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PROVINCIAL ROADS

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ANALYSIS (PEPA)

Performance and Expenditure Review of Provincial Roads

Project report

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1 Introduction

PDG was appointed in November 2014 to conduct an Expenditure and Performance Review (EPR) on provincial roads. The project was effectively suspended in June 2015 and finally terminated in January 2016.

This report presents some of the findings of the work done on the project during that time, highlights the reasons for suspension and makes recommendations about taking the work further in future.

2 Background on the EPR programme

As the name suggests, the purpose of the provincial roads EPR is primarily to understand what is being spent on provincial roads, what is driving this expenditure, and what is being delivered as a result of that expenditure. The ultimate goal is to highlight areas where expenditure might be inefficient, and to propose policy changes that can improve value for money and other expenditure outcomes.

The EPR process follows a clearly defined set of steps:

1. Develop a workplan for the project.
2. Describe the programme elements.
3. Develop a log frame or equivalent analysis.
4. Develop a costing analysis and costing model.
 - a. Develop a costing analysis that analyses expenditure at each step of the log frame and identifies cost drivers.
 - b. Develop a costing model that allows for scenario development.
5. Final reporting.

Steps 1, 2 and 3 were completed for the provincial roads EPR. A log frame was developed and signed off, and work on analysis of the expenditure data contained in BAS was commenced.

However, it was not possible to proceed with Step 4 due to lack of data.

3 Background on provincial roads

3.1 What are provincial roads?

The term for a 'road' includes a range of components in addition to the road layerworks and 'pavement'¹. Road structures (bridges, culverts, sidewalks) and road furniture (signage, signals, traffic calming) are typically included. In considering the activities of a roads department there may be several other related activities but for the purposes of the EPR, the definition of the provincial roads function excludes these

¹ Road layerworks are sometimes encapsulated in the term 'pavement' by roads practitioners.

other activities undertaken by provincial departments such as road safety campaigns, vehicle testing, public transport regulation etc.

The review focussed on proclaimed provincial roads only. Note that un-proclaimed roads are those not formally gazetted by any Authority. The table below gives a sense of the extent of provincial roads as a proportion of the full South African roads network.

Table 1: South African road network extent by authority

Authority	Paved	Gravel	Total
SANRAL	21,403	0	21,403
Provinces - 9	47,348	226,273	273,621
Metros - 8	51,682	14,461	66,143
Municipalities	37,691	219,223	256,914
Total	158,124	459,957	618,081
Un-Proclaimed (Estimate)		131,919	131,919
Estimated Total	158,124	591,876	750,000

Un-Proclaimed Roads = Public roads not formally gazetted by any Authority

3.2 The policy framework for provincial roads

Roads policy is defined in two key documents, namely the Roads Infrastructure Strategic Framework of South Africa (RISFSA) (2006) and the Roads Infrastructure Asset Management Plan (RIAMP) (draft v2.0 dated June 2013). These policy documents are supported by a large number of technical documents (Technical Recommendations for Highways (TRH) and Technical Methods for Highways (TMH) documents, with the most relevant TRH and TMH documents for this project being TRH22 (COTO (1994) Pavement Management Systems) and TMH22 (COTO (March 2013) Road Asset Management Manual DRAFT v 8b). The latter remains in draft form at the time of this project.

The vision outlined in the Roads Infrastructure Strategic Framework of South Africa (RISFSA) is as follows:

Achieve an integrated road network system that is managed efficiently by adequately resourced roads authorities providing access and mobility to all South Africans in a sustainable manner.

Provincial roads fall under Outcome 6 in the National Development Plan, namely 'An efficient, competitive and responsive economic infrastructure network.'

3.3 Role players in provincial roads

The following role players were identified during the development of the provincial roads log frame.

National Department of Transport

National Department of Transport (NDoT) is responsible for:

- Developing policy, strategies, plans and guidelines to guide roads authorities.

Roads Coordinating Body

The Roads Coordinating Body (RCB) is an entity made up of the NDoT (Chair), National Treasury, CoGTA, nine provincial road authorities and Limpopo Road Agency, eight metropolitan road authorities and Jo'burg Road Agency, SANRAL, SALGA and DPW. Attendees are usually chief engineers, DG and DDGs from the provinces. It is responsible for provide comment and input to policy, strategies, guidelines, norms, standards and benchmarks.

Committee of Transport Officials

The Committee of Transport Officials (COTO), formerly the Committee of Land Transport Officials consists of various technical sub-committees which create documentation or do studies requested by the RCB, make recommendations and then escalate this to the MINMEC. COTO consists mainly of HODs, decision makers, accounting officers, while the technical committees are generally practitioners, often chaired by SANRAL representatives. COTO is thus responsible for:

- Coordinating the development of guidelines, norms and standards
- Knowledge sharing and skills development.

South African National Roads Agency Limited

The South African National Roads Agency Limited (SANRAL) has several roles with regard to provincial roads. It:

- Collates and holds provincial data
- Acts as a consultant to provinces in some cases.
- Acts as a contractor to provinces in some cases².
- Sit on the RCB and COTO.

Provincial roads authorities³

Provincial roads authorities have a very broad range of responsibilities with regard to provincial roads. They:

- Gather and maintain data on the extent and condition of roads assets, and on road usage.
- Plan, prioritise and schedule projects.
- Implement roads activities internally.
- Outsource roads activities directly to contractors⁴.

² Note that SANRAL does not have any equipment/capability to carry out road works themselves. They would employ consultants and contractors on behalf of the provinces.

³ Note that in Limpopo province the authority is the Road Agency Limpopo (RAL).

⁴ These are often referred to as 'term' contracts or 'RMT' contracts. Contracts are managed by the roads authority directly and are for a period of time (three years is typical). Contractors

- Outsource roads activities via consultants⁵.
- Monitor and report.

Consultants

Where consultants are used, they prepare project designs, identify contractors to undertake work, manage the construction works, hand over the completed works to the roads authorities, and then close out the projects.

Contractors

Contractors carry out most of the roads activities on behalf of the provincial roads authorities.

3.4 Funding for provincial roads

Funding for provincial roads operations and maintenance is mainly provided through National Treasury's Equitable Share allocation to provinces. Some revenue for provincial roads may also be generated through vehicle license fees.

