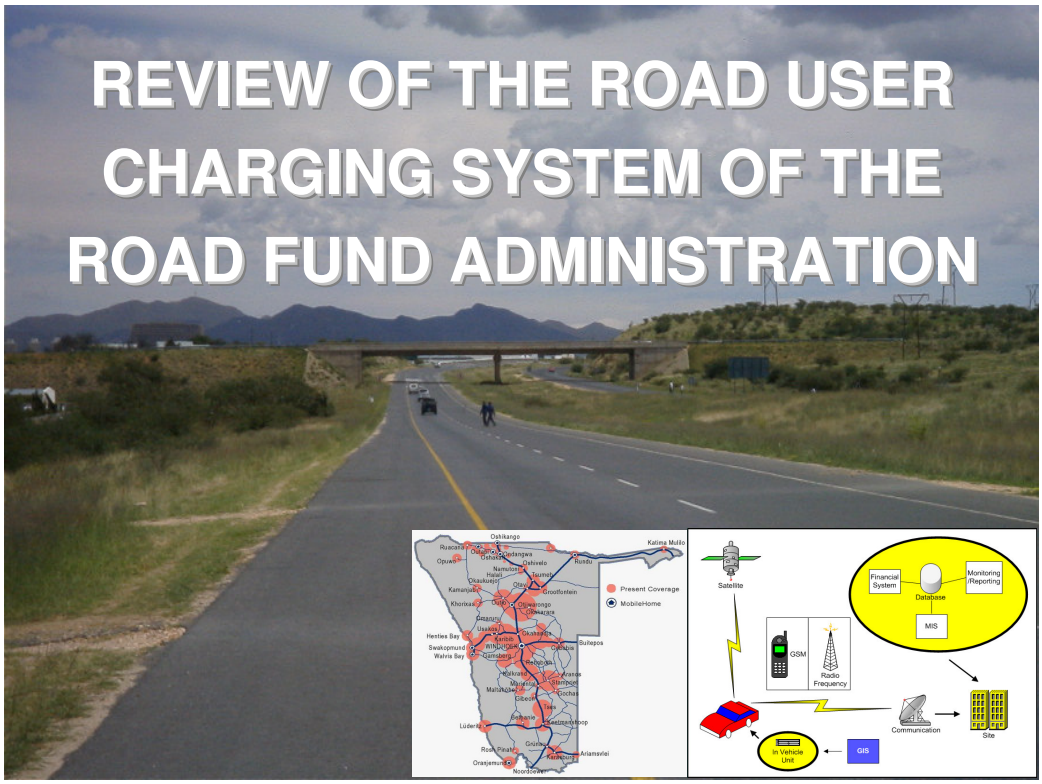
REVIEW OF THE ROAD USER CHARGING SYSTEM OF THE ROAD FUND ADMINISTRATION



PART C: REVIEW OF ROAD USER CHARGES

PHASE 3: REVIEW OF MASS DISTANCE CHARGES SYSTEM

FINAL REPORT

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EXECUTIVE SUMMARY

The purpose of this report was to provide the findings of the review of the MDC system. The review entailed a literature review, stakeholder consultation, possible implementation plan, and option development, cost estimates per option, criteria development and option evaluation.

The implementation of a MDCs will initially be based on a **assumed** annual travelling distance for each vehicle category (a so-called Flat Fee Approximation (FFA) MDC) as well as a parallel pilot project whereby the travelling distances are determined by means of a technological system.

The implementation of the FFA MDC will be done in two phases which are briefly as follows:

- Phase 1: for the first year of operation where the tare-based licence fees of those vehicle categories that should be subject to MDC be increased and collect GVM, axle configuration and fuel type data on these vehicles and officially enter these data into NaTIS.
- Phase 2: switch over from tare-based Phase 1 FFA MDC to GVM based Phase 2 FFA MDC in the second year of operation, using the GVM and axle configuration data captured in Phase 1. In parallel to Phase 2, a pilot project will be launched whereby the **actual** travelling distances are determined by means of a technological system. Based on the results of the pilot project, there will be a possible full-scale implementation of the technological system. The duration of the pilot project will be two years.

Three technological systems were investigated:

- Sub-option 2.1 Hub odometer: This option entails the installation of a hub odometer to monitor the actual kilometres travelled by the vehicle.
- Sub-option 2.2 Transponders / Route tracers / Electronic Number Plates: In this solution, a transponder / route tracer is installed in the vehicle. Signposts are erected along the road network. When the vehicle passes a signpost, the event is registered in the transponder / route tracer. The information is later communicated to a database, where the distance travelled can be calculated.
- Sub-option 2.3 GPS-based with GSM/RF technology: GPS-based technology consists of a unit installed in a vehicle. This unit uses satellites to determine its coordinates. By utilising a GIS component within the unit, the distance travelled is calculated and this distance is communicated to the central database.

For the technological system, it is recommended that sub-option 2.3: GPS-based with GSM/RF technology be implemented. The implementation of a full-scale technological solution is possible in Namibia. The management of the whole MDC system is however extremely important.

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1. INTRODUCTION

1.1 BACKGROUND

During June 2003 Africon Namibia was appointed to conduct a review study of the current RUC System, with the main purpose of investigating and determining whether current revenue levels are sufficient and adequate and also whether the current RUC System adheres to the principles of equity and efficiency.

The implementation of a basic structure for a RUC System in April 2000 was based on the findings and recommendations of the ICTE as per the *Proposed Policy on Road User Charging* document. The RUC System was designed to achieve the following objectives:

- Ensure that revenue needed to provide and maintain roads is raised from road users (including foreign road users) rather than the general taxpayer;
- Price the use of roads so as to improve economic efficiency in road transport by removing price distortions and charging road users according to the "consumption" of roads;
- Promote equity between different categories of road users
- Establish a link between supply and demand for transport infrastructure;
- Increase transparency in the road funding process; and
- Provide for equal competition between road and rail transport by letting road transport operators pay for their use of infrastructure.

Current cost recovery instruments are the fuel levy, license fees, cross-border charges as well as abnormal vehicle fees. Although these RUC instruments have been implemented since the development of a basic structure for road user charging structure in April 2000, Mass Distance Charges (MDCs) have not yet been implemented yet due to various constraints experienced in the implementation thereof. Legal provisions also need to be developed for the implementation of MDCs. This is one of the reasons that necessitated the review of the RUC System, of which this document forms part.

The study is conducted in the following parts:

- Part B: Macro-Economic Impacts of Economic Efficiency in the Road Sector (MIEERS) Study
  - Phase 1: Review of Road Sector
  - Phase 2: Review of Impact of Specific Instruments on the Economy
  - Phase 3: Review of Fuel Taxation Policy
  - Phase 4: Review of Economic Warrants of Loans for Development Projects
- Part C: RUC Review
  - Phase 1: Road User Charges
  - Phase 2: Fuel Levy Refund
  - Phase 3: Mass Distance Charges (MDC)
  - Phase 4: Cross Border Charges (CBC)

The purpose of this document is to provide the findings of the review of the implementation of a Mass Distance Charge System in Namibia, and forms part of Part C – Phase 3: Review of Mass Distance Charges (MDCs).

1.2 OUTLINE OF DOCUMENT

The remainder of this document is structured as follows:

- Section 2 presents the need for and previous investigation into MDCs.
- In section 3 various options pertaining to the implementation of a MDC system are developed and investigated.
- Section 4 concludes this document.

2. NEED FOR AND PREVIOUS INVESTIGATION INTO MDCS

The purpose of this section is to present the need for MDCs and to present previous investigation into MDCs.

The need for MDCs is discussed in terms of the following:

- General considerations; and
- Namibia specific considerations.

These are discussed in more detail below.

2.1 GENERAL CONSIDERATIONS

MDCs are aimed at recovering the excess variable cost responsibility for heavy vehicles that cannot be recovered using fuel levies only.

A diesel levy on its own does not sufficiently recover the costs of marginal damage inflicted on roads by heavy vehicles, the reason being that road damage increases more sharply with increases in vehicle weight than does with fuel consumption. The rationale for MDCs is illustrated by means of Figure 2-1.

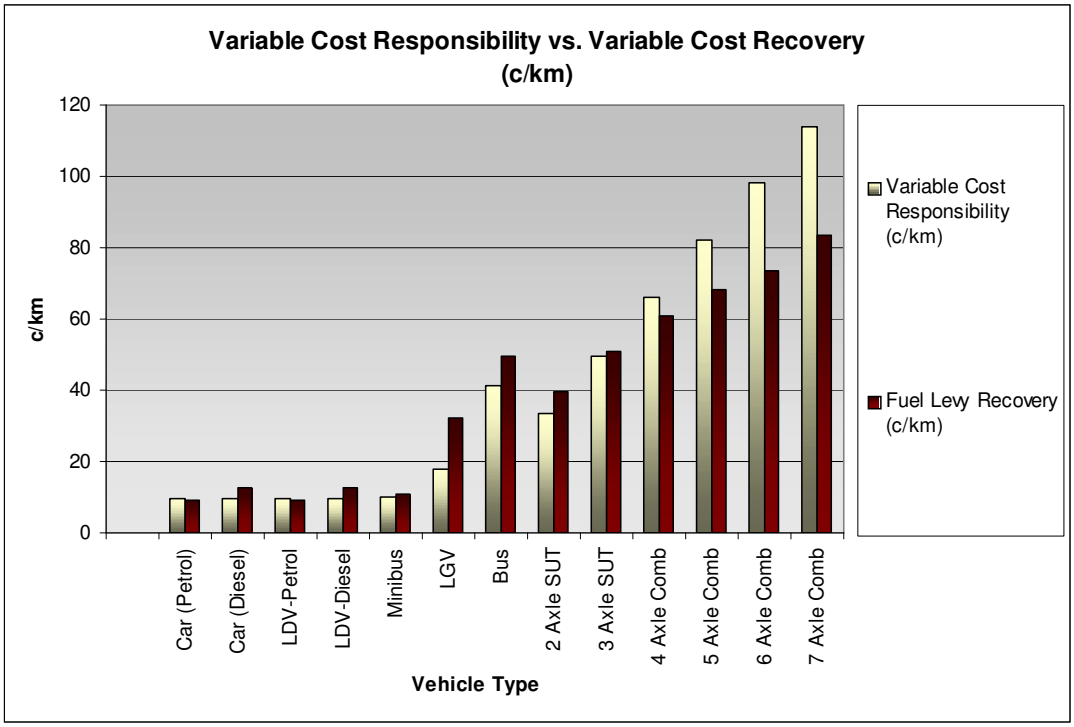

Figure 2-1: Rationale for MDCs

It will be noted from Figure 2-1 (which is based on actual data from the NAMRUC Model) that heavy vehicles (from 4 Axle Combination Vehicles upwards) are cross-subsidised by their lighter counterparts, and that the difference between variable cost responsibility and cost recovery increases as the weight or mass of vehicles increases.

MDCs should therefore only be considered for the heaviest vehicle types. This will imply that the most significant inequity will be addressed, and that MDC collection and administration costs will be minimised.

Mass-distance charges are expressed in terms of a rate/charge per distance and rates increase with the weight (gross vehicle mass – GVM) of a vehicle. The levying of such charges require the measurement of distances travelled by individual vehicles as well as additional administrative arrangements for their collection. This document therefore takes into consideration the options available of implementing MDCs as RUC instrument.

2.2 NAMIBIA SPECIFIC CONSIDERATIONS

MDCs are not currently employed by the RFA as a RUC instrument, but are being considered as an additional RUC instrument. The issue of MDCs in Namibia was initiated in the early 1990's and has up to date been characterised by several discussions and investigations.

Section 18(1)(a) of the RFA Act refers to mass distance charges as follows:

> *"A charge on any motor vehicle, whether registered in Namibia or not, in respect of the travelling distance in the course of on-road use, and which may be based on the mass, length, width or height of the vehicle or its loading, or the number of axles of such vehicle, or any combination of such factors".*

Over the past few years, the principle of equity between light and heavy vehicles and the respective costs incurred when using the road has led to the investigation of MDCs in Namibia on several occasions.

Several studies have been conducted previously in an effort to research the subject of MDCs and also the possible implementation thereof in Namibia, to correct the inequity problem experienced between light and heavy vehicles and to more accurately recover road costs from heavy vehicles.

In terms of the ICTE Report *(Report of the Inter-ministerial Committee of Technical Experts on the Proposed System of Road User Charges of August 1994),*

> *"weight-distance charges on certain categories of heavy domestically registered vehicles to recover the marginal road damage costs of such vehicles which cannot be recovered with a fuel levy that fully recovers the road damage costs of light vehicles", were recommended.*

The MDC System has to be implemented within the framework of certain policy guidelines, and in a previous report on the implementation of a MDC System, dated 15 January 2002, the following policy guidelines were recommended for the implementation of a MDC System:

- The road transport industry in Namibia is to be informed of the RFA's intention in this regard and the basic issue to be resolved is the technology to be used and not whether a system of MDC should be implemented or not;
- The RFA should consult with the road transport industry in designing and implementing a MDCS;
- Irrespective of the technology involved, it must be accepted that there will inevitably be revenue- and evasion losses. However, a system which permits evasion should be seen as inherently unacceptable since it promotes a culture of not conforming to the law and also results in unfair competition between road transport operators who comply with the law and those that do not;
- Increased law enforcement efforts and deterrents in the form of heavy fines and suspension of the operating licence of persons found guilty of evasion;
- Support systems to improve/monitor payment of MDCs should be investigated;
- The policy with regard to the road user diesel levy on fuel should receive further attention once a MDC System is in place; and
- The RFA's public relations policy should include objectives related to the introduction of a MDC System.

Some of the issues indicated above have contributed to the fact that a MDC System has not yet been implemented in Namibia. These are discussed in more detail below.

2.2.1 Delay of MDC implementation up to date

The implementation of a MDC System in Namibia has been delayed for several reasons over the past few years, which mainly relates to technical difficulties experienced with the technological and law enforcement aspects of implementing such a system.

Based on the technology options available and considered for the implementation of MDCS during the 1990's, which included (a) the option of taking readings of a vehicle's odometer[1], (b) the option of using a hub-odometer[2] and (c) a system in which a vehicle operator declares annual distances travelled by each of his vehicles, the Inter-ministerial Committee in the ICTE Report of 1994, recognised

[1] This option has several limitations and also considerable scope for evasion.

[2] The hub-odometer can be sealed to avoid tampering but is not completely immune to mechanical failure or of being removed between measurements in order to avoid the distance travelled by the vehicle concerned being accurately measured. It is necessary to inspect vehicles on the road to ensure that their hub-odometers are installed and functioning. This requires that sufficient personnel are available to undertake inspections.

"that the ability of NAMPOL to enforce a weight-distance charging system is suspect until such time as additional road traffic inspectors have been appointed. The Committee was therefore of the opinion that implementation of weight-distance charges on domestically registered vehicles may have to be held in abeyance".

One of the main concerns with regard to MDCS up to date has been the issue of how to obtain the true distance travelled by heavy vehicles. None of the options considered up to date has proved to be completely reliable and evasion-proof. The implication is that current technology options should pay attention to the following considerations:

(a) that adequate and up to date technology be applied that will assist in eliminating such evasion problems,
(b) that the required personnel capacity exist to ensure proper administration and policing of such a system and
(c) that the necessary enforcement mechanisms be in place to facilitate law enforcement.

The technology options considered for the implementation of MDCs are discussed in a later section in this document.

2.2.2 Literature Review and Stakeholder Consultation

The purpose of this section is to review the current information available on mass-distance charges (MDC) (or sometimes called weight-distance charges), with specific reference to Namibia as well as other countries in the world.
Our approach to the review was as follows:

1. Literature review: A review was done of previous studies that were undertaken on MDCs, with a focus on the extent / scope and cost of the systems considered, with the specific technology proposed.
2. Stakeholder consultation: Various stakeholders were consulted in order to obtain their views and opinions regarding the implementation of MDCs.

The following literature was reviewed for purpose of this study:

- Options for Weight - Distance Charges for Diesel Vehicles, Allan Kennaird, Sept. 1998
- Feasibility study to utilise passive satellite technology to measure distances travelled by individual vehicles, BG Consulting, July 2001 (plus RFA comments)
- Comments on RFA reports of June 2000 and July 2001: Implementation of a weight-distance charging system, W Ravenscroft, 2002
- Exempting non-road users from paying the diesel levy, Ian Heggie, March 1999
- Distance-Based Charges: A Practical Strategy for more Optimal Vehicle Pricing (Tod Litman, Victoria Transport Policy Institute, 1999)
- One page extract: 1.1.1. Weight Distance Charges

- Report on Study Tour to Australia/New Zealand 1 to 18 September 2002 (which includes options for recovering of road user costs from heavy vehicles).
- Tasmania Trial Programme on MDCS, 2000
- Austroads Intelligent Access Program (IAP)- Feasibility project, 2003

Stakeholders that were consulted include the following:

- Road Fund Administration;
- Blaauws Transport;
- Roads Authority;
- NETSTAR;
- Fischer Consulting; and
- NamRoads / FP du Toit Transport.

A detailed discussion on the literature review and the stakeholder consultation is presented in Annexure A to this document. The major findings from the literature review and the stakeholder consultation are as follows:

- MDCs are generally accepted as possible RUC instrument.
- The hub odometer is outdated and difficult to administer, and the use of PST shows a distinct advantage.
- GPS-based technology is new and not yet proven anywhere in the world, and various technology problems have been experienced in New Zeeland and Australia in their pilot projects.
- The combination of the best / most appropriate technologies remains an important issue. Electronic systems for monitoring and payment are improving all the time. PST with GSM for communication to a central server seem to be the best option for Namibia to pilot.
- The current high costs of technology remains a concern and possible stumbling bock for implementing MDCs.
- Enforcement procedures should be as simple and effective as possible with heavy penalties for defaulters.
- MDC for foreign registered vehicles would best be handled through the CBC system.
- A pilot MDC system in Namibia should be registered with SADC.
- The industry may be convinced to accept MDCs but only through proper consultation and communication.
- The road transport industry in Namibia is already using GPS-based tracking devices in their vehicles. The GPS-based MDC option should be as flexible and simple as possible to accommodate most technologies already in use.
- NaTIS should be configured as to accommodate a MDC system. MDCs should be based on GVM (Gross Vehicle Mass), and although NaTIS makes provision for GVM, this field is an “optional”, and therefore limited reliable data exists on the GVM in the NaTIS vehicle registry.
- An incentive scheme should be launched for the pilot technology-based MDCs to attract operators to participate.

- The penalties for non-compliance should be heavy to minimise evasion attempts. It seems that impoundment of vehicles as a possible penalty for non-compliance with MDC can only be achieved by redrafting of the legislation (RTT and RFA Act). Alternatively, the RFA can make a civil case against the road user for non-compliance which can also lead to the impoundment of the vehicle (although the process is significantly longer). There is currently a provision for the latter in the RFA Act.
- Payment procedures need special attention to minimise any debts. Advance payment on a quarterly basis should be considered.

3. OPTION DEVELOPMENT

In order to develop options of a MDC system the requirements as per the ToR of the study as well as other interim considerations were kept in mind.

These are discussed below in order to provide a background of the situation.

3.1 TOR REQUIREMENTS

The ToR for this study called for an investigation into a simple MDC system assuming a fixed travelling distance for each vehicle category (a so-called Flat Fee Approximation (FFA) MDC) as well as a parallel pilot project whereby the travelling distances are determined by means of a satellite-based system.

3.2 INTERIM CONSIDERATIONS

For the financial year 2005/2006 the Road Fund Administration of Namibia (RFA) needs to obtain additional funds of N$ 245 million. N$ 100 million will be financed from loan stock while N$ 145 million need to be raised through Road User Charges (RUCs).

It is currently not possible to recover the N$ 145 million in the form of increased fuel levies or licence fees for various reasons, including sensitivity regarding an increase in the fuel price in Namibia. The N$145 million therefore needs to be recovered from heavy vehicles in the form of mass-distance charges (MDCs).

Enabling legislation is not yet in place. This as well as other as other constraints, imply that MDCs cannot be implemented with immediate effect. In order to raise the N$145 million the following needs to be taken into consideration:

- To avoid the need for enabling legislation, the MDCs should be in the form of fixed annual fees to be added on top of the fixed annual vehicle licence fee.
- To be compatible with NaTIS, the MDCs should be recovered in the **interim** per tare weight group for self-propelled vehicles as well as trailers and semi-trailers.

Furthermore, the following issues need to be addressed:

- Domestic versus foreign vehicles; and
- Vehicle classes for incorporation into the MDC system.

These are discussed in more detail below.

3.3 DOMESTIC VERSUS FOREIGN VEHICLES

For purposes of determining the scope of the MDC system, a decision must be made regarding the inclusion of domestic vehicles and foreign vehicles into a MDC system.

Domestic vehicles are registered locally at NaTIS offices, whereas foreign registered vehicles are only 'registered' at CBC offices when entering the country.

