REPUBLIC OF NAMIBIA

MINISTRY OF WORKS, TRANSPORT AND COMMUNICATIC

DEPARTMENT OF TRANSPORT

FEASIBILITY STUDY ON THE NORTHERI RAILWAY EXTENSION FOR NAMIBIA

FINAL REPORT

VOLUME 3

APPENDICES

MAY 1999

Wilbur Smith Associates

Africon Namibia

THE U.S. TRADE AND DEVELOPMENT AGENCY

The U.S. Trade and Development Agency assists in the creation of jobs for Americans by helping U.S. companies pursue overseas business opportunities. Through the funding of feasibility studies, orientation visits, training grants, conferences, and various forms of technical assistance, TDA enables American businesses to become involved in the planning stages of infrastructure and industrial projects in middle-income and developing countries. By doing this, the agency provides American firms with market entry, exposure, and information, helping them establish a position in markets that are otherwise difficult to penetrate.

NOTICE

THIS DOCUMENT HAS BEEN REPRODUCED FROM THE BEST COPY FURNISHED TO NTIS BY THE SPONSORING AGENCY, THE U.S. TRADE AND DEVELOPMENT PROGRAM. ALTHOUGH IT IS RECOGNIZED THAT CERTAIN PORTIONS ARE ILLEGIBLE, IT IS BEING RELEASED IN THE INTEREST OF MAKING AVAILABLE AS MUCH INFORMATION AS POSSIBLE

PLEASE DIRECT QUESTIONS ABOUT ILLEGIBLE PAGES TO:

THE LIBRARY, THE U.S. TRADE AND DEVELOPMENT PROGRAM

TELEPHONE: 703-875-4357

THANK YOU

THE U.S. TRADE AND DEVELOPMENT AGENCY

The U.S. Trade and Development Agency assists in the creation of jobs for Americans by helping U.S. companies pursue overseas business opportunities. Through the funding of feasibility studies, orientation visits, training grants, conferences, and various forms of technical assistance, TDA enables American businesses to become involved in the planning stages of infrastructure and industrial projects in middle-income and developing countries. By doing this, the agency provides American firms with market entry, exposure, and information, helping them establish a position in markets that are otherwise difficult to penetrate.

Mailing and Delivery Address: 1621 North Kent Street, Suite 200, Arlington, VA 22209-2131

FEASIBILITY STUDY ON THE NORTHERN RAILWAY EXTENSIC NAMIBIA

FINAL REPORT

INDEX OF APPENDICES

SECTION 1: INTRODUCTION

APPENDIX 1.1

TERMS OF REFERENCE

The Contractor will undertake a feasibility study for the development of the Railway Extension between Tsumeb and the Ondanga-Oshakati-Oshikango T include the tasks described below:

TASK A: BASELINE ASSESSMENT

The proposed project will not operate as a freestanding railway, but will be an in of the national rail system. The Contractor will carry out a brief review of th national railway system, insofar as it will have an effect on the proposed Extension. This review will cover infrastructure, rolling stock, methods of legislation, policies and plans for future development, and the services that ar provided to the railway's customers. The Contractor will evaluate the existing ro fleet (locomotives, wagons, and coaches) so as to determine if this will be adequ Northern Extension or if additions to the fleet will be required.

TASK B: DEMAND FORECAST

Subtask B1 – Regional Development Context

One of the main objectives of the project is to stimulate economic growth in th regions of Namibia. The Contractor will define the regional economic pros identify sub-sectors and activities (such as exports of specific agricultural pr example) which could benefit from the availability of rail service. For majo analyze the logistics chains in order to identify any complementary investments (for example, cold storage facilities, grain elevators, agricultural extension and that may be required to maximize the development potential for the product i Identify existing programs and activities aimed at fostering regional economic de and determine the linkages, if any, that may be required between these progra

Subtask B2 – Commodity Flow Forecast

Analyze the trends in international traffic with southern Angola, taking into a likely end of the Angolan civil war and possible return of civil authority tc Estimate the types and volumes of export traffic five and ten years in Determine existing road freight rates and deliver times in the study area by com compare to other regions having existing rail service.

Estimate existing commodity flow rates for major products between the stud other regions, based on the results of a road traffic survey reported in Re Estimate future commodity flow rates for these same products both with and proposed Northern Extension.

Subtask B3 – Passenger Demand Forecast

Estimate the total passenger traffic between the Study Area and other regi country under existing conditions and for the horizon years.

TASK C: PRELIMINARY OPERATIONAL SCHEME

Based on the level of customer demand estimated in Task B, the contractor wil conceptual operating scheme that will define the frequency and composition of would meet this demand. The purpose of this scheme is to guide the alternatives and evaluation of impacts during the tasks that follow.

TASK D: DEFINITION OF ALTERNATIVES

Subtask D1 – Preliminary Design

The Contractor shall identify the most appropriate alignment or alternative taking into account any development in the vicinity of the route. The study will if this railway line is to terminate at Ondangwa or if it should instead contin

The Contractor will develop an alignment and typical sections for the entire le route and more detailed plans for sections where there would be a significant either the ecosystem or on any surrounding urban areas requiring land taki design shall include drainage and drainage structures across the oshanas areas, siding layouts, etc. The level of detail of the design drawings shall be a is required to obtain a quantity estimate with an accuracy of no less than ± 25%.

Subtask D2 – Construction Methods and Materials

The Contractor will develop a program for the use of labor-intensive constructic for the proposed project and will evaluate the practicality, costs and benefits o this approach. If the benefits outweigh the costs, then the Contractor w language for the bidding documents to require civil works contractors to em based methods.

The Contractor will determine the most suitable sources for the main c materials (rails, sleepers, ballast, etc.)

Subtask D3 – Cost Estimate

The Contractor will prepare an estimate of the cost to implement the projec professional services for planning, engineering and construction manage supervision, fixed and movable equipment, civil works to construct the infrastructure, and land compensation costs.

TASK E – EVALUATION OF IMPACTS

Subtask E1 – Environmental and Social Impacts

The Contractor will identify potential significant environmental impacts and soc impacts likely to result from the project, offer solutions for their remedy, and deve whereby the government can fully address these issues as a preliminary step

Subtask E2 – Economic Impacts

The Contractor will analyze and evaluate the economic impact of the propos
This will include a quantification of the consumer surplus accruing to users of t
and will also quantify the secondary impacts on the regional economy from the
of a new transportation service. The evaluation will include calculation of the
rate of return, net present value and benefit cost ratios, showing the distributi
and benefits between the public sector, private sector, and by income group.

Subtask E3 – Financial Impacts

The Contractor will identify a suitable scheme or schemes for financing the
project, and will analyze the financial impact of the construction and opera
project on the developer and owner, which is the Government of the Republic c
The Contractor will contact potential financiers such as multilateral and bila
agencies and private banks which may have an interest in participating in the f
the project and/or operation of future services on the proposed rail line.

TASK F: RECOMMENDED ALTERNATIVE

The Contractor will document the recommended alternative design in the final re

Study Reports

The contractor will submit reports to MWTC as follows:

1. An Inception Report (20 copies) to be presented to the Client within 6 w
effective date of commencement of the study. This report will desc
Contractor's understanding of the existing situation (baseline asse
detailed plan and methodology for the remaining work on the Study, an
assumptions and technical design criteria to be followed.

3. A Draft Final Report (20 copies) shall be submitted within 28 weeks effective date of commencement of the Study. The Contractor will ma presentation of the draft final report to MWTC within five weeks of submi this meeting, MWTC will submit its comments for incorporation in the Fin

4. The Final Report (20 copies) will be submitted after the oral presentat any case no later than 37 weeks from the effective date of commencem study, incorporating the comments of MWTC on the draft final report. report will include a separately bound Executive Summary (80 copies).

In addition, the Contractor will attend periodic management meetings with MW the course of the Study to discuss and deliberate on progress and problems enc

All written reports are to be presented in the English language in A4 format and suitably bound to enable ease of use and are to include all plans, drav photographs. For the Final Report, no spiral binding will be accepted. The study shall be printed on the spine of all volumes of the final report. The findi study shall be prepared as a main volume, accompanied by annexes in separat containing all basic information, calculations, design considerations in order to reader to verify all design steps. There is to be a separate executive summary.

Institutional Arrangement for Management of the Study

The Executing Agency for the Study shall be the Ministry of Works, Tran Communications (MWTC). MWTC will designate a member of its staff to serve Manager. MWTC will enter into a grant agreement with TDA, and will select a U.S. consulting firm on the basis of competitive bidding from a short-list of comp request for prequalification data shall be published in the Commerce Business I MWTC will select a short list of up to five firms on the basis of the data submitte firms will then be invited to submit technical proposals for the Study. MWTC wil selection on the basis of the technical proposals submitted and enter into a cor the selected firm. The Contractor will report directly to the Project Manager desi MWTC and will submit all reports and invoices to MWTC. MWTC will revi invoices, and upon approval will transmit them on to TDA for payment. TDA disbursements directly to the Contractor based on these approved invoices.

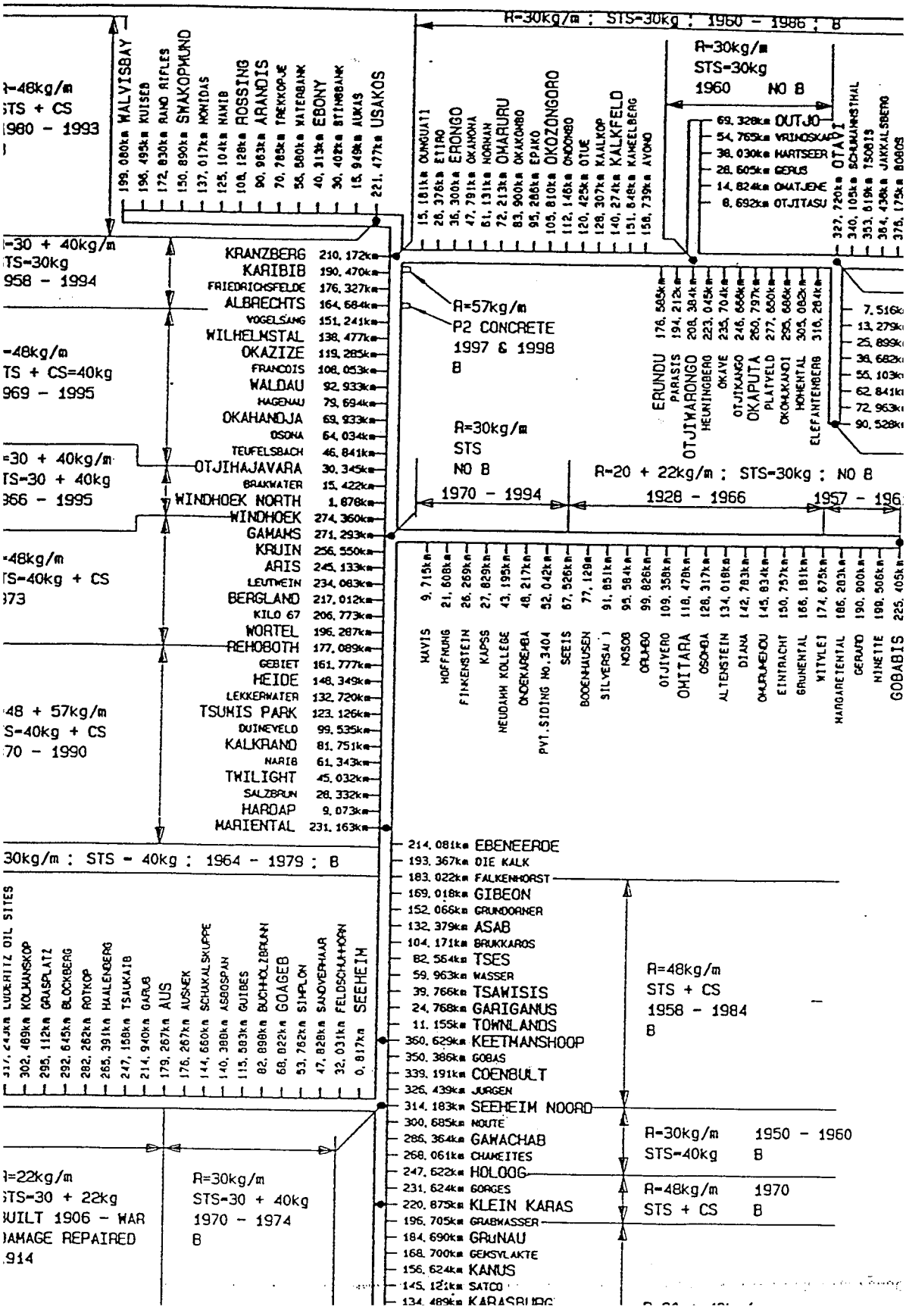
The Contractor should budget for all of its requirements including office sup

APPENDIX 1.2

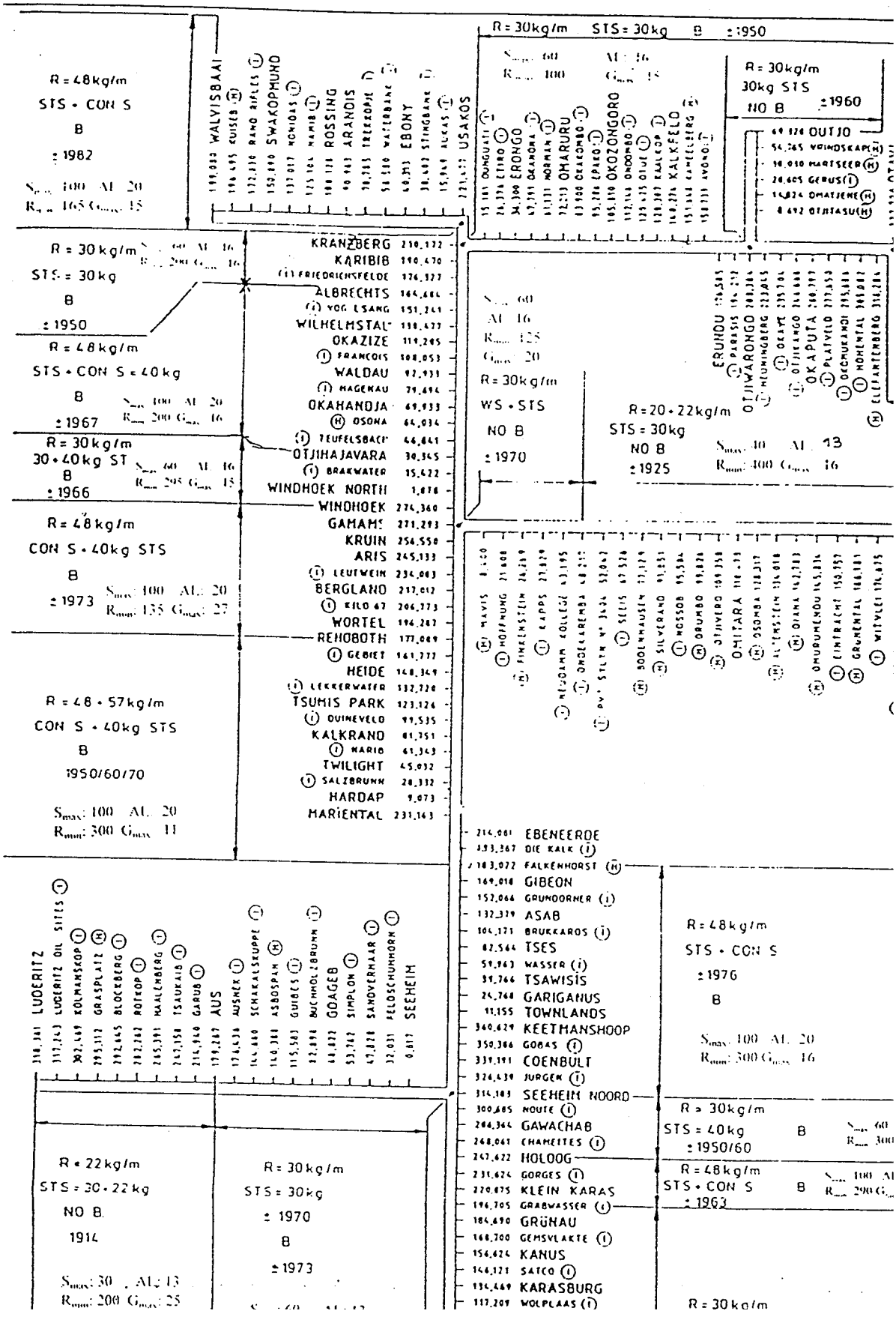
GENERAL REFERENCES

1. Ovambo Roads Master Plan; Bicon/LCE for MWTC 1992
2. National Transport Development Plan; Dogreah Ingeniere/Systra for MWTC 1997
3. Namibia Railway System – Future Link to Africa with Specific Reference to the Trans-Kalaha Dr Ing Klaus Dierks (Ph.D) MP MWTC 1996
4. SADC Protocol on Transport, Communications and Meteorology; SATCC-TU 10998
5. First National Development Plan (NDPI) Volume II, 1995/1996 – 1999/2000; National Planni Commission
6. TransNamib Train Operating Rules and Regulations
7. Strategic Rail Network – Construction of a Railway Line Between Tsumeb and Oshakati, Res for Transport Economic and Physical distribution Studies (RTPS), Sep 1995.
8. Submission for Group Management Meeting – Proposal for Construction of a Railway Line fr to Ondangwa; TNL, January 1994
9. TNL Civil Engineering Department. Numerous maps, track charts, construction specification and other related documents
10. TNL Operating Department. Train diagrams, train consists and other documents pertaining tc of traffic
11. TNL Mechanical Department Rolling Stock Rosters, specifications and information related to maintenance capabilities and procedures
12. TNL Finance Department. Financial data showing revenue, costs and breakdowns by functic
13. TNL Human Resources Department. Data existing employment by classification, wage and t structure and other information related to staffing
14. The First 100 years of State Railways in Namibia; Brendon Bravenboer and Walter Rusch, Tı Museum 1997
15. TransNamib Transport 1999-2002 Business Plan
16. TNL Annual Reports 1994 – 1998
17. National Transportation Master Plan Study, Final Report on Road User Charges, SWECO, M and VKE (Namibia)

APPENDIX 1.3
ROUTE AND STATIONS PHYSICAL DETAILS



APPENDIX 1.3
ROUTE AND STATIONS PHYSICAL DETAILS



APPENDIX 1.4
NAMRAIL ROLLING STOCK AND CONTAINER ROSTER

UPDATE ON 02 September 1998 DO 218

TYPE	DESCRIPTION	INITIAL NUMBER	NUMBER ADDED	NUMBER CONVERT	NUMBER SCRAP	NUMBER SOLD
	PASSENGER STOCK					
	REVENUE VEHICLES					
A	DINING & COUNTER CARS	5		0	3	0
B	LOUNGE CAR	1		0	0	0
C	1st CLASS MAINLINE	14		1	0	6
D	1st & 2nd CLASS COMPO	29		0	0	0
E	2nd CLASS MAINLINE	23		12	0	3
GD	1st & 2nd CLASS PASS. VAN	5		3	0	0
H	3rd CLASS MAINLINE(13SIT.9SL)	65		1	0	24
K	BAGGAGE &GUARDS VANS	14		0	14	0
KP	PARCEL VAN	20		0	1	1
	TOTAL REVENUE VEHICLES	176	0	17	18	34
	NON-REVENUE VEHICLES					
NO.3	PRIVATE	1		0	0	0
ZO	OFFICIAL	30		0	0	0
C25	MUSEUM	1		0	0	0
Z	MUSEUM	1		0	1	0
	TOTAL NON-REVENUE VEHICLES	33	0	0	1	0
	TOTAL PASSENGER STOCK	209	0	17	19	34
	GOODS STOCK					
	REVENUE VEHICLES					
AY-12	BALLAST	120	0	8	0	0
AYF-12	BALLAST	0	8	0	0	0
DAJ-5	ABNORMAL LOAD	1	0	1	0	0
DJ-2	GENERAL GOODS	200	1	6	0	0
DJL-2	GENERAL GOODS	0	6	0	0	0
DZA-9	GENERAL GOODS	300	0	1	1	0
FP-4	PARCELS	83	0	0	0	0
FZJ-7	GRAIN	75	0	1	2	0
FZFJ-7	GRAIN	0	1	0	0	0

APPENDIX 1.4
NAMRAIL ROLLING STOCK AND CONTAINER ROSTER

GZJ-1	LIVESTOCK	110	0	7	12	0
GZFJ-1	GRAIN	0	5	0	0	0
GZFJ-2	WOOD	0	2	0	0	0
GZJ-10	LIVESTOCK	150	1	0	3	0
LA-3	FROZEN PRODUCTS	28	0	0	1	7
LJ-1	FROZEN PRODUCTS	12	0	12	0	0
S-4	ABNORMAL LOADS	1	0	1	0	0
SMJ-1	CONTAINER TRAFFIC	150	0	0	0	0
SMJ-2	CONTAINER TRAFFIC	0	12	0	1	0
SMJ-3	CONTAINER TRAFFIC	0	69	0	0	0
SMJ-4	CONTAINER TRAFFIC	0	2	0	0	0
SMJL-3	CONTAINER TRAFFIC	0	8	0	0	0
U-17	ABNORMAL LOADS	1	0	0	0	0
X-4	WATER	40	0	22	0	15
X-16	WATER	4	0	0	1	0
XO-5	FURNACE/DIESEL OIL	7	6	0	0	0
XP-17	JET FUEL/PETROLEUM	33	0	0	0	0
XPJ-4	DIESELFUEL/PETROL	0	16	0	0	0
XPJ-11	DIESELFUEL/PETROL	22	0	0	0	1
XPJ-16	DIESELFUEL/PETROL	165	0	0	1	0
XSJ-9	SULPHURIC ACID	40	0	0	0	38
V-3	GOODS GUARDS VAN	77	0	77	0	0
NSF-1	STEAM HEAT VEHICLE	7	0	0	0	0
QZJ-3	EXPLOSIVES	2	0	0	0	0
	TOTAL REVENUE VEHICLES	1628	137	136	22	61
	NON-REVENUE VEHICLES					
NB	CABOOSE	5	0	0	1	1
NC	MATCH WAGON	5	0	0	0	0
NPS-5	RAILS	9	0	0	0	0
NV	BREAKDOWN TRAIN	10	17	0	4	0
NW	WHEELS	4	0	0	1	0
NZ	WORKSHOP/HARBOUR TRAFFIC	21	0	0	0	0
NZN	WORKSHOP/HARBOUR TRAFFIC	11	0	0	2	0
	BREAKDOWN CRANES	5	0	0	0	0
	TOTAL NON-REVENUE VEHICLES	70	17	0	8	1
	TOTAL GOODS STOCK	1698	154	136	30	62
	LOCOMOTIVES					
32 000	LOCOMOTIVE	36	0	0	1	35
32 200	LOCOMOTIVE	10	0	0	0	4
33 400	LOCOMOTIVE	82	0	4	1	36
33 500	LOCOMOTIVE	0	4	0	0	0
CLASS 24	STEAM LOCOMOTIVE	2	0	0	0	0
	TOTAL LOCOMOTIVES	130	4	4	2	75

APPENDIX 1.4
NAMRAIL ROLLING STOCK AND CONTAINER ROSTER

CONTAINERS					
MINI GRP	80	0	0	34	0
MINI STEEL	0	258	20	10	0
MINI INSULATED GRP	0	22	0	17	0
MINI INSULATED STEEL	0	30	0	0	0
3 METER GRP	80	0	3	0	0
3 METER STEEL	0	30	0	0	0
3 METER INSULATED	0	7	0	0	0
6 METER SIDE & END DOOR GRP	50	0	0	2	0
6 METER END DOOR GRP	50	0	2	0	0
6 METER END DOOR STEEL	12	0	0	3	0
6 METER INSULATED	4	2	0	3	0
6 METER ORE STEEL	38	0	0	1	13
6 METER PALLET FRIENDLY STEEL	0	157	0	5	0
MINI MILK TANK	0	6	0	0	0
MINI H2SO4 TANK	0	1	0	0	0
3 METER MILK TANK	2	0	0	0	0
3 METER JET FUEL TANK	4	0	0	0	0
3 METER TANK(CARRIERS)	0	6	0	0	0
3 METER TANK (EDELSTAHL BAU)	0	5	0	0	0
6 METER JET FUEL TANK	1	0	0	0	0
6 METER TANK (EDELSTAHL BAU)	0	1	0	0	0
6 METER TANK(NAMIBIA BULK)	0	4	0	0	0
7.5 METER FLAT RACK	0	20	0	0	0
TOTAL CONTAINERS	321	549	25	75	13

APPENDIX 1.5
STAR LINE PASSENGER SERVICE

T - WINDHOEK - KEETMANSHOOP - UPINGTON

Train No.		6607	2607
Days		Daily except Saturdays	Wed, Sat
Stations			
Windhoek	D	19:10	
Rehoboth	D	21:45	
Kalkrand	D	23:30	
Mariental	A	01:20	
	D	01:55	
Gibeon	A	03:00	
	D	03:02	
Asab	A	03:42	
	D	03:44	
Tses	A	04:40	
	D	04:42	
Keetmanshoop	A	06:27	
Keetmanshoop	D		08:10
Grünau	D		12:45
Karasburg	D		14:30
Ariamsvlei	D		18:30
Upington	A		21:30

D=Departure A=Arrival T=Trains B=Busses

Don't forget to book in advance!

