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Climate Adaptation: Risk Management and Resilience Optimisation for Vulnerable Road Access in Africa

Inception Report for Phase 2

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Council of Scientific and Industrial Research (CSIR), Paige-Green Consulting (Pty) Ltd and St Helens Consulting Ltd

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Abstract

The African continent may be facing a potential direct liability in excess of USD 150 billion to repair and maintain existing roads damaged from temperature and precipitation changes directly related to projected climate change through this Century. This liability does not include costs associated with impacts to critically-needed new roads, nor does it include indirect socio-economic effects generated from dislocated communities and from loss of rural access.

In order to help address this significant threat to Africa's development, the Africa Community Access Partnership (AfCAP), a research programme funded by UKAid, has commissioned a two-phased project that started in April 2016 and is expected to be completed by December 2018, to produce regional guidance on the development of climate-resilient rural access in Africa through research and knowledge sharing within and between participating countries. The output will assist the development of a climate-resilient road network that reaches fully into and between rural communities.

Research will be conducted on appropriate and economic methodologies for vulnerability and risk assessments; prioritisation of adaptation interventions; and optimisation of asset resilience in the context of rural access. In addition, evidence of cost, economic and social benefit links to rural communities arising from more resilient rural access will be required to support wider policy adoption across Africa.

This Inception Report for Phase 2 outlines the general methodology and programme that will be followed with respect to demonstrations, capacity building, uptake and embedment, and provides information on progress on the Adaptation Handbook and associated guidelines; workshops held in Tanzania and Zambia; and correlation between the proposed vulnerability assessment methodology and those developed by the World Bank, the European Union and the Asian Development Bank.

Key words

Capacity Building; Climate Adaptation; Climate Change; Climate Impact; Climate Threat; Climate Variability; Demonstration; Risk; Rural Access; Resilience; Vulnerability

AFRICA COMMUNITY ACCESS PARTNERSHIP (AfCAP)

Safe and sustainable transport for rural communities

AfCAP is a research programme, funded by UK Aid, with the aim of promoting safe and sustainable transport for rural communities in Africa. The AfCAP partnership supports knowledge sharing between participating countries in order to enhance the uptake of low cost, proven solutions for rural access that maximise the use of local resources. AfCAP is brought together with the Asia Community Access Partnership (AsCAP) under the Research for Community Access Partnership (ReCAP), managed by Cardno Emerging Markets (UK) Ltd.

See www.research4cap.org

Glossary (within the context of this project)

Adaptation	Autonomous or policy-driven adjustments in practices, processes or structures to take account of changing conditions.
Adaptive Capacity	The degree to which adjustments in practices, processes and structures can moderate or offset the potential for damage or take advantage of opportunities created by a given change [in climate].
Adaptation Needs	The circumstances requiring actions to ensure safety of populations and security of assets in response to climate impacts.
Adaptation Options	The array of strategies and measures that are available and appropriate for addressing adaptation needs. They include a wide range of actions that can be characterised as structural, institutional, or social.
Capacity Building	The ability of enhancing strengths and attributes of. And resources available to, an individual community, society, or organisation to response to change.
Climate Change	Change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity.
Climate Variability	Variations in the mean state and other statistics of the climate on all spatial and temporal scales beyond those of individual weather elements. Variability may be due to natural internal processes within the climate system (internal variability) or to variations in natural or anthropogenic external forcing (external variability).
Disaster	Severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery.
Early Warning Systems	The set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities, and organisations threatened by a hazard to prepare to act promptly and appropriately to reduce the possibility of harm or loss.
Exposure	The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected.
Extreme Weather Events	An event that is rare at a particular place and time of year. Definitions of rare vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile of a probability density function estimated from observations. By definition, the characteristics of what is called extreme weather may vary from place to place in an absolute sense. When a pattern of extreme weather persists for some time, such as a season, it may be classed as an extreme climate event, especially if it yields an average or total that is itself extreme (e.g., drought or heavy rainfall over a season).
Flood	The overflowing of the normal confines of a stream or other body of water, or the accumulation of water over areas not normally submerged. Floods include river (fluvial) floods, flash floods, urban floods, pluvial floods, sewer floods, coastal floods, and glacial lake outburst floods.

Hazard	The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources. In this report, the term hazard usually refers to climate-related physical events or trends or their physical impacts.
Impacts (Consequences, Outcomes)	Effects on natural and human systems. In this report, the term *impacts* is used primarily to refer to the effects on natural and human systems of extreme weather and climate events and of climate change. Impacts generally refer to effects on lives, livelihoods, health, ecosystems, economies, societies, cultures, services, and infrastructure due to the interaction of climate changes or hazardous climate events occurring within a specific time period and the vulnerability of an exposed society or system. Impacts are also referred to as consequences and outcomes. The impacts of climate change on geophysical systems, including floods, droughts, and sea level rise, are a subset of impacts called physical impacts.
Impact Assessment	The practice of identifying and evaluating, in monetary and/or nonmonetary terms, the effects of [climate] change on natural and human systems.
Likelihood	The chance of a specific outcome occurring, where this might be estimated probabilistically.
Mitigation	The lessening of the potential adverse impacts of physical hazards (including those that are human-induced) through actions that reduce hazard, exposure, and vulnerability.
Resilience	The capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation.
Risk	The potential for consequences where something of value is at stake and where the outcome is uncertain, recognising the diversity of values. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability, exposure, and hazard. In this report, the term 'risk' is used primarily to refer to the risks of climate impacts.
Risk Assessment	The qualitative and/or quantitative scientific estimation of risks.
Risk Management	Plans, actions, or policies to reduce the likelihood and/or consequences of risks or to respond to consequences.
Stressors	Events and trends, often not climate-related, that have an important effect on the system exposed and can increase vulnerability to climate related risk.
System Sensitivity	The degree to which a system is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise).
Vulnerability	The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.
Vulnerability Assessment	Process which attempts to identify the root causes for a system's vulnerability [to climate variability and change).

Acronyms, Units and Currencies

°C	Degrees Celsius
$	United States Dollar
AfCAP	Africa Community Access Partnership
ADB	Asian Development Bank
AfDB	African Development Bank
ANE	Administração Nacional de Estradas (National Roads Administration, Mozambique)
ARTReF	African Road and Transport Research Forum
ASANRA	Association of Southern African Road Agencies
AsCAP	Asia Community Access Partnership
AU	African Union
AUC	African Union Commission
BOAD	Banque Ouest Africaine de Développement (West African Development Bank)
CEDR	European Conference of Directors of Roads
CILSS	Comité permanent Inter-Etats de Lutte contre la Sécheresse dans le Sahel (Permanent Interstate Committee for Drought Control in the Sahel)
Climate-ADAPT	European Climate Adaptation Platform
COMESA	Common Market for Eastern and Southern Africa
COP	Conference of the Parties
CSIR	Council for Scientific and Industrial Research, South Africa
DEM	Digital Elevation Model
DFID	Department for International Development, UK
DFR	Department of Feeder Roads (Ghana)
EAC	East African Community
ECOWAS	Economic Community of West African States
EDF	European Development Fund
ERA	Ethiopian Roads Agency
EU	European Union
GCM	Global Climate model
GIS	Geographic Information System
IDA	International Development Association
ISO	International Standards Organisation
JICA	Japan International Cooperation Agency
LVRR	Low Volume Rural Roads
MDG	Millennium Development Goal
MRH	Ministry of Roads and Highways (Ghana)
N/A	Not Applicable
NDF	Nordic Development Fund
NEPAD	New Partnership for Africa's Development
NPCA	NEPAD Planning and Coordination Committee
OECD	Organisation for Economic Cooperation and Development
OHSAS	Occupational Health and Safety Assessment Series
PMU	Programme Management Unit, ReCAP
QC	Quality Control
ReCAP	Research for Community Access Partnership
RIMAROCC	Risk Management for Roads in a Changing Climate
ROADADAPT	Roads for Today, Adapted for Tomorrow
SADC	Southern African Development Community
T^2	Technology Transfer
TS	Transport Services
UK	United Kingdom (of Great Britain and Northern Ireland)
UKAid	United Kingdom Aid (Department for International Development, UK)
UEMOA	Union Economique et Monetaire de l'ouest Africaine (West African Economic and Monetary Union)
UN	United Nations

UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
URRAP	Universal Rural Roads Access Programme (Ethiopia)
WEI	Water Exploitation Index
WP	Work Package

Contents

1. Executive Summary

Africa is experiencing dramatic changes to the continent's climate, which is causing widespread damage to road infrastructure and its associated assets. Rural accessibility is being compromised in a number of countries and sub-regions for increasing proportions of the year, with both direct and indirect adverse effects on livelihoods and associated socio-economic development.

The African continent may be facing a potential direct liability in excess of $150 billion to repair and maintain existing roads damaged from temperature and precipitation changes directly related to projected climate change through this Century. This liability does not include costs associated with impacts to critically-needed new roads, nor does it include indirect socio-economic effects generated from dislocated communities and from loss of rural access.

In order to help address this significant threat to Africa's development, the Africa Community Access Partnership (AfCAP), a research programme funded by UKAid, commissioned a project in April 2016 to produce regional guidance on the development of climate-resilient rural access in Africa through research and knowledge sharing within and between participating countries. Research is being conducted on appropriate and economic methodologies for risk and vulnerability assessments; prioritisation of adaptation interventions; and optimisation of asset resilience in the context of rural access. In addition, evidence of cost, economic and social benefit links to rural communities arising from more resilient rural access will be required to support wider policy adoption across Africa.

Outputs from Phase 1 address current and projected climate threats and their impact on low-volume road infrastructure; risk and vulnerability assessment methodologies; adaptation methodologies; and engineering and non-engineering adaptation options. Preliminary work was also done to establish demonstration sections in three lead countries, namely Ethiopia, Ghana and Mozambique, followed by workshops held in these countries. The purpose of these workshops was to assess these outputs as well as to identify the countries' priorities for Phase 2 of this project.

Phase 2 will mainly focus on demonstrations of appropriate practices, capacity building, and the uptake and subsequent embedment of outcomes at a range of levels, from informing national policies, through regional and district planning, down to practical guidance on adaptation delivery at rural road level. The demonstrations will largely focus on demonstrating the vulnerability assessment and climate adaptation methodologies.

During Phase 2, synergies will be sought with relevant Development Partners' programmes such as Ethiopia (World Bank), Kenya (World Bank), Mozambique (EU, NDF, World Bank) and Tanzania (DFID), focussing on programmes that are aligned with the general objectives of this project. This is considered important to prevent duplication of efforts and to harmonise approaches that could be deployed across the sub-Saharan region.

This Inception Report outlines the general methodology and approach that will be followed with respect to capacity building, and the uptake and subsequent embedment of outcomes. The Report also provides information on activities undertaken between 1 April 2017 and 15 June 2017. These include:

- Stakeholder workshop held in Dar es Salaam, Tanzania (April 2017);
- AfCAP Workshop held at the 8th Africa Transportation Technology Transfer Conference held in Livingstone, Zambia (May 2017);
- Progress on aspects of the study:
    - Demonstration sections;
    - Climate vulnerability assessment methodology;
    - Climate Adaptation Handbook and associated Guidelines.

The Project Team will work with relevant partner country Road and Transport Ministries, Departments and Agencies/Authorities in a knowledge dissemination and capacity building programme. Various tools will be used for knowledge dissemination, uptake and embedment, one of which is publication of regular *Briefing Notes* on the ReCAP website, which is aimed at building awareness, sharing knowledge and encouraging participation and feedback. Other tools include training workshops, train-the-trainer workshops, and hands-on training in the field. Assistance will also be provided to particularly the three lead countries (Ethiopia, Ghana and Mozambique) on policy matters, among others.

The immediate priority for the Project Team is to produce the Handbook and associated Guidelines which will form the basis of in-country training workshops.

2. Introduction

2.1 Brief Introduction to the Programme and Beneficiaries

The Africa Community Access Partnership (AfCAP) is a programme of applied research and knowledge dissemination funded by the UK Government though the Department for International Development (DFID). AfCAP is promoting safe and sustainable rural access in Africa through research and knowledge-sharing between participating countries and the wider community.

The proposed main beneficiaries of this Regional Project are the AfCAP Partner Countries, which currently consist of the Democratic Republic of Congo, Ethiopia, Ghana, Kenya, Liberia, Malawi, Mozambique, Sierra Leone, South Sudan, Tanzania, Uganda and Zambia. The main focus is on low-volume road network and transport services that serve rural communities.

The AfCAP Partner Countries are shown on the map below:

2.2 Delivery Organisations

The delivery organisation of the project is a Consortium consisting of the Council of Scientific and Industrial Research (CSIR), Paige-Green Consulting (Pty) Ltd and St Helens Consulting Ltd. The Consortium is led by CSIR.

2.3 Key dates

The period of implementation of the Phase 2 of the project is 19 months (84 weeks), from 15 May 2017 to 15 December 2018.

3. Project Background

Africa is experiencing more extreme climate events such as droughts, floods, storms and cyclones. The 2012 Intergovernmental Panel on Climate Change Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (Field et al, 2012) provides clear evidence that climate change has already affected the magnitude and frequency of some climate extremes. Particularly vulnerable, are countries in Africa and include: Burkina Faso, Chad, Ethiopia, Kenya, Mali, Mauritania, Mozambique, Niger, Senegal, South Sudan, Sudan, Tanzania, and Uganda.

Dramatic changes to the continent's climate is causing widespread damage to road infrastructure and its associated assets. Rural accessibility is being compromised in a number of countries and sub-regions for increasing proportions of the year, with both direct and indirect adverse effects on livelihoods and associated socio-economic development.

The African continent is facing a potential direct liability in excess of $150 billion to repair and maintain roads damaged from temperature and precipitation changes directly related to projected climate change through 2100 (Chinowsky et al, 2012). This cost is strictly to retain the current road inventory. This cost does not include costs associated with impacts to critically-needed new roads. In many African countries, limited or non-existent funds for adaptation are challenging these countries to identify the threats that are posed by climate change, to develop adaptation approaches to the projected changes, to incorporate changes into midrange and long-term development plans, and to secure funding for the proposed and necessary adaptation.

Although there are good examples of multi-sectoral African National Climate Adaptation Strategies (e.g. United Republic of Tanzania, 2012), national adaptation policies have not, hitherto, been applied widely to the road and transport sector and even less to low volume rural roads. Overarching risk assessment descriptions of methodologies exist, internationally, to address vulnerability from climate extremes (World Road Association, 2013). Although there are general principles for creating resilience in road networks, country-specific adaptation methodologies are needed for vulnerable African countries.

In order to help address this significant threat to Africa's development, the Africa Community Access Partnership (AfCAP), a two-phased research programme funded by UKAid, commissioned a project in April 2016 to produce regional guidance on the development of climate-resilient rural access in Africa through research and knowledge sharing within and between participating countries. Research is being conducted on appropriate and economic methodologies for risk and vulnerability assessments; prioritisation of adaptation interventions; and optimisation of asset resilience in the context of rural access. In addition, evidence of cost, economic and social benefit links to rural communities arising from more resilient rural access will be required to support wider policy adoption across Africa.

Outputs from Phase 1 address current and projected climate threats and their impact on low-volume road infrastructure; risk and vulnerability assessment methodologies; adaptation methodologies; and engineering and non-engineering adaptation options. Preliminary work was also done to establish demonstration sections in three lead countries, namely Ethiopia, Ghana and Mozambique, followed by workshops held in these countries. The purpose of these workshops was to assess these outputs as well as to identify the countries' priorities for Phase 2 of this project.

Phase 2 will mainly focus on demonstrations of appropriate practices, capacity building, and the uptake and subsequent embedment of outcomes at a range of levels, from informing national policies, through regional and district planning, down to practical guidance on adaptation delivery at rural road level. The demonstrations will largely focus on demonstrating the vulnerability assessment and climate adaptation methodologies.

During Phase 2, synergies will be sought with relevant Development Partners' programmes such as Ethiopia (World Bank), Kenya (World Bank), Mozambique (EU, NDF, World Bank) and Tanzania (DFID), focussing on programmes that are aligned with the general objectives of this project. This is considered important to prevent duplication of efforts and to harmonise approaches that could be deployed across the sub-Saharan region.

4. Approach and Methodology

4.1 Research Objectives

The project objective is to build enduring capacity in AfCAP Partner Countries to deal with the threats and impacts of current and future climate on vulnerable rural access in a sustainable manner, from policy to practical level, and particularly in those countries that are most vulnerable and where adaptive capacity is low.

The overall project aim is to move forward from previous AFCAP research and deliver **sustainable enhancement in the capacity of AFCAP Partner Countries** to reduce current and future climate impacts on vulnerable rural infrastructure. This is to be achieved through the research, and consequent uptake and embedment, at both policy and practical levels, of pragmatic, cost-beneficial engineering and non-engineering procedures based on the recognition of locally-specific current and future climate threats.

The overall project objectives remain as follows (quoted from the project's Terms of Reference):

- *The fundamental research objective of this project is to identify, characterise and demonstrate appropriate engineering and non-engineering adaptation procedures that may be implemented to strengthen the long-term resilience of rural access*
- *Capacity Building and Knowledge Exchange. The appointed consultants must engage meaningfully, from project inception onwards, with relevant partner-country Road and Transport Ministries, Departments and Agencies/Authorities in a knowledge dissemination and capacity building programme based on the outputs from the research. Capacity building should include a wide range of targets from central government agencies to village groups.*
- *Uptake and Embedment are integral elements of this project. The appointed consultants must ensure that there is focus on uptake and subsequent embedment of outcomes. This must be aimed at a range of levels from informing national policies, through regional and district planning, down to practical guidance on adaptation delivery at rural road level.*

The focus of Phase 1 of the Project was primarily on the establishment of an approach to climate adaptation through research and knowledge exchange. A further aim was to provide consensus for the implementation of demonstration sections in Ethiopia, Ghana and Mozambique, and to deliberate on the initial guideline documents produced at workshops held in these three countries.

Phase 2 will mainly focus on demonstrations of appropriate practices, capacity building, and the uptake and subsequent sustainable embedment of Phase 1 outputs at a range of levels, from informing national policies, through regional and district planning, down to practical guidance on adaptation delivery at rural road level. The demonstrations will largely focus on demonstrating the vulnerability assessment and climate adaptation methodologies.

4.2 Scope of Phase 2

The following five distinct parts have been adopted for Phase 2, reflecting the programme's aim and objectives:

PART A: demonstrate appropriate engineering and non-engineering adaptation procedures

Identify, characterise and demonstrate appropriate engineering and non-engineering adaptation procedures that may be implemented to strengthen the long-term resilience of rural access. Assess the socio-economic impacts of adopting more climate resilient adaptations.

PART B: sustainable enhancement in the capacity of three AFCAP partner countries

Engage meaningfully, from project inception onwards, with relevant partner-country Road and Transport Ministries, Departments and Agencies/Authorities in a knowledge dissemination and capacity building programme based on the outputs from the research. Capacity building should include a wide range of targets from central government agencies to village groups.

PART C: sustainable enhancement in the capacity of additional AFCAP partner countries

Carry out situational analysis and initiate capacity building programme in additional countries.

PART D: uptake and embedment across AFCAP partner countries

Uptake and embedment will assume the format of informing national policies, through regional and district planning, down to practical guidance on adaptation delivery at rural road level.

PART E: Phase 3 recommendations

Set out costed long-term monitoring and evaluation proposals, as well as any future actions that may be required to strengthen uptake and embedment.

4.3 Methodology and Programme

The methodology for Phase 2 presented hereunder has been based on both the original Terms of Reference for the Project "Climate Adaptation: Risk Management and Resilience Optimisation for Vulnerable Road Access in Africa" and country-specific needs identified at the Workshops held in Ethiopia, Ghana and Mozambique.

