Road Water Management in LNR

Green Roads for Climate Resilience and Water Management

Tailor Made Training

Dhulikhel, Nepal

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GREEN ROADS FOR WATER

META META

Content

- Improved road water crossings
- Improved moisture retention in forest and pasture areas
- Road protection for unpaved roads
- Structures to reduce erosion and enhance recharge
- Water harvesting for agricultural use

Local Road network

- LRN in Nepal is very big – approximately up to 60.000km and expanding fast
- LRN are vulnerable, but have great potential also
- LRN is highly important to connect most remote people
- General approach – what to focus on
  - Low-cost & high-impact
  - Labour intensive
  - Local materials

(a)

(b)

ate 8: Muddy road surface interrupts/blocks traffic flows during rainy season

(a)

(b)

late 3: Erosion and gully formation from the edge of a road in (a) yellow and red

1. Improved road water crossings

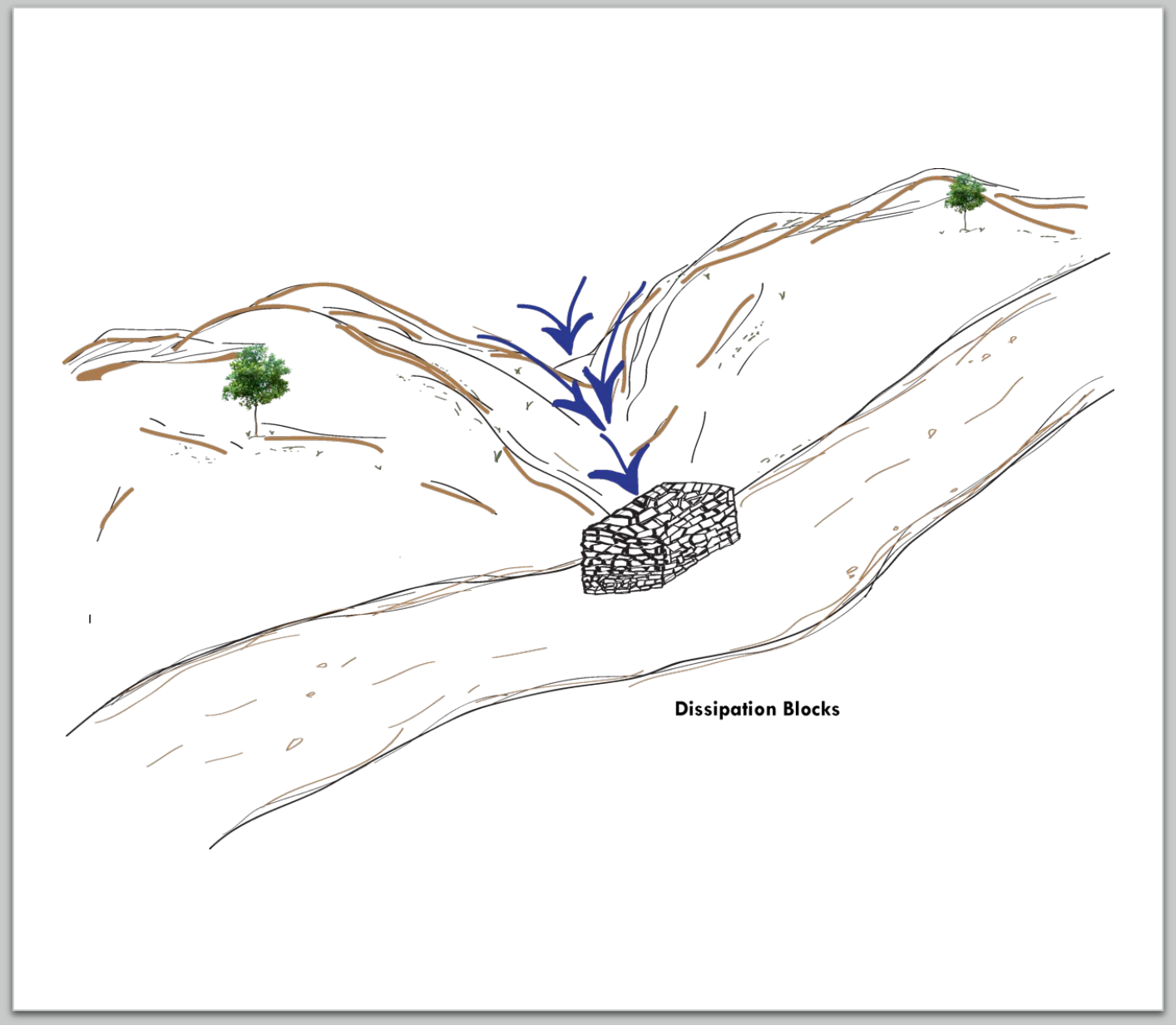
Dissipation Block

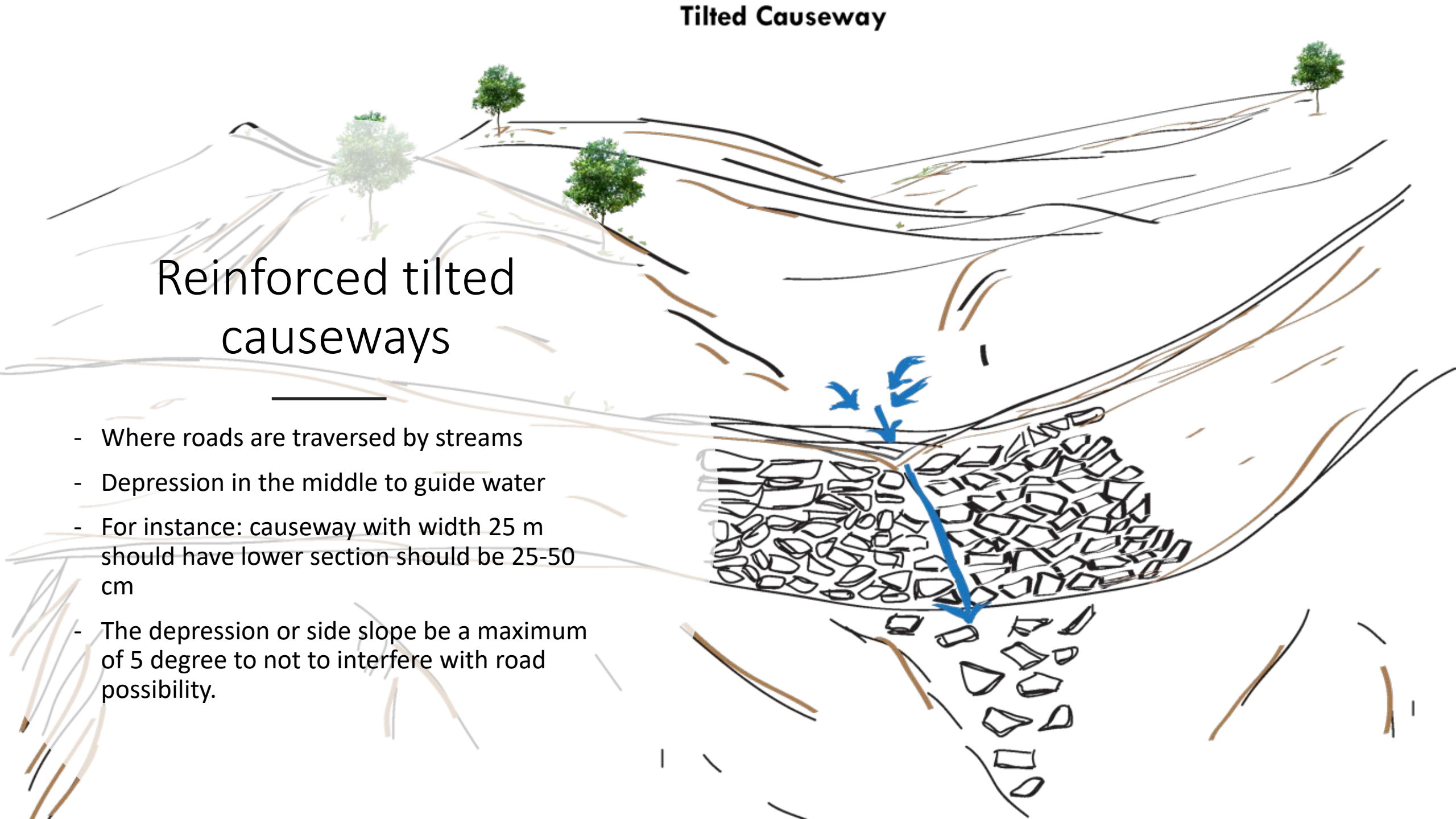
Tilted Causeways

Check dams and down-road protection

Dissipation Block

- It helps in break/baffle force of torrent/stream and reduce erosive power of the stream.
- Placed 30-40 centimeters away from the side-slope





