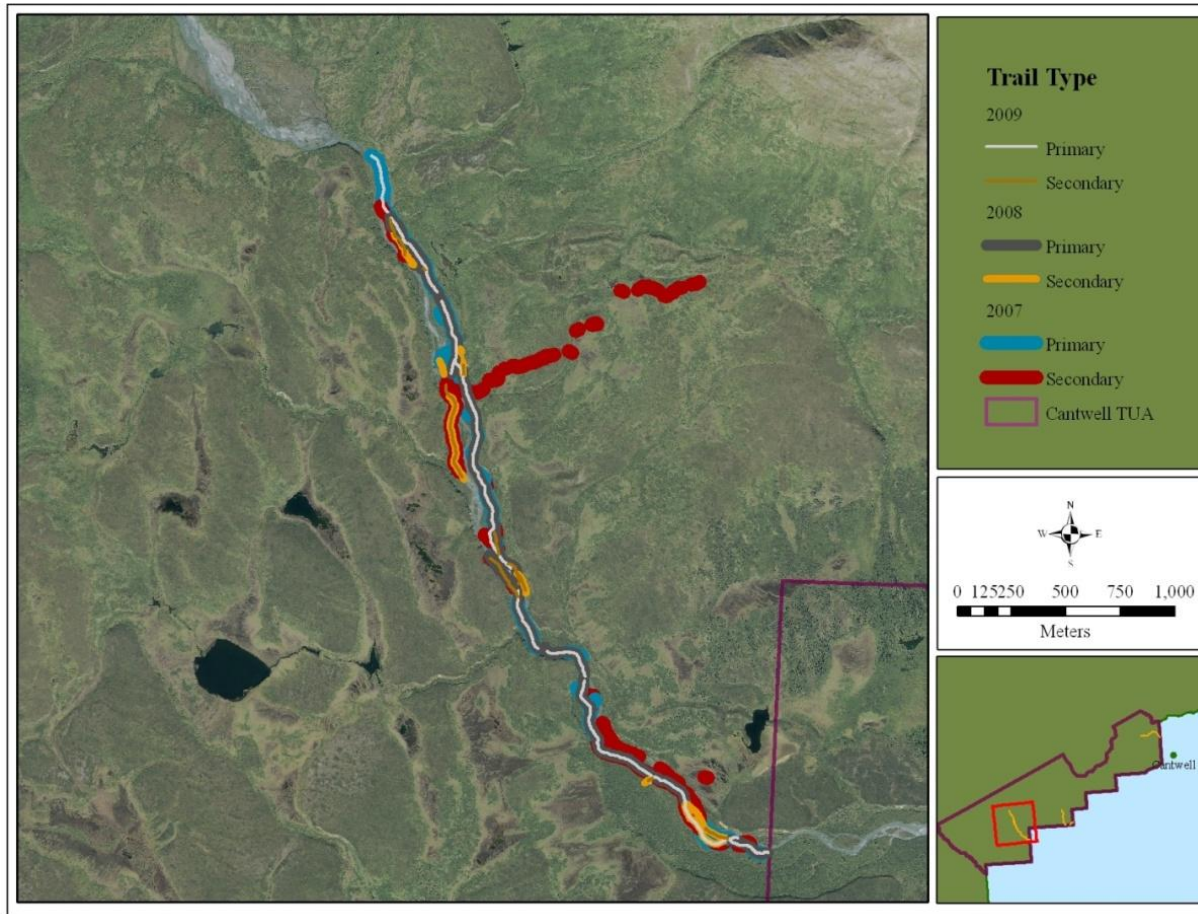
This reduction is due to the elimination of the spur east of the main trail that was mapped in 2007, but not in subsequent years (Figure 15). Field notes from 2007 indicate vegetation stripping and rutting were present on the incursion spur, but intermittently, making continuous mapping time-consuming and difficult. Based on 2008 and 2009 observations, continuous ORV tracks were not evident in the area; therefore the segment was not mapped. It appears that at least some of the damaged vegetation observed in 2007 has recovered in this incursion path, but data are not available along its length. Trail braiding is common on the Cantwell Creek Floodplain particularly near the park boundary (Figure 15). The designated route, established in 2009, should reduce trail braiding.

Table 14. Trail type classification by year on Cantwell Creek Floodplain Route.

Year	Primary	Secondary
2007	47 %	53 %
2008	71 %	29 %
2009	74 %	26 %

Note: Trail type is expressed as a percent of trail length.

Heavy vegetation stripping, in the categories of greater than 50 percent and 20 to 50 percent, may have decreased somewhat over time based upon our observations (Table 15). In general, ORV travel on the floodplain avoids vegetated areas and favors open areas, thus little vegetation stripping occurs in the open environments. In 2007, a few relatively short segments with greater than 50 percent vegetation stripping were present on the trail (Figure 16). In 2008 and 2009, vegetation stripping was classified as less than 20 percent in those areas (Figure 16).



Note: The full extent of the designated route, established in 2009, is not included on this map.

Figure 15. Trail type classification on Cantwell Creek Floodplain Route.

Table 15. Percent vegetation stripping by year on Cantwell Creek Floodplain Route.

Year	None	< 20%	20-50%	> 50%
2007	26 %	58 %	13 %	3 %
2008	67 %	32 %	1 %	0 %
2009	16 %	84 %	0 %	0 %

