



Bear Creek Watershed Trails Assessment

Assessment prepared by:
Amber Shanklin, RMFI Program Director

November 14, 2012

815 South 25th St, Suite 101 Colorado Springs, CO 80904

719.471.7736 rmfi@rmfi.org

Table of Contents

Background	3
Introduction	4
Project Areas.....	6
Zone A (USFS).....	6
Zone B (CSU)	11
Zone C (CSU).....	15
Zone D (CSU)	25
Zone E (USFS)	31
Zone F (USFS)	35
Zone G (USFS).....	40
Zone H (CSU)	43
Zone I (USFS)	46
Zone J (CSU)	50
Zone K (City of Colorado Springs)	54
Reroutes.....	58
Acknowledgments.....	66
Contact Information.....	66
Appendix A.....	67

Background

The Bear Creek Watershed lies just west of the City of Colorado Springs along the eastern flank of the Pikes Peak Massif (38°48'15", 104°55'30"). Encompassing National Forest lands administered by the Pike National Forest, private lands owned by Colorado Springs Utilities (CSU), and lands administered by the City of Colorado Springs, the watershed is extremely important for its recreational opportunities, its value as a water resource, and as vital habitat for the threatened greenback cutthroat trout (*Oncorhynchus clarki stomias*).

Recent studies have shown that Bear Creek is the location of the last surviving wild population of the federally protected greenback cutthroat trout. The US Fish and Wildlife Service will soon go through the process of reevaluating the taxonomy and status of this species, much of which will depend on current and future threats to the fish and its habitat.

The trail is popular for hiking, horseback riding, mountain biking, and off-highway vehicles (motorcycles). Impacts due to the recreational use of the trail are exacerbated by the highly erodible soils composed of Pikes Peak granite. The resulting conditions include trail outslope failure, severe over-steepening, poor drainage, and vegetation loss along cutslope sections of the trail.

The Rocky Mountain Field Institute (RMFI) has been involved in habitat improvement projects in the Bear Creek Watershed since 2009. The majority of work was completed in 2010 and focused on improving areas along the corridor of Trail #667. This area was eroding and causing sediment to be deposited into Bear Creek. Approximately 5,600 square feet of unsustainable trail was closed and restored and more than 1,200 linear feet of new trail was constructed. Failing slopes were stabilized and revegetated, 7 water bars were constructed to move water from the trail, stream banks were reconstructed, 15 rock and timber risers were installed in-trail to minimize sediment movement, and 18 check dams were strategically placed to catch sediment prior to in-stream deposition. The Bear Creek Watershed requires cautious water diversion to avoid stream sediment deposition. Waterbars and risers are crucial to reducing trail downcutting in certain situations; however, both structures need to be carefully planned in this watershed to move water from the trail only when the stream will not be impacted. Due to the unstable nature of the soils in this region and the recreational use of this trail, many of the structures placed in 2010 require regular maintenance. Brush and rock check dams are capable of capturing sediment before it reaches the stream; however, these structures fill quickly and regular sediment removal is required for continued proper functioning. Work during the 2011 field season focused on maintaining structures originally installed in 2010 as well as construction of additional sediment detention structures. Twenty-four additional structures were constructed and 18 structures were maintained with an estimated 1,296 cubic feet of sediment captured and removed from in-place structures. RMFI completed 2 days of work in 2012. Seven check dams were maintained, a total of 504 cubic feet of material was removed from the structures.

Introduction

Trails are separated into Zones (A-K) for discussion in this assessment (Figure 1). Each Zone discussion is broken into 3 sections: *Existing Conditions*, *Possible Solutions*, and *Continued Maintenance*. The *Existing Conditions* section will discuss the location of each zone and current trail conditions including known locations of existing structures. This section also includes any social trails found within the zone. *Possible Solutions* will focus on the type and number of structures that could be installed to bring the trail back up to grade and provide stabilization for the trail tread, thus reducing sediment transport into Bear Creek. Though social trail structures are discussed in this section, structures will not be shown on the map since the future of these social trails is unknown. Finally, the *Continued Maintenance* section will provide information regarding any annual and biennial maintenance on pre-existing structures within each zone. Many of the erosion control structures put in place by RMFI were designed as short-term solutions. Sediment transportation can be expected to continue once the storage capacity of any of these structures has been reached. Regular maintenance (cleaning the catchment basins by removing the sediment) is required on a regular basis to ensure continued effectiveness. Maintenance schedules will vary based upon annual rainfall; any maintenance suggestions found within this document are based upon an average precipitation year.

There is also a *Reroute*¹ section near the end of the document that discusses potential reroutes to relocate the existing trail away from Bear Creek. Potential reroutes found in this document are not intended to be exact; potential trail corridors were examined but proper alignment would take additional exploration and determination.

Initial exploration of trails within the Bear Creek Watershed indicated that the Forest Service GIS trail layer was inaccurate. Visible trails were digitized from LIDAR data received from Colorado Springs Utilities and ground truthed (Figure 21).

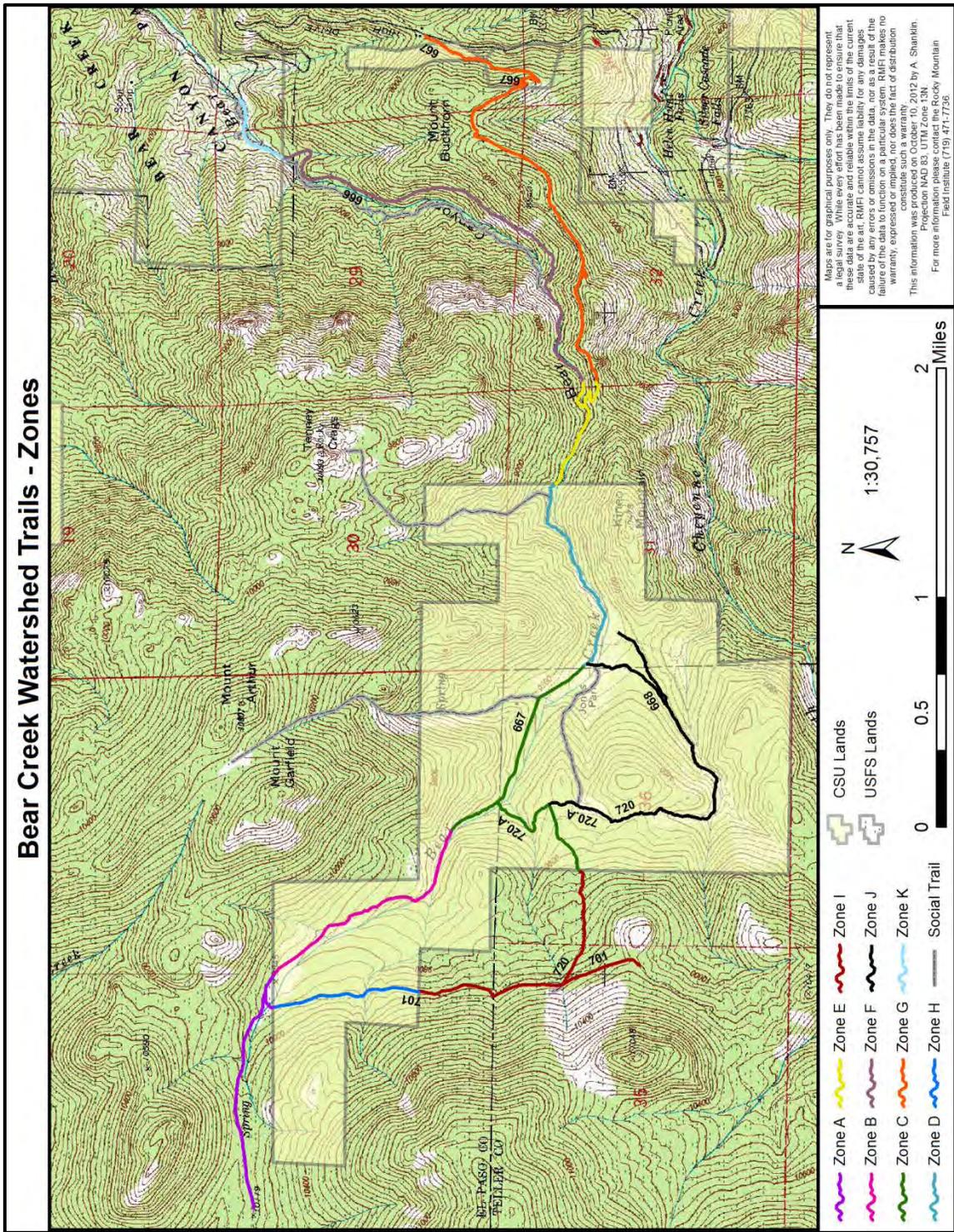
The Rocky Mountain Field Institute assessed 11.9 miles of designated trail within the Bear Creek Watershed and an additional 4.5 miles of social trails². We documented 2.75 miles of eroded system trails and 3.8 miles of non-system trails in need of repair or restoration and located over 100 different locations requiring maintenance and/or stabilization. In addition, approximately 4.6 miles of potential reroutes were evaluated.

A Trimble GeoXH receiver was used to collect GPS data. All GPS data was collected with Projected Coordinate System UTM, NAD83 Zone 13N. All GIS data and associated photos will be provided to land owners separately. Please contact the Rocky Mountain Field Institute with any additional questions.

¹ Reroutes were assessed by RMFI staff. RMFI does not specialize in motorized trail design. In this document RMFI is providing reroute possibilities, but does not endorse any particular route suggestion. Trail alignment and further route planning may include areas that will require engineered solutions and/or a motorized trail design expert.

² Suggestions regarding social trail closure and/or stabilization of social trail tread found throughout this document are not intended to make recommendations on the future of these trails. Land management agencies will make the final decisions concerning the future of all trails; RMFI offers suggestions for both closure and stabilization within this document.

Figure 1. Bear Creek Watershed Trail broken out by assessment zones.



Project Areas

Zone A (USFS)

Existing Conditions

This zone lies within the Pike National Forest and currently dead ends at the Colorado Springs Utilities South Slope watershed. The length of trail included in this zone is approximately 4,870 feet. Substantial downcutting, erosion, and gully formation can be found within the trail corridor of Zone A. Approximately 1,650 feet (34%) of the trail exhibits tread downcutting within Zone A.

There are currently 16 check dams within Zone A. Constructed of rock or brush, these dams are designed to capture sediment before it reaches the stream. Check dams traditionally require regular maintenance to remove trapped sediment and to ensure continued sediment capture. There are also 2 in-trail drains in this section, 6 timber risers, and one bridge. The drains are constructed of rock and are designed to create a clear path for water seeps to cross the trail without running down the trail and picking up sediment. Risers can be constructed of rocks or timber and are designed to reduce the speed of water as it moves down the trail. They create sheet flow water movement as opposed to water downcutting into the trail. The bridge (Photo 3) within Zone A is located where Trail #667 connects with Trail #701. The section of trail north of the bridge (#667) is relatively flat and open while the south section of the trail (#701) is on an incline. Sediment is currently entering the stream from both sides of the bridge. There are also 2 locations along the trail where unstable slopes were reinforced with timber or rock retaining walls. Retaining walls are designed to reduce the chances of slope failure along trails. These retaining walls are functioning as planned. Photos 1-5 show existing conditions throughout Zone A.

Table 1. Existing Structures in Zone A

Features	Count
Wood bridge	1
Timber risers	6
Brush check dam	13
Rock check dam	3
In-trail drain	2
Slope reinforcement/stabilization	2

Possible Solutions

RMFI estimates that 217 rock or timber risers could be constructed in this zone to stabilize the trail tread. Risers would bring the trail back up to grade and provide stabilization for the trail tread. Three

additional brush check dams and an additional retaining wall would minimize sediment transfer into the stream. Figure 2 shows the general location of the “Possible Solutions” structures³.

Table 2. Possible solutions in Zone A

Features	Count
Add rock or timber risers	217
Add retaining wall	1
Add brush check dam	5

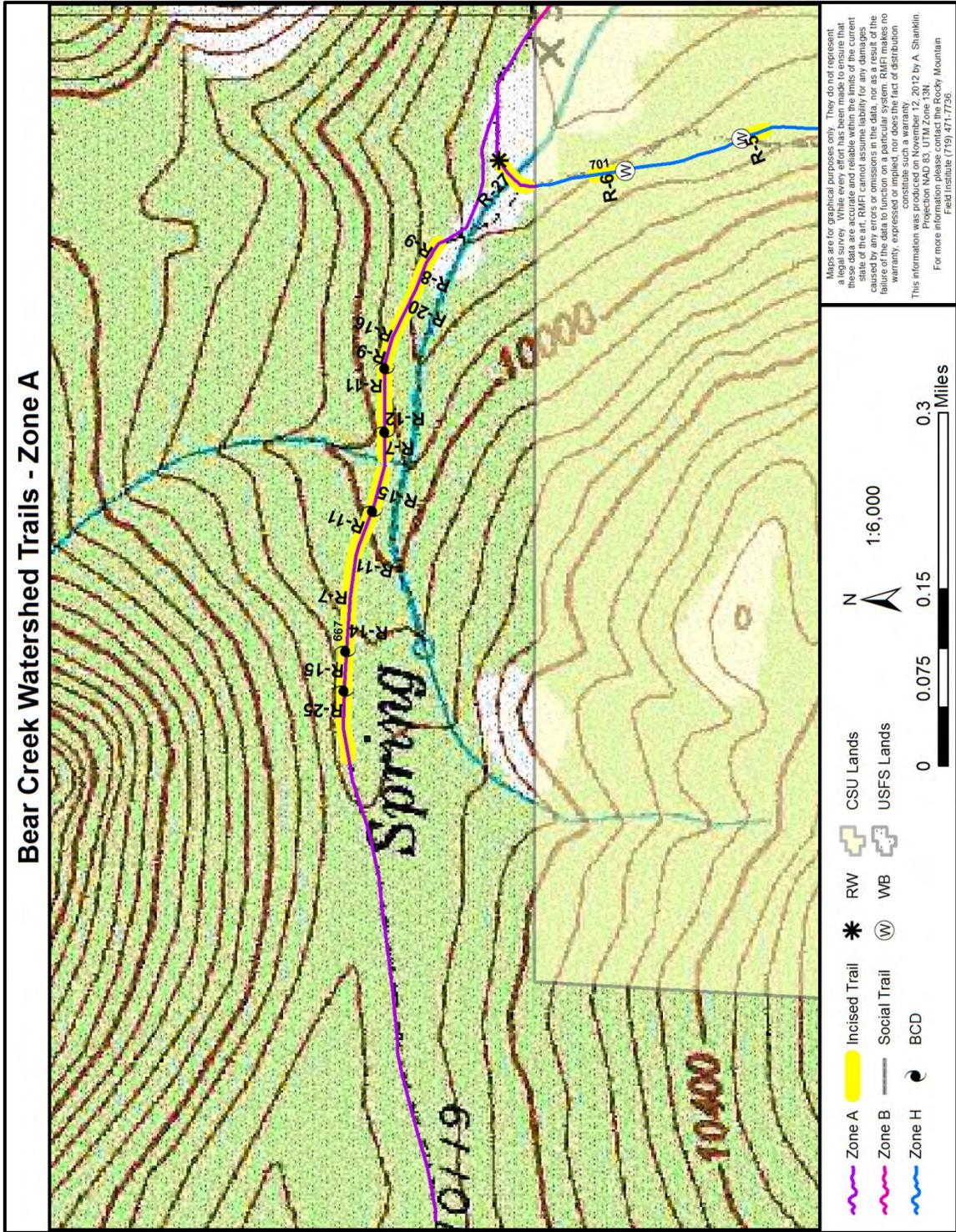
Continued Maintenance⁴

Annual maintenance is suggested for 16 total check dams (13 brush, 3 rock) in this Zone. Sediment should be removed from the dams, the catchment basin should be recontoured, and limbs within the brush dams should be replaced as necessary.

³ “Incised Trail” delineation on map indicates areas where the trail is downcutting. Each “Incised Trail” delineation is associated with a label on the map (“R-#”). These labels indicate the number of risers suggested to bring the trail back up to grade and to minimize further downcutting. Any installation of structures should be completed by trained individuals to ensure proper placement and construction.

⁴Maintenance requirements are based upon existing trail corridor structures. Maintenance of future structures should be determined by evaluating all associated trail corridor structures, new and existing. Additional work may change the annual requirements of existing structures and should be accounted for when determining the maintenance of any future placed structures.

Figure 2. Map of possible solutions for trails in Zone A.



Overview of Zone A



Photo 1. Erosion and downcutting along trail. Possible Solutions – construct 20 timber risers.



Photo 2. Erosion and downcutting along trail. Possible Solutions – construct 15 timber risers.



Photo 3. Sediment from trail entering stream. Possible Solutions – construct retaining wall.



Photo 4. Sediment deposition area.
Possible Solutions – add 2 brush check dams.



Photo 5. Functional brush check dam.
Possible Solutions – maintain by removing sediment.