Reinforced tilted causeways

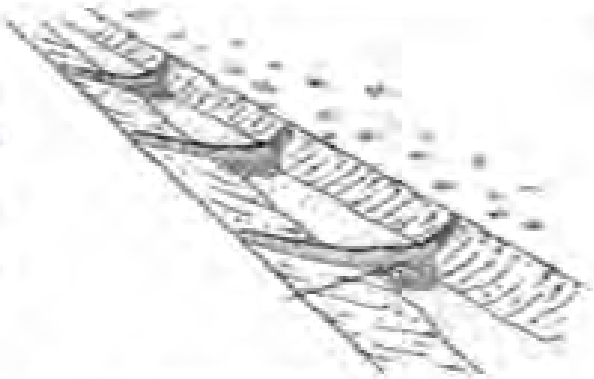
- Where roads are traversed by streams
- Depression in the middle to guide water
- For instance: causeway with width 25 m should have lower section should be 25-50 cm
- The depression or side slope be a maximum of 5 degree to not to interfere with road possibility.

Check dam and downstream protection

- At the upstream of the road with depression.
- It reduces the velocity of water crossing the roads
- Spoils like stone from road construction can be used for check dam building

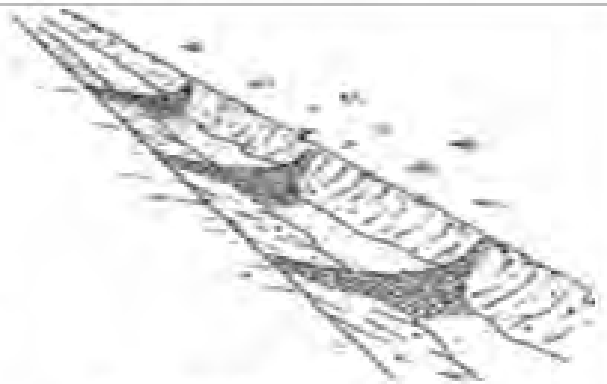
Scour Checks

Gradient	Spacing
< 3%	Not required
3% - 5%	20 metres
5% - 7%	10 metres



Scour check made from sticks

- Sticks about 3 cm diameter 40cm long.
- Hammer sticks into ground so check is 15cm high.
- Apron of stones or grass sods.

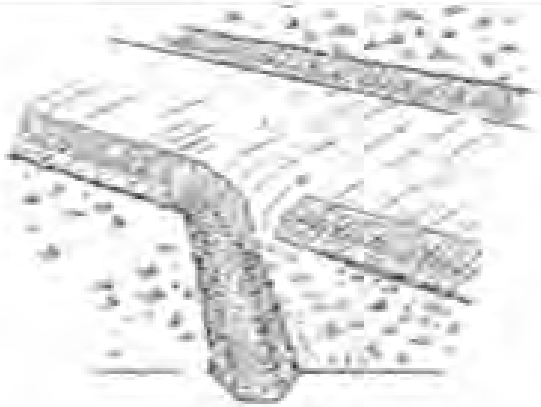


Scour check made from stones

- Same dimensions as stick scour check

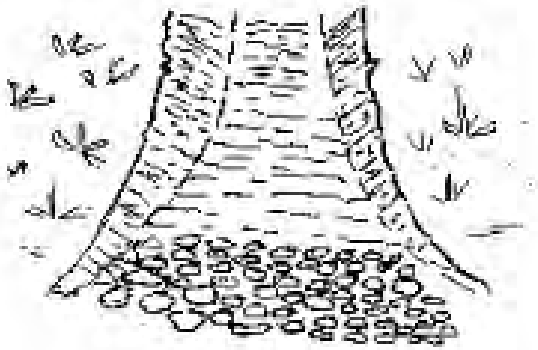
Turnout Ditch

Gradient	Spacing
< 4%	100 metres
4% - 6%	80 metres
6% - 7%	60 metres



Turnout detail

- Minimum 10 metres long



- Provide stones at end of turnout to prevent scouring

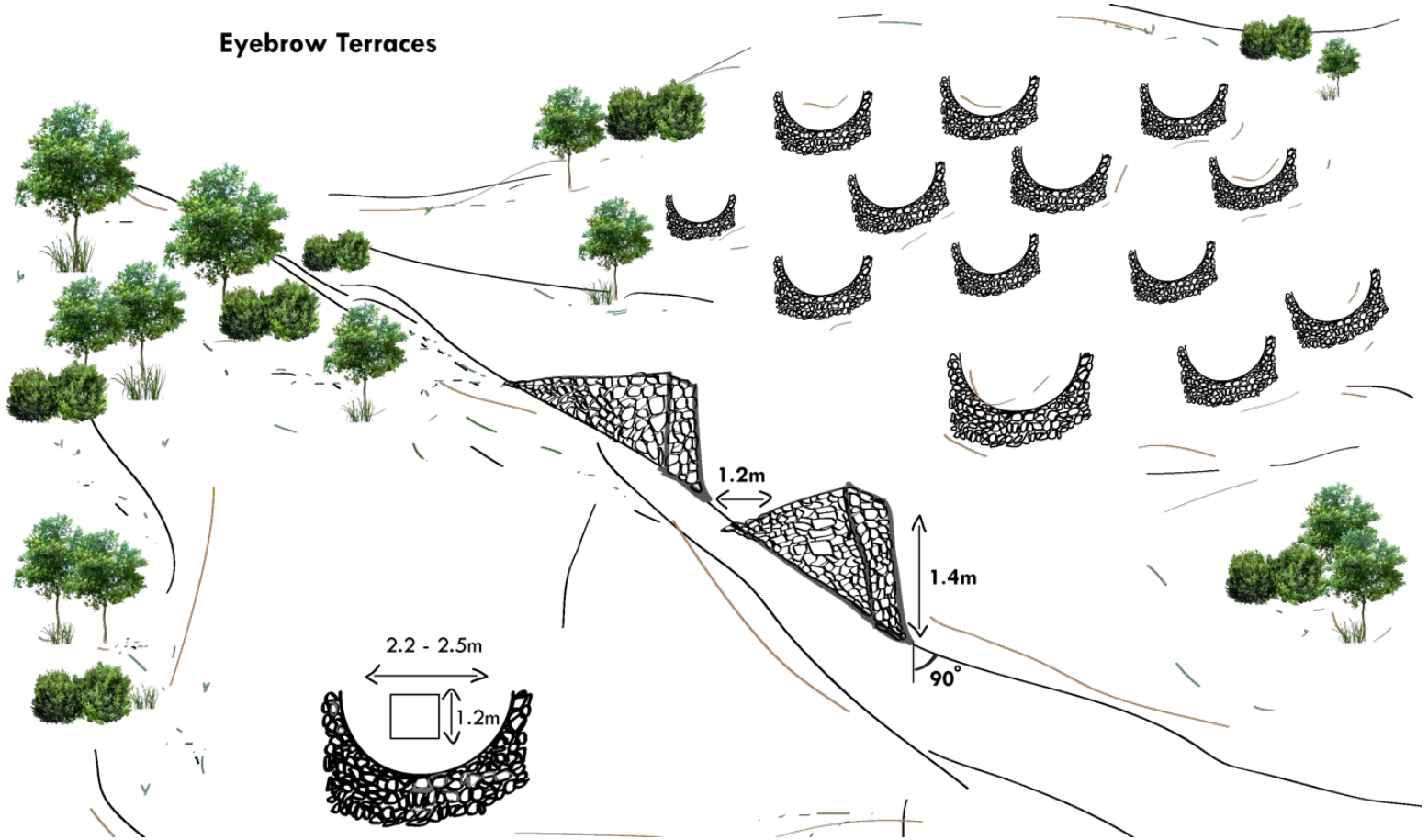
2. Improved moisture retention in forest and pasture areas

