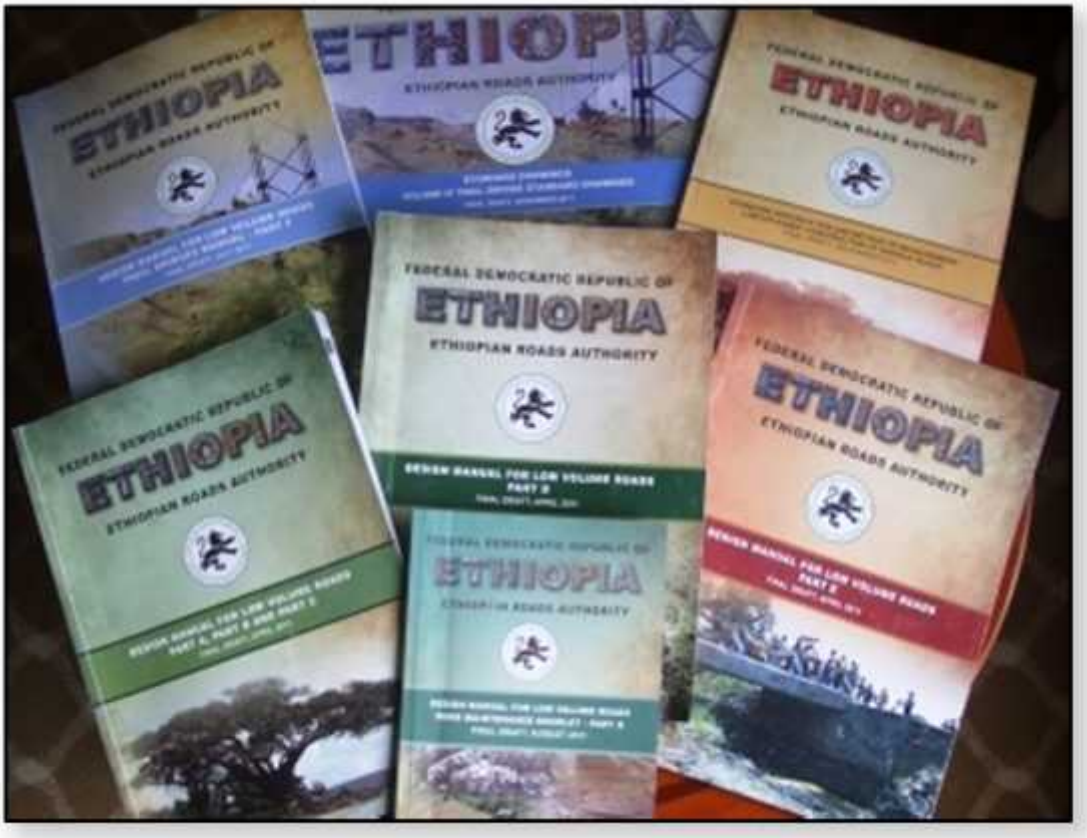
Crown Agents

AFCAP

UKaid from the Department for International Development



REVIEW OF DESIGN STANDARDS AND MAINTENANCE GUIDELINES FOR LOW VOLUME ROADS IN ETHIOPIA AFCAP/ETH/111

FINAL REPORT

20th October 2013

itt

This project was funded by the Africa Community Access Programme (AFCAP) which promotes safe and sustainable access to markets, healthcare, education, employment and social and political networks for rural communities in Africa.

Launched in June 2008 and managed by Crown Agents, the five year-long, UK government (DFID) funded project, supports research and knowledge sharing between participating countries to enhance the uptake of low cost, proven solutions for rural access that maximise the use of local resources.

The programme is currently active in Ethiopia, Kenya, Ghana, Malawi, Mozambique, Tanzania, Zambia, South Africa, Democratic Republic of Congo and South Sudan and is developing relationships with a number of other countries and regional organisations across Africa.

This material has been funded by UKaid from the Department for International Development, however the views expressed do not necessarily reflect the department's or the managing agent's official policies.

For further information visit **https://www.afcap.org**

This document is one of the outputs from the AFCAP funded Review of Design Standards and Maintenance Guidelines for Low Volume Roads in Ethiopia. The Review has been carried out by IT Transport Ltd (ITT). The views expressed are those of the authors and do not necessarily reflect those of Crown Agents or the Ethiopian Roads Authority.

Table of Contents

List of Abbreviations and Acronyms

AFCAP	Africa Community Access Programme
Cm	centimetre
DC	Design Class
DCP	Dynamic Cone Penetrometer
Drwgs	Drawings
EFY	Ethiopian Financial Year
ERA	Ethiopian Roads Authority
ILO	International Labour Office
LB	Labour-based
LVR	Low Volume Roads
RRA	Regional/Rural Roads Authority
SNNP	Southern Nations, Nationalities, and Peoples' Region
Specs	Specifications
URRAP	Universal Rural Road Access Programme

0 EXECUTIVE SUMMARY

- This report describes an Independent Review of ERA's Low Volume Roads (LVR) Manual that was carried out in August 2013 by a team from I T Transport comprising Gary Taylor and Alemgena Araya. This was Part 1 of a two phase process supported by the Africa Community Access Programme (AFCAP). Part 2 will be a separate assignment to implement the update of the LVR Manual.

- The main findings of the Review were:

  - The LVR Manual has been widely distributed and used, mainly for the Universal Rural Road Access Programme (URRAP). A total of 1,300 hard copies of most Parts of the Manual have been distributed by ERA in addition to soft copies downloaded from ERA's website. Overall, it is estimated that approximately 7,000 individuals in nearly 2,000 organisations are using the Manual.
  - There is potential for wider use of the LVR Manual. This is for roads carrying less than 300 vehicles per day that do not form part of the URRAP. There are estimated to be approximately 28,000 kilometres of roads in this category in Ethiopia.
  - The LVR Manual is also currently being used by local consultants designing the Small Towns Paving project. This involves the paving of a total of 202 kilometres of road in 66 towns. There is expected to be a significant cost saving using the LVR Manual instead of the existing ERA Manual for road surfacing works.
  - The roads upgraded by URRAP using the LVR Manual are achieving all weather access in many areas that were previous inaccessible to motor vehicles.
  - There have been some problems with implementation of the LVR design standards and guidelines such as unpaved roads constructed with a lack of camber and inadequate side drains. However, most of these relate to either misunderstandings or misinterpretations of the LVR Manual.
  - The LVR Manual has contributed to capacity building and knowledge transfer on low volume road design. This has been by involvement of local stakeholders in the preparation of the Manual; their use in the training of individuals involved with designing and implementing the URRAP; and in training of trainers for URRAP. It is estimated that over 3,600 professionals have been given training on labour-based technology and low volume road design using the LVR Manual. The Manual has also started to be used as a resource by some established local consultants and in some universities and training programmes.

- The main recommendations of the Review are:

  - In order to increase awareness and use of the LVR Manual, there should be a major launch once they have been updated.
  - The organisation of the Manual into the various Parts should be reviewed to establish whether there could be more clarity and less risk of duplications and inconsistencies with a different division of the topics. (This particularly relates to Parts B and D.)
  - There needs to be even stronger enforcement of the LVR standards if their benefits are to be fully realised.

- Summaries of some sections of the LVR Manual should be made into small pocket book guides in local languages. This is particularly important for routine maintenance and other activities that will be the primary responsibility of the woredas and the communities.
- Corrective action will be required for URRAP roads with no camber and lacking check dams in steep sections of side drains in erodible soils. These are some of the points that are already in the LVR Manual but that warrant greater emphasis.
- A full list of other suggestions for improvements to the LVR Manual is given in Annex 5.

****

1 INTRODUCTION

1.1 The Assignment

A new series of standards, manuals, guidelines and bidding documents for the design and maintenance of low-volume roads (LVR) in Ethiopia has been prepared by the Ethiopian Roads Authority (ERA) with support from the African Community Access Programme (AFCAP). These LVR documents came into use in Ethiopia from 2011 onwards with the intention that, after a period of time, they should be reviewed and updated. This review and updating is now being carried out with support from AFCAP in a two-phase process:

Phase 1: An Independent Review to examine the extent to which the documents are in use, identify any specific barriers to their use and provide recommendations for an updating process.

Phase 2: An updating of the documents to be carried out by their original authors based on the recommendations of Phase 1.

This report describes Phase 1 – the Independent Review of the documents.

1.2 Team and Mission Dates

AFCAP engaged consultants I.T.Transport Limited (UK) to carry out Phase 1 of the process in a contract signed in July 2013. The Team comprised:

1. Gary Taylor, and
2. Alemgena Araya (Dr.)

They carried out a mission in Ethiopia for the Independent Review from 12th to 29th August 2013. During this period, they held various discussions with the Ethiopian Roads Authority and consultants in Addis Ababa. They also visited the Southern Nations, Nationalities, and Peoples' Region; Tigray Region; and Amhara Region where discussions were held with regional and woreda authorities and visits made to some low volume road sites. Annex 1 gives a summary of their visit programme. Annex 2 gives a list of the persons met.

This is the Final Report for phase 1. AFCAP plans to carry out Phase 2 as a separate contract involving the original authors of the LVR Manual[1].

[1] Although the LVR Documents consist of more than Manuals, this is how they are referred to in Ethiopia.

2 MAIN FINDINGS

2.1 Distribution of the LVR Manual

The LVR Manual has been widely distributed. To date, 1,308 hard copies of Parts A to F have been distributed to individuals and organisations throughout the country. This includes to all regional offices and all woredas. Details of the full distribution of the hard copies of the LVR Manual is given in Annex 3. A Summary is given in Table2.1 below. The Manual has also been freely available to download from the ERA website.

