Appendix 8.1 Maintenance Cost Calculation

Table Maintenance Cost Calculation

Gravel Road

Present Expenditure

(ksh/km/year)

	Routine		*Periodic*
	Grading	*LBM*	*Gravelling*
Nyanza	*8,000*	*4,477*	*525,000*
Western	*6,500*	*2,100*	*947,368*
Average	*7,250*	*3,288*	*736,184*

Note: Present actual costs in the study area

Estimated by the Study

(ksh/km/year)

Activities	Unit Rate	Months	Frequency	Value	Finance Cost
Grading	6,797	12	0	81,563	81,563
Routine (LBM)	9,155	1	9,155	0	9,155
Gravelling	631,015	Gravelling Loss Calculation			631,015

Note: For LBM maintenance, operation must be the same as Paved Road.

Paved Road

Present Expenditure

(ksh/km/year)

	Routine		*Periodic*
	Pothole	*LBM*	*Resealing*
Nyanza	*121,250*	*15,260*	*1,587,029*
Western	*43,598*	*15,256*	*1,200,000*
Average	*82,424*	*15,258*	*1,393,515*

60% :labour percentage of LBM
15,258x60%=9,155

Note: Present actual costs in the study area

Estimated by the Study

(ksh/km/year)

Activities	Unit Rate	Months	Frequency	Value	Finance Cost
Pothole	70,324	1	70,324	0	70,324
Routine (LBM)	9,155	1	9,155	0	9,155
Resealing	1,206,884	@ 5year	1,206,884	0	1,206,884

Source: PWOs and DWOs of the study area

Homa Bay -Mbita Road (C19)
Length = 42km
Gravel Loss Calculation

		ADT *(V/D)*	IT= An. ADT *365*	7.5% R *m* *1.00*	Vertucal %	Factor	GL *mm*	Thickness *125*	Regravelling *mm*	Frequency of gravelling
1999		*123*	*45*	*1.00*	*3*	*0.7*	*37.3*	*87.7*	*0*	*0*
2000		*132*	*48*	*1.00*	*3*	*0.7*	*39.6*	*48.1*	*0*	*0*
2001		*142*	*52*	*1.00*	*3*	*0.7*	*42.0*	*6.1*	*125*	*1*
2002		*153*	*56*	*1.00*	*3*	*0.7*	*44.5*	*86.6*	*0*	*0*
2003		*164*	*60*	*1.00*	*3*	*0.7*	*47.3*	*39.3*	*125*	*1*
2004	1	177	64	1.00	3	0.7	50.2	114.1	0	0
2005	2	190	69	1.00	3	0.7	53.4	60.7	0	0
2006	3	204	74	1.00	3	0.7	56.8	3.9	125	1
2007	4	219	80	1.00	3	0.7	60.4	68.4	0	0
2008	5	236	86	1.00	3	0.7	64.3	4.1	125	1
2009	6	254	93	1.00	3	0.7	68.5	60.6	125	1
2010	7	273	99	1.00	3	0.7	73.0	112.5	0	0
2011	8	293	107	1.00	3	0.7	77.9	34.7	125	1
2012	9	315	115	1.00	3	0.7	83.1	76.6	125	1
2013	10	339	124	1.00	3	0.7	88.6	113.0	0	0
2014	11	364	133	1.00	3	0.7	94.6	18.4	125	1
2015	12	391	143	1.00	3	0.7	101.1	42.3	125	1
2016	13	421	154	1.00	3	0.7	108.0	59.4	125	1
2017	14	452	165	1.00	3	0.7	115.4	69.0	125	1
2018	15	486	177	1.00	3	0.7	123.4	70.6	125	1
2019	16	522	191	1.00	3	0.7	132.0	63.6	125	1
2020	17	562	205	1.00	3	0.7	141.2	47.4	125	1
2021	18	604	220	1.00	3	0.7	151.1	21.3	250	2
2022	19	649	237	1.00	3	0.7	161.8	109.5	125	1
2023	20	698	255	1.00	3	0.7	173.2	61.3	125	1

Homa Bay -Mbita Road (C19)
Length = 42km
Maintenance Cost

		Without								With	
		Unpaved road					Paved Road				
		Gravelling Cost	Routine Grading	LBM	Total Ksh/Km	Total (C19) 42	Routine LBM	Carriageway	Periodic Recealing	Total Ksh/Km	Total (C19) 42	Cost saving
		631,015	*81,563*	*9,155*	*721,732*	*30,312,751*	*9,155*	*70,324*	*1,206,884*	*1,286,362*	*54,027,202*	
1999		*0*	*81,563*	*9,155*	*90,717*	*3,810,127*	*0*	*0*	*0*	*0*	*0*	*-3,810,127*
2000		*0*	*81,563*	*9,155*	*90,717*	*3,810,127*	*0*	*0*	*0*	*0*	*0*	*-3,810,127*
2001		*631,015*	*81,563*	*9,155*	*721,732*	*30,312,751*	*0*	*0*	*0*	*0*	*0*	*-30,312,751*
2002		*0*	*81,563*	*9,155*	*90,717*	*3,810,127*	*0*	*0*	*0*	*0*	*0*	*-3,810,127*
2003		*631,015*	*81,563*	*9,155*	*721,732*	*30,312,751*	*0*	*0*	*0*	*0*	*0*	*-30,312,751*
2004	1	0	81,563	9,155	90,717	3,810,127	9,155	100,959	0	*110,113*	*4,624,765*	*814,638*
2005	2	0	81,563	9,155	90,717	3,810,127	9,155	108,531	0	*117,685*	*4,942,784*	*1,132,658*
2006	3	631,015	81,563	9,155	721,732	30,312,751	9,155	116,670	0	*125,825*	*5,284,656*	*-25,028,095*
2007	4	0	81,563	9,155	90,717	3,810,127	9,155	125,421	0	*134,575*	*5,652,167*	*1,842,040*
2008	5	631,015	81,563	9,155	721,732	30,312,751	9,155	134,827	1,206,884	*1,350,865*	*56,736,350*	*26,423,600*
2009	6	631,015	81,563	9,155	721,732	30,312,751	9,155	144,939	0	*154,094*	*6,471,948*	*-23,840,803*
2010	7	0	81,563	9,155	90,717	3,810,127	9,155	155,810	0	*164,964*	*6,928,506*	*3,118,379*
2011	8	631,015	81,563	9,155	721,732	30,312,751	9,155	167,495	0	*176,650*	*7,419,306*	*-22,893,444*
2012	9	631,015	81,563	9,155	721,732	30,312,751	9,155	180,058	0	*189,212*	*7,946,917*	*-22,365,834*
2013	10	0	81,563	9,155	90,717	3,810,127	9,155	193,562	1,206,884	*1,409,600*	*59,203,206*	*55,393,079*
2014	11	631,015	81,563	9,155	721,732	30,312,751	9,155	208,079	0	*217,234*	*9,123,818*	*-21,188,933*
2015	12	631,015	81,563	9,155	721,732	30,312,751	9,155	223,685	0	*232,840*	*9,779,266*	*-20,533,484*
2016	13	631,015	81,563	9,155	721,732	30,312,751	9,155	240,461	0	*249,616*	*10,483,874*	*-19,828,877*
2017	14	631,015	81,563	9,155	721,732	30,312,751	9,155	258,496	0	*267,651*	*11,241,326*	*-19,071,424*
2018	15	631,015	81,563	9,155	721,732	30,312,751	9,155	277,883	1,206,884	*1,493,921*	*62,744,696*	*32,431,946*
2019	16	631,015	81,563	9,155	721,732	30,312,751	9,155	298,724	0	*307,879*	*12,930,920*	*-17,381,831*
2020	17	631,015	81,563	9,155	721,732	30,312,751	9,155	321,129	0	*330,283*	*13,871,901*	*-16,440,849*
2021	18	1,262,030	81,563	9,155	1,352,747	56,815,375	9,155	345,213	0	*354,368*	*14,883,456*	*-41,931,918*
2022	19	631,015	81,563	9,155	721,732	30,312,751	9,155	371,104	0	*380,259*	*15,970,878*	*-14,341,873*
2023	20	631,015	81,563	9,155	721,732	30,312,751	9,155	398,937	1,206,884	*1,614,975*	*67,828,964*	*37,516,213*

