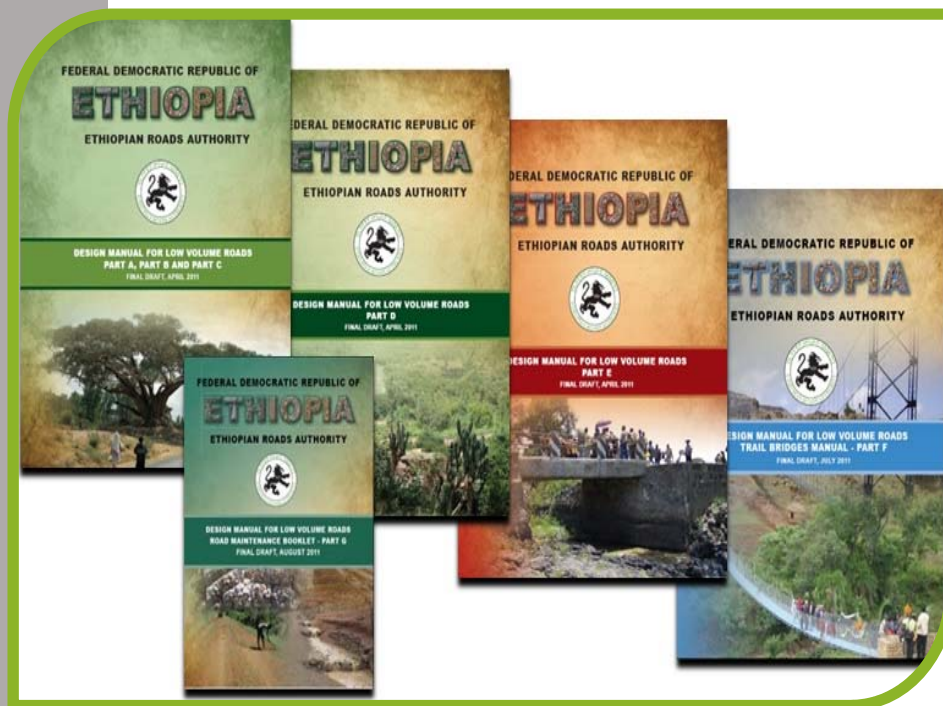




AfCAP
Africa Community Access Partnership



Finalisation of the Design Manual for Low Volume Roads for the Ethiopia Roads Authority (ERA) Aide Memoire (Final)



Author: RN Geddes

2nd December 2015

The views in this document are those of the author and they do not necessarily reflect the views of the Research for Community Access Partnership (ReCAP), the Africa regional component (AFCAP), or Cardno Emerging Markets (UK) Ltd for whom the document was prepared.

Cover Photo: Robert Geddes

<i>Quality assurance and review table</i>			
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Abstract

AFCAP is supporting the Ethiopian Roads Authority (ERA) in finalising the Low Volume Roads Design Manual, which was published in draft form in 2011. The assignment includes rectifying typing errors and incorrect cross-references throughout Parts A, B, C, D, E and G of the LVR Design Manual, responding to technical comments provided by users of the manual, and incorporating new technical content reflecting developments in LVR technology since 2011. The assignment includes the development of a new field maintenance handbook for use at the wereda level. The purpose of this Aide Memoire is to summarise agreements made during the visit to Addis Ababa by the Team Leader, Lead Authors and the ReCAP/AFCAP Infrastructure Research Manager from 17th to 19th November 2015.

Key words

Low Volume Roads, Manuals, Maintenance, Ethiopia

Acronyms, Units and Currencies

AFCAP	Africa Community Access Partnership
ASCAP	Asia Community Access Partnership
billion	One thousand million
Birr	Ethiopian national current exchange rate US\$1 = 20.6 Birr
DFID	Department for International Development
ERA	Ethiopia Roads Authority
ERTTP	Ethiopia Rural Travel and Transport Programme
GDP	Gross Domestic Product
GPS	Global Positioning System
GTP	Growth and Transformation Plan
ILO	International Labour Organisation
Kebele	The smallest administrative division in Ethiopia
LCS	Low Cost Surfacing
LVR	Low Volume Roads
PIARC	World Road Association
RECAP	Research for Community Access Partnership
RRA	Rural Road Authority
RSDP	Road Sector Development Programme
UK	United Kingdom
UKAid	United Kingdom (Department for International Development)
URRAP	Universal Rural Road Access Programme
USD	United States Dollar
Wereda	The third level administrative division of Ethiopia, similar to district

