



**PORTLAND PARKS & RECREATION**

Healthy Parks, Healthy Portland



# Trail Design Guidelines for Portland's Park System

May 2009

# Trail Design Guidelines

## Regional Trails, Natural Areas and Developed Parks

April 2009

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## Introduction

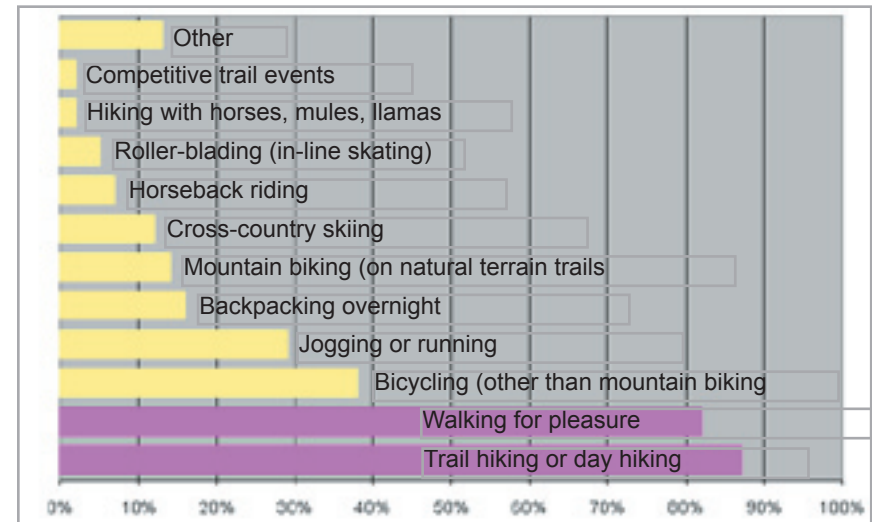
Trails are an integral part of our park and recreation system. They are used by people of all ages and abilities to exercise, relax, socialize, view wildlife, and travel to destinations such as school and work. Portland Parks & Recreation (PP&R) is committed to providing trails throughout Portland in response to local, state, and national studies indicating high demand for walking and biking. PP&R interprets the term ‘trail’ broadly to include sidewalks around parks, park pathways, sidewalks, and enhanced paths on green streets, as well as unpaved pathways in natural resource areas and regional multi-modal trails.



## Trails in *Parks 2020 Vision* Plan

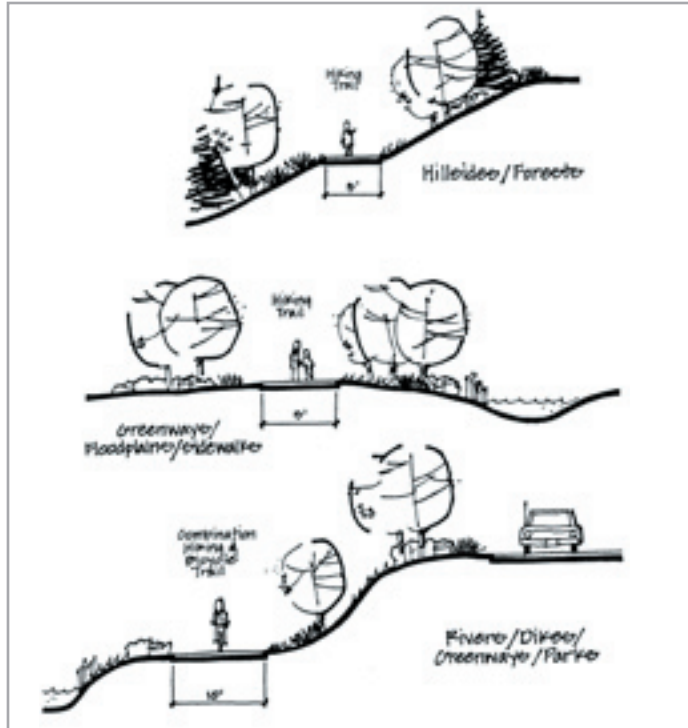
One of the goals of *Parks 2020 Vision* is to “create an interconnected regional and local system of paths and walks to make Portland ‘The Walking City of the West.’” This would provide safe and convenient access between parks, natural areas, and recreation facilities and connect them with residential areas, civic institutions, and businesses. The *Vision* identified trails as PP&R’s most heavily used resource. Completing specific regional trails, and adding more miles of soft-surface trails and other green connectors were key objectives.

The trails section in the appendix of *Parks 2020 Vision* noted that trails are places and connectors that traverse a variety of ownerships and environments, from remote forests to the Central City. It recognized multiple values: recreational, transportation, aesthetic, scenic, environmental, and economic. However, the trail system was acknowledged to have many gaps and lack of connectivity that limited its usability. Insufficient capacity, where older trail segments are too narrow for current, not to mention future, use was also identified as a problem.

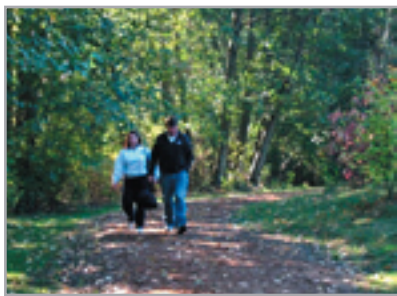


Oregon Trails Usage  
*Oregon Statewide Comprehensive Outdoor Recreation  
Plan 2003-2007*

## Trail Design



Minimum Trail Widths in 1983 40-Mile Loop Master Plan



## Need for Trail Standards

The *Parks 2020 Vision* plan identified “no trail standards” as an issue. It noted that trail standards are lacking for the many trail types, sizes, and materials needed in different settings. Impacts to sensitive habitat and stormwater quality and quantity must be considered. The specific recommendation “Develop trail standards for the different conditions and needs” recommended that PP&R:

- Develop standards for the different trail types in the 40-Mile Loop system and for non-Loop sites.
- Include other bureaus, agencies, and adjoining jurisdictions in developing trail standards. Encourage other agencies and jurisdictions to adopt similar standards and trail alignments.
- Rebuild trail sections to meet the revised standards as funding is available.
- Develop and implement a consistent, regional trail signage program to enable users to better utilize the system.

## Trail Design Guidelines

Since the *Vision* was published in 2001, more trail segments have been constructed in a variety of settings for different users. The existing system and its gaps have been documented in PP&R’s geographic information system (GIS), revealing a diverse range of widths and trail materials. Although some of the older trails are clearly ‘substandard,’ there are so many special settings and constraints that setting standards is too limiting. Instead, these ‘design guidelines’ establish a range of materials and widths so that trail designers can design trails more flexibly. This will guide PP&R staff in the design of trails and pathways in the entire parks system: regional trails, developed parks, and natural areas. It will also guide consultants, developers, and volunteer groups

that build trails, whether designing a narrow footpath through a woodland, an exercise circuit in a lawn area or a waterfront promenade. Although not intended as a maintenance guide, it should also be useful for volunteer trail building projects.

## Design Philosophy

Siting and design of every trail requires consideration of four main goals: safety, connectivity, response to location, and diversity of users.

1. **Safety** is the top concern. Ideally, cars and trucks alongside or crossing a trail should be minimized. If the trail parallels a roadway, separate bicycle and pedestrian space is preferred unless there are few vehicles and low travel speed. Higher speed and traffic volumes decrease users' perception of safety and tend to discourage less experienced users. Although parked cars sometimes slow traffic by making the street seem more narrow, there is danger of opening doors into bicyclists. Visibility is particularly important at intersections with roads and in natural areas, but design principles for crime prevention should be applied to all projects. Different trail users also travel at differing speeds, which can cause conflicts and accidents. In some sites, trail markers designate trails for use by hikers, bikers and/or equestrians; in others we urge everyone to 'share the path.' In corridors of high density (such as the Willamette Greenway in South Waterfront) a biking trail can be used in combination with a walking trail to form a dual trail to separate slower speed "feet" from higher speed "wheels." Additional education and enforcement are needed.

2. **Connectivity** is important because trail length makes longer trips possible, increasing usefulness for commuting and exercise. Trails also connect gaps in the on-street pedestrian network. Trails should have multiple access points from the surrounding system of sidewalks, other



### FOUR MAIN GOALS FOR TRAIL DESIGN

#### 1. SAFETY

- 1st Choice - Separate trail from vehicles
- 2nd Choice - Minimize vehicle crossings of trail
- 3rd Choice - If trail co-exists with road then choose route with lower speed and volume
- Design for visibility and crime prevention in all settings

#### 2. CONNECTIVITY

- Connected lengths of trails make longer trips possible, increasing usefulness for commuting and exercise
- Provide trail access points and connect trails to bicycle and pedestrian network in City rights-of-way

#### 3. CONTEXT

- Trail changes to meet opportunities and constraints of its surroundings

#### 4. DIVERSITY

- Provide range of trails to meet needs of all ages and abilities so everyone benefits, including those with disabilities

## Trail Design



*Vera Katz Eastbank Esplanade - stairs near Riverwalk on Steel Bridge*



*Vera Katz Eastbank Esplanade - accessible ramp near Riverwalk on Steel Bridge*



*Marine Drive Trail - rollerblader*



*Springwater Corridor - scooters*



*Springwater Corridor - Hood-to-Coast runners*



*Vera Katz Eastbank Esplanade - near plaza just north of Firehouse*

trails, and bikeways to make short trips and loops possible. However, these access points will be less frequent than in a typical street network in order to make fewer interruptions to flow of users along the trail.

3. **Response to location** means that trail design responds to opportunities, constraints, and character of the surroundings. In some locations, impacts to environmentally sensitive areas and wildlife can be avoided or minimized by relocating the trail or adjusting trail size and material to limit types of users. However, providing periodic views of water may avoid damaging user-made trails to reach the water. Metro's *Green Trails: Guidelines for environmentally friendly trails* discusses practices for minimizing natural resource impacts. Trail width, slope, and material of trails may also change to fit neighboring development, vegetation, drainage needs, vehicle circulation patterns, and so forth. Impacts to private property should be avoided or minimized. Although trails may be less consistent over their length, the adaptations enliven the overall trail experience and fit different neighborhoods and settings.

4. **Diversity of users** refers to activity, age, and ability. Although the overall recreational trail system includes challenging segments for the most fit and expert, the general aim is to provide challenge levels suitable for all ages and abilities. Trails provide potential health benefits for all, including those with disabilities and a growing number of seniors. Where possible, trail design should accommodate diverse modes and mobility devices – walkers and runners, bicyclists and rollerbladers, wheelchairs and baby strollers. However, in many locations, not all users may be accommodated. Although trail facilities can often be successfully shared, it is also important to have some locations where hikers need not fear being overtaken by mountain bikes, places where mountain bikers know there aren't supposed to be hikers, and trails where horses won't need to shy away from cyclists.



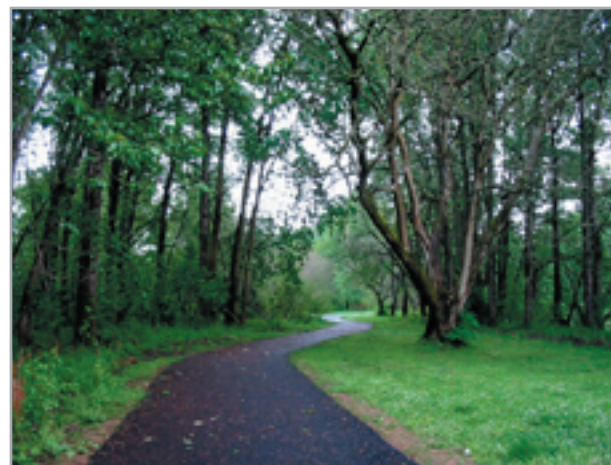
## Accessibility

The Americans with Disabilities Act (ADA) is a comprehensive civil rights law which prohibits discrimination on the basis of disability. It requires, among other things, that newly constructed and altered “places of public accommodation” be readily accessible to and usable by individuals with disabilities. Accessibility guidelines are developed by the Architectural and Transportation Barriers Compliance Board (Access Board). Most accessibility standards (ADAAG, Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities) are not readily applicable to the natural environment. The most pertinent to trails is the *Recommendations for Accessibility Guidelines: Outdoor Developed Areas Final Report*. The United States Department of Agriculture Forest Service (USFS) has developed Forest Service Trail Accessibility Guidelines (FSTG) based on the guidelines on outdoor developed areas. Although the USFS trail design parameters do not apply to the range of trails provided by PP&R, the FSTG are helpful because they “provide guidance for maximizing accessibility of trails... while recognizing and protecting the unique characteristics of their natural setting.”

Although there is a substantial amount of technical information regarding accessibility and trails, PP&R seeks to provide a range of challenge levels for outdoor facilities such as trails. These guidelines encourage design for increased accessibility but do not require unreasonable efforts to provide an accessible route in hiking trails in steep terrain without added surfacing. Where terrain allows accessible slopes, a range of surfacing choices from pavement to fine gravel to engineered wood fiber can create levels of accessibility that respond to the character and desired use of the trail. In an early review of some standard construction details for the *Trail Design Guidelines* by



*Kelley Point Park - some of the 40-Mile Loop Trail at the confluence of the Willamette and Columbia Rivers was once inaccessible gravel road*



*Kelley Point Park - accessible asphalt replaces gravel and sand*

## Trail Design



*Forest Park Ridge Trail*



*Oaks Bottom Connector - existing dirt road was paved, some slopes greater than 5%*



*Forest Park - accessible trail along Balch Creek in Lower Macleay*

the Portland Citizens' Disability Advisory Committee (PCDAC), the committee noted that trail users, including the disabled community, value diversity of experience.

The PCDAC agreed that there should be varying levels of physical challenge. Everyone would be able to use the level esplanade next to a major river; fewer could make the steep scramble up a 'wilderness' site. Steep hillsides in the west hills and east buttes are particularly challenging because the long lengths of trail (at 5%, 1:20 accessible slope) and multiple switchbacks may destroy the natural character of the site. The most challenging constraints to providing accessibility are:

- Steep slopes and landslide potential
- Sensitive vegetation or wildlife species
- Wetlands and waterways
- Desired character of minimal development

Public process and PCDAC review help determine what type and amount of use is likely and appropriate to each site. Most trails are fully accessible, although there is little signage indicating accessibility status. Examples of fully accessible trails include Springwater Corridor, Kelley Point Park, and Terwilliger Parkway. Some sites have higher challenge or no accessible features, such as Forest Park Ridge Trail, Woods Memorial Natural Area, Oaks Bottom Connector, and OHSU Trails #13 (Connor Trail) and #24 (proposed). In some locations PP&R made more site impacts by providing accessible features at one site so that other similar sites could avoid those impacts. Examples include the Lower Macleay paved accessible path along lower portion of Balch Creek, Stephens Creek Nature Park's boardwalk across part of the creek that also serves as a detention basin, and Johnson Creek Park's porous pavement to confluence with Crystal Springs Creek. Other creeks and other portions of Balch, Stephens, and Johnson Creeks are not fully

accessible. Unfortunately, nearly every trail in the PP&R system needs improvements in edge protection, wayfinding, and accessible signage.

The Technical Provisions for Access Routes, Outdoor Access Routes, and Accessible Trails table (page 8) gives the technical details of ADAAG and the Outdoor Developed Areas guidelines. ‘Access routes’ (ADAAG) relate to the built environment where all routes must meet accessibility requirements. ‘Outdoor access routes’ are in outdoor environments, e.g., parks where reasonable access is required, such as between a parking lot and a playground. ‘Accessible trails’ are those trails that meet the USFS guidelines. All refer to newly constructed or altered trails, not retroactively to existing trails. ‘Alteration’ differs from ‘maintenance’ by changing the trail from its original condition. Exceptions to the technical provisions can be made in certain situations.

Technical provisions for outdoor access routes and accessible trails may not apply if it cannot be provided because compliance would:

- cause substantial harm to cultural, historic, religious or significant natural features or characteristics;
- substantially alter the nature of the setting or purpose of the facility;
- require construction methods or materials that are prohibited by Federal, state or local regulations or statutes; or
- be infeasible due to terrain or prevailing construction practices

## Street Rights-of-Way

The Portland Bureau of Transportation (PBOT) manages the public street right-of-way in Portland. Many park sidewalks and/or edges of parks and natural areas are within the right-of-way; PBOT should be consulted regarding design standards and permits for development in rights-of-way adjacent to PP&R property. The most current guidance regarding accessibility that pertains to public right-of-way (*Revised DRAFT Public Rights-of-Way Accessibility Guidelines (PROWAG)*) permits the grade of a pedestrian access route within a sidewalk to be as steep as the grade of the adjoining roadway. In some areas of steep terrain, this allows ‘accessible’ sidewalks to be steeper than accessible trails.

## Trail Type Matrix Introduction

PP&R trail types (page 11 and 12) are based on trail user activity. The first section outlines trail types with single users. The second section outlines trail types shared by different types of trail users. Some basic design features (surface, width, longitudinal and cross-slope, accessibility) and notes are included. Individual sheets on each trail type provide a definition, describe users and materials, and show photograph(s) and typical detail. Some trail types can be built of several materials so other details are also referenced. Ranges of width or longitudinal and cross-slope allow flexibility to respond to site conditions and expected intensity of use.

## Trail Design, Construction, and Maintenance

Descriptions, charts, photographs, and construction details cannot convey the complete reality of selecting, designing, and building a trail that is appropriate for a site and its intended users. Trained designers and experience are essential for success. The following information

## Trail Design

TECHNICAL PROVISION FOR ACCESS ROUTES, OUTDOOR ACCESS ROUTES AND ACCESSIBLE TRAILS			
	Access Route (ADAAG)	Outdoor Access Route	Accessible Trail
<b>Surface</b>	stable, firm, and slip resistant	firm and stable	firm and stable (exception:*)
<b>Maximum Running Slope</b>	1:12 [8.33%]	1: 20 [5%] (for any distance) 1: 12 [8.33%] (for max. 50 ft) 1:10 [10%] (for max. 30 ft)	1: 20 [5%] (for any distance) 1: 12 [8.33] (for max. 50 ft) 1:10 [10%] (for max. 30 ft) 1: 8 [12.5%] (for max. 10 ft) (Exception: 1: 7 [14.3%] for 5 ft maximum for open drainage structures or when * applies )
<b>Maximum Cross Slope</b>	1:50 [2%]	1: 33 [3.03%] (Exception: 1: 20 [5%] for drainage purposes)	1: 20 [5%] (Exception: 1: 10 [10%] at the bottom of an open drain where clear tread width is a minimum of 42 inches)
<b>Minimum Clear Tread Width</b>	36 inches 32 inches for no more than 24 inches	36 inches (Exception: 32 inches when * applies )	36 inches (Exception: 32 inches when * applies )
<b>Tread Obstacles</b>	Changes in level: 1/4 inch with no beveled edge, 1/4 - 1/2 inch must have a beveled edge with a max slope of 1: 2 [50%] (over 1/2 inch = ramp)	1 inch high maximum Exception: 2 inches high maximum where beveled with a slope no greater than 1: 2 [50%] and where * applies.	2 inches high maximum Exception: 3 inches maximum where running and cross slopes are 1: 20 [5%] or less. (Exception: *)
<b>Passing Space</b>	Every 200 feet where clear tread width is less than 60 inches, a minimum 60 x 60 inch space, or a T-shaped intersection of two walks or corridors with arms and stem extending minimum of 48 inches.	Every 200 feet where clear tread width is less than 60 inches, a minimum 60 x 60 inch space, or a T-shaped intersection of two walks or corridors with arms and stem extending minimum of 48 inches. (Exception: Every 300 feet where * applies .)	Every 1000 feet where clear tread width is less than 60 inches, a minimum 60 x 60 inch space, or a T-shaped intersection of two walks or corridors with arms and stem extending minimum of 48 inches. (Exception: *)
<b>Resting Intervals</b>	Landings: 60 inch min length, minimum width as wide as the ramp run leading to it, if change in direction occurs, must have 60 x 60 inch space	60 inches minimum length, width at least as wide as the widest portion of the trail segment leading to the resting interval and a max slope of 1: 33 [3.03%] (Exception: A max slope of 1: 20 [5%] is allowed for drainage purpose.)	60 inches minimum length, width at least as wide as the widest portion of the trail segment leading to the resting interval and a max slope of 1: 20 [5%] (Exception: *)
* The provision may not apply if it cannot be provided because compliance would cause substantial harm to cultural, historic, religious, or significant natural features or characteristics; substantially alter the nature of the setting or purpose of the facility; require construction methods or materials that are prohibited by Federal, state, or local regulations or statues; or be infeasible due to terrain or the prevailing construction practices.			

Based on table in *Trail Planning, Design, and Development Guidelines: Shared Use Paved Trails, Natural Surface Trails, Winter-Use Trails, Bikeways* by Minnesota Department of Natural Resources Trails and Waterways, 2006

addresses some practical matters involved in design, construction, and maintenance of trails.

### **Permits**

Most trail projects will need land use review and many will require building permits. Projects in environmental zones, crossing drainageways, and along creeks and rivers will all be more complex. Staff at the Bureau of Development Services and appropriate state and federal agencies should be contacted early in the planning process. Adequate funds should be budgeted for application and permit fees.

### **Erosion Control**

Specific erosion and sediment control solutions have not been added to these details. This should be done when a construction management plan is developed and makes site specific edits to trail cross-sections and/or adds specific erosion control details to plan drawings. Additional information is included in the project specifications.

### **Grading and Drainage**

Ranges of longitudinal slope (along length of trail) and cross-slope are provided for different trail types. However, consideration of soil, surface water movement, and site hydrology will help determine appropriate trail alignment with crowned or side slope, swales, and/or rolling grade. Water is a valuable asset in the landscape but needs careful management to not cause problems on trails.

### **Vegetation Clearing Distances**

The figures for vertical and horizontal clearance shown in the Trail Types and illustrated in Trail Details apply to woody plants. The actual

cleared distance may be wider during construction due to cutting and filling on slopes. Generally, native herbaceous vegetation will repopulate sloped areas in natural areas not worn by passage of feet or wheels. Staff and/or volunteers should monitor for and manage any non-native invasive plants that appear. Trails in many developed parks will be bounded by mowed grass. When trails pass through landscapes with groundcover, shrubs, and trees, they should be sited to provide adequate visibility and enough space for plant growth.

### **Vehicle Usage**

PP&R staff use a wide range of vehicles in park and natural area sites. In some locations, utility and security companies, fire, and police may also access trails. Since driving or parking on soil or turf compacts it, trail widths should be adequate for the largest vehicle anticipated. Where regular park maintenance is provided, additional width or turnouts are needed for trail users to pass a parked vehicle. Designers must also provide adequate turning radius and pavement strength. Bureau of Development Services uses load standard of 100 psi (pounds per square inch) while the American Association of State Highway and Transportation Officials (AASHTO) uses 60 psi. Avoid siting benches, tables, lights, drinking fountains, and similar site furniture on the inside of curves where vehicles are more likely to damage them. PP&R electricians use a large boom truck to access park lights or buildings for maintenance and repairs. Maintenance staff use large dump trucks. Urban Forestry crews provide both regular and emergency maintenance with boom trucks.

