



Lake Canyon Trail Expansion

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WT 150 50 114

SUMMARY

Objective

Expanding the Lake Canyon Multi-use Trail System, meeting 30 SLD goals for Outdoor Recreation, Space to Explore initiative, and 30 SLD/CC Strategic Goals.

Goals

Increase easy access to Lake Canyon from the Main Cantonment area adjacent to the parade ground. Add approximately 4.5 miles to Recreational Trails, providing additional opportunities for recreation near the lakes and campground. Establish a Mountain Biking course for annual events that minimizes impact on base resources and maintains separation from mission-critical facilities.

Methods

Our methods for trail expansion are rooted in sustainability. We will utilize existing trails and legacy dirt roads and design new natural surface trails that will adhere to sustainable practices and ensure compliance with Natural Resource Conservation plans. By building out the trails with in-house resources and volunteers, we aim to create a sense of ownership and responsibility for those who will use and benefit from the project. We also plan to establish new access points along New Mexico Avenue across from the parade grounds, ensuring convenience without compromising on sustainability.

Project Outline

- Create conceptual design
 - Map out possible trail corridor
 - Utilize existing roads in the area for access points
 - Include legacy roads as much as possible if they can meet current sustainable trail standards
 - Assess the design for natural resource conservation issues
 - Complete Work Order approval
 - Develop a plan to include in-house resources as much as possible
 - Plan for Volunteer Work
 - Flag the trail corridor
 - Construction
 - Trim trail corridor using minimal impact machinery and hand-clearing
 - Fine-flag the exact trail tread location within the trail corridor
 - Use minimal-impact machinery and build the trail tread
 - Use hand tools and small power tools for sensitive areas and to finish machine work
 - Signage
 - Add a small Kiosk to the trailhead
 - Post trail markers at intersections
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TRAIL DESIGN

ELEMENTS OF SUSTAINABLE TRAILS

The trail project's conceptual design follows established methods for creating sustainable trails. The concept is that of rolling contour trails that resist erosion. Therefore, the general route gently traverses a hill or side slope. It follows the contours of the terrain, either climbing or dropping at reasonable grades. It incorporates undulations called grade reversals with a tread that slightly tilts towards the downhill edge (out sloping). These design features allow water to drain in a non-erosive manner called sheet flow.

There are five essential elements: the Half Rule, Ten Percent Average Guideline, Maximum Sustainable Grade, Grade Reversals, and Outslope.

The Half Rule. The trail grade should be at most half the side slope. Any trail that exceeds this rule is considered a fall-line trail; water will run down rather than across it. It is essential to manage this along the rim of the mesas since the side slope can be shallow. The upper limit to this rule is the maximum sustainable grade.

10% Average Guideline. The overall average trail grade for the project will be at most 10 percent. This aids in planning and has proven to apply to most soil conditions. It will minimize user-caused erosion while allowing some design flexibility. It also provides for future reroutes and accommodates undulation in the terrain.

Maximum Sustainable Grade. Trail segments will vary in gradients as they rise or descend. The maximum grade is the steepest section of the trail, which is more than 10 feet long. It is based on soil type, annual rainfall, and types and numbers of users. Based on these factors and experience with existing trails, the maximum grade for this project is 18%.

Grade Reversals. Grade reversals, also known as grade dip, grade brake, drainage dip, and rolling dip, are frequently used in this project. Depending on soil conditions, one will be included at 20 to 50-foot intervals.

Outslope. The tread will tilt slightly down and away from the high side. It encourages water to sheet across and off the trail instead of funneling down its center. This project will use a 5% out sloping.

DESIGN ASSESSMENT

Land managers must carefully assess the proposed trail corridor in areas such as natural resources, cultural resources, range, recreation, and infrastructure. This may result in modifications to the trail routes or define mitigation measures during construction. Some of this is done before creating a work request and completed during the work order coordinating process.