T - UPINGTON - KEETMANSHOOP - WINDHOEK

Train No.		6666	6666
Days		Daily except Saturdays	Sun, Thur
Stations			
Upington	D		05:00
Ariamsvlei	D		09:00
Karasburg	D		11:25
Grünau	D		12:38
Keetmanshoop	A		16:31
Keetmanshoop	D	18:30	
Tses	A	20:05	
	D	20:10	
Asab	A	21:00	
	D	21:03	
Gibeon	A	21:48	
	D	21:50	
Mariental	A	23:00	
	D	23:50	
Kalkrand	D	02:00	
Rehoboth	D	03:55	
Windhoek	A	06:15	

T - WINDHOEK - TSUMEB - WINDHOEK

Train No. 6666			Train No. 2213 /
Days		Sun Tue, Thur	Days
Stations			Stations
Windhoek	D	17:50	Tsumeb
Okahandja	A	20:10	Otavi
	D	20:25	
Karibib	D	23:00	Otjiwarongo
Kranzberg	A	23:25	
	D	23:45	Omaruru
Omaruru	A	01:10	
	D	01:40	Kranzberg
Otjiwarongo	A	04:20	
	D	05:35	Karibib
Otavi	A	07:55	Okahandja
	D	08:20	
Tsumeb	A	09:40	Windhoek

T - WALVIS BAY - TSUMEB - WALVIS BAY

Train No. 2213 / 2201 / 2612			Train No. 2603 /
Days		Mon Wed, Fri	Days
Stations			Stations
Tsumeb	D	10:30	Walvis Bay
Otavi	A	11:45	Kuiseb
	D	12:15	Swakopmund
Otjiwarongo	A	15:00	
	D	16:45	Arandis
Omaruru	A	19:40	Usakos
	D	20:35	Kranzberg
Kranzberg	A	22:00	
	D	22:30	Omaruru
Usakos	D	22:55	
Arandis	D	00:55	Otjiwarongo
Swakopmund	A	02:10	
	D	02:35	Otavi
Kuiseb	D	03:50	
Walvis Bay	A	04:00	Tsumeb

T - WINDHOEK - GOBABIS - WINDHOEK

Train No. 2403			Train No. 2404
Days		Sun Tue, Thur	Days
Stations			Stations
Windhoek	D	21:50	Gobabis
Hoffnung	D	23:05	Witvlei
Neudamm	D	23:45	Omitara
Omitara	A	02:39	
	D	02:43	Neudamm
Witvlei	D	04:23	Hoffnung
Gobabis	A	05:43	Windhoek

T - WINDHOEK - WALVIS BAY - WINDHOEK

Train No. 6608			Train No. 6607		
Days		Daily except Saturday	Days		Daily except Saturday
Stations			Stations		
Windhoek	D	20:00	Walvis Bay	D	19:00
Okahandja	A	21:55	Kuiseb	D	19:20
	D	22:05	Swakopmund	A	20:35
Karibib	D	00:40		D	20:45

SECTION 2: TRAFFIC DEMAND FORECAST

APPENDIX 2.1

SYNOPSIS OF TRAFFIC SURVEY FROM

"CONSTRUCTION OF A RAILWAY LINE BETWEEN TSUMEB /

OSHAKATI"

RESEARCH UNIT OF TRANSPORT ECONOMIC AND PHYSICAL DISTRIBUTION STUD

SEPTEMBER 1995.

1. DEMAND ANALYSIS

1.1 Purpose of the demand analysis

The quality and validity of the results of a feasibility study depend entirely upon the inte data. It was, therefore, essential to obtain market related information on traffic and car the Tsumeb-Oshakati link.

The objective of the demand analysis was to obtain such data to be utilised in the feasi This required a physical traffic survey at both ends of the road link. The collected da information on vehicle movements, directional flow of commodities and the freight commc the road link.

The survey was conducted during a representative time period (one operating week pe two calendar months) of the year in order to negate the influence of possible season fluctuations.

The nature of the cargo was also taken into account, allowing only for commodities suit freight transport.

Given the survey method, the representativeness of the time period and the choice of cc the validity of the information is guaranteed.

1.2 Survey method

The survey method utilised in the demand analysis can be described as a complete tr The traffic count was carried out on both road freight transport and road passenge vehicles.

Two traffic counting stations were established, one at Oshivelo and one at Oshikango provide information on directional flows. A representative survey period of one week was order to minimise external influences such as school holidays on traffic flow. The counti were operational on a 24-hour-day basis over the entire survey period.

- Company
- Company nationality
- Type of vehicle
- Commodity transported
- Tonnes of commodity
- Origin
- Destination

Traffic counts resulted in a comprehensive data base containing detailed information on t directional flows, commodities and the type of vehicles used on the specific road link survey period.

1.3 Data compilation

The data base obtained from the survey contained raw data which, in that format, was i for the feasibility study calculations. The information in the data base was therefore based on the required parameters of the feasibility study. These parameters reflect the a mix and took into account the suitability of the commodity for rail freight transport. The o the cargo was also taken into account which implies that only cargoes with a probability c rail freight transport of more than 50 percent, were considered in the feasibility study.

From the aggregated data set, three sub-data sets were extracted (see Table 2.1.1) ba following three scenarios, namely:

1. An optimistic penetration of the potential market
2. A real penetration of the potential market and
3. A pessimistic penetration of the potential market

The optimistic penetration of the potential market was calculated as an average 75 pe potential tonnage obtained from the traffic surveys. The real penetration of the potential an average of 61 percent and the pessimistic penetration of the potential market was b average 41 percent of the total potential of the market.

The three scenarios, optimistic, real and pessimistic, however, differed from cor commodity, as a result of each commodity's probability of shifting to rail freight transport. sub-data sets, based on the three scenarios, contained the tonnage of the selected c transported, and the places of origin and destination.

The data contained in the three data sets was based on actual data obtained from the tra and it excluded an increase in tonnage due to normal cargo growth. The feasibility study on those data sets and it also excluded the gradual shift in modal choice over time.

The actual revenue per ton per commodity was based on existing rail freight trans resulting in the current revenue figures per commodity which were utilised in the feasibility

The actual tonnages per commodity obtained from the traffic counts, which took plac periods of one week each, were used to calculate annual tonnage potential per Table 2.1.2 also shows the annual tonnage for each of the three scenarios described in s

Table 2.1.1 provides an overview of the total market potential of the proposed Tsumeb-(link, but it does not indicate the directional flows. Table 2.1.2 shows the actual to commodity on the main routes (origin and destination)

TABLE 2.1.1
TOTAL AND FORECAST FOR DIVERSION TO RAIL

COMMODITY	WEEKLY TONNAGE	ANNUAL TONNAGE	MARKET POTENTIAL		
			OPTIMISTIC	REAL	PESSIMISTIC
Beer	687	35,734	14,294	7,147	3,572
Beverages	121	6,292	3,146	1,808	1,258
Bricks	580	30,160	24,128	21,112	15,080
Building Material	151	7,852	6,282	5,496	3,141
Cement	1,110	57,720	51,948	46,176	40,404
Cooking Oil	61	3,172	634	317	0
Fish	68	3,546	2,837	2,482	1,418
Fuel	791	41,111	41,111	37,000	32,860
Furniture	30	1,560	312	0	0
LPG	101	5,252	4,202	3,676	2,626
General Cargo	78	4,056	3,245	2,028	1,217
Gravel	310	16,120	16,120	8,060	0
Groceries	35	1,820	1,274	1,082	728
Liquor	115	5,980	4,186	2,512	2,996
Livestock	166	8,736	4,368	3,484	1,747
Maize Meal	644	33,486	26,790	23,442	16,744
Meat	203	10,530	2,106	1,063	0
Milk	22	1,144	229	114	0
Pipes	277	14,404	14,404	11,523	8,642
Scrap	34	1,768	1,414	864	0
Stones	303	15,758	15,756	7,878	0
Sugar	860	44,730	35,784	31,311	22,365
Vegetables	70	3,640	1,092	364	0
Other	1,479	76,908	53,806	48,145	23,072
TOTALS	**8,296**	**431,479**	**329,468**	**267,084**	**177,870**

TABLE 2.1.2
ESTIMATED ANNUAL TONNAGE

EER	BEVE-RAGES	BRICKS	BUILDING MATERIAL	CEMENT	FUEL	GRAVEL	LIVE-STOCK	MAIZE MEAL	MEAT	STONES	SUGAR	OTHER
645	121	35	92	559	2			154	40		278	943
				128							15	44
		22			32				32			246
1		503	56	296	731	310	114	319	5	303	374	365
								20			157	183
				25.8			46		3		17	35
646	***121***	***560***	***148***	***1,008.8***	***765***	***310***	***160***	***493***	***80***	***303***	***841***	***1,816***
40				67				35	30		15	368
												88
												2
1		20	3	30	26			116			1	217
									92			2
				4.2			8		1		3	6
41	***0***	***20***	***3***	***101.2***	***26***	***0***	***8***	***151***	***123***	***0***	***19***	***683***
687	**121**	**580**	**151**	**1,110.0**	**791**	**310**	**168**	**644**	**203**	**303**	**860**	**2,499**

APPENDIX 2.2
TOTAL ANNUAL TRAFFIC TO ONDANGWA

Commodity	Origin	Destination	Annual Tons	Current r operati
Machinery and vehicles	Windhoek	Ondangwa	600	Truck
Generator sets	Windhoek	Ondangwa	100	Truck
Machine parts	Windhoek	Ondangwa	300	Truck
Fabricated metal products	Windhoek	Ondangwa	1,600	Truck
Bulk beer	Swakopmund	Ondangwa	26,300	Truck
Packaged Beer	Windhoek	Ondangwa	10,000	Truck
Other Beverages	Windhoek	Ondangwa	8,900	Truck
Cooking Oil	Windhoek	Ondangwa	3,200	Truck
Furniture	Windhoek	Ondangwa	4,000	Truck
	RSA	Ondangwa	3,000	Truck
	Walvis Bay	Ondangwa	3,000	Truck
Groceries	Windhoek	Ondangwa	1,900	Truck
Liquor	Windhoek	Ondangwa	1,000	Truck
Bottles and Packaging	RSA	Ondangwa	69,000	Truck
Maize Meal	Windhoek	Ondangwa	50,000	Truck
	Otavi	Ondangwa	26,800	Truck
Sugar, bagged or packaged	Windhoek	Ondangwa	25,000	Truck
	Otavi	Ondangwa	20,000	Truck
	Tsumeb	Ondangwa	5,000	Truck
Lubricants	Walvis Bay	Ondangwa	1,250	Truck
	Windhoek	Ondangwa	1,250	Truck
Fertiliser	Windhoek	Ondangwa	1,200	Truck
Perishables	RSA	Ondangwa	15,600	Truck
	Windhoek	Ondangwa	7,000	Truck
Hardware	Windhoek	Ondangwa	1,000	Truck
Bricks and kerbs	Tsumeb	Ondangwa	38,000	Truck
	Windhoek	Ondangwa	25,200	Truck
Steel	RSA	Ondangwa	2,500	Truck
	Windhoek	Ondangwa	2,400	Truck
	Zimbabwe	Ondangwa	1,100	Truck
Timber	RSA	Ondangwa	500	Truck
	Windhoek	Ondangwa	500	Truck
Cement	RSA	Ondangwa	25,000	Rail to Tsu
	Otjiwarongo	Ondangwa	25,000	Truck
Plastic pipe	RSA	Ondangwa	200	Truck
Roofing sheets	Windhoek	Ondangwa	1,000	Truck
Fuel	Walvis Bay	Ondangwa	17,700	Truck
	Walvis Bay	Ondangwa	60,500	Rail to Tsu
	Walvis Bay	Ondangwa	9,300	Rail to Ota
Scrap	Ondangwa	Windhoek	5,000	Truck
Aggregate	Tsumeb	Ondangwa	72,000	Truck
Electrical Poles and Equipment	Windhoek	Ondangwa	5,000	Truck
Miscellaneous Containerized Freight	Walvis Bay	Ondangwa	10,000	Truck
TOTAL			587,900	

SECTION 3: OPERATIONS

APPENDIX 3.1
PRESENT TONNAGE AND AXLE LIMITS ON LINE SEGMENTS SOUTH OF TSUMEB
MIXED TRAINS

LINE SEGMENTS	UP (NORTH)				DOWN (SOUTH)			
	1 LOCOMOTIVE		2 LOCOMOTIVES		1 LOCOMOTIVE		2 LOCOMO	
	TONS	AXLES	TONS	AXLES	TONS	AXLES	TONS	A
Windhoek - Otjiwarongo	820	64	1 340	108	820	72	1 340	
Walvis Bay - Otjiwarongo	730	56	1 340	108	820	64	1 340	
Otjiwarongo - Tsumeb	840	60	1 340	108	820	72	1 340	
Keetmanshoop - Windhoek	800	80	1 100	108	400	40	800	

FREIGHT TRAINS

LINE SEGMENTS	UP (NORTH)				DOWN (SOUTH)			
	1 LOCOMOTIVE		2 LOCOMOTIVES		1 LOCOMOTIVE		2 LOCOMO	
	TONS	AXLES	TONS	AXLES	TONS	AXLES	TONS	A
Windhoek - Otjiwarongo	840	60	1 680	120	920	64	1 840	
Walvis Bay - Otjiwarongo	840	60	1 680	120	920	64	1 840	
Otjiwarongo - Tsumeb	1 400	120	1 840	128	920	64	1 840	
Keetmanshoop - Windhoek	1 800	80	1 490	140	440	28	880	

APPENDIX 3.2
SCENARIO 1
WAGONS, CONTAINERS AND TONNAGE
TSUMEB - ONDANGWA

COMMODITY	ORIGIN	DESTINATION	NET TONS	WAGONS NUMBER	TARE TONS	CONTAINERS NUMBER	TARE TONS	TOTA TONS
Fuel	Walvisbay	Ondangwa	83 100	2 395	53 650	0	0	136 7
Cement	RSA	Ondangwa	25 000	568	11 360	0	0	36 3
	Otjiwarongo	Ondangwa	0	0	0	0	0	
Scrap	Ondangwa	Windhoek	4 800	139	2 780	0	0	7 5
Lubricants	Walvisbay	Ondangwa	1 200	78	1 420	120	360	2 9
	Windhoek	Ondangwa	1 200	78	1 420	120	360	2 9
Aggregates	Tsumeb	Ondangwa	0	0	0	0	0	
Bottles and packaging	RSA	Ondangwa	6 900	449	8 162	690	2070	17 1
Maize meal	Windhoek	Ondangwa	0	0	0	0	0	
	Otavi	Ondangwa	0	0	0	0	0	
Bricks	Tsumeb	Ondangwa	0	0	0	0	0	
	Windhoek	Ondangwa	3 200	73	1 460	0	0	4 6
Sugar	Windhoek	Ondangwa	2 500	57	1 140	0	0	3 6
	Otavi	Ondangwa	0	0	0	0	0	
Bulk beer	Swakopmund	Ondangwa	0	0	0	0	0	
Perishables	RSA	Ondangwa	1 100	143	2 603	220	660	4 3
Furniture	RSA	Ondangwa	400	52	940	80	240	1 5
	Windhoek	Ondangwa	300	39	700	60	180	1 1
	Walvisbay	Ondangwa	300	39	700	60	180	1 1
Packaged beer	Windhoek	Ondangwa	500	33	592	50	150	1 2
Other beverages	Windhoek	Ondangwa	900	58	1 040	90	270	2 2
Steel	Windhoek	Ondangwa	300	10	200	0	0	5
Electric poles and equipment	Windhoek	Ondangwa	2 500	84	1 667	0	0	4 1
Cooking oil	Windhoek	Ondangwa	200	13	237	20	60	4
Groceries	Windhoek	Ondangwa	100	17	310	25	75	4
Fabricated metal products	Windhoek	Ondangwa	100	13	237	20	60	3
Fertilizers	Windhoek	Ondangwa	100	7	127	10	30	2
Liquor	Windhoek	Ondangwa	100	7	127	10	30	2
Timber	Windhoek	Ondangwa	0	0	0	0	0	
Hardware and electrical products	Windhoek	Ondangwa	100	13	237	20	60	3
Roofing sheets	Windhoek	Ondangwa	100	7	127	10	30	2
Machines and vehicles	Windhoek	Ondangwa	0	0	0	0	0	
Mixed containerized freight	Walvisbay	Ondangwa	500	33	592	50	150	1 2
TOTALS			**135 500**	**4 405**	**91 828**	**1 655**	**4 965**	**232 2**

SCENARIO 2
WAGONS, CONTAINERS AND TONNAGE
TSUMEB - ONDANGWA

COMMODITY	ORIGIN	DESTINATION	NET TONS	WAGONS NUMBER	TARE TONS	CONTAINERS NUMBER	TARE TONS	TOT TOI
Fuel	Walvisbay	Ondangwa	83 100	2 395	53 650	0	0	136
Cement	RSA	Ondangwa	25 000	568	11 360	0	0	36
	Otjiwarongo	Ondangwa	10 000	228	4 545	0	0	14
Scrap	Ondangwa	Windhoek	4 800	139	2 780	0	0	7
Lubricants	Walvisbay	Ondangwa	1 200	78	1 420	120	360	2
	Windhoek	Ondangwa	1 200	78	1 420	120	360	2
Aggregates	Tsumeb	Ondangwa	14 400	360	8 532	0	0	22
Bottles and packaging	RSA	Ondangwa	27 600	1 794	32 650	2 760	8280	68
Maize meal	Windhoek	Ondangwa	18 000	1 170	21 294	1 800	5400	44
	Otavi	Ondangwa	7 000	455	8 281	700	2100	17
Bricks	Tsumeb	Ondangwa	3 000	69	1 380	0	0	4
	Windhoek	Ondangwa	16 000	364	7 280	0	0	23
Sugar	Windhoek	Ondangwa	8 000	182	3 640	0	0	11
	Otavi	Ondangwa	2 000	46	920	0	0	2
Bulk beer	Swakopmund	Ondangwa	7 900	514	9 346	1 580	3160	20
Perishables	RSA	Ondangwa	2 300	299	5 442	460	1380	9
Furniture	RSA	Ondangwa	1 200	156	2 810	240	720	4
	Windhoek	Ondangwa	900	117	2 110	180	540	3
	Walvisbay	Ondangwa	900	117	2 110	180	540	3
Packaged beer	Windhoek	Ondangwa	3 000	195	3 549	300	900	7
Other beverages	Windhoek	Ondangwa	2 700	176	3 170	270	810	6
Steel	Windhoek	Ondangwa	1 800	60	1 200	0	0	3
Electric poles and equipment	Windhoek	Ondangwa	3 500	117	2 340	0	0	5
Cooking oil	Windhoek	Ondangwa	1 000	65	1 182	100	300	2
Groceries	Windhoek	Ondangwa	600	38	692	75	225	1
Fabricated metal products	Windhoek	Ondangwa	300	39	710	60	180	1
Fertilizers	Windhoek	Ondangwa	500	33	601	50	150	1
Liquor	Windhoek	Ondangwa	300	20	364	30	90	
Timber	Windhoek	Ondangwa	400	10	200	0	0	
Hardware and electrical products	Windhoek	Ondangwa	300	39	710	60	180	1
Roofing sheets	Windhoek	Ondangwa	400	26	473	40	120	
Machines and vehicles	Windhoek	Ondangwa	200	10	200	0	0	
Mixed containerized freight	Walvisbay	Ondangwa	4 000	260	4 732	400	1200	9
TOTALS			**253 500**	**10 217**	**201 093**	**9 525**	**26 995**	**481**

APPENDIX 3.3
SUMMARY OF
INCREASED TONS AND AXLES ON ALL LINE SEGMENTS

SCENARIO 1

LINE SEGMENT	TOTALS PER WEEK		TOTALS PER TRAIN			
			6 TRAINS/WEEK		7 TRAINS PER WEEK	
	AXLES	TONS	AXLES	TONS	AXLES	TONS
Upington-Windhoek	50	444	8	74	7	63
Windhoek-Otjiwarongo	88	869	15	145	13	124
Walvis Bay-Otjiwarongo	50	658	8	110	7	94
Otjiwarongo-Ondangwa	339	4,467	56	744	48	638

SCENARIO 2

LINE SEGMENT	TOTALS PER WEEK		TOTALS PER TRAIN			
			6 TRAINS/WEEK		7 TRAINS PER WEEK	
	AXLES	TONS	AXLES	TONS	AXLES	TONS
Upington-Windhoek	173	1,584	29	264	25	226
Windhoek-Otjiwarongo	382	4,063	64	677	55	580
Walvis Bay-Otjiwarongo	113	1,262	19	210	16	180
Otjiwarongo-Ondangwa	786	9,261	131	1,543	112	1,323

Note: Wagons, axles and gross tons based on the following equipment specifications:

Wagon Type	Tare	Net	Gross
XPJ-16 (tank)	22.4	36.8	59.2
DZA-9 (gon)	19.8	44	63.8
SMJ-1 (flat)	18.2	44	62.2
Container Type	**Tare**	**Net**	
6 m Steel	3.0	21.0	24.0
6 m Insulated	3.0	18.0	21.0
3 m Insulated Tank	2.3	5.0	7.3

APPENDIX 3.4

ADDITIONAL LOCOMOTIVE REQUIREMENTS

SCENARIO 1

1.	Windhoek – Otjiwarongo		
	52 trips x 2 x 12 hrs (0.5 day)		52 days
2.	Walvis Bay – Otjiwarongo		
	402 trips x 2 x 12 hrs (0.5 day)		402 days
3.	Otjiwarongo – Tsumeb		
	78 round trips x 16 hrs (0.7 day)		55 days
	52 round trips x 16 hrs (0.7 day)		55 days
4.	Tsumeb – Ondangwa		
	312 round trips x 24 hrs		312 days
		TOTAL	876 days
			2.4 loco
		Plus 25%	3,0 loco

ADDITIONAL LOCOMOTIVE REQUIREMENTS

SCENARIO 2

1.	Windhoek – Otjiwarongo		
	312 trips x 2 x 12 hrs (0.5 day)		312 days
	104 trips x 2 x 12 hrs (0.5 day)		104
2.	Walvis Bay – Otjiwarongo		
	402 trips x 2 x 12 hrs (0.5 day)		402 days
3.	Otjiwarongo – Tsumeb		
	78 round trips x 16 hrs (0.7 day)		55 days
	52 round trips x 16 hrs (0.7 day)		55 days
4.	Tsumeb – Ondangwa		
	312 round trips x 2 units x 24 hrs		624 days
		TOTAL	1 552 day
			4.3 loco
		Plus 25%	5.3 loco

APPENDIX 3.5
SCENARIO 1
ADDITIONAL WAGON REQUIREMENTS

COMMODITY	ORIGIN	DESTINATION	NET TONS	WAGONS NUMBER	ADD RTD*	ADD WD*	WAGON TYPE
Fuel	Walvisbay	Ondangwa	83,100	2,395	1	4,447	XPJ-16
Cement	RSA	Ondangwa	25,000	568	2	1,136	DZA-9
	Otjiwarongo	Ondangwa	0	0	5	0	DZA-9
Scrap	Ondangwa	Windhoek	4,800	139	4	556	DZA-9
Lubricants	Walvisbay	Ondangwa	1,200	78	1	78	SMJ-1
	Windhoek	Ondangwa	1,200	78	1	78	SMJ-1
Aggregates	Tsumeb	Ondangwa	0	0	4	0	DZA-9
Bottles and packaging	RSA	Ondangwa	6,900	449	8	3,592	SMJ-1
Maize meal	Windhoek	Ondangwa	0	0	3	0	SMJ-1
	Otavi	Ondangwa	0	0	3	0	SMJ-1
Bricks	Tsumeb	Ondangwa	0	0	4	0	DZA-9
	Windhoek	Ondangwa	3,200	73	5	375	DZA-9
Sugar	Windhoek	Ondangwa	2,500	57	5	285	DZA-9
	Otavi	Ondangwa	0	0	4	0	DZA-9
Bulk beer	Swakopmund	Ondangwa	0	0	3	0	SMJ-1
Perishables	RSA	Ondangwa	1,100	143	8	1,144	SMJ-1
Furniture	RSA	Ondangwa	400	52	8	416	SMJ-1
	Windhoek	Ondangwa	300	39	3	117	SMJ-1
	Walvisbay	Ondangwa	300	39	3	117	SMJ-1
Packaged beer	Windhoek	Ondangwa	500	33	3	99	SMJ-1
Other beverages	Windhoek	Ondangwa	900	58	3	174	SMJ-1
Steel	Windhoek	Ondangwa	300	10	5	50	DZA-9
Electric poles and equipment	Windhoek	Ondangwa	2,500	84	5	420	DZA-9
Cooking oil	Windhoek	Ondangwa	200	13	3	39	SMJ-1
Groceries	Windhoek	Ondangwa	100	17	3	36	SMJ-1
Fabricated metal products	Windhoek	Ondangwa	100	13	3	39	SMJ-1
Fertilizers	Windhoek	Ondangwa	100	7	3	21	SMJ-1
Liquor	Windhoek	Ondangwa	100	7	3	21	SMJ-1
Timber	Windhoek	Ondangwa	0	0	5	0	DZA-9
Hardware and electrical products	Windhoek	Ondangwa	100	13	3	39	SMJ-1
Roofing sheets	Windhoek	Ondangwa	100	7	3	21	SMJ-1
Machines and vehicles	Windhoek	Ondangwa	0	0	3	99	DZA-9
Mixed containerized freight	Walvisbay	Ondangwa	500	33	3	174	SMJ-1
TOTALS			**135,500**	**4,405**	**123**	**13,573**	