### **Wood Preservatives**

The question of using native, rot-resistant woods versus a variety of wood preservatives and/or plastic lumber arouses fierce debates.

## Trail Design





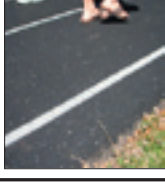

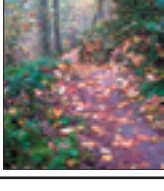
PP&R has included its most current details, but note the materials and preservatives are subject to change. Research continues on the effects of various substances on wildlife, fish, aquatic life, and humans so staff will address the topic with each design.

### Trail Maintenance

Trails wear out and types and numbers of users can change over time. Adjustments may be necessary through major maintenance, realignment or reconstruction. Seasonal maintenance techniques and schedules are not included in these *Trail Design Guidelines*. However, the Trail Details can provide basis for restoring slopes, surfaces, and vegetation clearances or improving management of water.

PP&R Vehicles	Length / wheel base	Width	Height	Weight	Turning Radius
Freightliner FL60	150" wheelbase		11'	20,000 lbs	
Six-Yard Dump Truck	160" wheelbase	9' - 6"	10' - 6"	35,000 lbs (loaded)	22'
O&M boom truck (for unloading "deep" cans) smaller than six-yard dump truck			20' above trash cans		
Urban Forestry Crane Truck	34' w/24' wheelbase	98"	13'		
<b>Fire Bureau Apparatus</b>					
Pumper	31'-3" w/184" wheelbase	9' - 10"	10' - 4"	37,660	23'
Brush Unit	20'-5" w/143" wheelbase	8'	8' - 3"	17,500	51' outside wall to wall
Water Tender	28' - 8" w/195" wheelbase	9' - 10"	10' - 7"	51,940	31' - 7"
Aerial (Tractor and Trailer)	53' - 10" overall length tractor = 140" wheelbase trailer = 305" wheelbase	9' - 10"	11' - 6"	58,000	15' - 7"

TRAIL TYPE MATRIX

Trail Type	Nature	Local Access	Community	Regional	facility name	Design Features					Users												Notes																	
						surface	width	longitudinal slope	cross slope	ADA	walker	runner	dog walker	equestrian	wheelchair or electric mobility device	skateboarder	rollerblader	cyclocross rider	mtn biker	road biker	gator	maintenance vehicle		police car	firetruck															
A	✓	✓		✓		hiking (high challenge)	soil / stairs	18" - 30"	0 - 15% (short segments steeper than 15%)	2% min 4% max	steepest (steps, rocks, roots)	◆	○	○																										
B	✓	✓		✓		hiking (moderate challenge)	soil / stairs	18" - 30"	0 - 8%	2% min 4% max	○ steep	◆	○	○		limited																								landings of 60" x 60" every 1000 feet
C	✓	✓		✓		hiking (accessible)	soil / gravel / engineered wood fiber or wood chips	4' (with passing areas) - 10'	0 - 5% (8% for max. 50')	2%	◆	◆	◆	◆	○	◆																							Columbia Slough ADA segments require 6' Fibar (or equivalent engineered wood fiber) and are closed to dogs and bicycles; use gravel causeway for poorly drained sites	
D		✓	✓	✓		walking ****	engineered wood fiber or chips / gravel / pavers asphalt / concrete / wood or plastic lumber	6' - 12' (8' min if paved for vehicles)	0 - 8%	1 - 2%	◆	◆	○	○		○	○	○																					sidewalks, boardwalks and trails in developed parks, sometimes include stairways; pave if used for maintenance (8' min. - 10' pref.), phase out chipseal; avoid wood fiber except for 10' wide walking loops in developed parks; landings of 60" x 60" every 1000 feet on accessible trails	
E		✓				exercise / fitness (resilient track)	synthetic rubber	2-4' / lane	0 - 1%	1%	○	○	◆																									discourage use of wheelchairs and baby strollers to protect resilient surface		
F	✓	✓	✓	✓		biking ****	asphalt / concrete	6' one-way, 10' min. - 12' pref. two-way	0 - 3% pref. (to 5% if needed, up to 10% for 500', up to 12% for 50' and ramps)	2%						*○	○	○						○	◆	○	○	○	○	○	○							to 12% for short segments & ramps; porous paving may be too rough for skateboarders and rollerbladers; 12' asphalt for bikes is sometimes paired with 10' concrete or paver "walking" for dual trail in high use areas		
G	✓	✓				mountain biking	soil / gravel / wood	18" - 4'	0 - 12%	2 - 5%															◆													18" one-way single track; add width & banking (superelevation) at turns; harden surface with compacted soil/gravel to prevent erosion		







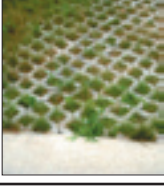
Recreational Trail Strategy Trail Types

Nature Community  
Local Access Regional

◆ Major use  
○ Minor use

\* Mobility devices that can equal bicycle speed  
\*\* Sometimes specialized shoulder on multi-use trail  
\*\*\* Some limitations in parks or congested areas  
\*\*\*\* Trail type unlikely to meet environmental zone standards due to width and/or paving material; will need environmental review if in e-zones.



	Trail Type					Design Features						Users											Notes					
	Nature	Local Access	Community	Regional	Image	facilityname	surface	width	longitudinal slope	cross slope	ADA	walker	runner	dog walker	equestrian	wheelchair or electric mobility device	skateboarder	rollerblader	cyclocross rider	mtn biker	road biker	gator		maintenance vehicle	police car	firetruck		
SINGLE USE						cyclocross ****	soil / wood / grass / concrete / asphalt	6' - 12'	varies	varies									◆							site specific loops with variety of challenges (& mud)		
		✓		✓		equestrian**	soil / gravel / wood chips	3' - 6' (pair of riders)	0-12% (prefer 5% max.)	2%					◆											wood chips difficult to maintain		
MULTIPLE USE		✓		✓		hiking and mountain biking	soil / gravel	4' (with passing areas) - 10'	0-5% (to 12% if needed)	2%	◆	◆	◆	○	○	○				◆	○	○				adjust width for user volume & vehicular use; 6' gravel allows wheelchairs to pass		
		✓	✓	✓		hiking and equestrian	soil / gravel / wood fiber	4' - 6' (pair of riders) - 10'	0-12% (prefer 5% max.)	2%	◆	◆	◆		◆	○						○				adjust width for user volume & shared use; use gravel causeway for poorly drained sites; wood chips difficult to maintain		
		✓	✓	✓		walking and biking ****	gravel / asphalt / concrete	8' - 25' (10' - 12' pref. maint. vehicles)	0-3% (5% as needed) (8% max.)	1%	◆	◆	◆	◆		◆	◆				***	***	○	◆	○	○	8' asphalt for minor park paths; 12' asphalt (8' min - 14' max) for major park path or lengthy multi-use trail; add fencing for rail-with-trail; 10' asphalt with 1' gravel shoulders used on narrow levees; 12' - 25' concrete for riverfront esplanades	
						walking, biking and equestrian ****	gravel / asphalt / concrete	8' - 25' (10' - 12' pref. maint. vehicles)	0-3% (5% max)	2%	◆	◆	◆	◆	◆	◆	◆	◆				○	◆	○	◆	○	○	6' asphalt for minor park paths; 12' asphalt (8' min - 14' max) for major park path or lengthy multi-use trail; add fencing for rail-with-trail; 10' asphalt with 1' gravel shoulders used on narrow levees; 12' - 25' concrete for riverfront esplanades
		✓		✓		fire and maintenance ****	gravel / turf block	10 - 14'	0-5% (to 12% as needed)	2%	◆	○	○	○	○	○						○	○	◆	◆	◆	◆	Forest Park "fire lanes" often function as trails for hiking and/or mountain biking

Recreational Trail Strategy Trail Types

Nature Community  
Local Access Regional

◆ Major use  
○ Minor use

\* Mobility devices that can equal bicycle speed  
\*\* Sometimes specialized shoulder on multi-use trail  
\*\*\* Some limitations in parks or congested areas  
\*\*\*\* Trail type unlikely to meet environmental zone standards due to width and/or paving material; will need environmental review if in e-zones.





# Trail Type A – Hiking (high challenge)

## DEFINITION

High challenge hiking trails are steep, narrow, irregular routes that may include steps and obstacles such as rocks and roots. They are located where accessible trails would have unacceptable impacts to the site and where the natural setting lends itself to a low impact trail. This type of trail may not be appropriate in areas where the resource value of the site is exceptionally high. Although used in limited hillside settings, they require higher physical exertion and increase the diversity of trail experience.

## USERS

The high challenge hiking trail is strenuous and requires good balance and moderate to high fitness. Single-file scrambling, walking, and (sometimes) running are desired uses.

## MATERIALS

Native soil and rock are most common although steps, railings, and boardwalks are used as needed. [See Technical Provisions table on page 8.]



*SW Trail #5 at Dickinson Park - steep segment on fill slope of SW 55th Avenue*

Width	18" - 30"
Surface	Soil / stairs
Longitudinal Slope	0 - 15% (short segments steeper than 15%)
Cross-Slope	2% min. - 4% max.
Radius	N/A - switchbacks
Sight Distance	Limited, consider safety needs
Easement Width	Tread + 10' min.
Side Slope	Varies
Vertical Clearance	8'
Horizontal Clearance	2' from side of tread

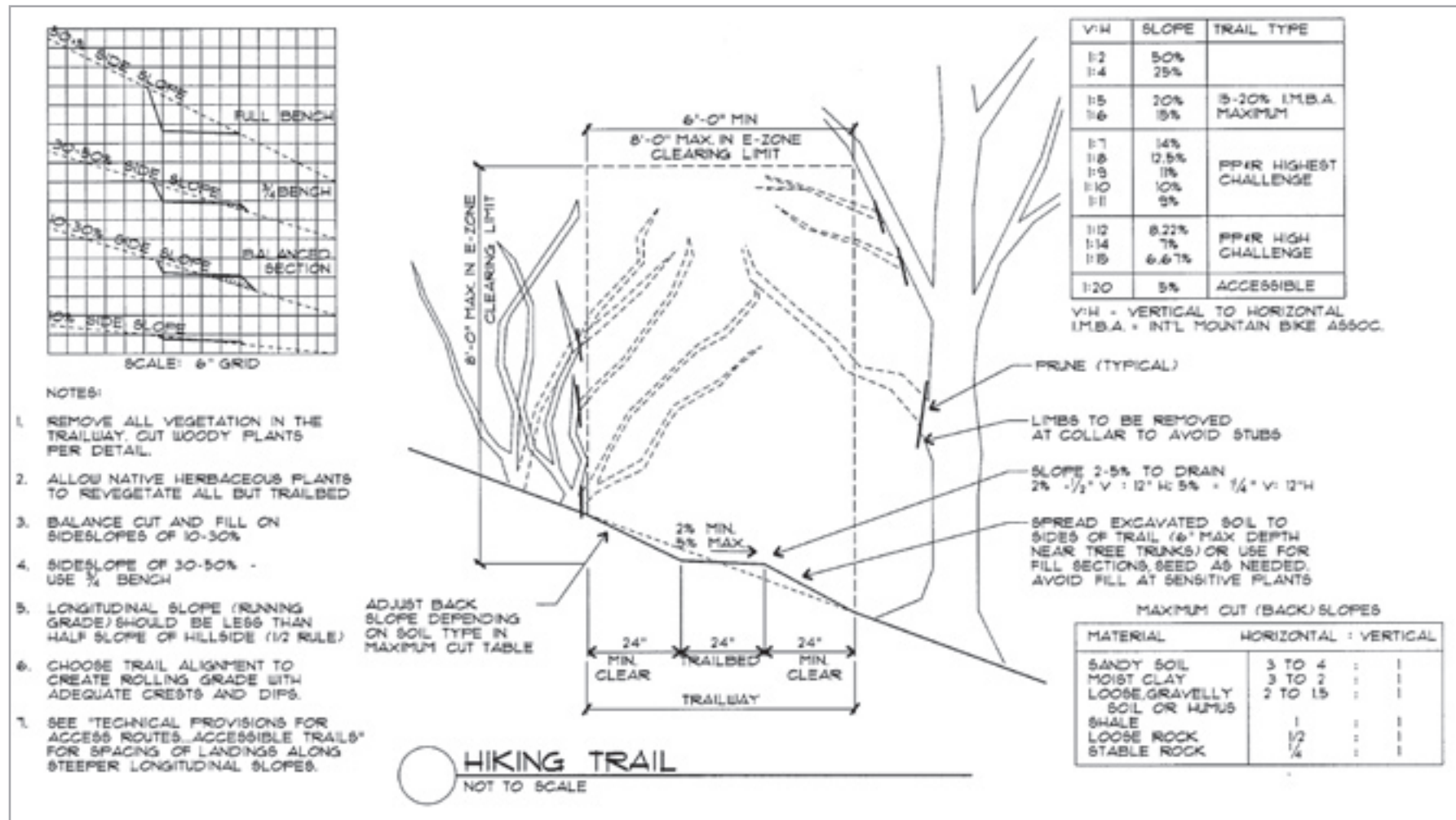


*Marshall Park Trail - steps built around tree root*



*Lower Macleay Trail in Forest Park*

## Trail Type A – Hiking (high challenge)



Also see Trail Details: 01-Cribbed Steps, 02-Timber Steps, 03-Boardwalk, 04-Wood Bridge, 05-Wood Bridge with Railing, 08-Causeway, 13-Signs, 14-Alignment Tread Crests, 15-Alignment Tread Dips

# Trail Type B – Hiking (moderate challenge)

## DEFINITION

Moderate challenge hiking trails may include steps and obstacles such as rocks and roots. They are located where some segments with slopes as steep as 8% are needed to avoid multiple switchbacks, tree removal or slope destabilization. Although less difficult than the high challenge hiking trails, they also require higher physical exertion and increase the diversity of trail experience.

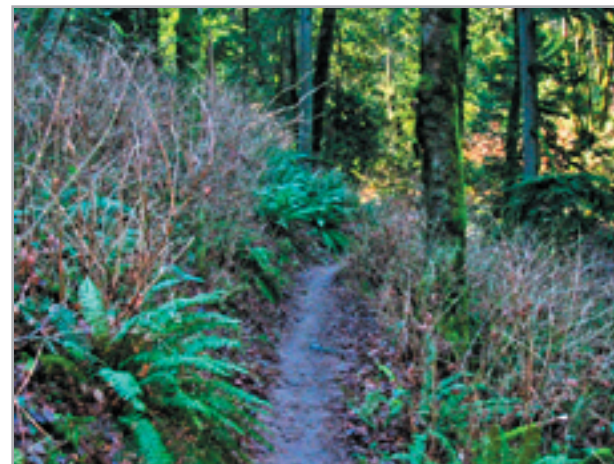
## USERS

The moderate challenge hiking trail requires good balance and moderate fitness. Single-file walking and (sometimes) running are desired uses. Moderate challenge trails are accessible to users who can navigate steeper slopes although there may be barriers such as steps, rocks or roots. Signs (Detail 12) or steps may be used at entry points to signal less accessible trail ahead.

## MATERIALS

Native soil and rock are most common although steps, railings, and boardwalks are used as needed. [See Technical Provisions table page 8 for landings and passing area.]

Width	18" - 30"
Surface	Soil / stairs
Longitudinal Slope	0 - 8%
Cross-Slope	2% min. - 4% max.
Radius	NA - switchbacks
Sight Distance	Limited, consider safety needs
Easement Width	Tread + 10' min.
Side Slope	Varies
Vertical Clearance	8'
Horizontal Clearance	2' from side of tread

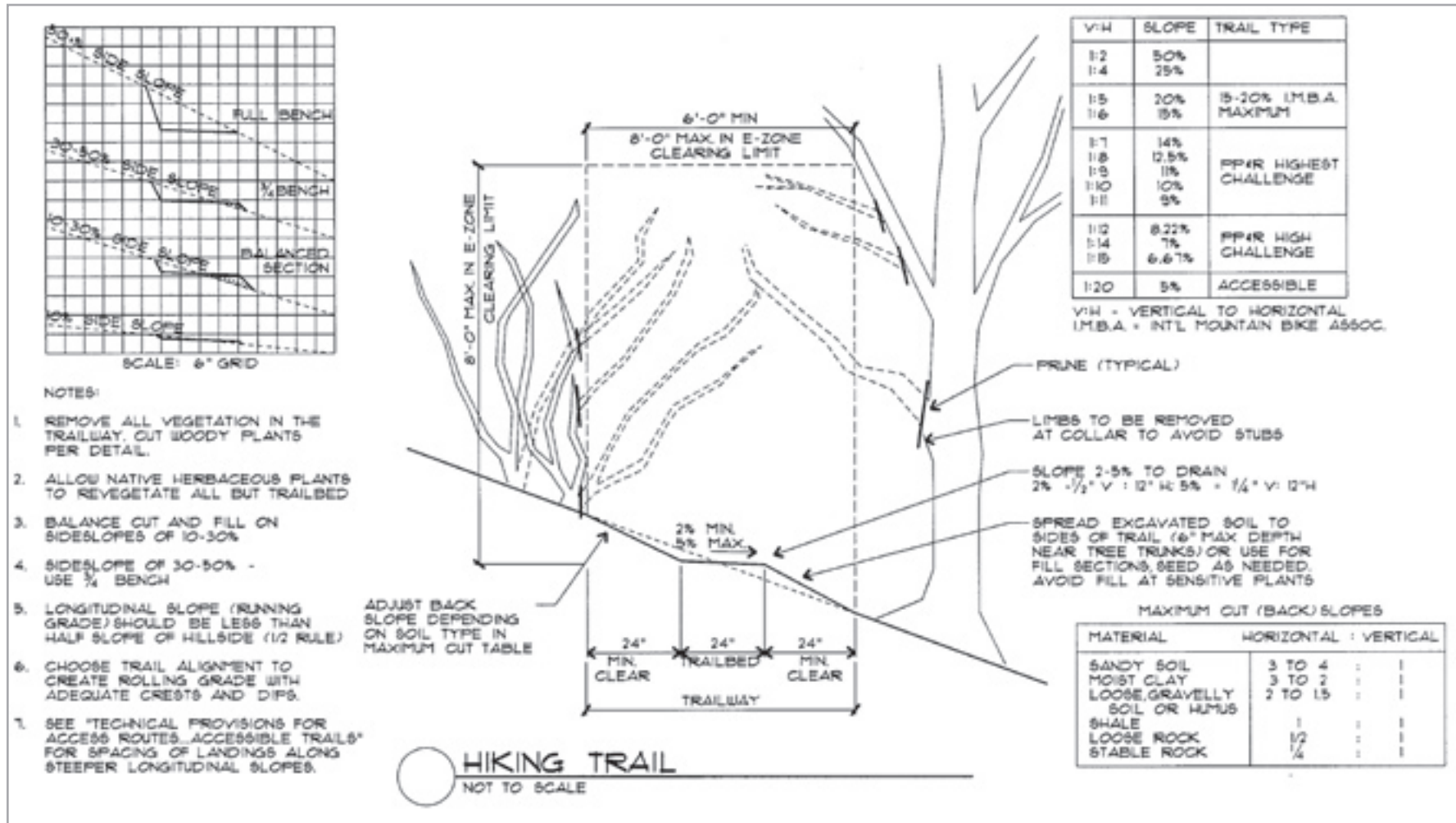


*Wildwood Trail - steep topography requires steep longitudinal slope*



*Connor Trail - steep segment of climbing turn near OHSU*

## Trail Type B – Hiking (moderate challenge)



Also see Trail Details: 01-Cribbed Steps, 02-Timber Steps, 03-Boardwalk, 04-Wood Bridge, 05-Wood Bridge with Railing, 08-Causeway, 13-Signs, 14-Alignment Tread Crests, 15-Alignment Tread Dips

# Trail Type C – Hiking (accessible)

## DEFINITION

PP&R’s accessible hiking trails have surface, slopes, and width that meet or exceed the dimensions of the *Forest Service Trail Accessibility Guidelines (FSTG)*. Trails with a longitudinal slope of less than 1 vertical to 20 horizontal and cross-slope that is less than or equal to 2% can be traversed by wheelchairs. Trail surfaces are firm and stable. Barriers such as steps, rocks or roots do not exist although the natural surface may have some irregularities, not to exceed 2” high. The goal is to provide access to natural settings without adding pavement. Path width is minimized unless high use is expected. Landings or wider portions of the trail are provided for resting and passing other trail users. [See Technical Provisions table on page 8.]

## USERS

The accessible hiking trail requires fair balance and fitness. Single-file walking and (sometimes) running are desired use at minimum width. Wheelchairs (motorized or human-powered) and mobility scooters may be used, but surface is not as reliably firm and slip-resistant as a paved walking trail.

## MATERIALS

Native soil and rock are most common although crushed rock or wood fiber are used as needed. Hand or guard railings and boardwalks may be added if necessary. Excellent drainage and gravel may be necessary at wet sites to provide slip-resistant surface through winter. Fibar is the brand name of an engineered, interlocking wood fiber that is accessible to wheeled modes. Equivalent products produced locally may be substituted. Wood chips biodegrade and are difficult to maintain so provide width for hauling additional material. [See Trail Detail 13 for signs regarding accessibility.]