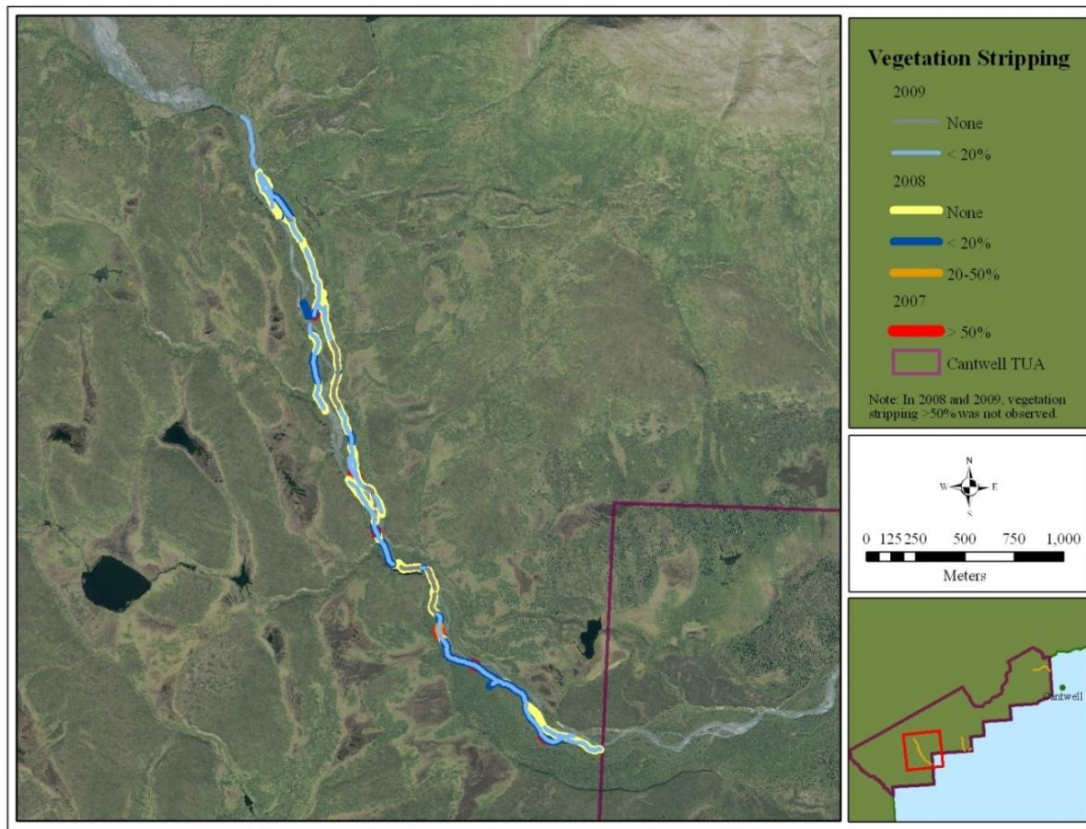
Note: Vegetation stripping is expressed as a percent of trail length.

The degree of rutting observed in 2008 and 2009 was similar; the bulk of the route was lightly used and thus not very rutted (Table 16). The gravel and cobble surfaces that occur on many sections of the route are relatively resistant to rutting, and ruts are difficult to discern in these substrates. In 2008, a small segment near the creek was classified as heavily rutted (Figure 17). Heavy rutting was not observed in 2009. In general, moderate rutting was relatively rare on the Cantwell Creek Floodplain Route, and concentrated toward the Park boundary.

Table 16. Degree of rutting by year on Cantwell Creek Floodplain Route.

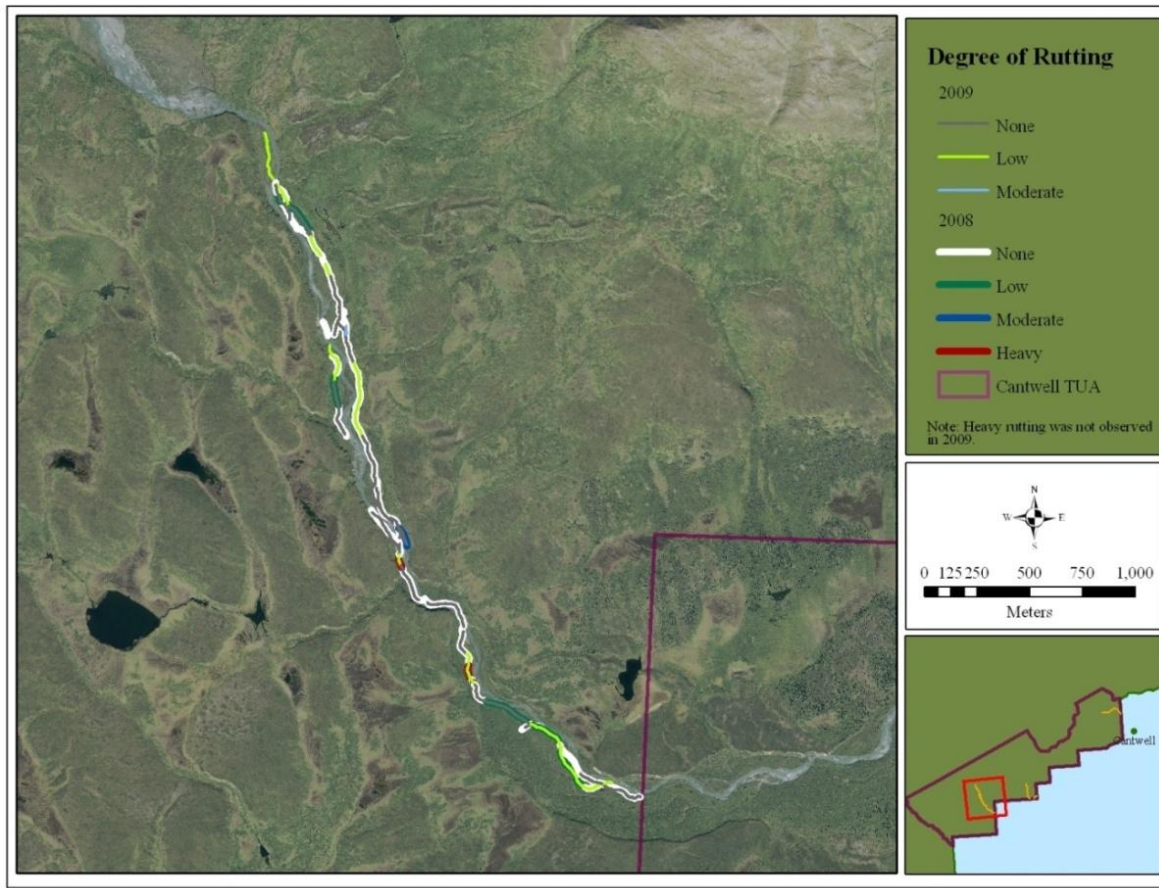
Year	None	Low	Moderate	Heavy	Unclassified
2007	5 %	31 %	18 %	1 %	45 %
2008	77 %	19 %	2 %	3 %	0 %
2009	65 %	34 %	1 %	0 %	0 %

Note: Degree of rutting is expressed as a percent of trail length.