ADD RTD = ADDITIONAL ROUND TRIP DAYS
ADD WD = ADDITIONAL WAGON DAYS
ADD WR = ADDITIONAL WAGONS REQUIRED

IAMRAIL VAGON TYPE	TOTAL DAYS	ADD WR*
XPJ-16	4,447	12.2
DZA-9	1,686	4.6

SCENARIO 2
ADDITIONAL WAGON REQUIREMENTS

COMMODITY	ORIGIN	DESTINATION	NET TONS	WAGONS NUMBER	ADD RTD*	ADD WD*	WAGON TYPE
Fuel	Walvisbay	Ondangwa	83,100	2,395	1	4,447	XPJ-16
Cement	RSA	Ondangwa	25,000	568	2	1,136	DZA-9
	Otjiwarongo	Ondangwa	0	0	5	1,140	DZA-9
Scrap	Ondangwa	Windhoek	4,800	139	4	556	DZA-9
Lubricants	Walvisbay	Ondangwa	1,200	78	1	78	SMJ-1
	Windhoek	Ondangwa	1,200	78	1	78	SMJ-1
Aggregates	Tsumeb	Ondangwa	0	0	4	1,440	DZA-9
Bottles and packaging	RSA	Ondangwa	6,900	449	8	14,352	SMJ-1
Maize meal	Windhoek	Ondangwa	0	0	3	3,510	SMJ-1
	Otavi	Ondangwa	0	0	3	1,365	SMJ-1
Bricks	Tsumeb	Ondangwa	0	0	4	276	DZA-9
	Windhoek	Ondangwa	3,200	73	5	1,820	DZA-9
Sugar	Windhoek	Ondangwa	2,500	57	5	910	DZA-9
	Otavi	Ondangwa	0	0	4	184	DZA-9
Bulk beer	Swakopmund	Ondangwa	0	0	3	1,542	SMJ-1
Perishables	RSA	Ondangwa	1,100	143	8	2,392	SMJ-1
Furniture	RSA	Ondangwa	400	52	8	1,248	SMJ-1
	Windhoek	Ondangwa	300	39	3	351	SMJ-1
	Walvisbay	Ondangwa	300	39	3	351	SMJ-1
Packaged beer	Windhoek	Ondangwa	500	33	3	585	SMJ-1
Other beverages	Windhoek	Ondangwa	900	58	3	528	SMJ-1
Steel	Windhoek	Ondangwa	300	10	5	300	DZA-9
Electric poles and equipment	Windhoek	Ondangwa	2,500	84	5	585	DZA-9
Cooking oil	Windhoek	Ondangwa	200	13	3	195	SMJ-1
Groceries	Windhoek	Ondangwa	100	17	3	114	SMJ-1
Fabricated metal products	Windhoek	Ondangwa	100	13	3	117	SMJ-1
Fertilizers	Windhoek	Ondangwa	100	7	3	99	SMJ-1
Liquor	Windhoek	Ondangwa	100	7	3	60	SMJ-1
Timber	Windhoek	Ondangwa	0	0	5	50	DZA-9
Hardware and electrical products	Windhoek	Ondangwa	100	13	3	117	SMJ-1
Roofing sheets	Windhoek	Ondangwa	100	7	3	78	SMJ-1
Machines and vehicles	Windhoek	Ondangwa	0	0	3	50	DZA-9
Mixed containerized freight	Walvisbay	Ondangwa	500	33	3	780	SMJ-1
TOTALS			**135,500**	**4,405**	**123**	**40,834**	

ADD RTD = ADDITIONAL ROUND TRIP DAYS
ADD WD = ADDITIONAL WAGON DAYS
ADD WR = ADDITIONAL WAGONS REQUIRED

NAMRAIL WAGON TYPE	TOTAL DAYS	ADD WR*
XPJ-16	4,442	12.2

APPENDIX 3.6
SCENARIO 1
ADDITIONAL CONTAINER REQUIREMENTS

COMMODITY	ORIGIN	DESTINATION	NET TONS	CONTAINER NUMBER	ADD RTD*	ADD CD*	CONTAINER TYPE
Fuel	Walvisbay	Ondangwa	83,100	0	1		
Cement	RSA	Ondangwa	25,000	0	2		
	Otjiwarongo	Ondangwa	0	0	5		
Scrap	Ondangwa	Windhoek	4,800	0	4		
Lubricants	Walvisbay	Ondangwa	1,200	120	1	120	6m steel
	Windhoek	Ondangwa	1,200	120	1	120	6m steel
Aggregates	Tsumeb	Ondangwa	0	0	4		
Bottles and packaging	RSA	Ondangwa	6,900	690	8	5,520	6m steel
Maize meal	Windhoek	Ondangwa	0	0	4		6m steel
	Otavi	Ondangwa	0	0	4		6m steel
Bricks	Tsumeb	Ondangwa	0	0	4		
	Windhoek	Ondangwa	3,200	0	5		
Sugar	Windhoek	Ondangwa	2,500	0	5		
	Otavi	Ondangwa	0	0	4		
Bulk beer	Swakopmund	Ondangwa	0	0	4		3 m tank
Perishables	RSA	Ondangwa	1,100	220	8	1,760	6m insulated
Furniture	RSA	Ondangwa	400	80	8	640	6m steel
	Windhoek	Ondangwa	300	60	4	240	6m steel
	Walvisbay	Ondangwa	300	60	4	240	6m steel
Packaged beer	Windhoek	Ondangwa	500	50	4	200	6m steel
Other beverages	Windhoek	Ondangwa	900	90	4	270	6m steel
Steel	Windhoek	Ondangwa	300	0	5		
Electric poles and equipment	Windhoek	Ondangwa	2,500	0	5		
Cooking oil	Windhoek	Ondangwa	200	20	4	80	6m steel
Groceries	Windhoek	Ondangwa	100	25	4	100	6m steel
Fabricated metal products	Windhoek	Ondangwa	100	20	4	80	6m steel
Fertilizers	Windhoek	Ondangwa	100	10	4	40	6m steel
Liquor	Windhoek	Ondangwa	100	10	4	40	6m steel
Timber	Windhoek	Ondangwa	0	0	5		
Hardware and electrical products	Windhoek	Ondangwa	100	20	4	80	6m steel
Roofing sheets	Windhoek	Ondangwa	100	10	4	40	6m steel
Machines and vehicles	Windhoek	Ondangwa	0	0	5		
Mixed containerized freight	Walvisbay	Ondangwa	500	50	4	200	6m steel
TOTALS			**135,500**	**1,655**			

* ADD RTD = ADDITIONAL ROUND TRIP DAYS
* ADD CD = ADDITIONAL CONTAINER DAYS
* ADD CR = ADDITIONAL CONTAINERS REQUIRED

NAMRAIL CONTAINER TYPE	TOTAL DAYS	ADD CR*
6m steel	1,850	5.1
3m tank	0	0

SCENARIO 2
ADDITIONAL CONTAINER REQUIREMENTS

COMMODITY	ORIGIN	DESTINATION	NET TONS	CONTAINER NUMBER	ADD RTD*	ADD CD*	CONTAINER TYPE
Fuel	Walvisbay	Ondangwa	83,100	0	1		
Cement	RSA	Ondangwa	25,000	0	2		
	Otjiwarongo	Ondangwa	0	0	5		
Scrap	Ondangwa	Windhoek	4,800	0	4		
Lubricants	Walvisbay	Ondangwa	1,200	120	1	120	6m steel
	Windhoek	Ondangwa	1,200	120	1	120	6m steel
Aggregates	Tsumeb	Ondangwa	0	0	4		
Bottles and packaging	RSA	Ondangwa	6,900	2,760	8	22,080	6m steel
Maize meal	Windhoek	Ondangwa	0	1,800	3	7,200	6m steel
	Otavi	Ondangwa	0	700	3	2,800	6m steel
Bricks	Tsumeb	Ondangwa	0	0	4		
	Windhoek	Ondangwa	3,200	0	5		
Sugar	Windhoek	Ondangwa	2,500	0	5		
	Otavi	Ondangwa	0	0	4		
Bulk beer	Swakopmund	Ondangwa	0	1,580	4	6,320	3 m tank
Perishables	RSA	Ondangwa	1,100	460	8	3,680	6m insulated
Furniture	RSA	Ondangwa	400	240	8	1,920	6m steel
	Windhoek	Ondangwa	300	180	3	720	6m steel
	Walvisbay	Ondangwa	300	180	3	720	6m steel
Packaged beer	Windhoek	Ondangwa	500	300	3	1,200	6m steel
Other beverages	Windhoek	Ondangwa	900	270	3	1,080	6m steel
Steel	Windhoek	Ondangwa	300	0	5		
Electric poles and equipment	Windhoek	Ondangwa	2,500	0	5		
Cooking oil	Windhoek	Ondangwa	200	100	3	400	6m steel
Groceries	Windhoek	Ondangwa	100	75	3	300	6m steel
Fabricated metal products	Windhoek	Ondangwa	100	60	3	240	6m steel
Fertilizers	Windhoek	Ondangwa	100	50	3	200	6m steel
Liquor	Windhoek	Ondangwa	100	30	3	120	6m steel
Timber	Windhoek	Ondangwa	0	0	5		
Hardware and electrical products	Windhoek	Ondangwa	100	60	3	240	6m steel
Roofing sheets	Windhoek	Ondangwa	100	40	3	160	6m steel
Machines and vehicles	Windhoek	Ondangwa	0	0	3		
Mixed containerized freight	Walvisbay	Ondangwa	500	400	3	1,600	6m steel
TOTALS			**135,500**	**9,525**			

* ADD RTD = ADDITIONAL ROUND TRIP DAYS
* ADD CD = ADDITIONAL CONTAINER DAYS
* ADD CR = ADDITIONAL CONTAINERS REQUIRED

NAMRAIL CONTAINER TYPE	TOTAL DAYS	ADD CR*
6m steel	17,220	47.2
3m tank	6,320	17.5

SECTION 4: ENVIRONMENTAL AND SOCIAL IMP ISSUES

APPENDIX 4.1

SYNOPSIS OF

DRAFT TERMS OF REFERENCE PROPOSED BY MINISTRY OF ENVIRONME TOURISM (MET)

A Draft Terms of Reference (TOR) proposed by the Ministry of Environment and Tourism (received on April 9, 1999 regarding "next steps" or further study investigations envisioned t complete a comprehensive Environmental Assessment during the final design of the proposed p This draft is available through MET. A summary of key topics addressed in this Draft TOR ir following:

1. Introduction
2. Project Description
3. Objectives
4. Environmental Impact Assessment Requirements
5. Study Area
6. Scope of Work
    - Task 1: Public Consultation
    - Task 2: Description of the Proposed Project
    - Task 3: Description of the Environment
    - Task 4: Legislative and Regulatory Considerations
    - Task 5: Determination of the Potential Impacts of the Proposed Project
    - Task 6: Analysis of Alternatives to the Proposed Project
    - Task 7: Development of Management Plan to Mitigate Negative Impacts
    - Task 8: Identification of Institutional Needs to Implement Environmental A Recommendations
    - Task 9: Development of a Monitoring Plan
7. Reporting
8. Consultant Team

The above Terms of Reference is preliminary and subject to change based on the funding arrange conclusions of this USTDA feasibility study. The consultant advises that, if for example, Worl

NORTHERN NAMIBIA RAIL EXTENSION PROJECT
TSUMEB-OSHAKATI-ONDANGWA-OSHIKANGO

DRAFT TERMS OF REFERENCE PROPOSED BY MET

1. INTRODUCTION

The *Ministry of Works, Transport and Communication (MWTC)* is presentl investigating the possibility of constructing a

.....

The *MWTC* (hereinafter referred to as the proponent) is t Ministry responsible for..... with which its main objective is to

.....

The Ministry of Environment and Tourism requires that an Environmental Assessment be done to ensure that the above mentioned development woul have the least possible negative effects to the environment.

The purpose of the Terms of Reference is to ensure that the methodology a objective of such a study is clear and uniform to consultants and prospectiv firms (contractors).

2. PROJECT DESCRIPTION

2. A brief description of the major components of the proposed project;
2.. A statement of the need for it and the objectives it is intended to meet
2.. The Implementing Agency
2.. A brief history of the project, (including alternatives considered)
2.. Its current status and timetable
2.. The identities of any associated projects

If here are other projects in progress or planned within the region, country which r co npete for the same resources, they should also be identified here.

3. OBJECTIVES

The overall objective of the Environmental Assessment is to ensure that the negative environmental factors are taken into account and that mitigation p and measures are prepared to overcome any negative impacts in the locatio planning, design, construction as well as long term management factors of facilities.

4. ENVIRONMENTAL IMPACT ASSESSMENT REQUIREMENTS

- National laws and/or regulations on environment, health,...
- Any regional or local regulations
- Environmental assessment regulations of any financing organizations involved in the project
- Any relevant corporate environmental policies
- Relevant documents:
  - Namibia's Environmental Assessment Policy
  - EU – sector checklist on Transportation Infrastructure
  - .....

5. STUDY AREA

Specify the boundaries of the study area for the assessment (e.g. water catchment, airshed). If there are any adjacent or remote areas, which should considered –for example an adjacent residential area –, they should be specified here.

6. SCOPE OF WORK

Tasks to be included in the scope of work:

Task 1

Public Consultation

Propose a thorough programme of consulting the public during the EA study The purpose of the programme will be to assist the proponent to both inform all interested parties about the project and solicit their views about it. Specifically, the consultant will propose an effective, comprehensive public consultation strategy which includes at least:

- A list of stakeholders or audiences to be consulted
- Methods for reaching these stakeholders/ audiences
- The scheduling of consultation activities, and
- How the consultation efforts will be analysed.

Task 2

Description of the Proposed Project

Provide a brief description of the relevant parts of the project, using maps (at appropriate scale) where necessary, including the following information:

- Location
- General layout
- Size
- Capacity
- Pre-construction activities
- Construction activities

Task 3

Description of the environment

Assemble, evaluate and present baseline data on the relevant environment characteristics of the study area. Include information on any changes anticipated before the project commences.

Annotate or modify the lists below to show the critical information for this project category, or that which is irrelevant to it. The compilation of irrele data should be avoided:

- Physical environment: geology, topography, soil, climate and meteorology, ambient air quality, ambient sound, surface and ground-water hydrology, existing sources of air emissions, existing water pollu discharges and receiving water quality;
- Biological environment: flora, fauna, rare or endangered species, sensi habitats, including parks or preserves, significant natural sites, etc, spe of commercial importance and species with potential to become nuisan vectors or dangerous.
- Socio-cultural environment (include both present and projected where appropriate): population, land use, land ownership, planned developme activities, community structure, employment, distribution of income, goods and services, public health, cultural properties, tribal peoples, an customs, aspirations and attitudes.

Task 4

Legislative and Regulatory Considerations

Describe the pertinent regulations and standards governing environmental quality, health and safety, protection of sensitive areas, protection of endangered species, siting, land-use control, etc, at international, national, regional and local level.

Task 5

Determination of the Potential Impacts of the Proposed Project.

The following non exhaustive list of impacts could be considered:

- Impacts of routing
  - Invasion of tribal lands
  - Loss of natural areas, habitats, built heritage
  - Loss of valuable bio-diversity
  - In large wetland areas, the construction of railways embankments can interfere wi the cross drainage and permanently impair the biological cycles and productivity the ecosystem.

- Impacts from construction

  Impacts on Human Health
  - Ground and surface water contamination by oil, grease and fuel spills
  - Creation of stagnant water bodies in borrow pits and quarries which act as habitat for disease vectors

- Vehicle tracks and movement of machinery

Impacts on Local Hydrology

- Interruption of subsoil and overland drainage
- Flood hazard
- Waste water

Impacts on Land Use

- Bush clearing
- Services and housing
- Stock piling of material
- Waste (hazardous) disposal

Socio-economic impacts

- Disturbance of community way of life
- Inconvenience in daily activities of inhabitants and effect on economic activities
- Loss of arable land and forests
- Increase in traffic, noise and air pollution caused by construction vehicles
- Increase in accidents

➢ Impacts from Rail Use (Operation)

Socio-economic impacts

- Improved access to markets, place of employment
- Increased speed of movement to goods and services
- Increase in tourism potential of area
- Improved employment opportunities
- Reduction in accidents
- Land prices rising out of reach of the local population
- Change in population due to attracted activities
- Noise, visual intrusion
- Secondary impacts from induced development
- Discharge of litter from moving train

Impacts on human health

- Contamination of ground water by herbicides applied for weed control
- Unsanitary management of facilities where improper disposal of waste may sprea diseases
- Dust
- Spread of pests and diseases
- Transport spillage of hazardous materials affecting flora and fauna and water supplies

Impacts on livestock

- Rail acting as a barrier to the movements of animals
- Animal mortality due to rail kills

Wherever possible, describe impacts quantitatively, in terms of environmen costs and benefits. In this analysis, distinguish between:

- Significant positive and negative impacts;
- Direct and indirect impacts
- Immediate and long-term impacts
- Impacts which are unavoidable or irreversible.

Task 6

Analysis of Alternatives to the Proposed Project

Describe alternatives that were examined in the course of developing the proposed project and identify other alternatives, which would achieve the same objectives.

The concept of alternatives extends to:

- Siting/ routing
- Design
- Technology selection
- Construction techniques and phasing
- Operating and maintenance procedures

Compare alternatives in terms of:

- Potential environmental impacts
- Capital and operating costs
- Suitability under local conditions
- Institutional, training and monitoring requirements

When describing the impacts, indicate which are irreversible or unavoidab and which can be mitigated. To the extent possible, quantify the costs and benefits of each alternative, incorporating the estimated costs of any associated mitigating measures. The alternative of not constructing the pr in order to demonstrate environmental conditions without it, must be inclu

Task 7

Development of Management Plan to mitigate Negative impacts.

Recommended feasible and cost-effective measures to prevent or reduce significant negative impacts to acceptable levels. Estimate the impacts an costs of those measures, and of the institutional and training requirements implement them. Consider compensation to affected parties for impacts, v cannot be mitigated. Prepare a Management Plan including proposed worl programs, budget estimates, schedules, staffing and training requirements other necessary support services to implement the mitigating measures.

Task 8

Identification of Institutional Needs to implement Environmental Assessm Recommendations.

If applicable, review the authority and capability of institutions at local, regional and national levels and recommend steps to strengthen or expand them so that the management and monitoring plans in the environmental assessment can be implemented. The recommendations may extend to ne agency functions, intersectoral arrangements,management procedures and training, staffing, operation and maintenance training, budgeting and fina

the plan an estimate of capital and operating costs and a description of oth
nputs (such as training and institutional strengthening) needed to carry it

7. REPORT

The Environmental Assessment report should be concise and limited to significant environmental issues. The main text should focus on findings, conclusions and recommended actions, supported by summaries of the dat collected and citations for any references used in interpreting those data. Detailed or uninterpreted data are not appropriate in the main text and sho be presented in appendices or a separate volume.
Organise the environmental assessment report according to the outline provided in Namibia's Environmental Assessment Policy.

8. CONSULTING TEAM

Environmental Assessment requires usually interdiciplinary analysis. Iden in this section the specialisations which ought to be included on the team f

APPENDIX 4.2

ENVIRONMENTAL REFERENCES AND AUTHORITIES CONTACTE

REFERENCES AND AVAILABLE RESOURCE DOCUMENTS

1. BEYERS, J.J. & KATSIAMBIRTAS, E.E., 1987 Climate of Owambo. South West Af Meteorological Service, Windhoek.

2. BROWN, C.J., 1991. A checklist of the birds of Owambo. pp 20-36. In: Directorate Conservation and Research. Report on preliminary biological survey of the Owan Unpublished report of the Directorate of Wildlife Conservation and Research, Windhoek.

3. CLARKE, N.V. & RAYNER, N.A. 1999. Freshwater Crustacea of the Cuvelai wetlands. Cin in press.

4. CURTIS, B.A., 1991. Freshwater macro-invertebrates of Namibia. Madoqua 17(2):163-187.

5. DU PLESSIS, W., 1991. Preliminary vegetation map of Owambo. pp 11-19 In: Directorat Conservation and Research. Report on preliminary biological survey of the Owan Unpublished report of the Directorate of Wildlife Conservation and Research, Windhoek.

6. GRIFFIN, M., 1991. Preliminary checklist of reptiles, amphibians and small mammals. p Directorate of Wildlife Conservation and Research. Report on preliminary biological su Owambo Region. Unpublished report of the Directorate of Wildlife Conservation and Windhoek.

7. HUBBARD, DIANNE. Law and the Environment in the Ovambo Region. Legal Assista March 1992.

8. KERVEN, CAROL. The Knife Cuts on Both Blades: Redefining Property Rights in Easte Region, Namibia. Final Draft.. Overseas Development Institute, London. 8 March 1997.

9. LINDEQUE, M., 1991. Status of large Mammals. pp 52-54. In: Directorate of Wildlife Conse Research. Report on preliminary biological survey of the Owambo Region. Unpublished r Directorate of Wildlife Conservation and Research, Windhoek.

10. MARSH, A. & SEELY, M.K. (eds) 1992. Oshanas - sustaining people, environment and dev central Owambo, Namibia. DRFN and SIDA. 58pp.

11. OWAMBO ROADS MASTER PLAN, 1992. Ministry of Works, Transport and Com Government of the Republic of Namibia.

12. VAN DER WAAL, B.C.W. 1991. Fish life of the oshana delta in Owambo, Namibia and the t of Cunene species. Madoqua 17(2):201-209.

13. WERNER, WOLFGANG. The Evolution of Land Tenure in Oshikoto. NEPRU, April 1997.

14. First National Development Plan, 1995/1996 - 1999/2000. National Planning Commission, (of the Republic of Namibia, 1995.

15. National Transport Development Plan, Ministry of Works, Transport and Communication, Go

17. Construction of a Railway Line Between Tsumeb and Oshakati, Strategic Rail Network, Limited, September 1995.

18. Namibia's Railway System - Future Link to Africa with Specific Reference to the Trans-Kalah Dr-Ing K Dierks (Ph.D). M.P., Ministry of Works, Transport and Communication, Republic June 1996.

19. Regional Master Water Plan for the Owambo Region, Ministry of Agriculture, Water Development, department of Water Affairs, Republic of Namibia, March 1991.

20. Namibia Human Development Report 1998, UNDP.

21. The Small Business Baseline Survey, Volume 1, The Four Northern regions, Ministry of Industry, Government of the Republic of Namibia, December 1998.

22. Living Conditions in Namibia. Basic Descriptions with Highlights. The 1993/1994 Namibia Income and Expenditure Survey. Central Statistics Office, National Planning Commission, T of Namibia, May 1996.

23. Oshikoto Regional Development Plan, Oshikoto Regional Council/TRP, July 1997.

24. Livestock and meat Marketing in the Northern Communal Areas of Namibia. Report Comm the Commission of European Communities for the Ministry of Agriculture, Water and Rural De Government of Namibia. KPMG Peat Marwick Namibia. Windhoek, June 1993.

LIST OF AUTHORITIES CONTACTED

Name	Institution	Contacts
Peter Tarr Jean-Jaques Dohogne	Environmental Assessment Division at Directorate of Environmental Affairs, Ministry of Environment and Tourism	P/Bag 13306 Windhoek 6 th Floor, Capital Centre Tell: 249015/6/7/8 Fax: 240339 Email: pwt@dea.met.gov.na
Chris Eyre	Chief Warden for the Far North, Ministry of Environment and Tourism	P/Bag 2014 Tsumeb Namutoni Tel: 067-229398 Fax:067-2293
Mike Griffin	Amphibian, Reptile and Small Mammal Biologist, Division: Specialist Support Services, Ministry of Environment and Tourism	P/Bag 13306 Windhoek Schubert House, Rev. Michael Sc St. Tel: 237552 Fax 237553
Dr Clinton Hay	Freshwater Fish Biologist, Ministry of Fisheries and Marine Resources	P/Bag 2116 Mariental Hardap Freshwater Fish Institute Tel: 063-240361/2 Fax: 063-242
Jericho Mulofwa	District Forestry Officer, Directorate of Forestry, Ministry of Environment and Tourism	P/Bag 5558 Oshakati Ongwediva Forestry Office Tel: 065-230296 Fax: 065-230552
Dr Stuart Kean Dr Alex Verlinden	Project Manager and Ecologist, Northern Namibia Environmental Project	P O Box 2881 Oshakati Ongwdiva Forestry Office Tel: 065-230296 Fax: 065-230552
Eugene Marais	Curator of Insects, National Museum of Namibia, Windhoek	P O Box 1204 Windhoek Old Emma Hogenhout School Robert Mugabe St.
Tony Robertson Alice Jarvis	Avifaunal Database, Directorate of Environmental Affairs M.E.T.	P/Bag 13306 Windhoek 7 th Floor, Capital Centre Tell: 249015/6/7/8 Fax: 240339 Email: amj@dea.met.gov.na

Name	Institution	Contacts
Mrs M Figuerira	Legal Advisor Ministry of Environment and Tourism (MET)	Contacted April 8, 1999 through M for copy of Draft Environmental Management Act (1998)

APPENDIX 4.3

BASELINE CONDITIONS REVIEW

4.3 Physical Conditions

4.3.1 Climate and Other Meteorological Conditions

The study area is classified as hot steppe according to Köppen with summer rainfal annual temperatures above 18° C (van der Merwe 1983).

Rainfall

Namibia's rainfall is extremely unpredictable in amount, time and space. The aver northern and central part of the study area is 400 - 500 mm, while the southern part, ap south of the veterinary fence, receives 500 – 600 mm. The rainy season is in summe rains falling from October to April. Mean annual rainfall at Ondangwa measured ove period is 493 mm.

Temperature

Temperatures in the study area are high. The mean monthly temperature at Ondangwa i December and 17.5° C in July. Although frost has been recorded in the study area it is rather than a regular event.

Humidity and Evaporation

Mean monthly humidity at midday ranges from 50 % in March to 17 % in September. A the high temperatures and low humidity, evaporation is extremely high. The averag evaporation in the oshana area is 2500 mm per year, thus potential evaporation from surfaces exceeds rainfall by a factor of five (Marsh & Seely 1992).

Wind

The southern part of the study area experiences calm conditions for about 25 % of the winds from the north-east prevail during the remaining time (van der Merwe 1983). Caln are reported for the northern section of the study area for most of the year (Beyers & K 1987 in Marsh & Seely 1992), although strong winds are sometimes associated with thun

4.3.2 Air Quality

Due to the lack of industry, air pollution is low, fairly localised and attributed to fires a fumes from vehicles. However, dust loads are high especially during the dry season. No quality measurements were available at the time of this report.

4.3.3 Noise

Anthropogenic noise is restricted to traffic, largely along the main roads B1 and C46 (o ambient noise measurements were available at the time of producing this report.

Physiographically, the study area can be divided into three zones (Roads Master Plan 19

1. The Karstveld;

2. The northern Kalahari Sandveld; and

3. The Etaka-Cuvelai drainage basin

Tsumeb, the northern terminal of the existing the railway line, lies within the Karst extends approximately 19 km northwest along the B1. Numerous solution caves occur i Karstveld. Two sinkholes near Tsumeb are filled with water. The larger of the two, Lake adjacent to the main road (B1) on the west, about 15 km north of Tsumeb.

