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

Fifth Quarterly Progress Report

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

AfCAP Project GEN2014C

September 2018

Verhaeghe, B., Maritz, J., Arnold, K., Le Roux, A., Paige-Green, P., Roux, M. (2018). Climate Adaptation: Risk Management and Resilience Optimisation for Vulnerable Road Access in Africa, Fifth Quarterly Progress Report, GEN2014C. London: ReCAP for DFID.

For further information, please contact: Benoît Verhaeghe, bverhaeg@csir.co.za

ReCAP Project Management Unit
Cardno Emerging Market (UK) Ltd
Level 5, Clarendon Business Centre
42 Upper Berkeley Street, Marylebone
London W1H 5PW United Kingdom

Cover photo: B Verhaeghe

Quality assurance and review table

Version	Author(s)	Reviewer(s)	Date
1	B Verhaeghe, J Maritz, K Arnold, A le Roux, P Paige-Green, M Roux	N Leta, ReCAP PMU	17.09.2018
2	B Verhaeghe, J Maritz, K Arnold, A le Roux, P Paige-Green, M Roux	ReCAP Technical Panel	(19.09.2018)

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

Reference No:	GEN2014C	Location	Sub-Saharan Africa
Source of Proposal	DFID/ReCAP	Procurement Method	Tender
Theme	Sustainability of access	Sub-Theme	Climate resilience
Lead Implementation Organisation	CSIR	Partner Organisation	Paige-Green Consulting St Helens Consulting
Start Date	April 2017	End Date	December 2018
Report Due Date	May 2018	Date Received	September 2018

Contents

Tables and Figures

Abstract

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, has commissioned a 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.

The study focusses on: (a) demonstrating appropriate engineering and non-engineering adaptation procedures; (b) sustainable enhancement in the capacity of three AfCAP partner countries to deal with the effects of climate on their low-volume access roads; (c) sustainable enhancement in the capacity of additional AfCAP partner countries; and (d) uptake and embedment across AfCAP partner countries.

This fifth Quarterly Progress Report outlines the progress that has been made since the fourth Quarterly Progress Report of May 2018, i.e. it covers the period from June 2018 to August 2018. It primarily focusses on the following five activities/events: (a) progress on the establishment of demonstration sections; (b) feedback on the embedment workshops and meetings held in Ethiopia and Ghana; (c) improvements to the Engineering Adaptation Guidelines; (d) status of the country reports; and (e) knowledge dissemination.

Key words

Change Management, Climate Adaptation; Climate Change; Climate Impact; Climate Threat; Climate Vulnerability; Rural Access; Resilience; Vulnerability

Glossary (within the concept 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.
Change Management	A collective term for all approaches to preparing and supporting individuals, teams and organisations in making organisational or institutional changes in order to equip them to address and resolve new or recurring challenges impacting on them and their stakeholders (e.g. impacts of climate variability and change on their operations)
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.
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

ADB	Asian Development Bank
AfCAP	Africa Community Access Partnership
AfDB	African Development Bank
ANE	Administração Nacional de Estradas (National Roads Administration, Mozambique)
AsCAP	Asia Community Access Partnership
CCA	Climate Change Adaptation
CEDR	European Conference of Directors of Roads
DFR	Department of Feeder Roads, Ghana
DUR	Department of Urban Roads
EPA	Environmental Protection Agency
ERA	Ethiopian Roads Authority
EU	European Union
GHA	Ghana Highway Authority
GIS	Geographic Information System
ICT	Information and Communication Technology
IRF	International Road Federation
MoT	Ministry of Transport
MRH	Ministry of Roads and Highways
NADMO	National Disaster Management Organisation
NDF	Nordic Development Fund
PIARC	World Road Association
PMS	Pavement Management Sysyem
PMU	Programme Management Unit, ReCAP
QGIS	Open-source GIS
RAI	Rural Accessibility Index
RAMS	Road Asset Management System
ReCAP	Research for Community Access Partnership
RIS	Road Information System
RRC	Road Research Centre
SARF	South African Road federation
SDG	Sustainable Development Goal
UK	United Kingdom (of Great Britain and Northern Ireland)
UKAid	United Kingdom Aid (Department for International Development, UK)
WB	World Bank

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.

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.

Previous outputs from this project included an overview of current and projected climate threats and their impact on low-volume road infrastructure particularly in AfCAP partner countries; 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 uptake and embedment.

The current focus of the project is 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.

This fifth Quarterly Progress Report presents the progress made since June 2018. The following were achieved during this quarter:

a) Further trialling of the vulnerability assessment method and Climate Adaptation Handbook and training of local engineers from the Ethiopian Roads Authority (ERA) in the purpose and technique of vulnerability assessments for climate resilience;

b) Two successful half-day workshops followed by three days of training and meetings held in Ethiopia (June) and Ghana (July), focussing on the uptake of the vulnerability assessment methodology, the integration of climate adaptation in asset management, and embedment of climate change in policies and strategies;

c) Updating of the Engineering Adaptation Guideline, and the introduction of a Vulnerability Assessment Manual;

d) Production of second drafts of the Ethiopian and Ghanaian Country Reports, which also include the outcomes of the embedment workshops and meetings held during June and July 2018;

e) Successful submission of papers for the AfricaGeo conference to be held in September 2018 and for the SARF/IRF/PIARC conference to be held in October 2018.

1 Background

1.1 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 in Figure 1.

Figure 1 AfCAP partner countries

1.2 Delivery organisations

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

1.3 Key dates

The period of implementation of this project is 33 months, from April 2016 to December 2018. It is conducted in two phases:

- Phase 1: April 2016 to February 2017 (11 months)
- Phase 2: April 2017 to December 2018 (21 months)

2 Project Background

2.1 General

Africa is experiencing more extreme climate events such as droughts, floods, storms and cyclones. 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.

In order to help address this significant threat to Africa's development, the Africa Community Access Partnership (AfCAP), a research programme funded by UKAid with the aim of promoting safe and sustainable transport for rural communities in Africa, 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. The evidence, through a cost-benefit analysis, is to be presented in the final report.

The project is being implemented in two Phases. The focus of Phase 1 (April 2016 to April 2017) 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.

Outputs from Phase 1 addressed 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 (May 2017 to December 2018) has focused mainly 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 the vulnerability assessment and climate adaptation methodologies.

During Phase 2, synergies are being sought with relevant Development Partners' programmes such as those in Ethiopia (World Bank), Kenya (World Bank), Mozambique (EU, NDF, World Bank) and Tanzania (DFID, EU), 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. The stated Development Partners have requested and been provided the current draft Guidelines to inform their own programmes in the lead countries.

2.2 Research objectives

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.*

2.3 Scope of Phase 2

The following five distinct parts have been adopted for Phase 2, reflecting the programme's aim and objectives (cf. Inception Report for Phase 2 (Verhaeghe et al., 2017a) for more information on the methodology and programme):

1. **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.

2. **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.

3. **PART C:** *sustainable enhancement in the capacity of additional AfCAP partner countries*

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

4. **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.

5. **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.

More information on the activities to be provided in Parts A to E are contained in the Inception Report for Phase 2 (cf. Verhaeghe et al., 2017a). Chapters 4 to 7 of this report address the progress achieved on Parts A to D, respectively.

3 Overview of Previous Progress Reports

Table 1 presents an overview of the project activities reported in the Inception Report and subsequent Progress Reports for the period April 2017 to May 2018.

Table 1 Project Activities reported in previous Progress Reports

Document/Period (Reference)	Activities Reported
Inception Report Apr to Jun 2017 (Verhaeghe et al., 2017a)	– Outcomes of two workshops: (a) Tanzania Stakeholder Workshop (April 2017), and AfCAP Workshop held at the 8th Africa Transportation Technology Transfer Conference held in Zambia in May 2017 – Methods and/or screening tools used by the World Bank, the EU, the European Conference of Directors of Roads (CEDR) and the Asian Development Bank (ADB) for mapping climate vulnerability regionally, nationally and locally, and benchmarking of the method proposed by the AfCAP Project Team against these four methods – Progress on drafting of a generic Handbook outlining the climate adaptation methodology, as well as on guidelines for non-engineering adaptation measures.
1st Progress Report Jun to Aug 2017 (Verhaeghe et al., 2017b)	– Progress on the establishment of demonstration sections – The development of a climate threat and vulnerability methodology for application at a local/project level – The development of the draft *Climate Adaptation Handbook* and the three associated guidelines, namely *Change Management Guidelines*, *Climate Threats and Vulnerability Assessment Guidelines*; and *Engineering Adaptation Guidelines*.
2nd Progress Report Aug to Nov 2017 (Verhaeghe et al., 2017c)	– Progress on the establishment of demonstration sections – Further progress made on a climate threat and vulnerability assessment methodology – Feedback on the workshop held in Mozambique in September 2017 – The adaptation of conventional asset management practices to incorporate climate effects – The status of the country progress reports primarily focussing on the aspects of change management.
3rd Progress Report Nov 2017 to Feb 2018 (Verhaeghe et al., 2018a)	– Progress update on demonstration sections – Feedback on workshops held in Ethiopia and Ghana – Updating of the Climate Risk and Vulnerability Assessment Guideline, and modification of the Handbook and Change Management Guidelines by the incorporation of the 'do nothing' strategic option – Status of the Country Reports for the three Lead Countries – Report back to the 1st Inter-Regional Implementation Meeting held in Uganda
4th Progress Report Mar 2018 to May 2018 (Verhaeghe et al., 2018b)	– Progress update on demonstration sections – Embedment workshops and meetings held in Mozambique – Updating of the Engineering Adaptation Guideline – Second draft of Mozambican Country Reports – Report back on poster presentation at the Gender Summit 14 – Africa (Climate Change through the Gender Lens – Focus on Africa) held in Kigali, Rwanda.

4 Activity Progress: Demonstrations (Part A)

4.1 Mozambique

A contractor has been appointed by ANE to construct the demonstration sections on the Mohambe to Maqueze road in Mozambique, funded by the World Bank. However, construction of the demonstration sections has yet to be initiated. The AfCAP Project Team is in regular contact with ANE, who reported towards the end of August that construction work will be initiated soon.

The field team of the Project Team is on standby and ready to mobilise when construction will start.

4.2 Ethiopia

4.2.1 Background on the Butajira to Gubre road

As was reported in 4th Quarterly Progress Report, the road in Ethiopia that was initially identified for the demonstration sections (Tulubolo to Kela road) became a non-viable option on account of the high standard of upgrading that had been proposed, and that in April 2018 three potential new roads were identified by ERA, out of which the Butajira to Gubre road was identified by ERA as a suitable demonstration section.

The Butajira to Gubre road (about 60 km) was found to be of a high standard (similar to the proposed upgrading of the Tulu Bolo to Kela Road) with a 7.2 m double seal bituminous surface, crushed stone base, sealed shoulders, mostly lined side drains and white and yellow road markings in many areas. The road is about four years old, is in generally good condition and there are no plans for upgrading or future work on this road.

4.2.2 Training intervention

A visit to Ethiopia was carried out by Dr P Paige-Green between the 30th of July and 4th of August 2018. The aim of the trip was to carry out trialling of the vulnerability assessment method and Vulnerability Assessment Manual (cf. Chapter 5) and to train local engineers from the Ethiopian Roads Authority (ERA) in the purpose and technique of vulnerability assessments for climate resilience. It was envisaged that some of these engineers would ultimately become trainers and train sufficient engineers from each Region and District to carry out such assessments in order to expedite the process in Ethiopia. The fact that 5 of the 12 participants were from the Road Research Centre (RRC) is a strong indication of the importance attached to the exercise and the potential for the RRC to be strongly involved in training as well as research.

Twelve Engineers were identified by ERA and attended all of the field work. Their names and affiliations are provided in Annex 1, as well as the programme of this capacity building exercise. The engineers were divided into four teams of three for the field assessment exercise and feed-back of results and adaptation options. Each team included staff from different departments within ERA.

Prior to departing for the Field Assessment exercise, a presentation discussing the objectives and techniques to be followed was presented at the ERA Head-office to all of the delegates.

Despite the current status and condition of the Butajira - Gubre road, successful demonstration of the assessment technique and manual was possible with almost all of the facility/attributes described in the Visual Assessment Manual being present at some point along the road. This allowed significant discussion of the rating system and the attributes with the trainees. The only issues that could not be demonstrated in the field were the surface erosion of unpaved roads and instability of fills, despite some high embankments being inspected. The Assessment results are shown in Annex 1. Some of the photographs that were taken to illustrate certain defects are provided in Figure 2.

Figure 2 Some defects observed on the Butajira to Gubre road

Poor shoulder maintenance and severe erosion of side drains

Blockage of side drains by landslide debris

Damage to erosion protection works

Erosion of river bank and damage to protection works

Poor maintenance of lined side drain

Poor control of water next to road leading to erosion of bridge approach fill

One issue raised by some of the delegates was that all roads (paved and unpaved) as well as bridges and culverts are regularly assessed in great detail every year for their respective Management Systems and that the vulnerability assessment was therefore probably a duplication of this work. While it is admitted that the existing assessments will be invaluable for providing additional information and detail to the vulnerability assessments, different issues are assessed from a different perspective (i.e. longer term effects). During the vulnerability assessments, the situation should be looked at in terms of expected changes based on the current visual evidence, unlike the current assessment process that monitors the existing condition. The standard assessment forms used by ERA for the routine assessment activities are presented in Annex 1.

4.2.3 Conclusion

It was clear from the discussions with the trainees that various sections of the Visual Assessment Manual and assessment form required expansion and clarification. Basic assumptions during preparation of the documents were not always clear to young and often inexperienced engineers and have required clarification. These have been made.

A request has been made to ERA that each group analyses the results of the assessments and makes suggestions as to appropriate adaptation measures for the road. As the predicted climate changes are expected to be minimal along the road, it was assumed that the number of extreme events will double in future, for adaptation purposes. The results are still being awaited.

4.3 Ghana

The format of the Climate Change vulnerability assessment training in Ghana will be similar to that of Ethiopia. It has been recommended that the visit will be undertaken between the 29th of October and the 3rd of November. The proposed programme and resources for this week are as follows:

- Sunday 28th October: arrival of Dr P Paige-Green in Accra
- Monday 29th October: Travel to Koforidua in morning, and briefing session at Training Centre in afternoon
- Tuesday 30th October: Site assessment exercise - Kukurantumi road - Team to walk and assess 2 to 3 km of each a paved and an unpaved section
- Wednesday 31st October: Site assessment exercise - Team to walk and assess at least 3 km of the road from Anum Apapam to Obuoho
- Thursday 1st November: Team to walk and assess at least 3 km of the road from Akwesiho to Twenedurase
- Friday 2nd November: Debriefing and adaptation exercise at Training Centre - return to Accra late afternoon.
- Saturday 3rd November: Dr Paige-Green returns to South Africa.

