

**Eagle Rim Trail Feasibility Assessment**  
**Mount Burdell Preserve**  
**Marin County Open Space District**



Prepared by:  
Marin County Parks  
Open Space Roads & Trails Division  
November 6, 2017



## Table of Contents

|  |               |             |
|--|---------------|-------------|
| Introduction .....                       | <del>4</del>  | Deleted: 3  |
| Project Location .....                   | <del>4</del>  | Deleted: 3  |
| Project Site .....                       | <del>4</del>  | Deleted: 3  |
| Project Summary .....                    | <del>7</del>  | Deleted: 6  |
| Project Purpose and Need .....           | <del>7</del>  | Deleted: 6  |
| Physical Setting .....                   | <del>9</del>  | Deleted: 8  |
| Climate .....                            | <del>9</del>  | Deleted: 8  |
| Hydrology .....                          | <del>9</del>  | Deleted: 8  |
| Geologic Setting .....                   | <del>10</del> | Deleted: 9  |
| Geologic Hazards .....                   | <del>10</del> | Deleted: 9  |
| Soils .....                              | <del>10</del> | Deleted: 9  |
| Faulting and Seismicity .....            | <del>12</del> | Deleted: 10 |
| Vegetation .....                         | <del>12</del> | Deleted: 10 |
| Methodology .....                        | <del>15</del> | Deleted: 12 |
| Site Observations .....                  | <del>16</del> | Deleted: 13 |
| Upper Ridge Trail .....                  | <del>16</del> | Deleted: 13 |
| Middle Ridge Trail .....                 | <del>17</del> | Deleted: 14 |
| Lower Ridge Trail .....                  | <del>17</del> | Deleted: 14 |
| Recommendations .....                    | <del>19</del> | Deleted: 15 |
| Upper Ridge Recommendation .....         | <del>19</del> | Deleted: 15 |
| Middle Ridge Trail Recommendation .....  | <del>19</del> | Deleted: 15 |
| Lower Ridge Recommendation .....         | <del>19</del> | Deleted: 15 |
| Lower Bowl Recommendation: .....         | <del>19</del> | Deleted: 15 |
| Conclusions .....                        | <del>20</del> | Deleted: 16 |
| Appendix A: Maps .....                   | <del>22</del> | Deleted: 18 |
| Appendix B: Trail Feature Typicals ..... | <del>25</del> | Deleted: 21 |
| References .....                         | <del>30</del> | Deleted: 26 |

## Introduction

The Marin County Open Space District (MCOSD) is exploring the feasibility of adopting of the Eagle Rim Trail on the Mount Burdell Open Space Preserve. This report details staff field observation and assessment of the existing trail, and its potential adoption as a hiking/cyclist trail. Because of topography and soils, it was determined early in the planning process that the Eagle Rim trail was not suitable as a full multi-use to include equestrian users. This process explored a multitude of reroutes and options to minimize resource impacts and ensure park visitor trail safety. Re-alignment options discussed in this report are based on vegetation assessments, wildlife assessments, consultation with MCOSD resource staff, consultation with environmental stakeholders, soil conditions, slopes, grades and sight lines.

## Project Location

The project is located in Region 4, located toward the northern end of Marin County near the City of Novato. It is the northernmost of the six regions. The region consists of six preserves totaling 2,874 acres. It includes the Mount Burdell, Little Mountain, Verissimo Hills, Indian Tree, Rush Creek, and Deer Island Preserves. Mount Burdell is the largest preserve in Region 4 (1,627 acres), followed by Rush Creek (522 acres), Indian Tree (242 acres), and Little Mountain (214 acres). Region 4 contains 59 miles of roads and trails, second only to Region 1. Olompali State Historic Park is located to the north of Mount Burdell Preserve, and U.S. 101 is located east of Mount Burdell Preserve. The Rush Creek Marsh and Petaluma Marsh Wildlife Refuges, managed by the California Department of Fish and Wildlife, are located north of the Rush Creek Preserve. Region 4 is the only region where roads and trails are located near “very rural” residential lands as designated by the Marin Countywide Plan (Figure 1).

## Project Site

The project site is located in the Mount Burdell Open Space Preserve, in Novato, CA (Figure 2). Mount Burdell comprises 1,627.3 acres of land that was previously part of C Ranch and was purchased by Marin County Parks in 1977. The preserve is surrounded by Olompali State Park to the northeast, private dairies to the northwest and west, and residential development in the City of Novato to the south and east. The preserve has been grazed by cattle for decades and is currently being grazed under lease to a private party. Mount Burdell currently contains 24.06 miles of roads & trails, water tanks and pipelines owned and operated by the North Marin Water District, PG&E lines, and telecommunication facilities.

The project site includes the Eagle Rim Trail, which is an undesignated trail is a well-established 2-foot wide trail. The trail originates next to the Communication Tower at the summit, and descends along the north ridge, until it intersects with the Deer Camp Fire Road. The existing trail is approximately 4,530 feet long and has an elevation change of 495 feet for an average gradient of a 10.9 percent.

Commented [CJ1]: Where did 24.06 come from?

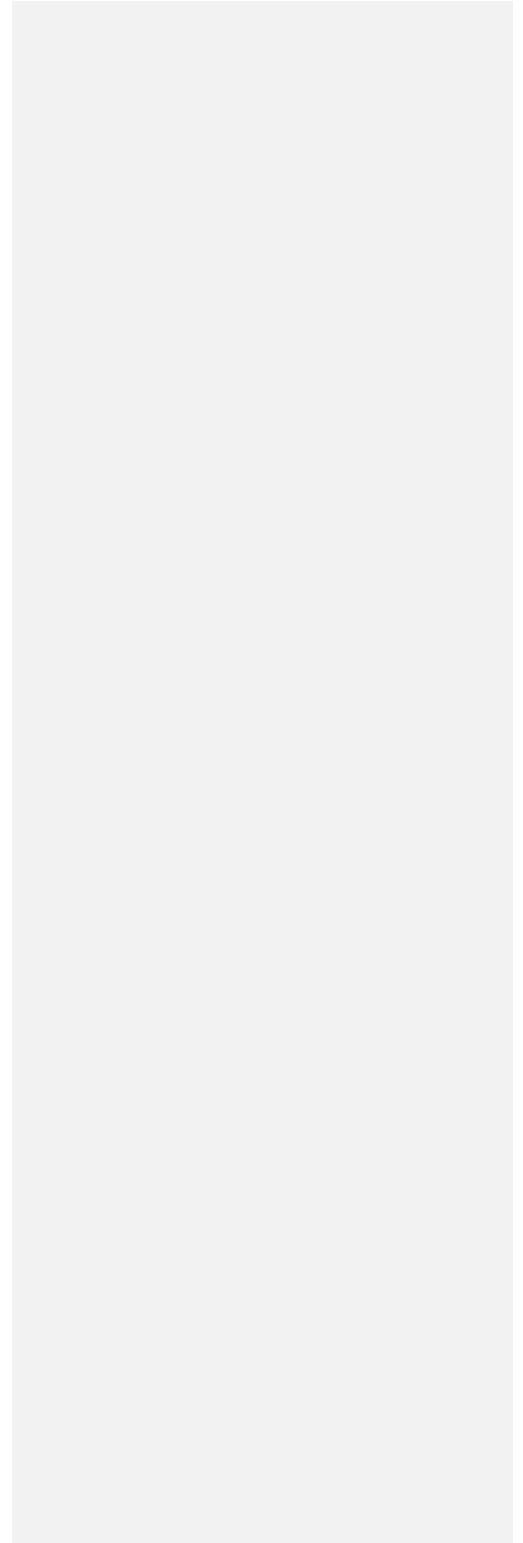
Commented [TK2R1]: RTMP

Commented [TK3]: Dave/Carl/Brian, what other improvements are at Burdell?