Table 2.1: Distribution of Hard Copies of the LVR Manual

Organisation	Number
ERA	42
Other Addis-based organisations	72
Regional Road Authorities	80
Zonal Road and Transport Offices	69
Woreda Road Offices	727
URRAP Consultants	271
Contingency	47
TOTAL	**1,308**

Source: Consultants based on ERA information

The distribution of the LVR Manual has particularly targeted those involved with the Universal Rural Road Access Programme (URRAP). Hard copies of the key Parts A, B, C, D and E relating to road upgrading works have been available to regions, woredas and URRAP consultants for 1-2 years. These have typically been distributed when URRAP training has been carried out.

Part F relating to Standard Trail Bridges and the associated volume of drawings have had a more limited distribution.

Hard copies of the Standard Specifications for Labour Based Works and Part G relating to maintenance works have only recently been distributed by ERA. They had not reached the woredas at the time of the Review visit. Hard copies of the Standard Bidding Documents and the Standard Drawings have not yet been distributed, however, the Standard Bidding Documents have been available in soft copy to download from the internet.

Finding: There has been a wide distribution of the key LVR Manual. Some hard copies have only recently been distributed. The Standard Drawings have not yet been distributed.

2.2 Awareness of the LVR Manual

The distribution of the LVR Manual to organisations has not always guaranteed awareness.

- In a meeting at the Rural Road Authority (RRA) Offices in SNNPR in Awassa, the Director and his Deputy had no knowledge of the LVR Manual and were not using them although ERA had sent hard copies to their offices. The explanation was that this office was not involved with the URRAP and both staff had only recently joined the RRA.

- In one woreda visited, we were told by the Head of the Road Desk that they only had the first volume covering Parts A, B and C. However, copies of Parts D and E of the LVR Manual were subsequently found on the woreda office shelves. The apparent explanation was that the woreda road desk personnel did not refer regularly to these other Parts.

The Consultant's Team distributed a questionnaire to all Regions represented at the ERA Annual Meeting held at Alemgena just outside Addis Ababa on 17th August 2013. These were filled out by staff representing the Transport Bureaux or Regional Road Authorities (RRAs). All the Regions that responded confirmed that they were aware of the LVR Manual. All but one respondent had copies of all Parts of the LVR Manual. Gambella RRA reported to have only some Parts of the LVR Manual.

Afar and Somali Regions were not present at the Alemgena Meeting and no response was obtained from them. These Regions are not yet part of the URRAP, therefore, they are probably not using the LVR Manual. However, this does not mean that they are not aware of them.

Table 2.2: Awareness and Availability of LVR Manual

Regional Authority	Aware of Manual?	Have copies?
SNNP	Yes	Yes
Amhara	Yes	Yes
Oromia	Yes	Yes
Tigray	Yes	Yes
Benishangul-Gumuz	Yes	Yes
Dire Dawa	Yes	Yes
Harar	Yes	Yes
Gambella	Yes	Partly
Somali	n/a	n/a
Afar	n/a	n/a

Source: Consultants

Finding: There is a high awareness of the LVR Manual by individuals at central, regional and woreda levels. However, this is closely related to those involved with the planning and implementation of the URRAP.

2.3 Use of the LVR Manual in the Project Cycle

The main use of the LVR Manual has been in the planning, design and implementation of the upgrading of community roads under the URRAP. This programme has a target to upgrade slightly over 70,000 kilometres of community roads to an all-weather standard over a five-year period. To date an equivalent of 27,600 kilometres have already been upgraded. These are roads in classes DC1 and DC2 carrying an average of less than 75 vehicles per day[2].

In the survey of regional authorities referred to above, it was generally reported that the LVR Manual are "always used" for the Design, Tender and Construction works under the URRAP. They are "usually used" in the identification and feasibility stages. Because to date no URRAP roads have

[2] The LVR Manual is applicable to all roads carrying less than 300 vehicles per day.

been handed over, the LVR Manual (i.e. Part G) has not yet been used for the maintenance stage of the project cycle.

Finding: The LVR Manual is mainly used at the Design, Preparation of Tenders and Implementation stages of the Project Cycle for URRAP Roads.

2.4 The Organisations and Individuals Using the LVR Manual

The method of implementation of the URRAP has been to organise the setting up of small consultancy organisations in each region typically comprising of a Highway Engineer, a Materials Engineer and a Surveyor together with other technical and support staff. Currently 271 small consulting companies have been established. These small consulting organisations and their engineers are currently the principal users of the LVR Manual. They are responsible for the feasibility, design and supervision of the road upgrading works.

In parallel with the establishment of these consultants, small contracting companies have been established to carry out the URRAP works. These have professional staff similar to the consultants - a Highway Engineer, a Materials Engineer and a Surveyor. However, they typically have a larger number of site foremen and other support staff. A total of 944 such contracting organisations have been established. They use the LVR Manual but, as to be expected, to a lesser extent than the consultants.

The work of the consultants and contractors is supervised and monitored by woredas, regions and ERA. Consequently, staff in these offices use the Manual to check the work carried out.

In the woredas, the supervision and monitoring involves most staff of the road desk. The staff typically comprises a Road Desk Head supported by a number of technicians. It is important to note that the Road Desk Head is a political appointment and often does not have a civil engineering background. Therefore, for them the LVR Manual is a source of information on the basics of roadworks. The technicians usually do have an engineering background although it appeared to us that some of the technical language of the LVR Manual was a challenge for them to understand.

At regional level, the URRAP is typically managed by a discrete team or unit. The members of this Team are Engineers with a good grasp of low-volume roadworks. They use the LVR Manual for reference and for monitoring the quality of the work of the consultants and contractors. They also use the Manual for training other staff and this is discussed further in the next Chapter.

At central level, ERA provides overall strategic planning, control and monitoring of the URRAP. The LVR Manual is used by the team of Engineers and Economists in ERA who are concerned with these aspects of the URRAP. As for the regions, they use the LVR Manual for monitoring the quality of the work of the consultants and contractors and for training.

The Trail Bridge Manual and associated Trail Bridge Standard Drawings are reported to be only in regular use by the Helvetas Trail Bridge Programme.

There appears to be little use of the LVR Manual by departments and organisations not involved with the URRAP. This is despite that fact that many other programmes and road projects could potentially benefit from the application of the LVR Manual. An exception is the Small Towns Paving project. Last fiscal year (July 2012 to June 2013), a total of 50 kilometres was designed in 51 towns

and 34 kilometres of paving was completed under this project. These designs made reference to the LVR Manual but did not follow the full design procedure. The work was justified primarily on environmental grounds - mainly reducing dust. It comprised the sealing of existing gravel roads by either using Double Surface Treatment or Otta Seal but with no other checking and improvement of the upper pavement layers as required by the LVR Manual.

In the current fiscal year (2013-2014), a further 168 kilometres is planned and 15 more towns have been included. This will bring the total number of towns covered to 66 and the total length of paved road included in the project to 202 kilometres. By contrast to the roads improved in last fiscal year (2012-2013), these roads are being designed closely following the LVR Manual. A cost saving is envisaged over the conventional design process of surfaced road construction with a crushed rock base course following the ERA 2002 Manual. The relaxed specifications in the new LVR Manual for upper pavement layers for sealed roads mean that locally occurring materials can be used instead of crushed rock meeting the old specifications (CBR 80% and PI<6). The estimated savings on haulage and processing costs are expected to be significant. However, until the work has been carried out, it is difficult to quantify this. This is the only example that we found of the use of the LVR Manual for surfacing works.

Overall, we estimate that the LVR Manual is currently being used by approximately 7,000 individuals in nearly 2,000 organisations in Ethiopia. The basis for this estimate is given in Table 2.3 below.

Table 2.3: Estimated Numbers Using the LVR Manual

Type of Organisation	No of organisations	Est. no. of staff per organisation using the LVR Manual	Est. total no. of staff using the LVR Manual
ERA	1	5	5
RRA/Transport Bureaux	8	10	80
Zonal offices	57	3	171
Woredas	634	5	3,170
URRAP consultants	271	3	813
Other consultants	5	3	15
URRAP contractors	944	3	2,832
TOTAL	**1,920**	**-**	**7,086**

Source: Consultants

Findings: An estimated 7,000 individuals are using the LVR Manual in almost 2,000 organisations. However, with a few exceptions, the LVR Manual is only being used by organisations involved with the URRAP Programme.

2.5 Potential for Wider Use

The LVR Manual is applicable to all roads carrying less than 300 vehicles per day. These are roads in classes DC1 to DC4. The community roads, including those that form part of the current phase of the URRAP, provide the longest road network to which the LVR Manual apply. However, as mentioned above, there are many roads outside the URRAP for which this Manual could be used. An estimate of the total length of low-volume roads to which the Manual could be applied is given in Table 2.4 below. This shows that approximately 100,000 kilometres of the total network of 125,000 kilometres

in Ethiopia are low-volume roads. URRAP covers 72,000 kilometres. Therefore, there is an additional 28,000 kilometres of low-volume roads to which the Manual could potentially apply.

Table 2.4: Estimate of the Length of Low-volume Roads in Ethiopia

Type of road	Total km	Est. %LVR	LVR km	% of total km
Community roads (URRAP)	72,000	100%	72,000	71%
Regional roads	27,600	95%	26,220	26%
Federal roads - paved	11,300	5%	565	1%
Federal roads - unpaved	14,500	15%	2,175	2%
Estimated total LVR	**125,400**		**100,960**	**100%**

N.B. These totals exclude roads under urban authorities
Source: Consultants estimates.

