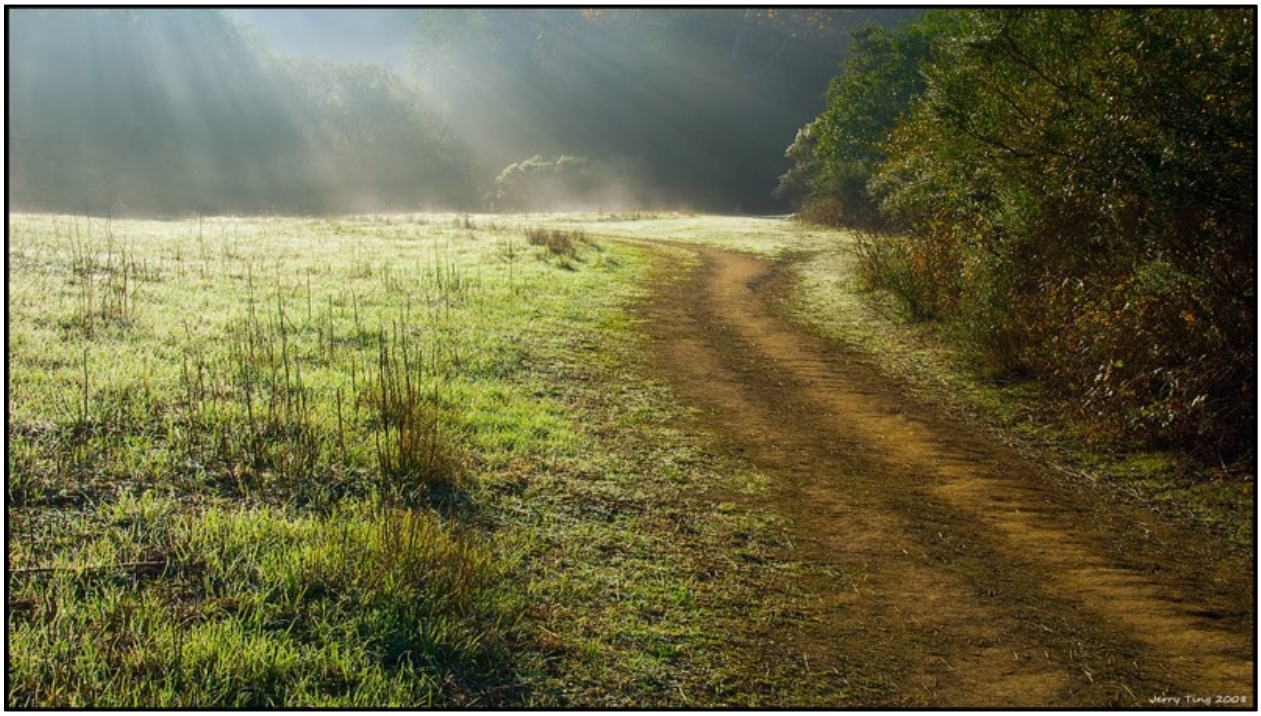
Trails Workshop



October 29, 2019

East Bay Regional Park District 85TH 1934 to 2019

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AGENDA

Board Workshop:
Sustainable Trails for All in New Parklands

October 29, 2019

12:00 p.m. **Introduction and Opening Comments**
Ayn Wieskamp, President, Board of Directors
Robert E. Doyle, General Manager

12:10 p.m. **Overview**
Kristina Kelchner, AGM, Acquisition, Stewardship & Development

12:20 p.m. **Sustainable Trail Design and Planning**
Sean Dougan, Trails Development Program Manager
Brian Holt, Chief of Planning and GIS

1:10 p.m. **Public Comment**

1:25 p.m. *Break*

1:45 p.m. **Facilitated Board Discussion**
Lou Hexter (Moore, Iacofano, & Goltsman, Inc.)

3:00 p.m. **Additional Public Comment/Response**

3:45 p.m. **Closing Comments**

4:00 p.m. **Adjournment**

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TABLE OF CONTENTS

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EAST BAY REGIONAL PARK DISTRICT

MEMORANDUM

October 29, 2019

To: Board of Directors

From: Robert E. Doyle, General Manager
Dr. Ana M. Alvarez, Deputy General Manager
Kristina Kelchner, Assistant General Manager, ASD Division

Subject: Board Workshop on Sustainable Trails for All in Recently Acquired Parklands

The Acquisition, Stewardship, and Development (ASD) Division appreciates the Board of Directors' request for this workshop on trails. As one of the primary ways that people engage with the parks, trails are critical to the Park District's mission of connecting people to nature. The workshop discussion will focus on the Park District's Master Plan policy of providing "trails for all" through development of new sustainable, natural surface, multi-use trails in recently acquired parklands. A stated goal of the Park District is to "expand its unpaved multi-use trails system as additional acreage and new parks are added," and to "continue to add narrow trails designated as both single- and multi-use" in order to "provide a diverse system of non-motorized trails to accommodate a variety of recreational users" (EBRPD 2013 Master Plan pages 28 and 63).

The topic of providing additional trails in newer parks is particularly timely, as the Park District is preparing to open new parklands for public access. The Park District recently completed two land use plans (Robert Sibley Regional Volcanic Preserve and Coyote Hills Regional Park) and is currently working to complete several more land use plans for recently acquired parklands (including Southern Las Trampas, Black Diamond Mines/Clayton Ranch, Concord Hills, and Roddy Ranch). In contrast to older parks where use patterns and expectations are often well established, the opening of new parklands provides fresh opportunity to create new, sustainable, multi-use trails that will provide broad public access while protecting the natural environment.

Staff recognizes there are many important issues related to Park District trails, such as trail maintenance and patrol, conversion of ranch roads to trails in older parks, closing gaps in paved regional trails, and management of existing user-created trails. Staff would welcome future Board discussion on these and other trail-related topics. For this workshop focused on "trails for all" in newer parks, staff is looking forward to an opportunity to review the Park District's existing trail network, establish some common trail terminology (for example, "road" versus "trail," and "trail bench" versus "trail tread"), and explore two of the key barriers to developing new multi-use trails: concerns about potential impacts of human activity on sensitive natural resources, and concerns about human-to-human conflicts on shared use trails. Staff will discuss the importance

of sustainable design in providing environmentally appropriate, multi-use trails, including grade and drainage, sight lines, speed control measures, and passing room. These sustainable trail design strategies are used by many park agencies including California State Parks, and represent best industry practices for building new trails. Staff will present how a well-designed trail built for the purpose of multi-use recreation can be safer, more enjoyable, and more environmentally protective than over-steep and erosive ranch roads.