Note: The full extent of the designated route, established in 2009, is not included on this map.

Figure 16. Locations where Vegetation Stripping Exceeds 50 Percent on Cantwell Creek Floodplain Route.



Note: The full extent of the designated route, established in 2009, is not included on this map.

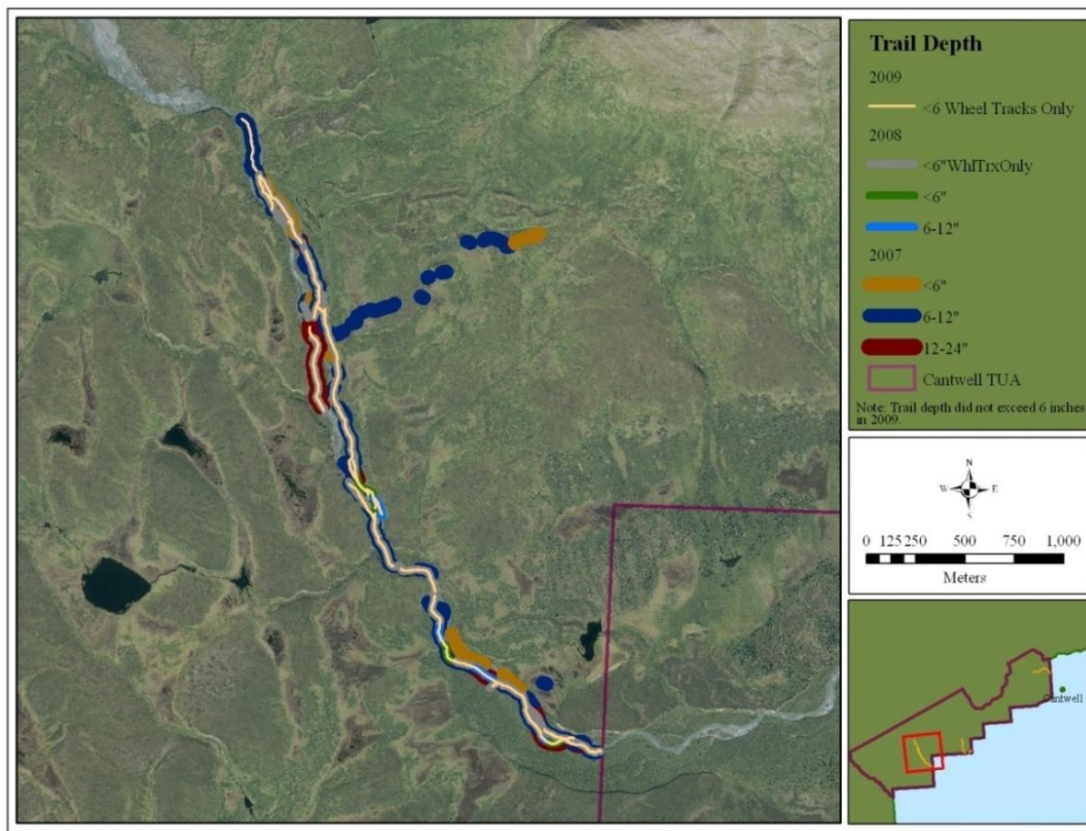
Figure 17. Degree of rutting by year on Cantwell Creek Floodplain Route.

For the short time frame that we have monitored this attribute, it appears that the total trail depth may have diminished somewhat over time. In 2007, the bulk of the trail, 69 percent, was classified as 6 to 12 inches deep (Table 17). In 2008, only 7 percent of the trail was 6 to 12 inches deep and 85 percent was wheel tracks only (Table 17). In 2009, nearly the entire trail was classified as wheel tracks only (Table 17, Figure 18). The reduction in total trail depth among years is likely at least in part due to variation in depth estimation among observers and/or differences in annual conditions that accentuate apparent trail depth, such as higher precipitation and subsequent ponding of water on the surface.

Table 17. Total trail depth by year on Cantwell Creek Floodplain Route.

Year	< 6" Wheel Tracks Only	<6"	6-12"	12-24"	>24"
2007	0 %	15 %	69 %	15 %	1 %
2008	85 %	9 %	7 %	0 %	0 %
2009	100 %	0 %	0 %	0 %	0 %

Note: Total trail depth is expressed as a percent of trail length.



Note. The full extent of the designated route, established in 2009, is not included on this map.

Figure 18. Total trail depth by year on Cantwell Creek Floodplain Route.

Repeat Photography

Repeat photos are used to visually assess trail conditions through time. Figure 4 includes the repeat photo points on Cantwell Creek Floodplain Route. Photos from the repeat photo points are included in Appendix C.

Summary

Windy Creek

ORV use in the Windy Creek area appears to be mostly confined to established, open trails. Side-trails and closed trail sections may be beginning to show signs of recovery and new vegetation growth. Heavily impacted areas, characterized by trail widening in sections with poor drainage, are mostly located outside of the park boundary on the 17B easement. The Denali Trail Crew installed several water bars and bridges to improve drainage and prevent additional rutting on the 17B easement trail. The terminus of the trail was a concern in past years, because there had been several incursions beyond the trail closure sign into a large meadow. Both 2008 and 2009 inspections indicate no obvious signs of major recent use beyond the closure and several previously-mapped trails are now classified as footpaths or game trails. Counter data suggests that ORV use in 2009 declined from previously recorded levels and that most trail users obey trail closure signs. In general, conditions on the Windy Creek Trail appear to have stayed the same or perhaps improved slightly since the inception of the new regulations governing ORV use in the TUA. This is confirmed both by the mapping that we have done and by the repeat photography, both of which indicate some improvement in conditions. This is a positive sign that we hope will continue in future years. One remaining element of concern is the possible continued (albeit greatly reduced) incursions of ORVs into closed areas beyond the trail terminus.