DRAFT

Zone B (CSU)

Existing Conditions

Zone B lies exclusively on Colorado Springs Utilities land. This zone includes approximately 4,540 feet of trail. RMFI has worked in this zone in past years, installing many sediment control structures in the northern portion of this zone to capture sediment before it reaches the stream. However, there is downcutting and sediment movement occurring in sections that have not been previously worked on by RMFI. In these sections, water flows freely down the trail, causing erosion within the trail corridor and sediment deposition in the stream. There is one particularly eroded section that is heavily downcut and depositing sediment into the stream near a bridge. Of the 4,540 feet of trail in Zone B, approximately 840 feet (19%) is incised.

RMFI installed 22 check dams to mitigate sediment transport into the stream in this section. Constructed of rock or brush, these dams are designed to capture sediment before it reaches the stream. Check dams traditionally require regular maintenance to remove trapped sediment and to ensure continued sediment capture. There are also 25 log erosion barriers and 1 waterbar in this zone. Log erosion barriers are placed in a depositional area to capture sediment. Sediment that is captured behind these structures eventually fills in the interspaces between the logs, raising the grade of the area. Waterbars are typically constructed of rocks, or sometimes timber, and are designed to reduce the flow of water down the trail. These structures divert water from the trail in key locations, preventing downcutting and increased sediment transport. Photos 6-9 show existing conditions throughout Zone B.

Table 3. Existing Structures in Zone B

Features	Count
Wood bridge	3
Brush check dam	11
Rock check dam	11
Rock waterbar	1
Log erosion barriers	25
Bank reconstructed	27 ft ³

Possible Solutions

RMFI estimates that 94 rock or timber risers could be constructed in this zone to stabilize the trail tread and minimize additional downcutting. While the construction of risers will substantially reduce sedimentation impacts to Bear Creek, an additional brush check dam, 30 log erosion barriers in an adjacent drainage, and 6 water bars would further minimize sediment deposition into the creek. Any

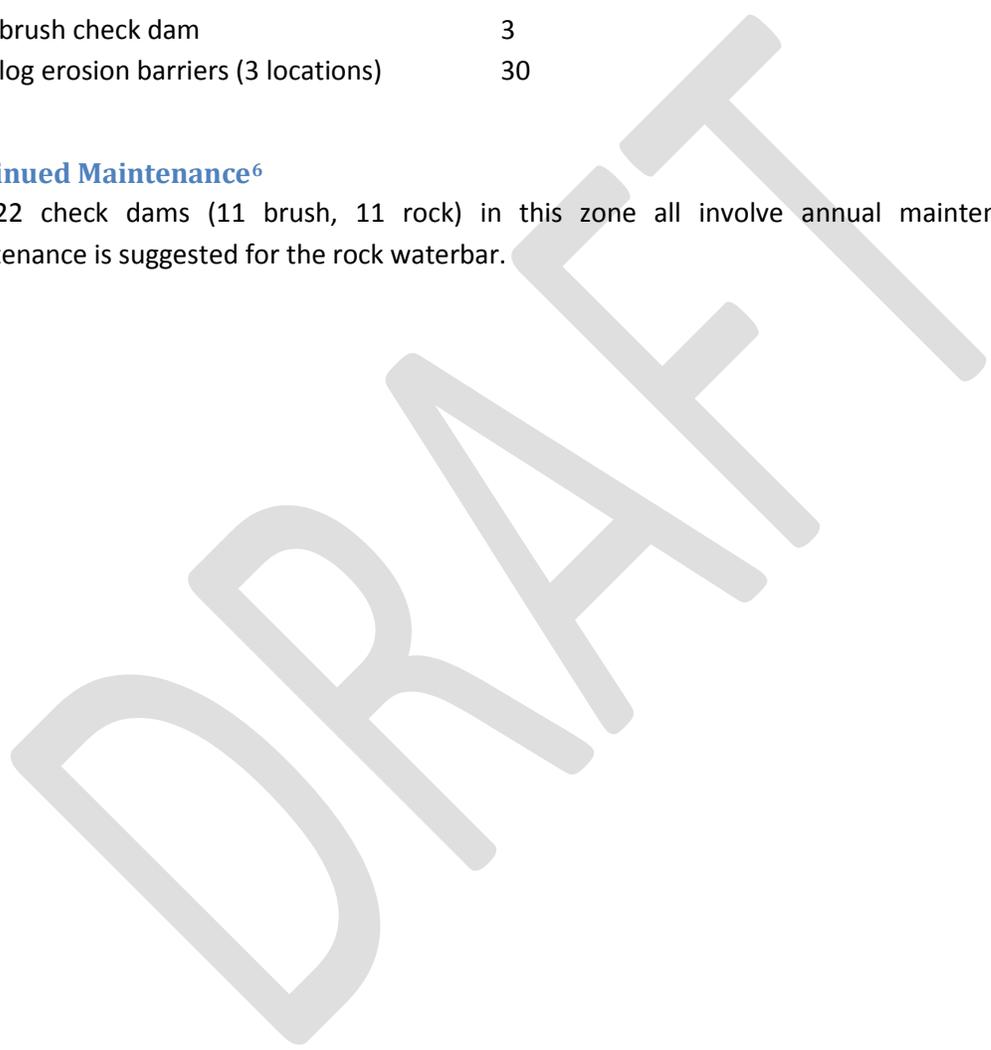
risers and waterbars installed should be carefully planned to ensure sediment is not being deposited into the stream. Figure 3 shows the general location of the “Possible Solutions” structures⁵.

Table 4. Possible solutions in Zone B

Features	Count
Add rock or timber risers	94
Stabilize and revegetate slope	1
Add waterbar	6
Add brush check dam	3
Add log erosion barriers (3 locations)	30

Continued Maintenance⁶

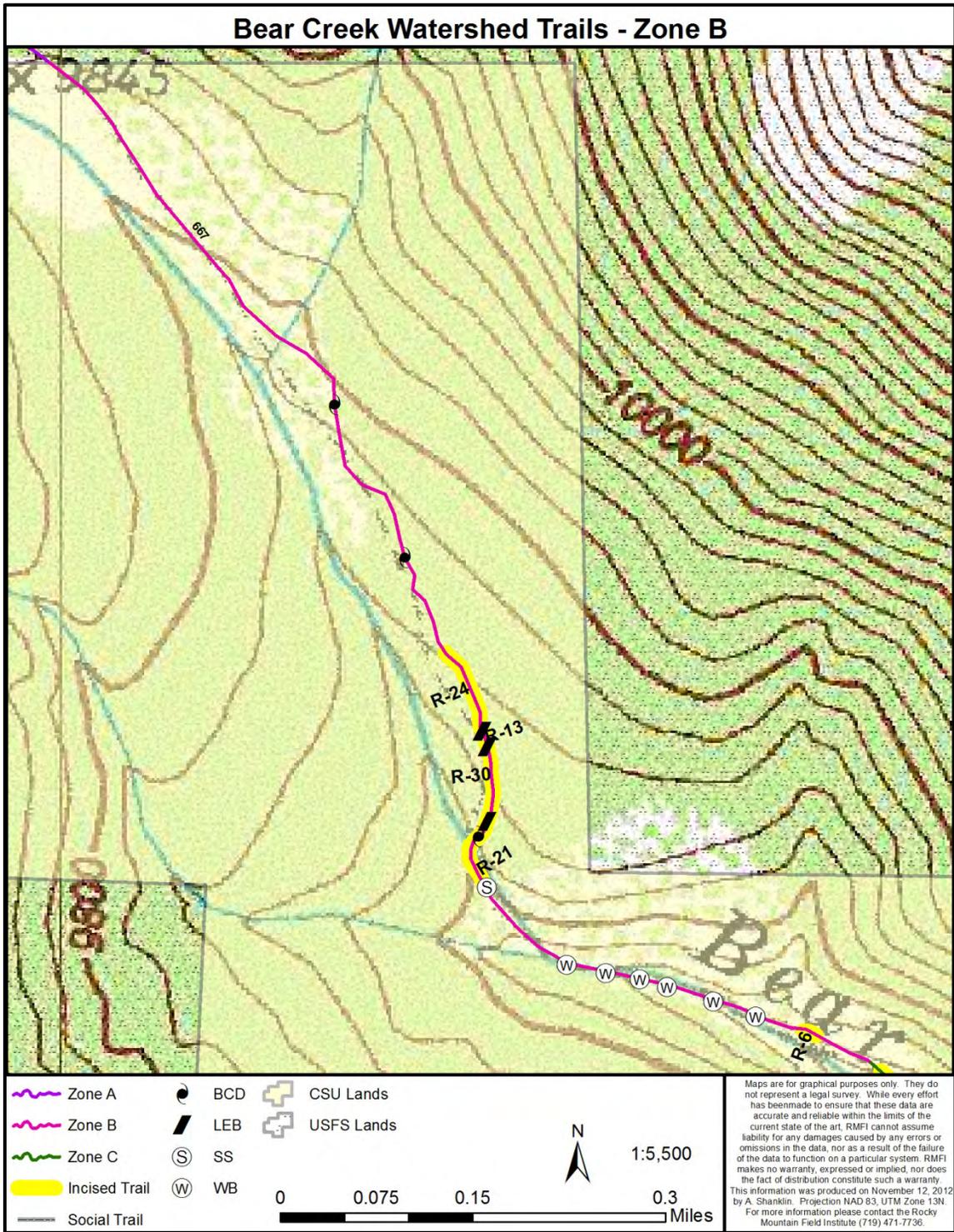
The 22 check dams (11 brush, 11 rock) in this zone all involve annual maintenance. Biennial maintenance is suggested for the rock waterbar.



⁵ “Incised Trail” delineation on maps indicates areas where the trail is downcutting. Each “Incised Trail” delineation is associated with a label on the map (“R-#”). These labels indicate the number of risers suggested to bring the trail back up to grade and to minimize further downcutting. Any installation of structures should be completed by trained individuals to ensure proper placement and construction.

⁶ Maintenance requirements are based upon existing trail corridor structures. Maintenance of future structures should be determined by evaluating all associated trail corridor structures, new and existing. Additional work may change the annual requirements of existing structures and should be accounted for when determining the maintenance of any future placed structures.

Figure 3. Map of possible solutions for trails in Zone B.



Overview of Zone B



Photo 6. Erosion and downcutting along trail. Possible Solutions – construct 30 timber risers.



Photo 7. Erosion occurring on bare slope. Possible Solutions – stabilize slope and revegetate.



Photo 8. Sediment depositional area. Possible Solutions – install 10 horizontal log check dams.



Photo 9. Erosion and downcutting along trail. Possible Solutions – construct 21 timber risers.

Zone C (CSU)

Existing Conditions

Zone C encompasses approximately 6,820 feet of trail on CSU property. Trail #720A connects with #667 in this zone. Approximately 2,864 feet of this zone fall on Trail #720A and the remaining 3,953 are located on Trail #667. Similar to the southern portion of Zone B, the trail along Zone C follows the stream closely and deposits sediment at a few key locations. Approximately 35% (2,390 feet) of the trail is eroded.

RMFI completed select work in this zone including construction of 3 retaining walls, 2 rock waterbars, and an in-trail drain. Constructed of rock or brush, check dams are designed to capture sediment before it reaches the stream. Check dams traditionally require regular maintenance to remove trapped sediment and to ensure continued sediment capture. Retaining walls, constructed of timber or rock, are designed to stabilize eroding slopes and to prevent future slope failure. Waterbars are typically constructed of rocks, or sometimes timber, and are designed to reduce the flow of water down the trail. These structures divert water from the trail in key locations, preventing downcutting and increased sediment transport. The drains are constructed of rock and are designed to create a clear path for water seeps to cross the trail without detouring down the trail and picking up sediment. These structures are functioning properly. Photos 20-22 show existing conditions throughout Zone C.

Table 5. Existing Structures in Zone C

Features	Count
Wood bridge	1
In-trail drain	1
Rock waterbar	2
Retaining wall	3

Loud's Cabin Social Trail

In addition to the designated trail, there are 2 social trails in Zone C. The first trail extends approximately 1,900 feet along a tributary to Loud's Cabin (Figure 4). This trail continues an additional 5,800 feet just past Mount Garfield, ending just before Mount Arthur, but does not lead directly to either mountain. The trail to Loud's Cabin has erosion issues in certain areas. There is a steep hill just west of Loud's Cabin that is extremely denuded due to over-use. There are over 6,000 feet of excessively downcut and eroding trails in this area, each averaging 3 feet deep and 5 feet wide. Also, much of the southern portion of this trail is depositing sediment where the social trail meets Trail #667. A headcut is beginning to form at this intersection and loose sediment is abundant. The remainder of this trail, leading to Mount Garfield, is a small trail that probably sees very little use throughout the year. The maximum width is about 12 inches and is hard to find in certain areas. Photos 10-16 show existing conditions on the Loud's Cabin social trail.

Jones Park Social Trail

The second is a trail that extends over 2,900 feet through Jones Park, connecting Trail #668 to #720A (Figure 5). The intersection of this social trail with Trail #668 has been partially restored, there is a sign closing the trail to motor vehicles and some log barriers have been placed across the trail. The first portion of this trail is in relatively good shape; however, multiple large gullies are located on a steep slope approximately 1,000 feet west of its connection with Trail #668. There is also some downcutting and erosion occurring on approximately a third of this trail. Neither of these trails appears to be depositing sediment into Bear Creek. Photos 17-19 show existing conditions on the Jones Park social trail.

Possible Solutions

RMFI estimates that more than 200 rock or timber risers could be constructed in this zone to stabilize the trail tread. In addition to risers, a brush check dam, a retaining wall, and 7 water bars would aid in the reduction of sediment deposition into Bear Creek. Figure 6 shows the general location of the “Possible Solutions” structures⁷.

Table 6. Possible solutions in Zone C

Features	Count
Add rock or timber risers	205
Add waterbar	7
Add brush check dam	1
Restore and stabilize	1

Loud’s Cabin Social Trail

Trail downcutting is occurring on approximately 640 feet of the Loud’s Cabin social trail. Should the agencies decide to leave this trail accessible, RMFI estimates installation of 75 risers could reduce downcutting and minimize sediment movement from the trail tread. In addition, 5 waterbars, 2 outslope timber logs, and 4 retaining walls could further reduce the impact of sediment into the Bear Creek Watershed. A below-ground culvert or above stream bridge could minimize the amount of in-stream activity. One section is rather steep and would benefit from the addition of rock or timber risers (approximately 30 in a 150 foot stretch).

Sediment is being deposited onto Trail #667 from the Loud’s Cabin social trail. A bare area approximately 1,000 feet² has formed in this area and would benefit from stabilization and revegetation. There is also a bare area approximately 2,500 feet² adjacent to Loud’s Cabin that would benefit from stabilization and revegetation.

⁷ “Incised Trail” delineation on maps indicates areas where the trail is downcutting. Each “Incised Trail” delineation is associated with a label on the map (“R-#”). These labels indicate the number of risers suggested to bring the trail back up to grade and to minimize further downcutting. Any installation of structures should be completed by trained individuals to ensure proper placement and construction.

Just west of Loud's Cabin there are multiple user-created social trails that have formed into large gullies. The gullies are highly incised and actively eroding. RMFI suggests construction of multiple revegetated, terraced walls within each gully to prevent further erosion along the denuded hillslope.

Similar work would be suggested should management choose to close this trail. Check dams rather than risers would be suggested to capture sediment and raise the grade of the trail. However, terraced retaining walls would benefit the denuded hillside whether the decision was made to close or to create a sustainable trail.

Jones Park Social Trail

RMFI estimates that the installation of approximately 75 risers along this trail could reduce erosion and help to create a sustainable trail tread. Revegetated, terraced walls are possible restoration solutions should the decision be made to restore or close the Jones Park social trail.