It has been suggested that a team of not more than ten road engineers, hydrologists and geotechnical engineers, led by Dr Paige-Green, would perform the assessment, inclusive of the identification of vulnerable sections and/or structures, and the formulation of proposal and concepts designs for remedial action to render these sections/structures climate resilient.

The only equipment necessary would be a measuring wheel that can measure 100 m intervals along the road and clipboards for each team member. Each team member will have a hard copy of the Vulnerability Assessment Manual for use on site; an electronic copy of the Manual will be sent to the team members prior to this training intervention. The logistics will involve the provision of a small 10 to 12 seater bus capable of navigating the roads identified, the accommodation of the MRH/DFR officials and arrangements for lunch and water during the site visits and trips.

4.4 Demonstration and application of vulnerability assessment procedures

Two 'soft' demonstration procedures have been developed and implemented in the three Lead Countries to guide practitioners through the processes of:

- Identifying vulnerable districts, as well as vulnerable road links within these districts, by using the vulnerability assessment framework developed during Phase 1 of this project and further improved on during Phase 2, for the purpose of developing local capacity for applying the vulnerability assessment *methodology* on a broader scale; and

- Initiating the embedment of '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.

Included in the above is the training of road condition assessors for identifying potential environment-related risks and threats within and outside the immediate road environment. This training has already been provided as part of the workshops and associated hands-on field training in the three countries (cf. 2nd and 3rd Progress Reports), with further training provided in Ethiopia and planned for Ghana (cf. Sections 4.2 and 4.3 above).

In addition to the above, half-day workshops and two to three days of meetings and further interactions in between were held in the three Lead Countries to not only address the implementation of the vulnerability assessment methodology and its integration in decision support systems, but also to provide support and technical advice to road authorities on the uptake and embedment of climate change/adaptation in policies, strategies and plans, among others (i.e. Part D of Phase 2).

The first country visit (Mozambique) was completed in April 2018, as reported in the fourth Quarterly Report. The second and third country visits took place in June 2018 (Ethiopia) and July 2018 (Ghana). The discussions held and the outcomes thereof are summarised in Chapter 7.

5 Activity Progress: Capacity Enhancement in Three Countries (Part B)

5.1 Vulnerability Assessment Manual (new deliverable)

5.1.1 Motivation for new deliverable

The impact of climate change on roads will require that vulnerabilities are identified and adaptations made to minimise the potential damage to the road infrastructure. These climate changes include changes in temperature and precipitation, increased windiness, sea-level fluctuations and the likely occurrence of increased numbers and frequencies of extreme events.

Currently, for road management and maintenance and rehabilitation planning purposes, visual condition assessments of the road network are usually routinely carried out at specified frequencies. These normally look at the road condition, classifying problems such as cracking, deformation, rutting, potholing, etc. by degree and extent to prioritise and budget for follow-up management operations. Generally, only the road carriageway area is assessed. It is, however, necessary to add to this information to provide the required inputs for climate resilience assessments and the implementation of adaptation techniques.

It is for this purpose that the Project Team has developed a *Vulnerability Assessment Manual* to support Stage 2 of the climate adaptation methodology contained in the *Climate Adaptation Handbook* and supplement the *Engineering Adaptation Guidelines*.

5.1.2 Scope of Manual

The Vulnerability Assessment Manual describes the nature and collection of data that normally does not form part of routine data collection for asset management purposes. This includes issues such as erosion, problem soils, drainage from the road and in the road's near environment as well as from outside the road reserve, instability of embankments and cuttings, construction issues and maintenance problems. Other indications of possible problems that may be observed on certain sites, such as the accumulation of sand and debris (due to wind and flooding), excessive vegetation caused by increased rainfall and high temperatures, leading to sight-distance and passability problems, etc. are also noted and addressed in the Manual.

A standard form for recording the necessary data is provided in the Manual. The assessment form contains cells, for a *degree* and *extent* rating of a distress. These ratings have to be determined on a 5-point scale where they exist (0 is entered if there is no evidence of the distress). A typical input would be 3/2 for a degree 3 and extent 2 problem. General descriptions of the degree and extent classifications are provided in Tables 2 and 3 below. The Manual contains visual imagery as to what would constitute typical 1, 3 and 5 degree of distress.

Table 2 General description of degree classification

Degree	Severity	Description
0	-	No potential vulnerabilities visible.
1	Slight	Only the first signs of distress are visible but these are difficult to discern. No adaptation measures necessary.
2	Slight to warning	Distress obvious but not at Degree 3
3	Warning	Start of secondary defects. (Distress notable with respect to possible consequences). Adaptation in the medium term may be necessary.
4	Warning to severe	Secondary defects clearly visible but not at Degree 5 yet.
5	Severe	Secondary defects are well developed (high degree of secondary defects) and/or extreme severity of primary defect. Adaptation measures should be implemented immediately.

Table 3 General description of extent classification

Extent	Description	Percentage of length*
1	Isolated occurrence. Not representative of the segment length being evaluated.	< 5
2	Occurs over parts of the segment length. More than isolated.	5 – 10
3	Intermittent (scattered) occurrence over most of the segment length (general), or Extensive occurrence over a limited portion of the segment length.	10 – 25
4	More frequent occurrence over a major portion of the segment length.	25 – 50
5	Extensive occurrence over the entire length	> 50

* The percentage of extent is only a guideline for the assessors and should not be literally interpreted. Local distresses highly likely to affect accessibility (i.e. high degree of severity) and thus requiring urgent spot improvements, and which may have an extent rating of only 1, will be catered for by weighting the distresses in asset management systems in which climate risks have been embedded.

For expedience and to minimise costs, this data collection should be done during the routine visual condition assessments, by the assessment teams or others trained specifically for the purpose. Although the objectives of the surveys differ, there may be a need to harmonise Tables 2 and 3 with the methodologies being developed under the AfCAP GEM and the LTPP monitoring projects where assessment of degree and extent of defects also form part of the visual assessment protocols.

5.1.3 Validation of Manual

The Manual, as well as the Climate Adaptation Handbook and associated Guidelines, were used for the training of Ethiopian practitioners in the execution of vulnerability assessments. Feedback received from these practitioners has been used to effect improvements to the Manual, and also to the visual assessment form.

The updated version of the Manual will be tested in Ghana towards the end of October and early November 2018 to reassess the additional value and usefulness of the Manual before releasing it for general use.

5.2 Status of Handbook and other Guidelines

Since the previous series of workshops, and follow-up embedment workshops/meetings and training on vulnerability assessments, further improvements have been made to the Handbook and linked Guidelines. These documents have now reached the point that they should be made available to the ReCAP community of practice for implementation and, at the same time, for eliciting feedback on their usefulness and further improvements required.

6 Activity Progress: Capacity Enhancement in Other Countries (Part C)

6.1 AfricaGEO 2018 Conference

A paper titled "Implementing a GIS Based Methodology for Determining Highly Vulnerable Rural Access Roads to a Changing Climate in Ethiopia" authored by K Arnold, A le Roux and S Khuluse-Makhanya has been accepted as a peer-reviewed paper for presentation at the AfricaGEO 2018 Conference to be held at Emperors' Palace, South Africa, between 17 and 19 September 2018.

The abstract of the paper reads as follows:

Climate-related natural disasters have been steadily increasing in both incidence and intensity across the globe over the last century. This is especially true for Ethiopia given the country's high and recurrent exposure to extreme droughts and floods, the two most notorious disasters that have impacted on the country's development trajectory and the livelihoods of its citizens. Climate-related risks are the major driver of hunger and food insecurity in Ethiopia, with the majority of poor communities being most vulnerable to their impacts. Due to the high degree of food and water insecurity caused partially by climate variability, it is argued that improved rural accessibility is vital to reducing the number of highly vulnerable communities, and increasing rural resilience. In this paper, a geospatial indicator-based risk and vulnerability assessment method was applied as a tool for determining rural access roads that are highly vulnerable to changing climate in Ethiopia. The assessment is intended to help guide, through prioritisation, the identification of highly vulnerable areas where appropriate climate adaptation measures would be most effective in reducing the impacts of climate variability and change. The research methodology relies on using GIS processes and spatial data to calculate a composite vulnerability index, the combined output of a hazard exposure index as well as a road criticality index, for identifying regions most at risk. It was found that almost half of Ethiopia's districts, mostly in the Awash River Basin and southern Somali lowlands, are highly vulnerable to a changing climate in terms of the impact on rural accessibility. The paper further elaborates on the processes used to identify major climate hazards affecting roads in Ethiopia as well as open source data sets used in this analysis. The methodology was validated through an elaborate stakeholder engagement process and was found to be an accurate, efficient and effective way of identifying high-risk regions in terms of community dependence on roads for accessibility and the physical impact of climate on road infrastructure in Ethiopia.

6.2 SARF/IRF/PIARC Conference

A paper titled "Making Africa's Roads More Resilient to Climate Change" authored by Dr P Paige-Green and B Verhaeghe that was submitted to the SARF/IRF/PIARC Conference for peer review has been accepted and will be presented by Dr Paige-Green at the Conference on 9 October 2018 (first day of Conference to be held in Durban, South Africa) under the theme "Preserving Africa's Road Assets".

The abstract of the paper reads as follows:

The inevitable impacts of climate change on the already stressed low volume rural road networks in Africa will have dire consequences in many countries. These networks generally suffer from a lack of appropriate construction standards and maintenance and are particularly prone to damage by the vagaries of the climate. As these changes in climatic conditions increase, the impacts on road networks will become more severe.

An assessment of these impacts related to various climatic stressors has indicated a wide range of adaptation measures to improve climate resilience. However, it is essential that the road networks are assessed adequately to identify vulnerable areas and the necessary adaptation techniques. This will involve the visual assessment of all roads within each network by assessors trained to identify specific conditions and consequences. Many of these are geomorphological issues such as run-off, erosion, slope instability and material degradation. In addition, subgrade conditions (materials and moisture) need to be determined.

The paper describes the main stressors and impacts on various components of the infrastructure and identifies the properties that need assessment and how this should be carried out.

6.3 CAPSA Conference

An abstract submitted for the Conference on Asphalt Pavements for Southern Africa (CAPSA), has been accepted. The conference will be held in October 2019 in Sun City, South Africa.

The title of the proposed paper is as follows: "The prioritisation and adaptation for climate change resilience of rural access roads", and the abstract reads as follows:

It has been estimated that by the end of the century, $150 billion will be required to repair and maintain existing roads in Africa, the majority of which will be low volume rural access roads. Research into the prioritisation and adaptation of roads to improve their climate resilience has shown that it is essential to provide good vulnerability assessment information to allow unbiased and equitable prioritisation for the installation of adaptation measures. Such measures will depend on the expected modes of climate change (higher or lower precipitation, higher or lower temperatures, etc.) as well as the nature, topography and materials along the road alignment. Most adaptation techniques will rely on exiting good engineering principles, although innovative solutions directly applicable to each situation will be necessary for low volume roads to ensure economic feasibility.

6.4 Other technology and transfer events

In addition to CSIR informal information exchanges with organisations such as Pakistani Highway Research and Training Centre among several others, other events were used to promote both ReCAP and the Climate Adaptation programme.

One such events was the *Tony Brink Memorial Lectures* organised by the South African Institute for Engineering and Environmental Geologists (SAIEG) where Dr P Paige-Green presented lectures on *Climate change and transport infrastructure: Engineering geological considerations*. These lectures were held in main centres in South Africa, also to raise awareness for practitioners that are operating in Africa.

6.5 Publication of the Handbook and Guidelines on the ReCAP Website

As was noted above, continual changes are being made to the Climate Adaptation Handbook, the three associated Guidelines and now also to the new Vulnerability Assessment Manual.

It was noted in the 4th Progress Report that, subject to a meeting with and approval obtained by ReCAP PMU, these documents should be published as soon as possible on the ReCAP Website, enabling practitioners in other sub-Saharan countries as well as allowing interested parties from other regions/ continents to access the documents and start implementing the relevant parts. The Project Team has already received several requests for the sharing of these documents for academic or other purposes.

As was suggested, these documents would be marked as "preliminary drafts" and will include a contact point for any enquiries or comments the readers/users might have. The feedback received would assist the Project Team to effect further improvements to the documents before they are formally launched.

7 Activity Progress: Embedment (Part D)

7.1 General

Part D of the project focusses on uptake and subsequent embedment of outcomes aimed at a range of levels from informing national policies, through regional and district planning, down to practical guidance on delivery at rural road level.

Whilst the latter has been addressed in preceding Parts of the project (A to C), particularly focussing on the engineering level (i.e. identification of vulnerabilities and adaptation solutions, supported by the Climate Adaptation Handbook, the three associated guidelines and the newly developed Vulnerability Assessment Manual), the former focusses on policies, strategies and plans, and the embedment of climate change into those with a particular focus on protecting and sustaining rural accessibility.

A series of workshops and subsequent meetings have been held in the three Lead Countries (Ethiopia, Ghana and Mozambique) with the aim to:

1. Identify and agree on areas and actions for the Project Team to assist the three Lead Countries with the embedment of climate resilience in policies, strategies and plans;
2. Explore the integration of climate adaptation considerations in asset management; and
3. Explore the embedment of the vulnerability assessment methodology in decision support systems, including Geographic Information Systems (GIS), and to demonstrate how it can be applied to support high-level decision making.

The Project Team's members involved in these workshops and meetings were Mr Johan Maritz (policy), Ms Kathryn Arnold (country-level vulnerability assessments) and Mr Michael Roux (asset management).

The outcomes of the workshops and meetings held in Mozambique were reported in the 4th Quarterly Progress Report, while those held with Ethiopia and Ghana are summarised below, with more details provided in Annex 2 (Ethiopia) and Annex 3 (Ghana).

7.2 Outcomes of Workshops and Meetings held in Ethiopia

Between 5 and 8 June 2018, a series of workshops and meetings were held with Ethiopian stakeholders to address the topics listed in Section 7.1 above, inclusive of the transfer of knowledge and information from the AfCAP Project Team to Ethiopian stakeholders.

The workshops and engagement activities held during the four days are outlined in Table 4 below. The proceedings are presented in Annex 2.

