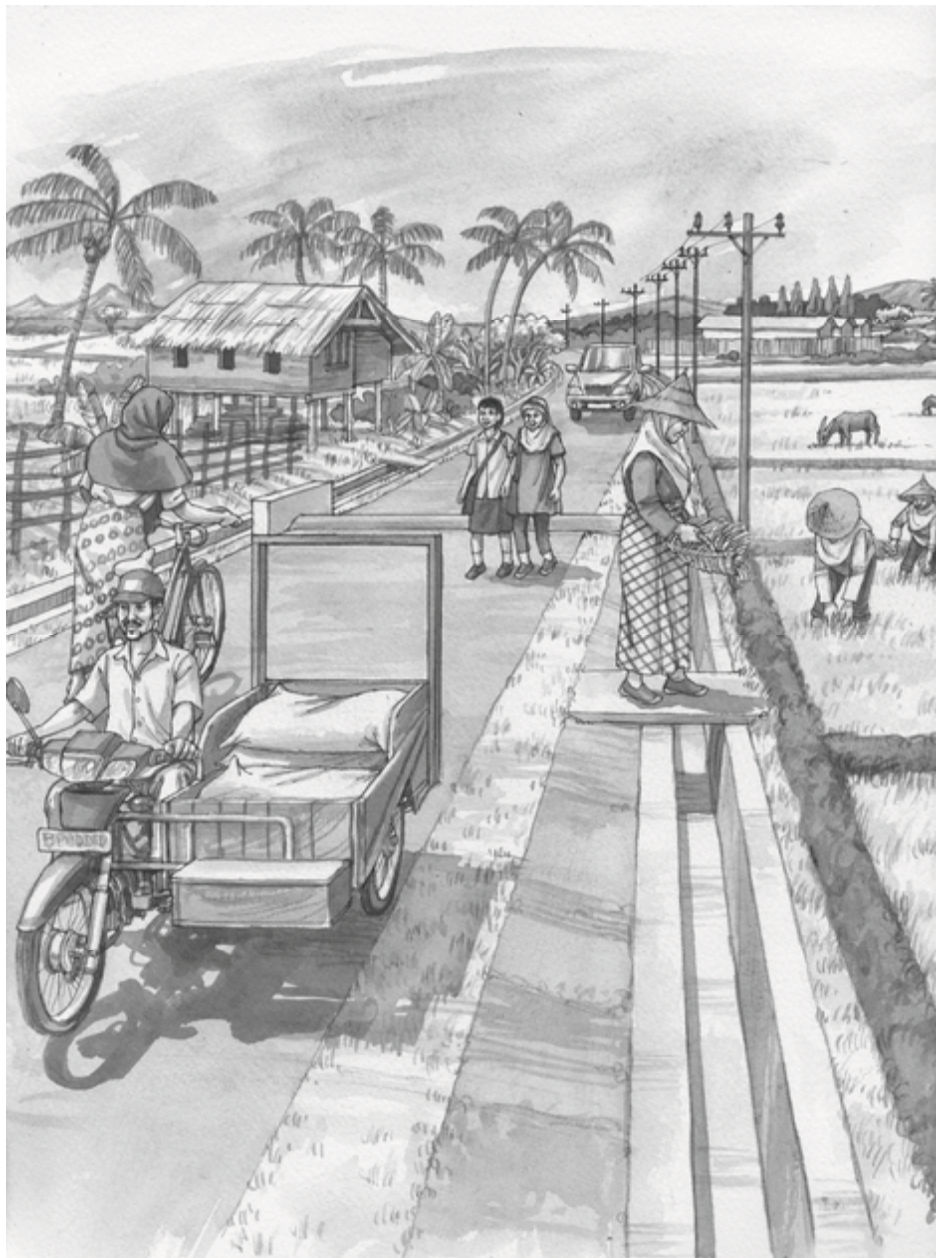


Handbook 2: Working to keep District roads in good condition



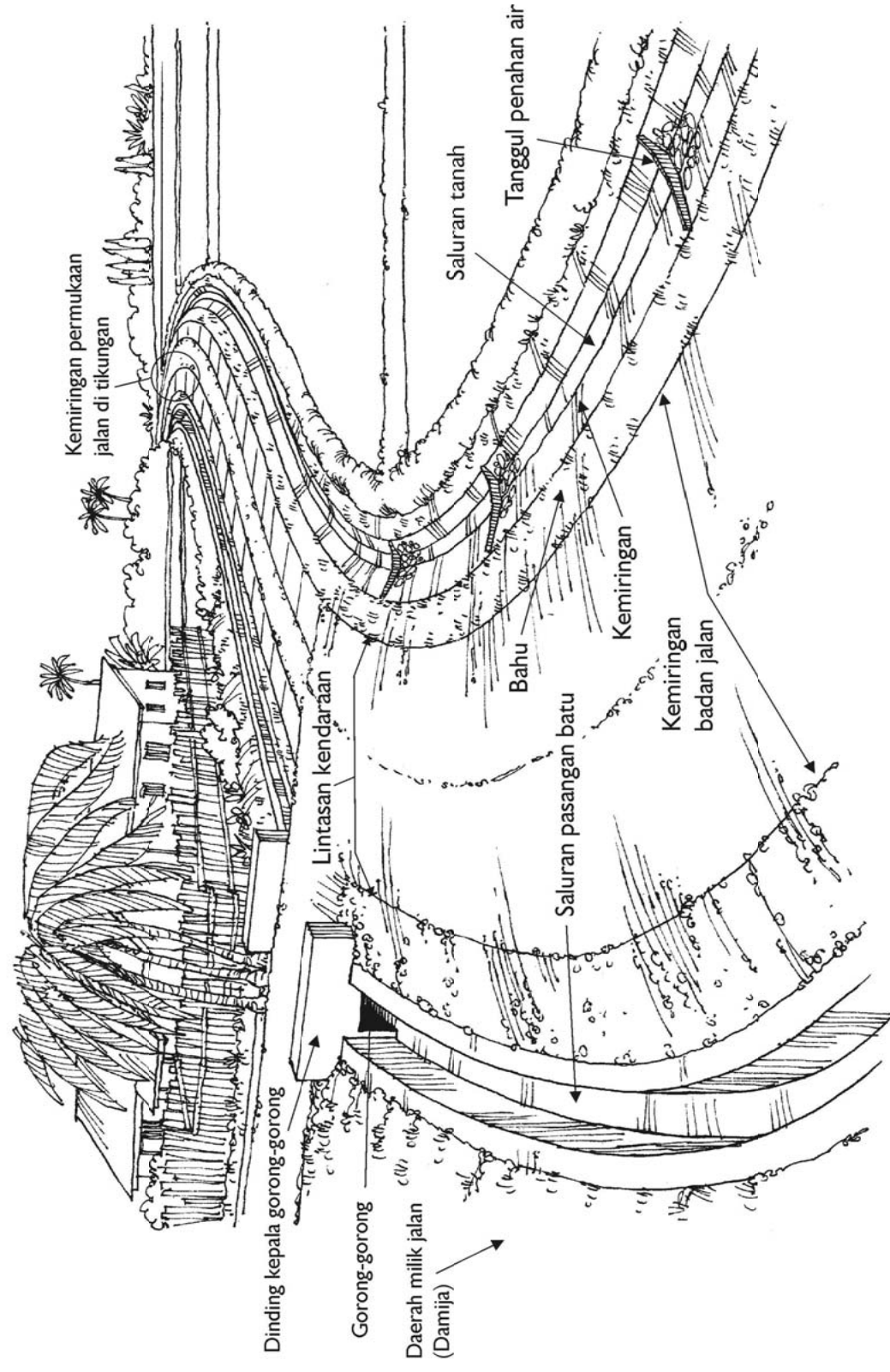
A well maintained road



Contents

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Elements of a Road



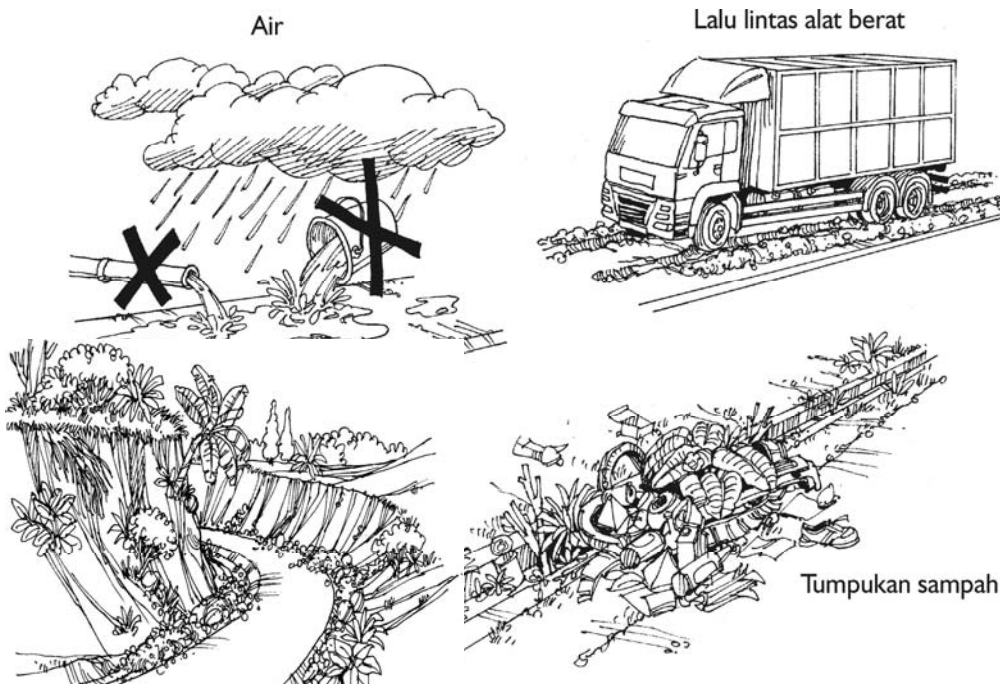
The picture above illustrates the main elements of a road so that everyone is familiar with the terms used later in this handbook.

What are the dangers to a good road?

Examples of construction

problems are:

Steep gradients,
low-lying flood
areas, steep side
cuts, lack of
culverts, drain
sides higher than
the road level, poor
soils, poor quality
gravel, poor quality
asphalt.



Construction problems: steep side cuts

How to keep a road in good condition

Routine Maintenance Activities

1. Clearing bush and cutting grass
2. Clear debris from bridges
3. Cleaning culverts including inlets and outlets
4. Cleaning of side and outlet drains
5. Repair of erosion on shoulders and slopes
6. Grubbing of carriageway
7. Grass planting
8. Non-standard activities:
 - Minor repairs to the **gravel** carriageway
 - Other tasks

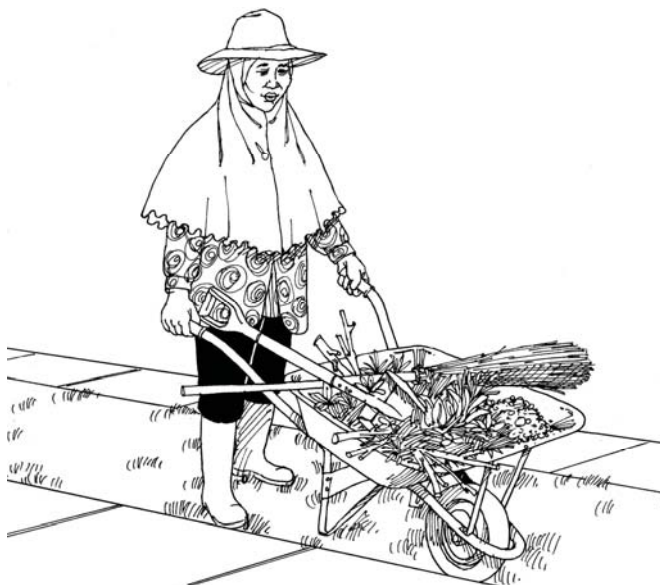
Which handtools are needed?

				
Wheelbarrow	Grass cutter	Bush knife	Handsaw	Axe
				
Crowbar	Shovel	Shovel with long handle	Hoe	Pickaxe
				
Rake	Broom/brush	Hand rammer	Watering can	Bucket
				
Basket	Hammer	Pegs and string	Mason's tools	Tool sharpeners
				
Road safety signs	Gloves	Gum boots	5m tape-measure	50m tape-measure

Not all of these handtools will be needed on each road. The tools to be ordered will depend on the work to be done

Routine Maintenance Activities

: A basic rule for every maintenance activity



Using wheelbarrows or baskets, take all grass, silt and rubbish removed from the culverts, drains and roadway away to a tip site agreed with the Supervisor or at a safe distance (at least 5 m) away from the road edge

If silt, rubbish, grass and bushes are not taken away from the roads and drain edges they will just be washed back into the drains with the next rains and the maintenance work will be wasted.