Staff looks forward to input from the Board and the public on these issues. Ultimately, providing new trails for all users in the highly populated and highly regulated environment of the East Bay will continue to require ongoing, open dialogue and engagement with the community. Staff has met with several trail user groups in preparation for this workshop, many of whom expressed great interest in participating. Staff deeply appreciates the willingness of these community groups to participate in a collaborative, constructive conversation. While values, experiences, and opinions may differ, the core passion of everyone staff met with was the same: to get out and enjoy nature in our wonderful Regional Parks.

Existing Roads and Trails in the East Bay Regional Park System

With over 1,330 miles of recreational roads and trails to explore, these pathways are the primary conduit for visitors to experience the natural wonders of the East Bay regional parks. The Park District's Master Plan recognizes the critical role that trails play in our regional park system, and that the demand for trail access has increased along with regional population growth and the popularity of the regional park system.

The Master Plan states: "Trail use consistently shows up on surveys as the most preferred activity in the Regional Parks." (EBRPD 2013 Master Plan, page 28.) The Plan also recognizes an increased demand for trail access: "In recent years, the demand for trails close to home has increased dramatically and trail use has been on the rise for every purpose from basic transportation to healthful outdoor exercise." (Master Plan, pg. 63). The Master Plan promises to address this growing demand by including a commitment to adding new trails and providing "a variety of trails for all." (Master Plan, page 28.)

Despite the critical role trails play in connecting people with nature, in recent decades the construction of new trails has not kept pace with the growth of the regional park system. Since 1990 the Park District has added nearly 56,500 acres of parkland, an increase of 46%. During that time, however, the Park District has built only 13 miles of new trails, with two-thirds of those new trails located in a single park (Crockett Hills Regional Park).

Instead, public access to these newly acquired lands has relied on existing ranch roads constructed before the properties were acquired as parkland. In fact, 76% of the Park District's current unpaved trail network is made up of "roads" (unpaved pathways managed to accommodate

operational and emergency vehicle access), and only 15% is made up of "trails" (unpaved pathways managed for recreational purposes that do not accommodate vehicle access). While former ranch roads play an important role in public access to parks, these roads were not designed specifically for recreational trail use and do not always provide the most desired user experience or the best protection of natural resources.

Why, then, has the Park District built so few new recreational trails in the past thirty years? Part of the reason lies in the characteristics of Contra Costa and Alameda Counties. Home to millions of people as well as rare, protected plants and animals, the East Bay is a unique place of both bustling human activity and rich natural resources. This presents two equally important, but distinct challenges to building new trails: (1) protection of natural resources through appropriate planning and permitting; and (2) perceived and real human conflicts among trail users.

Protecting Natural and Cultural Resources

The East Bay is fortunate to have protected habitat and resources for several endangered species. Protected species in the East Bay include California Tiger Salamander, California Red-Legged Frog, Alameda Whipsnake, Burrowing Owl, and San Joaquin Kit Fox. Unlike other large agencies with parklands, such as Marin County or Santa Clara County, these are terrestrial species that can be impacted by trails. The continued protection and support of these and other threatened species is central to the Park District's mission of conserving the natural environment.

To ensure protection of these species, the Park District acquires land for natural park and open space, protecting large ranches and other major land holdings from residential and commercial development. The Park District also partners with the East Contra Costa County Habitat Conservancy to acquire and preserve land for its resource conservation value. To date, the Park District has protected over 125,000 acres of park and open space land from development.

The Park District employs a full-time staff of biologists, including experts on amphibian, fish, bird, and plant populations. One of the Park District's first steps in considering public access possibilities in new parkland is an analysis of the potential impacts of any trail alignment on special species of concern. In planning for trail alignments, the Park District considers both the possibility of impacts from the proposed new trail, and the impacts from *not* building a new trail. In many cases, channeling human activity along a carefully designed trail route can help to avoid informal and user-created trails that can cause greater impacts.

The Park District works closely with staff from resource protection agencies such as the United States Fish and Wildlife Service, California Department of Fish and Wildlife, and Regional Water Quality Control Board. The process for assessing biological impacts and securing permits to ensure protection of the resources can be lengthy, often requiring permits from multiple agencies and requiring several years to complete. Several of the Park District's planned new trails are

currently awaiting permits, including trails planned in Pleasanton Ridge Regional Park, Vargas Plateau Regional Park, and Robert Sibley Volcanic Regional Preserve.

User Conflicts Concerns

The second key challenge to developing new unpaved trails is disagreements among park visitors about which uses should be allowed on those trails. To provide access to parks for all, the Park District seeks to provide opportunities on its trails for all modes of users, including hikers, equestrians, and mountain bikers. The Master Plan states that the Park District will provide a variety of trails to be enjoyed by all users:

> "RFA2: Both wide and narrow trails will be designed and designated to accommodate either single- or multiple users, as appropriate, based on location, recreational intensity, environmental and safety considerations" (pg. 63).
>
> "RFA3: The District will continue to add narrow trails designated as both single- and multi-use for hikers, equestrians, people with dogs and bike riders throughout the system of regional parklands" (pg. 63).

It should be noted that while these Master Plan objectives aim to provide trails for all users, the language acknowledges that all trails may not be appropriate for all users in all places. Instead, trail use designations will be based "on location, recreational intensity, environmental, and safety considerations." Each of these factors are considered when planning for new trails and trail uses.

Nonetheless, the Park District's goal of providing "trails for all" has raised concerns about anticipated user conflicts. It is important to note that the issue of conflicts between users is a social issue and is independent and separate from any concerns about environmental impacts. Trail user conflict does not, by itself, qualify as an environmental impact under the provisions of the California Environmental Quality Act (CEQA), which is focused on impacts to the physical environment. California State Parks has stated clearly that use conflict is not a CEQA issue:

> "Under the provisions of [CEQA] . . . human conflict on recreational roads and trails is a social issue that does not qualify, by itself, as an environmental impact. Analogously, driving over the legal speed limit, failure to yield, or other conflict-generating driver behaviors on a highway are not evaluated as significant environmental impacts under CEQA." (California State Parks Road and Trail Change-In-Use Evaluation Process Draft Program EIR, 2012, page 8-1 (CSP 2012).)

