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ETHIOPIA
ROAD MAINTENANCE STUDY
APPENDIX

IMPERIAL ETHIOPIAN GOVERNMENT
IMPERIAL HIGHWAY AUTHORITY

JUNE 1973

HARRIS

PREPARED BY
FREDERIC R. HARR
CONSULTING EN
NE

ETHIOPIA

ROAD MAINTENANCE STUDY

APPENDIX

June 1973

IMPERIAL ETHIOPIAN GOVERNMENT

IMPERIAL HIGHWAY AUTHORITY

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Consulting Engineers

Supported By:

ECONOMICS RESEARCH ASSOCIATES
Transportation Economists

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ECONOMICS APPENDIX	75-214
ADMINISTRATIVE APPENDIX	215-224

ENGINEERING APPENDIX

EXHIBIT III-B-1

ESTIMATED BASIC MAINTENANCE EFFORT AND COST BY ROAD TYPES
Crew-Days and E$ per Km per Year
TYPE 1 ROADS; ASPHALT-SURFACED, LESS THAN 10 YEARS OLD

Work Items	Dry Weather Zones			Moderate Rainfall Zones			High Rainfall Zones			Dry Weather Zones With Desert Allowance			Moderate Rainfall Zones With Desert Allowance		
	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M
A. ROUTINE MAINTENANCE															
1. Surface Patching															
Crew-days	0.625	0.625	0.625	0.875	0.875	0.875	1.250	1.250	1.250	0.625	0.625	0.625	0.875	0.875	0.875
Cost E$	516.90	516.90	516.90	723.66	723.66	723.66	1,033.80	1,033.80	1,033.80	540.08	540.08	540.08	756.11	756.11	756.11
2. Brush Control															
Crew-days	0.040	0.040	0.040	0.080	0.080	0.080	0.290	0.290	0.290	0.040	0.040	0.040	0.080	0.080	0.080
Cost E$	2.79	2.79	2.79	5.58	5.58	5.58	20.22	20.22	20.22	2.85	2.85	2.85	5.69	5.69	5.69
3. Culvert Maintenance															
a. Culvert Cleaning															
Crew-days	0.050	0.075	0.100	0.055	0.075	0.115	0.100	0.135	0.210	0.050	0.075	0.100	0.055	0.075	0.115
Cost E$	5.03	7.55	10.07	5.54	7.55	11.58	10.07	13.59	21.14	5.87	8.80	11.74	6.46	8.80	13.50
b. Culvert Repair															
Crew-days	0.300	0.467	0.800	0.300	0.467	0.800	0.300	0.467	0.800	0.300	0.467	0.800	0.300	0.467	0.800
Cost E$	52.29	81.39	139.43	52.29	81.39	139.43	52.29	81.39	139.43	57.13	88.94	152.35	57.13	88.94	152.35
4. Ditch Maintenance															
a. Primary Ditch															
(i) Machine															
Crew-days	0.132	0.136	--	0.381	0.456	--	0.381	0.456	--	0.132	0.136	--	0.381	0.456	--
Cost E$	24.38	25.12	--	70.36	84.21	--	70.36	84.21	--	25.13	25.89	--	72.54	86.82	--
(ii) Hand															
Crew-days	0.077	0.070	1.049	0.262	0.210	3.496	0.262	0.210	3.496	0.077	0.070	1.049	0.262	0.210	3.496
Cost E$	4.85	4.41	66.05	16.50	13.22	220.11	16.50	13.22	220.11	5.10	4.63	69.44	17.34	13.90	231.44
b. Secondary Ditch															
Crew-days	0.312	0.775	0.938	0.312	0.775	0.938	0.625	1.562	1.875	0.312	0.775	0.938	0.312	0.775	0.938
Cost E$	19.64	48.79	59.06	19.64	48.79	59.06	39.35	98.34	118.05	20.66	51.31	62.11	20.66	51.31	62.11
c. Shoulder Grading and Addition of Select Material															
Crew-days	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084
Cost E$	146.31	146.31	146.31	146.31	146.31	146.31	146.31	146.31	146.31	148.99	148.99	148.99	148.99	148.99	148.99
5. Miscellaneous Maintenance															
a. Bridge & Channel															
Basis	22% of Items 3a and 3b														
Cost E$	12.61	19.57	32.89	12.72	19.57	33.22	13.72	20.90	35.33	13.86	21.50	36.10	13.99	21.50	36.49
b. Other Miscellaneous															
Basis	2.5% of Items 1 through 4														
Cost E$	19.30	20.83	23.52	25.98	27.77	32.69	34.74	37.28	42.48	20.14	21.79	24.69	27.12	39.01	34.25
B. PERIODIC MAINTENANCE															
1. Asphalt Surface Maintenance															
a. Seal Coating															
Crew-days	0.200	0.200	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.200	0.200	0.200	0.250	0.250	0.250
Cost E$	885.66	885.66	885.66	1,107.08	1,107.08	1,107.08	1,107.08	1,107.08	1,107.08	889.49	889.49	889.49	1,111.86	1,111.86	1,111.86
b. Preparatory Leveling															
Crew-days	--	--	--	0.139	0.139	0.139	0.139	0.139	0.139	--	--	--	0.139	0.139	0.139
Cost E$	--	--	--	775.50	775.50	775.50	775.50	775.50	775.50	--	--	--	783.48	783.48	783.48
2. Shoulder Reconstruction															
Crew-days	0.200	0.100	--	--	--	--	--	--	--	0.200	0.100	--	--	--	--
Cost E$	55.25	27.62	--	--	--	--	--	--	--	56.05	28.03	--	--	--	--
COMBINED TOTAL	1,745.01	1,786.94	1,882.68	2,961.16	3,040.63	3,254.22	3,319.94	3,431.84	3,659.45	1,785.35	1,832.30	1,937.84	3,021.37	3,106.41	3,336.27
ROUNDED TOTAL	E$1,745.00	E$1,785.00	E$1,885.00	E$2,960.00	E$3,040.00	E$3,250.00	E$3,320.00	E$3,430.00	E$3,660.00	E$1,785.00	E$1,830.00	E$1,940.00	E$3,020.00	E$3,105.00	E$3,335.00

BEST AVAILABLE COPY

EXHIBIT III-B-2

TYPE 2 ROADS; ASPHALT-SURFACED, 10 OR MORE YEARS OLD

Work Items	Dry Weather Zones			Moderate Rainfall Zones			High Rainfall Zones			Dry Weather Zones With Desert Allowance			Moderate Rainfall Zones With Desert Allowance		
	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M
A. ROUTINE MAINTENANCE															
1. Surface Patching															
Crew-days	1.000	1.000	1.000	1.750	1.750	1.750	2.500	2.500	2.500	1.000	1.000	1.000	1.750	1.750	1.750
Cost E$	827.04	827.04	827.04	1,447.32	1,447.32	1,447.32	2,067.60	2,067.60	2,067.60	864.13	864.13	864.13	1,512.23	1,512.23	1,512.23
2. Brush Control															
Crew-days	0.040	0.040	0.040	0.080	0.080	0.080	0.290	0.290	0.290	0.040	0.040	0.040	0.080	0.080	0.080
Cost E$	2.79	2.79	2.79	5.58	5.58	5.58	20.22	20.22	20.22	2.85	2.85	2.85	5.69	5.69	5.69
3. Culvert Maintenance															
a. Culvert Cleaning															
Crew-days	0.050	0.075	0.100	0.055	0.075	0.115	0.100	0.135	0.210	0.050	0.075	0.100	0.055	0.075	0.115
Cost E$	5.03	7.55	10.07	5.54	7.55	11.58	10.07	13.59	21.14	5.86	8.80	11.74	6.46	8.80	13.90
b. Culvert Repair															
Crew-days	0.300	0.467	0.800	0.300	0.467	0.800	0.300	0.467	0.800	0.300	0.467	0.800	0.300	0.467	0.800
Cost E$	52.29	81.39	139.43	52.29	81.39	139.43	52.29	81.39	139.43	57.13	88.94	152.35	57.13	88.94	152.35
4. Ditch Maintenance															
a. Primary Ditch															
(i) Machine															
Crew-days	0.132	0.136	--	0.381	0.456	--	0.381	0.456	--	0.132	0.136	--	0.381	0.456	--
Cost E$	24.38	25.12	--	70.36	84.21	--	70.36	84.21	--	25.13	25.89	--	72.54	86.82	--
(ii) Hand															
Crew-days	0.077	0.070	1.049	0.262	0.210	3.496	0.262	0.210	3.496	0.077	0.070	1.049	0.262	0.210	3.496
Cost E$	4.35	4.41	66.05	16.50	13.22	220.11	16.50	13.22	220.11	5.10	4.63	69.44	17.34	13.90	231.44
b. Secondary Ditch															
Crew-days	0.312	0.775	0.938	0.312	0.775	0.938	0.625	1.562	1.875	0.312	0.775	0.938	0.312	0.775	0.938
Cost E$	19.64	48.79	59.06	19.64	48.79	59.06	39.35	98.34	118.05	26.66	51.31	62.10	26.66	51.31	62.10
c. Shoulder Grading and Addition of Select Material															
Crew-days	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084
Cost E$	146.31	146.31	146.31	146.31	146.31	146.31	146.31	146.31	146.31	148.99	148.99	148.99	148.99	148.99	148.99
5. Miscellaneous Maintenance															
a. Bridge & Channel															
Basis	22% of Items 3a and 3b														
Cost E$	12.61	19.57	32.89	12.72	19.57	33.22	13.72	20.90	35.33	13.86	21.50	36.10	13.99	21.50	36.49
b. Other Miscellaneous															
Basis	2.5% of Items 1 through 4														
Cost E$	27.06	28.58	31.27	44.09	45.86	50.73	60.57	63.12	68.32	28.39	29.89	32.79	37.81	47.98	53.16
B. PERIODIC MAINTENANCE															
1. Asphalt Surface Maintenance															
a. Seal Coating															
Crew-days	0.200	0.200	0.200	0.250	0.250	0.250	0.250	0.250	0.250	0.200	0.200	0.200	0.250	0.250	0.250
Cost E$	885.66	885.66	885.66	1,107.08	1,107.08	1,107.08	1,107.08	1,107.08	1,107.08	895.49	895.49	895.49	1,119.36	1,119.36	1,119.36
b. Preparatory Leveling															
Crew-days	--	--	--	0.139	0.139	0.139	0.139	0.139	0.139	--	--	--	0.139	0.139	0.139
Cost E$	--	--	--	775.56	775.56	775.56	775.56	775.56	775.56	--	--	--	783.48	783.48	783.48
2. Shoulder Reconstruction															
Crew-days	0.200	0.100	--	--	--	--	--	--	--	0.200	0.100	--	--	--	--
Cost E$	55.25	27.62	--	--	--	--	--	--	--	56.05	28.02	--	--	--	--
COMBINED TOTAL	2,062.91	2,104.83	2,200.57	3,702.99	3,782.44	3,995.98	4,379.63	4,491.54	4,719.15	2,129.64	2,170.44	2,275.98	3,801.68	3,888.94	4,118.79
ROUNDED TOTAL	E$2,060.00	E$2,105.00	E$2,200.00	E$3,705.00	E$3,780.00	E$3,995.00	E$4,380.00	E$4,490.00	E$4,720.00	E$2,130.00	E$2,170.00	E$2,275.00	E$3,800.00	E$3,890.00	E$4,120.00

EXHIBIT III-B-3

TYPE 3 ROADS; GRAVEL-SURFACED, ADT 100 OR MORE

Work Items	Dry Weather Zones			Moderate Rainfall Zones			High Rainfall Zones			Dry Weather Zones With Desert Allowance			Moderate Rainfall Zones With Desert Allowance		
	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M
A. ROUTINE MAINTENANCE															
1. Surface Maintenance															
a. Surface Grading															
Crew-days	2.440	2.440	2.440	2.121	2.121	2.121	2.106	2.106	2.106	2.440	2.440	2.440	2.121	2.121	2.121
Cost E$	450.62	450.62	450.62	391.71	391.71	391.71	388.94	388.94	388.94	464.55	464.55	464.55	403.82	403.82	403.82
b. Spot Regraveling															
Crew-days	0.431	0.368	0.334	0.431	0.368	0.334	0.518	0.397	0.397	0.431	0.368	0.334	0.431	0.368	0.334
Cost E$	1,151.13	982.87	892.06	1,151.13	982.87	892.06	1,383.50	1,167.16	1,060.32	1,160.70	991.04	899.48	1,160.70	991.04	899.48
2. Brush Control															
Crew-days	0.040	0.040	0.040	0.080	0.080	0.080	0.290	0.290	0.290	0.040	0.040	0.040	0.080	0.080	0.080
Cost E$	2.79	2.79	2.79	5.58	5.58	5.58	20.22	20.22	20.22	2.85	2.85	2.85	5.69	5.69	5.69
3. Culvert Maintenance															
a. Culvert Cleaning															
Crew-days	0.050	0.075	0.100	0.055	0.075	0.115	0.100	0.135	0.210	0.050	0.075	0.100	0.055	0.075	0.115
Cost E$	5.03	7.55	10.07	5.54	7.55	11.58	10.07	13.59	21.13	5.87	8.80	11.74	6.46	8.80	13.50
b. Culvert Repair															
Crew-days	0.300	0.467	0.800	0.300	0.467	0.800	0.300	0.467	0.800	0.300	0.467	0.800	0.300	0.467	0.800
Cost E$	52.29	81.39	139.43	52.29	81.39	139.43	52.29	81.39	139.43	57.13	88.94	152.35	57.13	88.94	152.35
4. Ditch Maintenance															
a. Primary Ditch															
(i) Machine															
Crew-days	0.132	0.136	--	0.381	0.456	--	0.381	0.456	--	0.132	0.136	--	0.381	0.456	--
Cost E$	24.38	25.12	--	70.36	84.21	--	70.36	84.21	--	25.13	25.89	--	72.54	86.82	--
(ii) Hand															
Crew-days	0.077	0.070	1.049	0.262	0.210	3.496	0.262	0.210	3.496	0.077	0.070	1.049	0.262	0.210	3.496
Cost E$	4.85	4.41	66.05	16.50	13.22	220.11	16.50	13.22	220.11	5.10	4.63	69.44	17.34	13.90	231.44
b. Secondary Ditch															
Crew-days	0.312	0.775	0.938	0.312	0.775	0.938	0.625	1.562	1.875	0.312	0.775	0.938	0.312	0.775	0.938
Cost E$	19.64	48.79	59.06	19.64	48.79	59.06	39.35	98.34	118.05	20.66	51.31	62.11	20.66	51.31	62.11
5. Miscellaneous Maintenance															
a. Bridge & Channel															
Basis	22% of Items 3a and 3b														
Cost E$	12.61	19.57	32.89	12.72	19.57	33.22	13.72	20.90	35.32	13.86	21.50	36.10	13.99	21.50	36.49
b. Other Miscellaneous															
Basis	2.5% of Items 1 through 4														
Cost E$	43.02	40.09	40.50	42.82	40.38	42.99	49.53	46.68	49.20	43.55	40.95	41.56	43.61	41.26	46.98
B. PERIODIC MAINTENANCE															
1. Gravel Resurfacing															
Crew-days	0.462	0.400	0.354	0.462	0.400	0.354	0.554	0.477	0.431	0.462	0.400	0.354	0.462	0.400	0.354
Cost E$	2,978.15	2,578.49	2,281.96	2,978.15	2,578.49	2,281.96	3,571.21	3,074.85	2,778.32	3,016.27	2,611.49	2,311.17	3,016.27	2,611.49	2,311.17
COMBINED TOTAL	4,744.51	4,241.69	3,975.43	4,746.44	4,253.76	4,077.70	5,615.69	5,009.50	4,831.04	4,815.67	4,311.95	4,051.35	4,818.21	4,324.57	4,162.97
ROUNDED TOTAL	E$4,745.00	E$4,240.00	E$3,975.00	E$4,745.00	E$4,255.00	E$4,080.00	E$5,615.00	E$5,010.00	E$4,830.00	E$4,815.00	E$4,310.00	E$4,050.00	E$4,820.00	E$4,325.00	E$4,165.00

EXHIBIT III-B-4

TYPE 4 ROADS; GRAVEL-SURFACED, ADT LESS THAN 100

Work Items	Dry Weather Zones			Moderate Rainfall Zones			High Rainfall Zones			Dry Weather Zones With Desert Allowance			Moderate Rainfall Zones With Desert Allowance		
	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M
A. ROUTINE MAINTENANCE															
1. Surface Maintenance															
a. Surface Grading															
Crew-days	1.167	1.167	1.167	1.500	1.500	1.500	1.576	1.576	1.576	1.167	1.167	1.167	1.500	1.500	1.500
Cost E$	215.52	215.52	215.52	277.02	277.02	277.02	291.06	291.06	291.06	222.19	222.19	222.19	285.59	285.59	285.59
b. Spot Regraveling															
Crew-days	0.259	0.218	0.201	0.259	0.218	0.201	0.345	0.293	0.264	0.259	0.218	0.201	0.259	0.218	0.201
Cost E$	691.75	582.24	536.84	691.75	582.24	536.84	921.44	782.56	705.10	697.50	587.08	541.30	697.50	587.08	541.30
2. Brush Control															
Crew-days	0.040	0.040	0.040	0.080	0.080	0.080	0.290	0.290	0.290	0.040	0.040	0.040	0.080	0.080	0.080
Cost E$	2.79	2.79	2.79	5.58	5.58	5.58	20.22	20.22	20.22	2.85	2.85	2.85	5.69	5.69	5.69
3. Culvert Maintenance															
a. Culvert Cleaning															
Crew-days	0.050	0.075	0.100	0.055	0.075	0.115	0.100	0.135	0.210	0.050	0.075	0.100	0.055	0.075	0.115
Cost E$	5.03	7.55	10.07	5.54	7.55	11.58	10.07	13.59	21.14	5.87	8.80	11.74	6.46	8.80	13.50
b. Culvert Repair															
Crew-days	0.300	0.467	0.800	0.300	0.467	0.800	0.300	0.467	0.800	0.300	0.467	0.800	0.300	0.467	0.800
Cost E$	52.29	81.39	139.43	52.29	81.39	139.43	52.29	81.39	139.43	57.13	88.94	152.35	57.13	88.94	152.35
4. Ditch Maintenance															
a. Primary Ditch															
(i) Machine															
Crew-days	0.132	0.136	--	0.381	0.456	--	0.381	0.456	--	0.132	0.136	--	0.381	0.456	--
Cost E$	24.38	25.12	--	70.36	84.21	--	70.36	84.21	--	25.13	25.89	--	72.54	86.82	--
(ii) Hand															
Crew-days	0.077	0.070	1.049	0.262	0.210	3.496	0.262	0.210	3.496	0.077	0.070	1.049	0.262	0.210	3.496
Cost E$	4.85	4.41	66.05	16.50	13.22	220.11	16.50	13.22	220.11	5.10	4.63	69.44	17.34	15.90	231.44
b. Secondary Ditch															
Crew-days	0.312	0.775	0.938	0.312	0.775	0.938	0.625	1.562	1.875	0.312	0.775	0.938	0.312	0.775	0.938
Cost E$	19.64	48.79	59.06	19.64	48.79	59.06	39.35	98.34	118.05	20.66	51.31	62.11	20.66	51.51	62.11
5. Miscellaneous Maintenance															
a. Bridge & Channel															
Basis	22% of Items 3a and 3b														
Cost E$	12.61	19.57	32.89	12.72	19.57	33.22	13.72	20.90	35.33	13.86	21.50	36.10	13.99	21.50	36.49
b. Other Miscellaneous															
Basis	2.5% of Items 1 through 4														
Cost E$	25.41	24.20	25.74	28.47	27.50	31.24	35.53	34.61	37.88	25.91	24.79	26.55	29.07	28.20	32.30
B. PERIODIC MAINTENANCE															
1. Gravel Resurfacing															
Crew-days	0.277	0.231	0.215	0.277	0.231	0.215	0.369	0.323	0.292	0.277	0.231	0.215	0.277	0.231	0.215
Cost E$	1,785.60	1,489.08	1,385.94	1,785.60	1,489.08	1,385.94	2,378.65	2,082.13	1,882.30	1,808.45	1,508.13	1,403.67	1,808.45	1,508.13	1,403.67
COMBINED TOTAL	2,839.87	2,500.66	2,474.33	2,965.47	2,636.15	2,700.02	3,849.19	3,522.23	3,470.62	2,884.65	2,546.11	2,528.30	3,014.42	2,685.96	2,764.44
ROUNDED TOTAL	E$2,840.00	E$2,500.00	E$2,475.00	E$2,965.00	E$2,635.00	E$2,700.00	E$3,850.00	E$3,520.00	E$3,470.00	E$2,885.00	E$2,545.00	E$2,530.00	E$3,015.00	E$2,685.00	E$2,765.00