Commented [CJ4R3]: looks



**Figure 2. Project Site**



## Project Summary

The proposed project would adopt in place most of the existing Eagle Rim trail along the ridgeline (3,846 linear feet) and make improvements to drainage and tread sustainability. The project includes the following components (Figure 3):

- Adopt in place 3,846 linear feet of the existing Eagle Rim Trail;
- Implement Lower Bowl Reroute, totaling 955 linear feet;
- Decommission two segments of the existing Eagle Rim Trail, totaling 1,401 linear feet;
- Decommission 1,621 feet of unnammed fall line social trail on Mount Burdell;
- Improve new Eagle Rim Trail with approximately 50 cubic yards of base rock;
- Install appropriate dewatering features to produce a more sustainable and hydraulically stable trail;
- Install approximately 30 rolling dips;
- Install fencing and signage, as needed; and
- Designate Eagle Rim Trail as hiker/biker.

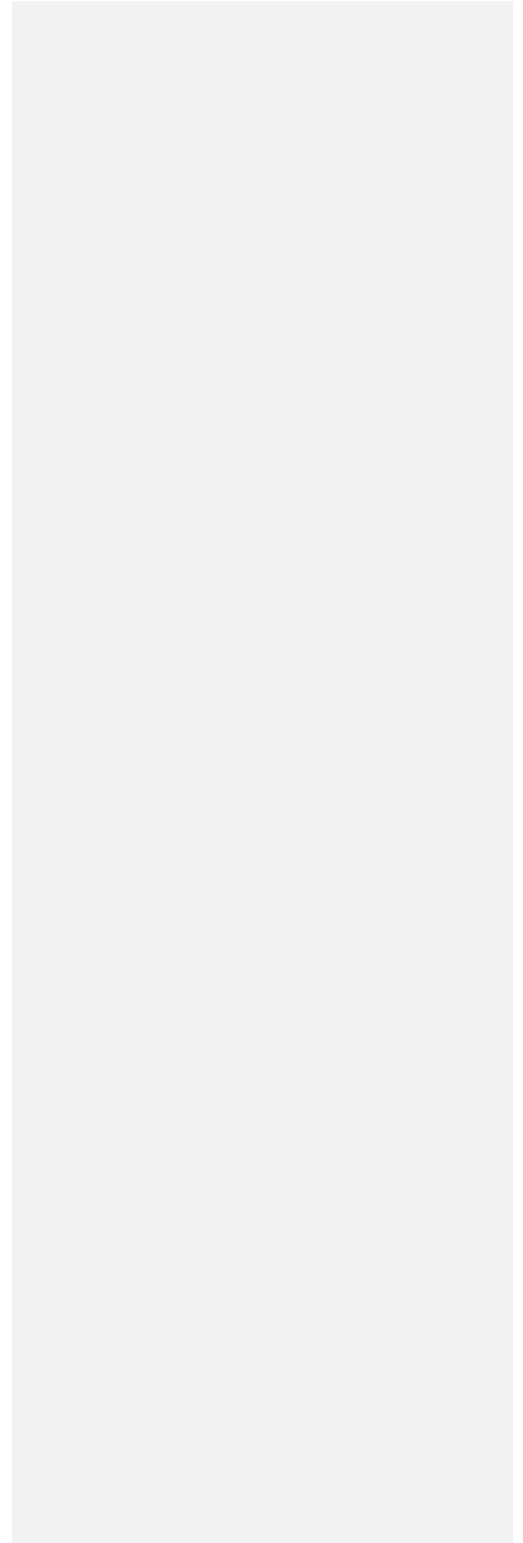
## Project Purpose and Need

In 2017, MCOSD provisionally designated the Eagle Rim Trail for hikers and bicycle use, pending environmental review and the implementation of needed improvements, during the Region 4 designation process in 2017. The map for Region 4 (Figure 2) includes Eagle Rim as part of the system. The primary purpose of the proposed project is to officially designate Eagle Rim as part of the MCOSD trail system in a sustainable manner that reduces the ecological footprint of the trail. Specific objectives include:

- Improve trail stability;
- Reduce trail gradient;
- Maintain the primitive nature of the existing conditions of the trail;
- Improve the visitor experience for hikers and cyclists;
- Reduce impacts to rare and sensitive vegetation;
- Reduce trail density; and
- Reduce habitat fragmentation.

Formatted: Justified

**Figure 3. Project Overview**





## Physical Setting

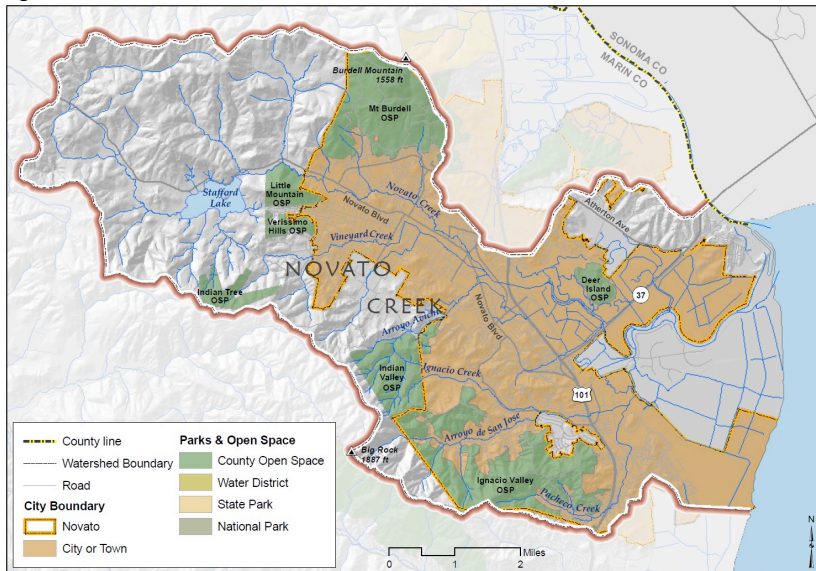
### Climate

Marin County has a mild Mediterranean climate with mean temperatures ranging from high 40s (degrees Fahrenheit) in the colder winter months to the low 70s (F) during the peak summer months of July and August. Most rainfall occurs in the winter during the months of November through March. Average annual rainfall varies greatly across the county, with a low of 18 inches at Point San Pedro up to 50 inches or more along the Mt. Tamalpais ridgeline. The central portion of the county, where the bulk of the MCOSD preserves are located, averages 30 to 40 plus inches a year. Often, significant runoff events occur in these areas in response to prolonged rainfall over two to three days interspersed with short bursts of intense rainfall. Prevailing winds throughout the county are generally from the northwest, with wind speeds highest along the west coast. Due to its varying topography and proximity to the Pacific Ocean and San Francisco Bay, Marin County has notable microclimates where weather can vary dramatically even within short distances. For example, fog and winds often linger along the coastal areas during the summer months while inland areas just 10 to 15 miles away can be sunny and hot (MCOSD, 2014a).

### Hydrology

Mount Burdell is mostly located in the Novato Creek watershed, with the eastern edge of preserve being located in the Rush Creek watershed. Novato Creek is the largest watershed in eastern Marin County and flows eastward through oak and bay forests, grasslands, the City of Novato, and into San Pablo Bay near the mouth of the Petaluma River and encompasses 45 square miles (Marin County, 2017; Figure 4). Hydrologic features in Mount Burdell Open Space Preserve include two small, unnamed creeks run through the preserve and Hidden Lake, one of Marin County's few vernal pools. Large proportion of preserve trails exhibit erosion and gullyng (MCOSD, 2014b).

Figure 4. Novato Creek Watershed



## Geologic Setting

The MCOSD preserves are located within the central portion of the Coast Range Physiographic Province of California, composed of a series of northwest-southeast aligned coastal mountain chains dominated by a similar trending San Andreas Fault Zone. Geology and associated hazards on either side of the active strike slip fault (i.e. San Andreas Fault) are distinctly different, with areas east of the fault dominated by the Franciscan Formation and associated mélangé and west of the fault by granitic rocks and overlying sedimentary rocks (MCOSD, 2014a).