It may not be viable to include foreign vehicles in a MDC system, but rather to adjust the CBC tariffs due to the following reasons:

- Possible resistance from foreign vehicles against the payment of another fee apart from the CBC as well as possible resistance from foreign vehicles against the fitment of tracking devices to be used to measure the travel distances for the technological option.
- The limited amount of travel of foreign vehicles. Based on information from the Road Management System (RMS) of the Roads Authority (RA) and the CBC system, the vehicle kilometres travelled (VKT) of foreign registered vehicles only contribute to 15% of total VKT in Namibia.

Various differences in the processes of possible MDC systems handling domestic and foreign vehicles are shown in Table 3-1.

Table 3-1: MDC processes for domestic and foreign vehicles

	Domestic Vehicles	Foreign Vehicles
1	Public is informed of MDC and the affected vehicle types by means of local public media	Affected vehicle operators / owners are informed of MDC by means of foreign public media and leaflets at border posts.
2	Procedures for application, payment, penalties etc are clearly explained	Procedures for application, payment, penalties etc are clearly explained
3	The vehicle owner / operator prepares and submits an application for a MDC licence	The vehicle owner / operator prepares and submits an application for a MDC permit
4	Agreement is reached on the appropriate mass and distance, the fee is calculated and paid; the receipt / licence is issued.	Agreement is reached on the appropriate mass and distance, the fee is calculated and paid; the receipt / permit is issued.
5	The licence information is captured on the automated MDC system	The permit information is captured on the automated MDC system
6	The vehicle owner / operator displays the licence on the vehicle.	The vehicle owner / operator displays the licence on the vehicle.
7	At any time enforcement officers can verify the validity of licences and charge penalties for non-compliance	At any time enforcement officers can verify the validity of permits and charge penalties for non-compliance
8	At the end of the licence validity period, the owner renews the licence.	At exit, the permit is returned at the border post and cancelled on the system
9	Should the owner be in default of renewing the MDC licence, the system will automatically produce a notice to the owner and notify the licensing system of default	Should the vehicle overstay in Namibia, beyond its validity period, the system will automatically produce a notice to the owner and notify the CBC system of default.
10	The process repeats itself every quarter.	The process repeats itself every quarter.

In order to simplify the MDC system, limit administrative costs and avoid possible resistance from foreign vehicle operators, it is proposed that MDCs are incorporated into CBC levels. It is therefore evident that the design of a MDC system will only focus on domestic vehicles.

3.4 VEHICLE CLASSES

In this sub-section, the identification of vehicle classes to be included in the MDC system is discussed.

A decision needs to be made which vehicle classification system (i.e. NaTIS, NAMRUC or CBC vehicle classification system) needs to be adopted for implementation of a MDC system.

The three vehicle classification systems are discussed below.

3.4.1.1 NaTIS Vehicle Classification

The NaTIS Database consists of eight classes as shown in Table 3-2.

Table 3-2: NaTIS Vehicle Classes

A: Motorcycle/Motortricycle/Quadrucycle	B: Light passenger mv(less than 12 persons)
C: Heavy passenger mv (12 or more persons)	K: Light load vehicle (GVM 3500Kg or less)
L: Heavy load veh(GVM>3500Kg, not to draw)	M: Heavy load veh(GVM>3500Kg,equip to draw)
U: Special Vehicle	O: Unknown

The following categories are included in these 8 classes:

- **Driven:** Unknown, Self-propelled vehicles, Trailers and Semi-trailers.
- **Fuel:** Unknown, Petrol, Diesel, Electricity, Paraffin, Gas, Ethanol, Methanol, Hydrogen Steam, Solar, None and Other.
- **Number of Axles**.
- **Tare Weight**.

Within the eight classes are 74 different vehicle descriptions which are shown in Table 3-3.

Table 3-3: NaTIS Vehicle Descriptions

Code	Description
00	Unknown
01	Motorcycle (no sidecar)
02	Motorcycle (with sidecar)
03	Scooter
04	Motor tricycle
05	Motor quadrucycle

Code	Description
11	Beach buggy
12	Sedan (closed top)
13	Sedan (open top)
14	Coupe (closed top)
15	Coupe (open top)
16	Station wagon

Code	Description
17	Jeep
18	Hatch back
21	Combi / Micro bus / Minibus
22	Bus (single deck)
23	Bus (double deck)
24	Bendi bus / Bus-train

Code	Description
31	Pick-up
32	Panel Van
41	Box body
42	Van body
43	Flat deck / Platform deck
44	Dropside
45	Tipper
46	Compactor body
47	Equipment platform / Low bed
48	Logger body
49	Sheet glass body
50	Mixer
51	Tanker
52	Truck tractor
53	Chassis-cab
54	Chassis
55	Skeletal
56	Adapter dolly

Code	Description
57	Converter dolly
58	Vehicle carrier
59	Mesh side body
61	Caravan
62	Tractor
63	Breakdown
64	Fire engine
65	Ambulance
66	Rescue vehicle
67	Hearse
68	Grader
69	Compactor
70	Roller
71	Loader
72	Crane
73	Tarmac spreader
74	Digger
75	Backacter
76	Drill / Borer / Drain Cleaner

Code	Description
77	Generator
78	Compressor
79	Sweeper
80	Pipelaying
81	Harvester
82	Baler/Mower
83	Planter
84	Hammer
A0	Mini bus (10 to 15 persons)
A1	Stationwagon / Combi
A2	Hearse / Ambulance
A3	Roadmaking
A4	Earthmoving
A5	Excavation
A6	Construction
A7	Mass/Diesel cart farming
A8	Utility vehicle
A9	Agriculture machine
B0	Mobile equipment

3.4.1.2 NAMRUC Vehicle Classification

The NAMRUC model consists of the vehicle classes as indicated in Table 3-4.

Table 3-4: NAMRUC Vehicle Classes

Motor Cycle
Car (Petrol)
Car (Diesel)
LDV – Petrol
LDV – Diesel
Mini Bus (Petrol)
Mini Bus (Diesel)
LGV (Diesel)
LGV (Petrol)
Bus (Diesel)
Bus (Petrol)
2 Axle SUT (Diesel)
2 Axle SUT (Petrol)
3 Axle SUT (Diesel)
3 Axle SUT (Petrol)
4 Axle Combination
5 Axle Combination
6 Axle Combination
7 Axle Combination
Caravan
Light Trailer
Other

It should be noted that although the NAMRUC model makes provision for the accommodation of vehicle classes such as Mini Bus (Diesel), LGV (Petrol), Bus (Petrol), 2 Axle SUT (Petrol), 3 Axle SUT (Petrol), these vehicles are considered to be exceptions.

3.4.1.3 CBC System Vehicle Classification

Table 3-5: CBC System Vehicle Classes

Light Vehicles	
Type 1	Motor cycles, motor tricycle and motor quadrucycle, caravans and light trailers by Type 2 vehicles
Type 2	All passenger cars, station wagons, S/C and D/C bakkies, 2x4 and 4x4 bakkies, kombis, microbus and minibus (fewer than 25 passengers)
Type 3	Light goods vehicle/delivery vehicles (GVM <3500kg)
Heavy Vehicles (Single units)	
Type 4	Bus with 2 axles (carrying capacity of 25 or more passengers)
Type 5	Bus with 3 axles (carrying capacity of 25 or more passengers)
Type 6	Single Unit Truck with 2 axles (Tare >3500kg)
Type 7	Single Unit Truck with 3 axles (Tare >3500kg)
Heavy Vehicles (Traction unit as part of a combination vehicle)	
Type 8	Truck tractor with 2 axles
Type 9	Truck tractor with 3 axles
Type 10	Truck tractor with 4 or more axles
Heavy Trailers (as part of a combination vehicle)	
Type 11	Trailer with 1 axle
Type 12	Trailer with 2 axles
Type 13	Trailer with 3 axles
Type 14	Trailer with 4 axles
Type 15	Trailer with 5 or more axles
Construction Vehicles	
Type 16	Tyre dozer, grader motor, front-end loaders, excavators, self propelled vibratory rollers
Type 17	Any other vehicle not listed

3.4.1.4 Vehicle Class Comparison

Vehicles to be included for MDCs relate to the following per vehicle classification:

- NaTIS
  - Class C: Heavy passenger mv (12 or more persons)
  - Class L: Heavy load veh(GVM>3500Kg, not to draw)
  - Class M: Heavy load veh(GVM>3500Kg,equip to draw)
- NAMRUC
  - Bus
  - 2 Axle SUT
  - 3 Axle SUT

  - 4 Axle Combination
  - 5 Axle Combination
  - 6 Axle Combination
  - 7 Axle Combination
- CBC
  - Type 4: Bus with 2 axles (carrying capacity of 25 or more passengers)
  - Type 5: Bus with 3 axles (carrying capacity of 25 or more passengers)
  - Type 6: Single Unit Truck with 2 axles (Tare >3500kg)
  - Type 7: Single Unit Truck with 3 axles (Tare >3500kg)
  - Type 8: Truck tractor with 2 axles
  - Type 9: Truck tractor with 3 axles
  - Type 10: Truck tractor with 4 or more axles
  - Type 11: Trailer with 1 axle
  - Type 12: Trailer with 2 axles
  - Type 13: Trailer with 3 axles
  - Type 14: Trailer with 4 axles
  - Type 15: Trailer with 5 or more axles

It should be noted that the following vehicle classes also relate to heavy vehicles but should not be included for MDCs, as their current cost recovery is considerably higher than their cost responsibility:

- NaTIS Class U: Special Vehicle and Class O: Unknown
- NAMRUC Other
- CBC Type 16: Tyre dozer, grader motor, front-end loaders, excavators, self propelled vibratory rollers and Type 17: Any other vehicle not listed

As it is the intention to use NaTIS for the collection of MDCs especially during the first two years of operation, the NaTIS vehicle classification should be used. There are 17 945 vehicles[3] (self-propelled and trailers/semi-trailers) in the classes C, L and M.

The FFA and the pilot project or the technological option are discussed below.

3.5 FFA MDC

In this section Option 1: Flat Fee Approximation MDC (FFA MDC) system is discussed. A FFA MDC system is defined as follows:

- Comprehensive system, involving the vast majority of heavy vehicles
- Non-technology MDC system
- Proxy MDC; using flat fees, based on GVM and estimated distance to be travelled
- Compulsory for all locally registered heavy vehicles (for specified types or classes) not participating in the voluntary pilot (GPS technology) project.

[3] As on 8 April 2004.

- The FFA MDCs is a non-technology based MDC system and is compulsory for all locally registered heavy vehicles (for specified types or classes) not participating in the voluntary technology based MDC pilot project.

Furthermore, the implementation of the FFA MDC will consist of the following two phases:

- Phase 1: for the first year of operation where the tare-based licence fees of those vehicle categories that should be subject to MDC be increased and collect GVM, axle configuration and fuel type data on these vehicles and officially enter these data into NaTIS.
- Phase 2: switch over from tare-based Phase 1 FFA MDC to GVM based Phase 2 FFA MDC in the second year of operation, using the GVM and axle configuration data captured in Phase 1.

These two phases are discussed below in terms of the following:

- Implementation requirements
- MDC levels per Tare weight group (Phase 1) and per GVM group (Phase 2).

3.5.1 Phase 1 MDC

As mentioned earlier, the first phase of the MDC system will be operational for one year and the charges will vary per tare weight category as in NaTIS for the classes C, L and M vehicles.

3.5.1.1 Implementation Requirements

The first phase of the MDC system will be implemented on 1 November 2004. This will require that NaTIS run a script on the NaTIS database overnight on 31 October 2004 in order to capture each vehicle's licence expiry date and to add the applicable MDC to the licence fee.

Based on discussions with NaTIS, the MDC will be payable over two months. In other words vehicle operators are granted time for payment of the MDC up to 31 December 2004.

During the first phase MDC data relating to axle configuration, fuel type and GVM will be collected by NaTIS and input into the database. This data and especially the GVM data will then be used during the Phase 2 MDC system.

3.5.1.2 MDC Levels

The MDC levels are shown in Table 3-6 and Table 3-7 for self-propelled vehicles and trailers/semi-trailers, respectively together with the number of vehicles, the assumed annual distance per tare weight category and the resultant revenue from MDCs.

It should be noted that the RFA slightly adjusted the calculated MDC levels as shown in Table 3-6 and Table 3-7. The methodology for the calculation of the MDC levels is presented in Annexure B.

Table 3-6: MDC Charge Levels per Tare Weight Group for Self-propelled Vehicles

A Tare of vehicle (kg)	B Assumed Average Annual Distance (km)	C Annual Mass Distance Charge (N$)	D Number of Vehicles (Number)	E Revenue (N$)
751-1000	N/A	-	4	-
1001-1250	N/A	-	97	-
1251-1500	N/A	-	739	-
1501-2000	N/A	-	1,329	-
2001-3000	N/A	-	2,130	-
3001-4000	87,702	8,340.00	1,240	10,341,600
4001-5000	87,862	8,820.00	1,417	12,497,940
5001-6000	88,816	9,156.00	1,292	11,829,552
6001-7000	88,896	9,708.00	1,250	12,135,000
7001-8000	88,780	10,296.00	984	10,131,264
8001-9000	87,967	10,524.00	915	9,629,460
9001-10000	86,578	10,752.00	1,122	12,063,744
10001-11000	83,582	10,944.00	416	4,552,704
11001-12000	79,615	11,124.00	234	2,603,016
12001-12500	85,976	11,316.00	82	927,912
12501-13000	78,923	11,508.00	65	748,020
13001-13500	82,308	11,688.00	39	455,832
13501-14000	84,783	11,880.00	23	273,240
14001-14500	83,333	12,072.00	9	108,648
14501-15000	85,714	12,252.00	21	257,292
15001-15500	85,000	12,444.00	6	74,664
15501-16000	90,000	12,636.00	5	63,180
16001-16500	84,545	12,816.00	11	140,976
16501-17000	85,000	13,008.00	6	78,048
17001-17500	77,143	13,200.00	7	92,400
17501-18000	90,000	13,500.00	4	54,000
18001-18500	90,000	13,692.00	4	54,768
18501-19000	90,000	13,872.00	1	13,872
19001-19500	90,000	14,064.00	0	-
19501-20000	90,000	14,256.00	1	14,256
20001-20500	90,000	14,436.00	0	-
20501-21000	90,000	14,628.00	1	14,628
21001-21500	90,000	14,820.00	0	-
21501-22000	90,000	15,000.00	1	15,000
22001-22500	90,000	15,192.00	1	15,192

A Tare of vehicle (kg)	B Assumed Average Annual Distance (km)	C Annual Mass Distance Charge (N$)	D Number of Vehicles (Number)	E Revenue (N$)
22501-23000	90,000	15,384.00	2	30,768
23001-23500	90,000	15,564.00	1	15,564
23501-24000	90,000	15,756.00	0	-
24001-24500	90,000	15,948.00	0	-
24501-25000	90,000	16,128.00	1	16,128
25001-25500	90,000	16,320.00	0	-
25501-26000	90,000	16,512.00	1	16,512
TOTAL			**13,461**	**89,265,180**

Table 3-7: MDC Charge Levels per Tare Weight Group for Trailers/Semi-Trailers

A Tare of vehicle (kg)	B Assumed Average Annual Distance (km)	C Annual Mass Distance Charge (N$)	D Number of Vehicles (Number)	E Revenue (N$)
0-1000	45,000	-	148	-
1001-2000	44,914	-	174	-
2001-3000	45,000	4,488.00	350	1,570,800
3001-4000	45,000	4,872.00	352	1,714,944
4001-5000	45,000	5,472.00	690	3,775,680
5001-6000	44,984	5,928.00	962	5,702,736
6001-7000	44,978	6,024.00	697	4,198,728
7001-8000	44,588	6,324.00	437	2,763,588
8001-9000	44,842	6,612.00	284	1,877,808
9001-10000	45,000	6,900.00	156	1,076,400
10001-11000	45,000	7,188.00	99	711,612
11001-12000	45,000	7,488.00	72	539,136
12001-12500	45,000	7,944.00	18	142,992
12501-13000	45,000	8,232.00	14	115,248
13001-13500	45,000	8,520.00	6	51,120
13501-14000	45,000	8,820.00	7	61,740
14001-14500	45,000	9,108.00	3	27,324
14501-15000	45,000	9,396.00	3	28,188
15001-15500	45,000	9,696.00	1	9,696
15501-16000	45,000	9,984.00	11	109,824
TOTAL			**4,484**	**24,477,564**

From Table 3-6 and Table 3-7, it will be noted that the revenue generated from the MDCs amounts to approximately N$113.74 million (N$ 89.27 million or 78% and N$ 24.48 million or 22% for self-propelled vehicles and trailers/semi-trailers, respectively).

Although the technology based pilot project will not be in place during the first phase of the MDC system which is ultimately aimed at recording the actual distances travelled, it is understood that the RFA have to make provision to pay *pro-rata* refunds to vehicle operators who can prove that they travelled less than the assumed annual distance as indicated in column B of Table 3-6 and Table 3-7.

It is proposed that the RFA applies a 10% margin of error to the actual versus assumed travelling distance. In other words if a vehicle falls within a tare weight category with an assumed annual distance of 90 000 km, then the vehicle operator would only be eligible for a *pro-rata* refund if the vehicle operator can prove that the vehicle was only used for less than 81 000 km per annum.

3.5.2 Phase 2 MDC

During the second phase of the MDC system, annual MDCs will be based on GVM data collected during the first phase.

3.5.2.1 Implementation Requirements

3.5.2.1.1 General

The second phase of the MDC system will be implemented on 1 November 2005. During this phase the MDCs will be based on GVM data collected during the first phase.

The technological pilot MDC system will be implemented in parallel to this phase which is aimed at recording the actual distances travelled. Based on the actual distances travelled, the participants in the pilot project will be eligible for a *pro-rata* refund if the actual distance is less than the assumed distance.

The objectives of the second phase are as follows:

- Determining the performance of the technological option in terms of the evaluation criteria
- Determining how accurately and regularly the technology provides the required information
- Performing functional testing of the software and hardware
- Determining the best operational and quality procedures to be implemented along with the technology
- Identifying any gaps that were overlooked in the reviews
- Ensuring that all the training needs are addressed (MDC centre staff, enforcement officers, etc.)
- To allow vehicles travelling less than the assumed distance to pay a more equitable fee.

3.5.2.1.2 MDCS Offices

MDCS offices should be set up at the appropriate locations to provide all the MDCS services. These offices should therefore be equipped with appropriate and efficient operational and financial systems that are linked to all key stakeholders. Supporting information systems should assist in monitoring, evaluation, reporting and decision-making.

MDCS offices should be linked to every town where NaTIS is represented. NaTIS has offices in the following 33 towns: Aranos, Bethanie, Eenhana, Gobabis, Grootfontein, Karasburg, Karibib, Katima Mulilo, Keetmanshoop, Khorixas, Luderitz, Maltahohe, Mariental, Okahandja, Okakarara, Omaruru, Ondangwa, Opuwo, Oranjemund, Oranjemund, Ongwediva, Otavi, Otjinene, Otjiwarongo, Outapi, Outjo, Rehoboth, Rundu, Swakopmund, Tsumeb, Usakos, Walvis Bay and Windhoek.

However, when considering the number of heavy vehicles registered per town, we propose the following:

- One MDCS office located and managed in Windhoek.
- Providing NaTIS with the necessary access and capabilities to receive payments from pilot project participants and re-issuing them with MDCS certificates.
- The customised MDCS software should be web-based to allow on-line applications for MDCS licences which should minimise the required computer hardware.
- For the technology option, include only vehicles in the region of the Windhoek and Swakopmund. The motivation is that the highest concentration of heavy vehicles is located in and around Windhoek. Swakopmund, together with Walvis Bay, has the second highest concentration of heavy vehicles.

3.5.2.1.3 Testing, Operation and Technology Management

All the components of the technological solution have to be thoroughly tested for Namibian conditions. Our proposed approach in this regard is as follows:

- Program and install necessary equipment
- Develop and install software
- Check regularly for connectivity between the control room and the IVU's
- Retrieve distance information on predetermined intervals
- Verify accuracy of information
- Determine if retrieve intervals are sufficient

During the MDCS operation, technology management will include:

- Installation of hardware and software components including:
    - Replacement of faulty components
    - Installations in new vehicles
    - Removal from old vehicles
- Regularly checking for connectivity between the control room and the IVU's
- Retrieve distance information on predetermined intervals
- Financial management including:
    - › Preparing invoices
    - › Receiving of payments

- Ensuring enforcement

3.5.2.1.4 Industry Consultation, Acceptance and Change Management

The change management of the stakeholders should focus on getting their full support and buy-in. The stakeholders must be managed and guided to the point where they willingly participate and support the MDCS.

Buy-in from the industry is essential. This should be achieved through consultations and education.

Road user expectations, opinions and levels of acceptance must be determined and acted upon. Proper change management is required. The process as indicated in Figure 3-1 can be used as guide.