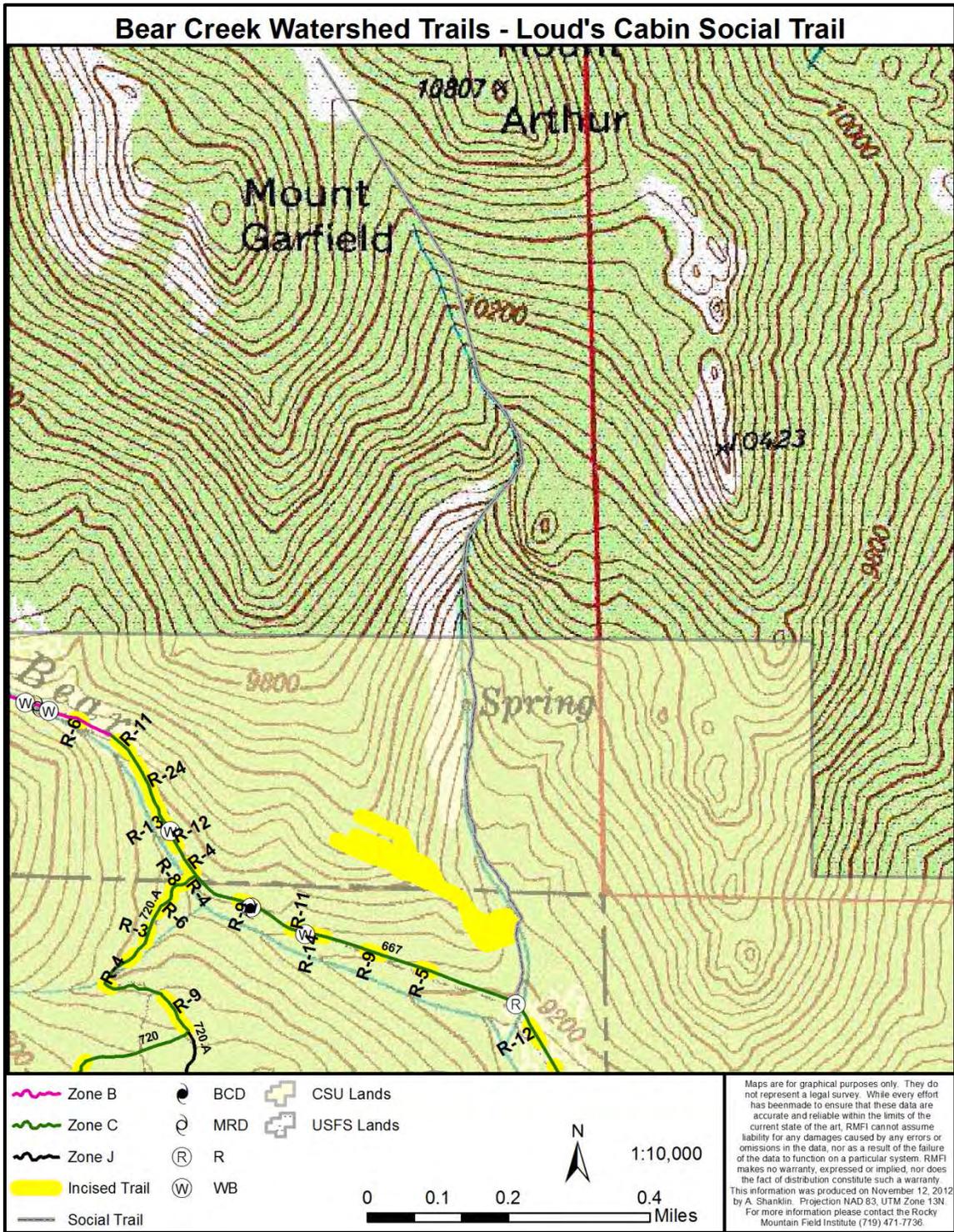
Given that these are currently undesignated trails, these features are not included in the list of possible solutions found above.

Continued Maintenance⁸

There are 4 brush check dams that involve annual maintenance in this zone and 2 rock waterbars that would benefit from biennial maintenance.

⁸ Maintenance requirements are based upon existing trail corridor structures. Maintenance of future structures should be determined by evaluating all associated trail corridor structures, new and existing. Additional work may change the annual requirements of existing structures and should be accounted for when determining the maintenance of any future placed structures.

Figure 4. Loud's Cabin social trail.



Loud's Cabin social trail Overview (Zone C)



Photo 10. Loud's Cabin social trail.



Photo 11. Loud's Cabin social trail.



Photo 12. Loud's Cabin social trail.



Photo 13. Loud's Cabin social trail.



Photo 14. Gullies near Loud's Cabin social trail.

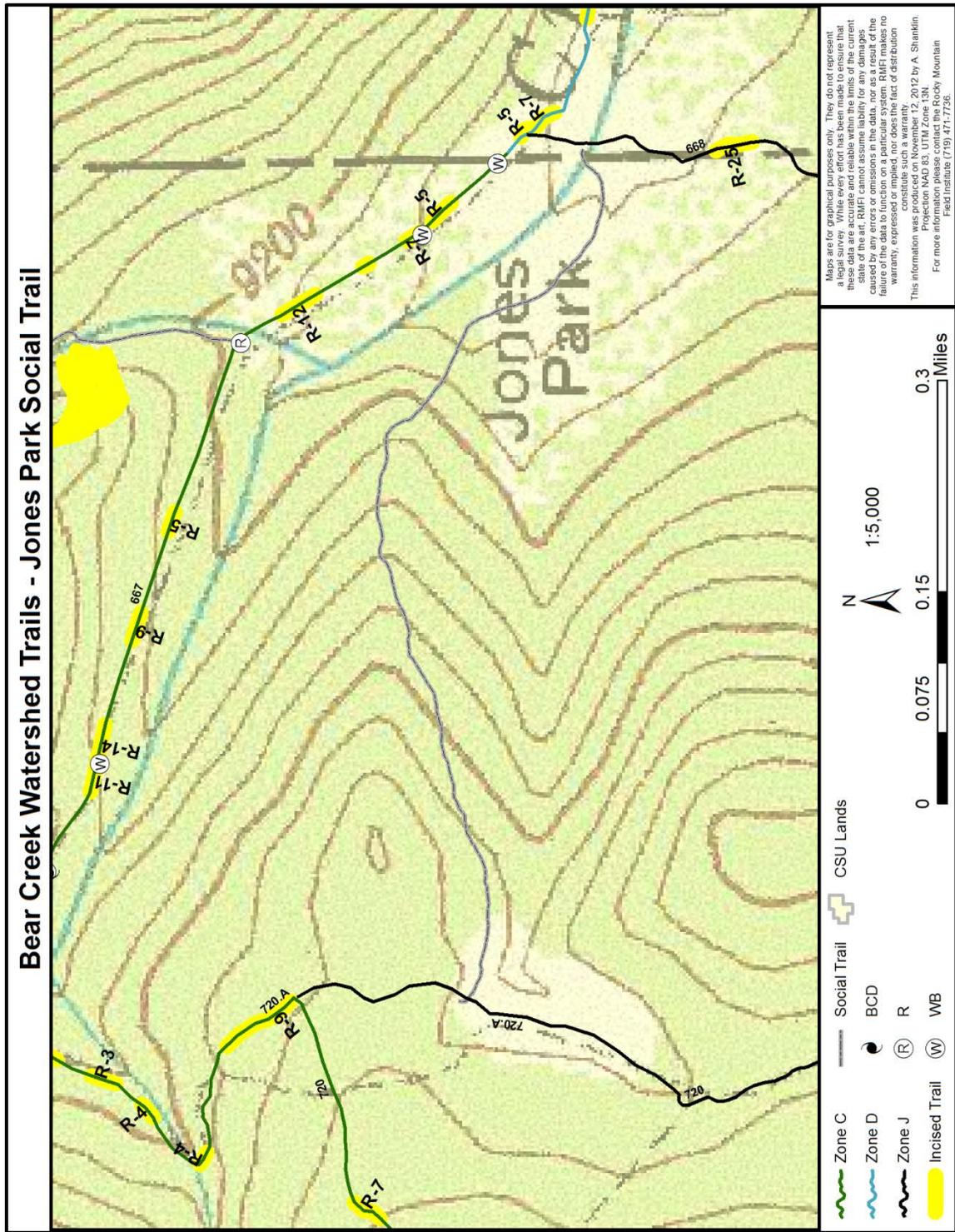


Photo 15. Gullies near Loud's Cabin social trail.



Photo 16. Gullies near Loud's Cabin social trail.

Figure 5. Jones Park social trail.



Jones Park social trail Overview (Zone C)



Photo 17. Jones Park social trail.

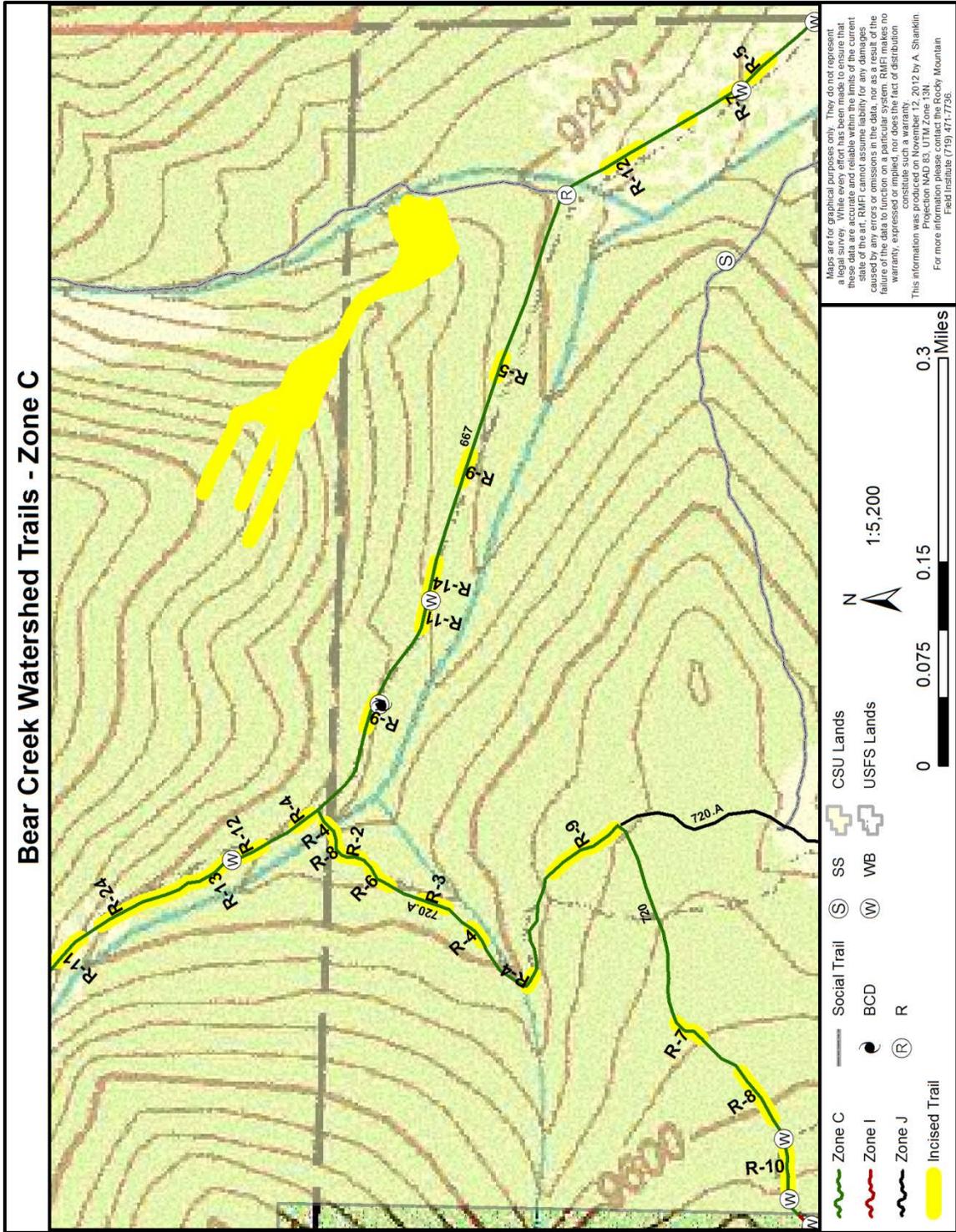


Photo 18. Jones Park social trail.



Photo 19. Jones Park social trail.

Figure 6. Map of possible solutions for trails in Zone C.



Overview of Zone C



Photo 20. Sediment depositional area.
Possible Solutions – install 2 brush check
dams (Trail #667).



Photo 21. Erosion and downcutting along
trail. Possible Solutions – construct 9
timber risers (Trail #667).



Photo 22. Sediment depositional area.
Possible Solutions – install 2 brush check
dams (Trail #667).

Zone D (CSU)

Existing Conditions

This Zone encompasses the last section of Trail #667 on CSU land. The trail along Zone D stretches approximately 3,940 feet adjacent to Bear Creek. Three percent (110 feet) of this trail is currently incised.

The section of trail in this zone was one of the highest priorities for RMFI in past years due to its contribution of sediment to Bear Creek. Drains, rock risers, waterbars, outslope retaining walls, and a culvert were installed by RMFI to reduce sediment in this section of trail. The drains are constructed of rock and are designed to create a clear path for water seeps to cross the trail without detouring down the trail and picking up sediment. Risers can be constructed of rocks or timber and are designed to reduce the speed of water as it moves down the trail. They create sheet flow water movement as opposed to water downcutting into the trail. Waterbars are typically constructed of rocks, or sometimes timber, and are designed to reduce the flow of water down the trail. These structures divert water from the trail in key locations, preventing downcutting and increased sediment transport. Retaining walls, constructed of timber or rock, are designed to stabilize eroding slopes and to prevent future slope failure. Culverts are designed pass water under a trail to minimize traffic within streams and tributaries and to keep water from traversing down the trail. The work that was completed appears to be functioning as planned and is presumably decreasing sediment deposition into Bear Creek. Photos 26-28 show existing conditions throughout Zone D.

Table 7. Existing Structures in Zone D

Features	Count
Rock culvert	1
Rock risers	12
Timber risers	1
In-trail drain	2
Rock waterbar	2
Timber outslope reinforcement	1
Outslope retaining wall	1

Tenney Crag Social Trail

There is also a social trail within this zone that travels to Tenney Crag (Figure 7). The Tenney Crag social trail runs north/south up a tributary at the eastern extent of Zone D. There are 3 tributary crossings along this social trail and 2 locations where the slope is eroding into the tributary. Photos 23-25 show the existing conditions on the Tenney Crag social trail.

Possible Solutions

RMFI estimates that approximately 24 risers could stabilize the trail tread and reduce further downcutting. The stream would also benefit from the addition 3 culverts or bridges, 2 retaining walls,

and the removal of one non-functioning waterbar. Replacing three existing in-trail drains with culverts or bridges would minimize in-stream disturbance. The drains are being inundated with sediment, which they were not designed to accommodate. By installing a culvert or a bridge, water will be allowed to pass under the trail rather than being diverted along the top of the trail. Figure 8 shows the general location of the “Possible Solutions” structures⁹.

Table 8. Possible solutions in Zone D.

Features	Count
Add rock or timber risers	24
Add bridge or culvert	3
Add retaining wall	2
Add waterbar	1
Remove waterbar	1

Tenney Crags Social Trail

The northern section of the Tenney Crags social trail is in relatively good shape; however, RMFI estimates that a few erosion control measures in the southern portion could help stabilize the trail tread. Retaining walls and risers in key areas would minimize sediment transport. Also, the tributary would benefit from 3 minor in-trail drains to minimize sediment movement and traffic within the tributary. Given that this is currently an undesignated trail, these features are not included in the list of possible solutions found above.

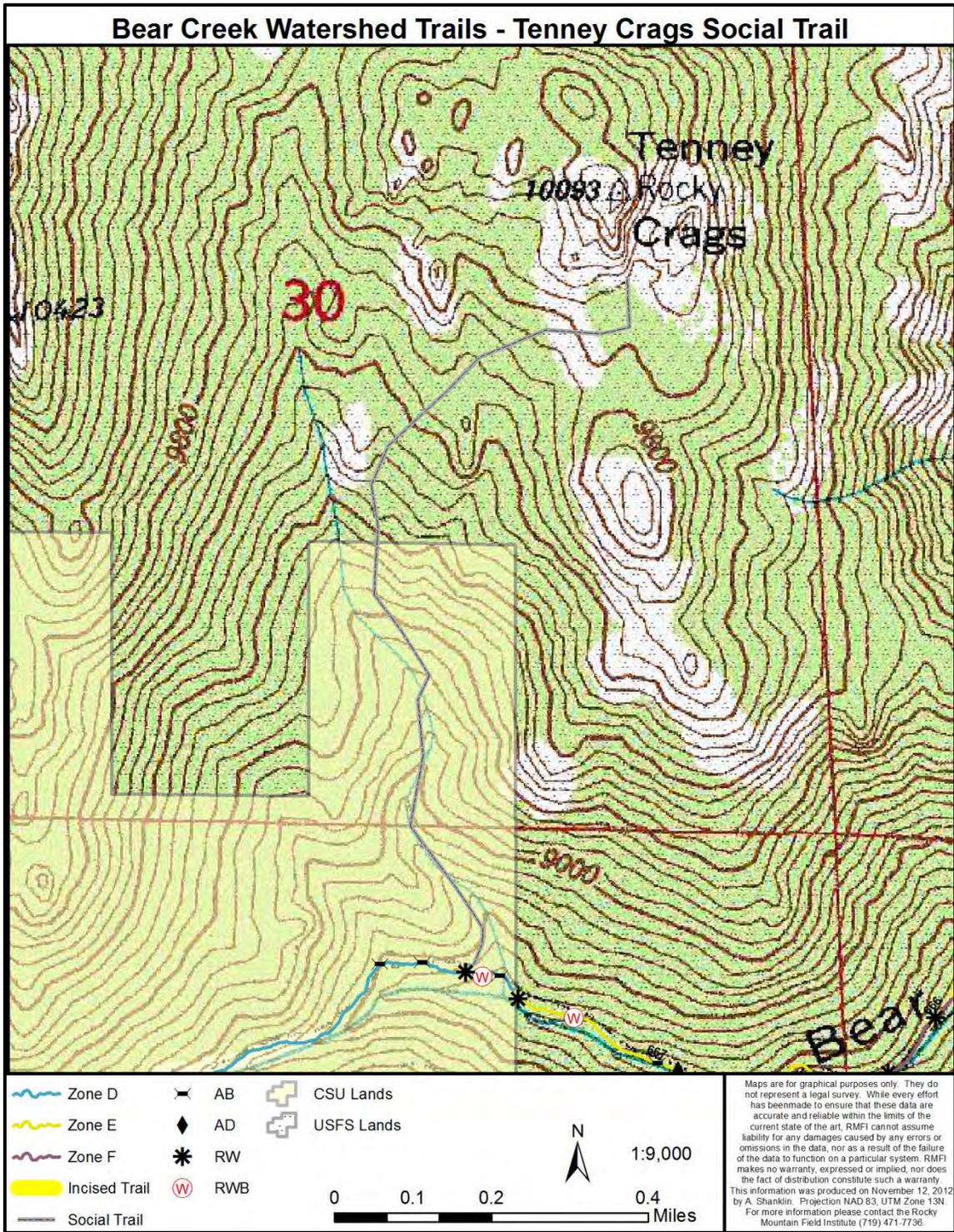
Continued Maintenance¹⁰

There are 2 drains and 1 rock culvert that involve annual maintenance in this zone. Biennial maintenance on the 2 rock waterbars is also suggested. The timber outslope reinforcement should be monitored biennially and replaced as necessary.