Eyebrows/half moon terraces

Stone strips

Infiltration bunds

Eyebrows/half moon terraces



- Typical diameter of eyebrows 1.4-2.5m with infiltration pit of size 40 cm wide by 50 cm deep
- Maximum preferred slope is 50%
- Spoils like stone during road construction can be used.
- Use of topsoil removed during construction to fill the inner side of semi-circular structure.
- Tree planting can be done in these structure
- Good to have high density of eyebrows in forest area

Size of eyebrows with gradient

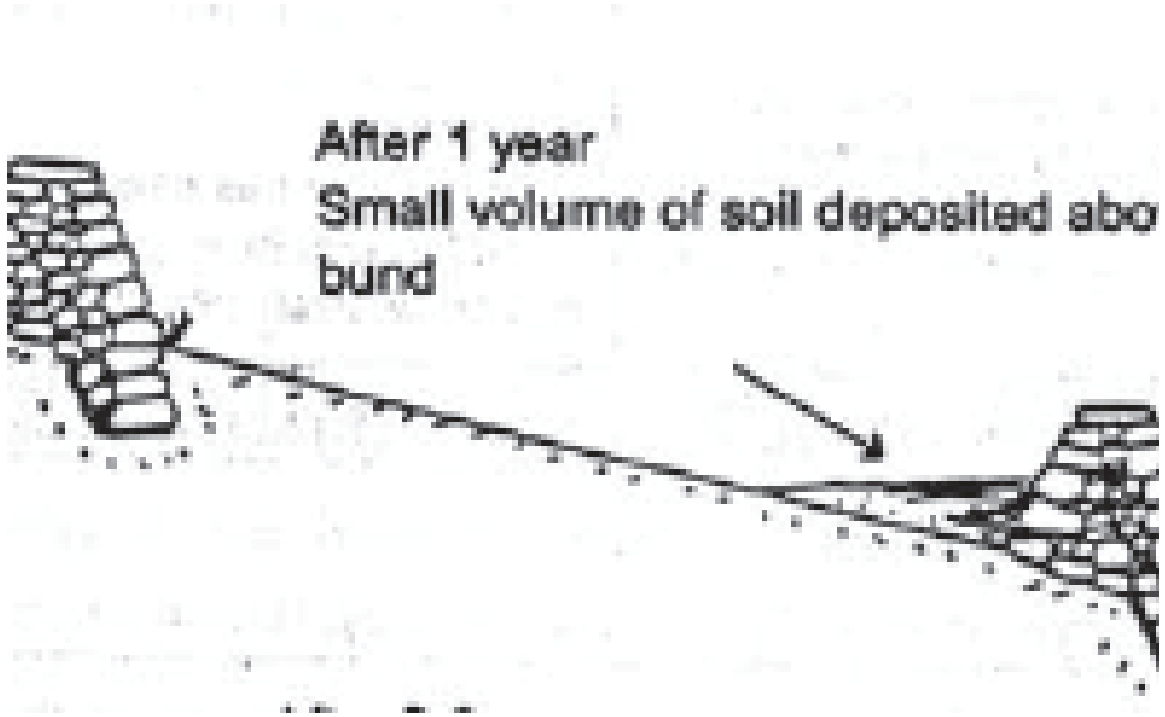
Gradient	Stone ring diameter	Inner cross width	Backwall height	Reinforced backwall
30	30 cm	220 cm	70	-
45	30 cm	180 cm	120	10 cm
60	30 cm	140 cm	180	20 cm

Preferred distance between lines of eybrows terraces

Gradient	Distance between lines of eybrow terraces (m)
30	15-20
45	10-15
60	8-10

Stone strips

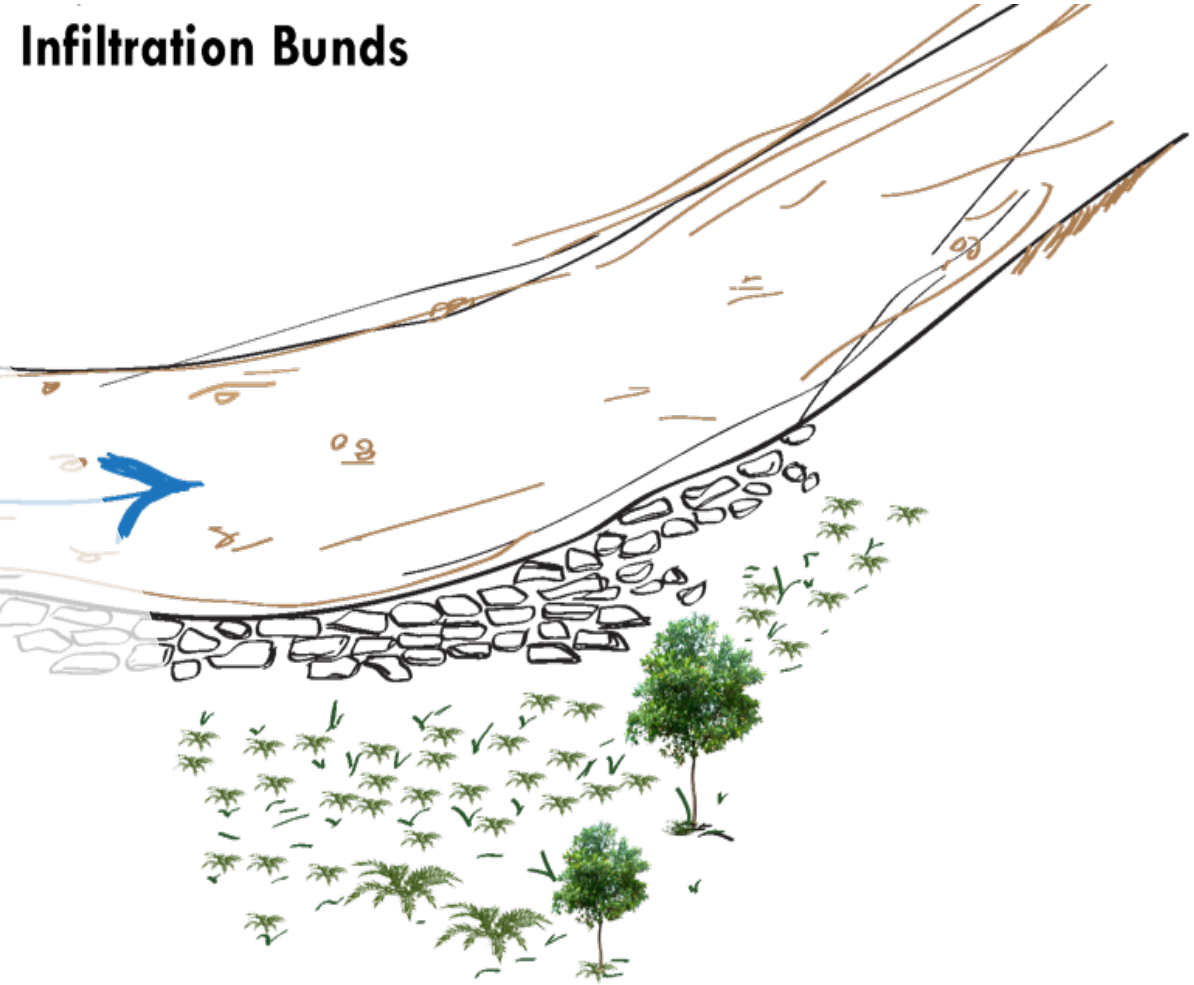
- Area relatively even and not too steep i.e. less than 50%
- Built of coarse stone and boulders (spoils like stones during road construction can be used
- The structure slows down the runoff, intercept sediments and build up soil layers
- Note: When slope increases, the field situation needed to be observed carefully