The Provincial Roads Maintenance Grant (PRMG) is a funding mechanism which can be used by provinces for the preventative, routine and emergency maintenance of their provincial road network. This grant had a R9.3 billion allocation in 2014/15. The allocations are made using a formula, based on the extent of the provincial road network, road traffic, weather, geo-climatic and topographic conditions.

3.5 Activities⁶ undertaken on provincial roads

Key to the understanding of expenditure on provincial roads is an understanding of the activities that are undertaken on these roads. A significant learning in the EPR project prior to termination was the fact that there is very poor consensus regarding definitions of the various activities. The costs of undertaking activities differ significantly and so the lack of clarity on definitions is critical in undertaking the EPR, because it means that different provinces define activities differently. In some cases, apparent differences in cost may thus be due only to differences in the way in which terminology is applied. The definitions applied in TMH22 (COTO, 2013) are shown in the table below.

Table 2: Definitions of roads activities as applied in TMH22 (COTO, 2013))

Category	Sub-category	Definition in TMH22
Routine maintenance	Cyclical	Routine cyclical activities carried out on daily basis (blading, drainage maintenance, road reserve and

are available on a call down basis: the roads authority issues a job instruction when work is required. These contracts are typically for routine maintenance only.

⁵ For periodic maintenance and capital projects, consultants are typically appointed. The consultants do the project design, provide support to the roads authority in the tendering process, and manage the contractor.

⁶ The term 'activity' or 'roads activity' is used in this report to refer to what is done to a road. The term 'activity' is used as this is aligned with the terminology in the Basic Accounting System (BAS). In the National Infrastructure Reporting Module (NIRM), the term 'nature of investment' is used.

		vegetation maintenance, maintenance of ancillary components)
	Condition based	Condition or event driven activities carried out at short notice (drainage repair, waterway repair, crack sealing and re-patching, repair of cut and fill slopes, reinstatement of line markings, minor repair of structures, spot re-gravelling, reshaping unpaved roads)
Periodic maintenance	Periodic maintenance	Long term cyclical activities including surfacing rejuvenation and thin slurries
	Resurfacing	Re-gravelling, resealing pavement surface using chip and spray or thin overlay
Special maintenance	Special maintenance	Resurfacing preceded by extensive patching and repair, major repair to damage
Rehabilitation	Rehabilitation	Repairs to pavement to restore condition and functionality
	Reconstruction	Reconstruction or replacement of asset
Betterment		Upgrades to elements of asset such as alignment and drainage improvements, intersection improvements, accident black spot elimination, bridge strengthening
Expansion		Increase in number of lanes (including structures)
Upgrading		Change in road type
New roads		
Ancillary assets		Weighbridges or other major ancillary assets

In a personal communication, Louw Kannemeyer from SANRAL provided the following definitions, which have been applied for the purposes of the Provincial Roads Maintenance Grant (PRMG).

- Routine maintenance (Opex): Include day to day routine activities such as cleaning drains & culverts, vegetation control, line marking, guard rail repair, road sign repair, crack sealing, patching, edge repair, spot re-gravel, blading).
- Periodic maintenance (Opex): Include periodically scheduled activities such as fog sprays/diluted emulsions/rejuvenators, surface seals and functional asphalt overlays < 50 mm in thickness.
- Special Maintenance (Opex): Includes the repair of selected pavement areas up to maximum of 25% of project length followed by application of surface seal or functional asphalt overlay < 50mm. Also includes reinstatement of slope stability, repairs to existing structures and the repair of damaged caused by floods or accidents.
- Rehabilitation (Capex): Includes increasing the structural capacity of an existing pavement through the recycling of existing layers and/or addition of new granular layers or structural asphalt overlays >80mm thick.
- Improvements (Capex): This comprises works that aim to improve the quality of service on roads with an unacceptable quality of service. These include measures of improving quality of service on existing roads such as increases the width in selected areas (i.e. addition of climbing/passing lanes), increases in the width

over the total length of the project i.e. addition of paved shoulder and localised geometric and intersection improvements. These activities could in some instances include complete rehabilitation of the existing pavement structure.

- **New Facilities (Capex):** This comprises works that aim to improve network capacity and includes the upgrading of earth (dirt) road to an engineered gravel road, the upgrading of a gravel road to a surfaced road and upgrading of single carriageway road to 4-lane or dual carriageway road. The construction of new gravel or surfaced road where previously no road existed (brown/green fields construction). The construction of new bridge to replace existing bridge or new interchange to replace intersection.

Provinces report to National Treasury on expenditure on roads in two databases; the Basic Accounting System (BAS) and the National Infrastructure Reporting Module (NIRM). The classification of activities in the two databases differ.

Expenditures are recorded in BAS against the following activities:

- Blading
- New
- No activity
- Other
- Preventative maintenance
- Re-gravel
- Rehab and refurb
- Reseal
- Routine maintenance
- Safety improvements
- Upgrade and additions

And in NIRM against the following:

- Routine maintenance
- Periodic maintenance
- Rehabilitation
- Replacement
- Upgrading
- New roads

Sound definitions for the activities are not provided in either case, and so it is likely that provinces are classifying projects differently. Re-gravelling and resealing projects in particular may be classified as routine maintenance, periodic maintenance or rehabilitation, depending on how the province applies the definitions.

3.6 The importance of road asset management

A key element of understanding expenditure on roads is an understanding of the need to manage roads on a lifecycle basis and to implement the various roads

activities timeously. Delaying road maintenance, for example, has a significant impact on the cost of that maintenance, as shown in the figure below.