Bumala-Port Victoria
Length = 44km
Gravel Loss Calculation

		ADT (V/D)	IT= An.ADT 365	7.5% R *m* 1.50	Vertical % 5	Factor	GL *mm*	Thickness 125	Regravelling *mm*	Frequency of gravelling
1999		109	40	1.50	5	0.7	39.4	85.6	0	0
2000		117	43	1.50	5	0.7	41.4	44.1	0	0
2001		126	46	1.50	5	0.7	43.6	0.5	125	1
2002		135	49	1.50	5	0.7	45.9	79.6	0	0
2003		146	53	1.50	5	0.7	48.4	31.2	125	1
2004	1	156	57	1.50	5	0.7	51.0	105.2	0	0
2005	2	168	61	1.50	5	0.7	53.9	51.3	125	1
2006	3	181	66	1.50	5	0.7	56.9	119.4	0	0
2007	4	194	71	1.50	5	0.7	60.1	59.3	125	1
2008	5	209	76	1.50	5	0.7	63.6	120.7	0	0
2009	6	225	82	1.50	5	0.7	67.3	53.4	125	0
2010	7	242	88	1.50	5	0.7	71.3	107.0	0	0
2011	8	260	95	1.50	5	0.7	75.6	31.4	125	1
2012	9	279	102	1.50	5	0.7	80.2	76.1	125	1
2013	10	300	110	1.50	5	0.7	85.2	115.9	0	0
2014	11	323	118	1.50	5	0.7	90.5	25.4	125	1
2015	12	347	127	1.50	5	0.7	96.2	54.2	125	1
2016	13	373	136	1.50	5	0.7	102.4	76.8	125	1
2017	14	401	146	1.50	5	0.7	109.0	92.9	125	1
2018	15	431	157	1.50	5	0.7	116.0	101.8	125	1
2019	16	463	169	1.50	5	0.7	123.7	103.2	125	1
2020	17	498	182	1.50	5	0.7	131.8	96.3	125	1
2021	18	535	195	1.50	5	0.7	140.6	80.7	125	1
2022	19	575	210	1.50	5	0.7	150.1	55.7	125	1
2023	20	618	226	1.50	5	0.7	160.2	20.4	125	1

Bumala-Port Victoria
Length = 44km
Maintenance Cost

			Unpaved road			Without	Paved Road				With	
		Gravelling Cost *631,015*	Routine Grading *81,563*	LBM *9,155*	Total Ksh/Km *721,732*	Total 44 *31,756,215*	Routine LBM *9,155*	Carriageway *70,324*	Periodic Resealing *1,206,884*	Total Ksh/Km *1,286,362*	Total (C19) 44 *56,599,925*	Cost saving
1999		0	81,563	9,155	90,717	*3,991,561*	*0*	*0*	*0*	*0*	*0*	*-3,991,561*
2000		0	81,563	9,155	90,717	*3,991,561*	*0*	*0*	*0*	*0*	*0*	*-3,991,561*
2001		631,015	81,563	9,155	721,732	*31,756,215*	*0*	*0*	*0*	*0*	*0*	*-31,756,215*
2002		0	81,563	9,155	90,717	*3,991,561*	*0*	*0*	*0*	*0*	*0*	*-3,991,561*
2003		631,015	81,563	9,155	721,732	*31,756,215*	*0*	*0*	*0*	*0*	*0*	*-31,756,215*
2004	1	0	81,563	9,155	90,717	*3,991,561*	9,155	100,959	0	*110,113*	*4,844,992*	*853,430*
2005	2	631,015	81,563	9,155	721,732	*31,756,215*	9,155	108,531	0	*117,685*	*5,178,155*	*-26,578,060*
2006	3	0	81,563	9,155	90,717	*3,991,561*	9,155	116,670	0	*125,825*	*5,536,306*	*1,544,745*
2007	4	631,015	81,563	9,155	721,732	*31,756,215*	9,155	125,421	0	*134,575*	*5,921,318*	*-25,834,897*
2008	5	0	81,563	9,155	90,717	*3,991,561*	9,155	134,827	1,206,884	*1,350,865*	*59,438,081*	*55,446,520*
2009	6	0	81,563	9,155	90,717	*3,991,561*	9,155	144,939	0	*154,094*	*6,780,136*	*2,788,574*
2010	7	0	81,563	9,155	90,717	*3,991,561*	9,155	155,810	0	*164,964*	*7,258,435*	*3,266,874*
2011	8	631,015	81,563	9,155	721,732	*31,756,215*	9,155	167,495	0	*176,650*	*7,772,607*	*-23,983,608*
2012	9	631,015	81,563	9,155	721,732	*31,756,215*	9,155	180,058	0	*189,212*	*8,325,341*	*-23,430,874*
2013	10	0	81,563	9,155	90,717	*3,991,561*	9,155	193,562	1,206,884	*1,409,600*	*62,022,406*	*58,030,845*
2014	11	631,015	81,563	9,155	721,732	*31,756,215*	9,155	208,079	0	*217,234*	*9,558,285*	*-22,197,930*
2015	12	631,015	81,563	9,155	721,732	*31,756,215*	9,155	223,685	0	*232,840*	*10,244,946*	*-21,511,269*
2016	13	631,015	81,563	9,155	721,732	*31,756,215*	9,155	240,461	0	*249,616*	*10,983,106*	*-20,773,109*
2017	14	631,015	81,563	9,155	721,732	*31,756,215*	9,155	258,496	0	*267,651*	*11,776,628*	*-19,979,587*
2018	15	631,015	81,563	9,155	721,732	*31,756,215*	9,155	277,883	1,206,884	*1,493,921*	*65,732,539*	*33,976,324*
2019	16	631,015	81,563	9,155	721,732	*31,756,215*	9,155	298,724	0	*307,879*	*13,546,678*	*-18,209,537*
2020	17	631,015	81,563	9,155	721,732	*31,756,215*	9,155	321,129	0	*330,283*	*14,532,468*	*-17,223,747*
2021	18	631,015	81,563	9,155	721,732	*31,756,215*	9,155	345,213	0	*354,368*	*15,592,192*	*-16,164,023*
2022	19	631,015	81,563	9,155	721,732	*31,756,215*	9,155	371,104	0	*380,259*	*16,731,396*	*-15,024,819*
2023	20	631,015	81,563	9,155	721,732	*31,756,215*	9,155	398,937	1,206,884	*1,614,975*	*71,058,915*	*39,302,700*