Table 4: Four-day workshop and engagement activities; Ethiopia, 5-8 June 2018

Day 1: Tuesday, 5 June 2018 (at ERA)
Meeting with representative of ERA
WORKSHOP/MEETINGS INVOLVING POLICY MAKERS, DEVELOPMENT PARTNERS AND INSTITUTIONS INVOLVED IN CLIMATE RESILIENCE
Introduction/discussion of the AfCAP Climate Adaptation project and its objectives; overview of Climate Adaptation Handbook/Guidelines
Introduction/discussion of climate change assessment methodologies and linkages to road asset management
Presentation/Discussion on change management issues related to climate change
Plenary Discussions/Summary

Day 2: Wednesday, 6 June 2018 (at ERA)
Brief presentation by ERA GIS person providing overview of GIS and it use in ERA (to assist team to understand current use, etc.) **Brief presentation by a person dealing with Asset Management in ERA** (to assist team to understand current system, use, etc.) **Technical training session:** Exploring the embedment of climate change in vulnerability assessments and decision support systems, including training and policy implications.
GIS information set training session (with GIS persons in ERA)
Day 3: Thursday, 7 June 2018
Meeting at **Environment and Climate Research Centre** at Ethiopian Development Research Institute.
Day 4: Friday, 8 June 2018
Meeting with the **World Bank**
Meeting with **Senior Management of ERA:** The outcomes of the previous days' deliberations; discussion and agreement on policy and embedment actions; and identification of any assistance that AfCAP and the Project Team could provide moving forward.
Transfer of additional files to Road Asset Management Department

Following the interactions, a number of items were identified and prioritised by ERA management representatives for immediate action. These are summarised in the sections below (more information can be obtained in Annex 2):

7.2.1 Action Item 1: World Bank study on climate resilience for roads

During engagements with the World Bank, reference was made to a study that was recently completed, entitled "Increasing Climate Resiliency of the Ethiopian Road Network" and it was suggested that a copy of the project report be requested from ERA, given its relevance to the AfCAP Climate Change Adaptation project.

This item was requested from Mr Ayele and was subsequently emailed to the team.

7.2.2 Action Item 2: Spatial information transfer

During the second day of the workshop and engagements, a session was held with Eng. Mohammed Abduraheman (Deputy Director General: Operations Department). Given his interest, he requested a set of the geospatial information. The geospatial map package was successfully installed and tested on his computer. He was also taken through the contents and the accompanying documentation. During the session, the ERA GIS representative, Mr Hawi Adupmo, was also present. He also received a copy of the geospatial package.

A separate discussion was held with Mr. Yosef Tamiro and he also was given a copy of the geospatial package (See Figure 3). These activities therefore concluded the transfer of the prepared spatial information to ERA.

Figure 3 Providing map package to Pavement Management System Team Leader.

7.2.3 Action Item 3: ERA Road Asset Management System and Climate Assessments

The AfCAP Project Team emphasized that it is key to link climate information to systems such as the pavement and bridge management systems. The spatial information currently available (at district level) could form the first round of information embedment. There is however also a more important need to include climate risk information at the local/road link level.

The Road Asset Management Department has several current systems including a Pavement Management system and a Bridge Management system. These two systems do not currently incorporate climate risk related information. ERA is currently engaged in a project for the Development of a Modern Road Asset Management System. The project has been launched and is funded by the AfDB. It was agreed that this project provides the ideal opportunity to embed climate change data and indices in the RAMS.

Another shortcoming that was identified is the lack of a policy to include climate aspects in the road asset management systems. Currently ERA does not have a climate change adaptation (CCA) policy. In order to fully operationalise CCA in ERA, such a policy should first have to be adopted. Mr Alemayehu Ayele indicated that the starting point would be to incorporate a CCA strategy in the Asset Management Strategy Project that is in the process of being completed. He indicated that he would task the consultants dealing with the Asset Management Strategy Project to add Climate Change Adaptation strategy components.

7.2.4 Action Item 4: Risk and climate threat vulnerability assessment: (linked to spatial information – Action Item 2)

Although climate related spatial information was supplied to ERA (See Action Item 2), the following aspects still have to be addressed:

- Where would be the best suitable place to house spatial information within ERA?
- How can the spatial information linkages between ERA and other institutions be established, and with whom?

- Who in ERA will be the key person responsible for climate change information, etc.?

As a result of the AfCAP work in Phase 1 (and expanded in Phase 2), climate change spatial data items are available for use by ERA (and other entities in Ethiopia). What has to be decided is the best place to house the information in ERA and the mechanism that could be used by ERA to make this climate change information available to other ministries and state entities.

Regarding the hosting of the geospatial information at ERA, it was concluded that it would be placed best in the Planning and ICT Department. This is due to the fact that this Department looks at environmental and social issues and would benefit from a range of (spatial) data categories (not limited to roads). According to Mr Alemayehu Ayele, it would then also be easier to access this information across the various departments and directorates within ERA. The current constraint is that their GIS capacity is currently limited and it would need to be expanded[1]. This can also be addressed by partnering/linking with other institutions, such as the Water and Land Resource Centre (Addis Ababa University) that has good GIS capability and that could also assist with training if required.

There are several institutions that ERA can establish connections with. These institutions are already active in Climate Change issues, and are also capacitated to deal with geospatial information. They include the:

- National Meteorology Agency,
- Ethiopian Mapping Agency, and
- Water and Land resource Centre (Addis Ababa University)

Regarding sharing the AfCAP geospatial information with the wider Climate Change community, this could also be the institutions to start with (possibly as part of a collaboration forum).

Currently there is no person in ERA that carries the responsibility to deal with Climate Change. ERA will need to consider tasking someone to take up the responsibility. Such a person would then deal with the Climate Change issues across all departments and directorates in ERA and should thus perform a coordination role.

7.2.5 Action Item 5: Research material/outputs provided

The Handbook and its associated guidelines were provided to ERA, both in printed copies during the two workshop days as well as in electronic format. The request was made for users of these documents to give input and comments that could be used to finalise the documents before they are shared with other AfCAP member countries.

Mr Alemayehu Ayele indicated that they will study the documents and provide written comments. ERA was requested to provide any inputs or comments by mid-July 2018[2].

7.2.6 Action Item 6: Inclusion of Climate Change Resilience in Policies/Plans:

Policy issues also need to be addressed to enable embedment of climate change information in ERA activities and systems. As stated earlier, the starting point would be to include this ERA's new Asset Management Strategy currently being completed. Mr Alemayehu Ayele indicated that he would task the consultants dealing with the drafting of the Asset Management Strategy to include CCA aspects.

[1] Future phases of AfCAP project to expand capacity development can also be considered to assist with GIS analysis capacity development.

[2] At the time this report was produced, the AfCAP Project Team had as yet not received feedback on the Handbook and Guidelines. A reminder was sent to ERA.

7.3 Outcomes of Workshops and Meetings held in Ghana

Between 10 and 13 July 2018, a series of workshops and meetings were held with Ghanaian stakeholders to address the topics listed in Section 7.1, inclusive of the transfer of knowledge and information from the AfCAP Project Team to Ghanaian stakeholders.

The programme of the four-day interaction is presented in Table 5 below.

Table 5 Four-day workshop and engagement activities; Ghana, 10-13 July 2018

Day 1: Tuesday, 10 July 2018 (at the MRH)
Meet with Chief Director Mr Edmund Offei-Annor and Director for Research, Statistics and Information Management, Mr Ernest Obeng.
WORKSHOP/MEETINGS INVOLVING POLICY MAKERS, DEVELOPMENT PARTNERS AND INSTITUTIONS INVOLVED IN CLIMATE RESILIENCE
Introduction/discussion of the AfCAP Climate Adaptation project and its objectives; overview of Climate Adaptation Handbook/Guidelines.
Introduction/discussion of climate change assessment methodologies.
Presentation/Discussion on change management issues related to climate change.
Plenary Discussions/Summary.
Day 2: Wednesday, 11 July 2018 (at the MRH)
Presentation by Richmond Ankrah (IT/CMS Admin DFR) providing overview of GIS and it use in the DFR (to assist team to understand current use, etc.) Introduction of **road asset management and links to climate change.** **Technical session:** Exploring the embedment of climate change in vulnerability assessments and decision support systems, including training and policy implications.
GIS information set training session (with GIS persons in the MRH)
Day 3: Thursday, 12 July 2018
Meeting with Mr Kwasi Agyeman-Boakye (Policy and Planning, MRH) Meeting with Mr Ernest K. Obeng (Director for Research, Statistics and Information Management, MRH)
Day 4: Friday, 13 July 2018
Meeting with Mr John Kobina Richardson (World Bank)

Following the interactions, a number of items were identified and prioritised by MRH/DFR management representatives for immediate action. These are summarised in the sections below (more information can be obtained in Annex 3):

7.3.1 Action Item 1: Contribution to the new National Transport Strategy

This item was raised during a number of discussions as well as during the workshops. There is a current World Bank funded project to draft a new National Transport Strategy. This therefore provides the ideal opportunity to incorporate climate change issues. The previous policy did not reflect climate issues at all. Currently, the consultant responsible for the project is preparing the draft Green Paper for validation by stakeholders. When the draft Green Paper had been made available to the project steering committee, a copy had to be forwarded to the AfCAP team for comments.

The draft Green Paper was submitted by the end of July (Agyeman-Boakye, 2018). The AfCAP Project Team provided their inputs and comments on the Green Paper.

7.3.2 Action Item 2: Spatial information transfer

During the second day of the workshop and engagements, a session was held with the Mr Richmond Ankrah (Head of the GIS/IT Section in DFR). The geospatial map package was provided to him and he was also taken through the contents and the accompanying documentation. A further set was provided on a USB data stick to Dr Patrick Bekoe for further distribution as well as for those not able to use the prepared DVD disks.

Regarding the hosting of the geospatial information at the MRH, it was concluded that it would best be placed within the GIS/IT Section in the DFR.

These activities therefore concluded the transfer of the prepared spatial information to the MRH.

7.3.3 Action Item 3: The MRH Road Asset Management System and Climate Assessments

The DFR road asset management system is a GIS-based system being used by Mr Richmond Ankrah and his colleagues. In the short term they will continue to use this system to manage and plan their road projects and maintenance. As the geospatial map package had been provided to Mr Ankrah, it is available to be drawn into the road asset management system. The spatial information currently available (at district level) could form the first round of information embedment. For the longer term it was indicated that the MRH is currently investigating a comprehensive Road Asset Management system that can possible be sourced and implemented by all the Departments within the MRH. It is in an exploratory phase with a final decision still to be made.

Currently the MRH does not have a climate change adaptation (CCA) policy. In order to fully operationalise climate change adaptation in the MRH, such a policy would have to be adopted. In the interim, added information to the road asset management system (GIS-based) can assist in the prioritisation of projects.

7.3.4 Action Item 4: Risk and climate threat vulnerability assessment: sharing the information

Although spatial information has been supplied to the MRH (See Action Item 2) it still raises several questions:

- How can the spatial information linkages between the MRH and other institutions be established, and with whom?
- Who in the MRH will be the key person responsible for climate change information, etc.?

As a result of the AfCAP work in Phase 1 (and expanded in Phase 2), climate change spatial data items are available for use by the MRH (and other ministries). The issue was the mechanism that could be used by the MRH to make this climate change information available to other Ministries and State Agencies.

Mr Obeng concurred that the MRH needs to encourage the relationship with departments and agencies that **are involved in climate science** such as NADMO, ETA and others. He indicated that they will invite them to the MRH to explore in more detail what information they have, and how they could possibly support the MRH. This will be an action initiated by the MRH and will address the sharing of the AfCAP geospatial information with the wider climate change community.

One forum where climate change work could also be shared and discussed (focussed on the roads sector) is the Transport Sector Working Group that meets quarterly and is coordinated by the World Bank and the MoT.

Mr Richardson (World Bank representative) indicated that AfCAP could be invited to such a meeting to inform the group on the AfCAP work.

7.3.5 Action Item 5: Research material/outputs provided

The Handbook and its associated guidelines were provided to the MRH in printed and electronic formats during the two workshop days. Users of these documents were requested to give input and comments that could be used to finalise the documents before they are shared with other AfCAP member countries. Mr Obeng indicated they would study these documents and provide comments where feasible.

In a separate meeting held with Mr John Richardson from the World Bank, he indicated that they would also provide comments/feedback.

7.3.6 Action Item 6: Assistance with a MRH Research Policy to incorporate climate science elements

Mr Obeng also raised the importance of developing a research policy for the MRH. This had already commenced, but it could also draw on the climate science work done by AfCAP as well as other Ministries and Agencies. He requested that AfCAP make comments and give inputs once a basic policy has been drafted. He requested that the AfCAP team consider this contribution (also in light of the AFCAP work and related policy embedment aims). He would make this draft policy available to AfCAP for comments.

7.4 Country reports

Second drafts of the Country Reports for Ethiopia, Ghana and Mozambique have been drafted. Each report contains the key climate challenges and vulnerabilities and are structured as follows (order of items may differ between countries):

- Approach
- Climate and projected changes
- Physiography, Livelihoods and Rural Connectivity
- Vulnerability to Climate Change
- Overview of Policy Environment
- Change Management options for Adaptation
- Actions for Implementation

The Actions for Implementation were mainly derived from the in-country meetings that were held with key stakeholders of the three countries.

These reports have to be reviewed by AfCAP PMU before they can be sent to the three Lead Countries for further assessment.

8 Progress against Target Dates

8.1 Summary of Progress

The planned start and completion dates for Work Packages are shown in Table 6 below (note that these are as per the dates shown in the Inception Report). Delivery dates that have not been met, or are unlikely to be met, are shown in **red**. New estimates for the delivery dates for these activities are shown in **blue**. The new estimates are dependent on the level of cooperation that the Project Team will receive from the AfCAP Lead Countries. Some of the current concerns with the Demonstration sections in particular were raised in Chapter 4 of this report, and addressed further in Section 8.2.

The overall project planning allowed for some float in the programme to accommodate unexpected events such as those currently experienced. However, these and other potential future risks will have to be managed very carefully from now on to ensure that the Project meets all deliverables by the set deadline of December 2018.

Table 6 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 (demonstrations)* • *Demo vulnerability assessment & RAMS*	15 June 2017 *1 July 2017* *To be determined* ***1 May 2018*** *End construction* *1 July 2017*	30 November 2018 *31 July 2017* *To be determined* ***31 October 2018*** *30 November 2018* *27 July 2018*
A.2: Ghana demonstration programme • *Detailed design* • *Construction* • *Monitoring & evaluation (demonstrations)* • *Demo vulnerability assessment & RAMS*	15 June 2017 ***10 July 2017*** ***(to be determined)*** ***30 October 2017*** ***(to be determined)*** *End construction* *1 July 2017*	30 November 2018 ***18 September 2017*** ***(to be determined)*** ***19 March 2018*** ***(to be determined)*** *30 November 2018* *27 July 2018*
A.3: Ethiopia demonstration programme • *Detailed design* ***Based on new road identified*** • *Construction* • *Monitoring & evaluation (demonstrations)* • *Demo vulnerability assessment & RAMS*	15 June 2017 ***7 August 2017*** ***1 June 2018*** ***13 November 2017*** ***(to be determined)*** *End construction* *1 July 2017*	30 November 2018 ***13 November 2017*** ***15 July 2018*** ***19 March 2018*** ***(to be determined)*** *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** **31 July 2018**
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 June 2018** 30 April 2018 **30 September 2018**
B.3: Training modules and training workshops • 1st set of workshops • 2nd set of workshops	15 June 2017 **2 April 2018** **1 June 2018**	**16 October 2017** **7 February 2018** **27 July 2018** **31 October 2018**
B.4: Translation of documents in Portuguese	24 July 2017 **1 May 2018**	30 April 2018 **31 October 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

8.2 Proposed Actions

The following actions, almost identical to those stated in the 4th Progress Report, are being undertaken on Part A and Part B in particular to ensure that project deliverables will be met by December 2018:

- **PART A:** With the exception of Mozambique, the physical executions of the demonstration sections are falling significantly behind schedule. The Project Team is concerned that, even if the construction processes in Ethiopia and Ghana were to be accelerated, there will be no time left to monitor the construction and performance monitoring of the implemented adaptation measures in Phase 2, unless these were to be postponed to Phase 3 of the project.

