Farm roads and tracks that withstand erosion – it's all in the design!

Webinar 27th November 2020

This event is supported by the ACT Government & the Australian Government's National Landcare Program

Hosted and presented by:

Farm track design and management to withstand erosion

Peter Fogarty: Certified Professional Soil Scientist, NSW Soil Knowledge Network

Ashley Bolton: NSW Soil Conservation Service, Cooma

Antia Brademann: Upper Murrumbidgee Demonstration Reach

November 27, 2020

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Why worry about track erosion?

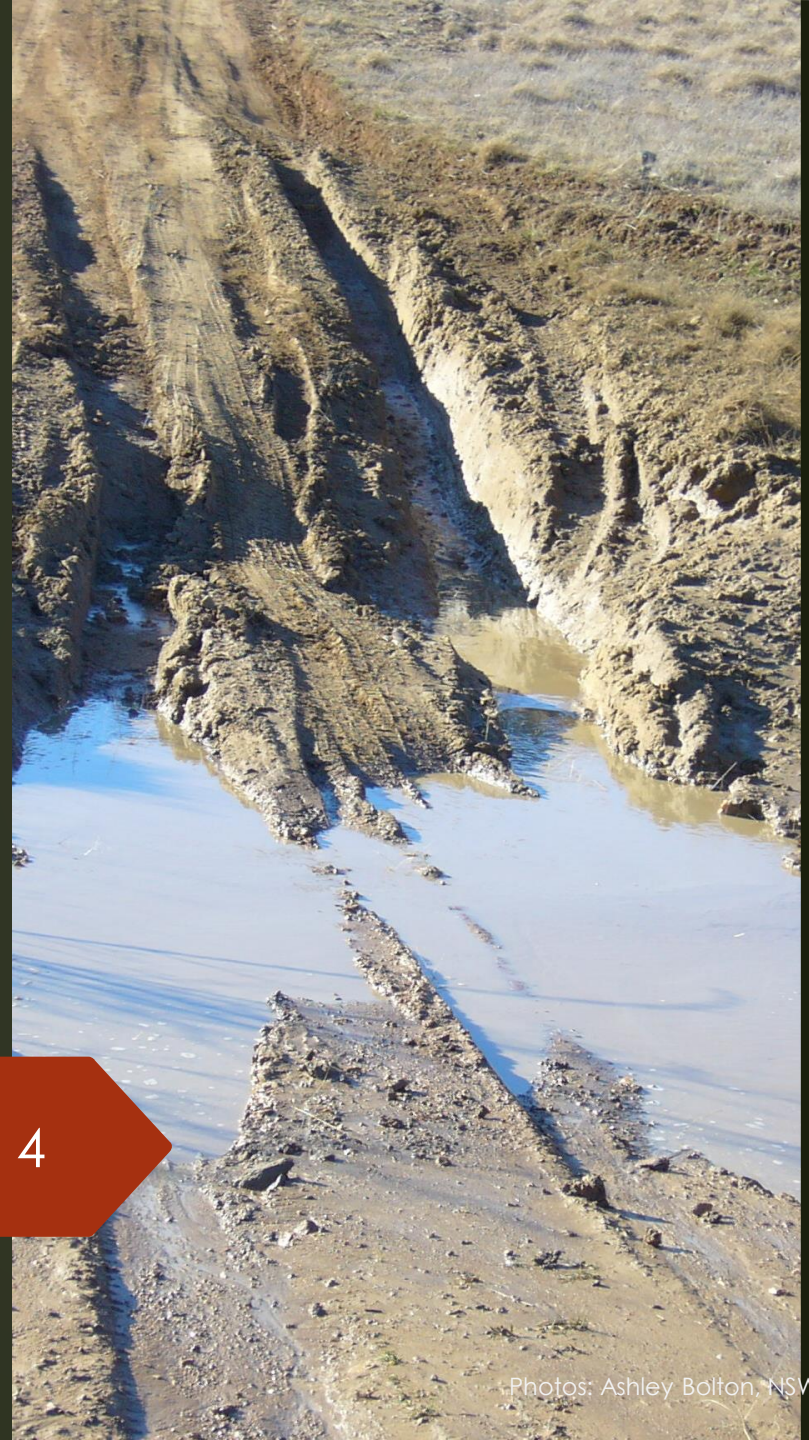
protect your investment, cost of construction typically $5,000 to $25,000 per kilometre

it costs much more to repair than to construct properly; get it right the first time

provide Emergency Services access such as for fire, household emergencies

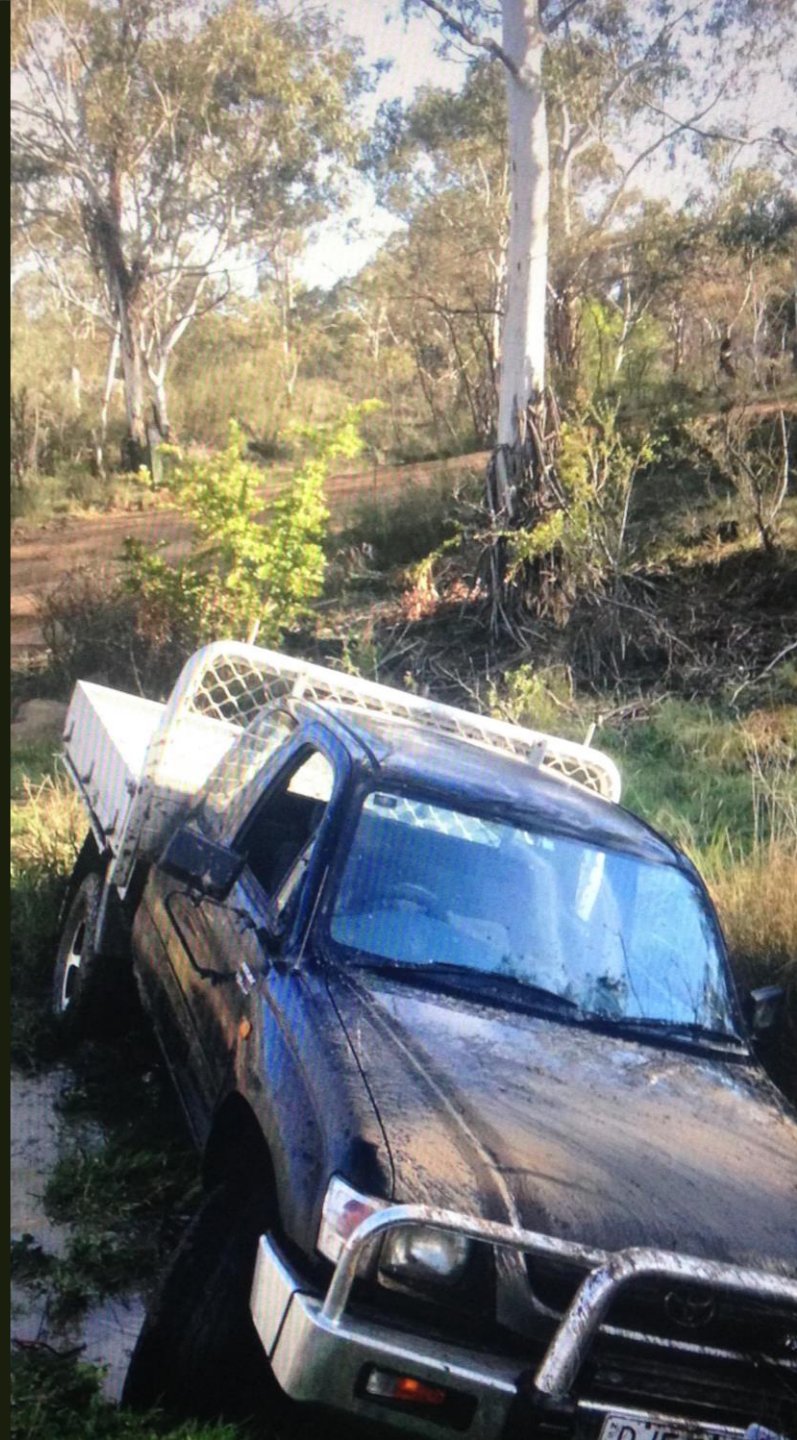
reduce off site impacts, particularly on water quality and stream condition

