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Development of Guidelines and Specifications for Low Volume Sealed Roads through Back Analysis

Inception Report

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TRL

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TRL THE FUTURE OF TRANSPORT

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Abstract

This report covers the inception period of the project on the Development of Guidelines and Specifications for Low Volume Sealed Roads (LVSRs) through Back Analysis. The project will be carried out in three phases which include Phase1 for the review of previous studies and creation of a database on the performance parameters for LVSRs, Phase 2 for the field investigation of LVSRs in a selection of 5 countries, and phase 3 for the preparation of guidelines and specifications for LVSRs and subsequent dissemination.

This inception report covers only Phase 1 of the project and involves the review of previously constructed LVSRs going back four decades. The activities include collection of data and information, development of a LVSRs database, population of the database, assessment and preliminary analysis. The preliminary analysis will results in the review of gaps in the data and knowledge i.e. the gap analysis. The results of the gap analysis shall be used to determine the information which should be collected through field and laboratory investigations in a selection of five countries which will work in partnership with TRL.

The report provides details of the project, the activities which were planned for the inception period, the achievements, the risks noted and other information.

Key words

Regional Back Analysis, Sub-Saharan Africa, Low Volume Sealed Roads, Low Volume Roads Performance of Low Volume Roads

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TRL

John Rolt	Team Leader	Author
Kenneth Mukura	LVSRs Expert	Author
Tom Buckland	Data Specialist	Author
Andrew Otto	Research Engineer	Technical Reviewer
Mike Mayanja	Research Engineer, Uganda	Collecting information on LVSRs

Regional Partners

Actor Zonde	Head of Research DoR,	Supplied 11 documents on

	Zimbabwe	LVSRs research

Acronyms, Units and Currencies

LVR	Low Volume Roads
LVSR	Low Volume Sealed Roads
AFCAP	Africa Community Access Partnership
RECAP	Research for Community Access Partnership
UKAid	United Kingdom Aid (Department for International Development, UK)
DoR	Department of Roads (in Zimbabwe)
MoTID	Ministry of Transport and Infrastructure Development
SFRDP	Secondary and Feeder Roads Development Programme
MESA	Million Equivalent Standard Axles
AADT	Annual Average Daily Traffic
DFID	Department for International Development

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1 Executive Summary

The economic and social development of communities in rural Africa is being severely compromised by poor roads and therefore poor access to markets, schools, health and other services and, indeed to all opportunities and activities necessary for development. It has proved difficult for most countries to adequately solve this problem for various reasons:

- Roads are generally expensive.
- Depletion of good road-building material and increased costs.
- The maintenance requirements are usually unsustainable at the present time.

Nevertheless, for low volume roads there are several issues that indicate that major improvements are possible. These include identifying proven specifications for materials of *appropriate* standards for such roads, allowing cheaper local materials to be used; more use of whole life cost principles, based on new knowledge, that indicate conclusively the benefits of sealing LVRs to preserve materials and reduce overall costs; and use of other methods of improving the performance of materials.

The performance of road pavements depends on many factors; factors that differ from region to region and area to area, based primarily on soils, geology and materials, and climate. As a result, the engineering knowledge is neither comprehensive, in full agreement, nor sufficiently well known throughout Africa. Indeed, there are some apparently contradictory results that undermine confidence but illustrate the difficult nature of road performance analysis and the need for the widest possible data set covering the full range of conditions. However many good research projects have been carried out over the past years by research organisations. Road investigations and trials have also been carried out by road authorities, universities, individual engineers and others. These projects have been reported in different ways and different places and many are considered to be extremely valuable resources that need to be brought together and made available to all. However, not all such studies have equal merit or are equally accessible. It is the purpose of this project to review these data sets and to 'capture' as much of this knowledge and the data on which it is based as possible and to make it available for engineers, scientists and research workers to study, analyse and improve in the future and to enable comprehensive Regional Guidelines and Specifications to be updated and further developed for LVRs making use of all proven innovations and rationalisations.

The project is in three Phases and this report is for the inception period for Phase 1. Phase 1 involves the collection of historical performance data from previous studies, processing of the data and the creation of a database for LVRs. A gap analysis shall also be carried out which will inform the scope of Phase 2. Phase 2 will involve field and laboratory investigations of some test sites on LVRs in a selection of up to five countries. The data will compliment that obtained in Phase 1. Phase 3 will involve analysis of data and the development of guidelines and specifications for LVSRs followed by dissemination and training.

The project is being carried out by TRL with support from the Department for International Development (DFID) under the ReCAP programme. It began on the 18th of April 2016 and Phase 1 is expected to run until the end of February 2017. A pool of experts has been set up to assist with the delivery of the project. The project is being managed directly by the Project Management Unit

(PMU) of ReCAP. Cardno Emerging Markets is managing ReCAP on behalf of DFID and working in partnership with many governments in the developing world particularly in Africa and Asia.

This report provides details of the main activities which will be undertaken as part of this assignment, what has already been accomplished, the challenges envisaged and other information.

2 Introduction

This report covers the inception phase of the project on the Development of Guidelines and Specifications for Low Volume Roads through Back Analysis. The report provides information on the nature of the project including the aims and objectives, the methodology, key activities, intended outputs and the progress to date.

2.1 Background

In Sub-Saharan Africa, 63% of the population live in rural areas[1]. Transport facilities have long been recognised as vital to the wellbeing of rural people. Transport to markets, health services, schools, opportunities for employment, participation in local affairs and much more, all depend on the rural road network and its ability to remain functional throughout the year. It has proved difficult for most countries to adequately satisfy this demand for various reasons:

- Roads are generally expensive and finances are scarce.
- The loss of material from a gravel road and the need for regular re-gravelling has depleted the sources of good material and increased costs.
- The use of poorer material has had a negative effect on the performance of gravel roads, thereby exacerbating the situation and increasing the demand for better maintenance. The maintenance requirements are usually unsustainable at the present time.
- The demand for human settlement has increased leading to population pressure on the limited land resources thus restricting sources of road building material still further.

These are the principle engineering problems but there are several issues that, taken together, should provide partial or even full solutions.