*Hoyt Arboretum - Wildwood Trail*



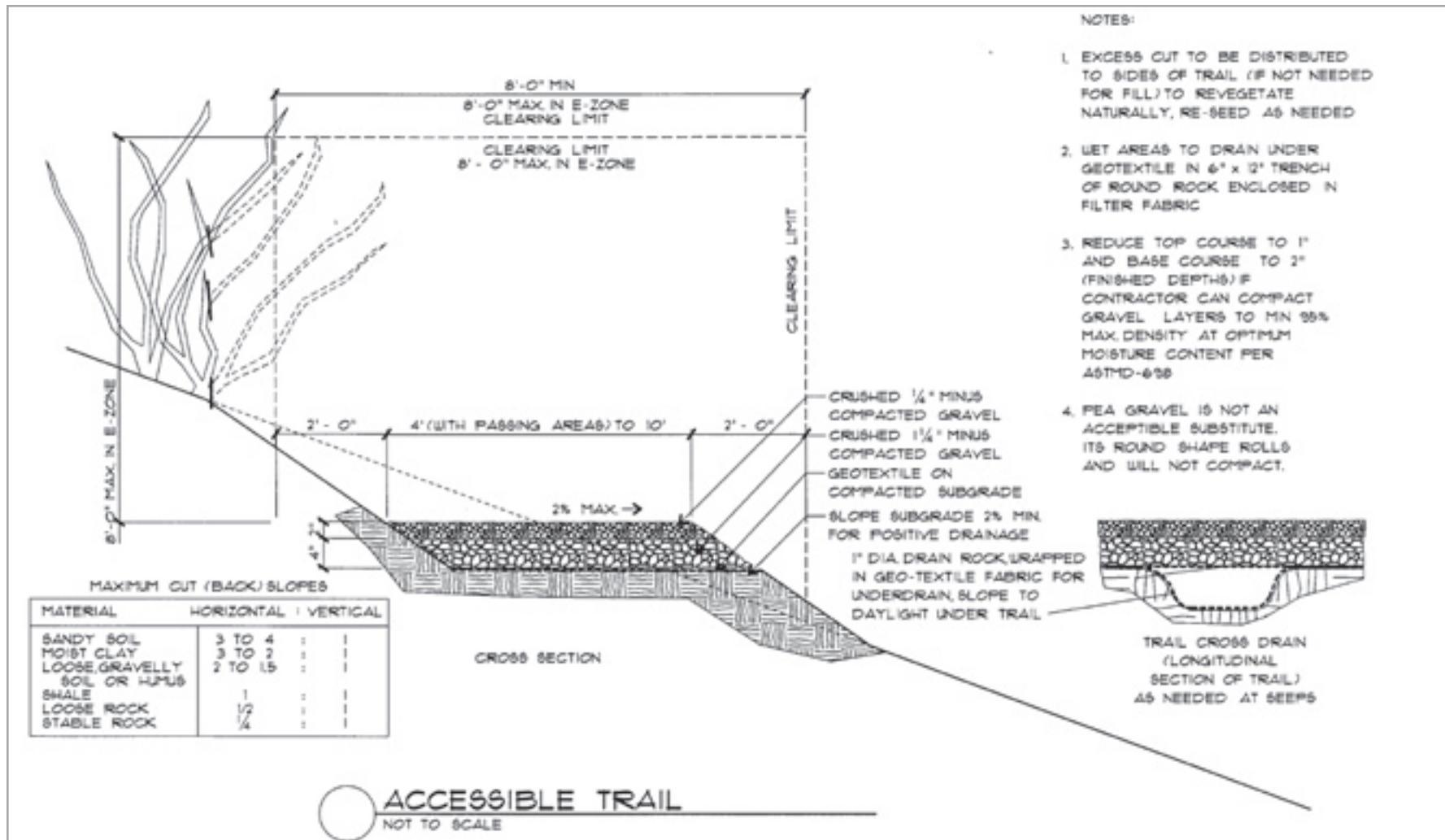
*40-Mile Loop Trail at base of Forest Park’s Ridge Trail, next to Bridge Access Road for St Johns Bridge*



*Oaks Bottom - interpretive loop*

Width	4' (with passing areas) - 10'
Surface	Soil, gravel, Fibar (or engineered wood fiber equivalent), wood chips
Longitudinal Slope	0 - 5% (8% for max. 50')
Cross-Slope	2%
Radius	Aesthetic consideration
Sight Distance	N/A except road crossings
Easement Width	Tread + 10' min.
Side Slope	Varies
Vertical Clearance	8'
Horizontal Clearance	2' from side of tread

## Trail Type C – Hiking (accessible)



Also see Trail Types B and D and Trail Details: 03-Boardwalk, 04-Wood Bridge, 05-Wood Bridge with Railing, 08-Causeway, 13-Signs, 14-Alignment Tread Crests, 15-Alignment Tread Dips

# Trail Type D – Walking

## DEFINITION

Walking trails are typically fully accessible with a maximum longitudinal slope of 5%. Some short segments of up to 8% longitudinal slope are used with slip-resistant paving. They offer a shorter, less vigorous “walk in a park” than the hiking trails. Sidewalks are in the public right-of-way and managed by PBOT. [See *Portland Pedestrian Design Guide*] In some locations, PBOT has allowed walking trails that meander farther into the park and away from the curb, instead of sidewalks, in order to improve the walking environment. These walking trails still need curb ramps and connections to sidewalks or road crossings in order to connect to the adjoining sidewalk system.



*Lents Park - wood chip exercise loop path*

## USERS

Walking trails serve all pedestrians, including those with fitness and balance limitations. These routes are the main circulation system in, around, and/or through developed parks. People of all ages walk and run to enjoy the environment, socialize, exercise, and access other parts of the community. Walking trails also serve wheelchairs and electric mobility devices used by persons who need assistance to be mobile. Bicycles are not allowed due to trail surface, width, adjacent uses, sight distance or desired environment. The walking trail is also used in combination with a bike trail to form a dual trail system to separate slower speed ‘feet’ from higher speed ‘wheels’ (bicycles, scooters, skateboards, rollerbladers) in corridors of high density, such as the South Waterfront neighborhood.

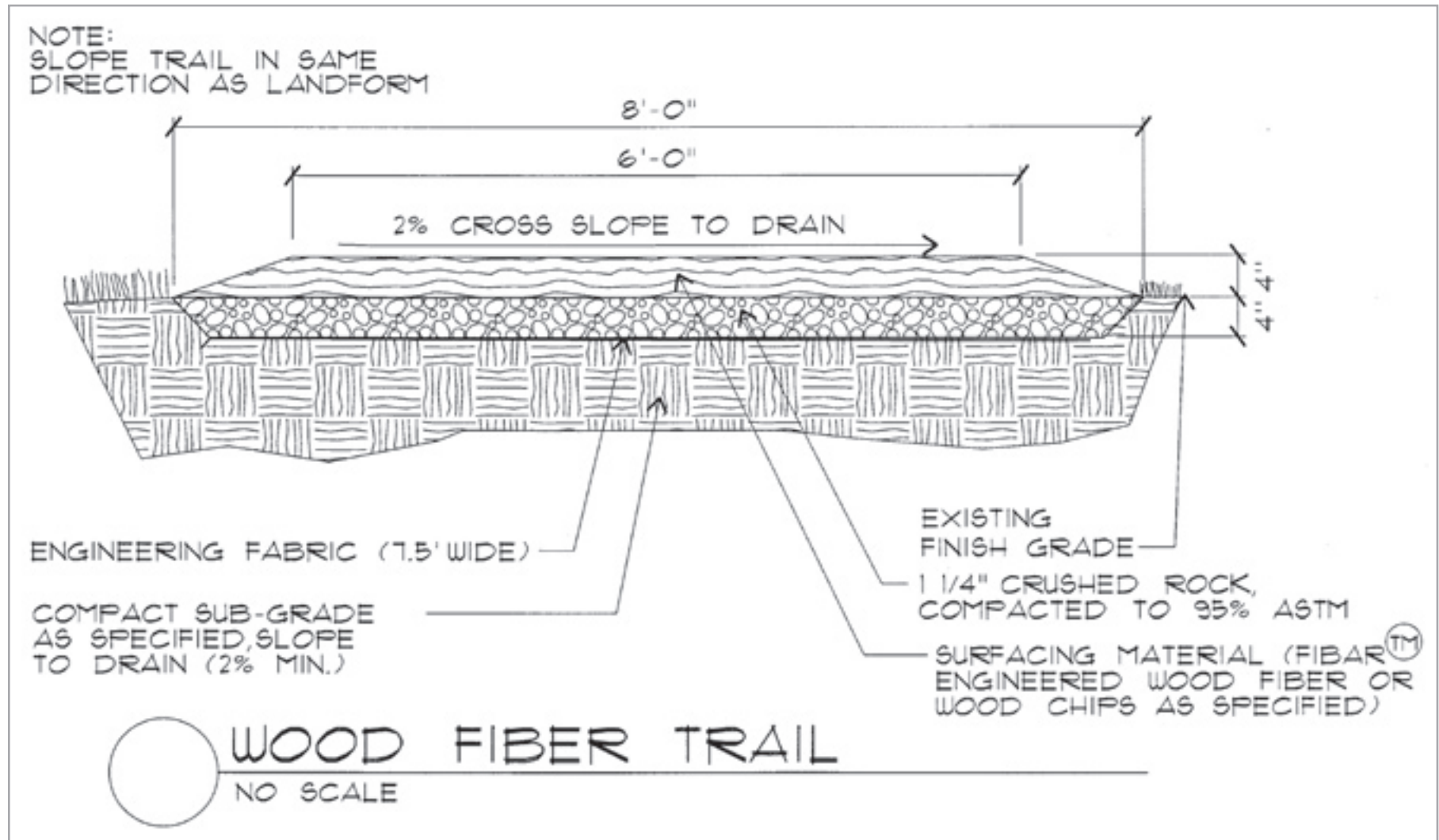
## MATERIALS

Walking trails are generally paved with unit pavers, asphalt or concrete. Trail width is based on projected use with a minimum expectation that two adults can walk side-by-side, or one user can pass another. Additional width is provided where the walking trail is also used for maintenance access.

Wood chips are used where desired for exercise loops or required by *33.515 Columbia South Shore Plan District* (based on the *Columbia South Shore Slough Trail Masterplan*). Code requires Fibar (or engineered wood fiber equivalent) for accessible segment between I-205 and NE 122 Avenue and wood chips between NE 122 and 185 Avenues (to discourage bicycles). Wood chips should not be used where flooding is likely.

Width	6' - 12'
Surface	Engineered wood fiber or wood chips, gravel, a.c., concrete, pavers, wood or plastic lumber
Longitudinal Slope	0 - 8%
Cross-Slope	1% - 2%
Radius	Aesthetic consideration
Sight Distance	N/A except road crossings
Easement Width	Tread + 10' min.
Side Slope	Varies
Vertical Clearance	8'
Horizontal Clearance	1' from side of tread

Trail Type D – Walking



Also see Trail Types B, C and M and Trail Details: 01-Cribbed Steps, 02-Timber Steps, 03-Boardwalk, 04-Wood Bridge, 05-Wood Bridge with Railing, 11-Soft Surface Switchback on Levee, 13-Signs, 14-Alignment Tread Crests, 15-Alignment Tread Dips



# Trail Type E – Exercise/Fitness (Resilient Track)

## DEFINITION

Exercise/fitness tracks are resilient surfaces developed primarily for competitive track events and training. They also serve for non-competitive walking, jogging, and running. Tracks are precisely engineered to be virtually flat with enough slope to shed rainfall. There are currently no resilient surfaces along narrow linear routes, although demand paths of hardened earth frequently develop next to asphalt or concrete walking (such as Laurelhurst Park), or walking and biking trails (such as Terwilliger Trail).

## USERS

Exercise/fitness trails are designed for competitive runners. Although the track may sometimes be scheduled for track and field events, there are frequent walkers, joggers, and/or runners who are encouraged to use the outer lanes in order to balance wear of racers on inner lanes. Wheelchairs, bicycles, and baby strollers are not allowed in order to preserve the resilient surface.

## MATERIALS

Exercise/fitness tracks are synthetic rubber (sometimes recycled athletic shoes) over an asphalt base. The number of lanes is based on projected use with a minimum of six lanes. Surface and/or subsurface drain systems ensure that runoff from adjacent areas is intercepted before reaching resilient surface.



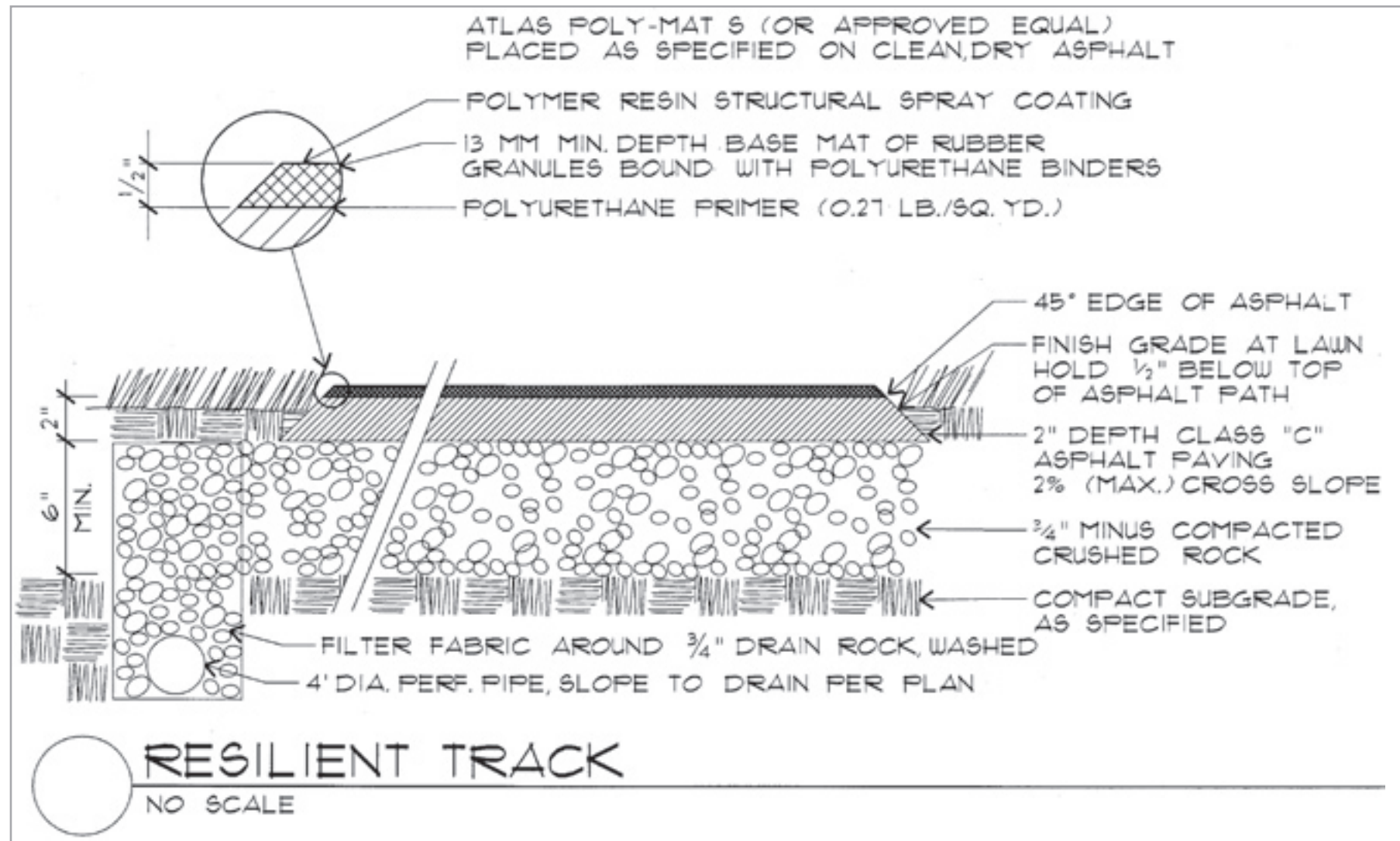
*Laurelhurst Park - "runners' rut"*



*Duniway Track*

Width	2' - 4' if developed as linear route
Surface	Synthetic rubber over a.c. or concrete
Longitudinal Slope	0 - 1%
Cross-Slope	1%
Radius	Use standard oval dimensions for track
Sight Distance	N/A
Easement Width	As needed
Side Slope	0%
Vertical Clearance	8'
Horizontal Clearance	Mowed grass next to tread

Trail Type E – Exercise/Fitness (Resilient Track)



Also see Trail Type F and Trail Detail 13-Signs

# Trail Type F – Biking

## DEFINITION

Biking trails have width, slope, cross-slope, and curve radii to enable one-way or two-way bicycle travel at various speeds. Bike lanes and bicycle boulevards are in right-of-way, subject to PBOT guidelines.

## USERS

Biking trails serve all cyclists, particularly those using road bikes. When there are no slower users, bicycle speed can be approximately 20 mph on flat trails and 30 mph on downgrade of 4%. Other higher speed wheeled users (scooters, skateboards, rollerbladers) use the bike portion of a dual (parallel, but separated) bike and walking trail system if their speeds are similar to cyclists. Motorized wheelchairs might use biking trails if they can match the speed of cyclists. Non-motorized or slower motorized wheelchairs would be more appropriate on adjacent walking paths.

## MATERIALS

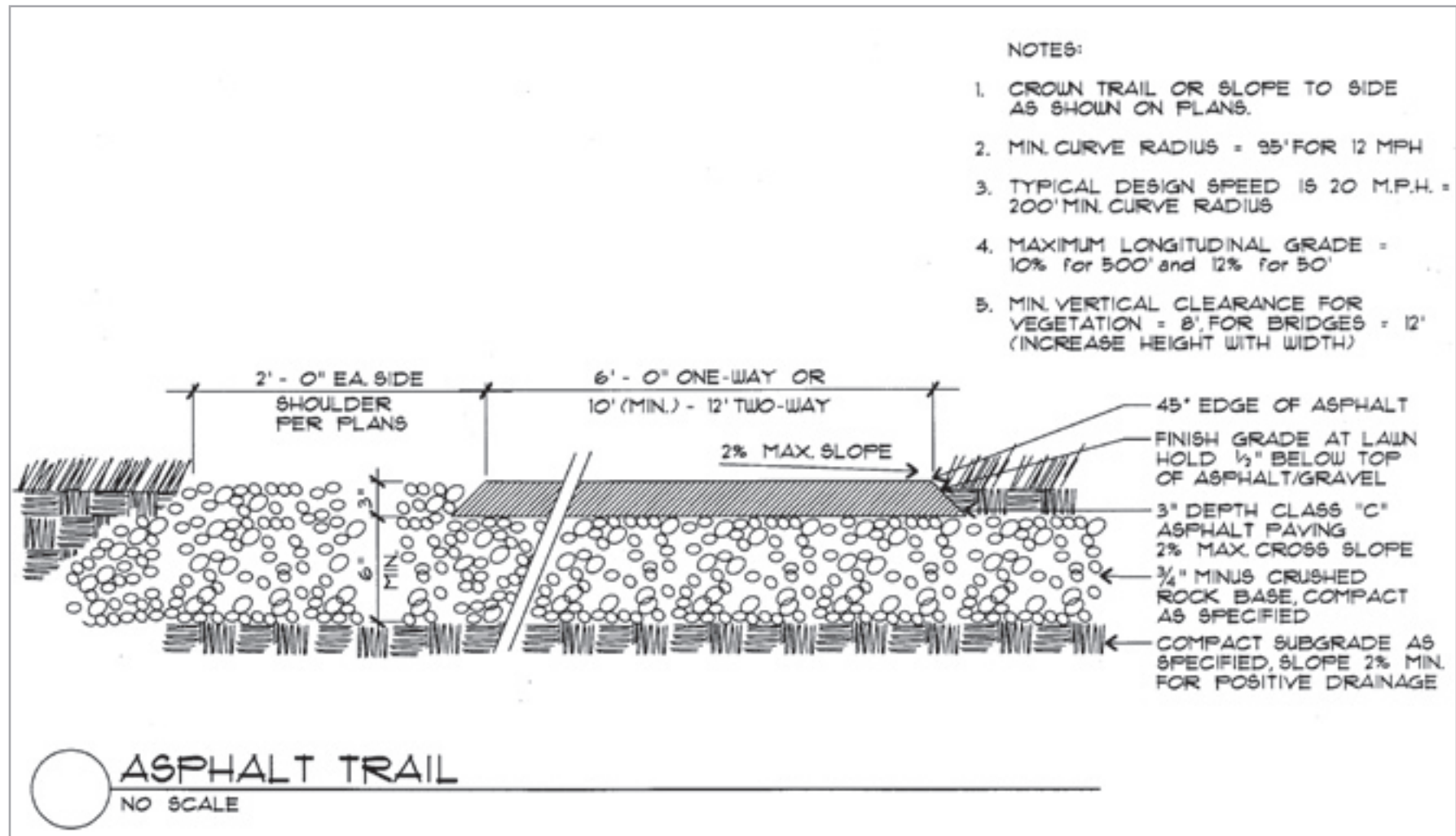
Biking trails are generally paved asphalt or concrete. Trail width is determined based on projected use. Constrained sites may mean that bicyclists travel single-file with no passing. Additional width is provided for passing or where the biking trail is used for two-way travel and/or maintenance access. The biking trail is also used in combination with walking trail to form a dual trail to separate slower speed ‘feet’ from higher speed ‘wheels’ in corridors of high density, as planned for the Willamette Greenway in South Waterfront. Some of the public perceives asphalt as too ‘road-like’ when new, but it weathers to less black color over time. Porous asphalt (Trail Detail 12) should be used where a more rough surface is acceptable and infiltration through trail is desired.



*Marine Drive Trail - looking west at Columbia River*

Width	6' one-way, 10' min. - 12' preferred two-way
Surface	Asphalt (porous or not), concrete
Longitudinal Slope	0 - 3% (preferred) (to 5% if needed, up to 10% for 500', up to 12% for 50' and ramps)
Cross-Slope	2%
Radius	Varies with design speed: 12 mph = 36' (95' preferred); 20 mph = 200'
Sight Distance	150'
Easement Width	Tread + 10' or code requirement
Side Slope	Varies
Vertical Clearance	8' (12' + under bridges)
Horizontal Clearance	2' from side of tread

## Trail Type F – Biking



Also see Trail Types F and M and Trail Details: 12-Open-Graded Asphalt Trail and 13-Signs

# Trail Type G – Mountain Biking

## DEFINITION

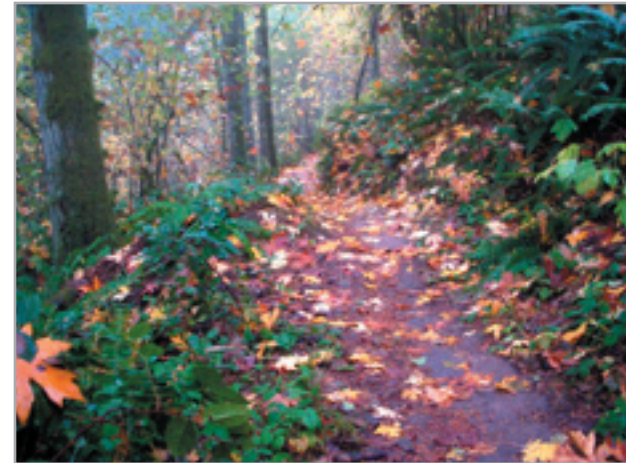
Mountain biking trails are narrow, sometimes steep and curving trails of soil often strengthened with gravel. They may be designed as either one-way single track or wider two-way routes. Steepness may require higher physical exertion and obstacles such as rocks and roots may increase the diversity of trail experience. Narrow width and sharp turns may be required in steep, irregular topography and increase trail difficulty. This trail type is not intended for the high speed, downhill, jumps, structures, and/or technical features of ‘free-riding.’

## USERS

Mountain bikers range from beginner to expert so that a range of trail types is desirable. Mountain bikes typically have shock absorbers and wider tires with special tread. This allows use on soil and gravel trails with irregular surfaces, boulders, and logs. Introductory trails are wider with alternative routes at boulder or log ‘obstacles.’ The most technically challenging mountain biking trail is strenuous and requires excellent balance and fitness. If the single-track flows with no sharp curves, mountain bicycle speed can be approximately 15 mph.