Rongo-Ogenbo
Length = 20km
Gravel Loss Calculation

		ADT *(VID)*	IT= An. ADT *365*	R *m* *1.50*	7.5% Vertical % *5*	Factor	GL *mm*	Thickness *125*	Regravelling *mm*	Frequency of Gravelling
1999		146	53	1.50	5	0.7	48.5	76.5	0	0
2000		157	57	1.50	5	0.7	51.1	25.4	125	1
2001		169	62	1.50	5	0.7	54.0	96.4	0	0
2002		181	66	1.50	5	0.7	57.0	39.4	125	1
2003		195	71	1.50	5	0.7	60.3	104.1	0	0
2004	1	210	77	1.50	5	0.7	63.8	40.3	125	1
2005	2	225	82	1.50	5	0.7	67.5	97.8	0	0
2006	3	242	88	1.50	5	0.7	71.5	26.3	125	1
2007	4	260	95	1.50	5	0.7	75.8	75.5	125	1
2008	5	280	102	1.50	5	0.7	80.4	120.1	0	0
2009	6	301	110	1.50	5	0.7	85.4	34.7	125	1
2010	7	323	118	1.50	5	0.7	90.7	68.9	125	1
2011	8	348	127	1.50	5	0.7	96.5	97.4	125	1
2012	9	374	136	1.50	5	0.7	102.6	119.8	0	0
2013	10	402	147	1.50	5	0.7	109.2	10.6	125	1
2014	11	432	158	1.50	5	0.7	116.3	19.2	125	1
2015	12	464	170	1.50	5	0.7	124.0	20.2	125	1
2016	13	499	182	1.50	5	0.7	132.2	13.1	125	1
2017	14	537	196	1.50	5	0.7	141.0	-2.9	250	2
2018	15	577	211	1.50	5	0.7	150.5	96.6	125	1
2019	16	620	226	1.50	5	0.7	160.7	60.9	125	1
2020	17	667	243	1.50	5	0.7	171.6	14.3	250	2
2021	18	717	262	1.50	5	0.7	183.4	81.0	125	1
2022	19	770	281	1.50	5	0.7	196.0	10.0	250	2
2023	20	828	302	1.50	5	0.7	209.6	50.4	125	1

Rongo-Ogenbo
Length = 20km
Maintenance Cost

							With						**Without**	
		Unpaved road						Paved Road						
		Gravelling Cost *631,015*	Routine Grading *81,563*	LBM *9,155*	Total Ksh/Km *721,732*	Total (C19) 20 *14,434,643*	Routine LBM *9,155*	Carriageway *70,324*	Periodic Resealing *1,206,884*	Total Ksh/Km *1,286,362*	Total (C19) 20 *25,727,239*	Cost saving
1999		0	81,563	9,155	90,717	*1,814,346*	*0*	*0*	*0*	*0*	*0*	*-1,814,346*
2000		631,015	81,563	9,155	721,732	*14,434,643*	*0*	*0*	*0*	*0*	*0*	*-14,434,643*
2001		0	81,563	9,155	90,717	*1,814,346*	*0*	*0*	*0*	*0*	*0*	*-1,814,346*
2002		631,015	81,563	9,155	721,732	*14,434,643*	*0*	*0*	*0*	*0*	*0*	*-14,434,643*
2003		0	81,563	9,155	90,717	*1,814,346*	*0*	*0*	*0*	*0*	*0*	*-1,814,346*
2004	1	631,015	81,563	9,155	721,732	*14,434,643*	9,155	100,959	0	*110,113*	*2,202,269*	*-12,232,374*
2005	2	0	81,563	9,155	90,717	*1,814,346*	9,155	108,531	0	*117,685*	*2,353,707*	*539,361*
2006	3	631,015	81,563	9,155	721,732	*14,434,643*	9,155	116,670	0	*125,825*	*2,516,503*	*-11,918,141*
2007	4	631,015	81,563	9,155	721,732	*14,434,643*	9,155	125,421	0	*134,575*	*2,691,508*	*-11,743,135*
2008	5	0	81,563	9,155	90,717	*1,814,346*	9,155	134,827	1,206,884	*1,350,865*	*27,017,310*	*25,202,964*
2009	6	631,015	81,563	9,155	721,732	*14,434,643*	9,155	144,939	0	*154,094*	*3,081,880*	*-11,352,763*
2010	7	631,015	81,563	9,155	721,732	*14,434,643*	9,155	155,810	0	*164,964*	*3,299,289*	*-11,135,355*
2011	8	631,015	81,563	9,155	721,732	*14,434,643*	9,155	167,495	0	*176,650*	*3,533,003*	*-10,901,640*
2012	9	0	81,563	9,155	90,717	*1,814,346*	9,155	180,058	0	*189,212*	*3,784,246*	*1,969,900*
2013	10	631,015	81,563	9,155	721,732	*14,434,643*	9,155	193,562	1,206,884	*1,409,600*	*28,192,003*	*13,757,360*
2014	11	631,015	81,563	9,155	721,732	*14,434,643*	9,155	208,079	0	*217,234*	*4,344,675*	*-10,089,968*
2015	12	631,015	81,563	9,155	721,732	*14,434,643*	9,155	223,685	0	*232,840*	*4,656,793*	*-9,777,850*
2016	13	631,015	81,563	9,155	721,732	*14,434,643*	9,155	240,461	0	*249,616*	*4,992,321*	*-9,442,322*
2017	14	1,262,030	81,563	9,155	1,352,747	*27,054,940*	9,155	258,496	0	*267,651*	*5,353,013*	*-21,701,928*
2018	15	631,015	81,563	9,155	721,732	*14,434,643*	9,155	277,883	1,206,884	*1,493,921*	*29,878,427*	*15,443,784*
2019	16	631,015	81,563	9,155	721,732	*14,434,643*	9,155	298,724	0	*307,879*	*6,157,581*	*-8,277,062*
2020	17	1,262,030	81,563	9,155	1,352,747	*27,054,940*	9,155	321,129	0	*330,283*	*6,605,667*	*-20,449,273*
2021	18	631,015	81,563	9,155	721,732	*14,434,643*	9,155	345,213	0	*354,368*	*7,087,360*	*-7,347,283*
2022	19	1,262,030	81,563	9,155	1,352,747	*27,054,940*	9,155	371,104	0	*380,259*	*7,605,180*	*-19,449,760*
2023	20	631,015	81,563	9,155	721,732	*14,434,643*	9,155	398,937	1,206,884	*1,614,975*	*32,299,507*	*17,864,864*

Appendix 9.1 Quantity Estimation

Table9.1.1 Quantity of Route C 19 (Section 1-1, L= 20 km)

(Homa Bay – Obanda)