2.2 Design Standards

First of all the specifications for roads have evolved over many years but were driven mainly by the requirements for heavily trafficked roads. Such roads have to be quite substantial and to be built with very good quality material because their performance, or deterioration, is controlled primarily by the effect of the heavy traffic. Because of their substantial construction, most environmental effects, with the possible exception of major floods for example, have a relatively minor effect. In contrast, low volume roads (defined as roads carrying less than 300 AADT or 1.0 million cumulative equivalent standard axles during their design life) are quite thin. They do not require material of such premium quality because the traffic is less damaging. However, the deterioration or performance of such roads depends much more on environmental conditions. As a result of these differences, the design of LVRs requires a different approach to that of high volume roads.

[1] Rural population as a percentage of total population for Sub-Saharan Africa in 2014. World Bank, World Development Indicators (2016)

2.3 Local Materials

The specifications do not need to be as stringent as those for high volume roads and this means that local materials with low haul distances and lower costs can often be used instead. The problem is simply one of knowing which materials can be used and what the revised specifications should be. Engineers are somewhat cautious in making such decisions and will not normally do so unless there is ample proof that the specifications are satisfactory or are incorporated in reliable manuals.

Fortunately, as a result of specific research projects over the years and trials carried out by engineers willing to experiment, there is a great deal of information available to enable this approach to be used with confidence for many materials and many situations

2.3.1 Rediscovering Techniques

There are various techniques, tried and tested in the past, that can also be used when adequate roadbuilding material is not available. Techniques such as 'armouring' and 'blending' for example need to be publicised and demonstrated with scientific evidence that already exists.

2.3.2 Saving Resources

Relatively recent research has shown that despite initial costs being relatively high, whole life costing principles indicate that it is economically effective to provide a surface seal on unpaved roads carrying traffic even as low as 50 AADT in some circumstances, such is the seriousness of depletion of good roadbuilding material, that this solution will be vital in future for preserving the material that is available.

2.3.3 Whole Life Costing

As part of the whole life costing exercise, the use of methods that fully quantify the disbenefits of poor road networks on rural people have helped to demonstrate the importance of sealing roads, not only to preserve good roadbuilding material but in providing all year access.

3 Purpose of the Project

There is a great deal of information concerning methods for reducing the cost of roads and making them more reliable that has been developed through specific research initiatives such as the DFID AFCAP programme, research carried out by specialist research institutions, investigations of road failures by consultants, and many other trials that may not have been reported in the engineering literature. It is the purpose of this project to capture as much of this information as possible, preferably including the initial raw data that was measured and analysed in project reports and to preserve it in a form that engineers and researchers can access and review in the future.

Also, by including as much data from different sources as possible, the full range of all the factors that affect pavement performance can be quantified giving rise to the possibility of combining data sets and carrying out some form of meta-analysis to capture all influences.

If we add the further observation that there are many factors that influence the performance of road pavements and that performance analysis is actually a rather difficult task and is often done badly, for example, by simply identifying a component that is simply out of specification even though this may not be the real cause of the problem, the nature of the project becomes apparent.

3.1 Project Phases

The project is conceived as a three phase project.

Phase 1

- Review of previous studies
- Creation of a suitable database to store the data from previous studies
- Identify gaps in the knowledge base that may result in further research.

Phase 2

- Field studies in up to 5 countries

Phase 3

- Preparation of guidelines and specifications for LVSR and dissemination.

3.2 Output

The final key outputs will be revised guidelines and specifications on LVSRs and a fully comprehensive database of information for use by research engineers in the future.

Once accomplished, the project will provide evidence-based guidelines and performance specifications which will be applicable in many countries in the Region. This will aid the wider uptake of the technology not only in ReCAP countries but many others too. This is in line with the ReCAP main objective of uptake and embedment of knowledge and technologies.

4 Approach and Methodology

4.1 Objectives

The main aim is to create a knowledge base on the performance of LVSRs especially where non-conventional materials and designs have been used and to have the data and information captured in a database. The database will form the main information resource for any future undertakings in the following areas:

1. Research – the database will provide the necessary historical data on the performance of LVSRs in different environments and conditions for use in future research work.
2. Design and construction of LVSRs – inputs into specifications for design and construction based on performance criteria.
3. Identification of knowledge gaps which will inform Phase 2 of the project and for the determination of any future research needs.

The objectives of this project are categorised into research, capacity building, knowledge exchange, uptake and embedment.

The research objective is to be met by carrying out a review of the performance of LVSRs constructed in the last four decades in order to:

1. Create a database of performance specifications in relation to the designs, pavement materials, climatic conditions, etc. and to use this information for the review and refinement of the specifications and guidelines for LVSRs.

2. To verify or refine catalogues which are currently being used in the design of LVSRs based on performance criteria.
3. To provide the basis for the use of non-conventional designs and materials on future projects in the provision of LVSRs.

4.2 Expected Outcomes

Phase 1

The expected outcome of Phase 1 of the Project shall be an agreed methodology to progress the project into Phases 2 and 3 involving fieldwork and dissemination of guidelines and specifications respectively.

Phase 2 and 3

1 The database

Once the database is successful completed and populated adequately and demonstrated to be functional, a host based in the Region shall take custody of it and make it more accessible to end users.

2 Guidelines and specifications

The database and consequent *General Specifications for LVRs* will provide the knowledge base from which more appropriate country-specific documents can be derived.

3 Implementation

An increase in the application of LVSR technology in the upgrading of unpaved roads to sealed road standards or rehabilitation of LVSRs or new construction.

4.3 Expected Outputs

Expected outputs of Phase 1 include:

1. The inception report detailing the progress, challenges and recommendations associated with the delivery of Phase 1.
2. Setting up of a pool of experts in LVSRs for the project who will assist in the provision of data and information, and provide technical recommendation for the Project Team.
3. The LVSR Database – preparation of a database that is populated with data and has demonstrable functionality.
4. Preliminary assessment or partial analysis of data and a comprehensive gap analysis.
5. The final report with accepted methodology and plans for Phase 2 of the assignment.

Expected outputs of the overall project include:

1. A fully functional database available to end users and a host local in the Region. The database should be able to interface with the users and should also be user friendly.
2. Regional Guidelines and General Specifications for LVSRs prepared and accepted by stakeholders.

3. Dissemination and training carried out through workshops and target groups or entities (e.g. host of database) to ensure knowledge transfer and embedment of the outputs of the research.
4. Publication of technical paper(s) in known international journal(s) as may be necessary.