To help you avoid situations such as these …



Photos: Ashley Bolton, NSW Soil Conservation

And these….

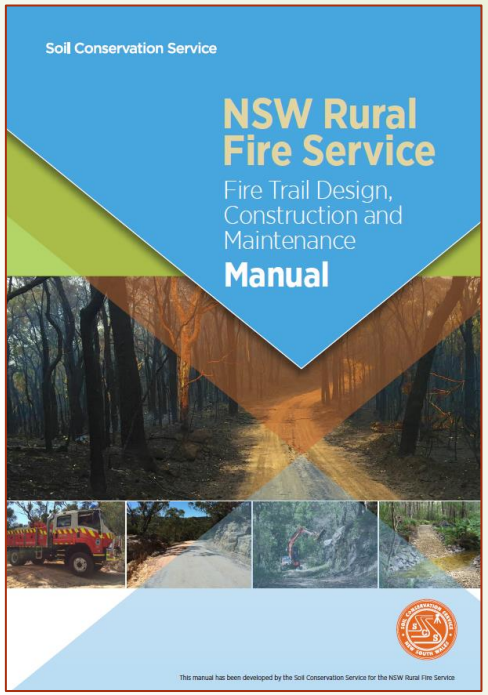


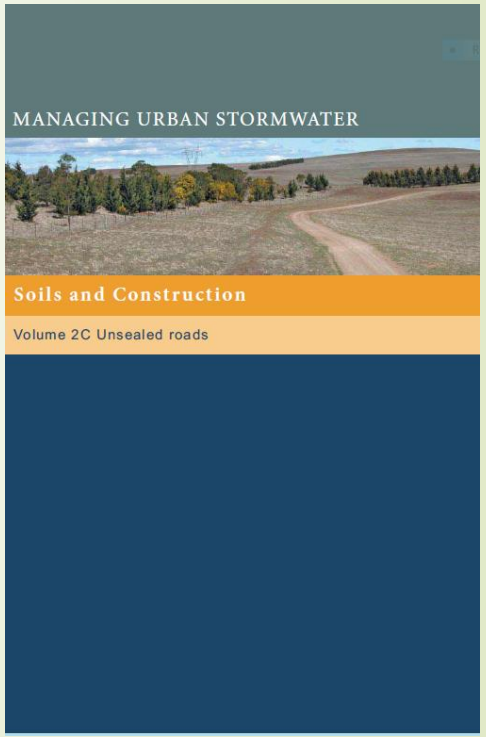
… and have something like this

Photo: Ashley Bolton, NSW Soil Conservation Service

Resources

- Experience
  - Soil Conservation Service
  - Some contractors
- Publications and guides
- Research
  - CRC for Catchment Hydrology major project





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Published information sources