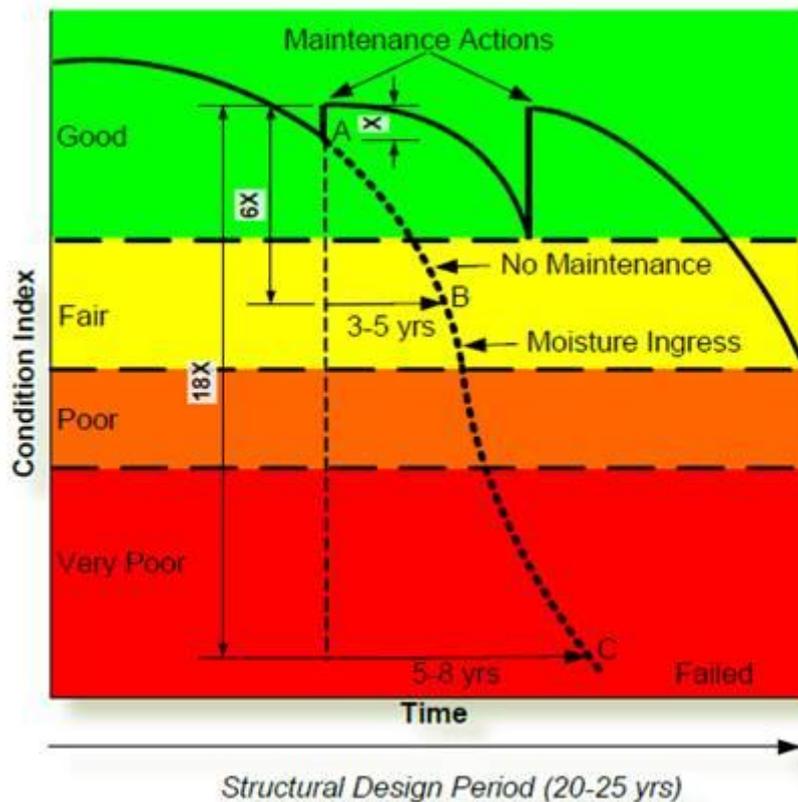


Figure 1: Impact of delayed road maintenance on road condition and maintenance cost

TMH 22 (COTO, 2013) estimates that delaying maintenance by 3 to 5 years raises cost 6 times. So for every 1km of road allowed to deteriorate to level B in the diagram above before being maintained, 6km fewer can be maintained at level A.

Higher costs are also borne by road users. The 6th State of Logistics Survey estimated that moving from a good condition to a bad condition road increases truck maintenance and repair costs by 121% (Ittman *et al*, 2010).

A similar logic applies to preventative maintenance compared to rehabilitation. Timeously resealing a paved road delays the need for rehabilitation, which is far more expensive. The window for resealing only exists when the road is in fair condition. If adequate resealing is not carried out at the required time, then rehabilitation becomes necessary.

It is for this reason that understanding road asset management becomes so important to analysing expenditure on provincial roads. The RIAMP defines roads asset management as "a strategic approach that identifies the optimal allocation of resources for the management, maintenance, operation, preservation and enhancement of road asset infrastructure in order to meet the needs of current and future customers".

3.7 A Theory of Change for provincial roads

A very brief Theory of Change for provincial roads can thus be summarised as follows:

“Implementing road activities at optimal timing and frequency will ensure that roads achieve their design life in adequate condition, and access and mobility are thus maintained at minimal total cost.”

In an ideal world, roads authorities gather data on roads condition and usage, identify projects to be undertaken based on condition and usage compared to benchmarks, implement projects and monitor impacts on condition and usage. Critically, this assumes sufficient budget to implement all projects required, as well as technical capacity to implement work (either internally or from external service providers) and project management capacity. Scheduling activities is a largely technical task: projects are identified based on technical data and then the correct intervention is identified and implemented. The overall condition of the road network does not deteriorate and so the budget demand for the next year remains roughly the same.

In a constrained budget environment, a series of activities related to project prioritisation and scheduling is introduced. The planning and optimisation stage becomes very important. Project selection and scheduling is no longer a purely technical exercise. There are a number of policy imperatives on roads authorities (ensuring equitable provision of services and employment creation for example) that also come into play. The overall condition of the road network deteriorates over time, leading to ever-increasing demands for budget (because deferring roads activities makes them more expensive).

4 Cost drivers for provincial roads

Literature and theory propose a large number of reasons why unit costs would vary from province to province, and indeed from project to project.

TMH22 (COTO, 2013) considers the following factors:

- Road type, with paved roads typically, but not always, costing more than gravel roads.
- Road class, with higher class roads costing more than lower class roads.
- Rainfall, with roads in wetter rainfall zones costing more than roads in dryer zones.
- Urban or rural setting, with roads in urban areas costing more than roads in rural areas.
- Road condition, with poorer condition roads costing more than better condition roads.

TMH22 (COTO, 2013) provides the following factors indicating how these cost drivers impact on cost.

Table 3: Roads cost drivers considered in TMH22

		Road type
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		Unpaved	Paved single carriageway	Dual	Freeway
Importance	Class 1		1.2	1.4	1.4
	Class 2	1.4	1.1	1.2	1.2
	Class 3	1.0	1.0	1.0	1.0
	Class 4	0.7	0.8		
	Class 5	0.4	0.5		
Rainfall (Weinert scale)	Wet	1.2	1.3	1.4	1.4
	Moderate	1.0	1.0	1.0	1.0
	Dry	0.9	0.7	0.6	0.6
Social environment	Urban	1.0	1.2	1.2	1.3
	Rural	1.0	1.0	1.0	1.0
Condition	Very good	0.4			
	Good	0.7			
	Fair	1.0			
	Poor	1.5			
	Very poor	2.0			

The PRMG formula considers three cost drivers when making grant allocations:

- Climatic zone.
- Road condition is allowed for in the formula, but is currently not used.
- Road usage, determined by fuel sales.

The variation in unit costs for maintenance due to climatic zone is assumed to be as shown below.

Table 4: Roads cost drivers considered in the PRMG formula

		Gravel roads	Paved roads
Climatic zone	Humid	1.4	1.8
	Moist humid	1.1	1.2

	Dry sub-humid	1.0	1.0
	Semi-arid	0.9	0.8
	Arid	0.8	0.7

The PRMG calculations assume a greater variability in unit cost due to climate zone than does the TMH22.

The Eastern Cape Department of Roads and Public Works produced a “Surfaced Road Construction Cost Analysis” in July 2013. That document notes several drivers of unit cost aside from those used in the TMH22 and PRMG calculations, specifically:

- Topography: affects bulk earthworks cost, primarily for higher class roads (lower class roads can be allowed to follow natural ground contours).
- Underlying geology: affects “both the structural strength of the soils underlying the roads as well as the potential for their use as construction material for roads.” Weak underlying soils require removal of weak soil, addition of extra structural layerworks and/or slope stabilisation. In addition, materials suitable for sub-base and base course must be quarried and crushed, existing materials must be strengthened, or suitable materials must be hauled in.

