



Road Network Evaluation Tools (RONET) Version 2.00

January, 2009
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Road Network Evaluation Tools

- Developed for SSATP by the World Bank.
- Helps decision makers:
 - Monitor network condition
 - Plan allocation of resources
 - Assess consequences of macro policies
 - Design Road Asset Managements Systems
- Developed for Africa region, but can be applied on any developing country worldwide.





RONET Version 2.00



Road Network Evaluation Tools

Version 2.00, January, 2009

Step	Configuration	Inputs	Calculations	Outputs
1)	C-Basic Configuration	I-Country Data I-Road Network Length	Current Condition Assessment	O-Length & Utilization O-Asset Value O-Roughness O-Network Distribution Charts O-Network Monitoring Indicators
2)	C-Standards Configuration	I-Historical Expenditures	Performance Assessment PAM	O-Network Performance O-Annual Work Program O-Solution Catalog O-Road Works Distribution O-Road Works Summary O-Historical Expenditures Comparison
3)	C-Vehicle Fleet Configuration	I-Road User Charges I-Funding Requirements	Road User Revenues	O-Fuel Consumption Revenues O-Road User Revenues O-Requirements & Revenues Comparison



The World Bank
Washington, D.C.





Road Network Length Matrix

Matrix of Road Classes: Overall Network Evaluation

Network Type	Road Type				
	Concrete	Asphalt	S.T.	Gravel	Earth
Motorways					
Primary					
Secondary					
Tertiary					
Unclassified					

Traffic Category	Condition Category				
	Very Good	Good	Fair	Poor	Very Poor
Traffic I					
Traffic II					
Traffic III					
Traffic IV					
Traffic V					



Total 5 X 5 X 5 X 5 = 625 Road Classes



Network Types

- Five or less network types are user defined as a function of functional, classification, region, terrain type or environmental type.

Network Type	Default Configuration	Alternative Configurations Examples	
	Types by Functional Class	Types by Geographic Region	Types by Terrain Type
1	Motorways	North Region	Flat Terrain
2	Primary	South Region	Hilly Terrain
3	Secondary	Eastern Region	Mountainous Terrain
4	Tertiary	Western Region	NA
5	Unclassified	Central Region	NA





Surface Types

- RONET defines five surface types. The country specific characteristics of the surface types are user defined.

Surface Type	Default Configuration
	Surface Type
1	Cement Concrete
2	Asphalt Mix
3	Surface Treatment
4	Gravel
5	Earth





Traffic Categories

- Traffic categories vary by surface type.

Surface Type	Traffic Category	Traffic Level	Average Annual Daily Traffic (AADT)			Illustrative Standards	
			Minimum (veh/day)	Maximum (veh/day)	Average (veh/day)	Geometry Standard	Pavement Standard
Earth	Traffic I	T1	0	10	5	1-lane warranted	Formation not warranted
	Traffic II	T2	10	30	20	1-lane warranted	Formation warranted
	Traffic III	T3	30	100	65	2-lane warranted	Gravel warranted
	Traffic IV	T4	100	300	200	2-lane warranted	Gravel warranted
	Traffic V	T5	300	1,000	650	2-lane warranted	Paved Surface warranted
Gravel	Traffic I	T2	10	30	20	1-lane warranted	Formation warranted
	Traffic II	T3	30	100	65	2-lane warranted	Gravel warranted
	Traffic III	T4	100	300	200	2-lane warranted	Gravel warranted
	Traffic IV	T5	300	1,000	650	2-lane warranted	Paved Surface warranted
	Traffic V	T6	1,000	3,000	2,000	2-lane warranted	Paved Surface warranted
Paved	Traffic I	T4	100	300	200	2-lane warranted	Gravel warranted
	Traffic II	T5	300	1,000	650	2-lane warranted	Paved Surface warranted
	Traffic III	T6	1,000	3,000	2,000	2-lane warranted	Paved Surface warranted
	Traffic IV	T7	3,000	10,000	6,500	2-lane warranted	Paved Surface warranted
	Traffic V	T8	10,000	30,000	20,000	4-lane warranted	Paved Surface warranted



Standard given for illustration purposes. Proper standards are country specific.

- AADT of motorized 4-tires or more 2-way traffic



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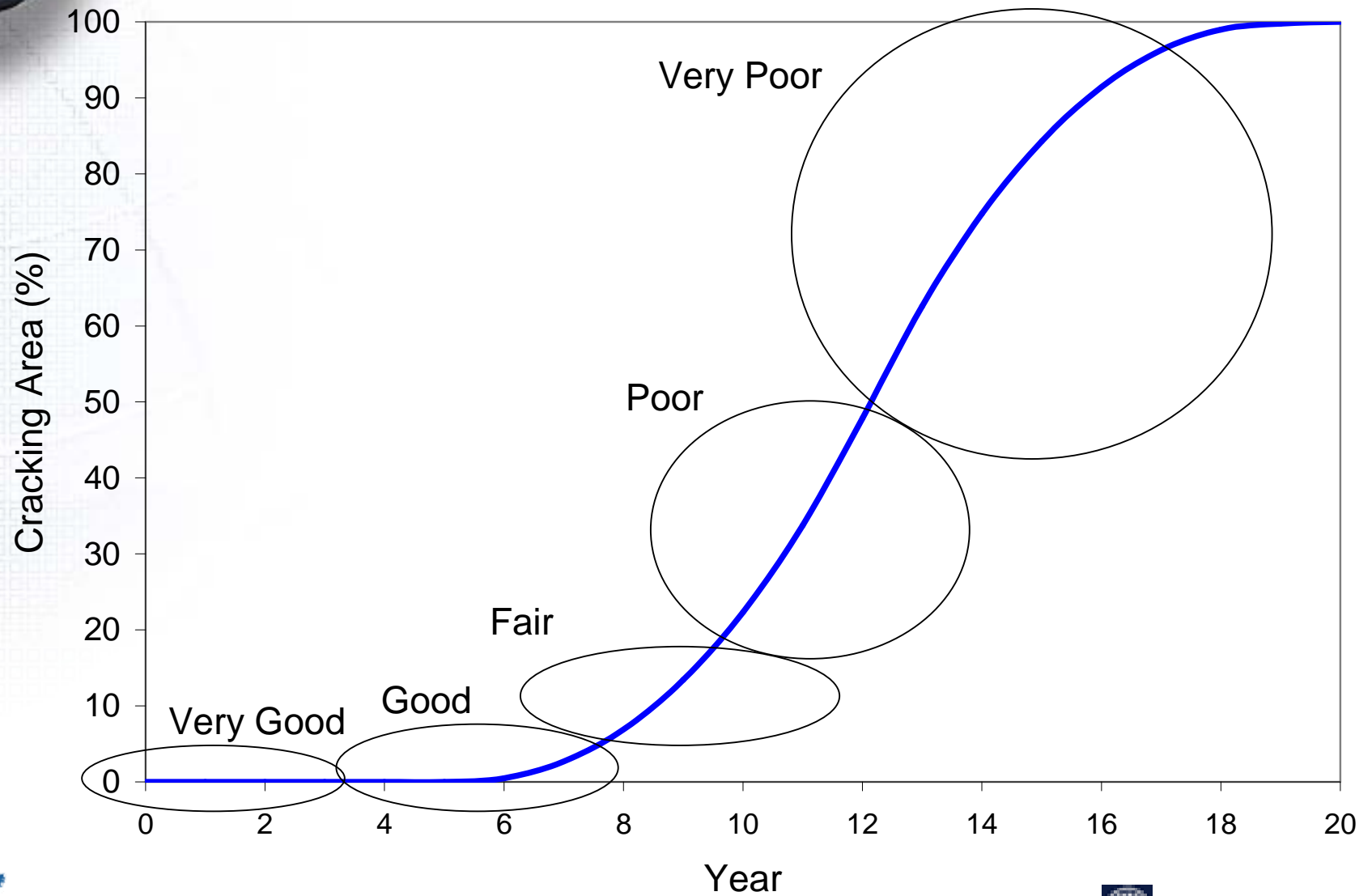
Road Condition Categories

- Very Good: requires only routine maintenance (RM)
- Good: requires RM plus preventive maintenance or spot regravelling or repairs
- Fair: requires RM plus periodic maintenance
- Poor: requires RM plus strengthening or partial reconstruction
- Very Poor: requires RM plus full reconstruction





Cracking Progression





Main Input: Road Network Length

Road Network Two-Lane Equivalent Length (km)

Primary Surface Treatment

Condition (IRI)		Very Good	Good	Fair	Poor	Very Poor	Total
Traffic (AADT)		3	4	5.5	9	13	
Traffic I	<300	0.0	0.0	0.0	0.0	0.0	0.0
Traffic II	300-1000	0.0	51.0	36.0	62.0	26.0	175.0
Traffic III	1000-3000	4.0	13.0	67.0	88.0	32.0	204.0
Traffic IV	3000-10000	0.0	0.0	0.0	0.0	0.0	0.0
Traffic V	>10000	0.0	0.0	0.0	0.0	0.0	0.0
Total		4.0	64.0	103.0	150.0	58.0	379.0