4.4 Assumptions

The anticipated successful completion of this project is based on the following assumptions:

1. Adequate historical data is obtainable and will satisfy the minimum quality necessary to be statistically viable.
2. It will be possible to design a database capable of accommodating the numerous sources anticipated and the differences in tests standards which can result in poor compatibility.

5 Inception Phase

The inception phase involved preparatory activities:

1. Mobilisation of the team.
2. Strategy and work plan.
3. Conducting a launch meeting.
4. Collection of sample data.
5. Review of available sources of the data in TRL
6. Review of possible sources of data outside TRL.
7. Setting up of the pool of experts.
8. Reviewing possible risks and mitigations.
9. Back Analysis – Database Architecture

5.1 Mobilisation of key project team members

The key project team members comprising John Rolt, Kenneth Mukura and Tom Buckland assembled on the 20th of April 2016 and met with the management of TRL to clarify and brainstorm on issues related to the delivery of the assignment. Most importantly the possible challenges which could be encountered in the execution of the project were discussed.

5.2 Strategy and work plan

The key issues are:

1. The criteria for selecting the members of the pool of experts. Access to research data, wide experience and skills in data analysis are prime requirements.
2. Targeting of potential sources which are reliable for supplying good data for the project.
3. The handling and processing of the data.
4. The nature of the database and software which is reliable.
5. The procedures and step by step process in executing the project including the collection of sample data.

5.3 Launch meeting

A launch meeting for the project was carried out on the 21st of April 2016 at OTB Offices in London and this involved the project team, TRL management and the ReCAP Programme Management Unit (PMU). A presentation of the details and intended methodology for the project was made which generated discussions and clarifications on some of the issues by the PMU. It was agreed that the PMU and the project team shall work together to ensure the success of the project. Key among the urgent requirements was to constitute the pool of experts and in so doing to ensure that the selection of its members was carried out carefully in order to maximise its impact of the project.

5.4 Selection of sample data

In order to test the level of difficulty in collecting and assessing published data a sample from a previous 'back-analysis' project was selected. Documents were collected from the Department of Roads (DoR) in Zimbabwe containing data on the study carried out by TRL and SWEROAD (Swedish Consultant) and which was archived in the Research Section of the T^2 Library. Eleven hard copy reports were collected, some containing raw data. The data were previously stored on floppy disc and are no longer available in electronic format. Making use of data that is not available electronically will be difficult but, with good data, it may be possible and worthwhile to explore methods of extracting it for the database.

Judging the quality and range of data in research and other reports, assessing the task of codifying it for entry into the database, and generally assigning a ranking to all the suitable reports and documents is a key task that will evolve from thorough review of more initial samples. It is vital task that is, in many ways, the key to the project and experiences, advice and ideas from the pool of experts are to be tapped as soon as possible. A matrix of road characteristics and performance variables has been drafted that will be used as a data capture form.

5.5 Review of data sources within TRL

The data held at TRL is still being reviewed through our librarians and Information Centre. A detailed search of historic project reports and data is ongoing. One of the pool of experts has already made a provisional list of projects and references for retrieval purposes, which can be found in Annex A. This is work in progress.

5.6 Review of data sources outside TRL

A few sources have already been identified. They include:

1. CSIR including previous staff of the CSIR and some of the road authorities in South Africa.
2. The study carried out by the French in Kenya in the 80's the data of which is contained in Report 435.
3. Data from West Africa and in this regard a few possible sources have been identified such as the BRRI of Nigeria and Ghana Ministry of Roads and Highways.
4. Studies carried out in Botswana on calcretes other materials.
5. Studies carried out in Malawi.
6. Other possible sources include consultants who have carried rehabilitation designs on LVSRs because such reports would have most the data required for the project including road condition at the time surveys and pavement evaluations, age, as built data, roughness etc.

5.7 Setting up of pool of experts

Most of the top experts in LVSRs in the Region have been secured and they include:

1. Phil Paige Green
2. Mike Pinard
3. Tony Greening
4. Frank Netterberg
5. Gama Sibanda
6. Dr. Adekunle Olowosulu (West Africa) – identified and yet to be confirmed.

5.8 Review of possible risks and mitigations

More detailed information is provided in Section 12 and Annex B. However, it is becoming more apparent that most of the data will be found in hard copies of reports and even if these data were in electronic format it may be impossible to retrieve because the software format in which they were recorded is obsolete and thus unreadable. The economic data may be provided in local currency and conversion will be necessary at the exchange rate of the period in which the research was undertaken to the common US dollar. Some back analysis projects were formulated for different purposes and it might be difficult to match data sets from various studies.

5.9 Back Analysis – Database Architecture

The key to developing a database for the Back Analysis project is accessibility of the data to a range of stakeholders. Without enabling a range of users (both in terms of expertise and geographic locations) to access the data, any use of the data will be severely restricted. Therefore, proper planning and design of the system at this stage will help to identify a sustainable solution going forwards.

There are a number of options for the database platform:

1. Standalone system
    a. Local database: In this case the system and the database would need to be installed on each local machine of every user.
    b. Hosted database: Here the interface would be installed locally on each machine of every user but there would be one central database hosted on a server accessible to all.
2. Web-based: In this option both the system interface and the database would be deployed on a server.

It is proposed that the system will be developed as a web-based tool that allows a user to interact with it through a web-browser. Therefore no specific software will need to be installed locally by users of the system; all they will need is an internet connection and a web-browser. One advantage of the web-based solution is that there is only one version of the database available to every user and so all users will be accessing the same data. A further advantage of the web-based solution is that any updates to the software (e.g. changes to the interface) can be rolled out in one central location, which will then be available to every user simultaneously.

While the database should be available for all to interrogate, there also needs to be restrictions on who can populate the database and who can edit it therefore several levels of authority will be required.

Figure 5.1 shows the proposed development structure for the complete system. It is proposed that the tool will be developed in Visual Basic .NET. The database platform proposed is SQL Server Express which is a freely available version of SQL Server with no licencing costs associated with it. Both the software and the database will reside on a server.

The database will store all the entered data from previous (and future) studies. In addition, it will be used to hold the export of data for external analysis in other software (e.g. export to .csv format). There will be a two-way flow of data between the middleware (objects and rules) and the database. The business layer will process any calculations within the tool. Any outputs and calculations will be fed to the user interface.