Work Item		Unit	Calculation	Quantity
(1) Site Clearance	a) Site clearance & Stripping	ha	(20x 20,000) / 10,000	40
	b) Demolish & dispose structure	m	(40 + 1) x 11.00	451
(2) Earth work	a) Cutting			
	Common	m^3	Refer to Table 9.1.12	24,082
	Rock	m^3	〃	
	b) Embankment	m^3	〃	150,386
	c) Sub-grade preparation	m^3	0.30 x 12.50 x 20,000	75,000
(3) Slope compaction		m^2	12.0 x 20,000	240,000
(4) Pavement Work (Carriage way)	a) Bitumen (1.0lit/m^2x2)	lit	7.00 x 1.00 x 2 x 20,000	280,000
	b) Chipping	m^3	7.00 x 0.03 x 20,000	4,200
	c) Base	m^3	0.15 x 7.00 x 20,000	21,000
	d) Sub-base	m^3	0.175 x 7.00 x 20,000	24,500
	e) Tack coat (0.5lit/m^2)	lit	7.00 x 0.50 x 20,000	70,000
	f) Prime coat (1.2lit/m^2)	lit	7.00 x 1.20 x 20,000	168,000
(5) Pavement Work (Shoulder)	a) Bitumen (1.0lit/m^2)	lit	1.50 x 2 x 20,000 x 1.00	60,000
	b) Chipping	m^3	0.015 x 1.50 x 2 x 20,000	900
	c) Sub-base	m^3	0.25 x 1.5 x 2 x 20,000	15,000
	d) Prime coat (1.2lit/m^2)	lit	1.50 x 2 x 1.20 x 20,000	72,000
(6) Black Cotton Soil Treatment	a) Sub-grade replaced by soil treated by lime	m^3	Refer to Table 9.1.8	75,000
	b) Boulder treatment	m^3	〃	80,000
(7) Culvert & Drainage	a) Box culvert		Refer to Table 9.1.7 &	
	25/20 concrete	m^3	9.1.8	90.4
	Reinforcement bar	t		9.0
	Levelling Concrete	m^3		7.5
	Foundation	m^3		15.0
	b) Pipe culvert			
	Pipe 600	m	〃	308.0
	Pipe 900	m		132.0
	Bed, surround, haunch	m^3		250.8
	c) Head wall, wing wall, apron, inlet, outlet	m^3	〃	142.1
	d) Fabric Mesh	m^2		1,656.4
	e) Gabion	m^3	〃	9.3
	f) Structure excavation and fill/ compaction	m^3	〃	3,068.0
	g) Grouted stone pitching	m^3	〃 0.15 x 1,325 x 2	397.5
(7) Road furniture	a) Traffic sign	no.	1 place/km x 20.0km	20
	b) Guardrail	m	0.2-0.5km/place x 4places	1,700
	c) Kilometer post	no.	1place/km x 20km	20
	d) Delineator	no.	1place/5m x 1,700m	340
	e) Centerline mark	m^2	20km x 10cm	2,000
(8) Land acquisition &(house compensation)		m^2	12,000 + (2,000)	

Table 9.1.2 Quantity of Route C 19 (Section I-2, L= 22.06 km)

(Obanda – Mbita)

Work Item		Unit	Calculation	Quantity
(1) Site Clearance	a) Site clearance & Stripping	ha	(20 x 22,060) / 10,000	44
	b) Demolish & dispose structure	m	(79+2) x 11	891
(2) Earth work	a) Cutting			
	Common	m^3	Refer to 9.1.12	39,560
	Rock	m^3		
	b) Embankment	m^3	〃	122,506
	b) Sub-grade preparation	m^3	0.3 x 12.5 x 22,060	82,725
(3) Slope compaction		m^2	12.0 x 22,060	264,720
(4) Pavement work (Carriage way)	a) Bitumen (1.0lit/m^2x2)	lit	7.00 x 1.00 x 2 x 22,060	308,840
	b) Chipping	m^3	7.00 x 0.03 x 22,060	4,633
	c) Base	m^3	0.15 x 7.00 x 22,060	23,163
	d) Sub-base	m^3	0.175 x 7.00 x 22,060	27,024
	e) Tack coat (0.5lit/m^2)	lit	7.00 x 0.50 x 22,060	77,210
	f) Prime coat (1.2lit/m^2)	lit	7.00 x 1.20 x 22,060	185,304
(5) Pavement Work (Shoulder)	a) Bitumen (1.0lit/m^2)	lit	1.50 x 2 x 1.00 x 21,670	66,180
	b) Chipping	m^3	0.015 x 1.50 x 2 x 21,670	993
	c) Sub-base	m^3	0.25 x 1.50 x 2 x 21,670	16,545
	d) Prime coat (1.2lit/m^2)	lit	1.50 x 2 x 1.2 x 21,670	79,416
(6) Black Cotton Soil Treatment	a) Sub-grade replaced by soil treated by lime	m^3	Refer to Table 9.1.8	112,500
	b) Rock	m^3	〃	120,000
(7) Culvert & Drainage	a) Box culvert		Refer to Table 9.1.7 and	
	25/20 concrete	m^3	Table 9.1.9	357.4
	Reinforcement bar	t		35.7
	Leveling Concrete	m^3		24.9
	Foundation	m^3		48.8
	b) Pipe culvert			
	Pipe 600	m	〃	495.0
	Pipe 900	m		374.0
	Bed, surround, haunch	m^3		495.3
	c) Head wall, wing wall, apron, inlet, outlet	m^3	〃	318.8
	d) Fabric Mesh	m^2	〃	3,355.1
	e) Gabion	m^3	〃	48.8
	f) Structure excavation and fill/ compaction	m^3	〃	7,071.5
	g) Grouted stone pit.	m^3	0.15 x 6,000 x 2	1,800.0
	a) Traffic sign	no.	1place/km x 21.67km	22
	c) Guardrail	m	0.1-0.3km/place x 3 places	600
	d) Kilometer post	no.	1place/km x 21.67km	22
	e) Delineator	no.	1place/5m x 600m	120
	f) Centerline mark	m^2	21.67km x 10cm	2,200
(9) Land acquisition &(house compensation)		m^2	750 + (-)	

Table 9.1.3 Quantity of Route C 19 (Section I-3, L= 0.35 km)

(Mbita causeway)

Work Item		Unit	Calculation	Quantity
(1) Site Clearance	a) Site clearance & Stripping	ha	[20 x 350] /1,000	1
(2) Earth work	a) Embankment	m^3	Refer to 9.1.12	3,724
	b) Sub-grade preparation	m^3	0.3 x 12.5 x 350	1,313
(3) Slope compaction		m^2	12.0 x 350	4,200
(4) Pavement work (Carriage way)	a) Bitumen (1.0lit/m^2x2)	lit	7.0 x 1.0 x 2 x 350	4,900
	b) Chipping	m^3	7.0 x 0.03 x 350	74
	c) Base	m^3	0.15 x 7.0 x 350	368
	d) Sub-base	m^3	0.175 x 7.0 x 350	429
	e) Tack coat (0.5lit/m^2)	lit	7.0 x 0.5 x 350	1,225
	f) Prime coat (1.2lit/m^2)	lit	7.0 x 1.2 x 350	2,940
(5) Pavement Work (Shoulder)	a) Bitumen (1.0lit/m^2)	m^3	1.5 x 2 x 1.0 x 350	1,050
	b) Chipping	m^3	0.015 x 1.5 x 2 x 350	16
	c) Sub-base	m^3	0.25 x 1.5 x 2 x 350	263
	d) Prime coat (1.2lit/m^2)	lit	1.5 x 2 x 1.2 x 350	1,260
(6) Rock slope protection		m^3	7.0 x 2 x 350 x 0.5	2,450
(7) Road furniture	a) Traffic sign	no.	1place/km x 0.35km	2
	b) Kilometer post	no.	1place/km x 0.35km	1
	c) Centerline mark	m^2	350m x 10cm	2,000