That document also proposes that a rural location, far from an urban centre, results in higher costs (in contradiction to TMH22, which suggests lower costs for rural locations) due to delivery distance and time for materials and services, material costs, difficulty in securing accommodation for staff, limited local skilled and semi-skilled labour base, reluctance of skilled labour, technical and managerial staff to work in remote rural areas.

The document does not provide any quantification of the impact that factors such as topography and underlying geology have on unit costs, and we have not been able to find any such factors elsewhere in the literature to date.

The document further suggests that there are factors that affect costs on particular projects, such as the level of collusion or competition between contractors. While not mentioned specifically in the documents it is important to recognise the state of economy as a factor. In times of strong economic growth work is plentiful for contractors and prices tendered for projects increase. Contractors may even look for 'super-profits' in order to accumulate reserves for the lean times they know will lie ahead when the same number of contractors chase fewer tenders. While not researched specifically for this report, it is understood that this can easily lead to differences of the order of 20% for the same work.

5 Reason for termination of project

Broadly, the agreed approach to the EPR was to calculate unit costs for various roads activities for the different provinces and then explain differences in the unit costs. In other words, we need to know what it costs one province to upgrade a kilometre of

gravel road compared to what it costs another province, with the requirement to determine why these unit costs differ between the provinces, based on theory.

The preferred approach articulated by GTAC is to do this analysis on a project by project basis, in other words, to compare the expenditure on individual roads projects in the provinces⁷. In order to do this, we need the following data per project:

- Total expenditure on the project.
- Nature of investment (activity carried out, for example new, rehabilitation, routine maintenance etc.).
- Length of road acted on.
- Characteristics of road acted on and its location (climatic zone, road class, the extent of drainage structures, topography and so on).

It became clear during work on the project to date that this data is not available on a project by project basis. Considerable efforts were made to identify and source possible datasets, and the data that we were able to access is discussed in Appendix 1 to this report.

There are potentially some additional data sources available from National Department of Transport (PRMG submissions and quarterly reports), but these have not been handed over to date and do not include detailed project level data (see also further discussions on p.15)

In May 2015 GTAC asked PDG to propose an alternative project approach, based on the average characteristics of a province, rather than analysis based on each project. The approach proposed is presented in Appendix 2 to this report. After reviewing this proposal, GTAC decided to terminate the existing project, attempt to source the required data per project, and decide whether to re-initiate the provincial roads EPR at a later date, should data become available.

6 Recommendations going forward

There are a number of ways to approach a cost analysis on provincial roads. Before discussing these in any detail the general approach to assessing costs of large scale networked infrastructure such as roads, bulk water supply and bulk wastewater systems needs to be considered⁸. These networks are complex systems and the projects used to expand or renew them are typically one part of a system and not a single facility. More often than not projects involve a mix of new works and renewal of existing works. Further, the networked systems are dependent on the intensity of use, a range of geographic circumstances and settlement circumstances. It may be

⁷ It must be noted that this was not the approach that PDG anticipated in the proposal submitted for this project. We expected at that time that data on the cost drivers for individual roads projects would not be available, and proposed an approach of applying average characteristics per province. It became clear during the project that GTAC prefer a project by project approach, in order to be able to identify efficiency or inefficiency in particular projects.

⁸ Electricity transmission and distribution is somewhat different as the infrastructure is mostly above ground and largely based on a limited number of relatively easy-to-identify components.

possible to break the systems down into individual components for comparison purposes but the more this is broken down the less use the comparative cost becomes. For example, one can compare the cost of a square meter of base course or a standard reservoir (excluding earthworks) and get a comparison between these costs from two projects. But this says little about the performance and cost of the whole system which is ultimately what is important.

This leads to the argument that one has to assess costs and performance of the system, not of an individual component of the system or a project which is used to improve or replace a part of the system.

While we as PDG believe in the systems argument and in assessing costs in relation to performance of the system (or network) as a whole, we understand that National Treasury wants to institute an assessment based on projects or components and hence propose a spectrum of options which fall roughly along a spectrum.

At one end of the spectrum is a **high level analysis** of expenditure per province looking at the average characteristics of the provincial road network, possibly broken down into different road categories (at least into gravel and paved categories, for example). Essentially this is an output based assessment with the extent and condition of the road network being the key parameters. This is the type of approach that PDG recommended in the original proposal to do this work, and in the alternative project approach presented in Appendix 2. This approach would require good data on existing extent (the number of kilometres of road in each category and possibly square km of road) as well as the extent of works carried out. Average characteristics for the province as a whole would be applied in assessing the drivers of cost (average moisture index, topology, urban/rural mix and so on). This could be achieved by requesting clarity or confirmation of the data already contained in the NIRM⁹.

In the middle of the spectrum is a **project-by-project analysis** of expenditure based on the characteristics of an individual project. In this case, data on the following characteristics of each project would be required:

- Contract number
- Contract description
- Activity undertaken (nature of investment), with careful definitions
- Route start and end information (this will allow for verification of the road characteristics provided using GIS, if necessary)
- Route length acted on
- Road width
- Road capacity
- RISFSA road class
- Road type (paved, gravel, graded)
- Climatic zone
- Topography

⁹ Clarity is required largely with regard to the definition of activities, with data on road lengths acted upon required in some cases.

- Underlying geology
- Location (urban, rural)
- Start date
- End date
- Expenditure incurred per year
- Level of construction work in the industry at the time

The concern here is that, with all analysis that considers variations in unit costs, there are a very wide range of factors that drive unit costs, only some of which are mentioned above. Provinces could still argue that there are factors not captured in the list above that influence the specific unit costs on their projects.

At the other end of the spectrum would be a very detailed analysis of **component costs**, considering the costs of specific activities or components, possibly down to the level of items in bills of quantity. In addition to the information required in the middle of the road spectrum above, analysis of this detailed nature would require a breakdown of expenditure as outlined in the table below. The table is adapted from one used by Eastern Cape Province in their surfaced road construction cost analysis (Province of the Eastern Cape, 2013).

