



**AfCAP**  
Africa Community Access Partnership



## Protocols for Improving the Proficiency of Material Testing Laboratories in Mozambique

Inception Report (Final)



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Cover Image:      Scenes from Mozambique laboratories

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## ReCAP Completion Report Template

ReCAP Database Details: Economic Growth through Effective Road Asset Management			
Reference No:	MOZ2094A	Location	Mozambique
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Theme		Sub-Theme	
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### Key Words

Materials, Quality Control, Capacity Development, Proficiency Testing

## **Acronyms, Units and Currencies**

\$	United States Dollars
AFCAP	Africa Community Access Partnership
ALD	Average Least Dimension
ANE	Administração Nacional de Estradas; National Road Administration
ARMFA	African Road Maintenance Fund Association
ASCAP	Asia Community Access Partnership
ACV	Aggregate Crushing Value
AIV	Aggregate Impact Value
BADEA	Arab Bank for Economic Development in Africa.
CBR	California Bearing Ratio
CDS	Civil Design Solutions
CSIR	Council for Scientific and Industrial Research
DCP	Dynamic Cone Penetrometer
DFID	Department for Further International Development
DIMAN	Directorate of Maintenance
DIPLAN	Directorate of Planning
DIPRO	Directorate of Projects
DN	Number of mm penetration per blow of a DCP
EU	European Union
FACT	Fine Aggregate Crushing Test
FWD	Falling Weight Deflectometer
GPS	Global Positioning System
ISO	International Standards Organisation's
INNOQ	Instituto Nacional de Normalização e Qualidade
LNEC	Laboratório Nacional de Engenharia Civil (Portugal)
LVR	Low Volume Road
MCA	Millennium Challenge Account
MDD	Maximum Dry Density
NLA	National Laboratory Association
OMC	Optimal Moisture Content
PMU	Project Management Unit
PT	Proficiency Testing
PTS	Proficiency Testing Scheme
ReCAP	Research for Community Access Partnership
RL	Reference Laboratory
RTFOT	Rolling Thin Film Oven Test
SC	Steering Committee
UK	United Kingdom (of Great Britain and Northern Ireland)
UKAid	United Kingdom Aid (Department for International Development, UK)

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## **1 Introduction**

### **1.1 Background to the Project**

The Africa Community Access Partnership (AfCAP) is building on the programme of high quality research established under AfCAP phase 1 and taking this forward to a sustainable future. The aim is to ensure that the results of the research are adopted in practice and influence future policy in the roads sector.

As part of this initiative AfCAP is providing a range of support to Mozambique, which is one of 12 countries in Africa that are participating in AfCAP. This support includes the development of design guidelines for low volume roads and the evaluation of existing road experimental sections constructed previously in Mozambique. The latter project will also include the identification of new experimental sections to be constructed and monitored by ANE, the National Roads Administration.

The validity of research on roads in Mozambique and the region depends on the reliability of laboratory test results. AfCAP is assisting ANE to establish a Road Research Centre (RRC), which will establish and maintain a materials database. The usefulness of the database will depend on the accuracy of the materials testing data used to populate it.

Mozambique is currently implementing a major integrated road sector investment programme known as PRISE. The programme includes rehabilitation and upgrading of all classes of roads with funding from the government and development partners. Reliable materials testing is crucial for the design of these road improvements and for quality control on site.

Meanwhile laboratory facilities and services in Mozambique are relatively underdeveloped. In recent years, the government has increased its support to the central materials laboratory, LEM (Laboratório de Engenharia de Moçambique), but LEM does not have capacity to provide testing services for the entire industry. LEM also does not have facilities for some important test procedures (e.g. RTFOT), for which samples must be sent to South Africa. For binder extraction and trial tests LEM has facilities but is still in the process of training its staff. Meanwhile the provincial materials laboratories tend to operate at a low level with minimal basic equipment and limited training of staff members. Some laboratories have a severe staff shortage. This situation was improved with the distribution of equipment from projects funded by the Millennium Challenge Account in Nampula Province, but the laboratories have not yet established a strong reputation as reliable testing facilities. They tend to service smaller maintenance projects on low volume roads implemented by the Provinces. Several private materials laboratories have now been established in Maputo and this trend should continue with increasing demand for improved quality in materials testing. However, systems are not yet in place for a coordinated accreditation of these laboratories. There is no quality control or accreditation carried out by LEM on site laboratories operated by contractors and supervising engineers in the Provinces.