⁹ “Incised Trail” delineation on maps indicates areas where the trail is downcutting. Each “Incised Trail” delineation is associated with a label on the map (“R-#”). These labels indicate the number of risers suggested to bring the trail back up to grade and to minimize further downcutting. Any installation of structures should be completed by trained individuals to ensure proper placement and construction.

¹⁰ Maintenance requirements are based upon existing trail corridor structures. Maintenance of future structures should be determined by evaluating all associated trail corridor structures, new and existing. Additional work may change the annual requirements of existing structures and should be accounted for when determining the maintenance of any future placed structures.

Figure 7. Tenney Crags social trail.



Tenney Crags social trail Overview (Zone D)



Photo 23. Tenney Crags social trail.

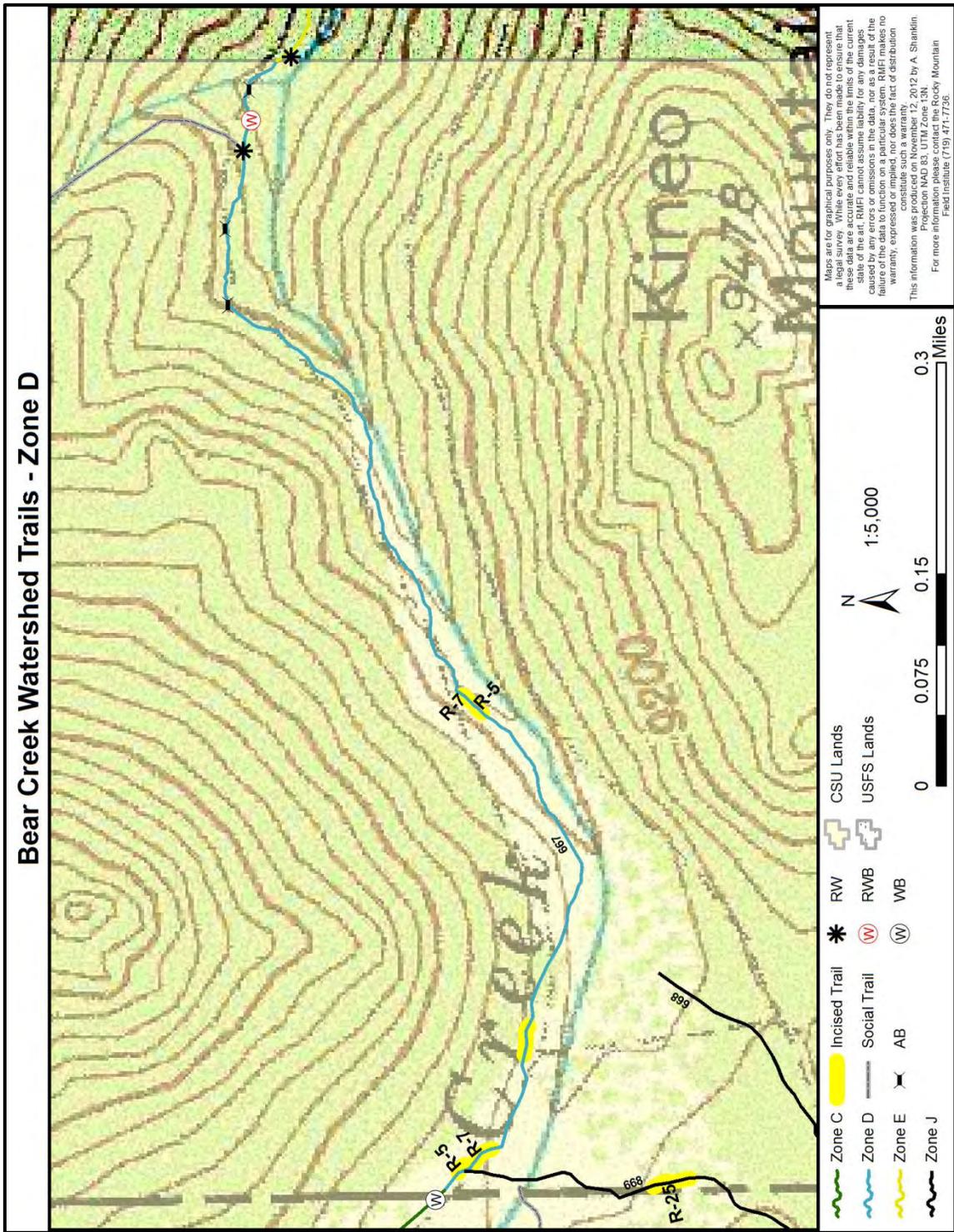


Photo 24. Tenney Crags social trail.



Photo 25. Tenney Crags social trail.

Figure 8. Map of possible solutions for trails in Zone D.



Overview of Zone D



Photo 26. Existing in-trail culvert is collecting sediment and diverting water down trail. Possible Solutions – needs repair and maintenance (could add bridge to minimize annual maintenance).



Photo 27. Erosion and downcutting occurring in trail. Possible Solutions – construct 15 timber risers



Photo 28. Erosion occurring in trail. Possible Solutions – remove logs and install timber risers.

Zone E (USFS)

Existing Conditions

Zone E contains portions of trail from both Trail #666 and #667. There are approximately 3,050 feet of total trail within this section, 2,137 feet from Trail #667 and 909 feet from Trail #666. The majority of this zone is relatively stable and has minimal negative stream impacts. However, the area where the Trail #667 crosses the stream is extremely unstable and is depositing sediment into Bear Creek. Approximately 653 feet (21%) of this zone is incised.

RMFI has worked in this area before, adding waterbars, reconstructing the stream bank, adding in-trail drains, and constructing both rock retaining walls and timber outslope reinforcements. Waterbars are typically constructed of rocks, or sometimes timber, and are designed to reduce the flow of water down the trail. These structures divert water from the trail in key locations, preventing downcutting and increased sediment transport. In-trail drains are constructed of rock and are designed to create a clear path for water seeps to cross the trail without detouring down the trail and picking up sediment. Retaining walls, constructed of timber or rock, are designed to stabilize eroding slopes and to prevent future slope failure. Structures are functioning properly with the exception of the in-trail drains which have filled with sediment. Photos 29-31 show existing conditions throughout Zone E.

Table 9. Existing Structures in Zone E

Features	Count
Wood bridge	1
Timber waterbar	4
Rock waterbar	2
In-trail drain	5
Retaining walls	3
Bank reconstruction	1

Possible Solutions

RMFI estimates that 25 risers could be constructed on the switchbacks that extend south from the stream crossing on Trail #667 up the side of Kineo Mountain to reduce sediment transport into Bear Creek. In addition, constructing one retaining wall to minimize the possibility of slope failure, one culvert or bridge to replace an existing drain, and one in-trail drain to deal with a newly discovered seep along the trail would be beneficial. One non-functioning water bar should be removed due to incorrect placement. Figure 9 shows the general location of the “Possible Solutions” structures¹¹.

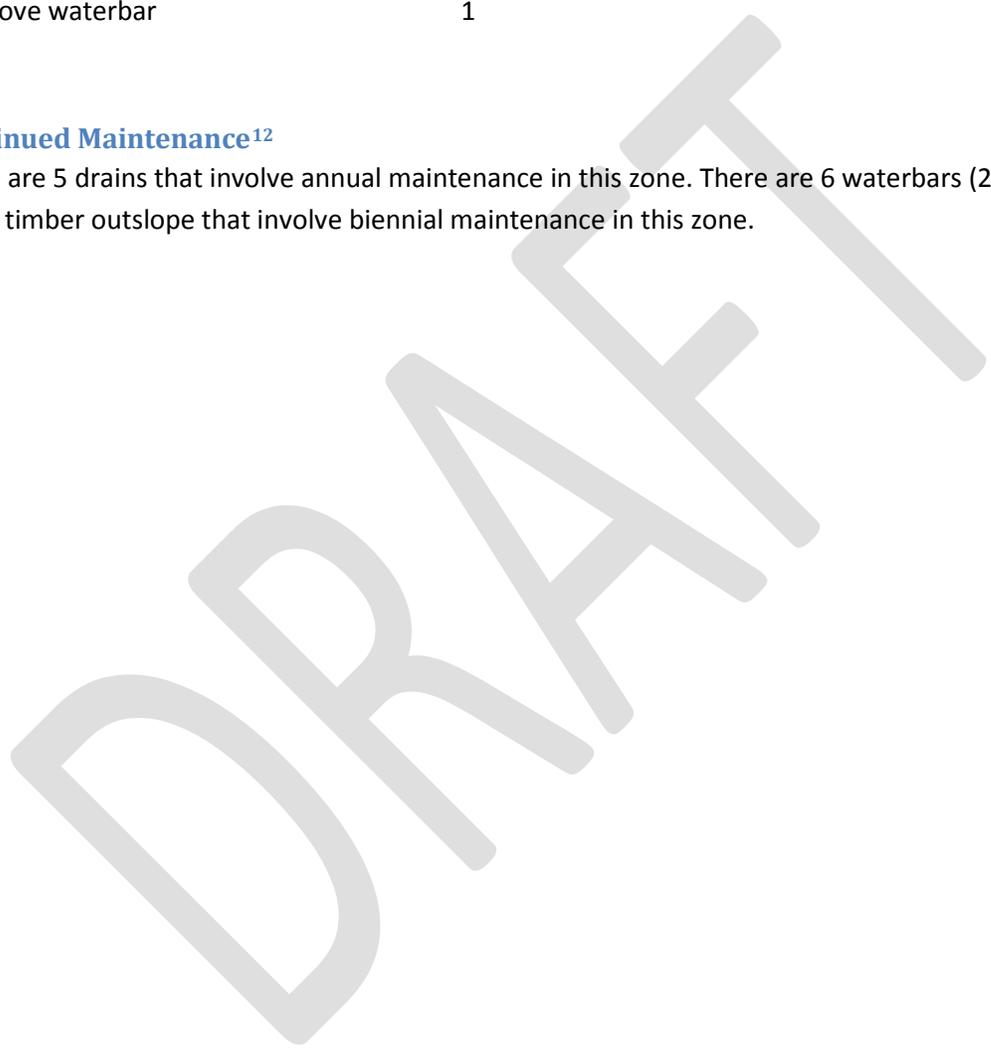
¹¹ “Incised Trail” delineation on maps indicates areas where the trail is downcutting. Each “Incised Trail” delineation is associated with a label on the map (“R-#”). These labels indicate the number of risers suggested to bring the trail back up to grade and to minimize further downcutting. Any installation of structures should be completed by trained individuals to ensure proper placement and construction.

Table 10. Possible solutions in Zone E.

Features	Count
Add rock or timber risers	25
Add retaining wall	1
Add bridge or culvert	1
Add drain	1
Remove waterbar	1

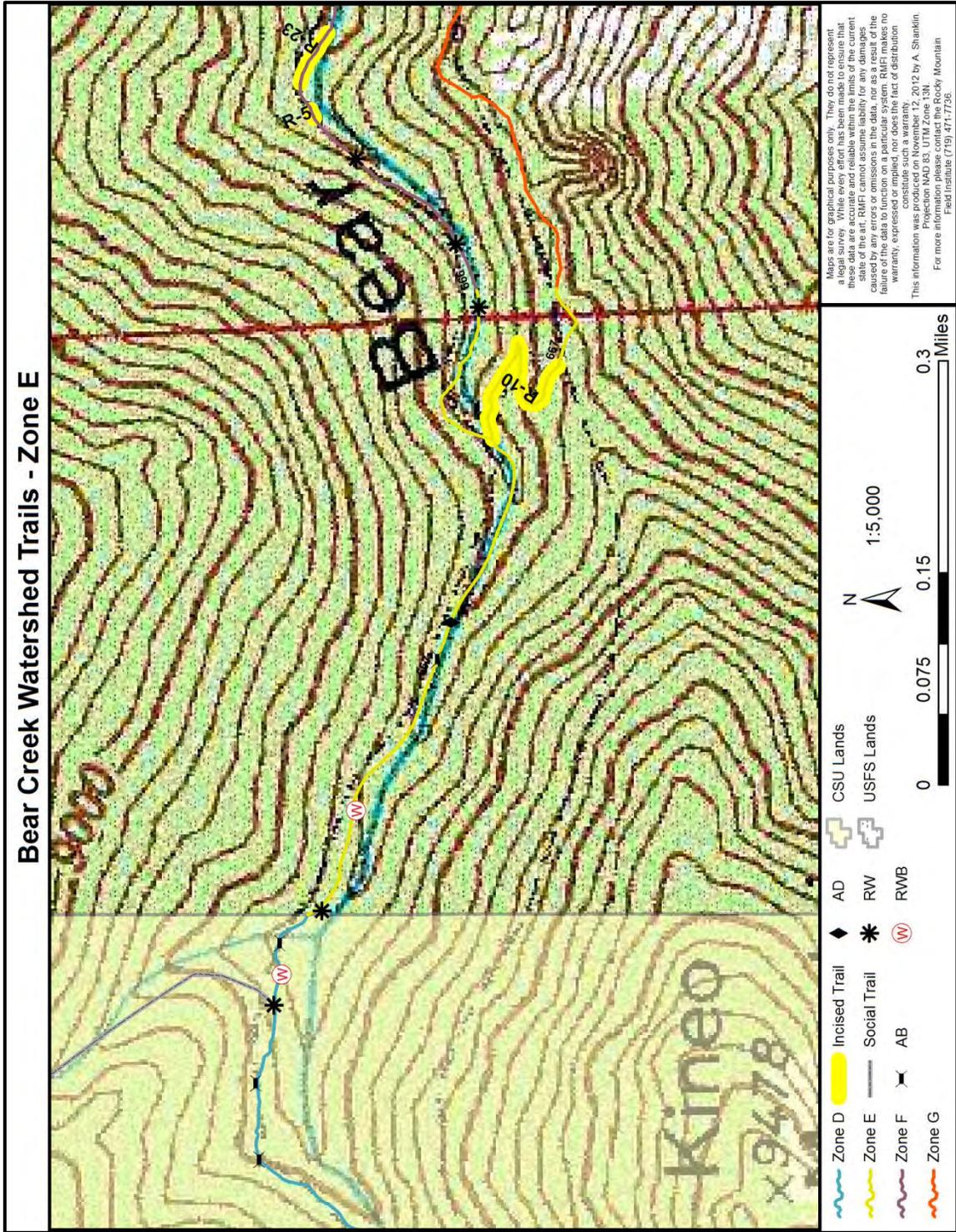
Continued Maintenance¹²

There are 5 drains that involve annual maintenance in this zone. There are 6 waterbars (2 rock, 4 timber) and 1 timber outslope that involve biennial maintenance in this zone.



¹² Maintenance requirements are based upon existing trail corridor structures. Maintenance of future structures should be determined by evaluating all associated trail corridor structures, new and existing. Additional work may change the annual requirements of existing structures and should be accounted for when determining the maintenance of any future placed structures.

Figure 9. Map of possible solutions for trails in Zone E.



Overview of Zone E



Photo 29. Headcut along trail. Possible Solutions – construction of 5 timber risers (Trail #667).



Photo 30. Drain that is clogged with sediment. Possible Solutions – maintain drain and/or replace with culvert or bridge (Trail #667).



Photo 31. Erosion occurring under existing retaining wall. Possible Solutions – add new log and reconstruct retaining wall (Trail #667).