Table 5: Expenditure breakdown for detailed analysis of cost

Overheads	General Requirements and Provisions
	Contractors Establishment on Site and General Obligations
	Housing Offices and Laboratory for Engineers Site Personnel
	Accommodation of Traffic
	Testing materials and Workmanship
	Quality Control
	Occupational Health and Safety
Bulk earthworks	Overhaul
	Clearing and Grubbing
	Borrow Materials
	Mass Earthworks
Structural layerworks	Selection, Stockpiling and breaking down the material from borrowpits, cuttings and existing pavement layers, and placing and compacting of the gravel layers
	Pavement Layers of Gravel Material
	Stabilization
	Crushed Stone Base
Surfacing	Prime Coat
	Asphalt Base and Surfacing
	Double Seals
	Bituminous Single Seal with Slurry
	Surfacing of Bridge Decks
	Concrete Pavement
	Guardrails

Finishing and furniture	Fencing
	Road Signs
	Road Marking
	Landscaping and Planting Plants
	Finishing the road and Road Reserve and treating Old Roads
Stormwater management and structures	Drains
	Prefabricated Culverts
	Concrete Kerbing, Concrete Chanelling, Chutes and Down Pipes, and Concrete lining for open drains
	Asphalt and Concrete Berms
	Pitching Stone work and Protection against Erosion
	Gabions
	Structures - Pedestrian Foot Bridge
	Foundations for Structures
	falsework, formwork and concrete finish
	Steel Reinforcement for Structures
	Concrete for structures
	No-fines concrete and drainage structures
	Reinforced Earth
	Prefabricated concrete bus shelters
	Standalone structures
Other	Dayworks
	Other (Dayworks, Extras, Special Materials, stoppage claims, etc)

This approach would be very onerous in terms of data collection and is probably not feasible for every roads project.

The approaches above are suggested to fall along a spectrum. There might be an option of combining approaches, conducting a high level analysis with very detailed analysis on a sample of projects.

Considerations in selecting the approach are largely related to the time and budget required for data collection.

At the very minimum, the following are recommended:

1. The set of roads activities reported on to National Treasury (in the BAS and the NIRM) and to NDoT should be aligned and clear, specific definitions agreed upon. If an EPR is to be conducted in future, it will be vital that all provinces mean the same thing when they refer to 'preventative maintenance' for example.
2. The following additional fields be included in the NIRM:
 - a. Route start and end information
 - b. Road length acted on
 - c. Average road width for the segment
 - d. RISFSA road class

National Treasury could consider including the other items recommended under the 'middle of the spectrum' analysis option outlined above in the NIRM. However, this would mean considerable extra data entry by provinces and it is uncertain how often this data would actually be analysed and used. The reporting burden on sub-national government entities is typically very high; it is not desirable to request additional reporting unless the data is analysed and feedback provided to the provinces¹⁰.

A final comment is that during the course of this project National Department of Transport was able to provide very little reporting or analysis on the provincial roads programme. Provinces submit roads asset management plans and various other reports to NDoT on a regular basis. If analysis is conducted, it was not provided to the project team during this EPR. The lack of oversight and detailed monitoring of provincial performance by the National Department is of concern.

In closing, the work done on this EPR prior to termination highlighted the complexity of conducting such analysis on a programme based on networked engineered infrastructure, where there are a multitude of factors that can drive cost. It is very clear that existing data in the roads sector is poor and the data that is there is not being used. There is a strong motivation to change the way that things are done. Improving and agreeing definitions for roads activities and the proposed extensions to the fields in the NIRM would be an important start. Only once this is done would an EPR be useful and could potentially provide valuable insight into a sector that is currently very opaque.

¹⁰ Recent work by National Treasury Cities Support Programme on reporting reforms has proposed some useful principles to inform reporting systems, as well as criteria for indicators reported on. Of particular relevance here are the principles of 'simple but sufficient' (fewer, simply constructed indicators) and 'reciprocation' (those reporting should receive feedback), and the criteria of 'cost effective' (the usefulness of the indicator must justify the cost of collecting the data).

Appendix 1: Data sources reviewed

The data sources reviewed during the EPR process prior to termination are discussed below.

6.1 Documents and data received from National DoT

Representatives from NDoT were present at meetings where the issues about finding data on the units and characteristics of roads provided were discussed but were not able to identify any potential sources of data.

The following documentation was provided directly by NDoT:

- Two documents regarding the S’hamba Sonke Programme, namely a conceptual approach document and an implementation manual, both dated May 2012. These were sent in response to a discussion at the 22 January meeting about whether there was a single document where roads needs for South Africa were brought together. The NDoT representatives at that meeting stated that they were not aware of anything like that, but that the S’hamba Sonke documentation might assist. Neither was found to have relevant information
- The draft TMH22 document in response to a direct request.
- Terms of reference for the Roads Coordinating Body, COTO and various COTO sub-committees, in support of the development of the Logframe for the project.

The NDoT also supported the EPR process by providing contact details for officials at KZN, Western Cape and Roads Agency Limpopo.

6.2 Data received from National Treasury

National Treasury provided National Infrastructure Reporting Module (NIRM) data for 2010-11 to 2013-4, as well as a document with the definitions of the ‘nature of investment’ as used in the NIRM.

Provinces report annually to the NIRM per project, indicating expenditure incurred per project, ‘nature of investment’ (activity undertaken, in the terminology used in this proposal) and number and type of units (number of kilometres, for roads projects).

The review of the NIRM conducted under this project raised concerns about the completeness and accuracy of the dataset, but for now it is the only dataset available that contains data on the expenditure on road projects, the activity undertaken and the length of road acted upon.

There are 347 projects handed over between 2010/11 and 2013/14 in the NIRM database that have useful expenditure and road length data¹¹.

¹¹ Note that it is possible to expand the number of projects for which there is useful data if we include projects that have not yet been handed over. Data on projects is provided to the NIRM at the end of a financial year, and the project may be at various stages of completion at that point (identified, tender, feasibility, design, construction, retention, handed over or cancelled). Only for handed over projects is the final expenditure certain. Projects at ‘retention’ stage, however, have been completed by the contractor and are at a stage of approval for hand over. In the case of some projects in retention, further work is still

The table below shows the number of projects with useful data by province and activity.