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Executive Summary

AFCAP is supporting the Ethiopian Roads Authority (ERA) in finalising the Low Volume Roads Design Manual, which was published in draft form in 2011. Civil Design Solutions was appointed to manage the updating process. The Consultant's Team Leader, Lead Authors, Expert Reviewer (Drainage) and ReCAP/AFCAP Infrastructure Research Manager visited Addis Ababa from 17th to 19th November 2015. The purpose of the visit was to discuss comments received from users of the manual and from the independent review of its use, which was carried out in 2013, and to assign responsibility for effecting the changes.

The outcome of these discussions was presented to ERA managers and experts at a meeting held in the ERA Boardroom on 19th November in order to agree the way forward. The following is a summary of the key recommendations made by the Consultant's team:

Tasks to be carried out under the current assignment:

- Update the manuals Part A, B, D, E and G to reflect recent developments in LVR technology and to be compatible with the ERA Drainage Design and Route Selection Manuals; prepare print-ready documents (Part A to G) for publishing by ERA as 2016 editions.
- Incorporate the DCP pavement design method in parallel to CBR catalogue method:
- Remove the existing section on construction in Part E but preserve for inclusion in a new ERA LVR Construction Manual.
- Remove the existing section on maintenance of structures from Part E and incorporate it in Part G.
- Prepare Maintenance Field Guide in English ready for translation to local languages, with the following attributes:
 - Image driven with minimal text
 - Road defect and corresponding maintenance task to be on facing pages
 - Productivity norms to be included for each task
 - Language: simple layman's text
 - Designed to be translated easily into the main local languages (by others)
 - Document size = A5
 - For printing in black and white, and not colour.

The following issues and aspects of LVR provision are not included in the assignment:

- Design of hairpin stacks.
- Detailed environmental measures.
- Wereda road planning.
- Construction issues including site quality control, borrow pit management and technical auditing.
- Review and update of URRAP specifications.
- Printing of the updated manual.
- Training in the use of the DCP pavement design method or other aspects of the manual and maintenance field book.

1 Background

The Africa Community Access Programme (AFCAP) is a programme of research and knowledge dissemination funded by the UK government through the Department for International Development (DFID). The first phase of AFCAP commenced in June 2008 and ended in July 2014. The second phase, which will also run for 6 years, commenced on the 1st August 2014. The management of AFCAP 2 is contracted by DFID to Cardno Emerging Markets, UK. The aim of the new AFCAP initiative, under the overall Research for Community Access Partnership (ReCAP) umbrella, is to build on the programme of high quality research established under AFCAP phase 1 and take this forward to a sustainable future in which the results of the research are adopted in practice and influence future policy.

As part of AFCAP 1, support was provided to Ethiopia through the Ethiopian Roads Authority (ERA). The support included the preparation of new design manuals, specifications, standard drawings and bidding documents for Low Volume Roads (LVRs) as well as the updating of the existing 2002 series of road design manuals for high volume roads and the development of a new Geotechnical Design Manual and Route Selection Manual.

The Design Manual for LVRs was published in draft form in May 2011 and distributed for use for a period of 2 to 3 years. An independent review was undertaken in October 2013 of the use of the new manual following which the draft manual was scheduled for updating as part of AFCAP 2.

Following meetings with ERA management during project scoping visits of 3-14 November 2014 and 23-27 March 2015 to identify priority projects for funding through AFCAP 2, it was agreed that there was an urgent need to start the process of updating and finalising the LVR Design Manual. It was agreed that this should be undertaken by the original drafting team of the manual.

2 Research objectives

The objectives of the assignment are:

- To prepare a revised draft LVR design manual based on comments received for presentation to a Peer Review Group meeting to agree the proposed changes.
- To develop a new shorter, pocket-sized, site-friendly, pictorial supplement of the Maintenance manual (Part G) to complement Part G.
- To prepare a final draft based on comments from the Peer Review Group for final Executive Review by ERA.
- To prepare a final print-ready master document of the ERA Design Manual for Low Volume Roads (including the new development for Part G) that has been approved by ERA and representatives of the peer and executive review groups.

