Trail Construction and Maintenance
Montesano City Forest

The City of Montesano is fortunate to have a managed forest to help offset water system cost to the citizens of Montesano and offer many recreational opportunities for residents and visitors. Our forest is unique in the area in that it is quite small compared to most areas that offer recreation in a harvest managed forest. Because of the unique aspects of the forest these restrictions and guidelines are established so that our forest can successfully maintain a sustainable forest harvest and provide recreational opportunities. These guidelines are established by a mayoral ad hoc citizens committee and approved by the City Parks and Recreation Board and the City Forester.

Trail building and maintenance follows procedures established and recognized world wide by the International Mountain Bike Association. In addition to these standards the "City" has added the following standards due to the unique nature of our forest:

1. New trail plans must be approved by the Parks Board and City Forester. They must comply with these stated standards and follow the permitting process. See attached permit.
2. All new trails must be suitable for trail running, mountain biking, and hiking and be of single track design.
3. Trail design must include “choke points” at trail entry-exit and at strategic points along the trail to discourage motorized vehicle access.
4. New trails must fit the overall network of trails and connect to provide a complete system, avoiding short trails that dead end unless to a view point.
5. Forest health is primary and all trails must be low impact and follow the natural flow of the terrain.
6. Trails can not include any purpose built obstacles or features as would be used in a bike park or mountain bike track.
7. All bridges and wet area passage must be designed, and be approved by the City of Montesano.
8. No use of heavy equipment by individuals other than employees or contractors of the City of Montesano, unless a written exception is granted.

The following guidelines have been taken from the IMBA trail building handbook

Trail Planning

A good trail may appear to have "just happened," but that appearance belies an incredible amount of work in scouting, design, layout, construction, and maintenance. Although this guide focuses on actual dirt work, we want you to understand that solid planning is essential. Keep this in mind when designing, constructing, and maintaining trails.

Recreation trails are for all people. They allow us to go back to our roots. Trails help humans make sense of a world increasingly dominated by automobiles and pavement. They put us in touch with our natural surroundings, soothe our psyches, challenge our bodies, and allow us to practice traditional skills.

Human psychology also plays a role. A useful trail must be easy to find, easy to travel, and convenient to use. Trails exist simply because they are an easier way of getting someplace. Many trails, such as wilderness trails, motorcycle routes, or climbing routes, are deliberately challenging with a relatively high degree of risk. Rest assured, however, that if your official trail isn't the ***path of least resistance***, users will create their own trail. Your trail must be more obvious, easier to travel, and more convenient than the alternatives or you're wasting your time and money.

Avoiding Trail Disasters

If you've ever encountered a trail disaster, chances are that it resulted from short-circuited planning. Acts of God aside, some of the worst trail problems result from not doing the hard work of thinking before putting on the gloves and hardhat. Some glaring examples are:

- Building out-of-rhythm sections (abrupt turns). Why did this happen? The trail's rhythm and flow weren't checked before cutting it in.

- Water funneling down and eroding the tread. Why did this happen? The trail grade was designed too steep.

- Multiple trails. Why did this happen? The trail wasn't laid out in the best place to begin with.

Planning is stupidity avoidance. Do good planning for all levels of trail work. Good planning also includes monitoring the trail's condition. It's hard to do good planning until you have some idea of the current situation and trend. Our focus in this notebook is field work, but other important work goes into trail planning. Requirements for trail planning vary, but they usually include consulting soil scientists, bridge and geotechnical engineers, fisheries and wildlife biologists, recreation planners, landscape architects, and persons skilled in documenting environmental and permitting requirements.

Planning the Route on the Map

Be certain you know the trail management objectives (TMOs) for your trail--things like the intended users, desired difficulty level, and desired experience. TMOs provide basic information for trail planning, management, and reporting.

Use topographic maps and aerial photos to map the potential route. On the map, identify control points--places where the trail has to go, because of:

- Destination
- Trailheads
- Water crossings
- Rock outcrops

Include ***positive control points***--features such as a scenic overlook, a waterfall, or lakes.