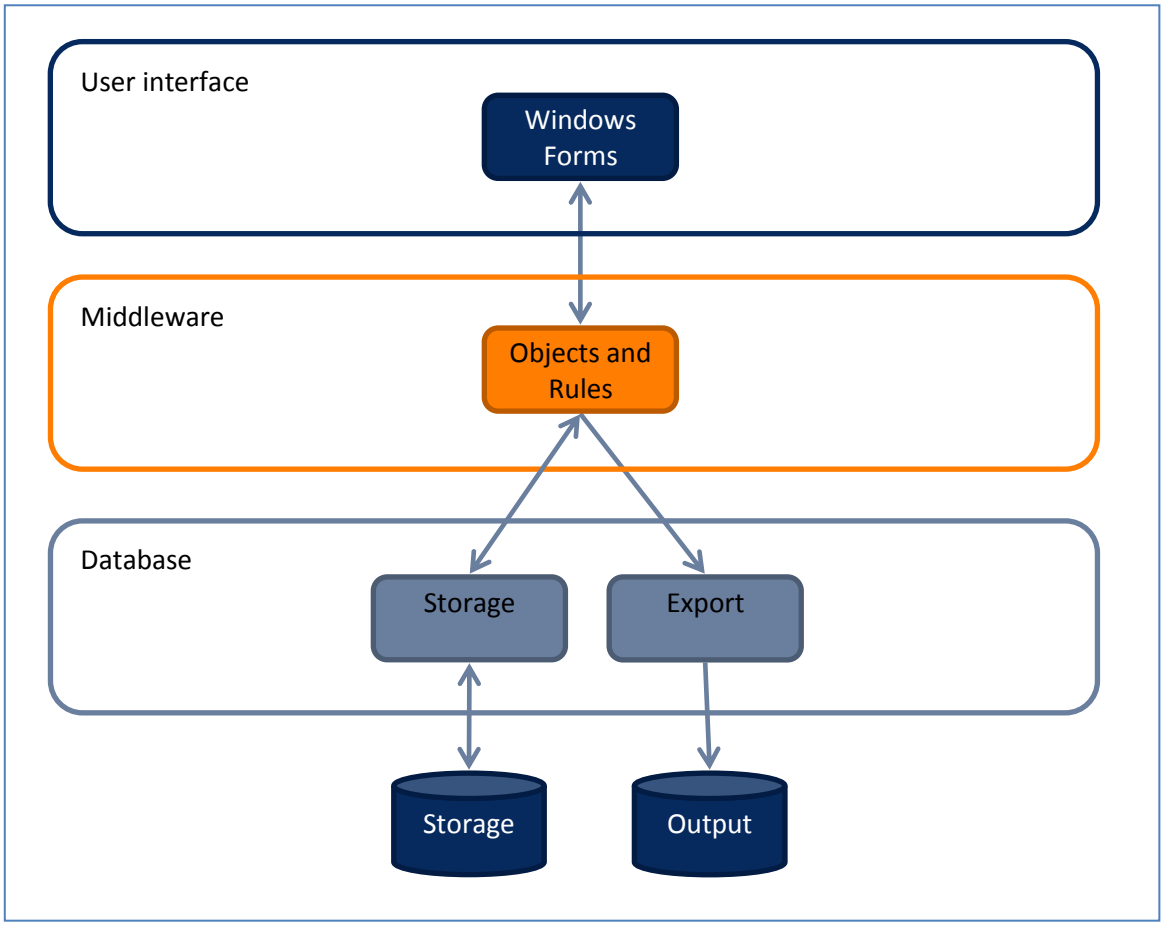


Figure 5-1 Proposed development structure

6 Comments on the ToR

There are no additional comments on the Terms of Reference since the original Technical Proposal for this project was submitted. Any general remarks about the project approach, including possible risks and mitigations, are provided in Sections 4 and 5 of this report, and also in Section 12 and Annex B.

7 Revised Work-Plan

The detailed work plan can be found in Annex C. However, it is apparent that if more of the data are found in hard copy than was originally envisaged at the time of tendering, then more effort and time may be required to classify the data and to identify data that is of sufficient quality to warrant digitising. If during the course of collecting the data it becomes apparent that a substantial amount of extra time will be required to digitise the data then this activity will end up on the critical path and may delay completion of the project. Reallocation of time inputs will be necessary in due course. This only pertains to the schedule for Phase 1.

The input schedule for the project shall remain flexible and will be adjusted regularly depending on the demands of the project. Regular reviews will be carried out in due course to ensure maximum effectiveness in the delivery of the assignment.

8 Management Approach

The success of the project hinges on the collaboration of partners. In recognition of this, TRL has selected experts for the project based on their anticipated resourcefulness in terms of providing access to research and other organisations where extensive data is likely to be available. In addition, some experts, for example Frank Netterberg, has an extensive personal library and archive which is likely to be an excellent source of data going back many decades. Some of the experts were involved in some key studies on LVSRs in the Region, Tony Greening (in Southern Africa), Mike Pinard (in Botswana and Malawi etc), Phil Paige Green (in South Africa etc).

The collection of sample data is designed to guide the preparation of the research matrix and framework for the database. Using the sample data a research matrix has been produced and is being refined. It contains all the parameters for the causatives and performance. The research matrix will then guide the selection of the data to be collected and subsequent categorisation.

The data will be collected into a central point, and data that needs to be digitised will be sent to TRL's Regional project office in Mozambique. Regular progress meetings will be held and information on any issues arising will be communicated to the PMU.

The team shall put a concerted effort in the management of anticipated risks in order to ensure adequate and timely mitigation.

9 Technical Inputs and Budget

9.1 Technical inputs

The technical inputs are given in the

Table 8-1. TRL does not envisage changing the allocation of technical inputs. However, regular reviews on the needs and demands dictated by the project will be considered as the project progress and any need for adjustments will considered as may be necessary.

