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.
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

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**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
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
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.

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.

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

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
### Technical Provision for Access Routes, Outdoor Access Routes and Accessible Trails

<table>
<thead>
<tr>
<th>Surface</th>
<th>Access Route (ADAAG)</th>
<th>Outdoor Access Route</th>
<th>Accessible Trail</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>firm and stable</td>
<td>firm and stable</td>
<td>firm and stable (exception: * )</td>
</tr>
<tr>
<td>Maximum Running Slope</td>
<td>1:12 [8.33%]</td>
<td>1: 20 [5%] (for any distance) 1: 12 [8.33%] (for max. 50 ft) 1:10 [10%] (for max. 30 ft)</td>
<td>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)</td>
</tr>
<tr>
<td>Maximum Cross Slope</td>
<td>1:50 [2%]</td>
<td>1: 33 [3.03%] (Exception: 1: 20 [5%] for drainage purposes)</td>
<td>1: 20 [5%] (Exception: 1: 10 [10%] at the bottom of an open drain where clear tread width is a minimum of 42 inches</td>
</tr>
<tr>
<td>Minimum Clear Tread Width</td>
<td>36 inches 32 inches for no more than 24 inches</td>
<td>36 inches (Exception: 32 inches when * applies )</td>
<td>36 inches (Exception: 32 inches when * applies )</td>
</tr>
<tr>
<td>Tread Obstacles</td>
<td>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)</td>
<td>1 inch high maximum Exception: 2 inches high maximum where beveled with a slope no greater than 1: 2 [50%] and where * applies.</td>
<td>2 inches high maximum Exception: 3 inches maximum where running and cross slopes are 1: 20 [5%] or less. (Exception: * )</td>
</tr>
<tr>
<td>Passing Space</td>
<td>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.</td>
<td>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.)</td>
<td>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: * )</td>
</tr>
<tr>
<td>Resting Intervals</td>
<td>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</td>
<td>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.)</td>
<td>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: * )</td>
</tr>
</tbody>
</table>

* 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.

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

### Design Features

<table>
<thead>
<tr>
<th>Facility Name</th>
<th>Surface</th>
<th>Width</th>
<th>Longitudinal Slope</th>
<th>Cross Slope</th>
<th>ADA</th>
</tr>
</thead>
<tbody>
<tr>
<td>hiking (high challenge)</td>
<td>soil / stairs</td>
<td>18' - 30'</td>
<td>0 - 15% (short segments steeper than 15%)</td>
<td>2% min 4% max</td>
<td>steepest (steps, rocks, roots)</td>
</tr>
<tr>
<td>hiking (moderate challenge)</td>
<td>soil / stairs</td>
<td>18' - 30'</td>
<td>0 - 8%</td>
<td>2% min 4% max</td>
<td>steep</td>
</tr>
<tr>
<td>hiking (accessible)</td>
<td>soil / gravel / engineered wood fiber or wood chips</td>
<td>4' (with passing areas) - 10'</td>
<td>0 - 5% (8% for max. 50')</td>
<td>2%</td>
<td></td>
</tr>
<tr>
<td>engineered wood fiber or chips / gravel / pavers asphalt / concrete / wood or plastic lumber</td>
<td>6' - 12' (8' min if paved for vehicles)</td>
<td>0 - 8%</td>
<td>1 - 2%</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>exercise / fitness (resilient track)</td>
<td>synthetic rubber</td>
<td>2'-4'/ lane</td>
<td>0 - 1%</td>
<td>1%</td>
<td></td>
</tr>
<tr>
<td>biking</td>
<td>asphalt / concrete</td>
<td>6' one-way, 10' min. - 12' pref. two-way</td>
<td>0 - 3% pref. (to 5% if needed, up to 10% for 500', up to 12% for 50' and ramps)</td>
<td>2%</td>
<td></td>
</tr>
<tr>
<td>mountain biking</td>
<td>soil / gravel / wood</td>
<td>18' - 4'</td>
<td>0 - 12%</td>
<td>2 - 5%</td>
<td></td>
</tr>
</tbody>
</table>

### Users

- walker ($\bullet$)
- runner ($o$)
- dog walker ($\bigcirc$)
- wheelchair or electric mobility device ($\bigcirc$)
- rollerblader ($\bigcirc$)
- cyclist ($\bigcirc$)
- police car ($\bigcirc$)
- maintenance vehicle ($\bigcirc$)
- firetruck ($\bigcirc$)
- skateboarder ($\bigcirc$)
- mtn biker ($\bigcirc$)
- road biker ($\bigcirc$)