Avoid ***negative control points***--areas that have noxious weeds, threatened and endangered species, critical wildlife habitat, or poor soils.

The 10-Percent Guideline

When plotting the trail on a map, connect the control points, following contour lines. Keep the grade of each uphill and downhill section less than 10 percent. Plotting your trail with 10-percent grades on a topographic map will help keep the route at a sustainable grade. When you get into the field to start scouting the route, you'll have better flexibility to tweak the grades.

Percent grade equals the rise divided by the run multiplied by 100

Example: An elevation of 10 feet divided by a distance of 100 feet times 100 = 10%

Elevation change up or down is always a positive number

Scouting the Route in the Field

Tools to scout the route include: clinometer, compass, altimeter, GPS receiver, flagging of different colors, wire pin flags, roll-up pocket surveyor's pole, permanent marker to write notes on the flagging, field book, probe to check soil depth to bedrock, and maps. The objectives of scouting or reconnaissance are to:

- Verify control points and identify additional control points that you did not spot when you were studying the maps and aerial photos.
- Verify that the mapped route is feasible.
- Find the best alignment that fits all objectives.
- Identify additional positive control points to enhance the user's experience.
- Validate that the route is reasonable to construct and maintain.

Hints for Locators

- Don't trust an eyeball guess for grade; use your clinometer (***clino***).
- Large trees often have natural benches on their uphill side. It's better to locate your trail there than on the downhill side where you'll sever root systems and generally undermine the tree. Your specifications will tell you how close the trail can be to the tree.
- Look for natural platforms for climbing turns or switchbacks. They save construction costs and better fit the trail to the land.
- Cross ravines at an angle rather than going straight up and down the ravine banks.
- Flag locations for grade reversals.
- Look for indications of shallow bedrock, such as patches of sparse vegetation.
- Flag the centerline location, particularly in difficult terrain.
- Look for small draws to locate grade reversals. The trail should climb gently for a few feet on each side of the draw.
- Avoid laying a trail out on flat terrain because water has no place to drain.

Field scouting requires sound knowledge of map and compass and of finding your way on the ground. Begin with the theoretical route, then try different routes until you find the best continuous route between control points. ***Walk, walk, walk***. Keep field notes of potential routes.
It may be useful to hang reference flags at potential control points or features so they are easier to relocate later.
Reconnaissance is easiest with two people. You and your partner need to use a clinometer to determine sustainable grades.

The Half Rule

Building sustainable trail grades helps keep maintenance at bay. So what makes a grade sustainable? This design element comes from IMBA's "Trail Solutions" book (2004). It's called the ***half rule***.

The half rule says that the trail grade should be no more than half the side slope grade (figure 3). This rule really helps when putting trails on gentle side slopes. For example, if you're working on a hill with a 6-percent side slope, your trail grade should be no more than 3 percent. If the trail is any steeper, it will be a fall-line trail.

Fall-line trails let water funnel down, causing erosion and ruts. As sideslopes get steeper, trails designed using the half rule can be too steep. Use your judgment and knowledge of the particular area.

Light on the Land

No discussion of trails is complete without attention to esthetics. We're talking scenic beauty here. Pleasing to the eye.

The task is simple. An esthetically functional trail is one that fits the setting. It lies lightly on the land and often looks like it just "happened."

Well-designed trails take advantage of natural drainage features, reducing maintenance that might be needed, while meeting the needs of the users. The trail might pitch around trees and rocks, follow natural benches, and otherwise take advantage of natural land features

The best trails show little evidence of the work that goes into them. A little extra effort spent limbing properly, scattering cut vegetation widely, blending backslopes, avoiding drill hole scars, raking leaves back over the scattered dirt, and restoring borrow sites pays off in a more natural-looking trail. Be a master. Do artful trail work.