1. Clearing bushes and cutting grass on the road and at the road edges

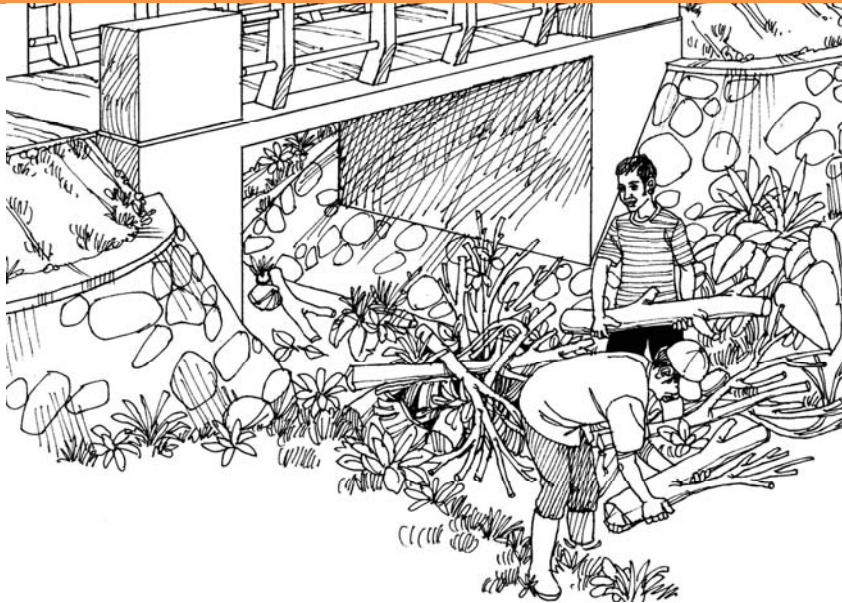


Tools:

Shovel
Grass-cutter
Wheelbarrow
Basket
Bush knife
Axe
Handsaw
Rake
Brush

Cut back grass or bushes which are growing at the road edge, and cut any grass growing in the roadway. Where grass is growing in the drains cut the grass but leave the roots. The roots help bind together the soil in the bottom and sides of the drain. Once cut, the grass should be not longer than 5 cm

2. Clear debris from bridges



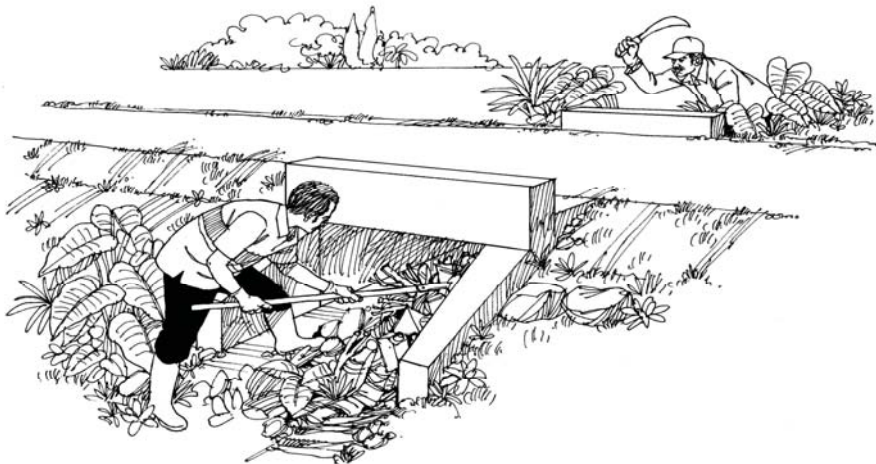
Tools:

Shovel
Hoe
Wheelbarrow
Bush knife
Axe
Handsaw
Crowbar

As a team working together remove all logs, large boulders and other debris blocking the path of the water flowing under the bridge.

If logs and other debris block the flow of water under the bridge, this can cause flooding of the surrounding area or may damage or wash away the bridge.

3. Cleaning of pipe and box culverts including the inlets and outlets



Tools:

Shovel
Hoe
Grass-cutter
Wheelbarrow
Long-handle
shovel
Rake
Basket

*Remove all silt and waste from the **whole length of the culvert**, and from the entrance and exit. Ensure that the levels of the drains are correct so that water will flow through the culvert and away from the exit. Cut grass and bushes where the entrance and exit to the culvert are overgrown.*

4. a) Clean rubbish and soil from side drains and turnout drains

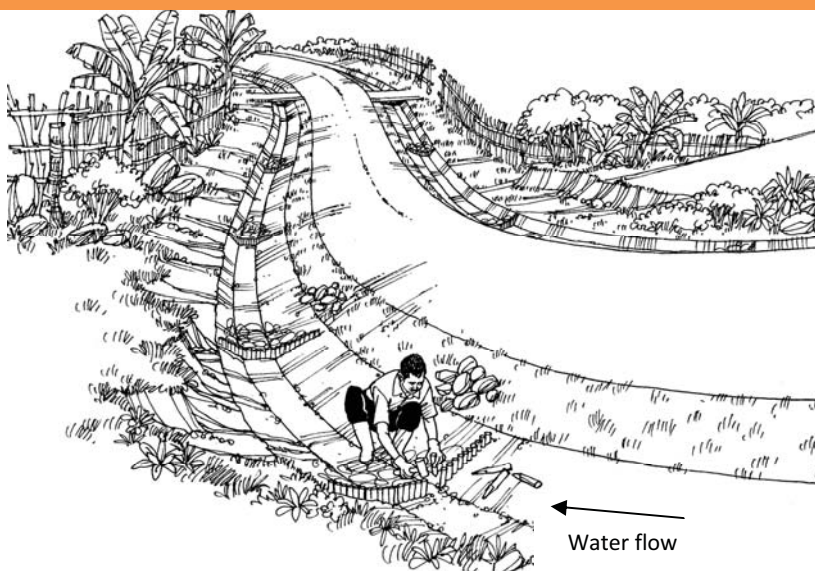


Tools:

Shovel
Hoe
Grass-cutter
Wheelbarrow
Basket
Rake
Brush

Remove household rubbish, soil and bushes from all drains. Make sure that once cleaned, the drains have flat bases with a constant slope so that water flows and there are no dips where water can gather. The sides of unlined drains need to be sloped back so that no soil falls back into the drain.

4. b) Repair damage to drains



Tools:

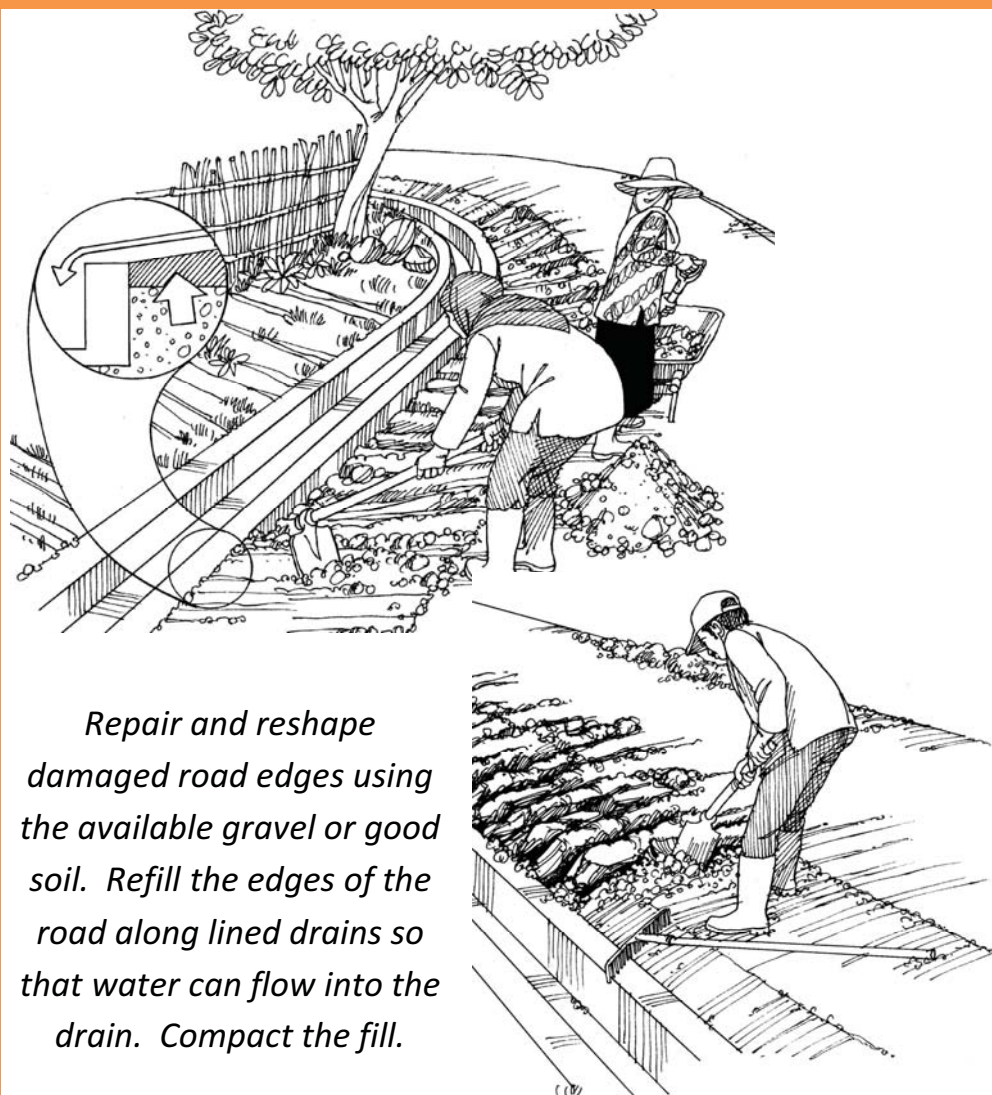
Shovel
Wheelbarrow
Hand rammer

Materials:

Sticks or stones
Bush-knife or
handsaw for
cutting sticks

Where water has damaged the drains repair the damage by filling with good soil and compacting. Where damage is due to water running in the drains down steep slopes, scour-checks should be added. A guide for the proper construction of scour checks is provided in Sheet B1 in Annex 1

5. Erosion and road shoulder repairs



Repair and reshape damaged road edges using the available gravel or good soil. Refill the edges of the road along lined drains so that water can flow into the drain. Compact the fill.

Tools:

- Shovel
- Hoe
- Grass-cutter
- Hand-rammer
- Wheelbarrow
- Rake
- Basket
- Watering can

6. Grubbing of the Carriageway on Gravel Roads



Remove all grass, including the roots, growing in the roadway and up to 10 cm on either side of the road way.

Tools:

- Shovel
- Hoe
- wheelbarrow
- Rake
- Basket
- Brush

7. Grass planting



Tools:

Hoe
Wheelbarrow
Watering can

Where there is a danger of erosion or where slopes have been newly repaired, these can be better protected in the future through the planting of grass – recommended – “Rumput Gajah”

8. Non-standard activities (gravel and earth roads)

8. (a) Fill potholes and ruts and reshape carriageway-Gravel Roads

Where the road has potholes fill the holes



Where the road has ruts, fill the ruts and reshape the road using the existing gravel or good soil to

Tools:

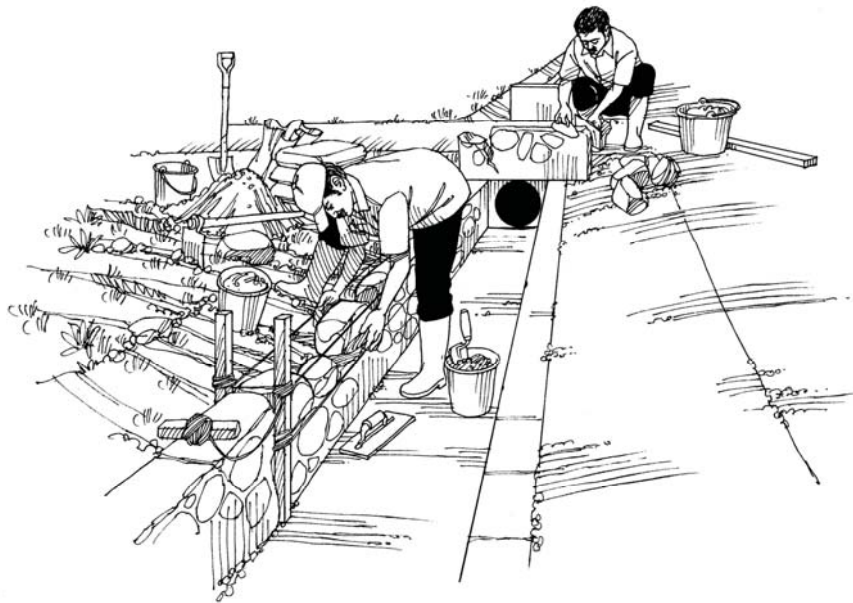
Shovel
Hoe
Hand-rammer
Wheelbarrow
Rake
Basket
Watering can

give the surface a roof shape. Instructions for pothole filling are provided in Sheet B2.



8. (b) Repair of culvert walls and lined drains

Repair damage to culvert and drain walls. If the repairs involve mortar or small patches of



concrete, this will be a job which needs mason's tools and experience and where concrete is used the advice in sheet B3 in Annex 1 should be followed.

Tools:

Masons' tools:
Trowel
Hammer
Watering can
Sacking

8. (c) Removal of small landslips



Remove the loose material caused by the landslip from the road carriage way and drainage system

Transport and dispose of the removed material to suitable place.

Tools:

Hoe
shovels
basket
wheelbarrow

If the land slide more than 10 m³ additional help is needed, and this should be reported to the district engineer to make a decision for additional help.

Remember: Under routine maintenance only minor repairs can be carried out.

When all the activities are complete the road should have a good shape and surface for the vehicles to run on and the drainage should be working properly.

How to organise and do the work:

Once a routine maintenance team have been selected (as described in handbook 1) the process will continue as follows:

One-day team training

The supervisor will train the Routine Maintenance Team in the work to be done based on pages 4 to 9 of this handbook.

Joint inspection of work to be done: District Supervisor and CRMT



Take the tasks list and quantities prepared by Supervisor, tape measure, *notebook* and pen for noting any important points and any amendments.

The Supervisor will already have inspected the road and identified the work to be done. Together with the routine maintenance team leader and team, they will walk down the road and show the team exactly where the work is to be done. The team leader should be sure of (i) the type of work (ii) the amount of work and (iii) the position on the road where each task is to be carried out, (as described in the completed **Forms 2 and 4** in Annex 1.