Furthermore, experience in Mozambique (and the region) suggests a general lack of reliability in materials testing for roads. For example, testing carried out under a previous AfCAP project investigating calcrete deposits in Inhambane Province gave some unusable results. Regional AfCAP research on the use of laterites and sand in road construction was hampered by unreliable testing carried out in South Africa. Meanwhile it has been found that laboratory tests performed on identical materials (split samples) under the same conditions may often yield different results. To some extent this is attributable to factors outside of the control of the laboratory, in particular the inherent variability in testing procedures and the variability in the material itself. However, there are important contributory factors that are within the control of the laboratory, including the skill, experience and diligence of the operator and the condition, suitability and calibration of the equipment. Laboratory conditions, for example temperatures, lighting, ventilation, etc. may also not comply with the requirements of a test method. In addition to these points, technicians may not be aware of the important differences between different international standards used to ostensibly measure the same parameter which will build in further variability in the results.

To address these challenges AfCAP is supporting the implementation of a pilot project for Proficiency Testing in selected laboratories. The overall objective is to establish laboratory testing in Mozambique that is “in line with international practices and standards and test results that can be used with confidence”<sup>1</sup>.

The Proficiency Testing Scheme (PTS) will require a baseline for the precision limits for each specific test included in the project. The baseline will be used to assess laboratory capacity and identify where the constraints lie and where specific training and other interventions may be required. It is expected that participating laboratories will ultimately become accredited to the International Standards Organisation’s standard ISO/IEC 17025.

The PTS pilot project is closely linked with the project currently being implemented by ANE to develop new Standards and Specifications for Roads in Mozambique. The project is being implemented by TRL of UK with support from the World Bank and the Nordic Development Fund. It will result in the publishing of a complete series of unique road design manuals for Mozambique and Standard Specifications for Road and Bridge Works. Key decisions are required to be made on the appropriate materials testing methods which will underpin these standards. The selected test methods will be incorporated in the PTS.

The Mozambique PTS project is a pilot project for Mozambique and for a possible AfCAP regional initiative to support capacity development in materials laboratory testing through a PTS process.

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<sup>1</sup> Terms of Reference.

## **1.2 Objectives**

The objectives of the assignment are as follows:

- To identify the repeatability and reproducibility (precision limits) of the principal test methods currently being carried out in Mozambican laboratories; evaluate the existing testing competence of laboratories in Mozambique.
- Determine how the test results of the Mozambican laboratories compare with those of internationally accredited (ISO/IEC 17025) laboratories and included these laboratories as independent controls in the baseline survey and PTS pilot.
- Identify where interventions are needed for improving test results and the type of intervention required.
- Design and manage a pilot PTS and transfer knowledge and expertise to Mozambican laboratory personnel on how to implement a PTS and to evaluate the test results obtained.
- Keep ANE and sector stakeholders fully informed on project implementation and outcomes in order for precision limits of tests to be included in relevant National Standards for Roads in Mozambique.

## **1.3 Approach**

The approach to the project implementation focuses on the following key objectives:

1. To ensure that ANE and LEM are the leaders of the research process.
2. To ensure effective linkages with parallel and associated project initiatives.
3. Establish linkages between the participating laboratories.

The purpose of establishing linkages between the participating laboratories is to promote the concept of a self-supporting network of laboratories, with a joint commitment to quality and reliability of results. It is noted that the PTS in South Africa is implemented by the National Laboratory Association (NLA), which is an accredited ISO 17043 PTS provider.

