遠築徑
Trail Building @ Country Parks

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Agriculture, Fisheries and Conservation Department

Challenges Along the Journey (Part 1)

Natural Trail Degradation

Country park trails, winding through peaks and valleys, form some of the most inviting landscapes in Hong Kong. However, these cherished trails face significant threats from natural degradation. Over time, factors such as erosion, weathering, and recreational activities can deteriorate trail conditions, turning them into increasingly challenging terrains. Such changes affect the aesthetics and accessibility of trails, as well as the surrounding ecosystems.

Like all things in nature, trails exposed to rainfall and soil loss must confront the challenge of "degradation."

Challenges from Natural Degradation

The most significant threats to trails arise from natural erosion and human activities. Water, specifically rainwater, is the major "enemy" among all the natural factors that cause the deterioration of trail conditions.

Hong Kong's subtropical climate brings abundant rainfall. According to data from the Hong Kong Observatory, its annual rainfall typically ranges between 2,000 mm and 2,500 mm, with approximately 80% occurring between May and September. The months of June and August often see monthly totals exceeding 400 mm, which frequently accompanied by tropical cyclones from April to November.

Water is a fundamental element for nourishing the earth; however, excessive rainwater can cause significant damages to our trails and its network in country parks.

In recent years, extreme weather events, such as prolonged heavy rain and sudden bursts of intense rainfall, have become more frequent. These events can cause devastating impacts to the country parks as well as their trail network. For example, Hong Kong experienced an unprecedented extreme rainfall event in September 2023, and prompted the Observatory to issue a black rainstorm warning for over 16 hours. This record-breaking rainfall caused significant damages to many country park trails, resulting in several trail closures due to landslides, fallen rocks, and uprooted trees.


Tree Failure – Tai Tam Country Park


Landslide – Ma On Shan Country Park

How Does Rainwater Affect Trails?

The impacts of rainwater on trails should not be overlooked. It can lead to various trail problems, making surfaces uneven and difficult to traverse. These problem can further affect visitors' behaviours and overall experiences in the country parks.

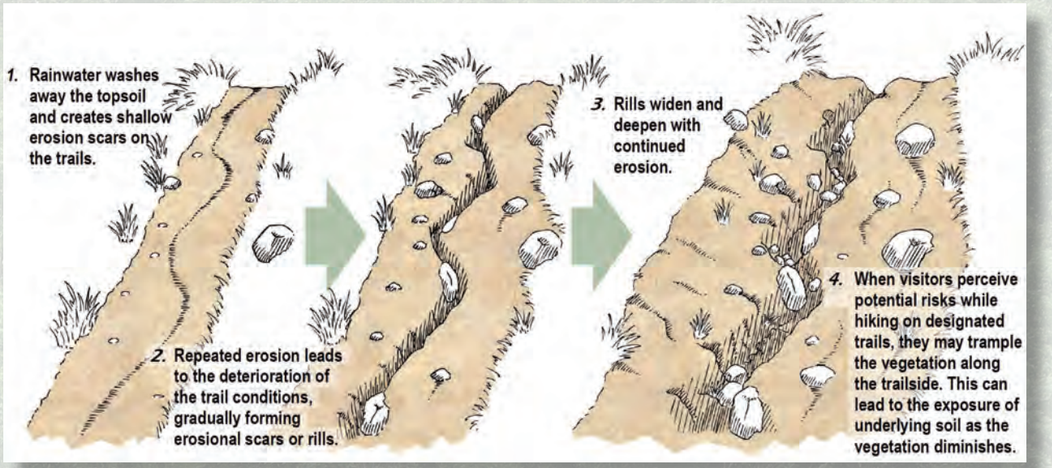
1. Soil Erosion

Prolonged or intense rainfall can wash away the topsoil of trails, leading to soil erosion. Signs of erosion may include rills, slope erosion, trail tread collapse, and tree roots exposure. The steeper the trail gradient, the more susceptible the trail is to erosion, especially when the trail has inadequate or damaged drainage features.

a. Rills and Gullies

When the rate of rainfall exceeds the rate of soil infiltration, surface runoff occurs. It erodes the topsoil and creates shallow rills on the trails. These rills deepen and widen with repeated erosion process. As trail tread conditions deteriorate, visitors may be discouraged from staying on the designated trail treads. Instead, they may trample surrounding vegetation in an attempt to navigate around the undesirable trail conditions. The underlying soil may be exposed to the air and become susceptible to further erosion. When the topsoil is eroded, it can lead to bedrock exposure.