The proposed methodology addresses the five Parts listed in Section 4.2. It has been structured as follows:

- **Part A** ("Demonstrators") consists of three Work Packages, one for each of the lead countries (Mozambique, Ghana and Ethiopia), and deals with the physical implementation of demonstration sections as well as "soft" demonstrators linked to vulnerability assessments and road asset management;
- **Part B** ("Capacity Building: three countries) consists of six Work Packages, addressing targeted engagements with the three countries; the development of a Handbook on the climate adaptation of rural access roads and associated training materials; training workshops on the Handbook as well as on-site training linked to the demonstration sections. It also makes provision for the translation of key documents in Portuguese.
- **Part C** ("Capacity Building: other AfCAP Partner Countries") consists of four Work Packages starting off with a situational and needs analysis of the countries and followed up with a series of regional training events (linked to the workshops in Part B), regional stakeholder meetings, participation of the Project Team in regional seminars/conferences, and the continued development of the website and associated discussion forum as a means for wider dissemination of the project's outputs and outcomes.
- **Part D** ("Embedment and Uptake") focusses on addressing the particular needs in both the three lead countries and other AfCAP Partner Countries, with respect to policies, strategies,

plans, norms, standards, manuals and guidelines, by the provision of advice and technical assistance.

- **Part E** ("Recommendations for Phase 3") is embedded in the programme component "Inception Phase and Management".

The proposed programme, spanning a period of 19 months (84 weeks), is provided in Annex A (in A3 format). The programme in Annex A is colour coded as follows:

- Phase 2 Scope Activities
- Extra Over Items (included in budget)
- Deliverables
- Demonstrations
- Prospective funding by World Bank
- Prospective funding by EU/AfDB

The "Phase 2 scope activities" (light blue) as well as the "Demonstrations" (in yellow) are those that are considered to be in line with the original Terms of Reference for the Project. The activities shown in red are in addition to the original scope, but included in the revised scope of the project. The deliverables are shown in black. A significant number of these "reports" be incorporated in the *Quarterly Progress Reports* and *Biannual Country Reports*. Activities shown in green and orange are those that involve, and could potentially be funded by, other Development Partners in the Lead Countries.

The methodology and programme form the basis for discussions with the AfCAP Partner Countries at the Stakeholder Workshop held in April 2017 in Dar es Salaam, Tanzania. Overall, the methodology and programme were accepted as is by the AfCAP Partner Country representatives. Minor modifications to the programme will be needed as a result of a delay in original start date. These relate mainly to preparations and detailing for the demonstration sites. These modifications will be incorporated after discussions at the initial country Workshops.

In the sections that follow, an outline of the proposed activities to be undertaken in each of the Parts and associated Work Packages are presented in tabular format.

4.3.1 Inception Phase and Management

1	**Project Initiation communication** Communication with all stakeholders and with the ReCAP community on the scope and programme of Phase 2 through both direct contact and through a Briefing Note based on the Inception Report.
2	**Programme and Work Plan development** (to be initiated in April 2017): • Discussions with ReCAP on the proposed scope and methodology • Discussions with Lead Countries to further refine programmes and outputs • Discussions with additional AfCAP country representatives to refine inputs • Information sourcing from other Development Partners to refine inputs.

3	**Finalisation of programme and plan** After inputs received from all Stakeholders
4	**Inception Update Report** To map out the programme of activities, inclusive of timelines and deliverables, and to report on progress made during the Inception Phase.
5	**Progress Reports** To be submitted quarterly and to include additional deliverables identified in the work plan.
6	**Country Reports** Specific reports on progress in the lead countries, submitted biannually.
7	**Contract completion report** Final report, including recommendations for Phase 3.

4.3.2 PART A: Demonstrations

Work Package A.1: Mozambique Demonstration Programme

A.1.1	**Demonstrate appropriate engineering and non-engineering adaptation procedures** • **Gaza Province Demonstrations** – R448 from Chokwe to Macarretane was identified as the preferred candidate for the establishment of demonstration sections. The road was classified 'vulnerable' based on both the AfCAP and World Bank screening tools. However, after inspection and identification of proposed adaptation measures, the Project Team was informed that the R448 was no longer a viable proposition for the establishment of the demonstration sections. – ANE has since proposed a new section in the Gaza Province: Mohambe to Maqueze. This road was visited by the Project Team in Phase 1, and information regarding some of the problem areas is available but will require reassessment. • **Zambesi-Nampula District Programme**, linked with EU the 11th European Development Fund (EDF) Programme: – Nametil to Angoche road in Nampula Province – Initial field visit to be undertaken in June/July 2017 – AfCAP's support was requested to supplement the Terms of Reference for the design consultants.
A.1.2	**Site investigations and detailed design** Road section: Mohambe to Maqueze - the following tasks will be performed: – Revisit the road sections inspected during Phase 1, apply the AfCAP adaptation methodology and procedures for low-volume access roads, and conduct rigorous site investigations with the objective of gathering sufficient data to produce detailed designs and plans for the implementation of engineering and non-engineering adaptation options. – Support the road authority (and its appointed consulting engineering team), where appropriate), with: (a) drafting of project specifications for the demonstration sites; (b) producing bills of quantities, inclusive of an indicative

	costs, based on item costs derived from projects completed or to be initiated in close vicinity of the planned demonstrations. – A Design Report will be produced (target date to be confirmed). The activities on the Nametil to Angoche road in the Nampula Province will be limited to a site investigation (June/July 2017) and a risk and vulnerability assessment during weeks 30 to 36. The objectives of the risk and vulnerability assessment is to understand the differences between the vulnerability ranking/rating done by the World Bank and the approach used by the AfCAP Project Team, and to build capacity within ANE (training in vulnerability assessments and prioritisation). Detailed site investigations and the identification of adaptation options for this road may have to be conducted but these will require further discussion between AfCAP and the EU, also to discuss funding arrangements. The purpose of these investigations and the adaptation design would be to amplify the Terms of Reference for the consulting engineer to be appointed for the design.
A.1.3	**Construction of the demonstration sections** The following tasks will be performed on the road section between Mohambe and Maqueze: – Provision of support during construction, including: ○ Meeting with the delivery team (road authority, consulting engineer, contractor, material suppliers) to discuss aspects related to the design, construction and quality assurance of the demonstrations from the perspective of climate resilience. ○ Assist with implementation of quality control and data capturing mechanisms to set a robust baseline that will be used as a reference for future monitoring. ○ Assist with setting up a regime of quality control testing, augmented by quality assurance testing witnessed by the AfCAP Project Team. ○ Technical support to the contractor, consultant and road authority if and when required. – Production of an *As Built* Report (target date to be confirmed). Although shown on the work plan in Annex A, it is unlikely that construction on the Nametil to Angoche road in Nampula Province will be initiated before the completion of Phase 2 of this project, based on the discussions held with the EU.
A.1.4	**Monitoring and evaluation** – A specific monitoring and evaluation plan for the Mohambe-Maqueze demonstration site will be developed and implemented. – Interactions with local authorities and rural communities prior, during and after the interventions will take place to capture relevant data on the impact of the interventions on their socio-economic well-being, inclusive of changes in traffic patterns (by volume and type).
A.1.5	**Demonstration of appropriate non-engineering adaptation options** 'Soft' demonstration procedures will be developed and implemented to guide practitioners through the processes of, for instance: – Identifying vulnerable districts and road links within those, using the vulnerability assessment framework developed in Phase 1 (with the necessary customisation based on World Bank and EU screening tools), and develop local capacity to apply this methodology on a broader scale; and

	– Embedding 'climate adaptation' in road asset management systems so as to support prioritisation and decision-making based on a broader spectrum of attributes, in addition to present road conditions. This will also require road condition assessors to be trained to identify potential environment-related risks and threats within and outside the immediate road environment.

Work Package A.2: Ghana Demonstration Programme

A.2.1	**Demonstrate appropriate engineering and non-engineering adaptation procedures** • **Tamale Demonstrations:** – Identified road: Tampion to Tidjo – Concept designs for entire length of the road completed by DFR – Need for finalising discussions between MRH, DFR and AfCAP Project Team on scope and timeline – Construction can only be initiated after rainy season (from September onwards) • **Alternative Surfacings for Steep Hill Sections**, AfCAP funded project in Ghana (GHA2065B): – Need was identified at the Ghanaian Workshop for an additional demonstration section in hilly terrain. – Recommendation was made to use above AfCAP project to implement climate adaptation options for access roads located in hilly terrain. – Road Engineering Specialist of the AfCAP Climate Adaptation project team to interact with team members of the AfCAP Project on Alternative Surfacings for Steep Hill Sections.
A.2.2	**Site investigations and detailed design** Tampion to Tidjo Road (Tamale): – Concept designs for demonstrations sections completed by Project Team. – Detailed (alternative) designs for climate resilience required to support planning. – Detailed site investigation and designs for demonstration sections planned to be initiated in Week 11 with target completion date of Week 18. Tasks to be performed will be similar to those of Activity A.1.2 – A Design Report will be produced (target date: Week 18)
A.2.3	**Construction of the demonstration sections** – Tasks to be performed on the Tampion to Tidjo road will be similar to those described in Activity A.1.3. – Construction of demonstration sections is planned to be initiated in Week 25 with a completion date of Week 44. – An *As Built* Report will be produced.
A.2.4	**Monitoring and evaluation** – A specific monitoring and evaluation plan for the Tampion to Tidjo demonstration site will be developed and implemented. – Interactions with local authorities and rural communities prior, during and after the interventions will take place to capture relevant data on the impact of the interventions on their socio-economic well-being, inclusive of changes in traffic patterns (by volume and type).

A.2.5	**Demonstration of appropriate non-engineering adaptation options** 'Soft' demonstration procedures will be developed and implemented to guide practitioners through the processes of, for instance: – identifying vulnerable districts and road links within those, using the vulnerability assessment framework developed in Phase 1 (with the necessary customisation based on World Bank and EU screening tools), and develop local capacity to apply this methodology on a broader scale; and – embedding 'climate adaptation' in road asset management systems so as to support prioritisation and decision-making based on a broader spectrum of attributes, in addition to present road conditions. This will also require road condition assessors to be trained to identify potential environment-related risks and threats within and outside the immediate road environment.

Work Package A.3: Ethiopia Demonstration Programme

A.3.1	**Demonstrate appropriate engineering and non-engineering adaptation procedures** • **Tullu Bollo to Kela Road:** – Concept designs for demonstration sections have been completed – Need further discussions between ERA and AfCAP Project Team on scope and timeline (e.g. latest decision by ERA is to surface the entire length of the road) – Construction can only be initiated after the rainy season (from September) • **Retrofitting existing road network (URRAP):** – Discussions required with ERA and World Bank to identify the need for the inclusion of sample roads in the AfCAP project, and on the scope, timeline and cost if sample roads were to be included. • **Somali Region:** – Request that a vulnerable access road from this Region be included in the demonstration programme to represent desert conditions impacted by flash floods during the rainy season. – Discussions to be held between ERA and the AfCAP Project Team to identify candidate roads in this Region. – Period between Week 18 and Week 24 earmarked for site visits to candidate roads (first-level assessment of problem areas and identification of tentative adaptation measures).
A.3.2	**Site investigations and detailed design** Tullo Bollo to Kela Road: – Concept designs not yet completed for entire road link; – Detailed (alternative) designs for climate resilience required to support planning; – Detailed site investigation and designs for demonstration sections planned to be initiated in Week 13 with target completion date of Week 26. Retrofitting existing road network (URRAP): – Scope to be agreed on between ERA, World Bank and AfCAP, as well as funding arrangements (i.e. not included in current budget of the project); – Period between Week 37 and Week 44 earmarked tentatively for site investigations and the identification of adaptation options, to be followed up with detailed investigations and proposals for retrofitting, and potential implementation, during the period between Week 53 and Week 84.

	Somali Region: – No demonstration projects have been planned for the Somali region. Tasks to be performed as part of the detailed design will be similar to those of Activity A.1.2, and will include the production of a Design Report for the demonstration projects on the Tullo Bollo to Kela Road (target date: Week 26).
A.3.3	**Construction of the demonstration sections** – Tasks to be performed on the identified demonstration section (Tullu Bollo to Kela Road) will be similar to those described in Activity A.1.3. – Construction of demonstration sections on the Tullu Bollo to Kela Road planned for Week 25 to Week 44 – *As Built* Reports will be produced (target date: Week 44).
A.3.4	**Monitoring and evaluation** – A specific monitoring and evaluation plan for each demonstration site will be developed and implemented. – Interactions with local authorities and rural communities prior, during and after the interventions will take place to capture relevant data on the impact of the interventions on their socio-economic well-being, inclusive of changes in traffic patterns (by volume and type).
A.3.5	**Demonstration of appropriate non-engineering adaptation options** 'Soft' demonstration procedures will be developed and implemented to guide practitioners through the processes of, for instance: – identifying vulnerable districts and road links within those, using the vulnerability assessment framework developed in Phase 1 (with the necessary customisation based on World Bank and EU screening tools), and develop local capacity to apply this methodology on a broader scale; and – embedding 'climate adaptation' in road asset management systems so as to support prioritisation and decision-making based on a broader spectrum of attributes, in addition to present road conditions. This will also require road condition assessors to be trained to identify potential environment-related risks and threats within and outside the immediate road environment.
A.3.6	**Resilience of the Ethiopian Road Network (World Bank)** – The World Bank intends to launch a programme to create awareness on climate vulnerability of roads and integrate climate resilience in road policy. – Many of the elements proposed in this programme overlap with those of the AfCAP programme on climate adaptation (e.g. improvements to current engineering practices, capacity building and development of guidelines – note: World Bank programme caters for all roads). – There is an opportunity for cooperation between the World Bank and AfCAP in order to minimize duplication of effort. – As from 1 April 2017 Phase 2 of the AfCAP programme will work in cooperation with the World Bank to facilitate common goals in climate resilience for the Ethiopian road network.

4.3.3 PART B: Capacity Enhancement (three countries)

WP B.1	**Engagement with Key Stakeholders in the three countries** – AfCAP Partner Countries identified the need for a briefing session at key strategic level to create awareness on the climate vulnerability of their road network and especially their low-volume rural access roads. – Purpose of the briefing sessions is to: o Create awareness on the effects of climate on road infrastructure, and high level impacts thereof on not only rural accessibility, but also on the (recurring) costs of maintenance and reinstatement of access, especially after the occurrence of severe climate events; o Provide information on the scope of the AfCAP study and what it aims to achieve, especially with respect to Phase 2 and the in-country activities planned; o Secure support for the activities to be undertaken in Phase 2**.** – Interactions with the Key Stakeholders are planned between Week 11 and Week 22. Briefing Notes will be prepared and distributed to the Stakeholders prior to the meeting.
WP B.2	**Generic (Regional) Handbook on Climate Adaptation** – A practical Handbook will be developed, dealing with all aspect related to risk management and resilience optimisation for vulnerable road access at the rural road level on the basis of a logical (stepwise) approach. – This Handbook could be used as a source document for the training of public and private sector practitioners. – Scoping of the Handbook will be initiated in Week 1, with a first version ready to be used for training purposes by Week 10. – Possibility for the production of the Handbook in **modules** (to assist in updating and augmentation) will be explored. – Further improvements to the Handbook will be done between Week 22 and Week 50, based on feedback received from participants (WP B.3). Also, additional modules covering design and implementation of demonstrations will be completed by Week 30 and Week 50, respectively.
WP B.3	**Training modules and training workshops** – Training material based on the Handbook (WP B.2) will be compiled by Week 10. – Training programmes for the three lead counties will take place from Week 10 to 22 and again from Week 52 to 62. The exact dates and scope of the training workshops will be discussed and agreed with the host countries. However, the following is proposed: o The training programme from Week 10 to 22 will consist of general training aimed at practitioners from both the public and private sector. o The training programme from Week 52 to 62 will be focusing on training the trainers. o Development Partners will be invited to both series of training workshops. – Preparations for the training workshops will be initiated in Week 1.

WP B.4	**Translations of documents and materials** – As per the request of Mozambique, all essential documents, including the Handbook and training material, will be translated in Portuguese. – A provisional amount has been included in the budget for Phase 2.
WP B.5	**On-site training** – On-site training will be provided on: o Condition and vulnerability assessments, and the selection of appropriate adaptation options; and o Implementation of the adaptation measures. – The on-site training will coincide with the following activities planned for the demonstrations: o Site investigations and detailed design (Activities A.1.2, A.2.2 and A.3.2); and o Construction of the demonstration sections (Activities A.1.3, A.2.3 and A.3.3). – The training will be aimed at district managers/engineers, but other interested parties (e.g. private sector consultants) would be equally welcome to participate.
WP B.6	**Peer-reviewed journal articles and conference paper submitted** – At least four journal articles or peer-reviewed conference papers are planned for Phase 2. – Peer-reviewed conference papers will be produced for regional conferences (e.g. T^2 Conference).

4.3.4 PART C: Enhancement of capacity in additional AfCAP countries

WP C.1	**Identification of priorities by engagement with AfCAP Partner Countries** – Prioritise capacity development needs related to the subject area of this study by means of: o Capturing and analysis of information obtained at regional events (i.e. stakeholder meeting held in April 2017 and T^2 Conference held in May 2017); o Analysis of results obtained from a survey directed to main stakeholder(s) in each of the AfCAP Partner Countries. – Identify gaps and solutions to bridge these gaps (e.g. as part of the development/improvement of the Handbook and associated training material, the implementation of regional training events, or by other means identified by country stakeholders). – The needs identification process will be initiated in Week 1 (Stakeholder Meeting), with regular hold and check points along the 84-week timespan planned for Phase 2 to verify whether expectations are being met.
WP C.2	**Capacity development events** – From the perspective of capacity development, AfCAP Partner Countries' participation at events such the ones listed below should be encouraged:

	○ Stakeholder meeting held in early April 2017; ○ T^2 Conference held in May 2017 (and other conferences/seminars to be held regionally featuring the project's subject area); ○ Climate Adaptation related training workshops to be held between weeks 12 and 22 (general training workshops), and again between weeks 52 and 62 (train-the-trainer workshops) in Mozambique, Ghana and Ethiopia. – An additional Stakeholder Meeting related to the theme of this project is planned for November 2017 in Uganda, while another potential stakeholder meeting could be held around May or June 2018 (to be confirmed). – In the AfCAP project's budget allowance has been made for two representatives from each of the AfCAP Partner Countries (apart from the three workshop host countries) to attend one two-day training workshop that is planned to be held between Weeks 11 and 22, as well as a three-day train-the-trainer workshop planned to be held between Week 52 and 62 in the host country that is geographically closest to their country. *Regional seminars:* – Regional seminars/conferences that are aligned with the subject area of this project will be identified. – The organisers of these events will be contacted to explore whether part of the proceedings of the seminar/conference could be devoted to issues related to climate adaptation. – The Project Team will support the organisers and contribute to the programme (e.g. facilitation, presentations).
WP C.3	**ReCAP Website** – The Project's webpage on the ReCAP website is an important instrument for disseminating knowledge and sharing information. – The project's webpage will be updated on a regular basis with new information, which will include: ○ Handbook and associated training material ○ Project reports; ○ Briefing Notes; ○ Workshop reports, including presentations. – The Project team will also manage the discussion forum and user group, and make proposals to improve both the access to and usefulness of the discussion forum (e.g. by introducing a "frequently asked questions" posting on the discussion forum).