There are hills of phyllite, quartzite and conglomerate around Tsumeb and to the south o it leaves the town (Geological Survey 1980). From there the terrain gently descends t north, with undulating plains and a diffuse drainage system.

The northern part of the study area is underlain by Kalahari sandstones (Marsh & S tertiary calcretes, gravel and alluvium (Roads Master Plan 1992). The Northern Kalaha lies to the east of the study area and crosses the B1 from the Karstveld to 18°10' S. The with low dunes and very few drainage lines. The Etaka-Cuvelai Drainage Basin starts ab and continues westwards, well beyond the study area.

4.3.5 Soils

The soil in the Karstveld area, the southern part of the study area, is vertic, derived from products and clay (B. Strohbach, pers. com.). The northern Kalahari Sandveld is covered sand which can vary in depth from 3 - 50 m. The clay content varies between 2% an Etaka-Cuvelai draiange consists of solonetz soils interspersed with aeolian sand ridges w a north - south direction (Owambo Roads Master Plan 1992).

The only soils with irrigation potential occur across a small stretch of road just south (Owambo Roads Master Plan 1992).

4.3.6 Hydrology and Existing Drainage Patterns

Local topography determines the drainage patterns in the study area. In the mountainou narrow channels prevail, while wide and shallow drainage lines characterise the gently n south-west sloping Etaka-Cuvelai drainage basin.

In the Karstveld area various localised, narrow drainage lines cross the proposed railway r the Omuramba Owambo, just south of the veterinary fence, marks the start of severa shallow drainage lines feeding into the Etosha pan from the north-east and east.

The northern section of the study area lies on the south-eastern edge of the Cuvelai drai (Marsh & Seely 1992). This drainage system starts in the highlands of Angola, where wa diverge, forming an inland delta that is about 130 km wide on the northern border of N Namibia, the water courses converge again and drain into lake Oponono, from where during a good season to Etosha Pan. The drainage system consists of shallow, inte channels and pans called "oshanas". These are often vegetated and support trees and sh their margins. Because the whole area is virtually flat, water movement is very slow. Th relief of the area is 1100 m above sea level.

Groundwater and Surface Water

Most underground water is contained in a deep regional aquifer (Department of Water Af This water is saline. However, localised aquifers of freshwater overlay the less perme horizons of the saline aquifer.

There is no shortage of boreholes, wells and dams along the proposed railway line. Ho of these are temporary and yield only small amounts of water. Along the road, people a use water piped from Oshakati. An updated list of all boreholes and wells is obta Department of Water Affairs, either directly or via the Environmental Profiles Project. Tl gives co-ordinates, depth, diameter, yield and other data. Namibian guidelines for e drinking water are provided in the appendix for this section.

4.4 Natural Conditions

The following paragraphs describe natural conditions in the study area region anc corridor impact area. The appendix provides a map showing general characteristi conditions and points of interest.

4.4.1 Flora

Much of the study area falls within "Forest savanna and woodland" according to Giess vegetation types (1971). This extends westwards to roughly 16° E and south westwa and the Karstveld. The western part of the study area is covered by "Mopane sav Karstveld falls within the "Mountain savanna and Karstveld" vegetation type.

The Owambo Roads Master Plan (1992) places the study area within the "Dry Bush Sav south and "Palm Tree Savanna" in the north. A small section of "Dry Woodlands" cro approximately 20 km south of Ondangwa, with the remainder occurring further to the e the study area.

From recent vegetation surveys (Hines, Environmental Profiles Programme, Namibia Project) and the reconnaissance field survey the vegetation along the proposed route ca into three main vegetation types.

1. shrubbed woodland in the area from Tsumeb to Oshivelo

2. open shrubbed woodland with extensive agriculture and occasional grasslands from Ondangwa and Oshikango and

3. Mopane shrubbed woodland with agriculture and grasslands between Oshakati and

(See table 4.A.1 of this appendix at the end of this section for a list of flora species pro the Forestry Ordinance)

Shrubbed Woodland between Tsumeb and Oshivelo

In more detail, from Tsumeb the proposed railway line passes initially through dense s the eastern side, dominated by *Combretum apiculatum* and *Terminalia prunioides*. Alsc *Croton gratissimus, Dichrostachys cinerea, Euclea divinorum* and *Grewia* species. Mucl has been disturbed.

Open Shrubbed Woodland between Oshivelo, Ondangwa and Oshikango

At the Veterinary Fence there is a marked change in the vegetation due to the increa population and different land use patterns. Coppiced trees and shrubs and bush en indicate heavy utilisation, and the species diversity is generally low. Many of the tall trees selectively cut down. North of Oshivelo are cleared lands, while the Etosha National Par to the west runs for several kilometres along the road. To the north east is dense bush a tall. The dominant shrubs are *Croton gratissimus* and *Dichrostachys cinerea* with four Acacia, indicating bush encroachment.

From about 18° 29' S the northern side of the road the land is cleared up to or just beyon lines, after which bush and woodlands predominate. On the southern side are some cle but the vegetation is mainly shrubby woodland dominated by *Lonchocarpus nelsii* and *sericea* with *T. prunioides, Acacia nilotica, A. fleckii, A. reficiens, Croton gratissimus* ar *petersiana.*

From 18° 27' there is dense Acacia shrubland with *Croton gratissimus, Albizia anthelm Terminalia prunioides* on both sides of the road and the Andoni grasslands visible to the dominant Acacia are *A. nilotica* and *A. arenaria* and species diversity is low. Some areas fenced off. One particular fenced-off area to the north has a higher species diversit surrounding area, including the grasses *Wilkommia sarmentosa* and *Sporobolus spicatus* would be worth conserving.

Mopane Shrubbed Woodland with Agriculture and Grasslands

Colophospermum mopane (Mopane) starts to become the dominant shrub from interspersed with *Combretum collinum* and Acacia *hebeclada subsp. tristis.* At 18° 11' 51 21" E there is a gum tree plantation on both sides of the road, which belongs to the De Forestry. In places further along there are large stands of *Mundulea sericea* and *Croton g*

At 18° 08' the Makalani palms, *Hyphaene petersiana*, and Marula, *Sclerocarya birrea* start Both these species are valuable to the local people and so are preserved. From here there are far more fields and livestock with many stunted shrubs. *Pechuel-Loeschea le* common along the roadside and in the disturbed areas. From 18° 00' there are mostly v plains, interspersed with crops, especially to the south. The dominant trees are Makalani Marula, with *Terminalia sericea* and *Combretum collinum.* The dominant shrubs ar *Loeschea leubnitziae* and *Croton gratissimus.*

Between Ondangwa and Oshakati the vegetation has been particularly disturbed, wit Marula and Makalani being dominant.

The vegetation along the road from Ondangwa to Oshikango is far less disturbed and and shrubs are left between the fields. In places there are stands of young trees of species and more or less a uniform height. Some of these stands have been fenced consist of Mopane and/or *Croton gratissimus.* The dominant trees, however, are *Termina* and *Combretum collinum* with *Diospyros mespiliformis*, Marula and *Peltophorum africani* is one Baobab tree, *Adansonia digitata*, right next to B1 at 17° 34' 39" S, 15° 54' 48" E.

The route from Oshakati to Oshikango cuts across an area with shallow oshanas, domina grass, *Wilkommia sarmentosa.* Between the oshanas are fields and homesteads and gra There is far more natural bush than along the section of B1 south of Ondangwa, and r trees have been left. Most of these are indigenous fruit trees, such as Marula, *Berchem Ficus sycamorus* and *Diospyros mespiliformis*, but many Acacias and other shrubs can

Numerous alien plant species (e.g. *Nicotiana glauca, Ricinus communis, Euphorbia tiraca* spp. and *Opuntia* spp.) have been planted or have come up around the homesteads, those "more modern" (ie. made of brick and corrugated iron) ones next to the B1. S spread to borrow pits and other disturbed areas.

Conservation Status of Flora

There are no endemic plants in the study area, but 17 trees protected by the Forest Or 1952 and the Forest Act no. 72 of 1968 occur in the study area. The protected *Adansor Pterocarpus angolensis* and *Acacia sieberiana* are uncommon (only one specimen of eacl during the reconnaissance trip) as well as *Ficus thonningii, Entandrophragma spicatum* ar *plurijuga*, which have been recorded by Hines and the Tree Atlas Project for the study were not seen during the reconnaissance trip. Aloe spp. are commonly used as live fe species of Aloe are CITES listed and *Harpagophytum procumbens subsp. procumbens* i by the Nature Conservation Ordinance of 1975. The latter is commercially harvested fo use, but only occurs sporadically in the study area.

4.4.2 Fauna

Invertebrates

There are some endemic populations of insects in the area, but most insect populations a to immediate impacts (Marais, pers. comm.). Raised roads and railways can cau disruption to ground dwelling and wingless insects, but the B1 is already a barrier to such

The oshanas are home to 37 species of aquatic crustaceans (excluding Ostracoda). T shrimp, *Triops granarius*, and the clam shrimps, *Caenestheriella australis* and *Leptesthe* dominate the shallow waters, while the fairy shirmps *Streptocephalus macrourus* and *S.* dominate the deeper water (Clarke and Rayner, in press). These, together with oth invertebrates such as mayflies larvae and dragonfly larvae (Curtis 1991) are an imp source for fish and birds.

The relatively large, edible freshwater snail, *Pila occidentalis*, occurs in the oshanas. Th are eaten by people and used as bait.

Reptiles and Amphibians

The reptile and amphibian fauna are fairly diverse, with 16 frog species and 99 rept recorded for the whole of the north central region (Griffin 1991). Of the 16 amphibia *Phrynomerus affinis* (Rubber frog) is rare, *Bufo dombensis* (Bullfrog) is endemic but throughout the north, and *Xenopus laevis* (Common platanna) is peripheral, which mea main distribution falls outside the area under discussion.

Reptiles are represented by 68 recorded species and 31 species which are expected to have so far not been recorded. Fourteen of the recorded species are peripheral, eight ar and the two tortoises, *Geochelone pardalis* and *Psammobates oculifer*, are vulnerable. Th rare or endangered species which would be affected by the construction of a railway (G comm.). Leguaans and tortoises are of general conservation concern in Namibia, but broad distributions and are threatened by people far more than they would be by a railway

Mammals

Large mammals have long since been exterminated north of the veterinary fence and n

In the south and west small groups of antelope may occasionally be seen, but the only ar a wide distribution is the steenbok. These occur in very small numbers and are severely by people. Occasional predators may pass by but do not stay long.

A total of 94 small mammals has been recorded for the whole northern region, but none be affected by a railway. Four of the recorded species are rare and five are vulner endemic species, the rock rat, *Petromus typicus*, is peripheral. The only migrations o which occur within any frequency affecting the corridor impact area are the seasonal mc cattle goats and other small herds of domestic animals.

On the commercial farms south of the fence wildlife may be encountered, but there are or endangered species which would be threatened by the railway line. The Etosha bounc veterinary fence prevent the natural migrations of the past.

The rocky outcrops around Tsumeb are home to important animal species such a mongoose and several reptile species, thus presenting an environmentally sensitive habi

Birds

Birds are the most common wildlife encountered, but these too are under pressure from population. Small birds which are thought to eat seeds or fruit are prevented from nes actively killed (Larsen, pers. com.). Larger birds, such as Guineafowl, Francolins anc trapped for food. Nevertheless, there are still 411 species which have been recorded frc area (Brown 1991), of which 332 are commonly seen in the area. About 30 – 40 speci infrequently and the rest have only been recorded once (SABAP database March 19 under Table 4.2 of this appendix).

The most commonly recorded ones are Cape turtle dove, Forktailed drongo, Glos Laughing dove, Lesser striped swallow, Palm swift, Pied Crow and Yellowbilled h endemics and 21 red data species have been recorded. Some red data species recorded fairly frequently in other areas of the North Central Region, but only the Batel common in the study area.

The diversity of birds appears to decrease northwards from Tsumeb. Up to Oshivelo have been recorded, along the B1 from Oshivelo to Ondangwa 188 species, around On Oshakati 175 species and along B1 from Ondangwa to Oshikango only 142 species recorded. The last figure most likely understates the diversity since only three record been received from this stretch. Brown (1991) gives totals of 242 for the Dry Bush Sava the Dry Woodland and 247 for the Palm Savanna.

Fishes

Fish are a very important natural resource in the northern part of the study area. seasonal and come down with the floods from Angola. Seventeen species are indige Cuvelai, of which the most important genera are *Barbus* (barb/yellowfish), *Clarias* (*Oreochromis* (bream) (van der Waal 1991).

Land Use

The southern section of Otjikoto Region, up to the Veterinary cordon fence, comprises ranches. Around Lake Otjikoto there are a few cultivated lands. North of the Veterir small-scale, "communal" subsistence farming, with a mixture of livestock (cattle anc crops (maize and mahango). In places there are plantations of indigenous and exotic

Conclusions Regarding Natural Environmental Impacts

No section of the proposed railway line crosses pristine wilderness area. The area veterinary fence has been degraded by a long history of commercial farming and shows with bush encroachment, while the area north of the veterinary fence presents the mo region in the Namibia. As a consequence virtually no piece of land along this route h cultivated, trampled and grazed by livestock or altered by various other human activities.

There are no endemic plants in the study area, but 17 species protected by the Fores and Forestry Act may occur in the immediate rail corridor impact area.

Game species are virtually not existent, but several small mammals, reptile, bird and in maintain viable populations, largely in more remote areas away from people.

Due to population pressure, the entire northern part of the study area shows seve degradation in form of deforestation, overgrazing, soil erosion and uncontrolled waste dis is particularly evident around towns and other population centres.

Existing larger, build up roads, such as the B1 and C46 (or C92), and canals crossing t have altered the natural drainage patterns, although mitigative measures have been during more recent construction projects.

TABLE 4.3.1 : LIST OF FLORA SPECIES PROTECTED UNDER FORESTRY ORDINANCE

. List of trees and shrubs recorded by B. Curtis and C. Hines along the route of the proposed railway line. F = Protected by the Forestry Ordinance.

Identification	Status
Acacia arenaria Schinz	
Acacia ataxacantha DC.	
Acacia erioloba E.Mey.	F
Acacia fleckii Schinz	
Acacia hebeclada DC. subsp. *tristis* A.Schreib.	
Acacia luederitzii Engl. var. *luederitzii*	
Acacia mellifera (Vahl) Benth. subsp. *detinens* (Burch.) Brenan	
Acacia *nilotica* (L.) Willd. ex Delile subsp. *kraussiana* (Benth.) Brenan	
Acacia *reficiens* Wawra subsp. *reficiens* .	
Acacia senegal (L.) Willd. var. *rostrata* Brenan	
Acacia sieberiana DC var. *woodi* (Burtt Davy) Keay & Brenan	F
Acacia tortilis (Forssk.) Hayne subsp. *spirocarpa* (Hochst. Ex A. Rich) Brenan	
Adansonia digitata L..	F
Albizia anthelmintica (A.Rich.) Brongn.	F
Bauhinia petersiana Bolle subsp. *macrantha* (Oliv.)	
Berchemia discolor (Klotzsch) Hemsl.	F
Boscia albitrunca (Burch.) Gilg & Gilg-Benedict	F
Burkea africana Hook.	F
Catophractes alexandri D.Don	
Colophospermum mopane (J.Kirk ex Benth.) J.Kirk ex ex J.Leonard	
Combretum apiculatum Sond. subsp. *apiculatum*	
Combretum collinum Fresen. subsp. *ondongense* (Engl. & Diels) Okafor	
Combretum engleri Schinz	
Combretum hereroense Schinz subsp. *hereroense*	
Combretum imberbe Wawra	F
Commiphora africana (A.Rich.) Engl. var. *africana*	
Commiphora angolensis Engl.	
Commiphora glandulosa Schinz	
Commiphora pyracanthoides Engl.	
Croton gratissimus Burch. var. *gratissimus*	
Croton gratissimus Burch. var. *subgratissimus* (Prain) Burtt Davy	

Diospyros mespiliformis Hochst. ex A.DC.	
Ehretia obtusifolia Hochst ex. DC.	
Elephantorrhiza suffruticosa Schinz	
Euclea divinorum Hiern	
Euclea undulata Thunb. var. *myrtina* (Burch.) Hiern	
Ficus sycomorus L. subsp. *sycomorus*	F
Flueggea virosa (Roxb. ex Willd.) Voigt subsp. *virosa*	
Grewia avellana Hiern	
Grewia bicolor Juss. var. *bicolor*	
Grewia flava DC.	
Grewia flavescens Juss. var. *flavescens*	
Grewia retinervis Burret	
Grewia villosa Willd. var. *villosa*	
Gymnosporia senegalensis (Lam.) Loes.	
Hyphaene petersiana Klotzsch	
Lantana angolensis Moldenke	
Leucosphaera bainesii (Hook.f.) Gilg	
Lonchocarpus nelsii (Schinz) Heering & Grimme	F
Mundulea sericea (Willd.) A.Chev.	
Ozoroa schinzii (Engl.) R.& A.Fern.	
Pechuel-Loeschea leubnitziae (Kuntze) O.Hoffm.	
Peltophorum africanum Sond.	F
Rhigosum brevispinosum Kuntze	
Rhus marlothii Engl.	
Rhus tenuinervis Engl. var. *tenuinervis*	
Sclerocarya birrea (A.Rich.) Hochst. subsp. *birrea*	F
Spirostachys africana Sond.	F
Terminalia prunioides M.A.Lawson	
Terminalia sericea Burch. ex DC.	
Triaspis hypericoides (DC.) Burch. subsp. *hypericoides*	
Ximenia americana L. var. *americana*	
Ximenia caffra Sond. var. *caffra*	
Ziziphus mucronata Willd. subsp. *mucronata*	

TABLE 4.3.2 : LIST OF FAUNA SPECIES AND HABITATS INCLUDING STATUS

. List of birds recorded by the South ;an Bird Atlas Project for all the quarter degree ares through which the study area passes. **Status:** = endemic (95% of world's population occurs within nibia). E = endangered V = vulnerable CE = cally endangered. **Habitat:** Those species rded as characteristic of one of the major habitats ugh which the study area passes have been ked (Brown 1991). 1 = Dry bush savanna Palm savanna 3 = Dry woodland

Species	Status	Habitat
im's Stork		
;an Cuckoo		
;an Golden Oriole		3
;an Hawk Eagle		
;an Jacana		
;an Marsh Warbler		
;an Spoonbill		
;ating Chat		
y Tit		
cet		
lon's Crake		
;cheeked Babbler	En	
1 Owl		
;ed Owl		
;ed Warbler		
;leur	E	1, 2, 3
rded Woodpecker		
nett's Woodpecker		
;k Coucal		
;k Crake		
;k Crow		
;k Cuckoo		
;k Cuckooshrike		
;k Eagle		
;k Flycatcher		
;k Kite/Yellowbilled Kite		2
;k Sunbird		
;kbreasted Snake Eagle		
;kcheeked Waxbill		
;kchested Prinia		1, 2, 3
;kcollared Barbet		
;kcrowned Tchagra		3
;kcyed Bulbul		2, 3
Blackwinged Stilt		
Bleating Warbler		
Blue Crane	E	
Blue Waxbill		
Bluecheeked Bee-Eater		
Booted Eagle		
Bradfield's Hornbill		
Bradfield's Swift		
Bronzewinged Courser		
Brown Snake Eagle		
Brownhooded Kingfisher		
Brownthroated Martin		
Brubru		
Buffy Pipit		
Burchell's Courser		
Burchell's Sandgrouse		
Burchell's Starling		
Cape Bunting		
Cape Penduline Tit		
Cape Reed Warbler		
Cape Sparrow		
Cape Teal		
Cape Turtle Dove		
Cape Wagtail		
Cape White-Eye		
Capped Wheatear		
Cardinal Woodpecker		
Carp's Black Tit	En	
Caspian Plover		
Cattle Egret		
Chat Flycatcher		
Chestnut Weaver		
Chestnutbacked Finchlark		
Chestnutbanded Plover	E	
Chinspot Batis		
Clapper Lark		
Common Quail		
Common Sandpiper		
Common Waxbill	E	
Crested Francolin		
Crimsonbreasted Shrike		
Crowned Crane	CE	
Crowned Plover		
Curlew Sandpiper		

ublebanded Sandgrouse		
sky Sunbird		
stern Redfooted Kestrel		
yptian Goose		
yptian Vulture	CE	
ropean Bee-Eater		1, 3
ropean Golden Oriole		
ropean Roller		
ropean Sedge Warbler		
ropean Swallow		
ropean Swift		
niliar Chat		
ıtailed Cisticola		
wncoloured Lark		
al Pigeon		
rynecked Nightjar		
cal Shrike		
ppet Lark		
ktailed Drongo		1
vous Duck		
bar Goshawk		
rden Warbler		
ınt Eagle Owl		
ssy Ibis	V	
ssy Starling		1, 3
den Bishop		
den Weaver		
denbreasted Bunting		3
dentailed Woodpecker		
at Crested Grebe	CE	
at Sparrow		
at Spotted Cuckoo		
at White Egret		
ater Blue-Eared Starling		
ater Flamingo	E	
ater Kestrel		
ater Striped Swallow		
en Pigeon		
enbacked Heron		
enshank		
enspotted Dove		3
y Heron		3
y Hornbill		1, 2, 3
y Kestrel	V	
y Lourie		1, 3
v-backed Bleating		

Gymnogene		
Hartlaub's Francolin	En	
Helmeted Guineafowl		
Hobby Falcon		
Hooded Vulture	V	
Hoopoe		
House Martin		
House Sparrow		
Icterine Warbler		
Jacobin Cuckoo		
Kalahari Robin		
Kittlitz's Plover		
Klass's Cuckoo		
Knobbilled Duck		
Kori Bustard		
Kurrichane Buttonquail		
Kurrichane Thrush		
Lanner Falcon		
Lappetfaced Vulture	V	
Laughing Dove		
Lesser Flamingo	E	
Lesser Grey Shrike		
Lesser Honeyguide		
Lesser Kestrel		
Lesser Masked Weaver		
Lesser Moorhen		
Lesser Spotted Eagle		
Lesser Striped Swallow		
Lilacbreasted Roller		
Little Banded Goshawk		
Little Bee-Eater		
Little Egret		
Little Sparrowhawk		
Little Stint		
Little Swift		
Longbilled Crombec		
Longtailed Shrike		
Maccoa Duck		
Marabou Stork	V	
Marico Flycatcher		
Marico Sunbird		
Marsh Owl		
Marsh Sandpiper		
Martial Eagle	V	
Masked Weaver		
Melba Finch		

maqua Sandgrouse		
enbilled Stork		
angebreasted Bush Shrike		
rich		1
ambo Sparrowhawk		
nted Snipe		
e Chanting Goshawk		1
ewinged Starling		
lid Flycatcher		3
m Swift		2, 3
mnut Vulture		
adise Flycatcher		
adise Whydah		
arlbreasted Swallow		
arlspotted Owl		
egrine Falcon		
d Babbler		1
d Barbet		1, 3
d Crow		2
d Kingfisher		
kbilled Lark		
inbacked Pipit		
mcoloured Starling		
it Batis		
fback		3
ple Gallinule		
ple Roller		1, 3
ail Finch		
tling Cisticola		2
l Bishop		
lbacked Shrike		
lbilled Buffalo Weaver		1
lbilled Firefinch		2
lbilled Francolin		1, 3
lbilled Hornbill		1
lbilled Quelea		1, 3
lbilled Teal		3
lbilled Woodhoopoe		3
lbreasted Swallow		2
lcapped Lark		
lcrested Korhaan		1, 3
leyed Bulbul		1, 3
leyed Dove		3
lfaced Mousebird		2
lheaded Finch		
lheaded Weaver		

Roberts 888		
Roberts 889		
Rock Bunting		
Rock Kestrel		
Rock Martin		
Rock Pigeon		
Rosyfaced Lovebird	En	
Ruff		
Rufousbellied Heron		
Rufouscheeked Nightjar		
Rufousnaped Lark		
Rüppell's Parrot	En	
Sabota Lark		
Sanderling		
Scalyfeathered Finch		
Scarletchested Sunbird		
Scimitarbilled Woodhoopoe		
Scops Owl		
Secretarybird		
Shafttailed Whydah		
Shorttoed Rock Thrush		
Sociable Weaver		
Southern Black Tit		
Southern Pochard		
Spikeheeled Lark		
Spotted Dikkop		
Spotted Eagle Owl		
Spotted Flycatcher		
Squacco Heron		
Steppe Buzzard		
Steppe Eagle		
Striped Kingfisher		
Swainson's Francolin		
Swallowtailed Bee-Eater		
Tawny Eagle	V	
Tawnyflanked Prinia		
Temminck's Courser		
Threebanded Plover		
Threestreaked Tchagra		
Tinkling Cisticola		
Titbabbler		
Violet Widowfinch		
Violeteared Waxbill		
Wahlberg's Eagle		
Water Dikkop		
Wattled Plover		

itebacked Mousebird		
itebacked Vulture		1
itebellied Sunbird		3
itebreasted Cormorant		
itebrowed Robin		3
itebrowed Sparrowweaver		1, 3
itecrowned Shrike		1, 3
itefaced Duck		
itefaced Owl		
itefronted Plover		
iteheaded Vulture	E	
itequilled Korhaan		
iterumped Swift		
itetailed Shrike	En	
itethroated Canary		
itethroated Swallow		
itewinged Tern		
low Warbler		
etailed Swallow		
od Sandpiper		
odland Kingfisher		
ollynecked Stork		
low Canary		
lowbellied Bulbul		
lowbellied Eremomela		
lowbilled Egret		
lowbilled Hornbill		1, 3
lowbilled Oxpecker	V	
lowbreasted Apalis		3
loweyed Canary		3
lowfronted Tinker Barbet		
lowthroated Sparrow		3

APPENDIX 4.4

POTENTIAL IMPACTS AND MITIGATION MEASURES

Impacts

All major construction projects, such as the construction of the proposed project railw associated with impacts on the environment.

Primary impacts are:

- related to the construction process;
- localised, and
- can usually be minimised or mitigated.