### Notes

- SINGLE USE
- SIDEWALKS, BOARDWALKS AND TRAILS IN DEVELOPED PARKS, SOMETIMES INCLUDE STAIRWAYS; PAVE IF USED FOR MAINTENANCE (8’ MIN. - 10’ PREF.), PHASE OUT CHISPEAL; AVOID WOOD FIBER EXCEPT FOR 10’ WIDE WALKING LOOPS IN DEVELOPED PARKS; LANDINGS OF 60’ X 60’ EVERY 1000 FEET ON ACCESSIBLE TRAILS

### Recreational Trail Strategy Trail Types

- Nature: Community
- Local Access: Regional

- *: Major use
- ○: Minor use

- **: 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 unlikely to meet environmental zone standards due to width and/or paving material; will need environmental review if in e-zones.
- Mobius 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.
<table>
<thead>
<tr>
<th>Trail Type</th>
<th>Nature</th>
<th>Local Access</th>
<th>Community</th>
<th>Regional</th>
<th>Users</th>
<th>Design Features</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Facility Name</td>
</tr>
<tr>
<td>SINGLE USE</td>
<td>H</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>cyclocross ***</td>
</tr>
<tr>
<td>I</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>equestrian**</td>
</tr>
<tr>
<td>MULTIPLE USE</td>
<td>J</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>hiking and mountain biking</td>
</tr>
<tr>
<td>I</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>hiking and equestrian</td>
</tr>
<tr>
<td>L</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>walking and biking ****</td>
</tr>
<tr>
<td>M</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>walking, biking and equestrian ****</td>
</tr>
<tr>
<td>N</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>fire and maintenance ****</td>
</tr>
</tbody>
</table>
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.]

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

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

<table>
<thead>
<tr>
<th>Width</th>
<th>18” - 30”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface</td>
<td>Soil / stairs</td>
</tr>
<tr>
<td>Longitudinal Slope</td>
<td>0 - 8%</td>
</tr>
<tr>
<td>Cross-Slope</td>
<td>2% min. - 4% max.</td>
</tr>
<tr>
<td>Radius</td>
<td>NA - switchbacks</td>
</tr>
<tr>
<td>Sight Distance</td>
<td>Limited, consider safety needs</td>
</tr>
<tr>
<td>Easement Width</td>
<td>Tread + 10’ min.</td>
</tr>
<tr>
<td>Side Slope</td>
<td>Varies</td>
</tr>
<tr>
<td>Vertical Clearance</td>
<td>8’</td>
</tr>
<tr>
<td>Horizontal Clearance</td>
<td>2’ from side of tread</td>
</tr>
</tbody>
</table>

Trail Type B – Hiking (moderate challenge)
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
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.]

### Trail Type C – Hiking (accessible)

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

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.

### Trail Type D – Walking

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

<table>
<thead>
<tr>
<th>Width</th>
<th>2’ - 4’ if developed as linear route</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface</td>
<td>Synthetic rubber over a.c. or concrete</td>
</tr>
<tr>
<td>Longitudinal Slope</td>
<td>0 - 1%</td>
</tr>
<tr>
<td>Cross-Slope</td>
<td>1%</td>
</tr>
<tr>
<td>Radius</td>
<td>Use standard oval dimensions for track</td>
</tr>
<tr>
<td>Sight Distance</td>
<td>N/A</td>
</tr>
<tr>
<td>Easement Width</td>
<td>As needed</td>
</tr>
<tr>
<td>Side Slope</td>
<td>0%</td>
</tr>
<tr>
<td>Vertical Clearance</td>
<td>8’</td>
</tr>
<tr>
<td>Horizontal Clearance</td>
<td>Mowed grass next to tread</td>
</tr>
</tbody>
</table>
Trail Type E – Exercise/Fitness (Resilient Track)

Also see Trail Type F and Trail Detail 13-Signs
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.

Trail Type F – Biking

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

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

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

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

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

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
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.