4.3.5 PART D: Embedment

WP D.1	**Review of policies, strategies and plans** – The objective of this Work Package is to identify those areas where the Project Team can provide optimal support and technical advice to road authorities in order to achieve the necessary uptake and subsequent embedment of climate adaptation in, for instance: ○ Policies, strategies and plans; ○ Norms and standards;

	○ Guidelines and manuals. – This comprehensive review will be undertaken for each of the lead countries (Ethiopia, Ghana and Mozambique), whereas a more general review will be undertaken for the other AfCAP Partner Countries in order to identify common threads between these countries. – The reviews will be based on the outcomes of the workshops held in Phase 1, the stakeholder meetings, desktop studies and engagement with stakeholders in each of the countries. – The outcomes of the above will be synthesised and will inform the scope and nature of technical assistance the countries will require. An action plan, supported by the necessary evidence, will be developed and submitted to ReCAP and country stakeholders for their appraisal and approval. – The above activities will be initiated in Week 1, with the aim to have the action plan approved by Week 14. This plan will be reviewed and updated biannually.
WP D.2	**Provision of advice and technical assistance** – The action plan developed in Work Package D.1 will inform the activities to be undertaken to maximise uptake and embedment in particularly the three lead countries but also in the other AfCAP Partner Countries. – The activities will span across a range of levels, from informing national policies, through regional and district planning, down to practical guidance on adaptation delivery at rural road level. – Case studies on 'best practices' will be produced and will be uploaded to the project webpage on the ReCAP website. – Although preliminary work will be done prior to Week 14 (e.g. auctioning some of the recommendations from the workshops held in January/February 2017), formal implementation of the action plan will be initiated in Week 15 and will span across the full duration of the project. – Progress on uptake and embedment will be reported in the quarterly Progress Reports as well as in the Biannual Country Reports.

4.4 Target dates

The planned start and completion dates for Work Packages and the Milestone Report (and other project output) delivery dates are shown in Tables 1 and 2, respectively.

TABLE 1: Anticipated start and end dates of Work Packages

WORK PACKAGE	START DATE	END DATE
Inception Phase	15 May 2017	15 June 2017
Management & Recommendations for Phase 3	15 May 2017	31 December 2018
PART A: DEMONSTRATIONS		
A.1: Mozambique demonstration programme • *Detailed design* • *Construction* • *Monitoring & evaluation*	15 June 2017 *1 July 2017* *To be determined* *End construction*	30 November 2018 *31 July 2017* *To be determined* *30 November 2018*

WORK PACKAGE	START DATE	END DATE
• *Demo vulnerability assessment & RAMS*	*1 July 2017*	*27 July 2018*
A.2: Ghana demonstration programme • *Detailed design* • *Construction* • *Monitoring & evaluation* • *Demo vulnerability assessment & RAMS*	15 June 2017 *10 July 2017* *30 October 2017* *5 February 2018* *1 July 2017*	30 November 2018 *18 September 2017* *19 March 2018* *30 November 2018* *27 July 2018*
A.3: Ethiopia demonstration programme • *Detailed design* • *Construction* • *Monitoring & evaluation* • *Demo vulnerability assessment & RAMS*	15 June 2017 *7 August 2017* *13 November 2017* *5 February 2018* *1 July 2017*	30 November 2018 *13 November 2017* *19 March 2018* *30 November 2018* *27 July 2018*
PART B: CAPACITY ENHANCEMENT (three countries)		
B.1: Engagement with key stakeholders in 3 countries	1 April 2017	16 October 2017
B.2: Generic handbook on climate adaptation • 1st draft • 2nd draft • Final version	1 April 2017 24 July 2017 11 December 2017	24 July 2017 11 December 2017 30 April 2018
B.3: Training modules and training workshops • 1st set of workshops • 2nd set of workshops	15 June 2017 2 April 2018	16 October 2017 27 July 2018
B.4: Translation of documents in Portuguese	24 July 2017	30 April 2018
B.5: On-site training	Linked to the Design & Construction components of Part A	
B.6: Journal articles & conference papers	1 April 2017	15 December 2018
PART C: ENHANCEMENT OF CAPACITY (OTHER COUNTRIES)		
C.1: Identification of priorities	1 April 2017	20 August 2018
C.2: Capacity development events	1 April 2017	15 December 2018
C.3: ReCAP website	1 April 2017	15 December 2018
PART D: EMBEDMENT		
D.1: Review of policies, strategies and plans	15 May 2017	20 August 2018
D.2: Provision of advice and technical assistance	21 August 2017	15 December 2018

TABLE 2: Anticipated delivery dates for Milestone Reports and other project outputs

DELIVERABLES	DUE DATE
MILESTONE REPORTS:	
Inception Report	15 June 2017
1st Quarterly Progress Report & Draft Handbook	15 August 2017
2nd Quarterly Progress Report & 1st Biannual Country Report	15 November 2017
3rd Quarterly Progress Report	15 February 2018
4th Quarterly Progress Report & 2nd Biannual Country Report	15 May 2018
5th Quarterly Progress Report	15 August 2018
3rd Biannual Country Report	15 November 2018
Completion Report, Scientific Papers & Recommendations for Phase 3	15 December 2018
OTHER PROJECT OUTPUTS:	
Design Reports for Demonstration Sections (final set)	13 November 2017
As Built Reports for Demonstration Sections (final set)	19 March 2018
Training Material for Workshops (first set)	7 August 2017
Training Workshop Summary Reports (1st series of workshops)	16 October 2017
Training Workshop Summary Reports (2nd series of workshops)	27 July 2018
Briefing Notes (for publishing on website)	Target: Quarterly

Most of the *Other Project Outputs* (e.g. Briefing Notes; workshop/training reports; Action Plans and progress on uptake and embedment; Case Studies) will either be uploaded to the Project's webpage on the ReCAP Website, or embedded in the Progress and Country Reports.

4.5 Links to RECAP Logframe.

In the Inception Phase of Phase 1, an initial assessment was made of the potential contribution of the project to the ReCAP Log Frame indicators. This assessment has been updated based on the activities and outcomes of Phase 1, and are summarized in tabular form in Annex B over the period of the project (i.e. Phases 1 and 2).

This project has good potential to contribute to ReCAP's objectives and has very relevant outputs and outcomes. It will inform a wide spectrum of regional and national authorities, policy makers, government officials, technical specialists and associated projects (cf. Output 3). It should attract and leverage additional funds and contributions from other Development Partners, Roads Boards and financial institutions, and its outputs are likely to be implemented throughout and outside Africa

(e.g. AsCAP countries). There is a probability that its subsequent uptake and implementation will make significant improvements to national climate resilience leading to improved socio-economic development. It should be noted, however, that most adaptation strategies might increase the initial construction cost of road provision over current practice.

Phase 1 review period was April 2016 to February 2017 and covers Milestone 1 (to July 2016) and part of Milestone 2 (only to end February 2017). Within the period covered by Phase 1 of the project, there were few reportable contributions, particularly as most of the work impacting on the Log Frame is planned for Phase 2. Contributions come from the results of circulation the Briefing Documents and Milestone reports, participation by African researchers/engineers in this study (inclusive of the site visits), and the workshops held in three countries.

Phase 2, given a start date of 15 May 2017 for a further 84 weeks, takes the end of the project target date to December 2018 (covering Milestone 3 and parts of Milestone 4). Several assumptions have been made for Milestones 2 and 3, but they might be speculative at this stage given the subjective nature of “capacity building, uptake and embedment” at this stage.

Climate Adaptation funding is available from various Development Partners such as DFID, the World Bank, the EU, NDF, JICA , AfDB and others. It is expected that the scope of this project will be augmented by synergies created between this project and those planned by the other Development Partners. Based on preliminary discussions held in particularly Mozambique and Ethiopia, closer collaboration between DFID, the World Bank and the EU are likely to materialise. The implication of this on this project and on the Log Frame are still to be determined.

5. Inception Phase

5.1 Introduction

Since the completion of Phase 1 of the project, two workshops on climate adaptation were held, namely: the Tanzania Stakeholder Workshop (April 2017), and an AfCAP Workshop held at the 8th Africa Transportation Technology Transfer Conference held in Zambia in May 2017. The outcomes of these workshops are presented in Section 5.2 below.

At the workshops held in the three lead countries during Phase 1, as well as at the two workshops held in Tanzania and Zambia since, it was noted that the various methods used by different organisations to map climate vulnerability regionally, nationally and locally should somehow be harmonised in order to avoid duplication and/or confusion in sub-Saharan countries as to which methodology to use and for what purpose. In order to address this issue, the Project Team assessed the methods and/or screening tools used by the World Bank, the EU, the European Conference of Directors of Roads (CEDR) and the ADB, and benchmarked the method proposed by the Project Team against these four methods. The outcomes of this preliminary assessment are presented in Section 5.3.

Finally, significant progress has been made on the drafting of a generic Handbook outlining the climate adaptation methodology, as well as on the guidelines for non-engineering adaptation measures. It is expected that a preliminary draft for the guidelines on engineering adaptation measures will become available towards mid-July, and the guidelines on vulnerability assessment methodologies by mid-July. Progress on the above is summarised in Section 5.5.

5.2 Workshops

5.2.1 Tanzanian Stakeholder Workshop

Structure of the Workshop:

Time	Topic	Presenter
Day 1 – Tuesday 4 April 2017		
09:30-10:30	Overview of AfCAP climate adaptation project	B Verhaeghe
11:00-12:30	Climate threats, vulnerability assessment and adaptation methodology	G Mans
13:30-15:30	Engineering adaptation measures	P Paige-Green
16:00-17:00	Recommended adaptations for demonstration sections	P Paige-Green
Day 2 – Wednesday 5 April 2017		
09:00-10:10	Non-engineering adaptation measures	P Paige-Green
10:10-10:30	Outcomes of workshops held in Mozambique, Ghana and Ethiopia	B Verhaeghe
11:00-12:20	Overview of Phase 2 of AfCAP climate adaptation project	B Verhaeghe
12:20-12:30	Closure	L Sampson

Climate threats & vulnerability assessment

The following issues were raised by delegates on the above topic, especially with respect to the data elements feeding into the vulnerability assessment methodology:

- Methodology appears to be complex; data availability may also be an issue;
- Who will be required to collect the data and conduct the assessment? – cross-sectorial cooperation will be required;

- If two or more people were made responsible for the assessment, will the same outcomes be achieved?
- The vulnerability model/framework needs to be "scalable" in terms of what is needed – identify the key parameters and prioritise, and make other indicators optional – build in redundancies;
- Parameter: *% of rural roads in a climate resilient condition* – "climate resilient condition" needs to be defined; can this ever be achieved for low-volume rural access roads?
- Parameter: *Average distance to the nearest town or market* – "town" may be the wrong term to use (possible alternatives: "village" or "ward").

The feedback received from the delegates will be evaluated by the Project Team and, together with a comparison between this method and those used by for instance the World Bank and the EU, will inform improvements to be made to the methodology.

Engineering adaptation measures & demonstration sections:

Following the presentation on the engineering adaptation measures and the proposed implementation of some of these options on the three demonstration sections, the following issues were raised by the delegates (in no particular order):

- The implementation of adaptation options will most likely increase the costs due to over design for the outliers, whereas construction is looking at how we can actually decrease cost – need to consider whole-life costing versus initial construction cost;
- Cost estimates for different areas will vary based on where (how far) materials need to be transported;
- Need better data on what the magnitude of extreme events will be and where (e.g. what will a once in ten-year storm look like in terms of size and area of impact);
- Increase bearing capacity through soil strengthening;
- Guidelines needed on evaluating soil particles to know how they would behave;
- Climate resilient does not mean all roads need to be sealed – proper compaction and shaping of unpaved roads might be sufficient;
- Width of the road is an important consideration as it impacts on cost – roads can be narrower, but of higher quality – must consider the width of the grader blade;
- Provision of good drainage is key;
- Regraveling roads is not sustainable;
- How is what has presented tell us something different regarding engineering than what we do not already know?
- All recommendations made are standard; what else should we include considering climate change?
- Consideration of geomorphology and the influence of that on roads given more water/saturation – this is still an unknown.

Following discussions on the *Engineering Adaptation Measures*, slightly updated versions of the tables containing potential adaptation measures for each climate variable and engineering issue included in the Climate Adaptation Options Report (Tables 13 to 19; Paige-Green et al, 2016) were distributed among seven "teams" of about eight delegates each for the addition of any issues or comments that the teams felt were missing or incorrect.

Numerous useful comments were received after allowing each team to spend about an hour deliberating the issues. Apart from the identification of various typographic mistakes and some terminology corrections, useful suggestions included:

- Perhaps to divide some of the tables into sub-sections, e.g. measures for Increased precipitation could be different in flat areas and hilly areas
- To upgrade earth to engineered earth (not only gravel)

- Increase the use of stabilisation/geotextiles
- Increase bio-engineering inputs
- The use of mechanical erosion protection measures in arid areas where vegetation is difficult to sustain
- The possible use of proprietary products
- Other drainage improvements
- Raise pavement levels
- Integrated catchment management
- Better overload enforcement
- Improved protection of wood (in bridges) against fire
- The use of vegetation as wind-breaks
- Increase workforce to speed up construction
- Improved compaction (QC improved)
- Temporary closure

It was noted that many of these are not necessarily related to climate change/adaptations, but are normal engineering practice and should be implemented as such. Many of these in fact still require significant research for their full, cost-effective and good engineering implementation.

During preparation of the Guidelines, each of the comments will be assessed and those relevant ones will be incorporated in the Guidelines.

Following the presentation of the *Demonstration Sections*, a second workshop was held. It involved the distribution of a list of the problems observed in the three target countries to the same "teams" as above, with the question being asked whether all the problems encountered by the teams in their respective countries were included in the list. The list was as follows:

- Shear failure due to excessive subgrade moisture
- Erosion of wearing course and side-drains on grades
- Slope instability
- Erosion of embankments near structures
- Collapse of structures
- Loss of surfacing on low lying roads during flooding
- Pavement failures due to raised moisture contents in sub-layers
- Erosion of high embankments and loss of surfacing during flooding
- Undermining of embankment due to flooding
- Poor road condition - unsuitable gravel
- Flooding of the road

Although there was some misunderstanding among a couple of the teams, who indicated the required adaptation measures, the following additional responses were received:

- Excessive vegetation growth affecting visibility and undermining the pavement
- Shear failures and undermining due to changes in river courses
- Subsidence (undermining) of the road
- Siltation inside culverts and in side-drains (normal maintenance problem)
- Scouring around supports and abutments
- Flooding of earth roads in black cotton soil areas

It should be noted that most of these problems are not necessarily related to climate change and/or are covered by the problems originally identified. However, additional guidance with respect to these will be included in the Guidelines.

Non-engineering adaptation measures & recommendations for Phase 2:

Following the presentations on non-engineering adaptation measures and the recommendations for Phase 2 of the AfCAP climate adaptation project, the following comments were received by the delegates:

- Rain harvesting should be considered – road infrastructure should be adapted (at water crossings, for instance) to enable rainwater to be captured and stored for use by rural communities;
- Good cooperation between different Ministries/Departments was considered key, but is often difficult to achieve in some countries;
- Each Ministry/Department/Agency should employ a climate change officer, possibly by combining this position with that of an environmental officer – should be an integrated function (not extra);
- Political will is required to prevent settlements to be established in climate vulnerable areas;
- Climate adaptation must become part of curriculums at universities;
- Climate adaptation handbook:
    - There was general agreement on the concept of a generic handbook supported by guidelines;
    - The Handbook must provide a well-defined yet practical step-by-step approach on how to undertake and implement climate adaptation;
    - Agreed that specific guidelines on design are not required;
    - Three guidelines should be prepared: (1) Vulnerability assessment; (2) Engineering adaptation measures; and (3) Non-engineering adaptation measures.

The above points will be taken cognizance of and will be integrated in the Handbook and associated Guidelines.

Feedback from the delegates:

The delegates rated the workshop on a scale from 1 (very poor) to 5 (very useful) using the standard evaluation form prepared by ReCAP Management. Overall, between 37 and 40 delegates rated the workshop "Climate resilience and adaptation", with the exception of the section on the Demonstration Section for which only 12 responses were received.

The summary of the ratings is provided below:

Question	Average score	Number of responses
How would you rate the presentation on Climate Threats, Vulnerability Assessment and Adaptation Methodology and the facilitated discussion?	4.3	40
How would you rate the presentation on Engineering Adaptation Measures and facilitated discussion?	4.4	40
How would you rate the presentation on Recommended Adaptations for Demonstration Sections?	4.6	12
How would you rate the presentations on non-engineering adaptation options?	4.3	39
How would you rate the presentation on the outcomes of workshops held in Mozambique, Ghana and Ethiopia?	4.3	39
How would you rate the summary of key points arising from the workshop?	4.3	37

The overall rating for the workshop on Climate resilience and adaptation was ***B: good and useful*** *(average score 4.3 out of 5.0)*.

Overall, the main aspects the participants learned from the Workshop and found useful were:

- Awareness climate change issues and how to address it – importance of taking climate change into account in projects;
- Climate change is a serious issue and needs to be incorporated in various aspects of design and construction;
- Climate change affects - how records show that certain regions are getting warmer while certain areas have become wetter over the years and models to project the change;
- Climate threat vulnerability and risk assessment, and adaptation with respect to low-volume roads;
- Need for greater preparedness to address climate effects;
- Consideration of climate change will change engineering decisions;
- Need to work collaboratively – need for proper coordination across government institutions (multi-disciplinary approach);
- Climate adaptation assessment of engineering and non-engineering parameters;
- Climate resilience boils down to good engineering – better engineering is required to design low-volume roads that are fit-for-purpose (divorce ourselves from high-volume road specifications);
- Importance of including/considering the effect of climate change in the design of structures such as bridges and roads in order the avoid significant loss of structures when disasters occur as a consequence of climate change;
- Importance of non-engineering adaptation options, including policies, strategies and plans;
- Need to develop in-country capacity.

5.2.2 AfCAP Workshop held at the Technology Transfer Conference

Overview:

The 8th African Transportation and Technology Transfer (T2) Conference was held in Livingstone, Zambia between the 8th and 10th May 2017. Part of the programme included various AfCAP workshops on current projects, one of which was the Climate Adaptation of Rural Road Networks, with the specific title: *Towards increased climate resilience of rural access roads in sub-Saharan Africa*.

This workshop was to be conducted by the Project Leader, Mr B Verhaeghe with a contribution by Dr P Paige-Green. Circumstances unfortunately prevented Mr Verhaeghe from attending and Dr J Cook stood in for him, presenting the background and introductory lecture. Dr Paige-Green then presented the basics of the Engineering Adaptation methodology.

The programme was modified as follows:

Presenter	Duration	Topic
Dr J Cook & Dr P Paige-Green	40 min	Introduction and overview of the AfCAP Climate Adaptation project
Dr P Paige-Green	50 min	Presentation entitled *Towards increased climate resilience of rural access roads in sub-Saharan Africa* with intermitted discussions

Synopsis of Dr Paige-Green's presentation:

The evidence and recent experience in many countries has indicated that the anticipated climate changes will have a major impact on the rural access road infrastructure. Although climate changes may have both negative and positive impacts on roads, the negative impacts are expected to dominate in many areas, particularly poorer rural areas. The rural access road networks and the communities that they serve are thus those most likely to be detrimentally affected.

The presentation discusses the important climate-related stressors and their individual impacts on the road networks. These include increased and decreased precipitation, temperatures and ground-water levels, increased windiness and more frequent extreme events. Although the application of good fundamental engineering principles in the design of rural access roads will overcome many of the potential problems, specific adaptations need to be incorporated in several design elements, including earthworks, roads and pavements and drainage structures. The types of problems and suggested cost-effective solutions are highlighted and briefly discussed in the presentation. However, an essential input during the road design and maintenance process is to identify those areas most at risk and to quantify the risk. It is thus essential that periodic assessments of the resilience of the road network are made: these are best carried out by suitably trained assessors during routine visual condition surveys of the road networks. Issues to be assessed and indicators of these are introduced in the presentation. The importance of these inputs in identifying the degree and extent of the potential problems and prioritising the adaptation needs will be briefly addressed.