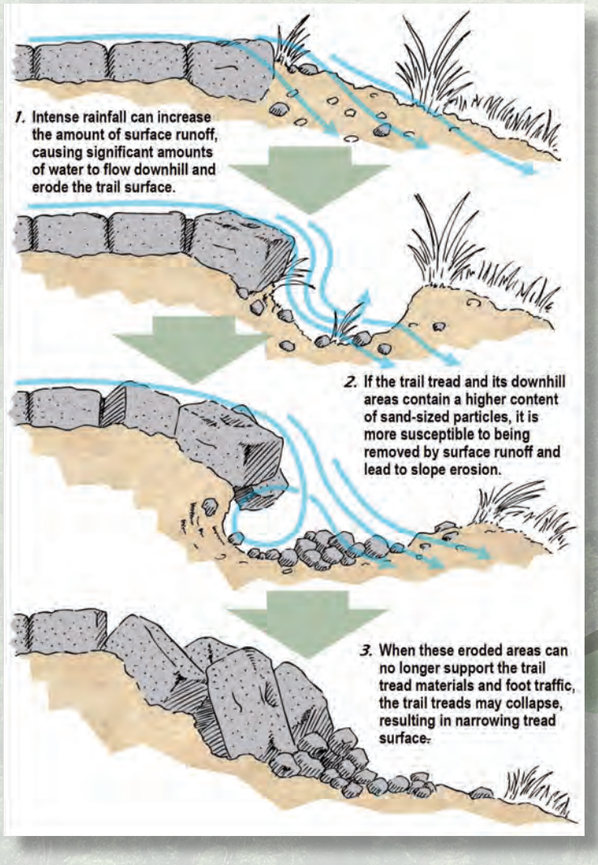
When visitors perceive potential risks while hiking on designated trails, they may trample the vegetation along the trailside. This can lead to the exposure of underlying soil as the vegetation diminishes.




Shallow erosional scar – Eagle's Nest Nature Trail


Rill erosion - Lin Ma Hang Country Trail


Rill becomes widen and deepen. Kai Kung Leng



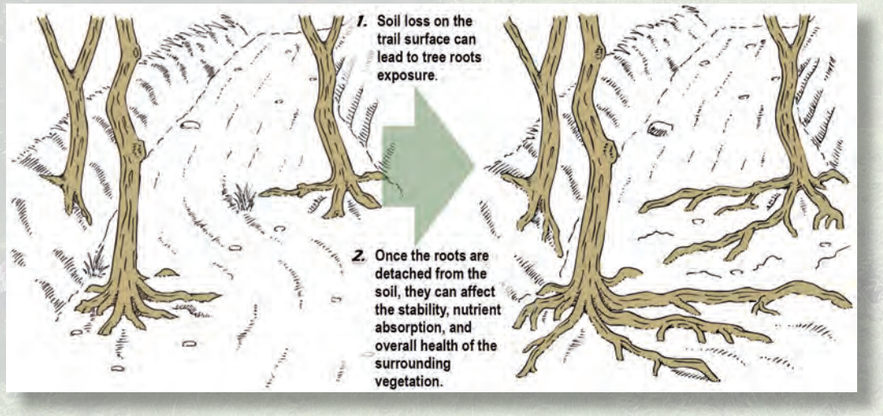
b. Slope Erosion and Tread Collapse

Increased surface runoff flowing downhill can exacerbate erosion on the trail tread, particularly affecting soils rich in sand-sized particles that are more susceptible to being washed away. If erosion continues, the downhill slope of the trail tread will experience significant soil loss. This can lead to trail tread collapse when these eroded areas can no longer support the trail tread materials and foot traffic.