Open space preserve areas, mainly located east of the San Andreas Fault, have a geology dominated by Cretaceous and Jurassic Age Franciscan Complex bedrock composed of sedimentary and volcanic rocks, serpentine, and sheared mélangé. Overlying the bedrock is a layer of colluvium and soil of varying thickness. Slopes underlain by the sheared mélangé bedrock tend to have a higher density of deep-seated landslides compared to those areas underlain by more competent sandstone. Alluvial sediments made up of unconsolidated sands, gravels, and silts are found along the valley bottoms (MCOSD, 2014a)

## Geologic Hazards

The main geologic hazards for the MCOSD preserves and trail infrastructure are landslides and other related slope-stability hazards, which might occur as a result of strong seismic shaking, or more commonly, during intense rainfall events that quickly saturate the soil. Landslides are the downward movement of materials such as rock, soil, or fill under the direct influence of gravity as a result of slope instability. Types of landslides include debris flows (the rapid downslope movement of a thick slurry composed of loose soil, rock, and organic material entrained with air and water) and debris avalanches (a more rapid or extreme debris flow). Landslides, particularly debris flows, have been widespread in Marin County during periods of heavy and intense rainfall.

Ground shaking is one of the key geologic hazards associated with seismic activity, with some areas more susceptible to strong shaking and potential damage due to their proximity to the fault zone or their underlying soil composition. Soils most susceptible to seismic shaking amplification tend to be younger alluvial deposits, bay mud, and artificial fill found in the lower lying areas around open water including Bolinas, San Pablo and Richardson Bays.

Some areas of Marin County have encountered liquefaction during previous large earthquakes. Liquefaction is when granular material quickly becomes unstable by moving from a solid state to a liquefied state because of increased pore-water pressure. Soils experiencing liquefaction lose their structural supporting capacity that can result in a range of effects, from the minor displacement of constructed buildings to the total collapse of structures (MCOSD, 2014a).

## Soils

Road and trail stability is also influenced by the underlying soils—how easily they are compacted and eroded, and how stable they are on slopes. Soils within the preserves are predominantly loam to clay loam, which poses a severe to very severe erosion hazard for earthen roads and trails. According to field observations, the soils are moderately drained with high erosion potential. Erosion is most evident in areas where runoff has been concentrated. The breakdown of soil under heavy trail use often leads to accelerated erosion and trail rutting (MCOSD 2014a).

**Commented [C15]:** I reduced the soils section down a bit and reworded. Let me know if this works or you want more info

The Eagle Rim Trail traverses Mt. Burdell Open Space Preserve predominately through a Saurin-Bonnydoon complex, Saurin (50%) and Bonnydoon (40%) The Saurin series consists of moderately deep, well drained soils that formed in material weathered from sandstone and shale. Saurin soils are on hills and have slopes of 2 to 75 percent. The Bonnydoon series consists of shallow, somewhat excessively drained soils that formed in material weathered from sandstone and shale. Bonnydoon soils are on uplands and have slopes of 5 to 85 percent (See Table 1 below).

Formatted: Justified

Deleted: The mean annual precipitation is about 30 inches and the mean annual temperature is about 59 degrees F.

Formatted: Font: Bold

**Table 1. Soil Survey for Project Area**

Formatted: Centered

| Soil Series | Composition within Saurin-Bonnydoon Complex, 30 to 50 percent slopes (%) | Recreational Development Rating (Paths and Trails) | Rangeland Wildlife Habitat | Building Site Development    | Features affecting Drainage         |
|-------------|--|--|----------------------------|------------------------------|-------------------------------------|
| Saurin      | 50%  | Severe: slope                                      | Good                       | Severe: slope                | Slope, Depth to Rock, erodes easily |
| Bonnydoon   | 40%  | Severe: slope                                      | Fair                       | Severe: Depth to Rock, Slope | Slope, Depth to Rock                |
| Tocaloma    | 2%   | Severe: slope                                      | Not Rated                  | Severe: Slope                | Slope, Depth to Rock                |
| Los Osos    | 2%   | Moderate: slope                                    | Good                       | Severe: Slope                | Slope, Depth to Rock                |
| Other       | 4%   | N/A  | N/A                        | N/A                          |                                     |

Source: Soil Survey of Marin County

Commented [TK6]: NRCS, 2017??

Soils in the project area have a rating of **Very Limited**. Very Limited indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures and poor performance and high maintenance levels can be expected. They exhibit a numerical rating of Slope (1.00) and Dusty (0.23) for the Saurin and (0.20) for the Bonnydoon. Numerical ratings indicate the severity of individual limitations and are shown as decimal fractions ranging from 0.01 to 1.00. The ratings indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00). The ratings are based on the soil properties that affect trafficability and erodibility. These properties are stoniness, depth to a water table, ponding, flooding, slope, and texture of the surface layer.

Formatted: Justified

Formatted: Font: Not Bold

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: Font: Not Bold

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: Font: Not Italic

The Saurin series consists of moderately deep, well drained soils that formed in material weathered from sandstone and shale. Saurin soils are on hills and have slopes of 2 to 75 percent.

The Bonnydoon series consists of shallow, somewhat excessively drained soils that formed in material weathered from sandstone and shale. Bonnydoon soils are on uplands and have slopes of 5 to 85 percent. The mean annual precipitation is about 30 inches and the mean annual temperature is about 59 degrees F.

The Tocaloma series consists of moderately deep, well drained soils that formed in material weathered from sandstone and shale. Tocaloma soils are on hills and have slopes of 2 to 75 percent. The mean annual precipitation is about 35 inches and the mean annual temperature is 58 degrees F.

The Los Osos series consists of moderately deep, well drained soils that formed in material weathered from sandstone and shale. Los Osos soils are on uplands and have slopes of 5 to 75 percent. The mean annual precipitation is about 25 inches and the mean annual air temperature is about 60 degrees F.

The slope rating of 1.00 indicates a very great negative impact. However, the Dusty rating of 0.20 and 0.23 indicate a fair trafficability and erodibility factor. *Soil Survey of Marin County, states, "If used for recreational development, the main limitation is steepness of slope. The Bonnydoon soil is also limited by shallow depth to rock. Slope restricts the use of areas of this unit mainly to paths and trails, which should extend across the slope."*

Based on the soils report and topography, the District would construct a trail approximately 30" in width. Alignment of this 955' reroute may be seen in the Appendix.

Deleted: ¶

... [1]

Deleted: ¶

... [2]

### Faulting and Seismicity

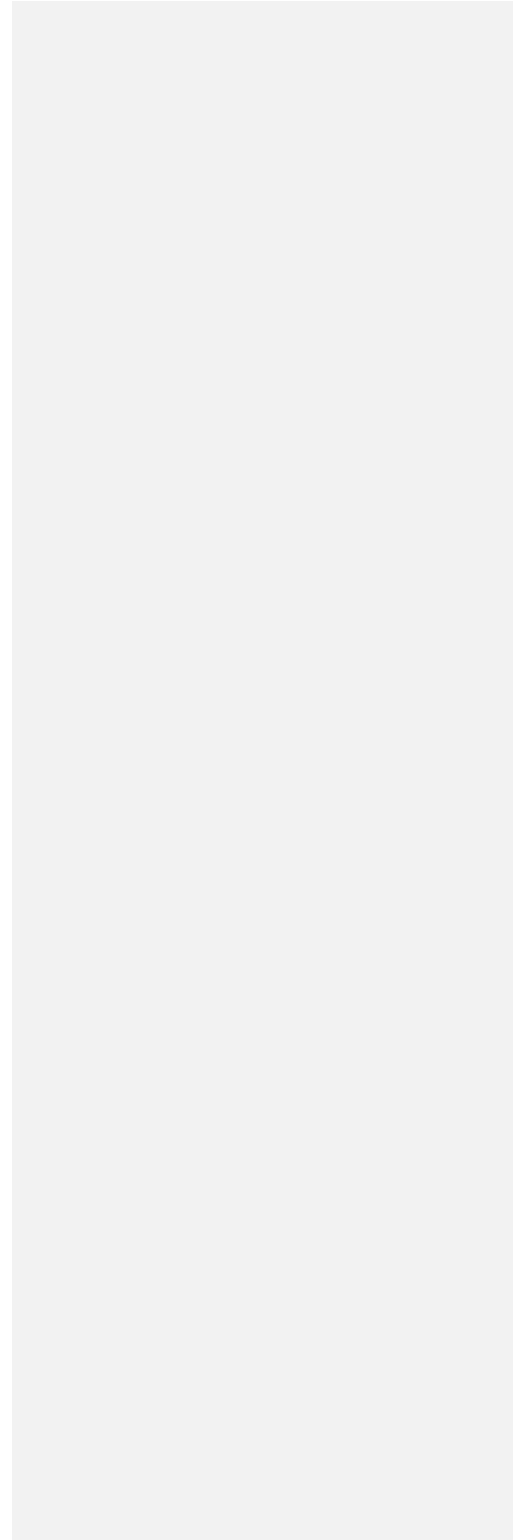
Marin County has several faults delineated by the California Division of Mines and Geology; however, the San Andreas is the only zone deemed sufficiently active under the Alquist-Priolo Earthquake Fault Zoning Act as is shown in Figure 8 3, where red and orange display the active faults. Additionally, an active portion of the Hayward fault lies near the county, but offshore. The last ground rupture along the San Andreas Fault in Marin County was in 1906. A 62 percent likelihood of fault rupture with a magnitude of 6.7 or greater has been forecast to occur on one of the San Francisco Bay Area active faults, including the San Andreas or the Hayward faults, before the year 2032. It is possible, but with a low probability, that earthquakes may occur on inactive or previously unidentified faults. The surficial deposits on either side of, and within, the San Andreas fault zone have greater potential for geologic hazards than elsewhere in Marin County, including: liquefaction, amplified shaking, subsidence, differential settlement and shallow slope failures (MCOSD, 2014a).