Discussion:

During Dr Paige-Green's presentation, three discussion/question and answer sessions were held. These were specifically to obtain feedback and consensus on the following questions:

1. *Are there any arguments against changing the Accessibility classification to the following by adding a 6th level of serviceability for roads that have appropriate alternative routes or cater to very low populations?*

Level of Serviceability	Required standards for accessibility		
	Comfortable driving speed (km/h)	Impassability	Duration of impassability
6	N/A	> 20 days/yr	> 5 days
5	15	< 20 days/yr	Not more than 5 days
4	20	< 5 days/yr	Not more than 2 days
3	35	Never	None
2	50	Never	None
1	60	Never	None

2. Were there any areas of the visual assessment data collection requirements on the proposed field form that were not covered adequately?

Road Number:		Date:		Assessors:		Weather:	

Chainage	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9		0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	
GPS and photo No																				
Erodibility																				
Soil																				
Road surface																				
Side drains																				
Embankments																				
Slopes																				
Drainage (in reserve)																				
Road shape																				
Shoulders																				
Side slopes																				
Side drains																				
Mitre drains																				
Drainage (streams)																				
Structure																				
Embankments																				
Erosion																				
Slope Stability																				
Cut Stability																				
Fill Stability																				
Construction																				
Compaction																				
Finish																				
Erosion protection																				
Maintenance																				
Quantity																				
Quality																				

COMMENTS:

3. Are there any major infrastructure problems that were not included in the discussion (excluding detailed bridge design)?

The pertinent responses to the three questions were as follows:

Question 1: In general, all agreed that this was a satisfactory classification and the sixth Level of Serviceability could be included.

Question 2: It was suggested that terrain and land-use be included in the general information. It was generally agreed that the parameters to be assessed covered the major issues. The form has been amended to include terrain and land-use.

Question 3: No additional problems were suggested for addition to the adaptation measures document – it was considered adequately inclusive.

Feedback from the delegates:

The delegates rated the workshop on a scale from 1 (very poor) to 5 (very useful) using the standard evaluation form prepared by ReCAP Management. Overall, 26 to 27 delegates rated the Workshop. The summary of the ratings is provided below:

Question	Average score	Number of responses
How would you rate the overall usefulness of this workshop?	4.3	27
To what extent did the workshop meet your expectations?	4.0	27
Were you as a participant able to effectively contribute to the different sessions of the workshop?	2.7	26
How do you rate the workshop schedule/timetable?	3.4	27
How would you rate the introduction to the Climate Adaptation Project?	4.2	27
How would you rate the presentation Towards Increased climate resilience of rural access roads in Sub-Saharan Africa?	4.1	26
How would you rate the facilitated discussion?	3.5	27
How would you rate the summary of key points arising from the workshop?	3.5	26

The overall rating for the Workshop was ***B: good and useful*** *(average score 3.7 out of 5.0)*.

Overall, the main aspects the participants learned from the Workshop and found useful were:

- Experience (through training) is required to assess potential impacts of climate change on roads;
- Climate variability and change will impact on the cost of maintenance;
- Serviceability classification of access roads;
- Knowledge sharing of best practices;
- Proper planning is paramount – building of climate resilience should be done at the planning stage – importance of asset management;
- Political will to effect changes is key;
- Climate change is about Smart Engineering – a priori designing for climate change;
- Identify and adopt local solutions for local changes in climate;
- Use of nanotechnology in roads to save on construction time and cost (some nano-products claim to improve marginal materials at a nanoscale, making it directly suitable for road construction whilst simultaneously providing a better performance than good quality materials);
- Prevention of turbulent flow across structures (often caused by trees and termite nests).

5.3 Demonstration sections

Several challenges have been encountered with respect to the proposed demonstration sections. Sections in Mozambique, Ethiopia and Ghana that were on upgrading/improvement programmes were identified and inspected in the three countries with local staff. Adaptation techniques for each road were identified. The following stage was to do the detailed design for each adaptation.

Since then, however, several changes have occurred:

a) The Ethiopian road that was to remain unpaved will now be upgraded to paved standard. This will involve a review of some of the proposals and new recommendations and designs for certain of the measures.
b) Confirmation is still being awaited that the road selected in Ghana will go ahead as planned.
c) The selected road in Mozambique was found to be unsuitable by the World Bank (funding the project) and three other roads were proposed, those between Ndonga and Dindiza, Mohambe and Maqueze, and Chinhacanine and Nalazi. The first two roads are already on the World Bank programme, and the ANE Delegate has suggested the Mohambe - Maqueze road. This has already had some work done on it and is logistically probably the most suitable project. It was visited during the initial site visit and information regarding some of the problem areas is available.

It is anticipated that the final design of the demonstration sections should be completed by the **end of August**, but this is dependent on the existing designs and drawings from the consultants being completed and made available to the Project Team prior to being able to complete the final detailed designs.

5.4 Climate vulnerability assessment methodology

5.4.1 Introduction

In order to prevent duplication an effort was made to benchmark the AfCAP climate threat and vulnerability assessment methodology against, and to find synergies with, the methodologies and screening tools used by the relevant Development Partners' programmes such as the World Bank, Asian Development Bank and European Union.

Development aid initiatives in Africa are widespread, and a range of methods for assessing climate threat induced road vulnerability already exist. The starting point for developing the proposed climate risk screening methodology was to list and comparatively asses existing methods used by international aid organisations based on their applicability to inform road vulnerability assessments at varying scale.

Based on this investigation, the Asian Development Bank and European Union methods (which focus on outlining a study wide approach for conducting projects in the climate adaptation domain) were found to be valuable in aligning the flow and overall structure of the proposed Climate Adaptation Handbook. The World Bank tool proved to be the most appropriate for national high level overview assessments while the proposed AfCAP method remained the most suitable for District level analysis.

Both the district level and local level analysis methodologies will be refined and harmonised to align with the compendium of proposed indicators, data and assessments of existing methodologies under each of the respective risk and vulnerability assessment sections.

Lastly, the ROADAPT tool proposed by CEDR (Conference of European Directors of Roads) will be used to inform the local level assessment given its alignment to fine scale detailed road vulnerability analyses.

In the sections that follow, a summary is provided of the differences between the proposed AfCAP methodology and those developed by the World Bank, the EU, CEDR and ADB.

5.4.2 World Bank: Climate & Disaster Risk Screening Tool for Roads Project

The Climate and Disaster Risk Screening Tool was developed to support the World Bank International Development Association (IDA) as a way of considering and incorporating short- and long-term climate and disaster risks in project and national/sector planning processes into the analysis of a country's development challenges and priorities (World Bank, 2017a).

The methodological framework of the tool is comprised of a four-stage screening process (World Bank, 2017a), namely:

- **Exposure** (the exposure of the project location to climate and disaster hazards)
    - Hazards and Location
- **Potential impact** (the sensitivity of the physical components of the project to climate and disaster hazards)
    - Physical Components
- **Adaptive Capacity** (the capacity of the project stakeholders to adapt to the identified impacts)
    - Non-Physical Components
    - Developmental Context
- **Project Risk** (overall climate and disaster risk for a road project)
    - Outcome

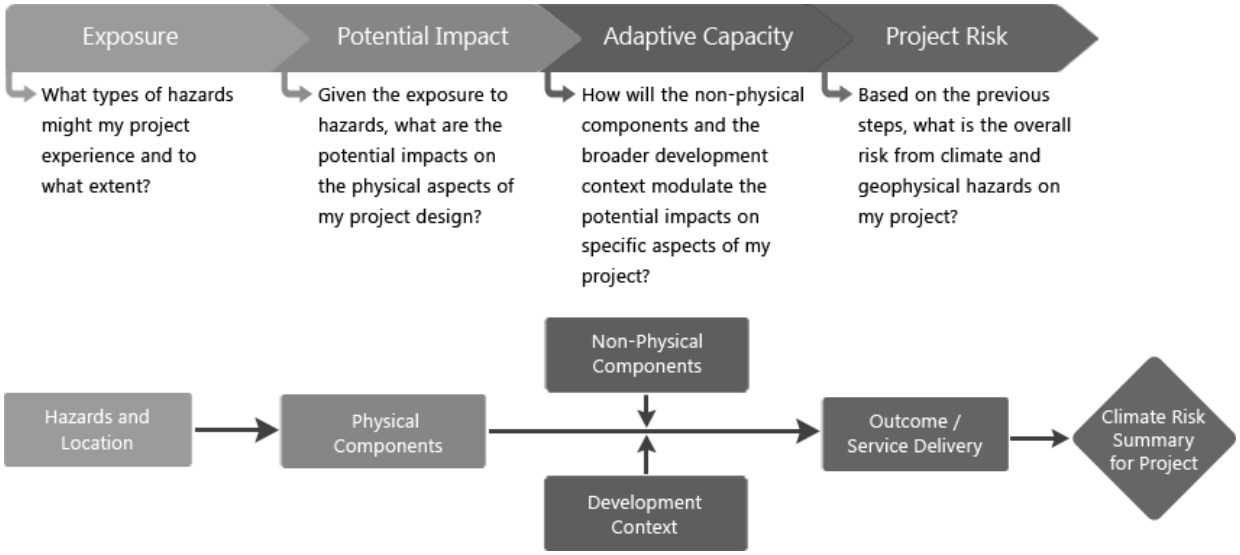


FIGURE 1: World Bank Climate and Disaster Risk Screening Tool Methodological Framework (World Bank, 2017a)

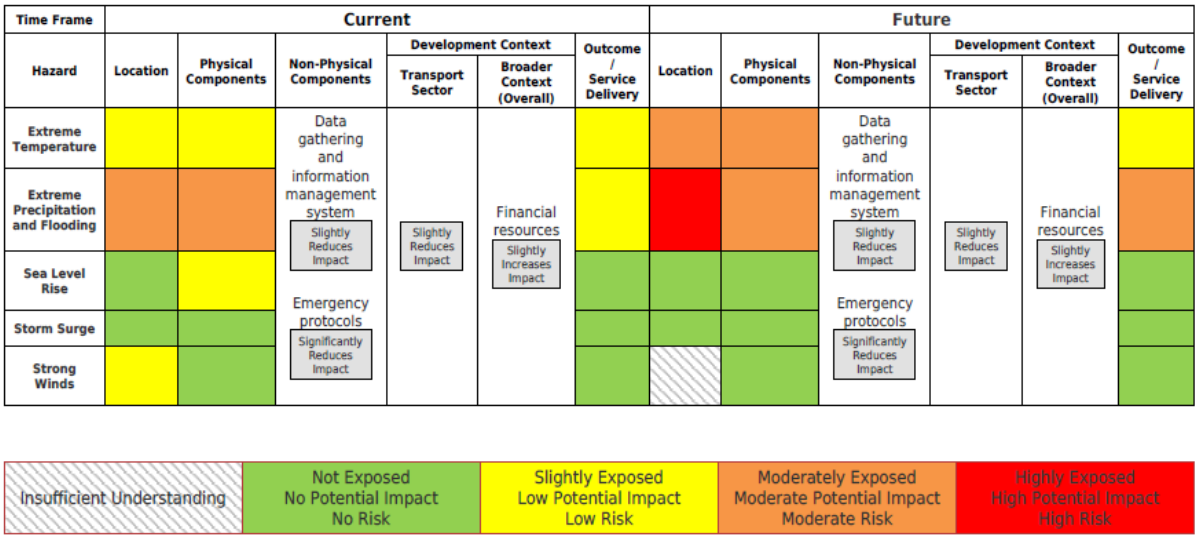


FIGURE 2: World Bank Climate and Disaster Risk Screening Tool Output (World Bank, 2017a)

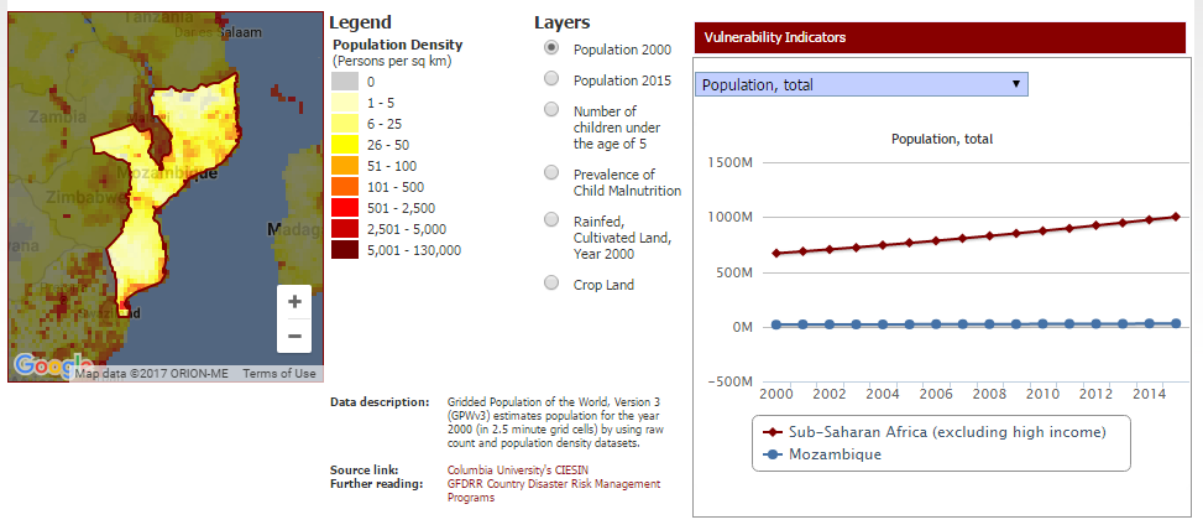


FIGURE 3: Example vulnerability map for population density from World Bank Climate and Disaster Risk Screening Tool

TABLE 3: Compendium of indicators, data and assessments relevant to the World Bank Climate and Disaster Risk Screening Tool (**bold** highlights similar indicators to our methodology)

Risk assessment components	Sub components	Assessments made
Exposure	**Hazards and Location** • Extreme Temperature • Extreme Precipitation & Flooding • Sea level Rise • Storm Surge • Strong Winds	*Current Climate:* **Average monthly temperature** **Current number of 'hot' days annually** **Number of heavy rainfall events annually** **Average monthly rainfall** **Flood prone areas** **Number of people affected annually by floods or storms** Size and location of storm surge events Intensity and location of cyclones

	• Geophysical Hazards	**Number of natural hazard occurrences per year** Location of earthquakes, tsunamis, volcanic eruptions landslides *Future Climate:* **Expected change in number of 'hot' days per year** **Expected change in number of 'hot' nights per year** **Expected change in number of 'cold' days per year** **Expected change in average monthly temperature** **Expected change in number of heavy rainfall events annually** **Expected change in average monthly rainfall** *Output:* Overall exposure rating per hazard for both the current situation and future predictions
Potential impact	Physical Components	*Considerations that inform rating:* Physical components include: • **Road infrastructure spatial data** (primary, secondary, and tertiary roads, highways, bridges, tunnels) • **Road Infrastructure attribute data** (elevation, erosion ratings, asphalt binder, wind ratings) *Output:* Overall rating for the level of potential impact from natural hazards on the physical components of the project
Adaptive Capacity	Non-Physical Components	*Considerations that inform rating:* Non-physical components include: • Policy development and implementation • Long-term strategic planning • Capacity building, training and outreach • Emergency protocols • Budgeting processes • Data gathering and information management system *Output:* Overall rating for how non-physical components might reduce or increase the risks posed by climate and geophysical hazards
	Developmental Context	*Considerations that inform rating:* **Current population density and distribution** Number of children estimated to be under 5 years old per 1000 persons Number of children under 5 years old and per 1000 persons Percent of rain fed cultivated land Estimated percent of cultivated land per pixel **Alternative means of transportation (secondary roads or other modes of transport)** Capacity and systems in place to identify and respond to disruptions from climate and geophysical hazards *Output:* Overall rating for how the broader transportation sector and social-economic factors reduce or increase the impacts due to climate and other natural hazards.

Source: World Bank, 2017a & 2017b

Comparison between our methodology and the World Bank Climate and Disaster Risk Screening Tool methods:

- Both methodology frameworks are based on a four-phase process, although the World Bank screening tool follows a linear process, whereas the proposed methodology is an iterative process.
- The World Bank screening tool is a non-detailed project risk screening tool which provides a project climate change risk rating, whereas the proposed methodological framework is a detailed risk assessment tool that can be used for regional or local level analysis.
- The World Bank tool uses an exposure–sensitivity–adaptive-capacity framework, similar to the adaption framework for the proposed methodology, although the World Bank tool does not include identifying adaptation options in its framework.
- Like our methodology, the World Bank framework considers both physical components and non-physical socio-economic components.
- The World Bank screening tool uses coarse 200 km spatial resolution global climate models or in some cases 50 km downscaled regional climate data, whereas the proposed framework uses a fine downscaled 8 km spatial resolution climate model.
- The proposed methodology identifies high risk rural access roads using information on historical and projected future climate patterns, whereas the World Bank screening tool was developed as a high level tool that is used to flag key risks in order to demonstrate the required level of effort needed for further more detailed studies.
- The World Bank tool does not geospatially quantify risk and vulnerability. Vulnerability visualisation through maps is therefore not possible.
- In the World Bank tool, impact ratings rely on the user's subject matter expertise and contextual understanding, whereas the proposed methodology relies on a scientifically informed semi-quantitative indicator-based risk assessment. The World Bank tool is thus more subjective in its analysis given that it relies on users providing a risk rating based on their own expertise and understanding.

5.4.3 EU: European Climate Adaptation Platform (Climate-ADAPT)

The European Climate Adaptation Platform (Climate-ADAPT) is a partnership initiative between the European Commission and the European Environment Agency which aims to support Europe in adapting to climate change (European Climate Adaptation Platform, n.d).

The methodological framework of the Climate-ADAPT adaptation support tool consists of six steps that together aid in analysing risks and vulnerability to the current and future climate, identifying and assessing adaptation options, developing and implementing a climate change adaptation strategy and monitoring its results. These steps are (European Climate Adaptation Platform, n.d):

- **Prepare the ground for adaptation**
- **Assess risks and vulnerability to climate change**
    - Analyse how past weather events have affected an area
    - Undertake a climate change risks and vulnerability assessment
    - Take transboundary issues into account
    - Develop an approach for addressing knowledge gaps and for dealing with uncertainties
- **Identify adaptation options**
- **Assess adaptation options**
- **Implement climate change adaptation strategy**
- **Monitor and evaluate**

FIGURE 4: European Climate Adaptation Platform (Climate-ADAPT) Methodological Framework

TABLE 4: Compendium of indicators, data and assessments relevant to Climate-ADAPT Screening Tool (**Bold** highlights similar indicators to our methodology)

Risk assessment components	Sub components	Assessments made
Assess risks and vulnerability to climate change	Climate Change	• **Change in annual mean temperature** • Decrease in number of frost days • Change in annual mean number of summer days • **Relative change in annual mean precipitation in winter months** • **Relative change in annual mean precipitation in summer months** • **Change in annual mean number of days with heavy rainfall** • Relative change in annual mean evaporation • Change in annual mean number of days with snow cover • Damages from weather and climate-related events

	Heat	• The Urban Heat Island effect
		  ○ Degree of soil sealing
		  ○ Observed surface temperature
		• Increase in the number of combined tropical nights (minimum temperature exceeding 20 °C) and hot days (maximum temperature exceeding 35 °C) under present and future climate conditions

	Flooding	• Relative change in the river discharge for flood events • Percentage of the city that would be flooded in case rivers rise one metre • **Change in annual mean number of days with extreme precipitation (> 20 mm/day)** • Mean per cent soil sealing • Potential inundation exposure for coastal cities due to projected sea level rise and storm surge events Historical flood events • **Number of flood events** • Percentage of city area flooded

Risk assessment components	Sub components	Assessments made
	Water scarcity and drought	• Probability for dry events (standard deviation less precipitation as in the baseline period) • Water stress indicator WEI for annual average on river basin level for the a) baseline, b) 2050 under 'economy comes first' scenario, and c) compared with urban population numbers
	Social sensitivity	• Proportion of aged population ≥ 65 in cities/countries • **Total population** in cities • **Change in population** between 2005 and 2050 under a status quo scenario • Human resources — age dependency index • Equity — percentage of women among elected city representatives • Education — percentage of population aged 15–64 qualified at tertiary level

	Infrastructure specific indicators	• Infrastructural capacity to adapt to climate change classified using three indicators:
		  ○ **Density of the road network**
		  ○ Number of hospital beds
		  ○ Water exploitation index

	Environmental Conditions	• Water-limited crop productivity • Forest growth • Distribution of plant species

Source: European Climate Adaptation Platform, n.d

Comparison between our methodology and Climate-ADAPT:

- The methodological framework of Climate-ADAPT is a high-level six-step process for conducting a climate adaptation project, whereas our methodology uses four steps. Both methodologies use an iterative process.
- Climate-ADAPT provides a generic climate adaptation framework that needs to be customised for a sector of interest (i.e. roads in our case).
- Our methodology was developed with the explicit purpose of analysing the vulnerability of rural roads to climate change hazards and the risks of decreased accessibility for settlements that have to rely on those roads. By comparison, the Climate-ADAPT platform provides high-level tools and information that are intended to highlight key issues to consider when planning and implementing an adaptation scheme. The platform focuses on urban adaptation for European cities, with very few guidelines for roads, especially rural roads.
- Like our methodology, the Climate-ADAPT framework considers both physical components and non-physical socio- sensitivity components.
- No information is given on the scale of data that is most appropriate, although most case studies use an EU-scale for GIS data, namely national and in some cases district-level scales for analysis. Our proposed framework uses a fine 8 km spatial resolution climate model.
- The Climate-ADAPT tool does not geospatially quantify risk and vulnerability. Vulnerability visualisation through maps is therefore not possible.