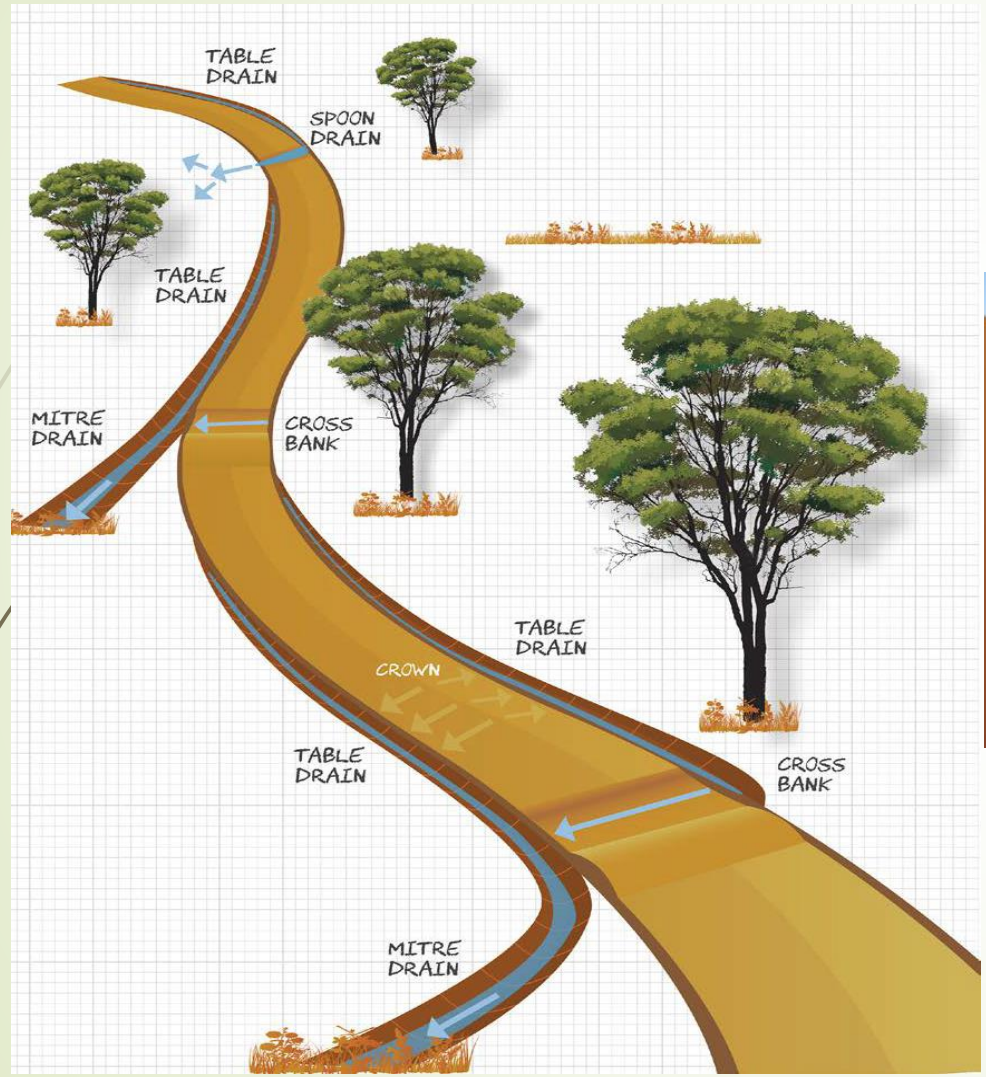
Key documents

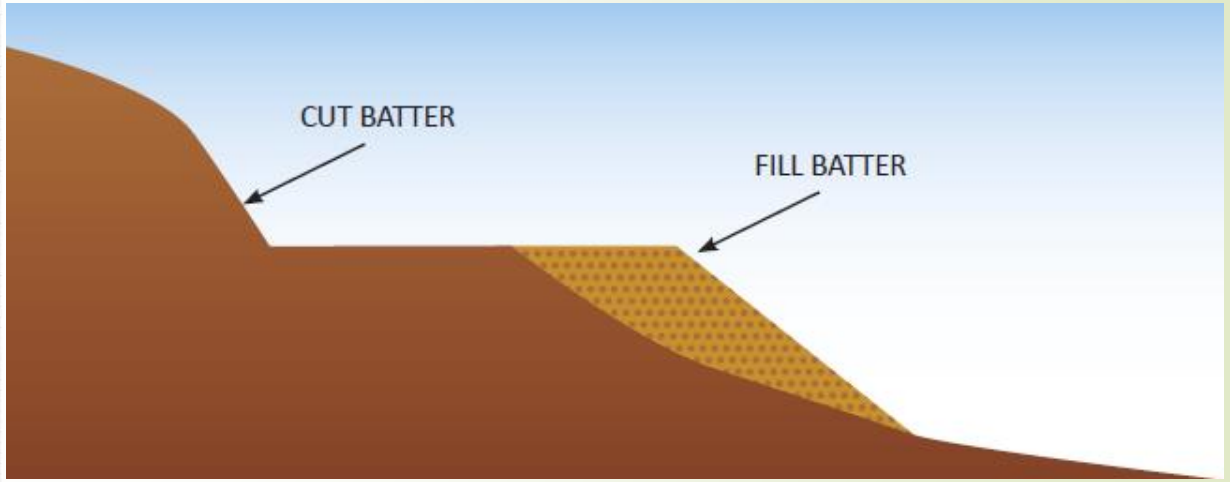
- NSW RFS (2017) Fire Trail Design, Construction and Maintenance Manual
- NSW Dept of Environment and Climate Change (2008) Soils and Construction Volume 2C: Unsealed roads

Useful background

- NSW Soil Conservation Service (1990) Earthmovers Training Course, Unit 17, Access Tracks
- Forests NSW (1999) Forest Practices Code, Part Four, Forest Roads And Fire Trails
- CRC for Catchment Hydrology (1999) Managing Sediment Sources and Movement in Forests

Track vocabulary and jargon





From: RFS (2017)

What causes tracks to erode

- Protective vegetation and topsoil removed
- Compaction, wheel ruts
- Increased runoff amount
- Soil erosion of track surface and drains
- Sediment washes off track to watercourses

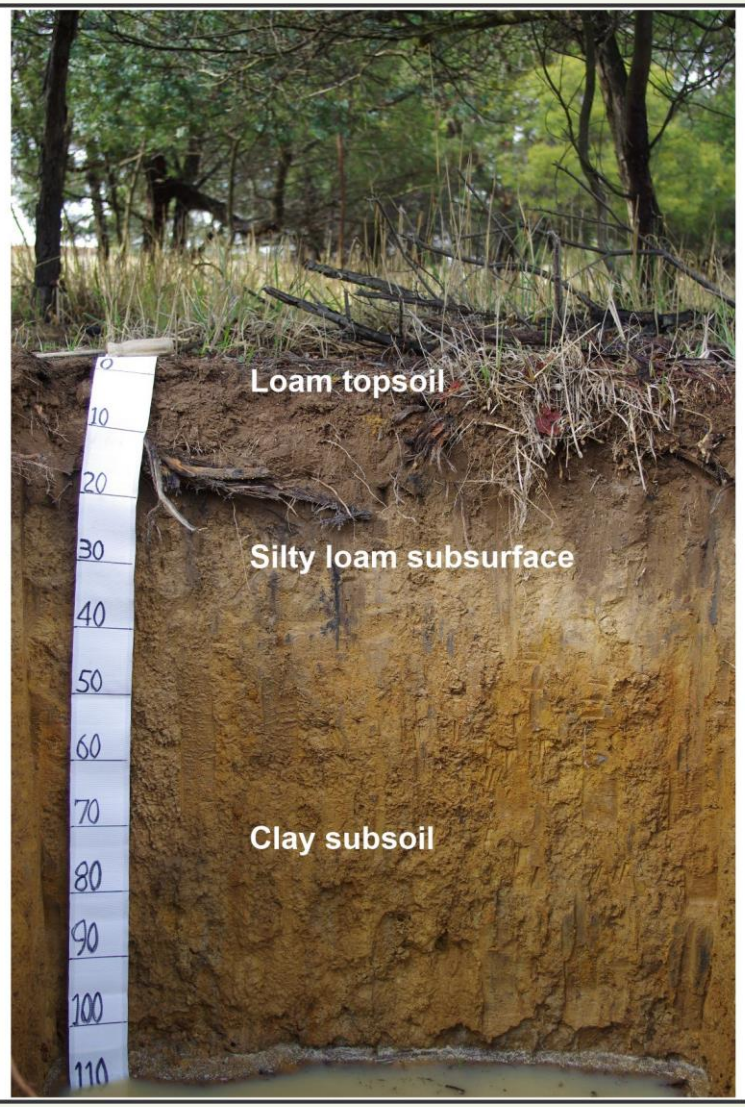
Photo: Ashley Bolton, NSW Soil Conservation Service