State Parks conducted an extensive study of trail user conflicts in 2011. The study found that while concern is high, the number of reported trail use incidents is very low:

> "Facts support a conclusion that trail use conflicts are not a source of significant environmental impacts and that while the level of concern about conflicts is high among

> trail managers and users, the number of actual reported trail use conflict incidents is very low by comparison and accidents affecting the safety of users are rare (CSP 2011)."

Despite the rarity of reported incidents, as documented in the 2011 State Parks Trail Use Conflict Study, there is a strong body of research and informed opinion indicating that trail use conflict is an important social issue, and that "perceptions, attitudes, and behavior of users" on both sides of conflicting parties are major factors in generating concern and complaints about trail conflict (CSP 2011). The State Parks report goes on to say:

> "Conflict can be described as goal interference, which can be either interpersonal when it is based on the physical presence of other users, or social when it is based only on perceptions of another group that may not be present. ***This means that trail conflict can stem from different users' lifestyles and values that overshadow the actual trail use***." (CSP 2011, emphasis added.)

Stated differently, perceived user conflicts can be influenced as much by perceptions and preferences as much as by actual experiences with other users or use of the trail (for example, opinions about the "right way" to enjoy nature). In meeting with stakeholder groups, Park District staff heard all trail users express the same core interest: enjoying the natural environment in the parks. Similarly, the State Parks study found that "the objectives of users representing different groups are expressed in very similar terms, i.e., ***to enjoy the resources offered by the park***." Despite this common core interest, the State Parks study found that opinions and values differed:

> "However, opinions also exist among different types of users about what are acceptable modes of travel, the focus of the trips people take, expectations of encounters with other users, attitudes about the environment or wilderness, level of tolerance of others, and different norms or stereotypes held by different users . . . these social values are seldom directly expressed by users, who instead tend to reflect perceptions that a change of use would be unsafe or that they are bothered by the presence of other types of trail users."

Oregon Metro Parks also conducted a 2017 study on trail use, and found that perceptions of conflicts were actually higher for hikers who had never personally encountered a biker on a trail:

> "Conflicts among user groups can arise without any actual contact occurring. In fact, perceived conflict is sometimes greater for people who haven't encountered other user groups on the trail. For instance, visitor surveys in New Zealand revealed that . . . more negative perceptions came from hikers that had not encountered a biker."

During the workshop, staff will review design strategies to minimize trail user conflicts, including speed control measures, protection of sight lines, and room for passing. Staff will also review trail management strategies to minimize trail user conflicts, such as one-way trails, alternating uses at different times, or partial trail separations. Staff recommends ongoing community engagement on shared trail use.

Sustainable Trail Design: Design Strategies for Resource Protection and Shared Use

Based on the definition provided by California State Parks, the District defines a "sustainable" trail as a trail that has been designed and constructed to a standard that:

1. Minimizes impact on natural and cultural resources,
2. Withstands the impacts of the natural elements and use with only routine maintenance,
3. Meets the needs of users so they stay within the established alignment, and
4. Incorporates design features to minimize user conflicts.

As discussed above, many former ranch roads and fire roads were not designed with proper drainage or recreational use in mind, but instead built by previous landowners to quickly and easily get from point A to B or to manage grazing access. Many existing ranch and fire roads within the Park District's parklands are steeper than modern trail design standards and have adverse surface qualities that can contribute to negative natural resource impacts such as erosion and creek sedimentation.

By contrast, sustainably built trails are designed for the purpose of trail use, specifically with the objective of providing an intentional exceptional user experience that connects park visitors with the special natural and cultural resources of the site. This can include siting and designing trails to take visitors to an iconic view, by or through different habitat types or providing varying levels of trail experiences from accessible loops close to visitor facilities, staging areas or picnic areas, to more technical and longer trails that provide a backcountry experience. Trail design requires knowledge of the soil types, drainage patterns, and topography sometimes referred to as the "trail triage." The trail triage accounts for proper grade and drainage, but design and construction of a sustainable trail must also consider user preferences and connectivity of other similar or different trail use designations within the trail network.

Damage to trails or habitats are more likely when trails are inappropriately located, designed, or maintained, or when unauthorized trails are allowed to proliferate. Research has also found that hikers and mountain bikers appear to have fairly similar types and severity of trail impacts. (Recreation Ecology Literature Review, Metro Parks, Portland Oregon, 2017 (Metro 2017).) Thus, the primary impacts on trails and habitat are due to the initial trail construction and the introduction of human activity, rather than the type of trail use.

Because the primary purpose of Park District recreational trails is to provide access to the natural, cultural, and scenic resources of a park, to enhance the visitor's enjoyment of these resources, and to provide opportunities for varied outdoor recreation, Park District trails will benefit from considering design criteria that specifically aim to reduce conflict among trail users.

Design features to provide passing refuge, such as trail turn-outs, can help trail users feel more comfortable on multi-use trails. Other features such as appropriate sightlines to reduce

unexpected encounters and to limit fast straightaways, pinch points and grade reversals to reduce speed, can also reduce concerns over user conflicts.

Trail width is often cited as an important factor in determining appropriate trail use. While adequate space for passing is an important factor, trail width varies along a trail segment, depending on topography, natural processes and use. While a trail bench may be initially constructed at six-feet wide or more, over time the width of the trail will narrow or vary depending on use patterns. More heavily used trails will result in a wider trail tread, while trails that see less use will see a narrowing of the trail tread over time.

Width also varies with topography, soil type, and other natural site-specific conditions. Although traditionally Park District documents have described trails as "narrow" or "wide," in practice the construction and maintenance of trails at specific, consistent widths is not realistic, making trail width a less useful metric to use in classifying trail types. In addition, trails with a curvilinear design, average grade of 15% or less with grade reversals, appropriate sight lines, compacted surface, and pinch points or other speed reducing measures can make a less-traveled (and therefore narrower) trail more appropriate for multi-use than an over-steep fire road with loose rock and ruts from poor drainage.

While creating dual-use or single-use trails that separate mountain bikers from equestrians or hikers may be an appropriate way to address trail use conflict in some cases, it could be viewed as displacing or excluding some users. In addition, it may not be possible to accommodate each user group with a purpose-built trail of their own due to increase effects on environmental, financial, and management resources. In addition, trail alignment options are limited due to topography, drainages or the presence of sensitive resources. Therefore, dual-use and single-use trails should be considered as an approach where possible, but may not be appropriate in all situations.