c. Tree Roots Exposure

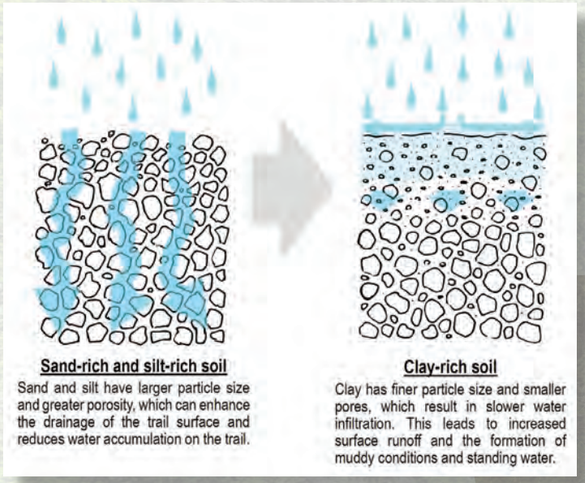
Rainwater can also impact the surrounding natural environment by eroding the topsoil and exposing tree roots that were previously protected by soil. Such exposure hinders the vegetation growth, destabilises the tree's root system and impairs nutrient absorption. It ultimately affects overall health of the nearby vegetation. In severe cases, it can lead to tree mortality or failure. Furthermore, exposed roots pose a safety risk for visitors, such as increasing the risk of trips and falls.


Tree roots exposure – Tai Tam Intermediate Reservoir



2. Muddiness and Standing Water

Light rainfall can make rock surfaces slippery. When rainfall increases, rainwater mixes with soil and create muddy conditions on the trails. This phenomenon is influenced by local geology and soil structure, particularly clay-rich soils with smaller pores that hinder rainwater drainage and reduce the infiltration rate. In some cases, water may even pool on the trails for several days.




Muddiness – Hong Kong Trail Section 1

3. Visitors' Behaviours

The overall trail condition deteriorates when erosion, flooding, muddiness, and exposed tree roots appear on the trail treads. This deterioration can compromise visitors' safety and comfort while navigating the rugged trail conditions. It can also influence how visitor behave on the trails, which could further exacerbate existing trail problems.

For instance, visitors may trample surrounding vegetation or create informal paths to navigate around rugged trail sections. When vegetation is damaged due to trampling, the underlying soil becomes exposed and more susceptible to erosion. This exacerbates soil loss and initiates a vicious cycle, making restoration increasingly difficult and threatening the integrity of the natural environment. The trail impacts related to visitors' behaviours and usage will be discuss in the next Newsletter.


Trail widening – Ma On Shan Country Trail


Multiple Trail Treads - MacLehose Trail Section 8

Mitigating Natural Trail Degradation: Strategies for Prevention and Restoration

Excessive rainfall can significantly contribute to the natural trail degradation. Although we cannot control the weather and rainfall, we can implement measures to prevent or mitigate the erosion.

Prevention: Drainage Facilities to Mitigate Erosion Effects

To mitigate the erosive effects of rainwater and runoff on the trails, thoughtful trail designs and effective drainage facilities are incorporated during trail construction as a proactive measure. The two fundamental principles for effectively draining excess water from the trail are: water naturally flows from higher to lower ground, and the use of natural features, such as trees and large rocks, to redirect water flow. AFCD trail building masters need to observe the local topography thoroughly, and then determine the best locations for constructing drainage facilities and making necessary slope adjustments to mitigate the impacts of rainwater and runoff.

The major purpose of trail drainage facilities is to quickly channel rainwater away from the trail. They can reduce the impacts of rainwater and runoff on the trail surface, and also prevent water accumulation that can lead to pooling or muddy conditions. By efficiently draining rainwater, we can keep the trails safe and walkable. It can ensure the safety of visitors while minimising the damages to the surrounding environment.