5.4.4 European Conference of Directors of Roads: ROADAPT (Roads for Today, Adapted for Tomorrow) Guidelines

The ROADAPT (Roads for Today, Adapted for Tomorrow) guidelines and tools are used within the Risk Management for Roads in a Changing Climate (RIMAROCC) risk assessment framework. The ROADAPT project was undertaken between 2013 and 2014 by several European nations and research institutes (CEDR, 2015a).

RIMAROCC produced a risk assessment framework to support decision-making regarding roads in light of climate change impacts. The ROADAPT project then developed guidelines and tools to be used with the RIMAROCC risk assessment framework in order to better inform detailed vulnerability and socioeconomic impact assessments, and the selection of adaptation strategies (CEDR, 2015a).

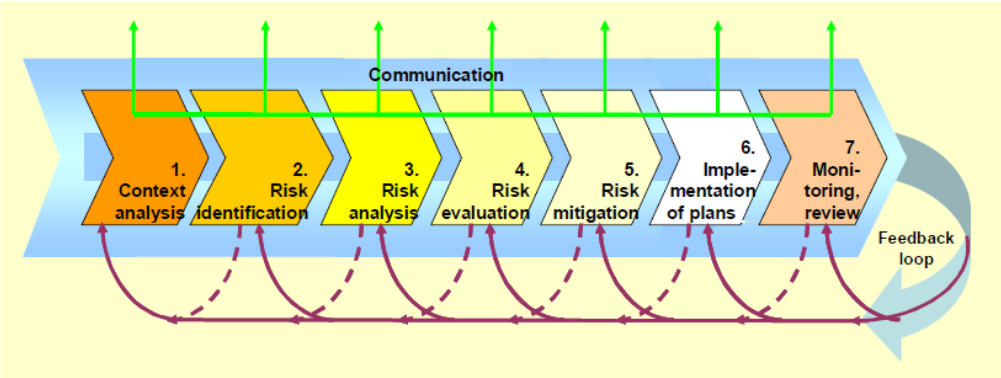


FIGURE 5: RIMAROCC Methodological Framework

The ROADAPT framework includes five parts (CEDR, 2015a):

- **Climate data for the current and future climate** (Cause)
- **Detailed vulnerability assessment** (Effect)
- **Socioeconomic impact analysis** (Consequences)
- **Risk assessment** (Evaluation)
- **Climate change adaptation techniques** (Risk mitigation)

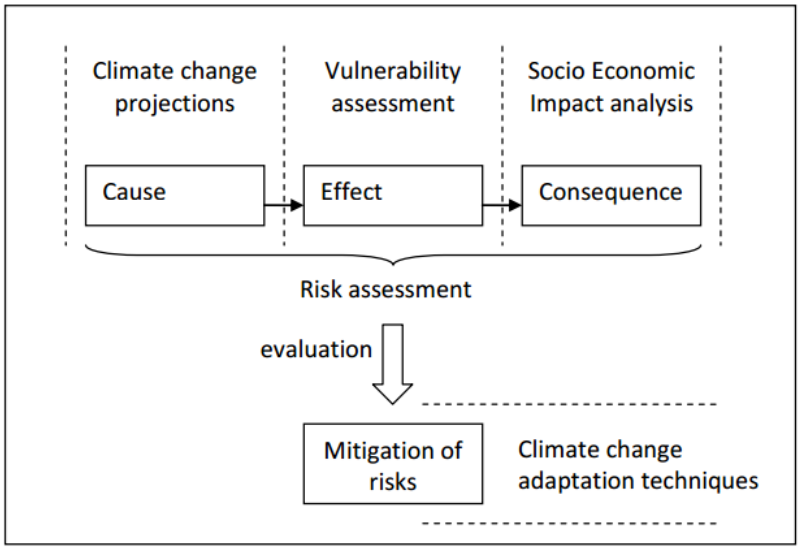


FIGURE 6: ROADAPT Methodological framework (CEDR, 2015a)

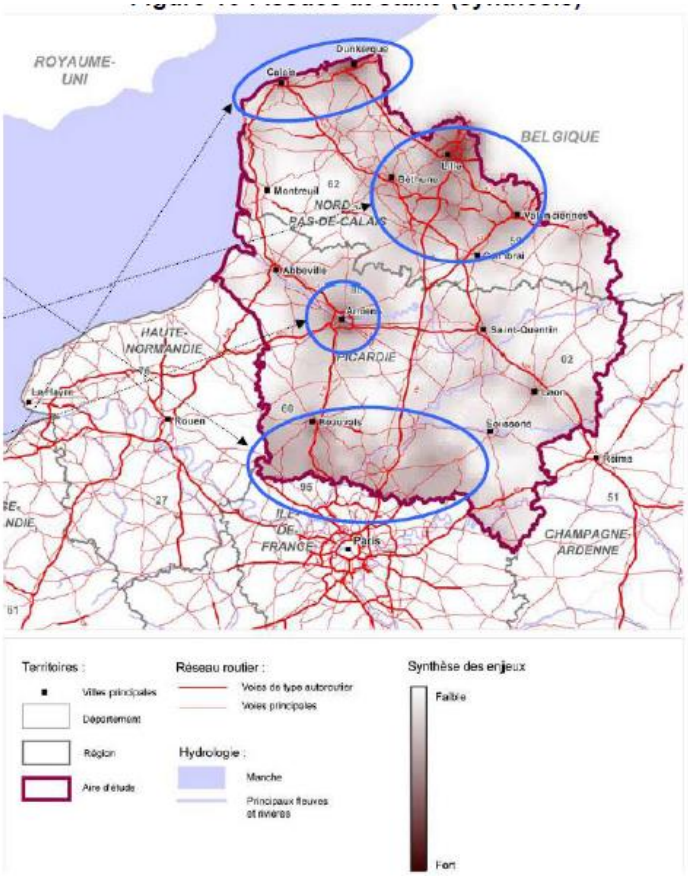


FIGURE 7: Example sensitivity map at regional level (CEDR 2015c)

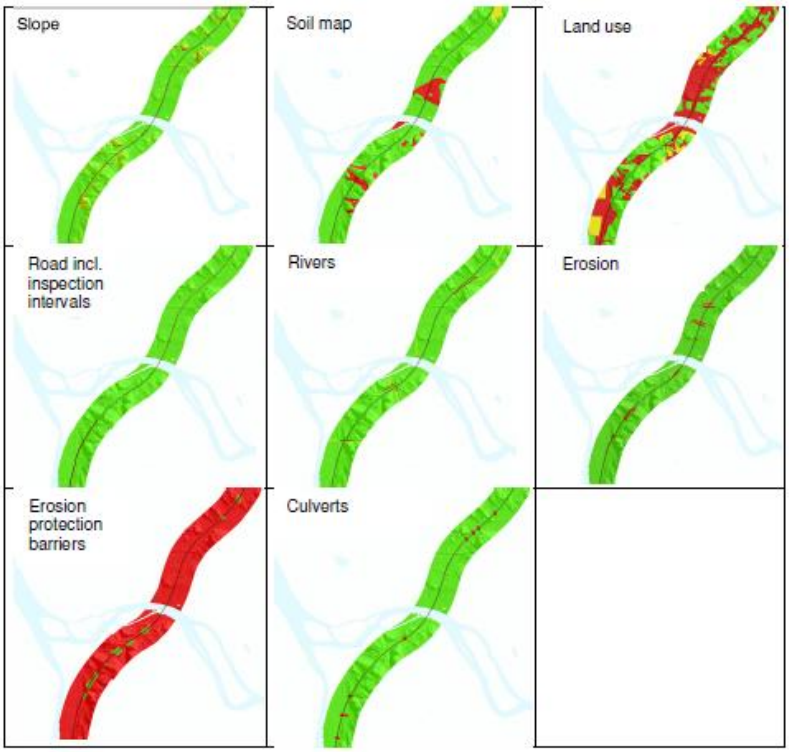


FIGURE 8: Data reclassified into vulnerability scores at project level (CEDR 2015b)

TABLE 5: Compendium of indicators, data and assessments relevant to the ROADAPT framework (**Bold** highlights similar indicators to our methodology)

Risk assessment components	Sub components	Assessments made	Output
Climate data for the current and future climate	Precipitation	**Average amount of rainfall per year** Average amount of rainfall per season Maximum rainfall intensity in heavy showers **Extreme rainfall intensity (long periods with rain)** Drought (consecutive dry days)	Projected changes compared to climate baseline
	Sea level rise	Sea level rise	
	Temperature	**Average temperature** Number of heat waves **Number of consecutive days with temperature over 30° C** Maximum temperature Number of frost days (Min temp < 0° C)	
	Wind Speed	**Maximum daily wind speeds** Wind direction	
Vulnerability assessment	Terrain and environmental Data	• **Road network** • Road width • DEM • **River network** • Underlying geology • **Slope** • Soil type • **Land use** • Vegetation • **Catchment areas** • Road maintenance data	Reclassifying input data into vulnerability factor scores and map
Socio economic impact analysis	**Population**	**Number of inhabitants (or density of inhabitants)**	Accessibility map that informs sensitivity map
	Employment	Number (or density) of employments (if possible, per categories)	
	Health	Number of health centres, and/or number of hospital beds (if available)	
	Defence	Ability to react in case of international conflict	
	Complementary transport infrastructures	**Chance of modal shift if road network is closed**	

Source: CEDR, 2015a, 2015b & 2015c

Comparison between our methodology and ROADAPT:

- Like our methodology, ROADAPT was developed with a specific focus on adapting road construction policy to climate change and an assessment of socioeconomic impacts.
- Like our methodology, the ROADAPT considers both physical components and non-physical socio- economic components.
- Both methodologies quantify risk and vulnerability in geospatial terms, which makes vulnerability visualisation through maps possible.

- ROADAPT can be used not only to identify vulnerable roads but also vulnerable sections of a road. Vulnerability is assessed per individual hazard. Our methodology considers vulnerability at the national, but it has yet to be further refined to identify specific vulnerable roads.

5.4.5 Asian Development Bank: 20 Step Guidelines for Climate Proofing Investment in the Transport Sector

The Asian development bank Guidelines for Climate Proofing Investment in the Transport Sector: Road Infrastructure Projects presents a step-by-step methodology to assist project teams to incorporate climate change adaptation measures into transport sector investment projects (ABD, 2011).

The methodological framework of the guidelines is comprised of a six stages, namely (ABD, 2011):

- **Project screening and scoping**
  - Screen the project exposure to climate change
  - Establish the adaptation objective
  - Survey existing information and knowledge
  - Identify and engage stakeholders
  - Identify methodology and data needs
  - Identify the required expertise
- **Impact assessment**
  - Construct climate change scenarios
  - Estimate future biophysical impacts
  - Assign probabilities to identified impacts
- **Vulnerability assessment**
  - Identify vulnerabilities
  - Identify biophysical drivers of vulnerabilities
  - Identify socioeconomic drivers of vulnerabilities
- **Adaptation assessment**
  - Identify all potential adaptation options
  - Conduct consultations
  - Conduct economic analysis
  - Prioritize and select adaptation option(s)
- **Implementation arrangements**
  - Establish arrangements for implementation
  - Identify needs for technical support and capacity building
- **Monitoring and evaluation**
  - Design monitoring and evaluation plan
  - Feedback into policy-making and knowledge management processes

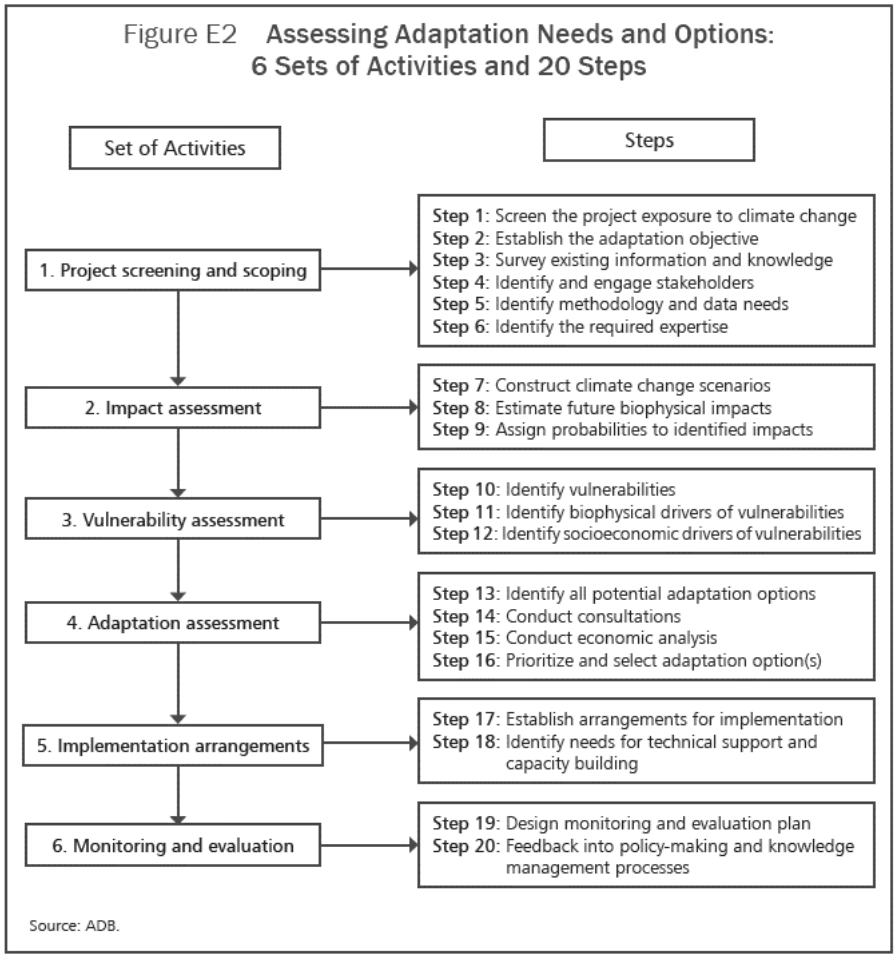


FIGURE 9: ADB guidelines (ADB, 2011)

TABLE 6: Compendium of indicators, data and assessments relevant to the ADB guidelines (**Bold** highlights similar indicators to our methodology)

Risk assessment components	Sub components	Assessments made	Output
Project screening and scoping	Screen the project exposure to climate change	• **Increases in very hot days and heat waves** • **Increases in very hot days and heat waves and decreased precipitation** • Later onset of seasonal freeze and earlier onset of seasonal thaw • Sea level rise and storm surges • **Increase in intense precipitation events** • Increases in drought conditions for some regions • Increase of storm intensity • **Increase in wind speed**	Risk posed to a planned project as a result of climate change and natural hazards
Impact assessment	Probabilities to Identified Impacts	• Probability of projected rainfall change • Probability of projected temperature change	**Future climate hazard maps**

Risk assessment components	Sub components	Assessments made	Output
Vulnerability assessment	Identify biophysical drivers of vulnerabilities	Land use **Land cover** Topography **Slope** Vegetation DEM **Road links** **Rivers**	Map areas that are particularly vulnerable due to biophysical and socioeconomic sensitive and climate variability
	Identify socioeconomic drivers of vulnerabilities	**Population distribution** **Projected population scenarios** Human development idiocies **Population density** Economic diversification Dependence of agriculture for livelihood Education levels Literacy rates	

Source: ABD, 2011

Comparison between our methodology and the ADB guidelines:

- The ADB guidelines follow a linear process, whereas the proposed methodology is an iterative process.
- Though the transport sector includes roads, waterways, rails, and airborne transport, both methodologies focuses solely on road infrastructure.
- Both methodologies consider the spatial resolution of the projected climate change data. However, the ADB guidelines only go as far as to recommend downscaling the coarse resolution of GCMs, but do not specify the most appropriate downscaled resolution, whereas the proposed framework uses a fine downscaled 8 km spatial resolution climate model.
- Like our methodology, the ADB guidelines considers both physical components and non-physical socio- economic components.
- The ADB guidelines map areas that are particularly vulnerable due to biophysical and socioeconomic sensitive and climate variability. Thus both methodologies quantify risk and vulnerability in geospatial terms.

5.5 Climate Adaptation Handbook

The Handbook is being produced as a result of feedback requests from the attendees of the Lead Country workshops and from Development Partners, who require a robust methodology to create more resilient infrastructure investments. It will provide a step-by-step route map for climate adaptation procedures for rural road access, along with instructions on an appropriate methodology to address climate threats and asset vulnerability in order to increase resilience for the foreseeable future.

Phase 2 proposal: Generic (Regional) Handbook on Climate Adaptation

- A dedicated Handbook will be developed dealing with all aspect related to “risk management and resilience optimisation for vulnerable road access”.
- This Handbook could be used as a source document for the training of public and private sector practitioners.

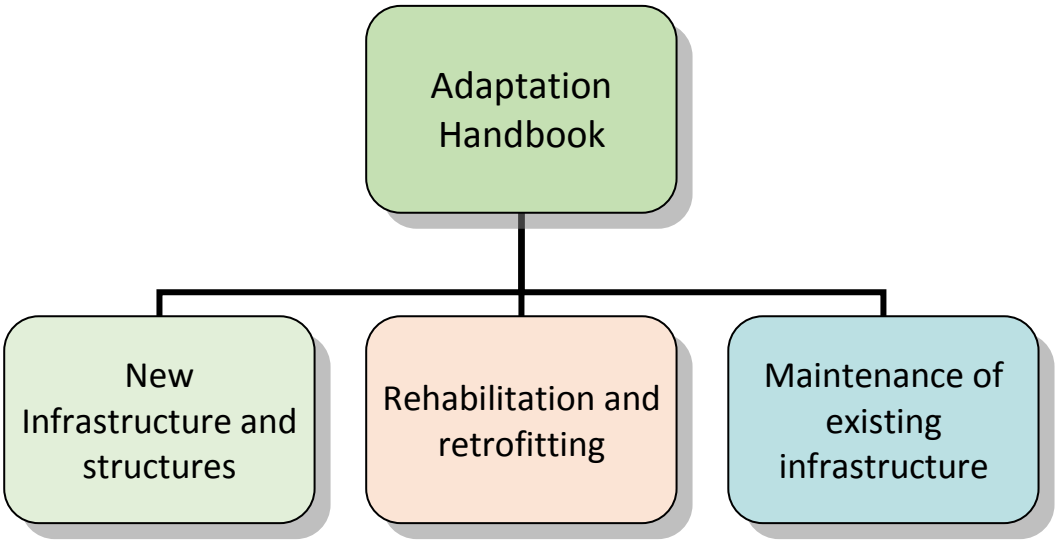
- Scoping of the Handbook will be initiated in Week 1, with a first version ready to be used for training purposes by Week 10.
- Possibility for the production of the Handbook in **modules** (to assist in updating and augmentation) will be explored.
- Further improvements to the Handbook will be done between Week 22 and Week 50, based on feedback received from participants (WP B.3). Also, additional modules covering design and implementation of demonstrations will be completed by Week 30 and Week 50, respectively.