EXHIBIT III-B-5

TYPE 5 ROADS; GRAVEL-SURFACED, FEEDER ROAD STANDARD

Work Items	Dry Weather Zones			Moderate Rainfall Zones			High Rainfall Zones			Dry Weather Zones With Desert Allowance			Moderate Rainfall Zones With Desert Allowance		
	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M
A. ROUTINE MAINTENANCE															
1. Surface Maintenance															
a. Surface Grading															
Crew-days	0.875	0.875	0.875	1.125	1.125	1.125	1.182	1.182	1.182	0.875	0.875	0.875	1.125	1.125	1.125
Cost E$	161.60	161.60	161.60	207.76	207.76	207.76	218.29	218.29	218.29	166.59	166.59	166.59	214.19	214.19	214.19
b. Spot Regraveling															
Crew-days	0.194	0.164	0.151	0.194	0.164	0.151	0.259	0.220	0.198	0.194	0.164	0.151	0.194	0.164	0.151
Cost E$	230.63	194.97	179.51	230.63	194.97	179.51	307.91	261.54	235.39	234.94	198.61	182.87	234.94	198.61	182.87
2. Brush Control															
Crew-days	0.040	0.040	0.040	0.080	0.080	0.080	0.290	0.290	0.290	0.040	0.040	0.040	0.080	0.080	0.080
Cost E$	2.79	2.79	2.79	5.58	5.58	5.58	20.22	20.22	20.22	2.85	2.85	2.85	5.69	5.69	5.69
3. Culvert Maintenance															
a. Culvert Cleaning															
Crew-days	0.050	0.075	0.100	0.055	0.075	0.115	0.100	0.135	0.210	0.050	0.075	0.100	0.055	0.075	0.115
Cost E$	5.03	7.55	10.07	5.54	7.55	11.58	10.07	13.59	21.14	5.87	8.80	11.74	6.46	8.80	13.50
b. Culvert Repair															
Crew-days	0.300	0.467	0.800	0.300	0.467	0.800	0.300	0.467	0.800	0.300	0.467	0.800	0.300	0.467	0.800
Cost E$	52.29	81.39	139.43	52.29	81.39	139.43	52.29	81.39	139.43	57.13	88.94	152.35	57.13	88.94	152.35
4. Ditch Maintenance															
a. Primary Ditch															
(i) Machine															
Crew-days	0.132	0.136	--	0.381	0.456	--	0.381	0.456	--	0.132	0.136	--	0.381	0.456	--
Cost E$	24.38	25.12	--	70.36	84.21	--	70.36	84.21	--	25.13	25.89	--	72.54	86.82	--
(ii) Hand															
Crew-days	0.077	0.070	1.049	0.262	0.210	3.496	0.262	0.210	3.496	0.077	0.070	1.049	0.262	0.210	3.496
Cost E$	4.85	4.41	66.05	16.50	13.22	220.11	16.50	13.22	220.11	5.10	4.63	69.44	17.34	13.90	231.44
b. Secondary Ditch															
Crew-Days	0.156	0.388	0.469	0.156	0.388	0.469	0.312	0.781	0.938	0.156	0.388	0.469	0.156	0.388	0.469
Cost E$	9.82	24.43	29.53	9.82	24.43	29.53	19.64	49.17	59.06	10.33	25.69	31.05	10.33	25.69	31.05
5. Miscellaneous Maintenance															
a. Bridge & Channel															
Basis						22% of Items 3a and 3b									
Cost E$	12.61	19.57	32.89	12.72	19.57	33.22	13.72	20.90	35.32	13.86	21.50	36.10	13.99	21.50	36.40
B. PERIODIC MAINTENANCE															
1. Gravel Resurfacing															
Crew-days	0.208	0.173	0.161	0.208	0.173	0.161	0.277	0.242	0.219	0.208	0.173	0.161	0.208	0.173	0.161
Cost E$	747.42	621.65	578.53	747.42	621.65	578.53	995.36	869.60	786.95	750.03	623.82	580.55	750.03	623.82	580.55
COMBINED TOTAL	1,251.42	1,143.48	1,200.40	1,358.62	1,260.33	1,405.25	1,724.36	1,632.13	1,735.91	1,271.83	1,167.32	1,233.54	1,382.64	1,287.96	1,448.13
ROUNDED TOTAL	E$1,250.00	E$1,145.00	E$1,200.00	E$1,360.00	E$1,260.00	E$1,405.00	E$1,725.00	E$1,630.00	E$1,735.00	E$1,270.00	E$1,165.00	E$1,235.00	E$1,385.00	E$1,290.00	E$1,450.00

EXHIBIT III-B-6

TYPE 6 ROADS; GRAVEL-SURFACED, SERVICE TO TRAFFIC STANDARD

Work Items	Dry Weather Zones F	Dry Weather Zones R	Dry Weather Zones M	Moderate Rainfall Zones F	Moderate Rainfall Zones R	Moderate Rainfall Zones M	High Rainfall Zones F	High Rainfall Zones R	High Rainfall Zones M	Dry Weather Zones With Desert Allowance F	Dry Weather Zones With Desert Allowance R	Dry Weather Zones With Desert Allowance M	Moderate Rainfall Zones With Desert Allowance F	Moderate Rainfall Zones With Desert Allowance R	Moderate Rainfall Zones With Desert Allowance M
A. ROUTINE MAINTENANCE															
1. Surface Maintenance															
a. Surface Grading															
Crew-days	0.584	0.584	0.584	0.750	0.750	0.750	0.788	0.788	0.788	0.584	0.584	0.584	0.750	0.750	0.750
Cost E$	107.85	107.85	107.85	138.51	138.51	138.51	145.53	145.53	145.53	111.19	111.19	111.19	142.79	142.79	142.79
b. Spot Regraveling															
Crew-days	0.130	0.109	0.100	0.130	0.109	0.100	0.172	0.146	0.132	0.130	0.109	0.100	0.130	0.109	0.100
Cost E$	154.55	129.58	118.88	154.55	129.58	118.88	204.48	173.57	156.93	157.44	132.00	121.10	157.44	132.00	121.10
2. Brush Control															
Crew-days	0.040	0.040	0.040	0.080	0.080	0.080	0.290	0.290	0.290	0.040	0.040	0.040	0.080	0.080	0.080
Cost E$	2.79	2.79	2.79	5.58	5.58	5.58	20.22	20.22	20.22	2.85	2.85	2.85	5.69	5.69	5.69
3. Culvert Maintenance															
a. Culvert Cleaning															
Crew-days	0.050	0.075	0.100	0.055	0.075	0.115	0.100	0.135	0.210	0.050	0.075	0.100	0.055	0.075	0.115
Cost E$	5.03	7.55	10.07	5.54	7.55	11.58	10.07	13.59	21.14	5.87	8.80	11.74	6.46	8.80	13.90
b. Culvert Repair															
Crew-days	0.300	0.467	0.800	0.300	0.467	0.800	0.300	0.467	0.800	0.300	0.467	0.800	0.300	0.467	0.800
Cost E$	52.29	81.39	129.43	52.29	81.39	139.43	52.29	81.39	139.43	57.13	88.94	152.35	57.13	88.94	152.35
4. Ditch Maintenance															
a. Primary Ditch															
(i) Machine															
Crew-days	0.099	0.102	--	0.286	0.342	--	0.286	0.342	--	0.099	0.102	--	0.286	0.342	--
Cost E$	18.28	18.84	--	52.82	63.16	--	52.82	63.16	--	18.85	19.42	--	54.45	65.11	--
(ii) Hand															
Crew-days	0.058	0.052	0.787	0.196	0.158	2.622	0.196	0.158	2.622	0.058	0.052	0.787	0.196	0.158	2.622
Cost E$	3.65	3.27	49.55	12.34	9.95	165.08	12.34	9.95	165.08	3.84	3.44	5.21	12.98	10.46	173.50
5. Miscellaneous Maintenance															
a. Bridge & Channel															
Basis	22% of Items 3a and 3b														
Cost E$	12.61	19.57	32.89	12.72	19.57	33.22	13.72	20.90	35.32	13.86	21.50	36.10	13.99	21.50	36.49
B. PERIODIC MAINTENANCE															
1. Gravel Resurfacing															
Crew-days	0.138	0.116	0.108	0.138	0.116	0.108	0.184	0.162	0.146	0.138	0.116	0.108	0.138	0.116	0.108
Cost E$	495.89	416.83	388.08	495.89	416.83	388.08	661.18	582.12	524.63	497.61	418.28	389.44	497.61	418.28	389.44
COMBINED TOTAL	852.96	787.67	849.56	924.70	865.12	1,000.36	1,172.65	1,110.43	1,208.28	868.64	806.42	829.98	948.54	893.57	1,036.96
ROUNDED TOTAL	E$ 855.00	E$ 790.00	E$ 850.00	E$ 925.00	E$ 865.00	E$1,000.00	E$1,175.00	E$1,110.00	E$1,210.00	E$ 870.00	E$ 805.00	E$ 830.00	E$ 950.00	E$ 895.00	E$1,035.00

EXHIBIT III-D

CANDIDATE ROADS - 1972/73 SYSTEM
ROUTES AND SEGMENTS, TRAFFIC VOLUME, CONDITION RATING, MAINTENANCE TYPE AND COST
Financial Costs in 1972 Ethiopian Dollars

Route and Segment Number	Route	Segment km to km	kms	1972 ADT	Condition Rating	Maintenance Type	Basic Cost/km E$	Special Maintenance Description	Special Maintenance Cost E$	Total Cost/km E$
	DISTRICT 20 - ALEMGENA									
	Addis Ababa to boundary Welo Province									
01 0 01		5 - 30	25	341	3	1-HR	3,430			85,750
02	(Sendafa = km 38)	30 - 38	8	227	4	1-HF	3,320			26,560
03		38 - 67	29	227	3	1-HR	3,430			99,470
04		67 - 75	8	227	3	1-HF	3,320			26,560
05		75 - 108	33	227	4	1-HR	3,430			113,190
06		108 - 113	5	227	4	1-HF	3,320			16,600
07	(D. Berhan = km 130)	113 - 130	17	227	4	1-HR	3,430			58,310
08		130 - 136	6	125	2	1-HF	3,320			19,920
09		136 - 171	35	125	2	1-HM	3,660			128,100
10	Paving in progress by D/L in 72/73	171 - 195	24	125	6	3-HM	4,830	Extensive retaining wall, slides, 3 tunnels with water problems.	33,160	149,080
11		195 - 220	25	125	6	3-HM	4,830	Retaining wall	7,250	128,000
12		220 - 240	20	125	4	3-HF	5,615	Flood damage repair	35,995	148,295
01 0 13		240 - 338	98	125	4	3-HR	5,010	Flood damage repair	13,500	504,480
	Addis Ababa to Dejen									
03 0 01		2 - 10	8	256	2	2-HM	4,720			37,760
02	(Chancho = km 35)	10 - 35	25	256	3	1-HR	3,430			85,750
03	(Fitche Jct. = km 113)	35 - 149	114	153	3/1	1-HR	3,430	Note: Cond. 3 km 35-70; Cond. 1 km 70-149		391,020
04		149 - 180	31	152	1	1-HF	3,320			102,920
05		180 - 186	6	152	1	1-HR	3,430			20,580
03 0 06	(Blue Nile Gorge km 185-230) (Dejen = km 230)	186 - 230	44	152	3	1-HM	3,660	Retaining wall, slide repairs, and ditches and drains	95,953	256,993
	Addis Ababa to Awash Station (Hararge Bdry.)									
04 0 01		4 - 18	14	3,300	1	1-HF	3,320			46,480
02		18 - 32	14	3,300	1	1-HR	3,430			48,020
03		32 - 45	13	3,300	1	1-HF	3,320			43,160
04	(Debre Zeit = km 45)	45 - 68	23	1,455	1	1-HR	3,320			76,360
05	(Modjo = km 72)	68 - 72	4	1,455	1	1-HR	3,430			13,720
06	(Nazreth = km 99)	72 - 99	27	1,098	1	1-MR	3,040			82,080
07		99 - 105	6	370	1	1-MR	3,040			18,240
08		105 - 130	25	370	1	1-MF	2,960			74,000
09		130 - 170	40	370	1	1-DR	1,785			71,400
10		170 - 185	15	370	1	1-DF	1,745			26,175
11		185 - 190	5	370	1	1-DR	1,785			8,925
04 0 12	(Awash Sta. = km 220 ± Awash R. Br. on new location = km 225 ±)	190 - 225	35	370	1	1-DF	1,745			61,075
	Addis Ababa - Ghimbi									
05 0 01		7 - 30	23	664	3	1-HR	3,430			78,890
02		30 - 119	89	383	3/4	1-HR	3,430	Note: Cond. 3 km 30-60; Cond. 4 km 60-119		305,270
03	(Agerehiwot = km 125)	119 - 126	7	383	4	1-HF	3,320			23,240
04	(Guder = km 135)	126 - 140	14	383	4	3-HR	5,010			70,140
05		140 - 149	9	239	4	3-HM	4,830			43,470
06		149 - 306	157	239	4	3-HR	5,010			786,570
07		306 - 311	5	239	4	3-HM	4,830			24,150
08	(Lekempty = km 334)	311 - 334	23	239	4	3-HR	5,010			115,230
09		334 - 355	21	216	2	3-HR	5,010			105,210
10		355 - 362	7	216	2	3-HM	4,830	Excess brush	195	34,005
11		362 - 405	43	216	2	3-HR	5,010	Slide problems; Excess brush	10,201	225,631
12		405 - 411	6	216	2	3-HM	4,830	Excess brush	165	29,145
05 0 13	(Ghimbi = km 440)	411 - 440	29	216	2	3-HR	5,010	Slide problems; Excess brush	9,811	155,101
06 0 01	Modjo - Awash R. Bridge	72 - 95	23	498	1	1-MF	2,960			68,080

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EXHIBIT III-D
(Continued)

Route and Segment Number	Route	Segment km to km	kms	1972 ADT	Condition Rating	Maintenance Type	Basic Cost/km E$	Special Maintenance Description	Special Maintenance Cost E$	Total Cost/km E$
	Addis Ababa - Ghibi R. Br.									
07 0 01		6 - 19	13	1,095	3	1-HR	3,430			44,590
02		19 - 24	5	602	3	1-HR	3,430			17,150
03	(Teji = km 55)	24 - 55	31	602	4	1-HF	3,320			102,920
04		55 - 99	44	602	3	2-HF	4,380			192,720
05	(Ghion = km 115)	99 - 115	16	602	3	2-HR	4,490			71,840
06		115 - 141	26	214	4	3-HF	5,615			145,990
07	(Welkite = km 155)	141 - 155	14	214	4	3-HR	5,010			70,140
08		155 - 171	16	214	4	3-HR	5,010			80,160
07 0 09	(Ghibi R. Br. = km 183)	171 - 183	12	214	4	3-HM	4,830			57,960
	Nazreth - Assela									
08 0 01	(Awash R. Br. = km 116)	99 - 116	17	644	2	1-MR	3,040			
02		116 - 124	8	212	4	3-MR	4,255			51,680
03		124 - 138	14	212	4	3-MF	4,745			34,040
04		138 - 150	12	212	4	3-HR	5,010			66,430
05		150 - 162	12	212	4	3-HF	5,615			60,120
08 0 06	(Assela = km 176)	162 - 176	14	212	4	3-HR	5,010			67,380
09 0 01	Alemgena - Kersa R. Br.	19 - 60	41	292	5	3-HR	5,010			70,140
	Tarmaber - Molale									205,410
14 0 01		0 - 59	59	14	3	5-HM	1,735	Slide problems	13,499	115,864
02	(Molale = km 75)	59 - 75	16	14	3	5-HR	1,630	Slide problems	9,001	35,081
14 1 01	Jct. to Mehal Meda	0 - 40	40	3	3	5-HM	1,735			69,400
16 0 01	Debre Berhan - Ankober	0 - 44	44	16	3	5-HM	1,735	Slide problems	9,001	85,341
28 0 01	Debre Berhan - Jihur	0 - 31	31	14	3	5-HR	1,630			50,530
02		31 - 86	55	3	3	5-HF	1,725			94,875
49 0 01	Tarmaber - Seladengie	0 - 10	10	26	3	5-HR	1,630			16,300
02		10 - 16	6	26	3	5-HF	1,725			10,350
03		16 - 22	6	26	3	5-HR	1,630			9,780
	Access Roads									
04 0 01	Koka Dam Access Road	0 - 14	14	25	2	1-MR	3,040			42,560
08 1 01	Sodere Spur	0 - 6	6	112	2	1-MR	3,040			18,240
03 2 01	Debre Libanos Road	0 - 4	4	9	2	1-HM	3,660			14,640
03 3 01	Cement Quarry Road	0 - 23	23	15	2	5-HR	1,630			37,490
03 1 01	Mukutere - Alem	0 - 20	20	11	7	6-HR	1,110			22,200
								COMBINED TOTAL, DISTRICT 20		E$6,994,426
	DISTRICT 21 - ASMARA									
	Asmara to Prov. Bdry. (Adigrat Dist. Bdry.)									
01 0 66		5 - 40	35	703	2	2-MR	3,780			132,300
65	(Decamere = km 40)	40 - 68	28	124	2	2-MR	3,780			105,840
64		68 - 98	30	124	2	2-MM	3,995	Retaining wall	8,700	128,550
63		98 - 123	25	124	2	2-MR	3,780			94,500
62	(Senafe = km 135)	123 - 135	12	124	2	2-MM	3,995	Retaining wall	3,480	51,420
01 0 61	(Prov. Bdry. = km 158)	135 - 158	23	124	2	2-MR	3,780			86,940

EXHIBIT III-D
(Continued)

Route and Segment Number	Route	Segment km to km	kms	1972 ADT	Condition Rating	Maintenance Type	Basic Cost/km E$	Special Maintenance Description	Special Maintenance Cost E$	Total Cost/km E$
	Asmara - Massawa									
01 0 67		0 - 25	25	462	1	2-MM	3,995	Retaining wall	7,250	107,125
68		25 - 60	35	503	1	2-MM	3,995	Retaining wall	10,150	149,975
69	(Dongollo - km 65)	60 - 65	5	503	1	2-DM	2,200	Retaining wall	1,450	12,450
70		65 - 72	7	503	1	2-DFd	2,130			14,910
71		72 - 82	10	503	1	2-DRd	2,170			21,700
01 0 72	(Massawa = km 115)	82 - 115	33	503	1	2-DFd	2,130			70,290
	Asmara to Mereb									
03 0 72		0 - 7	7	243	1	2-MF	3,705			25,935
71		7 - 15	8	243	1	2-MR	3,780			30,240
70		15 - 20	5	243	1	2-MM	3,995	Retaining wall	1,450	21,425
69		20 - 30	10	243	1	2-MR	3,780			37,800
68		30 - 43	13	243	1	2-MF	3,705			48,165
67	(Adi Ugri = km 55)	43 - 55	12	243	1	2-MR	3,780			45,360
66		55 - 67	12	243	2	2-MF	3,705			44,460
65		67 - 89	22	243	2	2-MR	3,780			83,160
64		89 - 93	4	243	1	2-MM	3,995	Retaining wall	1,160	17,140
63		93 - 98	5	243	1	2-MR	3,780			18,900
62		98 - 103	5	243	1	2-MF	3,705			18,525
03 0 61	(Prov. Bdry. = km 115)	103 - 115	12	243	1	2-MR	3,780			45,360
	Nefasit - Decamere									
10 0 01		0 - 22	22	53	1	2-MM	3,995	Retaining wall	6,380	94,270
02		22 - 34	12	53	1	2-MR	3,780			45,360
10 0 03		34 - 40	6	53	1	2-MM	3,995	Retaining wall	1,740	25,710
	Asmara - Sebderat									
11 0 01		0 - 41	41	275	1	2-MR	3,780			154,980
02		41 - 66	25	121	1	2-MM	3,995	Retaining wall	7,250	107,125
03		66 - 70	4	121	1	2-MR	3,780			15,120
04		70 - 75	5	121	1	2-MM	3,995	Retaining wall	1,450	21,425
05	(Keren = km 91)	75 - 91	16	121	1	2-MR	3,780			60,480
06		91 - 98	7	121	1	2-DMd	2,275			15,925
07		98 - 108	10	121	1	2-DRd	2,170			21,700
08		108 - 130	22	121	1	2-DFd	2,130			46,860
09	(Akordat = km 173)	130 - 173	43	121	4	3-DRd	4,310			185,330
10		173 - 259	86	71	4	4-DRd	2,545			218,870
11	(Teseney Jct. = km 349)	259 - 349	90	71	4	4-DFd	2,885			259,650
11 0 12	(Sebderat = km 384)	349 - 384	35	71	4	4-DFd	2,885			100,975
	Adi Ugri - Areza									
17 0 01		0 - 11	11	8	5	5-MM	1,260			13,860
02		11 - 16	5	8	5	5-MM	1,405			7,025
03		16 - 22	6	8	5	5-MR	1,260			7,560
04		22 - 26	4	8	5	5-MM	1,405			5,620
17 0 05	(Areza = km 42)	26 - 42	16	8	5	5-MR	1,260			20,160
50 0 01	Terramini - Decamere	0 - 22	22	8	5	5-MR	1,260			27,720
50 0 02		22 - 30	8	8	5	5-MF	1,360			10,880
12 0 01	Massawa - Agip	0 - 6	6	216	2	2-DFd	2,130			12,780
01 3 01	Massawa - Gurgussum	0 - 8	8	245	1	1-DFd	1,785			14,280
11 0 01	Teseney Access Road	0 - 6	6	76	4	4-DFd	2,885			17,310
								COMBINED TOTAL, DISTRICT 21		E$2,923,445

EXHIBIT III-D
(Continued)

Route and Segment Number	Route	Segment km to km	kms	1972 ADT	Condition Rating	Maintenance Type	Basic Cost/km E$	Special Maintenance Description	Special Maintenance Cost E$	Total Cost/km E$
	DISTRICT 22 - GONDER									
	Tigre Prov. Bdry. to Bahir Dar									
03 0 46		294 - 305	11	68	4	4-MM	2,700	Slide removal	1,862	31,962
45		305 - 325	20	68	4	4-MR	2,635			52,700
44		325 - 339	14	68	4	4-MM	2,700	Slide removal	2,365	40,365
43		339 - 344	5	68	4	4-MR	2,635			13,175
42		344 - 390	46	68	4	4-MM	2,700	Slide removal	7,780	131,980
41		390 - 401	11	68	4	4-MR	2,635			28,985
40		401 - 410	9	68	4	4-HM	3,470	Slide removal	1,520	32,730
39		410 - 415	5	68	4	4-HR	3,520			17,600
38		415 - 425	10	68	4	4-HM	3,470	Slide removal and retaining wall	6,720	41,420
37	(Debarak = km 430) (Dabat = km 455)	425 - 473	48	57	4	4-HR	3,520			168,960
36		473 - 479	6	57	4	4-HF	3,850			23,100
35		479 - 526	47	57	4	4-HR	3,520			165,440
34		526 - 528	2	185	2	2-HR	4,490			8,980
33	(Gonder = km 530)	528 - 530	2	185	5	3-HR	5,010			10,020
32		530 - 536	6	185	2	2-HR	4,490			26,940
31	(Azezo Jct. = km 541)	536 - 541	5	98	2	1-HR	3,430			17,150
30		541 - 545	4	98	2	1-HR	3,430			13,720
29		545 - 580	35	98	4	3-HR	5,010			175,350
28		580 - 585	5	34	4	4-HM	3,470			17,350
27		585 - 610	15	34	4	4-HR	3,520			52,800
26	(Adis Zemen Jct. = km 624)	610 - 624	14	34	4	4-HM	3,470			48,580
25		624 - 668	44	39	2	4-HF	3,850			169,400
24		668 - 697	29	39	2	4-HM	3,470			100,630
03 0 23	(Bahir Dar and Prov. Bdry. = km 705)	697 - 705	8	39	2	4-HF	3,850			30,800
	Gonder Airport - Gorgora									
27 0 01		0 - 5	5	47	4	4-HR	3,520			17,600
02		5 - 14	9	47	4	4-HF	3,850			34,650
03		14 - 20	6	47	4	4-HR	3,520			21,120
04		20 - 25	5	47	4	4-HF	3,850			19,250
05	(Gorgora = km 60)	25 - 60	35	47	4	4-HR	3,520			123,200
32 0 01	Gonder - Setit	0 - 20	20	6	6	6-HR	1,110			22,200
32 0 02		20 - 25	5	6	6	6-HM	1,210			6,050
								COMBINED TOTAL, DISTRICT 22		E$1,663,627
	DISTRICT 23 - COMBOLCIA									
	Shoa Bdry. to Tigre Bdry.									
01 0 14		338 - 350	12	125	4	3-HF	5,615			67,380
15		350 - 360	10	125	4	3-HR	5,010			50,100
16	(Combolcia = km 375 South) (Combolcia = km 702 North)	360 - 375	15	125	3	2-HR	4,490			67,350
17		702 - 697	5	163	2	2-HF	4,380			21,900
18	(Dessie = km 680)	697 - 680	17	163	2	2-HM	4,720	Slide problems	9,081	89,241
19		680 - 670	10	143	2	2-HM	4,720	Retaining wall	2,900	50,100
20		670 - 657	13	143	4	3-HM	4,830			62,790
21	(Hayk = km 651)	657 - 646	11	143	4	3-HR	5,010			55,110
22		646 - 632	14	143	4	3-HM	4,830			67,620
23		632 - 627	5	143	4	3-HF	5,615			28,075
24		627 - 609	18	143	4	3-HM	4,830			109,500
25		609 - 601	8	143	4	3-HR	5,010	Retaining wall and flood damage	22,460	40,080
26		601 - 595	6	143	4	3-HM	4,830			28,980
27		595 - 581	14	138	4	3-MR	4,255			59,570
28		581 - 574	7	138	4	3-MM	4,080			28,560
29		574 - 567	7	138	4	3-MR	4,255			29,785