Note: Section I-3, STA 41+485-41+875

Table 9.1.4 Quantity of Route D250/ 251 (Section II-1, L= 20 km)

(Bumala – Sio Port)

Work Item		Unit	Calculation	Quantity
(1) Site Clearance	a) Site clearance & Stripping	ha	(20x 20,000) / 10,000	40
	b) Demolish & dispose structure	m	(31+2) x 13.0	429
(2) Earth work	a) Cutting		Refer to 9.1.13	
	Common	m^3		139,929.0
	Rock	m^3		
	b) Embankment	m^3	〃	63,364.0
	c) Sub-grade preparation	m^3	0.30 x 12.50 x 20,000	75,000.0
(3) Slope compaction		m^2	12.0 x 20,000	240,000.0
(4) Pavement work (Carriage way)	a) Bitumen (1.0lit/m^2x2)	lit	7. x 1.00 x 20 x 20,000	280,000.0
	b) Chipping	m^3	7.0 x 0.03 x 20,000	4,200.0
	c) Base	m^3	0.15 x 7.00 x 20,000	21,000.0
	d) Sub-base	m^3	0.175 x 7.00 x 20,000	24,500.0
	e) Tack coat (0.5lit/m^2)	lit	7.00 x 0.50 x 20,000	70,000.0
	f) Prime coat (1.2lit/m^2)	lit	7.0 x 1.20 x 20,000	168000.0
(5) Pavement Work (Shoulder)	a) Bitumen (1.0lit/m^2)	lit	1.5 x x 1.002 x 20,000	60,000.0
	b) Chipping	m^3	0.015 x 1.50 x 2 x 20,000	900.0
	c) Sub-base	m^3	0.25 x 1.50 x 2 x 20,000	15,000.0
	d) Prime coat (1.2lit/m^2)	lit	1.50 x 2 x 1.2 x 20,000	72,000.0
(6) Culvert & Drainage	a) Box culvert		Refer to Table 9.1.7 and 9.1.9	
	25/20 concrete	m^3		
	Reinforcement bar	t		
	Leveling Concrete	m^3		
	Foundation	m^3		
	b) Pipe culvert			
	Pipe 600	m	〃	
	Pipe 900	m		
	Bed, surround, haunch	m^3	〃	
	c) Head wall, wing wall, apron, inlet, outlet	m^3		
	d) Faric Mesh	m^2	〃	
	e) Gabion	m^3	〃	
	f) Structure excavation & fill/ compaction	m^3	〃	
(7) Road furniture	a) Traffic sign	no.	1place/km x 20.0 km	20
	b) Kilometer post	no.	1place/km x 20.0 km	20
	c) Centerline mark	m^2	20 km x 10 cm	2,000.0

Table 9.1.5 Quantity of Route D250/251(Section II-2, L= 22.99 km)

(Sio Port -- Port Victoria)

Work Item		Unit	Calculation	Quantity
(1) Site Clearance	a) Site clearance & Stripping	ha	(20 x 23,130)/10,000	46.0
	b) Demolish & dispose structure	m	(30 + 1) x 12.00	372.0
(2) Earth work	a) Cutting		Refer to Table 9.1.13	
	Common	m^3		238,157.0
	Rock	m^3		
	b) Embankment	m^3	〃	327,787.0
	c) Sub-grade preparation	m^3	0.3 x 12.5 x 23,130	83,268.0
(3) Slope compaction		m^2	12.0 x 23,130	277,560.0
(4) Pavement Work (Carriage way)	a) Bitumen (1.0lit/m^2x2)	lit	7.0 x 1.00 x 2 x 23130	323,820.0
	b) Chipping	m^3	7.0 x 0.03 x 23,130	4,857.0
	c) Base	m^3	0.15 x 7.00 x 23,130	24,287.0
	d) Sub-base	m^3	0.175 x 7.00 x 23,130	28,334.0
	e) Tack coat (0.5lit/m^2)	lit	7.00 x 0.5 x 23130	80,955.0
	f) Prime coat (1.2lit/m^2)	lit	7.00 x 1.2 x 23,130	194,292.0
(5) Pavement Work (Shoulder)	a) Bitumen (1.0lit/m^2)	lit	1.50 x x 1.02 x 23130	69,390.0
	b) Chipping	m^3	0.015 x 1.5 x 2 x 23130	1,040.9
	c) Sub-base	m^3	0.25 x 1.50 x 2 x 23130	17,347.5
	d) Prime coat (1.2lit/m^2)	lit	1.50 x 2 x 1.20 x 23130	83,268.0
(6) Culvert & Drainage	a) Box culvert		Refer to Table 9.1.7 and	
	25/20 concrete	m^3	Table 9.1.9	
	Reinforcement bar	t		
	Leveling Concrete	m^3		
	Foundation	m^3		
	b) Pipe culvert		〃	
	Pipe 600	m		
	Pipe 900	m		
	Bed, surround, haunch	m^3		
	c) Head wall, wing wall,	m^3	〃	
	apron, inlet, outlet		〃	
	d) Fabric Mesh	m^2	〃	
	e) Gabion	m^3	〃	
	f) Structure excavation & fill/ compaction	m^3		
(7) Road furniture	a) Traffic sign	no.	1 place/km x 23.13 km	24
	b) Guardrail	m	0.2-0.5 km/place x 1 place	100
	c) Kilometer post	no.	1 place/km x 23.13 km	24
	d) Delineator	no.	1 place/5m x 100 m	20
	e) Centerline mark	m^2	23.13 km x 10 m	2,313
(8) Land acquisition & (house compensation)		m^2	4500 + (900)	

Table 9.1.6 Quantity of Route C20 (Section III, L= 19.02 km)

(Rongo - Ogembo)