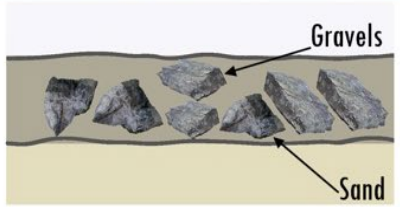
GRADIENT	HEIGTH (M)	VERTICAL INTERVAL (M)	DISTANCE BETWEEN STONE STRIPS (M)
30	1	2.8	6
40	1	2.8	5
50	1	2.8	4

Infiltration Bunds

- In the downslope road reserve or shoulder
- Can be made of road spoil like flat stones 8-10 cm thick
- Flat stone place in dense mosaic
- Width of infiltration bund is equal to road shoulder
- Larger stone (dia 20-25 cm) placed closed to road followed by rows of smaller stone (dia 10-15 cm) towards mosaic
- It intercepts road sediments flushing towards the lower side of road to adjoining farmland

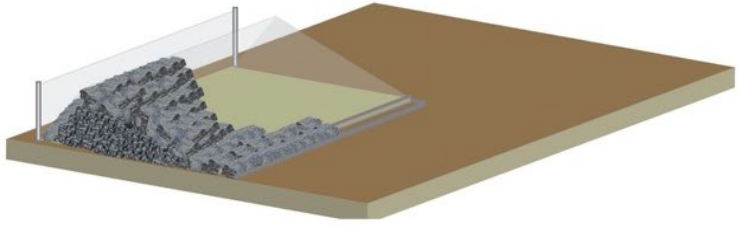


A: Sufficient density of infiltration bund required



B: Consider double layer in erodible soils

C: Steeper slopes: longer field bunds



D: Constructing reinforced filtration bund in high run-off area

E: T-shaped rock bunds reinforce infiltration bund in erodible areas

3. Road protection for unpaved roads

Water bars & rolling dips

Road water guiders

Water bars & rolling dips

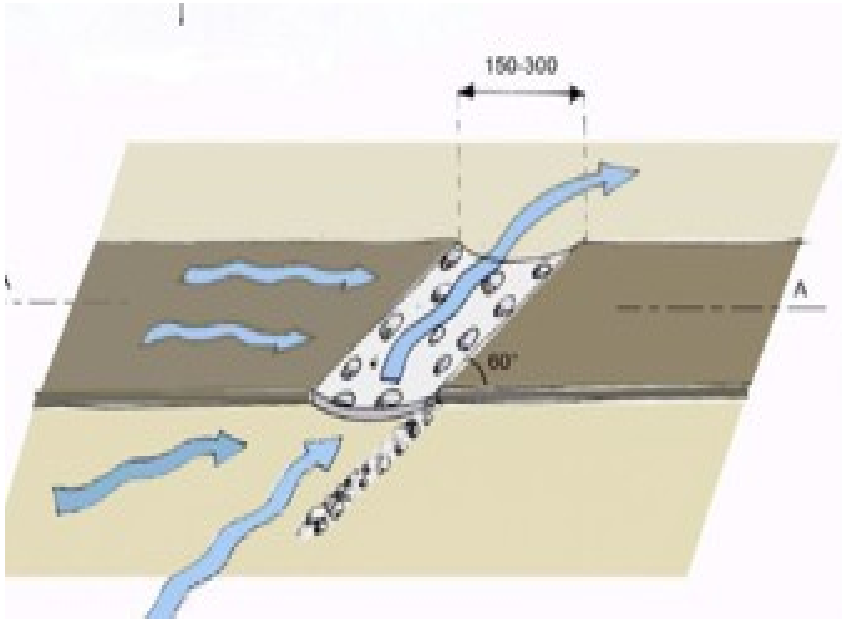
Water bars and rolling dips are used on unpaved roads to guide water running on the unpaved road surface away to the land

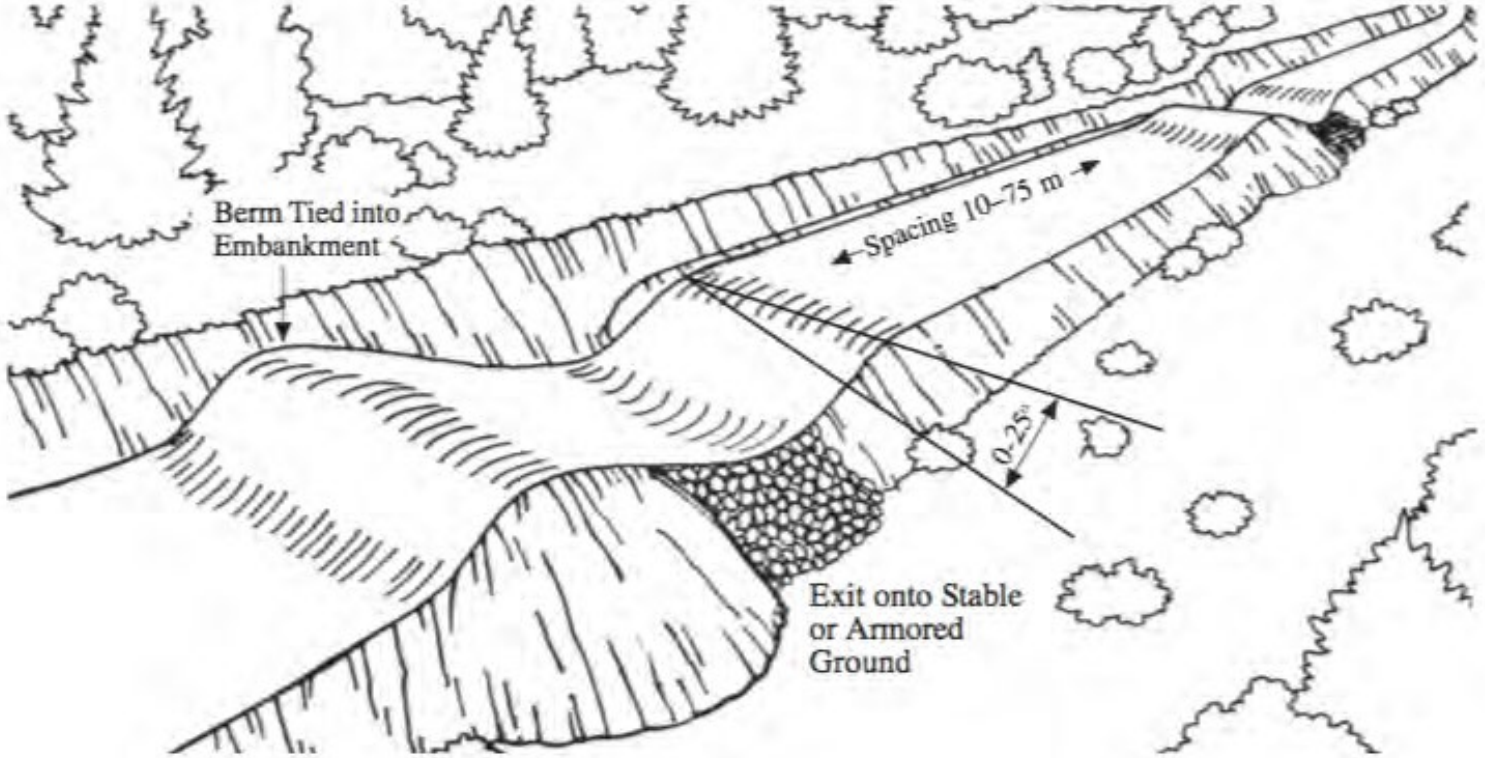
They prevent rain damage to the road

They also bring water to farmland or grazing land where good use can be made of it