Table 8-1 Technical Inputs

STAFFING	Inception (Days)	Desk Study (Days)	LVSR Database (Days)	Recommendations for Phase 2 (Days)	Stakeholder Workshop (Days)	Final Report/ Scientific Paper (Days)	Total Time Inputs (Days)
Team Leader/Research Expert (Dr. John Rolt)	12	42	21	25	10	10	**100**
LVSR Standards/Materials Expert (K. Mukura)	8	40	10	22	10	10	**120**
Data Management Specialist (Dr. Thomas Buckland)	3	10	40	10	7	10	**60**
Pool of Experts		20	15	15	10	5	**65**
Senior Researcher (Andrew Otto)	5	10			5		**20**
Support Engineer (Michael Mayanja)	3	15	20		2		**40**
Data Input Staff (to be named)			40				
Total (Days)	**31**	**137**	**146**	**72**	**44**	**35**	**405**

It is anticipated that the time allocated for data input will be adequate i.e. if the requirement for digitisation of the data does not increase significantly from what was envisaged during the inception of the project. If the additional time required for this is reasonable TRL will endeavour to absorb it through internal reallocation of resources.

9.2 Project budget

The project budget remains as originally planned, Table 8-2 and TRL does not envisage any significant changes to the original plan. However, the PMU will be duly informed should the situation change significantly. This assessment only refers to the execution of Phase 1 of the Project.

Table 8-2 Project Budget

Deliverable (Reports)	**Payment schedule**	**Amount to be Paid (£)**
Phase 1		
Inception Report	20%	58,740
Desk Study report	20%	58,740
LVSR Database and user manual	40%	117,480
Stakeholder workshop and report	Provisional Sum	10,000
Phase 1 Final Report and one (1) Scientific Paper	20%	58,740

Phase 2	
Bidders should assume a provisional sum of £455 000.	455,000
Phase 3	
Bidders should assume a provisional sum of £210 000.	210,000

10 Community Access

LVSRs are essentially for the provision of sustainable access. In this case accessibility is two pronged in two categories.

A. Full access – this aspect involves all-weather transitability and availability of efficient transport services

B. Basic access – this principle borders on the provision of all-weather passability where journey time and comfort are not considered as critical elements.

LVSRs fall under category (A) and should be designed to attract the minimum acceptable levels of transport services which will include commercial and public transport. Not everyone can afford a car. This will in turn reduce transport costs as a result of lower vehicle operating costs and increased supply and also prevent damage to agricultural produce in transit to the markets which may lead to loss of quality and value.

This project helps to promote the upgrading of unpaved LVRs to LVSRs and this will lead to improved access mostly from category B to category A.

11 Monitoring and Evaluation Plan

Regular report back meetings with the client will be conducted where evaluation of the reporting period and plans for the next reporting periods will be discussed.

In order to optimise the pool of experts, TRL has prepared Terms of Reference for each expert that will stipulate their roles and responsibilities on the project. The experts will also assist in providing recommendations for the standardisation of the data over and above their key roles of identifying and collating data.

TRL will utilise its relationship with other research partners, national governments in the Region and road authorities. This has already paid off as all of the experts which had been shortlisted responded positively to the invitation to participate in the project. Where difficulties are anticipated, TRL will seek the assistance of the ReCAP PMU, as agreed at the launch meeting.

The project team will liaise with national governments, road authorities and Research Centres where they exist, in order to make it easy to acquire relevant data and also to encourage them to participate in Phase 2 of the Project.

Dr Annabel Bradbury is the designated Project Manager who will oversee the project and will manage by exception. She will liaise with the Team Leader and the rest of the project team to ensure prompt delivery and client satisfaction.

12 Risks

Anticipated Risk	Impact of the Risk	Proposed Control
There is a risk that some of the data collected many years ago may not be accurate. ***Update*:** this risk still stands and can only be allayed when all the data has been collected and processed.	The database should not be populated with inaccurate data otherwise the outputs and including the results and conclusions may be affected significantly.	TRL will mitigate this by exploiting the vast experience which the team has in research. Establishing the range, quality and reliability of the data are key aspects of the project and the experiences of the expert team are vital to achieve this.
Lack of adequate data to populate the database or the data may be available but not electronic ***Update:*** this risk still stands but after collecting the sample data from Zimbabwe which is very comprehensive it is likely that there will be other sources with similar volumes of data.	The impact of this risk will be relatively small because TRL is already custodian to large volume of data on LVSRs. It is important to have the geographical technical distribution of the data for the outputs to be authentic	TRL is aware that a lot of data may not be electronic and a contingency plan has been put in place for such data entry for data that is assessed as being of high enough quality. The database will be compatible with Excel so that data can be imported directly from Excel to the database were necessary. TRL will coordinate with its pool of collaborating research organisations and the pool of experts to access the data. TRL has selected some of the pool of experts in relation to the potential sources of data to counter this risk.
Delay in the delivery of the data may be a significant risk. The data that will be collected from other organisations and entities will mostly involve 3rd parties and there is the risk that there could be delays or lack of co-operation. ***Update:*** The risk still stands but this is now a low level risk due to the fact that TRL has secured the six key experts	The impact may be significant in that there might be significant delays especially if the organisations are not closely related to TRL or if they feel that they can't spend too much time without getting paid for it.	The pool of experts has been chosen carefully with this risk in mind and to cover critical data sources such as CSIR (Eng. Benoit). As such, the provisional sums can be utilised for this if it becomes absolutely necessary. This first option would be to get the co-operation of the organisation and use this contingency as the last resort.
The data may not be in compatible formats. ***Update***: the risk still stands but may now be low level due to the fact that for most of the	This is an important factor and could significantly affect the database in that the data would not be comparable and cannot be grouped together in the database. This will affect the	TRL is fully aware of this challenge and will embark on a standardisation methodology for the data capture, data formats, and international standards for materials and