### Vegetation

The MCOSD classified vegetation within the preserves into four management zones, based on the ecological and/or cultural importance of distinctive vegetation types, the condition of resources in particular locations, and the proximity of particular locations to urban or suburban areas. This process is described in great detail in the MCOSD's Vegetation and Biodiversity Management Plan. Most preserves contain more than one of the following four zones. The Mt. Burdell Open Space Preserve is a rich mosaic of grassland, forest and riparian habitats with rich native flora. The project site occupies an area of the preserve which is primarily in the Natural Landscape Zone as identified in Vegetation and Biodiversity Management Plan (MCOSD, 2016).

The Natural Landscape Zone includes lands that support native plants and natural vegetation types that are typical of Marin County landscapes. These common vegetation types, while not legally protected or recognized as rare, provide valuable habitat for a diversity of local native species. They contribute to the beauty of Marin County landscapes and add to the ecologically rich natural communities and scenic vistas that define the MCOSD preserves. Vegetation within the natural landscape zone often provides important buffers between the wildland-urban interface and other zones and contains large tracts of grasslands, common oak and other woodland vegetation types, and coastal scrub. While this zone is more infested with invasive plants than the legacy and sustainable natural systems zones, it still provides valuable connectivity and important habitat for common wildlife and plants (MCOSD, 2016).

|





## Methodology

This report was based on field reconnaissance by MCOSD staff, literature review of available data, and site specific data, including:

- [MCOSD, 2014a. Road and Trail Management Plan Recirculated Final Tiered Program Environmental Impact Report, November;](#)
- [MCOSD, 2014b. Road and Trail Management Plan, December;](#)
- [MCOSD, 2016. Vegetation and Biodiversity Management Plan, October;](#)
- [Grassland Assessment and Rare Plant Survey of Mount Burdell Preserve's Upper Slope Oct 2, 2017;](#)
- [Soil Survey of Marin County, United States Department of Agriculture 1985; and](#)
- [USDA Natural Resources Conservation Services](#)

Site reconnaissance took place in October 2017 – December 2017 by Carl Szwarzewski, Equipment Operator Supervisor, David Frazier, Maintenance Equipment Operator, and included....

Formatted: List Paragraph, Bulleted + Level: 1 + Aligned at: 0.25" + Indent at: 0.5"

Deleted: provided by the

Commented [TK8]: List main data sources

Deleted: .

Formatted: No underline

Deleted: ,

Deleted: , the

Deleted: S

Formatted: Highlight

Deleted: on X

Formatted: Highlight

Deleted: INSERT NAME

Commented [TK9]: Describe process briefly

Formatted: Highlight

Deleted: AND TITLE

Formatted: Highlight

Formatted: Highlight

Formatted: Font: 11 pt, Not Bold

## Site Observations

The Eagle Rim Trail is comprised of four sections, based on the topography and the recommended improvements. These sections include the Upper, Middle, and Lower Ridge trail segments and the Lower Bowl. The top (3,864 foot) ridgeline section of the trail, along the northern property boundary, is comprised of the Upper, Middle, and Lower Ridge trail segments. The Lower Bowl segments totals 955 linear feet, extending from the climbing turn where the trail makes a 180 degree turn to .... (Figure 6). These sections are described below:

### Upper Ridge Trail

The top 1,500 linear feet of the trail has an overall average grade of 5.94 percent, as it traverses along the ridge of Mt. Burdell. The area is composed primarily of grassland with sparse groupings of oak and bay trees. Currently there are two trailheads, which converge roughly 970 linear feet down the trail, Upper Ridge Trail 1 and Upper Ridge Trail 2, which are described below.



Commented [TK10]: Jon, all photos and figures are off

- Upper Ridge Trail 1 (URT1) is the beginning 970 linear feet of the Upper Ridge segment. The trail head diverges from Mt. Burdell Fire Road, 220 feet before the towers, and swings around them to the north through a shallow grass swale continuing down the fall line. URT1 has an average grade of 7 percent, with max grades up to 14 percent. Sight lines are very good. It currently has no dewatering features.
- Upper Ridge Trail 2 (URT2) is a 670-linear foot social trail that begins directly behind the towers and has an average grade of 13.4 percent. URT2 has an immediate 20 percent fall line grade for 250 feet, which is rutted with no potential to dewater the existing alignment. The trail then transitions to a consistent 10-15 percent grade for 420 feet, still following the fall line, with no opportunity to dewater.

Photo 1: Upper Ridge Trail





### Middle Ridge Trail

This 1,600 linear feet of trail has an average grade of 8.25 percent. The trail continues to meander along the ridge and northern property line. It has no built dewatering features though a few natural grade brakes do exist. The segment shows little evidence of erosion, even though it runs down the fall lines in places. Overall this segment is in good condition, and has very good sight lines (See Photo 2).

### Lower Ridge Trail

The final 750 linear feet of the ridgeline segment, has an average grade of 20.4 percent, before the climbing turn down through the lower bowl. This portion of trail is highlighted by short segments of steep grades with rock steps and rock outcrops. The trail being predominately on bedrock is very stable given its grade. Overall this segment is in good condition and has very good sight lines. The side slope off, of the ridgeline alignment has grades of 50-75 percent, making any reroutes unfavorable (See Photo 3).

Photo 2: Existing Middle Ridge Trail



Photo 3: Existing Lower Ridge Trail



### Lower Bowl Trail

The final segment consists of 675 linear feet of narrow trail traverses through grassy bowl which terminates with the Deer Camp Fire Road. The current trail travels along a steep side slope, that has a shallow soil layer before bed rock. The trail sightlines are excellent, as you can see through the entire grassland segment. The existing alignment has an average grade of 18.4 percent with sections up to 26 percent, which does not show evidence of erosion or rutting on the alignment (See Photo 4).