3 Process

The process for the updating of the LVR manual includes the following steps:

- Conversion of PDF files of existing manuals to MS Word (Parts A, B and D are complete)
- Redrafting of illustrations (in progress)
- Collecting replacement photographs (in progress)
- Review of road maintenance practice in the weredas (completed in October 2015 – see separate report)
- Review of comments collected by ERA on existing manuals (completed during visit of Lead Authors to Ethiopia in November 2015 – see Annex B).

- Preparation of draft revisions to existing manuals (Due to be submitted to ERA in early January 2016)
- Peer group meetings to review proposed changes (Planned for mid-Feb 2016)
- Submission of final drafts to Executive Review Group (Due to be submitted in March 2016)
- Presentation to Exec Review Group (Planned for May 2016).
- Launch of manuals (Planned for July 2016).

4 Principles Previously Agreed

The following principles were agreed with ERA before the start of the assignment:

- The existing structure of LVR manual is to remain (Parts A to G) but the content will be brought up to date.
- No changes are required to Part C (Complementary Interventions) and Part F (Trail Bridges)
- There is a requirement for the development of new field guide for wereda road maintenance.

5 Deficiencies Noted in Existing LVR Manuals

The following deficiencies were noted in the existing LVR manual by users of the manual and in the independent review of the use of the manual, which was carried out by IT Transport Limited in 2013.

- Lack of advice on wereda road network planning
- Unclear recommendations on super elevation on LVRs
- Unclear or incorrect recommendations for maximum gradients and lengths of steep sections
- Lack of advice on design of hairpin stacks
- Incorrect subgrade compaction standards
- Lack of advice on environmental mitigation measures
- Incorrect references and typing errors.

It was noted that there were very few comments on Part G (Maintenance) because it has not yet been widely used.

6 Issues Emerging since 2011

Several new issues concerning the provision of LVRs have emerged in the region since the LVR manual was published in 2011. ERA has also furthered the development of road standards for Ethiopia through the development of new manuals and guidelines, which have an impact on the provision of LVRs. The key issues that relate to the updating of the LVR manual are summarised as follows:

- There is a need for a more holistic approach to LVR road provision, and guidance is therefore required on planning and construction related issues.
- AFCAP research in Malawi has resulted in the development of the DCP design approach for LVRs (paved and unpaved), which was found to be highly appropriate and is now being adopted in Tanzania, Kenya and Mozambique.
- New LVR design manuals have been published in South Sudan and Malawi (pavement design) and are under preparation in Tanzania and Mozambique.
- There is an increasing focus on maintenance of rural roads, in particular on the URRAP network.
- Since 2011 ERA has completed the following new documents:

- Standard Specifications for Roads and the Standard Drawings
- Drainage Design Manual
- Route Selection Manual.

There is a need to ensure that the ERA LVR Design Manual is compatible with these developments.

7 Recommendations for Way Forward

Following the Consultant team discussions in Addis Ababa in November 2015 and discussions with ERA the following recommendations are made for the way forward in the updating of the LVR manual¹:

The following tasks will be carried out:

- Update the manuals Part A, B, D, E and G to reflect recent developments in LVR technology and to be compatible with the ERA Drainage Design and Route Selection Manuals; prepare print-ready documents (Part A to G) for publishing by ERA as 2016 editions.
- Include references to ERA Standard Drawings for standard road cross-sections, but do not include the cross-sections in Part B (the existing cross-sections in Part B are more suitable because they allow all options in terms of geometric standards to be described, though they may need redrawing).
- Include reference to borrow pit management principles in Part D, but full details to be included in new ERA LVR Construction Manual (see below).
- Incorporate the DCP pavement design method in parallel to CBR catalogue method: DN catalogue in Part B and explanatory text in Part D; design examples may be included in the annexes (MP).
- Conduct gap analysis of new Tanzania LVR Manual for additional material on drainage (ME).
- Combine Drainage, Erosion Control and Water Crossing sections of existing Part B into one section (ME).
- Remove the existing section on construction in Part E but preserve for inclusion in the new Construction Manual (see below); retain other construction-related sections in the existing manual (RG).
- Remove the existing section on maintenance of structures from Part E and incorporate it in Part G (RP).
- Prepare Maintenance Field Guide in English ready for translation to local languages, with the following attributes (RP):
 - Image driven with minimal text
 - Road defect and corresponding maintenance task to be on facing pages
 - Productivity norms to be included for each task
 - Language: simple layman's text
 - Designed to be translated easily into the main local languages (by others)
 - Document size = A5
 - For printing in black and white, and not colour.