Primary Gravel

Condition (IRI)		Very Good	Good	Fair	Poor	Very Poor	Total
Traffic (AADT)		5	7	11	16	20	
Traffic I	<30	0.0	0.0	0.0	49.0	292.0	341.0
Traffic II	30-100	0.0	5.0	11.0	7.0	179.0	202.0
Traffic III	100-300	0.0	0.0	0.0	0.0	0.0	0.0
Traffic IV	300-1000	0.0	0.0	0.0	0.0	0.0	0.0
Traffic V	>1000	0.0	0.0	0.0	0.0	0.0	0.0
Total		0.0	5.0	11.0	56.0	471.0	543.0

Secondary Surface Treatment

Condition (IRI)		Very Good	Good	Fair	Poor	Very Poor	Total
Traffic (AADT)		3	4	5.5	9	13	
Traffic I	<300	0.0	0.0	10.0	0.0	0.0	10.0
Traffic II	300-1000	0.0	0.0	3.0	56.0	47.0	106.0
Traffic III	1000-3000	18.0	8.0	47.0	61.0	5.0	139.0
Traffic IV	3000-10000	0.0	0.0	0.0	0.0	0.0	0.0
Traffic V	>10000	0.0	0.0	0.0	0.0	0.0	0.0
Total		18.0	8.0	60.0	117.0	52.0	255.0

Secondary Gravel

Condition (IRI)		Very Good	Good	Fair	Poor	Very Poor	Total
Traffic (AADT)		5	7	11	16	20	
Traffic I	<30	7.0	56.0	393.0	631.0	503.0	1,590.0
Traffic II	30-100	11.0	15.0	53.0	507.0	618.0	1,204.0
Traffic III	100-300	0.0	0.0	0.0	37.0	14.0	51.0
Traffic IV	300-1000	0.0	0.0	0.0	0.0	0.0	0.0
Traffic V	>1000	0.0	0.0	0.0	0.0	0.0	0.0
Total		18.0	71.0	446.0	1,175.0	1,135.0	2,845.0





Main Input: Country Data

Country Data

Name and Year

Country Name	Country XYZ
Current Year	2007

Basic Characteristics

Land area (sq km)	121,000
Total population (million persons)	5.00
Rural population (million persons)	2.00
GDP at current prices (\$ Billion)	4.600
Vehicle fleet (vehicles)	100,000
Total road network length (km)	19,000
Total paved roads network length (km)	2,000
Diesel roads consumption (million liters/year)	350
Gasoline roads consumption (million liters/year)	210
Total accidents fatalities (persons/year)	470
Total accidents serious injuries (persons/year)	4,000
Discount rate (%)	12%

Traffic Growth Rate

Network	Annual Traffic Growth Rate (%/year)
Motorways	3.0%
Primary	3.0%
Secondary	3.0%
Tertiary	3.0%
Unclassified	3.0%





Main Input: Road Work Costs

Capital Road Works Unit Costs

Surface Type	Current Condition	Road Work Class	Road Work Type	Two-Lane Unit Costs of Road Works (\$/km)				
				Motorways	Primary	Secondary	Tertiary	Unclassified
Cement Concrete	Good Condition	Periodic Maintenance	Preventive Treatment	12,000	12,000	12,000	8,571	8,571
	Fair Condition		Resurfacing (Overlay)	100,000	100,000	100,000	71,429	71,429
	Poor Condition	Rehabilitation	Strengthening (Overlay)	200,000	200,000	200,000	142,857	142,857
	Very Poor Condition		Reconstruction	330,000	330,000	330,000	235,714	235,714
	No Road	New Construction	New Construction	400,000	400,000	400,000	285,714	285,714
Asphalt Mix	Good Condition	Periodic Maintenance	Preventive Treatment	12,000	12,000	12,000	8,571	8,571
	Fair Condition		Resurfacing (Overlay)	100,000	100,000	100,000	71,429	71,429
	Poor Condition	Rehabilitation	Strengthening (Overlay)	200,000	200,000	200,000	142,857	142,857
	Very Poor Condition		Reconstruction	330,000	330,000	330,000	235,714	235,714
	No Road	New Construction	New Construction	400,000	400,000	400,000	285,714	285,714
Surface Treatment	Good Condition	Periodic Maintenance	Preventive Treatment	12,000	12,000	12,000	8,571	8,571
	Fair Condition		Resurfacing (Reseal)	27,000	27,000	27,000	19,286	19,286
	Poor Condition	Rehabilitation	Strengthening (Overlay)	160,000	160,000	160,000	114,286	114,286
	Very Poor Condition		Reconstruction	260,000	260,000	260,000	185,714	185,714
	No Road	New Construction	New Construction	330,000	330,000	330,000	235,714	235,714
Gravel	Good Condition	Periodic Maintenance	Spot Regravelling	3,000	3,000	3,000	2,143	2,143
	Fair Condition		Regravelling	17,000	17,000	17,000	12,143	12,143
	Poor Condition	Rehabilitation	Partial Reconstruction	40,000	40,000	40,000	28,571	28,571
	Very Poor Condition		Full Reconstruction	60,000	60,000	60,000	42,857	42,857
	No Road	New Construction	New Construction	80,000	80,000	80,000	57,143	57,143
Earth	Good Condition	Periodic Maintenance	Spot Repairs	200	200	200	143	143
	Fair Condition		Heavy Grading	800	800	800	571	571
	Poor Condition	Rehabilitation	Partial Reconstruction	8,000	8,000	8,000	5,714	5,714
	Very Poor Condition		Full Reconstruction	25,000	25,000	25,000	17,857	17,857
	No Road	New Construction	New Construction	40,000	40,000	40,000	28,571	28,571





Network Length & Utilization

Network Length

Network Length by Network Type and Surface Type (km)

	Concrete	Asphalt	S.T.	Gravel	Earth	Total	Percent
Primary	0	1,175	379	543	0	2,097	10%
Secondary	0	117	255	2,845	3,230	6,447	31%
Tertiary	0	0	0	1,731	8,340	10,071	48%
Unclassified	0	0	0	0	0	0	0%
Urban	0	277	145	595	1,190	2,207	11%
Total	0	1,569	779	5,714	12,760	20,822	100%
Percent	0%	8%	4%	27%	61%	100%	

Network Length by Network Type and Road Condition (km)

	Very Good	Good	Fair	Poor	Very Poor	Total	Percent
Primary	376	691	230	261	539	2,097	10%
Secondary	389	1,379	1,450	2,042	1,187	6,447	31%
Tertiary	2	20	781	3,403	5,865	10,071	48%
Unclassified	0	0	0	0	0	0	0%
Urban	150	77	223	1,757	0	2,207	11%
Total	917	2,167	2,684	7,463	7,591	20,822	100%
Percent	4%	10%	13%	36%	36%	100%	

Network Length by Network Type and Traffic Level (km)

	Traffic I	Traffic II	Traffic III	Traffic IV	Traffic V	Total	Percent
Primary	341	641	998	0	117	2,097	10%
Secondary	1,600	2,149	1,290	1,181	227	6,447	31%
Tertiary	4,141	5,925	5	0	0	10,071	48%
Unclassified	0	0	0	0	0	0	0%
Urban	84	230	1,652	241	0	2,207	11%
Total	6,166	8,945	3,945	1,422	344	20,822	100%
Percent	30%	43%	19%	7%	2%	100%	

Similar Tables per Surface Type and Surface Class

Similar Tables for Network Utilization





Current Asset Value & Condition

Network Current Asset Value

Network Current Asset Value by Network Type and Surface Type (Million \$)

	Concrete	Asphalt	S.T.	Gravel	Earth	Total	Percent
Primary	0	393	88	15	0	496	53%
Secondary	0	28	44	85	61	219	24%
Tertiary	0	0	0	35	12	47	5%
Unclassified	0	0	0	0	0	0	0%
Urban	0	67	33	27	40	167	18%
Total	0	489	165	162	113	929	100%
Percent	0%	53%	18%	17%	12%	100%	

Network Current Asset Value by Network Type and Road Condition (Million \$)

	Very Good	Good	Fair	Poor	Very Poor	Total	Percent
Primary	131	234	65	46	20	496	53%
Secondary	12	42	62	75	28	219	24%
Tertiary	0	1	6	20	20	47	5%
Unclassified	0	0	0	0	0	0	0%
Urban	16	8	21	123	0	167	18%
Total	159	284	154	264	67	929	100%
Percent	17%	31%	17%	28%	7%	100%	

Network Current Asset Value by Network Type and Traffic Level (Million \$)