EXHIBIT III-D
(Continued)

Route and Segment Number	Route	Segment km to km	kms	1972 ADT	Condition Rating	Maintenance Type	Basic Cost/km E$	Special Maintenance Description	Special Maintenance Cost E$	Total Cost/km E$
30	(Woldia = km 559)	567 - 559	8	138	4	3-MM	4,080			32,640
31		559 - 528	31	138	4	3-DM	3,975			123,225
32		528 - 521	7	138	4	3-DR	4,240	Flood damage	24,700	54,380
33	(Kobo = km 510)	521 - 510	11	138	4	3-DF	4,745	Flood damage	38,800	90,995
34		510 - 478	32	138	4	3-DF	4,745	Flood damage	74,165	226,085
35		478 - 463	15	138	4	3-MM	4,080			61,200
36		463 - 442	21	138	4	3-HR	5,010			105,210
01 0 37	(Prov. Bdry. = km 435)	442 - 435	7	138	4	3-HM	4,830			33,810
	Combolcia - Asseb									
02 0 01		375 - 397	22	28	2	2-MM	3,995			87,890
02		397 - 402	5	28	2	2-MR	3,780			18,900
03		402 - 412	10	28	2	2-DM	2,200	Note: Traffic shown is estimated ADT after opening of Awash - Tendaho Hwy.		22,000
04	(Bati = km 416)	412 - 416	4	18	2	2-DR	2,105			8,420
05		416 - 440	24	18	4	3-DMd	4,050			97,200
06	(Mile = km 515)	440 - 522	82	17	4	3-DFd	4,815			394,830
07		522 - 640	118	181	2	2-DFd	2,130			251,340
08		640 - 650	10	181	3	2-DRd	2,170			21,700
09		650 - 665	15	181	3	2-DMd	2,275			34,125
10		665 - 675	10	181	3	2-DRd	2,170			21,700
11		675 - 710	35	181	3	2-DFd	2,130			74,550
12		710 - 760	50	181	3	2-DRd	2,170			108,500
02 0 13	(Asseb = km 860)	760 - 860	100	181	2	2-DFd	2,130			213,000
02 1 01	Asseb to Airport	860 - 875	15	39	2	2-DFd	2,130			31,950
								COMBINED TOTAL, DISTRICT 25		E$2,969,751
	DISTRICT 24 - ADIGRAT									
	Welo Bdry. to Eritrea Bdry.									
01 0 38		435 - 424	11	143	3	3-HM	4,830			53,130
39	(Maychew = km 418)	424 - 415	9	143	3	3-HR	5,010			45,090
40		415 - 364	51	143	3	3-HM	4,830			246,330
41		364 - 357	7	143	3	2-HM	4,720			33,040
42		357 - 345	12	143	3	2-MR	3,780			45,360
43		345 - 340	5	143	3	2-MF	3,705			18,525
44		340 - 335	5	143	3	2-MR	3,780			18,900
45		335 - 331	4	143	3	3-MR	4,255			17,020
46	(Quiha = km 309)	331 - 309	22	143	3	2-MR	3,780			83,160
47		309 - 295	14	69	3	2-MR	3,780			52,920
48		295 - 282	13	69	3	4-MM	2,700			35,100
49		282 - 270	12	69	3	2-MR	3,780			45,360
50		270 - 265	5	69	3	2-MF	3,705			18,525
51		265 - 260	5	65	3	2-MR	3,780			18,900
52		260 - 250	10	69	3	2-MM	3,995			39,950
53		250 - 225	25	69	3	2-MR	3,780			94,500
54		225 - 220	5	69	3	4-MR	2,635			13,175
55		220 - 210	10	69	3	4-MM	2,700			27,000
56	(Adigrat = km 195)	210 - 195	15	69	3	4-MR	2,635			39,525
57		195 - 186	9	106	1	1-MR	3,040			27,360
58		186 - 182	4	106	1	1-MM	3,250			13,000
59		182 - 175	7	106	1	1-MR	3,040			21,280
01 0 60	(Eritrea Bdry. = km 158)	175 - 158	17	106	1	1-MM	3,250			55,250
	Eritrea Bdry. - Begemdir Bdry.									
03 0 60		115 - 125	10	243	3	2-MR	3,780			37,800
59		125 - 132	7	243	3	3-MF	4,745			33,215
58		132 - 135	3	243	3	3-MM	4,080			12,240
57		135 - 150	15	243	3	2-MM	3,995			59,925
56	(Adi Abun = km 156)	150 - 160	10	243	3	2-MR	3,780			37,800
55	(Axum = km 177)	160 - 177	17	79	3	4-MR	2,635			44,795
54		177 - 209	32	79	3	4-MR	2,635			84,320
53		209 - 214	5	79	3	4-MF	2,965			14,825
52		214 - 220	6	79	3	4-MR	2,635			15,810

EXHIBIT III-D
(Continued)

Route and Segment Number	Route	Segment km to km	kms	1972 ADT	Condition Rating	Maintenance Type	Basic Cost/km E$	Special Maintenance Description	Special Maintenance Cost E$	Total Cost/km E$
51	(Enda Selasse = km 239)	220 - 239	19	79	3	4-MF	2,965			56,335
50		239 - 257	18	79	3	4-MF	2,965			53,370
49		257 - 262	5	79	3	4-MR	2,635			13,175
48		262 - 281	19	79	3	4-MF	2,965			56,335
03 0 47	(Tekeze R. Br. = km 294)	281 - 294	13	79	4	4-MM	2,700	Slide removal	5,296	40,396
	Adigrat - Adi Abun									
15 0 01		0 - 51	51	19	4	4-MR	2,635			134,385
02		51 - 59	8	19	4	4-MM	2,700	Slide removal	5,667	25,267
03		59 - 66	7	19	4	4-MR	2,635			18,445
04		66 - 96	30	19	4	4-MM	2,700	Slide removal	11,706	92,706
15 0 05	(Adi Abun = km 103)	96 - 103	7	19	4	4-MR	2,635			18,445
01 1 01	Quiha - Mekele	0 - 7	7	47	3	4-MF	2,965			20,775
01 1 02	(Mekele = km 10)	7 - 10	3	47	3	4-MM	2,700			8,100
01 2 01	Mekele - Maimekden	0 - 18	18	47	4	5-MM	1,405			25,290
03 4 01	Adi Abun - Adwa	0 - 5	5	87	4	4-MF	2,965			14,825
								COMBINED TOTAL, DISTRICT 24		E$1,980,979
	DISTRICT 25 - DEBRE MARKOS									
	Dejen to Bahir Dar									
03 0 07	(Dejen = km 230)	230 - 256	26	143	4	3-HF	5,615			145,990
08	(D. Markos = km 300)	256 - 300	44	143	4	3-HR	5,010			220,440
09		300 - 368	68	91	4	4-HR	3,520			239,360
10		368 - 381	13	91	4	4-HF	3,850			50,050
11		381 - 389	8	91	4	4-HR	3,520			28,160
12		389 - 394	5	91	4	4-HF	3,850			19,250
13		394 - 402	8	91	4	4-HR	3,520			28,160
14		402 - 410	8	91	4	4-HF	3,850			30,800
15		410 - 465	55	91	4	4-HR	3,520			193,600
16	(Dangla = km 485)	465 - 487	22	91	4	4-HF	3,850			84,700
17		487 - 500	13	101	4	3-HR	5,010			65,130
18		500 - 510	10	101	4	3-HF	5,615			56,150
19		510 - 515	5	101	4	3-HR	5,010			25,050
20		515 - 540	25	101	4	3-HF	5,615			140,375
21		540 - 555	15	101	4	3-HR	5,010			75,150
03 0 22	(Bahir Dar = km 565)	555 - 565	10	101	4	3-HF	5,615			56,150
23 0 01	Dejen - Bichena	237 - 268	31	30	5	5-HR	1,630			50,530
51 0 01	Bahir Dar - Tis Abat	0 - 30	30	48	4	5-HF	1,725			51,750
								COMBINED TOTAL, DISTRICT 25		E$1,560,795
	DISTRICT 26 - DIRE DAWA									
	Awash R. Br. to Jijiga									
04 0 15		225 - 230	5	196	4	3-MM	4,080			20,400
16		230 - 250	20	196	4	3-MF	4,745			94,900
17		250 - 260	10	196	4	3-MR	4,255			42,550
18		260 - 265	5	196	4	3-MM	4,080	Built as an S.T.T. road but classified as Type 3 because of width, traffic and necessary maintenance.		20,400
19		265 - 280	15	196	4	3-MF	4,745			71,175
20		280 - 285	5	196	4	3-MR	4,255			21,275
21		285 - 300	15	196	4	3-MF	4,745			71,175
22	(Mieso = km 302)	300 - 310	10	121	3	3-MF	4,745			47,450
23		310 - 320	10	121	3	3-MM	4,080			40,800
24	(Asbe Teferi = km 327)	320 - 330	10	121	2	3-HR	5,010	Slide problems	4,959	55,059
25	(Kuni = km 335)	330 - 335	5	98	2	4-HM	3,470	Slide problems	2,480	19,830
26		335 - 340	5	98	2	4-HR	3,520	Slide problems	2,480	20,000
27		340 - 365	25	98	2	4-HM	3,470	Slide problems	12,398	99,148

EXHIBIT III-D
(Continued)

Route and Segment Number	Route	Segment km to km	kms	1972 ADT	Condition Rating	Maintenance Type	Basic Cost/km E$	Special Maintenance Description	Special Maintenance Cost E$	Total Cost/km E$
28		365 - 375	10	98	2	4-HF	3,850	Slide problems	4,959	43,459
29		375 - 400	25	98	2	4-HM	3,470	Slide problems	12,[illegible]	99,140
30		400 - 415	15	98	2	4-HR	3,520	Slide problems	7,439	60,239
31	(Kobo = km 435)	415 - 435	20	98	2	4-HM	3,470	Slide problems	9,918	79,318
32	(Kulubi = km 465)	435 - 465	30	164	2	3-HM	4,830	Slide problems	14,877	159,777
33	(Dengego = km 495)	465 - 495	30	164	4	3-HR	5,010	Slide problems		150,300
34		495 - 502	7	517	1	1-MF	2,960			20,728
35		502 - 528	26	517	1	1-MR	3,040			79,040
36	(Harer = km 540)	528 - 540	12	517	4	3-MR	4,255			51,060
37		540 - 565	25	172	4	3-MF	4,745			118,625
38		565 - 583	18	172	4	3-DM	3,975			71,550
39		583 - 595	12	172	4	3-DR	4,240			50,880
40		595 - 603	8	172	4	3-DF	4,745			37,960
41		603 - 607	4	172	4	3-DM	3,975			15,900
42		607 - 625	18	172	4	3-DR	4,240			76,320
04 0 43	(Jijiga = km 630)	625 - 630	5	172	4	3-DF	4,745			23,725
04 4 01	Dengego - Dire Dawa	495 - 509	14	797	1	1-MM	3,250			45,500
04 4 02	(Dire Dawa = km 516)	509 - 516	7	797	1	1-MR	3,040			21,280
	Mieso - Dire Dawa									
20 0 01		300 - 330	30	DWO	7	X-MF	500	Dry weather only; earth surface, special maintenance only per year @E$500/km		15,000
02		330 - 395	65	DWO	7	X-MR	500			32,500
03		395 - 440	45	168	4	6-MR	865			38,925
20 0 04	(Dire Dawa = km 460)	440 - 460	20	168	4	6-MF	925			18,500
	Kuni - Gelemso									
35 0 01		335 - 343	8	10	4	5-HR	1,630			13,040
02		343 - 352	9	10	4	5-HM	1,735			15,615
03		352 - 358	6	10	4	5-HR	1,630			9,780
04		358 - 363	5	10	4	5-HF	1,725			8,625
05		363 - 376	13	10	4	5-HR	1,630			21,190
06		376 - 384	8	10	4	5-HF	1,725			13,800
35 0 07	(Gelemso = km 399)	384 - 399	15	10	4	5-HR	1,630			24,450
04 3 01	Kobo - Deder	435 - 447	12	67	2	4-HM	3,470			41,640
30 0 01	Jijiga - km 795 (Degehbur = km 795)	630 - 795	165	10	4	6-DFd	870	Const. std. is between Feeder and S.T.T. Classified as Type 6 because of low traffic.		143,550
								COMBINED TOTAL, DISTRICT 26		E$2,226,378
	DISTRICT 27 - SHASHAMANE									
	Awash R. Br. to Dilla									
06 0 02	(Meki = km 135)	95 - 135	40	498	1	1-MF	2,960	Excess brush	1,600	120,000
03		135 - 205	70	486	1	1-MF	2,960	Excess brush	2,800	210,000
04	(Shashamane = km 250)	205 - 250	45	466	1/2	1-MR	3,040	Note: Cond. 1 km 205-229; Cond. 2 km 229-250		136,800
05	(Awassa = km 276)	250 - 276	26	300	1	1-MF	2,960			76,960
06	(Yergalem Jct. = km 315)	276 - 315	39	300	4	3-HR	5,010			195,390
07	(Wondo = km 333)	315 - 333	18	298	4	3-HR	5,010			90,180
06 0 08	(Dilla = km 370)	333 - 370	37	133	5	3-HM	4,830			178,710
	Shashamane - Sodo									
41 0 01		250 - 260	10	217	4	3-MF	4,745			47,450
02		260 - 281	21	217	4	3-MR	4,255			89,355
03	(Alaba = km 315)	281 - 315	34	217	4	3-MF	4,745			161,330
41 0 04	(Sodo = km 390)	315 - 390	75	217	5	3-HR	5,010			375,750
	Sodo - Arbaminch									
09 0 30		390 - 450	60	15	3	4-HR	3,520			211,200
31		450 - 475	25	15	3	4-MF	2,965			74,125
32		475 - 484	9	15	3	4-MR	2,635			23,715
33		484 - 490	6	15	3	4-MF	2,965			17,790
09 0 34	(Arbaminch = km 515)	490 - 515	25	15	3	4-MR	2,635	Excess brush	1,000	66,875

EXHIBIT III-D
(Concluded)

Route and Segment Number	Route	Segment km to km	kms	1972 ADT	Condition Rating	Maintenance Type	Basic Cost/km E$	Special Maintenance Description	Special Maintenance Cost E$	Total Cost/km E$
	Dodola - Goba									
08 0 25		348 - 360	12	29	4	5-HR	1,630			19,560
26	(Adaba = km 360)	360 - 385	25	29	4	5-HM	1,735	Slide problems	17,984	61,359
27		385 - 430	45	6	4	5-HR	1,630			73,350
08 0 28	(Robey = km 452) (Goba = km 465)	430 - 465	35	6	4	5-HF	1,725			60,375
	Wondo - Negele									
44 0 01		333 - 365	32	74	4	4-HM	3,470			111,040
02		365 - 456	91	74	4	4-HR	3,520	Excess brush	1,290	321,610
03		456 - 466	10	74	4	4-HM	3,470	Excess brush	280	34,980
04	(Kebremengist - km 471)	466 - 471	5	74	4	4-HR	3,520	Excess brush	140	17,740
44 0 05	(Negele = km 595)	471 - 595	124	14	3	4-MR	2,635			326,740
06 1 01	Yergalem Spur	315 - 321	6	361	4	3-HM	4,830			28,980
	Shashamane - Dodola									
40 0 01	(Kofole = km 267)	247 - 267	20	258	5	3-HR	5,010			100,200
02		267 - 283	16	127	5	3-HR	5,010			80,160
40 0 03	(Dodola = km 348)	283 - 348	65	100	6	5-HR	1,630			105,950
								COMBINED TOTAL, DISTRICT 27		E$3,417,674
	DISTRICT 28 - JIMMA									
	Ghibi R. Br. to km 485									
07 0 10		183 - 200	17	164	4	3-HM	4,830			82,110
11		200 - 240	40	164	4	3-HR	5,010			200,400
12		240 - 247	7	164	4	3-HM	4,830			33,810
13		247 - 260	13	164	4	3-HR	5,010			65,130
14	(Asendabo = km 279)	260 - 279	19	164	4	3-HF	5,615			106,685
15	(Jimma = km 332)	279 - 332	53	164	4	3-HF	5,615			297,595
16		335 - 360	25	104	6	3-HR	5,010			125,250
17		360 - 370	10	104	6	3-HF	5,615			56,150
18		370 - 395	25	104	6	3-HR	5,010	Excess brush	700	125,950
19		395 - 420	25	104	5	3-HF	5,615	Excess brush	700	141,075
20	(Bonga Jct. = km 440)	420 - 440	20	104	5	3-HR	5,010			100,200
21		440 - 462	22	16	5	5-HM	1,735			38,170
07 0 22		462 - 485	23	16	5	5-HR	1,630			37,490
	Jimma - Bedele									
43 0 01	(Agaro = km 378)	335 - 378	43	286	1	1-HR	3,430	Excess brush	975	148,465
02		378 - 380	2	286	1	1-HR	3,430			6,860
03		380 - 385	5	286	2	3-HR	5,010			25,050
04		385 - 405	20	286	2	3-HF	5,615			112,300
05		405 - 430	25	286	2	3-HM	4,830			120,750
06		430 - 445	15	109	2	3-HF	5,615			84,225
07		445 - 455	10	109	2	3-HM	4,830			48,300
08		455 - 465	10	109	2	3-HF	5,615			56,150
43 0 09	(Bedele = km 480)	465 - 480	15	109	2	3-HR	5,010			75,150
07 2 01	Bonga Spur	442 - 446	4	87	5	4-HM	3,470			13,880
07 1 01	Ghimbo Access Road	425 - 435	10	22	6	6-HM	1,210			12,100
								COMBINED TOTAL, DISTRICT 28		E$2,113,245

EXHIBIT III-E

CANDIDATE ROADS - FUTURE REVISIONS AND ADDITIONS
Financial Maintenance Costs in 1972 Ethiopian Dollars

Route and Segment Number	Route	Segment km to km	kms	Project Description	Old Maintenance Type (72)	New Type	Old Maintenance Cost/km	New Maintenance Cost/km	Net Annual Cost Change	1st Year Change	Funding
	DISTRICT 20 - ALEMGENA										
	Debre Berhan - Robi										
01 0 10		171 - 195	24	Pave existing gravel	3-HM	1-HM	6,212 (S)*	5,042 (S)	(28,080)**	1973/74	D/L
11		195 - 220	25		3-HM	1-HM	5,120 (S)	3,950 (S)	(29,250)	1974/75	
01 0 12	(Part of Segment)	220 - 228	8		3-HF	1-HF	7.272 (S)	4,977 (S)	(18,360)	1975/76	
	Addis Ababa - Nazreth										
04 0 06	(Relocation; shortens length	72 - 94	22	Prev. km 72-99	1-MR	1-MR	3,040	3,040	(15,200)	1975/76	D/L
04 4 01	Akaki and Factory Access	13 - 19	6	Existing road, new maintenance length following relocation of main route	1-HR	1-HR	3,430	3,430	20,580	1974/75	
04 5 01	Modjo Access	66 - 72	6		1-HR	1-HR	3,430	3,430	20,580	1975/76	
04 6 01	Local Access	72- 99	27		1-MR	1-MR	3,040	3,040	82,080	1975/76	
	Agrehiwot - Lekempty - Ghir										
05 0 04	(Agrehiwot = km 125)	126 - 140	14	Pave existing gravel	3-HR	1-HR	5,510	3,430	(29,120)	1976/77	6th Loan
05		140 - 149	9		3-HM	1-HM	4,830	3,660	(10,530)		
06	(Part of Segment)	149 - 226	77		3-HR	1-HR	5,010	3,430	(121,660)		
06	(Part of Segment)	226 - 306	80		3-HR	1-HR	5,010	3,430	(126,400)	1977/78	6th Loan
07		306 - 311	5		3-HM	1-HM	4,830	3,660	(5,850)		
08	(Lekempty = km 334)	311 - 334	23		3-HR	1-HR	5,010	3,430	(36,340)		
09		334 - 355	21	Pave existing gravel	3-HR	1-HR	5,010	3,430	(32,180)	1974/75	5th Loan
10		355 - 362	7		3-HM	1-HM	4,858 (S)	3,688 (S)	(8,190)		
11	(Part of Segment)	362 - 387	25		3-HR	1-HR	5,048 (S)	3,469 (S)	(39,475)		
11	(Part of Segment)	387 - 405	18		3-HR	1-HR	5,048 (S)	3,469 (S)	(28,422)	1975/76	5th Loan
12		405 - 411	6		3-HM	1-HM	4,858 (S)	3,688 (S)	(7,020)		
05 0 13	(Ghibi = km 440)	411 - 440	29		3-HR	1-HR	5,156 (S)	3,576 (S)	(45,820)		
	Ghimbi - Kurmuk										
05 0 14	(to Nejo = km 510)	440 - 510	70	New Const. - S.T.T.	--	6-HR	--	1,110	77,700	1974/75	D/L
	Ghion - Jimma										
07 0 06	(Ghion = km 115)	115 - 141	26	Pave existing gravel	3-HF	1-HF	5,615	3,320	(59,670)	1975/76	5th Loan
07		141 - 155	14		3-HR	1-HR	5,010	3,430	(22,120)		
08		155 - 171	16		3-HR	1-HR	5,010	3,430	(25,280)		
07 0 09	(Ghibi R. Br. = km 183)	171 - 183	12		3-HM	1-HM	4,830	3,660	(14,040)		
	Alemgena - Hosana										
09 0 02	(Kersa R. Br. = km 60)	60 - 130	70	New Const. - Secondary	--	3-HR	--	5,010	350,700	1973/74	D/L
	Welkite - Indeber - Hosana										
13 0 01	(Welkite = km 155)	155 - 165	10	New Const. - Feeder std.	--	5-HR	--	1,630	16,300	1974/75	D/L
02		165 - 175	10		--	5-HF	--	1,725	17,250		
03	(Indeber = km 184)	175 - 184	9		--	5-HR	--	1,630	14,670		
04		184 - 232	48	New Const. - Feeder std.	--	5-HR	--	1,630	78,240		
05		232 - 240	8		--	5-HM	--	1,735	13,880		
06		240 - 250	10		--	5-HR	--	1,630	16,300		
07		250 - 258	8		--	5-HF	--	1,725	13,800		
08		258 - 266	8		--	5-HR	--	1,630	13,040		
09	(Hosaina = km 280)	266 - 280	14		--	5-HF	--	1,725	24,150		