Public outreach and education will be important to reduce potential conflicts and dispel misperceptions among all trail users, focusing on the common interests in the park resources held by everyone. While many of the interpersonal issues that lead to trail use conflict are social in nature, efforts to address conflict, improve perceptions, alter behavior, and generally increase tolerance among users will serve to reduce conflict on individual trails.

Trail Management Strategies to Protect Resources and Reduce User Conflicts

In addition to trail design features, management responses can also mitigate environmental impacts from trails and help address trail conflict issues. Land management agencies around the country including the Bureau of Land Management (BLM), Marin County, Napa County, and the Tahoe Rim Trail Association either designate uphill only trails, stagger days of use allowed by user, or designate trails for seasonal closure for wildlife protection. Similarly, the Park District closes the Goldfinch Trail in Crockett Hills during Golden Eagle breeding season. Educational campaigns and promotional programs aimed at educating the public on shared use trail etiquette are employed

by Santa Cruz County, Santa Clara County, San Mateo County and Marin County. These types of programs may provide written material or lead workshops to promote effective communication between user groups on and off the trail, use of bike bells, yield requirements, and avenues to report conflicts if necessary. These management strategies should be considered as a valuable part of any proposed approach.

The Park District's Process for Determining Trail Use

The Park District's practice has been to develop a Land Use Plan, Land Use Plan Amendment, or similar planning document prior to opening land banked property. These plans vary in their scope and level of detail depending on a variety of factors including size of the planning area, phasing of park improvements, and other variables that impact implementation of land use plan recommendations.

When planning for new natural surface trails, staff evaluates available natural and cultural resource data, site topography, connections to existing trail networks, and other factors to identify alignments that would be accessible to all users and provide a satisfactory experience in a manner harmonious with the natural environment. Based on these factors, the land use plan provides a recommendation as to whether a trail would be appropriate for multi-use.

As a trail is designed, permitted, constructed, and eventually used – typically a multi-year effort following completion of the land use plan -- additional factors that may arise that influence whether a trail should be multi-use, dual-use, or single-use. Ordinance 38 provides a process for the Board to make a final determination whether a trail will be multi-use, dual-use, or single-use at the time the trail is designed or constructed, or once the trail is in operation - when there is sufficient detail to allow Operations, Stewardship, Public Safety staff and others to make a recommendation.

Staff recognizes that the Ordinance 38 update guidelines could more clearly define this trail use designation process, and that ensuring ample opportunity for community input on final trail use decisions is critical to successful outcomes. Staff welcomes the opportunity to discuss trail use determination through the Ordinance 38 update process and opportunities to provide for stakeholder engagement through that process.

Conclusion

Spending time on the trails is one of the most popular ways that people enjoy the nature and wonder of the Regional Parks. Staff appreciates the Board's leadership in requesting a workshop discussion on this important issue and welcomes the opportunity to discuss the expansion of the District's trail network to provide a safe, environmentally sustainable, and enjoyable trail experience for all.

Trails Terms Glossary

Alignment: The route proposed for or taken by a trail.

Anchor: An object, such as a stone, that defines the sides of the trail, helping to keep users in the center of the tread.

Angle of Repose: The maximum angle measured from the horizontal at which rocks, sand, soil, etc. will stay at rest without moving down the slope.

Armoring: Reinforcement of a surface, whether trail or creek bed, with a protective layer of rock, brick, stone, aggregate, concrete, or similar material to carry traffic or prevent erosion.

Aspect: The compass direction a topographical slope face. Aspect affects the amount of solar radiation and year-round moisture to which a site is subjected.

Assessment, Trail: Physical assessments undertaken to better understand a trail or corridor. Assessments include an accurate description and documentation of native elements and an inventory of built structures and conditions along the trail or corridor.

Average Trail Grade (Overall Trail Grade): The average steepness of a trail over its entire length.

Average Trail Segment Grade: The average slope of a certain trail segment.

Backcountry: Remote areas where trails and trail facilities have lower levels of use, lower user expectations, and lower design and construction standards.

Backslope: The cut bank along the uphill side of the trail extending upward from the tread, sloped back to an angle (angle of repose) to where it is stable and will not unravel or slide onto the trail.

Bench Cut: A relatively flat, stable surface (travelway) on a hillside made by excavation often referred to as full or partial bench.

Bench Cut, Full: The total width of the trail tread is excavated out of the slope, and the trail tread contains no compacted fill material. The most durable and recommended style of bench cut trail.

Bench Cut, Partial: Part of the width of the trail tread is excavated out of the slope, and the rest of the trail tread is made up of fill material.

Berm: The ridge of material formed on the outer edge of the trail that is higher than the center of the trail tread. When improperly designed or unintentionally caused by tread compaction and soil displacement during trail use, a berm can trap water on the trail and lead

to erosion.

Brushing: The process of clearing the trail corridor of plants, trees, and branches less than 20 feet in height such as herbaceous plants and low-growing woody shrubs that could impede the progress of trail users on the travelway, completed on a cyclical basis.

Center Line: An imaginary line marking the center of the trail. During trail layout, the center line is usually marked by placing a row of flags or stakes. During construction, the outboard hinge is flagged.

Classification: A designation of the intended use, design, construction, and maintenance specifications for a trail.

Clearing Limits: The outer edge of the travelway/trailway to be cleared, usually specified by trail classification.

Climbing Turn: A turn to reverse direction on a trail constructed on a less than 30% slope that doesn't have a constructed turning platform or landing. The upper and lower legs of a climbing turn are generally joined by a short section of trail (the apex of the turn) that lies directly in the fall line. Climbing turns located on hillsides with too steep of a grade are erosion prone and should be replaced with well-built switchbacks.

Clinometer: A hand-held instrument used for measuring trail grade. The user sights through the Clinometer to a reference (usually a second person) and reads the measurement directly from the internal scale in degrees or percent.

Contour Line(s): A line on a topographic map connecting points of the land surface that have the same elevation.

Control Points: Existing natural or man-made features that the trail alignment must go to or avoid. The beginning and end of a trail are basic control points. Positive control points are places you want trail users to visit including parking areas, trailheads, viewpoints, slopes for turns or switchbacks, road or water crossings, and other trails. Negative control points are places you want users to avoid including sensitive habitat, culturally sensitive areas, adverse topography or sensitive vegetation.

