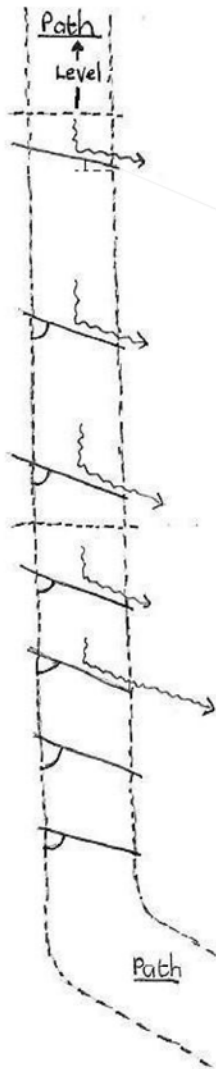


Appendix 1: Drainage – Guide Sheets

1.2a: Waterbars - Where to put them



---Downhill slope starts here---

Put the first waterbar near the top of the slope.

Make an angle of **30-40 degrees** to turn the water in the direction you want it to go.

<---**Repeat** at intervals,* to take water away before it gets faster and more destructive.

---Slope gets steeper---

<---So, put waterbars closer together*

<---- If the ground at the side is flat, a channel should be made to take the water to a slope where it can run away.

Protect a corner with a waterbar as it is vulnerable to erosion.

***How Far Should The Bars Be Apart?**

On a **Steep** slope of >10 degrees: <10m apart.

On a **Medium** Slope of 5-10 degrees: 10m-25m.

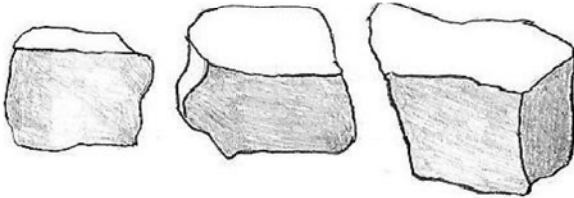
On a **Slight** slope of < 5 degrees: >25m.

These figures are taken from: Upland Path Advisory Group, *Upland Pathwork*, 2:3. Please think of them as advisory only and feel free to make your own decision based on conditions you see on site.

Appendix 1: Drainage – Guide Sheets

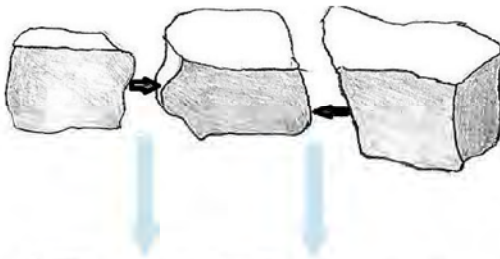
1.2b: Waterbars – selecting the stones

Bring together a selection of stones



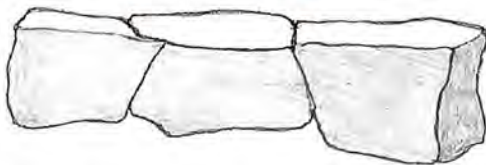
Big and heavy. If you can lift a stone and carry it on your own it is probably too small.

Try to find stones which will have a fairly **flat** face and top.



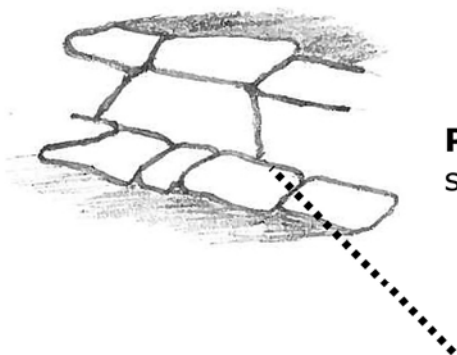
Stones need to fit tightly together or water will get through the spaces between.

Tops should be level to make them safe to walk on.



Try them out on the surface before you start building.

They need to be big enough for half to be buried below the tops of the paving stones.



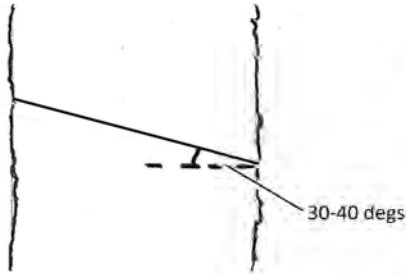
Paving stones should have flat tops, and be thick so water cannot get under them.

They should fit tight against the bar stones and should fit closely together. Joints between paving stones should not be next to joints between bar stones.