A draft will be produced in time for the first set of training workshops and will be used as the methodology to illustrate adaptation procedures for the demonstrations in the three lead countries.

The handbook is intended to cover a wide range of climatic, geomorphologic and hydrological circumstances, based on application to Mozambique, Ghana and Ethiopia, but equally applicable to any sub-Saharan country. Although produced for *low volume roads,* the principles will also apply to *high volume roads,* although there will be differing priorities and design parameters.

The contents related to Engineering adaptations will include the fundamental principles related to assessing the needs for both new and existing roads and identification of the potential adaptation measures required.

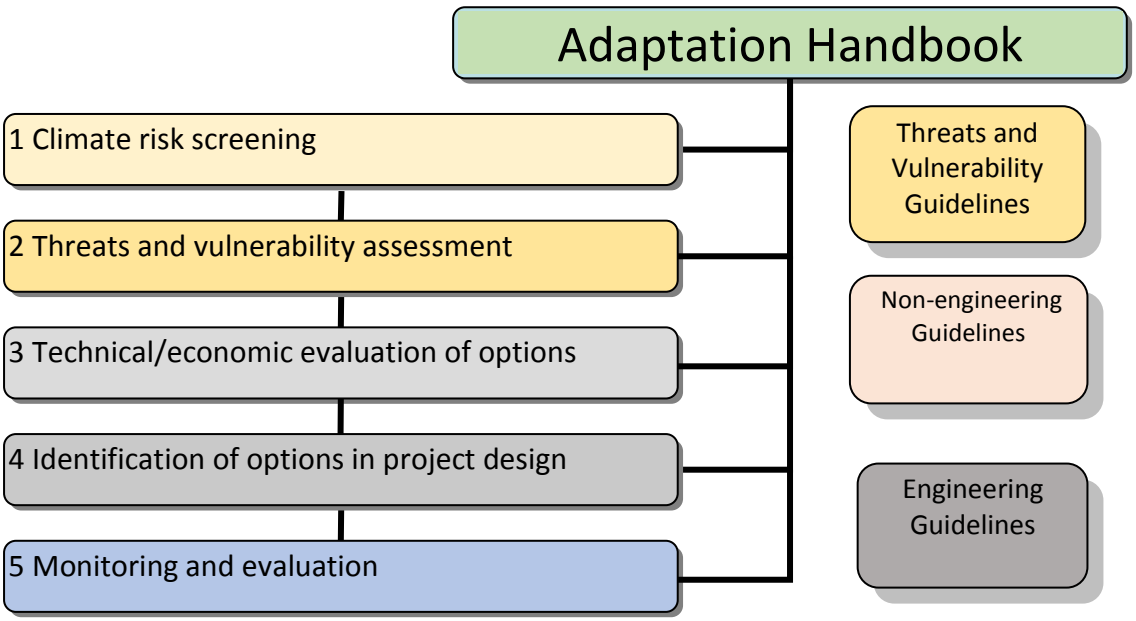
There are three specific but overlapping applications of the Handbook:



For the three applications:

- Accessibility objectives are the same but the design and construction processes may be different
- Principles of adaptation methodology remain the same
- Existing infrastructure will have more experience and understanding of climatic and hydrological effects
- Of the three countries studied, maintenance backlog failures of existing roads were the most problematic and highest priority
- Rehabilitation and retrofitting of vulnerable assets is the costliest.

It is proposed to structure the handbook into five sets of activities in order to cover the full project cycle, as follows.



The first two chapters will cover *risk, threats and vulnerability*. Chapter 3 will evaluate options in order that project design solutions can be identified in Chapter 4. Design will not be covered *per se* but important aspects will be identified, as will important aspects of construction and supervision. Finally, the Handbook will address monitoring and evaluation recommendations so that important feedback can be produced on performance. The Handbook will be backed up by and fully cross-referenced to three separate complimentary documents covering *Threats and Vulnerability, Non-Engineering* and *Engineering* Guidelines. The Guidelines will provide detailed adaptation methodologies and recommendations, illustrated by examples and case studies.

The following is the proposed outline of the Draft Handbook, which is divided into two parts: an Introduction to the Handbook; and the Methodology. Experience from the training workshops will be used to improve the document before finalisation. Consideration will also be given to how to build in experience from the Demonstrations before finalisation of the document.

PART A: COMPONENTS OF HANDBOOK

1 Introduction to Climate Adaptation Methodology

1.1 Scope

1.2 Policy and Strategy

2 Application of Handbook

3 Scope of Handbook

PART B: ADAPTATION METHODOLOGY IMPLEMENTATION

1. Climate Risk Screening

1.1 Screen rural accessibility and observed impacts by climatic factors

1.2 Identify adaptation objectives and assessment scope

1.3 Collect and analyse data and information

1.4 Determine classifications and methods of assessment

1.5 Identify and mobilise stakeholder and expertise involvement

2 Risk and Vulnerability Assessment

2.1 Analyse hydro-meteorological threat factors affecting project design, construction, and operation

2.2 Identify scenarios of projected climate change and sea level rise

2.3 Assess impact of climate change and sea level rise on rural roads

2.4 Evaluate exposure and adaptive capacity to climate change risks

2.5 Assess risk and vulnerability

3 Technical and Economic Evaluation of Asset Criticality

3.1 Identify strategies and potential adaptation measures

3.2 Undertake stakeholder consultation

3.3 Socio-economic analysis of 'do something' and 'do nothing'

3.4 Prioritize and select adaptation measures

4 Identification of Adaptation Options

4.1 Develop implementation plan

4.3 Design parameters and optimisation

4.4 Construction, supervision and documentation

5 Monitoring and Reporting

5.1 Develop monitoring and evaluation plan

5.2 Report and share implementation experiences

Training materials relating to the Handbook will be developed for use initially in the three lead countries. Further developments will take place around train-the-trainer modules and additional partner countries.

Phase 2 Proposal: Training modules and training workshops

- Training material based on the Handbook (WP B.2) will be compiled by Week 10.
- Training programmes for the three lead counties will take place from Week 10 to 22 and again from Week 52 to 62. The exact dates and scope of the training workshops will be discussed and agreed with the host countries. The first set of trainings will be general and the second focussing on Training the Trainer. Development Partners will be invited to both.
- Preparations for the training workshops will be initiated in Week 1.

Engineering Adaptation Guideline:

This document, which goes hand in hand with the Handbook will be a guideline on the adaptions required for different road infrastructure components in terms of the expected climate changes in the region. It is currently being compiled in a format that will relate the proposed infrastructure

element to the identified changes in climate stressors. A summary of the effects of each climate stressor on the different infrastructure elements will initially be provided.

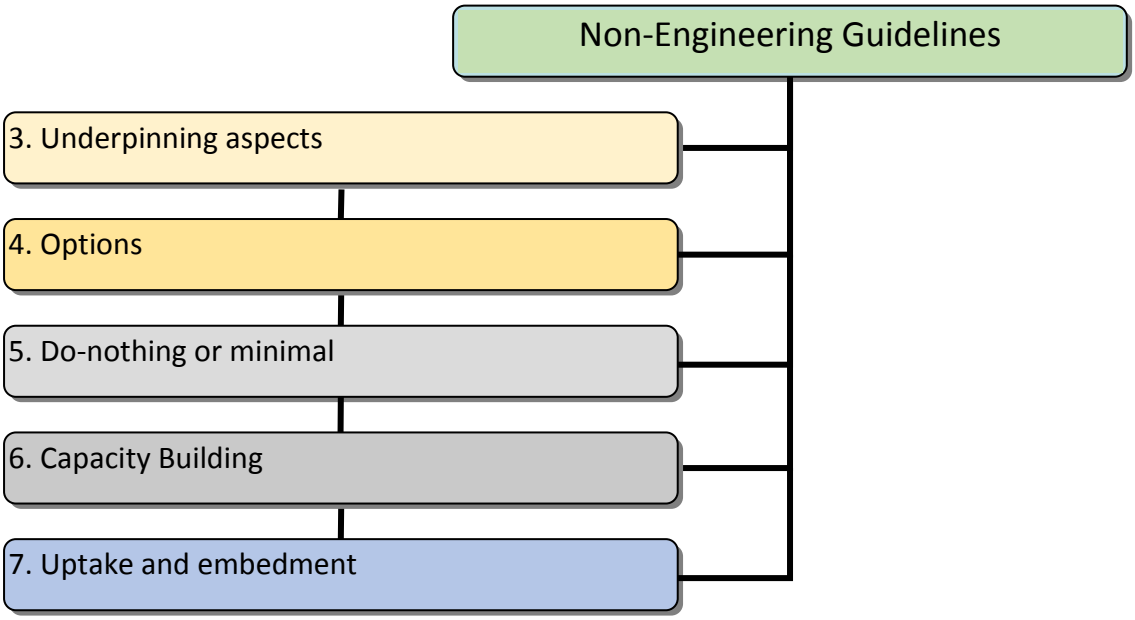
The adaptation requirements of the different infrastructure elements related to each stressor will also be provided, with additional detail to that provided in the current Engineering Adaptations Report. This will allow both an overall view of the potential problems affecting all infrastructure elements related to individual climate stressors to be identified as well as the adaptations for each element to handle the specific stressors, in greater detail.

Additional attention, following feedback from the Dar es Salaam workshop and other discussions, will be paid to cut-slope stabilisation, bioengineering and embankment design.

The drafting of the above Guideline is slightly behind the planned progress, although it is expected that the Guideline should be completed by the end of July 2017.

Non-Engineering Adaptation Guideline:

After two introductory chapters relating to links to the Handbook, the Guidelines are set out as Chapters 3 to 7, as follows:



Chapter 3 introduces aspects that underpin non-engineering options including policy, strategy and programme feedback cycle; adaptation prioritisation; serviceability classification and a range of decision support systems, particularly Asset Management Systems. Chapter 4 describes the options in detail and Chapter 5 covers management and implementation aspects of 'do nothing or minimal'. Chapter 6 sets out recommendations on Capacity building and Chapter 7 illustrates how to maximise uptake and embedment.

The proposed Contents of the Guidelines are as follows:

Abstract
Key words
Glossary (within the context of this project)
Acronyms, Units and Currencies
Summary

1 Background and context

1.1 Aims and Objectives
1.2 Scope
1.3 Introduction to the Adaptation Handbook

2 Non-Engineering Guidelines

2.1 Adaptation options in the roads sector
2.2 Scope of Guidelines

3 Underpinning aspects of Non-Engineering options

3.1 Establish Relevant Policies
3.2 Development of Adaptation Investment Strategies
3.3 Prioritisation of adaptation needs
3.4 Implementation Support Systems

4 Non-Engineering Options

4.1 Policy options
4.2 Alignment, master planning and land use planning
4.3 Improved network and programme management to anticipate and mitigate impacts
4.4 Improved asset management resilience
4.5 Maintenance planning and early warning
4.6 Environmental management
4.7 Emergency planning, maintenance operational budgets and early warning
4.8 Augmenting standards and design guides
4.9 Road safety
4.10 Research

5 Integrated approach

6 Do nothing or do minimum

7 Capacity building

Appendix 1: Project summary

Appendix 2: Case Studies

The Organisation for Economic Co-operation and Development (OECD, 2009) identifies the national and sector levels as policy entry points that may be useful for adaptation mainstreaming. National policies and plans include national visions, poverty reduction strategies, multiyear development plans, and national budgets. Sector development plans, such as transport master plans and their budgets, often flow from national plans and policies. Projects support sector plans and in some cases

also national plans, particularly those that are cross-sector, regional, and of extremely high priority. Therefore, influencing these overarching frameworks can affect which projects are prioritised and the criteria they must meet in order to be financed.

The Guidelines will address policies and programmes for the main Development Partners and their stance on risk and vulnerabilities. In terms of prioritisation, the guidelines will address management of effects and outcomes and decisions relating to:

- Potential loss of life
- Availability of alternative routes
- Cost and consequences of closure
- Environmental/sustainability issues (i.e. pollution, aesthetics, etc.)
- Cost of repair
- Available funds
- Accessibility requirements.

Support systems will cover relevant data and asset management. Shock events related to cllimate occur frequently even within the lifecycle of the shorter-lived road assets and therefore needs to be considered as part of the day-to-day business of the road authority. This includes preparing in advance of the events; how to respond during an event; and what is to be rebuilt after the event to ensure the network is more resilient for when the next event occurs.The World Bank's Technical Report on Integrating Climate Change into Road Asset Management (World Bank, 2017c) guides road authorities on how to go about integrating climate change thinking into their business-as-usual asset management processes.

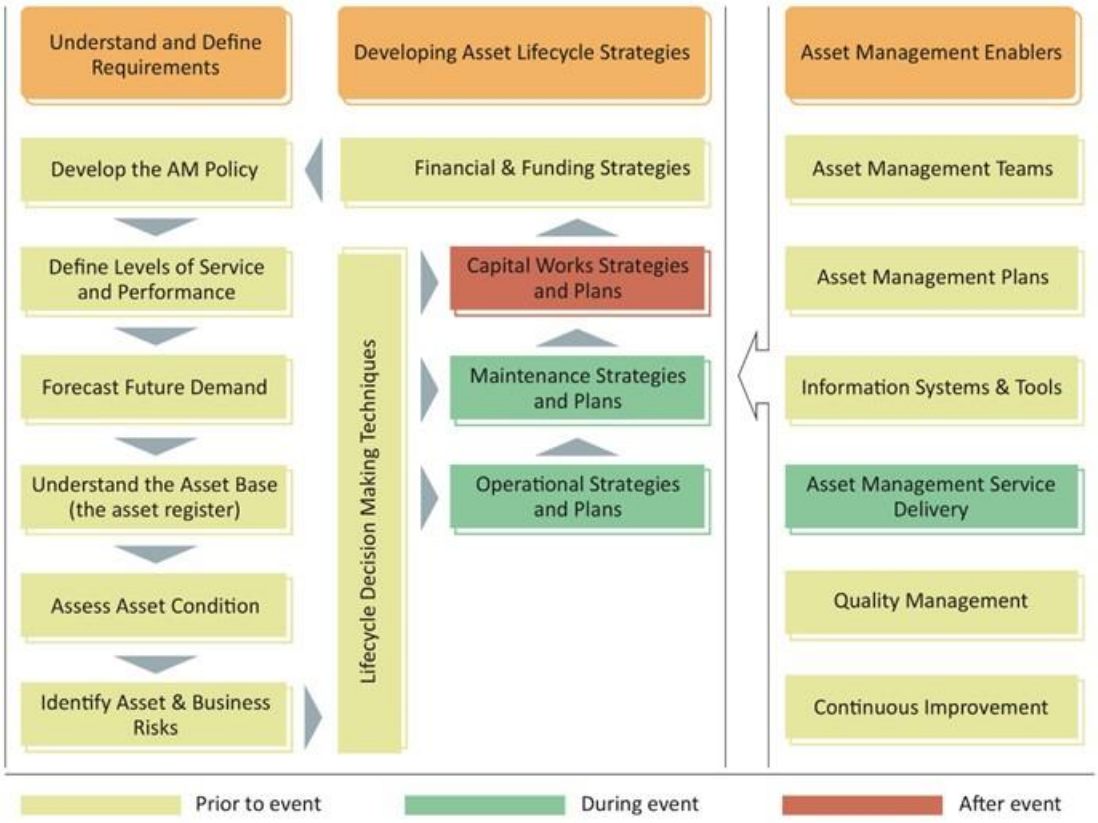


FIGURE 10: Asset Management Process versus Response Timing

Recognised components of non-engineering options and activities are set out below. Each will be described and a list of recommended actions produced:

Policy options - Policies and plans should be adaptive and robust, and steer the incorporation of climate change into spatial planning, long-term improvement plans, facility designs, maintenance practices, operations, and emergency response plans, amongst others.

Alignment, master planning and land use planning - Planning is the most important aspect of long-term climate adaptation to avoid recognised vulnerabilities. Climate change considerations, such as high and low risk categories for development, land use and future road alignments, should be incorporated in short- and long-range plans.

Improved network and programme management to anticipate and mitigate impacts - Climate changes necessitate the introduction of different design criteria, asset management policies, maintenance cycles, operational strategies, and therefore also different funding requirements/models.

Maintenance planning and early warning - Weather variability and the short and long-term effects of climate change will necessitate more frequent maintenance, rehabilitation and reconstruction of road infrastructure (e.g. access roads, geotechnical structures, bridges and drainage structures), as well as different design requirements, impacting on the budgets of road authorities.

Environmental management - Environmental Impact Assessments address effects of roads on the environment. Climate adaptation is the converse. However, many of the issues and considerations overlap or complement each other.

Emergency planning, maintenance operational budgets and early warning - Road and Transport Ministries will need to coordinate and link more effectively with other Ministries, administrations and authorities in dealing with climate change issues.

Augmenting standards and design guides - Most Standards and National guides do not incorporate adaptation principles in any meaningful way. Investments in the transport sector are generally guided by a large number of design standards and regulations that in most cases are reflective of historical rather than future climate conditions. The revision of regulatory and design standards in the transport sector, which could not take place on a project-by-project basis, may significantly enhance the resilience of transport sector investments to climate change.

Road safety - Road user safety should feature prominently in any climate change risk assessment process.

Research - The collection of data, piloting new approaches and evaluating outcomes provide evidence to underpin research outputs and to inform the form of future research.

The following supporting Sections and Chapters are proposed:

- **A case study will be used to illustrate an integrated approach to Adaptation.**
- **Do nothing or do minimum** - by necessity, this option is becoming much more prevalent as maintenance backlogs increase and funding becomes more problematic. Unfortunately, if

part of a *reactive* management programme it becomes impossible to address affected communities in any realistic prioritisation programme.

- **Capacity building** - In order to establish and implement climate adaptation successfully, national capacity will need to be developed across all relevant stakeholders.

5.6 Knowledge Dissemination and Capacity Building

The Project Team will work with relevant partner country Road and Transport Ministries, Departments and Agencies/Authorities in a knowledge dissemination and capacity building programme based on the outputs from the research. Capacity building will include a wide range of targets from central government agencies to village groups. Specific attention will be paid to National Road Fund Boards, Scientific Ministries and Environment Agencies, with the cooperation and buy-in of the Road Authorities.

While Phase 1 of the project concentrated on awareness and knowledge building, Phase 2 will focus on dissemination, capacity building and uptake. In practice, this component of knowledge generation, dissemination, training and capacity building will be active throughout the full duration of the project but will evolve through several stages. Training and capacity building will be important for:

- Understanding the challenges;
- Participation and knowledge sharing/exchange;
- Developing physical and social resilience;
- Disseminating knowledge and experience;
- Training the trainers.

The overarching objective of the communications activities under the project is to enhance the project's reach, to increase the involvement of targeted stakeholders and to optimise the research, capacity building and knowledge management and dissemination efforts.