Trail Foundation

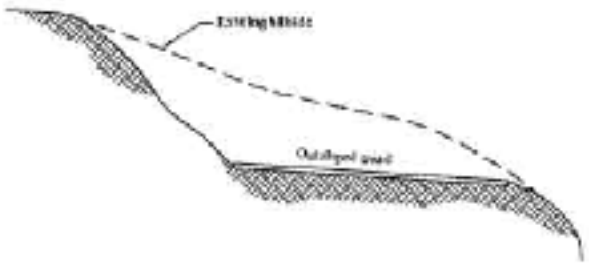
Here's how you can make sure your trail has a strong, long-lasting foundation.

Rolling Contour Trails

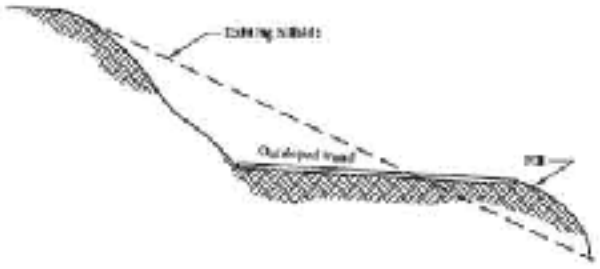
Constructing contour trails into the sideslope requires excavating the side of the hill to provide a solid, stable trail tread. Stay away from flat areas because water has nowhere to go. Keep grades sustainable by using the half rule and add plenty of grade reversals. Slightly outsloping the tread (about 5 percent) is a must to help move water across the trail.

Full-Bench Construction

Trail professionals almost always prefer ***full-bench*** construction. A full bench is constructed by cutting the full width of the tread into the hillside and casting the excavated soil as far from the trail as possible (figure 26). Full-bench construction requires more excavation and leaves a larger backslope than partial-bench construction, but the trailbed will be more durable and require less maintenance. You should use full-bench construction whenever possible.Partial-Bench Construction



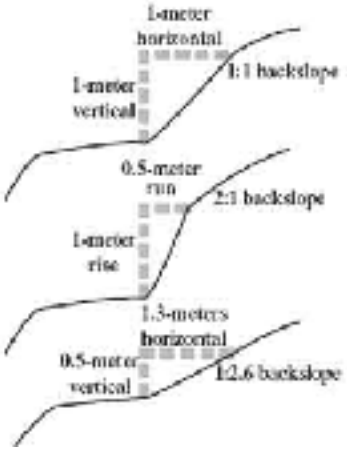
Partial-bench construction is another method to cut in a trail, but it takes a good deal of trail-building experience to get this method right. The trail tread will be part hillside and part fill material



The fillslope needs to be composed from good, solid material like rock or decay-resistant wood. And it has to get compacted evenly--this is the puzzle to solve. Solving Sudoku puzzles doesn't guarantee you'll get this one!
Backslope--The backslope is the excavated, exposed area above

the tread surface. The backslope should match the angle of repose of the parent material (the sideslope). You may come across trail specifications calling for 1:1 backslope. This means 1 meter vertical rise to 1 meter horizontal run.

Most soils are stable with a 1:1 backslope. Solid rock can have a steeper 2:1 backslope, while less cohesive soils may need a 1:2 backslope



Bottom line, angle the backslope until loose material quits falling down onto the trail tread. Stabilize the entire backslope by compacting it with the back of a McLeod.

One option to reduce backslope excavation is to construct a retaining wall. This can be less obtrusive than huge backslope excavations and more stable if the wall is well constructed.

Fillslope--The fillslope is that area below the tread surface on the downhill side. A full-bench tread will not have any fill on this side of the trail. Fillslopes are critical. Fillslopes often need to be reinforced with retaining or crib walls to keep them from failing. Fillslope failures are common and will wipe out the trail. That's why most trailbuilders prefer full-bench trails.Moving Dirt

Looking at construction plans is one thing, but going out and building a rolling contour trail is quite another. Here is a proven method that works even for the complete novice. This procedure is for the actual dirt moving once vegetation has been cleared.

- Place pin flags to keep the diggers on course.