## **1.4 Outputs**

The expected outputs of the project include:

- Inception Report including, resource mobilisation and a project implementation programme and report on a preliminary visit to at least one representative provincial laboratory.
- Draft Protocols for Proficiency Testing Scheme to be discussed with stakeholders at a workshop in Maputo.
- Workshop Report and Final Protocols based on the outcomes of the workshop.
- Baseline Study Report including the investigation of current practice in Mozambique related to the selected test methods, assessment of the proficiency of all participating laboratories and proposed corrective actions for participating laboratories.



- Proficiency Report including a second set of tests results with all participating laboratories using the same test methods after the corrective action interventions have been implemented from the baseline study with recommendations for the expected precision limits for the specific tests.
- Draft Final Report including a write-up of the results with final recommendations on a PTS testing protocols.
- Capacity Building and Skills Development Report including both practical and theoretical training programmes and expected competency levels to be attained by each category of laboratory personnel.
- Final Project Report summarising all the outcomes of the project
- At least one Technical Paper to be presented at an appropriate regional or international forum.

Some modifications have been made to the sequence of these outputs following the kick-off meeting on 10<sup>th</sup> January 2017.

### **1.5 Purpose of this Report**

This report covers the activities carried out in the Implementation Phase of the project. It includes a record of the Kick-Off Meeting held at ANE offices on 10<sup>th</sup> January 2017, modifications to the implementation programme, a questionnaire to be used to survey existing laboratory facilities, and a record of observations from a visit to two of the three materials laboratories in Maputo.

## **2 Kick-Off Meeting**

The Kick-Off Meeting was held at the offices of DIMAN on Tuesday 10<sup>th</sup> January 2017. The meeting was attended by the Director of ANE-DIMAN, members of the RRC, the ReCAP Infrastructure Research Manager, the ReCAP Regional Technical Manager, and the CDS team. The list of participants is in Annex A.

The Director of DIMAN chaired the meeting. The participants introduced themselves. The ReCAP Regional Technical Manager introduced the project including the regional context and background. The CDS Team Leader and Materials Engineer then described the proposed approach and methodology using a PowerPoint presentation (see Annex B). This provoked discussion amongst the participants. The main discussion points are summarised as follows:

1. A decision will be required from ANE on the relevant laboratory test methods for the PTS. (ANE is currently preparing new Standard Specifications for Road Works under a separate project).
2. ReCAP is currently developing a regional project for training middle-level laboratory staff.
3. The PTS project will provide some training to the participating laboratories and will develop a longer-term capacity development plan to be implemented separately.
4. CDS recommended starting the pilot PTS with aggregates because the samples are more consistent and likely to limit some of the variables; but ANE requested that the pilot be carried out using granular material, which is more frequently tested in the Provincial laboratories.
5. Training and assistance during the actual process of splitting samples will be provided by CDS on the sampling procedures. A protocol for the splitting of samples will also be provided.
6. On the South African PTS, the manager of the scheme does not know which results come from which laboratory. However, in Mozambique it will be necessary to know from which laboratories the results come from for the identification of training needs and other intervention requirements.
7. It will not be possible to provide precision limits for the tests until after the completion of the pilot project. These limits will still require further data from future PTS rounds to fine tune them into acceptable precision limits.
8. The RRC team members who will work with CDS during the PTS Project are: Mr Hilário Tayob (ANE), Mr Carlos Cumbane (LEM), Mr Santos Cuinica (LEM) and staff of the various laboratories participating in this study. Eng. Tayob has been appointed as the Coordinator of the PTS Project. The Materials Engineer noted that he spends about a week a month managing the South African PTS, which consist of between 10 and 40 participants depending on the material being tested.