## MATERIALS

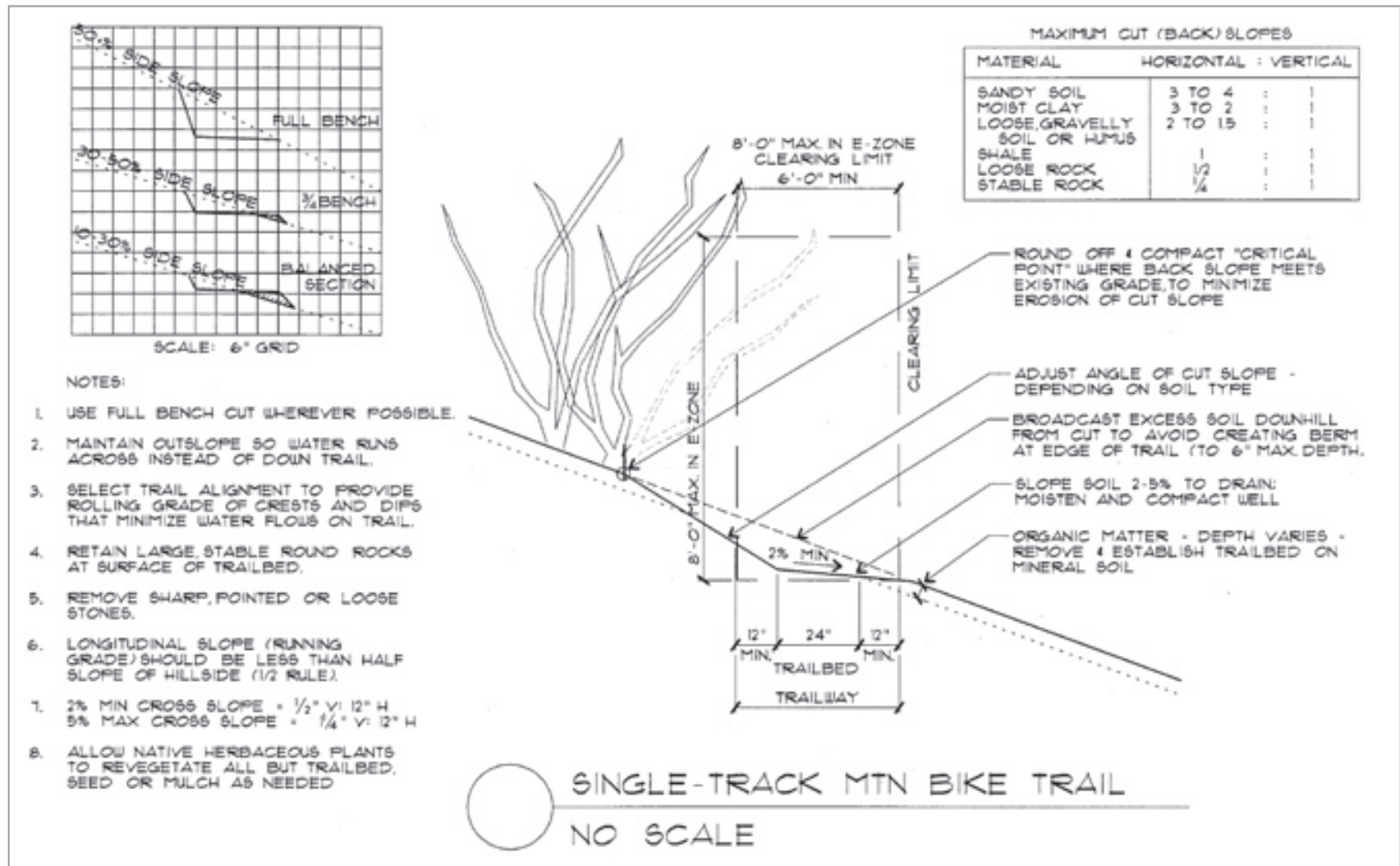
Native soil and gravel are most common although rock and boardwalks are used when needed. Trails at sites with silty soils, heavy use or high soil moisture may benefit from mixing a thin layer of gravel into soil and compacting it well. Curves may need to be banked and reinforced to resist soil displacement. Careful alignment for even flowing speed will reduce the skidding that loosens soil in the trail tread. Trail beds can also be armored with larger rocks in braking sections to reduce formation of brake bumps. Seasonal trail closures may be needed to prevent erosion. A site developed for free-riding might also use boulders, logs, steps, ladders, boardwalks, and varying widths to add challenge.



*Forest Park - Firelane 5 improvements by PUMP, Portland United Mountain Pedalers*

Width	18" (one-way single-track) - 4' (add width & super-elevation at curves as needed)
Surface	Soil (& gravel hardening where needed) (use caution with wood bridges, boardwalks & railings)
Longitudinal Slope	0 - 12%
Cross-Slope	2% - 5% (varies on curves)
Radius	4' min, 8'+ preferred
Sight Distance	10-100' depending on speed/flow
Easement Width	Tread + 10' min
Side Slope	Varies
Vertical Clearance	8' ( max. to avoid e-zone review)
Horizontal Clearance	1' from side of tread

## Trail Type G – Mountain Biking



Also see Trail Type C and Trail Details: 04-Wood Bridge, 05-Wood Bridge with Railing, 08-Causeway, 13-Signs, 14-Alignment Tread Crests, 15-Alignment Tread Dips

# Trail Type H – Cyclo Cross

## DEFINITION

According to *Wikipedia* and cyclo cross regulations, cyclo cross is a form of bicycle racing. Races take place typically in the autumn and winter, and consist of many laps of a short (1.5 – 2 miles) course featuring pavement, wooded trails, grass, steep hills, and obstacles requiring the rider to quickly dismount, carry the bike while navigating the obstruction, and remount in one motion. Races for senior categories are generally between 30 minutes and an hour long, with the distance varying depending on the ground conditions, which often become muddy.

## USERS

Cyclo cross bicycles are similar to racing bicycles but have special tread and brakes needed for muddy conditions. Cyclo cross racing requires aerobic endurance and strong bike-handling skills. Different classes of men, women, children, and masters compete against one another.

## MATERIALS

Native soil and turf are the most common course surfaces and wet conditions tend to generate mud. Careful design and/or maintenance is required to avoid erosion and to repair the course after the cyclo cross season.

## SITES

Cyclo cross events at both Creston and Pier Parks were phased out due to impacts to the sites and surrounding neighborhoods. The November 2008 Cycle Cross Crusade event held outside the track at Portland International Raceway had approximately 1,300 participants plus additional spectators. Potential new sites will need access, adequate parking, and funding for restoration and should minimize impact on natural resources. Sites such as Gateway Green might be developed as practice course if funding were secured for maintenance.



*Cyclo Cross Crusade course at Portland International Raceway - using concrete vault as obstacle*

Width	6' min - 12' typical (plus 20' - 40' at starting area)
Surface	Soil, wood, grass, gravel, concrete, asphalt
Longitudinal Slope	0 - 60%
Cross-Slope	0 - 50%
Radius	8' min.
Sight Distance	20' min.
Easement Width	N/A
Side Slope	0 - 50%
Vertical Clearance	10'
Horizontal Clearance	1' from side of tread

## Trail Type H – Cyclo Cross

### Cyclo Cross Crusade courses comply with these characteristics:

- About 75% of the course should be rideable. No more than half will be paved.
- Each lap should be at least 1 km in length.
- The start should be wide and long so that the stronger riders can get to the front before the narrower part.
- The course will be of sufficient width at all points to allow room for one rider to pass another.
- The course must be clearly marked. Riders are expected to remain inside the course following all markings.
- Barriers will not exceed 40 cm in height. Riders must go over artificial barriers placed on the course and may not ride around a barrier for any reason.



Race track



A - Start of race, groups of riders



B - Long, level paved stretch



C - Sharp turn on gravel & asphalt



D - Ride, push or carry bike



E - Sharp turn on turf



F - Plank barriers on uphill



G - Far turn on side of levee



H - Levee and maintenance road



# Trail Type I – Equestrian

## DEFINITION

Equestrian trails serve horseback riders. Horses prefer soil surfaces and require wider and higher clear areas than people on foot or wheels. There are some sites or regional trails in which a separate equestrian-only route could be developed.

## USERS

Equestrians currently share some trails in Forest Park and Powell Butte Nature Park with hikers, and the Springwater Corridor with walkers, runners, and bicyclists. Horses have good peripheral vision, but the location of their eyes causes a 5’ wide blind spot directly in front. They often travel at about 4-6 mph. Bicycles are specifically not allowed in order to not startle more nervous horses.

## MATERIALS

Equestrian trails are generally soil or gravel. Horse riders often request wood chips, but this is difficult to maintain. The Gresham portion of the Springwater Corridor has some wood chip segments, which are occasionally maintained by equestrian user groups. Additional vertical clearance is needed in forested areas. Where there are creek crossings or narrow trail corridors, equestrians must share walking and biking trails and bridges with other users. Special care should be taken to direct runoff (that may be contaminated by horse droppings) away from water bodies. See *Equestrian Design Guidelines for Trails, Trailheads & Campgrounds* by Jan Hancock, Jeff Engelmann, Jim Coffman & Kim Vander Hoek. Seasonal trail closures may be needed to prevent erosion.



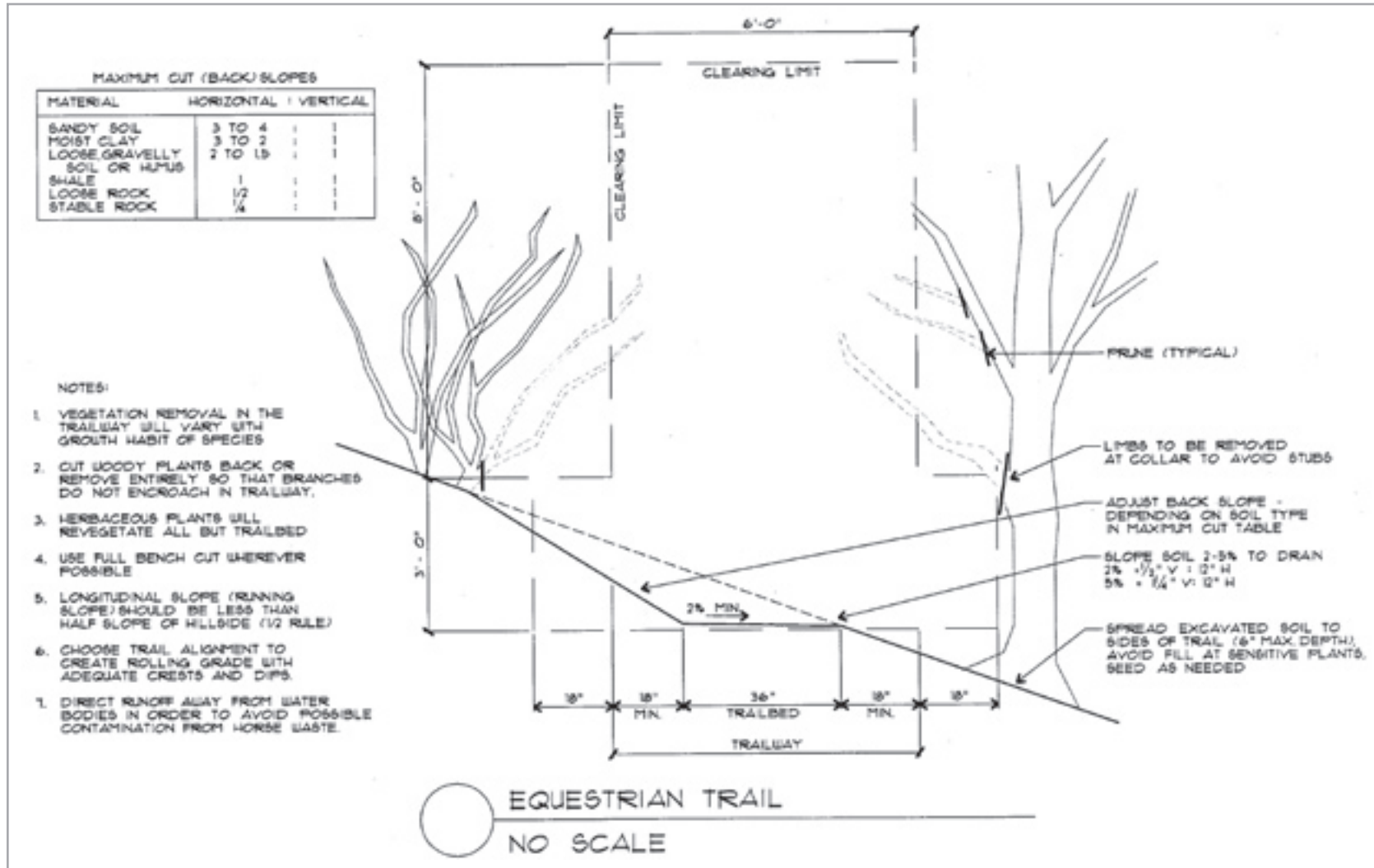
*Springwater Corridor in Gresham - wood chips on equestrian-only trail parallel to paved walking/biking trail*



*Springwater Corridor in Gresham - equestrian-only path splits from paved walking/biking trail*

Width	3' min. - 6' (pair of riders)
Surface	Soil, gravel, wood chips (not preferred)
Longitudinal Slope	0 - 12% (prefer 5% max.)
Cross-Slope	2%
Radius	Avoid sharp turns
Sight Distance	50-100'
Easement Width	Treat + 10' min.
Side Slope	Varies
Vertical Clearance	11'
Horizontal Clearance	3' from side of tread, at least 3' high, then 18" from side of tread above 3' high

## Trail Type I – Equestrian



Also see Trail Types C and D and Trail Details: 03-Boardwalk, 04-Wood Bridge, 05-Wood Bridge with Railing, 08-Causeway, 10-Trail on Levee; 11-Soft-Surface Switchback on Levee, 13-Signs, 14-Alignment Tread Crests, 15-Alignment Tread Dips

# Trail Type J – Hiking & Mountain Biking

## DEFINITION

Shared hiking and biking trails have surface and slope for both mountain bike and hiker. Additional width allows side-by-side hiking or riding or room for on-coming or overtaking trail users. There are no barriers such as steps, rocks or roots although the natural surface may have some irregularities. The goal is to provide access to natural settings without adding paving.

## USERS

The hiking and biking trail requires moderate balance and fitness. Walkers, mountain bikers, and runners are desired users. Since this trail does not have the obstacles desired by expert riders, it is more suitable for beginning and less experienced mountain bikers. Wheelchairs (motorized or human-powered) and mobility scooters may be used, but the surface is not as reliably firm and slip-resistant as on a paved walking trail.

## MATERIALS

Native soil and rock are most common although crushed rock and boardwalks are used as needed. Curves may need to be superelevated (banked) and reinforced to resist soil displacement. Trail beds can also be armored with larger rocks in braking sections to reduce formation of brake bumps. Curve radii and sight lines should be adequate to serve two-way travel. Path width is minimized unless high use is expected or maintenance vehicle access is needed. Hand or guard railing may be added in some areas for safety. Seasonal trail closures to mountain bikes may be needed to prevent erosion.



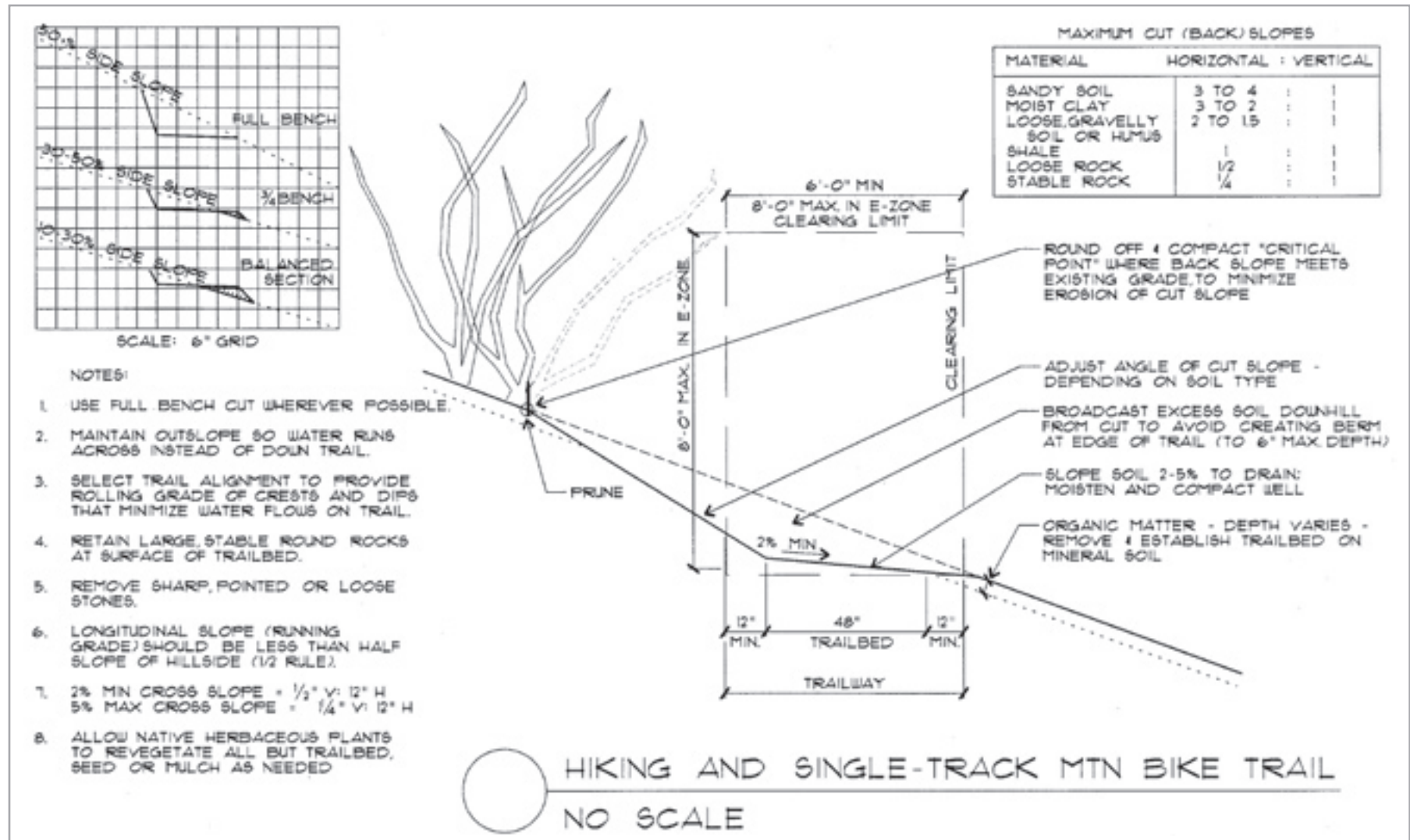
*Pioneer Orchard Trail - one of the Powell Butte Nature Park trails reserved for hiking and biking*



*Kelley Point Park - gravel trail*

Width	4' (with passing areas) - 10'
Surface	Soil, gravel
Longitudinal Slope	0 - 5% (to 12% if needed)
Cross-Slope	2%
Radius	10' min.
Sight Distance	40 - 100' depending on speed / flow
Easement Width	Tread + 10' min.
Side Slope	Varies
Vertical Clearance	8' (avoids e-zone review)
Horizontal Clearance	1' from side of tread

## Trail Type J – Hiking & Biking



Also see Trail Type C and Trail Details: 03-Boardwalk, 04-Wood Bridge, 05-Wood Bridge with Railing, 08-Causeway, 13-Signs, 14-Alignment Tread Crests, 15-Alignment Tread Dips

# Trail Type K – Hiking & Equestrian

## DEFINITION

Shared trails with surface, slope, and vegetation clearance that allows both hiking and equestrians. Hiking and equestrian trails are located in a few natural areas and regional trails. Barriers such as steps, rocks, and roots do not exist although the natural surface may have some irregularities. Landings or wider portions of the trail are provided for resting and passing on-coming trail users.

## USERS

Single-file walking, running, and horse riding are desired use. Bicycles are specifically not allowed in order to not startle more nervous horses. Dogs on regional trails such as the Springwater must be on-leash.

## MATERIALS

Hiking and equestrian trails are generally soil or gravel. Horse riders often request wood chips, but they are difficult to maintain. Additional vertical clearance is needed in forested areas. Where there are creek crossings or narrow trail corridors, equestrians must share walking and biking trails and bridges with other users. Special care should be taken to direct runoff (that may be contaminated by horse droppings) away from water bodies.



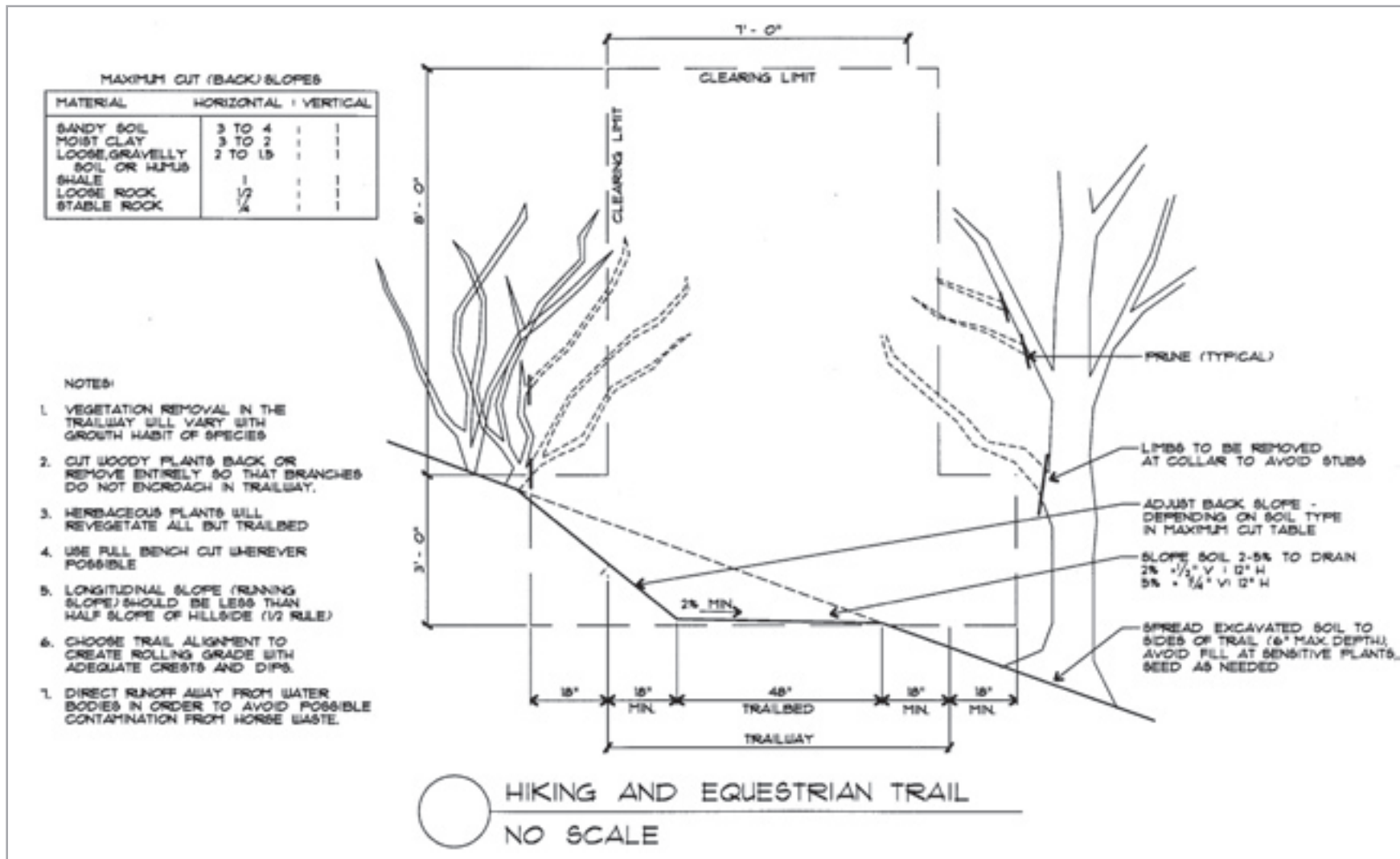
*Springwater between Palmbled and Rugg Roads - one gravel shoulder widened for equestrian and runner use*



*Wild Hawthorn Trail - one of the Powell Butte Nature Park trails reserved for mountain biking and equestrian use*

Width	4' - 6' (pair of riders) - 10'
Surface	Soil, gravel, wood chips (not preferred)
Longitudinal Slope	0 - 12% (prefer 5% max.)
Cross-Slope	2%
Radius	Avoid sharp turns
Sight Distance	50 - 100'
Easement Width	Tread + 10' min.
Side Slope	Varies
Vertical Clearance	11'
Horizontal Clearance	3' from side of tread, at least 3' high, then 18" from side of tread above 3' high

## Trail Type K – Hiking & Equestrian



Also see Types C and D and Trail Details: 03-Boardwalk, 04-Wood Bridge, 05-Wood Bridge with Railing, 07-Trail with Swale & Culvert, 08-Causeway, 09-Trail with Infiltration Trench, 10-Trail on Levee, 11-Soft-Surface Switchback on Levee, 13-Signs, 14-Alignment Tread Crests, 15-Alignment Tread Dips

# Trail Type L – Walking & Biking

## DEFINITION

Shared walking and biking trails are paved with asphalt or concrete and are generally fully accessible. They are often developed to connect parks and natural areas as part of the regional trail system. These multi-modal, multi-use paths (MUPs) have width, slope, cross-slope, and curve radii to enable two-way pedestrian and bicycle travel at various speeds.