- Straddle a centerline flag and face uphill. Swing your Pulaski or other tool to mark the area to be cleared. Where the tool strikes the hillside will be approximately the top of the backslope. The steeper the slope, the higher the backslope. Do this at each centerline flag, then scratch a line between the tool strikes. This defines the area to be dug to mineral soil. Clear about the same distance below the flag. Keep the duff handy by placing it uphill. It will be used later. Don't clear more trail than can be dug in a day unless you know it isn't going to rain before you can complete the segment.

- Stand on the trail and work the tread parallel to the direction of travel. Level out the tread and get the right outslope. Don't continue facing uphill when you're shaping the tread, despite the tendency to do so.

- Make sure that the width of the rough tread is about the length of a Pulaski handle. The finished tread will be about right for a good hiking trail.

- Make sure grade reversals and other drainage structures are flagged and constructed as you go.

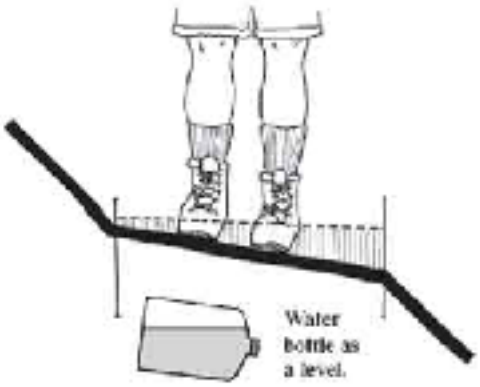
- Shape the backslope about as steep as the original slope. Backslope ratios are hard to understand. Instead, look at the natural slope and try to match it.

- Round off the top of the backslope, where the backslope meets the trail tread, and the downhill edge of the trail. Keeping these areas smooth and rounded will help water sheet across the trail.

- Walk the trail to check the tread's outslope. If you can feel your ankles rolling downhill, there is too much outslope (figure 29). The outslope should be barely detectable to the eye. A partially filled water bottle makes a good level or you can stand a McLeod on the trail tread--the handle should lean slightly downhill.

- Compact the entire tread, including the backslope, with the back of a McLeod. Don't leave compaction up to trail users. They will only compact the center, creating a rut that funnels water down the middle of the trail.

- Place the duff saved earlier onto the scattered dirt that was tossed downhill. The duff helps naturalize the outside edge and makes the new trail look like it has been there for years.



- Be careful not to create a berm with the duff.

Turns

Two types of turns are used to reverse direction on hillsides in order to gain elevation in a short distance. A climbing turn on the existing grade doesn’t have a constructed turning platform or landing. A switchback turn reverses direction with the help of a relatively level constructed landing. Both turns take skill to locate and are difficult and expensive to build and maintain. Think of them as a last resort. Whenever possible, it’s better to gain elevation by maxi- mizing long contour trail sections.