Secondary impacts are:

- associated more with the operation phase;
- can be far reaching;
- may be cumulative (i.e. interact with and enhance each other; and
- are often difficult to mitigate, since multi-sector policy or national legislation may be r effective co-ordination and implementation between the various Ministry sectors of go

This section discusses potential environmental and social impacts and outlines possibl measures for construction (primary aspects) and operation (secondary impacts) of t These are discussed on an item by item basis and are subject to adjustment or refinemen final design process or when more detailed investigations are completed. Th environmental and social impact 'parameter' item issues have been identified and are revi

- Human/Economic Development and Quality of Life Issues;
- Air Quality Impacts;
- Noise Impacts;
- Soil and Erosion Impacts;
- Water Quality and Hydrological Impacts;
- Plant and Animal Impacts;
- Historical and Cultural Impacts;
- Aesthetic Considerations; and
- Hazardous Materials and Waste Impacts.

TABLE 4.4.1: SUMMARY OF POTENTIAL IMPACTS AND MITIGATION MEASURES

Aspects	Activity	Mitigation
	Construction	
Land acquisition project affected persons and land use issues	- Project affected persons, land acquisition - Vehicle tracks and movement of machinery - Bush clearing - Borrow pits - Stock piling of material - Construction camp services and housing - Water abstraction	Compensation to affected perso acquisition impacts and rehabilit interrupted livelihoods. Prepare Minimise or avoid where possibl Develop rehabilitation programm tracks, borrow pits and quarries Avoid environmentally sensitive Negotiate with farmers Regional and MAWRD Cap newly established borehole hand dug wells used during cons
Flora and wildlife	- Bush clearing - Borrow pits - Stock piling of material - Construction camp services and housing - Illegal hunting - Firewood collection	Minimise Use existing pits and rehabilitate Avoid environmentally sensitive Strict control measures Strict control measures
Noise and Vibration	- Construction activity and heavy equipment	Conduct construction at selected Minimise with noise suppression
Air quality	- Dust	Dust suppression measures
Water Quality and Erosion	- Sewage - Waste - Water abstraction - Sedimentation and erosion control	Waste management programme Negotiate with farmers and MAW Cap newly established borehole reserve or protect any hand dug Design appropriate sedimentatio erosion control measures Develop borehole monitoring pro
	Operations	
Road traffic	+ Less road accidents	None necessary (Monitoring by t authorities
Air quality	+ Reduction of air pollution by vehicles	None necessary at this time, exc monitoring Establish standards
Settlements	- Uncontrolled settlements near railway stations and rail	Land use and town planning sch controls

Aspects	Activity	Mitigation
Waste Disposal and Hazardous Materials	- Spills of hazardous substances	Risk management programme a contingency plans for hazardou spills
Water quality	- Sewage - Waste - Water abstraction	Waste management programme Cap newly established borehole preserve or protect any hand du used Monitoring
Noise and Vibration	- Train operations	Design for noise mitigation mea sensitive receptors Scheduling of operations at nigh Establish standards
Drainage Patterns	- Obstruction of natural flows	Provide adequate drainage stru
Wildlife and Livestock	- Obstruction of migration routes - Accidents	Provide crossing points Selective use of fencing near we areas for safety reasons

- = negative impacts, + = positive impacts

Human/Economic Development and Quality of Life Impact Issues

Construction (Primary) Impacts

Consistent with conclusions of the baseline condition reviews of human/economic devel quality of life issues, social impacts should be investigated more thoroughly through prep Land Acquisition Action Plan (LAAP) for this project. This should be done prior to anc final design process to quantify more accurately such impacts. This includes the identific and equitable compensation policies and organization considerations for implemer monitoring of program objectives. This LAAP in itself is a mitigation measure. All this s done through an intensive community participation programme.

Table 4.4.2 summarises potential land acquisition needs of the proposed rail extensior the links identified earlier under study. These estimates were developed using available from documented resources and available engineering preliminary designs at the time o Density information and assumed household size and household per structure or structure for traditional buildings were utilised to estimate the number of household impacted and project affected persons (PAP's).

At this time it was estimated that construction of the proposed project railway line would r acquisition for a 60 meter right of way or reservation area for the complete route alignme estimated at 350 km, as well as additional land for station and supporting facility sites. Th needed for the main line would be approximately 2 100 hectares plus almost 60 hectares and other support facilities.

All this information is very preliminary and allows for a reasonable basis to estimate cost land acquisition and selected impacts associated with likely relocation of project affect

MARY OF CIVIL LAND ACQUISITION NEEDS AND ESTIMATED COSTS

RAIL EXTENSION PROJECT LINKS										
FIRST PHASE: TSUMEB TO ONDANGWA			SECOND PHASE: ONDANGWA TO OSHAKATI			THIRD PHASE : ONDANGWA TO OSHIKANGO			Total System	
Ha (km)	N$/ha Assumed unit/value (nature of land)	Estimated cost (N$)	Ha (km)	N$/ha Assumed unit/value (nature of land)	Estimated cost (N$)	Ha (km)	N$/ha Assumed unit/value (nature of land)	Estimated cost (N$)	Ha	Cost (N$)
600.00 (100.00)	250.00 (Commercial)	150000.00							600.00	150000.00
840.00 (140.00)	250.00 (Communal)	210000.00	300.00 (50.00)	250.00 (Communal)	75000.00	360.00 (60.00)	250.00 (Communal)	90000.00	1,500.00	375000.00
8.30	250.00 (Communal)	2075.00							8.30	2075.00
16.00	1500.00 (Urban Municipal)	24000.00							16.00	24000.00
			8.30	1500.00 (Urban Municipal)	12450.00				8.30	12450.00
			9.60	1500.00 (Urban Municipal)	14400.00				9.60	14400.00
						16.00	250.00 (Communal)	4000.00	16.00	4000.00
1,464.30		386,075.00	17.90		101,850.00	16.00		94,000.00	2,158.20	**581,925.00**

or reservation area

IMATE OF PROJECT AFFECTED PERSONS (PAPs) AND HOUSEHOLD STRUCTURES BY RAIL LINE LINK

timated of PAP's			Estimated Household/Structure (see Assumptions below)	Assumed Compensation Value Level per Household/Structure (N$)	Total PAP/Household/Structure Assistance or Compensation Cost (N$)
dangwa					
)	PAP's Density/km²	PAP's			
)	500	30	24	1,000.00	24,000.00
)	300	324	243	1,000.00	243,000.00
)	50	156	117	1,000.00	117,000.00
)	15	42	32	1,000.00	32,000.00
)	5	11	8	1,000.00	8,000.00
		564	**424**		**424,000.00**
Oshakati					
)	PAP's Density/km²	PAP's			
)	500	165	125	1,000.00	125,000.00
)	300	333	250	1,000.00	250,000.00
)	50	20	15	1,000.00	15,000.00
)	15	0	0	1,000.00	0.00
)	5	0	0	1,000.00	0.00
		518	**390**		**390,000.00**
Oshikango					
)	PAP's Density/km²	PAP's			
)	500	0	432	1,000.00	432,000.00
)	300	576	63	1,000.00	63,000.00
)	50	84	0	1,000.00	0.00
)	15	0	0	1,000.00	0.00
)	5	0	0	1,000.00	0.00
		660	**495**		495,000.00
		1,741	**1,309**		**1,309,000.00**

The following are potential construction impact issues. Wherever possible preliminary c of impacts (subject to adjustment during more detailed investigations) are presented:

a) Project Affected Persons (PAP's) and Household/Affected Structures

These are significant and important types of impacts likely to result from the prc on density information from available documented sources and estimate of 1 affected persons for various land areas along the rail reservation area was esta number of 'family households' structures was assumed and estimated at 1,3C assumptions of persons per household structure along each link. The problems o of residential structures affected is complicated by traditional practice ir homesteads. Homesteads are generally composed of a number of structures loc 'compound' settlement. These estimates are likely to be low. Table 4.4.3 sum information by link. Though these impacts are preliminary, they should be h sensitive and equitable manner. Household size was utilized and considered to number of residential structures likely affected and any assistance costs for fam considering all traditional members of the household. It was assumed that othe such as businesses or non-traditional residences would be very minor or avoided.

b) Effect on Housing Quality

Overall housing quality should be improved as older or substandard houses are and replaced by new houses built to higher standards. Where possible new hou connected to water and electricity services provided the users can handle the costs in the future. Resettled persons could likely be given cash subs transportation payments to aid in resettlement, consistent with Namibian govern Resettlement projects could be viewed as economic development projects resulting in improved living standards. Both traditional or non-traditional economically disadvantaged areas should approve of the removal of old or structures and resultant upgrading actions. These issues must, however, b through community participation surveys as a next step. They are, however, ofter a condition of loans by international funding agencies to improve quality o economically disadvantaged.

c) Division of Extended Families

A positive benefit could occur from provision of additional housing to allow young of extended families to establish separate households in new housing, which car a desirable result by the families involved.

d) Severance and Access

Some negative impact may result from separation of communities near the p alignment with respect to access to schools, heath facilities and other communit selected areas, particularly in densely populated areas. Similar social impacts separation from neighbours and families and disruption in patterns of social i urban areas. This is not considered significant, however, due to the rail traffic fc nature of most operations occurring during nighttime.

e) Disruption of Institutions and Businesses

f) Disturbance of Burial Places

Some burial places may have to be relocated by the proposed rail extension proje cause some disturbance to families affected. At this time no known burial sites are the rail project and will be avoided, where known, during the final design process.

g) Social Impact from Construction Workers

The construction work force could be housed temporarily at various sites. Any l large numbers of workers from outside of local settlements or villages is expec temporary impacts from social and economic interaction with the local populatic numbers of the work force come from local villages this will be a positive benefit.

h) Local Employment Opportunities

There should be temporary benefits to local residents as they provide food, and construction workers and as construction contractors make incidental purchases economies. The construction of the proposed rail extension project should creat to 300 jobs annually during the two year construction period. A large percentage o will be in the labourer classification. It is anticipated that persons residing within e disadvantaged rural areas will be provided job opportunities during construction.

i) Loss of Productive Lands

Amounts and types of productive lands likely to be lost by the proposed rail line c are summarised in table 4.42 presented previously. These are considered very 'order of magnitude' estimates. A total of more than 2 100 hectares of produc estimated to be lost and 34 hectares of municipal urban land. These are broke follows:

Land use	Hect
• Communal Lands (North of Oshivelo)	1,5
• Commercial Farm Lands (South of Oshivelo)	6(
• Urban Municipal Lands (Large Communities North of Oshivelo)	3

j) Separation from fields

It is not anticipated at this time that extensive land areas for commercial farmlan fields and other commercial farmland production areas will be separated from t houses by the proposed rail line. More detailed field surveys are needed as a r confirm this, however.

k) Disruption of Existing Traffic Flows

During construction there may be temporary diversions of traffic along the rail net the new railway line crosses existing roads, as well as temporary blockage of structures and roadside areas in urban built-up areas.

prevalent in the alignment corridor, except within densely populated urban cer Ondangwa, Oshakati or Oshikango.

m) Accidental Temporary Disruption Services

During construction there may be some accidental or temporary disruption of ele water supply or temporary blockage of access and other services.

Operational (Secondary) Impacts

a) Regional Economy

The regional economy is expected to improve due to improved access an transport efficiency. The local population will benefit from these improvem operations.

b) Access

Access should be improved for local residents for necessities, consumer goods, and transportation overall.

c) Income and Employment Opportunities

Income of local residents is expected to rise as a result of the improved transpc from the rail extension project. More diversified employment opportunities are a result.

d) Local Economy

After construction is completed, employment opportunities should be a maintenance of the rail line. Service and maintenance areas should be constru railroad stations, including restaurants and hotels, thus providing additional employment opportunities. As new economic development zones may be planne rail line, other employment opportunities could arise in the service sector.

Induced development should result from the proposed rail extension project at l and intermittent passenger platform locations near existing urban areas and growth points. This development should occur proportionally to the induced traffic both the railway and nearby roads.

e) Congestion on Existing Roads

As rail operations get underway, congestion on nearby existing roads to the propc line should decrease. This will provide time savings, decrease stress on passengers, decrease noise and improve air quality along existing roads.

f) Highway Operational Safety Issues

Improved operating conditions on existing nearby roads and appropriate effec standards on the rail line should improve safety conditions and decrease the acci existing roads.

g) Public Transport

h) Railway Public Safety Issues

Rail travel is considered the safest mode of vehicular ground travel. However, resi line communities and motor vehicles constitute the primary safety concern for a n Trains on the proposed railway line would travel at a maximum design spe kilometers per hour with an operating speed of 60 kilometers per hour, as allowed lines elsewhere in Namibia. Although the number of trains would be fairly mo would still be a need to inform and educate the public of the existence and potent of walking on or across the right of way. This is particularly true in the case of childı

i) Stations and Supporting Facilities

The trains, operating and infrequent intervals, will generate increased levels of traf stations, but will also create economic opportunities that will benefit the commu services, food and beverage services and parking facilities will be required.

Mitigation of Social Impact Issues

a) Avoidance of Impacts

The necessity for removal of houses, relocation of population and loss of productiv be minimised or avoided by careful final route selection and sensitive design d detailed design investigation.

b) Land Acquisition Action Plan

Provisions of the Land Acquisition Action Plan (LAAP) should be followed with compensation, relocation, reallocation of land, project affected persons (PAP's) and monitoring procedures consistent with Namibian policy guidelines and project agency procedures. Specific actions include the following considerations:

- The project impact area is extensively cultivated or used for grazing, invc commercial and communal lands, however some sections are developed in urban areas. Special attention should be given to road route designs to avoid impacts if possible. Construction of the railway will likely involve loss of agricu Consultation with local people is important. Incase of permanent losses, there serious negotiations between proposed Compensation Committees administrations and traditional leaders about new lands replacements. assessments should be conducted of the project impact area, including the s quarry and subbase material sites and considered in the compensation plan and implemented. (The representation of proposed Compensation Committee defined, responsibilities identified and status as to a permanent or temporai during final design.)

- While there would appear to be no restriction on constructing detours on arabl affected communities should have the right to be consulted over the se construction material sites and routes for haul access roads and detours to th to minimise potential damage.

- Adequate planning measures in the development of project rail and supporti road designs. The scheduling of construction activities should consider the l such utility services where available well in advance of construction. Consic contingency plans to handle negative impacts such as service overloads

- Consultations with regional or local administration and traditional leaders to n removal of houses should be seriously considered. The Compensation should be involved in all resettlement planning.

- Compensation should be made for property, especially any businesses, l land. Compensation according to Namibian and project proponent procedure paid for houses and business establishments. According to international compensation often may be required for all property within the right of way, re legal status, as part of the conditions of a loan. Other conditions of loans r formation of Compensation Committees to establish other assistance costs fo

- For economically disadvantaged non-farm enterprises which could be affect businesses and factories, in some instances, additional land might be made a expansion of the enterprises and loans might be given for technological impro possible mitigation measures.

c) General Public Safety Issues

To promote public safety, an adequate public awareness programme of rail ope safety issues should be implemented. Selective use of fencing in densely populat at selected highly traveled crossing points such as roads and livestock migra should help ensure safe operating conditions of the railway line. (The fencing, hov be maintained and protected by local authorities to be effective.) Well marked communications signals and signs should help warn vehicular drivers, pedestrians of train operations.

d) Severance and Access

To mitigate severance and access issues associated with construction and opera proposed rail line creating a barrier to the movement of pedestrians and vehicle side of the line to another several options are available. The needs of local res motorists to cross the route should be carefully studied and grade separations crossings established where needed. All major road crossings should be grade where possible or protected by barriers and/or signals as specified by traffic standards. Unprotected level crossings should be provided as required, but minimum. Pedestrian overpasses should be built at sensitive locations where a such as near schools. The design of the railway should, to the greatest exter maintain access across the rail route consistent with safety.

e) Construction Camp Labour and Site Impacts

To mitigate social impacts resulting from construction camps the following considered:

- Recruitment of unskilled and semi-skilled employment should be done with th operation of regional and traditional leaders. Consistent with the Namibian c women should be given equal opportunities. This not only has the ad fostering a positive view of the rail road by generating income for the affected but it will also minimise social disruption, because resident members of the do not place additional strains on local resources.

- Pressure on local accommodations may be greatly eased through strategies worker demand for accommodation consistent with the free enterprise

- Strategies regarding the catering sector should be considered. Catering t force generates additional local income in the restaurant sector and this w boost for what is predominantly a female occupation. Community income m enhanced if priority is given to local women when recruiting cooks for camps.

- The contractor should be responsible for setting up on-site first aid and cli with sufficient staff and facilities to undertake both preventative medicine an aid, if there is not an existing clinic. Where there are clinic outreach points, th developed. All of this should be done in co-operation with the Ministry of Social Services (MHSS).

- Health education about venereal diseases, especially HIV/AIDS transmissio introduced to the work force.

- Planned development of construction sites should be selected in a way whic consideration the available natural resources (such as availability of water, potential permanent settlement in the future. Such planning should 'fit' in Development Plans and should they be designed to become permanent operation with regional leaders to identify sites should be done. The fa contractor will choose the construction camps on technical bases, locatin intervals, should allow enough flexibility in selection of the sites. The prec choose the location of the camp should be the same as for any planned residence place. Enough water for present and future use, needed for settlement and their use, should be planned and controlled.

f) Health, Sanitation and Occupational Safety Issues Regarding Construction Activitie

Construction of the proposed project rail way can result in specific health impacts f close to construction sites and the workers. To minimise the potential healt following mitigation measures are recommended:

- Ensure that adequate health facility systems are in place on-site to deal with temporary workers and open these facilities to local residents as a benefit of to the community. An agreement should be reached with MOHSS on cost of be paid by users.

- Pre-employment medical screening and effective medical treatment of worl reduce the likelihood of disease outbreaks. All applicants for construction wo the very least have a check-up for debilitating diseases and be inocul possible. Those found to be carrying diseases should be referred to the medical authorities.

- Preventive measures for malaria should be strictly enforced in construction ca be important to ensure the use of nets and insect repellents, as well as medic of malaria cases.

- The provision of safe water supplies and appropriate waste disposal facilitie the provision of sanitary latrines to control other water-borne diseases provided.

- Upon project completion water supply facilities should be available to loca Hand over of any work camp water systems in good working condition to local

- Clearly visible and appropriate warning sign on the railroad during constructic erected.

- Borrow areas should be graded in consultation with local authorities after us the formation of ponds which may be conducive to mosquito breeding.

- To control the spread of sexually transmitted diseases and promote other p conditions, consideration should be given to contracting an organisation to w labour camp population to prevent spread of sexually transmitted diseases. should be allocated to local public health services to conduct public health with the local population. The contractor should also consider providing medical facility at the construction camp to put less pressure on local medical

- Construction generated air and noise hazards should be considered as a h Excessive dust may result in respiratory discomfort or infection among peopl the construction area, while vehicular and construction equipment exhaus may affect crop yields in fields adjoining construction. Steps should, therefo to minimse such emissions.

- Steps should be taken to ensure that construction does not occur during t darkness in areas of population concentration in order to minimise discom residents.

- Site security considerations are important. The introduction of heavy e equipment will not only arouse the curiosity of adults, but especially childre view it as a natural playground. Site security should be sufficiently effective children obtaining access to such machines to avoid accidents.

- Occupational safety is important. The contractor should ensure that all w aware of occupational safety procedures commensurate with their level of re Such measures should at the very least correspond to the requirements laid d Government of Namibia. Basic instruction in the local dialect (Oshikwa Oshindona) should be provided for unskilled labourers.

Air Quality Impacts

Construction Period

a) Dust

During construction dust can be a major problem, especially in populated areas. aggregate production, concrete mixing and construction traffic and emissions fr plants and from operation of heavy diesel equipment will affect air quality construction phase. It is likely that impacts will be confined to areas within 30(downwind from construction sites.

Operation Period

It should be noted that the energy consumed for a person travelling by rail is comparable bus and is about 50% less than the energy required per capita in a private car. Simila used by a ton-kilometer cargo on rail is about the same amount used by trucks.

a) Diesel/Locomotive Exhaust Gases

There would be two modes of diffusion of the exhaust gases, which are:

- Point static source diffusion during train stops at stations; and
- Moving point source during trains running.

Air quality impacts during train stops at a station will be only for a short time peric be between one to two minutes for normal operation. The immediate nearest rec within the station compound and the nearby community within a radius of about around the station. In case of a train travelling at an average speed of 60 km/hr point source of polluted air would generate only instantaneous impact to any which are located beyond the 25 m distance from the track. Initial dispersion at s trains running would eventually reduce the source to an appreciable level and it that impacts on the receptors along the line would be negligible.

b) Standards

At the time of this report Namibia had not officially established any ambien standards. Unofficially such standards are likely to be based on German, Sc United States or other international guidelines. The Ministry of Environment a (MET) should be contacted to obtain such guidelines and advice conc measurements of available ambient quality levels along the proposed rail alignr measurements be required to predict impacts. At this time such impacts are insignificant due to rail traffic forecasted.

Mitigation

a) Provision for water sprinkling of haul roads and construction zones should control by construction activities.

b) Minimising clearing of vegetation should help mitigate dust. Asphalt constru should be sited more than 400 m downwind from nearest settlement areas.

c) Dust suppression equipment should be installed on batch plants.

d) Proper maintenance of construction diesel equipment and curtailment of unnec should be practiced to help control emissions.

e) In order to reduce the effects of air pollution, new building construction should b within 100 m of the edge of the new rail line. Farmers should also be discoura prohibited) from growing crops used as fresh foods (such as vegetables) within 1 rail line.

f) Policies to encourage reduction of lead in fuels as an energy source should be Evidence concerning lead migration from the soil into crops is inconclusive, but cc from airborne particles is proven and all this may not be washed off before cooking

Noise Impacts

Construction Period

a) Noise impacts during construction can be severe. These result from construction general but particularly from operation of heavy machinery. Other operations

Operations Period

a) Once the line is in service the operation of trains typically produce sound lev 90 dBA measured at a point 30 m from the track. Considering the number of tr forecast, the equivalent sound level over a 24 hour period should be well below thresholds. With properly maintained trackage, vibrations should not be a signific

b) At the time of this report, Namibia had not officially established any noise qualit Unofficially such standards are likely to be based on German, South African, Unit other international guidelines. The Ministry of Environment and Tourism should l to obtain such guidelines and advice regarding any measurements of availa quality levels along the proposed rail alignment should measurements be requir impacts. At this time noise impacts and vibration should be considered minor due of traffic anticipated and its scheduling. This impact was judged to be mir mitigation measures are implemented.

Mitigation

a) To reduce night time disturbance from construction noise, construction activitie prohibited between the hours of 21h00 and 06h00 in areas which are withi residences or other noise sensitive receptors.

b) To help avoid the adverse impacts of noise, new construction should be prohibite m of the edge of the railway line.

c) Additional surveys should be undertaken in setting a final route location to sensitive receptors. Any schools or other land uses sensitive to noise (such as h which are found to be unavoidably impacted within a 100 m zone should be reloc beyond 200 m.

d) Final engineering design should be reviewed to determine whether any noise ser will be affected.

e) Noise sensitive receptor locations identified in any subsequent surveys should be of design analyses to incorporate appropriate mitigation measures. Solid ma earth berms, cuts in the natural terrain, other types of noise barriers and depre railway below the surrounding surface are considered effective noise attenuatic Planting of vegetation screens are not considered, in itself, as an effective metho of any noise mitigation measures should be included as a part of the final design c if required. At this time such measures are not considered likely needed in the sh may be needed on the long term when operational traffic intensity increases.

Soil and Erosion Impacts

Construction Period

Construction activities, including land reclamation, grading and excavation, can ger amounts of dust and storm water run-off that passes through construction areas. They sedimentation and turbidity in water into which the run-off drains. This could induce tem water quality, though only for short periods. However, mitigation measures should be de implemented to minimise the effects of construction activities on water quality in drainage other water resources.

b) Clean Up Issues

Failure to properly clean up and replant borrow areas, fill areas and spoil disposa lead to erosion problems. Some of the soils in the area of the railway are consider Final estimates of the area of coverage for waste solid disposal has not yet b pending further engineering analysis.

c) Diversion of Existing Drainage Courses

Diversion of major drainage courses or any significant alteration of surface wate along the railway could lead to erosion problems.

d) Diversion of Rivers

Short – or long-term diversion of rivers for bridge construction could lead to erosion, unless properly carried out. At the present time only one river bridge and location are just south and north of Oshivelo. From other drainage structures (culv located over oshanas between the Ondangwa and Oshakati link section.

e) Vehicle Tracks

Temporary haul roads on solonetz soils prevalent in the northern part of the study destroys surface structure and can leave enduring tracks. This facilitates soil e prevents re-establishment of vegetation.

f) Construction Camps

Apart from the physical impact on soil and vegetation, activities in the construction c in the creation of domestic, industrial waste and sewage. All these could severely human health, animal and plant life and could have a long-lasting, negative visua the landscape, including soil erosion and contamination implications.

Operation period

a) Runoff

Continuing run-off from areas not properly resurfaced or revegetated along finishe roadway cuts or embankments would lead to erosion.

b) Lead Contamination

Lead contamination of the soil from operating vehicles on service roads and exhaust emissions can be treated as both a soil and air pollution impact if lead base used.

Mitigation

a) Borrow areas will be excavated and fill areas should be filled in such a way as rehabilitation. Stability of slopes at cut faces should be maintained by 'benchi installing erosion protection devices during construction such as silt ba sedimentation ponds. Any trees or vegetation along borrow pit edges should be Random movement of heavy machinery at excavation sites should be prevente created borrow areas should be replanted or transformed into ponds in consultatio

c) For disposal of waste soil and rock, both the placement of the materials (not in dumping) and appropriate rehabilitation methods are important. Placement area selected with aesthetic considerations in mind as well ass for economy and transport. Spoil placements should be designed with slopes that will b consideration of the type of material to be placed. Rehabilitation should incl compaction and stabilisation, as well as planting with vegetation types that have r which would hold the soil in the early stages, then with trees and larger vegeta stages.

d) Maintenance of railway line slopes, cuts and embankments, such as watering, fer control and replanting when needed should be implemented. Maintenance of all should be budgeted as part of regular railway maintenance.

e) Keeping the use of temporary vehicle tracks to a minimum and developing a v rehabilitation program should help in mitigating both erosion and dust impacts.

f) To mitigate the negative impacts from construction camps on soils, avoid env sensitive areas in the location of such camps and implement a waste and sewa programme. Rehabilitation of land and soils after a construction camp is no long help to mitigate temporary unavoidable adverse impacts.

