

Appendix I - IMBA Principles of track design and location

IMBA lists 11 principles for designing and locating sustainable mountain bike tracks to allow water to drain off the track and keep users on the track.

1. Locate the track on a sidehill: It is much easier to drain water away from a track located on a slope than one on flat ground, and it is easier to keep users on the track.
2. Avoid the fall line: Tracks should always climb or descend a slope gradually, rather than travelling directly up or down it. Tracks that travel directly up or down hills (fall-line tracks) create a path for water that erodes soil and creates gullies. Riders may then widen tracks by riding around gullies.
3. Use the 'half rule' to guide track alignment: A track's grade should never exceed half the grade of the sidehill it is located on. Grade is the elevation gained divided by the distance of the segment of the track (expressed as a percentage). A track across a sideslope of 20% should not exceed 10%.
4. Follow the 'ten percent average' guideline for sustainable grade: The average track grade is the slope of the track for an entire uphill section. Generally, an average grade of 10% or less is most sustainable.
5. Maximum sustainable grade: typically, the maximum sustainable track grade is about 15% for a short distance, but it is site-specific and varies with track alignment, use of the half rule, soil type, annual rainfall, vegetation, use of grade reversals, type of users, number of users and level of difficulty.
6. Grade reversals: most tracks benefit from grade reversals every 6–16 metres. A grade reversal is a spot at which a track drops subtly and rises again, which forces water to drain off the track.
7. Outslope: most tracks should be built with a 5% outslope. An outslope is a tilt on the downhill or outer edge of the track, which encourages water to sheet across and off the track in a gentle manner instead of funnelling down the track's centre.
8. Adapt track design to soil texture: uniform soils dominated by one particle type such as sand are most sensitive. A mix of different types of soil particles drains well and holds together. The presence of rock and gravel can improve a soil's ability to withstand erosion.
9. Minimise user-caused soil displacement: Soil displacement by users can be reduced by three tactics: consistent flow, insloped turns and armouring. Consistent flow avoids abrupt and inconsistent turns that make riders brake hard or skid. Insloped turns (or bermed turns) improve track flow and reduce skidding. They must be carefully designed to drain water and withstand user impacts. Armouring involves hardening the surface with gravel, rocks, synthetic materials or wooden boardwalks. It can be used to elevate the track tread, especially in soft or wet terrain, or to armour the track against user-caused erosion.
10. Prevent creation of unauthorised tracks: unauthorised track creation can be reduced by having a stable and predictable surface and providing a high quality experience that meets riders' needs.
11. Maintenance: track maintenance, as well as track design, should focus on allowing water to drain off the track and containing users on the track.

Detailed guidelines for implementing these principles are presented in *Trail solutions: IMBA's guide to building sweet singletrack* and *Managing mountain biking: IMBA's guide to providing great riding* (see