<table>
<thead>
<tr>
<th>Width</th>
<th>3’ min. - 6’ (pair of riders)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface</td>
<td>Soil, gravel, wood chips (not preferred)</td>
</tr>
<tr>
<td>Longitudinal Slope</td>
<td>0 - 12% (prefer 5% max.)</td>
</tr>
<tr>
<td>Cross-Slope</td>
<td>2%</td>
</tr>
<tr>
<td>Radius</td>
<td>Avoid sharp turns</td>
</tr>
<tr>
<td>Sight Distance</td>
<td>50-100’</td>
</tr>
<tr>
<td>Easement Width</td>
<td>Treat + 10’ min.</td>
</tr>
<tr>
<td>Side Slope</td>
<td>Varies</td>
</tr>
<tr>
<td>Vertical Clearance</td>
<td>11’</td>
</tr>
<tr>
<td>Horizontal Clearance</td>
<td>3’ from side of tread, at least 3’ high, then 18” from side of tread above 3’ high</td>
</tr>
</tbody>
</table>
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 Cres, 15-Alignment Tread Dips
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.

Trail Type J – Hiking & Mountain Biking

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

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

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**Trail Type L – Walking & Biking**

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.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
<td>8’ - 25’ (Willamette Greenway esplanade) (prefer 10’ - 12’ for maintenance vehicles)</td>
</tr>
<tr>
<td>Surface</td>
<td>Gravel, asphalt, concrete</td>
</tr>
<tr>
<td>Longitudinal Slope</td>
<td>0 - 3% (to 5% if needed, 8% max.)</td>
</tr>
<tr>
<td>Cross-Slope</td>
<td>1%</td>
</tr>
<tr>
<td>Radius</td>
<td>Varies with design speed: prefer 12mph speed = 95’; 20 mph = 200’ (if pedestrians use allows)</td>
</tr>
<tr>
<td>Sight Distance</td>
<td>150’</td>
</tr>
<tr>
<td>Easement Width</td>
<td>Tread + 10’ min. or code requirement</td>
</tr>
<tr>
<td>Side Slope</td>
<td>Varies</td>
</tr>
<tr>
<td>Vertical Clearance</td>
<td>8’ min (12’ + under bridges)</td>
</tr>
<tr>
<td>Horizontal Clearance</td>
<td>1’ from side of tread</td>
</tr>
</tbody>
</table>
Trail Type L – Walking & Biking

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.
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
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.

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

Forest Park - Leif Erikson near Ridge Trail

Concrete turf block used to provide maintenance access in Vancouver, B.C.
Trail Type N – Fire & Maintenance

Also see Trail Types C, F, and M and Trail Detail 13-Signs
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.
Trail Detail 01 – Cribbed Steps

NOTES:

1. RISE AND RUN OF STEPS SHOULD BE ADJUSTED TO FIT SLOPE OF HILLSIDE, WHILE HOLDING STEP HEIGHT (RISE) CONSTANT IN EACH SERIES OF STEPS.

2. STEEPER SLOPES REQUIRE SHORTER TREADS AND TALLER RISERS. CALCULATE DIMENSIONS WHERE R = RISE AND T = TREAD WITH 2R + T = 26 OR 27

3. USE 2" X 8" AND 4" X 8" LUMBER FOR STEEPER STAIR (7 1/2" RISER)

4. USE ALL 4" X MATERIAL FOR BIGGER SERIES OF STEPS IF POSSIBLE.

BACKFILL WITH CRUSHED 1/2" MINUS GRAVEL, COMPACTED
TWO 2"X6" SIDES ATTACHED TO 4"X6" FRONT WITH THREE GALVANIZED LAG BOLTS

CROSS SECTION

TWO 16" X 1/2" DIA. REBAR, APPROX. 6" FROM ENDS

IF DRILLING FROM SIDE IS CONSTRAINED, USE LAG BOLTS FROM FRONT INTO WIDER SIDE BOARDS

CRIBBED STEPS WITH 5 1/2" RISERS
NOT TO SCALE
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.
Trail Detail 02 – Timber Steps

NOTES:
1. RISE AND RUN OF STEPS SHOULD BE ADJUSTED TO FIT SLOPE OF HILLSIDE, WHILE HOLDING STEP HEIGHT (RISE) CONSTANT IN EACH SERIES OF STEPS. THIS EXAMPLE SHOWS 1:2 (RISE:RUN) SLOPE, A 50% SLOPE.