Work Item		Unit	Calculation	Quantity
(1) Site Clearance	a) Site clearance & Stripping	ha	(25 x 19,014)/10,000	47.5
	b) Demolish & dispose structure	m	(49+1) x 11.0	550
(2) Earth work	a) Cutting		Refer to Table 9.1.14	
	Common	m^3		171,331
	Rock	m^3		
	b) Embankment	m^3	〃	172,261
	c) Sub-grade preparation	m^3	0.3 x 12.5 x 19.014	71,302.5
(3) Slope compaction		m^2	20.0 x 19,014	380,280.0
(4) Pavement Work (Carriageway)	a) Asphalt concrete	m^3	7.0 x 19,014 x 0.03	3,992.9
	d) Base	m^3	0.15 x 7.0 x 19,014	19,964.7
	e) Sub-base	m^3	0.10 x 7.0 x 19,014	13,309.8
	g) Prime coat (1.2lit/m^2)	lit	7.0 x 19,014 x 1.2	159,717.6
(5) Pavement Work (Shoulder)	a) Bitumen (1.0lit/m^2)	lit	1.50 x 2 x 19,014 x 1.0	57,043.0
	b) Chipping	m^3	0.015 x 1.50 x 2 x 19,014	855.6
	c) Sub-base	m^3	0.25 x 1.50 x 2x 19,014	14,260.5
	d) Prime coat (1.2lit/m^2)	lit	1.50 x 2 x 1.20 x 19,014	68,450.4
(6) Culvert & Drainage	a) Box culvert		Refer to Table9.1.7 and	
	25/20 concrete	m^3	Table 9.1.9	289.1
	Reinforcement bar	t		23.1
	Leveling Concrete	m^3		24.9
	Foundation	m^3		49.8
	b) Pipe culvert			
	Pipe 600	m	〃	539.0
	Bed, surround, haunch	m^3		307.2
	c) Head wall, wing wall, apron, inlet, outlet	m^3	〃	261.9
	d) Fabric Mesh	m^2	〃	2,247.8
	e) Gabion	m^3	〃	24.5
	f) Structure excavation & fill/ compaction	m^3	〃	4,658.5
	g) Grouted stone pitching	m^3	0.15 x 1,025 x 2	307.5
(7) Road furniture	a) Traffic sign	no.	1place/km x 19km	19
	b) Guardrail	m	0.1-0.3km/place x 7places	1,500
	c) Kilometer post	no.	1place/km x 19km	19
	d) Delineator	no.	1place/5km x 1,500m	300
	e) Centerline mark	m^2	19km x 10cm	1,900

Table 9.1.7 Quantity of Box Culvert

Route No.	Dimension	Item of Material	Unit	Culvert	Inlet& Outlet	Levellin g	Foundati on
C 19							
Section	3.0 x 3.0 --2	25/20concrete	m^3	90.4			
I-1	L=12.0	Reinforcement bar	t	7.2			
		15/20 concrete	m^3			7.5	
		Gravel	m^3				15.0
		20/20 concrete	m^3				
		Fabric mesh	m^2		65.3		
		Gabion	m^3		180.0		
		Structure Exca.	m^3	624.0	9.3		
Section	4.0x4.0-4				104.0		
I-2	L=12.0	25/20concrete	m^3	354.7			
	3.0x2.5-3	Reinforcement bar	t	28.4			
	L=12.0	15/20 concrete	m^3			24.9	
		Gravel	m^3				48.8
		20/20 concrete	m^3				
		Fabric mesh	m^2		167.1		
		Gabion	m^3		439.2		
		Structure Exca.	m^3	2,100.0	24.5		
					350.0		
D 250/251							
Section	3.0x3.0-3	25/20concrete	m^3	252.2			
II-1	L=12.0	Reinforcement bar	t	20.2			
	3.0x2.0-3	15/20 concrete	m^3			22.2	
	L=12.0	Gravel	m^3				44.4
		20/20 concrete	m^3		155.2		
		Fabric mesh	m^2		412.8		
		Gabion	m^3		22.6		
		Structure Exca.	m^3	1,440.0	240.0		
C 20							
Section	.3.0x2.5-3	25/20concrete	m^3	289.1			
III	L=15.0	Reinforcement bar	t	28.9			
	3.0x3.0-4	15/20 concrete	m^3			24.9	
	L=15.0	Gravel	m^3				49.8
		20/20 concrete	m^3		167.8		
		Fabric mesh	m^2		439.2		
		Gabion	m^3		24.5		
		Structure Exca.	m^3	1,536.0	256.0		

Table 9.1.8 Quantity of Black Cotton Soil Treatment

Counter Measure :

(a) Sub-grade replaced by soil treated by lime: 50cm ,

(b) Rock : 30cm

Route No.	Location	Length (km)	Quantity (m^3)
C 19	Section I-1 STA 10+000 -- 20+000 Section I-2 STA 20+000 – 35+000	10.0 km	(a) 15x0.5x10,000= 75,000 (b) 16 x 0.3 x 10,000=48,000 (a) 15 x 0.5 x 15,000=112,500 (b) 16 x 0.3 x 15,000=72,000

Table 9.1.9 Quantity of Pipe Culvert

Route No.	Location & Item of Material	Unit	Pipe/one place			No. of pipe	Total Quantity		
			Length (mean)	Inlet & Outlet	Surrounding etc.		Length	Inlet & Outlet	Surrounding etc.
C 19	Section I-1								
	Dia. 600	m	11.0			28	308.0		
	Dia. 900	m	11.0			12	132.0		
	15/20	m^3			6.27				250.8
	concrete	m^3		1.92				76.8	
	20/20	m^2		12.71	24.20			508.4	968.0
	concrete	m^3		9.00	49.50			360.0	1,980.0
	Fabric mesh								
	Structure								
	Exca.								
	Section I-2								
	Dia. 600	m	11.0			45	495.0		
	Dia. 900	m	11.0			34	374.0		
	15/20	m^3			6.27				495.3
	concrete	m^3		1.92				151.7	
	20/20	m^2		12.71	24.2			1,004.1	1,911.8
	concrete	m		9.00	49.50			711.0	3,910.5
	Fabric mesh								
	Structure								
	Exca.								
D 250/ 251	Section II-1								
	Dia. 600	m	13.0			12	156.0		
	Dia. 900	m	13.0			19	247.0		
	15/20	m^3			6.3				195.3
	concrete	m^3		1.9				59.5	
	20/20	m^2		12.7	24.2			394.0	750.2
	concrete	m^3		9.0	49.5			279.0	1,534.5
	Fabric mesh								
	Structure								
	Exca.								
	Section II-2								
	Dia. 600	m	13.0			16	208.0		
	Dia. 900	m	13.0			14	182.0		
	15/20	m^3			6.3				189.0
	concrete	m^3		1.92				57.6	
	20/20	m^2		12.7	24.2			381.3	726.0
	concrete	m^3		9.0	49.5			270.0	1,485.0
	Fabric mesh								
	Structure								
	Exca.								
C 20	Section III								
	Dia. 600	m	11.0			49	539.0		
	Dia. 900	m	11.0						
	15/20	m^3			6.3				307.2
	concrete	m^3		19.2				94.1	
	20/20	m^2		12.7	24.2			622.8	1,185.8
	concrete	m^3		9.0	49.5			441.0	2,425.5
	Fabric mesh								
	Structure								
	Exca								

Table 9.1.10 Quantity of Land Acquisition and House Compensation

Route No.	Location	Length (m)	Area (m^2)	Land or House
	Section I-1			
	8+850 – 9+350	400	8,000	Residential
C19	8+850 – 9+350	200	2,000	Semi-permanent houses
	14+400 – 14+725	380	4,000	Residential
	Section I-2			
	24+750 – 25+025	250	750	Residential
D250/251	Section II-2			
	26+ 800 – 26+830	30	900	Residential
	34+800 – 34+950	150	4,500	Semi-permanent houses
	38+700 – 38+820	120	3,600	Residential

Table 9.1.11 Quantity of Approach Road

Work Item		Unit	C 19		D 250/251		C 20
			Sec. I-1	Sec. I-2	Sec. II-1	Sec. II-2	Sec. III
(1) Site Clearance	a) Site clearance & Stripping	ha	0.07	0.06	0.05	0.10	0.23
(2) Earth work	a) Cutting	m^3	19.2	216.1	10.5	10.0	36.8
	b) Embankment	m^3	81.9	91.3	75.0	52.5	2,338.4
	c) Sub-grade preparation	m^3	131.5	142.4	125.0	150.0	487.2
(3) Slope Compaction		m^2					
(4) Pavement work	a) Bitumen (1.0lit/m^2)	lit	438.3	474.6	356.0	585.0	1,628.9
	b) Chipping	m^3	65.7	71.2	45.0	95.3	244.3
	c) Base	m^3	87.7	94.9	70.0	105.7	325.8
	d) Prime coat (1.2lit/m^2)	lit	525.9	569.5	450.0	1,659.3	1,954.7

Appendix 11.1 Economic Analysis

Appendix Table 11.1.1 Conversion to Economic Cost from Financial Cost

Bumala-Soi Port-Port Victoria 42.99km — Unit: 1000 Ksh.