Deleted: Lower Bowl Segment – INSERT DESCRIPTION OF EXISTING CONDITIONS

Formatted: Font: (Default) +Body (Calibri), 12 pt, Bold, Italic, Font color: Auto

Formatted: Normal

Formatted: Justified

Deleted: '

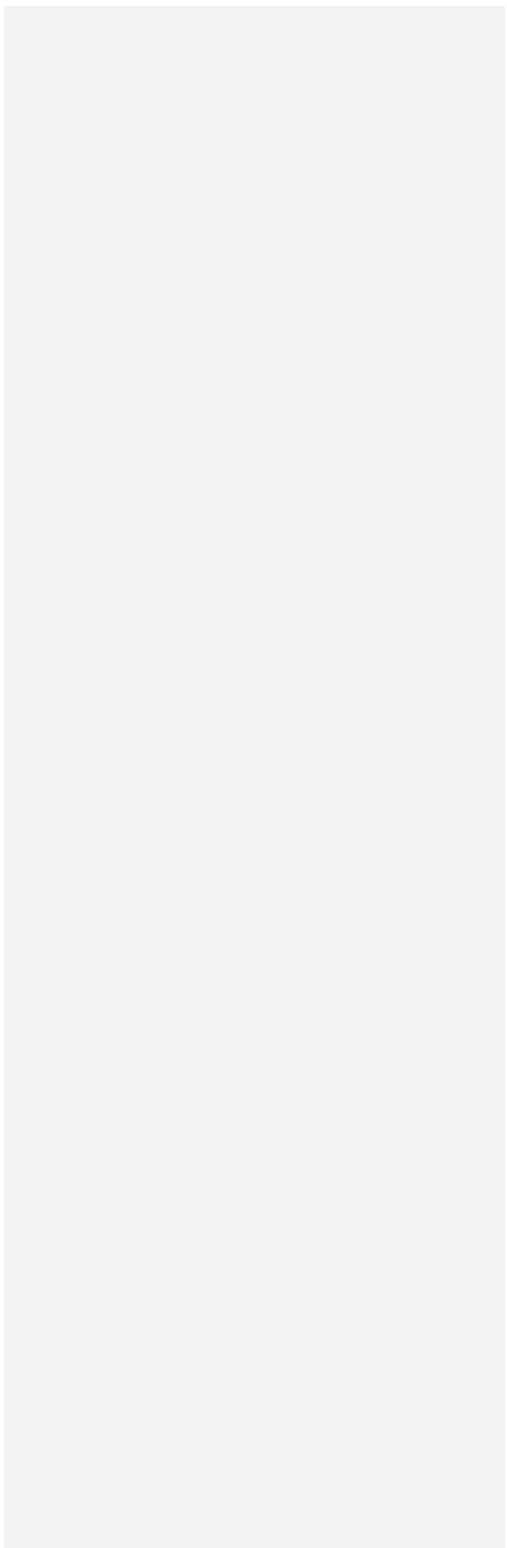
Deleted: %

Deleted: %

Deleted: %

Formatted: Normal

**Photo 4: Existing Lower Bowl Trail**



## Recommendations

### Upper Ridge Recommendation

The MCOSD recommends adopting the URT1 alignment. MCOSD recognizes the Towers to be an attractive eye nuisance, but anticipates by having the trail diverge prior would encourage users to stay out of the area. Both alignments have segments, which follow fall lines making dewatering difficult. URT1 does provide more opportunities for dewatering, however, and has an overall lower gradient. To mitigate the existing ruts MCOSD would fill and crown with amended native soil and base rock mix to encourage durability and longevity. The MCOSD would also install dewatering dips at regular intervals not to exceed 150' spacing.

### Middle Ridge Trail Recommendation

MCOSD would primarily adopt this segment in place. The MCOSD recommends the installation of dewatering, reverse grade dips, at 60-100' intervals, dependent on feasibility, soil stability, and grade. Minor realignments within the existing trail corridor, to pull the trail out of natural low areas, would be made to provide dewatering fall-lines. Import of amended native soil and base rock mix would be used, to fill ruts and create dewatering devices. Trees would be pruned to help increase sightlines where needed.

### Lower Ridge Recommendation

Adopt the alignment in place improving upon and installing dewatering features where feasible. The existing rock outcrops currently serve well as natural dewatering areas. Rock steps and rock grading would be incorporated to improve safety where appropriate. Trees would be pruned to improve sight lines.

### Lower Bowl Recommendation



Photo: 38+60 - 48+15

Upon field observation and review of USDA soil surveys, the area of the Lower Bowl trail realignment is composed of a relatively stable and rocky composition, providing an overall durable tread. The current 675 foot trail alignment has an average grade of 18.4 percent, with a maximum grade of 26 percent.

The proposed new alignment, would provide the ability to maintain a sustainable tread, reduce steep grades, maintain good sightlines, and improve passing zones. The rerouted alignment is 955 feet in length at a 10 percent average trail grade. Due to the steep cross slope, the trail would be approximately 30 inches wide, except at designated bulb outs on the trail. Dewatering reverse grade dips and knicks would be incorporated into the new alignment at 100' maximum intervals to ensure stability and longevity.

Photo 19 illustrates the new alignment with the blue line and the existing alignment to be decommissioned in red.

Deleted: 19

## Conclusions

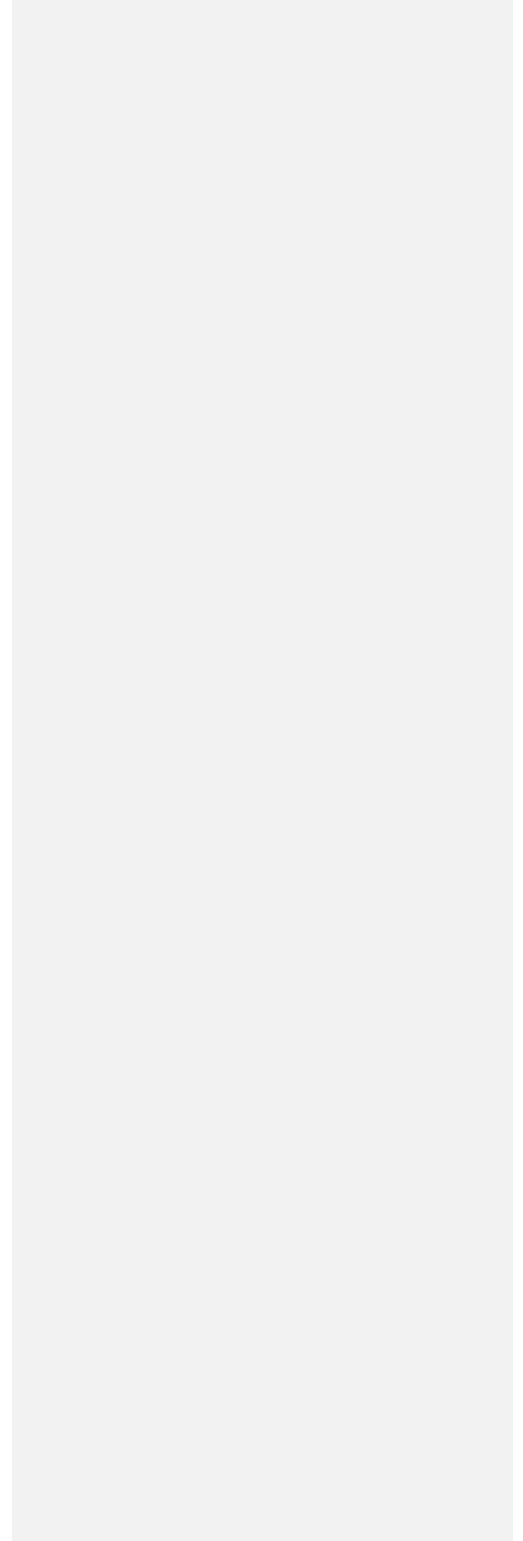
Based on research and investigations by MCOSD staff, the Eagle Rim Trail should be improved as follows. The proposed Eagle Rim Trail is a 4,815 foot single track at 9.34 percent average gradient trail, that predominately meanders along the north western corner of the Mount Burdell Open Space preserve. The first 2,800 feet, which run along the top of the Mt. Burdell ridgeline, has a low to moderate grade. Much of it has little to no cross slope fall line, meaning import of fill material will be needed to accomplish long-term sustainability. MCOSD estimates between 38-48 tons of base rock mix to be imported for this purpose. The trail then steepens for multiple short pitches, and becomes more rocky over the next 1,000 feet, as it descends to the climbing turn. This section is steeper than typical MCOSD sustainability standards, however due to the rocky soil and the very good sightlines, the MCOSD believes improvements can be made to satisfy sustainability goals and provide a safe and enjoyable trail that is different from other MCOSD trails. The final 955 foot segment after the climbing turn will descend back across the lower bowl at an average 10 percent grade to its terminus with the Deer Camp Fire Road.