  Since the focus of Phase 2 is on the demonstration and embedment of the climate adaptation methodologies proposed, it was recommended to the PMU that sharing common understanding on vulnerability assessments and appropriate engineering designs, and the embedment thereof, are probably of greater importance right now than to construct (i.e. focus on quality control of the implementation of proposed designs) and to monitor the performance of demonstration sections, especially in view of the (apparent) challenges experienced by ERA and DFR to mobilise funding for construction of new or previously designated roads, respectively.

Effort has been redirected towards the identification of new sites that are being challenged by climate effects. The Project Team together with nominated senior country engineers will make use of these sites to further validate and implement the adaptation methodology through training with the expectation that the learning will be diffused nationally. One such hands-on training event has already been completed (Ethiopia), with training of Ghanaian engineers planned for late October, early November 2018.

It should be noted that the demonstrations of the vulnerability assessments and the exploration into the integration of climate change in decision support systems (such as asset management systems), which both are included in Part A, have been completed ahead of schedule. These activities were conducted in parallel with the investigation into policy and other issues (Part D) through mini-workshops, training and discussion sessions held in the three countries. This said, a significant number of action items were recorded for each of the three AfCAP Lead Countries, which will require follow-up engagements with these countries.

- **PART B:** Delays were experienced with the initiation of first set of workshops following the production of the Handbook and Guidelines, mainly caused by the fact that the PMU decided that these workshops had to be held at the previously identified demonstration sites to demonstrate and validate the vulnerability assessment and engineering adaptation methodologies proposed. In retrospect, it has to be acknowledged that this was indeed the correct decision; the benefits that were accrued following this decision outweighed the lost time.

  Sufficient float has been provided in Phase 2 of the project to accommodate such delays, and the Project Team is of the belief that Part B will be completed by contractual end date of December 2018.

  The Project team is of the opinion that the updated Handbook, Guidelines and Manual should be released and made available on the ReCAP Website as soon as possible so that interested parties and practitioners across and beyond the sub-Saharan African region could start using and interrogating them. They should be marked as “Preliminary drafts” and should have the details of a contact person (B Verhaeghe) provided to receive and respond to enquiries and comments, and to record these, as inputs into the revision and finalisation of the documents.

- **PART E (Recommendations for Phase 3):** The completion of the three mini-workshops in the three AfCAP Lead Countries has enabled the Project Team to be in a better position to identify and prioritise additional assistance that the three countries may require to fully embed climate adaptation in their policies, strategies and operations.

  The following activities for uptake and embedment across AfCAP and AsCAP partner countries are proposed for consideration by the ReCAP PMU:

  - Independent review of Handbook and Guidelines, as was recommended at the Team Leader Workshop held in February 2018;
  - Informing/supporting policy changes in each ReCAP country by mapping risks and vulnerabilities within the context of rural accessibility and also to streamline policy work in conjunction with other initiatives (e.g. SDG 11 –RAI). Supporting these are:
    - If required, downscaled modelling of climate change for each country (i.e. to address the question “Where do we get information on future climate predictions?”), and to provide projections of future extreme events and the implications thereof at local level;
    - Vulnerability assessments (at “district” level within countries) similar to those completed for the three Lead Countries;
    - Collaborative (co-developed) Country Reports similar in scope to those developed for the three Lead Countries. The emphasis is on “collaborative”, i.e. involvement of local stakeholders/expertise so as to strengthen knowledge transfer and to ensure country buy-in from the onset.

- Roll-out and training/knowledge transfer of the handbook & guidelines to other ReCAP countries (individually), followed by further improvements to the Handbook, Guidelines and Manual by the integration of additional local/regional inputs received. This could include:
    - Training of local engineers in these countries (or train-the-trainer programmes), focusing on vulnerability assessments and the design of adaptation measures (i.e. probably at least a week spent on 'assessment' and a week on 'adaptation').
    - Incorporation of additional engineering adaptation solutions in Guidelines based on feedback received so as to reflect unique local conditions (sea level rise, wind-blown sand conditions, etc.);
- Embedment of climate adaptation in national decision support and asset management systems (similar in scope to what has been done for the three Lead Countries);
- Revisiting three Lead Countries to monitor/assess level of embedment of recommendations made;
- Inter-regional ReCAP Seminar/Conference focusing on Climate Adaptation, or on all ReCAP Regional Projects.

9 References

Head, M., Verhaeghe, B., Paige-Green, P., le Roux, A., Makhanya, S., Arnold, K. (2017). Climate Adaptation: Risk Management and Resilience Optimisation for Vulnerable Road Access in Africa: Climate Adaptation Handbook, GEN2014C. London: ReCAP for DFID.

Head, M. and Verhaeghe, B. (2017). Climate Adaptation: Risk Management and Resilience Optimisation for Vulnerable Road Access in Africa: Change Management Guidelines, GEN2014C. London: ReCAP for DFID.

Le Roux, A., Makhanya, S., Arnold, K., Mwenge Kahinda, J.M. (2018). Climate Adaptation: Risk Management and Resilience Optimisation for Vulnerable Road Access in Africa: Climate Threats and Vulnerability Assessment Guidelines (2nd version), GEN2014C. London: ReCAP for DFID.

Paige-Green, P., Verhaeghe, B., Head, M. (2018). Climate Adaptation: Risk Management and Resilience Optimisation for Vulnerable Road Access in Africa: Engineering Adaptation Guidelines (2nd version), GEN2014C. London: ReCAP for DFID.

Verhaeghe, B., Head, M., le Roux, A., Paige-Green, P. (2017a). Climate Adaptation: Risk Management and Resilience Optimisation for Vulnerable Road Access in Africa: Inception Report for Phase 2, GEN2014C. London: ReCAP for DFID.

Verhaeghe, B., Head, M., le Roux, A., Paige-Green, P. (2017b). Climate Adaptation: Risk Management and Resilience Optimisation for Vulnerable Road Access in Africa: (First) Quarterly Progress Report, GEN2014C. London: ReCAP for DFID.

Verhaeghe, B., Makhanya, S., Arnold, K., Roux, M., Head, M., Paige-Green, P. (2017c). Climate Adaptation: Risk Management and Resilience Optimisation for Vulnerable Road Access in Africa: (Second) Quarterly Progress Report, GEN2014C. London: ReCAP for DFID.

Verhaeghe, B., Paige-Green, P., Komba, J., Maritz, J., Arnold, K. (2018a). Climate Adaptation: Risk Management and Resilience Optimisation for Vulnerable Road Access in Africa: (Third) Quarterly Progress Report, GEN2014C. London: ReCAP for DFID.

Verhaeghe, B., Paige-Green, P., Komba, J., Maritz, J., Arnold, K. (2018b). Climate Adaptation: Risk Management and Resilience Optimisation for Vulnerable Road Access in Africa: (Fourth) Quarterly Progress Report, GEN2014C. London: ReCAP for DFID.

Annex 1 Training Workshop in Ethiopia

List of ERA staff involved in the training workshop on the Butajira to Gubre road:

Name	Affiliation
Kitufew Deselegen	RRC
Jalela Wedajo	Emergency
Famuel Girma	RRC
Adabnbnf Yisax	RRC
Mamush Troldesse	Landslide
Cherinut Endority	RRC
Tekleslassie Nida	Pavement & Bridge Design
Ehitabezaliu Nigussie	RRC
Haitu Amane	EWD
Amede Mulye	PBM
Asgadir Abate	PMS
Gesakeyn Waktole	PBMD

Road Number:	B - G	Date:	2018/08/01	Assessors:	PPG	Weather:	S. PC. C. R. H. Cold	Terrain	F. R. H. M.	Landuse	A. F. N. PU. O.

Chainage	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	2
Grade	F	F	F-U	U	U	U	U	U	U - F	F - D	D	D	D	D	D - F	F	F	F	F	F
GPS and photo No	08.1123 38.3535						65													
Erodibility																				
Subgrade	0	0	0	4/4	0	0	0	3/3	0	0	0	0	0	0	0	0	0	0	0	0
Road surface - unpaved	Paved																			
Side drains - unlined	2/4	5/1	0	4/5	0	0	4/5	4/3	0	0	0	0	0	0	0	0	0	0	0	0
Embankment slopes	0	0	0	5/4	5/1	0	3/3	3/3	0	2/1	2/1	2/1	3/2	3/5	3/5	0	0	0	0	0
Cut slopes																				
Subgrade problems																				
Material type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Moisture														Possible	Possible					
Drainage (in reserve)																				
Road shape	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shoulders	0	0	3/3	4/3	4/5	4/5	3/3	2/3	0	0	2/3	2/2	2/2	0	0	1/2	0	0	0	0
Side slopes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Side drains	0	0	5/5	0	0	0	0	5/3	5/3	0	0	0	0	0	0	0	2/1	0	0	0
Mitre drains																				
Drainage (streams)																				
Structure	3/1 - 1				4/1 -2	4/1 -2								5/1 -2	5/1 -2	5/1 -2				
Embankments																				
Erosion								5/1									3/1			
Protection works																				
Slope stability																				
Cut stability																				
Fill stability	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction																				
Overall finish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Erosion protection works																				
Maintenance																				
Quantity	3/4	0	5/4	5/4	5/4	5/4	4/4	5/4	5/4	5/4	5/4	5/4	5/4	5/4	5/4	5/4	5/4	5/4	5/4	5/4
Quality	2/5	2/5	2/5	2/5	2/5	2/5	2/5	2/5	2/5	2/5	2/5	2/5	2/5	2/5	2/5	2/5	2/5	2/5	2/5	2/5

COMMENTS:

1. Culvert silted at inlet
1. Needs culverts

Road Number:	B - G		Date:	2018/08/01		Assessors:	PPG		Weather:	Partly cloudy, hot		Terrain	M		Landuse	Forest/ Agric	

Chainage	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	
Grade	U																			

GPS and photo No	08.088 38.2856				72		73, 74													

Erodibility																				
Soil	0	0	0	0	0	0	0	0	0	0										
Road surface	Paved				0	0	0	0	0	0										
Side drains	Lined				0	5/5	0	0	0	5/1										
Embankments	0																			
Slopes	0	4/2	4/4	3/3	4/3	0	5/3	5/1	5/3	5/5										

Subgrade problems																				
Material	0	0	0	0	0	0	0	0	0	0										
Moisture	Seepage -1	Seepage -1	Flow -1	Flow - 1	Strong flow	Strong - spri	Seepage	Seepage	Road failure	Road failure										

Drainage (in reserve)																				
Road shape	0	0	0	0	0	0	0	0	0	0										
Shoulders	Paved		3/3	2/2	0	0	0	0	0	0										
Side slopes	0	3/4	2/2		5/2	5/2	3/2	0	5/5	3/3										
Side drains	0	0	0	1/2	0	5/3	5/4	5/3	5/3	5/5										
Mitre drains																				

Drainage (streams)																				
Structure								0												
Embankments								0												
Erosion								5/1												

Slope stability																				
Cut stability	0	5/5	5/5	0	5/5	5/5	4/5	3/3	5/2	5/5										
Fill stability	0	0	0		0	0 - 3	0	0												

Construction																				
Compaction																				
Finish	0	0	0	0	0	0	0	0	0	0										
Erosion protection																				

Maintenance																				
Quantity	0	2/5	2/2	2/5	?	5/5	5/5	5/5	5/5	5/5										
Quality	0	5/5	5/2	5/5	5/2	5/5	5/5	5/5	5/5	5/5										

COMMENTS:

1. Water flowing in drains
2. Drains blocked by landslide
3. Very steep embankment slopes - stable

Road Number:	B - W	Date:	2018/08/02	Assessors:	PPG	Weather:	Cloudy, warm some rain	Terrain	R - M	Landuse	Forest

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	
Grade	D	F	U																	

GPS and photo No	08.466 37.7636																			

Erodibility																				
Soil	0	0	0	0																
Road surface	Paved																			
Side drains	Lined																			
Embankments																				
Slopes	1/2		1/2	2/1																

Subgrade problems																				
Material	0	0	0	0																
Moisture	0	0	0	0																

Drainage (in reserve)																				
Road shape	0	0	0	0																
Shoulders	Paved	0	5/2	2/2																
Side slopes		0																		
Side drains	4/4	0	1/2	1/2																
Mitre drains																				

Drainage (streams)																				
Structure		0																		
Embankments		3/5																		
Erosion		5/5																		

Slope stability																				
Cut stability	0	0	2/2	0																
Fill stability		0																		

Construction																				
Compaction																				
Finish	0	0	0	0																
Erosion protection	0	0																		

Maintenance																				
Quantity	5/5	3/5	5/5	2/5																
Quality	5/5	5/5	5/5	5/5																

COMMENTS:

BRIDGES INSPECTION FORMAT

For Regular Inspection

RNMD Name _____ **Section** _____ **Road Segment** _____ **Bridge No** _____

IT. NO	Bridge part	Damage type	Defect Severity
	Super structure		Major , Minor, No, Total failure
1	**Deck Slab**	Cracking , Mt	
		Peel Off , Mt2	
		Rebar Exposure, Mt2	
		Honeycomb , Mt2	
		Void , Mt2	
		Water Leakage , Mt2	
2	**Concrete Girder/Arch**	Cracking ,Mt	
		Peel Off , Mt2	
		Rebar Exposure, Mt2	
		Honeycomb ,Mt2	
		Void , Mt2	
		Water Leakage , Mt2	
3	**Steel Girder**	Deformation , Mt	
		Cracking , Mt	
		Corrosion , Mt2	
		Wearing , Mt2	
		Bolt Missing , Each	
		Paint Peel off ,Mt2	
	Water Way adequacy (Over flooding, Siltation, Scouring,...) **Yes** **No**		

IT. NO	Bridge part	Damage type	Defect Severity
	Sub Structure		Major , Minor, No, Total failure
4	**Foundation**	Cracking ,Mt	
		Peel Off ,Mt2	
		Rebar Exposure , Mt2	
		Honeycomb , Mt2	
		Void ,Mt2	
		Water Leakage , Mt2	
		Displacement	
		Scour, Mt2	
5	**Abutment and Wingwall**	Cracking, Mt	
		Peel Off / Stone deterioration, Mt2	
		Rebar Exposure , Mt2	
		Honeycomb , Mt2	
		Void ,Mt2	
		Water Leakage , Mt2	
		Displacement / Bulging ,Mt2	
		Scour , Mt2	
6	**Embankment**	Depression , Mt2	
		Erosion , Mt2	
7	**Rip rap**	Missing, Each	
		Erosion, Mt2	
		Displacement, Mt2	

IT. NO	Bridge part	Damage type	Defect Severity
	Ancillaries		Major , Minor, No, Total failure
8	**Pavement**	Wave, Mt	
		Rutting, Mt	
		Cracking, Mt	
		Potholes , Mt2	
9	**Kerb & Railing**	Cracking, Mt	
		Peel Off, Mt2	
		Rebar Exposure , Mt2	
		Deformation, Mt	
		Corrosion, Mt	
		Missing, Each	
10	**Expansion Joint**	Noise, Mt	
		Water Leakage, Mt	
		Deformation, Mt	
		Peel Off, Mt	
		Missing, Mt	
11	**Bearing**	Main Damage, Each	
		Parts missing, Each	
		Anchor Damage, Each	
		Bed Damage, each	
		Unusual movement, Each	
12	**Drainage**	Pipe Damage , Each	
		Blocked, Each	
		Inlet Damage, each	

Inspected By _____ **Inspection date** .....