parameters the difference in the results of tests carried out using different methods is low to insignificant.	functionality of the database.	field test so that the data may be compatible.
The analysis of data from different source may be complicated. ***Update:*** this risk is still to be verified as more data is collected.	The outputs of this project are dependent on the successful analysis of the data. Populating the database with data alone is not useful to anyone but information which can be obtained as a result of a successful analysis process is what is useful to the practitioners. So the impact of inappropriate analysis may be significant	TRL has excellent backup in this regard with a whole statistical department which TRL can tap when the need arises. This provides TRL with the capacity to handle complex analyses where necessary and this is complimentary to the technical team which TRL has assigned for this project.
The key output of this project is a database and that database should be versatile and user friendly and handle both statistical and engineering aspects of performance data on LVSRs. Also in populating the database any necessary manipulation may be time consuming and complex. Training will be mostly practical and there is need for a lot of support to accomplish this. ***Update:*** ReCAP reiterated that support will be provided within reason.	This may have an impact on its future adaptation as a tool for the storage and analysis of data on LVSRs. If there is too much involved then leaving to one person may leave slippage in time. Having one expert to train on the database may not be adequate and effective enough.	TRL has a put in place a contingency plan by incorporating Eng. Mike Mayanja who is also an expert in databases. So TRL effectively have two experts in the team and this should enhance the quality of the database. Eng. Michael Mayanja will also be available to help with the training process.
Preparation for Phase 2		
The gap analysis might result in much more work being required in phase 2 in terms of the number of sites which should be investigated.	This is not anticipated but if it should occur then it might have a significant impact on the project. The volume of data has a significant impact on the quality of research outputs.	TRL has put in place contingency measures which include the formulation of a research matrix which will help in the prioritisation of the parameters for the analysis and also maintaining some of them as constants in order to minimise their effect in the analysis process. This will greatly minimise the effect risk and impacts. However, should TRL realise that some gaps cannot be closed without increasing the number of sites

		then the client shall be notified in good time so that a resolution can be reached.
Selection of Countries and candidate roads and test sites will dependent both on the level of collaboration that is offered in the countries and the potential usefulness of the sites in fulfilling the requirements of the research matrix	This may impact on the number of candidate roads and the sites which can be selected. The failure to secure certain technically important countries may impact on the data which will be collected under Phase 2.	TRL is well respected and regarded in the Regions no problems are anticipated in securing co-operation in this regard. However, TRL will carry out an awareness campaign on the benefits of participating and involve such organisation from the outset to ensure buy-in, ownership and collaboration.
Quality of testing in the field and laboratory may result in poor results.	This would impact the project significantly as poor results may lead to poor outcomes.	TRL has already carried out similar projects and has mitigated successfully in the past. TRL will standardise the testing and investigations by preparing a guideline for the field and laboratory testing. This will be accompanied by a short video which will show how the field investigations should be carried out.
Lack of equipment and other facilities in the candidate countries	This may have a significant impact on the project especially during phase 2 where the bulk of field and laboratory testing is expected.	TRL will have a preliminary selection of candidate countries well before the start of Phase 2 of the project. This will allow amble time for TRL to review the capabilities of each country to carry out the work. TRL will liaise with the clients so that a contingency plan can be put in place within the countries and where ReCAP can support the Research Centres/Departments. Also, TRL will secure authorisation well in time to be able to temporarily import some specialised equipment at minimal or no cost.

Annex A: Sample of TRL Data Sources

Information for back-analysis project (Source: Tony Greening)						
Project	**Project/Subject area**	**Date**	**Publications**	**Authors**	**Report**	**Notes**
No					**Available**	
1	Performance of calcrete gravel and paved roads in Botswana	1980-90	The development of specifications for the use of calcretes on lightly trafficked roads in Botswana	Lionjanga, Toole and Greening, Transport Research Record 1106 Vol 1 1984	TRL Library	
			The use of calcretes in paved roads in Botswana.	Lionjanga Toole and Greening. Soil Mechanics and foundation Engineering Conference for Africa, Lagos 1987	TRL Library	
			Laterites in Road Pavements	J H Charman. Construction Industry Research and Information Association (CIRIA/ TRRL) 1988	Yes	Contains useful data
			Evaluation of weak aggregates for surface dressing low-volume roads	Woodbridge Newill and Greening Tranportation Research Record 1291 Vol 2. 1991	Yes	
			Calcrete in road bases in the Kalahari region of southern Africa	Greening and Rolt PR/ORC/081/96, Transport Research laboratory	Yes	Lab and performance data
2	Sweroad Secondary and Feeder Roads project in Zimbabwe	1990 – 96	The design and early performance of the paved roads in the Secondary and Feeder Roads programme Zimbabwe	O'Connell Gourley and Greening PR/ORC/552/95. Transport Research Laboratory	TRL Library	
			Material properties and design of gravel roads in the secondary and feeder roads programme Zimbabwe	Gourley and Greening PR/ORC/552/95. Transport Research Laboratory. 1995	TRL Library	
3	Collaborative research programme on highway engineering materials in the SADC region	1994 – 2000	Use of sub-standard lateritic gravels as road base materials in southern Africa	Gourley and Greening. International Symposium on Thin Pavements. Surface Treatments and Unbound roads. University of New Brunswick, Canada. 1997	TRL Library	
			Establishment of information systems for managing road construction material resources in southern Africa	Gourley and Greening TRL Project Report PR/OSC/170/99 Transport Research Laboratory. 1999.	TRL Library	
			Performance of chemically stabilised road bases. Results and recommendations from studies in	Greening and Gourley. TRL Project Report PR/OSC/168/99. Transport Research laboratory. 1999	Yes	Data in appendices

			Southern Africa. Environmental damage from extraction of road building materials. Results and recommendations from studies in southern Africa.	TRL Project Report PR/OSC//169/99. Transport Research Laboratory. 1999	Yes	
	Research project on natural and stabilised materials used in road bases in southern Africa	1980-90	Performance of low-volume sealed roads. Results and recommendations from studies in southern Africa. Environmentally Optimised design.	Greening and Gourley TRL Project Report PR/OSC/167/99 Transport Research Laboratory 1999. Gourley, Hine and Greening PR/INT/183/00 Transport Research Laboratory 2000	Yes	Data in appendices
4	Research on the increased application of labour-based technology through appropriate standards roads Ethiopia Ghana Lesotho Mozambique Uganda Zimbabwe	1998-2006	Performance of labour-based gravel roads in Lesotho Minimising the cost of basic rural access Increasing the skills of labour-based contractors through the transfer of appropriate surfacing technology. New approaches to the provision of all-weather access at relatively low levels of traffic.	Morosiuk, Mukura and Elsworth Unpublished TRL Project Report 2006 Gourley, Done, Elsworth and Greening PR/INT/184/00. Transport Research laboratory. 2000 Gourley, Tournee and Greening. First Road Transportation Technology Transfer for Africa. Arusha, May 2001. Greening. 11th Regional seminar for labour-based practitioners Mombasa Kenya October 2005.	Yes TRL Library TRL Library TRL Library	Materials and monitoring data
5	Appropriate surfacing for low-volume roads	2001-3	Manual for the construction of labour-based surfacing on low-volume roads	Project Reference R7470. 2003	TRL Library	Data
6	Development of the SADC Guideline for low -volume sealed roads	1999 – 2006	SADC Guideline: Low-volume sealed roads New approaches to the provision of low-volume roads in the SADC region of Africa. New approaches to the provision of all-weather access at relatively low levels of traffic	Various authors and contributors Southern Africa Development Community. Revised version July 2006. Greening, Pinard, Gourley and Overby. Seminar on sustainable access and local resource solutions, Siem Reap Cambodia Nov 2005 Greening.	Yes TRL Library TRL Library	Summary data