Appendix 1: Drainage – Guide Sheets

1.2c: Waterbars – Building the bar stones and paving stones part (i)

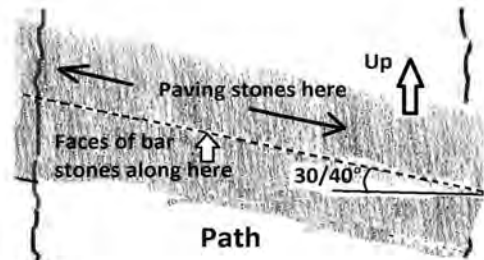
Building the bar stones:



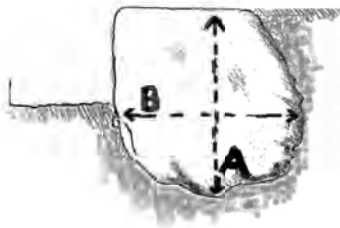
Mark a line across the path where the waterbar will be. Make an angle of 30-40 degrees to turn the water to the side.

Dig a trench along the line, approximately deep enough

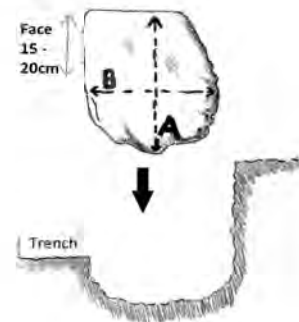
and wide enough for the stones. It should extend beyond the sides of the path by about 30cm.



Measure the first stone and mark the approximate shape of the hole it will need. Make adjustments to the trench so that it will fit.



Measure the stone where it is deepest (A) and widest (B).



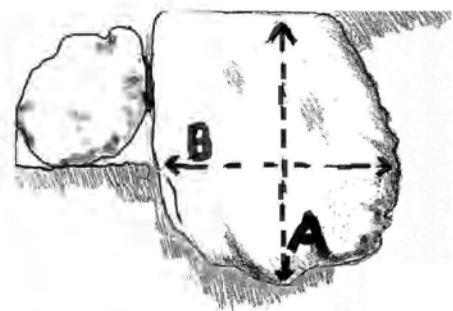
Keep the sides of the hole vertical – or the stone will get stuck and will not drop to the bottom.

Pack earth around it and make it secure.

If necessary, use another stone for temporary support while you work around it.

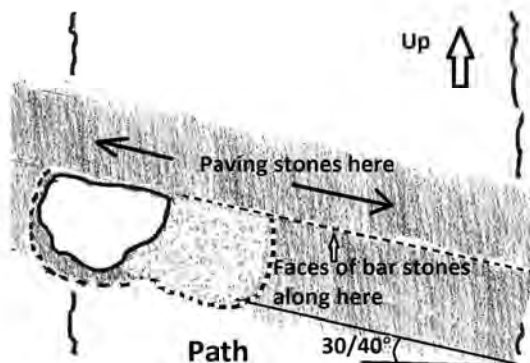
Check: is the face vertical? Is the top level with the path behind it?

(Continued, 1.2d: Waterbars – Building the bar stones and paving stones part (ii); finishing)



Appendix 1: Drainage – Guide Sheets

1.2d: Waterbars – Building the bar stones and paving stones part (ii); finishing



Prepare the hole for the second stone.

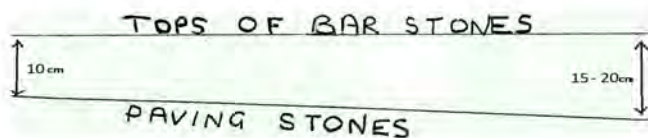
Put the second stone in and check as before. Make adjustments until the tops and faces are in line, and the stones fit tight together.

Repeat until all the bar stones are in.

Paving Stones:

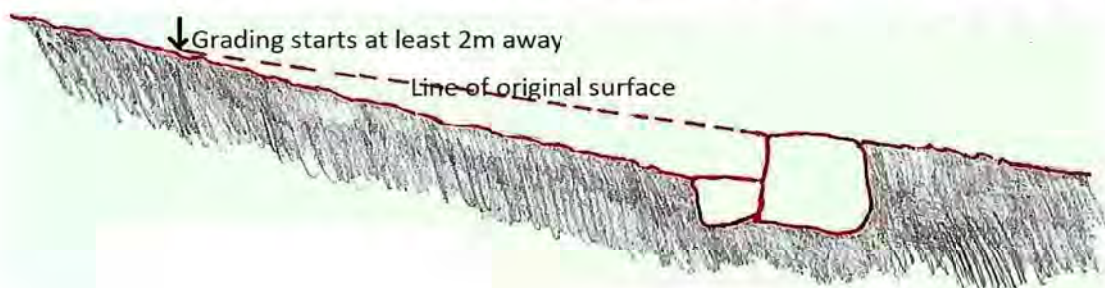
If possible, choose stones which fit together without leaving gaps. It's OK to use a small stone to fill a gap between paving stones if an exact fit isn't available.