Drainage dip with rocks – Twisk Nature Trail


Drainage dip with wood logs – MacLehose Trail Section 4

Restoration: Repair Eroded Trails to Restore Trail Environment

When a trail is damaged by rainwater and runoff, prompt trail repairing work becomes crucial.

Following heavy rainfall events, AFCD frontline staff inspect the trails in country parks and conduct risk assessments. For trails with minor damages, the maintenance team performs simple repairing works, such as clear debris and fallen tree branches. However, if the severe damage is observed or there is a significant risk of further collapse, the trail will be temporarily closed for slope stabilisation or large-scale trail maintenance works.

The maintenance team also employs some restoration techniques in areas suffering from serious erosion, such as check dams, stone baskets, and stone works for root protection. The fundamental principle behind these techniques is to slow down the water flow and capture sediments eroded from the uphill. Over time, the sediments can form a stable platform that can be used as a part of the trail tread surface or as an area for planting vegetation.

These restoration techniques aim to restore the eroded or degraded trail sections, enhance trail appearance and conditions, and facilitate the recovery of the degraded natural landscape.

Check Dams – MacLehose Trail Section 5

Stone Baskets – MacLehose Trail Section 10

Have you ever found any drainage facilities and restoration techniques on the trails while hiking in country parks?

Ingenious Techniques for Trails Protection

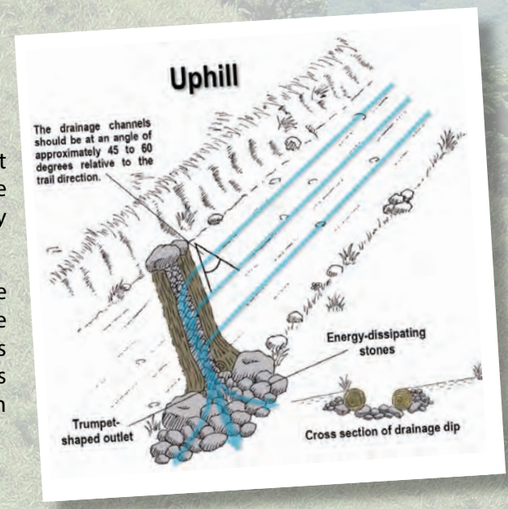
Both water drainage and restoration are equally vital strategies in trail maintenance. By adhering to natural principles, we can implement trail maintenance techniques tailored to the specific environmental characteristics of each site, as well as to utilise natural materials to create features and facilities that preserve and maintain the trails in good condition.

Drainage Design

1. Drainage Dip

This design is particularly suitable for flatter sections of the trail. It involves creating a sunken drainage channel that runs across the trail, which allows surface rainwater to flow in and collect, thereby directing it away from the trail.

In certain situations, it may be necessary to place stones at the bottom of the channels and create a trumpet-shaped drainage outlet. Adding energy-dissipating stones at the outlet helps disperse water energy onto more resilient surfaces. These features can effectively protect both the trail and drainage structure from potential water damage.