*(S) Indicates special maintenance included in total
**Parentheses indicate net cost reduction

EXHIBIT III-E
(Continued)

Route and Segment Number	Route	Segment km to km	kms	Project Description	Old Maintenance Type (72)	New Type	Old Maintenance Cost/km	New Maintenance Cost/km	Net Annual Cost Change	1st Year Change	Funding
	DISTRICT 20 - ALEMGENA (Continued)										
	Awash R. Br. - Assela										
08 0 02	(Awash R. Br. = km 116)	116 - 124	8		3-MR	1-MR	4,255	3,040	(9,720)		
03		124 - 138	14		3-MF	1-MF	4,745	2,960	(24,990)		
04		138 - 150	12	Pave existing gravel	3-HR	1-HR	5,010	3,430	(18,960)	1974/75	5th Loan
05		150 - 162	12		3-HF	1-HF	5,615	3,320	(27,540)		
08 0 06	(Assela = km 176)	162 - 176	14		3-HR	1-HR	5,010	3,430	(22,120)		
	DISTRICT 21 - ASMARA										
	Areza - Barentu										
17 0 06	(km 42 - 82 only)	42 - 82	40	New Const. - S.T.T.	--	6-MR	--	865	34,600	1974/75	D/L
	Teseney - Humera-Royan										
25 0 01		353 - 460	107		--	5-MFd	--	1,385	148,195		
02		460 - 468	8	New Const. - Feeder std.	--	5-MRd	--	1,290	10,320	1976/77	D/L with L.B.R.D.
25 0 03		468 - 485	17		--	5-MRd	--	1,290	21,930		
	DISTRICT 22 - GONDER										
	Azezo - Metema										
21 0 01	(Chelga = km 605)	545 - 605	60		--	6-HR	--	1,110	66,600	1973/74	
02		605 - 615	10		--	6-MRd	--	895	8,950		D/L with Armed Forces
03		615 - 625	10	New Const. - S.T.T. Std.	--	6-MMd	--	1,035	10,350	1974/75	
04	(Aykel = km 634)	625 - 634	9		--	6-MRd	--	895	8,055		
21 0 05	(Metema = km 745)	634 - 745	111		--	6-MRd	--	895	99,345		
	DISTRICT 23 - COMBOLCIA										
	Awash - Tendaho										
18 0 07	(Combolcia District Boundary = km 472)	472 - 477	5		--	1-DFd	--	1,785	8,925		
08		477 - 483	6		--	1-DRd	--	1,830	10,980		
09		483 - 491	8	New Const. - Paved Primary	--	1-DFd	--	1,785	14,280	1974/75	4th Loan
10		491 - 501	10		--	1-DRd	--	1,830	18,300		
18 0 11	(Jct. with Assab Rd-520)	501 - 520	19		--	1-DFd	--	1,785	33,915		
	DISTRICT 25 - DEBRE MARKOS										
	Bichena - Mota										
23 0 02		268 - 314	46	New Const. - Feeder	--	5-HR	--	1,630	74,980	1975/76	5th Loan
03		314 - 364	50		--	5-HR	--	1,630	81,500	1976/77	
	DISTRICT 26 - DIRE DAWA										
	Kuluti - Dengego										
04 0 33		465 - 495	30	Pave existing gravel	3-HR	1-HR	5,010	3,430	(47,400)	1977/78	6th Loan
	Babile - Fik										
04 7 01		0 - 21	21		--	6-MR	--	865	18,165		
02		21 - 40	19		--	6-MF	--	925	17,575		
03		40 - 47	7		--	6-DRd	--	805	5,635		
04		47 - 115	68	New Const. - S.T.T. Std.	--	6-DFd	--	870	59,160	1977/78	D/L
05		115 - 125	10		--	6-DRd	--	805	8,050		
06		125 - 130	5		--	6-DFd	--	870	4,350		
04 7 07		130 - 140	10		--	6-DRd	--	805	8,050		

Note: Awash River Bridge to Assela paving was added tentatively to the Fifth Highway Program in mid-August 1972. Its inclusion in the program increases the total kilometers of future revisions and additions of this Exhibit from 3311 to 3871 km. See Report Section III-A.

EXHIBIT III-E
(Continued)

Route and Segment Number	Route	Segment km to km	kms	Project Description	Old Maintenance Type (72)	New Type	Old Maintenance Cost/km	New Maintenance Cost/km	Net Annual Cost Change	1st Year Change	Funding
	DISTRICT 26 - DIRE DAWA (Continued)										
	Awash - Tendaho										
18 0 01	(Awash R. Br. = km 225)	225 - 240	15		--	1-MF	--	2,960	44,400	1973/74	4th Loan
02		240 - 375	135		--	1-DFd	--	1,785	240,975		
03		375 - 392	17		--	1-DFd	--	1,785	30,345		
04		392 - 397	5	New Const. - Paved Primary	--	1-DRd	--	1,830	9,150	1974/75	4th Loan
05		397 - 460	63		--	1-DFd	--	1,785	112,455		
06	(D. Dawa Dist. Bdry=km 472)	460 - 472	12		--	1-DRd	--	1,830	21,960		
	Jijiga - Ferfer										
30 0 02	(Degehbur = km 795)	795 - 800	5		--	6-DFd	--	870	4,350		
03		800 - 810	10		--	6-DRd	--	805	8,050		
04	(Shekosh = km 895)	810 - 895	85		--	6-DFd	--	870	73,950	1973/74	D/L
05	(Kebre Dehar = km 985)	895 - 985	90		--	6-DFd	--	870	78,300		
06	(Shelavo = km 1100)	985 - 1100	115	New Const. - S.T.T. std.	--	6-DFd	--	870	100,050		
07		1100 - 1140	40		--	6-DFd	--	870	34,800		
08		1140 - 1270	130		--	6-DRd	--	805	10,465	1977/78	D/L
30 0 09	(Ferfer = km 1280)	1270 - 1280	10		--	6-DFd	--	870	8,700		
	Gelemso - Mechara										
35 0 08		399 - 434	35		--	5-HR	--	1,630	57,050	1976/77	5th Loan
35 0 09		434 - 441	7	New Const. - Feeder std.	--	5-HM	--	1,735	12,145		
	DISTRICT 27 - SHASHAMANE										
	Awassa - Dilla										
06 0 06	(Awassa = km 276)	276 - 315	39		3-HR	1-HR	5,010	3,430	(61,620)		
07		315 - 333	18	Pave existing gravel	3-HR	1-HR	5,010	3,430	(28,440)	1977/78	6th Loan
08		333 - 370	37		3-HM	1-HM	4,830	3,660	(43,290)		
	Dilla - Moyale										
06 0 09	(Dilla = km 370)	370 - 395	25		--	1-HM	--	3,660	91,500		
10		395 - 402	7		--	1-HF	--	3,320	23,240		
11		402 - 411	9		--	1-HR	--	3,430	30,870		
12		411 - 446	35		--	1-HM	--	3,660	128,100	1974/75	4th Loan
13		446 - 459	13		--	1-HR	--	3,430	44,590		
14		459 - 467	8		--	1-HM	--	3,660	29,280		
15	(Agere Maryam = km 476)	467 - 476	9		--	1-HR	--	3,430	30,870		
16		476 - 486	10		--	1-MRd	--	3,105	31,050		
17		486 - 521	35		--	1-MRd	--	3,105	108,675		
18		521 - 557	36		--	1-DRd	--	1,830	65,880	1975/76	4th Loan
19	(Yabello = km 577)	557 - 577	20	New Const. - Paved surface	--	1-DFd	--	1,785	35,700		
20		577 - 582	5		--	1-DRd	--	1,830	9,150		
21		582 - 619	37		--	1-DFd	--	1,785	66,045		
22		619 - 627	8		--	1-DRd	--	1,830	14,640	1975/76	4th Loan
23		627 - 665	38		--	1-DFd	--	1,785	67,830		
24	(Mega = km 677)	665 - 677	12		--	1-DRd	--	1,830	21,960		
25		677 - 690	13		--	1-DRd	--	1,830	23,790		
26		690 - 747	57		--	1-DFd	--	1,785	101,745		
27		747 - 757	10		--	1-DRd	--	1,830	18,300	1976/77	4th Loan
28		757 - 763	6		--	1-DFd	--	1,785	10,710		
29	(Moyale = km 784)	763 - 784	21		--	1-DRd	--	1,830	38,430		

EXHIBIT III-E
(Concluded)

Route and Segment Number	Route	Segment km to km	kms	Project Description	Old Maintenance Type (72)	New Type	Old Maintenance Cost/km	New Maintenance Cost/km	Net Annual Cost Change	1st Year Change	Funding
	DISTRICT 27 - SHASHAMANE (Continued)										
	Assela - Dodola										
08 0 07	(Bekoji = km 230)	176 - 230	54		--	5-HR	--	1,630	88,020	1974/75	5th Loan
08		230 - 267	37		--	5-HR	--	1,630	60,310		
09		267 - 285	18	New Const. - Feeder std.	--	5-HF	--	1,725	31,050	1975/76	
10		285 - 290	5		--	5-HR	--	1,630	8,150		5th Loan
08 0 11	(Dodola = km 296)	290 - 296	6		--	5-HF	--	1,725	10,350		
	Robey - Ghinir										
08 0 29	(Jct. to Goba = km 452)	452 - 485	33		--	5-HF	--	1,725	56,925	1973/74	D/L
30	(Goro = km 512)	485 - 512	27		--	5-HR	--	1,630	44,010		
31		512 - 517	5		--	5-MF	--	1,360	6,800	1975/76	
32	(Sof Umer = km 552)	517 - 552	35	New Const. - Feeder std.	--	5-MR	--	1,260	44,100		D/L
33		552 - 567	15		--	5-MF	--	1,360	20,400	1976/77	
08 0 34	(Ghinir = km 592)	567 - 592	25		--	5-MR	--	1,260	31,500		D/L
	Butajira - Hosaina										
09 0 03	(Hosaina = km 237)	130 - 237	107	New Const. - secondary	--	3-HR	--	5,010	536,070	1975/76	D/L
	Butajira - L. Zuway										
09 1 01		130 - 160	30		--	5-HR	--	1,630	48,900	1974/75	
09 1 02	(L. Zuway = km 178)	160 - 178	18	New Const. - Feeder std.	--	5-HF	--	1,725	31,050		5th Loan
	Goba - Meslo										
36 0 01		465 - 555	90		--	6-HM	--	1,210	108,900	1977/78	
36 0 02		555 - 575	20	New Const. - S.T.T. std.	--	6-HR	--	1,110	22,200		D/L
	DISTRICT 28 - JIMMA										
	Ghibi R. Br. - Jimma										
07 0 10	(Jimma Prov. Bdry = km 183)	183 - 200	17		3-HM	1-HM	4,830	3,660	(19,890)		
11		200 - 240	40		3-HR	1-HR	5,010	3,430	(63,200)	1976/77	5th Loan
12		240 - 247	7	Paved existing gravel	3-HM	1-HM	4,830	3,660	(8,190)		
13		247 - 260	13		3-HR	1-HR	5,010	3,430	(20,540)		
14		260 - 279	19		3-HF	1-HF	5,615	3,320	(43,605)	1977/78	5th Loan
07 0 15	(Jimma = km 332)	279 - 332	53		3-HF	1-HF	5,615	3,320	(121,635)		
	Bonga - Mizan Teferi										
07 0 23	(Bonga = km 440)	485 - 498	13		--	5-HM	--	1,735	22,555		
24		498 - 506	8		--	5-HR	--	1,630	13,040	1975/76	
25		506 - 515	9	New Const. - Feeder std.	--	5-HM	--	1,735	15,615		5th Loan
26		515 - 521	6		--	5-HR	--	1,630	9,780		
07 0 27		521 - 564	43		--	5-HM	--	1,735	74,605	1977/78	5th Loan
	Jimma - Suntu										
37 0 01		332 - 392	60	New Const. - Feeder	--	5-HR	--	1,630	97,800	1973/74	D/L
	Agaro - Bedele - Metu										
43 0 03	(Agaro = km 378)	380 - 385	5		3-HR	1-HR	5,010	3,430	(7,900)		
04		385 - 405	20		3-HF	1-HF	5,615	3,320	(45,900)	1974/75	5th Loan
05		405 - 430	25		3-HM	1-HM	4,830	3,660	(29,250)		
06		430 - 445	15	Pave existing gravel	3-HF	1-HF	5,615	3,320	(34,425)		
07		445 - 455	10		3-HM	1-HM	4,830	3,660	(11,700)		
08		455 - 465	10		3-HF	1-HF	5,615	3,320	(22,950)	1975/76	5th Loan
09	(Bedele = km 480)	465 - 480	15		3-HR	1-HR	5,010	3,430	(23,700)		
10		480 - 521	41		--	1-HR	--	3,430	140,630		
11		521 - 531	10		--	1-HM	--	3,660	36,600		
12		531 - 541	10		--	1-HR	--	3,430	34,300		
13		541 - 557	16		--	1-HM	--	3,660	58,560	1973/74	4th Loan
14		557 - 565	8	New Const. - Paved primary	--	1-HR	--	3,430	27,440		
15		565 - 576	11		--	1-HM	--	3,660	40,260		
16		576 - 581	5		--	1-HR	--	3,430	17,150		
43 0 17	(Metu = km 597)	581 - 597	16		--	1-HR	--	3,430	54,880	1974/75	5th Loan
	Agaro - Ghira Gera										
43 1 01		0 - 48	48	New Const. - Feeder	--	5-HR	--	1,630	78,240	1976/77	5th Loan

EXHIBIT III-F

SELECT MATERIAL PITS

Route No.	Route and Local	Basic Formation	General Size Limits	Suitability for Surfacing: Rating	Suitability for Surfacing: Remarks	Record of Tests	Estimated Quantity (M^3)
DISTRICT 20 - ALEMGENA							
3	Addis Ababa - Fitche						
	km 80	Decomposed rock	1" plus	Poor	Oversize requires crushing	None	80,000 plus
5	Ambo - Bak						
	km 140	Decomposed rock	5" minus	Good	Oversize requires crushing	None	80,000 plus
	km 154	Decomposed rock	3" minus	Fair	Oversize requires crushing	None	80,000 plus
	km 158	Decomposed rock	3" minus	Fair	Oversize requires crushing	None	80,000 plus
	km 211	Decomposed rock	3" minus	Poor	Oversize requires crushing	None	80,000 plus
	km 228	Decomposed rock	3" minus	Poor	Oversize requires crushing	None	80,000 plus
	km 239	Decomposed rock	5" minus	Poor	Oversize requires crushing	None	80,000 plus
7	Addis Ababa - Ghibi R. Br.						
	km 128	Decomposed rock	5" to No. 40	Good	Oversize requires crushing - durable	None	Abundant
	km 168	Decomposed rock	5" to No. 40	Good	Oversize requires crushing - med. hard	None	Abundant
8	Nazreth - Assela						
	km 114	Decomposed rock	3" minus	Good	Oversize requires crushing	None	60,000
	km 143	Decomposed rock	3" minus	Poor	Oversize requires crushing	None	20,000
9	Alemgena - Kersa R. Br.						
	km 40	Red cinders	5" minus	Good	Oversize requires crushing	Tested	50,000
	km 50	Decomposed rock	3" minus	Fair	Oversize requires crushing	None	10,000
14	Tarmaber - Molale						
	km 26	Decomposed rock	5" minus	Poor	Oversize requires crushing	None	90,000
	km 28	Decomposed rock	5" minus	Good	Oversize requires crushing	None	80,000
	km 36	Decomposed rock	5" minus	Poor	Oversize requires crushing	None	90,000
	km 40	Decomposed rock	6" to 5" minus	Poor	Oversize requires crushing	None	90,000
	km 56	Decomposed rock	5" minus	Poor	Oversize requires crushing	None	90,000
	km 60	Decomposed rock	5" minus	Good	Oversize requires crushing	None	80,000
16	Ankober Road						
	km 10	Decomposed rock	5" minus	Good	Oversize requires crushing	None	80,000
	km 15	Decomposed rock	5" minus	Good	Oversize requires crushing	None	80,000
28	Tihur Road						
	km 30	Decomposed rock	1" minus	Good			80,000
	km 54	Decomposed rock	5" minus	Good	Oversize requires crushing		80,000

EXHIBIT III-F
(Continued)

Route No.	Route and Location	Basic Formation	General Size Limits	Suitability for Surfacing: Rating	Suitability for Surfacing: Remarks	Record of Testn	Estimated Quantity (M^3)
DISTRICT 21 - ASMARA							
11	Keren - Sebderat						
	km 142	Sedimentary rock	5" to No. 40	Fair	Oversize requires crushing - durable	None	10,000
	km 157	Sedimentary rock	1" to No. 80	Poor	Excess fines - not durable	None	15,000
	km 174	Sedimentary rock	1" to No. 40	Fair	Some excess fines - durable	None	20,000
	km 200	Sedimentary rock	1" to No. 80	Fair	Excess fines - durable	None	25,000
	km 243	River gravel	1" to No. 80	Fair	Dusty but stable	None	10,000
	km 285	River gravel	1" to No. 80	Fair	Dusty but stable	None	8,000
	km 310	Sedimentary soil	5" to No. 40	Fair	Oversize requires crushing - durable	None	10,000
	km 356	Sedimentary soil	1" to No. 80	Fair	Excess fines - durable	None	15,000
	km 379	River gravel	1" to No. 80	Fair	Excess fines - durable	None	20,000
17	Adi Ugri - Areza						
	km 12	Volcanic ash	5" to No. 40	Fair	Oversize requires crushing - durable	None	20,000
	km 21	Volcanic	3" to No. 40	Good	Oversize requires crushing - durable	None	100,000
	km 31	Volcanic rock	5" to No. 40	Good	Oversize requires crushing - durable	None	10,000
50	Decamere - Terramini						
	km 11	Sedimentary	1" to No. 80	Good	Deficient in fines	None	50,000
	km 15	Sedimentary	5" to No. 40	Fair	Oversize requires crushing - not durable	None	20,000
	km 21	Decomposed rock	3" to No. 40	Good	Oversize requires crushing - durable	None	50,000
DISTRICT 22 - GONDER							
3	Tekeze R. - Bahir Dar						
	km 410	Decomposed rock	6" to No. 40	Fair	Oversize requires crushing - not durable	None	35,000
	km 468	Decomposed rock	5" to No. 80	Fair	Oversize requires crushing - not durable	None	Unlimited
	km 564	Decomposed rock	5" to No. 40	Fair	Oversize requires crushing - not durable	None	20,000
	km 583	Decomposed rock	5" to No. 40	Good	Oversize requires crushing - durable	None	Unlimited
	km 626	Decomposed rock	5" to No. 40	Fair	Oversize requires crushing - not durable	None	Unlimited
	km 682	Decomposed rock	5" to No. 40	Fair	Oversize requires crushing - not durable	None	30,000

EXHIBIT III-F
(Continued)

Route No.	Route and Location	Basic Formation	General Size Limits	Suitability for Surfacing: Rating	Suitability for Surfacing: Remarks	Record of Tests	Estimated Quantity (M^3)
DISTRICT 23 - COMBOLCIA							
1	ba Bdry. - Combolcia						
	km 205	Decomposed rock	6" to 3/8"	Fair	Oversize requires crushing	None	250,000
	km 212	Decomposed rock	5" to 3/8"	Fair	Oversize requires crushing	None	400,000
	km 219	Decomposed rock	5" to 3/8"	Fair	Oversize requires crushing	None	200,000
	km 251	Decomposed rock	5" to No. 40	Fair	Oversize requires crushing	None	450,000
	km 256	Decomposed rock	5" to No. 40	Fair	Oversize requires crushing	None	290,000
	km 265	Decomposed rock	5" to No. 40	Fair	Oversize requires crushing	None	200,000
	km 295	Decomposed rock	5" to 3/8"	Fair	Oversize requires crushing	None	440,000
	km 312	Decomposed rock	5" to 3/8"	Fair	Oversize requires crushing	None	180,000
	km 328	Decomposed rock	5" to 3/8"	Fair	Oversize requires crushing	None	170,000
	km 337	Decomposed rock	5" to 3/8"	Fair	Oversize requires crushing	None	260,000
	km 347	Decomposed rock	1" to No. 80	Poor	Excess fines	None	520,000
	km 358	Decomposed rock	1" to No. 80	Poor	Excess fines	None	270,000
	km 371	Decomposed rock	5" to 3/8"	Fair	Oversize requires crushing	None	300,000
1	Tigre Bdry. - Combolcia						
	km 434	Decomposed rock	8" to 3/8"	Fair	Oversize requires crushing	None	355,000
	km 440	Decomposed rock	5" to 3/8"	Fair	Oversize requires crushing	None	220,000
	km 452	Decomposed rock	5" to 3/8"	Fair	Oversize requires crushing	None	390,000
	km 453	Decomposed rock	5" to 3/8"	Fair	Oversize requires crushing	None	490,000
	km 466	Decomposed rock	5" to 3/8"	Fair	Oversize requires crushing	None	200,000
	km 502	Decomposed rock	1" to No. 40	Good	Fair natural gradation	None	220,000
	km 506	Decomposed rock	1" to No. 40	Fair		None	230,000
	km 513	Decomposed rock	1/2" to No. 80	Fair	Gradation too fine	None	210,000
	km 520	Decomposed rock	1/2" to No. 40			None	200,000
	km 524	Decomposed rock	3/4" to No. 40	Fair		None	265,000
	km 530	Decomposed rock	1/2" to No. 80	Fair	Gradation too fine	None	270,000
	km 532	Decomposed rock	1/2" to No. 80	Fair	Gradation too fine	None	320,000
	km 537	Decomposed rock	1/2" to No. 80	Fair	Gradation too fine	None	250,000
	km 541	Decomposed rock	3/4" to No. 40	Fair	Gradation too fine	None	195,000
	km 552	Decomposed rock	3/4" to No. 40	Fair	Gradation too fine	None	360,000
	km 592	Decomposed rock	5" to No. 80	Fair	Oversize requires crushing	None	299,000
	km 595	Decomposed rock	5" to No. 40	Fair	Oversize requires crushing	None	375,000
	km 604	Decomposed rock	5" to 3/8"	Fair	Oversize requires crushing	None	300,000