Pyramid Peak

ORV use in the Pyramid Peak area appeared to be primarily confined to established, open trail in 2008-9. The northern trail section shows signs of recovery and new vegetation growth; areas of with heavy vegetation stripping were less common and total trail depth has declined in this section. Both 2008 and 2009 surveys indicated no obvious signs of recent use on the northern section of the trail, which was created by an incursion beyond the posted trail terminus.

There are several sections of this trail that are of concern – with relatively high levels of impact due to the interaction between poor drainage and ORV traffic. However, these areas have not deteriorated during the past three years even with the relatively high levels of use demonstrated by the traffic counters. Continued monitoring of this trail is necessary to ensure that conditions remain relatively stable and that new incursions into closed areas are not occurring from this trail.

Cantwell Creek Floodplain Route

ORV use in the Cantwell Creek route appears to be primarily confined to established, open routes; although trail braiding is common near the park boundary due to heavy use. There remain areas of concern within this segment of the route, especially sites with poor drainage and heavy use, in which rutting and related damages to the substrate persist, and may worsen with increased use. The designated route created this summer should help reduce trail braiding in this area and in the future allow for recovery on unused segments. However, an overall increase in use of this route that may accompany its increased visibility may result in deteriorating conditions over time. This will need to be monitored. The east spur incursion shows some signs of recovery and new vegetation growth. Continued monitoring of the Cantwell Creek Floodplain Route will reveal the results of establishing the new, marked floodplain route in 2009.

References

- Denali National Park and Preserve, (2005). Cantwell Subsistence Traditionally Employed ORV Determination, Final Determination.
- Geospatial Experts, LLC, (2006). GPS-Photo Link (Version 4.0.49 NPS edition) [Computer Software]. Geospatial Experts, LLC.
- Liebermann and Roland. (2006). ORV Use Impacts in the Cantwell Traditional Use Area and adjacent Areas of Denali National Park to 2005: Final Report. Denali National Park and Preserve.
- Liebermann and Roland. (2007) Summary of significant changes in ORV Impacts in the Cantwell TUA area 2005-2007. Denali National Park and Preserve.
- Trafx Research, Ltd. (2008). Trafx Manual: 2007 Edition. [Computer Software]. Trafx Research, Ltd. www.trafx.net
- Trafx Research, Ltd. (2008). Trafx Reporter Manual (Version 6). [Computer Software]. Trafx Research, Ltd. www.trafx.net

Appendix A Repeat Photography for Windy Creek Trail

Repeat photography photo points for Windy Creek Trail are shown on Figure 2 in the main text.

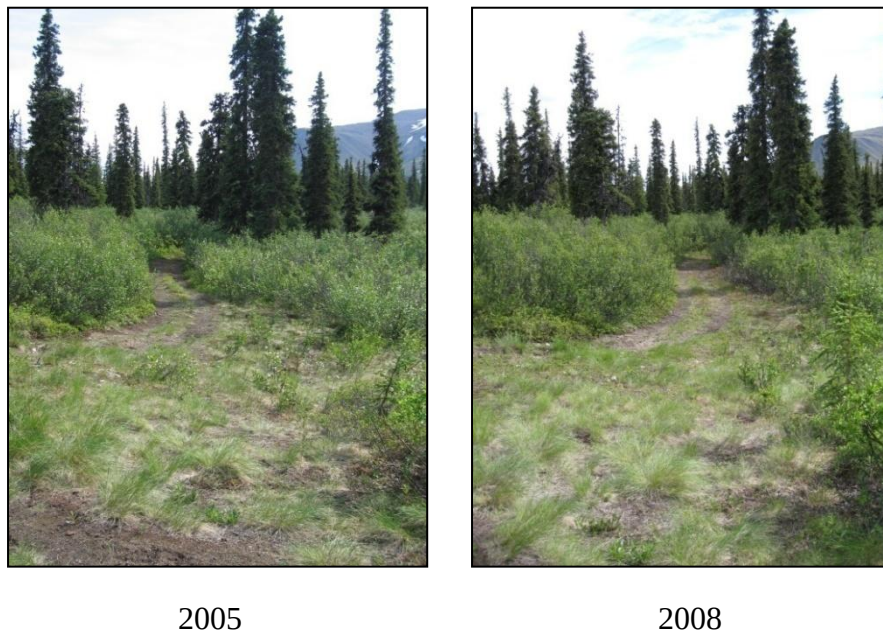


Figure A1. Windy Creek Repeat Photo Point 1. Conditions have remained similar over time. Photos from 2007 and 2009 are not available.

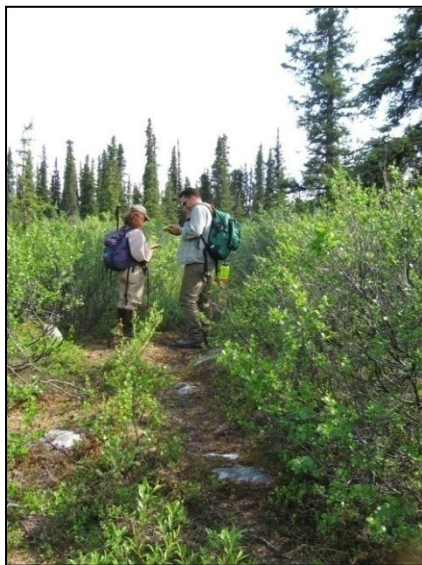


2007



2008

Figure A2. Windy Creek Repeat Photo Point 2. Conditions have remained similar over time. Photos from 2005 and 2009 are not available.