Water Quality and Hydrological Impacts

The only river crossing in the study impact area is located south of Oshivelo (Omuram Bridge). Four other culvert drainage structures are located on the Ondangwa to Oshaka railway line to provide sufficient drainage for the oshanas. One other culvert drainage located just north of Oshivelo.

Construction Period

a) Construction scheduling

Mitigation of constructing drainage facilities and railway embankments includes construction during the dry season to minimse any temporary short term negative e there is a possibility of ground water contamination and surface water contaminat of six drainage structures are presently proposed.

b) Alteration of Natural Drainage

The entire northern section of the study area presents an area of interconnecte channels forming the Cuvelai drainage basin. Any built-up structures, such as ra roads obstruct the natural flow of this drainage area. Apart from blocking the wa possible drying up of areas downstream of the obstructing structures, major flood cause wash-out of sections of the railway line and thus pose a safety risk. Wi culverts result in channelling of water and subsequent erosion down-stream. T negatively impacts on soil fertility and vegetation cover, as well as water quality.

Any construction which cuts off the oshanas, for example along the route d Oshakati to Oshikango, will have an adverse effect on the food and water resourc downstream of the obstruction. Although there will be no direct impact on the fish since they are seasonal and will either be eaten or die when the water drie pers.comm), fish will not reach the cut off sections of the oshanas.

as well as flooding and absorption of pollutants from areas which have not pre\ subject to flooding.

c) Contamination of Water Resources

Surface water or ground water may be contaminated by improper utilization o construction materials which are toxic or hazardous, such as chemicals o products.

d) Local Flooding

Local flooding could be caused by construction watering or flushing of constructior

e) Water Abstraction

The water requirements for the construction of the railway line equals thc construction, i.e. and is substantial. Abstraction of large amounts of water fi boreholes will likely result in the lowering of the water table and thus affect bore entire area of an aquifer. A major part of the proposed project rail line will likely water pipelines (bulkwater) north of Oshivelo.

f) Sewerage Disposal Contamination

Contamination could arise from lack of proper treatment and disposal of s\ construction work camps. Likewise, workers need an adequate supply of safe \ cooking water.

g) Sand and Gravel

Sand and gravel removal from drainage areas is not expected to have any adv\ These areas are traditional sources for sand and gravel and have long been in use

Operation period

a) Surface Run-off

One impact during operation is expected to be surface water and ground water cc from rainfall run-off from the railway line, where it has concrete roadbed surface, road crossings or other uses. This should be minimised.

b) Hazardous Materials

The risk of hazardous material spills is discussed elsewhere under this topic.

c) Contamination of Water Resources

Contamination of water resources from operations of untreated waste dispo: sewage and disposal of maintenance fluids, such as used oils, etc can contan resources. Ablutions will be needed to serve human needs which, in turn, will cre This could potentially pollute the ground water and thus negatively effect human h\

Mitigation

b) To maintain adequate flow of existing drainage systems, installations (culverts, bridges) must be based on hydrological studies and evaluations of existing dra Contaminated surface run-off from rail crossings or roads and other landus separated from existing drainage locations.

c) Toilet facilities for construction workers will as a minimum be pit privies which are s maintained, including removal and processing of sewage when they fill. permanent ablutions with french drains system should be maintained at any main camp. Sufficient portable toilets at the construction sites should be serviced a daily.

d) To mitigate water abstraction, the following options should be considered:

- avoid fresh water springs and their surroundings for location of supporting ir and other permanent land uses, associated with the railway;
- establish recharge potential of existing boreholes;
- develop strategy for borehole usage in consultation with respective farmers;
- devise water saving strategies; and
- cap newly established boreholes after use.

e) To further mitigate impacts on natural drainage systems and water quality:

- avoid crossing oshanas, where possible (eg by routing the northern section of line along the B1, rather than west-east from Oshakati;
- where the culverts are used, space closely to reduce the channeling effect; anc
- investigate the effect of different types of culverts along existing roads c drainage lines (oshanas).

f) Any surface run-off from rail maintenance facilities or railway crossings with roads be channeled directly into water courses, but should be directed to det sedimentation basins or allowed to flow over grassed areas. This will permit the se fine materials, the detention of oily water and the reduction of volume and rate of fl

Plant and Animal Impacts

Construction Period

a) Loss of Vegetation

Loss of vegetation and consequently flora and fauna natural habitats will occur unavoidable impact. Some flora species are protected under the Forestry Ordnan in base studies and may be present in the proposed right of way. There is expect impact on rare or endangered animals.

b) Indiscriminate Dumping

from negative effect on human health, vegetation in the vicinity would suffer eventually result in localised dying of plants.

d) Borrow Pits and Quarries

The excavation of fill, road, roadbed and supporting land use construction mater the removal of topsoil and seed bank, thus reducing the potential natura replenishment.

e) Earth Moving Equipment and Heavy Machinery

Heavy machinery require turning points and create deep tracks at those sites. destruction of soil structure and reduced rehabilitation potential, as well as ne effects are the main impacts. Plant seeds are often dispersed by the coarse trac machinery. This could contribute to the spread of weedy and exotic species.

f) Bush Clearing

In heavily bush encroached areas, such as parts of the commercial farmland, bus combination with appropriate farming practice may help the establishment of more diverse vegetation. Clearing of vegetation is part of the construction p results in localised removal of vegetation, albeit in many parts in already degr Apart from locally reducing plant populations and associated animals, the loss o cover may lead to erosion, subsequent loss of topsoil and creation of dust.

g) Illegal Hunting

Poaching of livestock and game could severely decimate animal populations in tl would result in conflicts with farmers. This would create a very negative public responsible for the construction work, as well as the project proponent a commissions the work.

h) Firewood

Although firewood is readily available in some parts of the study area, eg the south the additional pressure on fuel wood resources by construction workers will have impact on the natural resources in the area.

Operating Period

a) Spread of Alien Organisms/Diseases

Invasive weeds and alien organisms have reportedly been spread with improve facilities. A railway line would provide an additional route for spreading unwanted

b) Uncontrolled Settlements

Improved access may result in uncontrolled development of temporary and settlements in the vicinity of railway stations. This may result in clearing of trees material and firewood and depletion of grazing by livestock, thus having a negativ the natural resources of the study area.

c) Migration of Livestock and Wildlife

Mitigation

a) Since soil erosion will occur in areas left without vegetation, stabilisation with pl as soon as work ceases will be necessary. The use of fast growing local grasses trees is recommended.

b) Trees and other vegetation provide fiber, food and fuel, they reduce erosion ar they improve air quality by producing oxygen. Revegetated areas may also event habitat for animals. Replanting along the railway line should consist of a multi-sp local vegetation similar to the mix and composition in existence in the region. Th made a part of the railway contractor's responsibility, to be estimated and bu construction cost. This must be studied thoroughly in the final design phase. landscaping around stations, supporting facilities and other nearby rail land us employed using local species and replanting any protected flora species disco reservation areas. This also needs further study during the final design.

c) Most of the naturally occurring animal species have long since been lost to the than some common species of birds, small mammals and amphibians. However could be made to stop and reverse the steady decline in available habitat.

d) The negative impact of bush clearing can be mitigated by keeping clearing to a r operating in already disturbed areas, where possible.

e) To minimise clearance of vegetation and loss of animal habitat the following a measures:

- avoid environmentally sensitive areas, such as Lake Otjikoto, the Etosha Pa rock outcrops, springs and caves for route alignment;
- follow the existing trunk road B1 as close as possible; and
- locate the route for the railway line east of this road.

f) To mitigate the negative impacts of borrow pits and other materials sites the follo are available:

- use existing borrowpits, where possible;
- limit access roads to borrow pits to one;
- avoid environmentally sensitive areas for location of borrowpits;
- position new borrowpits out of sight, where possible; and
- rehabilitate all borrowpits no longer in use.

g) To mitigate the negative effect of earth moving equipment and heavy mach construction the following measures are available:

- develop track rehabilitation programme for heavy machinery; and
- Avoid areas with stands of invasive exotic species, such as Datura innox

- carrying out an awareness programme for livestock owners.

i) Mitigation of the use of firewood includes:

- providing commercially obtained firewood or charcoal or other alternative fu the construction work force; and
- imposing strict penalties for firewood collecting.

j) To mitigate the negative effects of alien organisms and diseases, measures incluc

- regular cleaning of wheels and tracks;
- cleaning of containers; and
- use existing livestock disease control checkpoints for regular checks of containers.

k) To mitigate uncontrolled settlements and other induced developments near oper stations, options include:

- developing urban area land use plans and settlement plans along the entire and
- providing services and facilities (such as water) only in areas designated for s such plans.

l) To mitigate the negative effects of indiscriminate dumping and stock piling of materials use of existing disturbed areas for dumping and stockpiling of material borrowpits should be considered. Selecting sites should be carefully studied and p

m) To mitigate illegal hunting, the imposition of strict penalties should be considered.

Historical and Cultural Impacts

Construction Period

a) Archaeological and Historical Sites

The proposed track alignment does not impact or encroach upon know archaeological or historical sites. There are several places of historical/cultural i the proposed rail corridor and in the Four "O" Region. These were reviewed un conditions. A possibility always exists of unanticipated finds of such resou excavation or site clearance activities.

Operation Period

a) No impacts on historic or cultural resources are expected during operation.

Mitigation

a) Due to the possibility of unexpected finds of historic sites, fossil or archaeological

Aesthetic Considerations

Construction Period

a) Spoils and Waste Sites

Placement and rehabilitation of spoils or waste soil areas could create negative vi unless properly carried out.

b) Visual Intrusion

The proposed track alignment is not routed through any areas where it would be c have detrimental visual effect.

Operation Period

a) No operational aesthetic impacts are anticipated

Mitigation

a) Placement and rehabilitation of spoils and waste soil should be planned and e sensitivity to topographic and visual aspects and should be carried out in such a disposal areas enhance rather than detract from the visual quality of the railway ro

b) Tree and vegetation landscaping along the railway especially at stations and facilities should be planned to be decorative and visually pleasing as well a Flowering shrubs should be included among the species planted.

Hazardous Material Impacts

The most common hazards occur from the transport and use of petroleum products an although occasionally problems occur with explosive, corrosives or toxic materia construction and operation there is a danger of spills in construction areas, on drainag on soils or into surface water. During construction the possibility of impact arises fr improper usage or storage of hazardous materials.

Construction Period

a) Accidental Spills and Improper Storage of Hazardous Material

Accidental spills or improper storage of hazardous materials at construction maintenance facilities may contaminate soil and water resources, wildlife habitat human settlements.

b) Domestic Waste

Some domestic waste, such as glass and tins is used as material for making toys be sold on local markets. Domestic waste in form of organic material, glass and p produced during the construction operations. Uncontrolled disposal in comb strong winds scattering the waste could result in a negative visual impact on the and a negative impact on human health, animal and plant life.

Operating Period

b) Industrial Wastes

Industrial waste will be created during maintenance of vehicles and machinery : scrap, waste oil and other lubricants. Liquid waste products could result in soil water pollution and severely impact on human health. Solid waste, such as serves as a death trap for children playing in the area and animals. It also has a negative visual impact on the landscape.

c) Probability of Risks

There are standard methods of calculating the probability of risks of hazardo spills. However, regardless of how small the probability may be, there is a possibility of a major spill on any given day. There is simply not enough available to predict the probability of spills and associated risks at this time. This needs f There is, however enough information available to indicate that there is a subst spills. Petroleum spills represent the most likely type of spills, but hazardou produced and used in the area in the future which may likely be shipped by rail (likely types of hazardous materials spills.

Mitigation

a) During design, provision must be included for paved side ditches, berms, cl detention ponds for run-off. Even though the primary function of these structur control rainfall run-off, they should be designed so that outlets can be temporally soil or other material to contain hazardous materials spills.

b) During construction, monitoring should be carried out to observe whether materials, including petroleum products, are being transported, handled and store(

c) Vehicle and rail equipment maintenance mitigation measures include:

- avoidance of environmentally sensitive areas for location of maintenance facili
- providing storage tanks for oil, fuel and other lubricants on erected con(surrounded by bund walls;
- using drip trays during oil and lubricant changes;
- draining all waste oil and lubricants into containers and keeping such materia tanks for final disposal; and
- following Namibian and international guidelines for industrial waste disposal refuse.

d) Hazardous spills contingency plans regardless of risk should be prepared an(should ensure that emergency response plans and monitoring plans have adeq allocated.

e) To handle domestic waste materials, mitigation measures include:

- initiating a litter awareness programme;

- collecting material for recycling such as glass separately and organise regul and

- encouraging of regulated collection of recyclable material by the local populatio

f) Mitigating of industrial waste from rail operations includes:

- using of municipal and other regular waste dumps for disposal; and

- separating hazardous from recyclable material and encouraging controlled c the local population.

g) An effective waste and sewerage disposal programme for construction camps and should be established. During design avoidance of any sensitive site areas for construction camps should be considered.

h) The only effective mitigation for hazardous materials spills during the operational be prepared for any type or magnitude of spill at any time. For protection during o spill contingency plan must be prepared and put into effect. The plan should spec take action and what will be done in the event of spills. It should also specify equi tools which must be available and material to be used to contain or control variou spills. Training must be given to maintenance and operations personnel in implem the plan and in addition, management, supervisory and administrative personne trained in their roles during response situation.

SECTION 5: ENGINEERING

APPENDIX 5.1

NAMRAIL SPECIFICATION FOR BALLAST STONE

1. GENERAL

1.1 Stone for road pavement layers, concrete and ballast shall comply with SABS 1083 (latest revision). In addition, concrete and ballast stone shall comply with the requirements specified hereinafter. Acceptance of the stone shall also depend on a full petrographic analysis to identify any microfissuring, weaknesses and/or the presence of undesirable minerals that could lead to early degradation.

2. CONCRETE STONE

2.1 In the soundness test described in Appendix A, the loss in mass shall not exceed 5% after 10 cycles of the tests.

2.2 The Los Angeles abrasion value, determined in accordance with ASTM C 131 - 89 grading B, shall not exceed 30% for concrete subject to abrasion and 35% for any other concrete.

2.3 The relative density shall not be less than 2.5 or more than 3.1.

3. BALLAST STONE

3.1 In the soundness test described in *Appendix A*, the loss in mass shall not exceed 5% after 20 cycles of the test.

3.2 No doleritic stone shall be found to be broken when conducting the durability test described in *Appendix B*.

3.3 The Los Angeles abrasion value determined in accordance with ASTM C 131 - 89 grading B, shall not exceed 22%.

3.4 The plasticity index on the fines developed from the Los Angeles abrasion test shall be less than 6.

3.5 Flakiness index, measured in accordance with SABS 1083 (latest revision) shall not exceed 30%.

3.6 Voids measured in accordance with SABS 1083 (latest revision) shall not be less than 40%.

3.7 The relative density shall not be less than 2.5

3.8 Grading shall comply with the following:

For ordinary lines (N1, N2& N3)

Nominal aperture size of sieve mm	% by mass passing
63.0	100
53.0	90-100
37.5	40-70
26.5	10-30
19.0	0-5
13.2	0-1

For heavy axle lines (S1,)

Nominal aperture size of sieve mm	% by mass passing
73.0	100
63.0	90-100
53.0	40-70
37.5	10-30
26.5	0-5
19.0	0-1
13.2	0

APPENDIX A

TEST FOR SOUNDNESS OF STONE (SODIUM SULPHATE METHOD)

A1. Test Solution

Prepare a saturated solution of anhydrous $Na_2 SO_4$ or crystalline $Na_2 SO_4 10H_2O$ in distilled or demineralised water between 33°C and 35°C. Use sufficient of the salt to give excess crystals after thorough stirring. Cool to between 22°C and 24°C and keep at this temperature for at least 16 h. Stir thoroughly before use.

A2. Preparation of test specimen

From a representative sample of stone take a random specimen of at least 500 gram passing a 19 mm and retained on a 13.2 mm sieve. Wash the specimen to remove all adhering material. Dry at 105°C in a well ventilated oven and determine the mass after cooling. Continue drying until the decrease in mass after each of 2 successive drying periods of 4 h does not exceed 0.1% of the total mass. Let this mass be M1.

A3. Procedure

A3.1 Place the specimen in a porcelain dish and cover fully with test solution between 20°C and 25°C for 7 h. Decant the solution taking care that no stone is lost.

A3.2 Dry the specimen for 15 h at 105°C. Allow the specimen to cool for 2 h. This completes one cycle of the soundness test.

A3.3 Repeat the cycle described in A3.1 and A3.2 as often as specified. After every fifth cycle, wash the specimen on a 1.70 mm sieve with hot water until no crystalline sodium sulphate is visible and continue the test with material retained on a 1.70 mm sieve.

A3.4 After completion of the final cycle, wash the specimen in hot water until the washings are free of sodium sulphate. Dry the specimen to constant mass and screen on a 1.70 mm sieve. Let the mass retained on this sieve be M2.

APPENDIX B

DURABILITY TEST FOR BALLAST STONE

B1. Preparation of test specimens

From a representative sample of ballast stone take at random 100 stones passing a 53.0 mm and retained on a 26.5 mm sieve. Wash the stones to remove all adhering material. Dry the stones at 105°C in a well ventilated oven and determine the mass after cooling. Continue drying until the decrease in mass after each of 2 successive drying periods of 4 h does not exceed 0.1% of the total mass.

B2. Procedure

Place the 100 stones in a suitable container and cover with ethylene glycol between 18° and 25°C for 20 days. Determine the number of stones that have broken, or can be broken by hand.

APPENDIX C

Mill abrasion test

1. Test method

1.1 Prepare a test sample of the ballast under test, consisting of 1.5 kg each of the following two particle sizes:

<37.5 mm >26.5 mm and <26.5 mm >19 mm.

The particles shall be washed and oven-dried to a constant weight before it is weighed and tested.

(Wo = the total weight of sample)

1.2 Place the sample in the porcelain mill pot and add 3 litres of distilled water. Ensure that the cork washer is correctly in position before tightening the lid securely.

1.3 The mill pot is placed in a horizontal position on the two rollers of the test apparatus with the lid on the side of the electric motor in order that the counter's sensor is activated with each revolution of the mill pot.

1.4 The mill pot shall be rotated at 33 r.p.m. for a total of 10 000 revolutions.

1.5 The sample shall then be wash-sieved through a 9.5 mm sieve placed on top of a 0.075 mm sieve and then oven-dried to a constant weight.

1.6 Record the dry mass of the material on the sieves:

W1 = mass of material on 9.5 mm sieve.

W2 = mass of material on 0.075 mm sieve

2. Evaluation method

Calculate the following abrasion value:

$$Wo - W1 - W2$$

APPENDIX 5.2

TEST RESULTS OF TSUMEB STONE

AFRICON

Contract Management and Materials Division
Engineering Materials Laboratory

Africon Engineering International (Pty) Limited Reg No 93/05435/07

Pretoria
993 Park Street
Hatfield, 0083
P O Box 11126, 0028 Hatfield
South Africa
Tel: 27 12 342-0524
Fax: 27 12 342-0410
e-mail:afrilab@africon.co.za
Laboratories: Durban, Maseru, Pietersburg, Pretoria, Windhoek
Divisions: Civil, Geotechnical and Environmental; Structural Engineering Services; International; Development Services and Project Management; Contract Management and Materials; Transportation; Information Technology; Electrical and Mechanical; Corporate Services; Training and Communications

TEST REPORT
SANAS
Accredited Laboratory No. T0023

REPORT No: 6719/15/4/1999/CHB/av/1

Africon Laboratory
P O Box 22600
WINDHOEK

Att: Mr H Cloete

Our Reference: 671
Your Reference:
Report Date: 15/4

RESULTS OF TEST ON STONE : HENNING CRUSHERS

1. **Samples :**

1.1 Sample Description : Attached are the results of the tests done a sample of ballast st
by the test sponsor to the Africon laboratory, for the above mentioned contract.

1.2 Date received: 8 March 1999
1.3 Date tested : 11 March - 14 April 1999

2. **Nature of test :**
Refer to the results page.

3. **Method of test :**

4. Refer to result page.

4. **Remarks :**
This report relates only to the samples tested.

C H BRITS
for AFRICON

JOB NO 6719

PROJECT: PROPOSED RAILWAY LINE

RESULTS OF TESTS ON BALLAST STONE

LAB NO	DESCRIPTION OF TEST	TEST METHOD	RESU
9/557	SOUNDNESS 20 CYCLES	* APPENDIX A	% MASS LOSS = 0,78
	DURABILITY	* APPENDIX B	NUMBER OF BROKEN - NO
	LOSS ANGELES ABRASION	ASTM C535 GRADING 3	20,4%
	ATTTERBURG LIMITS	TMH 1 A2, A3, A4	PI = NP
	R.D.	TMH1 B14	ARD = 2,860 BRD = 2,848 % WATER ABS = 0,13

* REFER TO TEST METHOD SUPPLIED BY THE TEST SPONSOR

BALLAST STONE

Previous tests done by NamRail on the dolomitic stone from Tsumeb indicated that the materi comply to the specification. In this regard the following extract from the American Railway E Association is included for information purposes:

"The ongoing ballast and roadway tests at the FAST Track have also confirmed that the Lc Abrasion laboratory Test is not indicative of the field performance of ballast materials.

We must bring to the attention of the engineer that considerable variables exist with many physical testing methods and procedures and the Los Angeles test is no exception. Not only d exist between individual tests, but between testing laboratories as well. Studies conducted Committee No C9 (the committee responsible for the ASTM abrasion test methods and p indicated that for nominal ¾ inch maximum coarse aggregate with percentages of wear in the ran to 45%, the multi-laboratory coefficient of variation is 4.55. Therefore, the results of two properly ASTM Los Angeles Abrasion tests from two different laboratories on the same sample of the sa aggregate could vary as much as 12.7%. ASTM C131 defines this variable as a part of the Lc Abrasion Test.

Likewise, the Sodium Sulphate Soundness Test is not at all precise, particularly in testing limest test results may be affected significantly if the test solution has previously been used to test other rock samples. The test does provide the opportunity to develop relationships between various ma will most certainly indicate the presence of shale in carbonate materials.

The variables in the aforementioned tests and the lack of correlation between the laboratory test performance of ballast material are the prime reasons for ongoing research to develop labora which are indicative of field performance of ballast materials. The AREA Ballast Committee pursuing current ballast testing programs in conjunction with railroads, the A.A.R, T.S.C, FAS railroad supply industry to develop laboratory tests to predict field performance."