CONSTRUCTION DETAILS

TRIMMING TRAIL CORRIDOR

Once the trail corridor is flagged, vegetation will be cleared along the route. Figure 1 details the vegetation types of each section of the trail. The vegetation is classed into four distinct types: Sparse Chaparral, Sparse Overgrowth, Mixed Oak, and Open Oak Understory.

The entire project area lies within the 2009 Highway Fire. Regeneration of typical Burton Mesa Chaparral and Mixed Oak Woodlands is progressing. Some places are overrun with invasive species, but overall, the project area is predominantly native species. The terrain is an elevated mesa deeply divided by several drainages that form the larger Lake Canyon and Creek to the south.

Name	Length	Veg Type	Tread	Side Slope	Description
Nebraska Trail 01	0.24	Sparse Overgrowth	Old Road Bed	Flat	Small Masticator
Nebraska Trail 02	0.29	Mixed Oak	Partial Bench	3 to 10%	Small Excavator
Nebraska Trail 03	0.98	Sparse Chaparral <4'	Flat	0 to 5%	Raked
Nebraska Trail 04	0.02	Open Oak Understory	Bench Cut	5 to 15%	Small Excavator
Nebraska Trail 05	0.70	Sparse Chaparral <4'	Flat	0 to 5%	Raked
Nebraska Trail 06	0.19	Mixed Oak	Partial Bench	3 to 10%	Small Excavator
Nebraska Trail 07	0.36	Open Oak Understory	Bench Cut	5 to 15%	Small Excavator
Nebraska Trail 08	0.18	Sparse Overgrowth	Old Road Bed	Flat	Hand Tools
Lake Canyon Reroute Sec. 01	0.20	Open Oak Understory	Bench Cut	>15%	Small Excavator
Lake Canyon Reroute Sec. 02	0.10	Mixed Oak	Partial Bench	<5%	Hand Tools
Mesa 01	0.59	Sparse Chaparral <4'	Flat	<3%	Small Masticator, Raked
Mesa 02	0.12	Mixed Oak	Partial Bench	<5%	Hand Tools
Mesa 03	0.11	Sparse Chaparral <4'	Flat	<3%	Small Masticator, Raked
Barrow Trail 01	0.35	Open Oak Understory	Bench Cut	5 to 15%	Small Excavator
Barrow Trail 02	0.37	Mixed Oak	Old Road Bed	5 to 20%	Acacia - Masticator

Fig. 1 Trail Segment Stats

Most of the trail sections are located along the rim of the mesas in transition zones between vegetation types. The rim area is characterized as Sparse Chaparral. Vegetation here is not continuous and is mainly under 4 feet deep. The predominant shrub is chamise, mixed with sage, ceanothus, manzanita, and associated plants. There are some areas dominated by manzanita. The soil is predominantly a hard-packed shale.

The trail layout will minimize impacts to the scrub by selectively routing through the area and avoiding sensitive areas and vegetation. Using a small masticator supervised by an experienced trail developer will significantly speed up the process and chip the vegetation in place rather than a cut-and-pile method of clearing. The width of the clearing here will be no wider than 6 feet (3 feet on either side of the trail centerline) and less where sensitive areas might be impacted.

Mixed Oak is characterized by young oak regeneration with mixed chaparral. Trail layout of this type is typically designed to avoid impacting oak regeneration while keeping an eye on the eventual development of the oak canopy. A small masticator under strict supervision is desired, with some sections designated as hand tools only.

The Open Oak Understory is characterized by a well-developed oak canopy with an understory dominated by poison oak. The trail layout here will be sensitive to avoiding impacts on tree roots. Corridor clearing will be limited to poison oak removal and judicious pruning of shrubs and small tree limbs. This will be accomplished using hand tools and a small excavator during tread construction. These areas are generally along side-slopes of greater than 10%, requiring a bench cut.

