SECTION 7. DESIGNING WITH NATURE

This Plan's goal is to create a sustainable system of off-road trails and facilities. However, the placement and use of any trail for any type of user may have ecological impacts.

The best practices in this section are consistent with industry standards established by the U.S. Forest Service and International Mountain Bicycling Association. They also align with the design guidelines and standards for trail construction established in existing Portland Park & Recreation and Bureau of Environmental Services plans and policies. Additional best practices related to construction and stewardship can be found in Section 8. Developing a Successful System.

Mitigation Hierarchy

Siting of trails and facilities should follow the mitigation hierarchy of avoidance of impacts, minimization of unavoidable impacts, and rehabilitation/restoration of resources through mitigation. This is the accepted best practice for protecting and restoring ecological health.

The mitigation hierarchy should be applied at both the system planning and site planning scale. Citywide planning should consider potential impacts, and ways to avoid/minimize/mitigate these impacts at a high-level scale. Site planning efforts should take a more detailed and nuanced approach to avoid/minimize/mitigate impacts to individual features or species on a given site. For each site, application of the hierarchy should be based on the location's particular ecological function and value, the uniqueness of the resource within the City and region, and the area's use by resident and migratory species.

Avoid

A primary approach to achieving such a system is to site facilities to avoid ecologically sensitive areas. Trails and facilities should avoid adverse impacts or result in net ecological benefits in areas with the highest ecological function and value. The City has mapped a variety of natural resources and habitat areas in documents like the Natural Resource Inventory (NRI) and Terrestrial Ecology and Enhancement Strategy (TEES). For example, the TEES defines special habitat areas as including oak woodland; interior forest; riparian, herbaceous and forested wetlands; and prairie. Various agencies and organizations have also identified fish and wildlife species of concern, including Endangered Species Act listed and threatened species, Special Status Species, and other at-risk species lists.

Bike Parks

The best practices in this section focus primarily on design of trails, rather than bike parks. Bike parks are more commonly located in developed park and recreation areas (as opposed to natural areas). Thus, they typically have fewer environmental constraints that demand best management practices. However, bike park design does need to consider potential soil erosion, water resource requirements, and risk management best practices among others.

Where appropriate, the City should prioritize trail development on sites with existing disturbance, such as low value natural areas that have been degraded, over development in higher value resources. Degraded areas offer a potential 'win-win' combination of potential environmental restoration and new compatible recreational access.

Minimize

To limit overall environmental impacts in other ecologically sensitive areas or in areas the City has prioritized for restoration, use best practices that minimize overall trail density. These include the

use of shared-use trails and 'east coast style' tight loop trail systems. Tight loop systems result in high trail densities in a small area, provide longer trail lengths in a minimal area, thereby minimizing the overall area impacted.

In other areas, plan any new trail alignments or trail management activities to result in the least adverse impact to sensitive fish and wildlife and their habitat areas.

Mitigate

Mitigation of unavoidable impacts generally includes efforts to enhance natural resources and functions in adjacent or nearby areas. This might include restoration activities, such as revegetation strategies, creating new habitat, or decommissioning nearby low-performing or unsanctioned demand trails.

PROPERLY DESIGNED AND DEVELOPED TRAILS CAN LIMIT NEGATIVE IMPACTS AND ENHANCE THE NATURAL AREA. THE VALUE OF BEING ABLE TO ACCESS TRAILS WITHOUT THE USE OF SINGLE OCCUPANCY VEHICLES CANNOT BE OVERSTATED.

- COMMUNITY MEMBER

Related Recommendations

Design with Nature

1. Apply ecologically sustainable best management practices and applicable Natural Resource Management Plans to the siting, design, construction, and maintenance of off-road cycling trails and parks.
2. Site and design trails and facilities according to the mitigation hierarchy of avoiding, minimizing, and then mitigating negative impacts.
3. Develop and maintain local design and management guidelines and construction specifications that reflect acknowledged best management practices and current science.
4. Pair enhanced recreational access with restoration of habitat, streams, and other natural resources.
5. Improve or decommission and restore existing trail segments that are unnecessary, poorly designed, unsustainable, or which negatively impact areas with the highest ecological function and value.
6. Locate off-road cycling parks (such as pump tracks) in developed parks, ideally in areas with no ecological value.