The specific objectives and action plans for the capacity enhancement of AfCAP Partner Countries was presented in Parts B, C and D in Chapter 4. Some of the mechanisms and tools that will be used are elaborated on below:

5.6.1 RECAP Website

One of the tools that will be used for awareness and knowledge dissemination is the ReCAP website. A specific domain and discussion forum have been established on this website to showcase this programme and for information dissemination, supporting uptake and subsequent embedment of project outputs and outcomes. This is aimed at a range of levels from informing national policies, through regional and district planning, down to practical guidance on adaptation delivery at rural road level.

5.6.2 Briefing Notes

As was the case in Phase 1, regular Briefing Notes will be produced for the Climate Adaptation website and as handouts for the training workshops and seminars to help build awareness, knowledge sharing, participation and feedback.

At the outset, a Briefing Note will be produced to sensitive main decision makers in government as to the impacts of climate change and the urgency to act now. This document will also be made available as a download that can be used extensively in the awareness campaign. It will also be useful as a policy briefing document.

5.6.3 Counterpart Researchers/Engineers

In Phase 1 two counterpart researchers/engineers from each country were integrated in the Project Team and participated in all in-country activities, inclusive of all engagements with central government agencies and district authorities, and especially in all site visits undertaken in the identified regions for the demonstration projects in all three countries.

Through interactions with the team and involvement in all in-country activities, all pertinent knowledge on all aspects of this study will be transferred to the counterpart researchers/engineers. They will form the primary focus of capacity building during Phase 2.

5.6.4 ARTReF

The ARTRef website will provide a link to the Climate Adaptation domain on the ReCAP website. The Project Team will also rely on the members of ARTReF to actively participate and contribute to this project. This may also include their participation in the ReCAP Stakeholder Workshops such as the one that was held in Dar es Salaam, Tanzania, in April 2017.

5.6.5 Training Workshops (Phase 2)

It is recognised that all AfCAP Partner Countries that are vulnerable to adverse and damaging climate effects will have an interest in receiving information and guidance at the earliest opportunity. It is also recognised that there may be a separation between the objectives of initiating evidence-based demonstration programmes and the objectives of disseminating generic AfCAP Guidelines. In order to maximise on dissemination of knowledge, to broaden the level of understanding (leading to wider capacity building) and to engage workshop delegates in hands-on training, two sets of training workshops as well as on-site training are recommended.

Under Work Package B.3 (cf. Chapter 4), it is planned to hold two Training Workshops in each of the three lead countries (Ethiopia, Ghana and Mozambique).

The purpose of the *first set of training workshops* is to implement a direct, hands-on capacity building programme directed to national stakeholders and particularly to those interested or involved in the implementation of climate adaptation measures. The training will be based on the generic Handbook and associated Guidelines on climate adaptation produced as an output of Work Package B.2. Where feasible, the workshops will be held in close proximity of the demonstrations sections. Two delegates from three AfCAP Partner Countries located closest to the lead country in which the workshop will be held will also be invited to participate in the workshop, as per the table below:

Host country for Training Workshops	AfCAP Partner Countries invited to participate (two delegates per country)
Ethiopia	Kenya South Sudan Uganda
Ghana	Democratic Republic of Congo Liberia Sierra Leone
Mozambique	Malawi Tanzania Zambia

The *second set of workshops* will be focussing on training the trainers of all twelve AfCAP Partner Countries, but other country and sub-regional participants will also be welcome to attend. The training will again be based on updated versions of the Handbook and associated Guidelines, but will have a greater hands-on component.

In addition to the above, *on-site training* will also be provided as per Work Package B.5. This training will focus on visual condition assessments and the identification of appropriate adaptation measures, and on the implementation of the adaptation measures. This training will coincide with the site visits to be undertaken by the Project Team to the demonstration sections (Part A; cf. Chapter 4).

5.7 Regional Organisations, Partners and Collaborators

5.7.1 Regional Organisations

The **African Union** believes climate change constitutes a major threat to the continent's development, and has major implications and impacts on African economies. COP 21 marks a decisive stage in their negotiations of the future international agreement on climate change. To this end it is working with African Heads of State and Government, African Parliamentarians and the principals of the four pan-African institutions namely: the African Union Commission, (AUC); the African Development Bank, (AfDB); the NEPAD Planning and Coordinating Agency (NPCA); and the United Nations Economic Commission for Africa (UNECA).

NEPAD (New Partnership for Africa's Development). The climate change programme focusses on Environment, Energy and Water, and works through a variety of mechanisms to meet its goals, including:

- Facilitating brainstorming and conferences across the continent;
- Assisting where possible with the work of climate change scientists in the region;
- Supporting the African Ministerial Conference on the Environment meetings;
- Participating in relevant climate change conferences; and
- Preparing policy briefs and providing technical support in building African positions.

The programme is also looking to start collecting data and information on climate change mitigation and adaptation on the continent. The objective is to establish a database of relevant climate change information. The programme is also looking to develop sub-regional climate change frameworks.

ECOWAS (Economic Community of West African States) works with West African Economic and Monetary Union (UEMOA), the Permanent Inter-State Committee for Drought Control in the Sahel (CILSS) and the West African Development Bank (BOAD) on climate vulnerability of ECOWAS, UEMOA and CILSS countries and consequently the need to mobilise funding of $100 billion per year for the successful implementation of major initiatives such as the Great Green Wall, the African Renewable Energy Initiative and the Niger Basin Climate Resilience Investment Plan.

SADC (Southern African Development Community), together with COMESA and EAC, are implementing a joint initiative called 'The African Solution' to address Climate Change. This approach is called the Tripartite Programme on Climate Change Adaptation and Mitigation. The programme is being funded by Norway, DFID and the European Union and is a five-year initiative. Although its focus is on agriculture and forestry, it is investing in strengthening capacity in national research and training institutions and implementation of research programs. It also wishes to implement climate vulnerability assessments and analysis.

ASANRA (Association of Southern African National Road Agencies) and **EAC** (East African Community) do not currently seem to have any relevant related programmes (to be further explored).

UNDP (United Nations Development Programme) has established an African Climate Adaptation Programme in the following African countries: Ethiopia, Ghana, Kenya, Malawi, Mozambique and Tanzania.

UNDP works internationally to help countries achieve the Millennium Development Goals (MDGs). Currently, the UNDP is one of the main UN agencies involved in the development of the Post-2015 Development Agenda.

5.7.2 ARTReF Members

The aims and objectives of ARTReF are to promote research and innovation in roads and transport through networking, coordination, collaboration, knowledge transfer and the provision of advice on policies for sustainable development in Africa.

The current members of ARTReF are national road and/or transport research entities, representing the following sub-Saharan African countries: Botswana, Democratic Republic of the Congo, Ethiopia, Ghana, Kenya, Malawi, Mozambique, Namibia, Nigeria, Sierra Leone, South Africa, South Sudan, Tanzania, Uganda, Zambia and Zimbabwe. The ultimate aim is to incorporate all sub-Saharan African countries in the membership base of ARTReF.

ARTReF is in the process of identifying and prioritising regional research and capacity development needs. Several of the ARTReF Members (i.e. Botswana, Ghana, Kenya, Malawi, Namibia, Nigeria, Tanzania, Uganda, Zambia and Zimbabwe, with others likely to follow) identified the provision of sustainable transport infrastructure in a variable and changing climate as one of their key challenges. Hence, synergies between this project and ARTReF should be further explored and strengthened.

5.7.3 National Organisations/Committees

Interactions with members of the AfCAP National Committees; National Climate Adaptation Committees; Ministries of Roads, Transport, Works, Maritime, Science, Environment; Environmental Protection Agencies; and Development Partners in particularly the three lead countries will be intensified during Phase 2 of this project.

5.7.4 Counterpart researchers/engineers in selected countries

Two counterpart researchers/engineers from each lead country have been integrated in the team and will participate in all in-country activities, inclusive of all engagements with central government agencies to district councils, and be involved in all site visits and activities associated with the demonstrators. It is expected that, through interactions with the Project Team and involvement in all in-country activities, that all pertinent knowledge on all aspects of this study will be transferred to the counterpart researchers, who in turn will assist with the building of national capacity in climate adaptation.

6. Management Approach

The project calls for a team of professionals with proven track record in research covering the professional areas of climate and climate change assessment; vulnerability and risk assessment; road engineering with a particular focus on engineering and non-engineering climate change adaptation; and knowledge dissemination and capacity development. All of the members of the Project Team are well qualified for carrying out this assignment given their accumulated previous experience in related projects. The members of the Project Team, as well as their Core Areas of responsibility, are indicated in the organisation chart shown in Figure 11, while their inputs for Phase 2 are summarised in Table 7 below:

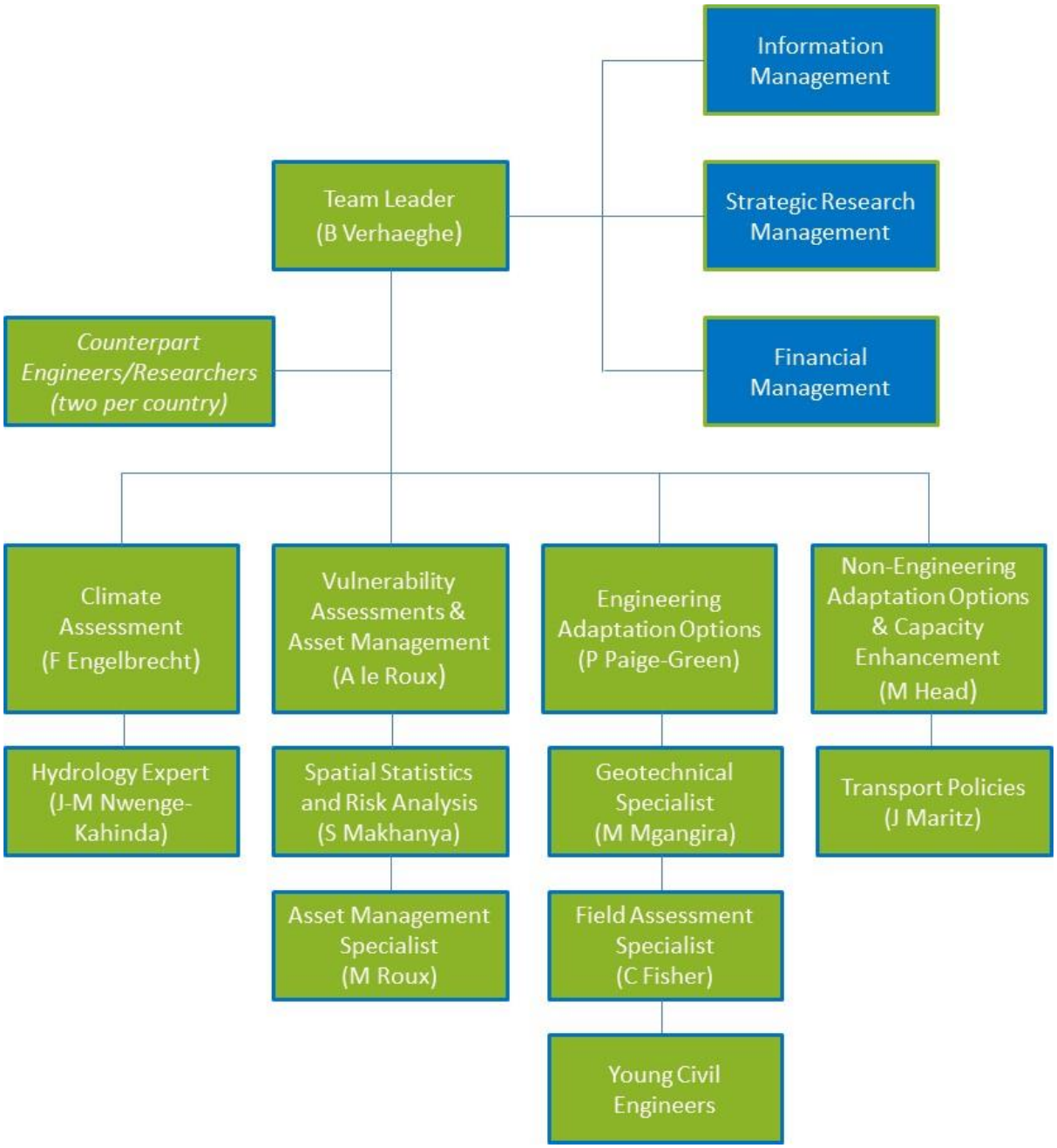


FIGURE 11: Project Organisational Structure

TABLE 7: Professional Inputs for Phase 2

Position Title	Technical Adviser	Total number of planned inputs
Team Leader	B Verhaeghe	183 days
Road Engineering Expert	Prof P Paige-Green	191 days
Climate Expert	Prof F Engelbrecht	11 days
Non-Engineering Adaptation Options & Capacity Building Specialist	M Head	80 days
Senior Geo-Informatics Scientist (Vulnerability Assessments)	A le Roux	125 days
Asset Management Expert	M Roux	49 days
Geotechnical Engineering Expert	Dr M Mgangira	22 days
Hydrology Expert	Dr J-M Mwenge-Kahinda	22 days
Spatial Statistics & Risk Analysis Scientist	S Makhanya	33 days
Transport Policies	J Maritz	39 days
Field Assessments	C Fisher	36 days
Six Counterpart Engineers/Researchers in three Lead Countries	Ethiopia (ERA): • Ato Alemayehu Endale • Ato Deribachew Mezgebu Ghana (MRH/DFR): • Mrs Efua Akwetea-Mensah • Mr Edmond Balika Mozambique (ANE): • Mrs Raquel Langa • Mr Rogério Simione	To be identified

The Project Team will be supported by a highly competent team of project administrators, financial accountants, ICT administrators, strategic research managers, risk managers (inclusive of an Ethics Clearing Committee), communication specialists, information services specialists and secretarial support staff, all provided by the CSIR.

The roles and responsibilities of the main team members with respect to project management are as follows:

- Benoît Verhaeghe (Team Leader):
  - Overall administration and contract (and subcontract) management
  - Planning and programming of the project
  - Risk identification and response planning
  - Manage and mitigate risks
  - Direct, manage and control project work
  - Perform integrated change control

- Validate and control scope
- Control/manage schedule and costs
- Perform quality assurance and quality control
- Ensure the Project Team's compliance with the quality plan, the risk management plan and the monitoring and evaluation plan, inclusive of the regular updating of these plans
- Manage communications with ReCAP PMU and relevant stakeholders in the region, and particularly those in the three lead countries (e.g. AfCAP National Steering Committees or similar structures)
- Management of all Milestone deliverables, as well as newsletters, journal articles, conference papers and workshop reports
- Reporting on the status of the project (e.g. monthly progress reports)
- Drafting of final report

- Profs Philip Paige-Green and Francois Engelbrecht, Alize le Roux and Mike Head (Core Area Leaders), supported by the Team Leader and CSIR financial administrators/accountants:
  - Maintain an appropriate project plan for each core area, inclusive of work breakdown structure, statement of work, sequence and interdependencies, budget, resource allocation and levelling, duration estimates
  - Establish, implement and maintain all project controls at Core Area level
  - Ensure compliance with project control standards and procedures
  - Report technical and financial progress to Team Leader
  - Identify and highlight variances ('red flags', risk factors) to the Team Leader, as well as proposed mitigation actions
  - Perform quality assurance and quality control
  - Adherence to the quality plan, the risk management plan and the monitoring and evaluation plan, inclusive of contributions to the regular updating of these plans
  - Ensure the timeous delivery of Milestone deliverables pertaining to each Core Area, as well as newsletters, journal articles, conference papers, training material and workshop reports, on brief, on budget and on time
  - Contribute to the dissemination of project outputs

7. Quality Management

The Project Team is well aware of the critical importance of quality assurance in the undertaking of a project of this nature. It views quality as a holistic concept incorporating internal efficiency of processes and systems as well as effectiveness in dealing with the external environment. In its activities, the Project Team will strive for the highest quality by:

- Deploying business and scientific excellence in the use of all systems, processes and practices required by this project – to this end, the Project Team will also adopt strict internal measures for ensuring that the outputs are subjected to rigorous quality assurance processes before they are submitted to the AfCAP Technical Manager and the ReCAP PMU for approval
- Implementing good governance practices that comply with all legal requirements as well as financial and operational best practices
- Mobilising the Project Team members and their core skills efficiently and optimally to ensure their ability to meet all project requirements
- Acting as responsible stewards of the environment and ensuring health and safety in all decisions taken.

More specifically, the following actions and measures will be implemented to ensure that all aspects of quality will be properly managed throughout the execution of the project:

- Ensuring that the *Monitoring and Evaluation Plan* is aligned with ReCAP's (and the ultimate recipients') expectations of the envisaged project outcomes, by continuously monitoring and evaluating the relevance, effectiveness, efficiency and impact of activities to be undertaking by the Project Team to achieve these specified objectives (cf. Chapter 8);
- Mobilising a team of experts with the required strength and breadth of professional expertise and experience to undertake this assignment in the most efficient and effective manner to yield the desired outcomes;
- Implementing efficient and effective project management systems to manage, monitor and account for all project expenditures (in line with budgets), progress against and achievement of targets (e.g. Milestones) and the delivery of outputs on budget, on brief, on time and to the required level of quality;
- Internal (CSIR) language editing and technical peer review of all project outputs before being submitted to ReCAP/AfCAP for external peer review and approval, and before being published, distributed and/or disseminated. This will apply to all correspondence with stakeholders, newsletters, webpages, questionnaires, progress reports, milestone reports, guidelines, presentation materials, workshop material and other documentation produced by the Project Team.
- Backing up of all data and reports on the restricted-access CSIR Document Management System to ensure protection of all information and knowledge created during project execution;
- Making optimal use of the ReCAP website to disseminate products of this project to stakeholders;
- Having *checks and balances* in place to continuously assess changes in the political, technical and physical environment in which the Project Team will operate, and have processes and procedures in place to implement adaptive strategies and action plans to meet the project's specific objectives and envisaged outcomes;

- Requirement that all Project Team members adhere to the rules and regulations of International Standards for which the CSIR has been certified. These include:
    - ISO 9001 (Quality Systems);
    - ISO 14000 (Environmental Management); and
    - OHSAS 18000 (Occupational Health and Safety);
- Ensuring that all adaptation design solutions undergo a check in terms of cost-effectivity of design options, fit-for-purpose attributes of design options, local-appropriateness of designs (also through community participation), safety-in-design features, and design for sustainability attributes.
- Encouraging the professional development of project-related staff to enhance and expand their work skills. This will be achieved at two levels:
    - While the young CSIR researchers appointed to contribute to the project and to support the Key Experts are fully versed in conducting generic (i.e. cross-discipline) vulnerability assessments and scientific/engineering functions, they are yet to gain additional experience on the vulnerability aspects particular to rural access. The Key Experts will be imparting their knowledge and expertise to them; and
    - The two counterpart researchers in each of the three lead countries will be fully integrated in the Project Team. They will participate in all national stakeholder meetings, on-site events (community interaction and road site evaluations) and workshops, and will gain experience and knowledge by working hand-in-glove with the Key Experts from the Project Team.

8. Monitoring and Evaluation Plan

Monitoring and Evaluation principles will be used as a management tool by the Project Team, and by ReCAP, to continuously gauge the performance of the project and whether the project is on track to attain the specified objectives and desired outcomes.

Monitoring will be used for tracking progress and assessing whether the planned outputs, deliverables and schedules have been reached, so that early action can be taken to red-flag and correct any deficiency that may have occurred. This will be managed on a daily basis (i.e. monitoring of progress against the timetable broken down to task/activity level, as outlined in Chapter 4, and will be reported in the quarterly Progress Reports. These Progress Reports will summarise work performed, milestones achieved in the previous month and schedule of activities for the following month, including the reporting of any deviations and action plans to minimise their impact on future activities.

Any major deficiencies or deviations that will significantly impact on the project will be communicated immediately to ReCAP/AfCAP.