Ethiopian Roads Authority - Paved Road Condition Form

Paved Road Condition Survey			Date		Inspector		District		Section		Page of
Road No		Start Km	Segment No		Start Km		Direction				Calibration Factor

Kilometre			Km				Km				Km				Km				Km				Action Required
			0-500		500-1000		0-500		500-1000		0-500		500-1000		0-500		500-1000		0-500		500-1000		
			Sev	Ext	Sev	Ext	Sev	Ext	Sev	Ext	Sev	Ext	Sev	Ext	Sev	Ext	Sev	Ext	Sev	Ext	Sev	Ext	
Left	Side drain /turnout	Silt																					
		Scour																					
	Shoulder	Deform																					
		Scour																					
		Vegetation																					
	Edge Step																						
	Edge Damage																						
Carriageway	Rutting																						
	Corrugations																						
	Cracking	Wheel Track																					
		Other																					
	Stripping/Fretting																						
	Potholes																						
	Bleeding																						
	Failures																						
	Safety																						
	Lane marking																						
Right	Edge Damage																						
	Edge Step																						
	Shoulder	Vegetation																					
		Scour																					
		Deform																					
	Side drain /turnout	Scour																					
		Silt																					
Notes																							

Revision: 0.3 Date: April 2005

RoadConForm.xls:PavedRoad

Ethiopian Roads Authority - Unpaved Road Condition Form

UnPaved Road Condition Survey			Date		Inspector		District		Section		Page of
Road No		Start Km	Segment No		Start Km		Direction				Calibration Factor

Kilometre			Km				Km				Km				Km				Km				Action Required
			0-500		500-1000		0-500		500-1000		0-500		500-1000		0-500		500-1000		0-500		500-1000		
			Sev	Ext	Sev	Ext	Sev	Ext	Sev	Ext	Sev	Ext	Sev	Ext	Sev	Ext	Sev	Ext	Sev	Ext	Sev	Ext	
Left	Side drain /turnout	Silt																					
		Scour																					
	Vegetation																						
Carriageway	Gravel Thickness																						
	Camber																						
	Scour																						
	Deformation																						
	Stoniness																						
Right	Vegetation																						
	Side drain /turnout	Scour																					
		Silt																					
Notes																							

Revision: 0.3 Date: April 2005

RoadConForm.xls:UnPavedRoad

Ethiopian Roads Authority

Structures/Furniture Inventory/Condition Survey			Date		Inspector		District		Section		Page of
Road No		Start Km	Segment No		Start Km		Direction				Calibration Factor
Km											Action Required
Item											
Right/Left	(side of road, for culverts direction of flow)										
Culverts	Silted/Blocked										
	Outfall Scoured										
	Structural damage										
Road Furniture	Dirty										
	Damaged/corroded										
	Missing										
Bridges	Structural damage										
Action required (Notes/comments)											**Culvert Type:** SC - Stone Culvert CC - Concrete Culvert AC - Steel Pipe
							Furniture: KM - Km Post + Number S - Sign (I-Info, D-Dir, T-Traffic) GP - Guard Post	**Bridge Type:** CB - Concrete Bridge SB - Stone Bridge BB - Steel/Bailey Bridge TB - Timber Bridge			**Record Size:** No of Pipes with Dia or WxH ie CC 2No1.2x3m

Revision: 0.3 Date: April 2004

RoadConForm.xls:Furniture

Annex 2 Workshops and Meetings held in Ethiopia

1. Attendees of the mini-workshop held on 5 June 2018 (morning session)

Workshop Programme:

Topic 1	09:00 - 10:00	Introduction/discussion of the AfCAP Climate Adaptation project and its objectives; overview of Climate Adaptation Handbook/Guidelines
Topic 2	10:00 - 11:00	Introduction/discussion of climate change assessment methodologies and linkages to road asset management
	11:00 - 11:30	*Tea*
Topic 3	11:30 - 12:30	Presentation/Discussion on change management issues related to climate change
Topic 4	12:30 - 13:00	Plenary Discussions/Summary

List of attendees:

Name	Organisation
1. Kitapeso Desalefr	ERA
2. Abebe Mekuriauw	EAS
3. Eden Aweke	ECPMI
4. Daniel Mengestie	ERA
5. Abrham Abdella	ERA
6. Noor Mohamed	WB
7. Zenebe Tilahun	WB
8. Alemayehu Ayele	ERA
9. Sisay Benele	ERA
10. Mohammed Abdoralman	ERA
11. Araya Cairma	ERA/ DG
12. Asmera Nassir	ERRA/RRC
13. Elias Fiseha	NMA
14. Frehaileab Admassu	AASTU
15. Birham Asifa	ERA,PE

Name	Organisation
16. Ehitabezalue Nigussie	ERA,RRC
17. Liksew Tesfu	ERA,ERD
18. Desta GlMariam	ERA-PPMD
19. Nuru Dawind	ERA Eng.Oper
20. Johan Maritz	CSIR
21. Michael Roux	CSIR
22. Kathryn Arnold	CSIR

2. Attendees of the mini-workshop held on 6 June 2018 (morning session)

Workshop programme:

Topic 5	09:00 - 13:00	**Technical training session:** Exploring the embedment of climate change in vulnerability assessments and decision support systems, including training and policy implications

List of attendees:

Name	Organisation
1. Sara Behailu	ERA
2. Kitafesu Desalefr	ERA
3. Abraham Abdella	ERA
4. Gezahefm Waktole	ERA
5. Yosef Tamiru	
6. Burivalem Kere	
7. Solomon Dab	ERA
8. Hawi Adupua	ERA
9. Zeyweba Bezu	ERA
10. Asmera Nassir	ERRA/RRC
11. Bejtual Asamnew	ERA
12. Woinshet Fetene	ERA

Name	Organisation
13. Wegdetes Tena	ERA
14. Amede Nuliye	ERA
15. Johan Maritz	CSIR
16. Michael Roux	CSIR
17. Kathryn Arnold	CSIR

3. Proceeding of the workshops and meetings

3.1 Topic 1 - Introduction/discussion of the AfCAP Climate Adaptation project and its objectives; overview of Climate Adaptation Handbook/Guidelines; linkages to any other related work

Johan Maritz presented a broad overview of the project and outlined the programme for the mini workshop and planned engagements. Considering that some of the participants were new to the project, this overview proved useful. It reiterated the project objectives, profiled the various project phases and emphasised the current phase of policy and embedment issues. In addition to sizable representation from various departments within ERA, there were a number of other institutions also present, including representatives from the National Meteorology Agency, the Addis Ababa Science and Technology University, Ethiopian Academy of Sciences, Ethiopian Construction Project Management Institute and the World Bank. The Climate Adaptation Handbook and associated three Guide documents were briefly profiled. Representatives from the World Bank indicated that they had recently completed a report on climate resilience that includes a diagnostic of data sources and corridor level assessments. This contribution was useful as it was not available previously (completed in May 2018). It was proposed to consider the AfCAP and World Bank items together to avoid duplication/overlap etc. Mr Maritz also indicated that a separate meeting would take place later during the week at the World Bank offices where this item could be discussed with World Bank officials.

Figure 1 Workshop session at Ethiopian Roads Agency offices – Day 1.

3.2 Topic 2 - Introduction/discussion of climate change assessment methodologies and linkages to road asset management

Kathryn Arnold presented the current climate change management assessment methodology for a national to district scale analysis. She also mentioned that a similar methodology exists that can be applied for local level assessments. This methodology has however not been trialled, although it is based on well-established methods of local data collection. The possible linkage between the climate assessment steps and RAMS was also described. Several possibilities exist to link climate related information to a RAMS. This would however be dependent on the nature/extent of the RAMS currently being used by ERA. Ms Arnold also raised the issue of embedding the climate change information in other ERA departments, and proposed that it should be placed with the Planning Department where the ERA's GIS capability currently resides. It was agreed that during the next day's technical session, the GIS person in ERA provide some perspective on the GIS capability and its current function in ERA.

Michael Roux then presented an overview of the integration of climate change into road asset management. Integration actions are required during the various steps in the Asset Management process and these actions were described in his presentation. He also provided suggestions on how the climate change information could be linked to the current RAMS within ERA. He indicated that an operational RAMS should be used where possible and be extended to include climate change information. It would however be important to investigate the nature and detail of the ERA asset management systems before a specific proposal for embedment could be made. Officials from ERA's Road Asset Management Department indicated that they have several systems that deal with road assets, including a Pavement Management System, Bridge Management System and a Vehicle Overload Control System. It was agreed that they would present an overview of the road asset management practice in ERA on day 2. (See day 2).

3.3 Topic 3 - Presentation/Discussion on change management issues related to climate change

Johan Maritz presented on policy and related embedment issues. He also reiterated that it was important to identify clear actions that can be taken forward in order to embed the key climate change data items into decision support systems. He profiled the main policies that deal with national climate change adaptation and provided an overview of key CAA structures currently operational within the Ethiopian government sphere. Upon enquiry from participants, it was reiterated that ERA does not currently have sufficient representation within the government sphere regarding climate change issues, although the recent Climate Resilient Transport Sector Strategy specifically mentions a number of relevant climate adaptation issues – this document also proposes a new structure (Inter-agency Coordination Directorate) within the Ministry of Transport that could provide a critical linkage between different transport functions and the Climate Change community (Minstry of Transport, 2017) . Considering the work initiated to update their current asset management system, there are opportunities to incorporate climate change adaptation in the short term.

Mr Maritz reported that the main policy and embedment issues will be reflected in a country report. The purpose of the country report would be to:

- Reflect on relevant policy items;
- Strengthen ERA adaptation policies;
- Agree on actions to reduce vulnerability to climate change;
- Help forge links to strengthen Government policy; and
- Facilitate development of more effective adaptation strategies.

The report will contain the key climate challenges and vulnerabilities and would be structured as follows:

- Approach
- Climate and projected changes*
- Overview of Policy Environment

- Physiography, Livelihoods and Rural Connectivity*
- Vulnerability to Climate Change*
- Change Management options for Adaptation
- Actions for Implementation

(* from Threats and Vulnerability assessment)

3.4 Topic 4 - Discussions and feedback after the morning session

After the morning session, the following feedback was received from participating organisations:

Participants representing the World Bank, Mr Noor Mohamed and Mr Zenebe Tilahun enquired about the use of remote sensing to deduce items such as land use adjacent to roads within the methodology described in the AfCAP guide (Climate threats and Vulnerability). It was stated that knowing the nature of land use could be beneficial to assist in managing the risk (and subsequently climate risk) to road infrastructure. In response Mr Maritz indicated that assessments at the district level do not look at land use, but it is part of the proposed local level assessment process. He indicated that land cover is a quick method to obtain land use type information, but for a local level assessment this has to be supplemented with local observations, engagements with local stakeholders, etc. The other issue raised by the World Bank related to the opportunity to harness stormwater run-off from roads and the question was whether it was being considered. In response, Mr Alemayehu Ayele (ERA) indicated that they are looking at this and that that there was already a project where this is being implemented in Ethiopia. It was agreed that it is an important issue which should be considered in more detail – perhaps by including it more pertinently in the AfCAP documentation.

A representative from the Addis Ababa Science and Technology University (Department of Construction Technology and Management), Mr Frehaileab Admassu also commented on the need for greater awareness of climate change in rural communities. He suggested that closer collaboration in rural communities (when dealing with road projects) could also inform and capacitate rural communities.

3.5 Topic 5 - Technical training session: Exploring the embedment of climate change in vulnerability assessments and decision support systems, including training and policy implications

As agreed the previous day, the session commenced with overviews by ERA representatives on the current state of GIS and road asset management in ERA. The first inputs were made by Mr Hawi Adupmo, the only GIS person currently at ERA. He only recently joined the ERA and is tasked to provide GIS mapping support to the Planning Department in ERA. He indicated that he has limited experience with GIS. ERA currently uses ArcGIS software and has a single GIS user licence. The ArcGIS being used is an older version of the software, which could present problems with sharing GIS information. GIS is currently not used to undertake spatial analysis, but is used more as a mapping tool to illustrate road network related information. Currently ERA does not use climate related geospatial information in their GIS. The entire Ethiopian road network (close to 100 000 km) was captured in GIS format by consultants and completed in 2013, but has not been updated since then (Ethiopian Road Information Management System (ERIMS)).

The second contribution was made by Mr Yosef Tamiru (Pavement Management System Team Leader), representing the Road Asset Management Department in ERA. His presentation outlined the following:

- RAM organisational structure;
- Current road maintenance practices;
- Budget allocations; and
- Existing systems supporting Road Asset Management.

Figure 2 Presentation on ERA Roads Asset Management Systems (at ERA offices).

The ERA is currently engaged in a project for the Development of a Modern Road Asset Management System. The project has been launched and is funded by the AfDB. The objectives of the project are to:

- Review the policies, system and structure of RAM;
- Prepare Road Asset Management Policy;
- Improve existing systems;
- Develop new required systems; and
- Integrate all the systems.

This project will also include the addition of GIS capability within the Road Asset Management Department.

Figure 3 Reflecting on the importance of the AfCAP documents.

Introducing the following presentations, Mr Maritz indicated that the sessions were also reflections of what was expressed in the AfCAP documents produced to support Climate Change Adaptation in the roads sector. A set of 4 documents were provided to each participant and participants were also requested to provide comments or feedback on these documents.