Table 6: Number of projects in NIRM with useful data per province and activity

Number of projects		GT	MP	WC	LIM	NC	EC	ALL
Tar roads	New		1	1			2	4
	Additions					2		2
	Rehabilitation		4	5		1	27	37
	Upgrading	29	7	4		1	9	50
	Periodic maintenance		6		23	3	1	33
	Routine maintenance				9	5	41	55
Gravel roads	New					1		1
	Rehabilitation						1	1
	Upgrading			6	47	9	3	65
	Periodic maintenance					2		2
	Routine maintenance					1	16	17
Access roads	Maintenance						38	38
	Upgrading			4	1	8	2	15
Bridges and culverts	New		1				1	2
	Rehabilitation		1	13		1	2	17
	Upgrading				1			1

required and so expenditure may increase, but for many expenditure will not increase. Adding projects in retention phase will increase the pool of projects with good data (there are about 383 additional projects with good data in retention stage) but will reduce the certainty with regard to total expenditure.

Number of projects		GT	MP	WC	LIM	NC	EC	ALL
	Periodic maintenance				1			1
	Routine maintenance						1	1
Drainage structures	Routine maintenance						1	1
TOTAL		29	20	34	85	34	145	347

There are no projects with useful data for KwaZulu Natal, North West or Free State.

Note also that the NIRM contains no data on the characteristics of the road on which a project was performed, and so provides no information that assists us to understand why costs differ from project to project or province to province.

6.3 Documents and data received through direct engagement with provinces

Leonard Malapane from NDoT identified Craig Maclachlan from KZN, Andre van der Gryp from Western Cape and Richard Rikhotso from Roads Agency Limpopo as useful contacts to discuss the programme elements and logframe for the EPR. Telephonic discussions were held with each of the three, and Craig and Andre provided some documentation.

Craig Maclachlan provided us with a number of reports that provinces submit to NDoT on a regular basis. These include:

- KZN Roads Asset Management Plan for 2015-16: this is a 100+ page word document indicating what the provinces intend to do with regard to managing their road infrastructure over the next year. It includes information on the current condition of their infrastructure, level of service that they aim to achieve, plans for each road activity, assessments of budgets required and indications of what they think they can do with their available budgets. Provinces apparently submit these annually to NDoT.
- IRM submissions: Monthly reports on expenditure of Equitable Share and Provincial Roads Maintenance Grants.
- PRMG submissions: Excel spreadsheets with monthly reporting on expenditure as well as on number of square meters of surface road resealed, number of kilometres of roads re-gravelled, number of square kilometres of blacktop patching and number of kilometres of roads bladed.
- Quarterly reports: Quarterly reports on performance against PIs, for example (for E Cape) lane km of new surfaced roads constructed, lane km of surfaced roads rehabilitated etc

None of these documents was mentioned to us by the NDoT representatives at the EPR meetings. A review of these documents indicate that the data that they contain will not meet the requirements of the EPR, but would be a step in the right direction.

Craig further provided the COTO road condition and budget needs report 2014, which is a very useful document containing estimates of the need for roads activities, unit costs and total budget requirements.

Andre van der Gryp provided various documentation outlining how the Western Cape prioritises roads activities and manages its road network:

- 2014 preservation report, which includes useful information on the unit costs that Western Cape is using in some cases.
- A summary of the approach to project prioritisation being used in the Western Cape.
- A presentation on the approach to roads asset management in the Western Cape.

6.4 Data received in response to letters to provinces

When it became apparent that data on the characteristics of roads on which expenditure had been undertaken was not available from the BAS or NIRM datasets, it was decided to try and source additional data directly from the provinces.

Letters were sent out to provinces at the end of March requesting data on route start and end km points for projects in NIRM, as well as confirmation of activities undertaken, with clearer definitions of activities provided. Data was received from one province only: Free State. Free State indicated that most of the projects for which data was requested are not yet complete, but did provide road length data for 7 projects that they indicated were completed between 2012/13 and 2013/14. Unit costs can be calculated for the Free State for these projects (there are no projects currently in NIRM with useful data for Free State).

6.5 Data received from SANRAL

Louw Kannemeyer from SANRAL provided the following:

- COTO road condition and budget needs report 2014
- PRMG calculation worksheet
- PRMG 2014 grant framework
- TRH26: Road Classification and Access Manual
- Data on existing gravel and paved road lengths per province per moisture index zone, VCI and RISFSA road class.

Appendix 2: Proposal on alternative analysis approach

The broad approach proposed is summarised below. We do not have the data to conduct project by project analysis of unit costs, and so are proposing an approach that considers the average characteristics of a province.

First, we will calculate actual unit costs per province for each roads activity based on the data available. Various different datasets will be used, but it is likely that we will not have a complete set of unit costs for all provinces.

Next, we will compare the actual unit costs to a theoretical average unit cost for each roads activity in each province. These will be arrived at by starting with an average theoretical unit cost and adjusting this for the average conditions in each province that may lead the cost in that province to be higher or lower.

Any variability in the actual unit costs that is in excess of the variability in the 'theoretical' unit costs will then be assumed to be due to cost drivers not considered in the 'theoretical' unit costs, inefficiency or corruption.

The following example may make this approach clearer. Actual unit cost data indicate that unit costs in Province A are three times those in Province B. According to theory, given its mix of road classes and climatic zones, unit costs in Province A would be double those in Province B. 67% of the difference in unit costs can thus be explained by theory, but 33% is not explainable. This must be due either to cost drivers other than road class and climatic zone, to inefficiency or to corruption.

The results of the analysis at this point will be shared with provinces and they will be provided with an opportunity to provide better unit cost data. This will be requested in a specific template format. We will indicate that we will proceed to report based on the data that we have, should better data not be forthcoming.

The analysis will be updated with improved data should we receive this, and final conclusions drawn.

This approach is explained in more detail below.

Step 1: Calculate actual unit costs per province

A unit cost is calculated by dividing the expenditure on a roads activity (rehabilitation, for example), by the number of kilometres of road on which that activity was undertaken. This can be done at an aggregate level (total expenditure in a year divided by number of kilometres acted on in that year) or at a project level (expenditure on a particular project divided by number of kilometres acted on in that project) and then averaged over a number of projects.