Adoption/Construction of the 4,815 foot single track, hiker and biker, Eagle Rim Trail would require the following:

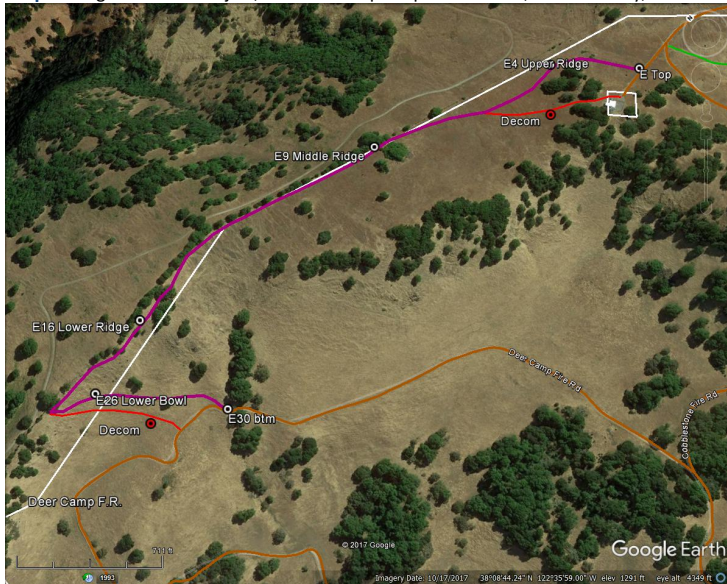
- 38 – 48 tons of base rock mix import
- Armoring of roughly 2,400 feet of tread
- Instillation/construction of 30 rolling dips
- Construction of 955 feet of 30inch max. width singletrack trail at an average gradient of 10%.
  - Grading/cut 132.6 cu yards
- Limbing trees along corridor for sightline improvements
- Shaping of 3-4 rock outcroppings
- Decommission of 675 feet and 726 feet of old Eagle Rim trail for a total of decom of 1,401 feet.
  - This includes but not limited to scarification and reshaping to natural contours
  - Installing dewatering features
  - Straw application
  - Split rail fencing if needed
  - Trail closure signage at top and bottom of both segments
- The MCOSD also proposes to decommission an additional 1,621 feet of unnamed fall line social trail on Mount Burdell, as an offset to this adoption of the Eagle Rim Trail. (Appendix Map 2) This trail head for this fall line decom comes off of the Burdell Mt. Fire Road, roughly a half mile to the East of the intersection with Cobblestone Fire Road.
  - The top 700 feet of this unnamed social trail descends off a small shoulder of the mountain through scattered Oak trees.
    - The trail will be scarified and re-graded to recountour the bench to match the surrounding terrain.
    - Dewatering features will be constructed where appropriate and needed to assure hydraulic disconnection.
    - Local downfall will also be used to brush the corridor to discourage future use of and camoflagh the the old trail. If needed straw will be applied.
  - The bottom 921 feet descends through open grassland down a steep slope on the fall line. It has become entrenched over the years and braided.
    - Scarification and straw will be applied as remediation.
    - Dewatering will be difficult, further field assessment of dewatering features is needed.

- 16 feet of split rail fence at the top intersection with Mt. Burdell FR, and 16 feet at the bottom intersection with Middle Burdell FR will be installed.
- Trail closure signs will be posted at these top and bottom intersections also.
- Open Space Ranger staff will provide monitoring and enforcement of the closure.

## Appendix A: Maps



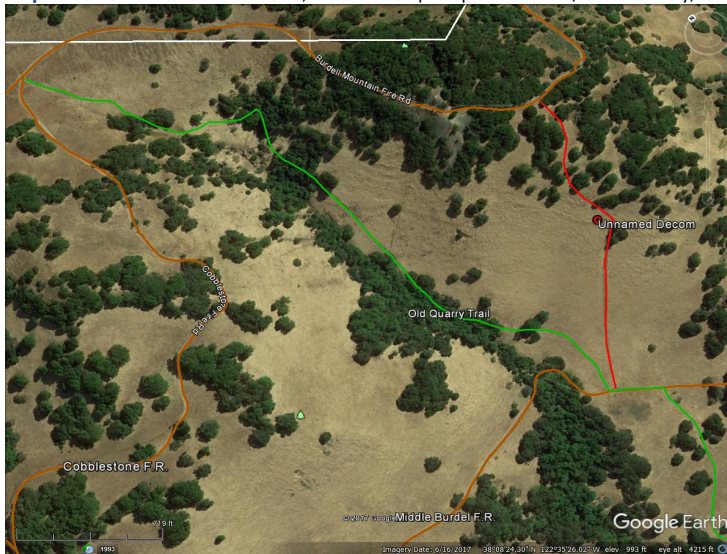
**Map 1 - Eagle Rim Trail Project, Mt. Burdell Open Space Preserve, Marin County, CA**



**Legend**

- Eagle Rim Trail  
4,815 foot single track, hiker and biker  
9.34% avg gradient
- Trails to be Decommissioned  
726 feet and 675 feet of old Eagle Rim trail for a total of decom of 1,401 feet
- Fire Road

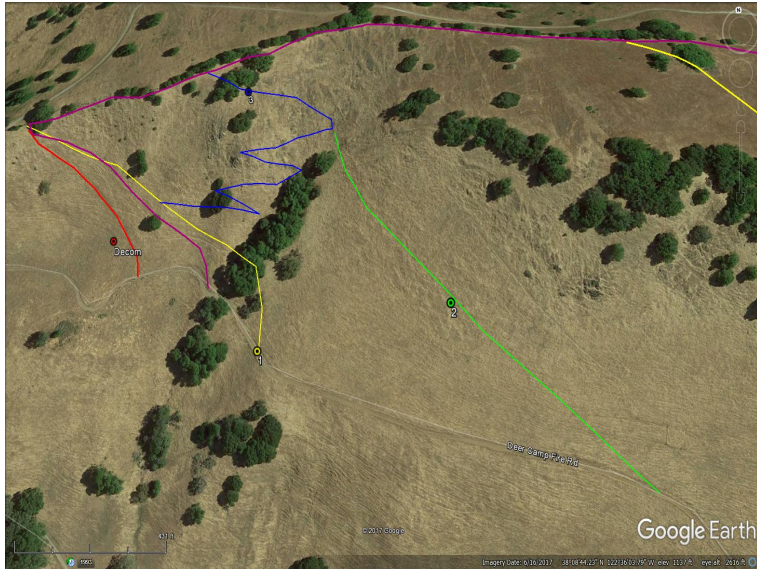
**Map 2 Unnamed Trail Decommission, Mt. Burdell Open Space Preserve, Marin County, CA**



**Legend**

- Trail to be Decommissioned  
1,621 feet of decom
- Fire Road
- Old Quarry Trail

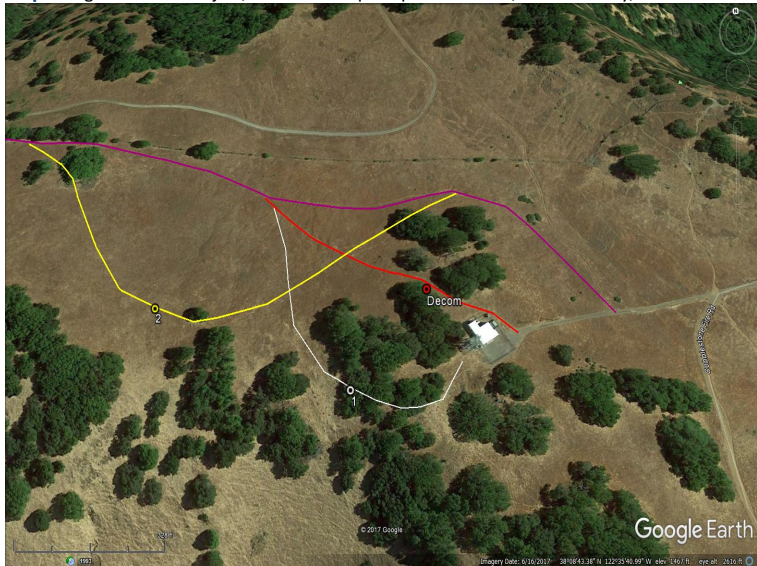
**Map 3 Eagle Rim Trail Project, Mt. Burdell Open Space Preserve, Marin County, CA - Alternatives**



**Legend**

- Eagle Rim Trail
- Trail to be Decommissioned
- Alternate 1  
This provides a 5% gradient.  
Negatives:  
Steeper cross slope  
Goes through drainage  
Reduced line of sight
- Alternate 2  
Eliminates steeper sections providing 10% avg. gradient  
Negatives:  
Goes through untouched area.  
Terrain composed of hard sharp rock, thus building trail will be extremely difficult.  
No barriers to shortcutters bombing down to Deer Camp FR.
- Alternate 3  
Eliminates steeper sections providing 10% avg. gradient  
Negatives:  
Goes through untouched area.  
Terrain composed of hard sharp rock, thus building trail will be extremely difficult.  
Stacked switchbacks are poor trail design for user enjoyment and compliance.