Findings: Except In a very few cases, the LVR Manual is only being used for URRAP roads although it is potentially applicable to many other roads in Ethiopia.

2.6 Impact

An important question to be answered by the Review is whether the LVR Manual is making a difference to the way that the improvement of Low Volume Roads is planned, designed and implemented in Ethiopia. For the reasons given above, our observations are limited to their impact on those roads upgraded under the URRAP.

Our overall impression is that the roads upgraded under URRAP and following the LVR Manual are having a major impact. Previous interventions to improve community roads under Food for Work, Safety Net and other programmes have often been substandard and not durable. The URRAP roads are achieving all weather access in areas that were previously inaccessible to motor vehicles for either part or all of the year.

URRAP road providing improved access at Halaba, SNNPR.

The major contribution of the LVR Manual to this improvement has been to establish uniform standards based on sound technical principles. In addition, the LVR Manual has provided a platform for training engineers and technicians in the principles of low volume road design. This is discussed further in the next Chapter.

For the roads visited, we interviewed a number of road users and community members. The main feedback obtained was positive. Although most roads had only been upgraded relatively recently, the improved access was already having a noticeable socio-economic impact. A number of the case studies that we recorded are given in Annex 4.

Findings: The improvement of community roads using the LVR Manual is having an immediate and significant impact on rural communities.

2.7 Problems Encountered

Although in general the principles of the LVR Manual are understood and applied in the URRAP, the standards achieved on the URRAP roads are variable. Some roads and some aspects of some roads are well constructed while others are not. For the purposes of reviewing the LVR Manual, it is important to disaggregate deficiencies in constructed roads into three categories

a) Those due to gaps or lack of clarity in the LVR Manual;

b) Those not due to gaps in the LVR Manual but that could be addressed at least in part by improving the details and explanations in the Manual; and

c) Those that are not related to the LVR Manual.

There are only a few issues under (a). There are a number of issues under (b) and (c) that are best addressed together. This is because most items not related to the LVR Manual could conceivably be addressed by the Manual.

The full list of items raised by the Users of the LVR Manual is extensive and range from the relatively minor to some quite fundamental issues. However, this Review is specifically not required to analyse or review the technical principles behind the LVR Documentation. The focus is on the implementation and roll-out of the LVR Design Approach. Therefore, the full list of items is given in Annex 5 to be taken forward in Part 2 of the AFCAP support. Some of the most important issues that are causing problems during implementation are described below.

2.7.1 Issues due to gaps or lack of clarity in the LVR Manual

Camber

The main technical problem noted on the sample of roads visited was the lack of camber. The URRAP roads (class DC1 and DC2 unpaved) are reportedly being constructed to 4% camber but this appears to be being lost during compaction and subsequent trafficking of the road. Most roads seen had an almost flat road carriageway cross section. During the current rains, this is already leading to erosion of the surfacing and water collection in the wheel ruts. Corrective action will be required.

The LVR Manual gives guidance on the issue of camber but this varies in different parts of the Manual. Part B specifies a maximum of 6% crossfall (Tables B.4.9 & 10), but show 4-6% crossfall in Section 6.3. The discussion in Section 4.4.5 of Part D states the optimum crossfall as between 4% and 7% with the recommendation of 6%. Elsewhere in Part D, the minimum camber is stated as 4% and normally 6% (section D.5.4.3); “Proper Camber” for engineered roads is described as 5-8% (Section

6.15); or 2-3% more than the paved roads figure of 2.5-3% (page D.6.162) i.e. 4.5% to 6%; or 3-8% (page D/7/200).

Flat Camber on URRAP Road, Dangila, Amhara.

Given the importance of this issue and the current non-compliance on the ground, the LVR Manual needs to give clear and unequivocal guidance on (a) the camber to which unpaved roads should initially be built; (b) the minimum final camber to be achieved after compaction and initial trafficking (i.e. before handover); and the minimum camber before intervention is required in the form of maintenance or rectification works.

Steep sections

Although examples were not seen in the field by the Review Team, most URRAP consultants expressed the opinion that the alignment standards in the LVR Manual were impractical for the steep mountainous and escarpment conditions found in some parts of the country. In particular, they were finding the maximum specified gradients of 12% for DC1 and 9% for DC2 (unpaved) to be too onerous to achieve roadworks at reasonable cost. Allied to this is the lack of an adequate description in the LVR Manual on the design of hairpin stacks. These are mentioned in Part D in section 4.6.4 and elsewhere but without giving sufficient guidance or illustrations for their design. Consequently, URRAP consultants are referring to other manuals for the detailed design of hairpin stacks and this is unsatisfactory.

Typical Hairpin bend stack on main road between Adigrat and Enticcio.

Gravel Layer

Many URRAP consultants expressed the view that there should be the possibility of using a thinner gravel layer than the 15 cm minimum stated in the LVR Manual on lightly trafficked roads with good subgrades. Currently, the LVR Manual gives the option of no gravel layer in areas where there is a very good natural subgrade and light traffic. For everywhere else, a minimum of 15 cm compacted gravel layer is required. The consultants' request was that where the natural subgrade is good but not quite meeting the standards required for no gravel layer, the LVR Manual should specify a thinner gravel layer of 10 cm compacted. The subgrade quality to which this should apply would need to be specified. The main justification would be the potentially significant cost and time savings of the lower gravel volume requirement per kilometre.

Small Structures Manual

Many consultants were confused by Part E of the Manual covering small structures. Because it is labelled "Design Manual for Low Volume Roads Part E", they expect it to cover all their needs. However, for Bridges over 10 metre span they are referred to ERA Bridge Design Manual 2011 that has not yet been issued. Consequently, they were referring to the ERA 2002 Manual for missing details. This is an issue that should be resolved once the High Volume Road Manual is issued.

2.7.2 Issues that could be improved through the LVR Manual

Check Dams

On the roads that were visited, there were no check dams (scour checks) in the side ditches. This is leading to erosion of the side ditches, particularly on steep slopes and in erodible soils. The reason given for this at one site was that the check dams were to be constructed by the woredas using local labour and this would be done later. Therefore, the construction of check dams was not included as part of the contractor's contract.

Eroding side ditch on URRAP road with no check dams.

There is emphasis under URRAP on cost sharing and the construction of check dams is seen as one activity that can be undertaken by communities. However, if there is a significant rainy period between the construction of the side ditches by the contractor and the construction of the check

dams by the communities, problems will be inevitable. As there is 12 months defects liability period after the construction, there is a risk that the check dams will not be constructed until after this when the roads have been finally handed over to the woreda. The issue for the LVR Manual is the need to emphasise the importance of constructing the check dams in the side ditches before rain falls and rainwater starts eroding the ditches.

On-site Testing

There is little evidence of onsite testing on the low-volume road sites visited. During discussions at regional level, the URRAP consultants suggested that there should be suitable tests for DC1 and DC2 roads that do not require a laboratory described in the LVR Manual. This should include simple checks such as dimensions (tape measure), gravel thickness (probe or core) and camber (camber board). Related to this, Part B section 5.1.2 refers to the use of the Dynamic Cone Penetrometer (DCP) to monitor the uniformity of the subgrade but this is not familiar to Engineers in Ethiopia and there is no detailed description of the use of the DCP in the LVR Manual.

Avoidance of Class DC1

It was found that most URRAP roads are now being constructed to class DC2. This is apparently due to previous difficulties of vehicles passing on the narrower class DC1 roads. The LVR Manual refers to the provision of passing places on single lane roads in Part D but not in the more frequently used Part B. This is possibly why Class DC1 roads have been constructed without passing places. This highlights a problem of what should be summarised in Part B and what left out. There is also the wider question of whether Parts B and D should be merged to reduce the risks of gaps and discrepancies between the two.

Gravel Width

All URRAP roads visited were gravelled across their full width i.e. including the shoulders. Therefore, the class DC2 roads seen were gravelled to 6 metres width instead of the 5 metres according to the standard given in the LVR Manual. We were told that the reason was the perceived need for a wider running surface to allow vehicles to pass more safely. One problem with this procedure was that the edges of the gravel surface needed retaining to avoid gravel material spilling into the side ditches.

A further problem that we were alerted to was that contractors were dumping gravel at a spacing along the road based on the LVR Manual gravel width i.e. assuming that gravelling of the shoulders was not required. Therefore, it is likely that the thickness of the gravel after spreading and compaction is less than the 15 cm required. There were no records of gravel thickness checks to enable us to verify this.

Gravelled shoulders.
(Note the larger stones retaining the gravel edge)

Interface between Works by Communities and Contactors

Part of the URRAP road upgrading works is the responsibility of the woredas and the communities. This varies in different regions depending on the degree of cost sharing. Typically, the communities are required to carry out site clearance and sometimes excavation to level before the contractor commences work. This is causing two problems. Firstly, the quality control of the community work does not appear as good or well controlled as that of the contractors. Secondly, the interface between the community's works and the contractor's works is problematic.

The noticeably poorer standard being produced on some roads that we visited may be related to the higher community involvement compared to other roads. An issue with regard to the LVR Manual is that the target audience for these is engineers and not woreda technicians and communities. Therefore, the application of the LVR Manual on the community part of the works is dependent on the involvement of consultants' engineers or the degree of understanding of the Manual by the woreda technicians.

An Example of a URRAP road constructed with a relatively high degree of community contribution.
(Note: no side ditch and no camber. The contractor's contract was for gravelling only.)