Zone F (USFS)

Existing Conditions

The trail in zone F is on Forest Service land and includes Trail #666. The eastern section of this trail runs into City of Colorado Springs property. This is one of 2 Zones within this assessment that are designated fully non-motorized. Of the 8,890 feet of trail in Zone F, approximately 1,690 feet (19%) is incised; this portion of trail is extremely steep and is causing an influx of sediment into the stream. In its current condition, water flows freely down the trail in these areas during rain events, causing erosion within the trail corridor and sediment to be deposited in the stream. There are currently two foot bridges in this zone. Photos 32-38 show existing conditions throughout Zone F.

Social Trails

Almost 7,000 feet of un-official social trail runs either parallel to the stream or navigates toward the stream from the trail within this zone. The large social trail that parallels Bear Creek is approximately 6,020 feet in length, running just north along the stream. There are also 7 smaller social trails that, for the most part, navigate to the stream from the designated and undesignated trails. The smaller trails average 134 feet in length (942 foot total length).

Table 11. Existing structures in Zone F.

Features	Count
Unimproved bridge	1

Possible Solutions

RMFI suggests construction of 470 risers along Trail #666 to bring this section of trail back up to grade. In addition to stepping much of this section of trail, there are 25 bare and eroding slopes that would benefit from the construction of retaining walls and/or stabilization and revegetation to minimize stream impacts. Other suggestions include adding 9 waterbars to remove water from the trail, 1 check dam to capture sediment, an in-trail drain to transport water over the trail, and 2 bridges to minimize traffic through the stream. Figure 10 shows the general location of the “Possible Solutions” structures¹³.

¹³ “Incised Trail” delineation on map indicates areas where the trail is downcutting. Each “Incised Trail” delineation is associated with a label on the map (“R-#”). These labels indicate the number of risers suggested to bring the trail back up to grade and to minimize further downcutting. Any installation of structures should be completed by trained individuals to ensure proper placement and construction.

Table 12. Possible solutions in Zone F.

Features	Count
Add rock or timber risers	401
Add retaining wall	21
Add waterbar	8
Stabilize and revegetate slopes	7
Add bridge	1
Remove in-stream dam	1

Social Trails

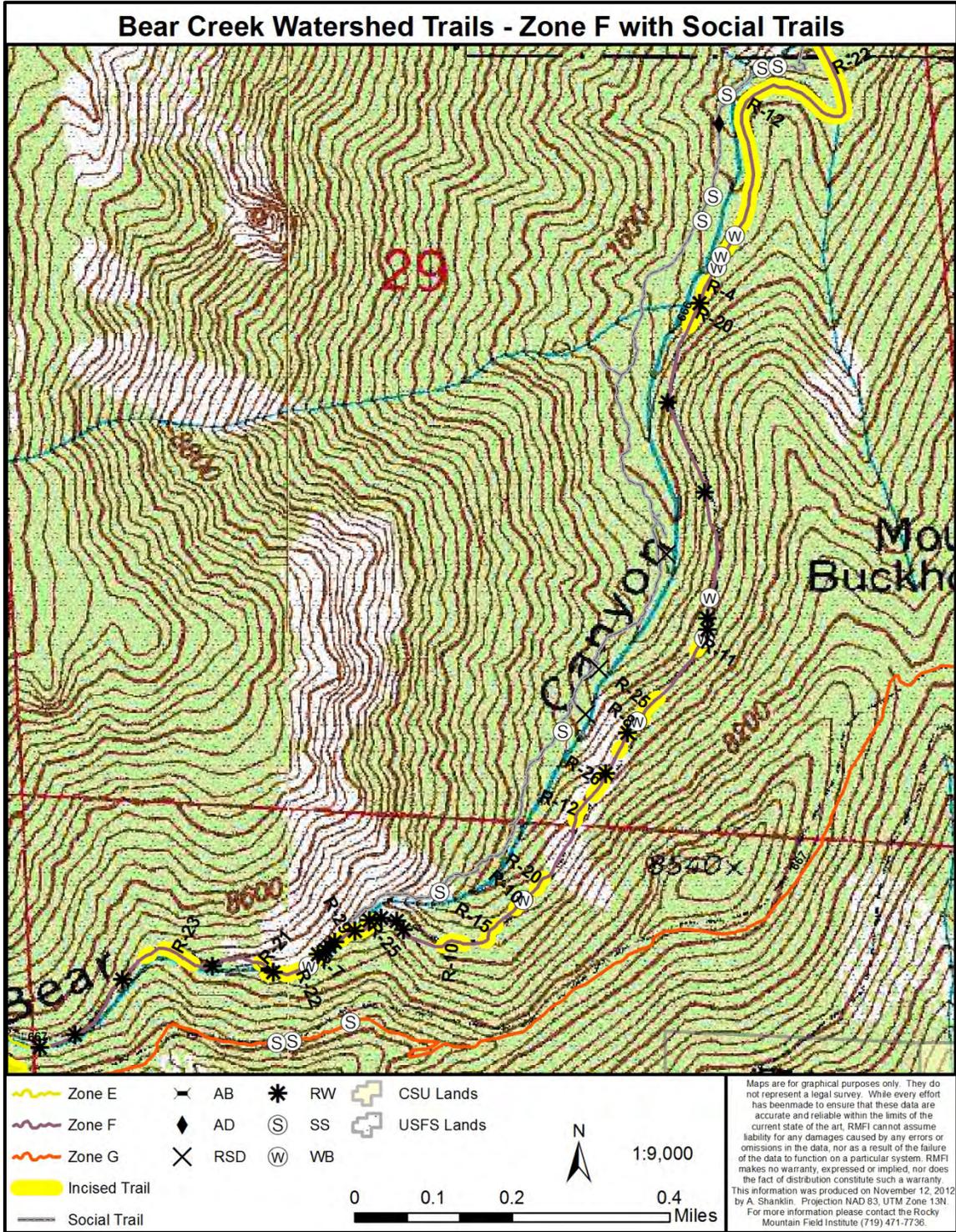
RMFI estimates that the construction of 1 in-trail drain, 1 new bridge crossing, and removing 3 man-made dams would benefit the larger social trail if management makes the decision to allow this trail to remain in use. There are also 8 bare slopes that would benefit from stabilization and revegetation along the large social trail. The smaller social trails in this area would benefit from stabilization and revegetation along 2 bare slopes and constructing 2 in-trail drains. Suggestions for closure (if management makes the decision to close these trails) would also include stabilizing and revegetating bare slopes and reducing the visibility of the trails. Given that these are currently undesignated trails, these features are not included in the list of possible solutions found above.

Continued Maintenance¹⁴

There is currently no continued maintenance in this zone because there are no existing structures that would benefit from maintenance.

¹⁴ Maintenance requirements are based upon existing trail corridor structures. Maintenance of future structures should be determined by evaluating all associated trail corridor structures, new and existing. Additional work may change the annual requirements of existing structures and should be accounted for when determining the maintenance of any future placed structures.

Figure 10. Map of possible solutions for trails in Zone F.



Overview of Zone F



Photo 32. Deposition from trail entering stream. Possible Solutions – construct outslope retaining wall.



Photo 33. Erosion and downcutting in trail. Possible Solutions – construct 21 timber risers.



Photo 34. Steep, bare slope causing sediment to enter stream. Possible Solutions – Construct outslope retaining wall with vegetated terraced boxes.



Photo 35. Deposition from trail entering stream. Possible Solutions – construct 24 foot outslope retaining wall and revegetate.

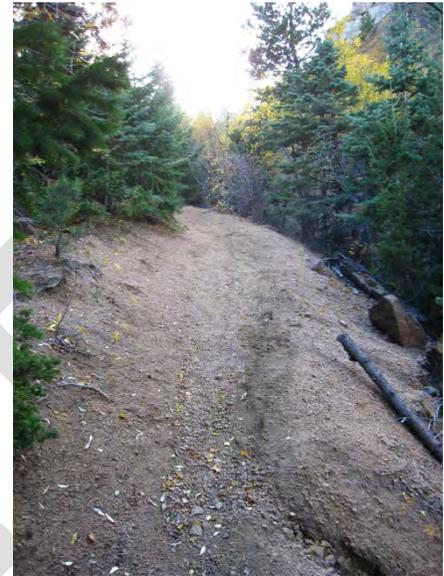


Photo 36. Erosion and downcutting in trail. Possible Solutions – construct 30 timber risers.



Photo 37. Erosion and downcutting in trail. Possible Solutions – construct 23 timber risers.



Photo 38. Sediment from trail entering stream. Possible Solutions – construct bridge over stream.

Zone G (USFS)

Existing Conditions

The section of trail in Zone G includes Trail #667, starting at High Drive and ending just before the trail meets Trail #666. The 10,800 foot section of trail in Zone G follows a contour line closely; this section of trail is sustainable and requires very little improvement. There are no existing structures in this zone. Photos 39-40 show existing conditions throughout Zone G.

Possible Solutions

There are 4 outslope areas totaling approximately 100 linear feet that would benefit from the installation of retaining walls and additional stabilization, but no in-trail construction is necessary along this reach of the trail. Figure 11 shows the general location of the “Possible Solutions” structures¹⁵.

Table 13. Possible solutions in Zone G.

Features	Count
Add retaining wall and stabilize	3

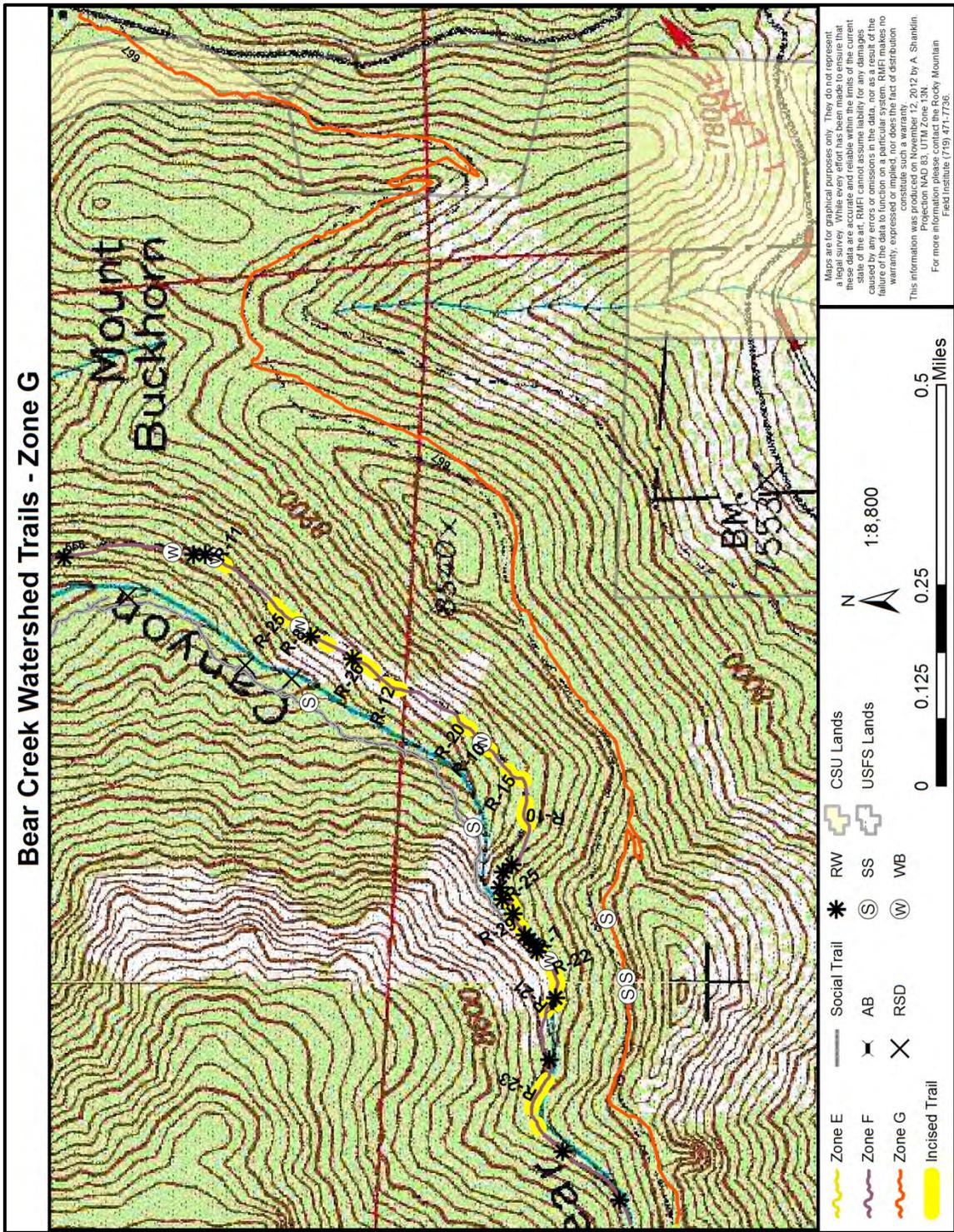
Continued Maintenance¹⁶

There is currently no continued maintenance in this zone because there are no existing structures.

¹⁵ “Incised Trail” delineation on map indicates areas where the trail is downcutting. Each “Incised Trail” delineation is associated with a label on the map (“R-#”). These labels indicate the number of risers suggested to bring the trail back up to grade and to minimize further downcutting. Any installation of structures should be completed by trained individuals to ensure proper placement and construction.

¹⁶ Maintenance requirements are based upon existing trail corridor structures. Maintenance of future structures should be determined by evaluating all associated trail corridor structures, new and existing. Additional work may change the annual requirements of existing structures and should be accounted for when determining the maintenance of any future placed structures.

Figure 11. Map of possible solutions for trails in Zone G.



Overview of Zone G



Photo 39. Bare, eroding slope. Possible Solutions – construct outslope retaining wall and revegetate.

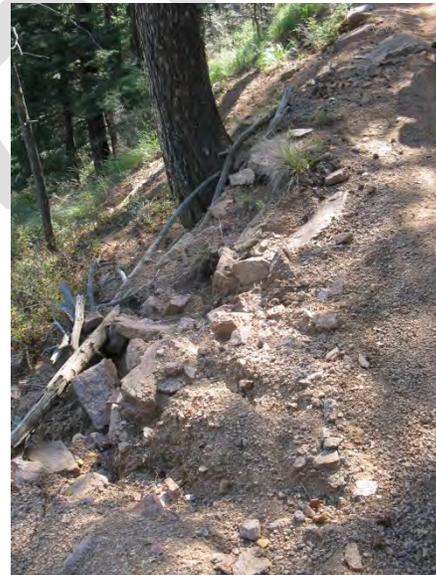


Photo 40. Bare, eroding slope. Possible Solutions – construct outslope retaining wall.

Zone H (CSU)

Existing Conditions

This trail is located on CSU land and is designated for multi-use, including motorized vehicles. Zone H encompasses Trail #701, which runs south from Trail #666 near the western extent of the Bear Creek Watershed to the edge of one of the southern borders of CSU property. Within this zone, the trail follows a contour line closely, creating a relatively stable trail with few maintenance issues. Of the 2,700 feet of trail in Zone H, approximately 320 feet (12%) are incised. There are no existing structures in this zone. There is one tributary crossing. Photos 41-42 show existing conditions throughout Zone H.

Possible Solutions

RMFI suggests installing 23 risers to fully stabilize this portion of the trail. In addition, the trail crosses a tributary of Bear Creek; construction of a rock culvert or a bridge is suggested. Figure 12 shows the general location of the “Possible Solutions” structures¹⁷.

Table 14. Possible solutions in Zone H.