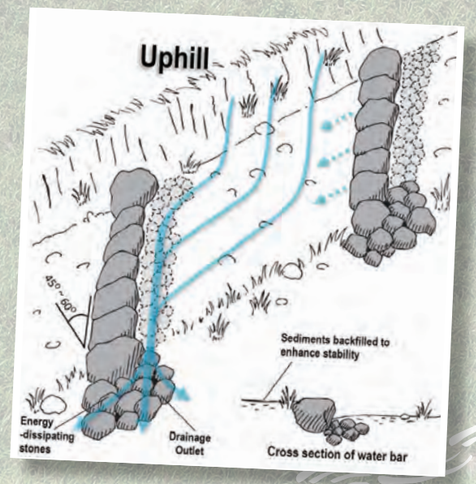


Trumpet-shaped outlet

Drainage dip with wood logs – Tai Lam Country Park

2. Water Bars

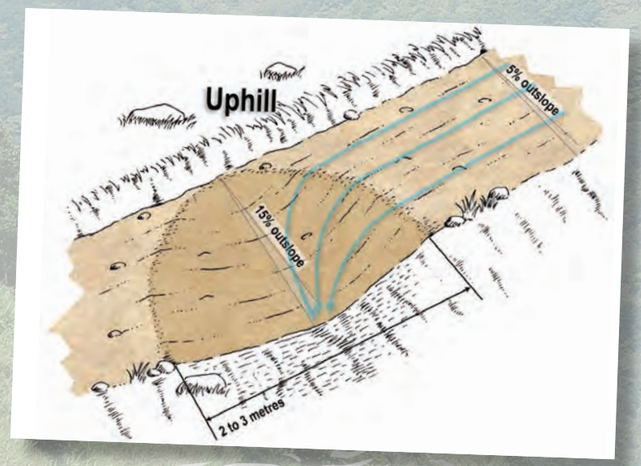
Placing hard natural materials, such as wood logs or stones on the trail surface, can effectively redirect rainwater. As water flows on trail surface and encounters a water bar, its direction changes and guide it off the trail. This design is applicable for both flatter and steeper sections of the trail.



Water bars with rocks – Cheung Sheung Country Trail

3. Fan-Shaped Drainage

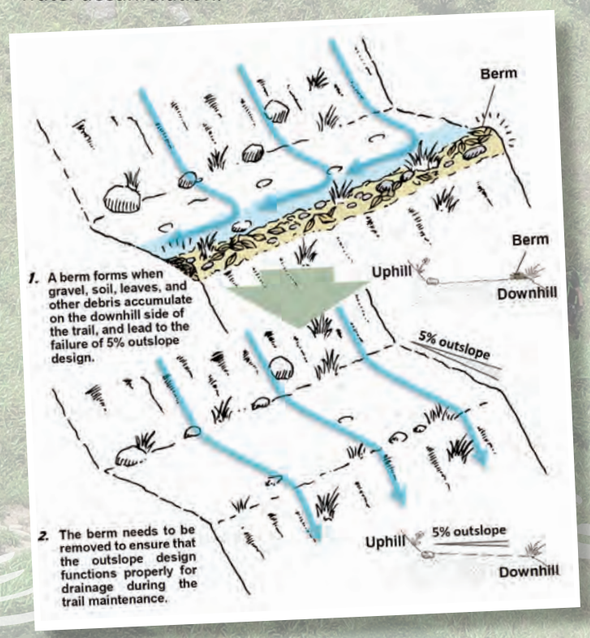
Leveraging the principle of gravity, fan-shaped drainage systems are designed to create a low point at the downhill slope of the trail. This design effectively directs rainwater away from the surface, so as to prevent rainwater from pooling and mitigate the trail problems of muddiness and erosion.