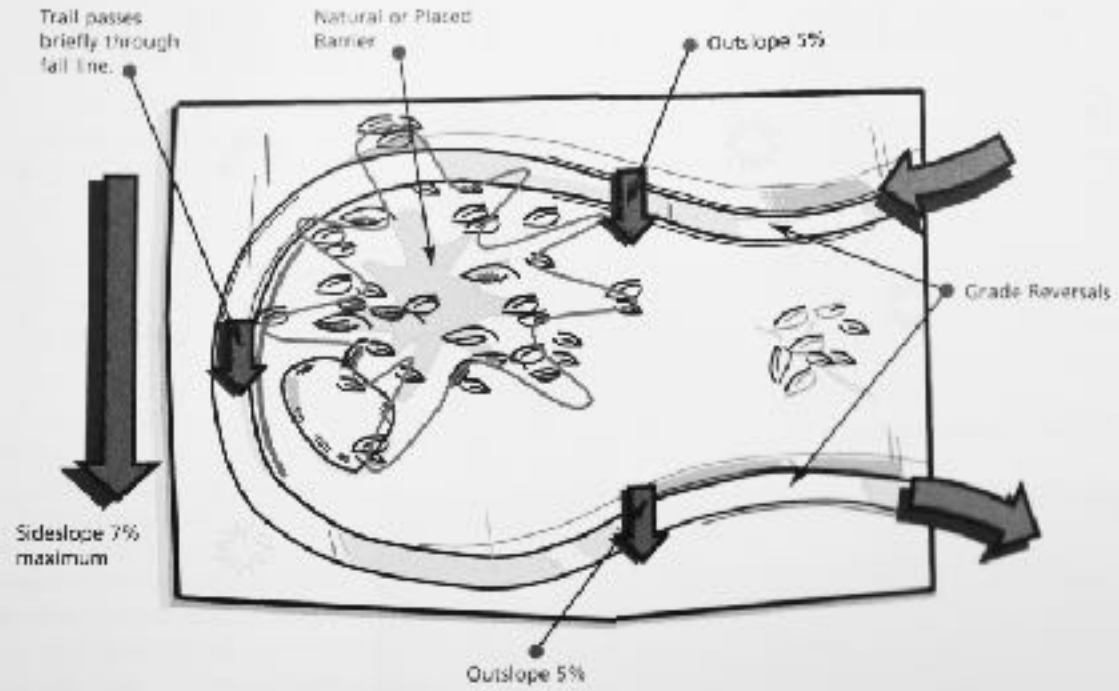
1. Climbing Turns

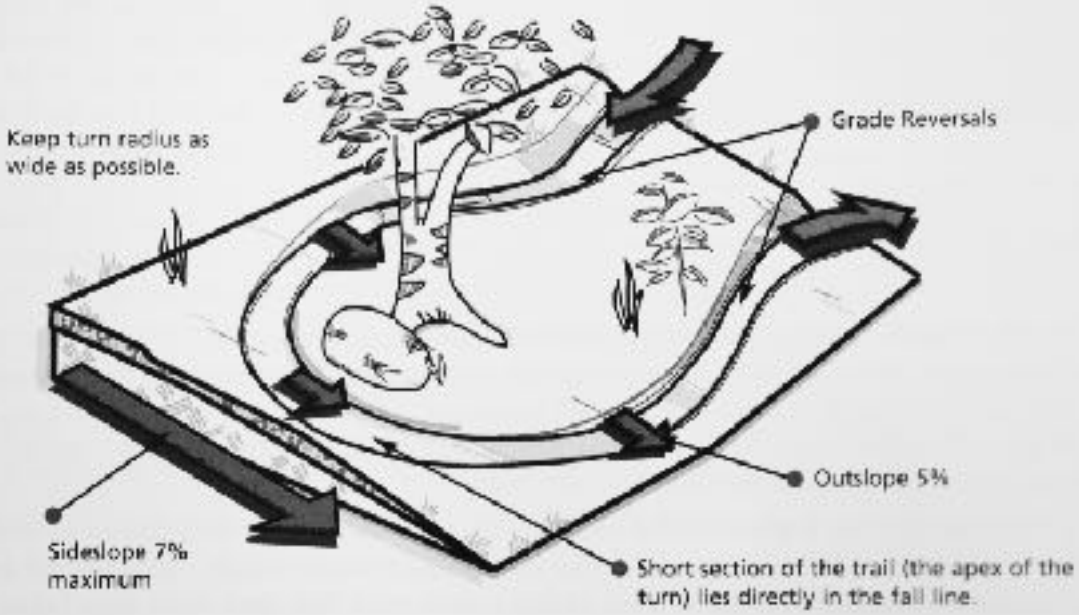
Climbing turns are used on shallow slopes that don’t exceed a grade of about 7 percent. To control cyclists’ speed and prevent skidding, climbing turns should be free flowing and gentle. Keep the turn radius as wide as possible, ideally 30 feet.

Minimize erosion by having a short uphill section or grade reversal just above the turn. A grade reversal diverts water off the trail before it reaches the fall-line section. Climbing turns are best used on elevated ridges or slopes where water accumulation is minimal.