▼ Sparse Overgrowth	0.32			
Nebraska Trail 01	0.14	Old Road Bed	Flat	Hand Tools
Nebraska Trail 08	0.18	Old Road Bed	Flat	Hand Tools, Raked
▼ Sparse Chaparral <4'	2.38			
Nebraska Trail 03	0.98	Flat	0 to 5%	Small Masticator, Raked
Nebraska Trail 03	0.70	Flat	0 to 5%	Small Masticator, Raked
Mesa 01	0.59	Flat	<3%	Small Masticator, Raked
Mesa 03	0.11	Flat	<3%	Small Masticator, Raked
▼ Mixed Oak	1.03			
Nebraska Trail 02	0.29	Partial Bench	3 to 10%	Small Excavator
Nebraska Trail 06	0.15	Partial Bench	3 to 10%	Small Excavator
Lake Canyon Reroute Sec. 02	0.10	Partial Bench	<5%	Hand Tools
Mesa 02	0.12	Partial Bench	<5%	Hand Tools
Barrow Trail 02	0.37	Old Road Bed	5 to 20%	Acacia - Masticator
▼ Open Oak Understory	0.93			
Nebraska Trail 04	0.02	Bench Cut	5 to 15%	Small Excavator
Nebraska Trail 07	0.36	Bench Cut	5 to 15%	Small Excavator
Lake Canyon Reroute Sec. 01	0.20	Bench Cut	>15%	Small Excavator
Barrow Trail 01	0.35	Bench Cut	5 to 15%	Small Excavator

Fig. 2 Distance through Vegetation Types

Sparse overgrowth is associated with old road beds that crisscross the project area. Some removal of the overgrowth will be required to establish a single-track trail on the old roadbed to allow the natural regeneration of local species.

This layout completely avoids riparian vegetation except where the trail must cross. Every effort was made to select the narrowest passage across. Three small bridges will span these crossings. The foliage will be judiciously pruned back and then allowed to restore itself around the bridges.

Clearing the trail corridor opens the path for establishing the trail tread. The trail segments through Sparse Chaparral total 2.6 miles with Open Oak Understory at 0.85 miles, Mixed Oak at 0.69 miles, and Sparse Overgrowth on old road beds totaling 0.42 miles (see Fig. 2)

TREAD CONSTRUCTION

Three general tread construction techniques are Full-Bench, Partial-Bench, and Flat. The Full-Bench method is the preferred method. It involves cutting the entire width of the tread into the hillside and dispersing loose soil (See Fig. 3). The tread is out-sloped by 3% to 5%. It is more durable and requires less maintenance since the tread is naturally compacted and undisturbed.

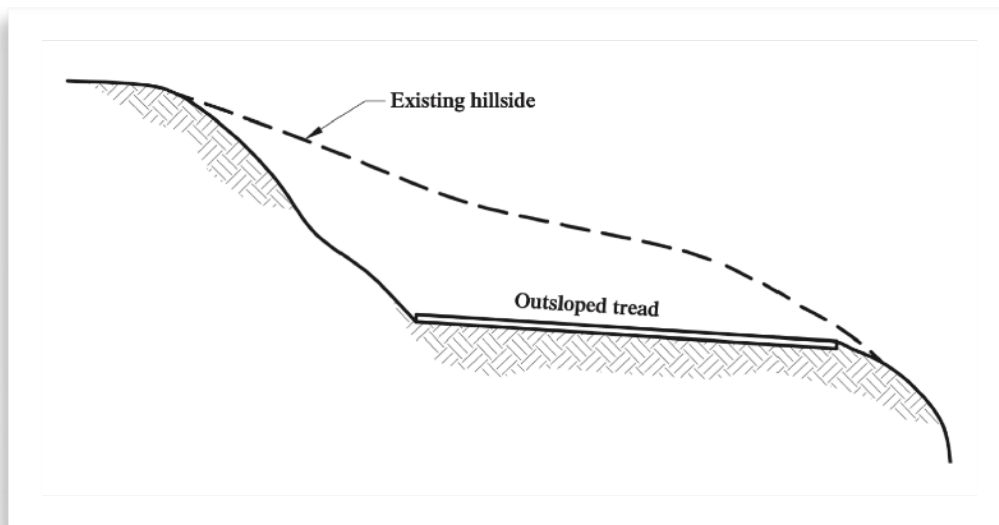


Fig. 3 Full-Bench Construction
USFS Trail Construction and Maintenance, 2007 pg. 52