9. There are currently only two accredited facilities in Mozambique for undertaking calibration of laboratory testing equipment, namely INNOQ<sup>2</sup> and Prova Impar. However, it is expected that the project will lead to an opportunity for increased capacity for establishing accredited calibration laboratories by creating the demand.
10. CDS recommends that as many laboratories as possible should participate in the PTS, as more data is good for the statistical analysis. This would include contractors site laboratories, consultants and commercial facilities.
11. The Provincial laboratories in Nampula, Niassa and Cabo Delgado recently benefitted from the laboratory testing equipment used on road improvement projects funded by the MCA.
12. It is probably not appropriate to use LEM as a reference laboratory (RL) from the start of the project. The reference point will be the robust consensus mean of the results obtained from all the participating laboratories as there are no reference materials for the civil road building materials.
13. LEM is currently doing testing for research purposes, quality control as well as commercial purposes.
14. It was agreed that the identification process for the participating laboratories should start with a questionnaire sent to all materials laboratories in Mozambique.
15. It will be necessary to provide on-site training for laboratory staff after the first round of the PTS; the first draft of the proposed capacity development plan will also be prepared after the first round of the PTS.
16. The stakeholder workshop will be held after the first round of the PTS to ensure maximum benefit to all laboratory facilities. It is proposed that even those facilities that did not take part in the PTS should attend the workshop.
17. In the longer term the Government should encourage the establishment of an association of testing laboratories in Mozambique.
18. The long-term success of the PTS will depend on the Government addressing all aspects affecting sustainability including the external environment (including political support), the institutional arrangements for laboratory testing in Mozambique, financing of materials testing, management arrangements in the relevant sector agencies, technical standards etc.

The meeting was followed by a visit to two of the three materials laboratories near the ANE offices: the LEM Laboratory and the ANE Maputo Provincial Laboratory. The ANE Central Laboratory was closed at the time of the visits. Observations from the laboratory visits are summarised in Chapter 3.

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<sup>2</sup> The Instituto Nacional de Normalização e Qualidade (National Institute for Standardization and Quality) is supervised by the Ministry of Industry and Commerce (MIC). It is responsible promoting and coordinating the National Quality Policy, through the implementation of standardization, certification and quality management.

### **3 Initial Visit to Laboratories**

#### **3.1 Laboratories Visited**

Due to the kick-off meeting taking place early in the new year, all three facilities were not up and running so it was not possible to observe the laboratories under full operating conditions. Due to this the effectiveness of the testing apparatus and the testers competencies were not able to be assessed. This will become apparent after the baseline PTS is held. The ANE research laboratory was not open so it was not possible to inspect that facility.

#### **3.2 Certification**

None of the facilities have calibration certification from an accredited laboratory. LEM does calibration for itself as well as for the ANE facilities. There seems to be a lack of systems and controls in place across all facilities to provide proof of the testing undertaken in the form of daily checks and verification sheets required to provide evidence of what was undertaken at the time of testing should a query be raised at a later date on a particular test result or range of test results.

#### **3.3 LEM Laboratory**

This is an extensive facility with lots of testing equipment beyond what will be incorporated in the PTS including extensive geotechnical, reinforcing bar and cement testing departments. All the basic testing apparatus is available for the granular and aggregate test methods being considered for inclusion in the PTS besides the ALD method.

The facility seems to be well organised with a fair amount of testing undertaken in the geotechnical, reinforcing bar analysis and cement sections. It would be advisable to have the granular and aggregate sections running testing on a weekly basis especially if LEM is to become the reference laboratory. This will allow the laboratory to build up a level of experience in the various materials tested and to gain confidence in the results they produce.

#### **3.4 ANE Maputo Provincial Laboratory**

This facility has far less testing apparatus than LEM but is set up for the basic testing envisaged for the PTS. The test methods used are predominantly from the AASHTO series. No traceable calibration was evident although internal verifications are being undertaken albeit in a less systematic manner.

Although the staff present seemed competent to undertake the methods, it is felt that this facility may need more support in conducting the testing during the PTS rounds.

## **4 Methodology**

### **4.1 Tasks**

The following tasks will be carried out to achieve the project objectives.