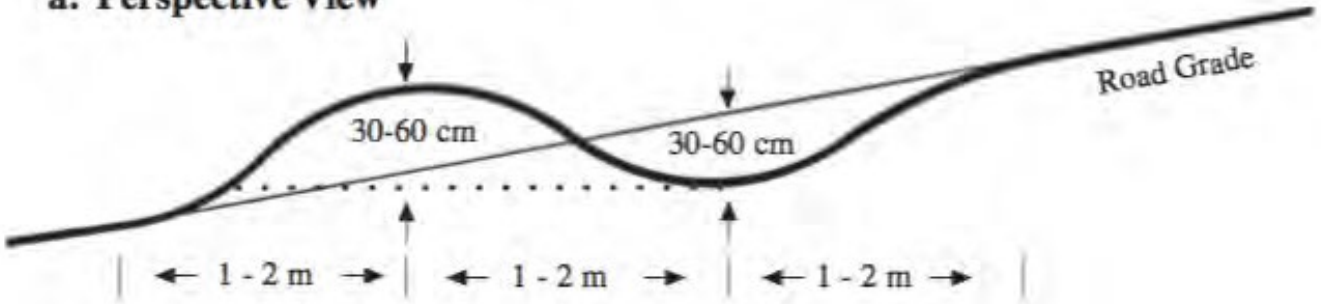
They consist of a road bump, very shallow drain in front of it and an outlet to the land

They are made every 30-100 metre: the steeper the road the closer the distance





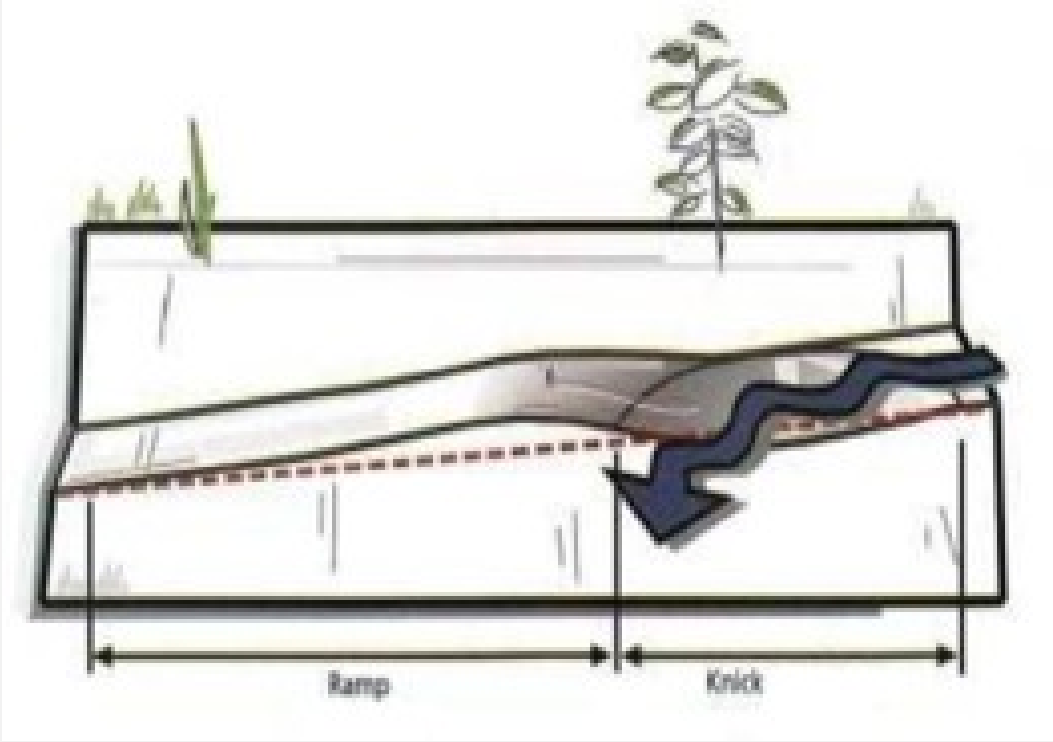
a. Perspective View



b. Cross-Section

Considerations

- Use on roads having grades between 3 and 15%
- The road bump is preferably 45-60 cm high
- The bump can be reinforced with stones
- The road bump is placed at 15-30 degree angle with the road
- In front of the bump there is very shallow drain of 90-150 centimetre width
- The drain has a slight down ward slope (4- 8 degrees) to flush out sediment
- The drain may be connected with upstream minor stream and be reinforced with stones



4. Structures to reduce erosion and enhance recharge

Road water guiders

Stone bunds

Culvert water spreader

Infiltration trenches

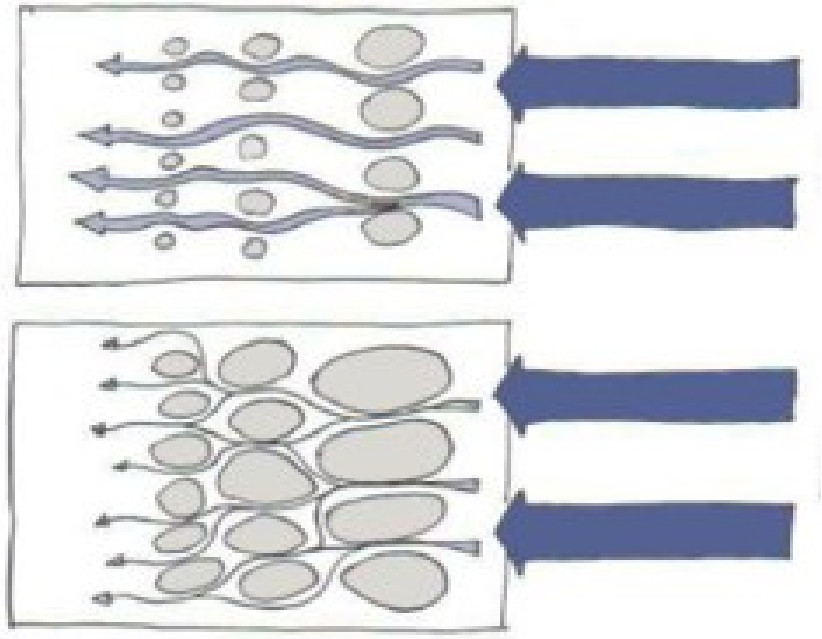
Road water guiders to take water from road surface to farmland

- Water from surface of paved roads is guided to rain- dependent farm land
- The guiders are made at 30-40 meter distance
- They are made at an angle with the road and are slightly curved

Stone bunds along road to reduce erosion

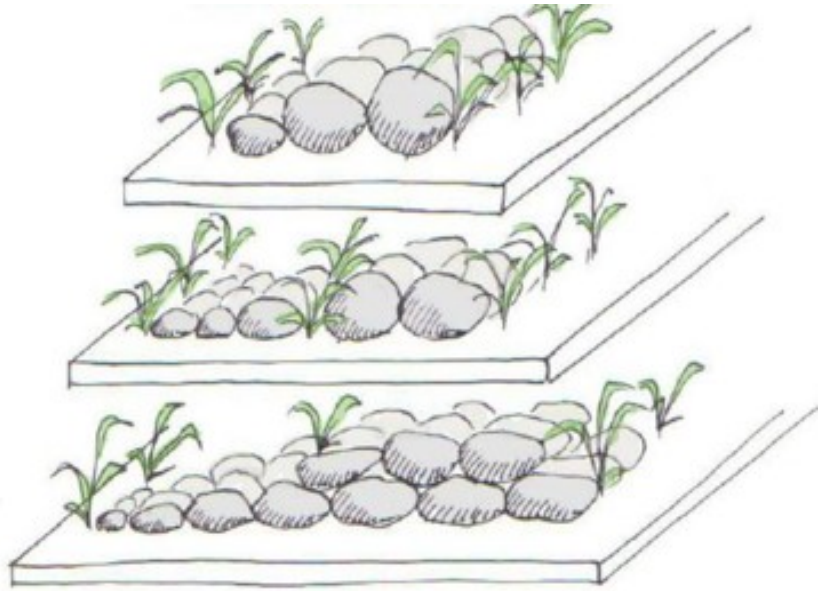
- Keep 2-3 meters distance from road
- Ensure bund is ‘dense’ enough
- If required make the bund wider

Ensure bund is ‘dense’ enough



Bad

Good !