2. LESS STEEP SLOPES REQUIRE LONGER TREADS AND SHORTER RISERS: CALCULATE DIMENSIONS WHERE R = RISER AND T = TREAD WITH 2R + T = 26 OR 27

3. TIMBERS SHOULD BE PLACED ON UNDISTURBED SUBGRADE IF POSSIBLE. IF NOT SUBGRADE MUST BE WELL-COMPACTED.

4. TIMBERS SHALL BE TREATED WITH WOOD PRESERVATIVE AS REQUIRED BY SPECIFICATIONS.

BACKFILL WITH CRUSHED 
1/2" MINUS GRAVEL, COMPACTED

24" X 1/2" DIA REBAR, COUNTERSUNK

CHAMFER LEADING EDGE

TRAIL AT MAXIMUM SLOPE:

MAXIMUM SLOPE
18% HIKING (HIGH CHALLENGE) EXCEPT FOR SHORT SEGMENTS
8% HIKING (MODERATE CHALLENGE)

TIMBER STEPS WITH 7" RISERS

NOT TO SCALE
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.
Trail Detail 03 – Boardwalk

NOTES:

LUMBER (EXCEPT RAILINGS AND DECKING) TO BE CEDAR OR DOUGLAS FIR. DOUGLAS FIR TO BE PRESSURE-TREATED CUPERM (COPPER NAPHTHALATE). PLASTIC LUMBER OR OTHER MATERIALS MAY BE USED DEPENDING ON SITE CONDITIONS. CONSULT APPROPRIATE SPAN TABLES FOR DIFFERENT COMBINATIONS OF STRUCTURAL AND DECKING MATERIALS AND BLOCK AS NEEDED. DIMENSIONS AND FASTENERS WILL BE ADJUSTED AS NEEDED OR RECOMMENDED BY SUPPLIERS.

FASTENERS TO BE 16 PENNY GALVANIZED BOX NAILS FOR DECKING, 16-20 PENNY GALVANIZED COMMON NAILS FOR STRUCTURE. SUBSTITUTE APPROPRIATE NAILS IF POWER IS AVAILABLE.

HELICAL PIERS OR PIN FOUNDATIONS MAY BE USED INSTEAD OF PIER BLOCKS, DEPENDING ON SITE CONDITIONS.

MAXIMUM ALLOWABLE SPAN FOR BEAMS (TABLE 460-4, TYPE B SAWER STANDARDS FOR LANDSCAPE ARCHITECTS)

- 4" x 6" beam: up to 6' span (beams 4" to 6" apart)
- 3" x 8" beam: up to 8' span (beams 4" to 5" apart)
- 3" x 6" beam: up to 10' span (beams 4" to 6" apart)
- 3" x 4" beam: up to 12' span (beams 4" to 6" apart)
- 4" x 2" beam: up to 12' span (beams 4" to 6" apart)

ALLOWABLE SPAN FOR 2" x 6" DOUGLAS FIR DECKING + 6/4" (TABLE 460-37)

- 4" x 6" beam: up to 6' span (beams 4" to 6" apart)
- 3" x 8" beam: up to 8' span (beams 4" to 5" apart)
- 3" x 6" beam: up to 10' span (beams 4" to 6" apart)
- 3" x 4" beam: up to 12' span (beams 4" to 6" apart)
- 4" x 2" beam: up to 12' span (beams 4" to 6" apart)

EXTEND KICK RAIL WITH LOGS, ROCKS, ETC. FOR VISUALLY IMPROVED USERS

HELMICAL PIER TO FILL INholes EXCAVATION

METAL 4" BRACKET

2" x 4" KICK RAIL, 4" LONG, 4" BLOCKS 3" O.C.

COMPACTED BACKFILL OR CRUSHED AGGREGATE LEADS UP TO BOARDWALK

3" x 6" PRECAST CONCRETE CEMENT PIER BLOCK BASE PLACED OUTSIDE CHANNEL ON UNDISTURBED SUBGRADE OR COMPACTED AGGREGATE

BOARDWALK

NOT TO SCALE
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).
NOTES:
LUMBER (EXCEPT RAILINGS AND DECKING) TO BE CEDAR OR DOUGLAS
FIR. DOUGLAS FIR TO BE PRESSURE-TREATED CUPERC (COPPER
NAPHTHALENE) PLASTIC LUMBER OR OTHER MATERIALS MAY BE
USED. DEPENDING ON SITE CONDITIONS, CONSULT APPLICABLE SPAN
TABLES FOR DIFFERENT COMBINATIONS OF STRUCTURAL AND DECKING
MATERIALS AND BLOCK AS NEEDED. DIMENSIONS AND FASTENERS
WILL BE ADJUSTED AS NEEDED OR RECOMMENDED BY SUPPLIER.
FASTENERS TO BE 16 PENNY GALVANIZED BOX NAILS FOR DECKING,
16-20 PENNY GALVANIZED COTTON NAILS FOR STRUCTURE.
SUBSTITUTE APPROPRIATE SCREWS IF POWER IS AVAILABLE.