The following issues and aspects of LVR provision are not included in the assignment:

- Design of hairpin stacks: users requiring this information will be referred to the ERA Geometric Design Manual (high volume roads).

¹ RG – R Geddes; MP – Mike Pinard; JR – John Rolt; RP – Rob Petts; ME – Manaye Ewunetu; GH – Gareth Hearn.

- Detailed environmental measures: users will be referred to the ERA Environmental Procedures Manual Planning.
- Wereda road planning: it is recommended that ERA should develop a new Planning Manual for wereda roads.
- Construction issues including site quality control, borrow pit management and technical auditing: it is recommended that ERA develop a new LVR Construction Manual.
- Review and update of URRAP specifications: some inconsistencies have been identified in the URRAP Specifications, and environmental requirements are not covered in sufficient detail.
- Printing of the updated manual of the new maintenance handbook.
- Training in the use of the DCP pavement design method or other aspects of the manual and maintenance field book.

Annex A: Attendance at Meeting

The table below includes a list of people attending the meeting held at the ERA Boardroom on 19th November 2015.

Name	Organisation
Alemayehu Endale (separate discussion after the main meeting)	Chief Engineer Research Centre
Deribachew Mezgebu	Highway Research Team Leader ERA RRC
Woinshet Fetene	Researcher RRC ERA
Sity Mensur	Researcher RRC ERA
Solomon Daba	Team Leader ERA Asset Management
Amede Muhye	Engineers ERA Asset Management
Samson Tesfaye	Director ERA Diredawa
Aklile Muwgerk	Engineers ERA Asset Management
Bekele Jebessa	General Manager Consuglast EIE
Les Sampson	Cardno Infrastructure Research Manager
Michael Pinard	Lead Author
Dr Manaye Ewunetu	Expert Reviewer
Dr John Rolt	Lead Author
Robert Petts	Lead Author
Robert Geddes	Team Leader, CDS

Annex B: Detailed Assignment of Tasks

The following is a detailed list of comments received from users of the LVR Manual and through the 2013 independent review:

Comment Ref nr.	Action	Details	Doc Ref. Vol/Ch/page	Agreed action following team discussions 17 th and 18 th Nov 2015
		Name: Mulugeta Demissie	Organisation: ERA	
1	MP	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	Advise if paragraph from Tanz manual can be included in Part A. Consider new Planning Manual for ERA
2	JR	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	Include text on “alignment fixes design speed” approach for approval of peer group.
3	JR	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	Superelevation not required on DC1 and DC2 (single lane roads). Improve fig in Part D and point out where needed. Also Table 4-11 in Part B.
4	JR	Delete Table B.4.11. It is confusing.	B/4/16	Decide whether table should be deleted or improved.
5	JR	Delete section 4.4. The design of tracks and undesignated roads is not part of the Manual.	B/4/17	Reword design by eye method using text from Tanz manual
6	JR	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.	B/4/17 and D/4/54	Allow flexibility. Camber essential. Wider side slopes may be good if less steep. Give options: naros road and distance between drains or drains remain and side slopes widened. Give pros and cons.

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		This would have the added advantage of allowing for future upgrading of the road to a higher class with a wider cross section.		
7	JR	Section 4.4.7 in Part D: delete sentence –“Super-elevation on unsealed LVRs is not necessary.”	D/4/62	Clarify that this is on narrow roads. Increased erosion where superelevation is provided.
8	RP	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?)	Where humps are necessary to achieve cover on culvert the surface should be paved. Drifts better than culverts in flat areas.
9	RP	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	Add text that headwalls should be perpendicular to culvert line and set back from road.
		Name: URRAP Staff	Organisation: Transport Bureau, SNNPR	
10	JR	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	Clarify
11	JR	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	Allow 1:3 side slope for height < 1m. Fill slopes only.
12	MP	When CBR >30, no sub base should be required	B/5/28	Add sentence to provide subbase if need to raise road level.
13	JR but it's Table B.4.13	Table B.4.15: Need to subdivide the earth category into soft/hard/etc.	B/4/17	Differentiate between hard and soft ground in cut.
14	JR	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	Review recommendations of Nepal and India manuals.
15	MP	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	Reduce to 95% or compaction to refusal without breaking down material.