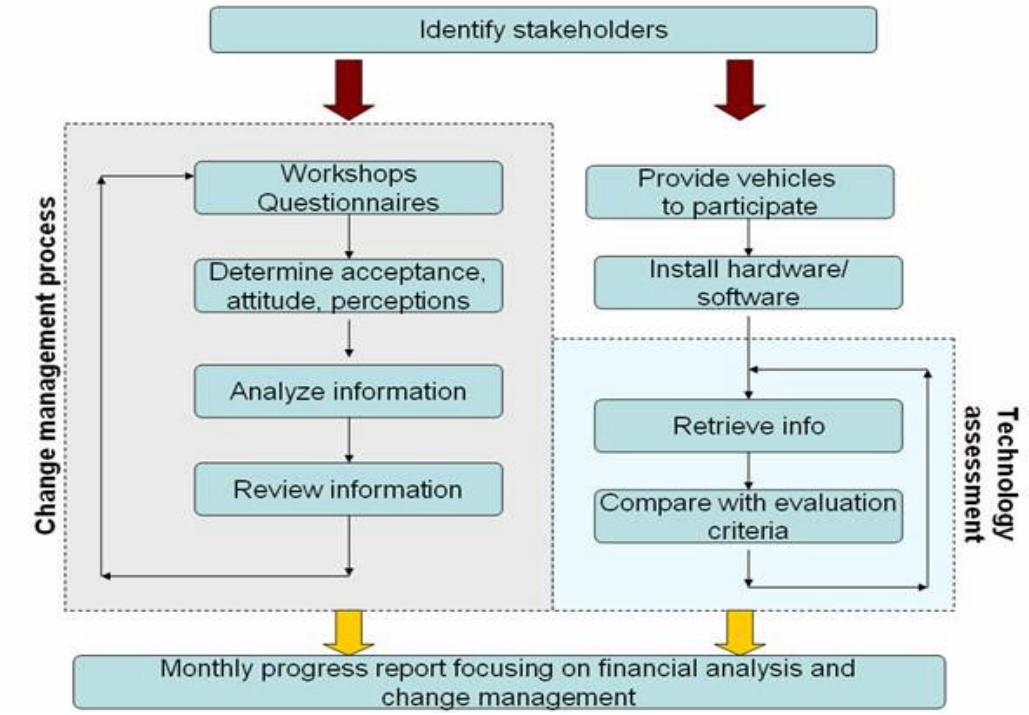

Figure 3-1: Change management process

3.5.2.1.5 Monitoring, Evaluation and Reporting

Although an evaluation of the pilot project will be done after the completion of the pilot project, it is proposed that regular evaluations be done throughout the pilot project.

The current and future world-wide trends with regard to MDCS may also affect the implementation of local full-scale technological MDCS.

3.5.2.2 MDC Levels

The MDC levels are shown in Table 3-8 and Table 3-9 for self-propelled vehicles and trailers/semi-trailers, respectively together with the number of vehicles, the assumed annual distance per GVM category and the resultant revenue from MDCs.

Regarding Table 3-8 and Table 3-9, the following should be noted:

- Column A refers to the GVM per vehicle in kilograms. In this regard, it should be noted that for vehicles in NaTIS with no GVM data (about 10% of all vehicles), tare weight (which is a mandatory field in NaTIS) was used to estimate GVM (refer to Annexure B for an explanation on the methodology that was applied). As it appears that the current GVM data in NaTIS is not entirely reliable, it is therefore of imperative importance to update the calculations once more reliable GVM data has been collected.
- Column B shows the average assumed annual distances (refer to Annexure B for an explanation on the methodology that was applied).
- Column C depicts the annual mass distance charge which was calculated on the basis of GVM and assumed annual distances (refer to Annexure B).
- Column D shows the number of vehicles in each category.
- Column E shows the resultant revenue from each GVM category based on column C and D.

Table 3-8: MDC Charge Levels per GVM for Self-propelled Vehicles

A GVM per Vehicle (kg)	B Assumed Average Annual Distance (km)	C Annual Mass Distance Charge (N$)	D Number of Vehicles (Number)	E Revenue (N$)
0-1000	86,250	7,116	8	56,928
1001-2000	75,918	6,456	49	316,356
2001-3000	61,318	5,325	1,730	9,212,114
3001-4000	85,939	7,608	362	2,754,120
4001-5000	82,713	7,469	988	7,379,853
5001-6000	86,244	7,940	1,286	10,210,936
6001-7000	87,489	8,264	657	5,429,517
7001-8000	87,134	8,323	335	2,788,117
8001-9000	87,850	8,597	321	2,759,522
9001-10000	88,826	8,841	460	4,066,695
10001-11000	88,884	9,029	484	4,370,007
11001-12000	89,076	9,188	422	3,877,272
12001-13000	89,019	9,328	428	3,992,189
13001-14000	88,035	9,373	565	5,295,895
14001-15000	87,011	9,430	823	7,761,035
15001-16000	84,320	9,341	338	3,157,234
16001-17000	83,668	9,426	1,194	11,254,577

A GVM per Vehicle (kg)	B Assumed Average Annual Distance (km)	C Annual Mass Distance Charge (N$)	D Number of Vehicles (Number)	E Revenue (N$)
17001-18000	79,167	9,031	144	1,300,460
18001-19000	88,636	10,305	110	1,133,588
19001-20000	86,071	10,216	84	858,149
20001-21000	90,000	10,736	90	966,253
21001-22000	89,545	10,889	66	718,654
22001-23000	89,952	11,065	620	6,860,439
23001-24000	89,400	11,208	350	3,922,863
24001-25000	89,200	11,370	150	1,705,497
25001-26000	89,890	11,677	546	6,375,901
26001-27000	90,000	11,830	64	757,150
27001-28000	88,947	11,899	114	1,356,524
28001-29000	90,000	12,210	152	1,855,860
29001-30000	90,000	12,270	30	368,086
30001-31000	90,000	12,396	10	123,964
31001-32000	90,000	12,646	21	265,571
32001-33000	90,000	12,962	81	1,049,960
33001-34000	90,000	13,103	83	1,087,552
34001-35000	82,737	12,030	95	1,142,859
35001-36000	90,000	13,325	13	173,224
36001-37000	90,000	13,401	4	53,603
37001-38000	90,000	13,630	39	531,586
38001-39000	90,000	13,690	2	27,380
39001-40000	90,000	13,988	13	181,841
40001-41000	90,000	14,076	27	380,040
41001-42000	86,250	13,613	8	108,907
42001-43000	90,000	14,313	6	85,880
43001-44000	90,000	14,544	9	130,899
44001-45000	90,000	14,703	3	44,108
45001-46000	86,667	14,417	9	129,753
46001-47000	86,667	14,417	-	-
47001-48000	84,000	14,182	5	70,911
48001-49000	84,000	14,182	-	-
49001-50000	90,000	15,501	6	93,007
50001-51000	90,000	15,537	1	15,537
51001-52000	90,000	16,128	1	16,128
52001-53000	90,000	16,128	-	-
53001-54000	90,000	16,147	3	48,440
54001-55000	90,000	16,334	2	32,669
55001-56000	90,000	16,478	5	82,388
56001-57000	90,000	16,660	1	16,660
57001-58000	90,000	16,782	2	33,564
58001-59000	90,000	16,826	1	16,826
59001-60000	90,000	17,148	1	17,148

A GVM per Vehicle (kg)	B Assumed Average Annual Distance (km)	C Annual Mass Distance Charge (N$)	D Number of Vehicles (Number)	E Revenue (N$)
60001-61000	90,000	17,148	-	-
61001-62000	90,000	17,382	1	17,382
62001-63000	90,000	17,382	-	-
63001-64000	90,000	17,382	-	-
64001-65000	90,000	18,009	6	108,052
65001-66000	90,000	18,043	1	18,043
66001-67000	90,000	18,043	-	-
67001-68000	90,000	18,043	-	-
68001-69000	90,000	18,043	-	-
69001-70000	90,000	18,775	1	18,775
70001-71000	90,000	18,775	-	-
71001-72000	90,000	19,085	3	57,254
72001-73000	90,000	19,085	-	-
73001-74000	90,000	19,085	-	-
74001-75000	90,000	19,730	2	39,460
75001-76000	90,000	19,730	-	-
76001-77000	90,000	19,849	1	19,849
77001-78000	90,000	20,077	1	20,077
78001-79000	90,000	20,240	2	40,480
79001-80000	90,000	20,240	-	-
80001-81000	90,000	20,240	-	-
81001-82000	90,000	20,240	-	-
82001-83000	90,000	20,891	1	20,891
83001-84000	90,000	20,891	-	-
84001-85000	90,000	21,256	3	63,768
85001-86000	90,000	21,379	1	21,379
86001-87000	90,000	21,379	-	-
87001-88000	90,000	21,705	1	21,705
88001-89000	90,000	21,754	2	43,509
89001-90000	90,000	21,754	-	-
90001-91000	90,000	21,754	-	-
91001-92000	90,000	21,754	-	-
92001-93000	90,000	21,754	-	-
93001-94000	90,000	21,754	-	-
94001-95000	90,000	21,754	-	-
95001-96000	90,000	21,754	-	-
96001-97000	90,000	21,754	-	-
97001-98000	90,000	21,754	-	-
98001-99000	90,000	21,754	-	-
99001-100000	90,000	23,657	1	23,657
100001-101000	90,000	23,657	-	-
101001-102000	90,000	23,657	-	-
102001-103000	90,000	23,657	-	-

A GVM per Vehicle (kg)	B Assumed Average Annual Distance (km)	C Annual Mass Distance Charge (N$)	D Number of Vehicles (Number)	E Revenue (N$)
103001-104000	90,000	23,657	-	-
104001-105000	90,000	24,471	1	24,471
105001-106000	90,000	24,471	-	-
106001-107000	90,000	24,471	-	-
107001-108000	90,000	24,471	-	-
108001-109000	90,000	24,471	-	-
109001-110000	90,000	25,285	1	25,285
110001-111000	90,000	25,285	-	-
111001-112000	90,000	25,285	-	-
112001-113000	90,000	25,285	-	-
113001-114000	90,000	25,285	-	-
114001-115000	90,000	25,285	-	-
115001-116000	90,000	25,285	-	-
116001-117000	90,000	25,285	-	-
117001-118000	90,000	26,587	1	26,587
118001-119000	90,000	26,587	-	-
119001-120000	90,000	27,194	1	27,194
120001-121000	90,000	27,194	-	-
121001-122000	90,000	27,194	-	-
122001-123000	90,000	27,194	-	-
123001-124000	90,000	27,194	-	-
124001-125000	90,000	27,194	-	-
125001-126000	90,000	27,194	-	-
126001-127000	90,000	27,194	-	-
127001-128000	90,000	27,194	-	-
128001-129000	90,000	27,194	-	-
129001-130000	90,000	28,539	1	28,539
130001-131000	90,000	28,539	-	-
131001-132000	90,000	28,865	1	28,865
132001-133000	90,000	28,865	-	-
133001-134000	90,000	28,865	-	-
134001-135000	90,000	28,865	-	-
135001-136000	90,000	28,865	-	-
136001-137000	90,000	28,865	-	-
137001-138000	90,000	28,865	-	-
138001-139000	90,000	28,865	-	-
139001-140000	90,000	28,865	-	-
140001-141000	90,000	28,865	-	-
141001-142000	90,000	30,492	2	60,984
142001-143000	90,000	30,492	-	-
143001-144000	90,000	30,492	-	-
144001-145000	90,000	30,980	1	30,980
145001-146000	90,000	31,104	1	31,104

A GVM per Vehicle (kg)	B Assumed Average Annual Distance (km)	C Annual Mass Distance Charge (N$)	D Number of Vehicles (Number)	E Revenue (N$)
146001-147000	90,000	31,104	-	-
147001-148000	90,000	31,104	-	-
148001-149000	90,000	31,104	-	-
149001-150000	90,000	31,794	3	95,382
TOTAL			**13,461**	**119,735,871**

Table 3-9: MDC Charge Levels per GVM for Trailers/Semi-Trailers

A GVM per Vehicle (kg)	B Assumed Average Annual Distance (km)	C Annual Mass Distance Charge (N$)	D Number of Vehicles (Number)	E Revenue (N$)
0-1000	45,000	3,694	77	284,453
1001-2000	44,400	3,743	25	93,566
2001-3000	45,000	3,899	30	116,979
3001-4000	45,000	3,988	63	251,265
4001-5000	45,000	4,049	323	1,307,706
5001-6000	45,000	4,139	58	240,082
6001-7000	45,000	4,234	61	258,265
7001-8000	45,000	4,310	68	293,103
8001-9000	45,000	4,385	95	416,537
9001-10000	45,000	4,479	68	304,555
10001-11000	45,000	4,552	45	204,848
11001-12000	45,000	4,654	41	190,810
12001-13000	45,000	4,701	73	343,170
13001-14000	44,769	4,771	65	310,126
14001-15000	44,810	4,856	79	383,604
15001-16000	43,316	4,790	98	469,437
16001-17000	44,972	5,055	528	2,668,859
17001-18000	45,000	5,145	102	524,798
18001-19000	45,000	5,240	45	235,806
19001-20000	44,583	5,258	72	378,593
20001-21000	45,000	5,365	15	80,473
21001-22000	45,000	5,470	53	289,926
22001-23000	45,000	5,527	54	298,475
23001-24000	44,830	5,618	88	494,388
24001-25000	45,000	5,691	129	734,199
25001-26000	45,000	5,798	69	400,029
26001-27000	45,000	5,862	60	351,742

A GVM per Vehicle (kg)	B Assumed Average Annual Distance (km)	C Annual Mass Distance Charge (N$)	D Number of Vehicles (Number)	E Revenue (N$)
27001-28000	45,000	5,956	92	547,923
28001-29000	45,000	6,017	61	367,058
29001-30000	45,000	6,131	197	1,207,905
30001-31000	45,000	6,181	183	1,131,161
31001-32000	45,000	6,280	129	810,083
32001-33000	45,000	6,367	145	923,262
33001-34000	45,000	6,460	140	904,421
34001-35000	45,000	6,538	156	1,019,902
35001-36000	45,000	6,640	466	3,094,154
36001-37000	45,000	6,663	15	99,945
37001-38000	45,000	6,807	95	646,664
38001-39000	45,000	6,841	21	143,658
39001-40000	45,000	6,956	89	619,080
40001-41000	45,000	7,025	9	63,221
41001-42000	45,000	7,201	27	194,416
42001-43000	45,000	7,264	73	530,299
43001-44000	45,000	7,322	10	73,217
44001-45000	45,000	7,385	20	147,698
45001-46000	45,000	7,403	15	111,038
46001-47000	45,000	7,488	5	37,441
47001-48000	45,000	7,650	8	61,204
48001-49000	45,000	7,682	5	38,412
49001-50000	45,000	7,845	5	39,225
50001-51000	45,000	7,845	-	-
51001-52000	45,000	7,845	-	-
52001-53000	45,000	7,845	-	-
53001-54000	45,000	7,845	-	-
54001-55000	45,000	8,097	2	16,194
55001-56000	45,000	8,192	2	16,383
56001-57000	45,000	8,330	1	8,330
57001-58000	45,000	8,330	-	-
58001-59000	45,000	8,330	-	-
59001-60000	45,000	8,574	1	8,574
60001-61000	45,000	8,574	-	-
61001-62000	45,000	8,574	-	-
62001-63000	45,000	8,574	-	-
63001-64000	45,000	8,574	-	-
64001-65000	45,000	8,946	4	35,783
65001-66000	45,000	8,946	-	-
66001-67000	45,000	8,946	-	-
67001-68000	45,000	8,946	-	-
68001-69000	45,000	8,946	-	-
69001-70000	45,000	9,379	4	37,514

A GVM per Vehicle (kg)	B Assumed Average Annual Distance (km)	C Annual Mass Distance Charge (N$)	D Number of Vehicles (Number)	E Revenue (N$)
70001-71000	45,000	9,379	-	-
71001-72000	45,000	9,379	-	-
72001-73000	45,000	9,379	-	-
73001-74000	45,000	9,379	-	-
74001-75000	45,000	9,795	1	9,795
75001-76000	45,000	9,795	-	-
76001-77000	45,000	9,795	-	-
77001-78000	45,000	9,998	1	9,998
78001-79000	45,000	9,998	-	-
79001-80000	45,000	10,201	2	20,403
80001-81000	45,000	10,201	-	-
81001-82000	45,000	10,201	-	-
82001-83000	45,000	10,201	-	-
83001-84000	45,000	10,201	-	-
84001-85000	45,000	10,201	-	-
85001-86000	45,000	10,201	-	-
86001-87000	45,000	10,201	-	-
87001-88000	45,000	10,201	-	-
88001-89000	45,000	10,201	-	-
89001-90000	45,000	10,201	-	-
90001-91000	45,000	10,201	-	-
91001-92000	45,000	10,201	-	-
92001-93000	45,000	10,201	-	-
93001-94000	45,000	10,201	-	-
94001-95000	45,000	10,201	-	-
95001-96000	45,000	11,503	1	11,503
96001-97000	45,000	11,503	-	-
97001-98000	45,000	11,503	-	-
98001-99000	45,000	11,503	-	-
99001-100000	45,000	11,829	1	11,829
100001-101000	45,000	11,829	-	-
101001-102000	45,000	11,829	-	-
102001-103000	45,000	11,829	-	-
103001-104000	45,000	11,829	-	-
104001-105000	45,000	11,829	-	-
105001-106000	45,000	11,829	-	-
106001-107000	45,000	11,829	-	-
107001-108000	45,000	11,829	-	-
108001-109000	45,000	11,829	-	-
109001-110000	45,000	11,829	-	-
110001-111000	45,000	11,829	-	-
111001-112000	45,000	11,829	-	-
112001-113000	45,000	11,829	-	-

A GVM per Vehicle (kg)	B Assumed Average Annual Distance (km)	C Annual Mass Distance Charge (N$)	D Number of Vehicles (Number)	E Revenue (N$)
113001-114000	45,000	11,829	-	-
114001-115000	45,000	11,829	-	-
115001-116000	45,000	11,829	-	-
116001-117000	45,000	11,829	-	-
117001-118000	45,000	11,829	-	-
118001-119000	45,000	11,829	-	-
119001-120000	45,000	13,456	1	13,456
120001-121000	45,000	13,456	-	-
121001-122000	45,000	13,456	-	-
122001-123000	45,000	13,456	-	-
123001-124000	45,000	13,456	-	-
124001-125000	45,000	13,456	-	-
125001-126000	45,000	13,456	-	-
126001-127000	45,000	13,456	-	-
127001-128000	45,000	13,456	-	-
128001-129000	45,000	13,456	-	-
129001-130000	45,000	13,456	-	-
130001-131000	45,000	13,456	-	-
131001-132000	45,000	13,456	-	-
132001-133000	45,000	13,456	-	-
133001-134000	45,000	13,456	-	-
134001-135000	45,000	13,456	-	-
135001-136000	45,000	13,456	-	-
136001-137000	45,000	13,456	-	-
137001-138000	45,000	13,456	-	-
138001-139000	45,000	13,456	-	-
139001-140000	45,000	15,083	2	30,167
140001-141000	45,000	15,083	-	-
141001-142000	45,000	15,083	-	-
142001-143000	45,000	15,083	-	-
143001-144000	45,000	15,083	-	-
144001-145000	45,000	15,083	-	-
145001-146000	45,000	15,083	-	-
146001-147000	45,000	15,083	-	-
147001-148000	45,000	15,083	-	-
148001-149000	45,000	15,083	-	-
149001-150000	45,000	15,083	-	-
150001-151000	45,000	15,083	-	-
151001-152000	45,000	15,083	-	-
152001-153000	45,000	15,083	-	-
153001-154000	45,000	15,083	-	-
154001-155000	45,000	15,083	-	-
155001-156000	45,000	15,083	-	-