MAXIMUM ALLOWABLE SPAN FOR BEAMS
(TABLE 460-6 TYPE BEEF STANDARDS
FOR LANDSCAPE ARCHITECTS)

4" x 6" BEAM
3" x 8" BEAM
3" x 10" BEAM
4" x 6" BEAM
4" x 8" BEAM
4" x 10" BEAM

ALLOWABLE SPAN FOR 2" x 6" DOUGLAS FIR DECKING
+ 64" (TABLE 460-3)

2" x 4" KICK RAIL
ON 4" LONG
4" x 4" BLOCKS
3" G.C.

COMPACTED BACKFILL
LEADS UP TO BRIDGE

2" x 2" PRECAST CONCRETE
CINDER BLOCK BASE
PLACED OUTSIDE CHANNEL
ON UNDISTURBED SUBGRADE
ON COMPACTED AGGREGATE

SECTION

PLAN

CROSS-SECTION

BRIDGE

NOT TO SCALE

Trail Detail 04 – Wood Bridge
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.
Trail Detail 05 – Wood Bridge with Railing

NOTES:
LUMBER (EXCEPT RAILINGS AND DECKING) TO BE CEDAR OR DOUGLAS FIR. DOUGLAS FIR TO BE PRESSURE-TREATED CUPERTIC (COPPER NAPHTHALES). PLASTIC LUMBER OR OTHER MATERIALS MAY BE USED, DEPENDING ON SITE CONDITIONS. DIMENSIONS AND FASTENERS WILL BE ADJUSTED AS NEEDED.

THE ENVIRONMENTAL PROTECTION AGENCY PROHIBITS USE OF CHROMATED COPPER ARSENIC (CCA) UNLESS SKIN CONTACT IS POSSIBLE, SUCH AS RAILINGS.

FASTENERS TO BE 16 PENNY GALVANIZED SINK NAILS FOR DECKING. 8-10 PENNY GALVANIZED COMMON NAIL FOR STRUCTURE.

MAXIMUM ALLOTTABLE SPAN FOR BEAMS (TABLE 460-6, TYPE II REINFORCEMENT STANDARDS FOR LANDSCAPE ARCHITECTS):
- 4" x 6" BEAM
  - UP TO 6 SPANS (BEAMS 4" TO 6" APART)
- 4" x 8" BEAM
  - UP TO 10 SPANS (BEAMS 4" TO 6" APART)
- 6" x 6" BEAM
  - UP TO 12 SPANS (BEAMS 4" TO 6" APART)

ALLOWABLE SPAN FOR 2" x 6" DOUGLAS FIR DECKING + 6" (TABLE 460-5):
- 4" x 6" BEAM
  - UP TO 8 SPANS (BEAMS 4" TO 6" APART)
- 4" x 8" BEAM
  - UP TO 10 SPANS (BEAMS 4" TO 6" APART)
- 6" x 6" BEAM
  - UP TO 12 SPANS (BEAMS 4" TO 6" APART)

SECTION

BRIDGE WITH RAILING

NO SCALE
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.
Trail Detail 06 – Erosion Control at Bridge

- Erosion Control at Bridge
  - No Scale

- 12" x 12" Precast Concrete Cinder Block Base, Placed Outside Drainageway, Excavation Primed
- Provide Landing Size to Slope Slightly Away From Bridge
- Min. 8 ft long if bridge to be used by bicycles or horses
- Decking Removed to Show Location of Mulch on all Disturbed Soil
- All Disturbed Soil Below Trail is Heavily Mulched with Leaves and Turf from Trail Clearing Work to Stabilize Soil and Prevent Revegetation
- Trail Side Slope Drains Water Across Trail Rather Than Along Length
- Protect Existing Leaf Litter and Vegetation
- Centerline of Drainageway (Seasonal Flow)

Notes:
- If water flow is likely, consider use of seed mix or similar product in drainageway.
- Add additional erosion control blankets or wattles at toe of fill, if needed.
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.
Trail Detail 07 – Trail with Swale & Culvert
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

Axonometric View

NOTES:
1. USE CAUSEWAY WHERE STEEPS RESULT IN POORLY DRAINED TRAIL
2. SIZE SIDE DITCHES AND LEADOFF DITCH AS NEEDED TO KEEP TRAIL SURFACE UsABLE.
3. ADD CROSS-TRAIL DRAIN PIPE AS NEEDED.
4. STABILIZE SIDE AND LEADOFF DITCH WITH WATTLES OR EROSION CONTROL Blankets, AS NEEDED.