Corralling: The act of placing anchors on the trail to define the sides and emphasize the turns, keeping users on the tread.

Curvilinear: A trail alignment that follows the contour of the landform, tucking in and out of features such as drainages, crenulations, and ridges, and crossing contours at oblique angles.

Downslope: The downhill side of a trail.

Drain Dip: A gradual dip in the trail bed between natural topographic watercourse features that diverts water off the trail bed. A good drain dip is one that is hardly noticeable.

Drainage: The way in which water flows downhill and/or off the trail.

Dual-Use Trail: A trail that allows two uses such as horses and hikers only or hikers and bicycles only.

Embankment: The outboard portion of the trail bench that is comprised of compacted fill material; often referred to as the "fill slope" or "outboard fill" material.

Entrenched Trail: A trail with cupping, rutting, or trenching on the trail tread from trampling, standing water, uncontrolled surface run off, and/or accumulation of slough and berm. The resulting tread surface is lower than the inboard and outboard hinges.

Equestrian: Of horses, horseback riding, riders, and horsemanship.

Erosion: The natural process of wearing down and removing rock and soil by wind and water. Trail erosion can be accelerated by a combination of users, slope, water, and gravity.

Erosion, Gully (Gullying): Concentrations of runoff water cut into the soil forming single or numerous channels, usually on steep terrain.

Fall Line: A trail aligned with the natural direction of water flowing down a slope. The direction water flows down a slope is the path of least resistance under most circumstances. Constructing a trail on the fall line creates a path of least resistance and encourages water to run down the trail and leads to erosion.

Flagging: A roll of thin, colored ribbon or squares of colored plastic fabric attached to wires ("pin flags") used for marking trail alignments, trail structure locations, or control points.

Frontcountry: The area near developed facilities such as campgrounds, visitor centers, or day use areas that have high levels of use, user expectations, and design and construction standards.

Grade: The amount of elevation change between two points over a given distance expressed as a percentage (feet change in elevation for every 100 horizontal feet, commonly known as "rise over run"). A trail that uses 8 vertical feet in 100 horizontal feet has an 8-percent grade.

Grade Reversal: A reverse in the trail grade - usually a short dip followed by a rise - that forces water off the trail and manages speed of trail users. Grade reversals are known by several different terms, including grade dip, grade brake, and rolling dip. Frequent grade reversals are a critical element of sustainable trail design for water drainage and speed control. Most trails will benefit from grade reversals every 20 to 50 feet, depending on soil type, topography and rainfall.

Half Rule: A trail's grade shouldn't exceed half the grade of the sideslope. If the trail grade is steeper than half the grade of the sideslope, it is considered a fall-line trail and gravity will pull water down the trail instead of across it. This leads to erosion of the trail tread.

Inboard Hinge: Slope transition on the inside, or uphill side, of trail tread where the trail tread and backslope converge.

Informal Trails: Unplanned/unauthorized trails (with no name) that may have been legacy trails that have been further established by consistent use by humans or cattle.

Legacy Trails (Legacy Roads): Trails or roads constructed inherited through acquisition; often created for ranching, logging, or other non-recreational purposes. These were not designed for recreational use and in most cases do not meet modern sustainable trail design standards.

Machine Built: A trail or feature constructed with the use of an excavator, trail dozer, or other piece of equipment.

Maximum Sustainable Grade: The steepest section of a trail that is still sustainable. Although maximum sustainable trail grade is typically about 15 to 20 percent, it is site-specific and fluctuates based on several factors.

Maximum Trail Grade: The steepest section of a trail. (The section must be more than 10 feet in length.)

Meander: A series of gentle curves in a trail.

Multi-Use Trail: A trail that permits all user groups – equestrians, hikers and mountain bikers - at a time.

Natural Surface (Trail): A tread made from clearing and grading the native soil and with no added surfacing materials.

One-Way Trail (Directional-Use Trail): A trail managed in such a way as to encourage users to travel in one direction.

Ordinance 38: Outlines the rules and regulations of the East Bay Regional Park District to govern public use of regional parklands and protect park resources.

Outboard Hinge or Critical Edge: Slope transition on the outside, or downhill side, of trail tread where trail tread and hillslope converge.

Outslope: Where trail tread is sloped downward toward the outboard hinge of the trail that leaves the outside edge of a trail lower than the inside to shed water. The outslope should be barely noticeable-usually no more than about 1-inch of outslope for every 18 inches of tread width (or about 5 percent).

Passing Refuge: A widened area of trail that allows for multiple users to pass at specific locations.

Percent of grade: Preferred method of measuring slope, or a hill's steepness. For example, a grade of 10 percent means there is a rise or fall of 10 vertical feet per 100 linear feet.

Pinch Points: Locations on a trail where features (anchors), such as downed and standing trees, rock outcrops, logs, or large rocks, are used in conjunction with curves in the trail to create the appearance that trail has substantially narrowed. Pinch points are used to slow user traffic, thereby reducing user conflicts and improving safety.

Purpose Built Trail: A trail constructed with design features that accommodate a specific user group or user experience.

Reconnaissance: Thorough investigation and evaluation of alternative trail locations prior to selecting the final trail route location.

Rise and Run: The angle of inclination of a slope or structure expressed as a ratio of the horizontal length (run) to the vertical ascent (rise).

Road (Ranch Road, Service Road, Fire Road): Unpaved pathways managed to accommodate emergency vehicle and maintenance access.

Runoff: Water (not absorbed by the soil) that flows over the land surface usually generated by rain falling on saturated ground or from heavy rain that cannot soak into the ground fast enough.

Sedimentation: Deposition of material carried in water, usually the result of a reduction in water velocity below the point at which it can transport the material.

Side Slope: The angle of a hill slope measured in degrees or percentage along the fall line.

Sight Line: The visible and unobstructed forward and rear view seen by a trail user from a given point along the trail.

Single-Track Trail: A trail so narrow that users must generally travel in single file.

Single-Use Trail: One that is open to only one type of trail user group (i.e. hiking only).

Sinuosity: The relative amount of curves along a trail alignment.

Slide: Section of soil or rock, located above, below, or within the trail, that gives way and moves down a slope.

Slope: The natural (or man-made) pitch of the land, as shown on contour maps. Generally refers to the hill, not the trail, as trail "slope" is called "grade."

Slope Board: An attachment to a trail dozer blade used to remove the berm on the outside edge of a trail and lay back and shape the cutbank on the uphill side of the trail.