A GVM per Vehicle (kg)	B Assumed Average Annual Distance (km)	C Annual Mass Distance Charge (N$)	D Number of Vehicles (Number)	E Revenue (N$)
156001-157000	45,000	15,083	-	-
157001-158000	45,000	15,083	-	-
158001-159000	45,000	15,083	-	-
159001-160000	45,000	15,083	-	-
160001-161000	45,000	15,083	-	-
161001-162000	45,000	15,083	-	-
162001-163000	45,000	15,083	-	-
163001-164000	45,000	15,083	-	-
164001-165000	45,000	15,083	-	-
165001-166000	45,000	15,083	-	-
166001-167000	45,000	15,083	-	-
167001-168000	45,000	15,083	-	-
168001-169000	45,000	15,083	-	-
169001-170000	45,000	15,083	-	-
170001-171000	45,000	15,083	-	-
171001-172000	45,000	15,083	-	-
172001-173000	45,000	15,083	-	-
173001-174000	45,000	15,083	-	-
174001-175000	45,000	15,083	-	-
175001-176000	45,000	15,083	-	-
176001-177000	45,000	15,083	-	-
177001-178000	45,000	15,083	-	-
178001-179000	45,000	15,083	-	-
179001-180000	45,000	15,083	-	-
180001-181000	45,000	15,083	-	-
181001-182000	45,000	15,083	-	-
182001-183000	45,000	15,083	-	-
183001-184000	45,000	15,083	-	-
184001-185000	45,000	18,745	1	18,745
185001-186000	45,000	18,745	-	-
186001-187000	45,000	18,745	-	-
187001-188000	45,000	18,745	-	-
188001-189000	45,000	18,745	-	-
189001-190000	45,000	18,745	-	-
190001-191000	45,000	18,745	-	-
191001-192000	45,000	18,745	-	-
192001-193000	45,000	18,745	-	-
193001-194000	45,000	18,745	-	-
194001-195000	45,000	18,745	-	-
195001-196000	45,000	18,745	-	-
196001-197000	45,000	18,745	-	-
197001-198000	45,000	18,745	-	-
198001-199000	45,000	18,745	-	-

A GVM per Vehicle (kg)	B Assumed Average Annual Distance (km)	C Annual Mass Distance Charge (N$)	D Number of Vehicles (Number)	E Revenue (N$)
199001-200000	45,000	19,965	1	19,965
200001-201000	45,000	19,965	-	-
201001-202000	45,000	19,965	-	-
202001-203000	45,000	19,965	-	-
203001-204000	45,000	19,965	-	-
204001-205000	45,000	19,965	-	-
205001-206000	45,000	19,965	-	-
206001-207000	45,000	19,965	-	-
207001-208000	45,000	19,965	-	-
208001-209000	45,000	19,965	-	-
209001-210000	45,000	19,965	-	-
210001-211000	45,000	19,965	-	-
211001-212000	45,000	19,965	-	-
212001-213000	45,000	19,965	-	-
213001-214000	45,000	19,965	-	-
214001-215000	45,000	19,965	-	-
215001-216000	45,000	19,965	-	-
216001-217000	45,000	19,965	-	-
217001-218000	45,000	19,965	-	-
218001-219000	45,000	19,965	-	-
219001-220000	45,000	19,965	-	-
220001-221000	45,000	19,965	-	-
221001-222000	45,000	19,965	-	-
222001-223000	45,000	19,965	-	-
223001-224000	45,000	19,965	-	-
224001-225000	45,000	19,965	-	-
225001-226000	45,000	19,965	-	-
226001-227000	45,000	19,965	-	-
227001-228000	45,000	19,965	-	-
228001-229000	45,000	19,965	-	-
229001-230000	45,000	19,965	-	-
230001-231000	45,000	19,965	-	-
231001-232000	45,000	19,965	-	-
232001-233000	45,000	19,965	-	-
233001-234000	45,000	19,965	-	-
234001-235000	45,000	19,965	-	-
235001-236000	45,000	19,965	-	-
236001-237000	45,000	19,965	-	-
237001-238000	45,000	19,965	-	-
238001-239000	45,000	19,965	-	-
239001-240000	45,000	19,965	-	-
240001-241000	45,000	19,965	-	-
241001-242000	45,000	19,965	-	-

A GVM per Vehicle (kg)	B Assumed Average Annual Distance (km)	C Annual Mass Distance Charge (N$)	D Number of Vehicles (Number)	E Revenue (N$)
242001-243000	45,000	19,965	-	-
243001-244000	45,000	19,965	-	-
244001-245000	45,000	19,965	-	-
245001-246000	45,000	23,708	2	47,416
246001-247000	45,000	23,708	-	-
247001-248000	45,000	23,708	-	-
248001-249000	45,000	23,708	-	-
249001-250000	45,000	23,708	-	-
250001-251000	45,000	23,708	-	-
251001-252000	45,000	23,708	-	-
252001-253000	45,000	23,708	-	-
253001-254000	45,000	23,708	-	-
254001-255000	45,000	23,708	-	-
255001-256000	45,000	23,708	-	-
256001-257000	45,000	23,708	-	-
257001-258000	45,000	23,708	-	-
258001-259000	45,000	23,708	-	-
259001-260000	45,000	23,708	-	-
260001-261000	45,000	23,708	-	-
261001-262000	45,000	23,708	-	-
262001-263000	45,000	23,708	-	-
263001-264000	45,000	23,708	-	-
264001-265000	45,000	23,708	-	-
265001-266000	45,000	23,708	-	-
266001-267000	45,000	23,708	-	-
267001-268000	45,000	23,708	-	-
268001-269000	45,000	23,708	-	-
269001-270000	45,000	23,708	-	-
270001-271000	45,000	25,742	1	25,742
271001-272000	45,000	25,742	-	-
272001-273000	45,000	25,742	-	-
273001-274000	45,000	25,742	-	-
274001-275000	45,000	25,742	-	-
275001-276000	45,000	25,742	-	-
276001-277000	45,000	26,231	1	26,231
277001-278000	45,000	26,231	-	-
278001-279000	45,000	26,231	-	-
279001-280000	45,000	26,231	-	-
280001-281000	45,000	26,231	-	-
281001-282000	45,000	26,231	-	-
282001-283000	45,000	26,231	-	-
283001-284000	45,000	26,231	-	-
284001-285000	45,000	26,231	-	-

A GVM per Vehicle (kg)	B Assumed Average Annual Distance (km)	C Annual Mass Distance Charge (N$)	D Number of Vehicles (Number)	E Revenue (N$)
285001-286000	45,000	26,231	-	-
286001-287000	45,000	26,231	-	-
287001-288000	45,000	26,231	-	-
288001-289000	45,000	26,231	-	-
289001-290000	45,000	26,231	-	-
290001-291000	45,000	26,231	-	-
291001-292000	45,000	26,231	-	-
292001-293000	45,000	26,231	-	-
293001-294000	45,000	26,231	-	-
294001-295000	45,000	26,231	-	-
295001-296000	45,000	26,231	-	-
296001-297000	45,000	26,231	-	-
297001-298000	45,000	27,939	1	27,939
298001-299000	45,000	27,939	-	-
299001-300000	45,000	27,961	1	27,961
300001-301000	45,000	27,961	-	-
301001-302000	45,000	27,961	-	-
302001-303000	45,000	27,961	-	-
303001-304000	45,000	27,961	-	-
304001-305000	45,000	27,961	-	-
305001-306000	45,000	27,961	-	-
306001-307000	45,000	27,961	-	-
307001-308000	45,000	27,961	-	-
308001-309000	45,000	27,961	-	-
309001-310000	45,000	27,961	-	-
310001-311000	45,000	27,961	-	-
311001-312000	45,000	27,961	-	-
312001-313000	45,000	27,961	-	-
313001-314000	45,000	27,961	-	-
314001-315000	45,000	27,961	-	-
315001-316000	45,000	27,961	-	-
316001-317000	45,000	27,961	-	-
317001-318000	45,000	27,961	-	-
318001-319000	45,000	27,961	-	-
319001-320000	45,000	27,961	-	-
320001-321000	45,000	27,961	-	-
321001-322000	45,000	27,961	-	-
322001-323000	45,000	27,961	-	-
323001-324000	45,000	27,961	-	-
324001-325000	45,000	27,961	-	-
325001-326000	45,000	27,961	-	-
326001-327000	45,000	27,961	-	-
327001-328000	45,000	27,961	-	-

A GVM per Vehicle (kg)	B Assumed Average Annual Distance (km)	C Annual Mass Distance Charge (N$)	D Number of Vehicles (Number)	E Revenue (N$)
328001-329000	45,000	27,961	-	-
329001-330000	45,000	30,543	1	30,543
330001-331000	45,000	30,543	-	-
331001-332000	45,000	30,543	-	-
332001-333000	45,000	30,543	-	-
333001-334000	45,000	30,543	-	-
334001-335000	45,000	30,543	-	-
335001-336000	45,000	30,543	-	-
336001-337000	45,000	30,543	-	-
337001-338000	45,000	30,543	-	-
338001-339000	45,000	30,543	-	-
339001-340000	45,000	30,543	-	-
340001-341000	45,000	30,543	-	-
341001-342000	45,000	30,543	-	-
342001-343000	45,000	30,543	-	-
343001-344000	45,000	30,543	-	-
344001-345000	45,000	30,543	-	-
345001-346000	45,000	30,543	-	-
346001-347000	45,000	30,543	-	-
347001-348000	45,000	30,543	-	-
348001-349000	45,000	30,543	-	-
349001-350000	45,000	30,543	-	-
350001-351000	45,000	30,543	-	-
351001-352000	45,000	30,543	-	-
352001-353000	45,000	30,543	-	-
353001-354000	45,000	30,543	-	-
354001-355000	45,000	30,543	-	-
355001-356000	45,000	30,543	-	-
356001-357000	45,000	30,543	-	-
357001-358000	45,000	30,543	-	-
358001-359000	45,000	30,543	-	-
359001-360000	45,000	30,543	-	-
360001-361000	45,000	30,543	-	-
361001-362000	45,000	30,543	-	-
362001-363000	45,000	30,543	-	-
363001-364000	45,000	30,543	-	-
364001-365000	45,000	30,543	-	-
365001-366000	45,000	30,543	-	-
366001-367000	45,000	30,543	-	-
367001-368000	45,000	30,543	-	-
368001-369000	45,000	30,543	-	-
369001-370000	45,000	30,543	-	-
370001-371000	45,000	30,543	-	-

A GVM per Vehicle (kg)	B Assumed Average Annual Distance (km)	C Annual Mass Distance Charge (N$)	D Number of Vehicles (Number)	E Revenue (N$)
371001-372000	45,000	30,543	-	-
372001-373000	45,000	30,543	-	-
373001-374000	45,000	30,543	-	-
374001-375000	45,000	30,543	-	-
375001-376000	45,000	30,543	-	-
376001-377000	45,000	30,543	-	-
377001-378000	45,000	30,543	-	-
378001-379000	45,000	30,543	-	-
379001-380000	45,000	34,611	1	34,611
380001-381000	45,000	34,611	-	-
381001-382000	45,000	34,611	-	-
382001-383000	45,000	34,611	-	-
383001-384000	45,000	34,611	-	-
384001-385000	45,000	34,611	-	-
385001-386000	45,000	34,611	-	-
386001-387000	45,000	34,611	-	-
387001-388000	45,000	34,611	-	-
388001-389000	45,000	34,611	-	-
389001-390000	45,000	34,611	-	-
390001-391000	45,000	34,611	-	-
391001-392000	45,000	34,611	-	-
392001-393000	45,000	34,611	-	-
393001-394000	45,000	34,611	-	-
394001-395000	45,000	34,611	-	-
395001-396000	45,000	34,611	-	-
396001-397000	45,000	34,611	-	-
397001-398000	45,000	34,611	-	-
398001-399000	45,000	34,611	-	-
399001-400000	45,000	34,611	-	-
400001-401000	45,000	34,611	-	-
401001-402000	45,000	34,611	-	-
402001-403000	45,000	34,611	-	-
403001-404000	45,000	34,611	-	-
404001-405000	45,000	34,611	-	-
405001-406000	45,000	34,611	-	-
406001-407000	45,000	34,611	-	-
407001-408000	45,000	34,611	-	-
408001-409000	45,000	34,611	-	-
409001-410000	45,000	34,611	-	-
410001-411000	45,000	34,611	-	-
411001-412000	45,000	34,611	-	-
412001-413000	45,000	34,611	-	-
413001-414000	45,000	34,611	-	-

A GVM per Vehicle (kg)	B Assumed Average Annual Distance (km)	C Annual Mass Distance Charge (N$)	D Number of Vehicles (Number)	E Revenue (N$)
414001-415000	45,000	34,611	-	-
415001-416000	45,000	34,611	-	-
416001-417000	45,000	34,611	-	-
417001-418000	45,000	34,611	-	-
418001-419000	45,000	34,611	-	-
419001-420000	45,000	37,866	1	37,866
TOTAL			**4,484**	**25,264,129**

From Table 3-8 and Table 3-9, it is evident that a total of N$ 145 million is recovered from vehicle classes C, L and M (83% from self-propelled vehicles and 17% from trailers/semi-trailers).

It should also be noted that the MDC levels based on GVM should be seen as preliminary, as the GVM data in NaTIS is currently not entirely reliable. Once more reliable GVM data has been collected as part of this phase, the calculations need to be updated.

3.6 TECHNOLOGY BASED MDC

The purpose of this chapter is to provide an overview of MDC OPTION 2: the technological option which is considered for pilot implementation. The current and expected future technologies available for use in MDC were reviewed. The review was done based on the following documentation:

1. Options for Weight - Distance Charges for Diesel Vehicles, Allan Kennaird, Sept. 1998
2. Feasibility study to utilise passive satellite technology to measure distances travelled by individual vehicles, BG Consulting, July 2001 (plus RFA comments)
3. Comments on RFA reports of June 2000 and July 2001: Implementation of a weight-distance charging system, W Ravenscroft, 2002
4. Exempting non-road users from paying the diesel levy, Ian Heggie, March 1999
5. Distance-Based Charges: A Practical Strategy for more Optical Vehicle Pricing (Tod Litman, Victoria Transport Policy Institute, 1999)
6. One page extract: 1.1.1. Weight Distance Charges
7. Report on Study Tour to Australia/New Zealand 1 to 18 September 2002 (which includes options for recovering of road user costs from heavy vehicles).
8. Tasmania Trial Programme on MDCS, + 2000
9. AustRoads Intelligent Access Program (IAP)- Feasibility project, 2003

10. Technology evaluation for implementation of Vehicle Mass Travelled (VMT) based revenue collection systems (by the Department of Industrial and Manufacturing Engineering Oregon State University of November 2002)
11. Electronic vehicle intelligence (by iPico of October 2002)
12. Practice and experience with implementing transport pricing reform in heavy goods transport in Switzerland (by Federal Office for Spatial Development, Switzerland) October 2003
13. The distance-related Heavy Vehicle Fee (HVF) in Switzerland (by Federal Office for Spatial Development, Switzerland) October 2003

3.6.1 Definition of sub-options

For MDC OPTION 2, three sub-options were considered, based on technologies available. These are briefly described in Table 3-10.

Table 3-10: MDC Option 2 - Sub-options

Sub-options	Description
Sub-option 2.1	*Hub odometer:* This option entails the installation of a hub odometer to monitor the actual kilometres travelled by the vehicle.
Sub-option 2.2	*Transponders / Route tracers / Electronic Number Plates:* In this solution, a transponder / route tracer is installed in the vehicle. Signposts are erected along the road network. When the vehicle passes a signpost, the event is registered in the transponder / route tracer. The information is later communicated to a database, where the distance travelled can be calculated.
Sub-option 2.3	*GPS-based with GSM/RF technology:* GPS-based technology consists of a unit installed in a vehicle. This unit uses satellites to determine its coordinates. By utilising a GIS component within the unit, the distance travelled is calculated and this distance is communicated to the central database.

The three sub-options are discussed in more detail below in terms of the following:

- General
- Simplicity;
- Reliability and Accuracy;
- Enforcement; and
- Costs (refer to Annexure C for a more detailed discussion on the assumptions made to arrive at the costs estimates)
    - Mobilisation cost: the initial set-up cost, including hardware, software and facilities to provide the basic infrastructure.
    - Implementation costs: the additional set-up cost for both options.
    - Operational costs: the day-to-day administration and management of the MDCS, the continual cost to be incurred to keep the system running.
    - Enforcement cost: staff, training and support systems.

3.6.1.1 Sub-option 2.1: Hub odometer

3.6.1.1.1 General

The readings on the hub odometer are used to calculate the actual distance travelled. The operator purchases a licence for a set distance. The start and end readings are printed on the licence to enable verification by inspectors. A diagrammatic presentation of the working of this sub-option is shown in Figure 3-2.

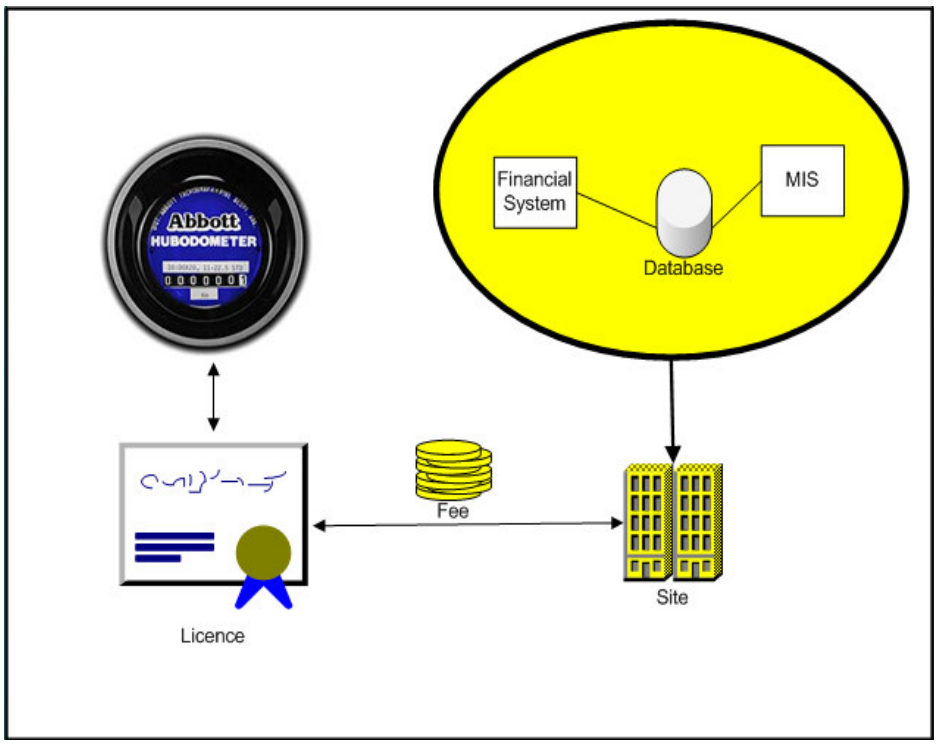

Figure 3-2: Working of Sub-option 2.1

3.6.1.1.2 Simplicity

Hub-odometer systems were replaced in other countries (such as Australia) by either an annual licence fee or an electronic system. Evasion and tampering is more difficult with more technologically advanced hub-odometers. However, enforcement still remains complex.

If hub odometers are to be used in Namibia, the following guidelines need to be applied:

- All hub odometers must be approved. A list of approved hub odometers must be published.
- The hub odometers must each have a unique serial number regardless of the brand.
- The hub odometer serial numbers must be easy to read.
- A register of all possible hub odometer serial numbers in Namibia must be kept.
- The hub odometer must be tamper-evident.
- There must be regulations with regards to the fitment of the hub odometers.

3.6.1.1.3 Reliability and Accuracy

Tampering with the hub-odometer is fairly easy, and therefore the system is not very reliable. However, the technology used in the hub odometers changed dramatically

during the past decade. The new hub-odometers are increasingly tamper-resistant. The digital hub-odometers are difficult or impossible to reset. Some vehicles also have mileage data recorded in the engine computers that can be checked to verify the hub-odometer readings.

3.6.1.1.4 Enforcement

Enforcement would include the following:

- Check the hub odometer for indications of tampering
- On older vehicles a small seal needs to be attached to the ends of the mechanical hub-odometer cable to be able to see if the cable has been disconnected. This is not necessary on newer vehicles with digital hub-odometers integrated with the engine computer.
- The tyres must be checked for the correct sizes since an incorrect tyre size can influence the hub-odometer readings.
- Check that the issued license is correct with regards to the mass of the vehicle.

The use of hub-odometers has been discontinued in other countries due to complex enforcement requirements (as indicated above) which makes the system more conducive to evasion.

3.6.1.1.5 Costs

3.6.1.1.5.1 Mobilisation cost

The mobilisation costs of sub-option 2.1 are indicated in Table 3-11.

Table 3-11: Mobilisation Costs - Sub-option 2.1

Item	Unit Cost	#	Total	Annual cost
Computer hardware infrastructure and furniture			N$270,000	N$54,000
Office facilities	N$70	49 m²	N$3,430	N$172
3rd party software				
- Windows (for 2 servers and 3 workstations)			N$21,000	N$7,000
- SQL Server			N$21,000	N$7,000
Customised MDCS software			N$400,000	N$133,333
Consumables			N$5,000	N$5,000
Communication lines			N$1,500	N$75
Total			**N$721,930**	**N$206,580**

3.6.1.1.5.2 Implementation costs

This includes the hub-odometers to be installed in the vehicles.

It is understood that the RFA will not be responsible for these costs. The owners of the heavy vehicles will have to pay for the hub-odometer and the installation.

The installation of hub-odometers is estimated at N$ 600 per hub-odometer. For the 17 945 heavy vehicles (self-propelled and trailers/semi-trailers) the once-off costs thus amount to N$ 10.767 million. If a depreciation period of 5 years is assumed the costs amount to N$ 2.153 million per annum.