Soil and Water Resources

Available research indicates that off-road cycling, when limited to established trails, has a similar impact on soils to hiking, and a lower impact than horseback riding. Keeping use on established trails is critical – the frequency of unpermitted off-trail activity by users was the greatest cause of adverse soil impacts.

More generally, trail design and landscape factors may have more potential to affect soils than the nature of the trail activity. For example, trails with slopes greater than 12% are strongly correlated with significant increase in impacts to soil and vegetation. Cross-slope trails also have lower erosion and runoff potential than fall line trails.

Erosion can cause trails to introduce soils, nutrients, and pathogens to nearby waterways and can increase water turbidity and sedimentation. Poorly designed trails can also alter the way water drains across the landscape and can divert water that serves important ecological functions.

To avoid and limit impacts to soil and water resources, trails should be planned, designed, and managed based on best practices for natural stormwater management.

Best Practices for Natural Stormwater Management

Trail design can minimize soil erosion and help protect water resources. The following best management practices align with those established by the U.S. Forest Service and those included in the River View Natural Area Management Plan.

Trail Alignment

Trails should be designed to avoid/minimize negative impacts, such as soil erosion, on streams, wetlands and other water resources through careful consideration and design of the stormwater flow path. First, avoid siting trails on level terrain and/or areas with incompatible soil types. Such precautions can prevent trails that easily become muddy, erosive, and challenging to users. Secondly, design rolling contour trails to enhance natural overland drainage and reduce soils erosion.

Tread Width

To reduce potential soil erosion, trail tread width should be kept to a minimum. This may be accomplished by constructing narrower trails or by narrowing existing trails to reduce the overall trail footprint. However, the width of a trail is a key factor that determines the associated recreational trail experience; as such, trail width, desired recreational experience, and soil suitability should all be considered in concert when siting trails.

Rolling Contour Trails

These trails are designed to follow the elevation contours of hillsides to encourage sheet flow of water across the trail. To minimize erosion, facilitate natural drainage patterns, and provide a fun trail experience, trails should maintain a 5-7% average running grade (i.e., the grade longitudinally along the trail) – or no more than half the grade of the side slope – and include frequent grade reversals. Grade reversals are short dips followed by a slight rise to allow water to drain off before it can gain volume and speed. Trail tread (or cross slope) should tip downhill or outslope (about 5 percent). Blending the trail's "backslope" (uphill slope) to the hillside's angle of repose will further encourage proper drainage. Developing rolling contour trails (as opposed to fall-line trails that follow the shortest route down a hill) with the following characteristics is a key element in developing environmentally sustainable trails that provide and enjoyable trail experience for users.

Full Bench-Cut Trail Construction

This type of trail involves cutting the trail tread into the uphill side of the slope and providing a solid, long-lasting and stable trail tread by retaining the lower edge without impacting native compact soils and existing well-rooted plants. Cut slopes soils should be broadcast thinly across the downslope over a larger area so as not to suffocate the roots of existing plants.

Slope rules - half rule and 10% grade, maximum grade

Trails should be aligned parallel to terrain contours, and a trail's grade should not exceed half the grade of the hillside or side slope that the trail traverses (half rule). An average grade of less than 10 percent (ideally 5-7%) should be maintained (10% rule) to minimize erosion of the trail surface, accommodate undulations and to provide the majority of trail users with a rideable trail gradient. Maximum trail grade is typically 15 to 20 percent in relatively low-use areas (lower in high-use areas), however it is site specific and the trail should comply with the half rule and take into consideration variables such as soil type, user density, annual rainfall and difficulty level of the trail. In general, limit maximum grades and sustained grades, and include frequent grade reversals along the trail to provide frequent drainage relief.

Edge Protection

Edge protection involves the placement of rocks or other materials to support the edge of a trail. Edge protection should be provided only when conditions warrant it (such as a steep drop off). In general, edge protection may reduce sheet flow and increase erosion and trail maintenance. If used, edge protection should use native vegetation and natural features such as rocks and logs that blend with the natural environment, installed in a manner to facilitate sheet flow.