Partial-Bench construction is part hillside cut and part fill material (Fig. 4). The fill slope must be composed of good, solid material and compacted evenly. The tread is out-sloped by 3 to 5%.

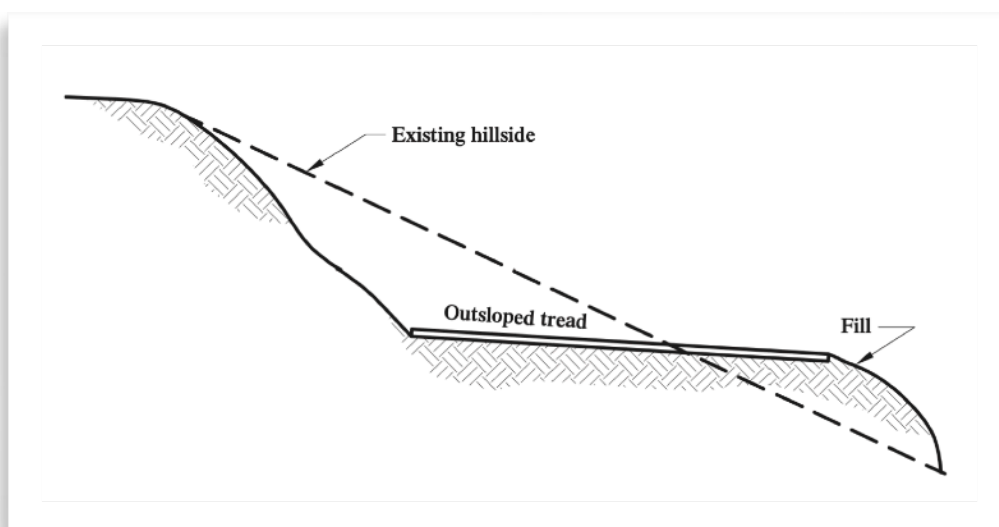


Fig. 4 Partial-Bench Construction
USFS Trail Construction and Maintenance, 2007 pg. 52

Flat ground tread construction is accomplished on slopes of 3% or less. It involves removing any obstructions within the tread, such as debris and rocks. This is done by hand raking or using a small farm rake pulled by a narrow ATV (Fig. 5). Little to no digging is involved, and only to even out small tread sections.