Agreement on the amount of work and the total sum of money

The value of the agreement will be based on the number of working days needed to complete all the tasks, multiplied by the wage rate. The team leader will be expected to work alongside the team members each day, but will receive a slightly higher daily wage than the team members because of the extra organisational work. (See handbook 1 for an example of a simple agreement)

Receipt of hand-tools

The Supervisor will provide/ or the team will be given money to buy sufficient handtools for carrying out the maintenance work. Each team member will need the commonly used hand-tools (for example: shovels, hoes,) and other tools (such as handsaws and hand-rammers) can be shared within the team. The final choice of tools will depend on the actual work to be done.

The Supervisor will prepare a **list of hand-tools** together with the team leader and the hand-tools will be the responsibility of the team leader and the team members until the maintenance work has been completed.

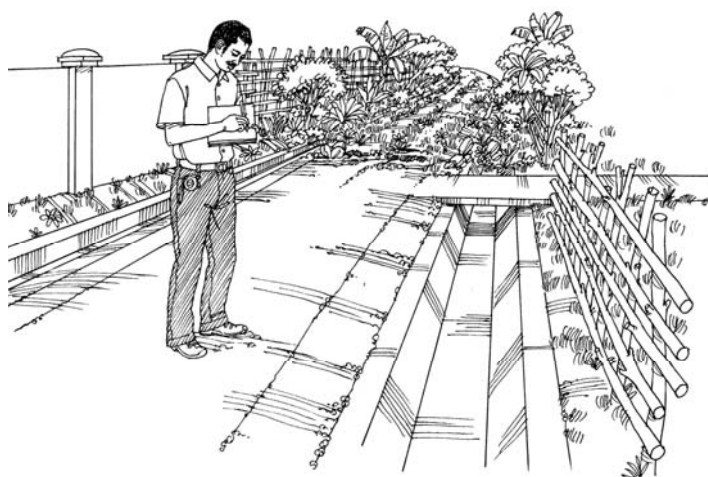
Work planning and implementation

The agreement between the District and the Community Routine Maintenance Team (CRMT) has been prepared based on output. In other words payment will be made based on how much work is achieved, not the hours taken to do the work. The team leader should use the strings and pegs to mark of the lengths and widths of the work to be done each day. At the end of the day the team leader must check how much has been achieved and plan the work for the following day.

From the completed **Form A4** the number of workerdays needed to complete all routine maintenance tasks for each 200m stretch of road is known. The team leader can then set goals for progress along the road based on the size of the team and the number of workerdays needed. For example, if the first 400m section is planned to be completed with $23 + 14 = 37$ workerdays, with a team of 4 (team leader plus 3) progress would be planned for completing the 400m in $37/4 = \text{approximately } 9$ days. The CRMT Leader would plan to complete all the activities in the 400m in 9 days. As a check for setting out each task the figures in the rows for each activity can be used as shown in the „Total WD“ column.

Two simple actions are needed to
organise the work

1. As the work will only take place over a few weeks it is assumed that all team members will be present every day. Attendance will be registered in a muster roll form provided as **Form 9**. In the case of a team member not

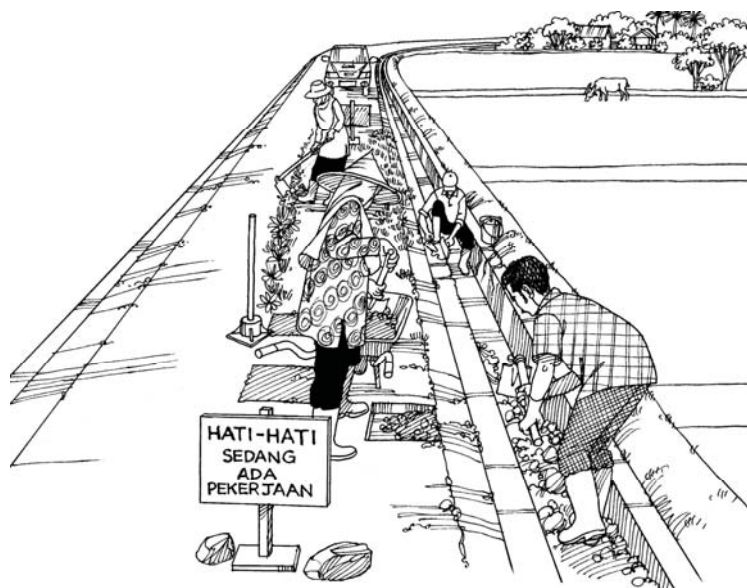


being able to come to work, no attendance will be marked. This absence will not be paid for.

2. The WDs and progress in metres calculated by the Supervisor can be entered into a planning and implementation **form 4**. This form shows the expected progress and can be referred to when checking if the team is making sufficient progress and will complete the work under the agreement within the number of days specified. Once the daily target set by the team leader has been completed to the correct standard and approved by the team leader, the team members are free to leave the site.

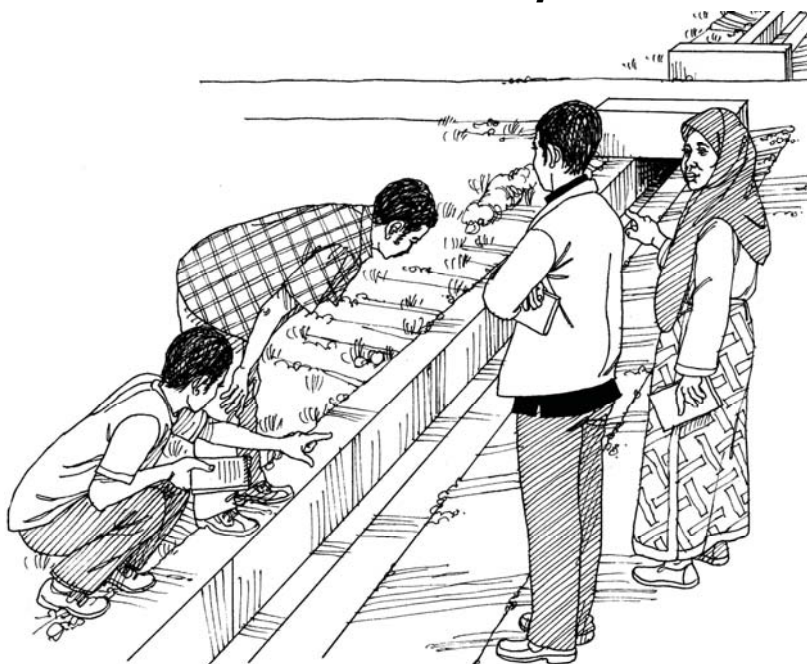
Safety

At the start of each working day road signs need to be set at the start and end of the section of road where the maintenance work is being carried out so that drivers are warned that people are working on the road.



up

Joint inspection of Completed Work



During the maintenance work, the Supervisor will be monitoring the progress and should advise the team leader if the work is being completed to the correct standard. The supervisor should also be available to assess and agree to any additional work which may be necessary but was not planned for. (For example: heavy rains cause damage to the road edges and the repairs will take more time and work than was originally planned for when the agreement was signed.)