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16	RG	Equation B.7.10: Make clearer that “P2” is accumulated rainfall over the period and not steady and continuous rainfall.	B/7/54 & 58	Check equation	
17	JR	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	Check ROW widths in Part B.	
18	RG	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	Advise ERA to revise L-B spec Table 2100-1	
19	RG	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	Revisions needed to L-B Spec	
20	RG	5104 Site testing: Standard Specification is for minimum 98% compaction. This is not possible with small compaction plant.	Standard spec p42	Advise ERA to change Spec to 95%	
21	RG	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	Include in new Construction Manual	
		Name: Bekele Jebessa bekelej@yahoo.com	Organisation: ETHIO-Infra Engineering plc Tel: 0911 224 809		
22	RG	Proper scale drawing of each and every road cross-section should be provided.	B/4/18-27	Check std drgs are consistent with manual. Refer to drg nos. in manual or paste in drgs?	
23	JR	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	Figures need changing to 6% camber	
24	MP	Section B.6.3. Table B.6.2. “Hmin” depends on soil type as well as climate	B/6/40	Check table B.6.2. Ask Jebessa for proposal on soli types.	

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25	JR	Maximum gradients should be 12% for lengths up to 400 metres	B/4/12-15	Check Nepal and India manuals.
26	JR	Reconsider design speeds in mountains and escarpments. We generally must work to lower radii than give in the Tables.	B/4/12-15	Check Nepal and India manuals.
27	JR	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	Check Nepal and India manuals but LVR manual will not included detailed design guidance for hairpin stacks.
28	JR	Specify Design Vehicle for each road class. This is required when designing e.g. tight hairpin curves.	B/4/12-15	No action required- see Tables D.4.1. and D.4.2.
29	JR	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	Change 16% to 12%.
30	MP	Part B, chapter 5.1 first paragraph,97% and Part D 6.5.1 paragraph 197% Compaction standards. 97% too high for subgrade. 93% should be adequate (as for ERA roads)	B/5/31 D/6/176	Change compaction to 95%
31	MP	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	Consult Jebesse on what works.
32	MP	DCP should be included as a pavement design option as testing on site seems far-off.	B/6/39 D/6/110	DN catalogue in Part B, explanations in Part D. Paved and gravel road design.
33	MP	Section 6.20.2: Could DCP be used for checking density/compaction as an additional tool?	B/5/31 D/6/176	Construction manual
34	MU	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)	B/7/51-61 E/6/47	SCS method not appropriate.

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		Also need better coordination of content between Manual B & E on this.		
35	MU	Guidance needed on the design of vented fords – with example calculation i.e. calculation of uplift forces, etc.	E/4/25	Review and recommend additional text if necessary.
		Name: Solomon Adugna solomonadugna@gmail.com	Organisation: Amhara URRAP Consultant Tel: 0911 57 77 43	
36	RG	Need guideline on woreda road network planning. Amongst other things, this should assist in deciding on the required road standard.	A or B	New Planning Manual
37	JR	Section 3.4.3: Need more explanation and guidance on how to forecast future traffic. Designers have difficulty with this.	B/3/6	Provide more explanation from Tanz manual. Consider effect of super singles.
38	JR	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	Nepal and India manuals
39	RP / RG	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	Add bullet on using material from side drain to form camber for ENS (RP) Change dimension on Fig B-6-1 to 35cm
40	RG	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/	Cross reference in B6 to Appendix D1
41	RG	Need structural details for drainage structures (note: this might be covered by standard drawings that have not yet been seen)	E	Refer to Std bridge drawings

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42	RG	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	Add sketch and photo if possible
43	RG	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)	Refer to ERA Envir Procedures Manual and Div 1600 os Std Specs. To be covered in Construction Manual
		Name: See attendance list of consultants and contractors at Amhara RRA on 21/8/13	Organisation: URRAP consultants & contractors in Amhara Region	
44	JR	Tables B.4.9 and b.4.10. General disagreement and dissatisfaction with the guidelines on maximum gradients.	B/4/15	See above
45	RG	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	Revise for small diam culverts
		Name: Demelash Samuel demesami@gmail.com	Organisation: <i>Classic Consulting Eng.</i> Tel: 0911 727 884	
46	RG	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	Refer to ERA seals manual
47	RG	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	Refer to ERA seals manual
		Name: Yosef Asrat	Organisation: <i>Rama Consulting</i> Tel: 0912 688 427	
48	RP	S-07: Dressed Stone/Cobble Stone Paving: No guidance in Part D on the maximum desirable gradient for cobblestone paving.	D/7/183	Add advixe on cobbles on slopes considering traction, washing out of joints, need to mortared joints, material selection, pattern of laying etc.