EXHIBIT III-F
(Continued)

Route No.	Route and	Basic Formation	General Size Limits	Suitability for Surfacing: Rating	Suitability for Surfacing: Remarks	Record of Tests	Estimated Quantity (M^3)
	km 609	Decomposed rock	5" to No. 40	Fair	Oversize requires crushing	None	300,000
	km 614	Decomposed rock	5" to No. 40	Fair	Oversize requires crushing	None	270,000
	km 624	Decomposed rock	5" to No. 40	Fair	Oversize requires crushing	None	500,000
	km 627	Decomposed rock	5" to 3/8"	Fair	Oversize requires crushing	None	190,000
	km 637	Decomposed rock	6" to 3/8"	Fair	Oversize requires crushing	None	250,000
	km 642	Decomposed rock	6" to 3/8"	Fair	Oversize requires crushing	None	305,000
	km 650	Decomposed rock	6" to 3/8"	Fair	Oversize requires crushing	None	210,000
2	Combolcia - Mile						
	km 389	Decomposed rock	5" to 3/8"	Fair	Oversize requires crushing	None	270,000
	km 430	Decomposed rock	5" to 3/8"	Fair	Oversize requires crushing	None	240,500
	km 431	Decomposed rock	5" to 3/8"	Fair	Oversize requires crushing	None	190,000
	km 440	Decomposed rock	5" to 3/8"	Fair	Oversize requires crushing	None	400,000
	km 452	Decomposed rock	5" to 3/8"	Fair	Oversize requires crushing	None	200,000
	km 465	Decomposed rock	5" to 3/8"	Fair	Oversize requires crushing	None	375,000
	km 480	Decomposed rock	5" to 3/8"	Fair	Oversize requires crushing	None	260,000
	km 482	Decomposed rock	5" to 3/8"	Fair	Oversize requires crushing	None	310,000
	km 503	Decomposed rock	5" to 3/8"	Fair	Oversize requires crushing	None	295,000
	km 580	Volcanic	1/2" to No. 80	Good	Fair natural gradation	None	570,000
	km 621	Volcanic	1/2" to No. 80	Good	Fair natural gradation	None	485,000
DISTRICT 24 - ADIGRAT							
1	Eritrea Bdry. - Maychew						
	km 270	Volcanic	6" minus	Poor	Excessively plastic - not durable	None	At least 20,000
	km 296	Volcanic	5" to 1"	Fair	Non-plastic but not durable	None	At least 20,000
	km 307	Volcanic	6" minus	Fair	Oversize requires crushing	None	At least 20,000
	km 316	Volcanic	5" to 1"	Fair	Oversize requires crushing	None	At least 20,000
	km 365	Volcanic	1" to 3/8"	Fair	Oversize requires crushing	None	At least 20,000
	km 367	Volcanic	1" to 3/8"	Good		None	At least 20,000
	km 374	Volcanic	1" to 3/8"	Good		None	At least 20,000
	km 382	Volcanic	1" to 3/8"	Good		None	At least 20,000
	km 420	Volcanic	6" minus	Good	Oversize requires crushing	None	At least 20,000
	km 433	Volcanic	6" minus	Good	Oversize requires crushing	None	At least 20,000

EXHIBIT III-F
(Continued)

Route No.	Route and Location	Basic Formation	General Size Limits	Suitability for Surfacing: Rating	Suitability for Surfacing: Remarks	Record of Tests	Estimated Quantity (M^3)
3	Eritrea Bdry. - Tekeze R.						
	km 169	Volcanic	1" to 3/8"	Fair	Crushing not required	None	At least 20,000
	km 187	Volcanic	6" minus	Fair	Oversize requires crushing	None	At least 20,000
	km 196	Volcanic	1" to 3/8"	Fair	Crushing not required	None	At least 20,000
	km 206	Volcanic	5" to 1"	Fair	Oversize requires crushing	None	At least 20,000
	km 207	Decomposed rock	5" to No. 80	Good	Good gradation - durable	None	Unlimited
	km 221	Decomposed rock	6" to No. 40	Fair	Oversize requires crushing - not durable	None	30,000
15	Adi Abun - Adigrat						
	km 9	Volcanic	6" minus	Fair	Oversize requires crushing	None	At least 20,000
	km 11	Volcanic	6" minus	Fair	Oversize requires crushing	None	At least 20,000
	km 25	Volcanic	1" to 3/8"	Fair		None	At least 20,000
	km 39	Volcanic	5" to 1"	Fair	Oversize requires crushing	None	At least 20,000
	km 46	Volcanic	5" to 1"	Fair	Oversize requires crushing	None	At least 20,000
	km 56	Volcanic	1" to 3/8"	Fair	Oversize requires crushing	None	At least 20,000
	km 78	Volcanic	5" to 1"	Fair	Oversize requires crushing	None	At least 20,000
	km 84	Volcanic	5" to 1"	Fair	Oversize requires crushing	None	At least 20,000
	km 97	Volcanic	1" to 3/8"	Fair	Oversize requires crushing	None	At least 20,000
DISTRICT 25 - DEBRE MARKOS							
3	Dejen - Bahir Dar						
	km 255	Decomposed rock	5" to 1"	Good	Oversize requires crushing - durable	None	3,000
	km 310	River gravel	6" minus	Fair	Oversize requires crushing	None	2,500
	km 365	Decomposed rock	5" to 1"	Good	Oversize requires crushing - durable	None	20,000
	km 387	River gravel	5" to 1"	Fair	Oversize requires crushing	None	1,500
	km 445	Volcanic cinders	3/8" to No. 40	Fair	Oversize requires crushing	None	20,000
	km 492	Decomposed rock	5" to 1"	Good	Oversize requires crushing - durable	None	3,000
	km 545	Decomposed rock	5" to 1"	Good	Oversize requires crushing - durable	None	1,500
	km 554	Decomposed rock	5" to 1"	Good	Oversize requires crushing - durable	None	2,500
51	Bahir Dar - Tis Abat						
	km 20	Decomposed rock	5" to 1"	Good	Oversize requires crushing - durable	None	12,500

EXHIBIT III-F
(Continued)

Route No.	Route and Location	Basic Formation	General Size Limits	Suitability for Surfacing: Rating	Suitability for Surfacing: Remarks	Record of Tests	Estimated Quantity (M^3)
DISTRICT 26 - DIRE DAWA							
4	Avash R. - Jijiga						
	km 242	Decomposed rock	3" to 3/8"	Good	Oversize requires crushing - med. hard	None	40,000
	km 255	Decomposed rock	3" to 3/8"	Good	Oversize requires crushing - med. hard	None	10,000
	km 260	Decomposed rock	3" to 3/8"	Good	Oversize requires crushing - med. hard	None	10,000
	km 271	Decomposed rock	1" to 3/8"	Poor	Plastic - not durable	None	15,000
	km 276	Decomposed rock	2" to 3/8"	Good	Requires some crushing - med. hard	None	40,000
	km 278	Decomposed rock	5" to 1"	Good	Oversize requires crushing - med. hard	None	30,000
	km 285	Decomposed rock	3" to 1"	Poor	Plastic - not durable	None	10,000
	km 295	Decomposed rock	1" to 3/8"	Good	Generally good material - med. hard	None	1,000
	km 298	Decomposed rock	3/8" to No. 40	Fair	Mediocre material - med. soft	None	20,000
	km 314	Granite	Quarry stone	Good	Requires crushing - durable	None	100,000
	km 369	Basaltic rock	Quarry stone	Good	Requires crushing - durable	Tested	100,000
	km 427	Basaltic rock	Quarry stone	Good	Requires crushing - durable	Tested	100,000
	km 443	Decomposed rock	1/2" to 3/8"	Good	Suitable material - med. hard	None	20,000 plus
	km 448	Decomposed rock	1/2" to 3/8"	Good	Suitable material - med. hard	None	20,000
	km 449	Decomposed rock	1/2" to 3/8"	Good	Suitable material - med. hard	None	10,000
	km 472	Granite	Quarry stone	Good	Requires crushing - durable	Tested	Unlimited
	km 500	Decomposed rock	1/2" to 3/8"	Good	Select material - med. hard	Tested	20,000
	km 530	Decomposed rock	1/2" to 3/8"	Poor	Poor gradation - not durable	None	5,000
	km 623	Volcanic	3/8" to No. 40	Fair	Acceptable surfacing - not durable	None	20,000
	km 625	Decomposed rock	3/8" to No. 40	Poor	Unsuitable for surfacing - not durable	None	5,000
20	Mieso - Dire Dawa						
	km 314	Decomposed rock	1" to 3/8"	Good	Good select material - med. hard	None	20,000
	km 332	Decomposed rock	1" to 3/8"	Good	Good select material - med. hard	None	20,000
	km 336	Decomposed rock	1" to 3/8"	Good	Good select material - med. hard	None	40,000
	km 340	Metamorphic rock	Quarry stone	Good	Requires crushing - durable	None	100,000
	km 386	Decomposed rock	1/2" to 3/8"	Good	Good select material - med. hard	None	30,000
	km 392	Decomposed rock	3" to 3/8"	Good	Oversize requires crushing - med. hard	None	30,000
	km 395	Decomposed rock	3" to 3/8"	Good	Oversize requires crushing - med. hard	None	30,000
	km 406	Decomposed rock	3" to 3/8"	Good	Oversize requires crushing - med. hard	None	20,000

EXHIBIT III-F
(Continued)

Route No.	Route and Location	Basic Formation	General Size Limits	Suitability for Surfacing: Rating	Suitability for Surfacing: Remarks	Record of Tests	Estimated Quantity (M^3)
	km 410	Decomposed rock	2" to 3/8"	Good	Oversize requires crushing - med. hard	None	30,000
	km 413	Decomposed rock	2" to 3/8"	Good	Oversize requires crushing - med. hard	None	40,000
	km 425	Decomposed rock	2" to 3/8"	Good	Oversize requires crushing - med. hard	None	30,000
	km 434	Decomposed rock	1" to 3/8"	Poor	Excess plasticity - med. hard	None	40,000
	km 438	Decomposed rock	3/8" to No. 40	Good	Suitable for surfacing - med. hard	None	40,000
	km 441	Decomposed rock	3/8" to No. 40	Fair	Excess fines	None	20,000
35	Kuni - Gelemso						
	km 327	Decomposed rock	3" to 3/8"	Good	Oversize requires crushing - med. hard	None	20,000
	km 340	Decomposed rock	4" to 3/8"	Good	Oversize requires crushing - med. hard	None	40,000
	km 341	Decomposed rock	4" to 3/8"	Good	Oversize requires crushing - med. hard	None	20,000
	km 343	Decomposed rock	3" to 3/8"	Good	Oversize requires crushing - med. hard	None	30,000
	km 354	Decomposed rock	4" to 3/8"	Good	Oversize requires crushing - med. hard	None	30,000
	km 367	Decomposed rock	3" to 3/8"	Good	Oversize requires crushing - med. hard	None	30,000
	km 373	Decomposed rock	3" to 3/8"	Good	Oversize requires crushing - med. hard	None	30,000
	km 380	Decomposed rock	4" to 1"	--	Used only for base course at present		5,000

DISTRICT 27 - SHASHAMANE

No reply submitted to questionnaire. Information below in non-standard format was taken from undated prior report of the IHA files.

6 Shashamane - Dilla

km 315	Excellent open face. Soft stone which develops sufficient fines when crushed for gravel surface.
km 364	Select material pit. If properly opened a good, usable material can be obtained.

8 Dodola - Ghinir

km 351	Excellent select material pit, adjacent to the road.
km 398	Quarry for crushing and select. From km 410 to km 465 construction crews have used river gravel for surfacing.
km 465	Volcanic cinder pit.
km 497	Select material pit.

EXHIBIT III-F
(Concluded)

Route No.	Route and Location	Basic Formation	General Size Limits	Suitability for Surfacing: Rating	Suitability for Surfacing: Remarks	Record of Tests	Estimated Quantity (M^3)
9	Sodo - Arbaminch						
	km 265	Select material pit (volcanic cinders)					
	km 345	Select material pit					
40	Shashamane - Dodola						
	km 316	Select material pit. Very good material for gravel surface maintenance.					
	km 337	Select material pit. Usable for gravel road maintenance.					
41	Shashamane - Sodo						
	km 265	Select material pit (volcanic cinders)					
	km 345	Select material pit					
44	Wondo - Negele						
	km 367	Excellent select material pit.					
	km 403	Select material pit of decomposed rock. Excellent for gravel road maintenance.					
	km 515	Select material pit.					
	km 580	Excellent select material pit. Also suitable for crushing.					
	km 583	Excellent select material pit. Also suitable for crushing.					
DISTRICT 28 - JIMMA							
7	Ghibi R. Br. - Bonga						
	km 201	Decomposed rock	5" to No. 80	Good	Oversize requires crushing - durable	None	Abundant
	km 241	Decomposed rock	5" to No. 80	Good	Oversize requires crushing - med. hard	None	Abundant
	km 264	Decomposed rock	5" to No. 40	Good	Oversize requires crushing - durable	None	Abundant
	km 398	Limestone	8" to No. 40	Good	Oversize requires crushing - durable	None	Abundant
	km 424	Limestone	8" to No. 40	Good	Oversize requires crushing - durable	None	Abundant
	km 436	Limestone	5" to No. 40	Good	Oversize requires crushing - durable	None	Abundant

MAINTENANCE COST ESTIMATE

Road Type: 1-2 **Work Item No.:** A-1

Work Description:

Surface Patching. The preparation and filling of breaks and holes with pre-mixed material, including base repair if necessary, and skin patching and leveling with bitumen-aggregate applications. Limited edge rebuilding.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Labor Foreman	1	7	1.087	7.61
Equipment Operator II	1	7	1.887	13.21
Equipment Operator II	1	7	1.887	13.21
Equipment Operator II	1	1	1.887	1.89
Laborer II	3	21	0.611	12.84
Laborer I	6	42	0.415	17.46
			Sub-total	E$66.22

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Dump Truck, 6-7 cu. yd.	1	7	14.90	104.30
Asphalt Heater, Trailer	1	7	3.90	27.30
Roller, Steelwheels, 2-5 Ton	1	7	13.90	97.30
Front End Loader, 1 - 1-1/2 Cu. Yd.	1	7	16.80	117.60
			Sub-total	E$346.50

C. PURCHASED MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
Bitu. Prime Coat	ton	0.04	187.38	7.50
Bitu. Binder Coat	ton	0.6	187.38	112.43
			Sub-total	E$119.93

D. IHA PRODUCED MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
Crushed Cover Aggregate (3/8")	m^3	3.0	18.00	54.00
Premix Crushed Aggregate (1/2")	m^3	4.0	32.00	128.00
			Sub-total	E$182.00

Sub-Total; Labor, Equipment & Purchased Material	E$532.15
Distributed Overhead 21.1%	112.39
IHA Produced Material	182.00
Total Cost Per Crew-Day	E$827.04

MAINTENANCE COST ESTIMATE

Road Type: 3-4 **Work Item No.:** A-1a

Work Description:

Surface Maintenance. (Surface grading.) Shaping of the travelway and should area of gravel roads by motor grader.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Equipment Operator II	1	7	1.887	13.21
Helper II	1	7	0.899	6.29
			Sub-total	E$19.50

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Motor Grader	1	7	19.00	133.00
			Sub-total	E$133.00

C. MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
			Sub-total	E$0.00

Combined Total; Labor, Equipment & Materials	E$152.50
Distributed Overheads (21.1%)	E 32.18
Total Cost per Crew-Day	E$184.68

MAINTENANCE COST ESTIMATE

Road Type: 3-4 **Work Item No.:** A-1b

Work Description:

Surface maintenance. (spot-regraveling) The addition of processed select material to gravel road surfaces in limited quantities, as a part of routine maintenance.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Labor Foreman	1	7	1.087	7.61
Equipment Operator II	4	28	1.887	52.84
Equipment Operator II	1	7	1.887	13.21
			Sub-total	E$73.66

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Dump Truck, 6-7 Cu. Yd.	4	28	14.90	417.20
Front End Loader, 1 - 1-1/2 Cu. Yd.	1	7	16.80	117.60
			Sub-total	E$534.80

C. PURCHASED MATERIAL

None

D. IHA PRODUCED MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
Processed Select Material	m^3	200	9.67	1,934.00
			Sub-total	E$1,934.00

Sub-Total; Labor, Equipment & Purchased Material	E$ 608.46
Distributed Overhead (21.1%)	128.38
IHA Produced Material	1,934.00
Total Cost per Crew-Day	E$2,670.74

MAINTENANCE COST ESTIMATE

Road Type: 5-6 **Work Item No.:** A-1b

Work Description:

Surface Maintenance (spot-regraveling). The addition of processed select material to gravel road surfaces in limited quantities, as a part of routine maintenance.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Labor Foreman	1	7	1.087	7.61
Equipment Operator II	4	28	1.887	52.84
Equipment Operator II	1	7	1.887	13.21
			Sub-total	E$73.66

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Dump Truck, 6-7 Cu. Yd.	4	28	14.90	417.20
Front End Loader, 1 - 1-1/2 Cu. Yd.	1	7	16.80	117.60
			Sub-total	E$534.80

C. PURCHASED MATERIAL

None

D. IHA PRODUCED MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
Bank-run Select Material	m^3	200	2.26	452.00
			Sub-total	E$452.00

Sub-Total; Labor, Equipment & Purchased Material	E$ 608.46
Distributed Overhead (21.1%)	128.38
IHA Produced Material	452.00
Total Cost per Crew-Day	E$1,188.84

MAINTENANCE COST ESTIMATE

Road Type: 1-4 **Work Item No.:** A-2

Work Description:

Brush Control. The cutting of brush, weeds and high grass by hand with sickle or bush knife.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Laborer (Contracted)	10	70	0.163	11.41
Equipment Operator I	1	3	1.586	4.76
			Sub-total	E$16.17

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
2.5 Ton Truck	1	3	13.80	41.40
			Sub-total	E$41.40

C. MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
			Sub-total	E$0.00

Combined Total; Labor, Equipment & Materials	E$57.57
Distributed Overheads (21.1%)	12.14
Total Cost per Crew-Day	E$69.71

MAINTENANCE COST ESTIMATE

Road Type: 1-4 **Work Item No.:** A-3a

Work Description:

Culvert Maintenance (culvert cleaning). The removal of sediment and trash from culverts by hand, including inlets and outlets.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Mason Foreman	1	7	3.321	23.25
Laborer I	10	70	0.415	29.10
Equipment Operator I	1	2	1.586	3.17
			Sub-total	E$55.52

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
2.5 Ton Truck	1	2	13.80	27.60
			Sub-total	E$27.60

C. MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
			Sub-total	E$0.00

Combined Total; Labor, Equipment & Materials	E$ 83.12
Distributed Overheads (21.1%)	17.54
Total Cost per Crew-Day	E$100.66

MAINTENANCE COST ESTIMATE

Road Type: 1-4 **Work Item No.:** A-3b

Work Description:

Culvert Maintenance (culvert repair and replacement). Primarily the construction of mortar masonry to repair or replace failed culverts, headwalls, etc. Also, the equivalent cost to repair with other materials (e.g. concrete) or replace with round pipe culvert.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Mason II	1	7	2.226	15.58
Mason I	2	14	1.586	22.20
Laborer II	1	7	0.611	4.28
Laborer I	2	14	0.415	5.82
Laborer (Contracted)	2	14	0.163	2.28
Equipment Operator II	1	3	1.887	5.66
			Sub-total	E$55.82

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
2.5 Ton Truck	1	3	13.80	41.40
			Sub-total	E$41.40

C. MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
Cut Stone	m^3	5.0	5.65	28.25
Sand	m^3	1.0	5.70	5.70
Cement (50 kg/bag)	bag	3	4.25	12.75
			Sub-total	E$46.70

Combined Total; Labor, Equipment & Materials	E$143.92
Distributed Overheads (21.1%)	30.37
Total Cost per Crew-Day	E$174.29

MAINTENANCE COST ESTIMATE

Road Type: 1-6 **Work Item No.:** A-4a-1

Work Description:

Ditch & shoulder maintenance (primary ditch cleaning by grader)

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Equipment Operator II	1	7	1.887	13.21
Helper II	1	7	0.899	6.29
			Sub-total	E$19.50

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Motor Grader	1	7	19.00	133.00
			ıb-total	E$133.00

C. MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
			Sub-total	E$0.00

Combined Total; Labor, Equipment & Materials	E$152.50
Distributed Overheads (21.1%)	32.18
Total Cost per Crew-Day	E$184.68

MAINTENANCE COST ESTIMATE

Road Type: 1-6 **Work Item No.:** A-4a-2

Work Description:

Ditch & shoulder maintenance (primary ditch cleaning by hand)

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Labor Foreman	1	7	1.087	7.61
Laborer (Contracted)	10	70	0.163	11.41
Equipment Operator I	1	2	1.586	3.17
			Sub-total	E$22.19

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Dump Truck, 6-7 Cu. Yd.	1	2	14.90	29.80
			Sub-total	E$29.80

C. MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
			Sub-total	E$0.00

Combined Total; Labor, Equipment & Materials	E$51.99
Distributed Overheads (21.1%)	10.97
Total Cost per Crew-Day	E$62.96

MAINTENANCE COST ESTIMATE

Road Type: 1-6 **Work Item No.:** A-4b

Work Description:

Secondary Ditch, hand cleaning.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Labor Foreman	1	7	1.087	7.61
Laborer (Contracted)	10	70	0.163	11.41
Equipment Operator I	1	2	1.586	3.17
			Sub-total	E$22.19

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Dump Truck, 6-7 Cu. Yd.	1	2	14.90	29.80
			Sub-total	E$29.80

C. MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
			Sub-total	E$0.00

Combined Total; Labor, Equipment & Materials	E$51.99
Distributed Overheads (21.1%)	10.97
Total Cost per Crew-Day	E$62.96

MAINTENANCE COST ESTIMATE

Road Type: 1-2 **Work Item No.:** A-4c

Work Description:

Shoulder grading and addition of select material.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Equipment Operator II	1	7	1.887	13.21
Helper II	1	7	0.899	6.29
Labor Foreman	1	7	1.087	7.61
Equipment Operator II	5	35	1.887	66.05
Equipment Operator II	1	7	1.887	13.21
			Sub-total	E$106.37

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Motor Grader	1	7	19.00	133.00
Dump Truck, 6-7 Cu. Yd.	5	35	14.90	521.50
Front End Loader, 1 - 1-1/2 Cu. Yd.	1	7	16.80	117.60
			Sub-total	E$772.10