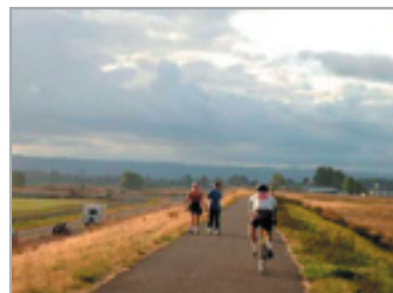
## USERS

Walking and biking trails serve the greatest diversity of users: pedestrians, including those with fitness and balance limitations; cyclists, particularly those using road bikes; scooters; skateboards; rollerbladers; wheelchairs; and electronic mobility devices used by persons who need assistance to be mobile. People of all ages walk, run, ride, and roll to enjoy the environment, socialize, exercise, and access other parts of the community. Since user speeds can vary substantially, this trail type requires extra courtesy in sharing the trail.

Many existing park trail systems were not designed for bicycles, although cyclists often ride to parks and young riders may come to develop bicycling skills in the park. If a city bikeway is allowed to connect to existing park paths, it is important that commuting cyclists slow down. In some sites, park character, sight distance, trail width or pre-existing uses (playgrounds, playing fields, natural resource protection, off-leash dog areas) may be negatively impacted and the bikeway system should not connect to park trails. In other sites, adding new bike trails or widening existing walking trail may be needed.

## MATERIALS

Walking and biking trails are generally paved asphalt or concrete. Trail width is based on projected use with a minimum expectation that two adults can walk side-by-side, or that a runner or cyclist can pass a walker.



*Marine Drive Trail*



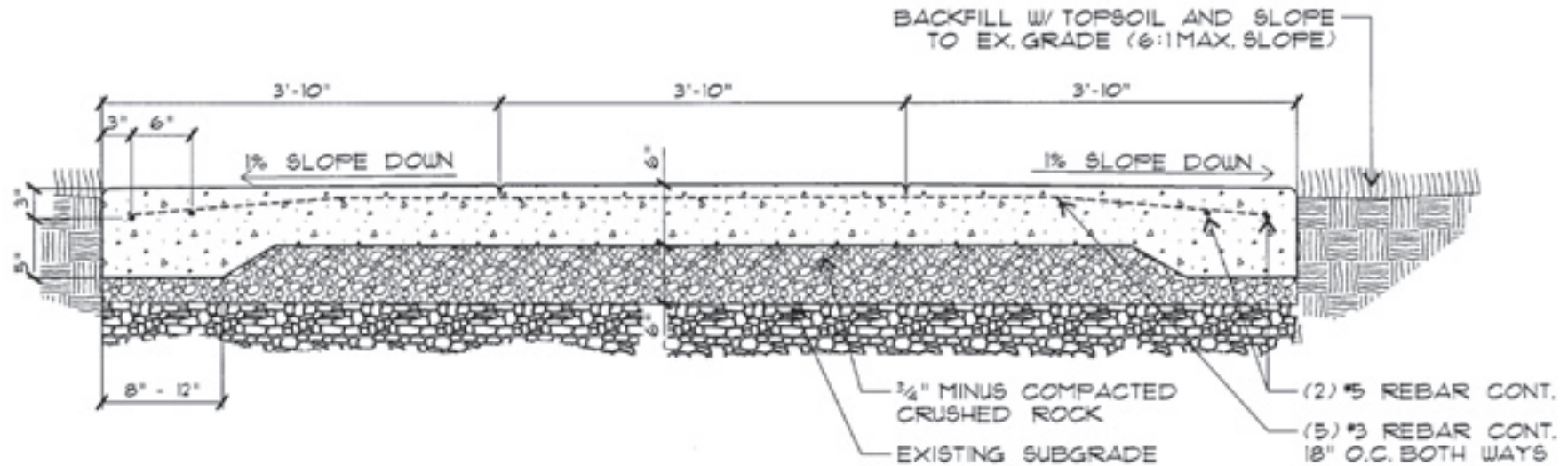
*NW Willamette Greenway at Riverscape*

Additional width is provided where the walking and biking trail is also used for maintenance access.

Sidewalks, bike lanes, and bicycle boulevards are in right-of-way, subject to PBOT guidelines (*Portland Pedestrian Design Guide* and City Engineer review). In some locations, PBOT has allowed trails in the park and away from the curb in order to improve the walking and cycling environment. These trails still need curb ramps and connections to sidewalks or road crossings in order to connect to the adjoining sidewalk and bikeway system.

Width	8' - 25' (Willamette Greenway esplanade) (prefer 10' - 12' for maintenance vehicles)
Surface	Gravel, asphalt, concrete
Longitudinal Slope	0 - 3% (to 5% if needed, 8% max.)
Cross-Slope	1%
Radius	Varies with design speed: prefer 12mph speed = 95'; 20 mph = 200' (if pedestrians use allows)
Sight Distance	150'
Easement Width	Tread + 10' min. or code requirement
Side Slope	Varies
Vertical Clearance	8' min (12' + under bridges)
Horizontal Clearance	1' from side of tread

Trail Type L – Walking & Biking



NOTES

1. DEPENDING ON SITE CONDITIONS, EITHER CROSS-SLOPE OR CROWNING MAY BE APPROPRIATE. SEE PLANS.
2. PLACE CONTROL JOINTS AS SHOWN ON PLANS.
3. WELDED WIRE MESH OR FIBERGLASS ADDITIVE MAY BE SUBSTITUTED FOR REBAR, IF APPROVED.

**REINFORCED CONCRETE PAVING**  
NOT TO SCALE

Also see Trail Types C, F and M and Trail Details: 03-Boardwalk, 04-Wood Bridge, 05-Wood Bridge with Railing, 07-Trail with Swale & Culvert, 08-Causeway, 09-Trail with Infiltration Trench, 10-Trail on Levee, 11-Soft-Surface Switchback on Levee, 13-Signs



# Trail Type M – Walking, Biking & Equestrian

## DEFINITION

Shared walking, biking, and equestrian trails are paved with asphalt or concrete and have gravel shoulders. The maximum longitudinal slope of 1 vertical to 20 horizontal (5%) is fully accessible. They are often developed to connect parks and natural areas as part of the regional trail system. These multi-modal, multi-use paths (MUPs) have width, slope, cross-slope, and curve radii to enable two-way pedestrian, bicycle, and equestrian travel at various speeds. Equestrians use either pavement or shoulder, typically using the trails in rural segments that have fewer road crossings.

## USERS

Walking, biking, and equestrian trails serve the greatest diversity of users: pedestrians, including those with fitness and balance limitations; cyclists, particular those using road bikes; scooters; skateboards; rollerbladers; wheelchairs and electric mobility devices used by persons who need assistance to be mobile; and equestrians. People of all ages walk, run, ride, and roll to enjoy the environment, socialize, exercise, and access other parts of the community. Since user speeds can vary substantially, this trail type requires extra courtesy in sharing the trail.

## MATERIALS

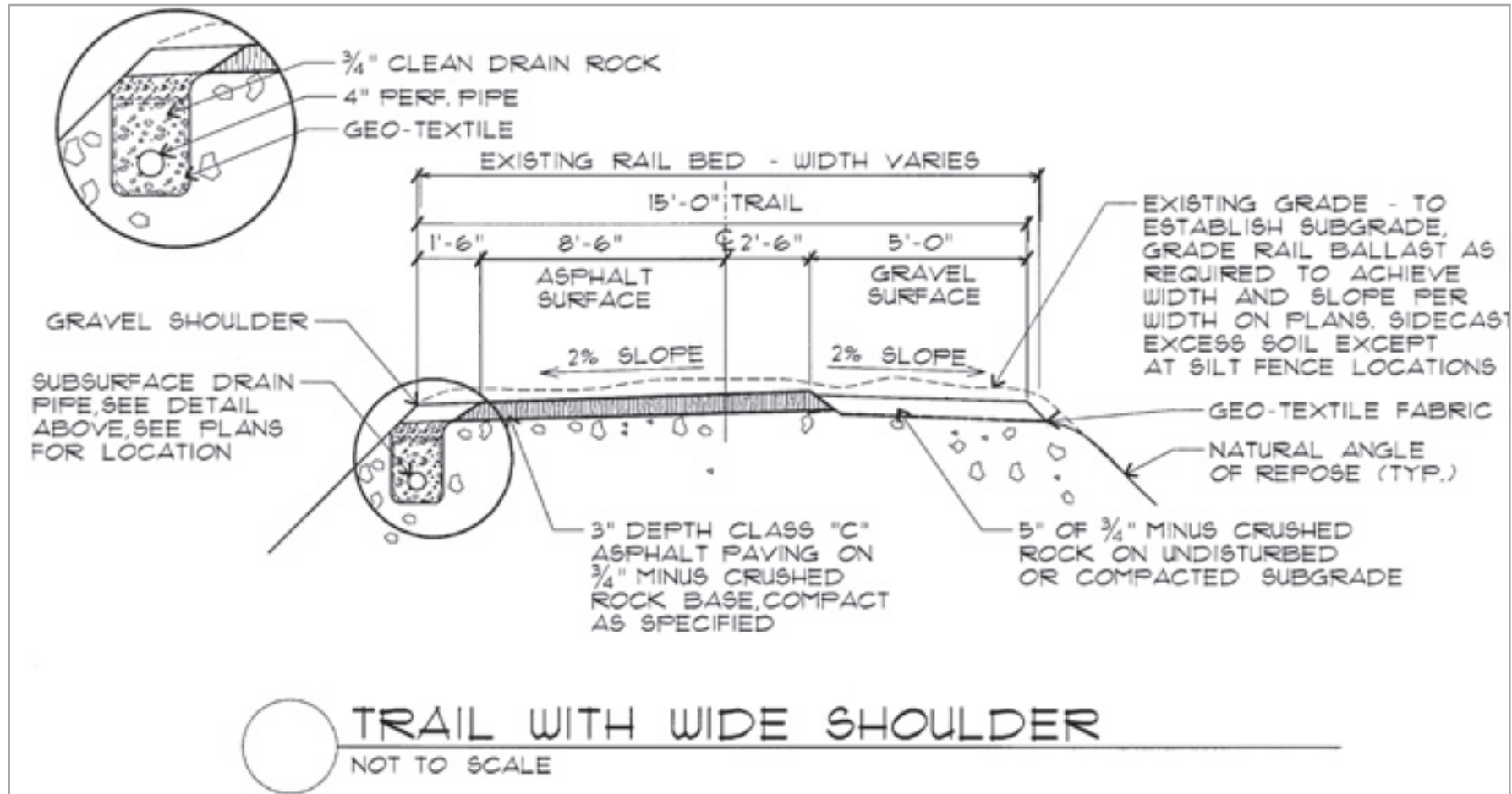
Walking, biking, and equestrian trails are generally paved asphalt or concrete. Trail width is based on projected use with a minimum expectation that two adults can walk side-by-side, or that a runner or cyclist can pass a walker. Gravel shoulders on asphalt trails are used by equestrians, especially when at least one side is widened. Additional width is provided where the trail is also used for maintenance access. Special care should be taken to direct runoff (that may be contaminated by horse droppings) away from water bodies. Seasonal trail closures to mountain bikes and equestrians may be needed to prevent erosion.



*Springwater between Palmblad and Rugg Roads - one gravel shoulder widened for equestrian and runner use*

Width	8' - 25' (prefer 10 - 12' for maintenance vehicles)
Surface	Gravel, asphalt, concrete
Longitudinal Slope	0 - 3% (5% max.)
Cross-Slope	2%
Radius	Varies with design speed: prefer 12mph speed = 95'; 20 mph = 200' (if pedestrians and equestrian use allows)
Sight Distance	150'
Easement Width	Tread + 10' min. or code requirement
Side Slope	Varies
Vertical Clearance	11'
Horizontal Clearance	3' from side of tread, at least 3' high, then 18" from side of tread above 3' high

Trail Type M – Walking, Biking & Hiking



Also see Trail Types C, F, and M and Trail Details: 03-Boardwalk, 04-Wood Bridge, 05-Wood Bridge with Railing, 07-Trail with Swale & Culvert, 08-Causeways, 09-Trail with Infiltration Trench, 13-Signs

# Trail Type N – Fire & Maintenance

## DEFINITION

Fire lanes and/or maintenance trails have surface, slope, and width for use by various vehicles. The goal is to provide maintenance and emergency access to parks and natural areas.

## USERS

Although various walkers, runners, cyclists, and equestrians also use these trails, they are intended for park maintenance vehicles, fire trucks, and police cars.

## MATERIALS

Materials vary depending on site and vehicles to be served. In some locations, crushed rock is added to native soil and compacted. In other locations, turf block (or similar concrete paver with openings) is used in order to minimize paving in turf areas but support vehicle loads. Asphalt and concrete roads for vehicles are not included in these *Trail Design Guidelines*.



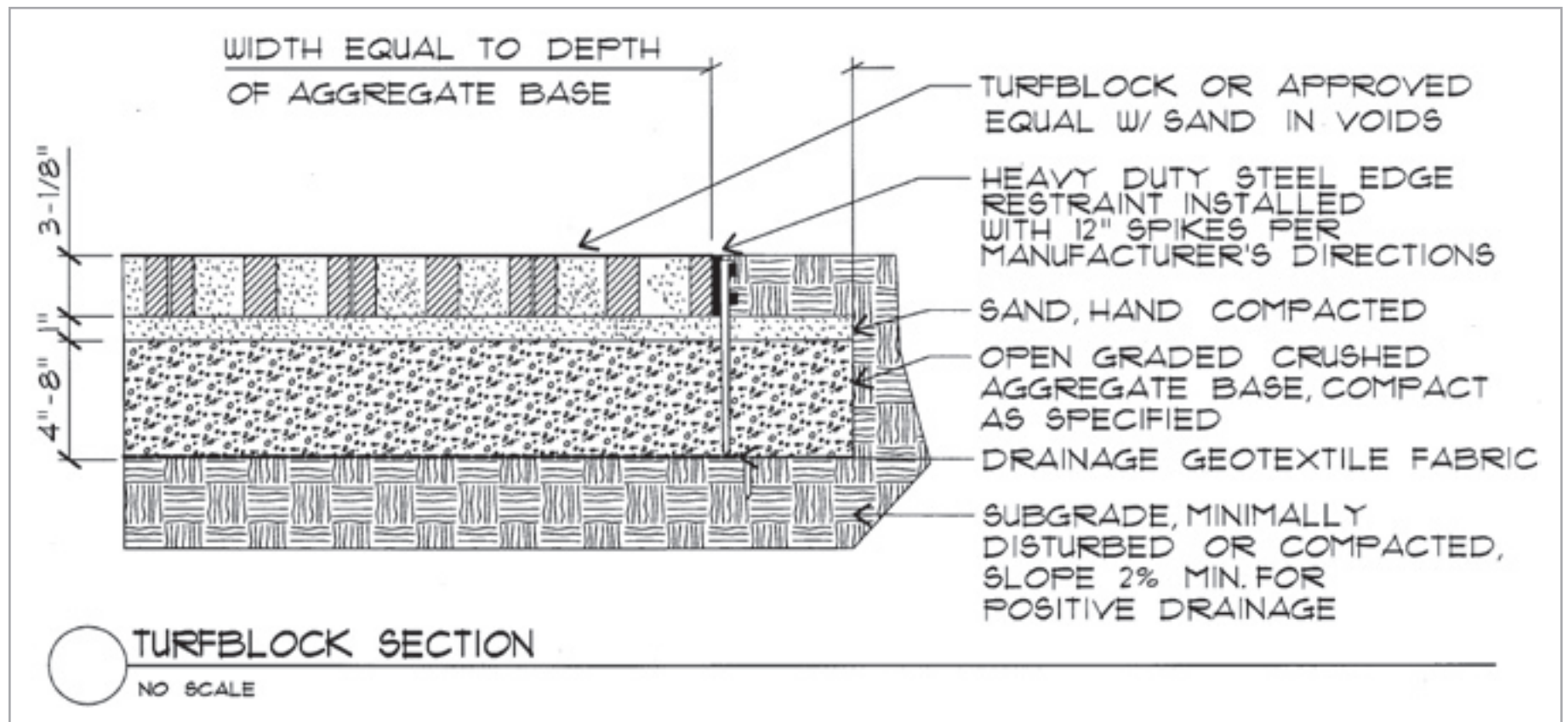
*Forest Park - Leif Erikson near Ridge Trail*



*Concrete turf block used to provide maintenance access in Vancouver, B.C.*

Width	10' - 14'
Surface	Gravel, turf block
Longitudinal Slope	0 - 5% (to 12% for fire lanes in hills)
Cross-Slope	2%
Radius	See table on vehicles on page 10
Sight Distance	50' min.
Easement Width	25' preferable, tread + 10' min.
Side Slope	Varies
Vertical Clearance	14' (20' above "deep" trash cans)
Horizontal Clearance	1' from side of tread

## Trail Type N – Fire & Maintenance



Also see Trail Types C, F, and M and Trail Detail 13-Signs

# Trail Detail 01 – Cribbed Steps

## CRIBBED STEPS

Cribbed stairs (that use ‘cribbing,’ a framework of wooden bars for support) are very stable and long lasting. They are more challenging to site and construct, fitting most easily into hillsides with consistent slope. This allows uniform riser and tread, improving safety.

There are several styles and a variety of materials for use in stairs. In general, steps are avoided if a longer, sloped route is possible. However, sometimes a more vertical route is needed to minimize the impact of a longer, sloped trail.

Steps and stairs should not be used on outdoor access routes and accessible trails. They can be used at the beginning of a trail to signal that trail is not accessible or is closed to bicycles and wheeled vehicles.

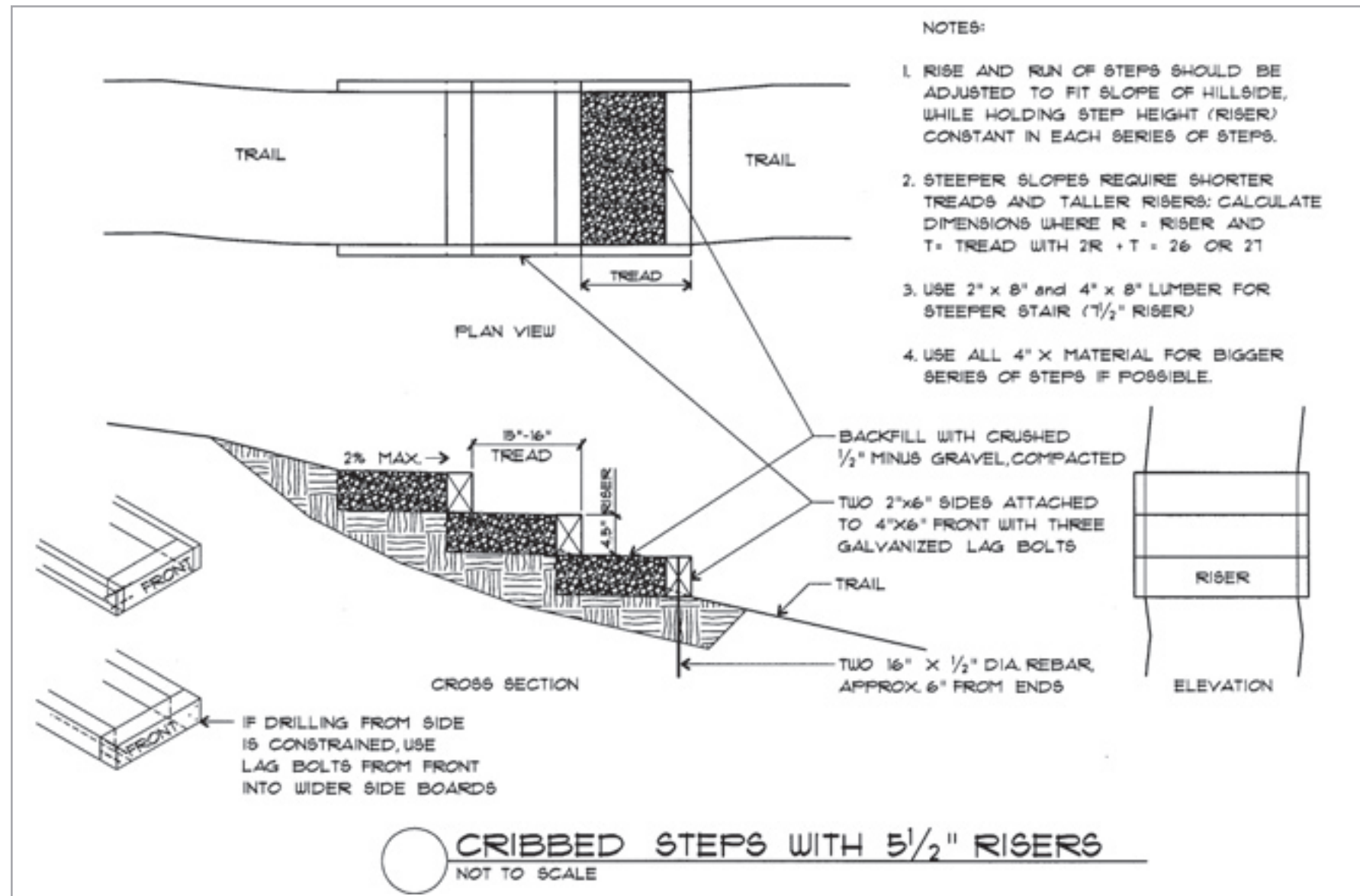


*Dickinson Park - cribbed steps*



*Woods Memorial Park - cribbed steps under construction*

# Trail Detail 01 – Cribbed Steps



# Trail Detail 02 – Timber Steps

## TIMBER STEPS

Timber steps are easier to build than cribbed steps. They may be more easily fitted into slopes that do not have a consistent slope. Although it is desirable to have consistent tread depths, timbers allow a consistent riser height and varying tread that can adjust to slope of the hillside.