Slough (pronounced "Sluff"): Material from the backslope (or area of the backslope) deposited on the inboard hinge of the trail bed.

Steps: A structure that provides a safe, stable, uniform vertical rise in steep or unstable terrain, usually made of wood or rock.

Stream Crossing: A trail section constructed across a natural stream, such as rock armored, step stone, open culvert, closed culvert, or bridge.

Surface (Surfacing): Material on top of the trailbed that provides the desired tread. It can lessen compaction of soil, provide a dry surface for users, and prevent potential erosion and abrasion. In addition to concrete and asphalt, trails can be surfaced with dirt, rock, gravel, sand, mud, snow, grass, and other substances.

Sustainable Trail: A trail designed and constructed to minimize impact on natural and cultural resources, withstand the impacts of the natural elements and use with only routine cyclical maintenance, meets the needs of users so they stay within the established alignment, and incorporates design features to minimize user conflicts.

Switchback: A sustainable turn in a trail constructed on a slope greater than 30%. The trail is routed onto a level deck where it makes a transition to the opposite direction.

Ten-Percent Average Guideline: Generally, an average trail grade of 10 percent or less is most sustainable. This does not mean that all trail grades must be kept under 10 percent. Many trails will have short sections steeper than 10 percent, and some unique situations will allow average trail grades of more than 10 percent.

Topographic Turn: A turn in a trail made by incorporating a topographic feature, such as a knoll or knob of land, to keep the lower section of the trail out of view of the upper section.

Topography: The shape and relief of the earth's surface.

Trail Bench (Trail Bed): The entire width of the trail that is graded and cross sloped to facilitate drainage and extends from the inboard hinge point at the base of the backslope to the outboard hinge at the outside edge of the trail.

Trail Corridor: The general location of a potential trail alignment; the full dimensions of the trail, including the area on either side of the travelway/ bench and the space overhead, that need to be cleared of brush and obstacles.

Trailhead: The access point to a trail, often accompanied by public facilities such as a parking area, drinking fountain, restroom, informational signage, and an equestrian or off- highway

Trail Loop: Trail or trail systems designed so that the routes are closed circuits connecting a number of points of interest, giving users the option of returning to the trailhead on a different

section of trail than they went out on.

vehicle staging area.

Trail Tread: The actual surface portion of a trail upon which users travel

Trail Triage: The set of measures used to maintain or design a trail that takes into account water drainage, trail grade, and gravity.

Trails: Unpaved pathways managed for recreational purposes that do not accommodate vehicle access.

Travelway or Trailway: The outer limits of the trail, extending several feet beyond the top of the cut bank and several feet beyond the outboard hinge.

Trio Maintenance: The set of measures used to maintain or design a trail, including removal of slough and berm, reestablishment of the designed surface drainage, and brushing to original construction standards. Takes into account water drainage, trail grade, and gravity.

User-Created Trails (Social Trails, Bootleg Trails): Unplanned/unauthorized trails (with no name) that have been created by users. They are either newly created or legacy trails or cattle/trails that are now being used for recreation.

CA STATE PARKS TRAIL DESIGN STANDARDS SUMMARY

Many of the trail policies, design guidelines, and best management practices followed by the Park District have been modeled after CA State Parks trail guidelines. The Park District's close relationship with CA State Parks has been consistent through the last 85 years. These two agencies continuously learn from one another and share ideas to address management issues regarding trail design and trail use policy. Trail professionals from both agencies follow a sound foundation of trail design standards adopted by CA State Parks and other parks and recreation districts throughout the nation.

Several Park District trail staff have been through extensive three-week course on best practices for designing, constructing and maintaining sustainable trails provided by CA State Parks. The standards and guidelines taught in this course are followed in every Park District trail project undertaken. Trails Development in partnership with Operations passes these skills on to field staff through a yearly Basic Trail Training.

This year CA State Parks completed and released an updated Trails Handbook. The handbook is a guide for trail managers to develop the most sustainable trail designs that reduce maintenance costs, minimize impacts to natural cultural resources, improve accessibility for all users, and provide the highest quality recreational opportunities available.

> A **sustainable trail** is a trail that has been designed and constructed to a standard that minimizes impact on natural and cultural resources; can withstand the impacts of the intended users and the natural elements while receiving only routine cyclical maintenance; and meets the needs of the users so they do not deviate from the established alignment.

To provide high quality recreation while protecting park resources, a trail must be routed, designed, constructed, and maintained to these standards. Trail design requires knowledge of the soils, drainage patterns, and topography as well as knowledge of the needs and design standards specific to each user group the trail is intended to serve. The combination of this information is required to develop sustainable trails and is actively practiced by the Park District.

Below is a summary of important trail terms and processes found in the CA State Parks Trails Handbook. The CA State Parks handbook provides graphics and basic trail design guidelines worth covering for this workshop. The entire handbook can be found and downloaded at: www.parks.ca.gov/handbook

Preliminary Trail Layout

All trails have an impact on the land where they are constructed. This impact can be minor or severe, depending on how well the trail is designed and constructed. In addition, all trails require maintenance. Even the best-designed and constructed trails require cyclical maintenance to perform properly.

Trail layout and design are the processes of applying modern trail design concepts to a systematic approach of laying out trails. They are used to determine the location and construction standards for a trail and are the most important elements of a trail system because if they are not performed correctly the trail will not be sustainable and will always be a liability. Trail layout and design are as much art as they are science, and a well-designed trail has both form and function.

Trail design and layout begins with the concept that a trail is needed to provide access to an area or destination. As with any large capital project, a preliminary (or rough) trail alignment provides the framework to develop a project description and to analyze and disclose potential project impacts. During this phase, mostly physical landform characteristics like soil, water, and vegetation and destination/control points are taken into consideration. This alignment is often represented as a rough flag line in the field translated into a schematic line on a map. The alignment will be adjusted and further analyzed as the trail moves through the design process.

Prior to setting foot on the landform, typically designers will use GIS map layers or Google Earth to give a "bird's eye" view of the landform. This helps locate potential problems, such as landslides, cliffs, and steep slopes. It also provides the designer with a view of the vegetation types growing within the trail corridor. On the ground, this kind of overview is more difficult and time-consuming to obtain. On-the-ground reconnaissance involves walking the trail corridor several times to become familiar with the landscape.