Why topsoil is important

infiltration >100mm/hr
saturation water storage: 60%

permeability: 10mm/hr
saturation water storage: 35%

permeability: 10mm/day
saturation water storage: 40%

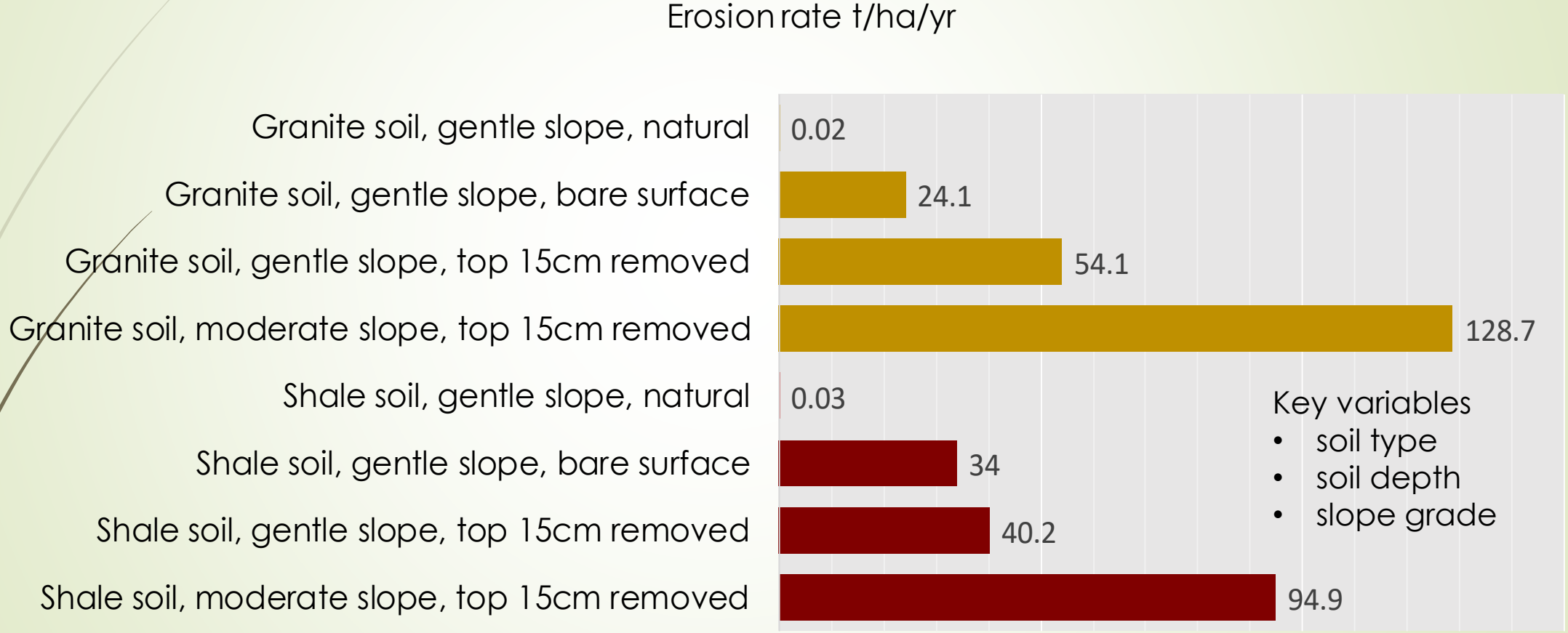


runoff rare, only after intense storms

runoff often, after all but very gentle rain

runoff almost always, after most types of rainfall events

Soil erosion rates on typical soils of the region



Based on RUSLE erosion model

Stable soil, coherent when wet

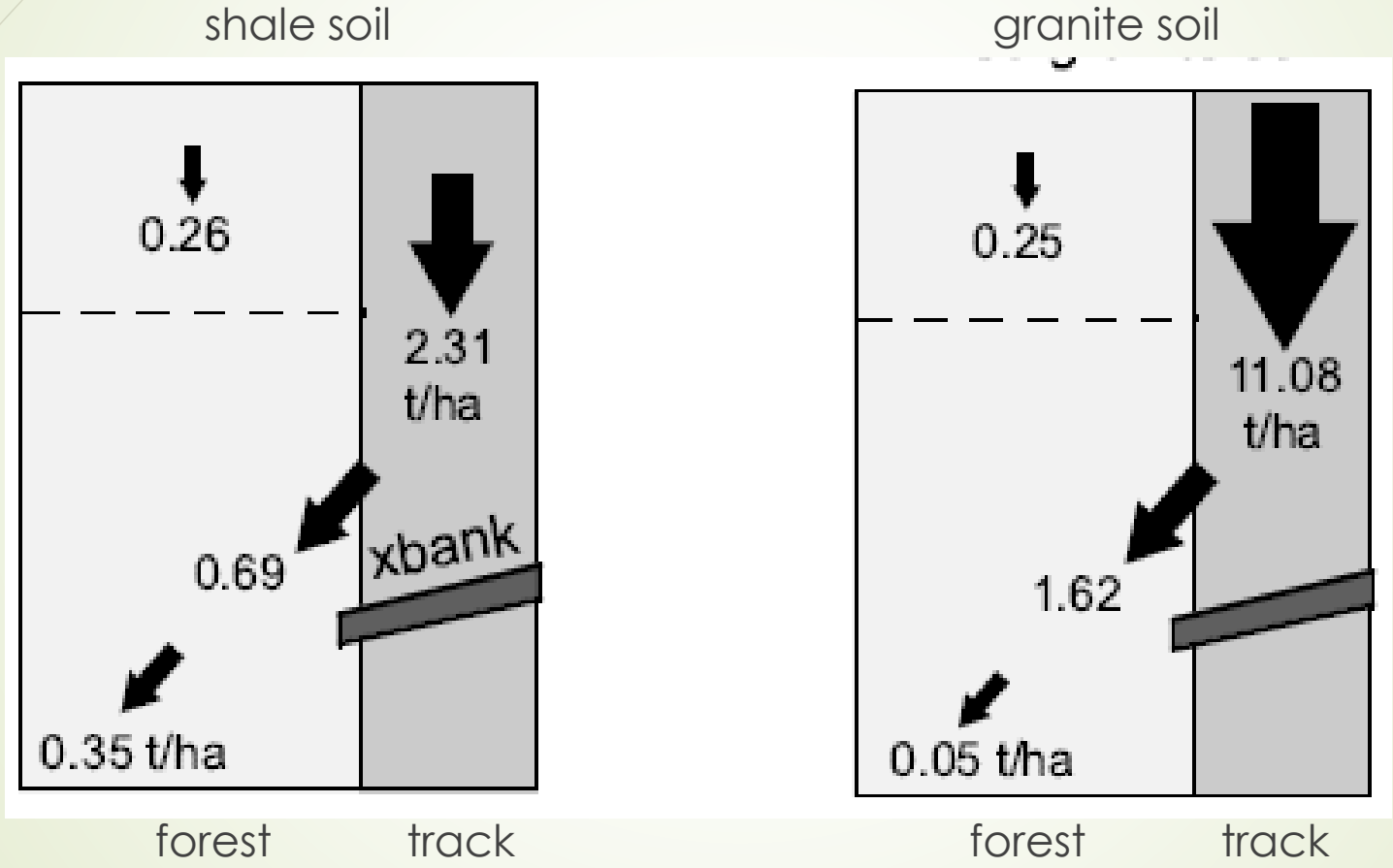
e.g. red shale soils

Unstable soil, low coherence when wet

e.g. yellow granite soils

Photos: Ashley Bolton, NSW Soil Conservation Service

Sediment export from tracks from a major storm



From: CRC CH, 1999

Noting:

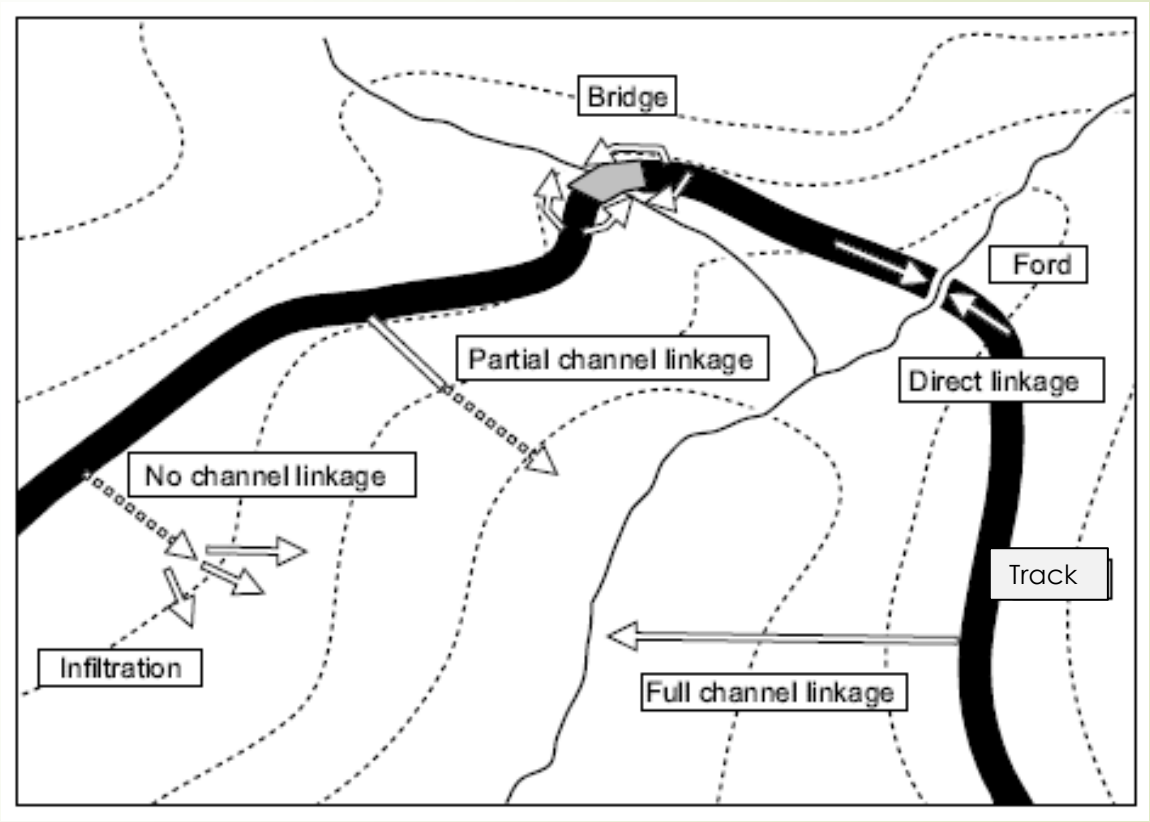
Higher soil erosion rate on sandy granite soil than on shale soil

Much of eroded soil from sandy granite deposited as runoff hits vegetated verge

Eroded soil from shale is mostly clay so carried well beyond track

Sediment delivery from tracks to streams

- Concept of **connectivity**
- Aim to minimise connectivity between tracks and streams
- Concentrated flow paths do not permit deposition and infiltration
- Dispersed flow paths allow infiltration and sediment deposition
- Track runoff tends to disperse and infiltrate within 20-50m on well vegetated hillslope
- Watercourse crossings most susceptible to sediment delivery to streams



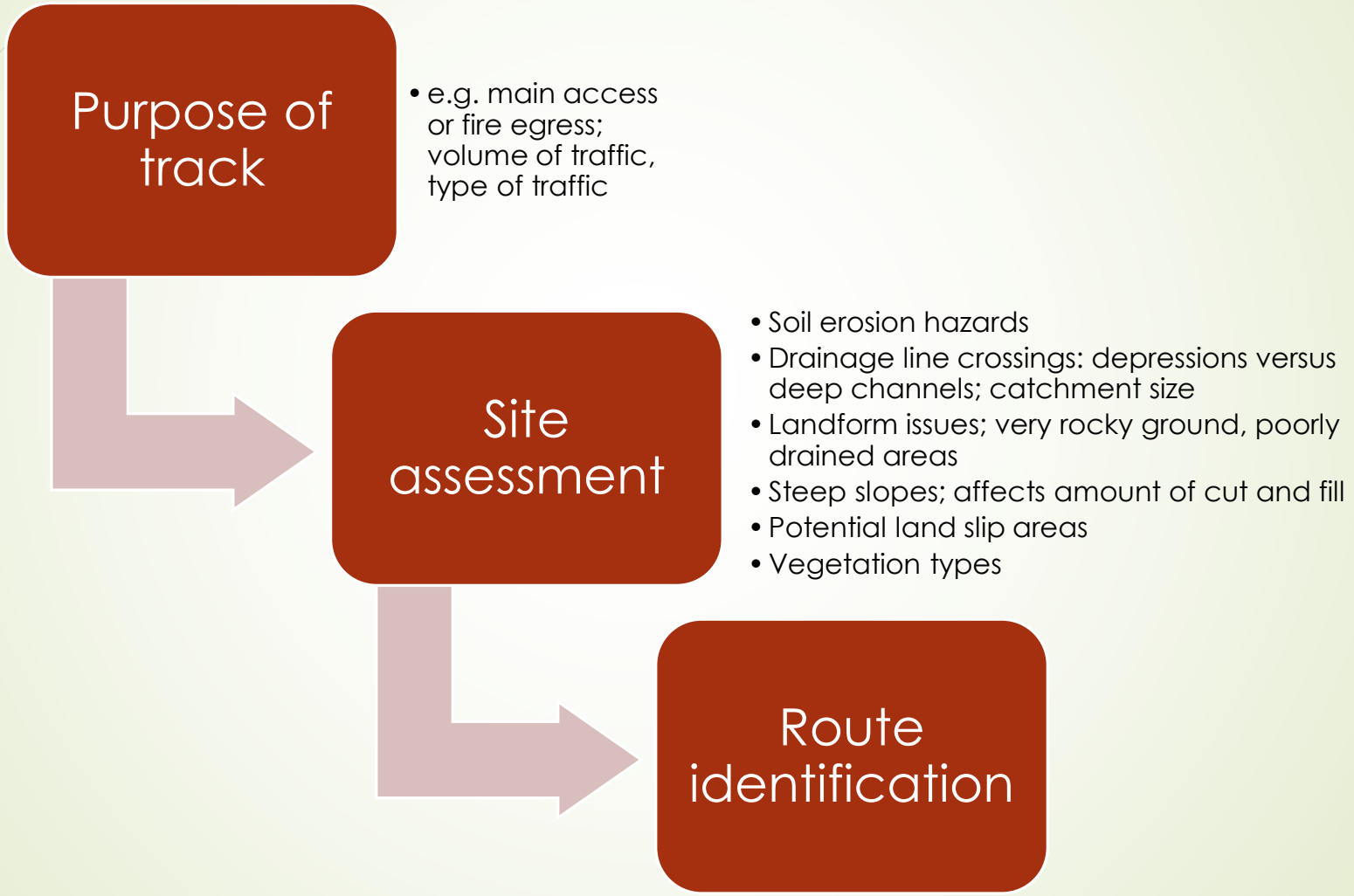
From: CRC CH, 1999

Key points on track erosion

- Track surface generates runoff even after few mm of rain
- Bare track surface has high erosion potential
- Traffic breaks up surface into easily eroded particles
- Sediment enriched runoff connects directly to watercourses
- While you can't avoid track erosion, good planning and construction can minimise these impacts!