	Traffic I	Traffic II	Traffic III	Traffic IV	Traffic V	Total	Percent
Primary	9	131	317	0	39	496	53%
Secondary	53	84	56	22	4	219	24%
Tertiary	19	27	0	0	0	47	5%
Unclassified	0	0	0	0	0	0	0%
Urban	20	54	71	22	0	167	18%
Total	101	296	443	44	44	929	100%
Percent	11%	32%	48% ¹⁴	5%	5%	100%	

Similar Tables per Surface Type and Surface Class

Similar Tables for Network Roughness





Current Asset Value Calculation

Road Type	Current Condition	Current Asset Value Unit Cost
Paved Roads	Very Good	Construction Unit Cost
	Good	Construction Unit Cost - Preventive Treatment Unit Cost
	Fair	Construction Unit Cost - Resurfacing Unit Cost
	Poor	Construction Unit Cost - Strengthening Unit Cost
	Very Poor	Construction Unit Cost - Full Reconstruction Unit Cost
Gravel Roads	Very Good	Construction Unit Cost
	Good	Construction Unit Cost - Spot Regravelling Unit Cost
	Fair	Construction Unit Cost - Regravelling Unit Cost
	Poor	Construction Unit Cost - Partial Reconstruction Unit Cost
	Very Poor	Construction Unit Cost - Full Reconstruction Unit Cost
Earth Roads	Very Good	Construction Unit Cost
	Good	Construction Unit Cost - Spot Repairs Unit Cost
	Fair	Construction Unit Cost - Heavy Grading Unit Cost
	Poor	Construction Unit Cost - Partial Reconstruction Unit Cost
	Very Poor	Construction Unit Cost - Full Reconstruction Unit Cost





Monitoring Indicators 1/2

Monitoring Indicator		Primary	Secondary	Tertiary	Overall
Network Length					
Road network length	km	2,097	6,447	10,071	18,615
Road network length that is unpaved	km	543	6,075	10,071	16,689
Road network length that is paved	km	1,554	372		1,926
Road network length that is paved	%	74.1%	5.8%		10.3%
Network Density					
Road network per thousand land area	km/1000 sq km	17.33	53.28	83.23	153.84
Road network per thousand total population	km/1000 persons	0.42	1.29	2.01	3.72
Road network per thousand rural population	km/1000 persons	1.05	3.22	5.04	9.31
Road network per thousand vehicles	km/1000 vehicles	20.97	64.47	100.71	186.15
Road network per \$ million GDP	km/million \$	0.46	1.40	2.19	4.05
Paved road network per thousand land area	km/1000 sq km	12.84	3.07		15.92
Paved road network per thousand total population	km/1000 persons	0.31	0.07		0.39
Paved road network per thousand rural population	km/1000 persons	0.78	0.19		0.96
Paved road network per thousand vehicles	km/1000 vehicles	15.54	3.72		19.26
Paved road network per \$ million GDP	km/million \$	0.34	0.08		0.42
Network Condition					
Percentage of road network in good and fair condition	%	61.9%	49.9%	8.0%	28.6%
Percentage of unpaved road network in good and fair condition	%	2.9%	50.0%	8.0%	23.1%
Percentage of paved road network in good and fair condition	%	82.4%	48.4%		75.9%
Percentage of paved road network with roughness 4 m/km IRI or less	%	68.3%	18.0%		58.6%
Paved roads average roughness weighted by km	IRI, m/km	4.27	7.23		4.84
Paved roads average roughness weighted by vehicle-km	IRI, m/km	3.66	6.96		3.96





Monitoring Indicators 2/2

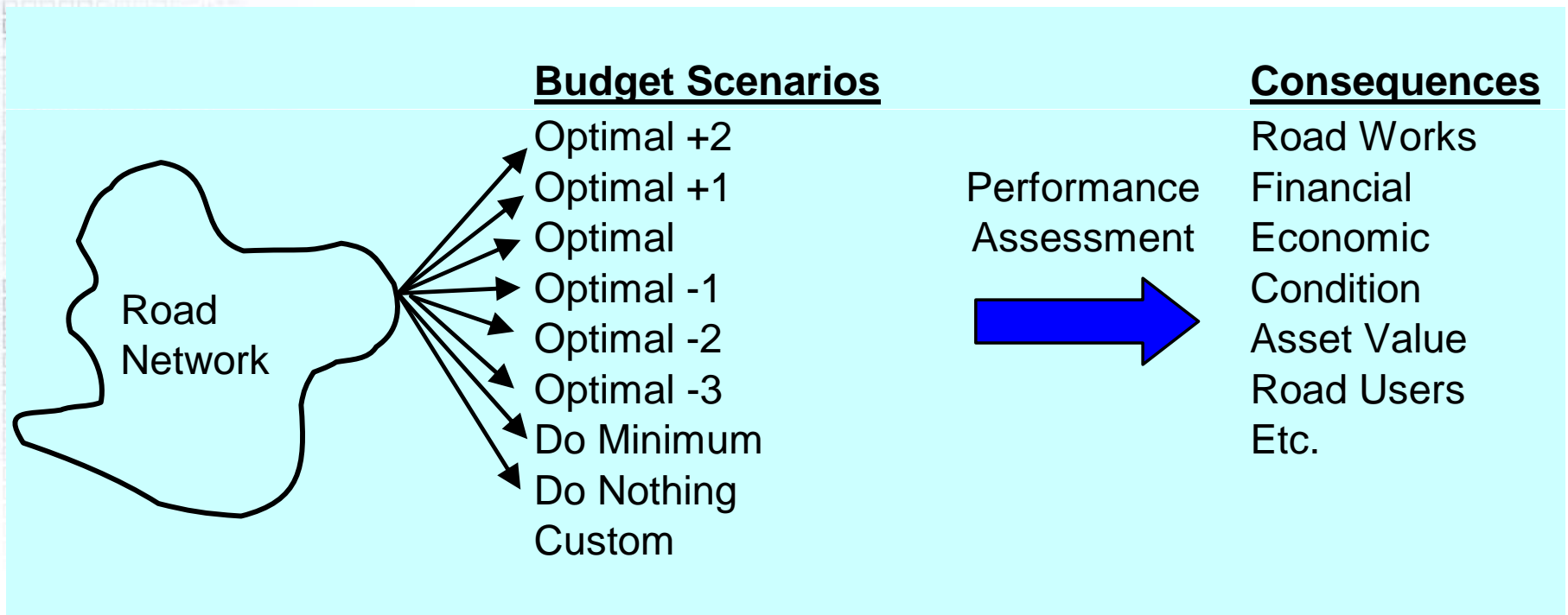
Monitoring Indicator		Primary	Secondary	Tertiary	Overall
Network Access					
Percentage of unpaved roads that are all-weather roads	%	2.9%	8.8%	1.5%	4.2%
All-weather roads area of influence (4 km wide) as a share of per land are	%	5.2%	3.0%	0.5%	8.7%
Network Standards					
Percentage of unpaved roads with 30 AADT or less	%	62.8%	38.5%	89.9%	70.3%
Percentage of unpaved roads with 300 AADT or more	%		3.7%		1.4%
Percentage of paved roads with 300 AADT or less	%		2.7%		0.5%
Percentage of paved roads with 10,000 AADT or more	%	7.5%			6.1%
Network Utilization					
Annual motorized vehicle utilization	million vehicle-km	1,694	383	72	2,149
Annual freight carried over road network	million ton-km	4,010	981	175	5,166
Annual passengers carried over road network	million pass-km	9,492	1,925	351	11,767
Average network annual average daily traffic	vehicles/day	2,213	163	20	316
Network Safety					
Annual number of fatalities	persons	169	38	7	215
Annual number of serious injuries	persons	1,694	383	72	2,149
Annual number of casualties	persons	1,863	422	79	2,364
Annual casualties cost	million \$	38.18	8.64	1.62	48.44
Annual casualties cost as a share of GDP	%	0.8%	0.2%	0.0%	1.1%
Annual number of fatalities per total population	#/100,000 persons	3.39	0.77	0.14	4.30
Network Asset					
Current road asset value	million \$	531.8	313.7	172.8	1,018.4
Current road asset value as a share of maximum road asset value	%	83.3%	64.3%	51.3%	69.6%
Current road asset value as a share of GPD	%	11.6%	6.8%	3.8%	22.1%