3.6.1.1.5.3 Operational costs

The operational costs of sub-option 2.1 are indicated in Table 3-12.

Table 3-12: Operational costs- Sub-Option 2.1

Item	Unit Cost	#	Total	Annual Cost
Human resources				
- Operational Manager	N$8,000	1	N$8,000	N$96,000
- MDCS Officer	N$5,000	2	N$10,000	N$120,000
- Hub-odometer technician	N$5,000	2	N$10,000	N$120,000
Hardware infrastructure and furniture			N$4,050	N$48,600
Office facilities	N$70	49 m²	N$3,430	N$41,160
3rd party software				
- Windows (for 2 servers and 3 workstations)			N$208	N$2,496
- SQL Server			N$210	N$2,520
Customised MDCS software			N$6,666	N$79,992
Consumables			N$5,000	N$60,000
Communication lines			N$5,000	N$60,000
Other equipment				
- Fax/photocopy combo			N$2,000	N$24,000
Total			N$54,564	N$654,768

3.6.1.1.5.4 Enforcement cost

Based on discussions with the road traffic inspectorate of the Roads Authority, it is assumed that an additional ten inspectors will be needed. The average total annual cost per inspector is N$133 000. The total annual cost for ten inspectors will be ***N$1 330 000***. This amount applies to all sub-options.

3.6.1.1.5.5 Cost Summary

A summary of the costs for sub-option 2.1 is shown in Table 3-13.

Table 3-13: Cost Summary – Sub-option 2.1

Cost element	Annual
Mobilisation cost	N$206,580
Implementation cost	N$0
Operational cost	N$654,768
Enforcement cost	N$1,333,000
TOTAL (RFA)	**N$2,194,348**
Cost of Hub-odometers (Vehicle owners)	N$2,153,400
TOTAL (RFA + Vehicle Owners)	**N$4,347,748**

3.6.1.2 Sub-option 2.2: Transponders / Route tracers / Electronic Number Plates

3.6.1.2.1 General

Transponder technology provides an area and street positioning within a network of signposts. This means that signposts are erected at set intervals along all possible routes. The density of this network (i.e. the distance between the signposts) determines the accuracy of the trip information. When a vehicle passes a signpost, the communication unit (transponder / route tracer) registers the event. The event is then transmitted to the data logger via radio communication. This transmission is performed each time the vehicle enters the identified premises.

The data logger transfers the data to the database (running on a workstation) at the identified premises. From here the data can be emailed or transmitted via other electronic communication to the MDC Centre. In the MDC centre, the data can be utilised by any of the following software:

- Monitoring and reporting
- MIS
- GIS
- Financial system.

Transponder technology is actually a post-trip monitoring system which provides details of the route taken by a vehicle and date/time data on its positioning along the route. GPS co-ordinates can be linked to the various signposts to enable linking of the downloaded data to GIS.

The transponder solution consists of the following components:

- Transponder / route tracer unit
- Data logger
- Workstation
- Software
- Communication system.

Figure 3-3 shows the interaction between the various components.

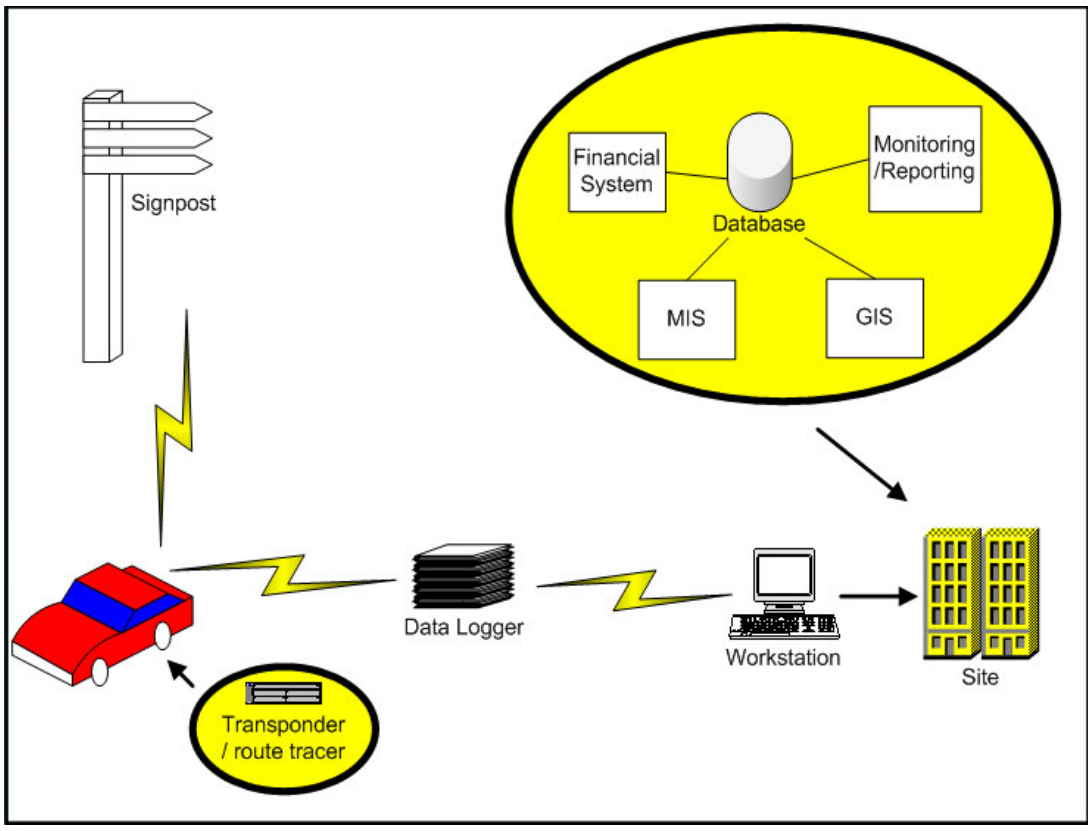

Figure 3-3: Working of Sub-option 2.2

3.6.1.2.2 Simplicity

The implementation of this sub-option is fairly complex and time consuming, as signposts need to be erected along the road network of Namibia as well as various sites with data loggers. An update of technology would require the update, servicing and replacement of each hardware and/or software item.

3.6.1.2.3 Reliability and Accuracy

The reliability of the system is influenced by the following:

- If there are no signposts in a specific area, there will be no reference to any trip undertaken in that area.
- The vehicle must pass within a specific distance from the signpost for the transponder / route tracer to register the event.
- The vehicle must also be within a certain distance of the data logger to enable the downloading / transmission of the events registered by the transponder / route tracer.

The accuracy is influenced by:

- Density of signposts in the network. Windhoek alone has a signpost network consisting of approximately 130 signposts. This provides very accurate data. It

would however not be feasible to implement the same density on a countrywide basis.

- The solution can be enhanced to enable linking to GIS. This means that the roads travelled on can be determined and the actual distance travelled can be estimated fairly accurate. Again, this depends on the density of the signpost network.

3.6.1.2.4 Enforcement

The following need to be checked regularly:

- System operational: The transponder / route tracer must be installed where it cannot be damaged. The communication must be tested regularly from the MDC centre. The only way of achieving this would be by monitoring the data received from the vehicles. If no data was transmitted for a certain period, it must be investigated. Data must also be transmitted at least once a month.
- Payment profile: Invoices will be issued by the MDC agent. The vehicle owner needs to pay within a certain period. If there are problems with outstanding payments, the vehicle may be impounded.
- System installation: A transponder / route tracer must be installed in every heavy vehicle. A written warning need to be issued to the owner if there is no installed communication unit. Enforcement would also include following-up on these cases.
- As with the previous sub-option, it must be verified that the issued license corresponds to the mass of the vehicle.

3.6.1.2.5 Costs

3.6.1.2.5.1 Mobilisation cost

Table 3-14: Mobilisation cost – Sub-option 2.2

Item	Unit Cost	#	Total	Annual cost
Computer hardware infrastructure and furniture			N$304,900	N$60,980
Office facilities	N$70	67 m²	N$4,690	N$235
3rd party software				
- Windows (for 2 servers and 3 workstations)			N$21,000	N$7,000
- SQL Server			N$21,000	N$7,000
Customised MDCS software			N$400,000	N$133,333
Consumables			N$5,000	N$5,000
Communication lines			N$1,500	N$75
Total			**N$758,090**	**N$213,623**

3.6.1.2.5.2 Implementation costs

This includes the transponders to be installed in the vehicles, as well as the data loggers to retrieve the data from the transponders / route tracers and the sign posts along the road.

It is our understanding that the RFA will not be responsible for the cost of the transponders. The owners of the heavy vehicles will have to pay for the transponder and the installation. The costs of a transponder is estimated at N$ 995 thus amounting to a total cost of N$17.855 million (for all heavy vehicles) or an annual cost of N$ 3.571 million (if a depreciation period of 5 years is assumed).

The costs of the signposts and data loggers however need to be borne by the RFA, and are indicated in Table 3-15.

Table 3-15: Implementation Costs – Sub-option 2.2

Item	Unit Cost	#	Total	Annual Cost
Sign post	400	550	220000	44000
Data logger	3500	15	52500	10500
Total			**N$272,500**	**N$54,500**

Note: Assume sign post every 10 kilometres.

3.6.1.2.5.3 Operational costs

The operational costs for sub-option 2.2 are indicated in Table 3-16.

Table 3-16: Operational costs - Sub-option 2.2

Item	Unit Cost	#	Total	Annual Cost
Human resources				
- Operational Manager	N$8,000	1	N$8,000	N$96,000
- MDCS Officer	N$5,000	2	N$10,000	N$120,000
- Transponder technician	N$5,000	2	N$10,000	N$120,000
- Control room office	N$5,000	2	N$10,000	N$120,000
Hardware infrastructure and furniture			N$4,650	N$55,800
Office facilities	N$70	67 m²	N$4,690	N$56,280
3rd party software				
- Windows (for 2 servers and 3 workstations)			N$208	N$2,496
- SQL Server			N$210	N$2,520
Customised MDCS software			N$6,666	N$79,992
Consumables			N$5,000	N$60,000
Communication lines			N$5,000	N$60,000
Other equipment				
- Fax/photocopy combo			N$2,000	N$24,000
Total			N$66,424	N$797,088

3.6.1.2.5.4 Enforcement cost

The enforcement costs are the same as for sub-option 2.1.

3.6.1.2.5.5 Cost Summary

A summary of the costs for sub-option 2.2 is shown in Table 3-17.

Table 3-17: Cost Summary – Sub-option 2.2

Cost element	Annual
Mobilisation cost	N$213,623
Implementation cost	N$230,500
Operational cost	N$797,088
Enforcement cost	N$1,333,000
TOTAL (RFA)	**N$2,574,211**
Cost of Transponders (Vehicle Owners)	N$3,571,055
TOTAL (RFA + Vehicle Owners)	**N$6,145,266**

3.6.1.3 Sub-option 2.3: GPS-based with GSM/RF technology

3.6.1.3.1 General

GPS-based monitoring consists of the following components:

- An In Vehicle Unit (IVU) with a GIS component
- Global Positioning Satellite
- Communication system
- Software.

The interaction of these components is illustrated in Figure 3-4.

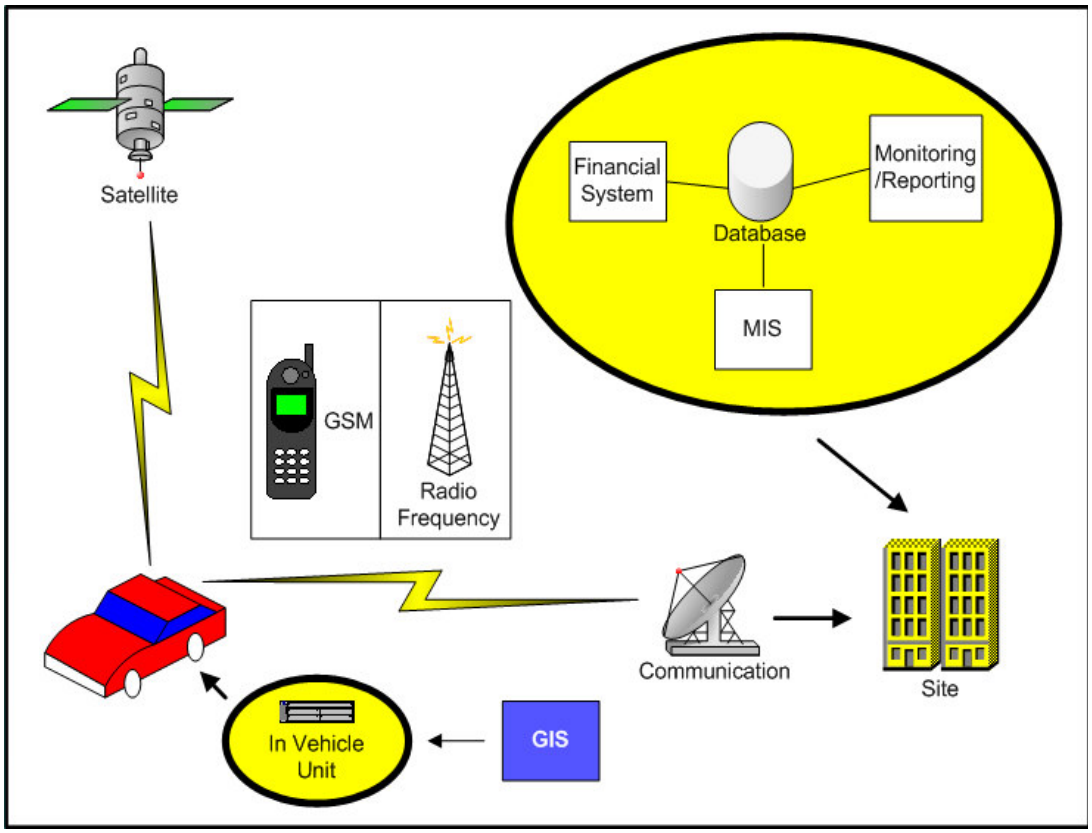

Figure 3-4: Working of Sub-option 2.3

The satellite is used to determine the exact location of the vehicle. The IVU (in vehicle unit) has memory and computing power to store information. In most instances the IVU stores the GPS coordinates, along with a date-and-time stamp for each. The intervals for the recording of GPS coordinates can be set. More accurate trip distances can be calculated with short intervals. The default interval is 5 minutes.

Since only the actual travelled distance is required for the calculation of the MDC fee, the normal functionality within the IVU can be customised. The customisation will enable the IVU to act as a virtual odometer by utilising waypoints. The waypoints can be programmed into the IVU with a GIS related application.

The IVU will thus be able to calculate the distance travelled by each vehicle. The distance will be measured by counting the number of passes made through waypoints stored on the IVU. These waypoints will be placed at every few kilometres on the road network. This could mean a slight increase in cost per unit, but will result in much lower transmission costs and information privacy will be guaranteed.

The data stored in the IVU can be communicated to the MDC Centre using either the GSM network (MTC) or radio frequency.

Another customisation will be the issuing of each IVU with a secure RFID tag. This tag will be used to securely identify each vehicle during data uploads and during routine inspections. Each data transaction will be encoded by the IVU and decoded by the central server.

The GSM network expanded since the study done by BG Consulting, and currently most of the main routes in Namibia are covered. There are however still huge areas with no GSM network coverage. This problem can be solved by ensuring that the IVU has sufficient memory capacity to store data for two weeks to one month. Figure 3-5 illustrates the GSM coverage in Namibia.

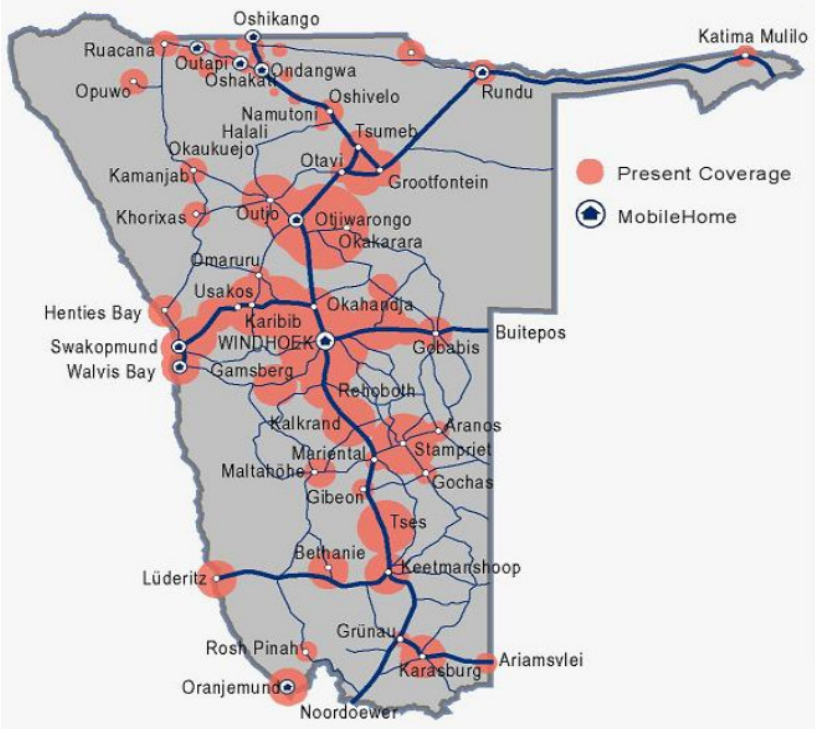

Figure 3-5: GSM coverage in Namibia

Currently Namibia does not have extensive radio trunking networks providing for data and voice communication between vehicles and central servers.

Once the data has been transmitted to the database at the MDC Centre, the integrated software packages can perform the necessary actions to extract the required information. The software packages will consist of a financial system, MIS and Monitoring/Reporting.

3.6.1.3.2 Simplicity

The technology is current and used in similar systems such as tracking as well as call and dispatch systems. GPS based tracking systems with GSM communication are actively used in Namibia.

3.6.1.3.3 Reliability and Accuracy

A GPS receiver collects data from between five to eight satellites at any time from any point on earth. This data is used to calculate the exact position of the GPS receiver at any given date and time. The calculated positions are accurate to below 20 metres.

Reliability is the ability to produce the same results for the same travel pattern. GPS system accuracy, signal loss and reacquisition, and initial signal acquisition are factors affecting the reliability. Signal loss and increased time to acquire a signal can be caused by obstructions like mountainous terrain, rain and clouds, and tall buildings and trees. Namibia is however the driest land south of the Sahara with an annual rainfall of below 250mm. The country also has two deserts – Namib Desert along the coast and the Kalahari Desert in the east. The factors affecting the reliability therefore do not really exist in Namibia. We can thus assume a high reliability.

3.6.1.3.4 Enforcement

The following need to be checked regularly:

- System operational: The GPS antenna must be installed where it cannot be damaged. Enforcement would mean verifying that the antenna is not covered. The communication unit must be connected and tested regularly from the MDC centre. Data must also be transferred at least once a month.
- Payment profile: Invoices will be issued by the MDC agent. The vehicle owner needs to pay within a certain period. If there are problems with outstanding payments, the vehicle may be impounded.
- System installation: A system must be installed in every heavy vehicle. A written warning need to be issued to the owner if there is no installed unit. Enforcement would also include following-up on these cases.
- Since every IVU will have a unique RFID tag associated with it, it will be possible to confirm that the IVU has not been removed from vehicle where it was originally installed. This can also be checked or verified by enforcement officers.
- As with the previous sub-options, it must be verified that the issued license is correct with regards to the mass of the vehicle.

3.6.1.3.5 Confidentiality of information

It could be feasible to calculate the distance travelled by the vehicle directly on the IVU using it as a “virtual odometer”. The distance will be calculated by counting the number of passes made through waypoints. These waypoints will be placed at every few

kilometres on the network. This will mean a slight increase in cost per unit, but will result in much lower transmission costs and information privacy will be guaranteed.

3.6.1.3.6 Costs

3.6.1.3.6.1 Mobilisation cost

The mobilisation costs for sub-option 2.3 are indicated in Table 3-18.

Table 3-18: Mobilisation cost – Sub-option 2.3

Item	Unit Cost	#	Total	Annual cost
Computer hardware infrastructure and furniture			N$304,900	N$60,980
Office facilities	N$70	67 m²	N$4,690	N$235
3rd party software				
- Windows (for 2 servers and 3 workstations)			N$21,000	N$7,000
- SQL Server			N$21,000	N$7,000
Customised MDCS software			N$600,000	N$200,000
Consumables			N$5,000	N$5,000
Communication lines			N$1,500	N$75
Total			**N$958,090**	**N$280,290**

3.6.1.3.6.2 Implementation costs

It is our understanding that the RFA will not be responsible for these costs. The owners of the heavy vehicles will have to pay for the IVUs and the installation. The cost estimate for one IVU is N$ 6 300, and the costs for the installation of IVUs for all heavy vehicles amounts to N$113 053 500. The annual cost amounts to N$22 610 700 if a depreciation period of five years is assumed.