If required make the bund wider

In flat terrain: line shape
In moderate terrain: T-shape
In slopy terrain: V-shape

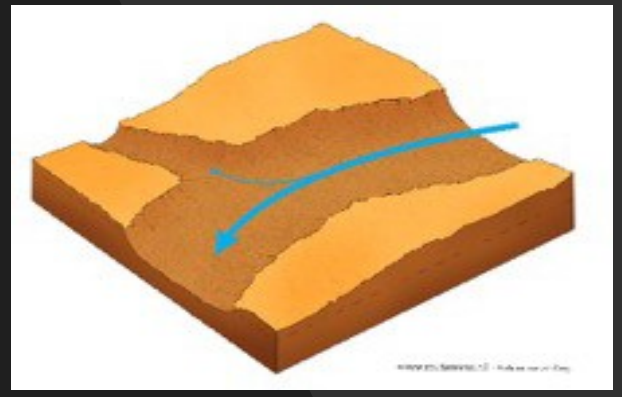
In moderate terrain: T-shape

In slopy terrain: V-shape

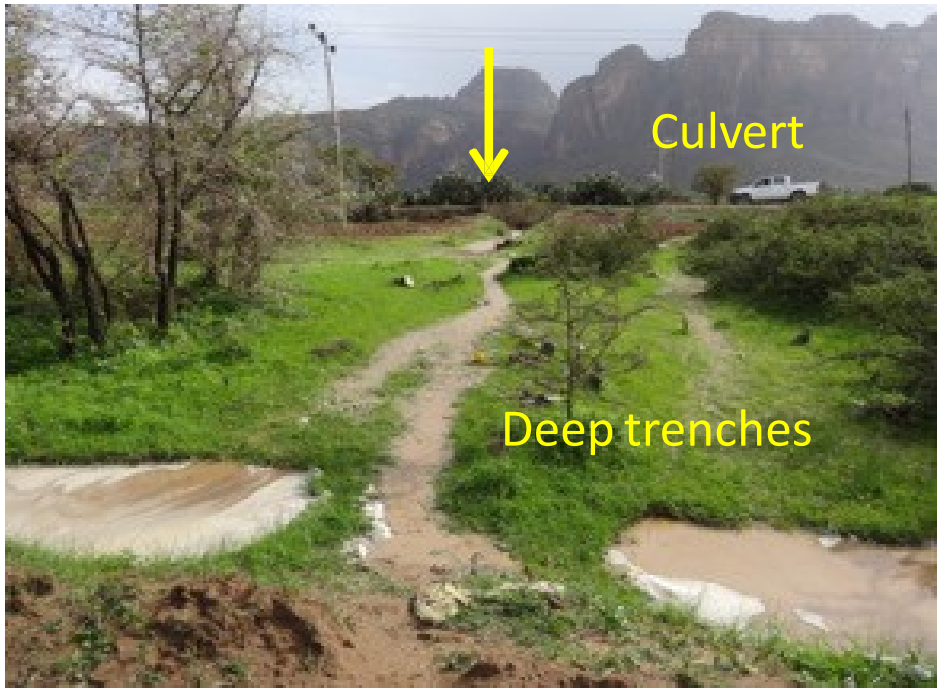
In flat terrain: line shape

Culvert water spreader to prevent gullies

- Water from a culvert is channeled into farmlands away from the road and used for farming, groundwater recharge and improving soil moisture)
- In steep areas a V-shaped spreader ensures water is guided gently in two direction and and no gully develops



Infiltration trenches on down-side roadside slopes for recharge and slope protection



- If possible series of infiltration trenches to collect run-off
- Water from culverts is led to the trenches
- Each trench is segmented – single trench is 1.5 m length, 0.5 m width and 0.7 m depth
- Optional: bund on downside of the the trench (0.4 m)