The first presentation, by Kathryn Arnold, dealt with Regional Climate Risk Screening for Climate Adaptation of Rural Road Networks and specifically Phases 1 to 3 as described in the Climate Threats and Vulnerability

Assessment Guideline. These phases where presented in detail, namely identifying the main regional climate threats that influence the risk and vulnerability of roads, collecting and preparing relevant data and finally analysing the data spatially in terms of road exposure and asset criticality to determine the more vulnerable districts. The presentation profiled the series of spatial data sets that present a range of climate information including rainfall, temperature, extreme storm events, etc., as well as national and open source data repositories of road network, flooding and socio-economic data. Data presented also contained the results of two climate models which have been downscaled to increase the resolution and allow for more specific road sections to be differentiated in terms of such climate information.

Ms Arnold also indicated that a geospatial data parcel had been prepared and packaged on a DVD (see Figure 4) consisting of a range of geospatial data layers for Ethiopia reflecting the following:

- Supporting Base Data;
- Population Density;
- Road Network Coverage;
- Flood Index;
- Criticality Index;
- Vulnerability Index; and
- Climate Data.

The geospatial data were provided in both a geodatabase- and in shapefile format. Although the dataset is mostly aimed at GIS users, non-GIS users were also considered and the same information can be viewed through the ArcReader – a free GIS viewer (also supplied on the DVD).

Figure 4 AfCAP geospatial data package, files and accompanying documentation.

The second presentation by Michael Roux dealt with Phase 4 of Climate Risk Screening Method described in the Climate Threats and Vulnerability Assessment Guideline, namely the embedment of the outputs from the climate threats and vulnerability assessment in the RAMS.

The embedment phase requires three steps. In Step 1 the climate threat indicators to include in the RAMS are identified, in Step 2 the data for these indicators are exported to the RAMS and in Step 3, the indicator data is analysed in the RAMS. The outputs from the district level climate threats and vulnerability

assessment, such as the Flood Exposure Index and the Road Critically Index could be exported to the RAMS. As these indicators are calculated at district level, the same indicator value would be allocated to all road links or structures (bridges and culverts) in a district. An alternative would be to only include these indicators in the GIS to be able to identify and display the most vulnerable districts. The road links and structures in these vulnerable districts could then be prioritised for the local/road level climate risk and vulnerability assessment.

Mr Roux then illustrated how the measuring and recording of specific climatic effects on the road network, as described in the Engineering Adaptations Guideline, could be incorporated in a RAMS. This would require a visual assessment process to identify and rate problems specifically related to climatic effects. These problems should then be rated in terms of likelihood of occurrence and the impact should they occur. By capturing these problems and ratings in the RAMS, an index (Climatic Effect Risk Index) can be calculated that can then be used to rank and prioritise specific road links for climate resilience adaptation. The Climatic Effect Risk Index could also be combined with other indices usually calculated in a RAMS, such as a Visual Condition Index (VCI), to arrive at a combined index for the further ranking and prioritising of road links for maintenance and resilience adaptation.

The presentation also included recommendations on how condition data relating to specific structural elements of river bridges and major culverts that could make a structure vulnerable during flooding events, could be used to rank such structures in terms of priority for climate resilience adaptation.

After the morning session Eng. Mohammed Abduraheman (Deputy Director General: Operations Department) invited the team to install the geospatial data package on his computer as well. This was successfully completed and the information could be viewed on his computer using the ArcReader viewer.

3.6 Engagement with the World Bank (8 June 2018, 09:30-11:00)

Although representatives from the World Bank attended the workshop on Day 1, a separate meeting was also scheduled with the World Bank staff based in Addis Ababa on 8 June. The representatives were Haileyesus Adamtei (Senior Highway Engineer) and James Markland (Senior Transport Specialist). During the meeting, Mr Maritz provided an introduction of the AfCAP project to the WB representatives. They mentioned that they were aware of the project and had been following its development.

They indicated that their focus is on road projects with a strong focus on the main road corridors in Ethiopia extending to the wider region. Within their projects they do have a climate screening approach. The focus is on identifying critical sections and to reflect the problems affecting the relevant sections. They do have an interest in assessment methodologies, especially if such methods are widely employed within a country such as Ethiopia. They also indicated the need to avoid duplication. Mr Markland indicated that the World Bank had recently conducted a study entitled “Increasing Climate Resiliency of the Ethiopian Road Network” and suggested that the AfCAP team request the project report though ERA. The main purpose of the project was to “*support the Ethiopia Roads Authority (ERA) in mainstreaming climate resilience considerations in the national road transport management by developing an effective methodology for assessing vulnerability of the road network to the climate related risks; and recommend institutional reforms needed (policy, institutional and operational level) to enhance capacity of the ERA in planning a climate resilient road network*”. It was acknowledged that there could be an overlap between the two projects.

The World Bank representatives were provided with the Handbook and Guideline documents and requested to give feedback and comments on these documents if possible. Mr Adamtei indicated that their geospatial screening focuses more on economic analyses. An area of concern raised by the World Bank representatives was that Ethiopian roads authorities are not doing sufficient maintenance and that often problems observed on roads are not reported during inspections – this has a detrimental effect when climate events occur. The resulting damage is worse due to prior preventative actions not been taken. He

indicated that the implementation challenge for such work is at the regional level as often the regions do not have the same level of capabilities than what can be found in ERA. For implementation or embedment to be successful, much more has to be done to capacitate the regional roads authorities – this might also require much more capacity development.

3.7 Environment and Climate Research Centre (7 June 2018, 14:30-15:30)

A meeting with Sahleselassie Amare (Research Officer and GIS analyst) was held at the Environment and Climate Research Centre (ECRS) at the Ethiopian Development Research Institute. The meeting was arranged to explore the extent of GIS information development and sharing within Ethiopia. Mr Amare provided a perspective on GIS within ECRC and indicated that within Ethiopia, the GIS landscape is not open and a central Spatial Data Infrastructure does not exist. This makes access to geospatial information more difficult. He indicated that organisations are generally operating separately as far as geospatial information is concerned. Part of the challenge is a lack of information on what others are doing with GIS data. He indicated that there are several key organisation that should have GIS capability and that would possibly benefit ERA GIS, including the following:

- National Meteorology Agency;
- Ethiopian Mapping Agency;
- Water and Land resource Centre (Addis Ababa University);
- The Ministry of Water, Irrigation and Electricity;
- National Disaster Centre; and
- Ministry of Agriculture and Natural Resources.

He also mentioned that there are private companies that provide geospatial services to the government, referring specifically to one - Geospatial Analytical Services (GeoSAS). He indicated that this company provides services in the planning, designing, implementing, monitoring and evaluation of development projects in infrastructure, health, agriculture and the environment.

His institution mainly considers the economic impact of climate change and support/informs policy development. They are not currently involved in a lot of spatial analysis. He indicated that ERA should establish key linkages with these institutions in order to access climatic and other non-transport related information. Given that no formal national GIS structure exists, it is up to the stakeholders involved to establish their own networks. He indicated that a good institution to link with is the Water and Land Resource Centre (Addis Ababa University) as they have developed several products such as the Geospatial Information System Ethiopia (EthioGIS), which features terrain, soil, land cover and use, climate, drainage, infrastructure, population and agriculture in GIS (Water and Land Resource Centre, 2012). They also undertake hydrographic analysis which would be important for road-related climate risk assessment. They also have a website to facilitate the compilation, archiving, and exchange of data and information for policy makers, the research community and all the stakeholders who need data for sustainable management of land and water resources (see website http://walris.wlrc-eth.org/about/overview.html). They have identified several user groups and data sharing protocols with mostly free access. It would be beneficial for ERA's GIS users to establish linkages with the abovementioned institutions.

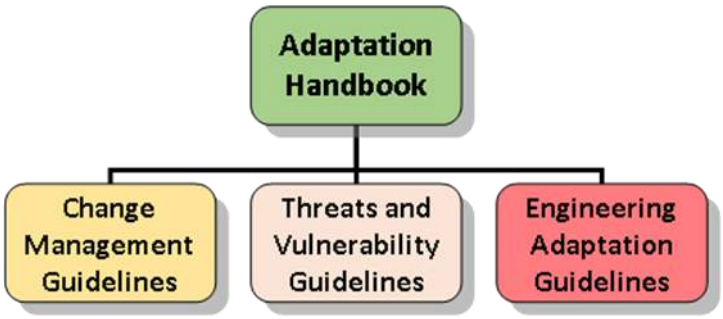
3.8 Meeting with Senior Management of ERA: Presentation of the outcomes of the previous two days' deliberations; discussion and agreement on policy and embedment actions; and identification of any assistance that AfCAP and the Project Team could provide going forward (8 June 2018, 11:00-12:30)

On 8 June, a meeting was held with some ERA senior management in order to provide feedback on the previous two days' sessions. Members from the ERA management team present were:

- Mr Alemayehu Ayele – AfCAP coordinator (ERA)
- Mr Yitagesu Desalegn – Director: Research and Development (ERA)

Due to their participation in the workshop and awareness of the project there was no need to provide an overview of the workshop sessions. Mr Maritz provided feedback on the week's activities, including meetings held with other institutions. He reiterated that the current focus in Phase 2 of the project is on dealing with policy and embedment. The main outputs of the climate resilience and adaptation research were discussed. Mr Maritz indicated that the four documents (Handbook and Guidelines – see Figure 5) are currently in a trial phase and in order to finalise them, comments are needed. He requested that ERA provide comments on these documents where feasible.

Figure 5 AfCAP document deliverables.



The discussions also identified key actions that should be undertaken in order to embed Climate Change into ERA. These key actions are described in Section 7.2 of this Quarterly Progress Report.

Annex 3 Workshops and Meetings held in Ghana

1. Attendees of the mini-workshop held on 10 July 2018 (morning session)

Workshop Programme:

Topic 1	09:00 - 10:00	Introduction/discussion of the AfCAP Climate Adaptation project and its objectives; overview of Climate Adaptation Handbook/Guidelines
Topic 2	10:00 - 11:00	Introduction/discussion of climate change assessment methodologies
	11:00 - 11:30	*Tea*
Topic 3	11:30 - 12:30	Presentation/Discussion on change management issues related to climate change
	12:30 - 13:00	Plenary Discussions/Summary
	Item change	*Change to the original programme – introduction to RAMS and Climate change was moved to 11 July 2018.*

List of attendees:

Name	Organisation	Position
1. Edmund Offei-Annor	MRH	Ag Chief Director
2. Ernest K Obeng	MRH	Director RSIM
3. Akwasi Asamoah	DFR	Principal Engineer
4. David Brobbey	DFR	Chief Engineer
5. Richmond Ankrah	DFR	IT/CMS Admin
6. Eric Kofi Forson	DFR	Engineer
7. Salifu Hardi	DFR	Assistant Development Planning Officer
8. E A Arbadiyo	MRH	Principal Engineer
9. J. Kwapong Atiemo	MRH	Assistant Quantity Surveyor
10. Samuel Owusu Ansah	Ghana Meteorological Agency	Senior Meteorologist
11. Bashara A. Abubakari	CERSGIS	GIS Specialist
12. George Ownsin	CERSGIS	Senior GIS Specialist
13. Famstima Sakyiwzah	EPA	
14. Antwi B Amoah	EPA	PPO

Name	Organisation	Position
15. Ernest Ekuban	GHA	S&D -GIS
16. Nana Kwesi Agyepong	GHA	Director of Materials
17. Richard Quartey Papato	MRH	Sen. Engineer
18. Efua Effah	MRH	Principal Engineer
19. Mawutor Keketsyor	DUR	Principal Engineer
20. Theodore Quaye	DUR	Chief Engineer
21. B.A Sowah	DUR	DD (F&H)
22. Frank Xiasta Agyemang	DFR	Assistant Engineer
23. Mawusi Joseph Adekponya	DFR	Assistant Engineer
24. Peter K Yawson	DFR	Chief Engineer
25. Balika Edmond	MRH	Assistant Engineer
26. Dr Paulina Agyekum	W/A Technical manager AFCAP	w/a Technical Manager
27. Evans Tutu Akoseh	Ablin Consult	Engineer
28. Emmanuel Pobee	MRH	Quantity Surveyor
29. Deborah Darko	CSIR Water Research Unit	Research Scientist (Climate/Hydrology)
30. Aparesea Racheal	MRH	AD Iia
31. Dr Patrick Amoah Bekoe	DFR	Principal Engineer
32. Ferdinand Yali	DUR	Principal Planner
33. Johan Maritz	CSIR	AfCAP Project Team
34. Kathryn Arnold	CSIR	AfCAP Project Team

2. Attendees of the mini-workshop held on 6 June 2018 (morning session)

Workshop programme:

Topic 4	09:00 - 13:00	**Brief presentation by the MRH GIS person providing overview of GIS and it use in the MRH** (to assist team to understand current use etc.)
Topic 5		**Introduction of** road asset management **and links to climate change.**
Topic 6		**Technical session:** Exploring the embedment of climate change in vulnerability assessments and decision support systems, including training and policy implications.

List of attendees:

Name	Organisation	Position
1. Richmond Ankrah	DFR	IT/CMS Admin
2. E.A. Abadayo	MRH	Principal Engineer
3. J. Kwapong Atiemo	MRH	Quantity Surveyor
4. Ernest Ekuban	GHA	S&D-GIS
5. Bashara A Abubakari	CERSGIS	GIS Applications Specialist
6. Ruth Osei-Asimani	DUR	Assistant Environmental Officer
7. Mawutor Keketsyor	DUR	Principal Engineer
8. Famstima Sakyiwzah	EPA	T.O.
9. George Ownsu	CERSGIS	Snr GIS Application Specialist
10. Charlotte Norman	NADMO	Director C/C
11. Ernest Obeng	MRH	Director RSIM
12. Ferdinand Yali	DUR	Principal Planner
13. Samuel Owusu Ansah	Ghana Meteorological Agency	Senior Meteorologist
14. Dr Patrick Amoah Bekoe	DFR	Principal Civil Engineer
15. Frank Xiasta Agyemang	DFR	Assistant Engineer
16. Stella Arthur	DFR	Tech. Engineer
17. Emmanuel Pobee	MRH	Quantity Surveyor
18. Mawusi Joseph Adekponya	DFR	Assistant Engineer
19. Alfrettina A-Chirawura	MRH	Assistant Project Officer
20. Kwasi Agyeman-Boakye	MRH	Senior Engineer
21. Balika Edmond	MRH	Assistant Engineer
22. Akwasi Asavisah	DFR	Principal Engineer
23. Nii Sarpei Nunoo	DFR	Chief Engineer
24. Eric Kofi Forson	DFR	Engineer (GIS)
25. Xatwi Boadisko	EPA	S.T.O

Name	Organisation	Position
26. Peter K Yawson	DFR	Chief Engineer
27. Deborah Darko	CSIR Water Research Unit	Research Scientist (Climate/Hydrology)
28. Salifu Hardi	DFR	Assistant Devt Planner
29. Michael Roux	CSIR (AfCAP)	AfCAP Project Team
30. Kathryn Arnold	CSIR (AfCAP)	AfCAP Project Team
31. Johan Maritz	CSIR (AfCAP)	AfCAP Project Team

3. Proceeding of the workshops and meetings

3.1 Topic 1 - Introduction/discussion of the AfCAP Climate Adaptation project and its objectives; overview of Climate Adaptation Handbook/Guidelines; linkages to any other related work

Johan Maritz presented a broad overview of the project and outlined the programme for the mini workshop and planned engagements. Considering that some of the participants were new to the project, this overview proved useful. It reiterated the project objectives, profiled the various project phases and emphasised the current phase of policy and embedment issues. Along with a sizable representation from the Ministry of Roads and Highways (various departments) a number of other institutions were also present, including the Ghana Meteorological Agency, the Centre for Remote Sensing and Geographic Information Systems (CERSGIS), the Environmental Protection Agency, and the CSIR Water Research Institute. During the presentation, the key written documentation (Climate Adaptation Handbook and associated three Guide documents) were briefly profiled.