#### **1. Identify the laboratories which should participate in the proficiency testing**

According to the TORs, the participation will initially include up to five ANE provincial laboratories, the ANE and LEM central laboratories in Maputo. Two international accredited laboratories will participate as control laboratories. However, it is recommended that at least one private laboratory in Mozambique should participate in the process.

It is recommended that a survey be carried out of existing facilities in Mozambique to facilitate the identification and selection process. This will be achieved through a questionnaire administered by ANE. The questionnaire is included in Annex C. It should be sent to as many materials laboratories as possible that are currently operating in Mozambique. It will need to be translated into Portuguese prior to sending.

CDS will propose two laboratories in South Africa to participate in the scheme, for approval by RRC. This will be done after the test methods to be used in the project have been confirmed.

#### **2. Determine the current level of operations in the various laboratories.**

A short-list of potential participants will be prepared from the questionnaire responses. The short-list will include up to six provincial laboratories and four laboratories in Maputo. The Materials Engineer and RRC team involved in the Project will visit each of the shortlisted laboratories to further assess their capacity to participate in the PTS, and thereafter make a final recommendation.

The existing capacity of the laboratories will be assessed in terms of availability and calibration of equipment, accuracy of testing methods and personal competencies as per ISO 17025 requirements. For this task to be effectively carried out the laboratories must be actively testing materials in the methods to be used in the PTS during these visits. If the laboratory is not actively testing during the visits, it will be difficult to identify any shortfalls in the laboratory practice. It may be necessary to send samples of material to the short-listed laboratories ahead of the assessment visit.

#### **3. Develop a protocol for the proficiency testing scheme**

The draft protocols for the PTS will be based on the protocols used in South Africa. It will be discussed with the RRC and other stakeholders in Maputo before it is implemented.

The test methods most relevant to current Mozambique industry requirements will be identified. The selected materials will be those commonly used in road construction and will

include materials that are known to be troublesome during testing, e.g. single-sized and non-cohesive sands and laterite. However, the selected materials for the initial PTS pilot must be those that are likely to give consistently acceptable results for typical granular and aggregate materials to limit the variables for analysis purposes.

The tests to be included in the PTS pilot project will be confined to routine soils and aggregate tests such as the normal classification tests (Grading and Atterberg limits), material compaction (OMC/MDD), material strength (CBR), laboratory DCP-DN tests, and aggregate basic methods (grading, Flakiness Index and Average Least Dimension), aggregate strength (ACV, AIV, and 10% FACT). It is expected that more complex test methods and methods related to concrete and bituminous materials can be added to the scheme after its establishment.

#### **4. Sampling and splitting of material**

Samples will be prepared for the various participating laboratories. The sampling and splitting will be carried out by LEM and ANE. ANE will arrange transportation of the samples to the various laboratories. Training will be provided for the sampling and splitting to ensure as representative as possible samples are provided to each of the participating laboratories as well as a protocol in how the splitting is to be undertaken.

#### **5. Implementation of the PTS Pilot**

The PTS pilot processes will be carried out in three phases as follows:

- a. Send the first samples of material for the PTS to the participating laboratories. Each laboratory will receive 3 samples to generate sufficient data for the statistical analysis and to assist in determining repeatability limits. ANE has requested that the samples should be of granular material. ***The sampling and splitting will be carried out by LEM and ANE with assistance from CDS. ANE (or LEM) will arrange for transport of the materials to the participating laboratories. CDS will pay for the transport of samples to South Africa but it will be organised by ANE (or LEM).***
- b. Receive reported results from the laboratories undertaking the testing (the report format will be the same for all participating laboratories). The laboratories will be required to report the results via return email on or before a specified closure date. ***The results will be received by ANE/RRC and passed on to CDS.***
- c. Prepare a summary report including analysis of results, recommendations for any corrections required, and comments on the performance of the various laboratories. Identify and investigate anomalous results to determine the reason(s) for such differences. ***This report will be prepared by CDS and reviewed by RRC.***
- d. Conduct a stakeholder workshop in Maputo to discuss the outcome of the first round of the PTS. ***The workshop will be organised by ANE. CDS will provide airfares and accommodation for participants from outside Maputo.***