Map 4 Eagle Rim Trail Project, Mt. Burdell Open Space Preserve, Marin County, CA - Alternatives

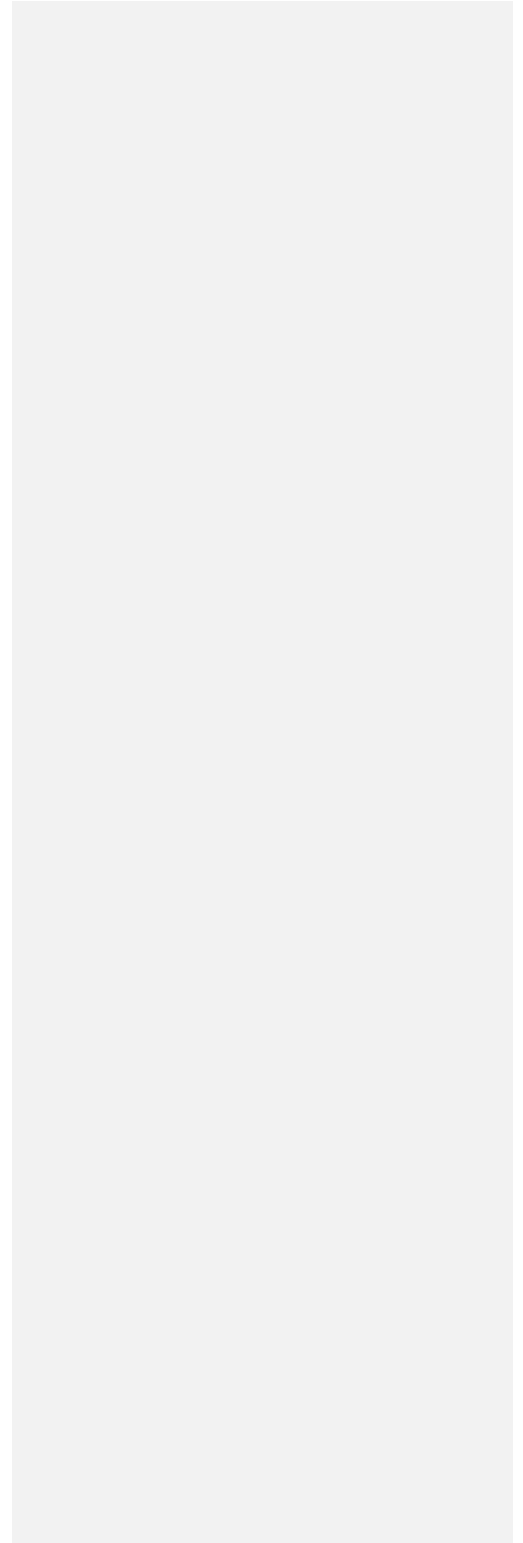


**Legend**

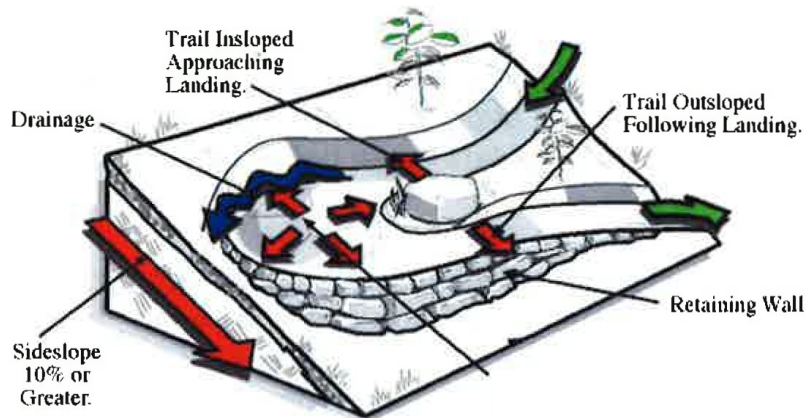
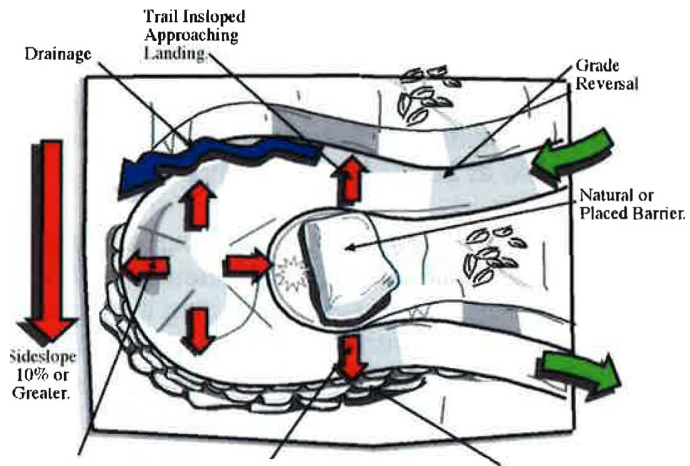
- Eagle Rim Trail
- Trail to be Decommissioned
- Negatives:**  
Steeper gradient  
Though cut with no opportunity to dewater.  
Brings users through the cell towers.
- Alternate 1  
Eliminates steeper sections providing 10% avg. gradient  
**Negatives:**  
Goes through untouched area.  
Terrain composed of boulders and rock, thus building trail will be difficult.  
Brings users closer to the cell towers.
- Alternate 2  
This provides a 5-7% gradient.  
**Negatives:**  
Significantly increases trail length through untouched area.  
Do not believe users will buy-in, and will potentially short-cut on old trail.  
Terrain is not great for sustainable trail tread, thus increased armoring needed.  
Observed multiple Coyote or other animal holes – thus habitat is in use  
Recent rare plant studies show higher numbers in this area