2.8 Sustainability

The LVR Manual affects the sustainability of low-volume roads in two ways. Firstly, by setting standards and providing guidelines they can help to ensure the construction of safe and durable low-volume roads. Secondly, by providing standards and guidelines for road maintenance that ensures that these standards are sustained over the longer term.

From the site visits reported above, there are a number of question marks over the durability of the roads. However, the problems seen were all related to deficiencies in the interpretation and implementation of the standards and guidelines in the Manual and not the contents of the LVR Manual.

Newly constructed URRAP roads are under a twelve month's defects liability period. Because of this, there are, as yet, no roads that have been handed over and put under normal routine maintenance. After the roads are finally handed over, the woredas will be responsible for road maintenance. In discussions with the woredas visited, we understand that the strategy will be for communities to carry out routine maintenance with woredas providing support when required. Given the experience with road maintenance in Ethiopia and elsewhere in sub-Saharan Africa, its importance cannot be overstated. Particular care is needed to ensure that routine maintenance of low volume roads is carried out correctly and in time.

The problem with the LVR Manual is that the guidelines provided for road maintenance (Part G) are not immediately usable by the communities. There is a need for simple guidelines in local language than can be used by woredas and community foremen for routine road maintenance activities. An example of such a guide is the "Headman's Handbook for Maintenance of Minor and Rural Access Roads" in Kenya. This is a pictorial pocket guide indicating the routine road maintenance activities to be carried out in each season of the year (see Annex 6).

Findings: There have been problems in using the LVR Manual for design and construction of low volume roads. Although most of these problems are not due to gaps or errors in the LVR Manual they could be addressed by making some improvements to the Manual.

3 CAPACITY BUILDING AND KNOWLEDGE TRANSFER

The Low Volume Roads (LVR) Manual has already made a significant contribution to capacity building and knowledge transfer in the road transport sector in Ethiopia. This can be reported under three headings:

3.1 During the Development of the Manual

The development and compilation of these documents was undertaken in close consultation with local industry and regional authorities. The Federal and Regional Roads Authorities, the contracting and consulting industry, the universities, training schools, the Road Fund and other industry stakeholders all participated in the formulation of the documentation. Local issues and experience on the geometric, earthwork, drainage, pavement and surfacing design for low volume roads were discussed and debated at length. A series of thematic peer review panels were established that comprised local experts from the public and private sector. These debates and discussions raised awareness of Low Volume Roads issues and transferred knowledge to professionals in the sector.

3.2 URRAP and Capacity Building

The Government of Ethiopia's Universal Rural Roads Access Program (URRAP) has the objective of connecting each Woreda and Kebele *(the last administrative echelon in the government structure*) to an all-weather road. The programme has a five-year life span, i.e. 2011-2015, and it is one of the components of the 4th Road Sector Development Program (RSDP IV) for the period 2011-5. As mentioned earlier, the Government plans to construct over 70,000 km of all-weather access roads mainly using local resources.

This work is being executed in partnership with emerging local small and medium scale entrepreneurs, i.e. both contractors and consultants. Table 3.1 gives the five-year human development plan for URRAP. As can be seen, over 27,000 individuals require training.

Table 3.1: URRAP Human Development Plan (Capacity Building Component)

No	Description	2004 EFY (2011/12)	2005 EFY (2012/13)	Total
1	Contractors	819	143	962
2	Consultants	246	70	316
3	Construction Superintendents, Foremen,(Level III-IV)	3,276	552	3,828
4	Surveyors	1,433	242	1,675
5	Material Technicians (Level II and III)	1229	207	1,436
6	Tractor Operators	2,458	414	2,872
7	Roller Operators	819	138	957
8	Masons, Carpenters, other tradesmen	11,466	1,933	13,399
9	Mechanics, Electricians etc.	1,638	276	1,914
10	Contract Management Experts	700	_	_
	Total	**24,084**	**3,975**	**27,359**

Source: ILO, Training Needs Assessment at ERA Labour-based Training Centres: Draft Report, Nov. 2011

The number of consultants and contractors established trained and actively engaged in URRAP up to June 2013 (end of 2005 EFY) was 271 consultants and 944 contractors. In each consultant's and contractor's association there are at least three professionals. In all, more than 3600 professionals in the URRAP consultants' and contractors' associations have been given training on labour based technology and low volume roads design and development principles and practices using the LVR Manual.

In addition, to create awareness and establish the conditions for the implementation of URRAP at regional, wereda and local industry levels, dissemination and training on the LVR design manual has been given to more than 220 industry professionals from ERA, Regional Road Authorities and consultants.

3.3 Training of Trainers

In addition to the initial training, another round of capacity building was carried out at Alemgena and Chancho Training Centres from 2nd to 7th August 2013. This was to train trainers based on the LVR Manual. This training of trainers was given after a survey and evaluation of the URRAP progress at national level. This identified that one of the gaps for the satisfactory progress of the URRAP program was the insufficient capacity of the professionals. This training of trainers was offered to professionals from all regions and more than 130 engineers from the URRAP consultants, contractors and regional road administrators were trained. These trainers were then to give similar training and transfer of knowledge on the concepts and practices of LVR development on return to their areas and organisations.

The LVR Manual has also been used by various established Ethiopian consultants such as Ethio-Infra Consulting Plc. and NOMY Engineering Plc. in the preparation of working manuals for Oromia URRAP programmes. Similarly, other consultants such as RAMA and Classic Consultants have also used the LVR Manual in the development of working manuals for small and medium scale contractors and consultants for town section surfacing design and construction. These are in the form of simplified training materials for lower skilled technicians.

Finally, various training institutes are using these LVR documents as reference materials and a source of information. Some universities in Ethiopia are using these documents as reference materials in their graduate courses and others organize seminars and workshop topics based on the LVR Manual. Similarly, these documents are referenced in the national TVET (Technical, Vocation and Educational Training) programmes.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

The LVR Manual has been successfully introduced in Ethiopia for the design and construction of low-volume roads. They are having a direct impact on producing better quality community roads. Currently, their use is mainly confined to the URRAP and, although URRAP is currently the largest low volume road programme in Ethiopia, it addresses only the lowest two categories of road, DC1 and DC2. Consequently, there is potential to make greater use of the LVR Manual for the higher classes of DC3 and DC4 roads, including paved road sections.

Training and other capacity building measures related to low volume road construction in Ethiopia have already become dependent on the LVR Manual. Again, this is particularly the case for the URRAP. However, some universities and other training centres are beginning to make use of the Manual as a source of best practice on the design and construction of low volume roads.

The engineering results of the application of the LVR Manual are variable. They are providing a common and technically sound basis for the construction and upgrading of low volume roads in Ethiopia. From visits to a small sample of URRAP sites, it is clear that considerably improved access is being provided to rural areas that were previously difficult to reach. However, in some cases the standards and guidelines given in the LVR Manual are being either misinterpreted or misunderstood. The situation could be improved by making some adjustments to the existing LVR Manual to give greater emphasis to certain key elements and by removing some discrepancies between different Parts of the Manual that can potentially cause confusion. The details are summarised in Chapter 2 and listed in Annex 5. Some current problems will be resolved when the High Volume Road Manual has been released and there is a single set of Manuals covering the full range of road design classes in Ethiopia.

A general overall conclusion is that many of the problems of poor quality roads that we noted on the small sample of roads visited was due to a lack of enforcement of the LVR Manual's standards.

The application of the LVR Manual to road maintenance has not yet commenced. However, we foresee potential problems in that the LVR Manual is not sufficiently targeted at woredas and communities who will mainly be responsible for road maintenance of the URRAP roads.

4.2 Recommendations

We recommend that there should also be a major launch of the LVR Manual once it has been revised and reprinted. The aim should be to raise awareness of the Manual and reduce confusion over which Manual should be used for low volume road design in Ethiopia. This should emphasise its application to all roads carrying less than 300 vehicles per day and dispel the commonly held belief that it is exclusively for URRAP. This should be accompanied by a clear instruction that this Manual should be used for all LVRs in Ethiopia. If possible this should be carried out together with a launch of the high volume roads manual to provide stakeholders with a full set of documents for road design in Ethiopia that supersedes the existing ERA 2002 Manual.

Following on from the recommendation above, we further recommend that the use of the LVR Manual should be extended to all LVRs in Ethiopia. This will require the following:

- A directive from ERA clarifying that the LVR Manual is to be followed for the design of all low volume roads in the country carrying less than 300 vehicles per day;
- Dissemination of the LVR Manual outside of URRAP;
- Training of the relevant ERA staff, regional staff, consultants and contractors who are not involved with URRAP. These individuals are not familiar with the LVR Manual and, in many cases, not even aware of the Manual (even if their offices have received copies).

A general issue to be considered is the organisation of the Manual and particularly the duplication between Parts B and D. Various comments that we received on the Manual related to inconsistencies between Parts B and D. These are mainly minor errors in cross referencing but also include gaps in Part B due to key items not being transferred from Part D. An example is the issue of hairpin stacks. Although these can be corrected following the existing format, an alternative and our recommendation would be to make each Part of the LVR Manual self-contained. Therefore, the existing Parts B and D could be merged into one. We would recommend that there should be a new Part D covering the DCP design method that is not currently included in the Manual. This re-arrangement would also avoid the risk that any future changes to the existing Part B were not reflected in the existing Part D and vice versa.