3.2 Topic 2 - Introduction/discussion of climate change assessment methodologies and linkages to road asset management

Kathryn Arnold presented the current climate change management assessment methodology for a national to district scale analysis. She also stated that a similar methodology exists that can be applied for local level assessments, which is based on well-established methods for local data collection and public participatory mapping. The possible linkage between the climate assessment steps and road asset management systems (RAMS) was also described. Several possibilities exist to link climate related information to road asset management systems. This would however be dependent on how road asset management is handled within the Ministry of Roads and Highways (MRH). Indications from participants were that the different departments handle asset management differently. There is no single system being used across all departments within the ministry. Given the AfCAP focus on rural access roads, a strong focus is currently on the Department of Feeder Roads (DFR), which is the department responsible for the lower order rural access road network (feeder roads).

The issue of embedding climate change information within the Ministry and its departments would be discussed during the next day's session, which also had a *strong focus on the geospatial data.* It was proposed that during the next day's more technical session Mr Richmond Ankrah, the IT/CMS Administrator in the DFR, provides an overview on the GIS capability and its current function in the DFR.

Figure 6 Workshop session at the Offices of the Ministry of Roads and Highways – Day 1.

3.3 Topic 3 - Presentation/Discussion on change management issues related to climate change

Johan Maritz presented on policy and related embedment issues. He also reiterated that it was important to identify clear actions that can be taken forward in order to embed the key climate change data items into systems. He profiled the main policies that deal with national climate change adaptation and provided an overview of key CAA structures currently operational within the Ghanaian government systems/structures. It is clear that there has been substantial policy development considering climate change across a number of national ministries. The National Climate Change Policy (NCCP) is Ghana's integrated response to climate change. It has been prepared and designed within the context of national sustainable development priorities, including achieving the objectives of the Ghana Shared Growth and Development Agenda (GSGDA) 2010–2013. It promotes an understanding of climate change issues among policymakers and implementers across all sectors. From a general overview of the national climate change strategies, it is clear that transport in general and the roads sector specifically do not feature strongly.

To support climate change policy development and to coordinate clime change activities, the National Climate Change Committee (NCCC) was established in 2009. This committee has not involved members of the transport and roads community. Participants indicated that the National Transport Strategy is being revised/updated – this presents an opportunity to reflect climate change issues more strongly. Mr Maritz

indicated that what needs to be added to the roads sector is a robust understanding of the vulnerability of the infrastructure to current and future climate impacts. Change management would then require that actions be taken to ensure the necessary policy is in place, standards and design guidelines for roads reflect climate change adequately, planning systems incorporate dimensions of climate change risk and vulnerability to enhance planning and project prioritisation. Other areas that can also be affected with the inclusion of climate change is research within the transport field (particularly the research agenda of the MRH).

Figure 7 Providing and overview of the contents of the Handbook and guides.

Mr Maritz indicated that the main policy and embedment issues will be reflected in a country report. The purpose of the country report would be to:

- Reflect on relevant policy items;
- Strengthen the MRH adaptation policies;
- Agree on actions to reduce vulnerability to climate change;
- Help forge links to strengthen government policy; and
- Facilitate development of more effective adaptation strategies.

The report will contain the key climate challenges and vulnerabilities and would be structured as follows:

- Approach;
- Climate and projected changes;*
- Overview of Policy Environment;
- Physiography, Livelihoods and Rural Connectivity;*
- Vulnerability to Climate Change;*
- Change Management options for Adaptation; and
- Actions for Implementation

(* from Threats and Vulnerability assessment)

3.4 Topic 4 - Discussions and feedback after the morning session

After the morning session the following feedback was received from participating organisations:

Questions were raised on the extent of quantification of the risk and vulnerability assessments. In response it was indicated that the items featured is used to create a risk index which provides a measure of severity of risk – Mr Michael Roux would on the following day reflect on how this could be reflected/incorporated in road asset management systems. The issue of planning land use and settlement change was also raised, due to the impact this can have on roads – for example hard surfaces resulting in increased runoff could lead to the flooding of roads or to the overloading of drainage infrastructure. Participants indicated that it is difficult for the roads sector to influence or affect land uses, as the land ownership in rural area is often in the hands of traditional leadership. This makes any form of control or management difficult. In response, it was suggested that it might be an issue to be addressed at local level where relationships between traditional and local government leadership and implementing agencies have to be developed to find shared solutions. The challenge here lies at the implementation level. It was proposed that the MRH collaborate with the ministries involved in rural sectoral development and settlement planning to identify climate risk areas where a more localised engagement process can then be followed in order for land use practices near roads (in high risk areas) to be altered.

A further discussion related to flash flood areas - whether extreme rainfall events as reflected in the climate models would reflect flash flood areas. In response, it was stated that extreme rainfall locations indicate areas where flash flooding could occur – it was however also influenced by other factors such as topography, vegetation and the nature of the catchment itself, as upstream weather events can affect downstream areas. It was suggested that extreme rainfall events be considered together with other factors when identifying possible flash flood areas. Ideally, hydrological modelling should be done to identify such flash flood risk areas.

The Environmental Protection Agency representative enquired if the spatial climate threats and vulnerability assessment extends over all districts in Ghana. In response Ms. Arnold indicated that the analysis has been done for the whole of Ghana and extending beyond Ghana's national boundary (the new climate models only). The subsequent risk indicators were also calculated at the district level. The EPA indicated that the University of Ghana is doing climate analysis work in a few districts, but at a fine scale. It was suggested that this new data be considered for future analysis as items that could enhance the current climate threats and vulnerability assessment.

The Ghana Meteorological Agency enquired about the reliability of the climate data (sources). In response Mr Maritz indicated that the sources for the spatial information used in the analysis are listed. The process used to compile new climate models have also been documented by the climate specialist. He indicated that an institution in Ghana should provide a peer review function to review such data items. He proposed that the Ghana Meteorological Agency could be the national institution that could provide or manage such a peer review process.

To be specific and to make policy application broader, it was proposed that policy be focused at the MHA, as it includes several departments to which policies would apply. The issues that affect feeder roads in many cases also affect urban roads and highways. These different networks are managed by different departments, which should take policy guidance from the MRH.

It was proposed by representatives from the MRH that senior engineers be involved to proactively look at design related issues, such as flood return periods, considering climate change. They indicated that it is in the practical implementation where real changes have to be made. Old design guides are currently used and these need to be updated. Dr Bekoe indicated that there needs to be broad spectrum adaptation and it needs to relate to planning, design and implementation.

The EPA indicated that they have, as part of their responsibilities, to report every 4 years to the UNFCCC on the progress Ghana has made in dealing with climate change. They indicated that they need to prepare a report in the near future, and that they would like to incorporate some of the AfCAP information in their report. They indicated that they might request some spatial information inputs from the AfCAP team.

To conclude, Mr Maritz indicated that it is important that the actions undertaken regarding embedment of climate change issues in policies and systems must be practical and doable. The responsibility lies with the MRH to decide on relevant actions.

3.5 Topic 5 - Technical training session: Exploring the embedment of climate change in vulnerability assessments and decision support systems, including training and policy implications

To initiate the morning session, the AfCAP team had requested the MRH to provide a short overview reflecting two items namely; the current state of GIS and an overview of the current road asset management practise in the MRH. Mr Richmond Ankrah (Head of IT/CMS Admin in the DFR) made the first presentation, detailing the GIS system currently in use at the DFR. He explained that it is not only a GIS, but it is also linked to an Access database that contains inventory and condition data for roads and structures (bridges and culverts). The GIS and database interface allows the DFR to draw reports and statistics. The GIS and database interface currently serves as the DFR's road asset management system. The GIS also contains social facility locations such as schools, health facilities, markets, etc.

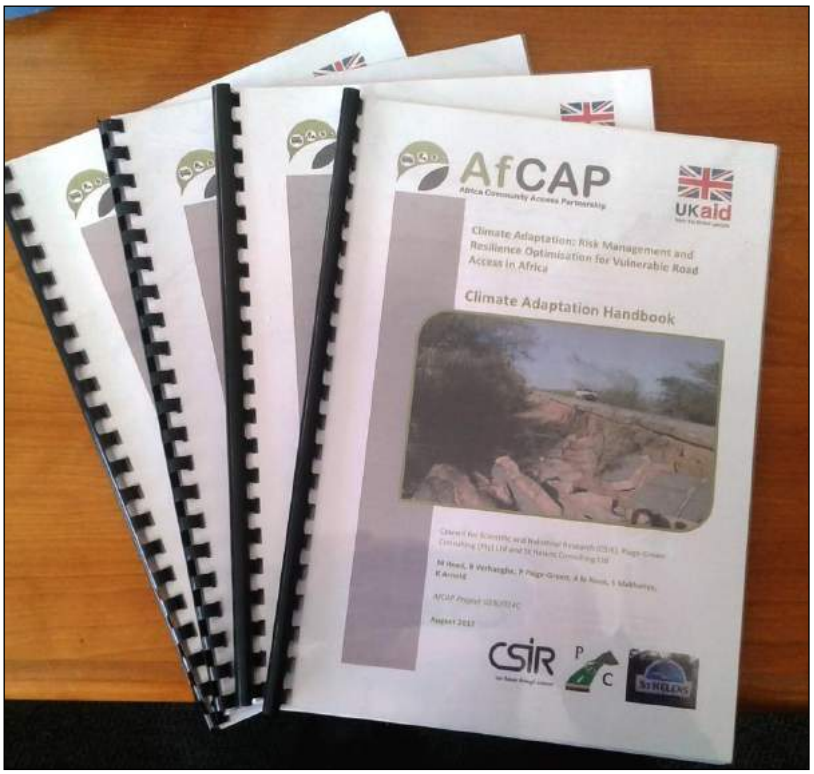
The DFR also has an MS Excel-based Maintenance Wizard that is used for routine road maintenance planning and budgeting. The Maintenance Wizard uses condition data from the GIS based RAMS to calculate maintenance requirements and budgets. The wizard makes provision for three levels of maintenance, namely minimum, basic and standard. It contains unit costs for these three maintenance levels for four different climate zones. It also includes traffic information. Routine road maintenance is only done on the engineered and partially engineered networks, while the un-engineered network is not maintained.

Road condition data is recorded at district level. Relying on this distributed assessment approach does have constraints and part of the challenge is applying a consistent form of evaluation across many districts. This requires training to ensure a standard measure is applied. He indicated that changes in what forms part of condition assessments will require retraining the officials from the districts. He indicated that the DFR also experimented (with the assistance of CERSGIS) to see if the combination of satellite and drone technology could be used to measure road condition. This project was not complete at the time of the session; it could however be a way to accelerate road condition assessments.

Ernest Obeng, the Director RSIM at the MRH made the second presentation on the MRH project for GIS Support for Transport Infrastructure Management. This project involves the creation of an enterprise GIS for the MRH. The project commenced in April 2014 and Phase 2 was finalized in June 2015.The outputs of Phase 2 of the project are a GIS enterprise database, GIS Desktop capabilities, a core Web GIS solution and knowledge transfer. The GIS system consists of a combination of Commercial off-the-shelf (COTS) and Open Source (OS) components. The proprietary software is underpinned by the ESRI ArcGIS software and QGIS is the Open Source software component selected to be integrated into the COTS stack to support data production. It will also include the use of web services (a means to expose the spatial information via the internet to other spatial data users). During the next phase of the project, data in the database will be cleaned-up; the database will be populated with data from designated/selected areas; and a RAMS will be developed or procured that would draw from the GIS backbone.

Introducing the subsequent presentations, Mr Maritz indicated that the sessions were also reflections of what was expressed in the AfCAP documents produced to support Climate Change Adaptation in the roads sector. A set of 4 documents (see Figure 8) were provided to participants and participants were also requested to provide comments or feedback if possible.

Figure 8 AfCAP documentation produced to support Climate Change Adaptation.



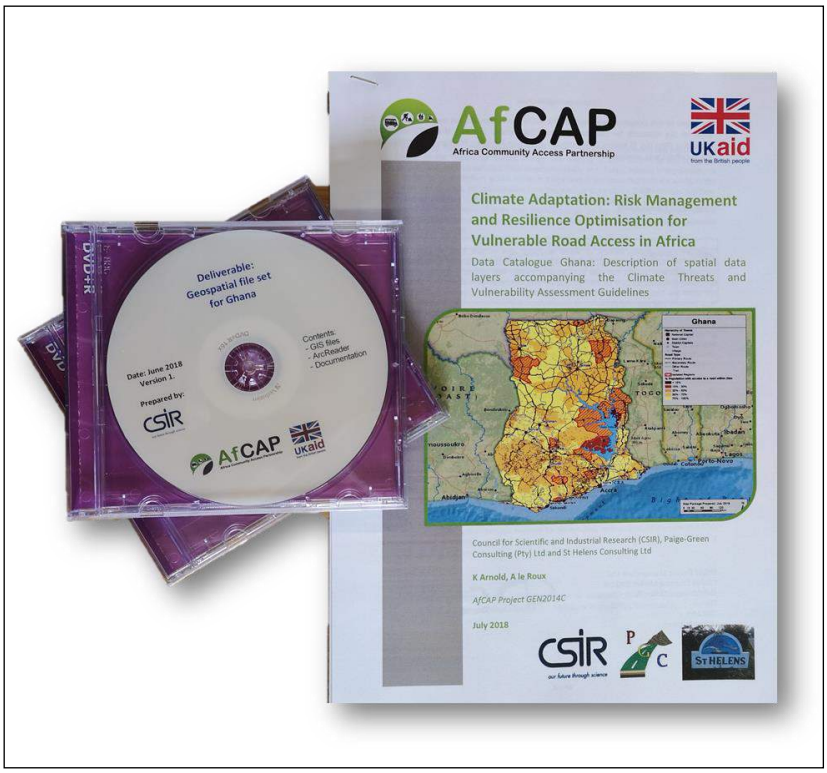
The next presentation by Ms Kathryn Arnold dealt with the **Regional Climate Risk Screening for Climate Adaptation of Rural Road Networks**, focusing on Phases 1 to 3, as described in the Climate Threats and Vulnerability Assessment Guideline. These phases, which include identifying the main regional climate threats that influence the risk and vulnerability of roads; collecting and preparing relevant data; and finally analysing the data spatially in terms of road exposure and asset criticality to determine the more vulnerable districts, were presented in detail. The presentation also profiled the series of spatial data sets that present a range of climate information including rainfall, temperature, extreme storm events, etc., as well as national and open source data repositories for road network, flooding and socio-economic data. Data presented also contained the results of two climate models which have been downscaled to increase the resolution and allow for more specific road sections to be differentiated by such climate information.