Performance Assessment

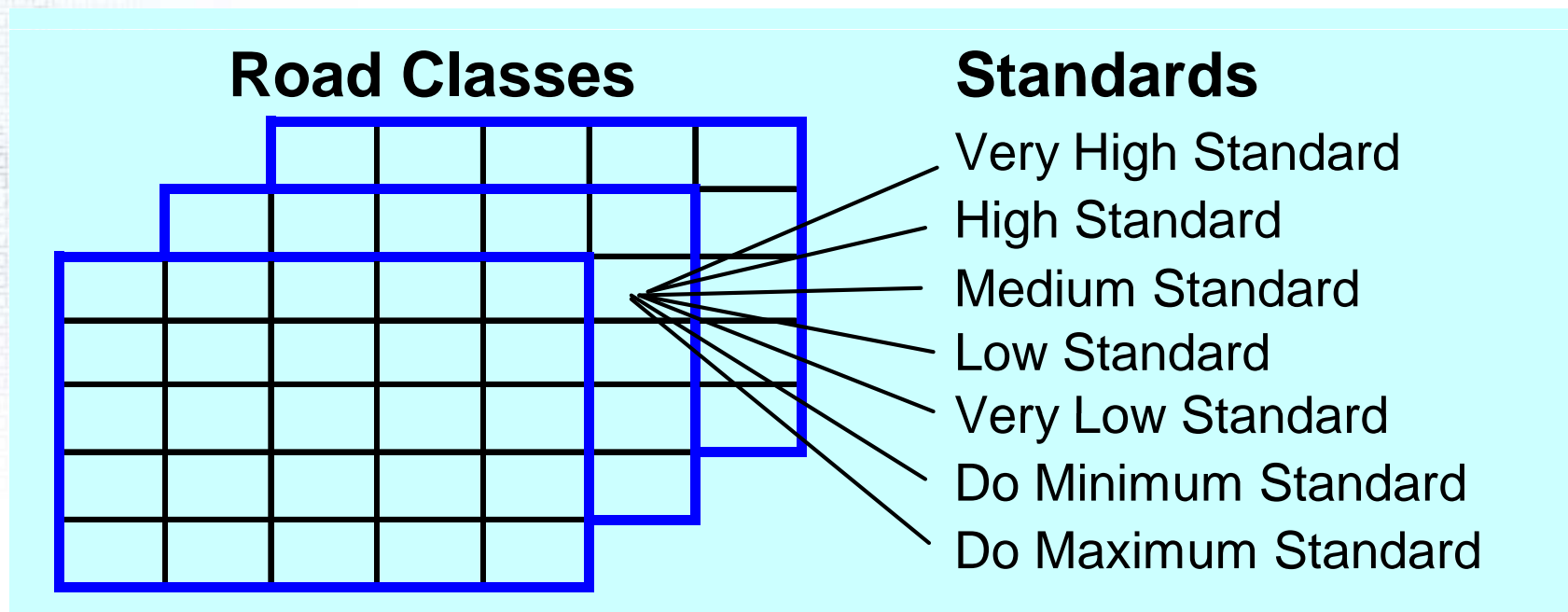
What are the consequences of different budget scenarios?





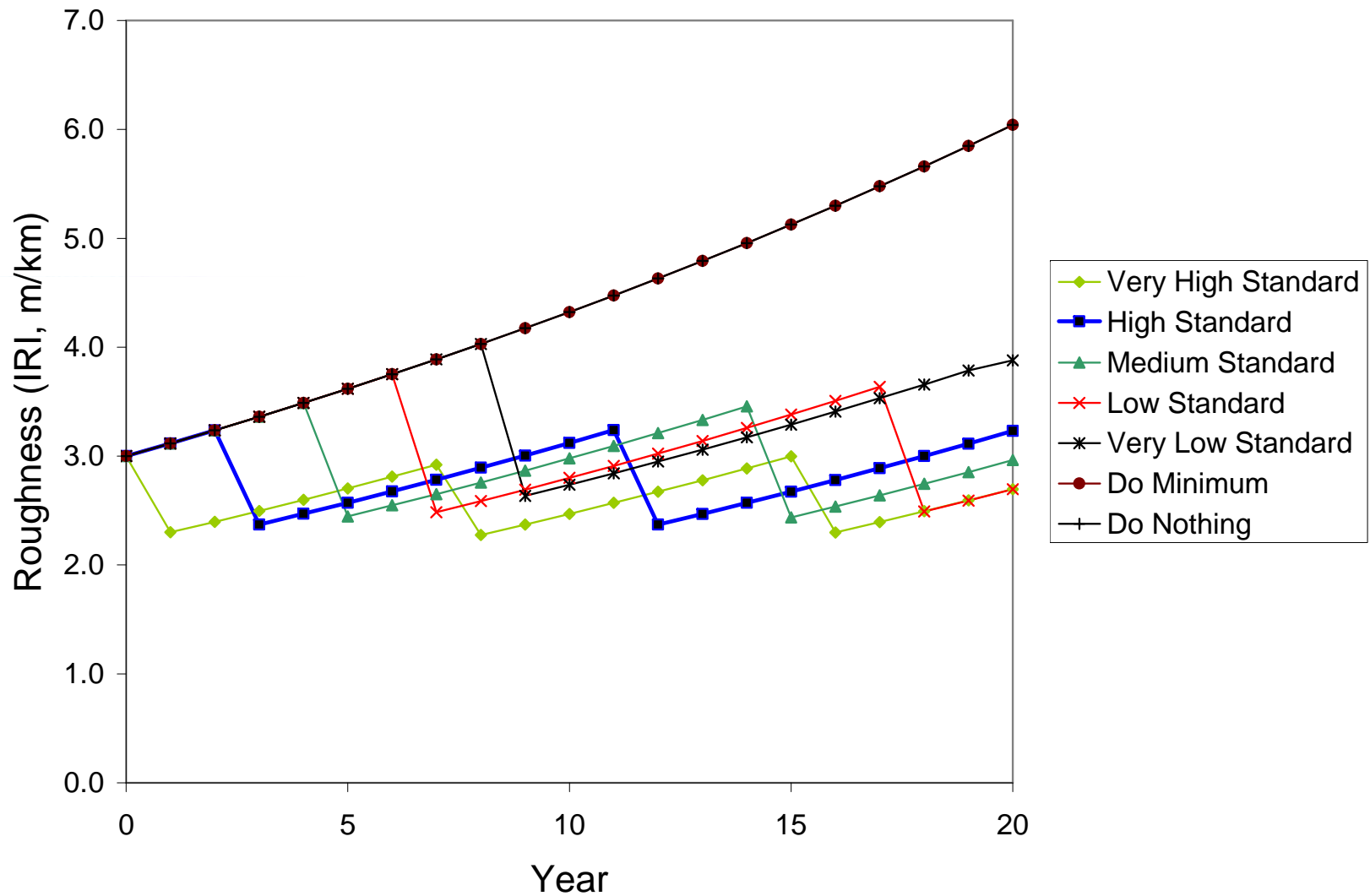
Road Work Standards

RONET evaluates alternative maintenance and rehabilitation road works standards for each road class.





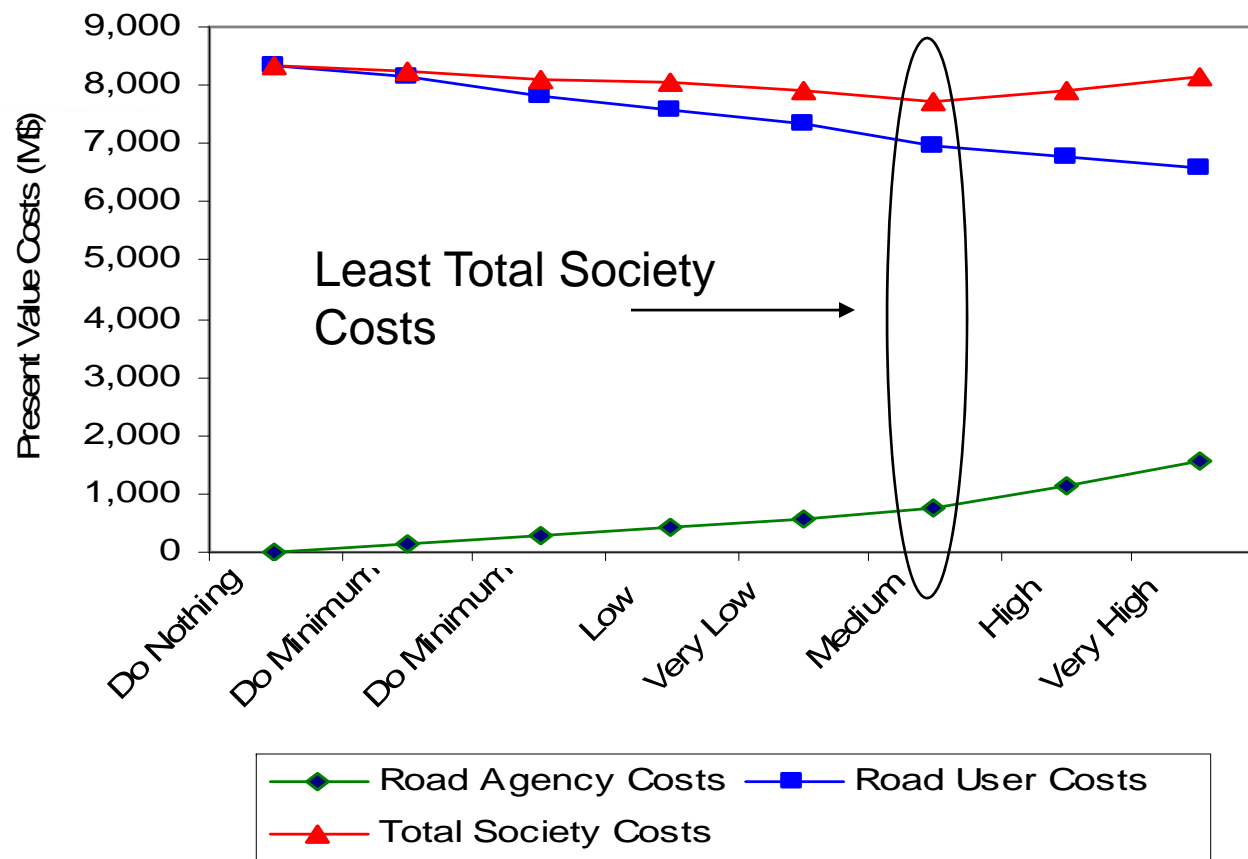
Asphalt Mix Roads Standards





Optimal Standard

RONET determines optimal standard per road class.