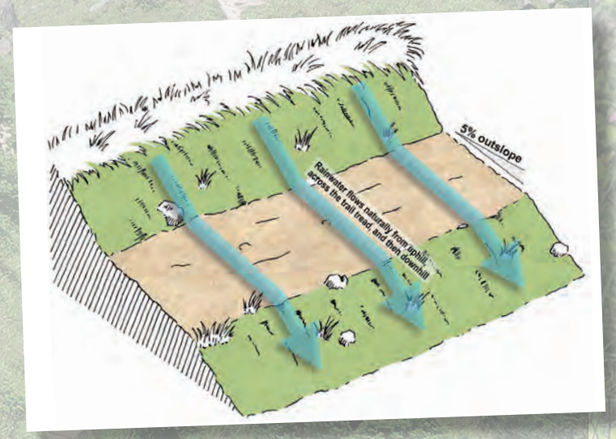


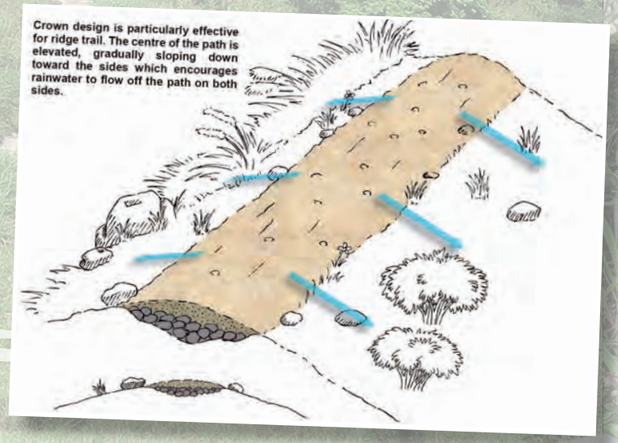

Fan-Shaped Drainage – Hong Kong Trail Section 1

4. Outslope

When constructing trails, it is essential to maintain a slight outward slope of approximately 5% on the surface. This design helps directing rainwater to flow laterally off the trail rather than along the trail direction, thereby reducing erosion and preventing water accumulation.



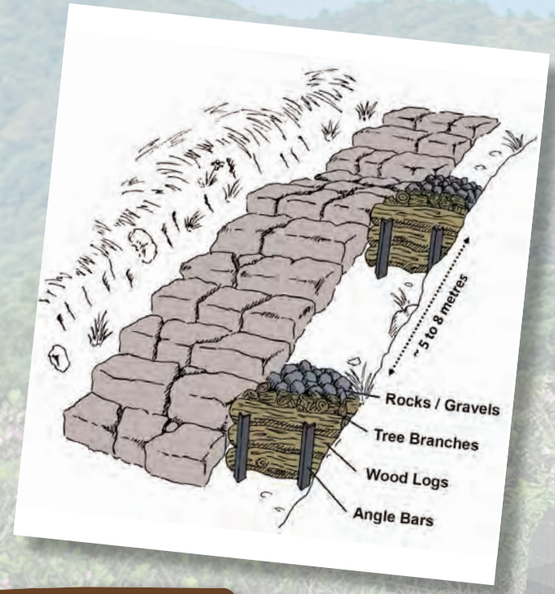




Erosion Restoration Design

1. Check Dams

By placing wood logs, stones and or steel angles in areas where the trail has experienced severe erosion, they can slow down rainwater flow and mitigate the erosive effect of surface runoff. This design helps intercept sediment being washed down and facilitate the deposition of sediment, thereby form a stable platform behind the check dam that can be utilized for vegetation planting and as part of the trail tread.



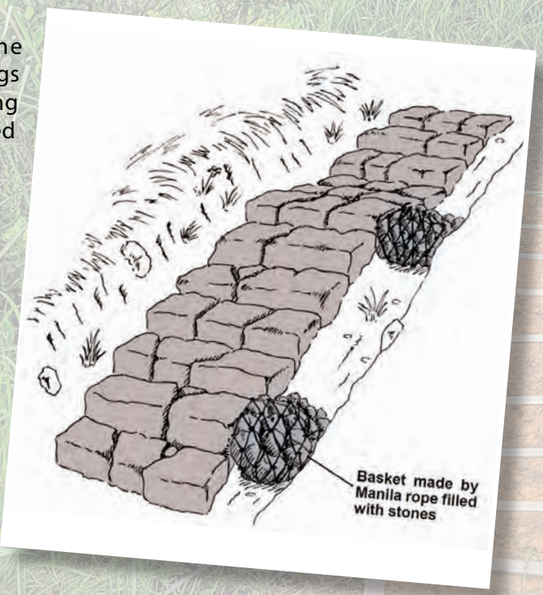

Check Dams – MacLehose Trail Section 10

2. Stone Baskets

This method is similar to the check dam approach but it is more suitable for trail sections that have experienced lighter soil loss along the tread. The size of the stone baskets can be adjusted based on the depth of the erosional scars.