5. Water harvesting for agricultural use

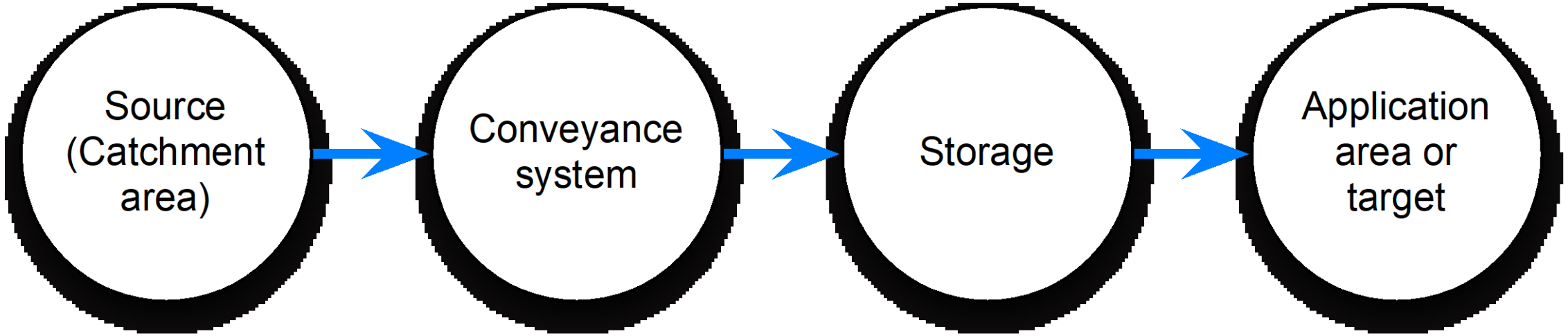
Trenches & cut-offs

Recharge pit

Water harvesting pond

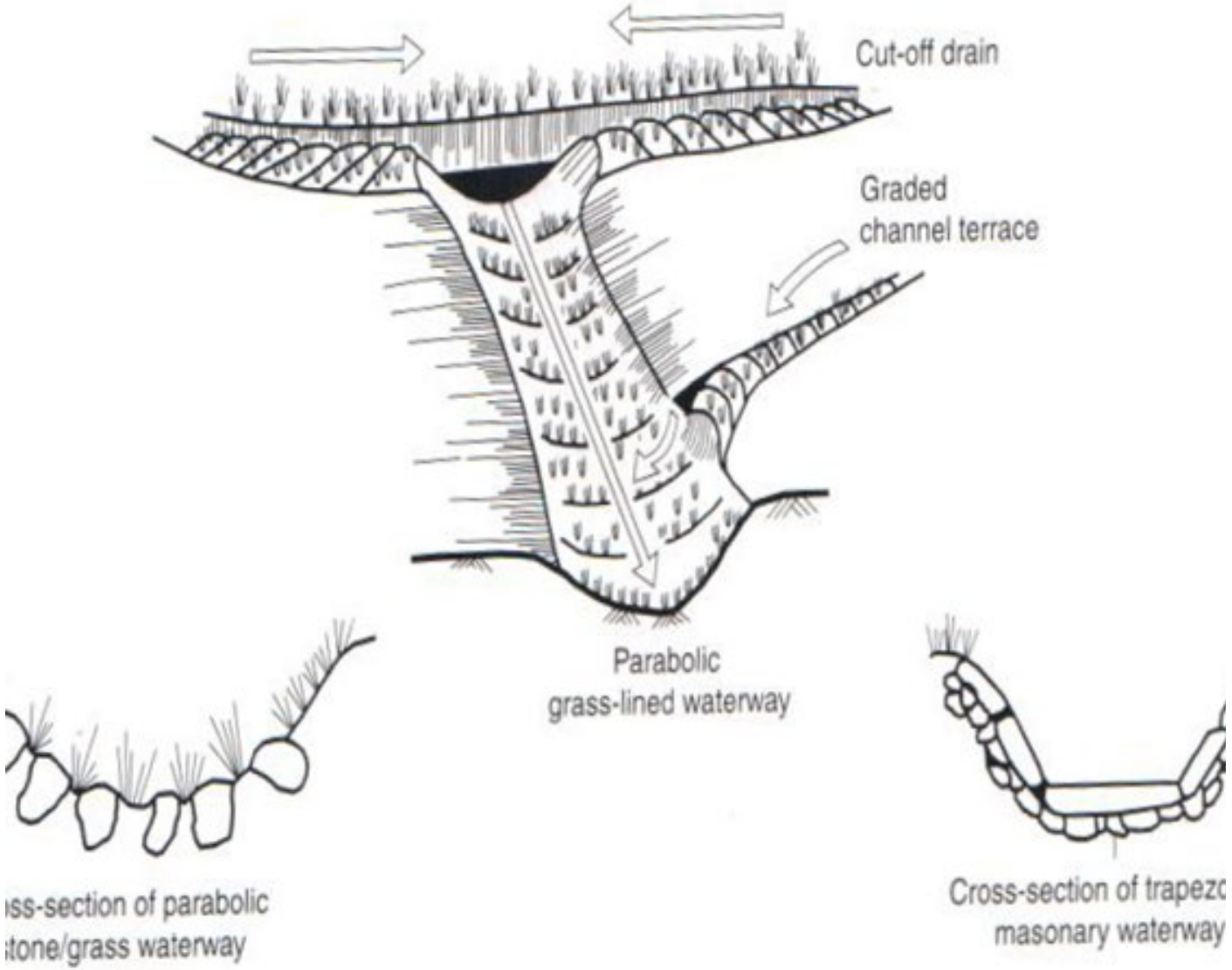
Borrow pit

4 steps in water harvesting

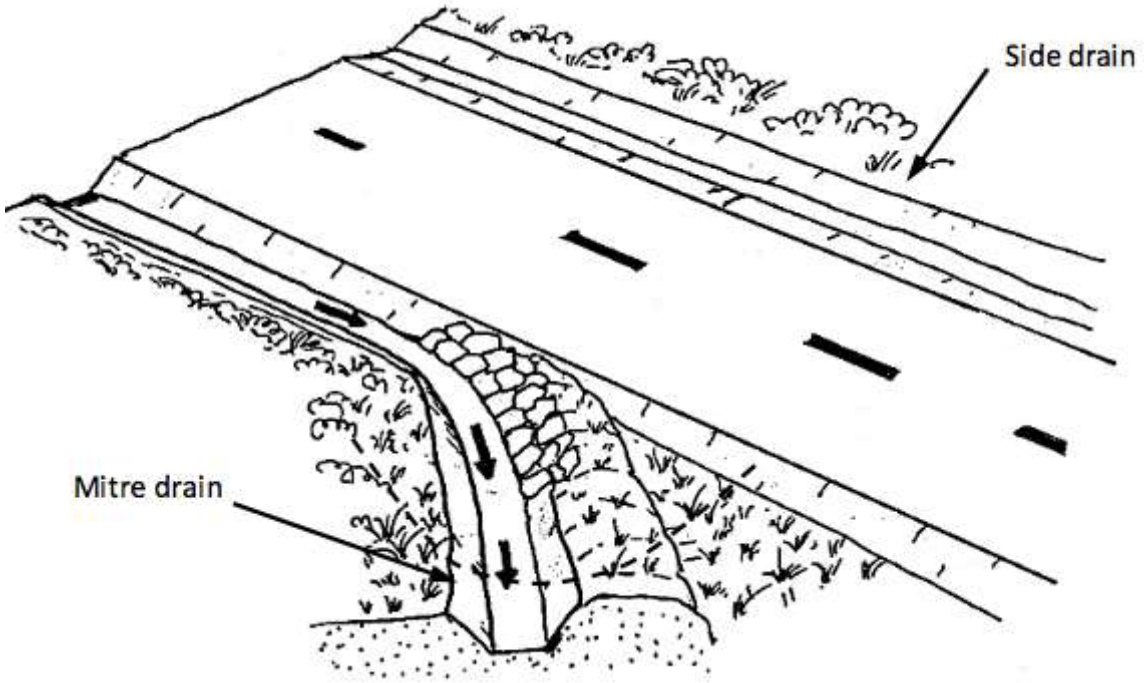


Trenches and Cut-offs

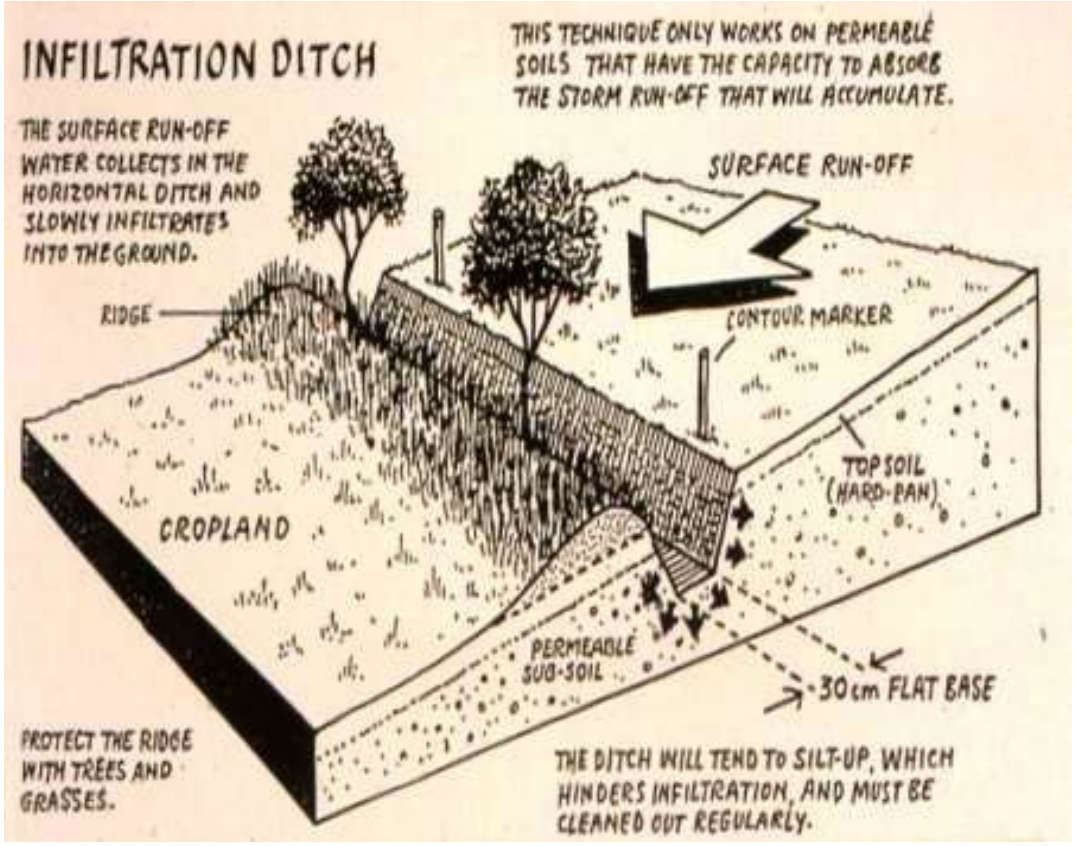
- Used to conduct run-off from cut-off drains to storage structures
- Grass waterways for slopes up to 25%
- Steeper slopes, channel lined with stones, masonry or reinforced concrete
- Dimension depends of the expected discharge
- Diagonally across de slope not recommended, if they break or overtop can cause serious damage
- The preliminary position should be determined from a reconnaissance field survey
- Where possible, it should be located in a natural depression or water way.