Items	Investment Costs In Market Prices	Foreign Portion	Local Portion					Overall Conversion Factor	Investment Costs in Economic Prices
			Tradable Goods	Non-tradable Goods	Skilled Labor	Unskilled Labor	Transfer (Tax)		
		1.004	1.004	0.996	0.985	0.300	0		
Construction	718,094	30%	15%	10%	5%	20%	20%	66%	474,696
Land Acquisitic	395	0%		80%				80%	315
Engineering	53,192	60%			20%		20%	80%	42,543
Total	771,681								517,554

Note: 15% of physical contingency is included in total construction.

Appendix Table 11.1.2 Conversion to Economic Cost from Financial Cost

Rongo - Ogenbo 19.02km — Unit: 1000 Ksh.

Items	Investment Costs In Market Prices	Foreign Portion 0.00%	Local Portion					Overall Conversion Factor	Investment Costs in Economic Prices
			Tradable Goods	Non-tradable Goods	Skilled Labor	Unskilled Labor	Transfer (Tax)		
		1.004	1.004	0.996	0.985	0.300	0	0	
Construction	336,742	30%	15%	10%	5%	20%	20%	66%	222,603
Land Acquisitic	0	0%		80%				80%	0
Engineering	24,944	60%			20%		20%	80%	19,950
Total	361,686								242,553

Note: 15% of physical contingency is included in total construction.

Appendix Table 11.1.3 Comparison between Financial Cost and Economic Cost of Maintenance

Bumala-Soi Port-Port Victoria 42.99 km

No.	Year	Economic Construction Cost		Financial Maintenance Cost				Economic Maintenance Cost			
				Routine	Pot-hole	Graveling	Total	Routine	Pot-hole	Graveling	Total
		%	1000Ksh.	Ksh./1km			1000Ksh.	Ksh./1km			1000Ksh.
1	2001	32%	163,173								
2	2002	54%	278,699								
3	2003	15%	75,681								
4	2004			9,155	100,959	0	4,670	2,195	66,739	0	2,923
5	2005			9,155	108,531	0	4,991	2,195	71,744	0	3,136
6	2006			9,155	116,671	0	5,336	2,195	77,125	0	3,364
7	2007			9,155	125,421	0	5,707	2,195	82,910	0	3,609
8	2008			9,155	134,828	1,206,884	57,290	2,195	89,128	797,811	37,708
9	2009			9,155	144,940	0	6,535	2,195	95,812	0	4,157
10	2010			9,155	155,810	0	6,996	2,195	102,998	0	4,461
11	2011			9,155	167,496	0	7,492	2,195	110,723	0	4,789
12	2012			9,155	180,058	0	8,025	2,195	119,027	0	5,141
13	2013			9,155	193,562	1,206,884	59,781	2,195	127,954	797,811	39,355
14	2014			9,155	208,080	0	9,213	2,195	137,551	0	5,927
15	2015			9,155	223,686	0	9,875	2,195	147,867	0	6,364
16	2016			9,155	240,462	0	10,586	2,195	158,957	0	6,834
17	2017			9,155	258,497	0	11,351	2,195	170,879	0	7,340
18	2018			9,155	277,884	1,206,884	63,357	2,195	183,695	797,811	41,719
19	2019			9,155	298,725	0	13,057	2,195	197,472	0	8,468
20	2020			9,155	321,130	0	14,007	2,195	212,283	0	9,096
21	2021			9,155	345,214	0	15,029	2,195	228,204	0	9,771
22	2022			9,155	371,106	0	16,127	2,195	245,319	0	10,497
23	2023			9,155	398,938	1,206,884	68,491	2,195	263,718	797,811	45,113
24	2024			9,156	428,859	0	18,576	2,195	283,497	0	12,116
25	2025			9,157	461,023	0	19,940	2,196	304,759	0	13,018
26	2026			9,158	495,600	0	21,407	2,196	327,616	0	13,987
27	2027			9,159	532,770	0	22,983	2,196	352,188	0	15,029
28	2028			9,160	572,728	1,206,889	75,662	2,196	378,602	797,814	49,985

Appendix Table 11.1.4 Comparison between Financial Cost and Economic Cost of Maintenance

19.02 km

No.	Year	Economic Construction Cost		Financial Maintenance Cost				Economic Maintenance Cost			
				Routine	Pot-hole	Graveling	Total	Routine	Pot-hole	Graveling	Total
		%	1000Ksh.	Ksh./1km			1000Ksh.	Ksh./1km			1000Ksh.
1	2001	0%	0								
2	2002	28%	67,027								
3	2003	72%	175,527								
4	2004			9,155	100,959	0	2,094	2,195	66,739	0	1,311
5	2005			9,155	108,531	0	2,238	2,195	71,744	0	1,406
6	2006			9,155	116,671	0	2,393	2,195	77,125	0	1,509
7	2007			9,155	125,421	0	2,560	2,195	82,910	0	1,619
8	2008			9,155	134,828	1,206,884	25,693	2,195	89,128	797,811	16,911
9	2009			9,155	144,940	0	2,931	2,195	95,812	0	1,864
10	2010			9,155	155,810	0	3,138	2,195	102,998	0	2,001
11	2011			9,155	167,496	0	3,360	2,195	110,723	0	2,148
12	2012			9,155	180,058	0	3,599	2,195	119,027	0	2,306
13	2013			9,155	193,562	1,206,884	26,811	2,195	127,954	797,811	17,650
14	2014			9,155	208,080	0	4,132	2,195	137,551	0	2,658
15	2015			9,155	223,686	0	4,429	2,195	147,867	0	2,854
16	2016			9,155	240,462	0	4,748	2,195	158,957	0	3,065
17	2017			9,155	258,497	0	5,091	2,195	170,879	0	3,292
18	2018			9,155	277,884	1,206,884	28,414	2,195	183,695	797,811	18,710
19	2019			9,155	298,725	0	5,856	2,195	197,472	0	3,798
20	2020			9,155	321,130	0	6,282	2,195	212,283	0	4,079
21	2021			9,155	345,214	0	6,740	2,195	228,204	0	4,382
22	2022			9,155	371,106	0	7,233	2,195	245,319	0	4,708
23	2023			9,155	398,938	1,206,884	30,717	2,195	263,718	797,811	20,232
24	2024			9,156	428,859	0	8,331	2,195	283,497	0	5,434
25	2025			9,157	461,023	0	8,943	2,196	304,759	0	5,838
26	2026			9,158	495,600	0	9,600	2,196	327,616	0	6,273
27	2027			9,159	532,770	0	10,307	2,196	352,188	0	6,740
28	2028			9,160	572,728	1,206,889	34,023	2,196	378,602	797,814	22,417