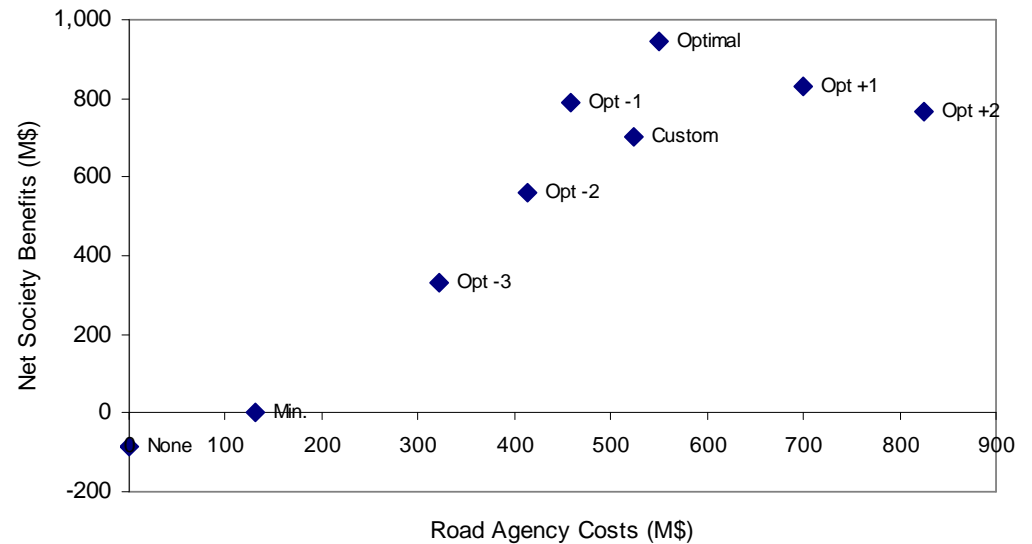
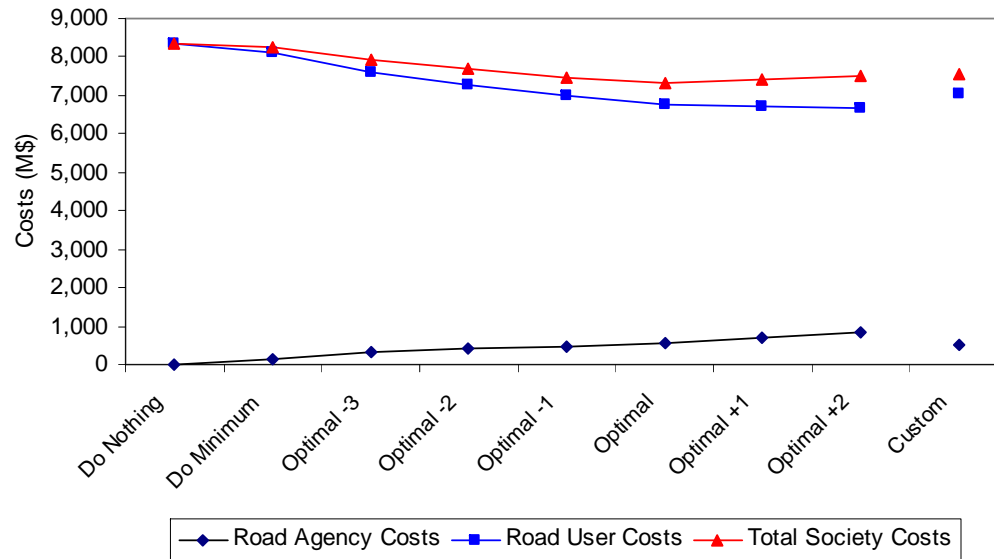
Budget Scenarios

Optimal + 2	Two standards above optimal standard per road class
Optimal + 1	One standard above optimal standard per road class
Optimal	Optimal standard per road class
Optimal – 1	One standard below optimal standard per road class
Optimal – 2	Two standards below optimal standard per road class
Optimal – 3	Three standards below optimal standard per road class
Do Minimum	Do minimum on all road classes
Do Nothing	Do nothing on all road classes
Custom	User defined standard per network type and traffic category





Society Costs and Net Benefits





Consequences to Road Agency

Road Agency Costs (Years 1-20)

Network	Scenario	Road Agency Total (M\$)	Road Agency Annual (M\$/year)	Compare with Optimal (%)
Total	Optimal +2	1,335	66.8	146%
Network	Optimal +1	1,102	55.1	121%
	Optimal	913	45.7	100%
	Optimal -1	817	40.8	89%
	Optimal -2	735	36.8	81%
	Optimal -3	629	31.4	69%
	Do Minimum	354	17.7	39%
	Do Nothing	0	0.0	0%
	Custom	977	48.8	107%

Road Agency Costs Breakdown (Years 1-20)

Network	Scenario	Annual Costs Years 1-20, M\$/year			
		Rehabilitation	Periodic Maint.	Recurrent Maint.	Road Agency
Total	Optimal +2	28.6	27.6	10.6	66.8
Network	Optimal +1	25.4	19.6	10.1	55.1
	Optimal	19.6	18.4	7.7	45.7
	Optimal -1	21.5	11.2	8.1	40.8
	Optimal -2	17.9	10.5	8.5	36.8
	Optimal -3	16.1	11.9	3.4	31.4
	Do Minimum	6.9	8.5	2.4	17.7
	Do Nothing	0.0	0.0	0.0	0.0
	Custom	16.6	24.9	7.4	48.8





Consequences to Society

Society Costs (Total Costs Years 1-20)

Network	Scenario	Total Costs Years 1-20, M\$		
		Road Agency	Road Users	Society
Total	Optimal +2	1,335	17,698	19,033
Network	Optimal +1	1,102	17,936	19,038
	Optimal	913	18,026	18,939
	Optimal -1	817	18,794	19,610
	Optimal -2	735	19,491	20,226
	Optimal -3	629	20,360	20,989
	Do Minimum	354	22,027	22,381
	Do Nothing	0	22,896	22,896
	Custom	977	18,635	19,612

Society Net Loss Compared to Optimal Scenario (Total Costs Years 1-20)

Network	Scenario	Society Costs (M\$)	Net Loss (M\$)	Net Loss (M\$/year)
Total	Optimal +2	19,033	94	4.7
Network	Optimal +1	19,038	100	5.0
	Optimal	18,939	0	0.0
	Optimal -1	19,610	672	33.6
	Optimal -2	20,226	1,287	64.4
	Optimal -3	20,989	2,050	102.5
	Do Minimum	22,381	3,443	172.1
	Do Nothing	22,896	3,958	197.9
	Custom	19,612	673	33.7





Consequences to Road Users

Impact of Road Agency Deficit on Road User Costs

Network	Scenario	Total Costs Years 1-20, M\$		Average* User Costs Increase per Agency Deficit	Marginal** User Costs Increase per Agency Deficit
		Agency Deficit	Users Costs Increase		
Total	Optimal +2	0	0	0.0	0.0
Network	Optimal +1	233	239	1.0	1.0
	Optimal	422	328	0.8	0.5
	Optimal -1	519	1,096	2.1	8.0
	Optimal -2	600	1,793	3.0	8.6
	Optimal -3	706	2,662	3.8	8.2
	Do Minimum	981	4,329	4.4	6.1
	Do Nothing	1,335	5,198	3.9	2.5
	Custom	358	937	2.6	5.6