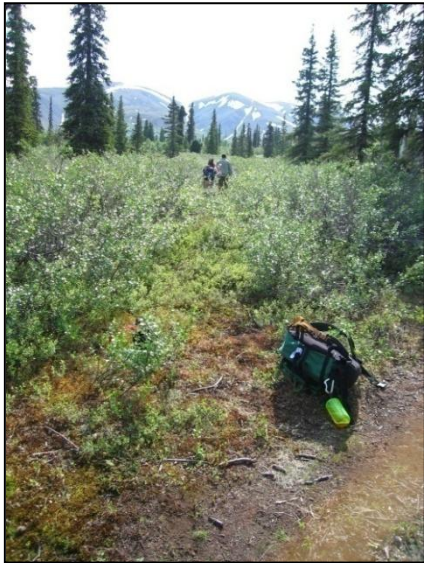


2005



2008

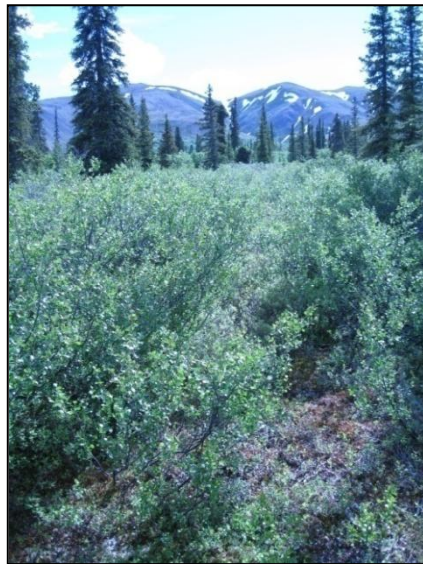
Figure A3. Windy Creek Repeat Photo Point 3. Vegetation cover has increased over time. Photos from 2007 and 2009 are not available.



2005



2007



2008

Figure A4. Windy Creek Repeat Photo Point 4. Vegetation cover has increased over time. Photos from 2009 are not available.

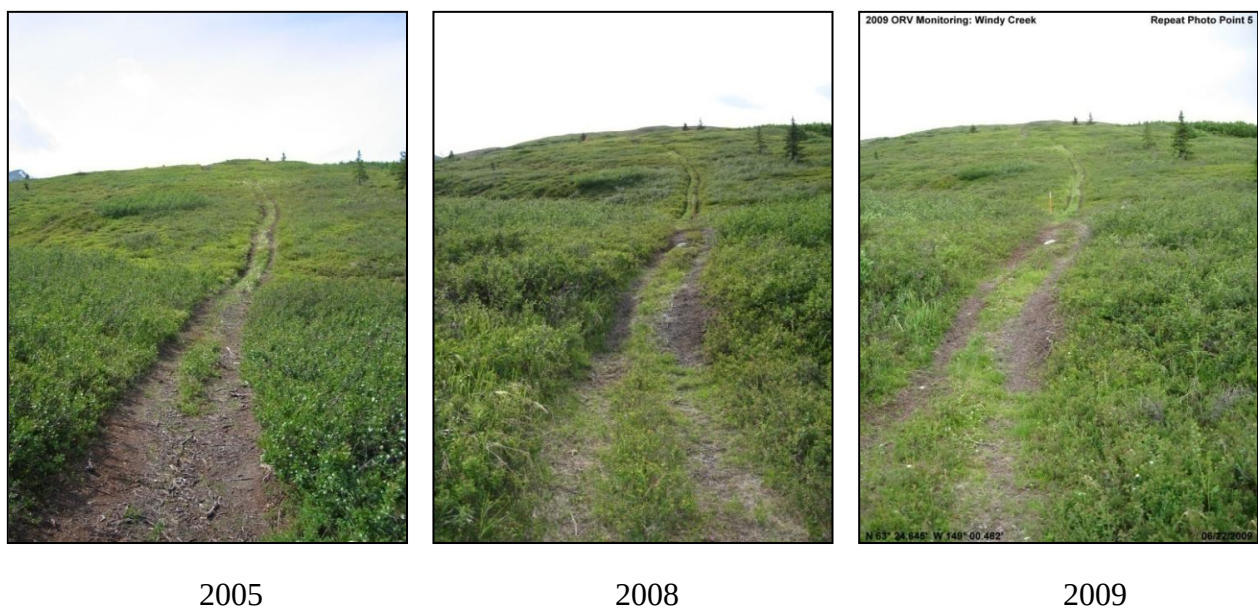


Figure A5. Windy Creek Repeat Photo Point 5. Vegetation cover has increased slightly over time; the degree of rutting has remained similar through time. Photos from 2007 are not available.



2005



2007



2008



2009

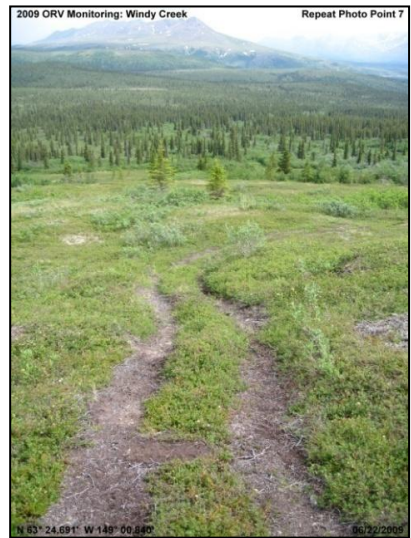
Figure A6. Windy Creek Repeat Photo Point 6. Vegetation cover and the degree of rutting have remained similar through time.



2007



2008



2009

Figure A7. Windy Creek Repeat Photo Point 7. Vegetation cover and the degree of rutting have remained similar through time. Photos from 2005 are not available.



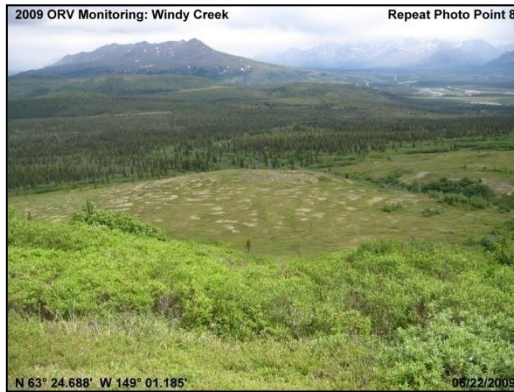
2008



2009



2008



2009

Figure A8. Windy Creek Repeat Photo Point 8. ORV Tracks in the meadow may be less prominent than in 2008. The photo point was established in 2008, thus photos from 2005 and 2007 are not available.