Appendix Table 11.2.1 Unit Vehicle Operating Cost Per Km by Base Speed

Unit: Ksh/Vehicle-km

Items	assenger Car	Matatu(Bus)	Large Bus	MediumTruck	HeavyTruck	M.Cycle
(1) Basic Financial Running Costs						
Fuel Costs	5.76	6.80	9.45	10.21	11.34	1.33
Lubricant Costs	0.23	0.38	0.42	0.57	0.65	0.04
Tyre Costs	0.53	1.03	1.63	2.40	9.00	0.27
Maintenance Spares Costs	1.33	0.41	1.41	0.62	1.14	0.05
Maintenance Labor Costs	0.96	4.79	4.79	3.83	4.79	0.64
Depreciation Costs	0.00	4.12	11.95	5.47	9.95	1.03
Total Running Costs/vehicle-km	8.81	17.53	29.64	23.10	36.86	3.36
(2) Basic Financial Fixed Costs	0.00	0.00	0.00	0.00	0.00	0.00
Capital Costs (Dep.-Time Relatio	494.65	30.88	52.73	54.68	122.27	17.22
Long Term Interest Cost	474.87	148.21	337.50	174.98	366.80	31.00
Overhead Cost	462.00	144.94	131.25	192.50	154.00	0.00
Crew Costs	38.50	154.00	140.00	154.00	154.00	0.00
Fixed Costs,All	1,470.02	478.03	661.48	576.16	797.07	48.22
Factor	0.70	0.85	0.85	0.85	0.85	0.60
Total Fixed Costs/Vehicle-hour	1,029.01	406.32	562.26	489.73	677.51	28.93
Total Fixed Costs/Vehicle-km	22.87	9.03	14.06	12.24	16.94	0.72
(1) Basic Economic RunningCosts						
Fuel Costs	4.90	5.78	8.03	8.68	9.64	1.13
Lubricant Costs	0.19	0.32	0.36	0.48	0.55	0.03
Tyre Costs	0.45	0.87	1.39	2.04	7.65	0.23
Maintenance Spares Costs	1.08	0.36	1.22	0.57	1.03	0.05
Maintenance Labor Costs	0.81	4.07	4.07	3.25	4.07	0.54
Depreciation Costs	0.00	3.58	10.40	4.98	9.02	0.94
Total Running Costs/vehicle-km	7.43	14.99	25.46	20.00	31.95	2.91
(2) Basic Economic Fixed Costs						
Capital Costs(Dep-TimeRelation)	400.36	26.86	45.88	49.76	110.80	15.61
Opportunity Cost of Capital	384.34	128.94	293.62	159.23	332.41	28.09
Overhead Cost	392.70	123.20	111.56	163.63	130.90	0.00
Crew Costs	34.65	138.60	126.00	138.60	138.60	0.00
Fixed Costs,All	1,212.05	417.60	577.07	511.21	712.71	43.70
Factor	0.30	0.65	0.65	0.70	0.70	0.30
Total Fixed Costs/Vehicle-hour	363.61	271.44	375.09	357.85	498.90	13.11
Total Fixed Costs/Vehicle-km	8.08	6.03	9.38	8.95	12.47	0.33

Appendix Table.11.2.2 Total Vehicle Operating Costs by Vehicle Groups

Unit: Ksh/Vehicle-km

Items	assenger Car	Matatu(Bus)	Large Bus	MediumTruck		M.Cycle
Total Running Costs/vehicle-km	7.43	14.99	25.46	20.00	31.95	2.91
Vehicle Component	100%	70%	30%	53%	48%	100%
Weghted	7.43	10.49	7.64	10.60	15.34	2.91
Sub total	7.43	18.13		25.94		2.91
Total Fixed Costs/Vehicle-km	8.08	6.03	9.38	8.95	12.47	0.33
Vehicle Component	100%	70%	30%	53%	48%	100%
Weghted	8.08	4.22	2.81	4.74	5.99	0.33
Sub total	8.08	7.04		10.73		0.33

Appendix Table 11.2.3 Vehicle Operating Cost by Different Speed
Passenger Car

Labo	0	0	Km	Running	Fixed	Total
Km/h	V.O.C	%	/Hour	Cost	Cost	V.O.C
10	4,081	235%	10	17.49	8.08	25.57
15	3,746	216%	15	16.06	8.08	24.14
20	3,437	198%	20	14.73	8.08	22.81
25	3,153	182%	25	13.52	8.08	21.60
30	2,896	167%	30	12.41	8.08	20.49
35	2,664	154%	35	11.42	8.08	19.50
40	2,440	141%	40	10.46	8.08	18.54
45	2,277	131%	45	9.76	8.08	17.84
50	2,122	122%	50	9.10	8.08	17.18
55	1,993	115%	55	8.54	8.08	16.62
60	1,890	109%	60	8.10	8.08	16.18
65	1,812	105%	65	7.77	8.08	15.85
70	1,760	102%	70	7.54	8.08	15.62
75	1,734	100%	75	7.43	8.08	15.51
80	1,733	100%	80	7.43	8.08	15.51
85	1,759	101%	85	7.54	8.08	15.62
90	1,810	104%	90	7.76	8.08	15.84
95	1,886	109%	95	8.09	8.08	16.17
100	1,989	115%	100	8.52	8.08	16.60

Appendix Table 11.2.4 Vehicle Operating Cost by Different Speed
Truck

Laboratory Data			Km	Running	Fixed	Total
Km/h	V.O.C	%	/Hour	Cost	Cost	V.O.C
10	5780	206%	10	52.79	10.73	63.52
15	5268	187%	15	48.11	10.73	58.84
20	4803	171%	20	43.87	10.73	54.60
25	4388	156%	25	40.07	10.73	50.80
30	4021	143%	30	36.72	10.73	47.45
35	3702	132%	35	33.81	10.73	44.54
40	3432	122%	40	31.35	10.73	42.08
45	3211	114%	45	29.33	10.73	40.06
50	3039	108%	50	27.75	10.73	38.48
55	2915	104%	55	26.62	10.73	37.35
60	2839	101%	60	25.93	10.73	36.66
65	2813	100%	65	25.69	10.73	36.42
70	2835	101%	70	25.89	10.73	36.62
75	2905	103%	75	26.53	10.73	37.26
80	3024	108%	80	27.62	10.73	38.35
85	3192	113%	85	29.15	10.73	39.88
90	3408	121%	90	31.13	10.73	41.86
95	3673	131%	95	33.55	10.73	44.28
100	3987	142%	100	36.41	10.73	47.14

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Acronym

PCI: Pacific Consultants International
CPC: Construction Project Consultant
HEC: Hokkaido Engineering Consultant
IDeA: International Development Association
MOC: Ministry of Construction
MOR&NHCS: Ministry of Home affairs and National Heritage, Culture & Social services
OOP: Office of the President
MOEC: Ministry of Environment and Conservation
VP, P& N Dep.: VP, Planning & National Development Department
MOR Dev.: Ministry of Rural Division
MONR: Ministry of National Resources