* Average: Comparison with Optimal +2

** Marginal: Incremental comparison with standard with lower agency deficit

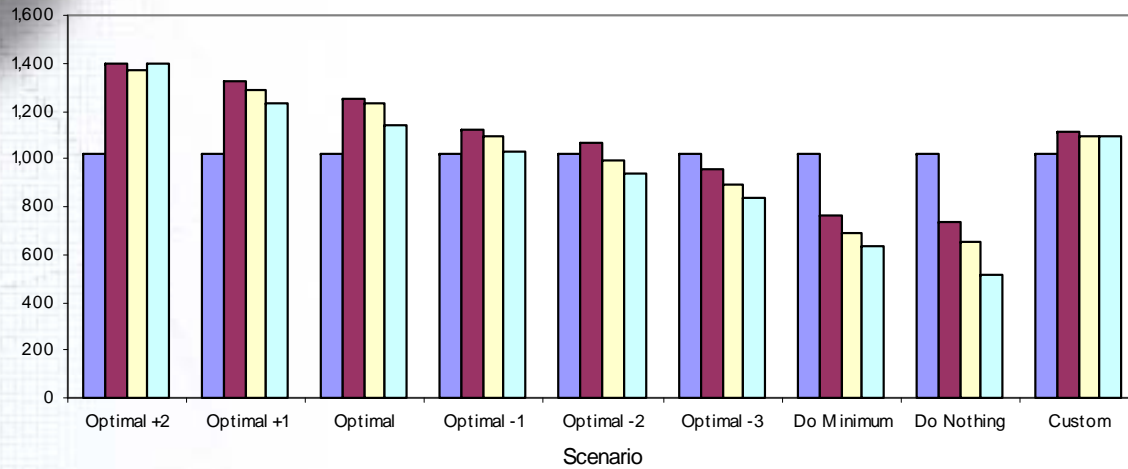
Unit Road User Costs

Network	Scenario	Unit Road User Costs (\$/vehicle-km)			
		Current	Years 5	Years 10	Years 20
Total	Optimal +2	0.328	0.298	0.298	0.296
Network	Optimal +1	0.328	0.299	0.301	0.306
	Optimal	0.328	0.301	0.301	0.308
	Optimal -1	0.328	0.309	0.313	0.325
	Optimal -2	0.328	0.318	0.326	0.339
	Optimal -3	0.328	0.335	0.339	0.352
	Do Minimum	0.328	0.355	0.369	0.397
	Do Nothing	0.328	0.362	0.376	0.420
	Custom	0.328	0.312	0.315	0.311

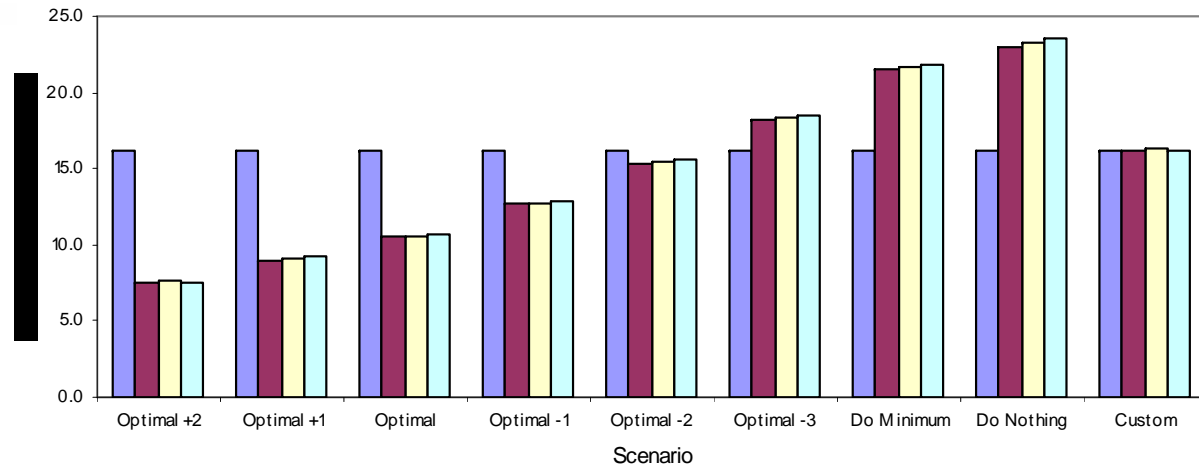




Consequences to Asset Value and Network Roughness



■ Current ■ Year 5 ■ Year 10 ■ Year 20



■ Current ■ Year 5 ■ Year 10 ■ Year 20





Road Works Distribution (M\$)

Other Tables for:
 (M\$)
 (M\$/year)
 (\$/km-year)
 (\$/veh-km)
 (km/year)

per surface class
 and surface type



Years 1-5

Road Agency Costs (M\$/year)

Network	Paved	Unpaved	Total	Percent
Motorways	0.0	0.0	0.0	0%
Primary	27.0	2.7	29.8	33%
Secondary	11.1	23.0	34.1	38%
Tertiary	0.0	27.1	27.1	30%
Total	38.2	52.9	91.0	100%
Percent	42%	58%	100%	

Rehabilitation Costs (M\$/year)

Network	Paved	Unpaved	Total	Percent
Motorways	0.0	0.0	0.0	0%
Primary	13.1	2.3	15.3	24%
Secondary	9.2	16.7	25.9	41%
Tertiary	0.0	22.5	22.5	35%
Total	22.2	41.5	63.7	100%
Percent	35%	65%	100%	

Periodic Maintenance Costs (M\$/year)

Network	Paved	Unpaved	Total	Percent
Motorways	0.0	0.0	0.0	0%
Primary	12.1	0.2	12.2	63%
Secondary	1.4	3.0	4.4	22%
Tertiary	0.0	2.9	2.9	15%
Total	13.4	6.1	19.6	100%
Percent	69%	31%	100%	

Recurrent Maintenance Costs (M\$/year)

Network	Paved	Unpaved	Total	Percent
Motorways	0.0	0.0	0.0	0%
Primary	1.9	0.3	2.2	28%
Secondary	0.5	3.3	3.8	50%
Tertiary	0.0	1.7	1.7	22%
Total	2.5	5.2	7.7	100%
Percent	32%	68%	100%	

Years 6-20

Road Agency Costs (M\$/year)

Network	Paved	Unpaved	Total	Percent
Motorways	0.0	0.0	0.0	0%
Primary	10.4	1.5	11.9	39%
Secondary	3.1	10.1	13.2	43%
Tertiary	0.0	5.4	5.4	18%
Total	13.5	17.0	30.5	100%
Percent	44%	56%	100%	

Rehabilitation Costs (M\$/year)

Network	Paved	Unpaved	Total	Percent
Motorways	0.0	0.0	0.0	0%
Primary	3.2	0.0	3.2	65%
Secondary	1.7	0.0	1.7	35%
Tertiary	0.0	0.0	0.0	0%
Total	4.9	0.0	4.9	100%
Percent	100%	0%	100%	

Periodic Maintenance Costs (M\$/year)

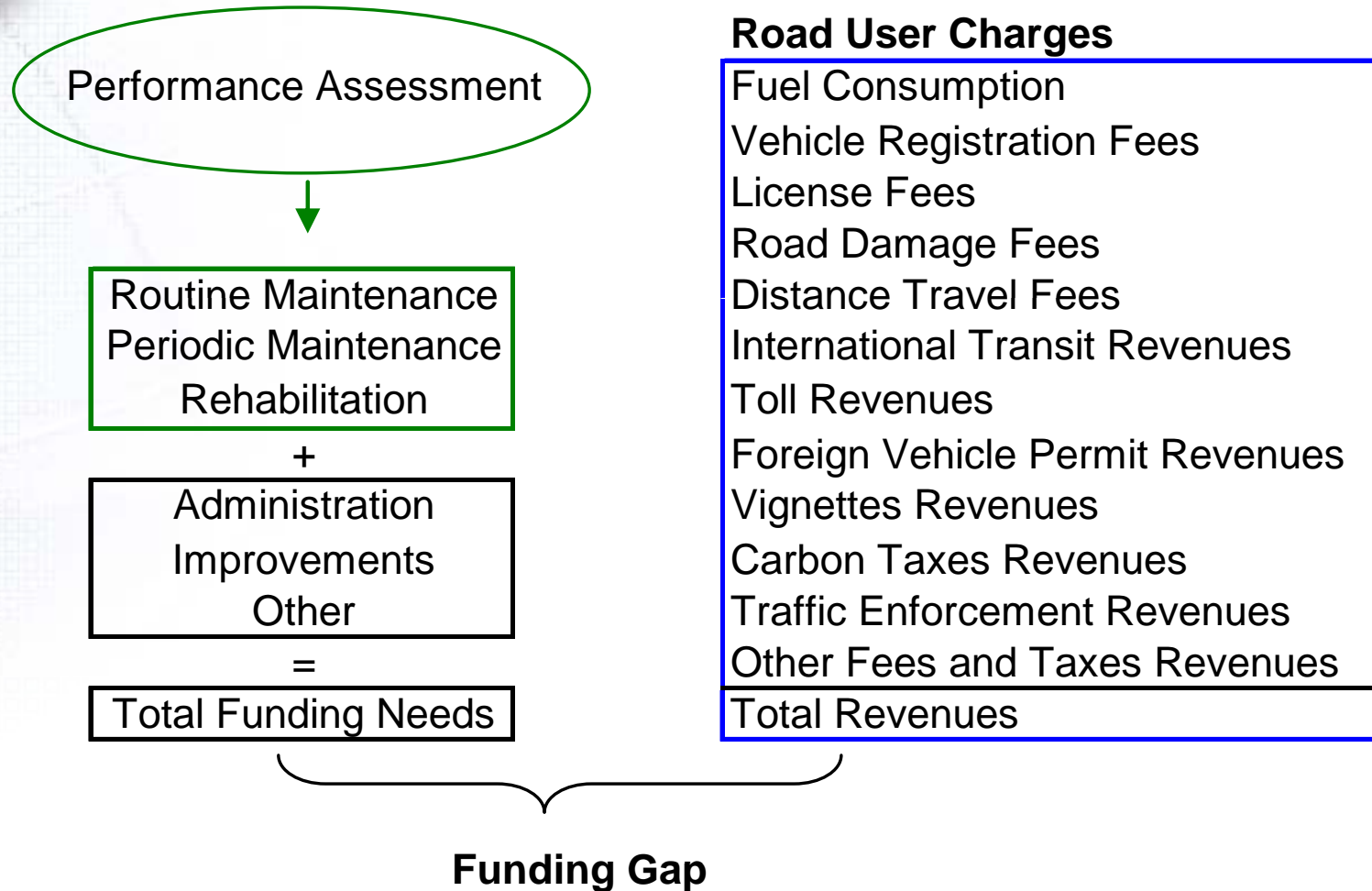
Network	Paved	Unpaved	Total	Percent
Motorways	0.0	0.0	0.0	0%
Primary	5.4	1.2	6.5	36%
Secondary	0.9	6.8	7.7	43%
Tertiary	0.0	3.8	3.8	21%
Total	6.2	11.8	18.0	100%
Percent	35%	65%	100%	