Any new instructions must be written in the team leader's notebook and signed by the District's Representative and the team leader.

Payments

Most workers would prefer not to have to wait till the end of the month to receive their wages, so even if the contract takes only one month to complete, part payment needs to be made based on progress. These payments are known as interim payments. For the interim payments, the Routine Maintenance Team will be paid according to the progress along the road, but the total sum will not exceed the final amount in the agreement. The team will agree with the Supervisor at which progress points the interim payments will be made. For example the interim payments will be made after each 400m or 500m. The team will then be paid the value of the work as laid out in **form 4**. Example:

From **form 4**, the amount set aside for progress for the first 400m is IDR 1,150,000 + 700,000 = 1,850,000. The estimated number of workerdays needed to complete the first 400m was $23 + 14 = 37$. The estimated wage rate was IDR 50,000.

If the team have finished the work and only used 35 days on the muster roll **Form 9**, then the WD to be paid to each workers will be factored by $37/35$, and this then multiplied by the actual days worked. The total amount to be paid to each worker will be their new Wds multiplied by the wage rate.

If however the team used 40 days, then the Wds to be paid will be reduced by $37/40$ times the number of worker days actually worked to give the new Wds, which in turn will be multiplied by the agreed wage rate of IDR 50,000.

Return of all handtools and final payment of all team members

Once the team leader is satisfied that all the work is complete, He/she should ask the Supervisor to inspect the work with the team and to pass the work as completed for payment. This should be done in writing. Within one week of the request, the Supervisor should meet with the team leader and the team members to:

1. Receive back the hand-tools or witness that the handtools are handed over to the village head for safe keeping
2. Pay the team leader the full amount. Where the tools have been provided by the district, the cost of any missing handtools will be deducted.
3. Witness the immediate payment of the team members by the team leader

The final payment must be based on the full amount of the Routine Maintenance Agreement, regardless of whether the team has taken more or less days to complete. The team leader will also be entitled to his full supervision allowance.

Problem solving

If any disagreements arise in connection with the agreement and the work done, then the District Engineer / Village Leader should be contacted and his/ her advice sought.