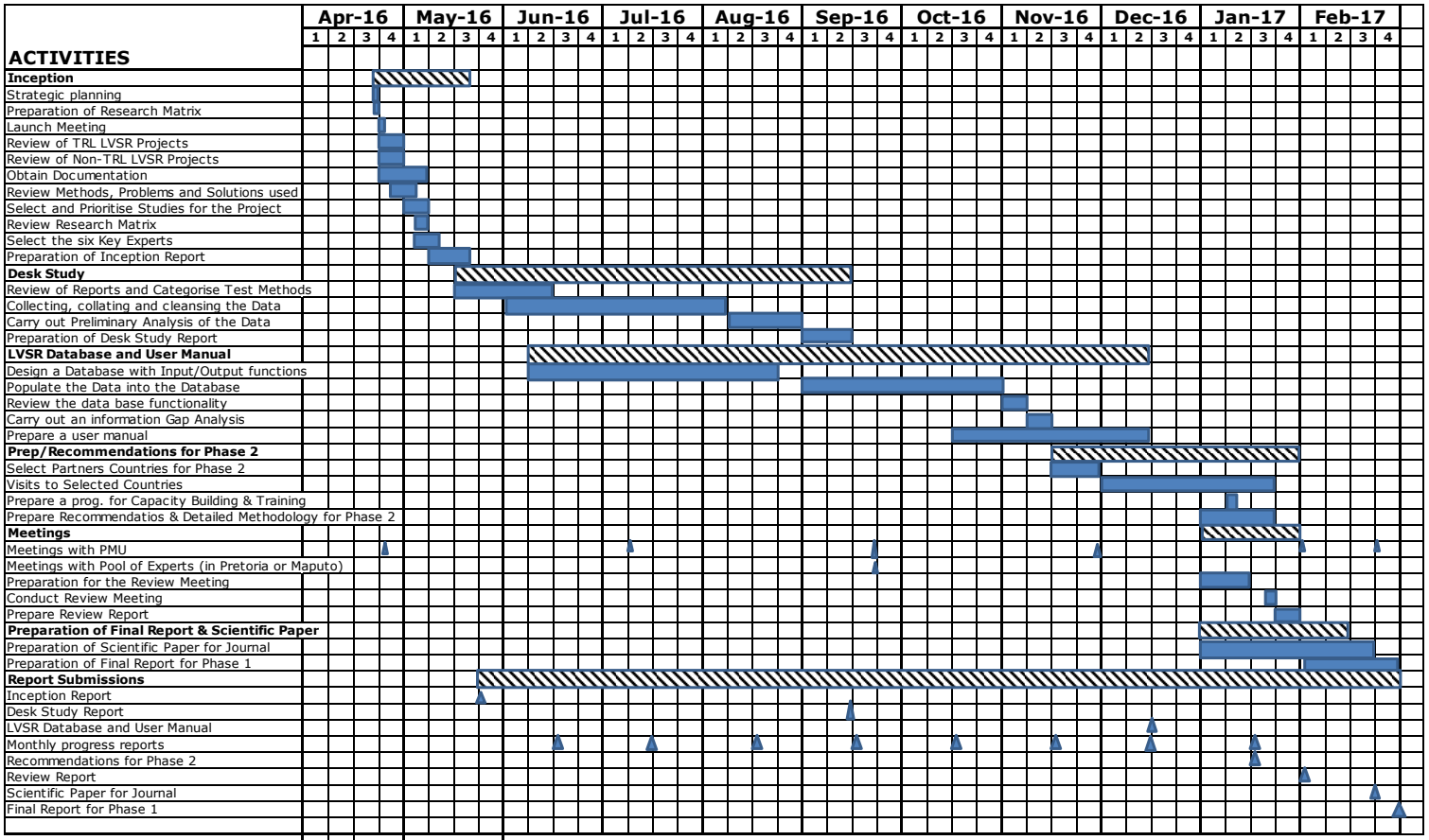
Annex B: Risk Matrix

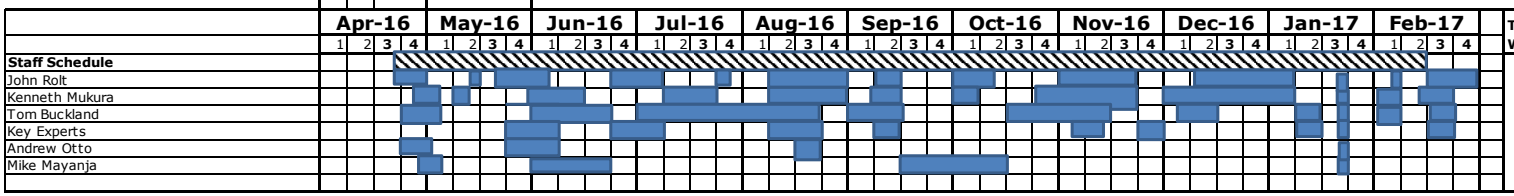
Programme Risk Assessment and Mitigation Matrix	Very High	High	Medium	Low

Potential Risk	Risk Grading[2]		Description of risk	Proposed Management and mitigation actions
	Probability	Impact		
A. Programme Management Risks				
A1:Implementation delays due to hazards / risks at country level	L	L	The risk is low because not much travelling to partner countries is necessary at this stage.	Travelling will be to 5 selected countries and high risk countries will be avoided if possible.
A2: Financial fraud	L	L	There are no third parties required to participate in the project financially during Phase 1 hence the risk of fraud is very low.	TRL runs a management system which ensured accountability and this should mitigate any fraud. Also the amounts involved in travel and subsistence or purchase of data is very little.
B. Risks associated with Research				
B1. Inadequate data is collected	M	M	This is possible but it is currently unknown until all sources have been identified and consulted.	TRL will use the pool of expert to identify the data sources and some of them are custodians of these data and were purposefully selected.
B2. Inaccurate data.	M	M	This risk is also possible because the data was collected or generated by different entities hence the risk of collecting inaccurate data is real.	TRL will collect the data in batches. The first sources would be from TRL reports and TRL would be confident of these data because of the QA system which is used on research projects. The second source would be from reputable organisations such as CSIR. TRL would also be confident with such data. This include studies in which the experts were directly involved because they would be able to shed more light on what transpired in the study and on any deficiencies which TRL need to take note.