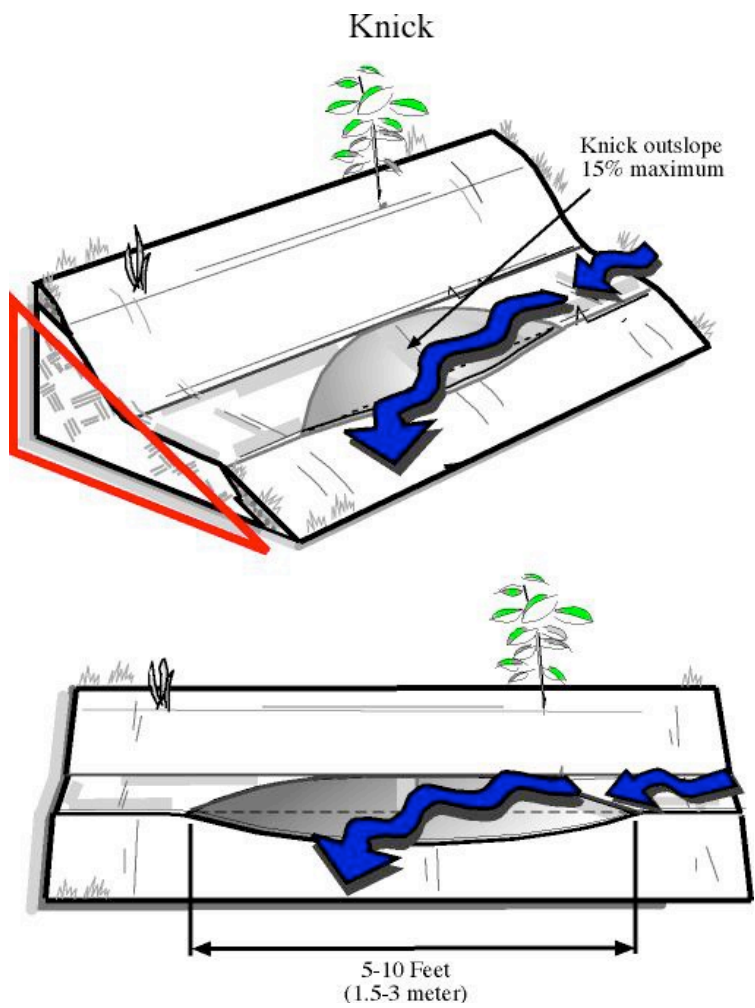
## Appendix B: Trail Feature Typical



## Climbing Turn

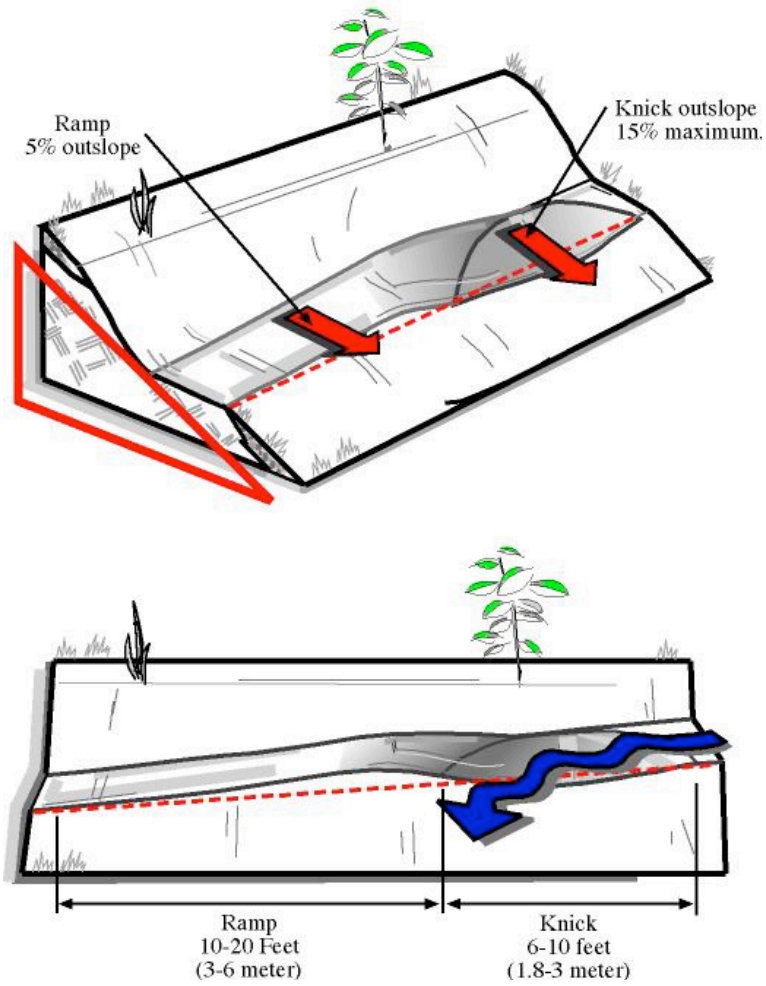


Sustainable Trail Development: A Guide to Designing and Constructing Native-surface Trails  
IMBA & Town of Castle Rock, CO  
<http://crgov.com/DocumentCenter/Home/View/1430>



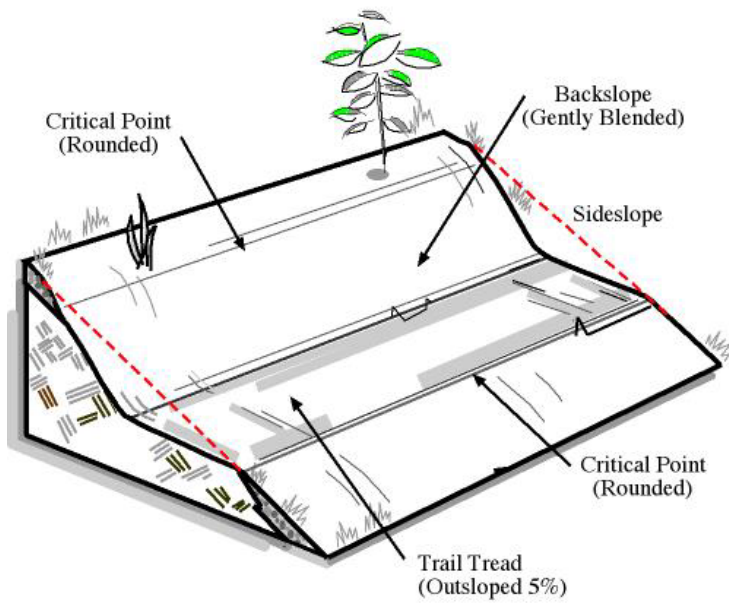
Sustainable Trail Development: A Guide to Designing and Constructing Native-surface Trails  
IMBA & Town of Castle Rock, CO  
<http://crgov.com/DocumentCenter/Home/View/1430>

## Rolling Grade Dip

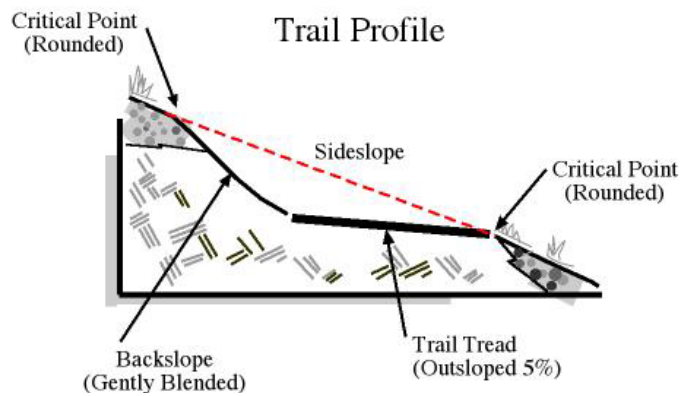


Sustainable Trail Development: A Guide to Designing and Constructing Native-surface Trails  
IMBA & Town of Castle Rock, CO  
<http://crgov.com/DocumentCenter/Home/View/1430>

## Full Bench Trail



## Trail Profile



## References

- U.S. Department of Agriculture. 2013 Natural Resource Conservation Service Web Soil Survey.  
<http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>
- Soil Survey of Marin County*, United States Department of Agriculture 1985
- Marin County, 2017. Department of Public Works - Marin County Watershed Program. Accessed on December 12, 2017. [http://www.marinwatersheds.org/novato\\_creek.html](http://www.marinwatersheds.org/novato_creek.html)
- Marin County Open Space District (MCOSD), 2014a. *Road and Trail Management Plan Recirculated Final Tiered Program Environmental Impact Report*, November.  
MCOSD, 2014b. *Road and Trail Management Plan*, December.  
MCOSD, 2016. *Vegetation and Biodiversity Management Plan*, October.
- Hesselbarth, W., Vachowsk, B., and Davies, M., 2007, Trail Construction and Maintenance Notebook, Tech. Rep. 0723-2806-MTDC  
([https://www.fhwa.dot.gov/environment/recreational\\_trails/publications/fs\\_publications/07232806/index.cfm](https://www.fhwa.dot.gov/environment/recreational_trails/publications/fs_publications/07232806/index.cfm)), United States
- Department of Agriculture, Forest Service, Technology & Development Program, In cooperation with United States Department of Transportation Federal Highway Administration.
- IMBA, 2001, Building Better Trails: Designing, Constructing and Maintaining Outstanding Trails, Boulder, International Mountain Bicycling Association.
- Sustainable Trail Development: A Guide to Designing and Constructing Native-surface Trails  
IMBA & Town of Castle Rock, CO  
<http://crgov.com/DocumentCenter/Home/View/1430>

Page 12: [1] Deleted Tierney, Kristina 1/9/18 10:51:00 AM

Page 12: [2] Deleted Campo, Jon 1/3/18 12:15:00 PM