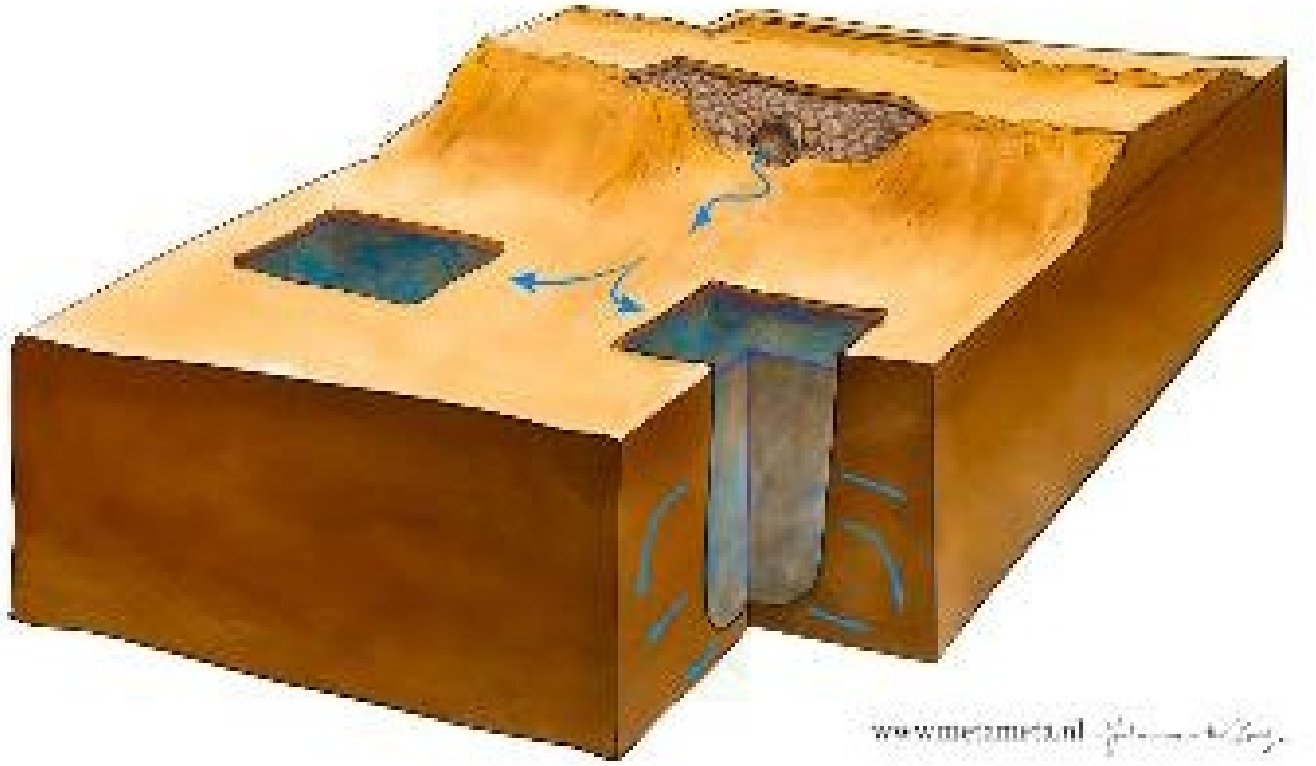
Mitre-drain / cut-off from side drain



Trenches in farmland



Recharge pit



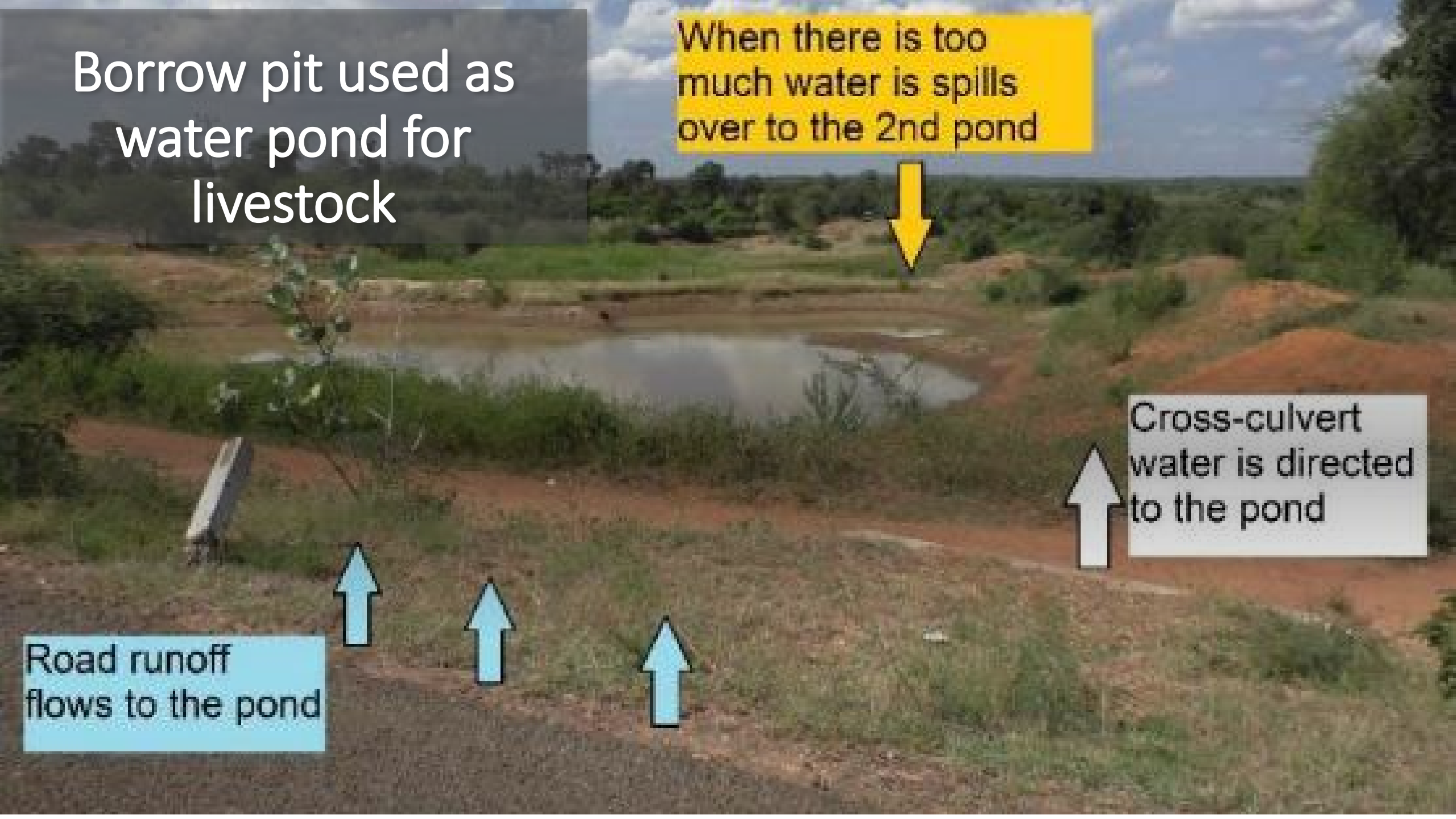
- Combine with infiltration bunds/side drains/cut-offs
- Direct water to target storage with very gentle slope conditions
- The storage structure enhances groundwater recharge

Cascading of soak pits/ harvesting ponds along the road


Picture credit: Helvetas

Water harvesting pond with a silt trap

Picture credit: Helvetas


Borrow pit used as water pond for livestock
When there is too much water is spills over to the 2nd pond
Cross-culvert water is directed to the pond
Road runoff flows to the pond

- धन्यवाद!
- Thank you!
- Bedankt!