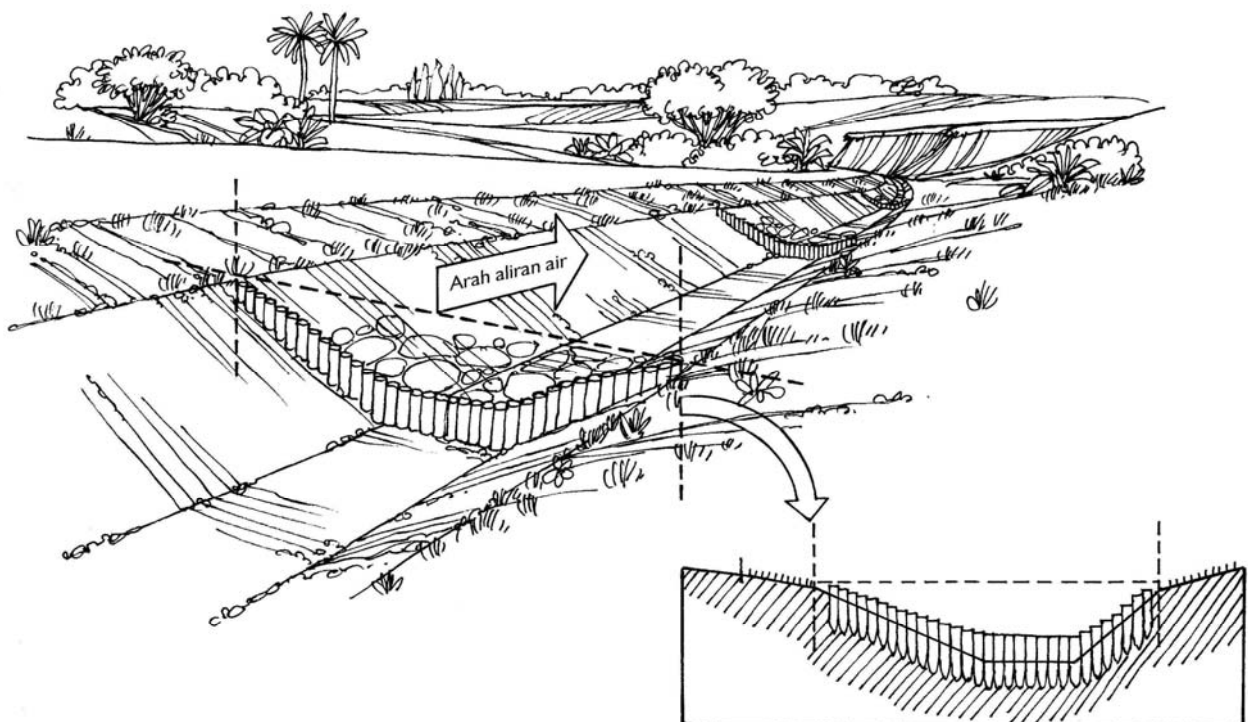
Annex 1

Building and/or repairing scour checks

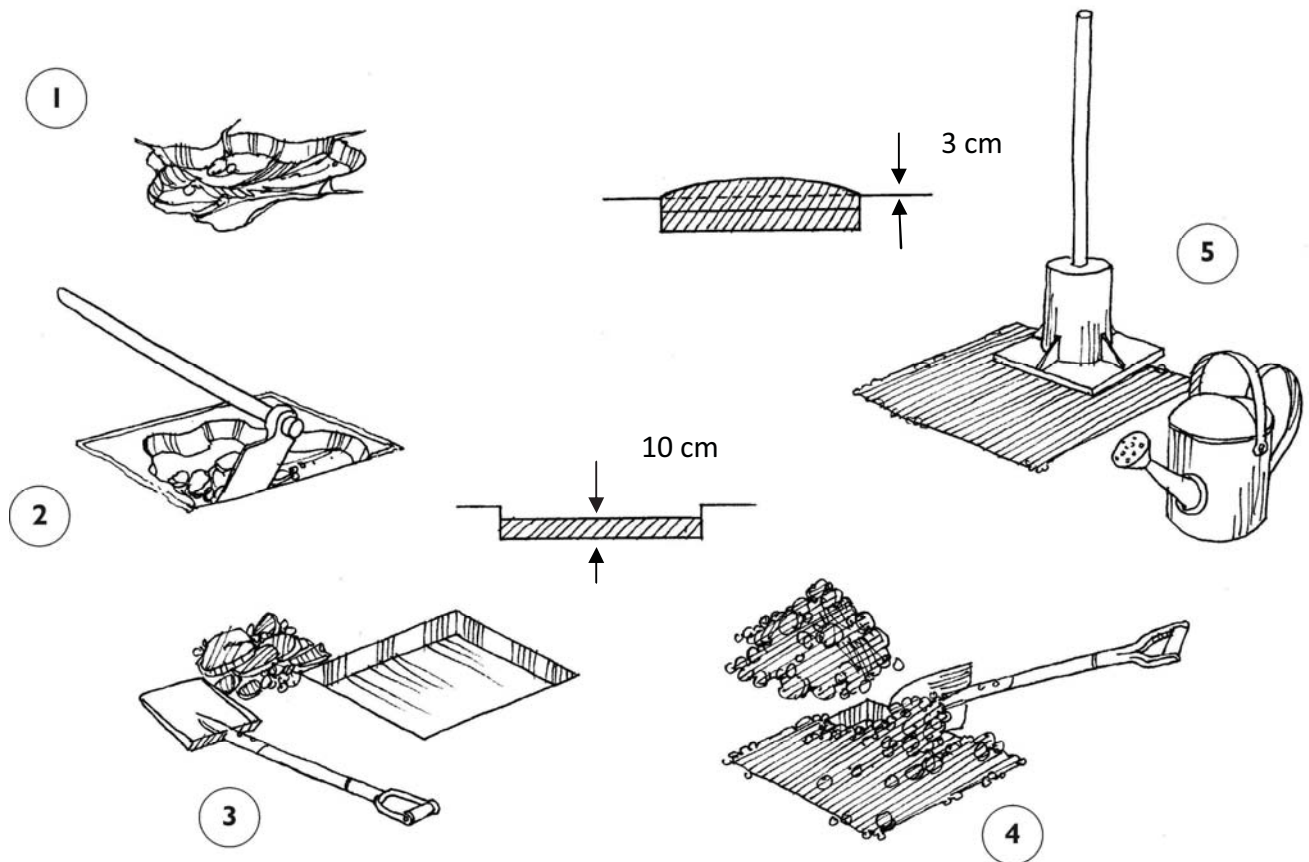
Scour checks can be constructed of natural stones, wooden stakes or masonry. The aim is to construct a series of mini dams to reduce the speed of the flow of water along steep sections of the drains. The important element of the construction is that the scour check should follow the same shape as the sides and base of the drain, only slightly higher, and should not be less than 20 cm lower than the edge of the carriage way. If the scour checks are too high they will block the drain and force the water into the road thus damaging the road.

The stones or wooden stakes need to be bedded into the soil so that they are firmly held in place. For the stone scour checks it is best to dig a small ditch across the drain and place the stones in this ditch.

Additional stones must be placed immediately below the scour check to protect the soil from erosion when the water flows over.



Repairing potholes in gravel roads



Steps

1. Remove all wet soil and loose stones and soil from the pothole
2. Dig out the pothole to make a square shape (This helps the filled material stay in place and it will not be pushed out again by the next truck that goes along the road)
3. Also make sure the base of the pothole is flat.
4. Fill the pothole in layers with good moist soil. The soil should be moist not wet, and the layers should be a maximum of 10 cm thick.
5. Each layer should be compacted using a hand rammer, with additional water **only** if needed. The final fill should be about 3 cm above the level of the surrounding road

For road surfaces, any mortar mix must be strong enough to take the weight and the wear of traffic running on it. Where minor cracks and surface damage are evident in concrete strips or stone and mortar strips, the following minor repair can be undertaken:

Surface damage:

- (i) Chip off and brush away any loose material from the surface or joint to be repaired.
- (ii) Prepare a strong mortar mix (1:4 – cement: sand). Add water until the mortar can be kneaded in the hand and retains its shape when the hand is opened. The mortar should not flow off the trowel. The amount of mortar mixed at one time should not be more than a mason can use within one hour.
- (iii) Dampen the old surface slightly, to help give a good bond with the new mortar, before applying the new mortar.
- (iv) Cover the new mortar with sand, or cloths and water regularly for one week to make sure that it develops its strength. If the new mortar is not protected from the sun, then the repair will not last very long.

Traffic should be kept away from any repairs for a minimum of 7 days, preferably 28 days. Traffic can be kept away from the repaired wall through the placing of large stones or branches along the edge of the road.

Masonry type ¹	Requirements for 1m ³ of finished wall	
Rubble stone masonry	Stones 1.3 – 1.5 m ³	Mortar 300 - 400 l/m ³
Shaped stone masonry	Stones 1.3 – 1.5 m ³	Mortar 200 - 300 l/m ³
Brick masonry	Stones 1.3 – 1.5 m ³	Mortar 250 - 270 l/m ³
Block masonry	Stones 1.3 – 1.5 m ³	Mortar 200 - 250 l/m ³

¹ Adapted from Beusch A., Winsvold M, Site Supervisors Course for Labour-Based and Community-Managed Upgrading of Urban Low-Income Settlements, Kewi, Kisii, ILO, 2002

Routine Maintenance Assessment Form - Off carriageway Form 2										Page of	
Province					Agreement no:						
District:					Assessed by:						
Sub-District:					Signature:						
Road link:					Date of assessment:						
Road link no:											
Off-Carriageway routine maintenance activities	Stan-dard WD/ km	Factors**	Conditions each 20% road section					Length =	1 km	km	
		Cross Section	Condition	First 200	Second 200	Third 200	Fourth 200	Fifth 200	Daily wage	50,000	IDR/day
1. Clearing bush and cutting grass	22	1	Light= 0.8 Medium= 1.0 Hard= 1.3	1	1			1	0.94	21	WD
				3.5	3.5	4.4	5.7	3.5			
2. Clear debris from bridges	10	1	Light= 0.8 Medium= 1.0 Hard= 1.5	1	0	0	0	0	0.20	2	WD
				2.0							
3. Cleaning culverts incl. in/outlets, slopes	15	1	Light= 0.3 Medium= 1.0 Hard= 1.7					1	0.88	13	WD
				5.1	5.1			3.0			
4. Cleaning of side and outlet drains	75	1	Light= 0.7 Medium= 1.0 Hard= 1.3	1	0	1	0	1	0.48	36	WD
				10.5		15.0		10.5			
5. Repair of erosion on shoulders	27	1	Light= 0.8 Medium= 1.0 Hard= 1.5	0	1	0	0	0	0.16	4	WD
					4.3						
6. Grubbing of carriageway	10	1	Light= 0.6 Medium= 1.0 Hard= 1.8	1			1	1	0.84	8	WD
				2.0	1.2	1.2	2.0	2.0			
7. Grass planting	25	1	Light= 0.4 Medium= 1.0 Hard= 1.6				1		0.08	2	WD
							2.0				
8. Non-standard routine maintenance activities						3			Total WD non-standard=	3	WD
Works to be recorded under this activity may include clearing of landslide etc. Estimate WDs directly											
Total workerdays / employment				23	14	24	10	19			
Employment to be created per kilometer of road =				90 WD / km				Sub-total =		90	WD
Total amount of wages for (physical) maintenance works: 90 x IDR 50,000 =				IDR 4,500,000						4,500,000	IDR
Allowance for TL for supervision for 23 work-days at 50%				25,000 IDR / day =						575,000	IDR
Total amount of works including supervision by the TL:										5,075,000	IDR
Amount in words =	Indonesian Rupiah five million and seventy five thousand										
Tools to be issued:				Implementation arrangements: Last page only							
Item	Item description	Unit	No	Planned number of workers:				90	workers		
1	Wheel barrows	No	2	Working days per week***				6	days/w		
2	Grass cutter with handles	No	4	Size of team:				4	team		
3	Grass cutting machine	No	0	Agreement duration:				4	weeks		
4	Bush knives	No	4	total for WD and team leader responsibility				IDR	5,075,000		
5	Shovel with handles	No	4	Total for handtools				IDR	1,975,000		
6	Hoe with handle	No	4								
7	Hand rammer with handle	No	1								
8	Basket	No	4								
9	Watering can	No	1								
10	Steel peg and string line	set	1								
11	Safety clothing	set	4								
12											
13											
14											
				Total				IDR	7,050,000		