Features	Count
Add rock or timber risers	23
Add waterbar	2
Add bridge or culvert	1

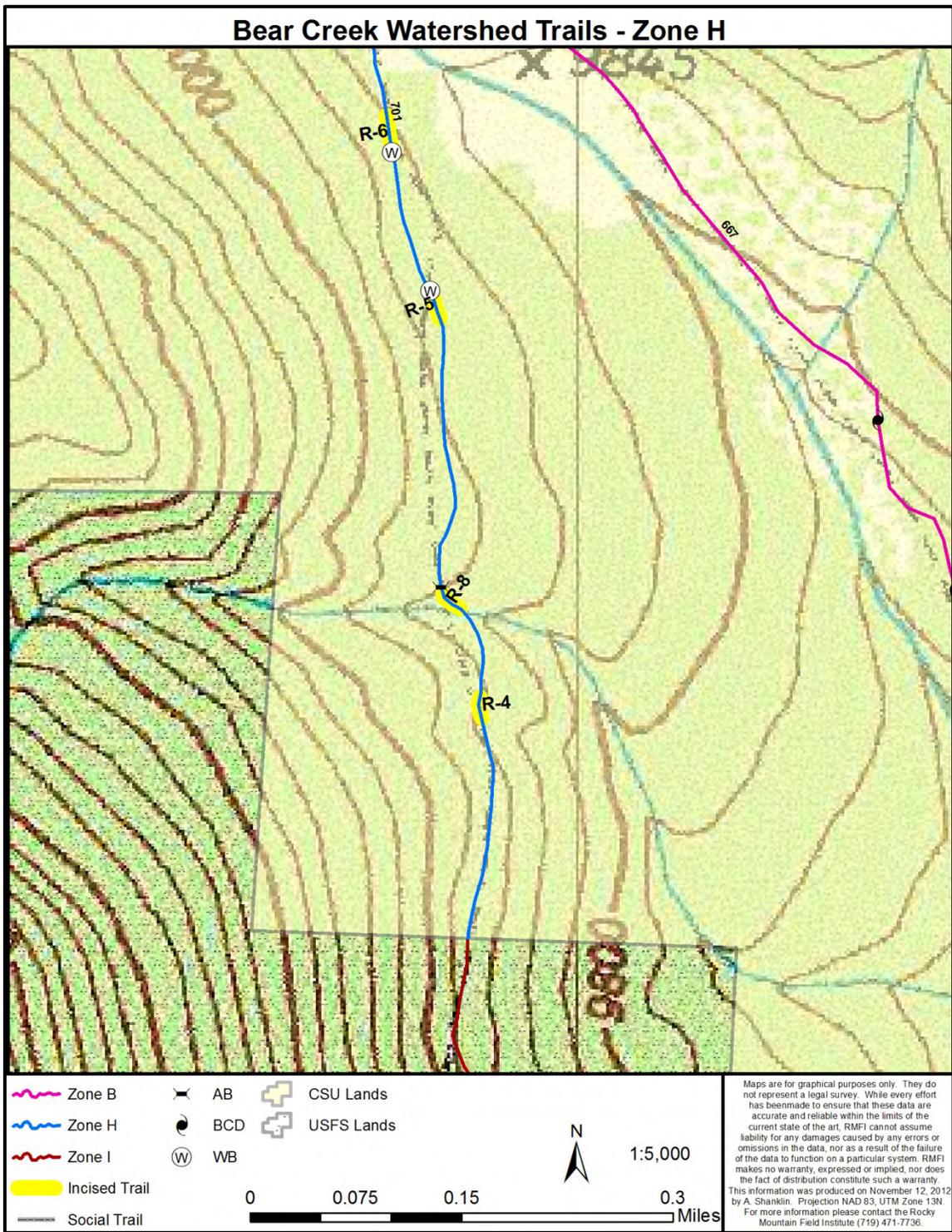
Continued Maintenance¹⁸

There is currently no continued maintenance in this zone because there are no existing structures.

¹⁷ “Incised Trail” delineation on map indicates areas where the trail is downcutting. Each “Incised Trail” delineation is associated with a label on the map (“R-#”). These labels indicate the number of risers suggested to bring the trail back up to grade and to minimize further downcutting. Any installation of structures should be completed by trained individuals to ensure proper placement and construction.

¹⁸ Maintenance requirements are based upon existing trail corridor structures. Maintenance of future structures should be determined by evaluating all associated trail corridor structures, new and existing. Additional work may change the annual requirements of existing structures and should be accounted for when determining the maintenance of any future placed structures.

Figure 12. Map of possible solutions for trails in Zone H.



Overview of Zone H



Photo 41. Trail crosses stream. Possible Solutions – install rock culvert or bridge.



Photo 42. Erosion and downcutting in trail. Possible Solutions – construct 8 timber risers.

Zone I (USFS)

Existing Conditions

Zone I falls entirely on Forest Service land, encompassing both Trail #701 and a portion of Trail #720 where it connects with Zone C. The total amount of trail in Zone I is 4,960 feet, 2,712 feet of which are located along Trail #701 and 2,251 feet along Trail #720. Like Zone H, the section of Trail #701 through Zone I closely follows a contour line, creating a relatively stable trail base with few maintenance issues. However, the portion of Trail #720 that runs east/west through Zone I drops approximately 600 feet in just under a mile. Of the 4,960 feet of trail in this zone, 285 feet (6%) of downcutting occur along the north/south running portion and 1,873 feet (87%) of downcutting occur along the east/west portion of the trail. An in-trail headcut is found within this zone (photo 27). Users are moving off trail to avoid this area and have created a small social trail in the process. There are no existing structures in this zone. Photos 43-47 show existing conditions throughout Zone I.

Possible Solutions

RMFI estimates that 15 risers could be constructed in this zone along Trail #701 to stabilize the trail tread. The gradient referenced in the previous section creates an extremely unstable trail along the east/west section of Zone I. RMFI estimates that 115 risers could be constructed along Trail #720 to stabilize the trail tread. A waterbar may also help minimize trail downcutting. Figure 13 shows the general location of the “Possible Solutions” structures¹⁹.

Table 15. Possible solutions in Zone I.

Features	Count
Add rock or timber risers	130
Add waterbar	1

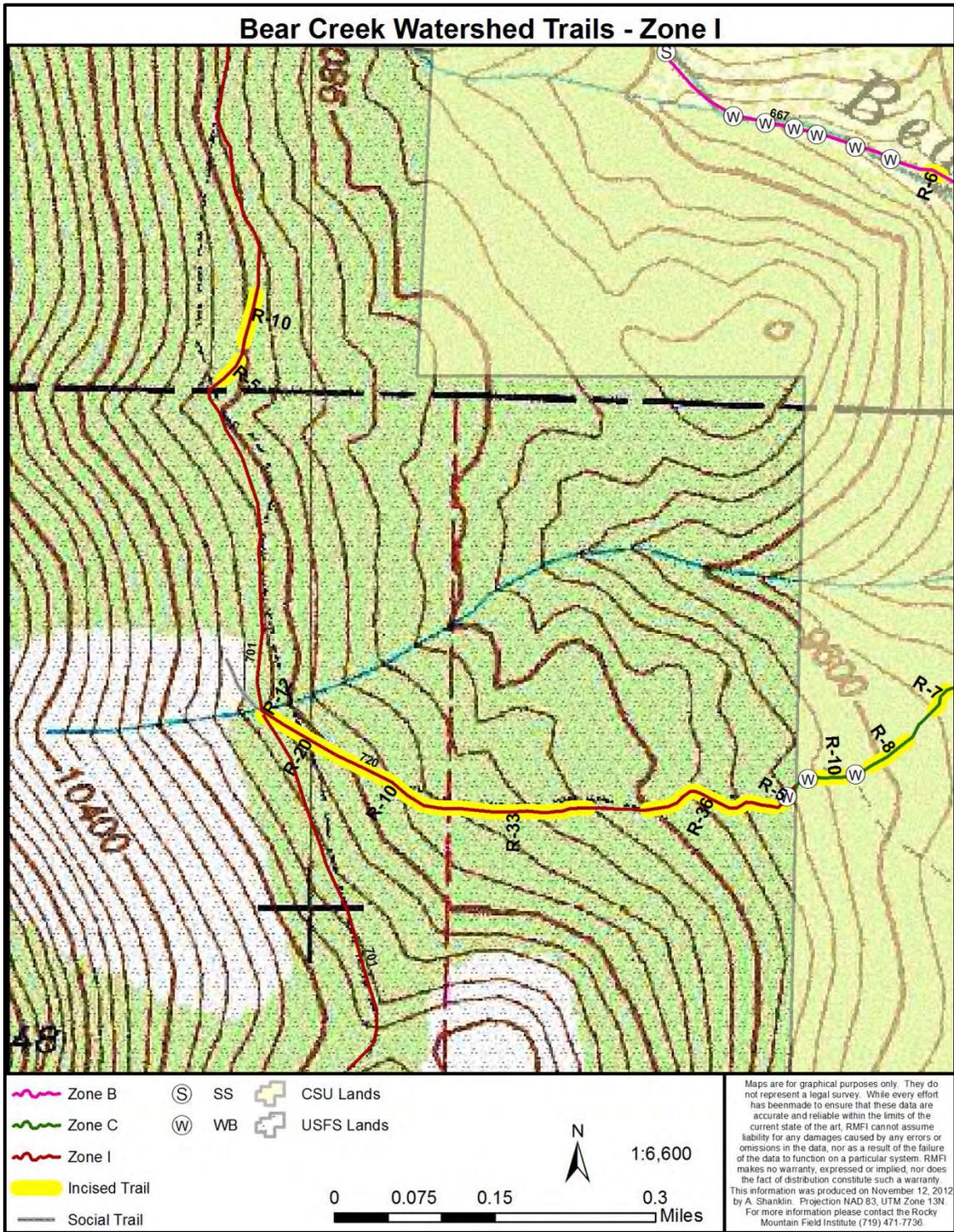
Continued Maintenance²⁰

There is currently no continued maintenance in this zone because there are no existing structures.

¹⁹ “Incised Trail” delineation on maps indicates areas where the trail is downcutting. Each “Incised Trail” delineation is associated with a label on the map (“R-#”). These labels indicate the number of risers suggested to bring the trail back up to grade and to minimize further downcutting. Any installation of structures should be completed by trained individuals to ensure proper placement and construction.

²⁰ Maintenance requirements are based upon existing trail corridor structures. Maintenance of future structures should be determined by evaluating all associated trail corridor structures, new and existing. Additional work may change the annual requirements of existing structures and should be accounted for when determining the maintenance of any future placed structures.

Figure 13. Map of possible solutions for trails in Zone I.



Overview of Zone I



Photo 43. Extensive headcut, users have created a new trail to avoid this area (Trail #720).



Photo 44. Erosion and downcutting occurring in trail. Possible Solutions – remove current log structure in trail and construct 12 timber risers (Trail #720).



Photo 45. Erosion and downcutting in trail. Possible Solutions – construct 10 timber risers (Trail #720).



Photo 46. Erosion and downcutting occurring in-trail. Possible Solutions – construct 36 timber risers (Trail #720).



**Photo 47. Erosion and downcutting in trail.
Possible Solutions – construct 27 timber risers
(Trail #701).**

Zone J (CSU)

Existing Conditions

The section of trail in Zone J includes portions of Trail #720A, #720, and #668. This zone contains the lower loop around Jones Park. This section has approximately 7,425 feet of trail (2,355 feet along Trail #720A, 2,400 feet along Trail #720, and 2,667 feet along Trail #668). Portions of this zone are not within the Bear Creek Watershed (the lower portion of Trail #720 and #668) but were analyzed in part to assess reroutes which will be discussed later in the document. Much of this trail is unstable and downcutting (approximately 45% of the trail). Many of the sharp turns in this zone are incised and have bare, eroding slopes. There are also 3 areas where new trails have been formed by users due to trail incision. There is one existing wooden bridge in this zone. Photos 48-51 show existing conditions throughout Zone J.

Table 16. Existing structures in Zone J.

Features	Count
Wooden bridge	1

Possible Solutions

RMFI estimates that 100 risers could be constructed in this zone to stabilize the trail tread. In areas where new trails have been formed by users, check dams could be used to restore the grade and to minimize the chance of further downcutting. Six failing slopes would benefit from the construction of rock or timber retaining walls. There are also approximately 12 locations along this section of trail where risers and/or waterbars would prevent future water transport and sediment movement. A bridge or culvert would reduce in-stream traffic. Figure 14 shows the general location of the “Possible Solutions” structures²¹.

Table 17. Possible solutions in Zone J.

Features	Count
Add rock or timber risers	100
Add retaining wall	6
Add waterbar	1
Add bridge or culvert	1

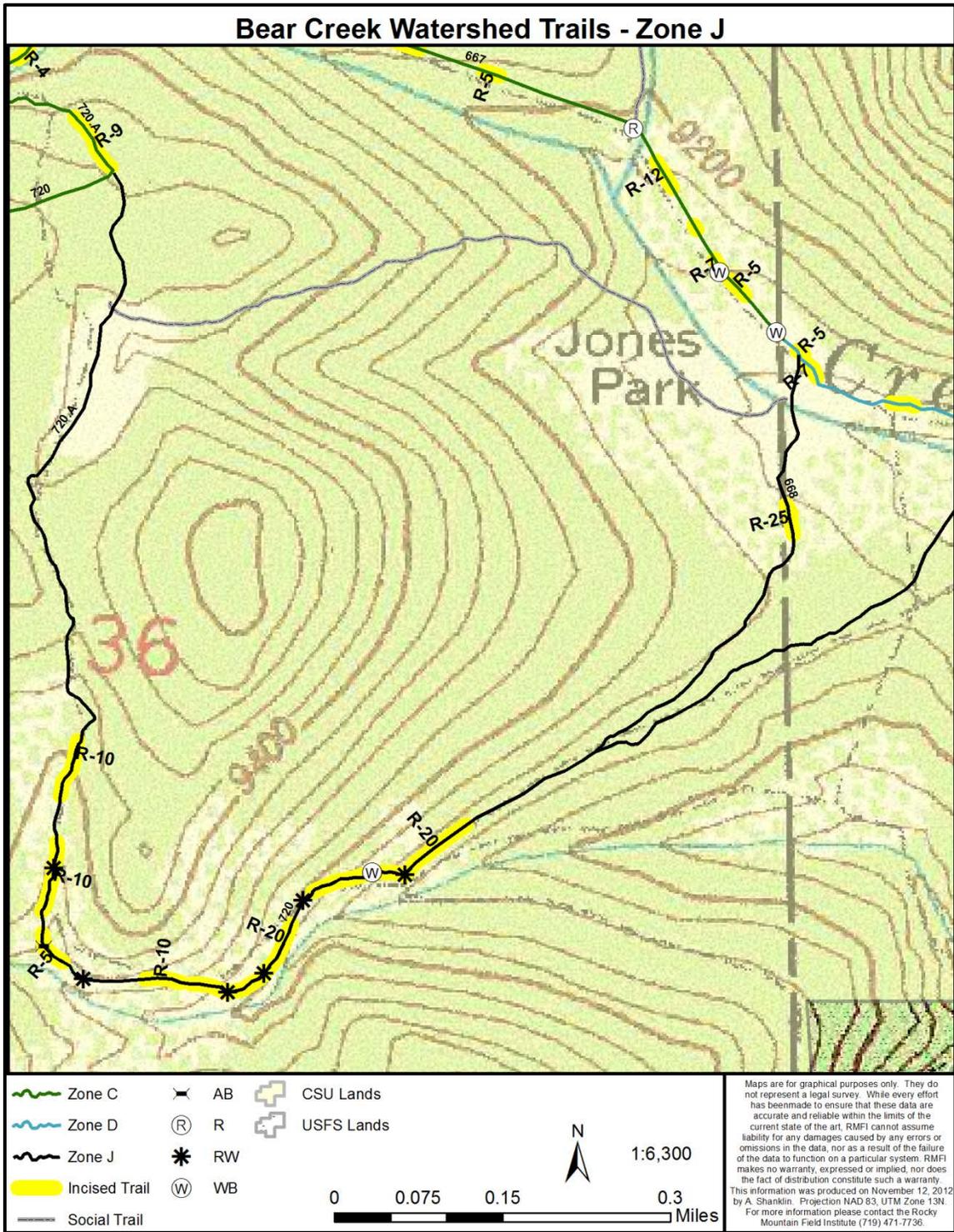
Continued Maintenance²²

There is currently no continued maintenance in this zone because there are no existing structures.

²¹ “Incised Trail” delineation on map indicates areas where the trail is downcutting. Each “Incised Trail” delineation is associated with a label on the map (“R-#”). These labels indicate the number of risers suggested to bring the trail back up to grade and to minimize further downcutting. Any installation of structures should be completed by trained individuals to ensure proper placement and construction.

²² Maintenance requirements are based upon existing trail corridor structures. Maintenance of future structures should be determined by evaluating all associated trail corridor structures, new and existing. Additional work may change the annual requirements of existing structures and should be accounted for when determining the maintenance of any future placed structures.

Figure 14. Map of possible solutions for trails in Zone J.



Overview of Zone J



Photo 48. Erosion issues along trail and sharp turn causing slope failure. Possible Solutions – install waterbars and rock retaining wall (Trail #720).



Photo 49. Trail downcutting caused users to create a new trail alongside old trail. Possible Solutions – fully restore area with check dams and vegetation (Trail #720).



Photo 50. Incision along trail. Possible Solutions – install timber risers and waterbars to move water from trail and to stabilize trail tread (Trail #720).



Photo 51. Incision along trail. Possible Solutions – install waterbars to move water from trail to reduce flow of water down trail (Trail #720).

Zone K (City of Colorado Springs)

Existing Conditions

The trail in Zone K is located on City of Colorado Springs land and includes portions of Trail #666. The eastern section of this trail connects to High Drive and the western section connects to Trail #666 where it enters US Forest Service land. This is the other only designated fully non-motorized section in this assessment (with Zone F). Of the 1,500 feet of trail in Zone K, approximately 293 feet (20%) is incised. There are 2 foot bridges in this zone. RMFI worked in this area during October 2012 restoring camp sites (3) and closing social trails (5). Photo 52 shows existing conditions in Zone K.

Social Trails

Over 2,000 feet of un-official social trail runs either parallel to the stream or navigates toward the stream from the trail. There are 16 small social trails that, for the most part, navigate to the stream from the designated and undesignated trails.

Table 18. Existing structures in Zone K.