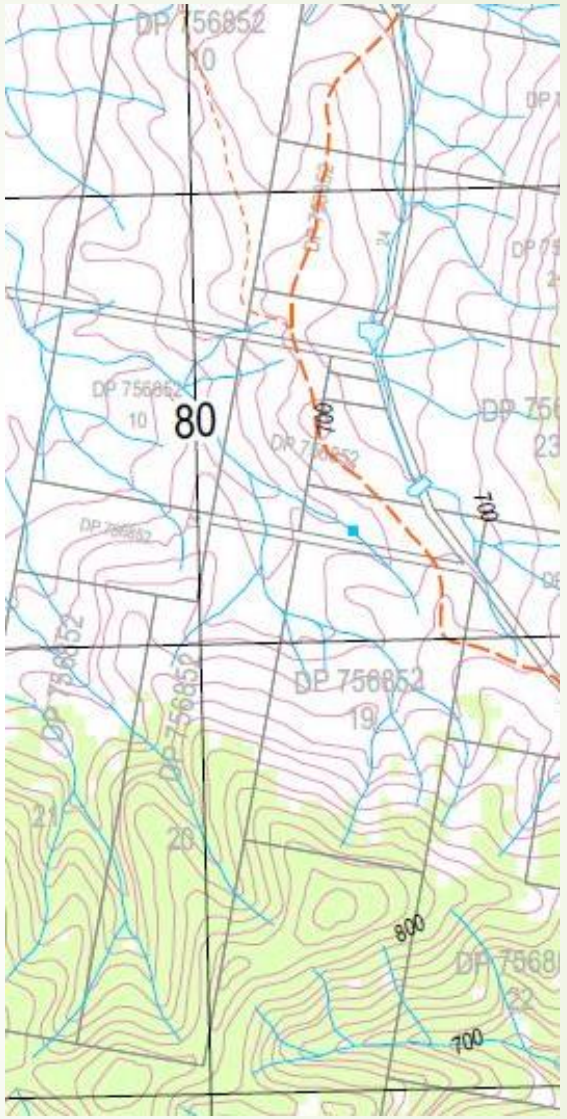
Managing track erosion

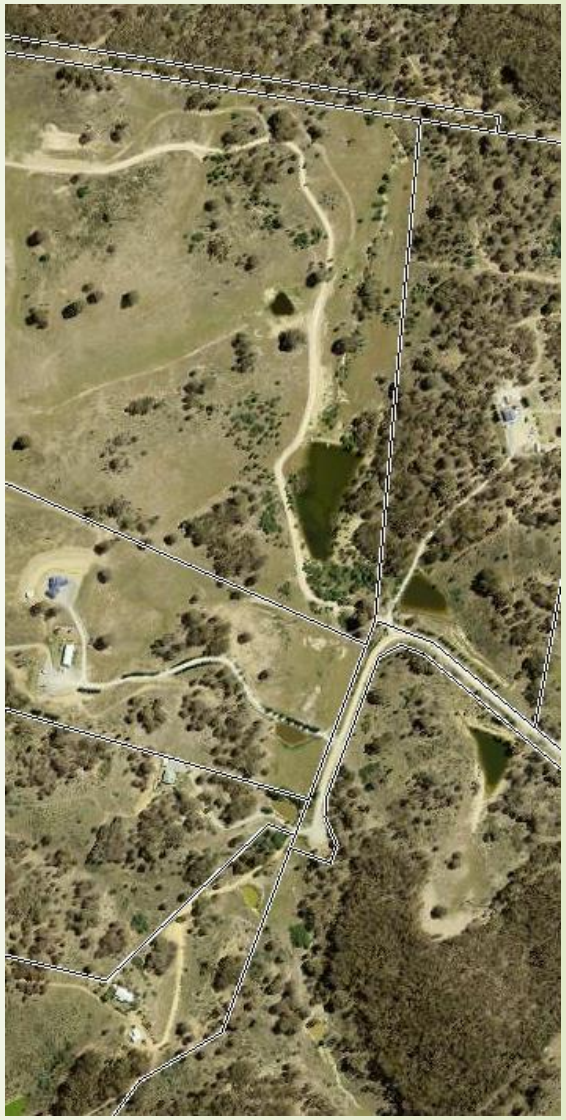
Planning


Purpose of track
• e.g. main access or fire egress; volume of traffic, type of traffic
Site assessment
• Soil erosion hazards
• Drainage line crossings: depressions versus deep channels; catchment size
• Landform issues; very rocky ground, poorly drained areas
• Steep slopes; affects amount of cut and fill
• Potential land slip areas
• Vegetation types
Route identification

Site assessment tools

- 1:25000 scale topo maps: show contours for grade, drainage features
- Six Viewer (http://maps.six.nsw.gov.au/); imagery with overlay of lot boundary
- ACT Mapi imagery for ACT (http://app.actmapi.act.gov.au/)
- Google imagery: good for vegetation
- Soil landscape maps for NSW and ACT (http://app.actmapi.act.gov.au)





Erosion and sediment control practices

Track surface drainage

- Crowning
- Infall
- Outfall
- Table drains

Relief drainage

- Cross (diversion) banks
- Mitre drains
- Culverts

Drainage line crossings

Track surfacing

- Natural
- Imported

Batter stabilisation

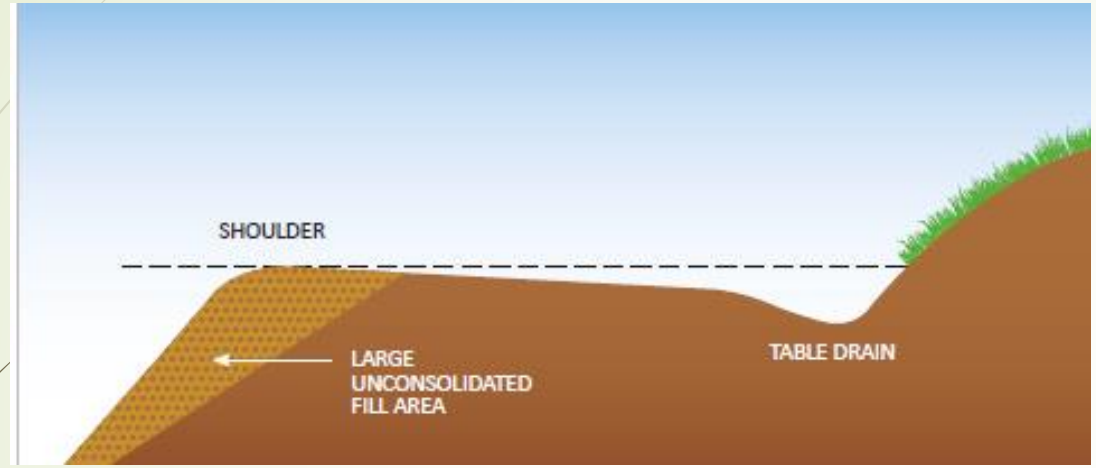
- Cut
- Fill

Topsoil management

Surface drainage: crowning

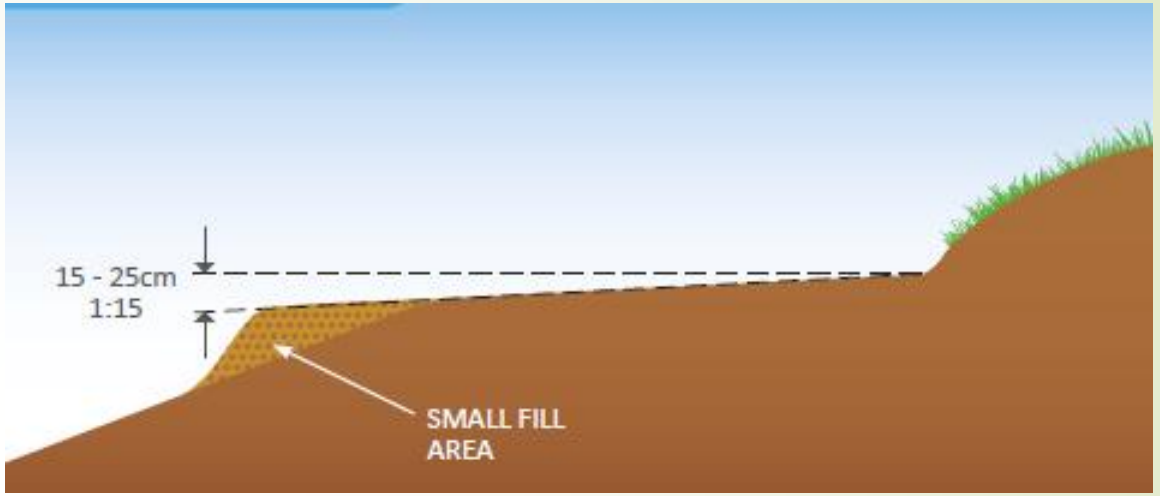
From: RFS (2017)