Related to the previous recommendation, there is confusion caused by the fact that Part E of the Manual covering standards for small structures is labelled on the cover as part of the "Design Manual for Low Volume Roads". This would be better labelled as either a "Small Structures" or "Low-cost Structures" Manual because it is applicable to both high and low volume of roads as the type of structure is defined by the drainage requirements and not primarily the traffic volume. This Part should be linked to and integrated with the "Bridges Manual" such that the two documents complement each other. Currently, users of the LVR Manual find that they are referred to another manual for the design of bridges over 10 metres span. The ultimate aim should be a full set of ERA Manuals covering all types of roadworks and, as mentioned above, this could be accomplished once the high volume road manual becomes available.

To take full advantage of the potential benefits of the LVR Manual, there needs to be stronger enforcement of the LVR Manual's standards Therefore, we recommend that there is a stronger system of independent inspection of LVR works. Where works are not to the standard set in the LVR Manual, the implementers of such works should be required to carry out rectification measures to bring the roads to the correct standard.

We strongly recommend that the key points of the LVR Manual should be translated into local languages for use by woredas and communities. This should focus on those parts of the works typically carried out by communities, particularly routine road maintenance. Our recommendation is that there should be a short handbook on routine maintenance with pictures and diagrams and few words – in local language (there is an example from the Minor Roads Programme in Kenya – See Annex 6). There could be similar handbooks on other activities such as earthworks. This is important if the design principles of the LVR Manual are to be translated into good practice on the ground.

There is a series of recommendations for improvements to the LVR Manual related to a range of detailed items listed in Annex 5. A summary of some of the important issues are these:

- Corrective action needs to be taken regarding the lack of camber on URRAP roads. Existing roads will need some reshaping of the surface if they are to survive beyond the next 1-2 rainy seasons. The guidelines in the LVR Manual need strengthening to emphasise the importance of achieving a final camber of at least 6%, as specified in Manual Part D (section 4.4.5). We would recommend that roads are constructed to 7-8% camber with the expectation that this will reduce to 5-6% after longer-term compaction, consolidation and trafficking.
- Check dams need to be constructed in the side ditches on steep slopes before the start of the rains. This will require either that the woredas organise the construction of the check dams in parallel with the main construction or that check dams are included in contractors' contract. This is an issue of procedure rather than a change in design standards. However, the LVR Manual should state that check dams should be constructed as soon as possible after the side ditches are constructed and before any significant rainfall.
- There should be more clarity in the Manual (including in Part B) on where and when passing places are required on single track roads.
- There should be some guidance on how to construct DC1 and DC2 standard roads when there is an existing earth road that is significantly wider than these standards e.g. it may be possible to use the existing side ditches rather than construct new ones.
- The issue of the gravelling of the shoulders of unpaved DC1 and DC2 roads should be revisited and a policy decision taken based on a sound technical justification.
- The alignment standards and guidance for steep mountainous and escarpment conditions should be revisited. A balance needs to be struck between giving standards to achieve access for most vehicles and the practicalities in terms of cost in steep areas. The Manual already includes the possibility of using steeper gradients by paving short sections of road but this needs more emphasis. Additional possible ways forward would be to:
    - Include in the Manual some additional guidelines for dealing with very steep gradients such as introducing concrete wheel strips, etc.;
    - Carry out research into the absolute standards that should apply to LVR in steep areas of Ethiopia taking account of the age and condition of typical vehicles; the effect of altitude on vehicle performance; and the types of subgrade.
- The guidelines on pavement thickness should be re-examined to investigate the feasibility using a thickness of 10cm for lightly trafficked roads on subgrades that have been found by testing to be good but not quite strong enough for an Engineered Natural Surface as described in section B.6.2 of the LVR Manual.
- On site tests appropriate for low-volume roads should be introduced into the main text of the Manual. This should include gravel and concrete testing as well as simple dimensional and camber checks. Connected to this, the use of the DCP should be added as an Annex to Part D or, as suggested above, become a new Part D.

4.3 Next Steps

As described in our Terms of Reference, this is only Part 1 of the planned assignment for updating the LVR Manual. Part 2 involves carrying out changes to the LVR Manual based on the recommendations made above. The Table below shows our suggested action plan for preparing and implementing Phase 2:

Short Term Action Plan for Phase 2		
Step 1	Add reference numbers to all recommendations and comments, eliminate duplications and link related comments	ERA/AFCAP
Step 2	Review all recommendations and comments and decide on the actions required	ERA/AFCAP
Step 3	Allocate the revision/updating work and contract the individuals	AFCAP
Step 4	Issue final versions	ERA

Annex 1: Mission Programme

This is a summary of the Consultants' mission programme in Ethiopia:

Day	Date		Details	Overnight
T	13	a.m.	Kick-off meeting at ERA	
		p.m.	Draft letters to Regions	Addis
W	14	a.m.	Organise logistics – travel/accommodation	
		p.m.	Prepare regional questionnaire	Addis
T	15	a.m.	Initial visit to Oromia Regional Offices	
		p.m.	Notes on kick-off meeting/prepare Inception Rep.	Addis
F	16	a.m.	Finalise Inception Report. Meet Bekele Jebessa.	
		p.m.	Finalise checklists for regional visits	Addis
S	17	a.m.	Join ERA Annual Meeting for lunch at Alemgena	
		p.m.	Collect Questionnaires	Addis
S	18	a.m.		
		p.m.	Travel to Awassa by road	Awassa
M	19	a.m.	SNNPR – RRA + Enterprise	
		p.m.	SNNPR – consultants & contractors	Awassa
T	20	a.m.	SNNPR - Visit woredas (Shebadinu and Halaba)	
		p.m.	Travel back to Addis by road	Addis
W	21	a.m.	Fly to Amhara/Tigray – RRA + Enterprise	Bahar Dar/Mekelle
		p.m.	Amhara/Tigray – consultants & contractors	
T	22	a.m.	Amhara/Tigray – visit woredas (Dangila and Tillili)	Bahar Dar /Mekelle
		p.m.		
F	23	a.m.	GT Travel back to Addis by air. Writing up site visit notes.	
		p.m.	Alemgena visiting woredas in Tigray.	Addis
S	24	a.m.	Alemgena Travel back to Addis by air	
		p.m.		Addis
S	25	a.m.	Visit AFCAP site at Tolobulo	
		p.m.		Addis
M	26	a.m.	Drafting Debriefing note	
		p.m.	Meeting at ERA: Mulugeta	Addis
T	27	a.m.	Meeting Contractors Association	
		p.m.	Drafting Debriefing note. Meeting Rama Consulting.	Addis
W	28	a.m.	Meetings at ERA offices. Contact Helvetas re Trail Bridges	
		p.m.	Meeting with Classic Consulting Eng.	Addis
T	29	a.m.	Debriefing Meeting at ERA. Finalise Debriefing Note.	
		p.m.	Update Debriefing note. Depart Addis	Travelling

Annex 2: List of Persons Met

This is a list of the key persons met:

List of Persons met at ERA		
S.no.	Name	Organization
1	Bekele Negussie	ERA
2	Mulugeta Demissie	ERA
3	Yetimgeta Asrat	ERA
4	Frew Bekele	ERA

List of Persons met at SNNP Regional Road Authority and Transport Bureau		
S.no.	Name	Organization
1	Lacha Garuma Chegen	SNNP Regional Road Authority
2	Aklilu Adagn	SNNP Regional Road Authority
3	Samuel Adem Dangiso	SNNP Transport Bureau
4	Lema Belayneh	SNNP Transport Bureau
5	Zelalem Alemayehu	SNNP Transport Bureau

List of Persons met at SNNP URRAP Consultants and Contractors		
S.no.	Name	Organization
1	Mindaye Endashaw	Express Construction
2	Habtamu Feyissa	Express Construction
3	Fikadu Simo	Express Construction
4	Luelseged Alemayehu	LBBT Construction
5	Ashebir Tajebe	Associated Construction
6	Siber Adefris	Biyanko Consulting
7	Kasiem Seid	KFF Consultant
8	Yirgalem Adugna	ESY Consultant
9	Wondimu Mammo	SURMA Construction
10	Bantayehu Uba	WUBET Consulting
11	Lemma Belayneh	SNNP URRAP Coordinator
12	Zelalem Alemayehu	SNNP URRAP Coordinator

List of Persons met at SNNP, Sidama Zone, Shebedino Wereda, Huwalso- Gorova – Gabalo Project Site Visit		
S.no.	Name	Organization
1	Teshome Mekonen	SNNP Sidama Zone URRAP Coordinator
2	Lemma Belayneh	SNNP URRAP Coordinator
3	Zelalem Alemayehu	SNNP URRAP Coordinator
4	Abnet Worku	AMA Consultant
5	Wondimu Mammo	SURMA Construction
6	Zerihun Yagetee	Shebedino Wereda Road and Transport

List of Persons met at SNNP, Halaba Special Wereda, Halaba – Ropi Project Site Visit		
S.no.	Name	Organization
1	Lemma Belayneh	SNNP URRAP Coordinator
2	Zelalem Alemayehu	SNNP URRAP Coordinator
3	Darkela Sirjeba	Halaba Spec. Wereda Road & Transport
4	Tegegn Elias	Halaba Spec. Wereda Road & Transport
5	Sabitu Bediru	Halaba Spec. Wereda Road & Transport

6	Luelseged Mindaye	LMT Consult
7	Dagmawi Getachew	LMT Consult
8	Alemayehu Kemisu	BETTER Construction
9	Gebrehiwot Meda	BETTER Construction