Since the timber steps lack the side-boards of the cribbed steps, fill will tend to fall to the side and may create tripping hazards. This can be minimized by adding native soil or larger rocks at the sides of the backfill.

There are several styles and a variety of materials for stairs. In general, steps are avoided if a longer, sloped route is possible. Maintenance access with wheelbarrows is much easier on slopes than steps. However, sometimes a more vertical route is needed to minimize the impact of a longer, sloped trail or to discourage bicycles.

Steps and stairs should not be used on outdoor access routes and accessible trails. They can be used at the beginning of a trail to signal that trail is not accessible or is closed to bicycles and wheeled vehicles.

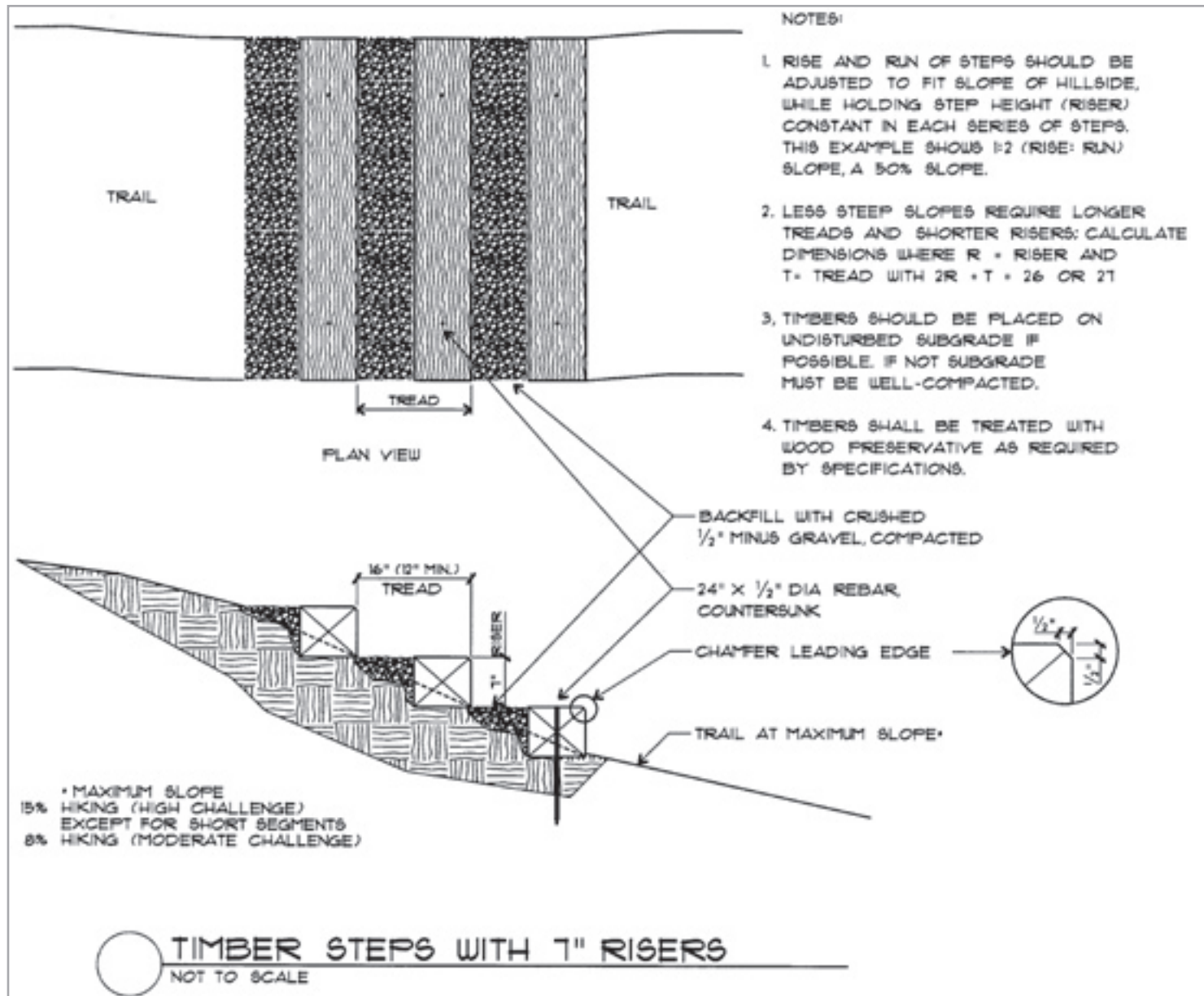


*Raz-Baack crossing at Stephens Creek Nature Park - timber steps*



*Mt Tabor Park - timber steps*

## Trail Detail 02 – Timber Steps





# Trail Detail 03 – Boardwalk

## BOARDWALK

Boardwalks are used to span unavoidable wet areas or depressions. They also can be used to provide trail in areas where grading and filling might harm tree roots or create trail surface that wildlife such as amphibians will not cross. Footings vary depending on soil conditions. Plastic lumber is more expensive than wood but very long-lasting for deck boards. Its heavier weight can help avoid floating in sites that flood and the pronounced texture can reduce slippery surfaces. Check test results on new products to find the least slippery product and maintain as recommended.

Wood surfaces in shaded or moist sites may become slick or even grow moss. This can be managed by attaching 1/2" hardware cloth (wire mesh), especially where boardwalks follow creek grade. Fasten with 1 1/2" heavy-duty staples approximately 8 - 12" apart. Upper side of mesh should have wires perpendicular to direction of travel. Ends of hardware cloth should be tucked between deck boards or lapped over sides and stapled every 4 - 6". Paint with sand texture may also help, depending on site conditions. An annual cleaning (after autumn leaves fall) is recommended. A kick rail is particularly important along accessible trails where it helps people using canes or wheelchairs stay on the structure.

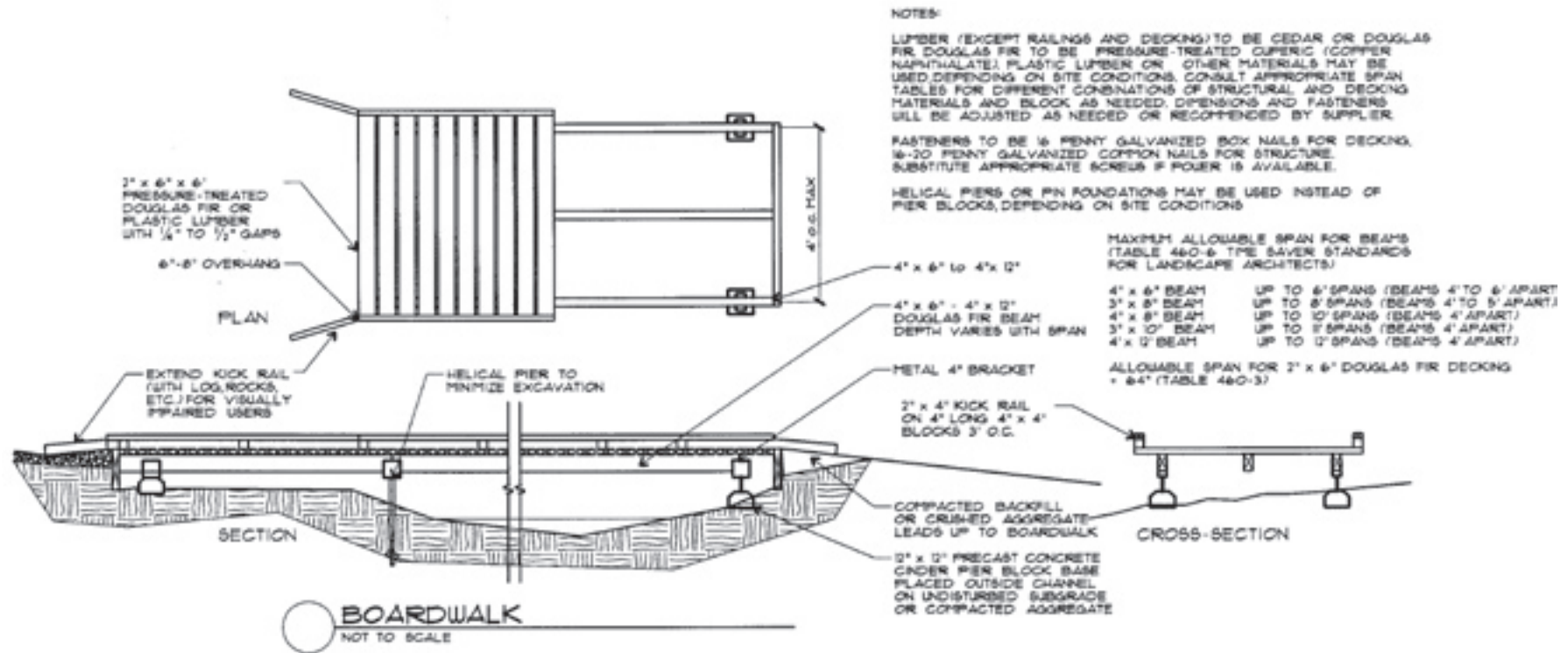


*Raz-Baack crossing at Stephens Creek Nature Park  
- boardwalk with plastic lumber decking*



*Stephens Creek Nature Park - side view of boardwalk structure*

# Trail Detail 03 – Boardwalk



# Trail Detail 04 – Wood Bridge

## WOOD BRIDGE

Bridging a small swale or ravine is often preferable to using a culvert, particularly in fish-bearing streams. This avoids the frequent maintenance needed to prevent culverts clogging with debris and associated damage if a culvert is blocked and water overtops the trail.

Bridges should be level and avoid a step up if the trail is intended to be accessible. Plastic lumber or wood may be used for the deck material. Spans greater than 10' should generally be engineered and may require site specific geotechnical work. The Cannon Trail Bridge design should be consulted for spans of 10' or more.

Wood surfaces in shaded or moist sites may become slick or even grow moss. This can be managed by attaching 1/2" hardware cloth (wire mesh) or painting with sand texture, depending on the site conditions. An annual cleaning (after autumn leaves fall) is recommended. [See Trail Detail 03 for guidance on using hardware cloth.]

Building codes require a guard rail if the fall distance is greater than 30" (Trail Detail 05).



*Forest Park Ridge Trail*



*Forest Park Ridge Trail*

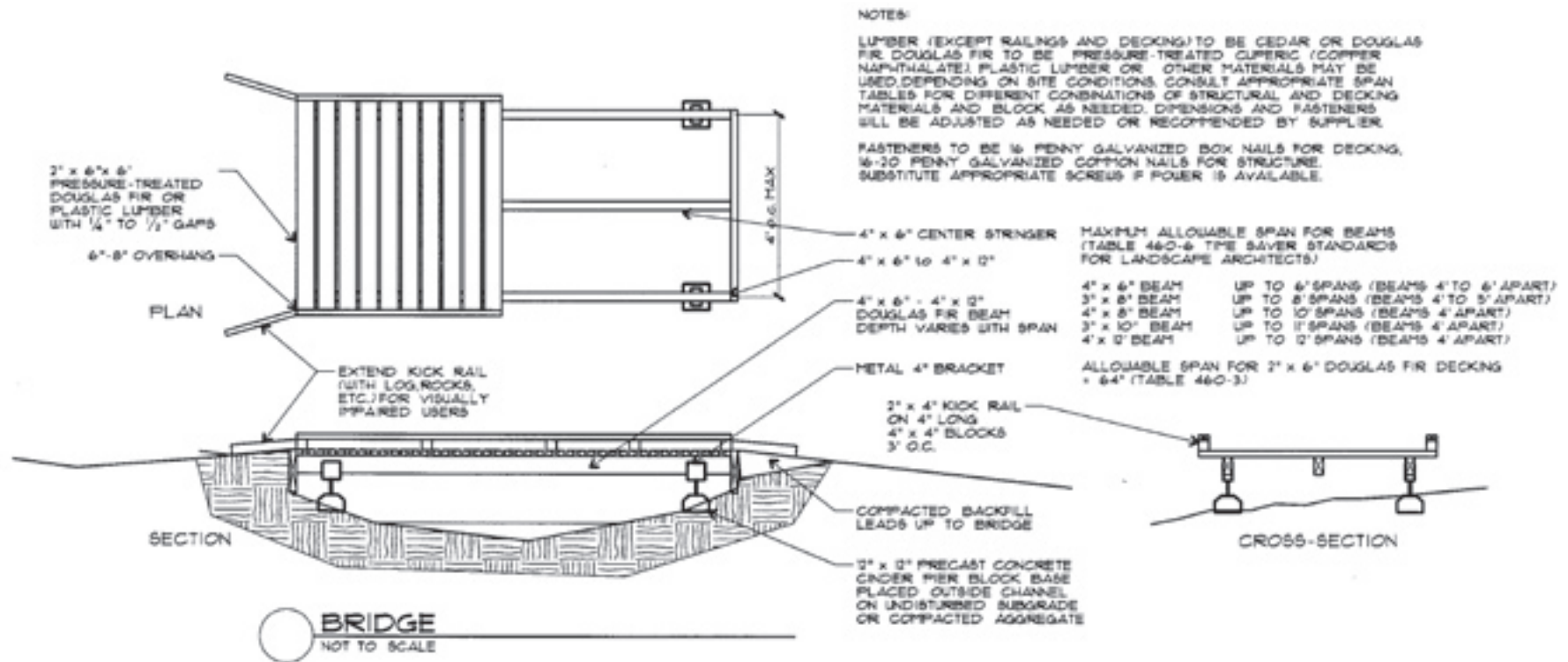


*Woods Park SW Urban Trail #7  
- step up limits accessibility*



*Raz-Baack crossing at Stephens Creek  
Nature Park - bridge pier block and beam*

# Trail Detail 04 – Wood Bridge



# Trail Detail 05 – Wood Bridge with Railing

## WOOD BRIDGE WITH RAILING

The *2007 Oregon Structural Specialty Code* (Section 1013) requires a guard rail if fall distance is greater than 30". Guard rails should be at least 42" higher than the adjacent walking surface. Additional fall protection may be used at bridges that have high use or children.

Code specifies balusters (small posts that support the railing) such that a 4-inch-diameter sphere cannot pass through any opening up to a height of 34" and a sphere 8" in diameter at 34 - 42". In natural areas along low use trails, a second horizontal railing (that makes opening less than 21" wide) is sometimes used instead of balusters (1013.3 Opening limitations exception 3).

PP&R recommends more simple railings in remote, less used trails because railings are sometimes vandalized by rocking against the whole railing or jumping on individual pieces. Consult with the Environmental Protection Agency for current information on wood preservatives deemed safe for skin contact to be used on railings.

Spans greater than 10' should generally be engineered and may require site specific geotechnical work. The Cannon Trail Bridge design should be consulted for spans of 10' or more.

Wood surfaces in shaded or moist sites may become slick or even grow moss. This can be managed by attaching 1/2" hardware cloth (wire mesh) or painting with sand texture, depending on the site conditions. Fasten hardware cloth with 1 1/2" heavy-duty staples approximately 8 - 12" apart. Upper side of mesh should have wires perpendicular to direction of travel. Ends of hardware cloth should be tucked between deck boards or lapped over sides and stapled every 4 - 6". An annual cleaning (after autumn leaves fall) is recommended.

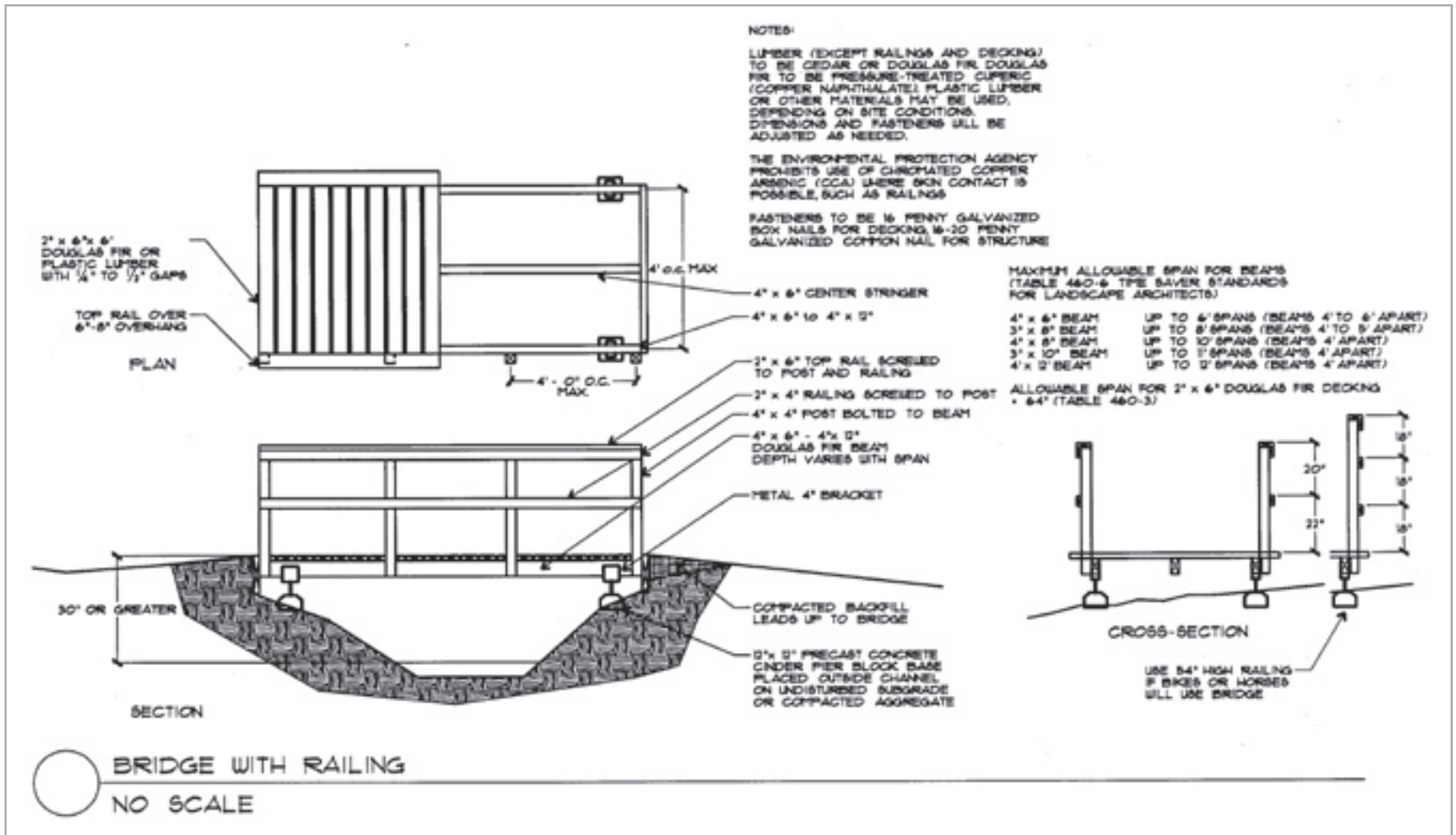


*Horizontal railing on side of bridge with minimal fall hazard  
- Ridge Trail in Forest Park*



*Balch Creek bridge on Lower Macleay Trail in Forest Park (part  
of an accessible trail) has balusters to prevent falls into creek*

# Trail Detail 05 – Wood Bridge with Railing



# Trail Detail 06 – Erosion Control at Bridge

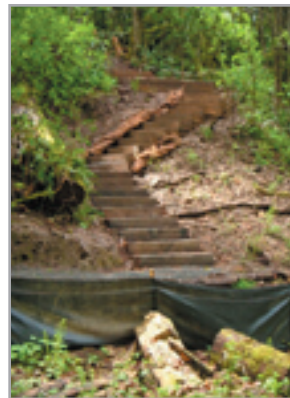
## EROSION CONTROL AT FENCE

Trail construction uses typical erosion control methods (silt fence, fiber rolls and wattles, mulch, surface roughening) and City of Portland standard details. In some instances, native groundcovers and duff in a forest setting are an existing ‘vegetated buffer’ as described in the Portland *Erosion and Sediment Control Manual*. The native groundcovers or mowed grass on the side slopes of levees also infiltrate runoff.

This detail supplements the Wood Bridge (Trail Detail 05) details. Additional erosion control methods will be added during the design process for sites with streams, but these techniques protect drainageways with small or infrequent flows.



*Woods Memorial Natural Area - silt fence between Woods Creek and trail relocation farther from waterway*

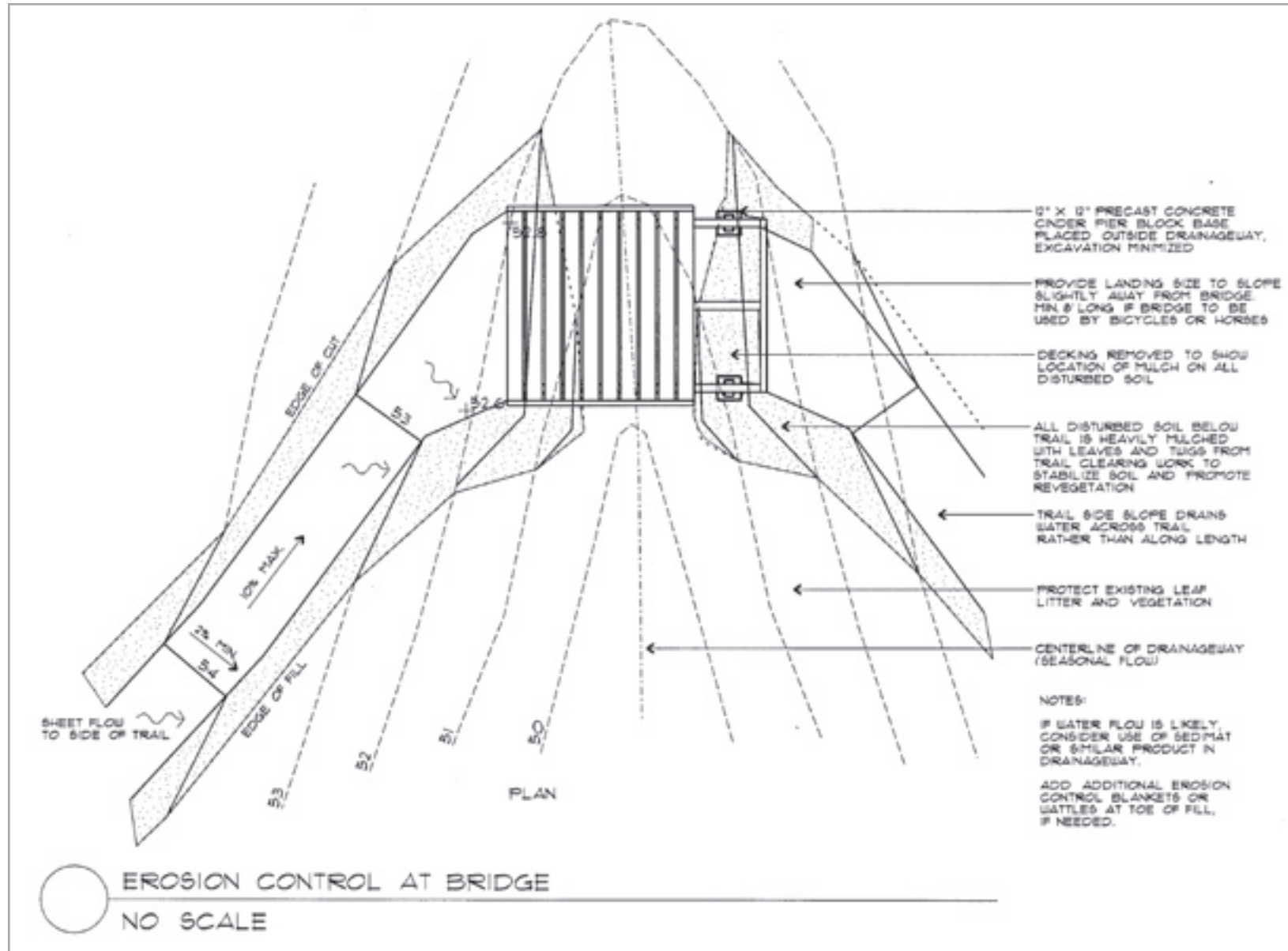


*Silt fence at base of timber steps protecting Woods Creek*



*Woods Memorial Natural Area - straw wattles and mulch protect Woods Creek from restoration planting and trail improvements*

# Trail Detail 06 – Erosion Control at Bridge





# Trail Detail 07 – Trail with Swale and Culvert

## TRAIL WITH SWALE AND CULVERT

Trails built in hillsides often intercept runoff. Although cross-slope and rolling grade dips are often used to carry water over and off the trail, it can also be intercepted by a swale on the upper side of the trail. When the trail is paved and the adjacent cut bank may tend to slough on to trail, a swale and rock edge can support the toe of slope and collect runoff.