APPENDIX 5.3

ESTIMATED CONSTRUCTION PERSONNEL REQUIREMENTS

FUNCTION	FOREMAN	SKILLED WORKER	UNSKILLED WORKER	MONTH
Clearing and Grubbing	4		95	20
Earthwork	19		380	22
Fencing and Crossings	2		14	30
Buildings	6	8	26	24
Culvert Manufacture	4	14	65	24
Sleeper Manufacture	3	3	26	28
Culvert Installation	10		200	22
Track Construction	15	18	73	24
Rail Welding	6	15	60	16

Employment Category	Average Over 30 months
Foreman	50
Skilled Worker	40
Unskilled Worker	690

APPENDIX 5.4

PHASE 1: TSUMEB - ONDANGWA INFRASTRUCTURE CONSTRUCTION

Item	Description	Unit	Quantity	Rate (N$)	Total Amount (N$)
1	Contractor's establishment on site and general obligations	Lump Sum	1	10,982,857	10,982,857
2	Clearing and grubbing	ha	992	1,160	1,150,720
3	Drainage:				
	i) Prefabricated culverts:				
	Supply and install complete with wing walls and floor slab, 6.1m long				
	a) 750mm x 450mm	No	331	16,725	5,535,975
	b) 1200mm x 450mm	No	158	19,060	3,011,426
	c) 1800mm x 600mm	No	180	27,604	4,968,790
	d) 1800mm x 900mm	No	60	34,326	2,059,549
	e) 1200mm x 900mm	No	0	25,345	0
4	Protection of services				
	i)Supply and install prefabricated culverts over existing water supply line, 300mm dia and over. Open ends of culverts to be build close with bricks.				
	a) 1200mm x 1200mm	No	3	27,604	82,813
	ii) Supply and install spilt concrete pipe, 500mm dia over existing water supply line, smaller than 300mm dia.				
	a) 500mm concrete pipe, 12.2m long	No	3	8,000	24,000
5	Earth works and pavement layers				
	i) Fill layers				
	a) Cut to fill	m3	75640	13	1,009,038
	b) Borrow to fill	m3	680760	23	15,357,946
	ii) Sub Ballast	m3	287680	29	8,388,749
	iii) Ballast	m3	310000	61	18,755,000

6	Rail Sleepers (concrete)	No	354286	210	74,400,060
7	Rail (second hand)	m	496000	137	67,715,321
8	Track laying and Equipment	m	248000	150	37,200,000
9	Level crossings:				
	i) Crossing with District roads, asphalt	No	7	26,000	182,000
	ii) Crossing for farmers, concrete blocks	No	15	23,000	345,000
	iii) Cattle crossing	No	148	1,800	266,400
10	Bridges:				
	i) Road over rail (2 off)	m2	352	5,000	1,760,000
	ii) Rail over river (1 off)	m2	176	5,000	880,000
11	Access roads	km	100	5,000	500,000
12	Power and Telephone line Crossings:				
	i)Power line crossing:	No	3	50,000	150,000
	ii)Telephone line crossing:	No	25	3,000	75,000
13	Railway stations:				
	i)Tsumeb	No	1	130,000	130,000
	ii) Oshivelo	No	1	1,000,931	1,000,931
	iii) Ondangwa	No	1	4,332,458	4,332,458
	iv) Ongwediwa	No	0	1,000,931	0
	v) Oshakati	No	0	1,872,075	0
	vi) Oshikango	No	0	1,700,662	0
	vii) Fuel depot at Ondangwa	No	1	1,200,000	1,200,000
14	Fencing:				
	6 wire fence 1.2m high complete with gates				
	i) Between Tsumeb and Oshivelo	km	50	3,430	171,500
	ii) Between Oshivelo and Oshakati	km		3,430	0
	iii) Between Ondangwa and Oshikango	km		3,430	0

15	Compensation: Land Acquisition				
	i) Purchase of land between Tsumeb and Oshivelo from farmers	ha	600	300	180,000
	ii) Re-establish existing farmers between Oshivelo and Oshakati and Ondangwa and Oshikango	No	500	10,000	5,000,000
16	Communications:	No	1	260,400	260,400
17	Design:				
	Project Management, Design, Site Supervision and EIA	No	1	12,754,286	12,754,286
	Total				**279,830,218**

APPENDIX 5.4

PHASE 2: ONDANGWA - OSHAKATI INFRASTRUCTURE CONSTRUCTION

Item	Description	Unit	Quantity	Rate (N$)	Total Amount (N$)
1	Contractor's establishment on site and general obligations	Lump Sum	1	1,771,429	1,771,429
2	Clearing and grubbing	ha	160	1,160	185,600
3	Drainage:				
	i) Prefabricated culverts:				
	Supply and install complete with wing walls and floor slab, 6.1m long				
	a) 750mm x 450mm	No	66	16,725	1,103,850
	b) 1200mm x 450mm	No		19,060	0
	c) 1800mm x 600mm	No		27,604	0
	d) 1800mm x 900mm	No	20	34,326	686,516
	e) 1200mm x 900mm	No		25,345	0
4	Protection of services				
	i)Supply and install prefabricated culverts over existing water supply line, 300mm dia and over. Open ends of culverts to be build close with bricks.				
	a) 1200mm x 1200mm	No	1	27,604	27,604
	ii) Supply and install spilt concrete pipe, 500mm dia over existing water supply line, smaller than 300mm dia.				
	a) 500mm concrete pipe, 12.2m long	No	1	8,000	8,000
5	Earth works and pavement layers				
	i) Fill layers				
	a) Cut to fill	m3	12200	13	162,748
	b) Borrow to fill	m3	109800	23	2,477,088
	ii) Sub Ballast	m3	46400	29	1,353,024
	iii) Ballast	m3	50000	61	3,025,000

6	Rail Sleepers (concrete)	No	57143	210	12,000,030
7	Rail (second hand)	m	80000	137	10,921,826
8	Track laying and Equipment	m	40000	150	6,000,000
9	Level crossings:				
	i) Crossing with District roads, asphalt	No	6	26,000	156,000
	ii) Crossing for farmers, concrete blocks	No	5	23,000	115,000
	iii) Cattle crossing	No	40	1,800	72,000
10	Bridges:				
	i) Road over rail (1 off)	m2	176	5,000	880,000
	ii) Rail over river (5 off)	m2	880	5,000	4,400,000
11	Access roads	km	20	5,000	100,000
12	Power and Telephone line Crossings:				
	i)Power line crossing:	No	0	50,000	0
	ii)Telephone line crossing:	No	20	3,000	60,000
13	Railway stations:				
	i)Tsumeb	No	0	130,000	0
	ii) Oshivelo	No	0	1,000,931	0
	iii) Ondangwa	No	0	4,332,458	0
	iv) Ongwediwa	No	1	1,000,931	1,000,931
	v) Oshakati	No	1	1,872,075	1,872,075
	vi) Oshikango	No	0	1,700,662	0
	vii) Fuel depot at Ondangwa	No	0	1,200,000	0
14	Fencing:				
	6 wire fence 1.2m high complete with gates				
	i) Between Tsumeb and Oshivelo	km	0	3,430	0
	ii) Between Oshivelo and Oshakati	km	0	3,430	0
	iii) Between Ondangwa and Oshikango	km	0	3,430	0

15	Compensation: Land Acquisition				
	i) Purchase of land between Tsumeb and Oshivelo from farmers	ha	0	300	0
	ii) Re-establish existing farmers between Oshivelo and Oshakati and Ondangwa and Oshikango	No	200	10,000	2,000,000
16	Communications:	No	1	64,300	64,300
17	Design:				
	Project Management, Design, Site Supervision and EIA	No	1	2,057,143	2,057,143
	Total				**52,500,164**

APPENDIX 5.4

PHASE 3: ONDANGWA - OSHIKANGO INFRASTRUCTURE CONSTRUCTION

Item	Description	Unit	Quantity	Rate (N$)	Total Amount (N$)
1	Contractor's establishment on site and general obligations	Lump Sum	1	2,745,714	2,745,714
2	Clearing and grubbing	ha	248	1,160	287,680
3	Drainage:				
	i) Prefabricated culverts:				
	Supply and install complete with wing walls and floor slab, 6.1m long				
	a) 750mm x 450mm	No	0	16,725	0
	b) 1200mm x 450mm	No	0	19,060	0
	c) 1800mm x 600mm	No	0	27,604	0
	d) 1800mm x 900mm	No	0	34,326	0
	e) 1200mm x 900mm	No	60	25,345	1,520,719
4	Protection of services				
	i)Supply and install prefabricated culverts over existing water supply line, 300mm dia and over. Open ends of culverts to be build close with bricks.				
	a) 1200mm x 1200mm	No	1	27,604	27,604
	ii) Supply and install spilt concrete pipe, 500mm dia over existing water supply line, smaller than 300mm dia.				
	a) 500mm concrete pipe, 12.2m long	No	1	8,000	8,000
5	Earth works and pavement layers				
	i) Fill layers				
	a) Cut to fill	m3	18,910	13	252,259
	b) Borrow to fill	m3	170,190	23	3,839,486
	ii) Sub Ballast	m3	71,920	29	2,097,187
	iii) Ballast	m3	77,500	61	4,688,750

6	Rail Sleepers (concrete)	No	88,571	210	18,599,910
7	Rail (second hand)	m	124,000	137	16,928,830
8	Track laying and Equipment	m	62,000	150	9,300,000
9	Level crossings:				
	i) Crossing with District roads, asphalt	No	0	26,000	0
	ii) Crossing for farmers, concrete blocks	No	5	23,000	115,000
	iii) Cattle crossing	No	62	1,800	111,600
10	Bridges:				
	i) Road over rail (1off)	m2	176	5,000	880,000
	ii) Rail over river (0 off)	m2	0	5,000	0
11	Access roads	km	20	5,000	100,000
12	Power and Telephone line Crossings:				
	i)Power line crossing:	No	1	50,000	50,000
	ii)Telephone line crossing:	No	15	3,000	45,000
13	Railway stations:				
	i)Tsumeb	No	0	130,000	0
	ii) Oshivelo	No	0	1,000,931	0
	iii) Ondangwa	No	0	4,332,458	0
	iv) Ongwediwa	No	0	1,000,931	0
	v) Oshakati	No	0	1,872,075	0
	vi) Oshikango	No	1	1,700,662	1,700,662
	vii) Fuel depot at Ondangwa	No	0	1,200,000	0
14	Fencing:				
	6 wire fence 1.2m high complete with gates				
	i) Between Tsumeb and Oshivelo	km	0	3,430	0
	ii) Between Oshivelo and Oshakati	km	0	3,430	0
	iii) Between Ondangwa and Oshikango	km	0	3,430	0

15	Compensation: Land Acquisition i) Purchase of land between Tsumeb and Oshivelo from farmers	ha	0	300	0
	ii) Re-establish existing farmers between Oshivelo and Oshakati and Ondangwa and Oshikango	No	300	10,000	3,000,000
16	Communications:	LS	1	66,500	66,500
17	Design: Project Management, Design, Site Supervision and EIA	No	1	3,188,571	3,188,571
	Total				**69,553,475**

TABLE 5.4

SUMMARY OF INFRASTRUCTURE CONSTRUCTION COST

DESCRIPTION	ESTIMATED COST			
	PHASE 1: TSUMEB TO ONDANGWA	PHASE 2: ONDANGWA TO OSHAKATI	PHASE 3 : ONDANGWA TO OSHIKANGO	
	Cost (N$)	Cost (N$)	Cost (N$)	TOTAL (N$)
Land Acquisition	5,180,000	2,000,000	3,000,000	10,180
Contractor's Establishment	10,982,857	1,771,429	2,745,714	15,500
Clearing and Grubbing	1,150,720	185,600	287,680	1,624
Earth work (fill, sub-ballast and ballast)	43,510,732	7,017,860	10,877,683	61,406
Trackwork (sleepers and rail)	179,315,381	28,921,856	44,828,740	253,065
Structures (culverts, bridges and power line towers)	19,512,453	7,508,971	2,712,924	29,734
Stations, Platforms and Buildings	6,663,389	2,873,006	1,745,662	11,282
Roadwork (access roads)	500,000	100,000	100,000	700
Communications	260,400	64,300	66,500	391
Project management, Design and Site Supervision	12,754,286	2,057,143	3,188,571	18,000
Network System Totals	**279,830,218**	**52,500,164**	**69,553,475**	**401,883,**

Appendix 5.4

TSUMEB - ONDANGWA - OSHAKATI - OSHIKANGO INFRASTRUCTURE CONSTRUCTION

Item	Description	Unit	Quantity	Rate (N$)	Total Amount (N$)
1	Contractor's establishment on site and general obligations	Lump Sum	1	15,500,000	15,500,000
2	Clearing and grubbing	ha	1400	1,160	1,624,000
3	Drainage:				
	i) Prefabricated culverts:				
	Supply and install complete with wing walls and floor slab, 6.1m long				
	a) 750mm x 450mm	No	397	16,725	6,639,825
	b) 1200mm x 450mm	No	158	19,060	3,011,426
	c) 1800mm x 600mm	No	180	27,604	4,968,790
	d) 1800mm x 900mm	No	80	34,326	2,746,065
	e) 1200mm x 900mm	No	60	25,345	1,520,719
4	Protection of services				
	i)Supply and install prefabricated culverts over existing water supply line, 300mm dia and over. Open ends of culverts to be build close with bricks.				
	a) 1200mm x 1200mm	No	5	27,604	138,022
	ii) Supply and install spilt concrete pipe, 500mm dia over existing water supply line, smaller than 300mm dia.				
	a) 500mm concrete pipe, 12.2m long	No	5	8,000	40,000
5	Earth works and pavement layers				
	i) Fill layers				
	a) Cut to fill	m3	106750	13	1,424,045
	b) Borrow to fill	m3	960750	23	21,674,520
	ii) Sub Ballast	m3	406000	29	11,838,960
	iii) Ballast	m3	437500	61	26,468,750

6	Rail Sleepers (concrete)	No	500000	210	105,000,000
7	Rail (second hand)	m	700000	137	95,565,978
8	Track laying and Equipment	m	350000	150	52,500,000
9	Level crossings:				
	i) Crossing with District roads, asphalt	No	13	26,000	338,000
	ii) Crossing for farmers, concrete blocks	No	25	23,000	575,000
	iii) Cattle crossing	No	250	1,800	450,000
10	Bridges:				
	i) Road over rail (4 off)	m2	704	5,000	3,520,000
	ii) Rail over river (6 off)	m2	1056	5,000	5,280,000
11	Access roads	km	140	5,000	700,000
12	Power and Telephone line Crossings:				
	i)Power line crossing:	No	4	50,000	200,000
	ii)Telephone line crossing:	No	60	3,000	180,000
13	Railway stations:				
	i)Tsumeb	No	1	130,000	130,000
	ii) Oshivelo	No	1	1,000,931	1,000,931
	iii) Ondangwa	No	1	4,332,458	4,332,458
	iv) Ongwediwa	No	1	1,000,931	1,000,931
	v) Oshakati	No	1	1,872,075	1,872,075
	vi) Oshikango	No	1	1,700,662	1,700,662
	vii) Fuel depot at Ondangwa	No	1	1,200,000	1,200,000
14	Fencing:				
	6 wire fence 1.2m high complete with gates				
	i) Between Tsumeb and Oshivelo	km	50	3,430	171,500
	ii) Between Oshivelo and Oshakati	km		3,430	0
	iii) Between Ondangwa and Oshikango	km		3,430	0

15	Compensation: Land Acquisition i) Purchase of land between Tsumeb and Oshivelo from farmers	ha	600	300	180,000
	ii) Re-establish existing farmers between Oshivelo and Oshakati and Ondangwa and Oshikango	No	1000	10,000	10,000,000
16	Communications:	No	1	391,200	391,200
17	Design: Project Management, Design, Site Supervision and EIA	No	1	18,000,000	18,000,000
	Total				**401,883,857**

SECTION 7: OPERATING AND MAINTENANC EXPENSE

APPENDIX 7.1
SPOORNET ROLLING STOCK
HIRE CHARGE EXPENSE

SCENARIO 1			
WAGON DAYS INCREASE			
DZA-9		1,136	days
SMJ-1	6/8 X 5,152	3,864	days
TOTAL WAGON DAYS		**5,000**	days
CONTAINER DAYS INCREASE			
6m steel	6/8 x 6,160	4,620	days
6m insulated	6/8 x 1,760	1,320	days
TOTAL CONTAINER DAYS		**5,940**	days
SCENARIO 2			
WAGON DAYS INCREASE			
DZA-9		1,136	days
SMJ-1	6/8 X 17,992	13,494	days
TOTAL WAGON DAYS		**14,630**	days
CONTAINER DAYS INCREASE			
6m steel	6/8 x 24,000	18,000	days
6m insulated	6/8 x 3,680	2,760	days
TOTAL CONTAINER DAYS		**20,760**	days

INCREASED COSTS

SCENARIO 1		
Wagons	5,000 days x N$41.00	N$ 205,000
Containers	5,940 days x N$25.65	N$ 152,400
TOTALS		**N$ 357,400**
SCENARIO 2		
Wagons	14,630 days x N$41.00	N$ 599,800
Containers	20,760 days x N$25.65	N$ 532,500
TOTALS		**N$ 1,132,300**

APPENDIX 7.2

COMPARISON OF NAMRAIL COSTS AND EXTENSION COSTS

Scenario 2

Net Tons		253,500
Net Ton-km		278,765,600
Wagons		10,217
Wagon-km		7,625,200
Cost/net ton-km		0,065
Cost/wagon-km	(loaded)	2,37
	(roundtrip)	1,18
Operating Cost		N$18,080,300

NamRail

Sept 98 – Feb 99	Fixed (N$)	Variable (N$)	Total (N$)
Cost/net ton-km	0,06	0,12	0,18
Cost/wagon-km	1,13	2,15	3,28

Main reasons for differences:

1. Extension figures are only variable costs
2. Trains run at full capacity. Better utilisation of crews, locos and wagons
3. New railroad has very low maintenance costs
4. Mainly increasing utilisation of present rolling stock fleet
5. Nearly all inbound traffic and loads, wagons are unloaded and depart quickly. Car delays reflected on the existing rail network, rather than the extension
6. Few staff added, mostly transfers from Tsumeb station

SECTION 8: FINANCIAL AND ECONOMIC EVALUA

APPENDIX 8.1

CURRENT NAMRAIL TARIFFS

TRANSNAMIB RAIL
(COMPILED 25 FEB 1999)

1. TARIFFS FOR MAIN COMMODITY GROUPS FOR 1998/99

1.1 IMPORTS EX RSA

COMMODITY	1998/99 N$/TON
MINING PRODUCTS:	
Manganese ore	116.22
Platinum	177.12
Copper conc.	147.92
Ores	189.37
TOTAL	**119.90**
AGRICULTURAL PRODUCTS:	
Phosphate & fertilizer	192.96
Maize and other grain	147.35
Stock feed and luceme	83.43
Misc. agric. products	201.60
TOTAL	**125.33**
BUILDING MATERIAL	
Lime, cement and slagment	139.14
Steel and steel products	175.24
Timber	271.45
Misc. building material	231.74
TOTAL	**147.68**
BULK LIQUID PRODUCTS	
Liquid petroleumgas	414.92
Other	256.91
Fuel	223.54
TOTAL	**381.10**
OTHER TRAFFIC	
Sugar and grain products	184.90
Explosives	533.22
Motors and tractors	937.78
General cargo	377.84
Refrigerated cargo	220.14
TOTAL	**673.45**
CONTAINER TRAFFIC (LOADED)	
6-Metre cont. (nett ton)}	
3-Metre cont. (nett ton)}	187.53
Mini cont. (nett ton)	308.00
TOTAL	**189.57**
LIVESTOCK	
Large animals (nett ton)	165.06

1.2 EXPORTS TO RSA

COMMODITY
MINING PRODUCTS:
Salt ex W/bay
Salt ex Swakopmund
Zinc concentrate (Ex Ausnek)
Lead and copper ingots
TOTAL
AGRICULTURAL PRODUCTS:
Fish-meal
Seaweed
Phosphate, fertilizer, guano
Wool
Stock feed and luceme
Wood, charcoal & firewood
Misc. agric. products
TOTAL
BUILDING MATERIAL:
Steel and steel products
Misc. building material
TOTAL
BULK LIQUID PRODUCTS:
Miscellaneous
TOTAL
OTHER TRAFFIC:
Motors and tractors
General cargo
Refrigerated cargo
TOTAL
CONTAINER TRAFFIC (LOADED):
6-Metre cont. (nett ton)}
3-Metre cont. (nett ton)}
Mini cont. (nett ton)
TOTAL
LIVESTOCK:
Large animals (nett ton)
Small animals (nett ton)
TOTAL

3 LOCAL RAIL TRAFFIC NAMIBIA

OMMODITY	1998/99 N$/TON
INING PRODUCTS:	
alt (To Walvis Bay)	24.59
alt (other N. points)	53.28
rite	66.33
opper concentrate (Hoffnung)	87.61
opper/lead concentrate (Kombat)	32.04
opper concentrate (Walvis Bay)	94.17
ad concentrate (Walvis Bay)	94.17
ad concentrate (Aus)	118.01
nc concentrate (Aus)	100.48
opper and lead ingots (Tsb)	89.91
orspar (Otjikango)	75.92
al (ex Walvis Bay)	67.89
anium	66.46
cenic and Cadmium	102.65
arble	56.68
anite	58.17
her mining products(Soda Ash)	147.06
nganese Ore	30.80
lphur	36.18
TAL	**58.74**
RICULTURAL PRODUCTS:	
h-meal	102.63
ize and other grain	81.98
ck feed and lucerne	106.10
c. agric. products	187.14
TAL	**83.40**
ILDING MATERIAL:	
e, cement and slagment	89.44
el and steel products	128.37
c. building material	92.06
TAL	**100.16**
LK LIQUID PRODUCTS:	
l	123.00
phuric acid and other	42.57
TAL	**122.23**
HER TRAFFIC:	
gar and grain products	89.00
tors and tractors	528.04
neral cargo	222.96
rigerated cargo	231.50
TAL	**159.66**
NTAINER TRAFFIC:	
letre cont. (nett ton)	83.00
letre cont. (nett ton)	104.00
i cont. (nett ton)	139.00
TAL	**101.43**
ESTOCK:	

1.4 IMPORTS EX RSA, EXPORTS TO RSA ANI

COMMODITY	1998/99 N$/TON
MINING PRODUCTS	66.16
AGRICULTURAL PRODUCTS	118.44
BUILDING MATERIAL	144.91
BULK LIQUID PRODUCTS	127.50
OTHER TRAFFIC	221.35
CONTAINER TRAFFIC (LOADED)	122.05
LIVESTOCK	172.50
GRANDTOTAL	**117.07**

APPENDIX 8.2

CALCULATION OF RESIDUAL VALUE

ITEM	% VALUE AT YEAR 20
Contractor's Establishment	0
Clearing and Grubbing	0
Drainage structures	50
Protection of pipelines and power lines	0
Earthwork	0
Ballast	50
Sleepers	60
Rail	70
Track laying	0
Level crossings (Concrete blocks only)	10
Bridges, culverts	20
Access roads	0
Powerline Crossings	0
Stations and Support Facilities	60
Fencing	0
Land	100
Design, Project Management	0
Communications Equipment	50
Rolling Stock	55
Container Handling Equipment	50
Employee Relocation	0
AVERAGE	**42,8**

APPENDIX 8.3
ESCALATION OF OPERATING EXPENSE TO ACCOMMODATE INCREASED TRAF
SCENARIO 1

EXPENSE CATEGORY	ESCALATION FACTOR	EXPE (N$
INFRASTRUCTURE	CONSTANT	
LOCO OPERATION	YEAR 4	
	YEAR 5 – 8	
	YEAR 9 – 14 + 10%	
	YEAR 15 – 20 + 10%	
WAGON OPERATION	YEAR 4	
	YEAR 5	
	YEAR 6 – 20 INCREASE 3% PER YEAR FROM YEAR 5	
COACH OPERATION	CONSTANT	
TRAIN CREWS	YEAR 4	
	YEAR 5 - 8	
	YEAR 9-14 + 10%	
	YEAR 15 – 20 + 10%	
ROLLING STOCK HIRE	YEAR 4	
	YEAR 5	
	YEAR 6 – 20 INCREASE 3% PER YEAR FROM YEAR 5	
STATIONS OPERATIONS AND STAFF	YEAR 4	
	YEAR 5 - 8	
	YEAR 9 – 14 + 10%	
	YEAR 15 – 20 + 10%	

SCENARIO 2

EXPENSE CATEGORY	ESCALATION FACTOR	EXPE (N$
INFRASTRUCTURE	CONSTANT	
LOCO OPERATION	YEAR 4	
	YEAR 5	
	YEAR 9 – 14 + 10%	
	YEAR 15 – 20 + 10%	
WAGON OPERATION	YEAR 4	
	YEAR 5	
	YEAR 6 – 20 INCREASE 3% PER YEAR FROM YEAR 5	
COACH OPERATION	CONSTANT	
TRAIN CREWS	YEAR 4	
	YEAR 5 - 8	
	YEAR 9-14 + 10%	
	YEAR 15 – 20 + 10%	
ROLLING STOCK HIRE	YEAR 4	
	YEAR 5	
	YEAR 6 – 20 INCREASE 3% PER YEAR FROM YEAR 5	
STATIONS OPERATIONS AND STAFF	YEAR 4	
	YEAR 5 - 8	
	YEAR 9 – 14 + 15%	
	YEAR 15 – 20 + 15%	

APPENDIX 8.4

FINANCIAL AND ECONOMIC ANALYSES SPREAD-SHEETS

3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Sum	IRR	NPV
	10,275,100	21,166,800	21,801,800	22,455,900	23,129,600	23,823,500	24,538,200	25,274,300	26,032,500	26,813,500	27,617,900	28,446,400	29,299,800	30,178,800	31,084,200	32,016,700	32,977,200			
	- 6,959,800	- 9,579,400	- 9,621,900	- 9,665,700	- 9,710,800	- 10,480,000	- 10,527,900	- 10,577,200	- 10,628,000	- 10,680,300	- 10,734,200	- 11,583,400	- 11,640,600	- 11,699,500	- 11,760,200	- 11,822,700	- 11,887,100			
- 125,382,000																				
																	119,967,300			
- 125,382,000	3,315,300	11,567,400	12,179,900	12,790,200	13,418,800	13,343,500	14,010,300	14,697,100	15,404,500	16,133,200	16,883,700	16,863,000	17,659,200	18,479,300	19,324,000	20,194,000	141,057,400	95,542,000	2%	-N$ 126,551,570.86

3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Sum	IRR	NPV
	19,366,300	39,894,600	41,091,400	42,324,100	43,593,800	44,901,600	46,248,600	47,636,100	49,065,200	50,537,200	52,053,300	53,614,900	55,223,300	56,880,000	58,586,400	60,344,000	62,154,300			
	- 14,310,900	- 20,171,900	- 20,304,700	- 20,441,400	- 20,582,300	- 22,235,700	- 22,385,100	- 22,539,100	- 22,697,600	- 22,860,900	- 23,029,100	- 24,865,500	- 25,044,000	- 25,227,800	- 25,417,100	- 25,612,100	- 25,812,900			
- 130,062,000																				
																	123,409,600			
- 130,062,000	5,055,400	19,722,700	20,786,700	21,882,700	23,011,500	22,665,900	23,863,500	25,097,000	26,367,600	27,676,300	29,024,200	26,749,400	30,179,300	31,652,200	33,169,300	34,731,900	159,751,000	276,907,800	6%	-N$ 72,574,855.14

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Sum	IRR	NPV
		23,239,600	47,873,500	49,309,700	50,789,000	52,312,700	53,882,100	55,498,600	57,163,600	58,878,500	60,644,900	62,464,200	64,338,100	66,268,200	68,256,200	70,303,900	72,413,000	74,585,400			
		- 14,310,900	- 20,171,900	- 20,304,700	- 20,441,400	- 20,582,300	- 22,235,700	- 22,385,100	- 22,539,100	- 22,697,600	- 22,860,900	- 23,029,100	- 24,865,500	- 25,044,000	- 25,227,800	- 25,417,100	- 25,612,100	- 25,812,900			
)	- 130,062,000																				
)	- 130,062,000	8,928,700	- 27,701,600	29,005,000	30,347,600	31,730,400	31,646,400	33,113,500	34,624,500	36,180,900	37,784,000	39,435,100	39,472,600	41,224,200	43,028,400	44,886,800	46,800,900	123,409,600 172,182,100	441,613,900	9%	-N$ 19,264,261.49

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Sum	IRR	NPV
		15,493,000	31,915,700	32,873,200	33,859,400	34,875,200	35,921,500	36,999,100	38,109,100	39,252,400	40,430,000	41,642,900	42,892,200	44,179,000	45,504,400	46,869,500	48,275,600	49,723,900			
		- 14,310,900	- 20,171,900	- 20,304,700	- 20,441,400	- 20,582,300	- 22,235,700	- 22,385,100	- 22,539,100	- 22,697,600	- 22,860,900	- 23,029,100	- 24,865,500	- 25,044,000	- 25,227,800	- 25,417,100	- 25,612,100	- 25,812,900			
)	- 130,062,000																				
)	- 130,062,000	1,182,100	- 11,743,800	12,568,500	13,418,000	14,292,900	13,685,800	14,614,000	15,570,000	16,554,800	17,569,100	18,613,800	18,026,700	19,135,000	20,276,600	21,452,400	22,663,500	123,409,600 147,320,600	112,208,800	3%	-N$ 125,883,497.23