List of Persons met at Amhara Regional Roads Authority (ARRA) and URRAP Consultants and Contractors		
S.no.	Name	Organization
1	Gizaw Birhanu	KOREB Consultant
2	Siltan Habtewold	AHADU Contractor
3	Habtamu Ginbeneh	GUNA Contractor
4	Assegid Tesfaye	LOZA Consultant
5	Aklilu Mekonnen	DONDOR Consulting Engineers
6	Solomon Kahsay	Sol & Friends Construction
7	Bantgize Chanie	Yelikal Contactor
8	Sintayehu Aysheshim	Tabor Contractor

List of Persons met at Amhara Region, Tillili Wereda Rural Road Office Site Visit		
S.no.	Name	Organization
1	Aschale Yismaw	Wereda Rural Road Office Head
2	Wondifraw Gashaw	Contract Administration
3	Desalew Tibebu	Road Construction and Maintenance
4	Alemu Nigusie	Community Participation
5	Moges Tafere	Road Construction and Maintenance
6	Yalemtibebe Berhanu	Secretary science & office management

List of Persons met at Amhara Region, Dangila Wereda Rural Road Office site visit		
S.no.	Name	Organization
1	Nitsuh Shiteraw	Wereda Rural Road Office Head
2	Kelemie Berihun	Contract Administration
3	Nigus Ashebir	Material Control
4	Misganaw Tsegu	Community Participation
5	Getachew Anley	RoadMaintenance
6	Akebel Abere	Secretary

List of Persons met at Tigray Bureau of Transport, Road Development and Administration		
S.no.	Name	Organization
1	Abraha Weldu	Tigray Road Dev't & Administration (TRDA)
2	Ashenafi Kiros	Tigray Road Construction Enterprise (TRCE)
3	Mengistab Kassahun	TRDA
4	Gebreslasie Tekelehaimanot	TRDA
5	Tsehay Meressa	TRDA
6	Harnet Kiros	TRCE
7	Guesh Menkr	TRDA
8	Dessu Tsegay	TRDA
9	Mehari Hagos	TRDA
10	Kiros Welday	TRDA
11	Trhas Zeray	TRDA

List of Persons met at Tigray Region Consultants and Contractors		
S.no.	Name	Organization
1	Moges Tsegay	Nomy Engineering
2	Fikadu Gebremedhin	CATWALKS Construction

3	Fasil Kahsay	AHADU Consulting Engineers & Arch. Plc
4	Asmerom Mehari	A.S.A.A. Construction Plc.
5	Samuel Gebrekidan	ASES Construction Plc.
6	Robel B/Hiwot	RADK Construction plc.
7	Mesfin Teka	Tigray Water Works Design and Supervision
8	Gebrehiwet Arefine	NOMISS Construction plc
9	Haftu Woldu	ALKER Design and Consultancy Plc
10	Yohannes Zeru	AYOME Consulting plc.
11	Solomon Okubay	HBS Engineering
12	Samuel Berhane	SHA Consulting Plc.
13	Hailay Gebremeskel	ALTMATE Construction Plc.
14	Muez Hailu	Shilanat Construction

List of Persons met at Tigray Region, Tanqua-Abergele Wereda, Aqebtarma – Tseykeme – Jijique Project Site Visit		
S.no.	Name	Organization
1	Dessu Tsegay	TRDA, URRAP Coordinator
2	Samuel Birhane	SHA Consulting Plc.

List of Persons met at Tigray Region, Hintalo-Wejerat Wereda, Adigudem – Hareko Project Site Visit		
S.no.	Name	Organization
1	Dessu Tsegay	TRDA, URRAP Coordinator
2	Samuel Birhane	SHA Consulting Plc.
3	Alula Hailesilassie	AYOME Consulting Plc.

List of other Persons met in Addis Ababa		
S.no.	Name	Organization
1	Les Sampson	Sampson Consulting
2	Bekele Jebessa	Ethio-Infra Engineering Plc.
3	Melaku Tadesse	Ethiopia Contractors Association
4	Demelash Samuel	Classic Consulting - North region town section surfacing consultant
5	Yosef Asrat	Rama Consulting -Central region town section surfacing consultant

Annex 3: Distribution of LVR Manual

No.	Distributed to	LVR Manual Title							Total
		Part A, B, & C	Part D	Part E	Part F	Part G	Drwgs (Trail Bridges)	Standard LB Specs.	
1	DG, DDG, Training Centers, and Directors in ERA	42	42	42	42	42	42	42	252
2	AAU, Department of Civil Engineering	10	10	10	10				40
3	Consultants Association, Ethiopia	5	5	5	5				20
4	Contractors Association, Ethiopia	5	5	5	5				20
5	LB Road Construction and Maintenance Association	5	5	5	5				20
6	Road Fund, Ethiopia	5	5	5	5				20
7	Addis Ababa Roads Authority	10	10	10	10				40
8	Individual Requests	32	32	32	32	8	6	14	156
9	**Tigray Region**								**0**
	Regional Road Authority	10	10	10	10	10	5	10	65
	Zone Road and Transport Offices	4	4	4	4	4		4	24
	Woreda Road Offices	35	35	35	35	35		35	210
	Consultants involving in URRAP	10	10	10	10	10		10	60
	Contingency	5	5	5	5	5		5	30
10	**Amhara Region**								**0**
	Regional Road Authority	10	10	10	10	10	5	10	65
	Zone Road and Transport Offices	11	11	11	11	11		11	66
	Woreda Road Offices	124	124	124	124	124		124	744
	Consultants involving in URRAP	40	40	40	40	40		40	240
	Contingency	10	10	10	10	10		10	60
11	**Oromia Region**								**0**
	Regional Road Authority	15	15	15	15	15	10	15	100
	Zone Road and Transport Offices	18	18	18	18	18		18	108
	Woreda Road Offices	295	295	295	295	295		295	1,770
	Consultants involving in URRAP	128	128	128	128	128		128	768
	Contingency	10	10	10	10	10		10	60
12	**SNNPR Region**								**0**
	Transport Bureau/Regional Road Authority	15	15	15	15	15	5	15	95
	Zone Road and Transport Offices	14	14	14	14	14		14	84
	Woreda Road Offices	134	134	134	134	134		134	804
	Consultants involving in URRAP	83	83	83	83	83		83	498
	Contingency	10	10	10	10	10		10	60
13	**Benishangul Gumuz Region**								**0**
	Regional Road Authority	5	5	5	5	5	3	5	33
	Zone Road and Transport Offices	3	3	3	3	3		3	18
	Woreda Road Offices	23	23	23	23	23		23	138
	Consultants involving in URRAP	6	6	6	6	6		6	36
	Contingency	3	3	3	3	3		3	18
14	**Gambela Region**								**0**
	Regional Road Authority	5	5	5	5	5	3	5	33
	Zone Road and Transport Offices	3	3	3	3	3		3	18
	Woreda Road Offices	11	11	11	11	11		11	66
	Consultants involving in URRAP	2	2	2	2	2		2	12
	Contingency	3	3	3	3	3		3	18
15	**Harari Region**								**0**
	Regional Road Authority	5	5	5	5	5	3	5	33
	Zone Road and Transport Offices	2	2	2	2	2		2	12
	Woreda Road Offices	8	8	8	8	8		8	48
	Consultants involving in URRAP	1	1	1	1	1		1	6
	Contingency	2	2	2	2	2		2	12
16	**Diredawa City Administration**								**0**
	City Road Authority	5	5	5	5	5	3	5	33
	Zone Road and Transport Offices	2	2	2	2	2		2	12
	Woreda Road Offices	4	4	4	4	4		4	24
	Consultants involving in URRAP	1	1	1	1	1		1	6
	Contingency	2	2	2	2	2		2	12
17	**Somali Region**								**0**
	Regional Road Authority	5	5	5	5	5			25
	Zone Road and Transport Offices	8	8	8	8	8			40
	Woreda Road Offices	62	62	62	62	62			310
	Contingency	1	1	1	1	1			5
18	**Afar Region**								
	Regional Road Authority	5	5	5	5	5			25
	Zone Road and Transport Offices	4	4	4	4	4			20
	Woreda Road Offices	31	31	31	31	31			155
	Contingency	1	1	1	1	1			5
	Total	**1,308**	**1,308**	**1,308**	**1,308**	**1,244**	**85**	**1,133**	**7,694**

Source: ERA

Annex 4: Socio-economic Impacts

Although most roads constructed using the LVR Manual have only been completed in the last few months, there are already some immediate impacts. This is illustrated by the following case studies based on interviews with local people and road users during the site visits.

Case Study Tillili to Wumbery Road, Tillili Woreda, Amhara Region
Interviewee: Ayenew Engida (farmer)

Previously this road was a muddy track passable only by pedestrians due to a missing bridge near to the main market of Tillili. A new 9 metre span bridge and a 6 kilometre road have been constructed under URRAP between October 2012 and June 2013. This has transformed access to this hilly area. It used to take at least an hour to travel by foot with mud up to knee level in some places. Now it takes no more than 30 minutes along the new gravel road. Moreover, because of the bridge, animal carts and motor vehicles can pass allowing safer, faster and easier transport for goods and people.

The road serves two kebeles directly and a further two beyond the end of the road with a total population of approximately 20,000. Already, the area has benefited from access for the woreda ambulance. Several women requiring emergency assistance during childbirth have been carried by the ambulance since the road opened.

The area is a producer of potatoes, gum poles and cereals. Previously farmers had to headload their produce to the market at Tillili. Now they can use animal carts. Furthermore, traders have started coming to their farms to buy their produce. This has not only saved farmers the time and effort of transporting goods to the market but has created some competition between traders. Consequently, the price obtained for a quintal of potatoes, for example, has increased from ETB 150 to as much as ETB 200. Thus, farmers have gained a double benefit from the new road.