*Connor Trail (from Marquam Nature Park to OHSU)  
- well-disguised culvert*

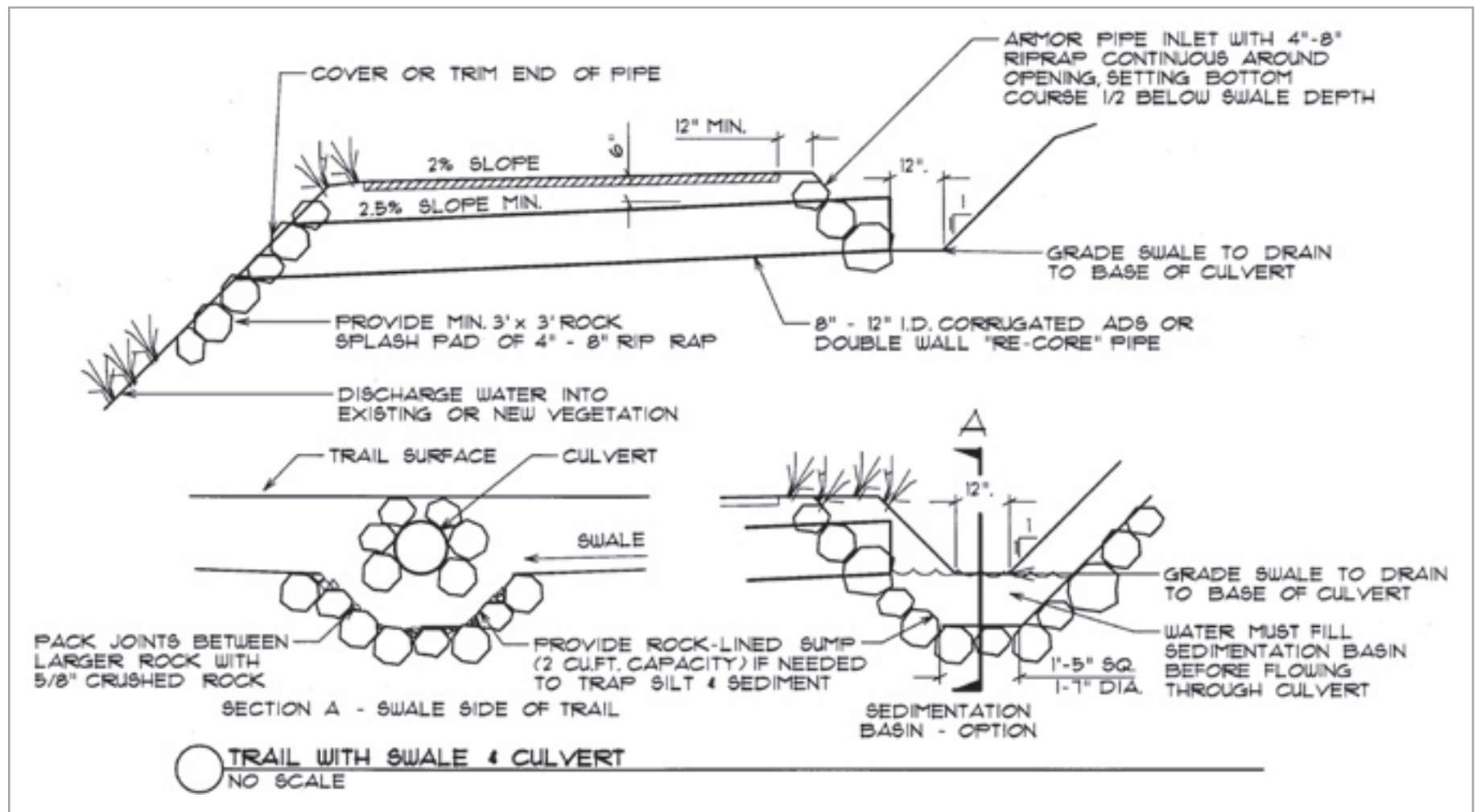


*Woods Memorial Park - hiking path (under construction),  
intercepting runoff in swale and piping under segment of  
causeway in poorly drained area near Woods Creek*



*SE 146 Ave connector path to Springwater Corridor (southwest of  
Powell Butte) right after installation - water in swale next to rail  
berm and trail flows through corrugated metal pipe,  
vegetation will grow and obscure pipe*

Trail Detail 07 – Trail with Swale & Culvert



# Trail Detail 08 – Causeway

## CAUSEWAY

Causeways are raised portions of trails that are useful in poorly drained soils or where seeps moisten soil tread. Adding rock and elevating the trail allow water to drain to the side and help avoid trails that are widened when users walk at edge of damp areas. Causeways are not intended for use crossing wetlands.



*Wild Hawthorn Trail in Powell Butte  
- split cedar causeway and small drain pipe*

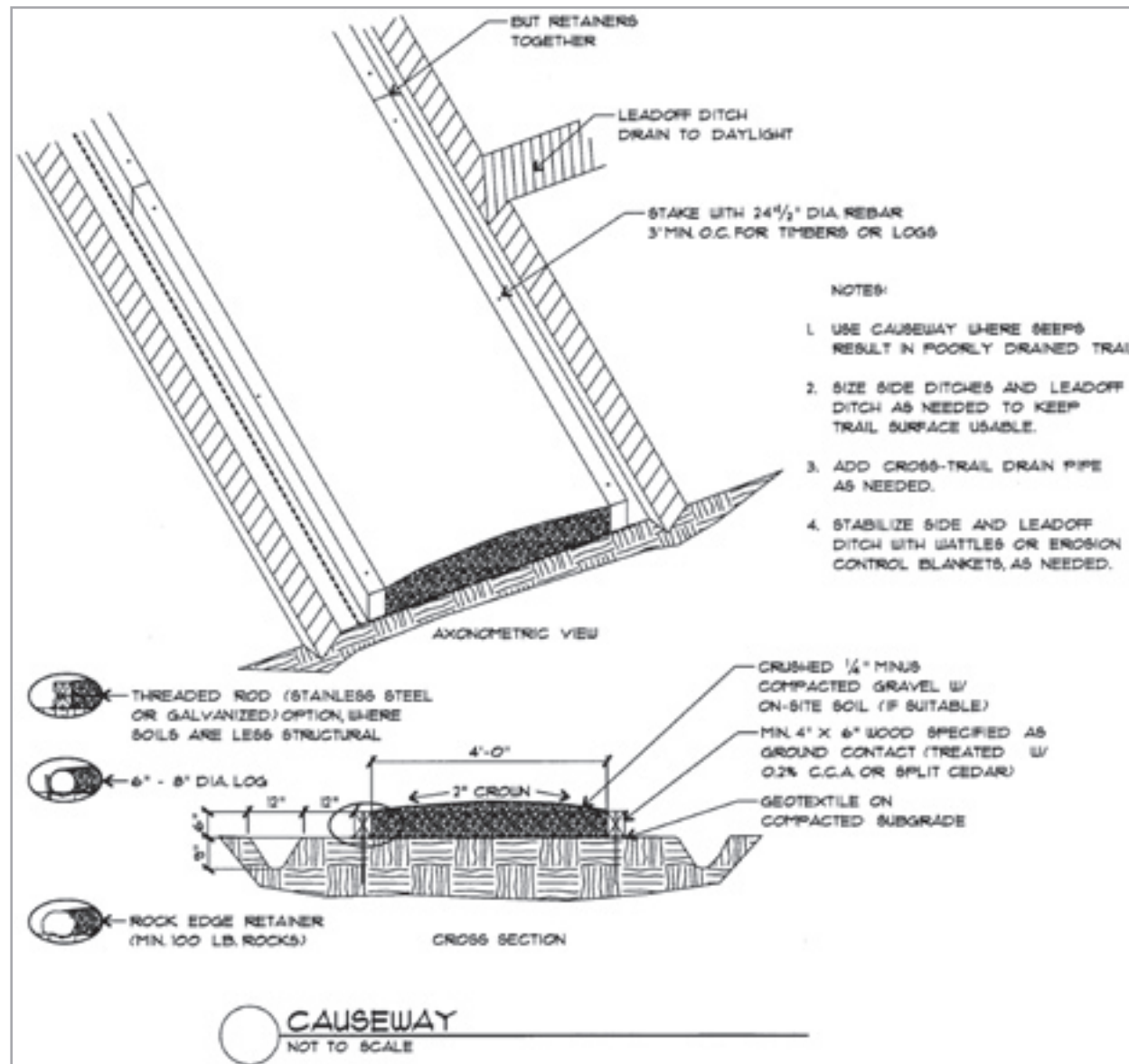


*Woods Memorial Park - causeway using 4" x 6" timbers (under construction with temporary metal fence to protect new plantings and prevent trampling of bank of Woods Creek)*



*Wild Hawthorn Trail in Powell Butte - cedar log causeway  
in level, poorly drained area near base of bluff*

# Trail Detail 08 – Causeway



# Trail Detail 09 – Trail with Infiltration Trench

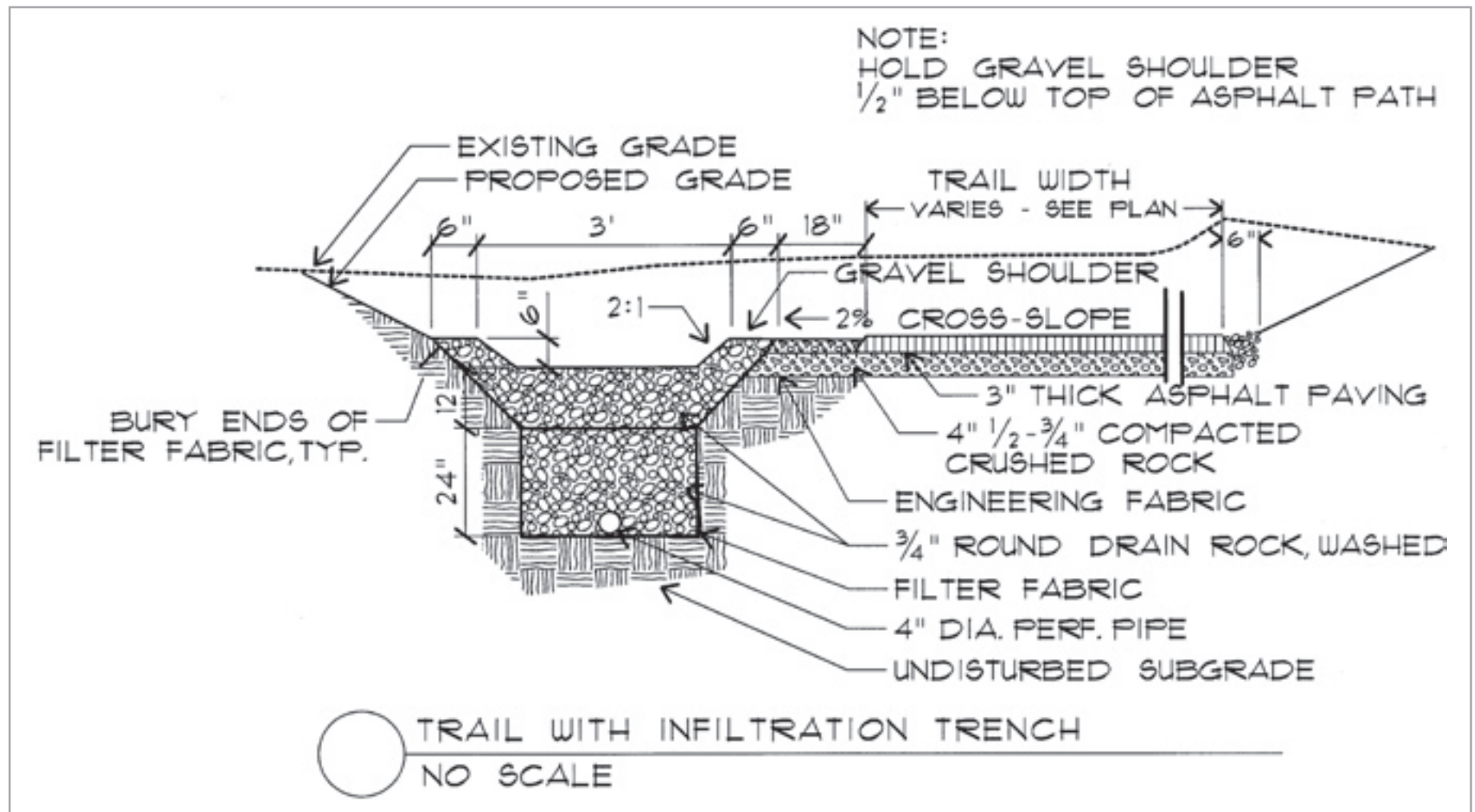
## TRAIL WITH INFILTRATION TRENCH

Trail materials are often impervious, whether constructed from compacted gravel, asphalt or concrete. Although porous asphalt and concrete are available, some subgrades of old railroad berms or gravel roads may not be pervious, so runoff will still drain to the side of the trail rather than infiltrate under the trail surface. The pores in porous paving are also vulnerable to clogging by dust and seed (often plentiful in natural areas). Unless equipment is available to vacuum particles from the pores, pervious pavement may not remain porous. Alternate ways to clean and infiltrate stormwater are desirable. Although many trails do get limited use by maintenance vehicles, the stormwater is much cleaner than from roads and parking lots. The narrow width of impervious area and linear nature of most trails mean bioswales and infiltration trenches are particularly easy to site. Trails on levees can also use the adjacent mowed grass slopes as biofiltration strips.



*Oaks Bottom Connector at undercrossing to Springwater on the Willamette - infiltration trench on right side*

Trail Detail 09 – Trail with Infiltration Trench



# Trail Detail 10 – Trail on Levee

## TRAIL ON LEVEE

Portions of the Marine Drive and Columbia Slough trails are placed on top of or on benches on flood control levees. The trail is often an upgrade to the route used to inspect and maintain the levee.

Site specific details are developed cooperatively with the drainage district staff. They can provide information on dimensions and location of ‘critical levee section’ and help secure project approval from the Army Corps of Engineers. In some locations, porous pavement, filling or special water quality features may be needed. The district staff also work closely with the landowners and can help with neighbors’ concerns regarding trail design and management.

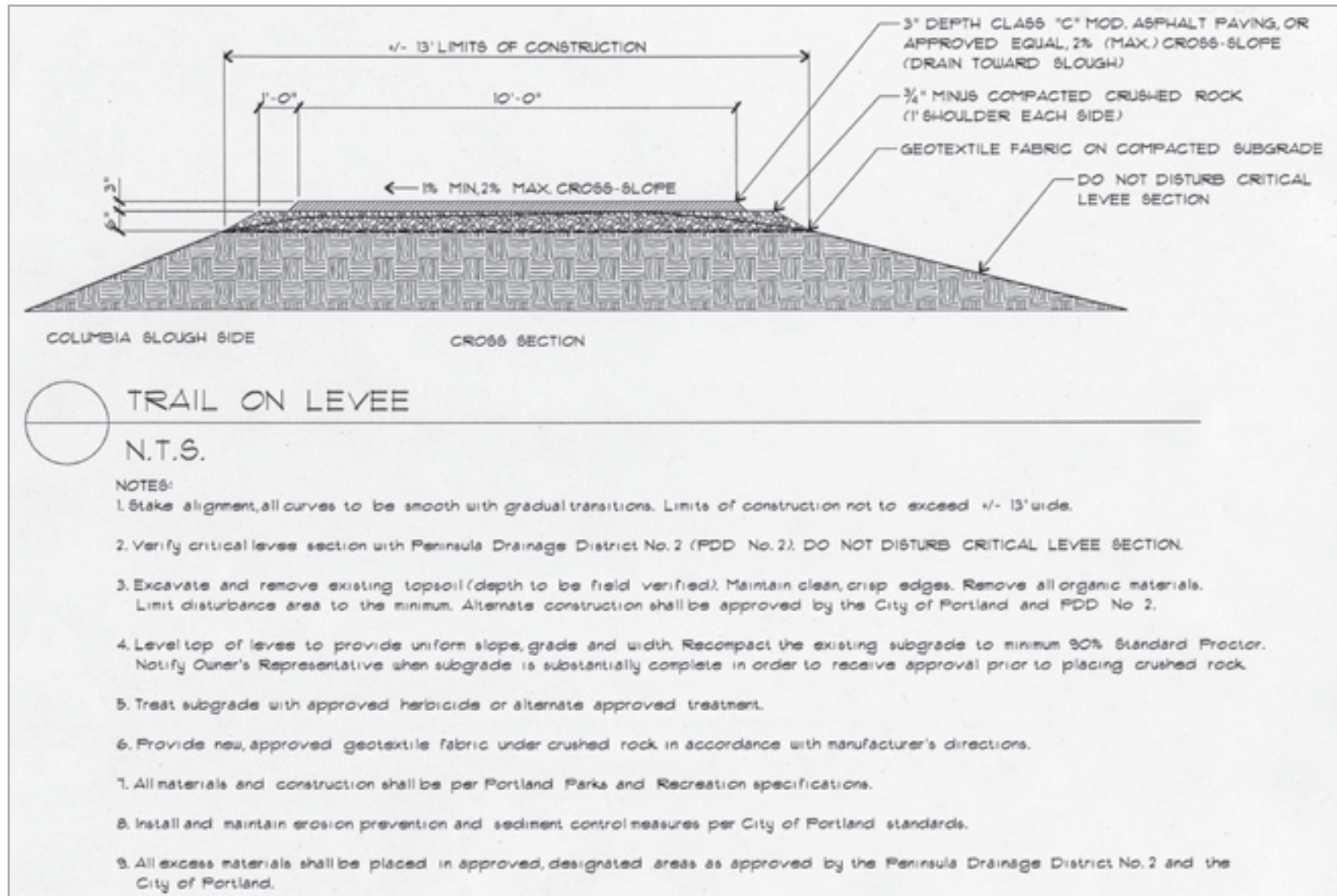


*Marine Drive Trail near the airport - stormwater runoff from asphalt infiltrates on grassy side slopes*



*Columbia Slough Trail at PIR and Heron Lakes Golf Course - this segment is surfaced with chipseal, a product no longer used by PP&R due to its rough surface and lack of durability*

## Trail Detail 10 – Trail on Levee





# Trail Detail 11 – Soft-Surface Switchback on Levee

## SWITCHBACK ON LEVEE

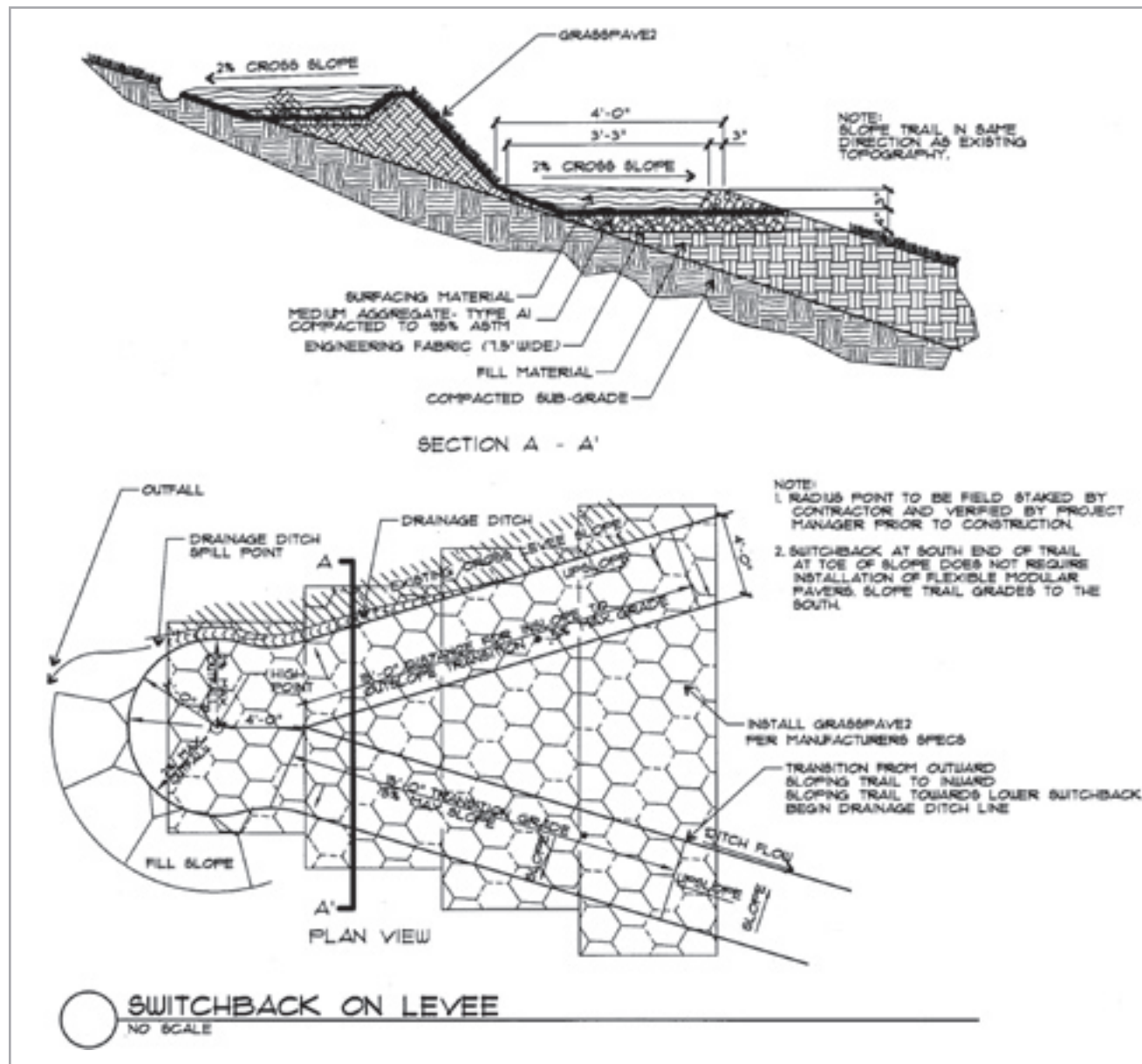
There are three cross-levees between and at right angles to the longer levees along the Columbia River and Columbia Slough. The cross-levees divide the protected area into sub-basins for additional flood protections. At approximately 30' feet height above adjacent land, they require a substantial climb for hikers or portage for those using water trails. The switchback is used to create a zig-zag up the hillside so that the top of portage is near (but above) the bottom of portage route.