3.6.1.3.6.3 Operational costs

The operational costs for sub-option 2.3 are indicated in Table 3-19.

Table 3-19: Operational costs – Sub-option 2.3

Item	Unit Cost	#	Total	Annual Cost
Human resources				
- Operational Manager	N$8,000	1	N$8,000	N$96,000
- MDCS Officer	N$5,000	2	N$10,000	N$120,000
- IVU technician	N$5,000	2	N$10,000	N$120,000
- Control room office	N$5,000	2	N$10,000	N$120,000
Hardware infrastructure and furniture			N$4,650	N$55,800
Office facilities	N$70	67 m²	N$4,690	N$56,280

Item	Unit Cost	#	Total	Annual Cost
3rd party software				
- Windows (for 2 servers and 3 workstations)			N$208	N$2,496
- SQL Server			N$210	N$2,520
Customised MDCS software			N$8,000	N$96,000
Consumables			N$5,000	N$60,000
Communication lines			N$5,000	N$60,000
Other equipment				
- Fax/photocopy combo			N$2,000	N$24,000
Total			N$67,758	N$813,096

3.6.1.3.6.4 Enforcement cost

The enforcement costs are the same as for sub-options 2.1 and 2.2.

3.6.1.3.6.5 Cost Summary

A summary of the costs for sub-option 2.3 is shown in Table 3-20.

Table 3-20: Cost summary – Sub-option 2.3

Cost element	Annual
Mobilisation cost	N$280,290
Implementation cost	N$0
Operational cost	N$813,096
Enforcement cost	N$1,333,000
TOTAL	**N$2,426,386**
Cost of IVUs (Vehicle Owners)	N$22,610,700
TOTAL (RFA + Vehicle Owners)	**N$25,037,086**

3.6.2 Evaluation of sub-options

The purpose of this sub-section is to assess the suitability of each sub-option in terms of the following criteria:

- Simplicity;
- Reliability and Accuracy; and
- Enforcement.

The scores are on a scale of 1 to 4. A score of 1 indicates the poorest performance, whereas a score of 4 is the best performance. This is performed in Table 3-21.

Table 3-21: Summary of sub-option evaluation

Sub-Options	Simplicity	Reliability and Accuracy	Enforcement	Total Score
2.1.	3	1	1	5
2.2.	2	2	1	5
2.3.	4	4	3	11

From Table 3-21, it is evident that sub-option 2.3 receives the highest overall score or ranking.

In summary the following can be stated regarding the various sub-options:

- Sub-option 2.1: The hub odometer option is now more feasible than a decade ago due to better technology being used for the odometers and the hub odometers.
- Sub-option 2.2: Although the concept of transponders / route tracers are being used in Namibia, the feasibility for a project with a large number of vehicles belonging to more than one owner is questionable. The biggest obstacles are the maintaining of the signpost network and the communication of the data from the various data loggers.
- Sub-option 2.3: The GPS-based option is the most reliable and accurate. Since this technology is used daily in Namibia by various companies, this sub-option is very feasible.

On the basis of the above, it is therefore recommended to implement sub-option 2.3 (GPS-based with GSM/RF technology).

It should however be noted that vehicle owners face the highest cost for this sub-option, as the necessary units to be fitted in the vehicles for this sub-option cost significantly more than for the other sub-options (i.e. the IVUs which are necessary for sub-option 2.3 cost N$6 300 per unit compared to the cost of the units for sub-options 2.1 and 2.2 of N$600 and N$995, respectively).

Therefore the RFA should consider to assist vehicle operators with the financing of the units, as the relatively more expensive IVUs necessary for sub-option 2.3 provide the RFA with the benefit of improved reliability and accuracy relative to the other sub-options. The RFA should also consider to entirely finance the fitment of IVUs, in order to minimise possible resistance from heavy vehicle operators. The costs can then be recovered again from heavy vehicle operators as part of the costs of administering the system.

4. CONCLUSIONS AND RECOMMENDATIONS

The purpose of this report was to provide the findings of the review of the MDC system. The review entailed a literature review, stakeholder consultation, possible implementation plan, and option development, cost estimates per option, criteria development and option evaluation.

The implementation of a MDCs will initially be based on a **assumed** annual travelling distance for each vehicle category (a so-called Flat Fee Approximation (FFA) MDC) as well as a parallel pilot project whereby the travelling distances are determined by means of a technological system.

The implementation of the FFA MDC will be done in two phases which are briefly as follows:

- Phase 1: for the first year of operation where the tare-based licence fees of those vehicle categories that should be subject to MDC be increased and collect GVM, axle configuration and fuel type data on these vehicles and officially enter these data into NaTIS.
- Phase 2: switch over from tare-based Phase 1 FFA MDC to GVM based Phase 2 FFA MDC in the second year of operation, using the GVM and axle configuration data captured in Phase 1. In parallel to Phase 2, a pilot project will be launched whereby the **actual** travelling distances are determined by means of a technological system. Based on the results of the pilot project, there will be a possible full-scale implementation of the technological system.

Three technological systems were investigated:

- Sub-option 2.1 Hub odometer: This option entails the installation of a hub odometer to monitor the actual kilometres travelled by the vehicle.
- Sub-option 2.2 Transponders / Route tracers / Electronic Number Plates: In this solution, a transponder / route tracer is installed in the vehicle. Signposts are erected along the road network. When the vehicle passes a signpost, the event is registered in the transponder / route tracer. The information is later communicated to a database, where the distance travelled can be calculated.
- Sub-option 2.3 GPS-based with GSM/RF technology: GPS-based technology consists of a unit installed in a vehicle. This unit uses satellites to determine its coordinates. By utilising a GIS component within the unit, the distance travelled is calculated and this distance is communicated to the central database.

For the technological system, it is recommended that sub-option 2.3: GPS-based with GSM/RF technology be implemented. The implementation of a full-scale technological solution is possible in Namibia. The management of the whole MDC system is however extremely important.

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ANNEXURE A

MDC Literature Review and Stakeholder Consultation

Introduction

The purpose of this Annexure is to review the current information available on mass-distance charges (MDCs) (or sometimes called weight-distance charges), with specific reference to Namibia.

Our approach to the review was as follows:

1. Literature review: A review was done of previous studies that were undertaken on the MDCs, with a focus on the extent / scope and cost of the systems considered, with the specific technology proposed.
2. Stakeholder consultation: Various stakeholders were consulted in order to obtain their views and opinions regarding the implementation of a MDCs.

Literature Review

Available documentation was scrutinised, taking into consideration the specific requirements of the study and the tasks as per the Terms of Reference. Documentation reviewed were:

1. Options for Weight - Distance Charges for Diesel Vehicles, Allan Kennaird, Sept. 1998
2. Feasibility study to utilise passive satellite technology to measure distances travelled by individual vehicles, BG Consulting, July 2001 (plus RFA comments)
3. Comments on RFA reports of June 2000 and July 2001: Implementation of a weight-distance charging system, W Ravenscroft, 2002
4. Exempting non-road users from paying the diesel levy, Ian Heggie, March 1999
5. Distance-Based Charges: A Practical Strategy for more Optical Vehicle Pricing (Tod Litman, Victoria Transport Policy Institute, 1999)
6. One page extract: 1.1.1. Weight Distance Charges
7. Report on Study Tour to Australia/New Zealand 1 to 18 September 2002 (which includes options for recovering of road user costs from heavy vehicles).
8. Tasmania Trial Programme on MDCS, + 2000
9. Austroads Intelligent Access Program (IAP)- Feasibility project, 2003

These are discussed in more detail below.

Options for Weight - Distance Charges for Diesel Vehicles, Allan Kennaird, Sept. 1998

This document was prepared as contribution for the establishment of the Road Fund Administration and Roads Authority. MDC is regarded as the third tier of road user charges after vehicle licence fees and fuel levies. Three MDC options were presented and evaluated:

- Option A: MDC for heavy diesel vehicles only plus a diesel levy with refund system
- Option B: MDC for all diesel vehicles, except for the “other” vehicle category (and no diesel levy & refund system)

- Option C: MDC for heavy diesel vehicles only (and no diesel levy & refund system). The variable costs of light diesel vehicles will be recovered in the form of licence fees.

The advantages and disadvantages of each option are summarised in the following table.

Option	Advantages	Disadvantages
A	1. Limited number of vehicles simplify administration and minimise costs; 2. Two instruments spreading the RFA revenue risk.	1. High refund rates provide incentive for fraud; 2. Refund system subject to legal challenge; 3. Increasing refunds require more staff; 4. Difficult to draw distinction between those qualifying and those not qualifying for refunds.
B	1. No need for refund of road user levy on diesel with big cost savings for RFA; 2. License fees for light diesel vehicles are kept low.	1. Additional 12,890 vehicles are added to the MDCs; 2. Diesel price would drop below that of adjacent countries, resulting in smuggling.
C	1. No need for refund of road user levy on diesel with big cost savings for RFA; 2. MDC can be limited to heavier vehicles.	1. Diesel price would drop below that of adjacent countries, resulting in smuggling. 2. License fees for light diesel vehicles would be very high.

Conclusions:

- A refunding system is costly and difficult to manage; difficult to distinguish between activities that qualify and those that do not qualify for refunds; only significant off road use should be refunded
- MDCs should be limited to heavier vehicles to minimise collection and administration costs
- Licence fees be increased for light diesel-powered vehicles
- It is recommended to start with Option A as a pilot project and then eventually move to implement Option C. The study concludes that only for Option C the overall advantages exceed its disadvantages.

Feasibility study to utilise passive satellite technology to measure distances travelled by individual vehicles, BG Consulting, July 2001 (plus RFA comments)

The RFA requested BG Consulting to investigate a MDC system using passive satellite technology (PST) in depth.

The five possible systems identified for transferring location data to the central server were:

a. Satellite technology (full coverage, but most expensive – N$45.8m implementation cost)
b. GSM (partial coverage and second cheapest - N$33.1m implementation cost)
c. Touch key system (partial coverage, cheapest (N$24m), but more open to evasion)

d. GMSS (not yet available in 2001)
e. Radio trunking (not yet available in 2001)

The feasibility study for the utilisation of PST to measure distances travelled by individual vehicles indicated that it is viable for implementation in Namibia. It indicated that a small sector, namely the truck transporting industry, was then not fully in favour of the introduction of MDC.

The Feasibility study highlighted the advantages and disadvantages of a MDC system and the shortcomings of the current charging instruments are listed. System requirements and technical solutions for a MDC system were also discussed in detail.

Conclusions:

- Satellite based MDCS is viable for implementation in Namibia.
- Initially start with installing technology on trucks only; trailers should also be fitted for improved equity.
- Various technical solutions are available at different costs. A pilot project need to be conducted to determine the feasibility of a specific solution – taking into account all the costs involved and the revenue generated. After the successful completion of the pilot project, a full implementation can commence following a phased approach.
- Various avoidance possibilities should be considered. Policing will be required to regularly check whether systems are installed, operational and whether payment is up to date.
- Since the study in 2000, various technology advances have taken place; The RFA feels that the technical solutions offered are too limited and more innovative options should be considered.
- The abolishing of diesel levies should be considered.
- The RFA regards the figures used not necessarily correct and that the costs indicated are possibly too optimistic.

Comments on RFA reports of June 2000 and July 2001: Implementation of a weight-distance charging system, W Ravenscroft, 2002

Although the RFA never approved this report, the report was reviewed for purposes of completeness. Shortcomings on the report as identified by the RFA include the following:

- concerns about assumptions
- lack of written and actual proof of successful implementation, as the outcome from pilot testing in Australia and USA was still pending
- no recommendations on technology to be employed for a MDC system

Possible MDC options that were compared are as follows:

1. No MDCS, but increase licence fees for heavy vehicles
2. No MDCS, but introduce a fixed Extra Heavy Fee (EHF)
3. MDCS using Hub odometer
4. MDCS using passive satellite technology (PST)

Conclusions:

- 3900 very heavy vehicles qualify to be included in a MDCS (assuming foreign registered vehicles excluded); definition of very heavy vehicles to be determined
- Foreign registered heavy vehicles will be liable for MDC through the CBC system
- The use of passive satellite technology shows a distinct advantage compared to the use of hub odometers
- A MDCS using passive satellite technology is viable; A pilot study was proposed to resolve some of the details
- Technology considered included the installation of GPS receiver and antenna in each vehicle; downloading of data can be done either via satellite links, cell phone links, by radio trunking links or manually by touch keys; The preferred option was cell phone technology.
- Passive satellite technology has not yet been proven tamper proof; the evasion potential is therefore not yet been determined
- A culture of conformance is a prerequisite for success
- Effective law enforcement and heavy fines should be implemented
- Diesel fuel levies should be reconsidered after MDCS implementation
- Implementation of a MDCS should be phased in, starting perhaps with a simple system using no devices, but based on mass category and average annual travelling distances
- A consultant should be appointed to review the RUC System. A final comprehensive report on the introduction of a MDCS with a TOR be completed

In our opinion the four options which were evaluated can be reduced to three, as option 1 and 2 are essentially the same.

Exempting non-road users from paying the diesel levy, Ian Heggie, March 1999

This document discusses six ways in which different countries attempt to ensure that non-road users do not have to pay the fuel levy destined for a road fund. MDCS is one option. The other ways are exemptions, colouring of un-taxed diesel, reimbursing or compensating non-road users. The only MDCs then available, as used in New Zealand and Iceland, was the use of sealed hub odometers. Licences were issued in multiples of 1,000 km. Evasion can take place through understating mass and tampering with the odometer. In New Zeeland it was found that collection and enforcement absorb 3.2 and 2.0 percent respectively of gross revenues with evasion of 12% and legal avoidance of 7% of net revenues. This system only works effectively with good administration and vigorous enforcement. New Zeeland was then piloting its GPS/GIS-based MDCs.

Conclusions:
MDC using hub odometers is difficult to administer.

- There is considerable scope for evasion – by understating vehicle weight or tampering with the meter
- The odometer system is now generally regarded as outdated; Heggie recommended waiting for the outcome of pilot electronic / technology MDC systems before introducing MDC.

Distance-Based Charges: A Practical Strategy for more Optical Vehicle Pricing (Tod Litman, Victoria Transport Policy Institute, 1999)

This paper promotes the use of odometer audits. These audits are performed when a vehicle's licence and insurance are annually renewed. It records odometer readings, checks the speedometer for any tampering, accuracy and correct tyre size. This system does not distinguish between the different types of roads and does not indicate location or time of day.

Conclusions:

- Distance-based fees are the best way to charge for many costs imposed by vehicles, including road use, insurance, pollution emissions and other environmental impacts.
- Distance-based charging, using odometers, are feasible and relatively inexpensive.

One page extract: 1.1.1. Weight Distance Charges

This report list some advantages and disadvantages of using the hub odometer as measuring and controlling instrument for weight-distance charging. The hub odometer has been implemented in New Zealand with some success, but various questions are raised with regard to the administration and enforceability. The hub odometer is a special device attached and sealed unto the hub of a heavy vehicle which measures the distance the vehicle travels. The operator of a heavy vehicle then purchase a licence base on its actual weight and an estimated distance it will travel. Traffic inspectors then have to check that the reading on the hub odometer does not exceed the value authorised in the licence.

Conclusions:

Concerns or disadvantages of the hub odometer include:

- Whether the levy justifies the additional costs for both the government and the vehicle operators.
- A number of auditors, inspectors and traffic law enforcement agents have to be employed and regular inspections have to be made to make it work
- Hub odometers have to be fitted on all heavy vehicles (this will pose a problem for Namibia with many vehicles entering from neighbouring countries).
- An additional licensing system has to be set up.
- Tampering is still possible.

Report on Study Tour to Australia/New Zealand 1 to 18 September 2002 (which includes options for recovering of road user costs from heavy vehicles).

A study tour to Australia and New Zealand was undertaken during September 2002. Based on the various visits, options identified for Namibia were:

1. No MDCs, but increase in licence fees for heavy vehicles
2. No MDCs, but introduce a fixed extra heavy fee

3. MDCs using hub odometers
4. MDCs using GPS and PST

In our opinion Options 1 and 2 are essentially the same.

Conclusions:

- There is a clear trend towards the use of electronic monitoring and payment systems, although not widely applied, especially not for MDC; research worldwide is ongoing
- A system should be appropriate for Namibian conditions – in terms of sophistication, complexity, acceptability manageability and affordability
- An optimal balance amongst equity, cost and evasion losses should be found for Namibia
- A simple MDCS based on vehicle mass categories and average annual travelling distances, without any devices, should be considered as a first step towards MDC
- Uniform standards to ensure interoperability of electronic RUC systems, e.g. with SADC countries is important. A pilot project will therefore be valuable for all SADC countries
- Namibia should register its pilot project with the appropriate SADC technical committee to access donor funds
- How to deal with foreign registered vehicles have not been clearly addressed in this report.

Tasmania Trial Programme on MDCS, + 2000

The National Road Transport Commission (NRTC) in Australia is supporting a trial programme on using GPS technology to monitor truck travel for charging purposes. This programme was led by the Tasmanian Department of Transport. GPS with load cells or related technology provided the basis for a possible future MDCs.

Conclusions:

- Valuable information was gained from this pilot project conducted by the Tasmanian Department of Transport. The problems they encountered were mainly hardware/technology related. A few of these problems are listed below:
- Modem Lockup
- DGPS Registration
- Multiple transmissions due to lack of coverage or bad signal
- Hardware lockup
- Disabled antennae
- Faulty antennae connectors
- Battery drain
- Since then, some of these issues have been solved by more modern technology. The other issues can also be resolved with the implementation of a full-scale project.
- The work done in Tasmania is a clear indication that the technology certainly exists to implement a passive satellite tracking system.

Namibia's GSM coverage is similar to that in Tasmania and can be overcome by sufficient memory in the units installed in the vehicles.
- The biggest problem, however, was not the technology, but the high costs involved.

Austroads Intelligent Access Program (IAP) - Feasibility project, 2003

Austroads is the association of Australian and New Zealand road transport and traffic authorities. Chris Koniditsiotis was the project manager of this study conducted from Sydney to determine the feasibility of using satellite based telematic services to monitor the location of freight vehicles in space and time and to monitor and report on compliance of vehicles with respect to access conditions or operating conditions set by jurisdictions. It is using vehicle tracking technologies to monitor the route compliance of heavy vehicles. The Technical Feasibility and Standards Sub-project tasks included identifying a range of possible technical and standards solutions (ranging from a government prescribed solution to an outcome-based solution), to develop benefit-cost profiles and assess the existing telematics market. Hyder Consulting was appointed in July 2002 to assist.

Conclusions:

- IAP is feasible
- Parameters tested are: vehicle and trailer identification, vehicle length, vehicle location, vehicle time, distance travelled, speed, mass, exhaust emissions, suspension temperature, driver identification and freight / consignment identification.
- For vehicle distance travelled, 100% accuracy can be achieved within a distance of 100m. The equipment cost per vehicle is AUD800 – AUD2 000 (approximately between N$4000 and N$10000 based on an exchange rate of AUD1 = N$5.0. Twenty service providers and 16 types of equipment were available in Australia and New Zeeland.
- It allows for differential charging for different pavement types, restricted roads and restricted hours
- Implementation should be phased in two stages with a stage 1 duration of 3-5 years
- Private sector service providers will be used with clear certification and auditing regime.

Stakeholder Consultation

Meetings were held with some role-players in the transport industry to obtain their inputs regarding the implementation of MDCs. The purpose was to obtain the general expectations and views to identify issues/concerns and to obtain information regarding technology that is appropriate and suitable for implementation of MDCs in local conditions.

The following table lists the institutions consulted.

INSTITUTION	CONTACT PERSON	MEETING DATE
Road Fund Administration	G Seydack	From Oct 2003
Blaauws Transport	D Blaauw	21 Oct 2003
Roads Authority	FW Poolman	22 Oct 2003
NETSTAR	H Jacobs	22 Oct 2003
Fischer Consulting	W Nel	5 Nov 2003
NamRoads / FP du Toit Transport	W du Toit	30 Jan 2004

Road Fund Administration

Mr Gunter Seydack was interviewed on 20 October 2003 and 29 January 2004. His views are presented below.

- It is required to reconcile the mass categories of NaTIS and CBC; possibly to standardise on CBC mass types.
- The RFA's goal is to pilot a MDC system and then to evaluate it thereafter for a six-month period.
- The MDCS will probably be of two main categories – a pilot project based on GPS / satellite technology and on a simplified / proxy MDCS.
- The technological options only incorporate heavy vehicles. The two main MDC options should be:

  "a license-type MDC system for immediate implementation, which will be the official system applying to all operators of heavy vehicles falling within the proposed classes, and a GPS-based pilot project running concurrently, which will allow participating operators to claim a refund on the MDC paid under the official system".