Evaluation will be used for assessing the relevance, effectiveness, efficiency and impact of activities in line with the specified objectives and desired outcomes described above. The Project Team will use evaluations not only as a retrospective tool to gauge progress in reaching the objectives (and capture lessons learnt), but especially as a forward-looking tool to improve processes and adjust the methodology so that the specified objectives and desired outcomes will be attained. This also will be reported in the quarterly Progress Reports. Potential risks to effective impact will be identified timeously and addressed via the appropriate project management structures.

Table 8 provides a list of evaluation questions that can be used as a basis for conducting an on-going monitoring programme. The Project Team has developed monitoring questions for the following three Focus Areas for Evaluation: (a) *Process*, (b) *Outcomes*; and (c) *Learning*. These are provided in Table 9.

It is acknowledged that the drafting of monitoring questions for *Outcomes* might be somewhat premature for a project duration of 84 weeks or 19 months (i.e. *Outputs* might not necessarily translate in *Outcomes* and *Impact* over such a short period of time). However, the monitoring questions have been framed in such a way that they are applicable to Phase 2 of the project. In addition, the intention is to focus on the planning required to address critical process and other elements that need to be in place to obtain the required impact (i.e. the impact pathway) by paying attention to outputs and outcomes required for reaching certain impacts.

No monitoring questions have been proposed for the following two Focus Areas for Evaluation: (a) *Investment* and (b) *What Next*. It is believed that these questions should rather be addressed in Phase 3. This said, cost-effectivity has to a limited extent been addressed under *Process*.

TABLE 8: Evaluation Questions for the Monitoring & Evaluation Plan

Focus of Evaluation	Evaluation questions
PROCESS	How well was the project designed and implemented (i.e. its quality)
	To what extent did the engagement method encourage stakeholders to take part in the project?
OUTCOME (Phase 1)	To what extent did the project meet the overall needs and priorities of the stakeholders (i.e., ReCAP PMU and AfCAP Partner Countries)?
	How valuable are the outcomes to ReCAP/AfCAP and to regional stakeholders (e.g. AfCAP Partner Countries)?
	To what extent has the project led to long-term behaviour change?
	To what extent did the training workshops lead to increased support for action to tackle climate change?
LEARNING	What worked and what did not?
	What were the unintended consequences?
INVESTMENT	Was the project cost-effective?
	Was there another alternative that may have represented a better investment?
WHAT NEXT?	Can the project be scaled up?
	Can the project be replicated elsewhere?
	Is the change self-sustaining or does it require continued intervention?

TABLE 9: Monitoring Questions for the Monitoring & Evaluation Plan

Focus of Evaluation	Evaluation questions	Monitoring questions	Indicator	Data source/method	Responsibility	Timeframe
PROCESS	How well was the project designed and implemented (i.e. its quality)	Does the programme logic (i.e. sequence of Work Packages and activities/tasks) result in the achievement of the planned outputs and outcomes?	Milestone deliverables	Progress Reports	Project Leader	Quarterly
		How will progress be monitored?	Progress against Gantt chart	Project meetings and timesheets	All Team Members	Bi-weekly
		How will project expenditures be managed?	Actual expenditure versus budget	Actual costs incurred	Project Leader and financial administrators	Bi-weekly, but monthly reporting
		How will quality of all project documentation be managed?	Feedback from ReCAP (external peer review)	Internal peer review of all outputs	Project Leader and CSIR internal processes	Continuously
		Will all key experts and researchers be available for project delivery?	Confirmation letters	Each individual Team Member	Project Leader	At project initiation
		How will all knowledge created during the course of the project be protected?	Back-up of all electronic documents	CSIR Document Management System	Project Leader & all team members	Continuously
	To what extent did the engagement method encourage stakeholders to take part in the project?	Have all relevant stakeholders been identified inside AfCAP Partner Countries?	Stakeholder feedback	Information scan	All Team Members and ReCAP PMU	Requires regular updates (monthly)
		Have all relevant stakeholders been identified outside AfCAP Partner Countries (e.g. ARTReF members, regional bodies)?	Stakeholder feedback	Information scan	All Team Members and ReCAP PMU	Requires regular updates (monthly)
		Will the Project's website reach the expected audience (inclusive of information sharing and Newsletters)?	Number of website hits categorised by country	Website activity reports	ReCAP	Quarterly
		What volume of feedback communication messages were issued and picked up by media or put into the public domain?	No. of media releases	Media monitoring	Media / comms organisation / ReCAP	Quarterly
		Are the key stakeholders in the three identified AfCAP Partner Countries fully committed to engage in the project?	e.g. Positive engagement in demonstrators	Commitment to invest	Project Leader & Counterparts	Weekly
		Have adequate processes been deployed to attract stakeholders to the Training Workshops and to optimise their participation in the workshops?	- Number of attendees in each country (target: 100 per workshop) - Participatory course and responses from participants	- Attendance registers and Training Workshop reports - Workshop programme and evaluation reports	Knowledge Dissemination / Capacity Building Key Expert	As per the Workshop schedule

Focus of Evaluation	Evaluation questions	Monitoring questions	Indicator	Data source/method	Responsibility	Timeframe
OUTCOME	To what extent did the project meet the overall needs and priorities of the stakeholders (i.e., ReCAP PMU and AfCAP Partner Countries)?	Are the particular country needs and priorities, as well as common regional needs and priorities, well understood?	- Synthesis report - Stakeholder feedback	- Engagements with 3 selected countries	Project Team	Monthly
		Have the needs and priorities of stakeholders been considered in the Work Packages and activities/tasks?	Country Reports	Regular review of scope of tasks/activities to ensure alignment	Project Leader	Biannual
		Is there a process in place to approve project outputs, verifying whether they are in line with overall needs and priorities of stakeholders?	Approval of all Milestone deliverables (monthly/ biannual reports	Review of outputs by ReCAP and, where appropriate, national stakeholders	ReCAP	Milestones
	How valuable are the outcomes to ReCAP/AfCAP and to regional stakeholders (e.g. AfCAP Partner Countries)?	Are the main project outputs such that they create a greater awareness of the impacts of climate change on rural road networks and rural accessibility?	Stakeholder feedback	Website, report and workshop feedback	Project Team	Milestones
		Are the main project outputs such that they provide guidance to stakeholders on how to address climate change impacts on rural road networks and rural accessibility?	Stakeholder feedback	Website, report and workshop feedback	Project Team	Milestones
		What other measures for sensitising stakeholders and providing guidance have been deployed?	Stakeholder feedback	Stakeholder meetings, website, newsletters, training Workshops, seminars	Project Team	Milestones
		Have the demonstration programmes, inclusive of the proposed engineering and non-engineering adaptation options and proposed designs, for each of the three countries been accepted?	Final approval	Road owner approval & engagement	Project Team	Months 1 to 3
	To what extent has the project led to long-term behaviour change?	Have potential changes in national policy (e.g. budget allocation, asset management, network planning, review of standards, environmental protection, procurement, land use management, etc.) been identified and prioritised?	No. of (potential) policy changes by country (for 3 countries)	AfCAP National Steering Committees (or equivalent)	Project Team	Milestones
	To what extent did the training workshops lead to increased support for action to tackle climate change?	Have the training workshops managed to engage stakeholders to take action to tackle climate change?	Responses from participants	Workshop evaluation reports	Knowledge Dissemination / Capacity Building Key Expert	Milestones
LEARNING	What worked and what did not?	Was the project well structured, well planned and adequately resourced?	Quarterly and Final Reports	Retrospective analysis	Project Leader	Quarterly
		Were the processes deployed for interaction with stakeholders effective and efficient?	Quarterly and Final Reports	Retrospective analysis	Project Leader	Quarterly
		Where deficiencies and deviations when first identified reported and acted upon in an efficient and effective manner?	Quarterly and Final Reports	Retrospective analysis	Project Leader	Quarterly
	What were the unintended consequences?	Have interactions with national stakeholders resulted in scope changes (significantly) impacting on the consummation of project resources?	Minutes of stakeholder interactions	Feedback from stakeholders & workshops	Project Leader and ReCAP PMU	Quarterly

9. Risks

The two primary risks to the success of this project are whether the required participation and data can be obtained from the AfCAP Lead and other Partner Countries, in line with the agreed programme. In order to mitigate these risks, a great deal of effort will go into the identification and communication with the countries. Some time contingencies has been built into the programme but there are key dates, particularly relating to award of construction contracts and rainy seasons, that are outside our control.

Close monitoring of progress, specifically in relation to obtaining the required engagement and data at the required periods within the project, would help to ensure that any delays can be swiftly addressed.

A key risk to the successful completion of the project is the non-availability of the Key Experts contracted for this project. The CSIR, however, as a large scientific organisation, has both the necessary support staff for administration, information management and financial controls as well as research staff in various domains of expertise who can be mobilised into specific parts of the project work if additional resources were to be required.

The Risk Profile is provided in Annex C. The probability and impact of occurrence for each identified risk will be assessed on a continuous basis by the Project Leader, with input from the Project Team, using the following approach:

Probability:

- High: Greater than 70% probability of occurrence
- Medium: Between 30% and 70% probability of occurrence
- Low: Below 30% probability of occurrence

Impact:

- High: Risk that has the potential to greatly impact project cost, project schedule or performance
- Medium: Risk that has the potential to slightly impact project cost, project schedule or performance
- Low: Risk that has relatively little impact on cost, schedule or performance

RISK LEVEL		Probability		
		Low	Medium	High
Impact	High	M	H	H
	Medium	L	M	H
	Low	L	L	M

10. References

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Annex A: Work Plan

WORK PACKAGE		TASKS	Timeframe in weeks: 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84
INCEPTION PHASE AND MANAGEMENT		**Inception Phase & Management**	
	1	**Project Initiation communication**	
	2	**Programme and workplan development**	
	3	**Finalisation of programme and plan**	
	4	**Inception Update report**	
	5	**Progress Reports**	
	6	**Country Reports (Ethiopia, Ghana and Mozambique)**	
	7	**Recommendations for Phase 3 (PART E)**	
	8	**Contract Completion Report**	
PART A: DEMONSTRATORS		**Mozambique Demonstration Programme**	
	WP A.1	A.1.1 Demonstrate appropriate engineering and non-engineering adaptation options	
		Gaza Province: Chokwe-Macarretane Road (R448)	
		Districts in Zambesi/Nampula Province, linked with EU	
		A.1.2 Site investigations and detailed design	
		A.1.3 Construction of demonstration sections	
		A.1.4 Monitoring and evaluation	
		A.1.5 Demonstrate appropriate non-engineering adaptation options	
		Demonstrate methodologies for conducting risk and vulnerability assessments	
		Embedment in road asset management systems	
		Ghana Demonstration Programme	
	WP A.2	A.2.1 Demonstrate appropriate engineering and non-engineering adaptation procedures	
		Tamale region: Tampion-Tidjo Road	
		Coordination with AfCAP Project "Alternative surfacings for steep hill sections"	
		A.2.2 Site investigations and detailed design	
		A.2.3 Construction of demonstration sections	
		A.2.4 Monitoring and evaluation	
		A.2.5 Demonstrate appropriate non-engineering adaptation options	
		Data and methodologies to conduct risk and vulnerability assessments	
		Embedment in road asset management systems	
		Ethiopia Demonstration Programme	
	WP A.3	A.3.1 Demonstrate appropriate engineering and non-engineering adaptation procedures	
		Tullu Bollo to Kela Road	
		Retrofitting existing network (URRAP)	
		Somali Region	
		A.3.2 Site investigations and detailed design	
		A.3.3 Construction of demonstration sections	
		A.3.4 Monitoring and evaluation	
		A.3.5 Demonstrate appropriate non-engineering adaptation options	
		Data and methodologies to conduct risk and vulnerability assessments	
		Embedment in road asset management systems	
		A.3.6 Adaptation methodology for World Bank (adaptation options for all roads)	
PART B: CAPACITY ENHANCEMENT (three countries)		**Capacity Enhancement: Three target countries**	
	WP	B.1 Engagement with key stakeholders and Development Partners	
		Mozambique	
		Ghana	
		Ethiopia	
		B.2 Generic (Regional) Handbook on Climate Adaptation	
		B.3 Training modulus and training workshops based on Handbook	
		Mozambique	
		Ghana	
		Ethiopia	
		Development Partners	
		B.4 Translations of documents and materials	
		B.5 On-site training: condition assessments, adaptation options, implementation	
		Mozambique	
		Ghana	
		Ethiopia	
		B.6 Peer-reviewed journal articles and conference papers submitted	
PART C: CAPACITY ENHANCEMENT (AfCAP Partner Countries)		**Enhancement of capacity in additional AfCAP countries**	
	WP	C.1 Identification of priorities by engagement with AfCAP Partner Countries	
		C.2 Capacity development events	
		- Regional training workshops (held in three target countries)	
		- Stakeholder meeting and PIT meeting	
		- Regional seminars	
		C.3 Continued development of website for interaction with AfCAP Partner Countries	
		- Continued population of website with information	
		- Manage user group and discussion forum	
		- Produce and publish Briefing Notes	
PART D: EMBEDMENT		**Review of policies, strategies and plans**	
	WP D.1	D.1.1 Mozambique	
		D.1.2 Ghana	
		D.1.3 Ethiopia	
		D.1.4 Other AfCAP Partner Countries	
		D.1.5 Synthesis and formulation of support activities (and revision thereof)	
		Provision of advice and technical assistance	
	WP D.2	D.2.1 Support embedment in policies, strategies and plans (three target countries)	
		D.2.2 Support embedment in norms and standards (three target countries)	
		D.2.3 Support embedment in design guidelines and manuals (three target countries)	
		D.2.4 Support intersectoral cooperation (environment, land use, etc.)	
		D.2.5 Case studies on 'best practices' (for all AfCAP Partner Countries)	

Annex B: Contribution to ReCAP Log Frame

An initial assessment has been made of the estimated contribution of the project to the ReCAP Log Frame indicators. This assessment is summarized in the following Table over the period of the project. Indicators forming the basis for calculation and recording are contained below. Phase 1 review period is April to October/November 2016 and covers Milestone 1. The Phase 2 option of a further 70 weeks takes the end of project target date to April 2018, covering Milestone 2, and is speculative at this stage. Milestone 3 assumptions are based on a project extension.

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) relates to 3No demonstration sites, staff time and research programme and Core Contributions (C)			K=£1,000 C= £0	K=£20,000 C=£200,000	K=£30,000 C=£10,000,000		Two staff months for participating countries. Climate fund contributions from World Bank, EU, DFID, AfDB and others.
	2. Concrete examples of change (applied or formally adopted), influenced by ReCAP research that will be allied to #km of road in focus countries.			0 km	500 km	20,000km		Improved access through targeted interventions on network of 11 countries
	3. Number of citations in academic articles of ReCAP peer reviewed articles and/or working papers, conference papers etc.			0	5	15		Journal article and peer-reviewed paper at regional conference (e.g. Ghana), followed by several key conferences events
Output 1: RESEARCH and	1.1 LVRR: Number of peer reviewed papers generated from ReCAP supported or related LVRR research							

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
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)	projects made available in open access format.			0	2	5		Venues to be determined
	1.2. TS: Number of peer reviewed papers generated from ReCAP supported or related LVRR research projects made available in open access format.			0	1	3		Based on climate effects on transport sub-regionally
	1.3 Engineering Research: National policies, manuals, 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 AsCAP adaptations). To include introduction of new policies and modification to existing policies.			0	0	9		Refers to policy and guidelines Targeting all AFCAP partner countries with 3 in Phase 2
	1.4 TRANSPORT SERVICES Research: National policies, regulations and/or practices for rural transport services modified or introduced as a result of ReCAP 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							Inception Report

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
	reviewed. Total to include research papers, final research reports, workshop reports, manuals and guidelines.			4	14	24		Monthly Reports Briefing Document Guideline document Final report Phase 1 and 2
Output 2: CAPACITY BUILDING: The building of sustainable capacity to carry out research on low volume rural roads, and rural transport services in African countries.	2.1. African / Asian experts or institutions taking lead roles in ReCAP Research Projects.			12	12	16		Project Team Country Counterpart Team
	2.3. Research projects with female researcher inputs at senior technical level.			4	4	6		Project Team Country Counterpart Team
Output 3: KNOWLEDGE: Generated evidence base of LVRR and TS knowledge widely disseminated easily accessible by policy makers and practitioners (including education and training institutions).	3.2. ReCAP generated knowledge presented and discussed at high level international development debates and conferences			1	3	5		Sub-Saharan regional and national authorities
	3.3.ReCAP generated knowledge disseminated through significant workshops and dedicated training, virtually or physically, that are rated by participants as effective.			3	6	11		Phase 1: 3 countries Phase 2: 11 countries International, participation, multiple stakeholder groups, multi-topic, multi-country, regional, or local.

Annex C: Risk Matrix

RISK STATEMENT	CONSEQUENCES	IMPACT	PROBABILITY	RISK LEVEL	ACTION PLANS
COUNTRY/STAKEHOLDER RISKS					
Failure to further engage three countries	Significant impact on scope, and projected outcomes and impact of project	High	Low	Medium	Priority Countries already committed during Phase 1. Early engagement ensures sufficient commitment with programme flexibility
Failure to maintain engagement of key stakeholders throughout programme	Insufficient buy-in from stakeholders for actions and activities to be undertaken	High	Medium	Medium	Stakeholders committed during Phase 1. Greatest risk from delays to delivery of agreed actions, so maintaining programme flexibility essential
Risks at country level (environmental/political)	Delays in implementation of project	Medium	Low	Low	Select different country if problems are unlikely to be resolved within a short period of time (weeks)
Insufficient funding for trial sites	Fewer outcomes and reduced impact of ReCAP investment beyond the life of the project	High	Low	Medium	Identification and early engagement with other Development Partners, possibly in alternative countries
Insufficient funding for long-term Monitoring & Evaluation of demonstration sections	No long-term information on efficacy of proposed solutions: reduced impact	Medium	Medium	Medium	Early integration of Demonstration Sections in Asset Management system
Delays in implementation of demonstrators	Knock-on effects to outputs and outcomes of project	High	Medium	High	Early engagement with applicable road authorities (include in budgets)
Failure to engage additional Countries	Significant impact on scope, and projected outcomes and impact of project	High	Medium	Medium	Early engagement in Phase 2
Failure of additional countries to attend workshops	Significant impact on scope, and projected outcomes and impact of project	Medium	Medium	Low	Early commitment with alternative stand-ins
Failure of additional countries to implement resilience programme	Diminished outcomes	Medium	Medium	High	Long term follow-up support in Phase 3
Insufficient government funds to apply adaptation measures to make network more resilient (long-term impact)	Fewer outcomes and reduced impact of ReCAP investment beyond the life of the project	High	High	High	Development and prioritisation of engineering and non-engineering solutions in the most cost-effective manner; policy changes. Long term follow-up support in Phase 3
PROJECT EXECUTION RISKS					
Inability to mobilise key experts & researchers	Delay in initiation and execution of project	Low	Low	Medium	All researchers have confirmed their availability
Access to supercomputing resources at the CSIR Centre for High Performance Computing (due to upgrading to more powerful system)	Impacts on high-resolution climate simulations (at 8km resolution)	Low	Low	Low	Project to be given 'high priority' status
Delay in the delivery of high-resolution climate projections	All vulnerable and risk analyses depend on climate projections	Low	Low	Low	Project to be given 'high priority' status
Lack of quality records/data	Poor basis for making the correct decisions	Medium	Medium	Low	Use proxy data
Cancellation/postponement of stakeholder meetings	Impact on project timeline and deliverables	**High**	High	**High**	Building of sufficient flexibility in the programme to accommodate changes in the meeting schedules. Fix meetings early.
Poor attendance at Training Workshops	Reduced impact of capacity building and skills transfer programme	High	Medium	Medium	Early engagements with stakeholders and mobilisation of counterpart researchers in three countries. Fix dates as early as possible.