Surface drainage: infall



From: RFS (2017)

Surface drainage: outfall



From: RFS (2017)

Surface drainage: table drains

- Run beside track surface
- Collect runoff from track and direct to disposal point

From: RFS (2017)

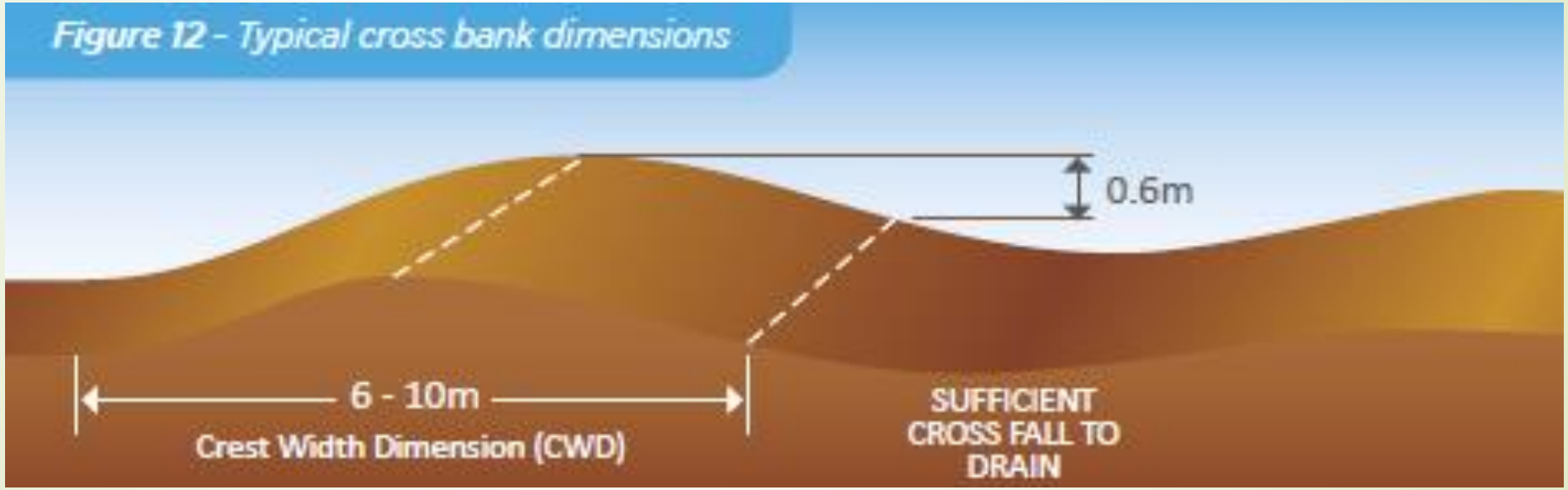
Table drains: cont'd

- Prone to washing out if:
  - soil is erodible
  - inadequate relief i.e. water runs in drain too far
- Erodible soils likely to need protection (rock, jute mesh)

Photos: Ashley Bolton, NSW Soil Conservation Service

Relief drainage: cross banks

- Simple and effective for unformed roads
- Pick up track runoff and direct onto undisturbed ground
- Easy to drive over if well constructed
- Maximum suitable grade 20%



From: RFS (2017)

Cross banks cont'd

From: RFS (2017)

Well constructed diversion bank

Poor construction, failed due to lack of volume and storage capacity

Cross banks: recommended spacing

Low erodibility ——— High erodibility

Road grade %	Road grade °	Soil class A	Soil class B	Soil class C	Soil class D
<14	<8	70-90 m	60-70 m	20-30 m	*
14-21	8-12	60-70 m	50-60 m	*	*
21-28	12-16	40-60 m	*	*	*
28-36	16-20	30-40 m	*	*	*
36-40	20-22	20m	*	*	*

From: RFS (2017)

Relief drainage: mitre drains

- Sometimes called 'push outs'
- Aim to take water from table drain out onto hillslope where it disperses
- Should slow water down before exit
- Should direct water onto undisturbed ground
- Not suited where runoff drains back to track

From: DECC (2008)

Relief drainage: mitre drains cont'd

From: RFS (2017)

Relief drainage: culverts

- Culverts convey water under a road or track, in the following situations
  - Relieve flows in a table drain on the inside of the track, and
  - Convey small watercourses under the track
- Comprise pipes and headwalls
- Without a headwall, fill around pipe will be prone to washing out
- Outwash protection with rock often required to protect channel

Photo: Antia Brademann, NSW Waterwatch

Relief drainage: culverts cont'd

- Pipe size is crucial, too small and they will block up with debris, (photo 1)
- Blow out due to the large volume of runoff (photo 2)

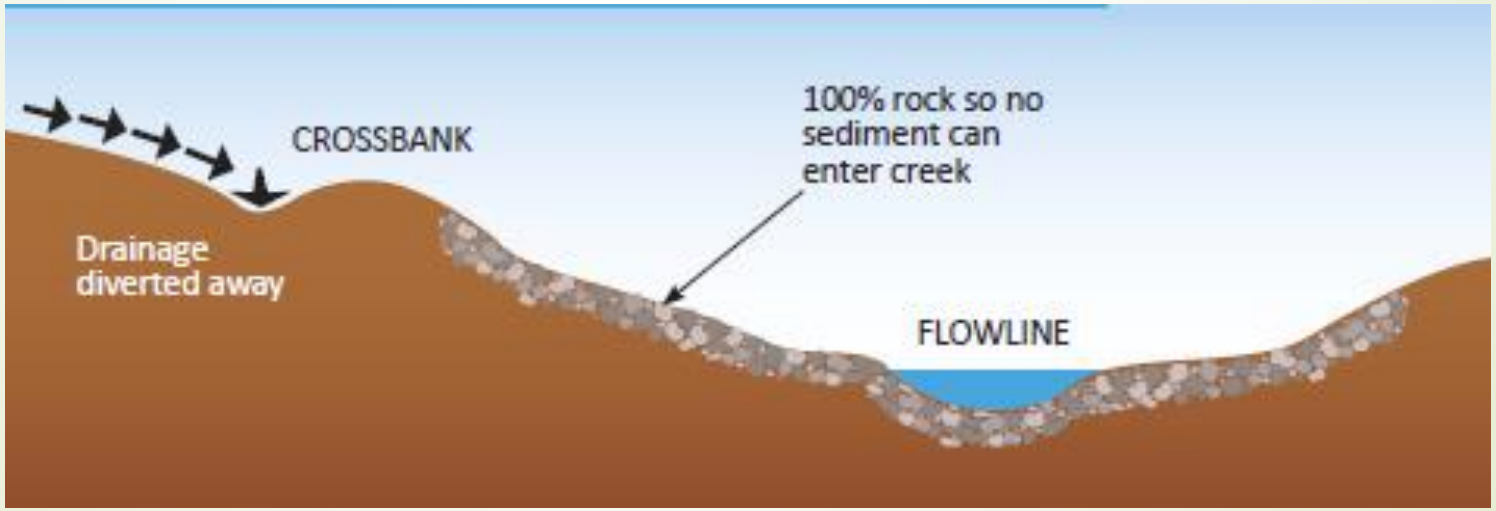
From: RFS (2017)