Recurrent Maintenance Costs (M\$/year)

Network	Paved	Unpaved	Total	Percent
Motorways	0.0	0.0	0.0	0%
Primary	1.9	0.3	2.1	28%
Secondary	0.5	3.3	3.8	50%
Tertiary	0.0	1.7	1.7	22%
Total	2.4	5.2	7.6	100%
Percent	31%	69%	100%	



Road User Charges





Funding Requirements

Annualized Funding Requirements Years 1-5

		Motorways	Primary	Secondary	Tertiary	Total
Routine Maintenance	Very Good, Good and Fair Roads	0.00	1.56	1.89	0.17	3.61
	Poor and Very Poor Roads	0.00	0.64	1.95	1.50	4.08
	Subtotal (M\$/year)	0.00	2.19	3.84	1.67	7.70
Periodic Maintenance	Very Good, Good and Fair Roads	0.00	12.03	2.07	0.10	14.20
	Poor and Very Poor Roads	0.00	0.21	2.32	2.85	5.37
	Subtotal (M\$/year)	0.00	12.23	4.39	2.94	19.57
Rehabilitation	Very Good, Good and Fair Roads	0.00	0.06	2.40	0.92	3.38
	Poor and Very Poor Roads	0.00	15.27	23.51	21.58	60.37
	Subtotal (M\$/year)	0.00	15.33	25.91	22.51	63.75
Investment Expenditures	New Construction (M\$/year)					0.00
	Upgrading (M\$/year)					0.00
	Widening (M\$/year)					0.00
						0.00
						0.00
	Other (M\$/year)	0.00				
Subtotal (M\$/year)	0.00	0.00	0.00	0.00	0.00	
Administration and Other Expenditures	Administration (M\$/year)					3.00
	Road Safety (M\$/year)					0.00
						0.00
						0.00
						0.00
	Other (M\$/year)	0.00				
Subtotal (M\$/year)	0.00	1.00	1.00	1.00	3.00	
Total Expenditures	Total (M\$/year)	0.00	30.76	35.14	28.12	94.01





Funding to be Cover by Road User Charges

Annualized Funding Requirements Years 1-5

		Motorways	Primary	Secondary	Tertiary	Total
Routine Maintenance	Very Good, Good and Fair Roads	0.00	1.56	1.89	0.17	3.61
	Poor and Very Poor Roads	0.00	0.64	1.95	1.50	4.08
	Subtotal (M\$/year)	0.00	2.19	3.84	1.67	7.70
Periodic Maintenance	Very Good, Good and Fair Roads	0.00	12.03	2.07	0.10	14.20
	Poor and Very Poor Roads	0.00	0.21	2.32	2.85	5.37
	Subtotal (M\$/year)	0.00	12.23	4.39	2.94	19.57
Rehabilitation	Very Good, Good and Fair Roads	0.00	0.06	2.40	0.92	3.38
	Poor and Very Poor Roads	0.00	15.27	23.51	21.58	60.37
	Subtotal (M\$/year)	0.00	15.33	25.91	22.51	63.75
Investment Expenditures	New Construction (M\$/year)					0.00
	Upgrading (M\$/year)					0.00
	Widening (M\$/year)					0.00
	Other (M\$/year)					0.00
	Subtotal (M\$/year)	0.00	0.00	0.00	0.00	0.00
Administration and Other Expenditures	Administration (M\$/year)		1.00	1.00	1.00	3.00
	Road Safety (M\$/year)					0.00
	Other (M\$/year)					0.00
	Subtotal (M\$/year)	0.00	1.00	1.00	1.00	3.00
	Total Expenditures	Total (M\$/year)	0.00	30.76	35.14	28.12

Funding Requirements

Percentage to be Cover by Road User Charges

Annualized Funding Requirements Years 1-5 to be Financed by Road User Charges

		Motorways	Primary	Secondary	Tertiary	Total
Routine Maintenance	Very Good, Good and Fair Roads	0.00	1.56	1.89	0.17	3.61
	Poor and Very Poor Roads	0.00	0.64	1.95	1.50	4.08
	Subtotal (M\$/year)	0.00	2.19	3.84	1.67	7.70
Periodic Maintenance	Very Good, Good and Fair Roads	0.00	12.03	2.07	0.10	14.20
	Poor and Very Poor Roads	0.00	0.21	2.32	2.85	5.37
	Subtotal (M\$/year)	0.00	12.23	4.39	2.94	19.57
Rehabilitation	Very Good, Good and Fair Roads	0.00	0.06	2.40	0.92	3.38
	Poor and Very Poor Roads	0.00	15.27	23.51	21.58	60.37
	Subtotal (M\$/year)	0.00	15.33	25.91	22.51	63.75
Investment Expenditures	New Construction (M\$/year)	0.00	0.00	0.00	0.00	0.00
	Upgrading (M\$/year)	0.00	0.00	0.00	0.00	0.00
	Widening (M\$/year)	0.00	0.00	0.00	0.00	0.00
	Other (M\$/year)	0.00	0.00	0.00	0.00	0.00
	Subtotal (M\$/year)	0.00	0.00	0.00	0.00	0.00
Administration and Other Expenditures	Administration (M\$/year)	0.00	1.00	1.00	1.00	3.00
	Road Safety (M\$/year)	0.00	0.00	0.00	0.00	0.00
	Other (M\$/year)	0.00	0.00	0.00	0.00	0.00
	Subtotal (M\$/year)	0.00	1.00	1.00	1.00	3.00
	Total Expenditures	Total (M\$/year)	0.00	30.76	35.14	28.12

Funding to be Cover by Road User Charges





Fuel Consumption

Vehicle Type	Fuel Type (Diesel or Gasoline)	Vehicle Fleet		Annual Utilization		Fuel Consumption			
		Country Fleet Composition (%)	Country Vehicle Fleet (veh)	Kilometers Driven per Year (km/yr)	Vehicle Utilization (million veh-km/yr)	Fuel Consumption (liters/veh-km)	Annual Fuel Consumption		
							Diesel (million liters/yr)	Gasoline (million liters/yr)	Total (million liters/yr)
Motorcycle	G	0%	0	15,000	0	0.05	0	0	0
Car (Gasoline)	G	45%	45,000	25,000	1,125	0.12	0	135	135
Car (Diesel)	D	5%	5,000	25,000	125	0.12	15	0	15
Utility (Gasoline)	G	20%	20,000	35,000	700	0.12	0	84	84
Utility (Diesel)	D	5%	5,000	35,000	175	0.12	21	0	21
Truck Light	D	10%	10,000	35,000	350	0.15	53	0	53
Truck Medium	D	8%	8,000	50,000	400	0.23	92	0	92
Truck Heavy	D	2%	2,000	70,000	140	0.43	60	0	60
Truck Articulated	D	1%	1,000	80,000	80	0.64	51	0	51
Bus Light	D	1%	1,000	50,000	50	0.14	7	0	7
Bus Medium	D	2%	2,000	70,000	140	0.21	29	0	29
Bus Heavy	D	1%	1,000	80,000	80	0.29	23	0	23
Total		100%	100,000		3,365	0.17	352	219	571
Annual fuel consumption (million gallons/yr)							93	58	151
Annual fuel consumption (000 ton/yr)							299	164	463