Trail Hardening or Armoring

Trails can be hardened to prevent erosion, stabilize steep sections of contour trail, cross low-lying muddy or sandy areas and to toughen high use areas. Each scenario may require a different trail hardening technique. Considerations include whether the erosion is caused by users or water, available materials, access to the site, or trail use patterns (e.g. high traffic vs. low traffic). IMBA's Trail Solutions describes each method of trail hardening. The preferred technique is rock armoring, because it is long-lasting, uses natural materials and is aesthetically pleasing.

Trail hardening in bike park facilities can prevent soil erosion and reduce maintenance requirements, but can also make it harder to update the layout and construction of park features over time.

Related Recommendations

Soil and Water Resources

1. Locate trails to avoid crossing streams, wetlands, and floodplain areas. Where no avoidance alternatives exist, design and construct trails to minimize and mitigate for impacts and follow applicable best management practices.
2. Site and design trails using best management practices for natural stormwater management to minimize soil erosion and help protect water resources.
3. Develop and implement specifications for low impact trail crossings of streams and drainages, based on best practices.

Vegetation

All trail-based recreational activities have the potential to negatively impact vegetation, especially on unestablished trails.

Most vegetation impacts occur with initial trail construction, as building a trail often requires the removal of vegetation within and adjacent to the planned trail route. Disturbed landscapes can also set the stage for invasive vegetation. Trails should be sited and designed to minimize the removal of native vegetation. When removal cannot be avoided, revegetation strategies should mitigate for this impact.

Once trails are constructed, there is a diminishing increase in vegetation impact with increasing trail use. Instead, accelerated soil erosion becomes the primary impact and trails should be designed to minimize erosion (see Soil and Water Resources, page **). Off-trail use by any type of user can cause also cause trampling or damage to vegetation.

Related Recommendations

Vegetation

1. Pair construction or improvement of trails with vegetation restoration through removal of invasive species and the planting of native vegetation.
2. Manage vegetation immediately adjacent to trails in concert with recreational access and safety (for example, vegetation may need to be pruned to allow safe clearances for trail users.
3. Use targeted plantings or fencing to deter trail users from venturing off-trail into sensitive areas.

INSERT Gateway Green Example

(paired restoration and trail development)

Wildlife and Habitat

Minimizing wildlife disturbance

Wildlife disturbance from recreational trail use can extend much further into natural landscapes than other forms of trail impacts, which tend to be limited to the narrow trail corridor. Existing research on wildlife impacts focuses on a limited set of bird and mammal species, and the results appear to differ depending on the species studied. For some species, disturbance from mountain biking trail use on foraging and nesting behavior may be minimal, but fragmentation and alteration of habitat by trails may reduce quality of nesting habitat.

Additional research on the impacts of recreational use generally, and off-road cycling specifically, on wildlife and habitat is needed. There also a need for additional research on the cumulative impacts of recreational activities in natural areas, both urban and rural.

Best Practices

Wildlife impacts of recreational trails and activities are species- and site-dependent. As such, it is important to understand the extent and needs of resident and migratory species on a planned site. Wildlife impacts can be reduced by avoiding sensitive or critical wildlife habitats, including riparian corridors and wetlands. Other strategies, such as seasonal closures during migratory, nesting, or mating seasons can reduce impacts during critical times.

Maintaining habitat quality and function

Maintaining habitat quality and function relies on avoiding or minimizing impacts to overall habitat patch size, fragmentation and edge effects.

Best Practices

There are many ways to site and design trails to help maintain habitat quality and function:

- Route trails to avoid particularly sensitive areas.
- Where trails are near habitat, establish habitat buffers – based on the type of resource and presence of wildlife species - to avoid impacts to sensitive ecological and hydrological systems.
- Locate trails at habitat edges, to avoid disturbance to intact interior habitats.
- Restore disturbed edge habitat by replacing invasive plants with natives.

In addition, trail corridors can be narrowed to improve habitat function, where opportunities exist.

Related Recommendations

Wildlife and Habitat

1. Site and design trails using best management practices to maintain and improve habitat connectivity and limit impacts to wildlife.
2. Use adaptive management strategies, such as seasonal closures during migratory, mating or nesting seasons, where trail use would adversely impact species of concern.
3. Continue and expand monitoring of natural resources and fish and wildlife populations in the City's parks and natural areas. Use monitoring data to inform trail siting, design, and management.