Ms Arnold also indicated that a **geospatial data parcel** had been prepared and packaged on a DVD (see Figure 9) consisting of a range of geospatial data layers for Ghana reflecting the following:

- Population Density;
- Road Network Coverage;
- Flood Index;
- Criticality Index;
- Vulnerability Index; and
- Climate.

The geospatial data were provided as a geodatabase and in shapefile format. Although the dataset is mostly aimed at GIS users, non-GIS users were also considered and the same information can be viewed through the ArcReader, a free GIS viewer that was also supplied as part of the package.

Figure 9 AfCAP geospatial data package, files and accompanying documentation.



Michael Roux then presented an **overview of the integration of climate change into road asset management**. He indicated that integration actions are required during the various steps in the Asset Management process and he provided suggestions on how the climate change information could be linked to the current GIS-based asset management systems within the DFR. As the current GIS system in the DFR is also fulfilling the function of a Road Asset Management System, it might make it easier to relate other spatial information (climate) to the existing roads data.

In response officials from the MRH indicated that as they are currently involved with the development of an enterprise GIS and the implementation of a MRH RAMS, this could present an opportunity to include other spatial information such as the climate risk and related information in the GIS and the RAMS.

3.6 Topic 6 - Technical training session: Exploring the embedment of climate change in vulnerability assessments and decision support systems, including training and policy implications

The second presentation by Mr Michael Roux dealt with **Phase 4 of Climate Risk Screening Method** described in the Climate Threats and Vulnerability Assessment Guideline, dealing with the embedment of the outputs from the climate threats and vulnerability assessment in the RAMS.

The embedment phase requires three steps. In Step 1 the climate threat indicators to include in the RAMS are identified, in Step 2 the data for these indicators are exported to the RAMS and in Step 3, the indicator data is analysed in the RAMS. The outputs from the district level climate threats and vulnerability assessment, such as the Flood Exposure Index and the Road Critically Index could be exported to the RAMS. As these indicators are calculated at district level, the same indicator value would be allocated to all road links or structures (bridges and culverts) in a district. An alternative would be to only include these indicators in the GIS to be able to identify and display the most vulnerable districts. The road links and structures in these vulnerable districts could then be prioritised for the local/road level climate risk and vulnerability assessment.

Figure 10 Presentation on embedment of climate change aspects in RAMS

Mr Michael Roux then illustrated how the measuring and recording of specific climatic effects on the road network, as described in the Engineering Adaptations Guideline, could be incorporated in a RAMS. This would require a visual assessment process to identify and rate problems specifically related to climatic effects. These problems should then be rated in terms of likelihood of occurrence and the impact should they occur. By capturing these problems and ratings in the RAMS, an index can be calculated that can then be used to rank and prioritise specific road links for climate resilience adaptation. The Climatic Effect Risk Index could also be combined with other indices usually calculated in a RAMS, such as a Visual Condition Index (VCI), to arrive at a combined index for the further ranking and prioritising of road links for maintenance and resilience adaptation.

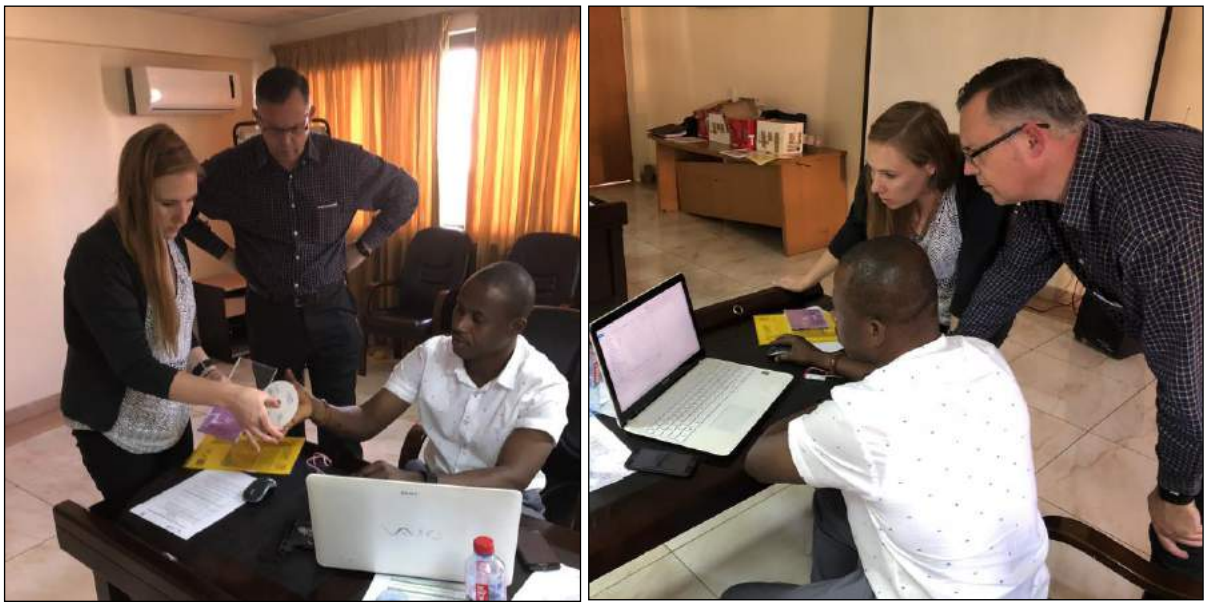
The presentation also included recommendations on how condition data relating to specific structural elements of river bridges and major culverts that could make a structure vulnerable during flooding events, could be used to rank such structures in terms of priority for climate resilience adaptation.

Enquiries after the presentation focussed on the calculation of the Climate Effect Risk Index. A remark was made that it would be useful to rank roads and structures in terms of the risk assessment only. With reference to the combined indices, for example Combined Index 1 = a x VCI + b x CERI, where a + b =1, a question was asked regarding the proposed values of a and b and whether these calculations have been applied anywhere. In reply, Mr Roux explained that the equations in his presentations are proposals that have not been applied yet. The idea is for road authorities to apply these equations to their data using different values for the various coefficients in order to see which values gives the most useful results.

3.7 Technical session: GIS information set training session and transferring the GIS data package to DFR (11 July 2018, 14:00-16:00)

Subsequent to the morning presentation by Mr Richmond Ankrah (Head of the GIS/IT Section in DFR), a separate session was held in order to transfer the prepared geospatial map package to DFR. Ms Kathryn Arnold explained the contents of the package and also reflected on the list of spatial items contained in the set (see Figure 11). A document was also provided that lists and describes the spatial data items as well as the relevant source information.

Figure 11 Transfer of geospatial data package to DFR.



The DFR has a current ArcGIS system and can utilise the provided information which have been prepared with the same software. The current GIS based road management system already use climate zones. Initially the AfCAP spatial information can be related to their climate zones if this is at a sufficient spatial scale.

3.8 Policy discussion with Mr Kwasi Agyeman-Boakye, Acting Director for Policy and Planning, MRH (12 July 2018, 09:00-11:00)

Mr Agyeman-Boakye indicated that the **National Transport Policy** is currently being updated. This is a critical strategy document for all transport stakeholders as it will provide guidance on government priorities and strategic objectives for transport to key stakeholders and institutions involved in planning, financing, developing, providing, maintaining and regulating transport infrastructure and services. The project is managed by the Ministry of Transport with funding support from the World Bank (also reflected in topic 10). This process has progressed and all regional consultations have been completed. As part of this process a green paper, which is a consultative document, is being prepared. It is designed to offer options and to pose questions that need be answered in order for government to formulate policy. It presents an opportunity for AFCAP and others (non-sector) groups to respond.

Mr Agyeman-Boakye indicated that the MRH would share this green paper with the AfCAP team at the end of July 2018 (via Dr Patrick Amoah Bekoe). This would present an opportunity to reflect on the extent to which climate change issues has been incorporated. *The AfCAP team has subsequently provided written inputs for consideration by the Ministry and the project team.*

This National Transport Policy development process will also require validation seminars which will take place with the other (non-transport) sectors. This will also present an opportunity for the MRH to engage and incorporate the issues of climate change.

Mr Agyeman-Boakye also indicated that the problem lies not at the level of policy but rather at the level of implementation. He indicated that uncertainty existed on how to get involved in other sectors or at a more local administrative level – the only mechanism seems to be through dialogue with other stakeholders.

3.9 Meeting with Senior Management representative of the MRH: Presentation of the outcomes of the previous two days' deliberations; discussion and agreement on policy and embedment actions; and identification of any assistance that AfCAP and the Project Team could provide going forward (12 July 2018, 11:00-13:00)

On 12 July, a meeting was held with Mr Ernest K. Obeng, representing senior management, in order to provide feedback on the previous two days' sessions. Mr Maritz reflected on the discussions held earlier in the day with the Policy and Planning Directorate and particular reference was made to the opportunity to provide inputs to the forthcoming new National Transport Policy. In support of this process Mr Obeng indicated that it might be of value if some best practice examples can be provided to the MRH – this could also include principles and indicators that feature climate change issues. Mr Maritz proposed that the MRH send a request for such contributions via Dr Patrick Bekoe, the AfCAP coordinator, in order for the AfCAP team to respond sufficiently to the issues. Mr Obeng indicated that he would also compile a short summary for the Director General which would feature the following issues:

- Uptake and Embedment (the need for clear actions);
- Practical site (decision on moving ahead to establish the site); and
- Policy (opportunities to contribute/ include climate change).

He also indicated that for the MRH, climate science is still a new item and he acknowledged that due the nature of their asset management systems, the ease of relating the spatial information to it will vary. It would be easier for the DFR given that the base of their system is a GIS. Mr Maritz acknowledged that climate change is a new aspect to deal with and as such it is also opportune to develop a relationship with the climate science network. This would be essential in order to deal with climate change in future research, etc. or if the MRH want to repeat/redo such analysis. Mr Maritz also repeated that the MRH could also share the AfCAP based climate change work with others dealing with climate research. It should also receive stronger consideration when looking at new road projects.

Mr Obeng concurred that they need to encourage the relationship with departments and agencies that are involved in climate science such as NADMO, ETA and others. He indicated that they will invite them to the MRH to explore in more detail what information they have, and how they could possibly support the MRH.

Mr Obeng mentioned that another important policy item they need to develop is a research policy for the MRH. Such a policy will need to be far reaching and it should also draw on the climate science work done by AfCAP, as well as other ministries and agencies. The process to develop such a policy has commenced but it is necessary to consider more inputs. He requested that once they have progressed and drafted a basic policy, AfCAP could give comments and inputs. He emphasised that the AfCAP work should find practical implementation, and should be incorporated in the update of road design guidelines[3].

Mr Maritz indicated that the four documents (Handbook and Guides) provided at the sessions are currently in a trial phase and in order to finalise it, comments are needed. He requested that the MRH provide comments to the team where feasible.

3.10 Meeting with a World Bank representative, Mr John Kobina Richardson (13 July 2018, 14:00-16:00)

Mr Richardson indicated that the World Bank has a basket of projects that deal with a number of aspects related to roads, including asset preservation, regional integration, road value chains, rehabilitation, maintenance and reconstruction. Considering the issue of climate change, it has not always reflected in projects. One item that has taken place is a review of Intensity-Duration-Frequency (IDF) curves. The IDF relationship is a mathematical relationship between the rainfall intensity, duration and frequency. It is a

[3] Work on this has commenced.

hydrologic statistical tool that is commonly used by engineers during planning and designing of hydraulic infrastructure, such as drainage system and water storage facilities for urban and rural areas. New curves have replaced the prior versions which dated from 1974. This will then contribute to the update of the engineering guidelines. Mr Richardson indicated that the process to update the engineering guidelines has started and is being managed by the MRH. He indicated that the AfCAP site projects and the other engineering issues can still make a contribution to the process to update the engineering standards.

He mentioned they are involved in the review of the National Transport Policy and indicated that it should reflect issues of climate change more than previously. This policy is currently at the green paper stage, which will be subjected to consultations. It is expected that a draft policy would be available by December 2018. It is being driven by the Ministry of Transport.

He indicated that they can look at the AfCAP documents and provide feedback as they are interested in the AfCAP work. Mr Maritz also requested that the processes featured in the documents be reviewed for comments.

The MRH has undertaken a study to review the classification of the road network in order to redefine responsibilities for roads. This was also done to provide relief to district assemblies who might not have the necessary resources for the management and maintenance of critical roads. In effect it relieves the pressure of local authorities when it comes to deal with roads whilst some of the local feeder roads will be seeded to the district assemblies – such roads would then no longer be the responsibility of the MRH. This is also part of the ongoing process of decentralisation in Ghana, whereby local authorities become more responsible for infrastructure within their areas. Gaps in resources and capacity however make this difficult.

The World Bank in Ghana does not really deal with spatial information in their activities, and it is currently limited to the online screening tool that the Bank has developed and which is applied on a project basis. Mr Maritz suggested that it would be useful to establish whether the AfCAP geospatial information could contribute towards such screening.

Mr Richardson mentioned that as part of their basket of projects they have identified several agriculture value chain roads forming a network of roads. These rehabilitation and maintenance of these roads are supported by the World Bank for a fixed period. Mr Maritz indicated that these roads could also be important when dealing with sectors such as agriculture and the effect their land use practises have on roads.

A concern was raised regarding current practice when dealing with road projects (especially relevant to those in the MRH not aware of the AfCAP climate change work). Using old design standards would mean that climate change is not sufficiently addressed. This places more emphasis and urgency on the need to update design guidelines and the question was raised on how AfCAP could assist such a process to update design guidelines. Mr Maritz responded that under the current AfCAP project, the team could provide some assistance (inputs/comments) but that a wider process to update design guidelines would require a separate, more targeted action. In anticipation of such a process it might be better if the MRH request AfCAP's assistance, specifically to deal with the updating of design guidelines. Maritz indicated that as part of the project it is also important to identify needs where the AfCAP work could assist further. Such needs might not be addressed under the current project, but it could be considered by AfCAP in a possible further project phase or as a separate initiative.

Mr Richardson indicated that there is an established coordination group where common transport issues are discussed, the **Transport Sector Working Group**. The working group involves development partners and government representatives and it meets quarterly. This group is coordinated by the MRH and co-chaired by the MoT and the local World Bank office. Mr Richardson proposed that AfCAP could be invited to such a meeting to share with the working group all the activities of AFCAP on climate change.