Because climbing turns include a section of trail on the fall line, they aren’t as durable as well-constructed switchbacks.

Climbing Turn





2. Switchbacks

Switchbacks are difficult to build but are more durable on steep slopes. They will last longer than climbing turns if properly designed. We recommend a version called the "rolling crown" switchback. It’s carefully engineered for good drainage.

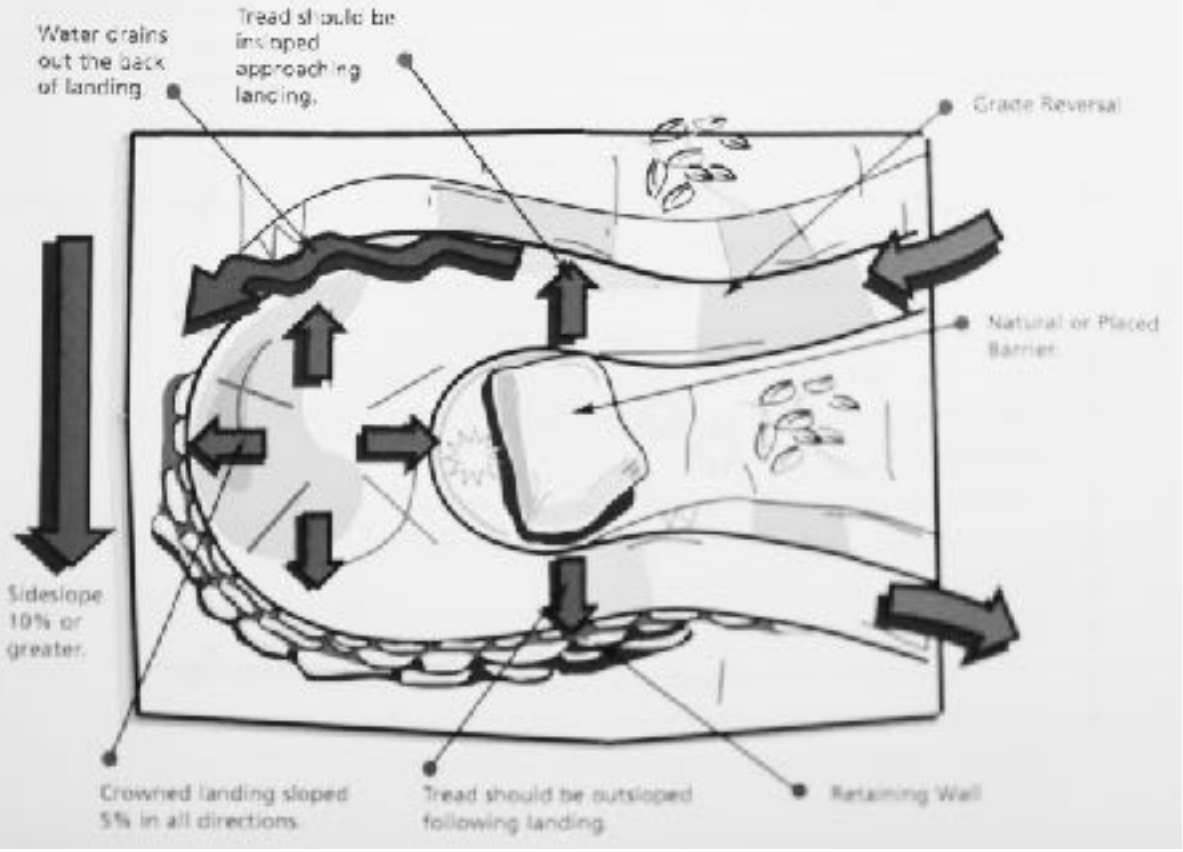
Key Features of a Rolling Crown Switchback.