To further develop the preliminary alignment, some of the many steps that should be taken are as follows:

Review of Existing Information

Before a trail designer begins field work they must have a thorough understanding of the landform the trail will be traversing. This may include a review of all applicable literature, including geology, hydrology, soils, topography, and cultural and natural resources. Extra attention needs to be given to reports on sensitive cultural, plant, and animal resources that could be impacted by the proposed trail. Other important background information includes property boundaries, easements, rights-of-way, and existing trail connectivity.

Identification of Major and Minor Control Points

Once the existing information is reviewed and assimilated, the major control points between the starting and ending of the trail are identified. Generally, these points are where the new trail alignment must pass through or avoid and the beginning and end of the alignment. After these points are confirmed and established, the broad trail corridor is narrowed and adjusted to accommodate these locations.

Minor control points are locations that the trail should go to or avoid. They differ from major control points in that issues they present may be resolved through engineering or construction techniques. Identification and mapping of minor control points further narrows the trail corridor and breaks it up into smaller segments. Segmenting the trail corridor in this way simplifies the layout process and provides the designer with information necessary to more easily "tight flag" the trail route.

Identification of Topographic Control Points

Sometimes there are topographic features on the landform that can serve as control points. The most common of these features is a low point or saddle on an extended ridge. These locations control the elevation of a potential trail alignment simply by being the lowest point of land that a trail can pass through. Recognizing these control points early in the layout and reconnaissance process can expedite the determination of the trail corridor, the location of control points, and the grades between those control points.

Identification of Designed Control Points

Designed control points are locations on the landform that call for a trail structure. Incorporating certain characteristics of the landform is essential to the successful performance of some trail structures, such as water course crossings, grade reversals and climbing turns.

Determination of Maximum and Average Linear Grade

Maximum linear grade is the linear grade of a trail that, when combined with proper layout and construction, will result in a trail bed that requires only routine maintenance and will not carry water, even when subjected to severe weather conditions or heavy use. The Park District aims to design trails with a maximum grade of between 10% - 15%, although steeper grades may be needed for short distances. The maximum sustainable linear grade depends on the side slope of the landscape the trail is traversing. This is important for proper drainage as well as user experience. The average linear grade is the grade allowed over the entire alignment and should not exceed the maximum linear grade.

The following variables are evaluated to establish the sustainable maximum trail grade:

- User group, user interaction with the trail, and amount of use
- Soil strength and durability
- Annual rainfall
- Rainfall intensity
- Canopy cover
- Percent of hillslope
- Location on the hillslope
- Evaluation of existing trails nearby

If the average linear grade is steeper than the maximum sustainable grade, the trail alignment needs to be adjusted (lengthened) to conform to the grade limit. If land base, resource, aesthetic, or construction feasibility issues prohibit lengthening the trail in a curvilinear fashion, then trail features and structures such as topographic turns, climbing turns, and switchbacks need to be considered to lengthen the trail. These trail features and structures must be placed at appropriate locations and themselves become minor control points.

Field Reconnaissance

Once a proposed trail corridor that incorporates the major control points and average linear grade between the points is identified on a map, field reconnaissance is performed along the route to investigate the landform. This now involves resource specialists, including engineering geologist, hydrologist, botanist, resource ecologist, wildlife biologist, archeologist, and historians. Getting their involvement early in the design and layout process improves the evaluation of the landform, enhances the synergy that occurs between disciplines, and reduces any conflict that may occur before the environmental review.

Identification of Turn Locations

If land base, resource, aesthetic, or construction feasibility prohibits lengthening the trail in a curvilinear fashion, then trail features such as climbing turns and switchbacks are used to overcome elevation gains between control points. The appropriate location for a turn will depend on a number of criteria related to the design, function, and sustainable performance of the feature.

A climbing turn or a switchback is the next option for a turn. Generally, a climbing turn is preferable to a switchback because it requires less excavation and retaining wall construction. Typically, a climbing turn is located on a hillslope of 30% or less, and a switchback is located on a hillslope steeper than 30%.

Switchbacks located on steep slopes require more excavation into the hillside to construct the upper leg and the inside (upper) corner of the turn. The lower portion of the switchback usually requires a retaining structure to support the fill material used to build the lower or downhill portion of the turn. The best place for these turns is on the nose of a ridge or near the upper flanks of a watercourse. Both locations allow the water collected on the upper leg to drain freely off the corner of the turn. In order to prevent trail users from "cutting" the switch back, placement of switchbacks around a feature such as a tree or large rock will discourage going off trail.

Turns can be designed to provide appropriate sight lines and control speed if properly placed. A turn that is designed to require the user to go up hill in either direction will control the speed by which trail users enter the turn. In addition, a blind turn that slows trail users down and provides them a "lookout" to see if other trail users are present before making the turn will increase safety.

Identification of Problematic Topography

Certain locations on the landform should be avoided by trail designers whenever possible. One of these locations is a ridge top. Trail designers often locate trails along the tops of ridges for the view and to minimize the amount of required brushing, clearing, and trail construction. If the ridge is comprised of very durable bedrock, this layout practice is acceptable. However, if the ridge top is comprised of soil the construction of the trail tread (even light brushing and clearing) will result in the trail bed being lower than the surrounding soil horizon. With the trail bed lower than the terrain adjacent to it, surface runoff cannot flow off the trail, and it will begin to flow down the trail. The trail effectively becomes a ditch and the combination of water erosion and mechanical wear quickly incises the trail bed.

A similar problem occurs when trail designers lay out trail on flat ground. As soon as the trail is constructed, the trail bed is lower than the surrounding soil horizon. The initial user traffic will compact the soil in the trail bed below the adjacent terrain. Sheet flow accumulates in trail bed and ponds in or flows down the trail. Again, the combination of soil saturation, mechanical wear, and water erosion creates an entrenched trail that cannot be corrected with water bars or grades reversals. If flat, poorly drained areas cannot be avoided then the trail must be hardened or elevated using construction techniques or structures such as aggregate surfacing, turnpikes and causeways, stone pitching, timber planking, puncheons, or boardwalks, etc.

Final Grade Reconciliation

Once all major and minor control points are located within the trail corridor, the average and maximum sustainable linear grades between control points are identified. The maximum sustainable grade and average linear grade can then be compared to the designed trail grade. The final linear grade between each control point must be equal to or less than the maximum sustainable linear grade limit and the designed grade. By the end of the field reconnaissance, the designer has explored every possible routing and selected one that represents the best possible alignment.