Road User Charges

Road User Charges

Fuel Consumption

Revenue Source	Fuel Type	Fuel Levy Assigned to the Road Sector				Taxes Assigned to General Budget (cent\$/liter)	Total Road User Charges (cent\$/liter)
		Road Fund (cent\$/liter)	Urban Road Entities (cent\$/liter)	Other Road Entities (cent\$/liter)	Total Road Sector (cent\$/liter)		
Fuel Consumption	Diesel	5.00			5.00	5.00	10.00
	Gasoline	5.00			5.00	15.00	20.00

Vehicle Fees

Revenue Source	Vehicle Type	Number of Vehicles per Year (vehicles/year)	Assigned to the Road Sector				Assigned General Budget (\$/vehicle)	Total Road User Charges (\$/vehicle)
			Road Fund (\$/vehicle)	Urban Road Entities (\$/vehicle)	Other Road Entities (\$/vehicle)	Total Road Sector (\$/vehicle)		
Vehicle	Motorcycle	0		5.60		5.60	5.60	
New Vehicle	Car (Gasoline)	4,500		22.00		22.00	22.00	
Registration	Car (Diesel)	500		22.00		22.00	22.00	
Fees	Utility (Gasoline)	2,000		33.00		33.00	33.00	
	Utility (Diesel)	500		33.00		33.00	33.00	
	Truck Light	1,000		33.00		33.00	33.00	
	Truck Medium	800		72.00		72.00	72.00	
	Truck Heavy	200		130.00		130.00	130.00	
	Truck Articulated	100		150.00		150.00	150.00	





Fuel Consumption Revenues

Fuel Consumption Revenues

Fuel Consumption Assignment	Fuel Revenues (cent\$/liter)		Fuel Revenues (M\$/year)		
	Diesel	Gasoline	Diesel	Gasoline	Total
Road Fund	4.50	4.50	15.82	9.86	25.67
Urban Road Entities	0.00	0.00	0.00	0.00	0.00
Other Road Entities	0.00	0.00	0.00	0.00	0.00
General Budget	4.50	13.50	15.82	29.57	45.38
Total	9.0	18.0	31.64	39.42	71.06

Fuel Levy Needed to Finance Funding Requirements

Annualized Funding Requirements Years 1-5 to be Covered by Road User Charges for Optimal Scenario (Million \$/year)			Fuel Levy (cent\$/liter)
Routine Maintenance	Very Good, Good and Fair Roads	3.61	0.63
	Poor and Very Poor Roads	4.08	0.72
	Subtotal	7.70	1.35
Periodic Maintenance	Very Good, Good and Fair Roads	14.20	2.49
	Poor and Very Poor Roads	5.37	0.94
	Subtotal	19.57	3.43
Rehabilitation	Very Good, Good and Fair Roads	3.38	0.59
	Poor and Very Poor Roads	60.37	10.58
	Subtotal	63.75	11.17
Investments		0.00	0.00
Administration & Other		3.00	0.53
Total		94.01	16.48





Road User Charges Revenues

Road User Charges Revenues Assignment (M\$/year)

Revenues (M\$/year)	Assigned to the Road Sector				Assigned to General Budget	Total Road User Charges
	Road Fund	Urban Road Entities	Other Road Entities	Total Road Sector		
Diesel Consumption	15.82	0.00	0.00	15.82	15.82	31.64
Gasoline Consumption	9.86	0.00	0.00	9.86	29.57	39.42
New Vehicle Registration Fees	0.00	0.31	0.00	0.31	0.00	0.31
License & Inspection Fees	0.00	0.26	0.00	0.26	0.00	0.26
Insurance & Other Vehicle Fees	0.00	0.00	0.00	0.00	0.00	0.00
Road Damage Fees	0.65	0.00	0.00	0.65	0.00	0.65
Distance Travel Fees	0.00	0.00	0.00	0.00	18.86	18.86
International Transit Revenues	0.88	0.00	0.00	0.88	0.00	0.88
Tolls Revenues	0.00	0.00	0.00	0.00	1.46	1.46
Foreign Vehicle Permit Revenues	0.00	0.00	0.00	0.00	0.00	0.00
Vignettes Revenues	0.00	0.00	0.00	0.00	0.00	0.00
Carbon Taxes Revenues	0.00	0.00	0.00	0.00	0.00	0.00
Traffic Enforcement Revenues	0.00	0.00	0.00	0.00	0.00	0.00
Other Fees & and Taxes Revenues	0.00	0.00	0.00	0.00	0.00	0.00
Total	27.20	0.57	0.00	27.78	65.70	93.47





Funding GAP

Annualized Funding Requirements Years 1-5 to be Covered by Road User Charges for Optimal Scenario

		Total (M\$/year)
Routine Maintenance Expenditures	Very Good, Good and Fair Roads	3.61
	Poor and Very Poor Roads	4.08
	Subtotal	7.70
Periodic Maintenance Expenditures	Very Good, Good and Fair Roads	14.20
	Poor and Very Poor Roads	5.37
	Subtotal	19.57
Rehabilitation Expenditures	Very Good, Good and Fair Roads	3.38
	Poor and Very Poor Roads	60.37
	Subtotal	63.75
Investment Expenditures	New Construction	0.00
	Upgrading	0.00
	Widening	0.00
	Subtotal	0.00
Administration and Other Expenditures	Administration	3.00
	Road Safety	0.00
	Subtotal	3.00
Total Expenditures	Total	94.01

Road User Charges Revenues

Assignment	Total (M\$/year)
Road Fund	27.20
Urban Road Entities	0.57
Other Road Entities	0.00
General Budget	65.70
Total Revenues	93.47

Comparison of Road Fund Revenues and Funding Requirements

Actual Revenues (M\$/year)	Estimated Needs (M\$/year)	Gap (M\$/year)	Gap (%)
27.20	94.01	66.81	71%

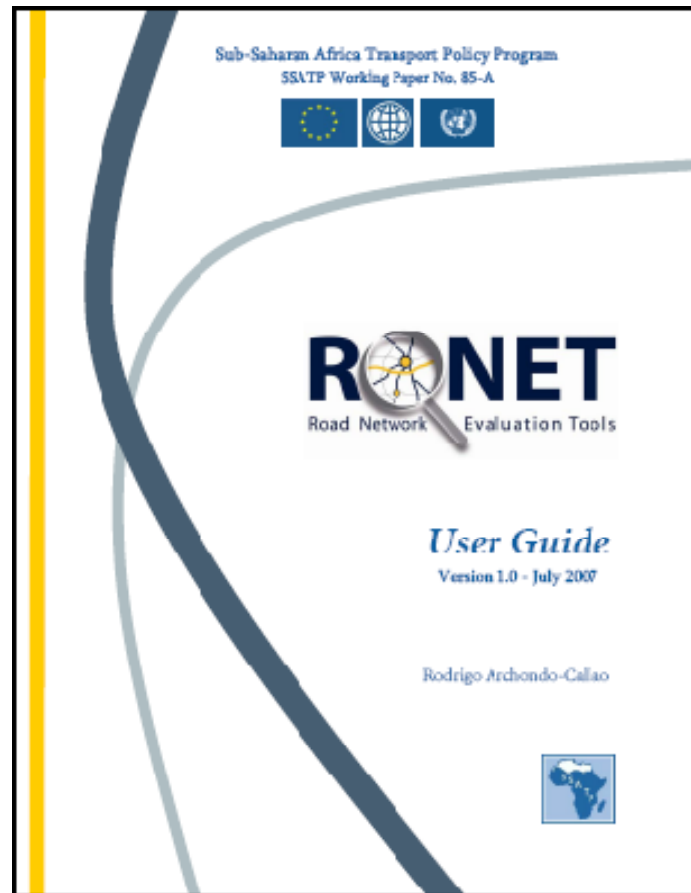
Comparison of Total Revenues and Funding Requirements

Actual Revenues (M\$/year)	Estimated Needs (M\$/year)	Gap (M\$/year)	Gap (%)
93.47	94.01	0.54	1%





RONET v2 Documentation





RONET Version 2.00 Distribution

- RONET 2.00 is available for free internet download at:
<http://www.worldbank.org/afr/ssatp>
- RONET 2.00 can be obtained by contacting:
 - Rodrigo Archondo-Callao
(rarchondocallao@worldbank.org)
- Technical issues contact:
 - Rodrigo Archondo-Callao
(rarchondocallao@worldbank.org)





What's Next for RONET

- Development
 - Translate it to French
 - Prepare case studies
- Dissemination
- New Tool?
 - New tool to evaluate homogeneous road sections, suited to support programming of road works





Conclusions

RONET Version 2.00 may contribute well to:

- ❑ Assessing network condition and asset value
- ❑ Budget forecasts
- ❑ Identifying challenging areas
- ❑ Country comparisons that now can be based on the same framework
- ❑ Fast and low-cost network evaluations

We encourage countries to start using it

Thank You !