Appendix B Repeat Photography for Pyramid Peak Trail

Repeat photography photo points for Pyramid Peak Trail are shown on Figure 3 in the main text.

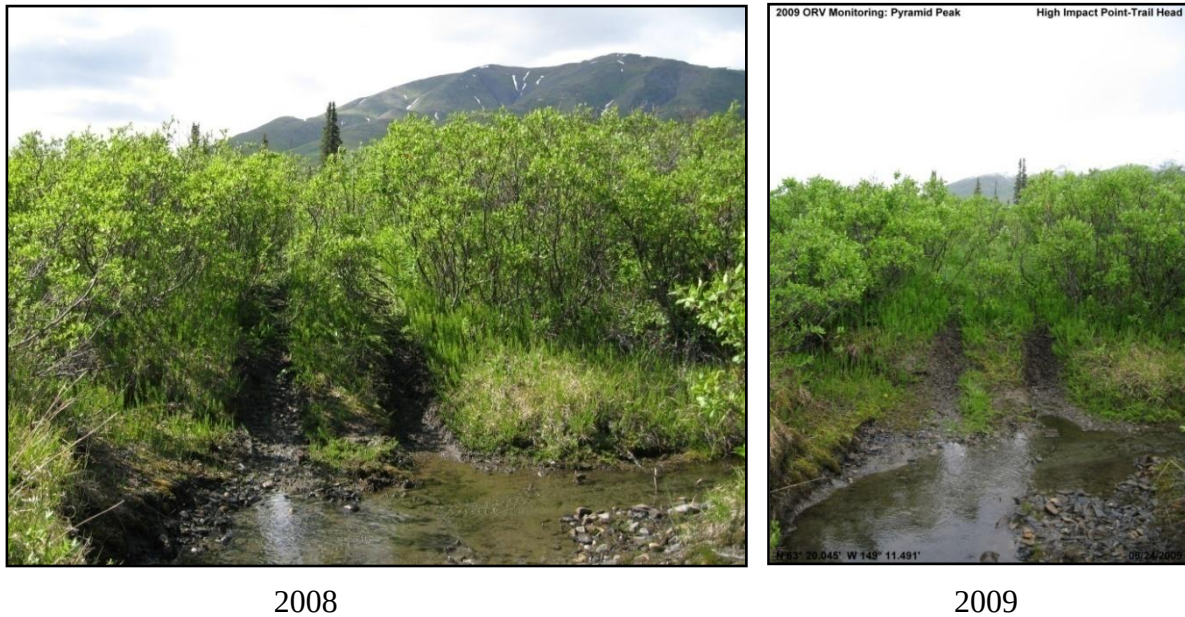
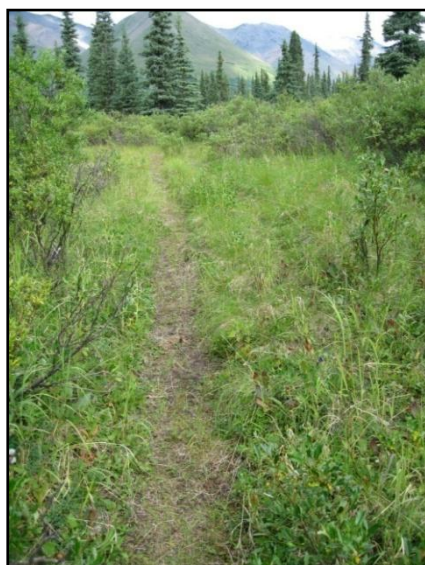
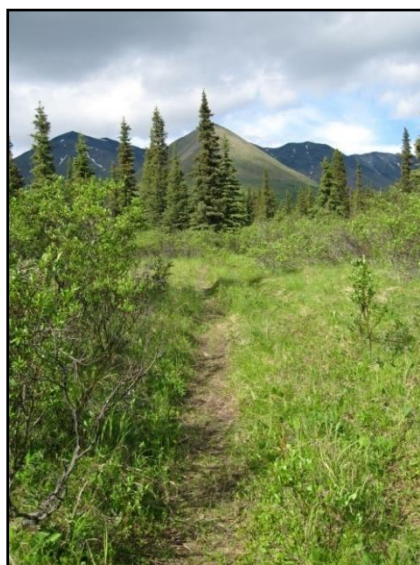


Figure B1. A high impact area near the trailhead of Pyramid Peak Trail. Conditions have remained similar over time.



2007

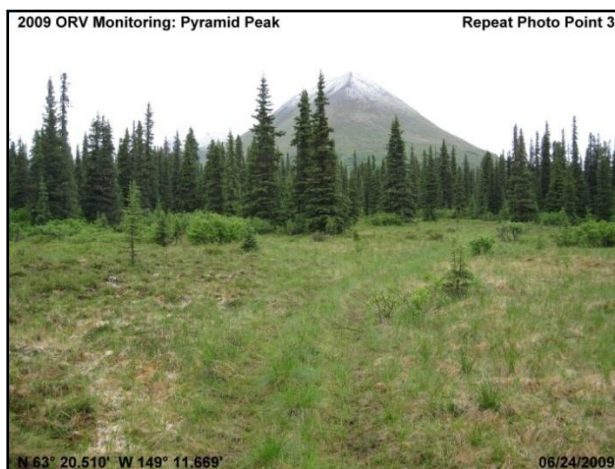


2008

Figure B2. Pyramid Peak Repeat Photo Point 2. Conditions have remained similar over time.



2008



2009

Figure B3. Pyramid Peak Repeat Photo Point 3. Conditions have remained similar over time.



2008



2009

Figure B4. Pyramid Peak Repeat Photo Point 4. Conditions have remained similar over time.