At this point in the design and layout process, the trail designer determines if the proposed trail alignment and any features needed are sustainable or not. If it is sustainable, move forward with flagging the trail alignment. If it is not sustainable, the findings should be documented, and the proposed trail may need to be realigned. If the proposed trail is required due to critical operational needs or public demand, the designer should identify the deficiencies in the proposed trail and quantify the additional costs required to construct and maintain the trail.

Conclusion

The CA State Parks Handbook explains the importance of providing and maintaining a robust trails system through a comprehensive trails management program:

> "Recreational trails are developed to provide access to the natural, cultural, and scenic resources of a park, to enhance the visitor's enjoyment of these resources, and to provide opportunities for varied recreation. Trails are park facilities similar to campsites and picnic areas. As such, they need to be funded, operated, and maintained through a comprehensive management program."

The Handbook, including its review of sustainable trail design standards and a system for evaluating trail priorities, is intended to provide tools for park planners, administrators, maintenance staff, and trail crews to ensure that trail systems are managed and administered consistently within the state park system. This Handbook provides a valuable resource that the Park District currently references to design and construct sustainable trails, and which could be used in the future as the Park District continues to develop and refine its trails management system. As recognized in both the CA State Parks Handbook and in the Park District's Master Plan, trail use is the most preferred activity in the parks and is the way that most visitors experience the incredible natural and scenic beauty of our parklands. The Trails Development Program team is proud to be part of expanding and caring for this unique resource in the East Bay Regional Parks.

EAST BAY REGIONAL PARK DISTRICT
Existing and Potential Parklands and Trails

- Potential Regional Trails
- SF Bay Water Trail
- Existing Regional Trails
- Juan Bautista de Anza National Historic Trail
- Roads
- Highways / Freeways
- Master Plan Sector Boundaries
- County Boundary
- Potential EBRPD Parklands
- EBRPD Park Boundary
- EBRPD Parkland
- EBRPD Landbank
- Other Open Space

Note: Designation of an area as a potential site for EBRPD acquisition does not assure acquisition of the site. All existing EBRPD Parklands may be expanded. The map shows all EBRPD land and trails acquired as of October 2013. Locations of potential EBRPD parklands and trails are approximate; some could include several facilities.

Potential Regional Trails (or partially completed)

1 **San Francisco Bay Trail ****
- 1A Santa Clara County to Coyote Hills
- 1B Coyote Hills to Hayward Shoreline
- 1C Martin Luther King Jr. to Crown Beach
- 1D Crown Beach to Alameda
- 1E Oakland Estuary
- 1F Martin Luther King Jr. to Eastshore State Park
- 1G Eastshore State Park
- 1H Pt. Isabel to Miller/Knox
- 1I Miller/Knox to Wildcat Creek
- 1J Wildcat to Pt. Pinole
- 1K Pt. Pinole to Carquinez Strait
- 1L Carquinez Strait to Martinez Shoreline
- 1M Martinez Shoreline to Pt. Edith

2 **East Bay Greenway**
- 2A Santa Clara County to Fremont
- 2B Union City to Oakland
- 2C Ohlone Greenway

3 **Bay Area Ridge Trail ****
- 3A Mission Peak to Vargas Plateau
- 3B Vargas Plateau to Garin/Dry Creek Pioneer
- 3C Garin/Dry Creek Pioneer to Chabot
- 3D Kennedy Grove to Sobrante Ridge
- 3E Sobrante Ridge to Carquinez Strait
- 3F Feeder Trail #1

4 **Calaveras Ridge Trail ****
- 4A Sunol to Pleasanton Ridge
- 4B Pleasanton Ridge
- 4C Pleasanton Ridge to Las Trampas
- 4D Las Trampas to Briones

5 **Iron Horse Trail ****
- 5A San Joaquin County to Shadow Cliffs
- 5B Shadow Cliffs to Alameda County
- 5C Walnut Creek Channel Extension

6 **Mokelumne Coast to Crest Trail****
- 6A Contra Loma to Marsh Creek Trail
- 6B Marsh Creek Trail to Delta

7 **Delta/DeAnza Trail ****
- 7A Walnut Creek Channel to Bay Point
- 7B Antioch to Oakley
- 7C Marsh Creek Trail to Rock Slough

8 **San Francisco Bay to San Joaquin River Trail ****
- 8A Niles Canyon
- 8B Niles Canyon to Shadow Cliffs
- 8C Shadow Cliffs to Morgan Territory
- 8D Round Valley to Big Break

Other Regional Trails

9 Coyote Hills to Ardenwood
10 Ardenwood to Quarry Lakes
11 Old Alameda Creek
12 Dunsmuir Heights to Chabot
13 Knowland Park to Redwood
14 Temescal to Sibley
15 Claremont Canyon to Tilden
16 Wildcat Creek**
17 Hercules to Briones
18 Carquinez Strait to Briones
19 Briones to California State Riding & Hiking
20 Orinda Loop (Sibley, Orinda, Tilden)
21 Lafayette/Moraga to Lafayette Reservoir
22 Lamorinda to Redwood
23 Indian Ridge to Moraga
24 Cull Canyon to Bishop Ranch
25 Don Castro to Pleasanton Ridge
26 Don Castro to Vargas Plateau
27 Garin to Pleasanton Ridge
28 Vargas to Sunol Ridgeline
29 Pleasanton Ridge to Shadow Cliffs
30 Shadow Cliffs to Del Valle**
31 Doolan Canyon to I-580
32 Arroyo Mocho Trail
33 Tassajara Creek/Ridge Trail**
34 Iron Horse to Mt. Diablo
35 Lime Ridge to Mt. Diablo
36 California State Riding and Hiking**
37 CNWS to Black Diamond Mines
38 Contra Costa Canal Trail to Delta/DeAnza
39 Great California Delta Trail
40 Black Diamond Mines to Mt. Diablo
41 Black Diamond Mines to Round Valley
42 Big Break Shoreline**
43 Delta Island Shoreline Trail
44 Southern Pacific Railroad
45 Marsh Creek Trail to Discovery Bay
46 Mokelumne to Discovery Bay
47 Delta Trail Extension
48 Vasco Caves to Brushy Peak
49 Brushy Peak to Bethany Reservoir
50 Brushy Peak to Del Valle
51 Del Valle to Dam Extension
52 Del Valle to Cedar Mountain

Notes:
Permit is required on trails that cross EBMUD Lands
** Partially completed trails