Features	Count
Unimproved bridge	2

Possible Solutions

RMFI estimates that 35 risers could be constructed along Trail #666 to stabilize this section of trail. In addition, there are 6 bare and eroding slopes that would benefit from the construction of retaining walls and/or stabilization and revegetation to minimize impacts to the stream. Other possible solutions include adding 1 waterbar to remove water from the trail, 1 check dam to capture sediment, and 2 wooden bridges to minimize traffic through the stream. Figure 15 shows the general location of the “Possible Solutions” structures²³.

Table 19. Possible solutions in Zone K.

Features	Count
Add rock or timber risers	35
Add retaining wall	2
Stabilize and revegetate slope	3
Add waterbar	1
Add check dam	1
Add wooden bridge	2

²³ “Incised Trail” delineation on map indicates areas where the trail is downcutting. Each “Incised Trail” delineation is associated with a label on the map (“R-#”). These labels indicate the number of risers suggested to bring the trail back up to grade and to minimize further downcutting. Any installation of structures should be completed by trained individuals to ensure proper placement and construction.

Social Trails

The majority of the social trails in this zone are small, if the City decides to stabilize the social trails there are a few slopes that would benefit from revegetation and two stream crossings that would benefit from bridges or culverts. If the decision is to close these trails, stabilization and revegetation would benefit the stream. Given that these are currently undesignated trails, these features are not included in the list of possible solutions found above.

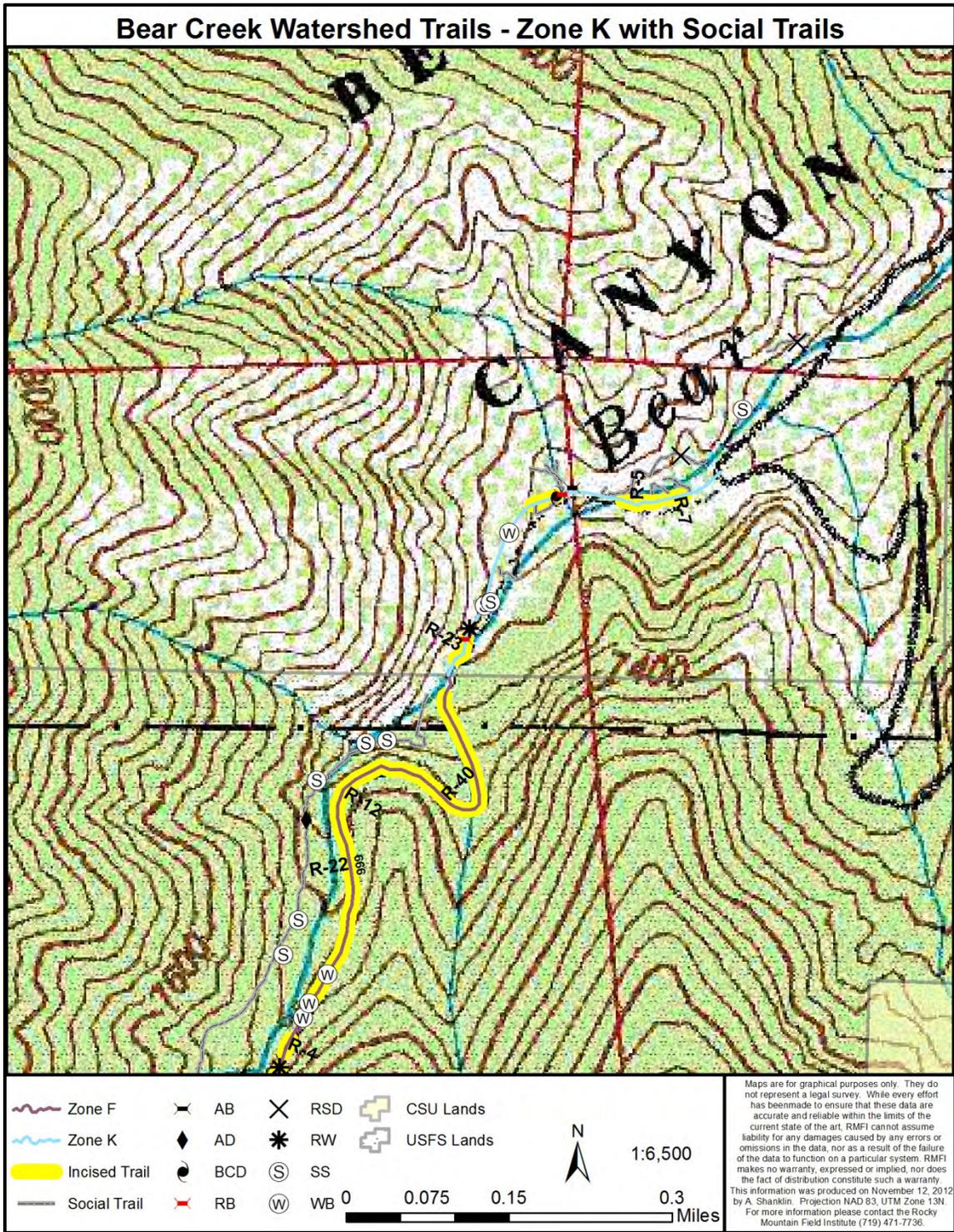
Continued Maintenance²⁴

There is currently no continued maintenance in this zone because there are no existing structures.

DRAFT

²⁴ Maintenance requirements are based upon existing trail corridor structures. Maintenance of future structures should be determined by evaluating all associated trail corridor structures, new and existing. Additional work may change the annual requirements of existing structures and should be accounted for when determining the maintenance of any future placed structures.

Figure 15. Map of possible solutions for trails in Zone K.



Overview of Zone K



Photo 52. In-stream sediment deposition. Possible Solutions – construct retaining wall to minimize sediment movement.

Reroutes

RMFI explored much of the Bear Creek Watershed in search of potential reroutes. Reroutes were initially explored via aerial imagery and were ground-truthed in the field. Much of the area north of Trail #667 was eliminated from analysis due to the steep slopes and rocky outcroppings discovered (Figure 16).

Option 1 – A potential reroute for Zone A was discovered along the southern portion of the trail in this zone (Figure 17). RMFI staff walked a route that departs from the Trail #667 between $104^{\circ}58'12.46''\text{W}$, $38^{\circ}48'33.731''\text{N}$ and $104^{\circ}58'3.553''\text{W}$, $38^{\circ}48'35.131''\text{N}$. Following the contour in this area leads directly to Trail #701. The route parallels Trail #667 for approximately 1,500 feet before diverging in a southeastern direction and connecting with Trail #701. This route would require one stream crossing over a tributary of Bear Creek and may necessitate a switchback along the southeastern portion to reconnect to Trail #701. Switchbacks may be avoided by extending this route and connecting farther south to Trail #720. This reroute avoids the majority of Zone A.

Option 2 – RMFI personnel walked a potential reroute between Trail #720 and #720A (Figure 18). This reroute would navigate southeast between coordinates $104^{\circ}57'17.114''\text{W}$, $38^{\circ}47'33.518''\text{N}$ and $104^{\circ}57'13.478''\text{W}$, $38^{\circ}47'34.184''\text{N}$. This route would connect to Trail #720 farther south (near coordinates $104^{\circ}56'55.475''\text{W}$ and $38^{\circ}47'18.534''\text{N}$) and would allow users to avoid the unstable portion of #720. This reroute has a few areas that are relatively steep and may require construction of switchbacks to protect slopes from erosion and downcutting; this reroute may not have any advantages over stabilizing and continuing to utilize the northern portion of Trail #720. It should be noted that some of this reroute is outside the Bear Creek Watershed.

Option 3 – RMFI personnel walked a potential reroute just north of Zone D. Though there are some steep sections along the northern portion of the watershed, a carefully aligned trail may be feasible along the northern section of Zone D. Traversing northeast from Trail #667 near coordinates $104^{\circ}53'15.581''\text{W}$ and $38^{\circ}47'31.654''\text{N}$ may be a practical solution for moving this section of trail away from the stream. RMFI staff followed the contour for approximately 3,000 feet before heading east and southeast. However, there may be an additional route farther south from this route as well. The slopes along the eastern portion of this reroute are steep. Reconnecting this reroute to Trail #667 may require the construction of switchbacks to lose the grade necessary for connecting the reroute to the existing trail. There is a 320 foot elevation loss over a length of 1,000 feet with no switchbacking (Figure 19).

Other Attempts – Other reroutes were explored via aerial imagery with some on-the-ground exploration. Initial explorations of these routes did not seem feasible as steep slopes and rocky outcroppings made reconnecting with the current system trail difficult (Figure 16). However, additional examination in these areas may offer more options.

- 1) A reroute across the northern and southern slopes of Kineo Mountain was explored (and walked by RMFI personnel) but no full routes were determined to be practical. The eastern portions of all attempted routes were deemed too steep for construction of sustainable trails. (Designated "A" on Figure 20)

- 2) An additional reroute was explored to remove the need for the stream crossing along Trail #667 where it connects to #666. RMFI proposed that if a reroute could be found connecting Trail #666 to Trail #667 farther east of the current connection, much of the section of Trail #666 that is depositing sediment into the stream could be closed. This section of the watershed is very steep and a trail in this area would most likely need to be constructed entirely of timber or rock risers to reduce erosion (Designated "B" on Figure 20). In fact, this reroute would extend just over 500 feet, but would need to climb approximately 300 feet in elevation to reach Trail #667. In addition, to completely remove the stream crossing and reduce the input of a large portion of sediment into the stream, the switchbacks just south of the stream crossing would also need to be closed. In order to accomplish this, a reroute near coordinates 104°55'191.1"W and 38°47'31.009"N would most likely be required. This reroute would travel from the top of the switchbacks back down to the stream approximately 1,150 feet west of the start location (Designated "C" on Figure 20). Unfortunately, this section of Kineo Mountain is very steep and a reroute was determined to be unfeasible. In addition, more switchbacks would be required to reconnect with the stream and the existing trail is on the opposite side of the stream, requiring an additional bridge. These routes were investigated on-the-ground, but were not fully walked by RMFI personnel due to the unstable nature of the terrain and the impracticality of constructing trail in the area.

Figure 16. Slope percentage throughout Bear Creek Watershed.

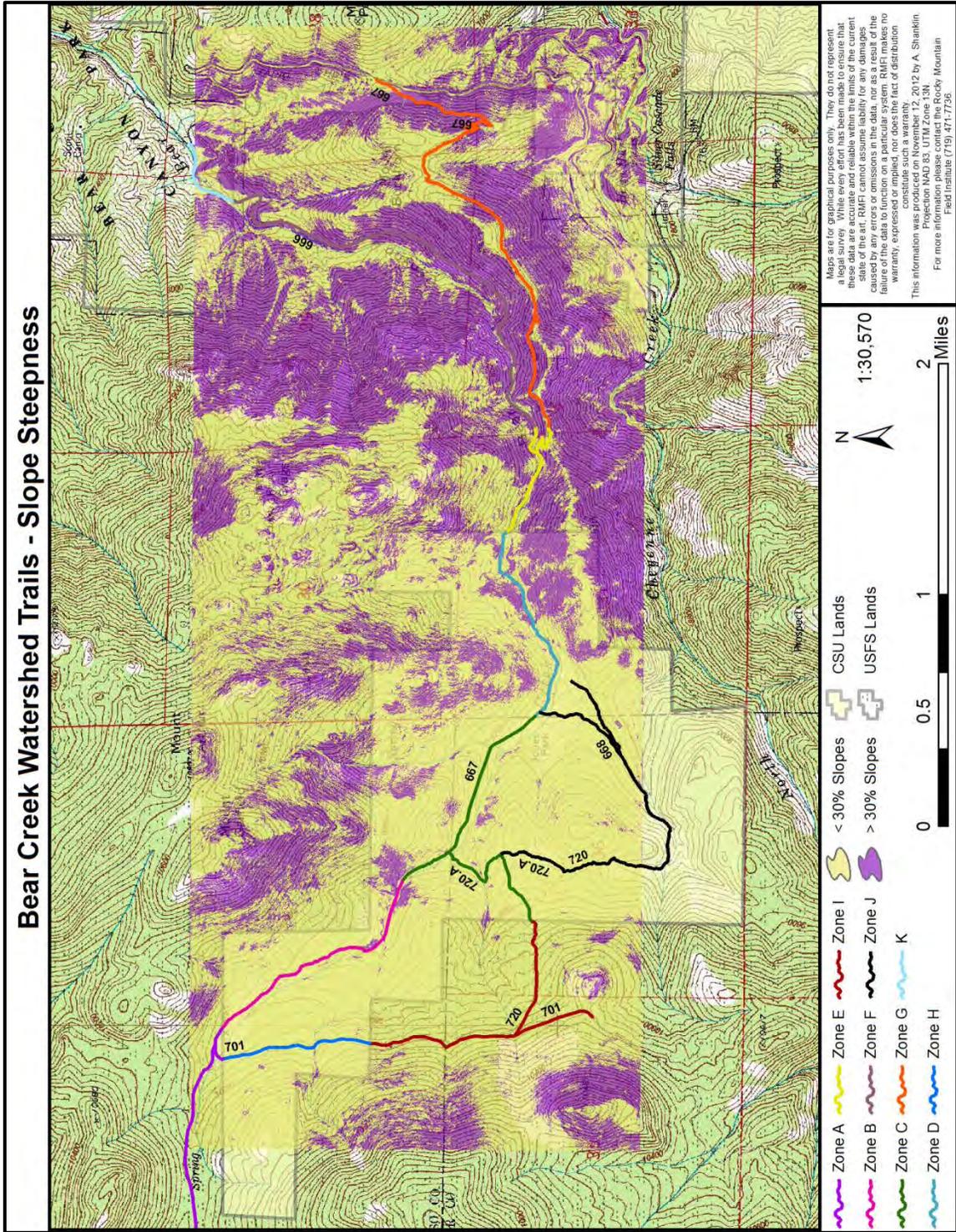


Figure 17. Potential reroutes, Option 1.

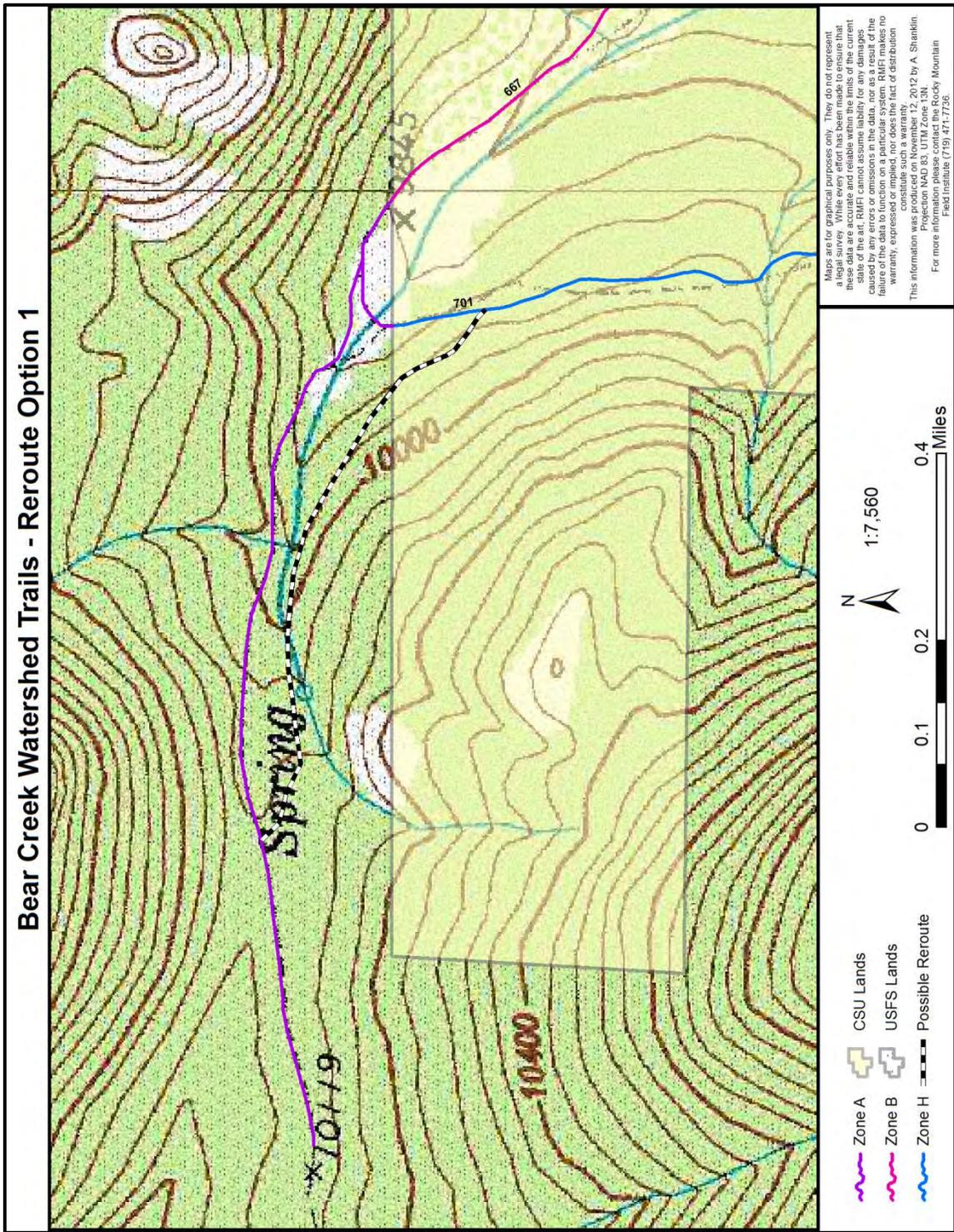


Figure 18. Potential reroutes, Option 2.