Photo: Ashley Bolton, NSW Soil Conservation Service

Try to avoid culverts for watercourse crossings, often better suited to a 'bed level' crossing

Drainage line crossings

- **Warning**: approvals required for any disturbance to bed and banks of a watercourse
- Likely to need engineering design on all but smallest drainage features
- Aim to cause as little disturbance as possible to bed and banks
- Do not obstruct or divert flow



Minor drainage features

- Bed level crossing or ford
- Typically depressions rather than streams, no defined channel
- Bed of watercourse and approaches protected with rock or concrete

From: DECC (2008)

Major drainage features

- Discrete channel and banks, carry large flows during and after rain events
- Banks may be vertical or sloping
- Best option is for bed level crossing
- Bed floor reinforced with rock if not natural
- Gullies and steep banks best avoided, likely to require box culvert or bridge

From: RFS (2017)

Photos: Ashley Bolton, NSW Soil Conservation Service

Track surfacing: natural materials

- Most tracks and trails will have a natural surface
- Best suited to flatter (<10%) grades, low erodibility soils (classes 1 and 2)
- Well drained sites
- Steeper sites supported by underlying rock

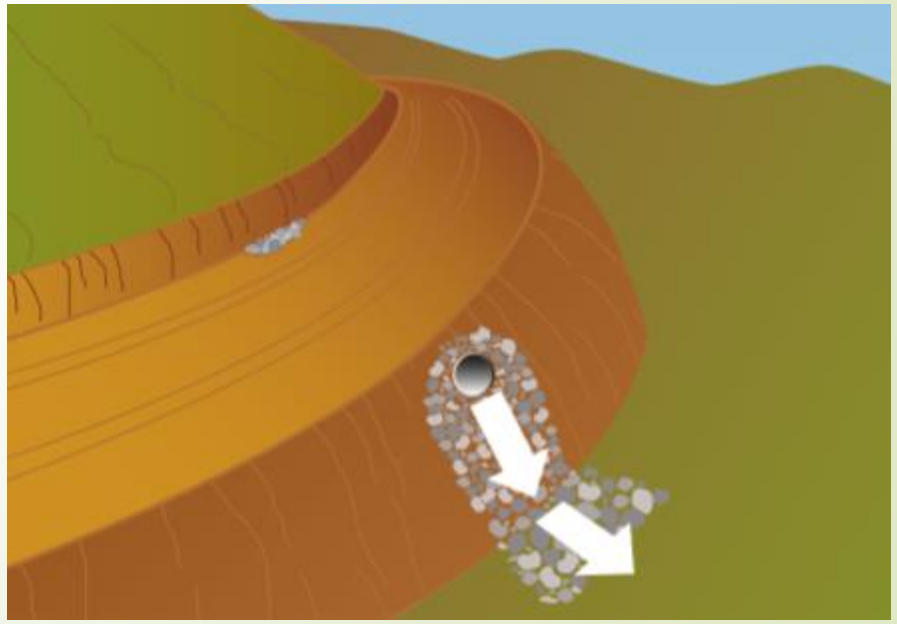
Track surfacing: imported materials

- Typically used for difficult sites
- Moderately to steeply sloping to provide protection and traction
- Boggy poorly drained areas
- Heavy use sections
- Warning - know source of material (weeds, asbestos, other waste)

Batter stabilisation

- Track construction across the slope creates a cut and a fill batter
- Aim to have batter grades gentler than 2:1, to hold topsoil and permit good grass cover
- As a guide aim to keep batter height to less than 1m
- Tracks on steeper slopes (>30%) will need geotechnical design as batters will exceed 1.5m height with high risk of erosion and slumping
- Drain outlets should be onto natural ground

Photo: Ashley Bolton, NSW Soil Conservation Service



From: RFS (2017)

Batter stabilisation cont'd

From: Forests NSW (1999)

From: Forests NSW (1999)

Topsoil management

- Keep topsoil disturbance to minimum required for track
- Topsoil crucial for rehabilitation of cut and fill batters after construction
- Ensure it is retained separately in stockpiles
- Respread on batters after construction finished
- Respread with max. depth 15cm

Track maintenance

- Absolutely will be required, no track is maintenance free
- Assess after storms, plus at least every two years
- Clean out blocked culverts and drains
- Cross banks fill with sediment and overtop

From: RFS (2017)

Key points on erosion and sediment control practices

- Keep area of disturbance to minimum required for desired track width
- Effective route planning to avoid difficult situations wherever possible
- Track drainage is the key. It minimises erosion and therefore sediment export to watercourses

Good practice = minimise(erosion + sediment export)

Practical examples

Repair powerline maintenance track

Photo: Ashley Bolton, NSW Soil Conservation Service

- Powerline maintenance track on red clay shale derived soils
- Soils not highly erodible, problem due to lack of surface drainage
- Repair entailed
  - Drainage banks at 40m spacing, draining to left side so runoff does not run back onto track
  - Flatten and compact track surface

Repair fire trail

Photo: Ashley Bolton, NSW Soil Conservation Service

- Fire trail on stony yellow clay loam, prone to erosion
- Inadequate drainage of surface due to windrow along right side of trail
- Repair entailed
  - Removal of windrow to allow for outfall drainage
  - Install cross banks to divert track runoff

Repair to diversion banks

Track management | SKN

- Fire trail on yellow brown sandy clay, granite derived soils
- Lack of capacity in old diversion banks leading to overtopping
- Repair entailed increasing height and volume of cross bank to allow 0.5m freeboard on high side

Track recovery after bushfire emergency

Photo: Ashley Bolton, NSW Soil Conservation Service

- Fire trail on light grey silty loam
- Rapid construction during bushfire emergency
- Excessive disturbance along edge of trail
- Repair entailed reinstating topsoil cover on track verge to encourage natural regeneration and diversion banks to redirect track runoff from upslope

Track management | SKN

Q&A session

For more information:

Webinar will be available on the Rivers of Carbon website www.riversofcarbon.org.au

Antia Brademann
upperbidgeereach@gmail.com

Peter Fogarty
slcc@grapevine.com.au

Ashley Bolton
ashley.bolton@scs.nsw.gov.au

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Jenilee DeLandre
Jenilee.DeLandre@act.gov.au