We do not have a dataset that will provide us with reliable unit costs for each road activity and each province, but we have a few datasets that can possibly provide us with unit costs for some of the activities for some of the provinces.

BAS data combined with Quarterly Reports

From our engagement with Eastern Cape Province, it has emerged that provinces provide Quarterly Reports to National Department of Transport that include information on:

- Number of km of new surfaced roads constructed.
- Number of km of new gravel roads constructed.

- Number of km of gravel roads upgraded to surfaced roads.
- Number of lane km of surfaced roads rehabilitated.
- Number of square metres of surfaced roads resealed.
- Number of km of gravel roads re-gravelled.
- Number of square metres of blacktop patching (including pothole repairs).
- Number of kilometres of gravel roads bladed.
- Number of square metres of surfaced road upgraded.

We have had sight of this report for Quarter 4 of 2013/14 for the Eastern Cape only. We will try to obtain these reports from National Department of Transport for each province for the 2011/12, 2012/13 and 2013/14 financial years.

If the indicators are consistent across the provinces, and if the data has been provided for all three years, then we will have some data on road lengths acted upon that can be combined with the expenditure data in BAS to calculate aggregate level unit costs for at least some provinces and some roads activities.

Note that it is very likely that the indicators are not consistent across all provinces or that the data is not available for all three years. In that case, we will use whatever is available, and will have unit costs for some provinces for some roads activities from this data source.

National Infrastructure Reporting Model (NIRM) data

Provinces report annually to the NIRM per project, indicating expenditure incurred per project, 'nature of investment' (activity undertaken, in the terminology used in this proposal) and number and type of units (number of kilometres, for roads projects).

Our review of the NIRM to date has raised concerns about the completeness and accuracy of the dataset, but for now it is the only dataset that we have that contains data on the expenditure on road projects, the activity undertaken and the length of road acted upon.

There are 347 projects handed over between 2010/11 and 2013/14 in the NIRM database that have useful expenditure and road length data.

The NIRM allows provinces to classify projects into one of the following activities.

- Routine maintenance
- Periodic maintenance
- Rehabilitation
- Replacement
- Upgrading
- New roads

Sound definitions for the activities are not provided, and so it is likely that provinces are classifying projects differently. Regravelling and resealing projects in particular, may be classified as routine maintenance, periodic maintenance or rehabilitation, depending on how the province applies the definitions.

Where we are able to, we will reclassify projects to try and improve consistency. This is only possible where provinces have indicated precisely what the project is in the

'project details' column. Many provinces use this column simply to repeat the nature of investment or asset type, and so provide no additional information here.

We will not be able to calculate unit costs for all provinces on all activities: as may be seen from Table 6 in the body of the report, there are not projects in NIRM for each activity in each province. We will be able to obtain unit cost estimates for those provinces and activities for which there are projects with data. There are no projects with useful data for KwaZulu Natal, North West or Free State.

Note that it is possible to expand the number of projects for which we have useful data if we include projects that have not yet been handed over. Data on projects is provided to the NIRM at the end of a financial year, and the project may be at various stages of completion at that point (identified, tender, feasibility, design, construction, retention, handed over or cancelled). Only for handed over projects is the final expenditure certain. Projects at 'retention' stage, however, have been completed by the contractor and are at a stage of approval for hand over. In the case of some projects in retention, further work is still required and so expenditure may increase, but for many expenditure will not increase. Adding projects in retention phase will increase the pool of projects with good data (there are about 383 additional projects with good data in retention stage) but will reduce the certainty with regard to total expenditure.

Provincial Roads Maintenance Grant (PRMG) spreadsheet

PRMG allocations are determined in part based on unit cost information provided by provinces. PRMG covers only the following activities:

- Routine maintenance of paved roads.
- Periodic maintenance of paved roads.
- Routine maintenance of gravel roads.
- Blading of gravel roads.
- Regravelling of gravel roads.

Unit cost information is available for Eastern Cape, KwaZulu Natal, Northern Cape, Gauteng and Western Cape for both paved and gravel roads, and for Mpumalanga for paved roads, from this source. Note that it is not clear how the unit costs were arrived at.

It is proposed that these unit costs be used only to supplement the other unit cost sources where necessary.

Data received directly from Free State Province

Letters were sent out to provinces at the end of March requesting data on route start and end km points for projects in NIRM, as well as confirmation of activities undertaken. Data was received from one province only: Free State. Free State indicated that most of the projects for which data was requested are not yet complete, but did provide road length data for 7 projects that they indicated were completed between 2012/13 and 2013/14. Unit costs can be calculated for the Free State for these projects (recall that there are no projects currently in NIRM with useful data for Free State).

Concerns to flag about this step

We know by now that there is no complete and reliable dataset that will allow us to calculate unit costs for each province and each activity. It is likely that even after

considering all of the datasets above, we will still have no unit costs for some activities in some of the provinces. In this case, we will have no basis to comment on the levels of expenditure for these activities in these provinces.

Step 2: Determine theoretical average unit cost for each road activity

Theoretical average unit costs for each road activity will be obtained from the literature. Our primary source of data will be the Draft TMH22 Road Asset Management Manual (March 2013), which indicates the following unit costs.

<i>2013 Rands</i>	Unpaved	Paved single carriageway	Paved dual carriageway	Freeway
Routine cyclical maintenance (per km pa)	3 000 + 0.02xADT	20 000	50 000	80 000
Routine condition maintenance (per km pa)	2 000	30 000	50 000	60 000
Periodic maintenance (per sqm pa)	0	3	3	3
Resurfacing (per sqm)	7	80	80	80
Special maintenance (per sqm)	0	100	120	120
Rehabilitation (per sqm)	0	200	220	240
Reconstruction (per sqm)	0	500	600	700

The activities used above will have to be aligned with those in the BAS and NIRM. For example, reconstruction in TMH22 is defined as 'reconstruction/replacement of the asset' and is thus aligned with 'replacement' in the NIRM; in the BAS, reconstruction is combined with new expenditure under the 'new/replacement' category.

TMH22 does not provide unit costs for all activities. It does not include upgrading or new roads, for example. We will rely on SANRAL to fill in the gaps where necessary.