The people in the area are now looking forward to the second phase of the URRAP project that will extend the road a further 6 kilometres to connect the remaining two kebeles.

Case Study Dangila to Dengeshta Road, Dangila Woreda, Amhara Region
Interviewees: Meseret Mengistu (farmer) and Mequanint Bekele (ex-road worker)

This road is in a fairly flat and fertile area connecting two kebeles and is the main access for a population of about 32,000 people. The road is 7.5 kilometres long and was constructed under URRAP between September 2012 and April 2013. The area is a major producer of maize, teff and other cereal crops. These are usually marketed in the woreda headquarters town of Dangila at the start of the road.

Before the road was constructed it was often difficult for pedestrians and animals to pass due to low-lying swampy areas and there was no access for motorised vehicles. Now the travel time has been reduced from over an hour to only 15 minutes. The new road is used by a large number of pedestrians and animal carts (garis) as well as some motorised vehicles. The farmers used to only be able to obtain fertiliser in the dry season. Now it is available throughout year. Now this main connector road has been built, Meseret Mengistu is hoping that the woreda will build side roads to the communities away from the road.

Local people have also benefited from the jobs created by the road construction. Mequanint Bekele worked on the road and has since followed the contractor to obtain more casual work as a labourer on road construction elsewhere. He is hoping to continue and eventually develop skills as a mason.

Case Study Aqebtarma – Tseykeme – Jijique, Tanqua-Abergele Woreda, Tigray Region
Interviewee: Farmers and driver

This project is a 22 kilometre road that has been constructed under URRAP between February 2012 and January 2013. The road serves many villages and couple of kebeles directly and a further connection even to a major roads and the Amhara region. The area produces mainly maize, sorghum and some animal products such as honey and butter. The road construction now permits access for small vehicles and, importantly, ambulances[3]. Giving access to health stations especially for pregnant women highly improves and saves life

Although the road has transformed access to this hilly area, the first 800 metres, which is very steep and not constructed properly, limits the access and use of the road is highly reduced due to this difficult section of the road. Some improvement on hilly part of the road would facilitate more access of goods and products transport by trucks and it has a potential of reducing the travel time by half.

Steep section of the road

Local people have also benefited from the jobs created by the road construction. Many of these farmers and young boys worked on the road construction on the basis of food for work organized by the woreda and also as labourers for the contractor for which they were paid 30 biir/day. They said that this helped them as income generation to support their family.

Local communities were ready to work for the road and they were happy to give their land but now are unsatisfied with the quality of access.

[3]All woredas in Ethiopia have been allocated a 4WD ambulance. The access provided by URRAP for these ambulances was frequently quoted as an important immediate benefit.

Case Study Adigudem to Hareko Road Project, Hintalo – Wejerat Wereda, Tigray Region
Interviewees: Farmers

The road is 26.3 kilometres long and was constructed under URRAP between January 2012 and November 2013. It connects 6 kebeles the area is a major producer of wheat, barley, teff and other cereal crops. After construction of the road, public transport (mini-buses) services have started and access to health centres and education has highly improved.

Before the road was constructed it was difficult for pedestrians and animals to pass specially during the rainy season because of the big rivers crossing the road. There was no access for motorised vehicles. Now the travel time in the rainy season has been reduced from over about 2 hours to only 30 minutes. The new road is used by a large number of pedestrians and animals as well as some motorised vehicles.

A problem is that the road has been damaged severely by heavy sand trucks (>20 tonnes), that are using the road as the main access to the river sand quarry site. There are particular difficulties at the swampy sections of the road that have been constructed without proper cumber on black cotton subgrade.

Annex 5: List of Problems Encountered

This is a detailed list of problems encountered by the users of the LVR Manual:

Comment Ref nr.	Details	Doc Ref. Vol/Ch/page
Name: Mulugeta Demissie Tel:	Organisation: ERA	
	Sections A.1.1 and/or B.3. The LVR Manual should contain guidance on (woreda) road network planning. This should provide one of the starting points for taking decisions on the design standard of roads as well as checking connectivity.	A/1/2 and/or B/3/4
	Phasing of horizontal and vertical design is mentioned in Part D (section D.4.7.3) but not in Part B. It is not being observed in practice and therefore should be included in Part B.	B/4/11
	Adverse camber is observed on many URRAP roads. The issue of super-elevation needs more emphasis in the Part B, preferably with a clear diagram showing how super-elevation is developed on curves.	B/4/16
	Delete Table B.4.11. It is confusing.	B/4/16
	Delete section 4.4. The design of tracks and undesignated roads is not part of the Manual.	B/4/17
	Sections B.4.5 and D.4.3. Guidance is required where there is an existing wide earth road with side ditches to be replaced by a narrower DC1 or DC2 class road on the same alignment. For example, use should be made if possible of the existing side ditches instead of excavating new side ditches to the narrower cross section. This would have the added advantage of allowing for future upgrading of the road to a higher class with a wider cross section.	B/4/17 and D/4/54
	Section 4.4.7 in Part D: delete sentence –"Super-elevation on unsealed LVRs is not necessary."	D/4/62
	The wrong location of cross drainage structures (culverts, fords, etc.) is frequently observed on URRAP roads. This includes both invert level of the cross drainage and the location relative to the crossing stream. This is because full design is not carried out. More emphasis and guidance is needed in Part E.	Part E (E/6/55?)
	Headwalls of skew structures are constructed at right angles to the stream and not parallel to the road edge. This needs to be explained and illustrated in Part E section 8.6.	E/8/132

Comment Ref nr.	Details	Doc Ref. Vol/Ch/page
Name: URRAP Staff Tel:	Organisation: Transport Bureau, SNNPR	
	Table B.4.8: Min radii of 102m & 135m not practical in built up areas. Min = 100m with widening would be better.	B/4/14
	Table B.4.15: side slope of 1:4 too wide and should be steeper. Suggest: 0-1 m ht 1:2; 102 m ht 1:3; Cut slope 0 -1 1:2	B/4/17
	When CBR >30, no sub base should be required	B/5/28
	Table B.4.15: Need to subdivide the earth category into soft/hard/etc.	B/4/17
	Table B.4.10: reconsider the relief gradient of 6% for 200m based considering vehicle performance (research needed). Need an empirical formula. Better to apply 400-500 m if possible.	B/4/15
	Section 5.1: CBR 97% soaked for 4 days should be reconsidered for drier areas of the country i.e. soak for less.	B/5/28
	Equation B.7.10: Make clearer that "P2" is accumulated rainfall over the period and not steady and continuous rainfall.	B/7/54 & 58
	Right of Way widths in Table D.4.5 and Figure B.4.2 are different. Need to resolve the discrepancy.	B/4/18-25 & D/4/57
	Table B.4.10: Discrepancy between Volume B and Standard Spec Table 2100-1 in horizontal radius for DC1 in flat terrain – 110 m and 120 m. should be the same.	B/4/15 & Standard Spec. p19
	The definition of soil types is not consistent with the BOQ. (This may be resolved once the new standard bidding documents are issued.)	Standard Spec 3102 p22
	5104 Site testing: Standard Specification is for minimum 98% compaction. This is not possible with small compaction plant.	Standard spec p42
	Field compaction test is provided for in the contract - sand replacement method every 500m. Should be specified in the Manual & Spec. 5104. (N.B. no one interviewed had ever made reference to Appendix D.1 p238 of part D. This describes simple compaction tests but a description of DCP or RCCD would be required for Ethiopian users.)	B, D & Standard spec

Comment Ref nr.	Details	Doc Ref. Vol/Ch/page
Name: Bekele Jebessa **bekelej@yahoo.com** Tel: 0911 224 809	Organisation: *ETHIO-Infra Engineering plc*	
	Proper scale drawing of each and every road cross-section should be provided.	B/4/18-27
	Figure B.4.2, Figure B.4.4, Figure B.4.6, Figure B.4.8, Figure B.4.10 at least for DC1 and DC2 roads the cross fall shall be 6 % as provided in Table B.4.4 to Table B.4.10 with the exception of paved scenario. Figure B.6.2. Camber should be 6%. 4% is too small.	B/4/18-27 B/6/40
	Section D.6.3. Table B.6.2. "Hmin" depends on soil type as well as climate	B/6/40
	Maximum gradients should be 12% for lengths up to 400 metres	B/4/12-15
	Reconsider design speeds in mountains and escarpments. We generally must work to lower radii than give in the Tables.	B/4/12-15
	Hairpin stacks: more details required with illustrations. I use Indian Road Congress Hill Roads Manual for guidance.	B/4/12-15 D/4.6.4/66
	Specify Design Vehicle for each road class. This is required when designing e.g. tight hairpin curves.	B/4/12-15
	Table B.4.11: Maximum gradient should be 12% for lengths up to 400 metres. 16% is too steep for the old vehicles and high altitudes encountered in Ethiopia.	B/4/16
	Part B, chapter 5.1 first paragraph, ...97% and Part D 6.5.1 paragraph 1 ....97% Compaction standards. 97% too high for subgrade. 93% should be adequate (as for ERA roads)	B/5/31 D/6/176
	Section 6-19-2, expansive soils, clear recommendations need to be provided for DC1 and DC2 roads , the countermeasure recommendation shall be re-visited from Ethiopian Context	D/6/165
	DCP should be included as a pavement design option as testing on site seems far-off.	B/6/39 D/6/110
	Section 6.20.2: Could DCP be used for checking density/compaction as an additional tool?	B/5/31 D/6/176
	The use of Rational Method or SCS Method should be made mandatory for estimating peak flows. (Methods 1 & 2 in "E" use for cross checking) Also need better coordination of content between Manual B & E on this.	B/7/51-61 E/6/47
	Guidance needed on the design of vented fords – with example calculation i.e. calculation of uplift forces, etc.	E/4/25