2008



2009

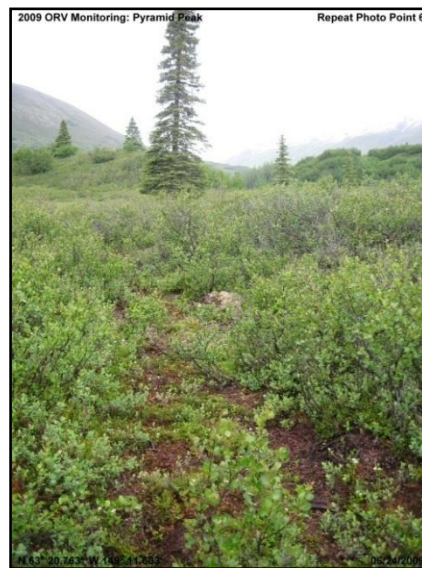
Figure B5. Pyramid Peak Repeat Photo Point 5. Conditions have remained similar over time.



2007



2008



2009

Figure B6. Pyramid Peak Repeat Photo Point 6. Conditions may have deteriorated over time.

Appendix C Repeat Photography for Cantwell Creek Floodplain Route

Cantwell Creek Floodplain Route repeat photo points are shown in Figure 4.

Photos from repeat photo points 1, 2, 3, 8, 13 and 16 were omitted for various reasons (i.e. incomplete photo set or poor photo quality).

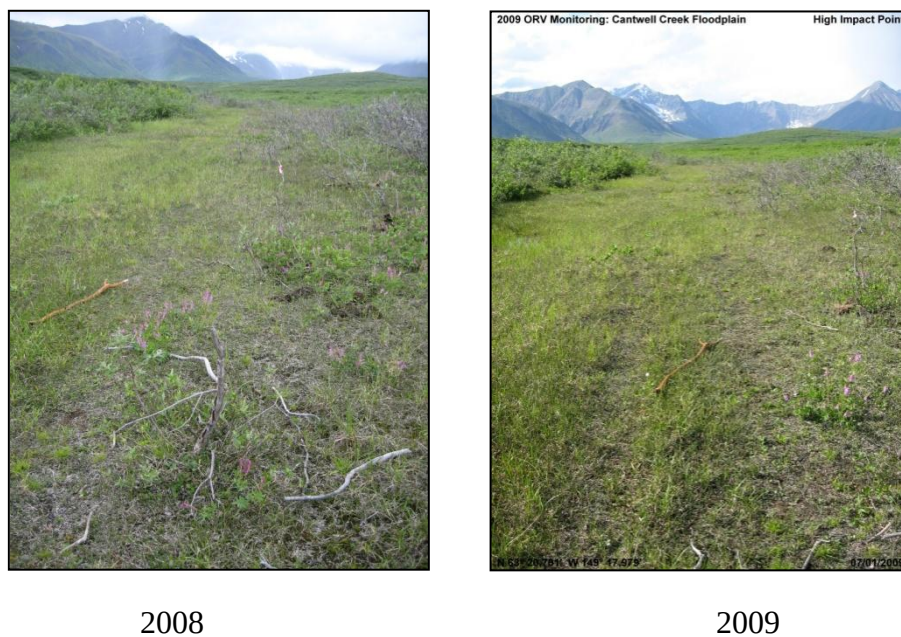


Figure C1. Cantwell Creek Floodplain Route, high impact area. Conditions have remained similar over time.

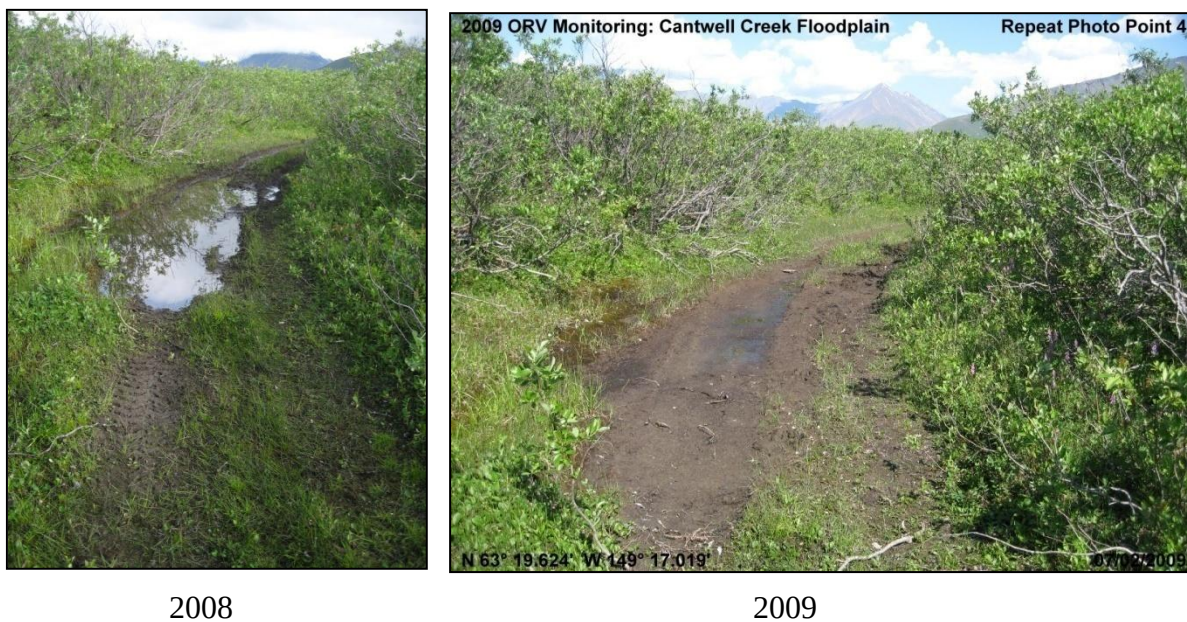


Figure C2. Cantwell Creek Floodplain Repeat Photo Point 4. Conditions were drier in 2009, but otherwise appear similar.