CRUSHED ½” MINUS
COMPACTED GRAVEL W/ ON-SITE SOIL (IF SUITABLE)
MIN. 4” X 6” WOOD SPECIFIED AS GROUND CONTACT (TREATED W/ 0.2% C.C.A. OR SPLIT CEDAR)
GEOTEXTILE ON COMPACTED SUBGRADE

NOT TO SCALE
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.
Trail Detail 09 – Trail with Infiltration Trench
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.
Trail Detail 10 – Trail on Levee

NOTES:
1. Stake alignment, all curves to be smooth with gradual transitions. Limits of construction not to exceed 1/° 13’ wide.

2. Verify critical levee section with Peninsula Drainage District No. 2 (PDD No. 2). DO NOT DISTURB CRITICAL LEVEE SECTION.

3. Excavate and remove existing topsoil (depth to be field verified). Maintain clean, crisp edges. Remove all organic materials. Limit disturbance area to the minimum. Alternate construction shall be approved by the City of Portland and PDD No 2.

4. Level top of levee to provide uniform slope, grade and width. Recompact the existing subgrade to minimum 90% Standard Proctor. Notify Owner’s Representative when subgrade is substantially complete in order to receive approval prior to placing crushed rock.

5. Treat subgrade with approved herbicide or alternate approved treatment.

6. Provide new, approved geotextile fabric under crushed rock in accordance with manufacturer’s directions.

7. All materials and construction shall be per Portland Parks and Recreation specifications.

8. Install and maintain erosion prevention and sediment control measures per City of Portland standards.

9. All excess materials shall be placed in approved, designated areas as approved by the Peninsula Drainage District No. 2 and the City of Portland.
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.
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.
Trail Detail 12 – Porous Asphalt Trail

NOTES:
1. MIN. CURVE RADIUS = 95’ FOR 12 MPH
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)

45° EDGE OF ASPHALT
FINISH GRADE AT LAWN HOLD ½” BELOW TOP OF ASPHALT PATH
OPEN GRADED ASPHALT PAVING 2% MAX. CROSS SLOPE
COMPACT CRUSHED ROCK AGGREGATE BASE AS SPECIFIED
COMPACT SUBGRADE AS SPECIFIED, SLOPE 2% MIN. FOR POSITIVE DRAINAGE

POROUS ASPHALT TRAIL
NO SCALE
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.
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
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.
Trail Detail 14 – Alignment Tread Crests

Also see Trail Detail 15-Alignment Tread Dips
ALIGNMENT TREAD DIPS

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Trail Detail 15 – Alignment Trail Dips

Also see Trail Detail 14-Alignment Tread Crests
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.
Trail Detail 16 – Removable Bollard

- Weld cap to post
- 1/4" all sides
- 4" galv. tube steel bollard
- Weld 3/8" galv. steel "U" to bollard
- 4 1/2" galv. tube galv. collar, weld to post
- 3/8" galv. steel "U" welded to sleeve
- 10" long galv. chain, attach to "U" on collar
- 4 1/2" x 4 1/2" x 3/8" tube steel sleeve
- Conc. pavement
- Finish grade at drive
- Concrete footing
- 1/2" x 1 1/2" rod (2 sides) weld to sleeve
- Drain rock
- Compacted subgrade

Removable Bollard

No Scale
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:

Good cribbing is often used to reinforce a bank that has failed or might fail either above or below a trail.

PROPOSED TRAIL SURFACE PER SPEC:

4’ x 4’ P.T. "DEADMAN" KEY INTO UNDISTURBED HILLSIDE

4’ x 6’ P.T. TIMBER KEY INTO UNDISTURBED HILLSIDE

10” HOT-DIPPED GALVANIZED SPIKE

NATIVE SOIL OR IMPORTED FILL, COMPACTED

EXISTING GRADE, UNDISTURBED

CROSS SECTION

4’ O.C., MAX

ELEVATION

18” 3/8” - 1/2” REBAR TO PIN "DEADMAN" TO UNDISTURBED HILLSIDE

CRIBBED RETAINING WALL

NOT TO SCALE
Appendix A – References

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