C. PURCHASED MATERIAL

None

D. IHA PRODUCED MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
Pit-Run Select Material	m^3	300	2.26	678.00
			Sub-total	E$678.00

Sub-Total, Labor, Equipment & Purchased Material	E$ 878.47
Distributed Overhead (21.1%)	185.36
IHA Produced Material	678.00
Total Cost per Crew-Day	E$1,741.83

MAINTENANCE COST ESTIMATE

Road Type: 1-2 **Work Item No.:** B-1a and b

Work Description:

Asphalt Surface Maintenance (seal coating)

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Construction Foreman II	1	7	3.623	25.36
Labor Foreman	1	7	1.087	7.61
Equipment Operator III	1	7	2.226	15.58
Helper II	1	7	0.899	6.29
Equipment Operator III	1	7	2.226	15.58
Helper II	1	7	0.899	6.29
Equipment Operator II	4	28	1.887	52.84
Equipment Operator II	2	14	1.887	26.42
Equipment Operator II	1	7	1.887	13.21
Laborer I	10	70	0.415	29.05
			Sub-total	E$198.23

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Asphalt Distributor	1	7	25.60	179.20
Asphalt Relay Truck	1	7	23.90	167.30
Dump Truck, 6-7 Cu. Yd.	4	28	14.90	417.20
Roller, Steel Wheel, 2-5 Ton	2	14	13.90	194.60
Front End Loader, 1 - 1-1/2 Cu. Y	1	7	16.80	117.60
Aggregate Spreader, Push Type	1	7	8.18	56.70
			Sub-total	E$1,132.60

C. PURCHASED MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
Bituminous Binder Coat	Ton	8.05	187.38	1,508.41
			Sub-total	E$1,508.41

D. IHA PRODUCED MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
Crushed Cover Aggregate (3/8")	m^3	55	18.00	990.00
			Sub-total	E$990.00

Sub-Total; Labor, Equipment & Purchased Material	E$2,839.24
Distributed Overhead (21.1%)	599.08
IHA Produced Material	990.00
Total Cost per Crew-Day	E$4,428.32

MAINTENANCE COST ESTIMATE

Road Type: 1-2 **Work Item No.:** B-1b

Work Description:

Asphalt surface maintenance (leveling course only)

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Construction Foreman II	1	7	3.623	25.36
Labor Foreman	1	7	1.087	7.61
Equipment Operator III	1	7	2.226	15.58
Helper II	1	7	0.899	6.29
Equipment Operator III	1	7	2.226	15.58
Helper II	1	7	0.899	6.29
Equipment Operator II	4	28	1.887	52.84
Equipment Operator II	2	14	1.887	26.42
Equipment Operator II	1	7	1.887	13.21
Laborer I	10	70	0.415	29.05
Equipment Operator II	2	14	1.887	26.42
			Sub-total	E$224.65

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Asphalt Distributor	1	7	25.60	179.20
Asphalt Relay Truck	1	7	23.90	167.30
Dump Truck, 6-7 Cu. Yd.	4	28	14.90	417.20
Roller, Steelwheels, 2-5 Ton	2	14	13.90	194.60
Front End Loader, 1 - 1-1/2 Cu.Yd.	1	7	16.80	117.60
Motor Grader	2	14	19.00	266.00
			Sub-total	E$1,341.90

C. PURCHASED MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
Bituminous Binder Coat	Ton	3.46	329.54	1,122.90
Bituminous Prime Coat	Ton	6.3	187.38	1,180.49
			Sub-total	E$2,303.39

D. IHA PRODUCED MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
Premix Crushed Aggregate (1/2")	m^3	59.54	15.00	893.10
			Sub-total	E$893.10

Sub-Total, Labor, Equipment & Purchased Material	E$3,869.04
Distributed Overhead (21.1%)	816.58
IHA Produced Material	893.10
Total Cost per Crew-Day	E$5,579.72

MAINTENANCE COST ESTIMATE

Road Type: 1-2 **Work Item No.:** B-2

Work Description:

Shoulder Reconstruction. The reconstruction of shoulders and outer fill slopes, primarily by tractor-dozer, in special circumstances.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Equipment Operator II	1	7	1.887	13.21
			Sub-total	E$13.21

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Dozer, D-7	1	7	30.70	214.90
			Sub-total	E$214.90

C. MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
			Sub-total	E$0.00

Combined Total; Labor, Equipment & Materials	E$228.11
Distributed Overheads (21.1%)	48.13
Total Cost per Crew-Day	E$276.24

MAINTENANCE COST ESTIMATE

Road Type: 5-6 **Work Item No.:** B-1

Work Description:

Gravel Resurfacing. (Base & Surface) The replacement of gravel surfacing at intervals of several years, with watering and rolling.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Construction Foreman II	1	7	3.623	25.36
Labor Foreman	1	7	1.087	7.61
Equipment Operator II	8	56	1.887	105.67
Equipment Operator II	2	14	1.887	26.42
Equipment Operator II	2	14	1.887	26.42
Equipment Operator II	2	14	1.887	26.42
Equipment Operator II	2	14	1.887	26.42
Laborers I	10	70	0.415	29.05
			Sub-total	E$273.37

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Dump Truck, 6-7 Cu. Yd.	8	56	14.90	834.40
Motor Grader	2	14	19.00	266.00
Water Truck, 1,500 Gal.	2	14	23.90	334.60
Front End Loader, 1 - 1-1/2 Cu. Yd.	2	14	16.80	235.20
Roller, Steel Wheels, 8-10 Ton	2	14	21.80	305.20
			Sub-total	E$1,975.40

C. PURCHASED

None

D. IHA PRODUCED MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
Bank-Run Select Material	m^3	385	2.26	870.10
			Sub-total	E$870.10

Sub-Total; Labor, Equipment & Purchased Material	E$2,248.77
Distributed Overhead (21.1%)	474.50
IHA Produced Material	870.10
Total Cost per Crew-Day	E$3,593.37

MAINTENANCE COST ESTIMATE

Road Type: 3-4 **Work Item No.:** B-1

Work Description:

Gravel Resurfacing (base & surface). The replacement of gravel surfacing at intervals of several years, with watering and rolling.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Construction Foreman II	1	7	3.623	25.36
Labor Foreman	1	7	1.087	7.61
Equipment Operator II	8	56	1.887	105.67
Equipment Operator II	2	14	1.887	26.42
Equipment Operator II	2	14	1.887	26.42
Equipment Operator II	2	14	1.887	26.42
Equipment Operator II	2	14	1.887	26.42
Laborers I	10	70	0.415	29.05
			Sub-total	E$273.37

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Dump Truck, 6-7 Cu. Yd.	8	56	14.90	834.40
Motor Grader	2	14	19.00	266.00
Water Truck, 1,500 Gal.	2	14	23.90	334.60
Front End Loader, 1 - 1-1/2 Cu. Yd.	2	14	16.80	235.20
Roller, Steel Wheels, 8-10 Ton	2	14	21.80	305.20
			Sub-total	E$1,975.40

C. PURCHASED MATERIAL

None

D. IHA PRODUCED MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
Processed Select Material	m^3	385	9.67	3,722.95
			Sub-total	E$3,722.95

Sub-Total; Labor, Equipment & Purchased Material	E$2,248.77
Distributed Overhead (21.1%)	474.50
IHA Produced Material	3,722.95
Total Cost per Crew-Day	E$6,446.22

MAINTENANCE COST ESTIMATE

Road Type: 1-4 **Work Item No.:** Special

Work Description:

Slide Removal. The emergency removal of slides on the road or replacement of failed embankment sections, as required.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Labor Foreman	1	7	1.087	7.61
Equipment Operator II	1	7	1.887	13.21
Equipment Operator II	1	7	1.887	13.21
Equipment Operator II	2	14	1.887	26.42
Equipment Operator II	1	7	1.887	13.21
Laborer (Contracted)	4	28	0.163	4.56
		Sub-total		E$78.22

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Dozer, D-7	1	7	30.70	214.90
Front End Loader, 1-1-1/2 cu. yd.	1	7	16.80	117.60
Dump Truck, 6-7 cu. yd.	2	14	14.90	208.60
Motor Grader	1	7	19.00	133.00
		Sub-total		E$674.10

C. MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
		Sub-total		E$ 0.00

Combined Total; Labor, Equipment & Materials	E$752.32
Distributed Overheads (21.1%)	E$158.74
Total Cost per Crew-Day	E$911.06

MAINTENANCE COST ESTIMATE

Road Type: 1-4 **Work Item No.:** Special

Work Description:

Flood Damage. The repair of roadway sections damaged by floods, as required.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Labor Foreman	1	7	1.087	7.61
Equipment Operator II	1	7	1.887	13.21
Equipment Operator II	1	7	1.887	13.21
Equipment Operator II	2	14	1.887	26.42
Equipment Operator II	1	7	1.887	13.21
Laborers (Contracted)	4	28	0.163	4.56
			Sub-total	E$78.22

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Dozer, D-7	1	7	30.70	214.90
Motor Grader	1	7	19.00	133.00
Dump Truck, 6-7 cu. yd.	2	14	14.90	208.60
Front End Loader, 1-1-1/2 cu. yd.	1	7	16.80	117.60
			Sub-total	E$674.10

C. PURCHASED MATERIAL None

D. IHA PRODUCED MATERIAL

	Units	Units Required	Cost per Unit	Total Cost
Pit-run Select Material	m^3	150	2.26	339.00
			Sub-total	E$339.00

Sub-total; Labor, Equipment & Purchased Material	E$752.32
Distributed Overhead (21.1%)	158.74
IHA Produced Material	339.00
Total Cost per Crew-Day	E$1,250.06

MAINTENANCE COST ESTIMATE

Road Type: X **Work Item: Special**

Work Description:

Intermittent maintenance of earth roads. Track-shaping by motor grader, including minimal addition of local borrow and minor rehabilitation of drainage.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Labor Foreman	1	7	1.087	7.61
Equipment Operator II	1	7	1.887	13.21
Equipment Operator II	1	7	1.887	13.21
Helper II	1	7	0.899	6.29
Laborer (Contracted)	6	42	0.163	6.85
			Sub-total	E$47.17

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Motor Grader	1	7	19.00	133.00
Dump-Truck 6-7 cu. yd.	1	7	14.90	104.30
			Sub-total	E$237.30

Combined Total (Labor & Equipment)	E$284.47
Distributed Overheads (21.1%)	62.87
Total Cost per Crew-Day	E$347.34

MAINTENANCE COST ESTIMATE

Road Type: Y **Work Item:** Special

Work Description:

Intermittent maintenance of earth roads. Track-shaping by crawler tractor, including minimal addition of local borrow and minor rehabilitation of drainage.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Labor Foreman	1	7	1.087	7.61
Equipment Operator II	1	7	1.887	13.21
Equipment Operator II	1	7	1.887	13.21
Laborer (Contracted)	6	42	0.163	6.85
			Sub-total	E$40.88

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Dozer - D-7	1	7	30.70	214.90
Dump Truck 6-7 Cu. Yd.	1	7	14.90	104.30
			Sub-total	E$319.20

Combined Total (Labor & Equipment)	E$360.08
Distributed Overheads (21.1%)	75.98
Total Cost per Crew-Day	E$436.06

MAINTENANCE COST ESTIMATE (Including Desert Allowance)

Road Type: 1-2 **Work Item No.:** A-1

Work Description:

Surface Patching. The preparation and filling of breaks and holes with pre-mixed material, including base repair if necessary, and skin patching and leveling with bitumen-aggregate applications. Limited edge rebuilding.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Postion	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Labor Foreman	1	7	1.357	9.50
Equipment Operator II	1	7	2.357	16.50
Equipment Operator II	1	7	2.357	16.50
Equipment Operator II	1	7	2.357	16.50
Laborer II	3	21	0.764	16.05
Laborer I	6	42	0.519	21.80
			Sub-total	E$96.85

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Dump Truck, 6-7 Cu. Yd.	1	7	14.90	104.30
Asphalt Heater, Trailer	1	7	3.90	27.30
Roller, Steel Wheels, 2-5 Ton	1	7	13.90	97.30
Front End Loader, 1 - 1-1/2 Cu. Yd.	1	7	16.80	117.60
			Sub-total	E$346.50

C. PURCHASED MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
Bitu. Prime Coat	Ton	0.04	187.38	7.50
Bitu. Binder Coat	Ton	0.6	187.38	112.43
			Sub-total	E$119.93

D. IHA PRODUCED MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
Crush Cover Aggregate (3/8")	m^3	3.0	18.00	54.00
Premix Crushed Aggregate (1/2")	m^3	4.0	32.00	128.00
			Sub-total	E$182.00

Sub-Total; Labor, Equipment & Purchased Material	E$563.28
Distributed Overhead (21.1%)	118.85
IHA Produced Material	182.00
Total Cost per Crew-Day	E$864.13

MAINTENANCE COST ESTIMATE (Including Desert Allowance)

Road Type: 3-4 **Work Item No.:** A-1a

Work Description:

Surface Maintenance (Surface Grading). Shaping of the travelway and shoulder area of gravel roads by motor grader.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Equipment Operator II	1	7	2.357	16.50
Helper II	1	7	1.103	7.72
			Sub-total	E$24.22

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Motor Grader	1	7	19.00	133.00
			Sub-total	E$133.00

C. MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
			Sub-total	E$0.00

Combined Total; Labor, Equipment & Materials	E$157.22
Distributed Overheads (21.1%)	33.17
Total Cost per Crew-Day	E$190.39

MAINTENANCE COST ESTIMATE (Including Desert Allowance)

Road Type: 3-4 Work Item No.: A-1b

Work Description:

Surface Maintenance (Spot-regraveling). The addition of processed select material to gravel road surfaces in limited quantities, as a part of routine maintenance.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Labor Foreman	1	7	1.357	9.50
Equipment Operator II	4	28	2.357	66.00
Equipment Operator II	1	7	2.357	16.50
			Sub-total	E$92.00

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Dump Truck, 6-7 Cu. Yd.	4	28	14.90	417.20
Front End Loader, 1 - 1-1/2 Cu. Yd.	1	7	16.80	117.60
			Sub-total	E$534.80

C. PURCHASED MATERIAL None

D. IHA PRODUCED MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
Pit-Run Cru. Sel. Material	m^3		9.67	1,934.00
			Sub-total	E$1,934.00

Sub-Total; Labor, Equipment & Purchased Material	E$ 626.80
Distributed Overhead (21.1%)	132.25
IHA Produced Material	1,934.00
Total Cost per Crew-Day	E$2,693.05

MAINTENANCE COST ESTIMATE (Including Desert Allowance)

Road Type: 1-4 **Work Item No.:** A-2

Work Description:

Brush Control. The cutting of brush, weeds and high grass by hand with sickle or bush knife.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Laborer (Contracted)	10	70	0.163	11.41
Equipment Operator I	1	3	1.980	5.94
			Sub-total	E$17.35

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Flat Bed Truck	1	3	13.80	41.40
			Sub-total	E$41.40

C. MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
			Sub-total	E$0.00

Combined Total; Labor, Equipment & Materials	E$58.75
Distributed Overheads (21.1%)	12.39
Total Cost per Crew-Day	E$71.14

MAINTENANCE COST ESTIMATE (Including Desert Allowance)

Road Type: 1-4 **Work Item No.:** A-3a

Work Description:

Culvert Maintenance (culvert cleaning). The removal of sediment and trash from culverts by hand, including inlets and outlets.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Mason Foreman	1	7	4.149	29.04
Laborer I	10	70	0.519	36.33
Equipment Operator I	1	2	1.980	3.96
			Sub-total	E$69.33

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Flat Bed Truck	1	2	13.80	27.60
			Sub-total	E$27.60

C. MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
			Sub-total	E$0.00

Combined Total; Labor, Equipment & Materials	E$ 96.93
Distributed Overheads (21.1%)	20.45
Total Cost per Crew-Day	E$117.38

MAINTENANCE COST ESTIMATE (Including Desert Allowance)

Road Type: 1-4 **Work Item No.:** A-3b

Work Description:

Culvert Maintenance (culvert repair and replacement). Primarily the construction of mortar masonry to repair or replace failed culverts, headwalls, etc. Also, the equivalent cost to repair with other materials (e.g. concrete) or replace with round pipe culvert.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Mason II	1	7	2.781	19.47
Mason I	2	14	1.980	27.72
Laborer II	1	7	0.764	5.35
Laborer I	2	14	0.519	7.27
Laborer (Contracted)	2	14	0.163	2.28
Equipment Operator II	1	3	2.357	7.07
			Sub-total	E$69.16

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Flat Bed Truck	1	3	13.80	41.40
			Sub-total	E$41.40

C. MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
Cut Stone	m^3	5.0	5.65	28.25
Sand	m^3	1.0	5.70	5.70
Cement (50 kg/bag)	bag	3	4.25	12.75
			Sub-total	E$46.70

Combined Total; Labor, Equipment & Material	E$157.26
Distributed Overheads (21.1%)	33.18
Total Cost per Crew-Day	E$190.44

MAINTENANCE COST ESTIMATE (Including Desert Allowance)

Road Type: 1-6 **Work Item No.:** A-4a-1

Work Description:

Ditch & shoulder maintenance (primary ditch cleaning by grader).

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Equipment Operator II	1	7	2.357	16.50
Helper II	1	7	1.103	7.72
			Sub-total	E$24.22

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Motor Grader	1	7	19.00	133.00
			Sub-total	E$133.00

C. MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
			Sub-total	E$0.00

Combined Total; Labor, Equipment & Materials	E$157.22
Distributed Overheads (21.1%)	33.17
Total Cost per Crew-Day	E$190.39

MAINTENANCE COST ESTIMATE (Including Desert Allowance)

Road Type: 1-6 **Work Item No.:** A-4a-2

Work Description:

Ditch & shoulder maintenance (primary ditch cleaning by hand).

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Labor Foreman	1	7	1.357	9.50
Laborer (Contracted)	10	70	0.163	11.41
Equipment Operator I	1	2	1.980	3.96
			Sub-total	E$24.87

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Dump Truck, 6-7 Cu. Yd.	1	2	14.90	29.80
			Sub-total	E$29.80

C. MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
			Sub-total	E$0.00

Combined Total; Labor, Equipment & Materials	E$54.67
Distributed Overheads (21.1%)	11.53
Total Cost per Crew-Day	E$66.20

MAINTENANCE COST ESTIMATE (Including Desert Allowance)

Road Type: 1-6 Work Item No.: A-4b

Work Description:

Secondary Ditch hand cleaning.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Labor Foreman	1	7	1.357	9.50
Laborer (Contracted)	10	70	0.163	11.41
Equipment Operator I	1	2	1.980	3.96
			Sub-total	E$24.87

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Dump Truck, 6-7 Cu. Yd.	1	2	14.90	29.80
			Sub-total	E$29.80

C. MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
			Sub-total	E$0.00

Combined Total; Labor, Equipment & Materials	E$54.67
Distributed Overheads (21.1%)	11.54
Total Cost per Crew-Day	E$66.21

MAINTENANCE COST ESTIMATE (Including Desert Allowance)

Road Type: 1-2 **Work Item No.:** A-4c

Work Description:

Shoulder grading and addition of select material.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Equipment Operator II	1	7	2.357	16.50
Helper II	1	7	1.103	7.72
Labor Foreman	1	7	1.357	9.50
Equipment Operator II	5	35	2.357	82.50
Equipment Operator II	1	7	2.357	16.50
			Sub-total	E$132.72

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Motor Grader	1	7	19.00	133.00
Dump Truck, 6-7 Cu. Yd.	5	35	14.90	521.50
Front End Loader, 1 - 1-1/2 Cu. Yd.	1	7	16.80	117.60
			Sub-total	E$772.10

C. PURCHASED MATERIAL

None

D. IHA PRODUCED MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
Pit-Run Select Material	m^3	300	2.26	678.00
			Sub-total	E$678.00

Sub-Total; Labor, Equipment & Purchased Material	E$	904.82
Distributed Overhead (21.1%)		190.92
IHA Produced Material		678.00
Total Cost per Crew-Day		E$1,773.74

MAINTENANCE COST ESTIMATE (Including Desert Allowance)

Road Type: 1-2 **Work Item No.:** B-1a and b

Work Description:

Asphalt Surface Maintenance (seal coating)

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Construction Foreman I	1	7	3.300	23.10
Labor Foreman	1	7	1.357	9.50
Equipment Operator III	1	7	2.781	19.47
Helper II	1	7	1.103	7.72
Equipment Operator III	1	7	2.781	19.47
Helper II	1	7	1.103	7.72
Equipment Operator II	4	28	2.357	66.00
Equipment Operator II	2	14	2.357	33.00
Equipment Operator II	1	7	2.357	16.50
Laborer I	10	70	0.519	36.33
			Sub-total	E$238.81

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Asphalt Distributor	1	7	25.60	179.20
Asphalt Relay Truck	1	7	23.90	167.30
Dump Truck, 6-7 Cu. Yd.	4	28	14.90	417.20
Roller, Steelwheel, 2-5 Ton	2	14	13.90	194.60
Front End Loader, 1 - 1-1/2 Cu. Yd.	1	7	16.80	117.60
Aggregate Spreader, Push	1	7	8.10	56.70
			Sub-total	E$1,132.60

C. PURCHASED MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
Bituminous Binder Coat	Ton	8.05	187.38	1,504.41
			Sub-total	E$1,504.41

D. IHA PRODUCED MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
Crushed Cover Aggregate (3/8")	m^3	55	18.00	990.00
			Sub-total	E$990.00

Sub-Total; Labor, Equipment & Purchased Material	E$2,879.82
Distributed Overhead (21.1%)	607.64
IHA Produced Material	990.00
Total Cost per Crew-Day	E$4,477.46

MAINTENANCE COST ESTIMATE (Including Desert Allowance)

Road Type: 1-2 **Work Item No.:** B-1b

Work Description:

Asphalt surface maintenance (leveling course).