The paving stones should slope gently down to the place where the water leaves the waterbar. Start building at the low end and work towards the high end.



Adjust the depth of the trench to get the top of each paving stone to the right height. This will be around 15 - 20cm below the top of the bar stones at the lower end rising to 10cm at the upper end.

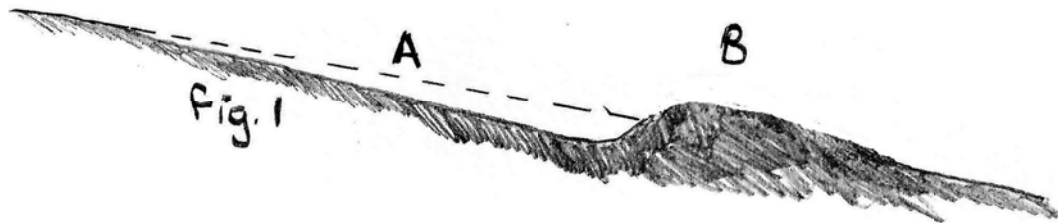
This means the slope is quite gradual. So **don't make it too steep** at the beginning or your stones will get too high too soon. Finally, **grade the path**, i.e. make a gentle slope from the original level of the path to the bar.



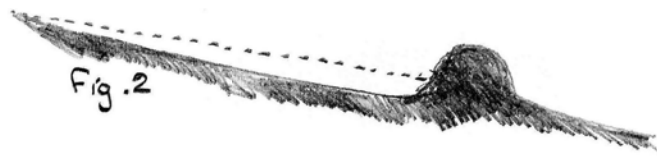
(See also 1:6a - Extra information for building stone waterbars and drains)

Appendix 1: Drainage – Guide Sheets

1.2e: Waterbars– Building an earth bar



Grade the path surface as you would for a stone waterbar (A). Use the material you have removed to make a *low, wide*, mound across the path in the place where the bar stones would normally be (B). The face of the earth bar should slope to reduce erosion. On the downhill side, the slope down to path level should be as gradual as you can make it – if available, extra earth can be added for this. Stamp the earth down to make it firm.



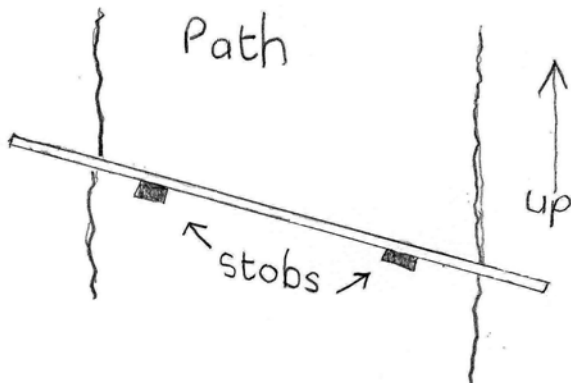
Avoid making the kind of hump shown in fig.2. This is unstable and will soon break down. The bar should be low and broad to withstand being walked on.

Good earth bars are a subtle and attractive re-landscaping of the path. They require time and patience to get right. They should not be a hasty 'quick fix'.

Appendix 1: Drainage – Guide Sheets

1.2f: Waterbars – Building a wooden bar

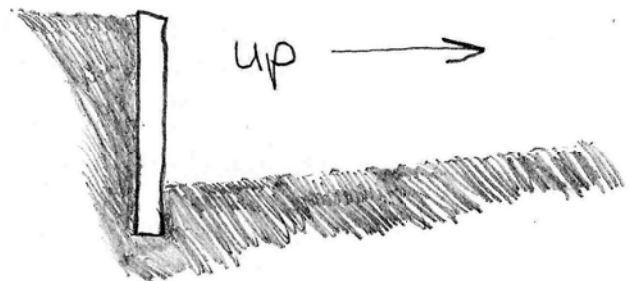
These are not often used now but they have been used in the past and sometimes we have to rebuild them. We should avoid building new ones. They are unstable and are much less robust than stone. Construction timber is used instead of bar stones and is held in place by stobs. They can suffer from undermining, so require frequent maintenance.



The timber should, if possible, be well dug into banks at the side of the path as this helps stability.

Stobs are fixed behind the bar timber. This is not as strong as putting them in front but they would impede the flow of water if they were there.

Wooden bar, side view ----->



Grading the path and landscaping are the same as for stone water bars. (See *1.2d Waterbars – Building the bar stones and paving stones part (ii); finishing.*)