This detail was developed for a portion of the Columbia Slough Trail that is constructed of wood chips. It can be adapted to other sites, preferably with more easily maintained materials.



*Columbia Slough Trail switchback on west side of cross-levee - grass has grown so vigorously that grasspave material and swale are no longer visible*

# Trail Detail 11 – Soft Surface Switchback on Cross-Levee



# Trail Detail 12 – Porous Asphalt Trail

## POROUS ASPHALT TRAIL

Asphalt is the most commonly used trail material in the PP&R system. It can be readily placed on slopes and curves. Porous asphalt is created by eliminating the smaller, graduated sizes of crushed rock and using a larger, uniform size. This results in a rougher surface that has open pores. If the pore space is maintained, water will seep through the trail, minimizing puddles and potential hydroplaning. This helps infiltrate stormwater through the trail if the existing subgrade is suitable. If the subgrade is too compact, it should be sloped so that water drains to an appropriate water quality treatment facility. Porous asphalt is not recommended for sites that flood or are likely to receive large amounts of seed that can clog the pores. The smoother surface of regular asphaltic concrete is preferred by rollerbladers and skateboarders.

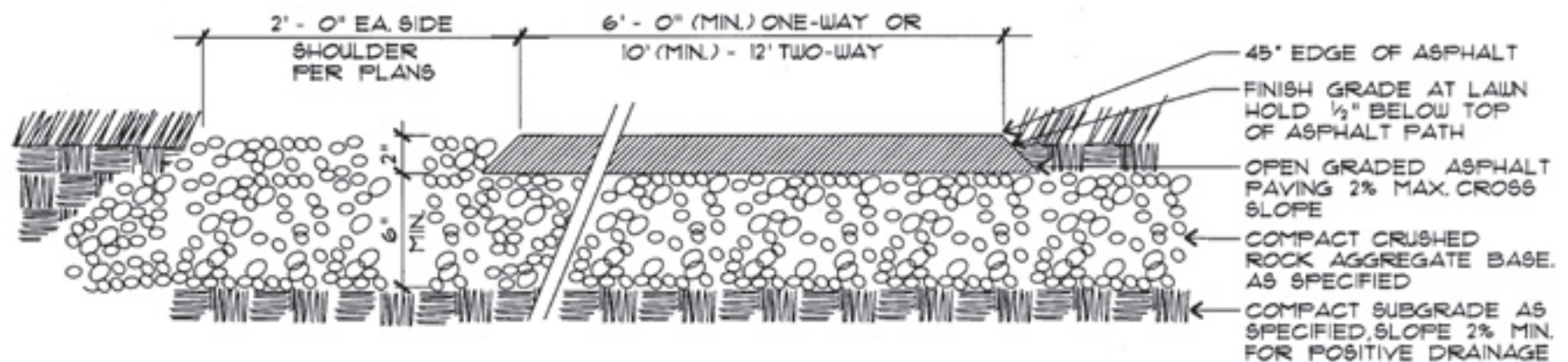


*Kelley Point Park - newly installed porous asphalt trail*

## Trail Detail 12 – Porous Asphalt Trail

### NOTES:

1. MIN. CURVE RADIUS = 95' FOR 12 MPH  
TYPICAL DESIGN SPEED IS 20 M.P.H.
2. 200' MIN. CURVE RADIUS
3. MAXIMUM LONGITUDINAL GRADE = 10% for 500' and 12% for 50'
4. MIN. VERTICAL CLEARANCE FOR VEGETATION = 8', FOR BRIDGES = 12' (INCREASE HEIGHT WITH WIDTH)



 **POROUS ASPHALT TRAIL**  
NO SCALE

# Trail Detail 13 – Signs

## SIGNS

There are four basic types of signs: identity, wayfinding, regulatory, and interpretive. PP&R has a variety of trail signage plans that have been developed over the years. The *PP&R Signage Standards Manual* that was developed for park signage in 1998 did not fully incorporate the range of existing or needed trail signage. So the current practice is to apply individual sign plans (for 40-Mile Loop, Springwater Corridor, Powell Butte, Willamette Greenway, etc.) as needed. This helps with identity and wayfinding, but regulatory and interpretive signs are less methodical.

The overall intention is to minimize sign clutter. PBOT uses the Manual on Uniform Traffic Control Devices (MUTCD) and some locally devised directional signs and pavement markings in the public right-of-way. Although individual projects have developed accessibility signs to indicate higher level of challenge, a system similar to ski slopes with symbols for difficulty would be useful.



*Columbia Slough Trail*



*Proposed pavement marking at Riverplace*



*Springwater Corridor*



*Oaks Bottom - interpretive sign*



*Powell Butte Nature Park*



*Marquam Nature Park*



*Forest Park*



*Springwater on the Willamette*



*Willamette Greenway*

Trail Detail 13 – Signs



*Slope caution*



*A.D.A. caution uphill*



*A.D.A. access*



*No bikes*



*Grooved pavement*



*Stay on path*



*Traffic caution*



*A.D.A. caution downhill*

# Trail Detail 14 – Alignment Tread Crests

## ALIGNMENT TREAD CRESTS

'Rolling grade design' fits trails to topography so that water is shed to the side of the trail. It responds to small drainageways or ridges on hillside and individual trees as opportunities to create small trail watersheds. A rolling grade mixes short segments of downgrade into an ascending trail or vice versa. Depending on underlying topography, the trail may curve to the side to create dip or crest, or a straight alignment will form a dip or crest when it crosses even a small valley or ridge.

Although most trails drain to the side (cross-slope or outslope), alternating up and down grades will help prevent water flowing and potentially eroding long lengths of trail. Tread shape can change over time through soil compaction or displacement, but a rolling grade with adequately sized crests and dips will periodically force water flowing down the trail to drain to the side. Since the erosive force of water increases with slope and different soil types, distance between crests and dips will vary. Spacing can be increased with thick, evergreen tree canopy to intercept rainfall. Spacing should be decreased with higher amounts of trail use.



*Connor Trail - rolling grade construction*



*Forest Park - Ridge Trail about three years after construction*

# Trail Detail 14 – Alignment Tread Crests

**JOGGING NEAR-LEVEL ALIGNMENT CREST**

SIDESLOPE IS FAIRLY STRAIGHT BUT TREAD JOGS UP THE SLOPE TO FORM THE CREST

CLIMBS AT TREE OR OTHER ANCHOR TO PREVENT BYPASSING

**IN-LINE NEAR-LEVEL ALIGNMENT CREST**

TREAD CLIMBS OVER A NATURAL CREST OR RIDGE WITHOUT JOG SO CREST IS IN-LINE WITH TRAIL TREAD

APPROACHES NEED TO STAY WITHIN ACCEPTABLE LEVEL OF STEEPNESS

**ROLLING GRADE PROFILE**

10'-20'

3% OR GREATER SLOPE REVERSAL

DEVELOP NEW TRAIL ALIGNMENTS USING ROLLING GRADES (CLIMBING ALTERNATED WITH DESCENDING) IN ORDER SHED WATER FROM TREAD.

UTILIZE NATURALLY OCCURRING CRESTS AND VALLEYS IF AVAILABLE.

CREATE OR USE NATURAL CRESTS OR RIDGES TO DIVIDE THE TRAIL INTO INDIVIDUAL WATERSHEDS TO AVOID CONCENTRATING RUNOFF.

IF TRAIL MUST JOG TO CREATE A CREST, ANCHOR BY BITING AT TREE OR ROCK

STEEPER TRAIL GRADES WILL REQUIRE LARGER TREAD CRESTS.

3-D SKETCHES MODIFIED FROM MINNESOTA'S TRAIL PLANNING, DESIGN AND DEVELOPMENT GUIDELINES (2007)

**APPROXIMATE MAXIMUM TREAD LENGTH (FROM CREST TO DIP)**

TREAD TEXTURE	0%	2%	4%	6%	8%	10%	12%	14%	16%
CLAY LOAM WITH HIGH QUANTITY OF GRAVELS, COBBLES AND STONES	28'	16-0'	10-0'	9-0'	6-7'	5-0'	3-8'	2-4'	1-6'
GRAVELLY CLAY	18-0'	13-2'	9-6'	6-9'	4-9'	3-4'	2-2'	1-4'	8'
LOAM WITH HIGH QUANTITY OF GRAVEL AND COBBLES	16-0'	11-7'	8-3'	5-7'	3-9'	2-6'	1-7'	1-0'	6'
CLAY	14-8'	10-4'	7-4'	5-1'	3-4'	2-2'	1-3'	7'	4'
LOAM	13-5'	9-0'	5-7'	3-7'	2-3'	1-4'	8'	4'	
CRUSHED ROCK, ANGULAR PARTICLES, 3/4" MINUS, 5" THICK	25'	18'	12'	9-0'	7-0'	5'	3'		

THESE NUMBERS FROM NATURAL SURFACE TRAILS BY DESIGN BY TROY SCOTT PARKER ASSUME AERIAL WELL-COMPACTED TREAD WITH MODERATE USE BY HIKERS AND HIGH SPLASH EROSION (NO TREE CANOPY) AND NO WATER OTHER THAN RAIN AND RUNOFF.

**ALIGNMENT TREAD CRESTS**  
NOT TO SCALE

Also see Trail Detail 15-Alignment Tread Dips



# Trail Detail 15 – Alignment Tread Dips

## ALIGNMENT TREAD DIPS

'Rolling grade design' fits trails to topography so that water is shed to the side of the trail. It responds to small drainageways or ridges on hillside and individual trees as opportunities to create small trail watersheds. A rolling grade mixes short segments of downgrade into an ascending trail or vice versa. Depending on underlying topography, the trail may curve to the side to create dip or crest, or a straight alignment will form a dip or crest when it crosses even a small valley or ridge.

Although most trails drain to the side (cross-slope or outslope), alternating up and down grades will help prevent water flowing and potentially eroding long lengths of trail. Tread shape can change over time through soil compaction or displacement, but a rolling grade with adequately sized crests and dips will periodically force water flowing down the trail to drain to the side. Since the erosive force of water increases with slope and different soil types, distance between crests and dips will vary. Spacing can be increased with thick, evergreen tree canopy to intercept rainfall. Spacing should be decreased with higher amounts of trail use.



*Connor Trail - rolling grade construction*



*Forest Park - Ridge Trail about three years after construction*

# Trail Detail 15 – Alignment Trail Dips

**JOGGING NEAR-LEVEL ALIGNMENT DIP**  
SIDESLOPE IS RELATIVELY UNIFORM BUT TREAD JOGS DOWN SLOPE TO FORM DIP

**IN-LINE NEAR-LEVEL ALIGNMENT CREST**  
TREAD DIPS THROUGH A NATURAL SGALE WITHOUT JOG SO DIP IS IN-LINE WITH TRAIL TREAD  
APPROACHES NEED TO FOLLOW THE TREAD CLIMB PATTERN

**JOGGING CLIMBING ALIGNMENT DIP**  
DIP AND CREST ABOVE IT ARE DEVELOPED AS UNIT  
TREAD CREST FORMED BY ALIGNMENT

**IN-LINE CLIMBING ALIGNMENT DIP**  
TREAD DIP FORMED BY ALIGNMENT  
NATURAL TREAD CREST

**ROLLING GRADE PROFILE**  
10'-20'  
3% OR GREATER SLOPE REVERSAL

DEVELOP NEW TRAIL ALIGNMENTS USING ROLLING GRADES (CLIMBING ALTERNATES WITH DESCENDING) IN ORDER SHED WATER FROM TREAD.  
UTILIZE NATURALLY OCCURRING DIPS AND CRESTS IF AVAILABLE.  
CREATE OR USE NATURAL DIPS OR VALLEYS TO DIVIDE THE TRAIL INTO INDIVIDUAL WATERSHEDS TO AVOID CONCENTRATING RUNOFF.  
IF TRAIL MUST JOG TO CREATE A DIP, ANCHOR BY SITING AT TREE OR ROCK.  
STEEPER TRAIL GRADES WILL REQUIRE MORE FREQUENT DIPS.  
3-D SKETCHES MODIFIED FROM MINNESOTA'S TRAIL PLANNING, DESIGN AND DEVELOPMENT GUIDELINES (2007)

**APPROXIMATE MAXIMUM TREAD LENGTH (FROM CREST TO DIP)**

TREAD TEXTURE	0%	2%	4%	6%	8%	10%	12%	14%	16%
CLAY LOAM WITH HIGH QUANTITY OF GRAVELS, COBBLES AND STONES	25'	16-0'	10-0'	9-0'	8-0'	5-0'	3-0'	2-4'	1-6'
GRAVELLY CLAY	18-0'	12-0'	8-0'	6-0'	4-0'	3-4'	2-2'	1-4'	8'
LOAM WITH HIGH QUANTITY OF GRAVEL AND COBBLES	16-0'	11-0'	8-0'	6-0'	3-0'	2-6'	1-7'	1-0'	6'
CLAY	14-0'	10-4'	7-4'	5-0'	3-4'	2-2'	1-0'	7'	4'
LOAM	13-0'	9-0'	6-0'	3-0'	2-3'	1-4'	8'	4'	4'
CRUSHED ROCK, ANGULAR PARTICLES, 3/4" MINUS, 5" THICK	12-0'	8-0'	4-0'	3-0'	1-0'	9'	5'		

THESE NUMBERS FROM NATURAL SURFACE TRAILS BY DESIGN BY TROY SCOTT PARKER ASSUME ANNOUL, WELL-COMPACTED TREAD WITH MODERATE USE BY HIKERS AND HIGH SPLASH EROSION (NO TREE CANOPY) AND NO WATER OTHER THAN RAIN AND RUNOFF.

**ALIGNMENT TREAD DIPS**  
NO SCALE

Also see Trail Detail 14-Alignment Tread Crests

# Trail Detail 16 – Removable Bollard

## REMOVABLE BOLLARD

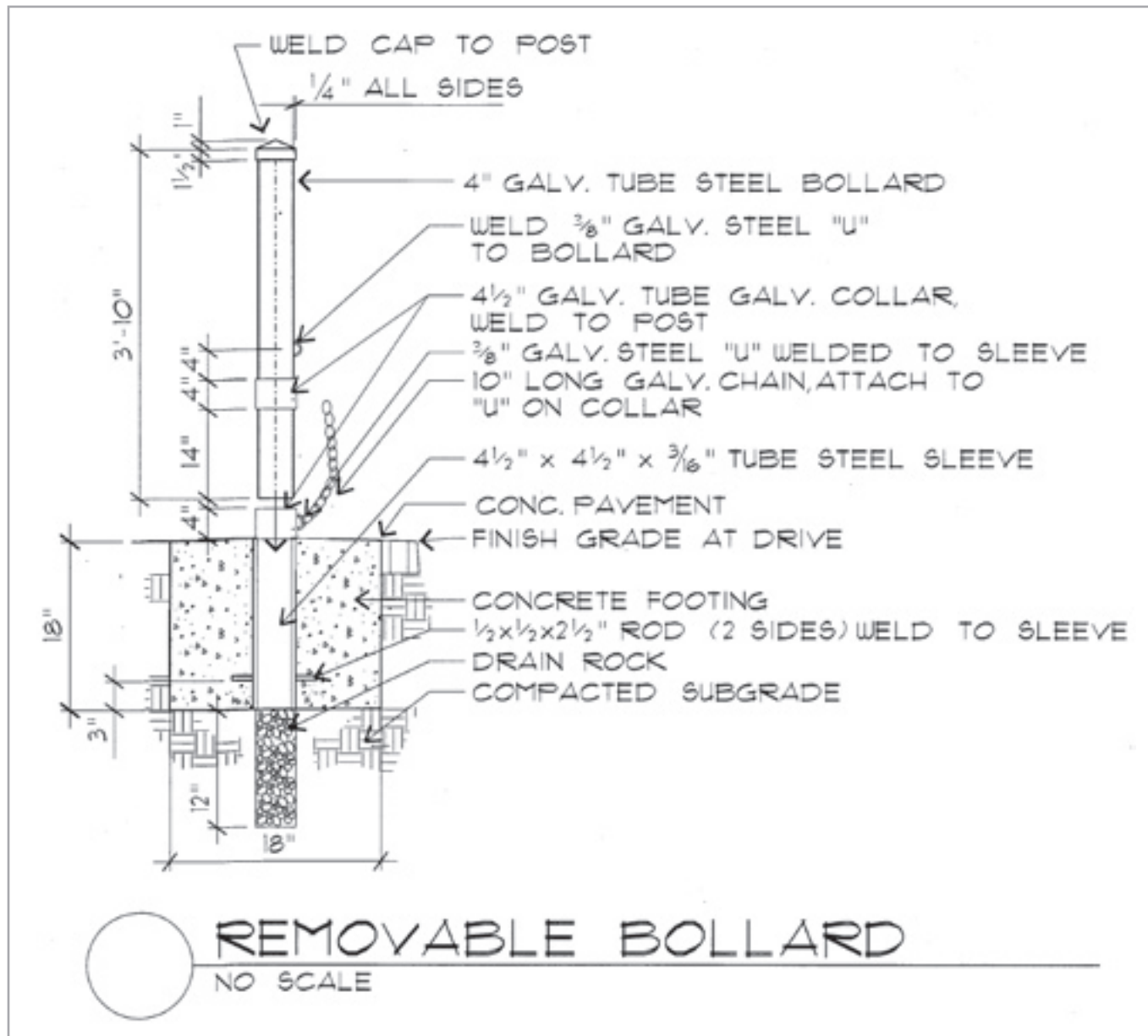
Bollards are used primarily to prevent unauthorized vehicular access to off-street trails. They can also warn trail users of vehicle crossings, identify the trail or cross-streets, and slow trail users near crossings. The removable bollard is placed in center of the trail and locked in place. The space between the fixed (side) and removable bollards is too narrow for vehicles but allows passage by pedestrian, cyclists, and horses. The PP&R design for the center, removable bollard has evolved over the years but still needs improvement. The weight has been reduced by using thinner metal but still needs revised security solution. The current design has a sleeve in the ground with hasp and chain. This base protrudes several inches above the trail surface and can trip users if the bollard is not replaced right after driving into trail. Alternate designs that are flush with the trail surface can fill with liquid and do not lock well.

Until the design is revised, one solution is to remove the center bollard in some trail segments that have frequent road crossings that slow down maintenance access. Signage allowing only authorized vehicles does seem to prevent illegal use of ODOT's I-205 trail.



*Columbia Slough Trail near N. Portland Road  
- two of three bollards to control access*

Trail Detail 16 – Removable Bollard



# Trail Detail 17 – Cribbed Retaining Wall

## CRIBBED RETAINING WALL

Cribbing is typically used if a segment of trail has failed or the side slope is steeper than desirable. The individual pieces are more portable than stone, minimizing the weight carried to sometimes remote areas along narrow trails. The ‘deadmen’ pieces that are perpendicular to the face of the wall must be keyed into undisturbed slope and securely fastened to the pieces parallel to edge of trail. The weight of soil on the ‘deadman’ helps secure the entire structure. The openness allows water to move through the wall without building up pressure or lubricating slide-prone soils.

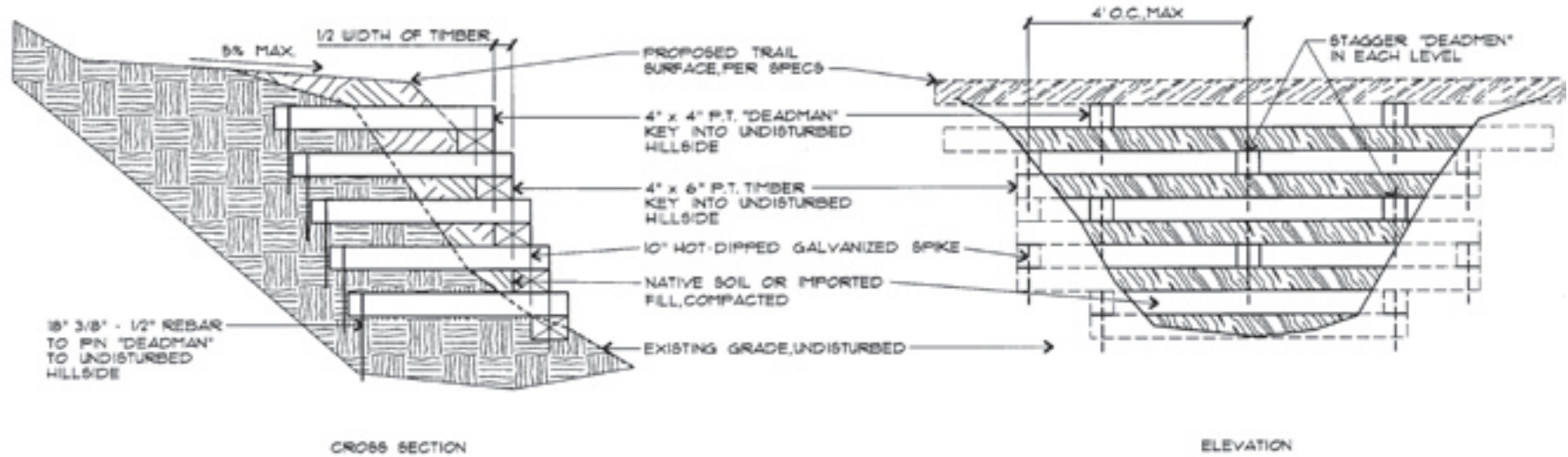


*Woods Memorial Natural Area - this cribbed retaining wall helped relocate trail away from edge of creek*

# Trail Detail 17 – Cribbed Retaining Wall

**NOTE:**

WOOD CRIBBING IS OFTEN USED TO REINFORCE A BANK THAT HAS FAILED OR MIGHT FAIL EITHER ABOVE OR BELOW A TRAIL.



**CRIBBED RETAINING WALL**  
NOT TO SCALE

# Appendix A – References

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