Planning and cost estimate Form 4

Planning and Implementation Form 4		Name of Province:		Name of District:		for the District		for the CRMT		witnessed		Sheet _ of _	
Road link no:		Name of Village:		Name:		Name:		Name:		Name:			
Prepared by:		Name of Road:		Position:		Team Leader:		Team Leader:		Village Leader:			
Date:		Date:		Signature:		Signature:		Signature:		Signature:			
		0.000 km		0.200 km		0.400 km		0.600 km		0.800 km		1.000 km	
1. Clearing bush and cutting grass		WDs Wage rate IDR Wage Costs IDR		3.5 50,000 175,000		3.5 50,000 175,000		4.4 50,000 220,000		5.7 50,000 285,000		3.5 50,000 175,000	
2. Clear debris from bridges		WDs Wage rate IDR Wage Costs IDR		2 50,000 100,000		0 50,000 0		0 50,000 0		0 50,000 0		0 50,000 0	
3. Cleaning culverts incl. in/outlets ,slopes		WDs Wage rate IDR Wage Costs IDR		5.1 50,000 255,000		5.1 50,000 255,000		0 50,000 0		0 50,000 0		3 50,000 150,000	
4. Cleaning of side and outlet drains		WDs Wage rate IDR Wage Costs IDR		10.5 50,000 525,000		0 50,000 0		15 50,000 750,000		0 50,000 0		10.5 50,000 525,000	
5. Repair of erosion on shoulders		WDs Wage rate IDR Wage Costs IDR		0 50,000 0		4.3 50,000 215,000		0 50,000 0		0 50,000 0		0 50,000 0	
6. Grubbing of carriageway		WDs Wage rate IDR Wage Costs IDR		2 50,000 100,000		1.2 50,000 60,000		1.2 50,000 60,000		2 50,000 100,000		2 50,000 100,000	
7. Grass planting		WDs Wage rate IDR Wage Costs IDR		0 50,000 0		0 50,000 0		0 50,000 0		2 50,000 100,000		0 50,000 0	
8. Non-standard routine maintenance activities e.g. Masonry repairs, landslides etc. minor carriageway repairs		WDs Wage rate IDR Wage Costs IDR		0 50,000 0		0 50,000 0		3 50,000 150,000		0 50,000 0		0 50,000 0	
Total WDs and total wage costs per 200m Wage rate = IDR 40,000		Total WDs Total wage costs IDR		23 1,155,000		14 705,000		24 1,180,000		10 485,000		19 950,000	
Total WDs for km 1.1 Total WDs from previous sheets kms 1.1 to 1.1 Total wds at the end of km 1.1		= 90 WDs = 0 WDs = 90 WDs		Employment to be created per kms = Total amount of wages for (physical) maintenance works: Allowance for TL for supervision for 23 work-days at 25,000 IDR/day = Total amount for works including supervision by the TL:		90 WD/km 4,500,000 IDR 5,075,000 IDR		Sub-total = 4,500,000 IDR 5,075,000 IDR		90 WD/km 4,500,000 IDR 5,075,000 IDR		Quantity Sand Stone Aggregate Cement Total	
size of team = 90 / 24 days is > 3, therefore 4 persons in the team supervision = 23 days @ 25,000 extra =		IDR 575,000		Handtools as per Sheet 8		IDR 1,975,000		IDR 1,975,000		IDR 1,975,000		IDR 1,975,000	
Total Costs for wages, supervision, handtools and Materials =		7,050,000 IDR		Contingencies 5% =		352,500 IDR		352,500 IDR		352,500 IDR		7,402,500 IDR	

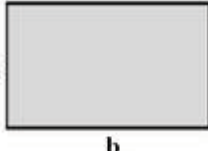
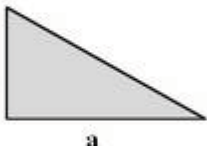
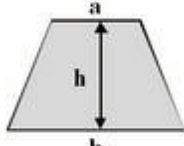
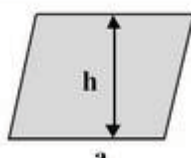
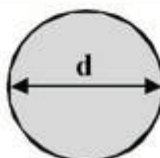
Sheet S1: Simple shapes and calculations
Useful Tables for calculating the amount (volume) of the work²

Length – units

	mm	cm	m	km
1 mm	1	0.1	0.001	0.000001
1 cm	10	1	0.01	0.00001
1 m	1,000	100	1	0.001
1 km	1,000,000	10,000	1,000	1

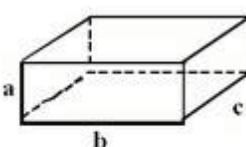
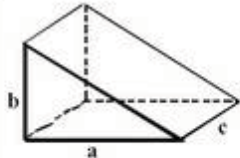
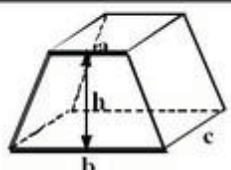
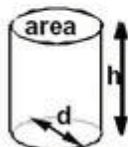
	mm ²	cm ²	m ²	hectare	km ²
1 mm ²	1	0.01	0.0000001		
1 cm ²	100	1	0.0001		
1 m ²	1,000,000	10,000	1	0.0001	0.000001
hectare			10,000	1	0.10
1 km ²			1,000,000	100	1

Area - Units

 square: $a \times a$	 rectangle: $a \times b$
 triangle: $\frac{a \times h}{2}$	 trapezoid: $\frac{a + b}{2} \times h$
 rhombus: $a \times h$	 circle: area = $\frac{d^2 \times \pi}{4}$ circumference = $d \times \pi$

Volume Units

	cm ³	dm ³ (1 litre)	m ³
1 cm ³	1	0.001	0.000001
1 m ³	1,000,000	1,000	1

 rectangular prism: $a \times b \times c = v$	 triangular prism: $\frac{a \times b}{2} \times c = v$
 quadrilateral prism: $\frac{a + b}{2} \times h \times c = v$	 cylinder: area $\times$ h $\frac{d^2 \times \pi}{4} \times h = v$

² Adapted from Beusch A., Winsvold M, Site Supervisors Course for Labour-Based and Community-Managed Upgrading of Urban Low-Income Settlements, Kewi, Kisii, ILO, 2002