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Sum	IRR	NPV
		19,366,300	39,894,600	41,091,400	42,324,100	43,593,800	44,901,600	46,248,600	47,636,100	49,065,200	50,537,200	52,053,300	53,614,900	55,223,300	56,880,000	58,586,400	60,344,000	62,154,300			
		- 14,310,900	- 20,171,900	- 20,304,700	- 20,441,400	- 20,582,300	- 22,235,700	- 22,385,100	- 22,539,100	- 22,697,600	- 22,860,900	- 23,029,100	- 24,865,500	- 25,044,000	- 25,227,800	- 25,417,100	- 25,612,100	- 25,812,900			
)	- 162,577,500																				
)	- 162,577,500	5,055,400	- 19,722,700	20,786,700	21,882,700	23,011,500	22,665,900	23,863,500	25,097,000	26,367,600	27,676,300	29,024,200	28,749,400	30,179,300	31,652,200	33,169,300	34,731,900	153,266,500 189,607,900	235,144,200	4%	-N$ 125,323,912.62

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Sum	IRR	NPV
		19,360,500	24,379,900	29,040,800	34,418,700	43,593,800	44,901,600	46,248,600	47,636,100	49,065,200	50,537,200	52,053,300	53,614,900	55,223,300	56,880,000	58,586,400	60,344,000	62,154,300			
		- 14,310,900	- 20,171,900	- 20,304,700	- 20,441,400	- 20,582,300	- 22,235,700	- 22,385,100	- 22,539,100	- 22,697,600	- 22,860,900	- 23,029,100	- 24,865,500	- 25,044,000	- 25,227,800	- 25,417,100	- 25,612,100	- 25,812,900			
-	130,062,000																				
-	130,062,000	5,049,600	- 4,208,000	8,736,100	13,977,300	23,011,500	22,665,900	23,863,500	25,097,000	26,367,600	27,676,300	29,024,200	28,749,400	30,179,300	31,652,200	33,169,300	34,731,900	123,409,600 159,751,000	241,431,300	5%	-N$ 93,071,194.40

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Sum	IRR	NPV
		19,366,300	39,894,600	41,091,400	42,324,100	43,593,800	44,901,600	46,248,600	47,636,100	49,065,200	50,537,200	52,053,300	53,614,900	55,223,300	56,880,000	58,586,400	60,344,000	62,154,300			
		- 17,173,100	- 24,206,300	- 24,365,600	- 24,529,700	- 24,698,800	- 26,682,800	- 26,862,100	- 27,046,900	- 27,237,100	- 27,433,100	- 27,634,900	- 29,842,200	- 30,052,800	- 30,273,400	- 30,500,500	- 30,734,500	- 30,975,500			
-	130,062,000																				
-	130,062,000	2,193,200	- 15,888,300	16,725,800	17,794,400	18,895,000	18,216,800	19,386,500	20,589,200	21,828,100	23,104,100	24,418,400	23,772,700	25,170,500	26,606,600	28,085,900	29,609,500	123,409,600 154,588,400	200,196,600	4%	-N$ 98,320,056.16

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Sum	IRR	NPV
		19,366,300	39,894,600	41,091,400	42,324,100	43,593,800	44,901,600	46,248,600	47,636,100	49,065,200	50,537,200	52,053,300	53,614,900	55,223,300	56,880,000	58,586,400	60,344,000	62,154,300			
		- 11,448,700	- 16,137,500	- 16,243,800	- 16,353,100	- 16,465,800	- 17,788,600	- 17,908,100	- 18,031,300	- 18,158,100	- 18,288,700	- 18,423,300	- 19,892,400	- 20,035,200	- 20,182,200	- 20,333,700	- 20,489,700	- 20,650,320			
-	130,062,000																				
-	130,062,000	7,917,600	- 23,757,100	24,847,600	25,971,000	27,128,000	27,113,000	28,340,500	29,604,800	30,907,100	32,248,500	33,630,000	33,722,500	35,188,100	36,697,800	38,252,700	39,854,300	123,409,600 164,913,580	353,615,380	7%	-N$ 46,830,518.90

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Sum	IRR	NPV
		19,366,300	39,894,600	41,091,400	42,324,100	43,593,800	44,901,600	46,248,600	47,636,100	49,065,200	50,537,200	52,053,300	53,614,900	55,223,300	56,880,000	58,586,400	60,344,000	62,154,300			
		- 14,310,900	- 20,171,900	- 20,304,700	- 20,441,400	- 20,582,300	- 22,235,700	- 22,385,100	- 22,539,100	- 22,697,600	- 22,860,900	- 23,029,100	- 24,865,500	- 25,044,000	- 25,227,800	- 25,417,100	- 25,612,100	- 25,812,900			
-	91,043,400																				
-	91,043,400	5,055,400	- 19,722,700	20,786,700	21,882,700	23,011,500	22,665,900	23,863,500	25,097,000	26,367,600	27,676,300	29,024,200	28,749,400	30,179,300	31,652,200	33,169,300	34,731,900	91,838,000 128,179,400	331,279,800	9%	-N$ 8,644,090.86

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Sum	IRR	NPV
		19,366,300	39,894,600	41,091,400	42,324,100	43,593,800	44,901,600	46,248,600	47,636,100	49,065,200	50,537,200	52,053,300	53,614,900	55,223,300	56,880,000	58,586,400	60,344,000	62,154,300			
	-	14,310,900	- 20,171,900	- 20,304,700	- 20,441,400	- 20,582,300	- 22,235,700	- 22,385,100	- 22,539,100	- 22,697,600	- 22,860,900	- 23,029,100	- 24,865,500	- 25,044,000	- 25,227,800	- 25,417,100	- 25,612,100	- 25,812,900			
0 -	65,031,000																				
			-															61,306,500			
0 -	65,031,000	5,055,400	19,722,700	20,786,700	21,882,700	23,011,500	22,665,900	23,863,500	25,097,000	26,367,600	27,676,300	29,024,200	28,749,400	30,179,300	31,652,200	33,169,300	34,731,900	97,647,900	358,044,000	13%	N$ 32,566,692.38

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Sum	IRR	NPV
		19,366,300	39,894,600	41,091,400	42,324,100	43,593,800	44,901,600	46,248,600	47,636,100	49,065,200	50,537,200	52,053,300	53,614,900	55,223,300	56,880,000	58,586,400	60,344,000	62,154,300			
	-	14,310,900	- 20,171,900	- 20,304,700	- 20,441,400	- 20,582,300	- 22,235,700	- 22,385,100	- 22,539,100	- 22,697,600	- 22,860,900	- 23,029,100	- 24,865,500	- 25,044,000	- 25,227,800	- 25,417,100	- 25,612,100	- 25,812,900			
0 -	52,024,600																				
			-															49,045,162			
0 -	52,024,600	5,055,400	19,722,700	20,786,700	21,882,700	23,011,500	22,665,900	23,863,500	25,097,000	26,367,600	27,676,300	29,024,200	28,749,400	30,179,300	31,652,200	33,169,300	34,731,900	85,388,562	374,430,662	16%	N$ 53,618,798.60

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Sum	IRR	NPV
		19,366,300	39,894,600	41,091,400	42,324,100	43,593,800	44,901,600	46,248,600	47,636,100	49,065,200	50,537,200	52,053,300	53,614,900	55,223,300	56,880,000	58,586,400	60,344,000	62,154,300			
	-	14,310,900	- 20,171,900	- 20,304,700	- 20,441,400	- 20,582,300	- 22,235,700	- 22,385,100	- 22,539,100	- 22,697,600	- 22,860,900	- 23,029,100	- 24,865,500	- 25,044,000	- 25,227,800	- 25,417,100	- 25,612,100	- 25,812,900			
0 -	58,527,900																				
			-															62,137,300			
0 -	58,527,900	5,055,400	19,722,700	20,786,700	21,882,700	23,011,500	22,665,900	23,863,500	25,097,000	26,367,600	27,676,300	29,024,200	28,749,400	30,179,300	31,652,200	33,169,300	34,731,900	98,478,700	373,198,800	15%	N$ 44,127,523.60

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Sum	IRR	NPV
		10,275,100	21,168,800	21,801,800	22,455,900	23,129,600	23,823,500	24,538,200	25,274,300	26,032,500	26,813,500	27,617,900	28,446,400	29,299,800	30,178,800	31,084,200	32,016,700	32,977,200			
	-	6,959,800	- 9,579,400	- 9,621,900	- 9,665,700	- 9,710,800	- 10,480,000	- 10,527,900	- 10,577,200	- 10,628,000	- 10,680,300	- 10,734,200	- 11,583,400	- 11,640,600	- 11,699,500	- 11,760,200	- 11,822,700	- 11,887,100			
0 -	150,458,400																				
			-															144,731,900			
0 -	150,458,400	3,315,300	11,587,400	12,179,900	12,790,200	13,418,800	13,343,500	14,010,300	14,697,100	15,404,500	16,133,200	16,883,700	16,863,000	17,659,200	18,479,300	19,324,000	20,194,000	165,822,000	83,946,800	1%	-N$ 167,916,419.03

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Sum	IRR	NPV
		10,275,100	21,168,800	21,801,800	22,455,900	23,129,600	23,823,500	24,538,200	25,274,300	26,032,500	26,813,500	27,617,900	28,446,400	29,299,800	30,178,800	31,084,200	32,016,700	32,977,200			
	-	6,959,800	- 9,579,400	- 9,621,900	- 9,665,700	- 9,710,800	- 10,480,000	- 10,527,900	- 10,577,200	- 10,628,000	- 10,680,300	- 10,734,200	- 11,583,400	- 11,640,600	- 11,699,500	- 11,760,200	- 11,822,700	- 11,887,100			
	-	8,351,760	- 11,495,280	- 11,546,280	- 11,598,840	- 11,652,960	- 12,576,000	- 12,633,480	- 12,692,640	- 12,753,600	- 12,816,360	- 12,881,040	- 13,900,080	- 13,968,720	- 14,039,400	- 14,112,240	- 14,187,240	- 14,264,520			
0 -	125,382,000																				
			-															119,967,300			
0 -	125,382,000	1,923,340	9,671,520	10,255,520	10,857,060	11,476,640	11,247,500	11,904,720	12,581,660	13,278,900	13,997,140	14,736,860	14,546,320	15,331,080	16,139,400	16,971,960	17,829,460	138,679,980	59,630,260	1%	-N$ 138,666,954.55

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Sum	IRR	NPV
		10,275,100	21,166,800	21,801,800	22,455,900	23,129,600	23,823,500	24,538,200	25,274,300	26,032,500	26,813,500	27,617,900	28,446,400	29,299,800	30,178,800	31,084,200	32,016,700	32,977,200			
		- 6,959,800	- 9,579,400	- 9,621,900	- 9,665,700	- 9,710,800	- 10,480,000	- 10,527,900	- 10,577,200	- 10,628,000	- 10,680,300	- 10,734,200	- 11,583,400	- 11,640,600	- 11,699,500	- 11,760,200	- 11,822,700	- 11,887,100			
		- 5,915,830	- 8,142,490	- 8,178,615	- 8,215,845	- 8,254,180	- 8,908,000	- 8,948,715	- 8,990,620	- 9,033,800	- 9,078,255	- 9,124,070	- 9,845,890	- 9,894,510	- 9,944,575	- 9,996,170	- 10,049,295	- 10,104,035			
		1,775,600	1,828,900	1,883,800	1,940,300	1,998,500	2,058,500	2,120,300	2,183,900	2,249,400	2,316,900	2,386,400	2,458,000	2,531,700	2,607,700	2,685,900	2,766,500	2,849,500			
) -	97,437,300																				
																		89,812,000			
) -	97,437,300	6,134,870	14,853,210	15,506,985	16,180,355	16,873,920	16,974,000	17,709,785	18,467,580	19,248,100	20,052,145	20,880,230	21,058,510	21,936,990	22,841,925	23,773,930	24,733,905	115,334,665	203,187,405	6%	-N$ 50,947,573.45

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Sum	IRR	NPV
		19,366,300	39,894,600	41,091,400	42,324,100	43,593,800	44,901,600	46,248,600	47,636,100	49,065,200	50,537,200	52,053,300	53,614,900	55,223,300	56,880,000	58,586,400	60,344,000	62,154,300			
		- 14,310,900	- 20,171,900	- 20,304,700	- 20,441,400	- 20,582,300	- 22,235,700	- 22,385,100	- 22,539,100	- 22,697,600	- 22,860,900	- 23,029,100	- 24,865,500	- 25,044,000	- 25,227,800	- 25,417,100	- 25,612,100	- 25,812,900			
		- 12,164,265	- 17,146,115	- 17,258,995	- 17,375,190	- 17,494,955	- 18,900,345	- 19,027,335	- 19,158,235	- 19,292,960	- 19,431,765	- 19,574,735	- 21,135,675	- 21,287,400	- 21,443,630	- 21,604,535	- 21,770,285	- 21,940,965			
		3,297,500	3,396,400	3,498,300	3,603,200	3,711,300	3,822,600	3,937,300	4,055,400	4,177,100	4,302,400	4,431,500	4,564,400	4,701,300	4,842,300	4,987,600	5,137,200	5,291,300			
) -	98,965,300																				
																		90,265,900			
) -	98,965,300	10,499,535	26,144,885	27,330,705	28,552,110	29,810,145	29,823,855	31,158,565	32,533,265	33,949,340	35,407,835	36,910,065	37,043,625	38,637,200	40,278,670	41,969,465	43,710,915	135,770,535	448,629,015	12%	N$ 26,196,624.84

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Sum	IRR	NPV
		23,239,600	47,873,500	49,309,700	50,789,000	52,312,700	53,882,100	55,498,600	57,163,600	58,878,500	60,644,900	62,464,200	64,338,100	66,268,200	68,256,200	70,303,900	72,413,000	74,585,400			
		- 14,310,900	- 20,171,900	- 20,304,700	- 20,441,400	- 20,582,300	- 22,235,700	- 22,385,100	- 22,539,100	- 22,697,600	- 22,860,900	- 23,029,100	- 24,865,500	- 25,044,000	- 25,227,800	- 25,417,100	- 25,612,100	- 25,812,900			
		- 12,164,265	- 17,146,115	- 17,258,995	- 17,375,190	- 17,494,955	- 18,900,345	- 19,027,335	- 19,158,235	- 19,292,960	- 19,431,765	- 19,574,735	- 21,135,675	- 21,287,400	- 21,443,630	- 21,604,535	- 21,770,285	- 21,940,965			
		3,297,500	3,396,400	3,498,300	3,603,200	3,711,300	3,822,600	3,937,300	4,055,400	4,177,100	4,302,400	4,431,500	4,564,400	4,701,300	4,842,300	4,987,600	5,137,200	5,291,300			
0	- 98,965,300																				
																		90,265,900			
0	- 98,965,300	14,372,835	34,123,785	35,549,005	37,017,010	38,529,045	38,804,355	40,408,565	42,060,765	43,762,640	45,515,535	47,320,965	47,766,825	49,682,100	51,654,870	53,686,965	55,779,915	148,201,635	613,335,115	15%	N$ 79,507,218.49

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Sum	IRR	NPV
		15,493,000	31,915,700	32,873,200	33,859,400	34,875,200	35,921,500	36,999,100	38,109,100	39,252,400	40,430,000	41,642,900	42,892,200	44,179,000	45,504,400	46,869,500	48,275,600	49,723,900			
		- 14,310,900	- 20,171,900	- 20,304,700	- 20,441,400	- 20,582,300	- 22,235,700	- 22,385,100	- 22,539,100	- 22,697,600	- 22,860,900	- 23,029,100	- 24,865,500	- 25,044,000	- 25,227,800	- 25,417,100	- 25,612,100	- 25,812,900			
		- 12,164,265	- 17,146,115	- 17,258,995	- 17,375,190	- 17,494,955	- 18,900,345	- 19,027,335	- 19,158,235	- 19,292,960	- 19,431,765	- 19,574,735	- 21,135,675	- 21,287,400	- 21,443,630	- 21,604,535	- 21,770,285	- 21,940,965			
		3,297,500	3,396,400	3,498,300	3,603,200	3,711,300	3,822,600	3,937,300	4,055,400	4,177,100	4,302,400	4,431,500	4,564,400	4,701,300	4,842,300	4,987,600	5,137,200	5,291,300			
0	- 98,965,300																				
																		90,265,900			
0	- 98,965,300	6,626,235	18,165,985	19,112,505	20,087,410	21,091,545	20,843,755	21,909,065	23,006,265	24,136,540	25,300,635	26,499,665	26,320,925	27,592,900	28,903,070	30,252,565	31,642,515	123,340,135	283,930,015	8%	-N$ 27,112,017.25

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Sum	IRR	NPV
		19,366,300	39,894,600	41,091,400	42,324,100	43,593,800	44,901,600	46,248,600	47,636,100	49,065,200	50,537,200	52,053,300	53,614,900	55,223,300	56,880,000	58,586,400	60,344,000	62,154,300			
		- 14,310,900	- 20,171,900	- 20,304,700	- 20,441,400	- 20,582,300	- 22,235,700	- 22,385,100	- 22,539,100	- 22,697,600	- 22,860,900	- 23,029,100	- 24,865,500	- 25,044,000	- 25,227,800	- 25,417,100	- 25,612,100	- 25,812,900			
		- 12,164,265	- 17,146,115	- 17,258,995	- 17,375,190	- 17,494,955	- 18,900,345	- 19,027,335	- 19,158,235	- 19,292,960	- 19,431,765	- 19,574,735	- 21,135,675	- 21,287,400	- 21,443,630	- 21,604,535	- 21,770,285	- 21,940,965			
		3,297,500	3,396,400	3,498,300	3,603,200	3,711,300	3,822,600	3,937,300	4,055,400	4,177,100	4,302,400	4,431,500	4,564,400	4,701,300	4,842,300	4,987,600	5,137,200	5,291,300			
0	- 123,708,600																				
																		90,265,900			
0	- 123,708,600	10,499,535	26,144,885	27,330,705	28,552,110	29,810,145	29,823,855	31,158,565	32,533,265	33,949,340	35,407,835	36,910,065	37,043,625	38,637,200	40,278,670	41,969,465	43,710,915	135,770,535	395,903,615	9%	-N$ 15,846,904.83

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Sum	IRR	NPV
		19,360,500	24,379,900	29,040,800	34,418,700	35,451,300	36,514,800	37,610,200	38,738,500	39,900,700	41,097,700	42,330,600	43,600,500	44,908,500	46,255,800	47,643,500	49,072,800	50,545,000			
		- 14,310,900	- 20,171,900	- 20,304,700	- 20,441,400	- 20,582,300	- 22,235,700	- 22,385,100	- 22,539,100	- 22,697,600	- 22,860,900	- 23,029,100	- 24,865,500	- 25,044,000	- 25,227,800	- 25,417,100	- 25,612,100	- 25,812,900			
		- 12,164,265	- 17,146,115	- 17,258,995	- 17,375,190	- 17,494,955	- 18,900,345	- 19,027,335	- 19,158,235	- 19,292,960	- 19,431,765	- 19,574,735	- 21,135,675	- 21,287,400	- 21,443,630	- 21,604,535	- 21,770,285	- 21,940,965			
		3,297,500	3,396,400	3,498,300	3,603,200	3,711,300	3,822,600	3,937,300	4,055,400	4,177,100	4,302,400	4,431,500	4,564,400	4,701,300	4,842,300	4,987,600	5,137,200	5,291,300			
0	- 98,965,300																				
																		90,265,900			
0	- 98,965,300	10,493,735	10,630,185	15,280,105	20,646,710	21,667,845	21,437,055	22,520,165	23,635,665	24,784,840	25,968,335	27,187,365	27,029,225	28,322,400	29,654,470	31,026,565	32,439,715	124,161,235	285,983,715	8%	-N$ 28,599,640.73

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Sum	IRR	NPV
		19,366,300	39,894,600	41,091,400	42,324,100	43,593,800	44,901,600	46,248,600	47,636,100	49,065,200	50,537,200	52,053,300	53,614,900	55,223,300	56,880,000	58,586,400	60,344,000	62,154,300			
		- 14,310,900	- 20,171,900	- 20,304,700	- 20,441,400	- 20,582,300	- 22,235,700	- 22,385,100	- 22,539,100	- 22,697,600	- 22,860,900	- 23,029,100	- 24,865,500	- 25,044,000	- 25,227,800	- 25,417,100	- 25,612,100	- 25,812,900			
		- 14,597,100	- 20,575,300	- 20,710,800	- 20,850,200	- 20,993,900	- 22,680,400	- 22,832,800	- 22,989,900	- 23,151,600	- 23,318,100	- 23,489,700	- 25,362,800	- 25,544,900	- 25,732,400	- 25,925,400	- 26,124,300	- 26,329,200			
		3,297,500	3,396,400	3,498,300	3,603,200	3,711,300	3,822,600	3,937,300	4,055,400	4,177,100	4,302,400	4,431,500	4,564,400	4,701,300	4,842,300	4,987,600	5,137,200	5,291,300			
0	- 98,965,300																				
																		90,265,900			
0	- 98,965,300	8,066,700	22,715,700	23,878,900	25,077,100	26,311,200	26,043,600	27,353,100	28,701,600	30,090,700	31,521,500	32,995,100	32,816,500	34,379,700	35,989,900	37,648,600	39,356,900	131,382,300	383,427,600	10%	N$ 4,313,987.01

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Sum	IRR	NPV
		19,366,300	39,894,600	41,091,400	42,324,100	43,593,800	44,901,600	46,248,600	47,636,100	49,065,200	50,537,200	52,053,300	53,614,900	55,223,300	56,880,000	58,586,400	60,344,000	62,154,300			
		- 14,310,900	- 20,171,900	- 20,304,700	- 20,441,400	- 20,582,300	- 22,235,700	- 22,385,100	- 22,539,100	- 22,697,600	- 22,860,900	- 23,029,100	- 24,865,500	- 25,044,000	- 25,227,800	- 25,417,100	- 25,612,100	- 25,812,900			
		- 9,731,400	- 13,716,900	- 13,807,200	- 13,900,200	- 13,996,000	- 15,120,300	- 15,221,900	- 15,326,600	- 15,434,400	- 15,545,400	- 15,659,800	- 16,908,500	- 17,029,900	- 17,154,900	- 17,283,600	- 17,416,200	- 17,552,800			
		3,297,500	3,396,400	3,498,300	3,603,200	3,711,300	3,822,600	3,937,300	4,055,400	4,177,100	4,302,400	4,431,500	4,564,400	4,701,300	4,842,300	4,987,600	5,137,200	5,291,300			
0	- 98,965,300																				
																		90,265,900			
0	- 98,965,300	12,932,400	29,574,100	30,782,500	32,027,100	33,309,100	33,603,900	34,964,000	36,364,900	37,807,900	39,294,200	40,825,000	41,270,800	42,894,700	44,567,400	46,290,400	48,065,000	140,158,700	513,830,400	13%	N$ 48,079,257.21

APPENDIX 8.5

CALCULATION OF ROAD USER CHARGES

Cost per truck – km N$0.72

YEAR 4	SCENARIO 1	SCENARI
Tons	135,500	253,50(
Trucks @ 27 tons	4,972	9,233
Truck-km for 496 km	2,466,100	4,579,8(
RUC @ N$0,72 truck-km	N$ 1,775,600	N$ 3,297,!
Increases by 3% per year to Year 2000		

SECTION 9: IMPLEMENTATION PHASING AN FINANCIAL PLAN

APPENDIX 9.1

SUGGESTED TENDER WORDING RELATIVE TO LABOUR BASED CONST REQUIREMENTS

LABOUR INTENSIVE CONSTRUCTION

The attention of the Tenderers is drawn to the following:

1. LIMITATIONS ON THE USE OF MECHANICAL PLANT AND EQUIPMENT

The works to be constructed under this project are generally to be constructed maximisi Labour Intensive Construction Methods and the use of mechanical plant and e accordingly restricted in terms of the provisions of the Contract, to that which would cle economical if done with Labour Intensive Methods.

2. UTILISATION OF LOCAL WORKERS

It is the intention that the Contractor shall make maximum use of the available Labour Fc in the vicinity of the site and the Contractor is accordingly required to restrict his utilisa local workers to Key personnel only.

Each Tenderer shall state how many non-local Key personnel he intends to employ in categories. The numbers specified will be strictly controlled during the contract peri increase in numbers will be subject to the approval of the Employer.

3. TERMS AND CONDIITONS OF THE EMPLOYMENT OF LOCAL WORKERS

Tenderers shall take note of the requirements of the particular Specification relating to th conditions under which local workers are to be employed.

Tenderers will be required to pay workers in accordance with the current approved (rates.

4. PROVISION OF TRAINING

Tenderers shall take particular note of the requirements relating to the provision of workers engaged on the contract, as described in the Particular Specification.

Each Tenderer shall outline the proposed Structured Training Programme which he wil should his tender be accepted. Such outline should indicate:

a) the format and content of the Structured Training Programme

b) the numbers of Trainers to be provided (full and part time)

5. MINIMUM WORK TO BE DONE UNDER LABOUR BASED CONSTRUCTION METHO

The following work elements will be done by labour based methods:

a) Clearing and grubbing

b) Excavating and placing the first two layers of subgrade material

c) Land crossing construction

d) Manufacturing and installing culverts

e) Fencing

The Tenderers will submit a work plan detailing how each element will be performed, th workers required in each category (foreman, skilled and unskilled workers) and the employment.

6. HOUSING

Temporary housing sites must be set up in accordance with existing labour and en standards. When work is complete the housing sites will be dismantled in an orderly fash

Temporary housing sites will have security provisions to ensure that poaching, illegal wo and other activities that will create problems with land owners or members of the community are prevented.