It will be necessary to align the units in some cases. For example, TMH22 provides a 'theoretical' unit cost for rehabilitation per square metre, but the Quarterly Reports ask about 'lane km of roads rehabilitated' and the NIRM units used for rehabilitation

are largely km. Average road widths will have to be used to convert the TMH22 costs per square metre into costs per km or lane km.

Note also that there are in some cases conflicting data on 'theoretical' unit costs. The COTO Condition and Needs Assessment (2014), for example, used the following unit costs:

- Routine maintenance: R64 000 per km pa on paved roads and R7 200 per km pa on gravel roads.
- Periodic maintenance: R0.76 million per km per 10 years on paved roads and R0.25 million per km per 8 years on gravel roads.
- Rehabilitation: R6 million per km per 25 years on paved roads.

We will propose a set of 'theoretical' unit costs to be used, based on an assessment of the literature, and request the EPR Steering Committee to sign these off for use in the analysis.

Concerns to flag about this step

'Theoretical' unit costs are not available for every activity in TMH22. We will be reliant on SANRAL to guide us with regard to theoretical unit costs where we do not have existing information. This requires us being able to obtain a meeting with Louw Kannemeyer at SANRAL.

Step 3: Propose factors that quantify theoretical impact of each cost driver on unit cost

The possible drivers of unit costs for provincial roads are discussed in Section 4 of the main report. It is proposed that a 'calculator' is developed that allows the user to specify the factors by which each cost driver impacts overall road unit cost.

We will propose a set of factors to be used in the analysis, based on an assessment of the literature and iterative testing of different factors where none are available in the literature, and request the Steering Committee to sign these off for use in the analysis.

Concerns to flag about this step

The literature provides a basis for estimating the impact of some cost drivers on unit costs, but is silent on others (topography and underlying geology, for example).

There is also nothing in the literature on the relative importance of cost drivers. So, for example, if a road in a wet area costs 1.3 times as much as a road in a moderate climatic zone, and a road in an urban area costs 1.2 times one in a rural area, does this mean that a wet, rural road has approximately the same cost factor as a moderate, rural road (1.3x1.0 and 1.0x1.2 respectively)? Or does the climatic zone affect the cost more than the location, meaning that the wet, rural road will have a cost factor that is relatively higher than the dry, urban road?

The proposed calculator will allow both the factors and their weights to be varied. But the extent to which these factors are important is likely to be a subject of significant debate, with different provinces proposing different importance for factors in order to explain their unit costs.

Step 4: Calculate a theoretical average unit cost per province

Using the average characteristics of each province, we can now arrive at a theoretical average unit cost per province. These theoretical average unit costs will demonstrate the expected variability in unit costs based on theory.

This requires data on the average characteristics for all provinces. With regard to the characteristics discussed above:

Characteristic	Data currently available
Road type	Lane km of paved and gravel road per province ex PRMG Km of road of paved and gravel road per province ex SANRAL
Road class	Km of road in each RISFSA class per province ex SANRAL
Rainfall	Km of road in various moisture index zones per province ex SANRAL
Urban or rural	Km of road in urban and rural locations per province ex SANRAL
Road condition	Km of road per VCI condition class per province ex SANRAL
Topography	No data
Underlying geology	No data

We will ask SANRAL whether they have data on topography or underlying geology.

It may be possible to estimate this data by sub-contracting a GIS company, but this is not allowed for in the current budget.

We have had sight of a Provincial Road Asset Management Plan submitted by Eastern Cape Province to National Department of Transport. This report includes some data on the unit costs that Eastern Cape Province is assuming when estimating their roads needs. We will try to obtain these reports from National Department of Transport for all provinces, and compare the unit costs that they contain (if any) with the theoretical average unit costs derived above.

Step 5: Compare actual unit costs with theoretical average unit costs per province

Any unexplained variability will be assumed to be either to cost drivers not considered, or to inefficiency or corruption in provinces.

Step 6: Allow provinces an opportunity to provide additional unit cost data

At this point we will share the results of the analysis with the provinces and allow them the opportunity to provide better unit cost data. This will be in a template format and is likely to include:

- Contract number
- Contract description
- Activity undertaken (nature of investment), with careful definitions
- Route start and end information (this will allow us to verify the road characteristics provided using GIS, if necessary)
- Route length acted on
- Road width
- RISFSA road class
- Road type
- Climatic zone
- Topography
- Underlying geology
- Location (urban, rural)
- Start date
- End date
- Expenditure incurred per year (we can consider asking for a detailed expenditure breakdown, for example into overheads, bulk earthworks, structural layerworks, surfacing, finishing and furniture, stormwater management and structures).

Provinces will also be provided with an opportunity to provide comment on the cost drivers, the extent of the assumed impact of these cost drivers, and the relative weights assigned to cost drivers. They will be asked to provide supporting evidence or literature for any changes in the cost drivers, cost factors or weights that they propose.

Step 7: Finalise expenditure analysis

The analysis will be updated with improved unit cost data where forthcoming, and the project finalised.

Process to be followed

Request and receive the following from National DoT:

- Road Infrastructure Asset Management Plans for each province for the most recent financial year for which these are available.
- PRMG submissions for each province for 2010/11, 2011/12 and 2013/14.
- Quarterly reports for each province for Q4 of 2010/11, 2011/12 and 2013/14.

Calculate unit costs per province using all data available and assess completeness of unit cost set.

Request and receive unit cost data from SANRAL.

Send letters to provinces notifying them of the unit costs that we have arrived at and outlining how we propose to use these unit costs to assess their expenditure. Note that they can provide better unit cost data if they have it (and specify a format for this data).

Source theoretical unit costs from literature, propose cost drivers and set up a calculator that allows us to calculate theoretical average unit costs per province.

Produce preliminary report on expenditure analysis and circulate to provinces. Notify them that they now have a final opportunity to provide better unit cost data if they have it (in specified format).

Key risks associated with this revised approach

Delays or non-responsiveness from National Department of Transport in providing the requested datasets.

Delays or non-responsiveness from SANRAL in providing unit costs or other data.

Remaining gaps in unit costs data: taking all available datasets into account, it still may not be possible to calculate a unit cost for every activity undertaken by every province.

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