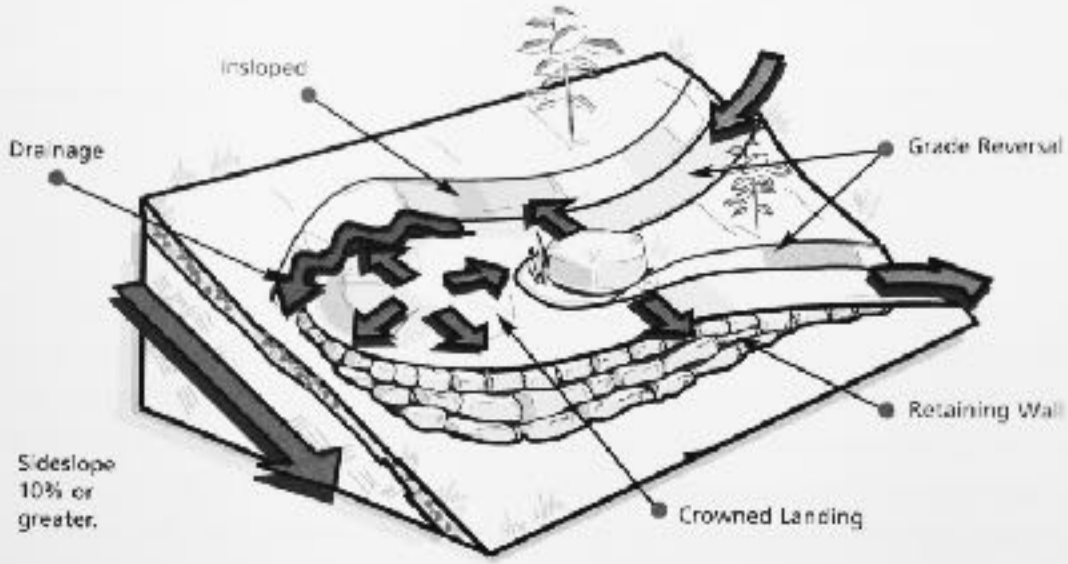
n It’s located on a gentle slope (consider it a control point). n Water drains off the back of the turn.

This shows the most sustainable type of turn on steep sideslopes. Inslope the trailbed only on the upper leg as it transitions to the crowned landing. The landing should have a 12- to 18-foot diameter, depending on trail width. The landing is outsloped in all directions. Build a grade reversal just before the upper leg to move water off the trail before it reaches the landing.

- Turns occur on a near-level platform that’s slightly crowned (domed).
- The trail stays on the contour on both approaches.
- Bench cuts and crib walls are combined as needed.
- Material excavated from the top leg is used to build up the bottom leg behind a crib wall.
- Crib walls are carefully built to ensure stability.
- The upper leg is insloped.
- The lower leg is outsloped.
- Approaches are designed to control user speed.
- Grade reversals in the approaches divert water.
- Switchbacks aren’t built directly above one another. They’re staggered on a hillside to prevent shortcutting and water accumulation.

Rolling Crown Switchback





City of Montesano
Recreation Trail Proposal
Planning prospectus and Construction Application

Project Name:_____

Applicant_____Phone number_____

Address_____email_____

Trail Purpose and Attraction: (Master plan, trail system connection, re-route for resource protection, destination, vistas, ect.)

Description of Landscape conditions: (slope, soil, vegetation type, trail map, length, stream crossings, nearby critical habitat, ect.)

Trail Facilities: (way-finding signage, benches, bridges, turnpike, boardwalk, interpretive media, introductory kiosks, rule signage, ect.)

Proposed Schedule: (include approved designs, environmental review, and permit)

All proposed trails are to comply with the current Trail Construction and Maintenance Standards. An application for a proposed recreation trail must include a map of route in GPX and/or paper copy. Route must be flagged in orange tape prior to application.

Signature_____date_____

City of Montesano
Recreation Trail Proposal
Planning prospectus and Construction

STAFF USE ONLY

Environmental Concerns:

Public Access/Safety issues:

Planning and Cost Estimate:

Maintenance/signage issues:

Other Comments/Instructions:

Forester Approval to Proceed_____**date**_____

Park and Rec Board Approval to Proceed_____**date**_____