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Cost per Hour E$	Total Cost E$
Construction Foreman I	3.300	23.10
Labor Foreman	1.357	9.50
Equipment Operator III	2.781	19.47
Helper II	1.103	7.72
Equipment Operator III	2.781	19.47
Helper II	1.103	7.72
Equipment Operator II	2.357	66.00
Equipment Operator II	2.357	33.00
Equipment Operator II	2.357	16.50
Laborer I	0.517	36.19
Equipment Operator II	2.357	33.00
	Sub-total	E$271.67

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Asphalt Distributor	1	7	25.60	179.20
Asphalt Relay Truck	1	7	23.90	167.30
Dump Truck, 6-7 Cu. Yd.	4	28	14.90	417.20
Roller, Steelwheels, 2-5 Ton	2	14	13.90	194.60
Front End Loader, 1 - 1-1/2 Cu. Yd.	1	7	16.80	117.60
Motor Grader	2	14	19.00	266.00
			Sub-total	E$1,341.90

C. PURCHASED MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
Bituminous Binder Coat	Ton	3.16	324.54	1,122.90
Bituminous Prime Coat	Ton	6.3	187.38	1,180.49
			Sub-total	E$2,303.39

D. IHA PRODUCED MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
Premix Crushed Aggregate (1/2")	m^3	59.54	15.00	893.10
			Sub-total	E$893.10

Sub-Total; Labor, Equipment & Purchased Material	E$3,916.96
Distributed Overhead (21.1%)	826.48
IHA Produced Material	893.10
Total Cost per Crew-Day	E$5,636.54

MAINTENANCE COST ESTIMATE (Including Desert Allowance)

Road Type: 1-2 **Work Item No.:** B-2

Work Description:

Shoulder Reconstruction. The reconstruction of shoulders and outer fill slopes, primarily by tractor-dozer, in special circumstances.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Equipment Operator II				16.50
				E$16.50

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Dozer, DC-7	1	7	30.70	214.90
			Sub-total	E$214.90

C. MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
			Sub-total	E$0.00

Combined Total; Labor, Equipment & Materials	E$231.40
Distributed Overheads (21.1%)	48.83
Total Cost per Crew-Day	E$280.23

MAINTENANCE COST ESTIMATE (Including Desert Allowance)

Road Type: 3-4 **Work Item No.:** B-1

Work Description:

Gravel Resurfacing (base and surface). The replacement of gravel surfacing at intervals of several years, with watering and rolling.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Construction Foreman II	1	7	4.526	31.68
Labor Foreman	1	7	1.357	9.50
Equipment Operator II	8	56	2.357	132.00
Equipment Operator II	2	14	2.357	33.00
Equipment Operator II	2	14	2.357	33.00
Equipment Operator II	2	14	2.357	33.00
Equipment Operator II	2	14	2.357	33.00
Laborers I	10	70	0.519	36.33
			Sub-total	E$341.51

B. EQUIPMENT

Description	Required	Hrs/Day	Hour E$	Total Cost E$
Dump Truck, 6-7 Cu. Yd.	8	56	14.90	834.40
Motor Grader	2	14	19.00	266.00
Water Truck, 1,500 Gal.	2	14	23.90	334.60
Front End Loader, 1 - 1-1/2 Cu. Yd.	2	14	16.80	235.20
Roller, Steelwheels, 8-10 Ton	2	14	21.80	305.20
			Sub-total	E$1,975.40

C. PURCHASED MATERIAL

None

D. IHA PRODUCED MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
Pit-Run Cru. Sel. Material	m^3	385	9.67	3,722.95
			Sub-total	E$3,722.95

Sub-Total; Labor, Equipment & Purchased Material	E$2,316.91
Distributed Overhead (21.1%)	488.86
IHA Produced Material	3,722.95
Total Cost per Crew-Day	E$6,528.72

MAINTENANCE COST ESTIMATE (Including Desert Allowance)

Road Type: 1-4 Work Item No.: Special

Work Description:

Flood Damage. The repair of roadway sections damaged by floods, as required.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Labor Foreman	1	7	1.357	9.50
Equipment Operator II	1	7	2.357	16.50
Equipment Operator II	1	7	2.357	16.50
Equipment Operator II	2	14	2.357	33.00
Equipment Operator II	1	7	2.357	16.50
Laborer (Contracted)	4	28	0.163	4.56
			Sub-total	E$96.56

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Dozer, DC-5	1	7	30.70	214.90
Motor Grader	1	7	19.00	133.00
Dump Truck, 6-7 cu. yd.	2	14	14.90	208.60
Front End Loader, 1 - 1-1/2 cu. yd.	1	7	16.80	117.60
			Sub-total	E$674.10

C. PURCHASED MATERIAL None

D. IHA PRODUCED MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
Pit-Run Select Material	m^3	150	2.26	339.00
			Sub-total	E$339.00

Sub-Total; Labor, Equipment & Purchased Material	E$ 770.66
Distributed Overhead (21.1%)	162.61
IHA Produced Material	339.00
Total Cost per Crew-Day	E$1,272.27

MAINTENANCE COST ESTIMATE (Including Desert Allowance)

Road Type 1-4 **Work Item No.:** Special

Work Description:

Slide Removal. The emergency removal of slides on the road or replacement of failed embankment sections, as required.

RESOURCES AND COST REQUIRED PER CREW - DAY

A. LABOR

Position	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Labor Foreman	1	7	1.357	9.50
Equipment Operator II	1	7	2.357	16.50
Equipment Operator II	1	7	2.357	16.50
Equipment Operator II	2	14	2.357	33.00
Equipment Operator II	1	7	2.357	16.50
Laborer (Contracted)	4	28	0.163	4.56
			Sub-total	E$96.56

B. EQUIPMENT

Description	Number Required	Total Hrs/Day	Cost per Hour E$	Total Cost E$
Dozer, DC-5	1	7	30.70	214.90
Front End Loader, 1 - 1-1/2 cu.yd.	1	7	16.80	117.60
Dump Truck, 6-7 cu.yd.	2	14	14.90	208.60
Motor Grader	1	7	19.00	133.00
			Sub-total	E$674.10

C. MATERIAL

Description	Units	Units Required	Cost per Unit	Total Cost
			Sub-total	E$0.00

Combined Total; Labor, Equipment & Materials	E$770.66
Distributed Overheads (21.1%)	162.61
Total Cost per Crew-Day	E$933.27

A basic system of accounts classification for the IHA maintenance program should first identify by code the District, Sub-District if any, and other organizational subdivision, such as the present Maintenance Section.

The classification system should next indicate the class of road, as Primary/Secondary (separately if necessary), Feeder Standard or Service to Traffic.

Finally, the basic identification should include the surface type: Bituminous; Gradation-controlled Gravel; or Pit-Run Gravel.

A. Classification

Within these fundamental classifications the major and minor functional activities should be given, with the following recommended structure:

1. Routine Maintenance
   - a. Roadway Surface
   - b. Shoulders and Side Approaches
   - c. Ditches, Culverts and Slopes
   - d. Bridges and Structures
2. Periodic Maintenance
   - a. Roadway Surface
   - b. Shoulders and Side Approaches
3. Traffic Service
   - a. Signs and Markers
   - b. Guard Rails
   - c. Other
4. Special Maintenance
5. Emergency Maintenance

EXHIBIT XV-1
(Continued)

The foregoing major and minor functional activities would be defined as follows:

1. Routine Maintenance

a. Roadway Surface

Labor, labor additives, expenses of material and supplies, equipment rental, and other costs incurred in the keeping of the roadway in the condition to which it was originally constructed or improved under normal condition, such as; patching holes, rough spots, breaks and ravelled edges; blotting bleeding spots and spot sealing; blading, reshaping, scarifying, minor replacement of granular material; other normal upkeep of roadway surface or base.

b. Shoulders and Side Approaches

Labor, labor additives, expenses of material and supplies, equipment rental and other costs for the repair and maintenance of shoulders and side approaches, such as: patching, blading, rolling, filling ruts, replacing of washouts (minor) and other reshaping work; replacing, repairing sub-drains on shoulders; replacement in kind of shoulder surface; seeding, sodding for erosion control.

c. Ditches Culverts and Slopes

Labor, labor additives, expenses of material and supplies, equipment rental and other costs for drainage control and slope treatment, such as: clearing, entrenching all drains, ditches, channels or culverts; repair and other maintenance of rip rap and paved ditches; seeding, reseeding, control of ground cover and roadside growth; repairing and trimming of cuts, fills, slopes, washouts, retaining walls and removal of minor slides to restore the original design shape.

EXHIBIT XV-1
(Continued)

d. Bridges and Channels

Labor, labor additives, expense of material and supplies, equipment rental and other costs for cleaning, painting, inspection and repair of bridges (all components) and ford structures.

2. Periodic Maintenance

a. Roadway Surface

Labor, labor additives, expenses of material and supplies, equipment rental and other costs associated with such as: reprocessing of bituminous surfaces including additional bituminous material and aggregate; application of seal coat surfaces; removal and replacement of unsatisfactory base material, other stabilization of base section to conform to original design standard; major rehabilitation and replacement of granular material sections of roadway surface; other special surface or base repair.

b. Shoulders and Side Approaches

Labor, labor additives, expenses of material and supplies, equipment rental and other costs related to such as: trenching out shoulder sections and replacement in kind of shoulder base and surface; major rehabilitation of side approaches, including surface replacement in kind.

3. Traffic Services

a. Signs and Markers

Labor, labor additives, expenses of materials and supplies, equipment rental and other costs for providing traffic control services such as: painting of pavement surface marking; replacement, repair and maintenance of signs and markers; repair and maintenance of highway lighting, traffic signals and control devices.

b. Guard Rail

Labor, labor additives, expenses of materials and supplies, equipment rental and other costs for such as: repair and maintenance, including replacement in kind of guard rails, exclusive of structure parts.

4. Special Maintenance

Labor, labor additives, expenses of materials and supplies, equipment rental and other costs identified by maintenance project account established for replacement of minor washouts and removal of minor slides which occur in a repetitive pattern (excludes major remedial measures required to prevent reoccurrence of washouts and slides at repetitive pattern locations).

5. Emergency Maintenance

Labor, labor additives, expenses of material and supplies, equipment rental, contract and other costs associated with unusual or disaster operations, such as: cleaning and restoration to original design standards of roadway surfaces and base, road beds, shoulders, road sides, drainage facilities, structures, traffic controls and service signs and control devices damaged or destroyed by flood, storm, fire, earthquakes, major slides or other catastrophies (excludes major relocation of roadways and structures).

B. Cost Components of Major and Minor Functional Activities

1. Personal service charges for time on the job, for daily contract labor and monthly employees, including desert allowances.

2. Indirect personal service additives for such as vacation, sick leave, workmen's compensation, subsistence and terminal pay.

EXHIBIT XV-1
(Concluded)

3. Undistributed labor, supervision and allocation of district overhead expenses.

4. Major material charges, including factors for transportation, warehousing and handling for such items as bitumen, cement, crushed aggregate, sand, culvert pipe, and road signs acquired by contract purchase or through IHA production control centers. Minor materials and small tools charges based on a computed factor to direct labor hours.

Equipment rental charges including computed or estimated factors for preventive maintenance and repair, fuel, lubricants, servicing, and depreciation.

ECONOMICS APPENDIX

Section 1.0

DERIVATION OF VEHICLE OPERATING COST

1.1 The following paragraphs describe in detail the derivation of the financial and economic vehicle operating cost (VOC) used in this study.

1.2 Determination of Vehicle Life

Exhibit 1.1 lists the final cost to the purchasers of the major classes of vehicles that are currently used in Ethiopia. Since the GRS effort, costs have risen appreciably due to higher factory prices, increasing transportation costs and increased customs duties. The increased purchase price and hence the increased annual depreciation cost is a major reason for increased VOC's during the past 5 years.

Exhibit 1.2 provides the assumed vehicle speeds on the different surface types in Ethiopia. No attempt was made to reflect changing VOC's with speed on a particular surface as it was not considered relevant to the ranking process. Reduction in speed due to congestion is not a common experience in Ethiopia and this factor has not been considered. The VOC's for these base speeds are modified later to reflect topography.

Exhibit 1.3 illustrates the annual and lifetime usage indices of vehicles on different surfaces. Exclusive vehicle use on a paved surface assumes a 100 percent life. The life of vehicles is assumed to be 70 percent on gravel roads and 40 percent of the normal life on earth surfaces.

1.3 Vehicle Utilization

Based upon these relationships between vehicle life and surface, Exhibit 1.4 shows the annual and lifetime usage of the prevailing vehicle types in Ethiopia. The truck lives given here are shorter than those estimated by the GRS. It was found in discussion with the National Transport Company (NATRACO) that the longer vehicle lives

EXHIBIT 1.1 VEHICLE PURCHASE PRICE (E$)

	10-Ton Truck	Trailer	7-Ton Truck	Large Bus	Small Bus	Large Bus	Small Car
List Price	42,400	19,200	22,950	92,850	31,600	11,800	7,150
Average Discount	2%	-	2%	2%	2%	2.5%	-
Sales Tax	831	384	446	1,820	619	238	150
Purchase Price	43,684	20,284	23,800	95,800	32,600	12,140	7,300

Source: Dealer Interviews

EXHIBIT 1.2 ASSUMED VEHICLE SPEEDS*(KM/HR)

Surface Type	Cars	Trucks & Buses
Paved	75	65
Gravel	64	56
Earth	40	35

EXHIBIT 1.3 LIFE INDICES*

Paved	100 Percent
Gravel	70 Percent
Earth	40 Percent

*General Road Study.

EXHIBIT 1.4 VEHICLE USAGE

Vehicle Type	Paved Surface	Gravel Surface	Earth Surface
Truck-Trailer Combination			
a. Truck			
Life, years	10	7	7
Annual usage, km	50,000	50,000	28,500
Lifetime usage	500,000	350,000	200,000
b. Trailer			
Life, years	18	14	13
Annual usage, km	55,000	48,700	30,000
Lifetime usage	975,000	682,500	390,000
10-Ton Truck			
Life, years	12	10	7
Annual usage, km	40,000	33,600	27,400
Lifetime usage	480,000	336,000	192,000
7-Ton Truck			
Life, years	10	7	7
Annual usage, km	40,000	40,000	22,800
Lifetime usage	400,000	280,000	160,000
Large Bus			
Life, years	14	12	11
Annual usage, km	45,000	38,000	23,600
Lifetime usage	650,000	455,000	260,000
Small Bus			
Life, years	11	9	8
Annual usage, km	50,000	43,000	27,000
Lifetime usage	550,000	385,000	220,000
Large Car			
Life, years	8	7	6
Annual usage, km	20,000	16,000	10,700
Lifetime usage	160,000	112,000	64,000
Small Car			
Life, years	6	5	4.5
Annual usage, km	20,000	17,000	10,600
Lifetime usage	120,000	84,000	48,000

were assumed on the Addis-Asseb route and that the lives implied a high level of maintenance which is not practiced by all truck operators. The annual usage figures were revised downward as a result of these interviews. The lives of the vehicles were also changed, because it became evident that, although a truck may still be physically in existence, it is for all practical purposes completely rebuilt at the end of a somewhat shorter period than that provided by the GRS. The normal maintenance costs as determined by interviews did not reflect the costs of this complete rebuilding; rather NATRACO assumed a shorter life with normal maintenance and a scrap value at the end of a certain period. The lives shown here are based on zero scrap value.

1.4 Fuel and Oil Consumption

Through interviews, the fuel and oil consumption rates for the vehicle types as defined in the GRS were confirmed as being correct. These consumption figures have not been verified by specific study in Ethiopia. Therefore, it was necessary after the initial verification to adopt the consumption figures and indices for surface types as they were presented in the GRS. These figures are shown in Exhibits 1.5, 1.6, and 1.7.

1.5 Tires and Tubes

Interviews confirmed the overall findings of the GRS concerning the life of tires. No new research or study into the life of tires in Ethiopia could be found. The lives used in determining the vehicle operating costs are shown in Exhibit 1.8. The prices of tires have increased during the past 4 years and this increase is reflected in Exhibit 1.9. These prices were determined by contacting tire dealers in Addis Ababa. It seems relevant to note that vehicle life in Ethiopia in relation to vehicle life as stated in East Africa Transport Study was considered high, while tire life was much lower. As tires are a good index of wear and tear on a vehicle it seems evident that vehicle life in Ethiopia was overstated in previous work.

EXHIBIT 1.5 FUEL CONSUMPTION ON PAVED SURFACES (KM/LITER)

Vehicle Type	Fuel Consumption
Truck Trailer	2.5
10-Ton Truck	3.9
7-Ton Truck	5.0
Large Bus	3.9
Small Bus	5.0
Large Car	9.6
Small Car	12.4

EXHIBIT 1.6 COMPARATIVE INDICES

Paved	100
Gravel	87-90
Earth	60-65

EXHIBIT 1.7 ASSUMED FUEL CONSUMPTION ON DIFFERENT SURFACES (KM/LITER)

Vehicle Type	Paved	Gravel	Earth
Truck-Trailer	2.5	2.2	1.5
10-Ton Truck	3.9	3.4	2.3
7-Ton Truck	5.0	4.3	3.0
Large Bus	3.9	3.4	2.3
Small Bus	5.0	4.3	3.0
Large Car	9.6	8.[illegible]	6.2
Small Car	12.4	11.2	8.1

EXHIBIT 1.8 TIRE AND TUBE LIFE (KILOMETERS)

Vehicle Type	Paved	Gravel	Earth
Trucks & Buses	35,000	31,500	17,500
Trailers	40,000	36,000	20,000
Large Cars	36,000	32,000	18,000
Small Cars	30,000	27,000	15,000

Indices: Paved - 100, Gravel - 90, Earth - 50.

EXHIBIT 1.9 PRICES FOR VEHICLE TIRES (E$)

Vehicle Type	Price Per Tire	Number Required	Cost Per Set
Truck/Trailer	540	7	3,780
10-Ton Truck	540	9	4,860
7-Ton Truck	270	7	1,890
Large Bus	540	7	3,780
Small Bus	160	7	1,120
Large Car	80	5	400
Small Car	51	5	255

Source: Dealer Interviews.

EXHIBIT 1.10 ANNUAL WAGES, DRIVER AND ASSISTANT (E$)

Truck-Trailer	6,600
10-Ton Truck	5,000
Small Truck	4,000
Large Bus	7,000
Small Bus	2,600

1.6 Wages

Exhibit 1.10 shows the wages that are currently being paid to the drivers and assistants of the various types of commercial vehicles. In general, wages have increased only slightly during the past 4 years. Possibly, this can be attributed to the truck fleet over-capacity that was found to exist by the GRS and the resulting competitive situation. As a cross-check on wage increases, the IHA payroll for skilled labor was examined and it was found that wages in most categories had remained stable. During the interviews with the bus and truck operators it was found that a wide range of salaries were paid for specific positions. The answers provided by the larger companies were used as a guide, as these companies tend to be more stable in their employment and more careful in calculating their expenses, to remain competitive.

1.7 Maintenance and Repair Costs

This expense is one of the largest unknowns in the calculation of vehicle operating costs. Large trucking companies such as NATRACO tend to perform much periodic maintenance which gives their vehicles longer lives and higher annual costs. Individual operators perform their own maintenance and use rebuilt or used parts. Bus companies tend to keep maintenance records for the entire fleet of all sizes of buses. The GRS experience concerning the collection of data pertaining to maintenance was repeated without any more concrete results.

Generally it was found that operators considered the GRS maintenance costs for truck-trailers to be too low. This was partially due to the increase in the price of vehicle parts. However, the practice of assuming 12 percent of the value of the 10-ton truck for maintenance was not followed as this resulted in a very high, unvalidated, annual maintenance cost. For 10 and 7-ton trucks, the reported maintenance costs appeared to be closer to 10 percent of the value. The maintenance costs of large and small buses and of cars were also adjusted upwards to compensate for the increase in the cost of parts. This upward adjustment is largely arbitrary as no records were found which indicate

the value of periodic, routine or extraordinary maintenance of any class of vehicle, let alone the breakdown of parts and labor for a specific vehicle class. Exhibit 1.11 illustrates the maintenance costs for all vehicle types.

The difference in maintenance costs due to road surface type road is reflected in the indices developed by the GRS. These indices are shown below:

	Cars	Trucks/Buses
Paved surface	100	100
Gravel surface	130	140
Earth surface	200	250

1.8 Registration and Inspection Fees

Exhibit 1.12 provides the current registration and inspection fees that are in force. These fees have changed only slightly during the past 4 years.

1.9 Vehicle Insurance

The Road Transport Administration recently completed an extensive analysis of insurance in Ethiopia, with the general conclusion that there are no prevailing insurance practices among commercial operators of vehicles. There seems to be an infinite variety of insurance packages and associated costs. Large truck fleet operators that were contacted provided insurance figures on new trucks that were purchased on terms. There is no indication of the amount of insurance that an individual operator carries, or if any insurance is in force at all. The Consultants were faced with an intensive investigation of insurance practices in Ethiopia. As the GRS survey canvassed insurance companies and was unable to come up with anything better than a good guess, the only other line of investigation was to sample truck and bus operators. It was felt that the time and effort involved in such an effort would be of insufficient value since insurance costs are a relatively

EXHIBIT 1.11 MAINTENANCE COSTS PER YEAR (E$)

	E$ Per Year
Truck-Trailer	7,500
10-Ton Truck	4,000
7-Ton Truck	2,200
Large Bus	4,000
Small Bus	2,200
Large Car	500
Small Car	300

EXHIBIT 1.12 REGISTRATION AND INSPECTION FEES FOR SELECTED VEHICLES (E$)

Vehicle Type	Annual Vehicle Inspection	Annual Registration Fee	Total Annual Fees
10-Ton Truck	15	223	237
12-Ton Trailer	15	97	112
7-Ton Truck	15	200	215
Large Bus	15	190	205
Small Bus	8	85	93
Large Car	4	40	44
Small Car	4	40	44

EXHIBIT 1.13 VEHICLE INSURANCE

Vehicle Type	Annual	Life
Truck-Trailer	4,000	10,525
Trailer	265	1,025
10-Ton Truck	4,120	9,500
7-Ton Truck	1,200	8,300
Large Bus	1,500	32,180
Small Bus	-	12,200
Large Car	800	2,400
Small Car	340	1,200

Source: General Road Study.

small percentage (2 to 4 percent) of the total vehicle operating costs. Even more important is the fact that the cost-benefit analysis and ranking procedure will utilize the shadow vehicle operating cost. This cose, by definition, does not include such expenses as insurance and license and inspection fees. Exhibit 1.13 provides the insurance costs.

1.10 Actual Operating Costs by Surface Type

Based on the above data, VOC's were developed for each of the vehicle types for each of the surface types. The results of these calculations are shown in Exhibits 1.14, 1.15, 1.16, 1.17, 1.18, 1.19 and 1.20. Also shown on these exhibits are the fixed and variable costs associated with each surface type. In the subsequent discussion, the VOC of the vehicle types due to the gradient will be calculated.

1.11 Vehicle Operating Costs Adjusted for Gradient

For the purpose of determining both the road maintenance costs and the VOC it was necessary to develop a general grouping of grades which could be used to reflect the changing costs. The groupings shown below are generally accepted as being representative classifications for costing purposes.

Flat terrain	0-3 percent gradients
Rolling terrain	3-5 percent gradients
Mountainous terrain	over 5 percent gradients

The gradient factors shown in Exhibit 1.21 were adopted after discussions as to their validity with the IHA planners and truck operators. These gradient factors were applied to the variable cost elements for each vehicle type on each surface. The variable costs include fuel, oil, tires and tubes, and maintenance.