- e. Prepare recommendations for immediate interventions required to improve uniformity on the methods as used and the accuracy of results obtained. Provide this advice at the facilities where problems were encountered. ***This task will be carried out by CDS and RRC will participate in the training.***
- f. Develop a capacity building plan for ongoing training of laboratory technicians to improve competency. Identify suitable training courses that could run in Mozambique for this purpose. Link the training, if possible, with the Materials Testers qualification currently being implemented in South Africa under the Quality Council on Trades and Occupations (QCTO). ***CDS will prepare a draft plan for review by RRC.***
- g. Distribute further samples of the first-round material from the same source for the second PTS round. ***LEM and ANE will be responsible for this task. CDS will pay for the transport of samples to South Africa.***
- h. Prepare a summary report on the second PTS round including analysis of results, recommendations for any corrections required, and comments on the performance of the various laboratories. ***This report will be prepared by the RRC and reviewed by CDS.***
- i. Distribute samples of a new material for the third PTS round. ***LEM and ANE will be responsible for this task. CDS will pay for the transport of samples to South Africa.***
- j. Prepare a summary report on the third round including any improvements in testing performance observed. ***This report will be prepared by the RRC and reviewed by CDS.***
- k. Establish appropriate interim precision limits for the specific tests. ***CDS will prepare a draft proposal for discussion with RRC.***
- l. Prepare the Final Report with all protocols included as an appendix for future PTS. ***CDS will prepare a draft for review by RRC.***

#### **4.2 Reference Laboratory**

The Terms of Reference envisage identifying a “Reference Laboratory” (RL) to act as a local control laboratory for the PTS. It is expected that the RL will be responsible for “sample preparation and distribution, analysis of results and reporting to the participating laboratories”. The RL will provide recommendations to participating laboratories on “corrective actions” to improve confidence in the results. The reference laboratory might also manage the scheme on an ongoing basis.

The only laboratory in Mozambique that could take the role of the RL is LEM, working in association with the RRC. However, it is too early to determine whether LEM can take on this responsibility. It is recommended that the decision to appoint a RL be delayed until more is known about the capacity of LEM and other laboratories in Mozambique. It is noted that the South Africa PTS has been developed without a RL.

## 5 Work Plan and Inputs

### 5.1 Overall Programme

There are some changes to the project work plan (as set out in the CDS Technical proposal) following the kick-off meeting. The project workshop will now be held after the first round of the PTS and there are now three rounds of testing in the pilot phase. The Capacity Building and Skills Development Draft Report will be prepared after the first round of the PTS, rather than at the end of the project. The Capacity Building and Skills Development Report will be revised after the 2<sup>nd</sup> & 3<sup>rd</sup> rounds based on the improvements observed and other possible interventions that may be noted with a final report at the end of the project.

Activity	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17
Project launch meeting												
Identify the laboratories												
Determine the current level of operations												
Develop a protocol for the PTS												
Sampling and splitting of material												
Implementation of the PTS Pilot	First round											
	Second round											
	Third round											
Final reporting												
<b>Workshops and visits to participating laboratories</b>												
Sample laboratory	X											
All participating laboratories			X				X		X			
Stakeholder workshop						X						
<b>Outputs</b>												
Inception report	X											
Draft Protocols for Proficiency Testing Scheme			X									
Workshop Report and Final Protocols							X					
Baseline Study Report							X					
Proficiency Report										X		
Draft Final Report											X	
Capacity Building and Skills Development Report							X					
Final Project Report and Technical Paper												X

Expert	Estimated time inputs (days)												Total days
Team Leader	3	1	3	2	1	2	4	1	1	1	3	3	25
Materials Engineer	3	3	10	4	1	3	10	2	10	4	3	2	55
													80

55 Inputs provided in Mozambique

Figure 5.1: Revised Work Plan

### 5.2 Short Term Programme

The short-term programme includes the key task of identifying the participating laboratories. The basis for the identification process will be a questionnaire-based survey of existing laboratories conducted by ANE. This will be followed by visits to short-listed laboratories by the Materials Engineer and RRC team members involved in this Project in order to make a final recommendation. This will occur in the planned March 2017 visit.