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		Name: Alemgena A. Araya alemgena@yahoo.com	Organisation: ITT/ALERT Engineering Plc. Tel: 0911 982909	
49	MP	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	Change to 95%
50	RG	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	Check cross references
51	MP	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	Correct table from ORN 31
52	MP	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	Improve explanatory text.
53	MP	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	Ignore? Already covered.
54	MP	Some in situ testing such as DCP should be included as testing method for design as well as quality control	B/6/39	Refer to AFCAP document on use of DCP for quality control. Guidane included in construction manual.
		Gary Taylor gary.taylor@ittransport.co.uk	Organisation: ITT. Tel: +44 1235 833753	
55	RG	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	Revise covers

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56	RG	Check page number e.g. Road Furniture & Signage is page B72 not B71.	Overall table of contents	Check page nos
57	RG	Here and elsewhere: “complimentary” is used where “complementary” is meant.	Glossary-xvii	Correct spellings
58	JR	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.	Check and add terms to glossary if necessary
59	JR	Section 3.4.1: not very clear in the Manual how a count of NMT and IMT affects geometrics.	B/3/5	Add sentence below table B.3.1 explaining how NMT is catered for in designs. Adjust column headings in table. Explain use of table better. Correct 3 axle truck value.
60	JR	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	Add sentence to explain better.
61	MP	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	Add reference
62	JR	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	Outside scope of LVR manual.
63	RG	Reference to basic access approach at foot of page should refer to Table B.4.11 not B.4.10?	B/4/15	Correct reference
64	JR	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	Remove table.

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65	JR	Text above Table B.4.12: it would be clearer to say “For all classes of roads above basic access,”	B/4/16	Review text
66	JR	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	See above (Point 2)
67	ME	The rainfall intensity charts need a caveat regarding the potential effect of climate change on return periods.	B/7/52	Suggest revised text and updated charts.
68	GH	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. All of Section 2.3 in part D needs rewriting and referencing to the new Route Selection manual	D/2/9-10	Review whole of section 2 regarding planning and feasibility studies. What info is required before design can start? (Does existing Route Selection Manual provide for LVRs?)
69	RG	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	Check references
70	JR	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	See above
71	RG	Plates D.6.9 and D.6.10 look the same. Looks like D.6.10 is wrong.	D/6/166	Replace photo
72	GH	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	Review cut slope angles
73	JR	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	D/4/62	See above

		curves need not be removed. There are many cases where URRAP roads have adverse camber on curves.		
74	RG	Figure D.6.22: subgrade not subgrade?? (spelling)	D/6/155	Correct spelling
75	RG	Plate E.8.39: "Road Narrows Sign" should be Plate E.8.40. (wrong labelling)	E/8/167	Correct labelling
76	RP	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	Add explanatory text
77	RG	Header should say Chapter 6 not Chapter 5.	E/6/47	Correct header
78	RP	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	Add text for this option.
79	RP	Suggest adding the "lost earth" method for construction of arch culverts.	E/8/151	Consider whether this should be included.
80	-	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	Comment- no action
81	RP	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	Add text.
82	RP	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	Add to text

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83	RP	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	Refer to URRAP experience.
	Various sources.		Organisation: Team Members	
84	-	Figures B.4.11 and 12 disappeared in the final pdf version	LS email 12/02/13	Already put back
85	MP	Need a section concerned with upgrading an earth or gravel road to a paved standard	JR email 26/08/11	Covered by DCP design method
86	JR	Traffic categories: “We should never have agreed to use 0.3 - 0.5, and 0.5 - 1.0 for LVRs when the main manual uses 0.3 - 0.7 and 0.7 - 1.5”	RG/JR emails of 26/08/11 and 18/03/13	Too late to change this now. Linked to definition of LVR.
87	MP	Table D. 7.9- bitumen and aggregate application rates.	RP email 12/02/13	Correct the table. Refer to ERA seals manual and the Std Specs.
88	RG	Typo in column heading table D.7.9		Correct typo.