[2] **Probability** = the likelihood of this risk occurring despite the management and mitigation activities being in place. **Impact:** = the effect on the ability of the programme to achieve its objectives without major revision or review.

Annex C: Updated Workplan





	TOTAL Weeks	TOTAL Days
Staff Schedule		
John Rolt	**20**	**100**
Kenneth Mukura	**24**	**120**
Tom Buckland	**16**	**80**
Key Experts	**13**	**65**
Andrew Otto	**4**	**20**
Mike Mayanja	**8**	**40**

Annex D: Contribution to ReCAP Log Frame

Intervention Logic	Indicator	Source of Verification	Baseline (Date)	Milestone 1 31 July 2016	Milestone 2 31 July 2017	Milestone 3 31 July 2018	End of Project Target (Date)	Assumptions
Outcome: Sustained increase in evidence base for more cost effective and reliable low volume rural road and transport services, promoted and influencing policy and practice in Africa and Asia	1. SUSTAINABILITY: Partner Government and other financiers co-funding research with ReCAP. Contributions in kind (K) and Core Contributions (C)	Information and data volunteered by the experts and collaborating governments, road authorities, RRC and other research organisations. Data from Zimbabwe T^2 Library of the Research Section of the Department of Roads, Min. of Transport and Infrastructure Development. More to be identified	Not known because it depends on when and how collaborators will respond	Not known yet	Not known yet	Not known yet	Phase 1 – 31st March 2017	

Intervention Logic	Indicator	Source of Verification	Baseline (Date)	Milestone 1 31 July 2016	Milestone 2 31 July 2017	Milestone 3 31 July 2018	End of Project Target (Date)	Assumptions
	2. Concrete examples of change (applied or formally adopted), influenced by ReCAP research that will be a llied to #km of road in focus countries.	N/A in Phase 1	N/A in Phase 1	N/A in Phase 1	N/A in Phase 1	N/A in Phase 1		
	3. Number of citations in academic articles of ReCAP peer reviewed articles and/or working papers, conference papers etc.	Scientific journals	Beyond end of project					
Output 1: RESEARCH and UPTAKE: Generation, validation and updating of evidence for effective policies and practices to achieve safe, all-season, climate-resilient, equitable and affordable LVRR and transport services in African and Asian countries. (Low Volume Rural Roads : LVRR / TS – Transport Services)	1.1 LVRR: Number of peer reviewed papers generated from ReCAP supported or related LVRR research projects made available in open access format.	Reports, database, publications in an international journal, conference papers	February 2017					
	1.2. TS: Number of peer reviewed papers generated from ReCAP supported or related LVRR research projects made available in open access format.	As above	As above					
	1.3 Engineering Research: National policies, manuals,	Guidelines and General Specifications	Determined by schedule of	Not known yet	Not known yet	Not known yet	Not known yet	

Intervention Logic	Indicator	Source of Verification	Baseline (Date)	Milestone 1 31 July 2016	Milestone 2 31 July 2017	Milestone 3 31 July 2018	End of Project Target (Date)	Assumptions
	guidelines and/or research outputs that have been fully incorporated into Government/Ministerial requirements, specifications and recommended good practice as a result of ReCAP engineering research (including climate change adaptation and AfCAP and SEACAP adaptations). To include introduction of new policies and modification to existing policies.	to be produced as part of this assignment which may be used directly. National manuals which will be updated to incorporate the new or refined specifications on LVSRs.	each country					
	1.4 TRANSPORT SERVICES Research: National policies, regulations and/or practices for rural transport services modified or introduced as a result of ReCAP research (including road safety and gender and AFCAP and SEACAP							

Intervention Logic	Indicator	Source of Verification	Baseline (Date)	Milestone 1 31 July 2016	Milestone 2 31 July 2017	Milestone 3 31 July 2018	End of Project Target (Date)	Assumptions
	research) To include introduction of new policies and modification to existing policies.							
	1.6. LVRR and TS information generated for dissemination, and disseminated, that is not peer reviewed. Total to include research papers, final research reports, workshop reports, manuals and guidelines.	Presentations and dissemination workshop papers, training material and final reports for Phases, 1, 2 and 3.	April 2016	Inception Report	Database and user manual Stakeholder workshop Desk Study Report Scientific Paper	Not known yet	Phase 1 – 31st March 2017	
Output 2: CAPACITY BUILDING: The building of sustainable capacity to carry out research on low volume rural roads, and rural transport services in African and Asian countries.	2.1. African / Asian experts or institutions taking lead roles in ReCAP Research Projects.	Pool of Expert (6), RRCs, CSIR, Zimbabwe DoR Research Section and others to be identified.						
	2.3. Research projects with female researcher inputs at senior technical level.							
Output 3: KNOWLEDGE: Generated	3.2. ReCAP generated knowledge presented and discussed at high	Presentations to be made at AFCAP and	Not known yet	Not known yet	Not known yet	Not known yet	Phase 1 – 31st March	

Intervention Logic	Indicator	Source of Verification	Baseline (Date)	Milestone 1 31 July 2016	Milestone 2 31 July 2017	Milestone 3 31 July 2018	End of Project Target (Date)	Assumptions
evidence base of LVRR and transport services knowledge is widely disseminated and easily accessible by policy makers and practitioners (including education and training institutions).	level international development debates and conferences	other international conferences					2017	
	3.3.ReCAP generated knowledge disseminated through significant workshops and dedicated training, virtually or physically, that are rated by participants as effective..	Project has scheduled dissemination workshops. These will be aided by a LVR video produced by TRL. Information posted on websites	April 2016	Not known yet	Stakeholder workshop and workshop report	Not known yet	Phase 1 – 31st March 2017	