- There should be an incentive, such as a discount on licence fees or lower MDC rates, by purchasing the required devices/technology for their vehicles to participate in the pilot technology MDC project.
- A flat fee approximation (FFA) MDC, based on estimated distances, for the remainder of heavy vehicles is proposed. On what these estimates will be based, should be investigated.
- Tender documentation for the technology and FFA options should be delayed until the options are formally approved.

Blaauws Transport

Mr Deon Blaauw was interviewed on 21 October 2003. His views are presented below.

- Blaauws Transport accepted the MDC concept in principle.
- Blaauws Transport already installed GPS-based technology in most of their heavy vehicles to track them, mostly for safety reasons, and to determine distances travelled.
- The truck industry should be formally consulted at a later stage.
- The technology option should be as simple, tamper-proof and compatible as possible to accommodate the various existing technologies.

FP du Toit Transport / NamRoad

Mr Willie du Toit was interviewed on 30 January 2004. He is also chairman of NamRoads. His views are presented below.

- The implementation of a complex system such as a MDC system should be viewed with caution, as Namibia is a developing country. A road user charges system for Namibia should be as simple and efficient as possible, preferably limiting road user charges to licence fees and fuel levies only.
- Even satellite tracking devices are not entirely foolproof and accurate.
- The administration of a MDC system will not be easy, as even licence fees are currently not properly administered in Namibia
- It should be kept in mind that with any licence-fee style charge (including MDC) charges for trailers or semi-trailers should be kept to a minimum (as these are often specialised trailers and are not used as extensively as the power units), and that the majority of costs should rather be recovered from the power units and not from the trailers or semi-trailers.

Roads Authority

Mr FW Poolman was interviewed on 22 October 2003. His views are recorded below.

- MDC should be implemented, but 1 April 2004 may be too soon for all the required preparation work.
- He proposes that say 500 domestic heavy vehicles (say 5 axles and more) be included in a pilot project – 250 using GPS and 250 using route tracers / transponders. Both technologies should be tested.
- Construction vehicles may require a different system than the commercial truck operators, as they often move in short distances in the same location, often out of reach of GPS or route tracers.
- An incentive for using the technology should be offered, e.g. a discount on licence fees.
- The technology /system should be regularly tested and audited.
- The penalty for non-compliance should be heavy.
- Payment should preferably be in advance. If in arrears, monthly payments should be required. This will be a challenge to collect debts.
- He noted that the current licence fee includes a distance variable, as determined by the NAMRUC model.
- When MDC is introduced, how will the user get a discount on other RUC's? – reduce licence fees, reduce fuel levies or introduce a fuel rebate/refund?
- The VAT implications should be clarified. Fuel is zero rated. What will be the VAT regime on MDC?

NETSTAR

Mr Hannes Jacobs from NETSTAR was interviewed on 22 October 2003. He had previous discussions with Ben Gericke of BG Consulting.

- His personal proposal was to use route tracers in vehicles (N$995) and beacons (N$400 each) along roads radio signalling to data loggers (N$3500 per 100 vehicles)
- This system does not make use of satellite technology or GPS
- It is relatively cheap and tamper / evasion proof
- There are currently various beacons on all major routes in Namibia; Windhoek alone has 130 beacons installed.
- Travel data (distances) can be e-mailed from NETSTAR to a MDC office.

NATIS / Fischer Consulting

Electronic communication with Mr Werner Nel (Fischer Consulting) on 5 November 2003 revealed the following:

- · NaTIS will install the latest (and last official) release of NaTIS early 2004. This release has already been finalised and only contains minor system enhancements - no major changes are accommodated in this release. No changes in NaTIS can be included in the normal releases as provided for free of charge under the current agreement between South Africa and SADC concerning NaTIS software. It will however be technically possible to change the NaTIS for Namibian specific requirements, but by taking aspects such as the following into consideration:
    - The software contractor responsible for the development of the current NaTIS does not know when the Department of Transport in South Africa (SA) will terminate the project, or at least scale down considerably, as the latest release is now being implemented. This will leave them with no personnel to effect the changes. NaTIS submitted a proposal to MWTC in 1998 for the inclusion of the MDCS as a module of NaTIS. It was then estimated that the project would take 12 months to complete at a total estimated cost of approximately N$1,000,000.
    - The cost aspects – Africon's recommendations on RUC's may only be approved during 2004. The updating of NaTIS may only be completed in 2005. The functionality of the old NaTIS could therefore be available for 6 -12 months until the new NaTIS is implemented, where after one will again have to pay for changing the new NaTIS to accommodate a MDCS. The cost would not be justifiable for the advantage gained of having the MDCS for such a short period. Only an in depth investigation, taking all factors into consideration, such as the income that will be derived for operating the system during that time, will determine its viability.
    - One will have to investigate the different options available, i.e. the cost of changing the current NaTIS and then again the new NaTIS as opposed to having a totally new stand-alone system, or possible other solutions that may be viable, such as the incorporation of the MDCS in the system proposed by the RFA for implementation at a traffic authority level.
    - At this stage it is difficult to say when exactly the new NaTIS is going to be implemented in Namibia, but currently SA is aiming for early 2005. One would like to make sure that all the initial implementation problems

are sorted out in SA before implementing the system in Namibia. Additionally, the customisation of the new NaTIS has to be done to suit the Namibian needs (i.e. change in some of the functionality that was done on the old NaTIS to be reflected in the new NaTIS, such as the Namibian numbering system, etc).

- It may be possible to combine the changes required for a MDCS and incorporate them at this early stage before NaTIS upgrading. Its feasible or viable is unknown. Mr Nel suggested that one should only do such a study once the MDCS recommendations have been presented in more detail.
- Payment considerations - currently there is only an annual licensing transaction for each vehicle (excluding when more than one change of ownership was done during a year). Should payments / renewals be done more than once per annum, it will require more resources (more stationery, more licensing officers, etc.), as the number of transaction performed on the system will significantly increase. One would then have to consider a fixed transaction fee plus the variable licensing fee for the specific vehicle type / mass and period of time, etc.

Road Traffic Inspectorate of the Roads Authority

In a discussion with Mr Lutombi, head of the road traffic inspectorate of the Roads Authority, on 23 February 2004, he commented as follows:

- Currently 40 inspectors are employed;
- The average total annual cost per inspector is N$133 000;
- With a MDCS, a further 5 to 10 inspectors may be required;
- They have the authoritative powers of equivalent to that of traffic officers;
- The inspectors mainly operate from the weigh bridges, where all heavy vehicles from CBC type 4 or 6 are required to stop; Their focus is currently on commercial heavy vehicles;
- They only visit border posts from time to time; road blocks are also sporadic events.
- Their role and presence could be expanded, should RFA formally approach the RA in this regard.

ANNEXURE B

Methodology for the determination of the Levels of the interim MDCs for Heavy Vehicles and the Determination of CBC Levels

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1 Introduction

For the financial year 2005/2006 the Road Fund Administration of Namibia (RFA) needs to obtain additional funds of N$ 245 million. N$ 100 million will be financed from loan stock while N$ 145 million need to be raised through Road User Charges (RUCs).

It is currently not possible to recover the N$ 145 million in the form of increased fuel levies or licence fees for various reasons, including sensitivity regarding an increase in the fuel price in Namibia. The N$145 million therefore needs to be recovered from heavy vehicles in the form of mass-distance charges (MDCs).

Enabling legislation is not yet in place. This as well as other as other constraints, imply that MDCs cannot be implemented with immediate effect. In order to raise the N$145 million the following needs to be taken into consideration:

- To avoid the need for enabling legislation, the MDCs should be in the form of fixed annual fees to be added on top of the fixed annual vehicle licence fee.
- To be compatible with NaTIS, the MDCs should be recovered per tare weight group for self-propelled vehicles as well as trailers and semi-trailers.

Furthermore, the RFA expressed the need to increase the cross-border charges.

The objective of this document is therefore to provide the methodology that was used to arrive at the levels of the fixed annual MDCs as well as the CBCs.

In order to address the above objective, this document is structured as follows:

- Section 1 (this section) provides the background and introduction.
- Section 2 presents the methodology that was used to arrive at the levels of the fixed annual MDCs as well as the CBCs.
- Section 3 presents the resulting levels of the fixed annual MDCs and CBCs.
- Section 4 concludes this document.

2 Methodology

The methodology is presented separately for MDCs and CBCs, and is discussed in more detail below.

2.1 MDC Methodology

In order to determine the level of MDCs to be recovered from heavy vehicles, the following broad methodology was applied:

- The NaTIS database containing details on the heavy vehicle classes (classes C: Heavy Passenger Motor vehicles (12 or more persons), L: Heavy Load Vehicles (GVM>3500kg, not to draw), M: Heavy Load Vehicles (GVM>3500kg, equipped to draw) was obtained and used. The database consists of a total of 17 945 class C, L and M vehicles.
- As per the Namibia Road User Charges (NAMRUC) Cost Allocation Methodology, the N$145 million was split into vehicle, axle, passenger car

equivalent (PCE) and equivalent standard axles (ESA) related costs. These costs were allocated on the basis of vehicle kilometres traveled (VKT), Axle-km, PCE-km and ESA-km respectively. The applied split of the different costs is as follows:

- Vehicle related 66.50%
- Axle related 5.89%
- PCE related 2.88%
- ESA related 24.72%.

- In order to determine the VKT, an annual distance of 60 000km, 90 000km and 45 000km was assumed for vehicle classes C, L and M and non-self-propelled vehicles respectively.[1] The distances are based on information from South African bus operators (more specifically KwaZulu-Transport, Great North Transport and Golden Arrow Bus Services) and information from the South African Road Freight Association (SARFA) which publishes vehicle cost and vehicle characteristic information for 22 vehicle types on an annual basis. In this regard it should be mentioned that the annual distance traveled varies from 48 000km to 140 000km per annum as per the SARFA figures. It was however not possible to distinguish between different vehicle types in NaTIS due to missing information such as number of axles and GVM, and therefore an annual distance of 90 000km was applied to self-propelled trucks.
- The number of axles per vehicle were taken from the NaTIS database. For vehicles where the number of axles is zero (0) (approximately 61% of all vehicles in NaTIS) two (2) axles were assumed.
- A uniform PCE factor of 2.5 was applied to each vehicle class. It is believed that the application of different PCE factors will have no significant impact on the overall results as only 2.88% of the costs are PCE related.
- The gross vehicle mass (GVM) as per NaTIS was used to arrive at the ESA factor by dividing the GVM by 8160kg (the maximum permissible GVM of an equivalent standard axle). For vehicles in NaTIS with no GVM data (about 10% of all vehicles), tare weight (which is a mandatory field in NaTIS) was used to estimate GVM. The findings of the Transit New Zealand Heavy Vehicle Limits Project were applied in this regard whereas:
  - Vehicles with less than 3 000kg tare have a GVM of 4 500kg.
  - Vehicles with between 3 000kg tare and 10 499kg tare have a GVM of 17 000kg.
  - Vehicles with a tare of 10 500kg or more have a GVM of 35 000kg.
- By applying the units of allocation (e.g. VKT, Axle-km etc) a fixed annual fee for each vehicle was arrived at.
- An average of all fixed annual fees was applied to each tare weight group for self-propelled vehicles as well as for trailers/semi-trailers.[2]

[1] The rationale behind the assumption of a lower annual distance for non-self-propelled vehicles (trailers/semi-trailers) is due to the fact that trailers/semi-trailers are utilized less than the propelling units.

[2] NaTIS has a different license fee structure for self-propelled vehicles and trailers/semi/trailers. To differentiate between self-propelled vehicles and trailers/semi-trailers, the NaTIS database field "Trailer type" was used. This field consists of the following four codes, namely 0: Unknown, 1: Self-propelled, 2: Trailer and 3: Semi-trailer. Codes 0, 2 and 3 were used for trailers/semi-trailers and code 1 was used for self-propelled vehicles.

2.2 CBC Methodology

In order to determine the level of CBCs to be recovered from foreign vehicles, the following broad methodology which is discussed in more detail below was applied pertaining to the distances travelled by foreign vehicles and the vehicle characteristics of foreign vehicles.

2.2.1 Foreign Vehicle Distances

Distances traveled between the respective border posts and the main central towns of Namibia were calculated. To do this, the average distance traveled per vehicle type was taken into consideration. The following methodology was followed to arrive at the average distance traveled per vehicle type:

- The number of vehicles per vehicle type (type 1-17) entering Namibia at the various border posts was determined.
- Centroid towns[3] were identified in each of the respective regions of Namibia.
- Distances were measured between each of the centroid towns and the respective border posts (refer to Table 2-1).
- Each distance was then multiplied with the number of vehicles per vehicle type.
- The product of each origin-destination (OD) pair for each vehicle type was then summed, and divided by the total number of vehicles per vehicle type in order to arrive at an average annual distance per vehicle type (refer to Table 2-2).

The current validity period of CBC permits is unlimited. However, immigration laws do not allow a person to stay longer in Namibia for more than three months, and therefore the calculated distances were multiplied with four in order to arrive at annual distances.

Based on different periods of stay of foreigners, the average daily distance travelled per foreign vehicle type may not be realistic, and it is therefore proposed that the future CBC permits should be valid for different periods and the amount payable should vary accordingly.

[3] A centroid town can be defined as a town that is situated in the centre of a respective region.

Table 2-1: Border Post – Central Town Travel Distances

Border Post	NAMIBIA REGION AND CENTRAL TOWN PER REGION												
	Caprivi	Erongo	Hardap	Karas	Khomas	Kunene	Ohangwena	Okavango	Omaheke	Omusati	Oshana	Oshikoto	Otjozodjupa
	Katima Mulilo	Usakos	Mariental	Keetmanshoop	Windhoek	Sesfontein	Eenhana	Rundu	Gobabis	Okahao	Oshakati	Tsumeb	Okakarara
Ariamsvlei	2009	1011	537	333	798	1494	1568	1498	1003	1543	1476	1224	1093
Ariamsvlei	2009	1011	537	333	798	1494	1568	1498	1003	1543	1476	1224	1093
Aroab	1870	867	451	163	652	1321	1418	1231	857	1416	1356	1072	927
Buitepos	1533	531	381	802	320	1016	1090	1020	115	775	708	746	618
Buitepos1	1533	531	381	802	320	1016	1090	1020	115	775	708	746	618
Hohlweg	1933	930	514	226	715	1384	1481	1294	920	1479	1419	1135	990
Katima Mulilo	0	1192	1472	1693	1211	1389	893	511	1418	1061	989	819	1060
Mahenene	1220	744	1107	1328	846	551	268	731	1109	82	119	420	695
Mohembo	330	916	1196	1417	935	1113	594	235	1140	897	825	543	784
Ngoma	67	1259	1539	1760	1278	1456	959	578	1485	1128	1056	886	1127
Noordoewer	1997	999	525	304	786	1482	1556	1486	991	1566	1494	1241	1082
Noordoewer1	1997	999	525	304	786	1482	1556	1486	991	1566	1494	1241	1082
Oshikango	949	714	994	1215	733	517	60	615	938	167	95	307	582
Ruacana	1253	716	1121	1342	860	323	284	742	1065	224	152	434	709
Veloorsdrift	1997	999	525	304	786	1482	1556	1486	484	1556	1494	1212	1082
Wenella	0	1192	1472	1693	1211	1389	893	511	1418	1061	989	819	1060
Windhoek	1211	211	261	482	0	696	770	700	205	780	708	426	296

Table 2-2: Estimated Average Annual Distances Travelled Per Vehicle Type

Vehicle Type	Description*	Average Distance traveled per vehicle type (km/annum)**
Type 1	Motor cycles, motor tricycle and motor quadrucycle Caravans and light trailers drawn by type 2 vehicles)	5,132
Type 2	All passenger cars, station wagons, S/C and D/C bakkies, 2x4 and 4x4 bakkies, Kombis, Microbus and minibus. (up to 16 seaters)	4,172
Type 3	Light goods vehicle/delivery vehicles/buses > 16 to 25 seaters (GVM < 3500kg)	3,120
HEAVY VEHICLES: (single units)		
Type 4	Bus with 2 axles. (carrying capacity of 25 or more passengers)	5,860
Type 5	Bus: with 3 axles. (carrying capacity of 25 or more passengers)	6,208
Type 6	Single unit Truck with 2 axles	4,128
Type 7	Single unit Truck with 3 axles	3,180
HEAVY VEHICLES: (Traction unit as part of a combination vehicle)		
Type 8	Truck tractor: with 2 axles	3,636
Type 9	Truck tractor: with 3 axles	5,672
Type 10	Truck tractor: with 4 or more axles	3,288
HEAVY TRAILERS (as part of a combination vehicle)		
Type 11	Trailer: with 1 axle (GVM > 1500 kg/ < 3500 kg)	5,384
Type 12	Trailer: with 2 axles or (GVM > 3500 kg)	5,876
Type 13	Trailer: with 3 axles	5,492
Type 14	Trailer: with 4 axles	3,900
Type 15	Trailer: with 5 or more axles	8,808
CONSTRUCTION VEHICLES		
Type 16	Tyre dozer, grader motor, front-end loaders, excavators, self-propelled vibratory rollers.	3,620
Type 17	Any other vehicle not listed.	3,940

Note: * The vehicle descriptions are based on the descriptions as per notice under section 18(1)(c) of the Road Fund Administration Act, 1999 (Act No. 18 of 1999)

** An assumption was made that a vehicle would enter and exit at the same border post.

2.2.2 Foreign Vehicle Characteristics

The vehicle characteristics needed for cost allocation in terms of Fuel Type, number of axles, Passenger Car Equivalent (PCE) Factor, Equivalent Standard Axle (ESA) Factor and Fuel Consumption Rate are shown in Table 2-3.

Table 2-3: Foreign Vehicles Characteristics

Vehicle Type	Fuel Type	Axles	PCE Factor	ESA Factor	Fuel Con. Rate (litres/km)
Type 1	P	2	0.5	0	0.05
Type 2	P	2	1	0	0.10
Type 3	D	2	2	0.35	0.26
Type 4	D	2	2.5	1.39	0.40
Type 5	D	3	2.5	1.39	0.40
Type 6	D	2	2.5	1.05	0.32
Type 7	D	3	2.5	1.74	0.41
Type 8	D	2	1.2	1.05	0.49
Type 9	D	3	1.4	1.5	0.55
Type 10	D	4	1.5	1.74	0.59
Type 11	N	1	1.8	1.5	0.00
Type 12	N	2	2	2	0.00
Type 13	N	3	2.2	2.2	0.00
Type 14	N	4	2.5	2.5	0.00
Type 15	N	5	3	2.7	0.00
Type 16	D	2	3	0	0.35
Type 17	D	2	3	0	0.35

3 Resultant Recovery Levels

The resultant recovery levels for MDCs and CBCs are discussed in more detail in section 3.1 and section 3.2.

3.1 Resultant Fixed Annual MDC Levels

The resultant interim fixed annual MDC levels are shown in the Main Report.

3.2 CBC levels

Based on the current charge levels and cost responsibilities of foreign vehicles, the current recovery as well as the required charge levels are indicated in Table 3-1.