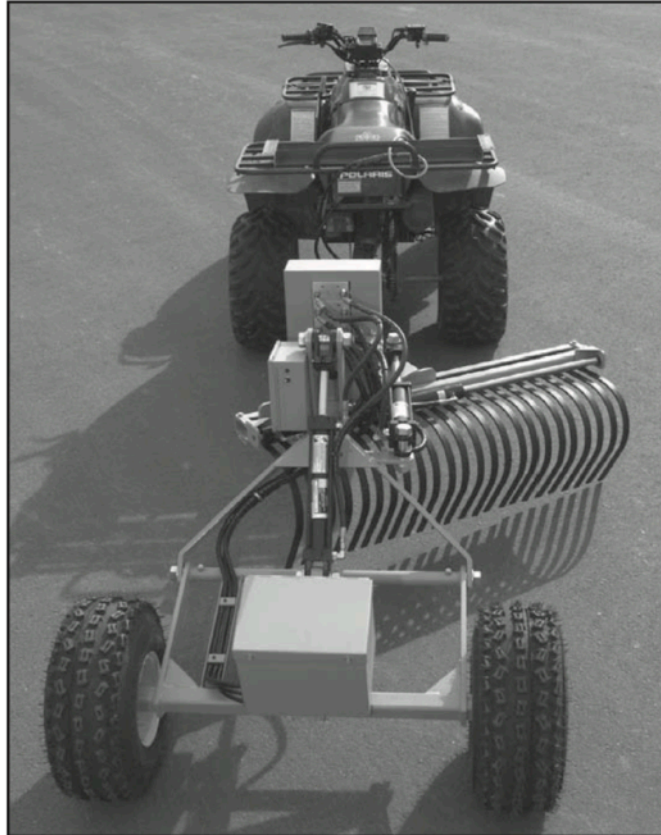


Fig. 5 Farm Rake

USFS Trail Construction and Maintenance, 2007 pg. 158

The preferred method is to use mechanized equipment for bench cutting. Mini-excavators can excavate tread and move material and rocks from place to place. This project is conducive to using the mini-excavator rather than a trail dozer. Wherever mechanized equipment is used, all finish work is done by hand tools. Building bench-cut trails by hand tools alone is labor intensive, while mechanized equipment can complete 1/4 mi. or more daily. The total amount of trail to be built by mini-excavator is approximately 1 mile (Fig. 6).

The backslope is the excavated, exposed area above the tread surface. It should match the angle of repose of the parent material (the side slope). Most areas are stable with a 1:1 backslope (rise to run). Depending on the stability of the soils, the back slope may be greater or less than 1:1.

Finish work involves shaping the tread surface, dispersing loose soil, compacting the tread where needed, and covering the soil with duff if available.

TRAIL SPECIFICATIONS

▼ Bench Cut		0.94			
Nebraska Trail 04	0.02	Open Oak Understory	5 to 15%	Small Excavator	
Nebraska Trail 07	0.37	Open Oak Understory	5 to 15%	Small Excavator	
Lake Canyon Reroute Sec. 01	0.20	Open Oak Understory	>15%	Small Excavator	
Barrow Trail 01	0.35	Open Oak Understory	5 to 15%	Small Excavator	
▼ Old Road Bed		0.69			
Nebraska Trail 01	0.14	Sparse Overgrowth	Flat	Hand Tools, Raked	
Nebraska Trail 08	0.18	Sparse Overgrowth	Flat	Hand Tools, Raked	
Barrow Trail 02	0.37	Mixed Oak	5 to 20%	Acacia - Masticator	
▼ Partial Bench		0.66			
Nebraska Trail 02	0.29	Mixed Oak	3 to 10%	Small Excavator	
Nebraska Trail 06	0.15	Mixed Oak	3 to 10%	Small Excavator	
Lake Canyon Reroute Sec. 02	0.10	Mixed Oak	<5%	Hand Tools	
Mesa 02	0.12	Mixed Oak	<5%	Hand Tools	
▼ Flat		2.38			
Nebraska Trail 03	0.98	Sparse Chaparral <4'	0 to 5%	Small Masticator, Raked	
Nebraska Trail 05	0.70	Sparse Chaparral <4'	0 to 5%	Small Masticator, Raked	
Mesa 01	0.59	Sparse Chaparral <4'	<3%	Small Masticator, Raked	
Mesa 03	0.11	Sparse Chaparral <4'	<3%	Small Masticator, Raked	

Fig. 6 Types of Tread Construction

Design Feature	Specification	Notes
Tread Width	30 Inches	Can be modified for specific situations but not more than 60 in. and no less than 12 in.
Trail Corridor - Flat Ground	5 feet	2.5 feet from centerline of trail
Trail Corridor - with Sideslope	4 feet uphill, 2 feet downhill	Measured from centerline of trail
Overall Grade	10%	Average of the entire trail
Maximum Sustainable Grade	18%	Over 10 feet in length
Grade Reversals - Frequency	every 20 to 50 feet	
Grade Reversal - Length	minimum of 15 feet	From high point to high point

Attachment: Lake Canyon Trail Project Maps.pdf (15 pages)