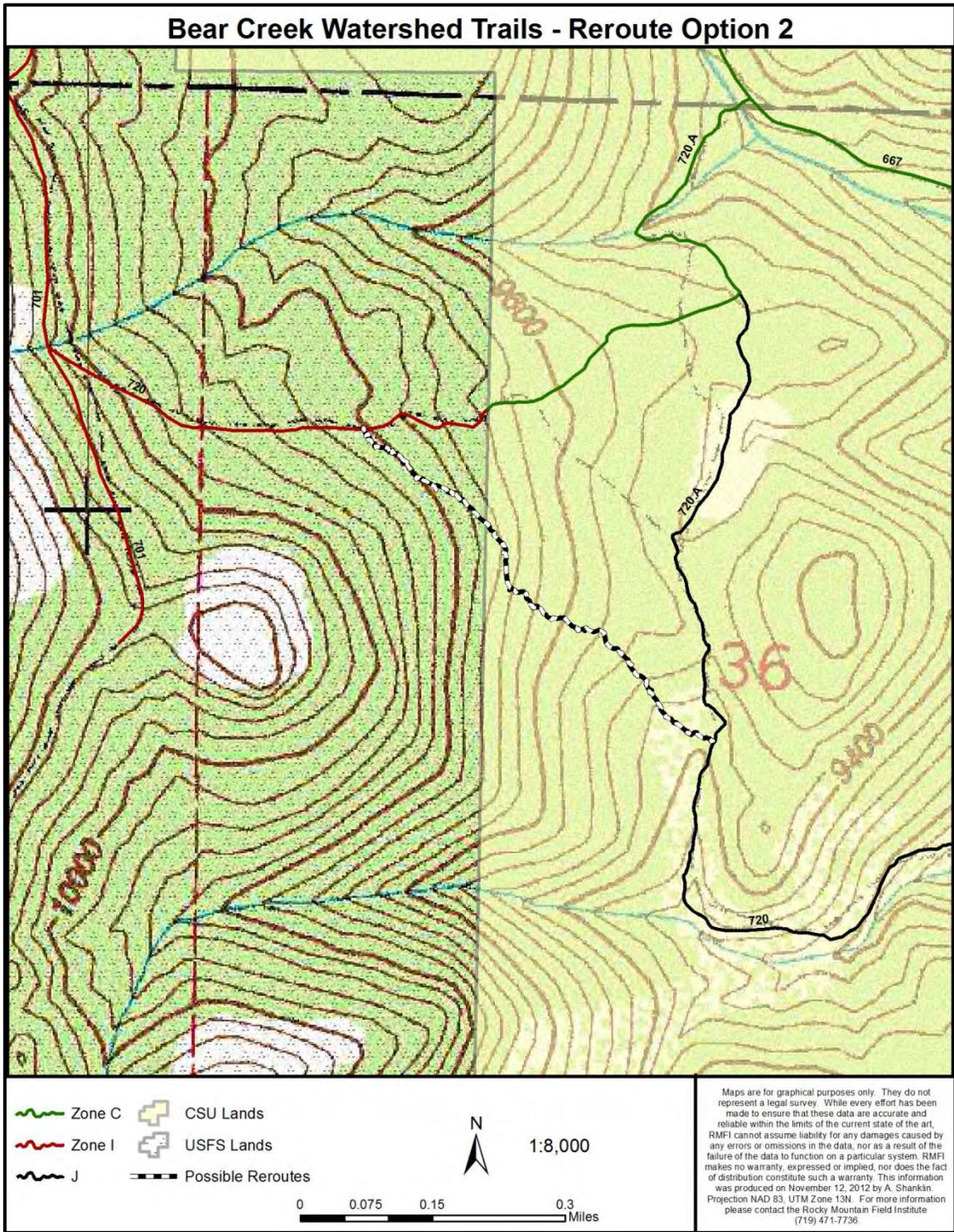


Figure 19. Potential reroutes, Option 3.

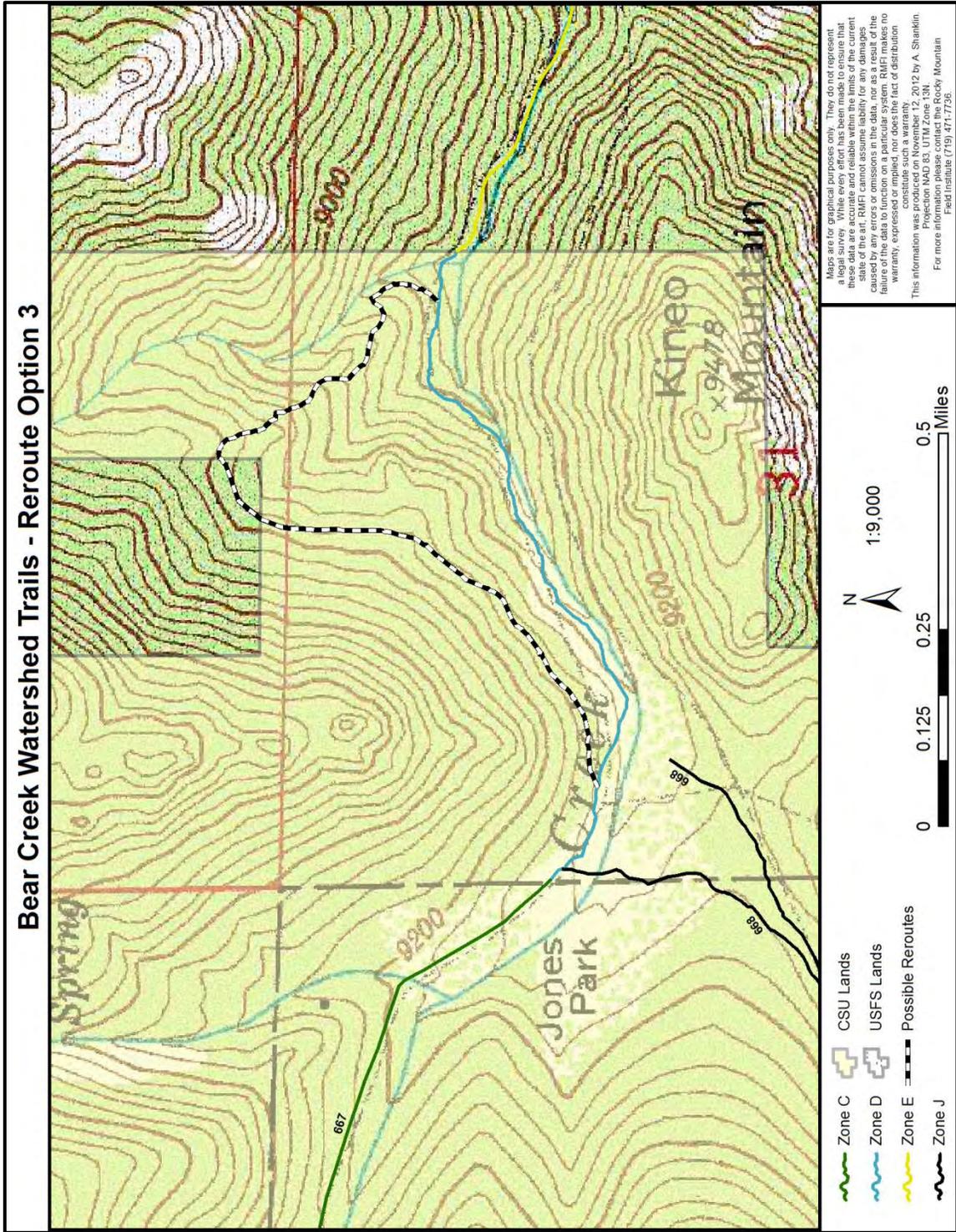


Figure 20. Potential reroutes, Other Attempts.

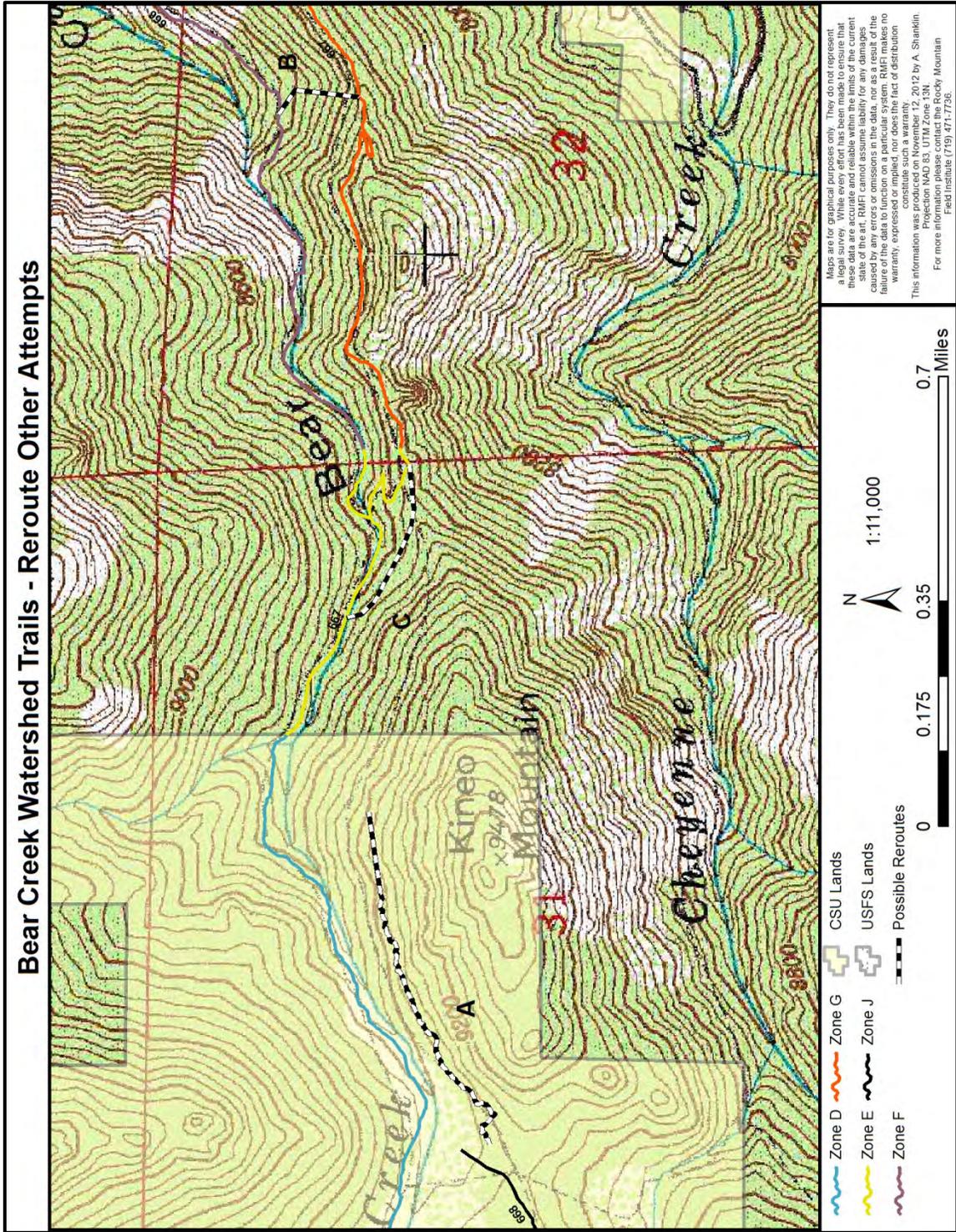
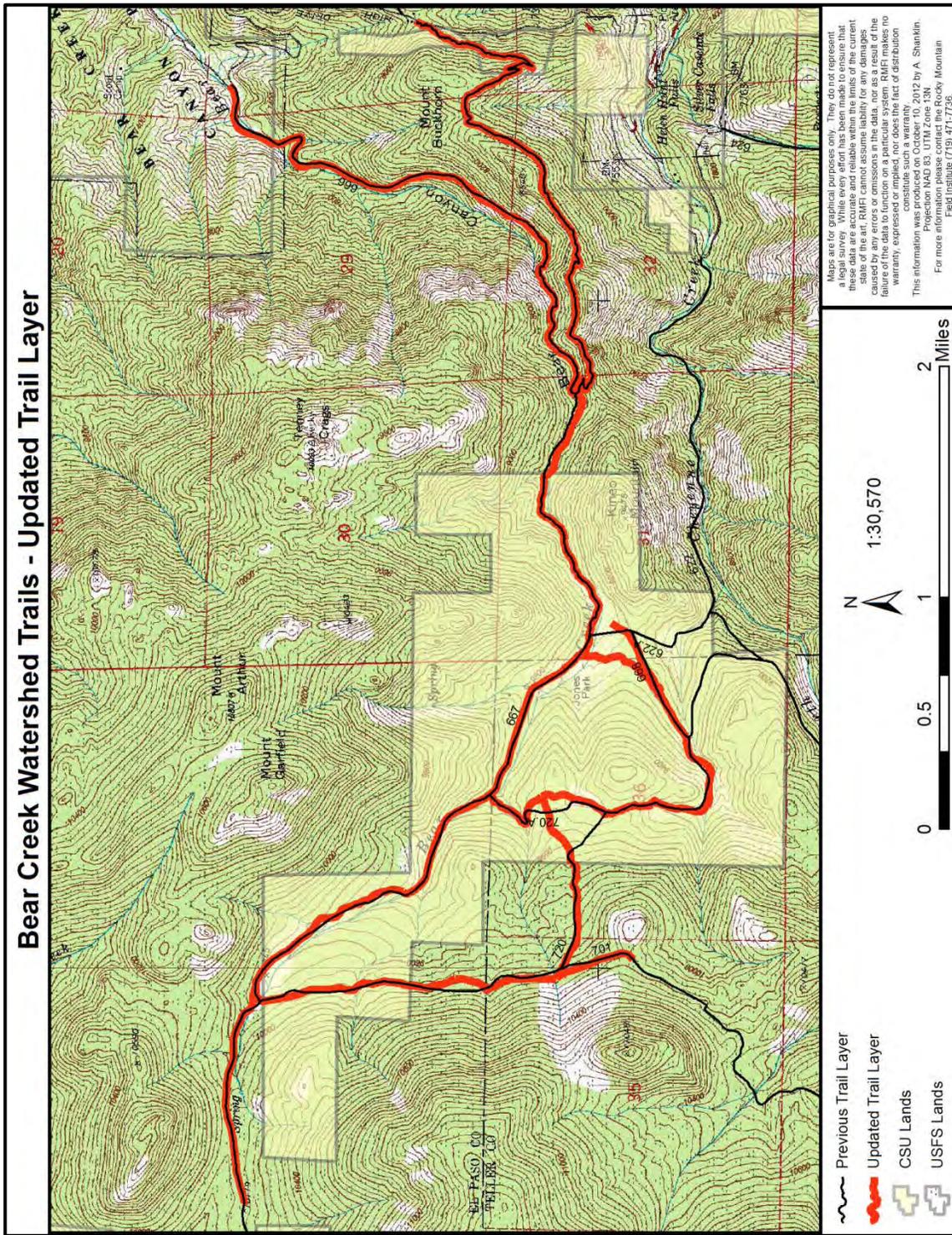


Figure 21. Map distinguishing previous GIS layer of Bear Creek Trails with updated trails layer.



Acknowledgments

Rocky Mountain Field Institute would like to acknowledge all the groups and individuals involved in this assessment. RMFI would like to thank Denny Bohon (USFS) and Kirsta Scherff-Norris (CSU) for their suggestions and revisions. Rebecca Jewett (RMFI Executive Director), Joe Lavorini (RMFI Program Coordinator), and Eric Billmeyer (RMFI Senior Advisor) contributed expertise and time to this document. Scott Dullus (USFS), and Ned Suesse, Drew Stoll, and Mike Kunz from Colorado Motorcycle Trail Riders Association spent time in the field searching for reroutes with RMFI. RMFI thanks everyone for the time and expertise contributed to this project.

Contact Information

Amber Shanklin, Program Director
amber@rmfi.org
(719) 471-7736

Appendix A

Abbreviation	Symbol on Map	Possible Solution
AB		Add bridge or culvert
AD		Add drain
BCD		Add brush check dam
LEB		Add log erosion barrier
R		Restore
RB		Remove bridge
RSD		Remove in-stream dam
RW		Add retaining wall
RWB		Remove waterbar
SS		Stabilize and revegetate slope
R		Add rock or timber riser
WB		Add waterbar