Table 3-1: CBC - Current Recovery and Required Charges

Vehicle Type	Fuel Type	Current Charges		Current Recovery		Required Charges (Basket of Instruments)			MDC and Fixed Fee Only		MDC Only	Fixed Fee Only
		CBC/entry (N$)***	Fuel Levy (c/l)****	Current Recovery from CBC (N$/year)	Current Recovery from Fuel Levies (N$/year)	Fuel Levy- (c/l)	MDC - supplement to Fuel Levy (N$/100km)	Fixed Fee (N$/day)	MDC (N$/100km)	Fixed Fee (N$/day)	MDC (N$/100 km)	Fixed Fee (N$/day)
1	P	7.10	73.00	72,839	1,921,695		3.27	3.21	7.36	3.21	13.05	7.36
2	P	47.10	73.00	3,311,413	21,412,114		0.00	2.84	7.60	2.84	13.80	6.33
3	D	127.10	73.00	546,022	2,543,988		0.00	3.38	12.35	3.38	22.21	7.61
4	D	177.10	73.00	122,907	1,187,517		5.50	6.54	25.29	6.54	35.45	22.83
5	D	237.10	73.00	21,813	166,772		6.06	6.93	25.85	6.93	36.01	24.56
6	D	177.10	73.00	832,901	4,535,107		5.30	8.07	21.14	8.07	38.92	17.65
7	D	237.10	73.00	167,156	671,001		9.83	6.21	30.12	6.21	47.90	16.74
8	D	177.10	73.00	791,814	5,814,970		0.00	6.13	20.52	6.13	35.86	14.33
9	D	237.10	73.00	6,350,012	60,990,863		0.00	9.56	26.66	9.56	42.01	26.18
10	D	477.10	73.00	28,626	84,968		1.01	5.54	30.20	5.54	45.54	16.46
11	N	97.10	-	124,482	-		25.74	6.07	25.74	6.07	36.00	21.30
12	N	177.10	-	5,971,458	-		32.50	6.63	32.50	6.63	42.76	27.61
13	N	237.10	-	2,393,287	-		35.59	6.19	35.59	6.19	45.86	27.67
14	N	317.10	-	64,371	-		39.96	4.40	39.96	4.40	50.22	21.52
15	N	397.10	-	3,177	-		43.20	9.93	43.20	9.93	53.46	51.74
16	D	707.10	73.00	1,414	1,850		0.00	3.07	8.56	3.07	16.28	6.48
17	D	97.10	73.00	486	5,033		0.00	3.34	8.56	3.34	16.28	7.05
Petrol Vehicles						**81.87**						
Diesel Vehicles						**49.48**						
Total				**20,804,178**	**99,335,879**							

*** Excl. Admin Fee of N$ 52.90 per vehicle (incl. 15% VAT).
P = Petrol, D = Diesel, N = None.

Regarding Table 3-1 the following should be noted:

- The current recovery of foreign vehicles is N$ 20.80 million per annum in terms of the CBC permits and N$ 99.34 million in terms of fuel levies (if it is assumed that foreign vehicles only use Namibian fuel for their travel in Namibia).
- The required charges are indicated in the colored cells, and consist of the following:
  - Basket of Instruments (first set of colored cells)
    - Required Fuel levy (c/l)
    - MDC to supplement fuel levy (N$/100km)
    - Fixed Fee (N$/day)
  - MDC and Fixed Fee only (second set of colored cells)
    - MDC (N$/100km)

        - Fixed Fee (N$/day)
    - MDC only (third set of colored cells)
        - MDC (N$/100km)
    - Fixed Fee only (fourth set of colored cells)
        - Fixed Fee (N$/day)
- The various sets of charges are substitutes (i.e. if for instance the basket of instruments is chosen as the most suitable set of charges, the MDC and Fixed Fee only will not be needed, as this would result in over-recovery).
- The basket of instruments is the most theoretical correct set of charges, as variable costs are covered by MDCs and fixed costs by a fixed daily fee. This set of charges is however not necessarily the most practical set of charges, as foreign vehicles may not necessarily use Namibian fuel and it may in the case of MDCs not be practical to charge foreign vehicles according to their distance traveled.

Table 3-1 can now be adapted/simplified to show only fixed fees for foreign vehicles for two options, namely Option 1 which represents the case where foreign vehicles use **no** Namibian fuel and Option 2 where foreign vehicles **only** use Namibian fuel. This is done in Table 3-2.

Table 3-2: CBC Charge Levels – Total Cost Recovery

Vehicle Type	Fuel Type	Option 1 Fixed Fee (N$/day)	Revenue from Option 1s (N$ /year)	Option 2 Fixed Fee (N$/day)	Revenue from Option 2 Fixed Fees (N$/year)	Revenue from Fuel Levies- Option 2 (N$/year)	Total Revenue - Option 2 (N$/year)
1	P	7.36	6,870,652	5.30	4,948,956	1,921,695	6,870,652
2	P	6.33	40,469,053	2.98	19,056,938	21,412,114	40,469,053
3	D	7.61	2,976,486	1.11	432,498	2,543,988	2,976,486
4	D	22.83	1,441,644	4.02	254,127	1,187,517	1,441,644
5	D	24.56	205,651	4.64	38,880	166,772	205,651
6	D	17.65	7,555,629	7.06	3,020,522	4,535,107	7,555,629
7	D	16.74	1,073,911	6.28	402,911	671,001	1,073,911
8	D	14.33	5,829,287	0.04	14,316	5,814,970	5,829,287
9	D	26.18	63,811,397	1.16	2,820,534	60,990,863	63,811,397
10	D	16.46	89,848	0.89	4,880	84,968	89,848
11	N	21.30	2,484,822	21.30	2,484,822	-	2,484,822
12	N	27.61	84,717,390	27.61	84,717,390	-	84,717,390
13	N	27.67	25,420,516	27.67	25,420,516	-	25,420,516
14	N	21.52	397,595	21.52	397,595	-	397,595
15	N	51.74	37,670	51.74	37,670	-	37,670
16	D	6.48	1,179	(3.69)	(671)	1,850	1,179
17	D	7.05	3,207	(4.01)	(1,827)	5,033	3,207
Total			243,385,937		144,050,058	99,335,879	243,385,937

Regarding Table 3-2, the following should be noted:

- If it is assumed that foreign vehicles do **not** use Namibian fuel, the fixed daily fees for Option 1 (3rd column) will result in an estimated cost recovery from foreign vehicles of N$ 243.39 million per annum (as shown in the 4th column). This amount represents the total cost responsibility of foreign vehicles based on the number of vehicles entering the border posts which was extracted from the current CBC system.
- If it is assumed that foreign vehicles **do** use Namibian fuel, the fixed daily fees for Option 2 (5th column) will result in an estimated cost recovery from foreign vehicles of N$ 144.05 million per annum (as shown in the 6th column). A further amount of N$ 99.34 million is recovered by means of bringing the total amount recovered in terms of Option 2 to N$ 243.39 million per annum.
- It should be considered to slightly adjust the fixed daily fees to represent a gradual increase as the vehicle sizes increase. Care should however be taken not to increase the trailers and semi-trailers (vehicle types 11-15), as these are used less extensively than the propelling units (vehicle types 8-10).

Table 3-3 shows a more gradual phasing-in of CBC increases, and the following should be noted regarding Table 3-3:

- Part (about 15% or N$ 51.4 million based on the amount of travel of foreign vehicles relative to total amount of travel) of the N$ 145 million to be recovered in the form of interim MDCs (refer to section 3.1) is to be recovered from foreign vehicles (**all** foreign vehicles and not only heavy vehicles).
- As per Table 3-2, the required daily fixed fees are shown for Option 1 and Option 2, and again it may be necessary to slightly adjust the daily fee levels.

Table 3-3: CBC Charge Levels – Phased-In Cost Recovery

Vehicle Type	Fuel Type	Option 1 Fixed Fee (N$/day)	Revenue from Option 1s (N$ /year)	Option 2 Fixed Fee (N$/day)	Revenue from Option 2 Fixed Fees (N$/year)	Revenue from Fuel Levies- Option 2 (N$/year)	Total Revenue - Option 2 (N$/year)
1	P	2.15	2,011,515	0.10	89,819	1,921,695	2,011,515
2	P	1.82	11,672,691	(1.52)	(9,739,423)	21,412,114	11,672,691
3	D	1.83	716,422	(4.67)	(1,827,566)	2,543,988	716,422
4	D	4.57	288,548	(14.23)	(898,970)	1,187,517	288,548
5	D	4.95	41,465	(14.97)	(125,306)	166,772	41,465
6	D	3.63	1,553,563	(6.97)	(2,981,544)	4,535,107	1,553,563
7	D	3.23	207,341	(7.23)	(463,660)	671,001	207,341

Vehicle Type	Fuel Type	Option 1 Fixed Fee (N$/day)	Revenue from Option 1s (N$ /year)	Option 2 Fixed Fee (N$/day)	Revenue from Option 2 Fixed Fees (N$/year)	Revenue from Fuel Levies- Option 2 (N$/year)	Total Revenue - Option 2 (N$/year)
8	D	2.95	1,199,380	(11.34)	(4,615,590)	5,814,970	1,199,380
9	D	5.16	12,567,491	(19.87)	(48,423,372)	60,990,863	12,567,491
10	D	3.19	17,413	(12.37)	(67,555)	84,968	17,413
11	N	4.16	485,473	4.16	485,473	-	485,473
12	N	5.17	15,864,337	5.17	15,864,337	-	15,864,337
13	N	5.14	4,718,034	5.14	4,718,034	-	4,718,034
14	N	3.94	72,707	3.94	72,707	-	72,707
15	N	9.41	6,853	9.41	6,853	-	6,853
16	D	1.80	327	(8.37)	(1,523)	1,850	327
17	D	1.96	890	(9.11)	(4,143)	5,033	890
Total			51,424,450		(47,911,429)	99,335,879	51,424,450

If the phased-in approach as depicted in Table 3-3 is to be followed, it can be considered to decrease the interim MDCs for domestic heavy vehicles accordingly (i.e. by 15%).

4 Conclusion

The purpose of this document was to present the methodology that was used to arrive at the interim MDC levels to be recovered from heavy vehicles (NaTIS classes C, L and M) in the form of fixed annual fees in addition to annual license fees.

It is proposed that the RFA in collaboration with NaTIS inform road users that the additional fees to be leveled in addition with the existing license fees are only interim in nature, and that they will be replaced in future by a more equitable proper MDC system.

This document also set out the methodology used to determine the CBC levels and presented various options to be considered when recovering road costs from foreign road users.

ANNEXURE C

Cost Estimate Assumptions

The main cost categories are:

- **Mobilisation cost** – the initial set-up cost, including hardware, software and facilities to provide the basic infrastructure.
- **Implementation cost** - the additional set-up cost for both options.
- **Operational cost** – the day to day administration and management of the MDCS; the continual / monthly cost to be incurred to keep the system running.
- **Enforcement cost:** staff, training and support systems.

It is also important to clarify the terms *once-off costs* and *monthly costs*, and explain our understanding of these terms.

Once-off costs (mobilisation and installation costs) include:

- Deposits that must be paid (for office space)
- Installation costs (for communication lines)
- Once-off costs such as purchasing of furniture and hardware, development of the software system and purchasing of 3rd party software

Monthly costs (operational and enforcement costs) include:

- Salaries
- Office rent
- Rental of equipment
- Communication lines
- Support and maintenance fees (on MDCs software and hardware, including network infrastructure)
- Annual licence fees (on 3rd party software)
- Consumables (includes printer cartridges, licence/permit paper and other stationary)

With regard to costing, the following should be noted:

- All costs are February 2003 basis costs
- 15% VAT is excluded from all the costs
- A contingency of 10% should be added for budgeting purposes.

All costs are expressed in terms of annual costs. A depreciation period of 5 years is taken for computer equipment and 10 years for furniture.

In the calculation of our costs, we assumed that the technology-based MDCS will be interfacing with the NaTIS system.

It is also important to note that we investigated the feasibility of a MDCS office in every town where NaTIS is represented. That will be a total of 33 offices. After considering the estimated volumes of heavy vehicles per town, we concluded that 33 offices might not be feasible. A solution where the MDCS Head Office is situated in Windhoek with the support of 9 (nine) branch offices distributed across the country seems more realistic.

Since the FFA MDCS is to be implemented on the NaTIS system, and the technology-based MDCS will also be interfacing with NaTIS, a distribution of MDCS office across the country is no longer an issue. The technology-based MDCS will required one office to accommodate the controlroom. The technology-based MDCS office will then communicate the data of the vehicles to NaTIS, where the necessary processing and financial management of the MDCS data will be done. This will enable the public to obtain their MDCS licenses (for the FFA or technology-based solution) from their closest NaTIS office.

Throughout our cost calculations we assume that NaTIS will be assisting with the financial management of the technology-based MDCS.

The various costs are now individually presented. The format of sub-sections will be to define the type of cost and explain the calculations. At the end of each sub-section the actual costs will be listed.

Sub-option 2.1: Hub-odometer

Mobilisation cost

The mobilisation cost refers to all infrastructure required to be able to commence with MDCS. The mobilisation cost elements are:

a. Computer hardware infrastructure and furniture

We assume that the MDCS software will be web-based. This implies the following hardware requirements:

- Database server with tape-backup device
- Web-server
- Domain controller with tape-backup device
- 3 workstations
- 2 printers
- Switch
- A rack to mount the servers safely and neatly
- Network cables

(Consideration must be given to the installation of UPS facilities for the abovementioned devices).

The furniture will consist of 3 workstation units, each with a data typist chair. Each workstation unit already provides for a printer to be installed. A table for the fax machine will also be provided for, as well as a filing cabinet. (In later a section the fax-and-photo-copy/scanner combo to be rented is discussed).

b. Office facilities

The hardware infrastructure and furniture determine the office space required.

The following space is required:

- 40 m² for the 3 workstations, the printers, fax, photo-copy machine and the applicable furniture (the distribution of the dimensions depends on the office space available – e.g. an open-plan area or three separate offices)
- 9 m² for the server room where all the servers and network hardware will be hosted. An air conditioner must be installed in the server room.

c. 3rd party software

The 3rd party software will depends on the MDCS software installed. We foresee that the following will be applicable:

- Windows platform for the workstations
- Windows platform for the domain controller and web-server
- For a SQL database, the platform of the database server will also be Windows

d. Customised MDCS software

In calculating the estimated cost for the customised MDCS software we make the following assumptions:

- That the MDCS software will be developed from scratch – i.e. no customisations on an existing package
- That the full project life-cycle will be followed in the development. This includes the following steps:

- User Requirement specification
- Functional specification
- Technical specification
- Development
- Development testing
- Testing in a simulated environment
- On-site installation
- On-site testing
- ATP and commissioning
- Training

e. Consumables

Consumables include printer cartridges, pre-printed licensing paper, pens, pencils, scrap pads and other stationary required.

f. Communication lines

The communication lines consist of telephone and fax lines. The office will have 3 telephone lines and 1 dedicated fax line.

- For the development of the customised MDCS software the following rates were used:

- Analyst N$ 350 per hour
- Developer N$ 250 per hour
- Trainer N$ 150 per hour
- In converting the costs to annual costs the following depreciation periods were are used:
- Computer equipment and furniture: 5 years
- Software: 3 years
- Office space and communication lines: 20 years
- Consumables: 1 year

h. Other issues

Human resources are required to install and test the hub-odometers. The hub-odometers will be discussed as part of the "implementation costs" and the human resources as part of the "operational costs".

Implementation cost

This includes the hub-odometers to be installed in the vehicles.
Please note that it is our understanding that the RFA will not be responsible for these costs. The owners of the heavy vehicles will have to pay for the hub-odometer and the installation. The RFA can however negotiate with the heavy vehicle owners to finance a part of these implementation costs.

Operational cost

The operational cost refers to the day-to-day administration and management of the MDCS and the implicable costs.

a. Human resources

Based on our recommendation of only one office in Windhoek, we recommend that 1 (one) operational manager and 2 (two) MDCS officers will be sufficient to man the office. Two (two) hub-odometer technicians will be required for the installation of the hub-odometers.

Note: *We recommend the outsourcing of the support of all the hardware, the MDCs software and the 3rd party software. This implies that no departmental support staff will be required. The costs for the outsourcing are included in the calculations with regards to the hardware, customised software and the 3rd party software.*

The job descriptions and responsibilities of the staff members are briefly outlined below:

- MDCS Operational Manager:
  - Day-to-day management of the system
  - Regular visits to the branch offices
  - Daily reconciliation of fees received and licences issued
- MDCS Officer:
  - Issue the MDCS licences to the public
  - Assist with queries and problems from the public
  - The day-to-day activities for their branch– including the financial reconciliation and the banking of the fees received
  - Visits to towns in their region

b. Computer hardware infrastructure and furniture

As stated above, we recommend the outsourcing of the maintenance of the computer hardware infrastructure.

c. Office facilities

As part of the mobilisation cost, the office space was determined as 49m².

d. 3rd party software

The monthly and annual costs are calculated for the following 3rd party software:

- Windows platform for the workstations
- Windows platform for the domain controller, web-server and database server
- SQL database

e. Customised MDCS software

The customised software need to be maintained, just as the 3rd party software.

f. Consumables

The consumables are the same as discussed under Mobilisation costs.

g. Communication lines

The communication lines are 3 (three) telephone lines and 1 (one) dedicated fax line.

h. Other equipment

The following additional equipment can be either purchased or rented:

- Fax machine
- Photocopy machine

We recommend that this equipment be rented. The costs are for a photocopy machine (with a built-in fax machine and scanner features) rented over a 3 year period.

Enforcement cost

A further 10 inspectors may be required. The average total annual cost per inspector is N$133 000. The total annual cost for ten inspectors will be ***N$1 330 000***.

Sub-option 2.2: Transponders / Route tracers / ENP

Mobilisation cost

The default mobilisation costs as for sub-option 2.1 are also applicable for this sub-option. The transponders require additional human resources to install and test the transponders, as well as for the erection of additional sign posts, if the existing signpost network is insufficient. The transponders , data loggers and signposts will be discussed as part of the "implementation costs" and the human resources as part of the "operational costs".

The additional control room staff would however need additional hardware and other equipment to perform their tasks. The additional items include:

- Two workstations with a printer
- Two workstation table units with chairs
- Additional office space required (at least 18m²)

Implementation cost

This includes the transponders to be installed in the vehicles, as well as the data loggers to retrieve the data from the transponders / route tracers and the sign posts along the road.

Please note that it is our understanding that the RFA will not be responsible for the cost of the transponders. The owners of the heavy vehicles will have to pay for the transponder and the installation. The RFA can however negotiate with the heavy vehicle owners to finance a part of these implementation costs.

We calculated the estimated number of sign posts required as 2 750. The calculations were done as follows:

- Estimated paved kilometer road in Namibia: 5 500km;
- Density of sign post network: Every 2 kilometers;
- Required number of sign posts: (5 500 / 2);

Implementing a less dense sign post network is an option to reduce the costs. A network existing of 550 sign posts is possible.

- Estimated paved kilometer road in Namibia: 5 500km;
- Density of sign post network: Every 10 kilometers;
- Required number of sign posts: (5 500 / 10);

Please note that in the last instance the available data will be less accurate.

Data loggers must be installed to allow the regular download of data from the route tracers. We propose data loggers in the following towns:

- Ariamsvlei

- Keetmanshoop
- Mariental
- Windhoek
- Gobabis
- Okahandja
- Swakopmund
- Walvisbay
- Otjiwarongo
- Grootfontein
- Tsumeb
- Rundu
- Katima Mulilo
- Oshakati
- Ruacana

The downloaded data must *daily* be forwarded to the MDC centre.

Operational cost

This includes the normal operational cost as indicated for the previous sub-option, as well as the transponders / route tracer technician, the testing and maintenance of the transponders / route tracers and the obtaining of information from the data loggers.

a. Human Resources

This includes the route tracer / sign post technicians, the control room officers, the testing and maintenance of the route tracers / sign posts and the transfer of the information from the data loggers. We foresee that two control room officers will be sufficient.

b. Office space

The control room officer would require additional office space to be rented per month. The cost is calculated at least 18 m².

c. Hardware maintenance

The monthly maintenance on the additional hardware is required.

d. Monitoring cost of route tracers

Please note that it is our understanding that the RFA will not be responsible for these costs. The owners of the heavy vehicles will have to pay for the monitoring costs of the route tracers.

Enforcement cost

The same as discussed for the previous sub-option.

Sub-option 2.3: GPS based with GSM/RF technology

Mobilisation cost

The default mobilisation costs as discussed for sub-option 2.1 are also applicable for this sub-option. The GPS based solution requires additional hardware and other equipment, as well as two control room officers. These staff requirements will be discussed in detail in the “operational cost” section. They would however need

additional hardware and other equipment to perform their tasks. The In Vehicle Units (IVU) will be discussed in the "implementation cost" section.

The additional items include:

- Two workstations with a printer;
- Two workstation table units with chairs;
- Additional office space required (at least 18m²).

Implementation cost

This includes the IVUs to be installed in the vehicles. The current IVUs need to be customised to include the GIS component. ***The unit cost per IVU is N$ 6 300*** (including customisations and installation costs)

Please note that it is our understanding that the RFA will not be responsible for these costs. The owners of the heavy vehicles will have to pay for the IVU and the installation. The RFA can however negotiate with the heavy vehicle owners to finance a part of these implementation costs. ***For the RFA there is no implementation cost in utilising the GPS-based solution.***

The following table indicates the estimated annual implementation costs for the GPS-based solution using a depreciation period of 5 years for converting these implementation costs to annual costs.

Operational cost

This includes the normal operational cost as indicated for sub-option 2.1, as well as the control room officers and IVU technicians, the testing of the IVUs and the transfer of the information from the IVUs.

a. Human resources

We foresee that two control room officers will be sufficient. Two IVU technicians will be required for the installation of the units, as well as for testing and maintaining the units.

b. Office space

The control room officers would require additional office space to be rented per month. The additional space required is calculated as 18 m².

a. Hardware maintenance

Monthly maintenance on the additional hardware is required.

b. Monitoring cost of IVUs

The monitoring cost of the IVUs is an estimated N$ 200 per IVU per month. Based on an estimated 10 000 heavy vehicles it is a total of N$ 2 000 000 per month. This results in an estimated N$ 24 000 000 per annum.

The monitoring cost as indicated above per IVU, already include maintenance costs of approximately N$ 90 per IVU, per month. For an estimated 10 000 heavy vehicles the maintenance costs then amounts a total of N$ 900 000 per month.

Maintenance costs therefore represent approximately 45% of the IVU monitoring cost.

Please note that it is our understanding that the RFA will not be responsible for these costs. The owners of the heavy vehicles will have to pay for the monitoring costs of the IVUs.

Enforcement cost

The same as for the other sub-options.