Comment Ref nr.	Details	Doc Ref. Vol/Ch/page
Name: Solomon Adugna **solomonadugna@gmail.com** Tel: 0911 57 77 43	Organisation: Amhara URRAP Consultant	
	Need guideline on woreda road network planning. Amongst other things, this should assist in deciding on the required road standard.	A or B
	Section 3.4.3: Need more explanation and guidance on how to forecast future traffic. Designers have difficulty with this.	B/3/6
	Table B.4.10: Need higher value than 12% for the maximum gradient in mountainous and escarpment areas e.g. give an absolute maximum of say 14% with relief gradients. There also needs to be more guidance on what to do in extreme conditions e.g. concrete climbing strips on short v. steep sections.	B/4/15
	Consultants are confused on pavement design where the subgrade is good. They are not sure of the zero thickness (ENS). They also feel need for an intermediate thickness between zero and 15 cm. They need to understand when and how they can shape and compact the in situ material as a surfacing.	B/6/39
	Some basic Materials Testing should be given in the Manual. Simple specific tests based on traffic level and subgrade type. The LVR Manual recommendations are often too much. Need simple tests not requiring a laboratory e.g. could do PI and sieve analysis?	B/6/
	Need structural details for drainage structures (note: this might be covered by standard drawings that have not yet been seen)	E
	Section 8.5.3: Masonry culvert with precast concrete top slab is a useful solution that should be illustrated with structural details. Good alternative to pipe culverts in some cases.	E/8/122
	Section D.6.12: Need more clarifications on environmental mitigation measures for different conditions. Consultants need simple mitigation measures.	D/6/140 (D/3/26)

Comment Ref nr.	Details	Doc Ref. Vol/Ch/page
Name: See attendance list of consultants and contractors at Amhara RRA on 21/8/13	Organisation: URRAP consultants & contractors in Amhara Region	
	Tables B.4.9 and b.4.10. General disagreement and dissatisfaction with the guidelines on maximum gradients.	B/4/15
	Fig E.8.21 & 22. Confusion over space for backfilling trenches. Trench width of 1.5 x OD considered too small.	E/8/129-130

Comment Ref nr.	Details	Doc Ref. Vol/Ch/page
Name: Demelash Samuel **demesami@gmail.com** Tel: 0911 727 884	Organisation: *Classic Consulting Eng.*	
	Chip Seal (S-11): The LVR Manual should be self-contained as much as possible. More details should be provided with key tables for chip seals instead of referring to TRL Overseas Road Note 3.	D/7/192
	Otta Seal (S-13): Engineers in Ethiopia have not been trained and do not have experience of "otta seal". More design details are needed in the LVR Manual. Currently, there is only reference to the Botswana Guideline to which I do not have access. I need to see difference in gradings and quality for natural and crushed aggregates, etc.	D/7/194
Name: Yosef Asrat Tel: 0912 688 427	Organisation: *Rama Consulting*	
	S-07: Dressed Stone/Cobble Stone Paving: No guidance in Part D on the maximum desirable gradient for cobblestone paving.	D/7/183

Comment Ref nr.	Details	Doc Ref.Vol/Ch/page
Name: Alemgena A. Araya **alemgena@yahoo.com** Tel: 0911 982909	Organisation: *ITT/ALERT Engineering Plc.*	
	Sec. B 5.1 Subgrade CBR is based on soaked CBR 97%compaction 97% compaction is too high can be based on 93% and soaked CBR for all climatic regions	B/5/28
	On paragraph particle size distribution citation/ref of table B.5.6 shall be replaced by B.5.5 Similarly paragraph plasticity table B.5.7 shall be replaced by B.5.6 Need to check all citations in sec. B 5.2 tables B.5.6 to B.5.13 shall be corrected to B.5.5 to B.5.12 (Note that table B.5.13 doesn't exist	B/5/34 B/5/34 to B/5/37
	Table B.5.8 gradation Spec. for sieve size 20 mm shall be 6 - 100% instead of 60 – 80% even sieve size 5 mm is 30 – 100 % (Note: table D.6.15 page D.6.133 for comparison)	B/5/35
	Table B.6.1 for AADT up to 300 VPD, is 1 million ESA sufficient enough in the countries axle load context or is there any axle load restrictions assumed for the LVR's?	B/6/39
	For pavements on Low strength soils (section D 6.19.7) instead of remove/undercut and replace, suggest that the manual recommends raising the formation. This would also facilitate drainage.	D/6/173
	Some in situ testing such as DCP should be included as testing method for design as well as quality control	B/6/39

Comment Ref nr.	Details	Doc Ref. Vol/Ch/page
Gary Taylor **gary.taylor@ittransport.co.uk** Tel: +44 1235 833753	Organisation: ITT	
	It would be helpful to have the title of the Manual on the cover of each document (instead of only "Part D" etc.)	All Parts of the manual
	Check page number e.g. Road Furniture & Signage is page B72 not B71.	Overall table of contents
	Here and elsewhere: "complimentary" is used where "complementary" is meant.	Glossary-xvii
	Section D.4.4.5: The difference between "camber" "crossfall" and "super-elevation" should be explained. These terms should also be included in the glossary of technical terms at the front of Part A.	D/4/61 & page xvi of Part A.
	Section 3.4.1: not very clear in the Manual how a count of NMT and IMT affects geometrics.	B/3/5
	Table B.4.1: Why are "pcu" equivalents not listed in the table for larger motor vehicles (e.g. buses and trucks?)	B/4/10 D/4/48
	Table B.5.2: the definition of LV1, LV2, etc. is not clear here. Needs a cross reference to Table B.6.1	B/5
	Hairpin bend design is not covered in Manual B although there are various references in Manual D e.g. section D.4.6.4. However, even in Part D more design details are required with diagrams e.g. to show change in gradients between hairpin bends and the linking limbs as well as the widening required on hairpin bends, etc.	B/4
	Reference to basic access approach at foot of page should refer to Table B.4.11 not B.4.10?	B/4/15
	Table B.4.11: Consultants are confused as to when to use these basic access standards. It might clearer to label these as the absolute minimum standard for vehicular access. Another possibility is to label these as the standards for tracks i.e. the class below DC1. The table would then be a more logical follow on from Tables B.4.4 to B.4.10.	B/4/16
	Text above Table B.4.12: it would be clearer to say "For all classes of roads above basic access, ……."	B/4/16
	Section B. 4.4: "Design by Eye". This method is open to abuse e.g. in Tigray Region. We recommend that it should be deleted.	B/4/17
	The rainfall intensity charts need a caveat regarding the potential effect of climate change on return periods.	B/7/52
	Section 2.3.2: the reference to "headwalls" in this sub-section needs to make clear that this is not the same as headwalls to culverts, etc.	D/2/9-10
	Section 4.2.5: the references to Tables B.3.11 to B.3.17 appear incorrect. Should the reference be to the tables in section B.4.3 (page B/4/11)	D/4/50
	As the comments referring to page B/4 above, the hairpin bend design explanation (section 4.6.4) needs more details and explanation with some illustrations. (Currently, URRAP consultants are referring back to the old ERA 2002 manual on this issue.)	D/4/66
	Plates D.6.9 and D.6.10 look the same. Looks like D.6.10 is wrong.	D/6/166

	The recommended cut slope angles are not very practical in extremely steep terrain – mountains and escarpments. The philosophy used in Nepal and elsewhere on low volume roads is to excavate the uphill cut slope only 5 degrees off vertical. Retaining walls or toe walls are provided where the soil is obviously weak; there is a risk of toe failure; or where slides occur.	D/3/29
	Section D. 4.4.7. We recommend that the phrase "Super-elevation on unsealed roads is not necessary" should be deleted or, at least qualified. It can be interpreted as suggesting that adverse camber on curves need not be removed. There are many cases where URRAP roads have adverse camber on curves.	D/4/62
	Figure D.6.22: subgrade not subgrade (spelling)	D/6/155
	Plate E.8.39: "Road Narrows Sign" should be Plate E.8.40. (wrong labelling)	E/8/167
	Dry stone walls – from experience it is often good to have cement-bound top course. This is better than dense soil filling shown in Figure E.7.4. This reduces the risk of dislodged top stones causing progressive collapse of the wall.	E/7/65
	Header should say Chapter 6 not Chapter 5.	E/6/47
	Could show option of permanent steel formwork for longer span arch bridges and large elliptical openings. These can be appropriate for hilly and mountainous areas where there are large flash floods but good rock foundations. As solid structures, they can usually be safely overtopped in extreme floods.	E/8/11/9
	Suggest adding the "lost earth" method for construction of arch culverts.	E/8/151
	Fig E.8.17 correctly shows a dished culvert base to a masonry culvert but needs explanation. Reduces risk of water penetration in the edge joint between wall and base at low flows.	E/8/122
	For all stone masonry walls. The importance of through-stones needs clearer explanation. This detail is important for structural integrity. Show some through stones in wall cross-section diagram e.g. in Figure E.7.4.	E/7/65-67
	Work Options: under option 3 – what about mentioning other community level organisations such as church groups? Such groups have mobilised to work on keeping roads open.	G sect. 1.2
	Work Options: under option 5 – Voluntary – compulsory labour. Suggest mentioning particular application to community roads (tracks) i.e. roads not under central, regional or local government ownership/responsibility.	G sect. 1.2

Annex 6: Headman's Handbook Example