## Annex A. Participants in Kick-Off Meeting

No.	Name	Institution	Email	Phone
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## **Annex B. Consultant's Presentation**



# Protocols for Improving Proficiency of Material Testing Laboratories in Mozambique

Kick-off meeting  
10th Jan 2017  
ANE office, Maputo

Civil Design Solutions in association with Learning Matters etc



## Overall objective




### Quality laboratory facilities

#### Providing results that are trusted

- For approval for design
  - For approval of payment for construction
  - Ensuring value for money
  - Appropriate return on capital expenditure
  - Acceptable life cycle costing for infrastructure developments
  - Continued work



## Methodology




**Identify participating laboratories in proficiency testing**

- Including 2 SA ISO 17025 accredited labs
  - Test methods critical (SA SANS 3001)
- **Reference laboratory**
  - Plan & run scheme & drive process
  - Funding for ongoing process


**Determine current level of operations in various laboratories**

- ANE, commercial, site facilities
  - Questionnaire / audits regarding abilities, levels of competence & readiness
- Base line from which to gauge progress/improvements
  - Round 1 of consistent material preferably aggregates
- Used to determine variance in various methods assessed
  - Rounds 2 & possibly a further round 3



Private and confidential 3

## Methodology



**Establish testing protocols to suit Mozambican scenario**

- Test methods to be used
  - SANS, BS, EU, ASTM
- Consider the bigger picture for the SADC region as a whole

**Develop a protocol for the proficiency testing scheme**

- Consistent material to start with preferably aggregates


**Sampling / splitting of material by reference lab**

- Critical to get this right to ensure representative samples
- Especially so in more variable materials

**Implementation of the PTS Pilot**


- Aggregate
- Granular

**Analysis, feedback & corrective action process**



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## Issues required to be addressed



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**Mind shift into PTS approach**

**Current state of laboratory activities**

**Champion to drive the process**

- & continue process after 12 months

**Standardized test methods across all projects**

- SANS, BS, ASTM, EN

**Calibration of testing equipment**

- Traceability

**Competency of testers**

- Training & experience

**Extent of PTS**

- ANE, commercial labs, site labs
  - The more the better
  - AG, GR, BT, CO, AS, NG

**FUTURE DEVELOPMENTS**


**ISO 17025 – lab accreditation**

**ISO 17043 – PTS accreditation**

- Applicable to reference lab


**Calibration facilities in Mozambique**

- Additional job opportunities




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## Sustainability



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**ROAD PRESERVATION PYRAMID**



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## **Annex C. Questionnaire**

# Questionário de participação no Sistema de Proficiência de Testagem(SPT)

## Introdução ao questionário

- 1 A ANE está implementando o sistema de Proficiência de testagem(SPT) para os laboratórios de análise de materiais em Moçambique, cujo objectivo é de obter melhorias na qualidade de testagem de materiais. Durante o primeiro ano de execução(2017), o projecto será efectuado a título experimental.
- 2 Este questionário está sendo realizado para estabelecer a capacidade existente dos laboratórios e sua aptidão em participar no projecto piloto.
- 3 As informações obtidas através do questionário serão usadas apenas para os fins do estudo e serão mantidas em sigilo.
- 4 As informações serão usadas pela ANE para seleccionar laboratórios para participar no projecto piloto.