After being in place for some time, these stone baskets assist with soil and stone backfilling. The bags themselves naturally decompose, ultimately leaving behind stones that are stabilised by the accumulated sand and soil.

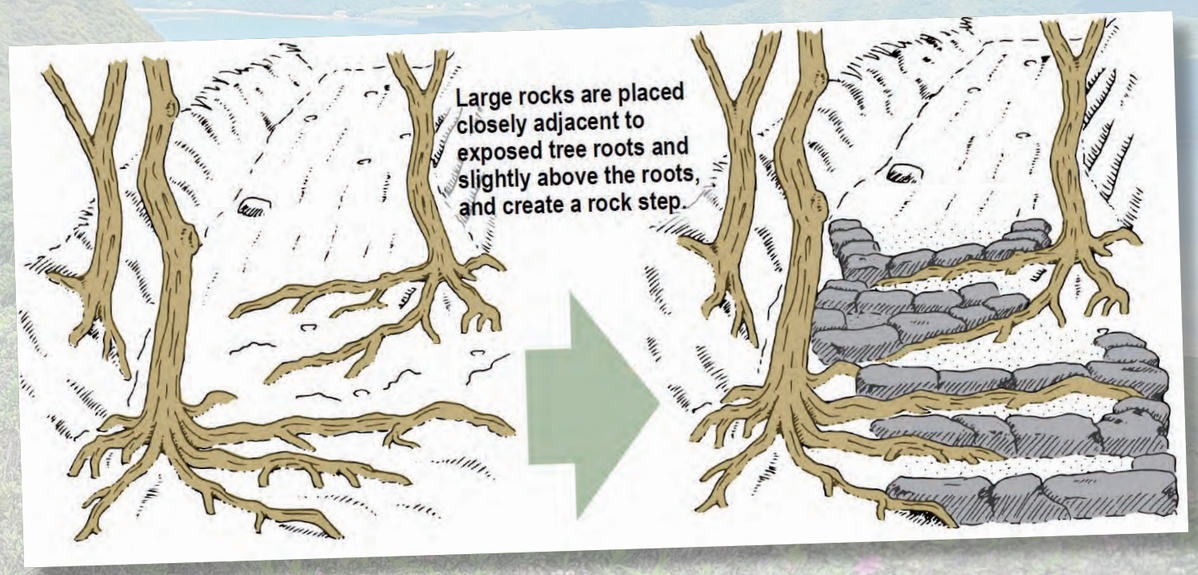

Stone Baskets – Tai Lam Country Park



3. Stone Works for Root Protection

This design involves placing large stones on the uphill side, closely adjacent to exposed tree roots, with a height of approximately 0.5 to 1 inch above the roots, creating stone steps. Suitable-sized stones are then inserted into the gaps between the roots and the soil. This approach protects the exposed roots from trampling and enhances the overall stability of the trail.

Additionally, this deign promotes the accumulation of sand and soil in the gaps between the stones, which allows the exposed roots to reconnect with the soil. This is beneficial for root development and the overall growth of the tree, while also enhancing the safety of visitors walking nearby.



Soil Infiltration Rate:
The velocity at which water penetrates the soil. It refers the soil's capacity to absorb water. Higher infiltration rates indicates better drainage and less surface runoff.

Surface Runoff:
The flow of water that occurs when excess rainwater flows over the ground's surface. It occurs when the rate of precipitation exceeds the capacity of soil infiltration.

Trail Widening:
The process by which a trail becomes wider in width due to erosion, foot traffic, and other environmental factors. This often occurs when visitors stray from the designated trail due to poor conditions, leading to vegetation loss and increased soil exposure.

Multiple Trail Treads:
The phenomenon where several parallel footpaths emerge in an area due to repeated foot traffic. This can result in landscape fragmentation and cause damages to the surrounding natural environment.

Berm:
A raised area of soil, gravel, and leaves that accumulates on the downhill side of a trail. This berm can alter water flow patterns and impact drainage efficiency on the trail.

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