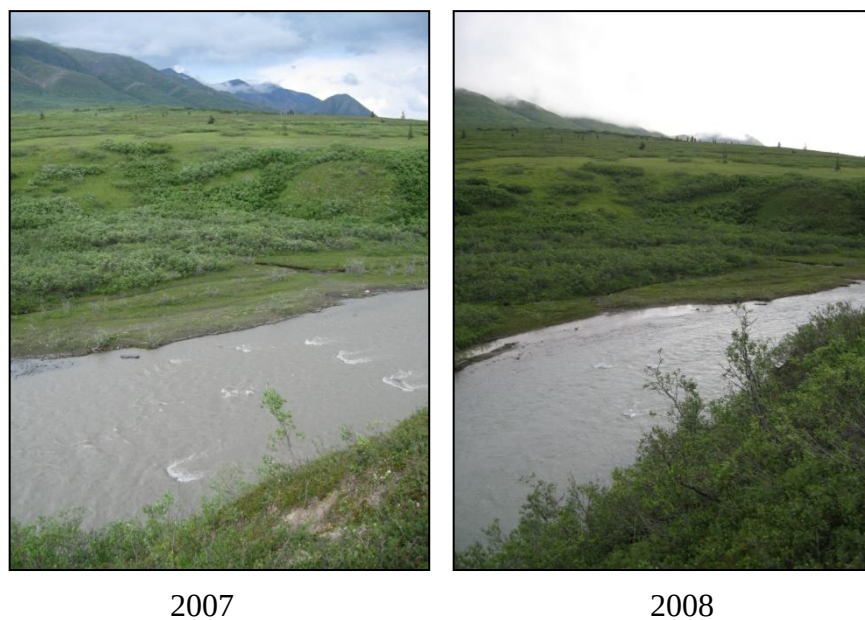


Figure C3. Cantwell Creek Floodplain Repeat Photo Point 5. Conditions appear similar. No 2009 photo.



2007



2008



2009

Figure C4. Cantwell Creek Floodplain Repeat Photo Point 6. Moisture status varies, but conditions appear similar.



Figure C5. Cantwell Creek Floodplain Repeat Photo Point 7. Conditions have remained similar.



Figure C6. Cantwell Creek Floodplain Repeat Photo Point 9. Conditions may have improved, ruts appear less prominent.

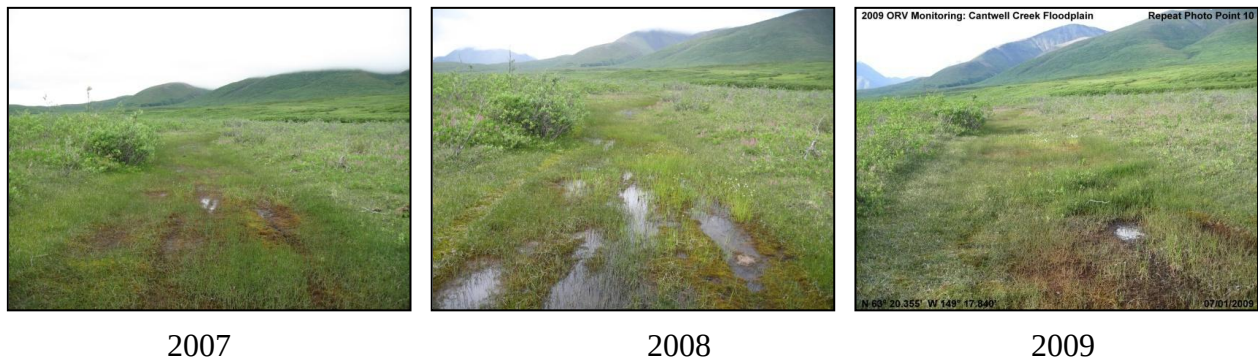


Figure C7. Cantwell Creek Floodplain Repeat Photo Point 10. Conditions may have improved, ruts appear less prominent.

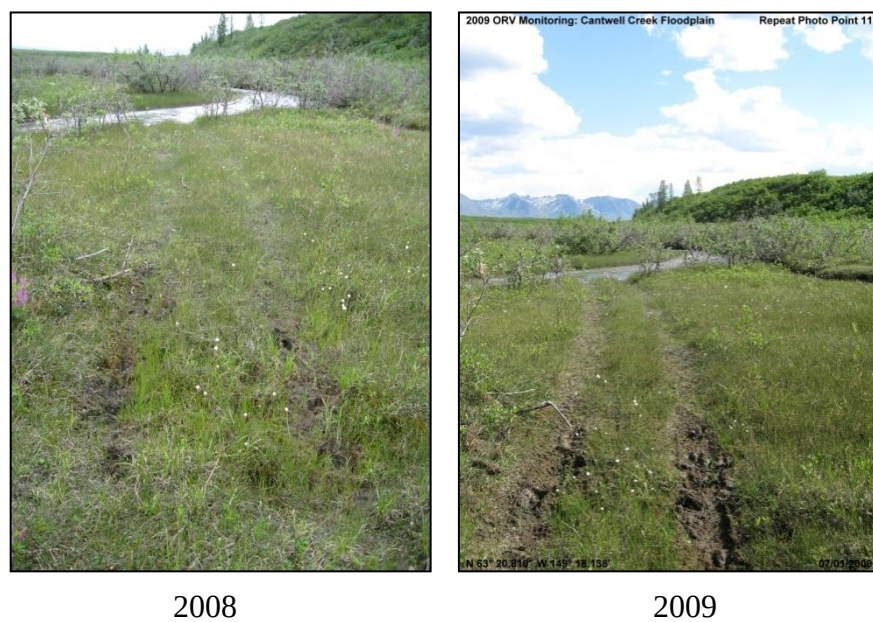


Figure C8. Cantwell Creek Floodplain Repeat Photo Point 11. Conditions have deteriorated.



2008



2009

Figure C9. Cantwell Creek Floodplain Repeat Photo Point 12. Conditions appear similar.



2008



2009

Figure C10. Cantwell Creek Floodplain Repeat Photo Point 14. Conditions appear similar.



2008



2009



2008



2009

Figure C11. Cantwell Creek Floodplain Repeat Photo Point 15. Moisture status varies, but conditions appear similar.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 184/105807, October 2010

National Park Service
U.S. Department of the Interior



Natural Resource Program Center

1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

www.nature.nps.gov

EXPERIENCE YOUR AMERICA™