### 1 Informações da Organização

1 Nome da organização

2 Endereço físico

3 Email

### 2 Pessoa de contacto

1 Apelido

Nome

2 Número de celular

3 Email

4 Telefone de serviço

### 3 Testes & amostragem – Quais das seguintes séries de métodos de testes você usa?

- |   |      |                                                             |   |        |                                                             |   |      |                                                             |   |       |                                                             |
|---|------|-------------------------------------------------------------|---|--------|-------------------------------------------------------------|---|------|-------------------------------------------------------------|---|-------|-------------------------------------------------------------|
| 1 | TMH1 | <input style="width: 40px; height: 20px;" type="checkbox"/> | 2 | TMH5   | <input style="width: 40px; height: 20px;" type="checkbox"/> | 3 | SANS | <input style="width: 40px; height: 20px;" type="checkbox"/> | 4 | BS    | <input style="width: 40px; height: 20px;" type="checkbox"/> |
| 5 | ASTM | <input style="width: 40px; height: 20px;" type="checkbox"/> | 6 | AASHTO | <input style="width: 40px; height: 20px;" type="checkbox"/> | 7 | EU   | <input style="width: 40px; height: 20px;" type="checkbox"/> | 8 | Outro | <input style="width: 40px; height: 20px;" type="checkbox"/> |

### 4 Testes de materiais Granulares – qual dos seguintes métodos de testagem de materiais granular você executa?

	S/N	Séries	NO. de Referência do Test	Frequência/mês
<i>Exemplos</i>	S	SANS 3001	GR30	20
	N	Não aplicável	Não aplicável	Não aplicável
1				
2				

## Questionário de participação no Sistema de Proficiência de Testagem(SPT)

3 L.Plasticidade	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
4 L. de Retração	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
5 I. de Plasticidade	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
6 MDD/OMC	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
7 CBR	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

### 5 Testes de Agregados - qual dos seguintes métodos de teste de agregados você executa?

	S/N	Séries	No. de Referência	Frequência/mês
1 Granulometria	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
2 I.Lamelacão	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
3 ALD	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
4 ACV	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
5 10% FACT	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
6 AIV	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
7 Equiv. de areia	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

### 6 Equipamento – que fornecedor(s) de equipamento você usa? *Mencione os nomes de fornecedores abaixo.*

- 1
- 2
- 3
- 4
- 5

### 7 Com que frequência realiza a calibração do seu equipamento?

Número de vezes por ano

### 8 Quem são os seus provedores de calibrações? Mencione os nomes das empresas ou instituições abaixo

- 1
- 2



# Questionário de participação no Sistema de Proficiência de Testagem(SPT)

3

4

5

9 Os seus provedores de calibração estão acreditados pela ISO(Organização internacional que padroniza as medições)?

"Sim", "Não" ou "Não sei"

10 Qual dos seguintes equipamentos está calibrado no seu laboratório?

	<i>Sim</i> ✓ / <i>Não</i>		<i>Sim</i> ✓ / <i>Não</i> ✗
1 Prensa de CBR	<input type="text"/>	4 Concha de casagrande	<input type="text"/>
2 Pesos	<input type="text"/>	5 Medidor de tempo	<input type="text"/>
3 Termómetros	<input type="text"/>	6 Paquímetro	<input type="text"/>

11 Quantos técnicos de ensaios trabalham no seu laboratório?

< 5       6 - 10       11 - 15       > 15

12 Competências do pessoal – anos de experiência em testes & qualificações.

1 Quanto a experiência dos membros da sua equipa:

Diga o número de funcionários em cada período de tempo.

< 1 ano       2 - 5 anos       6 - 10 anos       > 10 anos

2 Quantos funcionários têm nível superior, nível médio ou foram treinados localmente?

Nível superior       Nível médio       Treinado localmente

13 Você está disponível a participar no projecto piloto da ANE - sistema de proficiência de testagem (SPT)?

Sim       Não

Assinatura \_\_\_\_\_

Data \_\_\_\_\_

OBRIGADO PELA SUA ASSISTÊNCIA NESTA PESQUISA