The vehicle operating costs were then adjusted for the gradient classes by multiplying the variable cost portion of the VOC by the gradient factor and adding back the fixed VOC. Exhibit 1.22 shows the VOC for each vehicle on the different surfaces and terrain classes.

EXHIBIT 1.14 22-TON TRUCK-TRAILER ACTUAL OPERATING COSTS (E¢/KM)

Cost Element	Paved Surface ¢	Paved Surface %	Gravel Surface ¢	Gravel Surface %	Earth Surface ¢	Earth Surface %
Depreciation	10.8	12.1	15.5	14.6	27.0	14.9
Interest at 9 Percent	5.6	6.3	5.8	5.5	9.8	5.4
Fuel	17.0	19.1	19.3	18.2	28.3	15.6
Oil	1.7	1.9	2.1	2.0	3.5	1.9
Tires and Tubes	22.9	25.7	25.5	24.0	45.9	25.3
Wages	13.2	14.8	13.2	12.4	23.1	12.7
Maintenance & Repair	15.0	16.8	21.0	20.0	37.0	20.4
Insurance	2.0	2.2	3.1	2.9	5.4	3.0
License & Inspection	0.7	0.8	0.7	0.6	1.1	0.6
Total Costs	89.1		106.2		181.2	
Variable Costs	56.6		67.9		114.7	
Fixed Costs	32.5		38.3		66.5	

EXHIBIT 1.15 10-TON TRUCK ACTUAL OPERATING COST (E¢/KM)

Cost Element	Paved Surface ¢	Paved Surface %	Gravel Surface ¢	Gravel Surface %	Earth Surface ¢	Earth Surface %
Depreciation	9.1	14.6	13.0	16.9	22.7	18.9
Interest	4.9	7.9	5.8	7.5	7.1	5.9
Fuel	10.9	17.5	12.5	16.2	18.5	15.5
Oil	1.2	1.9	1.5	1.9	2.3	19.2
Tires and Tubes	10.8	17.3	12.0	15.6	21.6	18.0
Wages	12.5	20.1	14.9	19.3	18.2	15.2
Maintenance & Repair	10.0	16.0	14.0	18.2	25.0	20.9
Insurance	2.4	3.8	2.8	3.6	3.5	3.0
License & Inspection	0.5	0.8	0.6	1.8	0.8	0.7
Total Costs	62.3		77.1		119.7	
Variable Costs	32.9		40.0		67.4	
Fixed Costs	29.4		37.1		52.3	

EXHIBIT 1.16 7-TON TRUCK ACTUAL OPERATING COST (E¢/KM)

Cost Element	Paved Surface ¢	Paved Surface %	Gravel Surface ¢	Gravel Surface %	Earth Surface ¢	Earth Surface %
Depreciation	5.9	14.3	8.5	17.3	14.9	17.4
Interest	2.7	6.5	2.7	5.5	4.7	5.6
Fuel	8.5	20.6	9.9	20.1	14.2	12.0
Oil	0.8	1.9	1.0	2.0	1.6	1.9
Tires and Tubes	5.4	13.1	6.0	12.2	10.8	12.9
Wages	10.0	24.2	10.0	20.3	17.5	20.9
Maintenance & Repair	5.5	13.3	7.7	15.6	13.7	16.4
Insurance	2.0	4.8	2.9	5.9	5.2	6.2
License & Inspection	0.5	1.2	0.5	1.0	0.9	1.1
Total Costs	41.3		49.2		83.5	
Variable Costs	20.2		24.6		40.3	
Fixed Costs	21.1		24.6		43.2	

EXHIBIT 1.17 LARGE BUS ACTUAL OPERATING COST (E¢/KM)

Cost Element	Paved Surface ¢	Paved Surface %	Gravel Surface ¢	Gravel Surface %	Earth Surface ¢	Earth Surface %
Depreciation	14.7	19.0	21.0	21.6	36.8	22.5
Interest	9.6	12.4	11.3	11.6	18.3	11.2
Fuel	10.9	14.1	12.5	12.9	18.5	11.3
Oil	1.5	1.9	1.9	1.9	3.2	1.9
Tires and Tubes	10.8	14.0	12.0	12.3	21.6	13.2
Wages	15.5	20.1	18.4	18.9	29.7	18.1
Maintenance & Repair	8.9	11.5	12.5	12.9	22.2	13.6
Insurance	4.9	6.3	7.0	7.2	12.4	7.6
License & Inspection	0.4	0.5	0.5	0.5	0.9	0.5
Total Costs	77.2		97.1		163.6	
Variable Costs	32.1		38.9		65.5	
Fixed Costs	45.1		58.2		98.1	

EXHIBIT 1.18 SMALL BUS ACTUAL OPERATING COST (E¢/KM)

Cost Element	Paved Surface ¢	Paved Surface %	Gravel Surface ¢	Gravel Surface %	Earth Surface ¢	Earth Surface %
Depreciation	5.9	17.8	8.5	20.4	14.8	21.6
Interest	2.9	8.7	3.4	8.1	5.4	8.6
Fuel	8.5	25.6	9.9	23.7	14.2	20.7
Oil	1.7	2.1	0.8	1.9	1.3	1.9
Tires and Tubes	3.2	9.6	3.6	8.6	6.4	9.3
Wages	5.2	15.7	6.0	1.4	9.6	14.0
Maintenance & Repair	4.4	13.2	6.1	14.6	11.0	16.0
Insurance	2.2	6.6	3.2	7.7	5.5	8.0
License & Inspection	0.2	0.6	0.2	0.5	0.3	0.4
Total Costs	33.2		41.7		68.5	
Variable Costs	16.8		20.4		32.9	
Fixed Costs	15.4		21.3		35.6	

EXHIBIT 1.19 LARGE CAR ACTUAL OPERATING COST (E¢/KM)

Cost Element	Paved Surface ¢	Paved Surface %	Gravel Surface ¢	Gravel Surface %	Earth Surface ¢	Earth Surface %
Depreciation	7.6	27.0	10.8	39.4	19.0	42.7
Interest	2.7	12.7	3.4	12.4	5.1	11.5
Fuel	5.2	24.5	5.8	21.2	8.0	16.0
Oil	0.4	1.9	0.5	1.8	0.9	2.0
Tires and Tubes	1.1	5.2	1.2	4.4	2.2	4.9
Maintenance & Repair	2.5	11.8	3.2	11.7	5.0	11.3
Insurance	1.5	7.1	2.1	7.7	3.8	8.6
License & Inspection	0.2	0.9	0.3	1.1	0.4	0.9
Total Costs	21.2		27.4		44.4	
Variable Costs	9.2		10.7		16.1	
Fixed Costs	12.0		16.7		28.3	

EXHIBIT 1.20 SMALL CAR ACTUAL OPERATING COST (E¢/KM)

Cost Element	Paved Surface ¢	Paved Surface %	Gravel Surface ¢	Gravel Surface %	Earth Surface ¢	Earth Surface %
Depreciation	6.1	39.3	8.7	43.7	15.2	46.5
Interest	1.6	10.3	1.9	9.5	3.1	9.5
Fuel	4.0	25.8	4.5	22.6	6.2	19.0
Oil	0.3	1.9	0.4	2.0	0.6	1.8
Tires & Tubes	0.8	5.2	0.9	4.5	1.7	5.2
Maintenance & Repair	1.5	9.7	1.9	9.5	3.0	9.2
Insurance	1.0	6.5	1.4	7.0	2.5	7.6
License & Inspection	0.2	1.3	0.2	1.0	0.4	1.2
Total Costs	15.5		19.9		32.7	
Variable Costs	6.6		7.7		11.5	
Fixed Costs	8.9		12.2		21.2	

EXHIBIT 1.21 ASSUMED GRADIENT FACTOR

Vehicle Type	Terrain		
	Flat	Rolling	Mountainous
Cars	1.0	1.1	1.35
7-Ton Truck and Small Bus	1.1	1.5	2.15
10-Ton Truck and Large Bus	1.2	1.6	2.50
22-Ton Truck-Trailer	1.5	2.4	3.70

EXHIBIT 1.22 VEHICLE OPERATING COSTS ON PAVED, GRAVEL, AND EARTH SURFACES (E¢/KM)

Terrain	22-Ton Tr./Tr.	10-Ton Truck	7-Ton Truck	Large Bus	Small Bus	Large Car	Small Car
Paved Surfaces							
Flat, Straight	89.1	62.3	41.3	77.2	33.2	21.2	15.5
Flat	117.4	68.9	43.3	83.6	33.9	21.2	15.5
Rolling	168.1	82.0	51.4	96.5	40.6	22.1	16.2
Mountainous	241.9	111.7	64.5	125.4	51.5	24.4	17.8
Gravel Surfaces							
Flat, Straight	106.2	77.1	49.2	97.1	41.7	27.4	19.9
Flat	140.1	85.1	51.6	104.9	43.7	27.4	19.9
Rolling	201.3	101.1	61.5	120.4	51.9	28.5	20.7
Mountainous	289.5	137.1	77.5	155.4	65.1	31.1	22.6
Earth Surfaces							
Flat, Straight	181.2	119.7	83.5	163.6	68.5	44.4	32.7
Flat	238.5	133.2	87.5	176.7	71.8	44.4	32.7
Rolling	341.8	160.1	103.6	202.9	84.9	46.0	33.8
Mountainous	490.9	220.8	129.8	261.8	106.3	50.0	36.7

1.12 The Effects of Surface Condition on VOC

It is now possible to revise the VOC's to reflect the surface condition. Again a literature search was conducted to determine whether any significant analysis of surface condition on VOC had been undertaken recently. Due to the numerous road surface classifications it was necessary to determine costs for a wide range of surface conditions. As the road theoretically deteriorates, an annual rise in VOC must be calculated. The literature search revealed nothing which would be useful in determining VOC on specific surfaces as the road condition worsened. Most literature is limited to the basic surface types and no analysis indicating VOC's on excellent, good, fair, poor, and bad surfaces was found. As the study required that all the present and adopted IHA road systems be classified into surface condition both for maintenance and VOC cost purposes, it was decided to scale the VOC linearly between surface types. This is probably not the actual case but the derivation of the true curve for numerous conditions would entail a lengthy field survey and sampling analysis effort beyond the available time. For paved surfaces, the following four standards are used:

Condition 1: Operating costs assumed to be "normal" for paved surfaces.

Condition 2: Normal operating costs plus one-third of the difference between normal costs on gravel and asphalt.

Condition 3: Normal operating costs plus two-thirds of the difference between normal costs on gravel and asphalt.

Condition 4: Operating costs on gravel surfaces.

These levels are directly related to the condition ratings described in report Section IV.

Gravel surfaces have a more non-linear deterioration than asphalt surfaces; therefore, seven conditions were adopted. In reality the surface passes through the first condition rather quickly if the road is neglected. After that, the deterioration is more linear until the gravel surface becomes equivalent to an earth surface, or nearly so. The various conditions used are as follows.

Condition 1: Operating costs equivalent to normal gravel operating costs.

Condition 2: Normal gravel operating costs plus one-sixth of the difference between normal cost on gravel and earth.

Condition 3: Normal gravel operating cost plus one-third the difference between gravel and earth.

Condition 4: Normal gravel operating cost plus one-half the difference between gravel and earth.

Condition 5: Normal gravel operating costs plus two-thirds of the difference between gravel and earth.

Condition 6: Normal gravel operating costs plus five-sixths of the difference between gravel and earth.

Condition 7: Operating costs equivalent to normal operating costs on earth surfaces.

No attempt was made to classify degrees of surface condition on earth roads. No earth surfaces are contained in the present or proposed IHA system of roads, with minor exceptions.

Exhibits 1.23 and 1.24 illustrate the costs of operating the various vehicle types on different surfaces with different gradients for each kind of surface.

EXHIBIT 1.23 VEHICLE OPERATING COSTS BY ROAD CONDITION AND TOPOGRAPHY (E¢/KM) (PAVED ROADS)

		Vehicle Type						
Terrain	Highway Standard	Truck-Trailer	10-Ton Truck	7-Ton Truck	Large Bus	Small Bus	Large Car	Small Car
Flat	1	117.4	68.9	43.3	83.6	33.9	21.2	15.5
	2	125.0	74.3	46.1	90.7	37.2	23.3	17.0
	3	132.5	79.7	48.8	97.8	40.4	25.3	18.4
	4	140.1	85.1	51.6	104.9	43.7	27.4	19.9
Rolling	1	168.1	82.0	51.4	96.5	40.6	22.1	16.2
	2	179.2	88.4	54.8	104.5	44.4	24.2	17.7
	3	190.2	94.7	58.1	112.4	48.1	26.4	19.2
	4	201.3	101.1	61.5	120.4	51.9	28.5	20.7
Mountainous	1	241.9	111.7	64.5	125.4	51.5	24.4	17.8
	2	257.6	120.2	68.8	135.4	56.0	26.6	19.4
	3	273.3	128.6	73.2	145.4	60.6	28.9	21.0
	4	289.5	137.1	77.5	155.4	65.1	31.1	22.6

EXHIBIT 1.23 VEHICLE OPERATING COSTS BY ROAD CONDITION AND TOPOGRAPHY (E¢/KM) (PAVED ROADS)

Terrain	Highway Standard	Vehicle Type: Truck-Trailer	10-Ton Truck	7-Ton Truck	Large Bus	Small Bus	Large Car	Small Car
Flat	1	117.4	68.9	43.3	83.6	33.9	21.2	15.5
	2	125.0	74.3	46.1	90.7	37.2	23.3	17.0
	3	132.5	79.7	48.8	97.8	40.4	25.3	18.4
	4	140.1	85.1	51.6	104.9	43.7	27.4	19.9
Rolling	1	168.1	82.0	51.4	96.5	40.6	22.1	16.2
	2	179.2	88.4	54.8	104.5	44.4	24.2	17.7
	3	190.2	94.7	58.1	112.4	48.1	26.4	19.2
	4	201.3	101.1	61.5	120.4	51.9	28.5	20.7
Mountainous	1	241.9	111.7	64.5	125.4	51.5	24.4	17.8
	2	257.6	120.2	68.8	135.4	56.0	26.6	19.4
	3	273.3	128.6	73.2	145.4	60.6	28.9	21.0
	4	289.5	137.1	77.5	155.4	65.1	31.1	22.6

EXHIBIT 1.24 VEHICLE OPERATING COSTS BY ROAD CONDITION AND TOPOGRAPHY (E¢/KM) (GRAVEL ROADS)

Terrain	Highway Standard	Vehicle Type: Truck-Trailer	10-Ton Truck	7-Ton Truck	Large Bus	Small Bus	Large Car	Small Car
Flat	1	140.1	85.1	51.6	140.9	43.7	27.4	19.9
	2	156.5	93.1	57.6	116.4	48.4	30.2	22.0
	3	172.9	101.1	63.6	128.3	53.0	33.0	24.1
	4	189.3	109.1	69.6	140.2	57.7	35.8	26.2
	5	205.7	117.1	75.6	152.1	62.4	38.6	28.3
	6	222.1	125.1	81.6	164.0	67.0	41.4	30.4
	7	238.5	133.2	87.5	176.7	71.8	44.4	32.7
		98.4	48.1	35.9	71.8	28.1	17.0	12.8
Rolling	1	201.3	101.1	61.5	120.4	51.9	28.5	20.7
	2	224.7	110.6	68.5	134.1	57.4	31.4	22.9
	3	248.1	120.1	75.5	147.9	62.9	34.3	25.1
	4	271.5	129.6	82.5	161.6	68.4	37.2	27.3
	5	294.9	139.1	89.5	175.4	73.9	40.1	29.5
	6	318.3	148.6	96.5	189.1	79.4	43.0	31.7
	7	341.8	160.1	103.6	202.9	84.9	46.0	33.8
		140.5	59.0	42.1	82.5	33.0	17.5	13.1
Mountainous	1	289.5	137.1	77.5	155.4	65.1	31.1	22.6
	2	323.0	151.0	86.2	173.1	71.9	34.2	24.9
	3	356.0	164.9	94.9	190.9	78.8	37.4	27.3
	4	390.1	178.8	193.6	208.6	85.6	40.5	29.6
	5	423.7	192.7	112.3	226.4	92.5	43.7	32.0
	6	457.2	206.6	121.0	244.1	99.3	46.8	34.3
	7	490.9	220.8	129.8	261.8	106.3	50.0	36.7
		201.4	83.7	52.3	106.4	41.2	18.9	14.1

Section 2.0

TRAFFIC FORECASTS BY SECTION

2.1 District Traffic Forecasts

The following are detailed forecasts of traffic by Maintenance District and Route. Exhibit 2.1 is a numerical indentification of the count stations referred to in the text.

2.11 Alemgena District

a. Addis Ababa-Welo Province Boundry; Route 01

This section is composed of segments 01001 to 01013. Traffic on the section has grown steadily during the past decade and the ADDT and vehicle kilometers traveled over this section have been a constant percentage of the system total. As a result, traffic is forecast to grow at the system rate of 7 1/2% per year. There is one demonstration minimum package program (MPP) along this route, and four observation areas. At maximum output, that is, seven years after inception, one minimum package program generates about 7,510 tons of incremental yield per year. This is equivalent to about 21 tons per day, or 3 truck-loads assuming a 70 percent load factor. This incremental traffic has unknown destinations, but would not be a significant percentage of the total truck traffic on the route. The section is divided into 3 traffic forecasting subsections. Exhibit 2.2 shows the historical traffic mix at stations on this section.

The first subsection consists of segment 01001. This subsection is separate because it contains high counts of local traffic to and from Addis Ababa. Count station 3, to Addis, provides the historical base. The 1972 base forecast is 111 cars, 135 buses, 72 trucks and 23 truck-trailers per day after the opening of the Awash-Tendaho Highway.

Segments 01002 through 01007 comprise the second subsection. Count station 21 at Debre Berhan, towards Sendafa, provides the traffic forecast. Subsequent to the opening of the Awash-Tendaho highway the traffic on this route is estimated to be 53 medium/heavy trucks and 21

truck-trailers. Given the fact that none of the minimum package programs are actually in existence now and are not actually scheduled as yet, it is unlikely that the program will generate significant traffic which can affect the ranking prior to 1977/78.

The third subsection covers segments 01008 through 01013, a distance of 197 kilometers. The limit of this subsection is the Alemgena District boundary. Cars, buses and trucks fall off from the previous section to 24, 57 and 29 respectively, while truck-trailer traffic shows an increase to 35 vehicles per day. These figures are forecast for 1972 after the diversionary effects of the Awash-Tendaho Road are accounted for.

b. Addis Ababa to Dejen; Route 03

This section covers segments 03001 to 03006, a total distance of 230 kilometers. Traffic forecast in 1972 on the section ranges from 84 cars, 103 buses, 66 trucks and 3 truck-trailers near Addis to 67 cars, 44 buses, 39 trucks and 1 truck-trailer in the vicinity of Dejen. The volume is expected to grow at 7.5 to 8.0 percent per year. As indicated, the majority of this traffic is composed of cars and buses, with truck traffic rapidly dropping off as one leaves the vicinity of Addis. Within the Alemgena District there are two demonstration areas associated with the minimum package program. Again the number of trucks required to support these programs is not significant compared to the existing traffic. There are four minimum packages to the north of the Alemgena District in the Debre Markos District. As stated earlier, there are no data available on the destinations of marketable surpluses generated by these projects. However the major towns of Debre Markos, Bahir Dar and Gonder, with a total population of over 80,000, are located near these projects. It is therefore unlikely that the maximum output representing 12 truckloads per day would find its way to the Addis markets. Additionally, this output would not be reached until 1977. As such it is difficult to ascertain what the addition to the projected traffic is. However, it is not considered to be a significant percentage increase in its effects on the ranking.

The section is divided into 3 subsections. Subsection number one

encompasses the 33 kilometers to the north of Addis; segments 03001 and 03002. Forecast 1972 traffic as derived from count station number 4 (south) is 84 cars, 103 buses, 66 trucks and 3 truck-trailers. The assumed growth rate is 7.5 percent. Exhibit 2.3 shows the historical vehicle mix on route 3.

Subsection two, segment 03003, covers the 114 kilometers from Chancho to Fitche Junction. Count station 10a data is used as the traffic forecasting base. Car and bus traffic has increased steadily over time, but truck traffic has been erratic. The estimated growth rate is 7.5 percent annually.

Subsection three, segments 03004 through 03006, is the 81 kilometers from Fitche Junction to Dejen. Data from count station 10b and 23 were averaged to produce historical traffic along this subsection. All types of traffic except truck-trailer were significantly correlated with time. Therefore, the station regression analysis was used to generate a forecast. The 1972 base estimate is 68 cars, 44 buses, 39 trucks and 1 truck-trailer per day. Car traffic is higher than on the previous subsection due to local traffic. Annual traffic growth has been extremely erratic with increases of 190 percent occuring from 1968 to 1969 and a decrease of 15 percent from 1969 to 1970. Traffic by specific vehicle type shows even greater annual variation. Similarly, traffic mix has been fluctuating.

c. Addis Ababa to Awash

This section is made up of segments 04001 to 04012, a total distance of 225 kilometers. This is the most heavily utilized section in the country. Traffic falls off rapidly from an estimated 2017 cars, 637 buses, 672 trucks and 274 truck-trailers on the first 45 kilometers near Addis to 118 cars, 38 buses, 94 trucks and 105 truck-trailers at a distance of 105 kms from Addis. The heavy traffic includes the estimates of marketable surplus from the CADU project. The estimated growth rate for this project (Assela-Dodela Road) is 5.5 percent per year. The estimated growth for the highway section is 7.5 percent per year. In the direction of Assela-Nazreth-Addis, the generated CADU and other agricultural projects production is not a

significant proportion of the forecast. In the direction of Awash, traffic has been increased by 30 truck-trailers per day to account for new projects in the region. This is approximately a 33 percent increase in the previously estimated traffic without the Awash-Tendaho Road. This projection represents the highest mix of truck, truck-trailer and bus traffic in the country. Exhibit 2.4 shows the historical mix of traffic on this section.

d. Addis Ababa-Ghimbi

This is a 440-kilometer section encompassing segments 05001 through 05013. Again, the heaviest traffic is in the proximity of Addis with an estimated traffic of 277 cars, 208 buses, 170 trucks and 9 truck-trailers. This traffic declines by 50 percent within 119 kilometers from Addis. There is no actual count station data to account for this drop, but the Consultants' field work plus the information contained in the GRS tend to support this decrease in traffic. The traffic for the first 119 kilometers is estimated to grow at 7.5 percent per year. Beyond this distance the car traffic falls off, as does bus traffic, but truck traffic begins to increase at a distance of 334 km from Addis. This is due to activity to and from Lekempty. The overall growth rate, however, falls off from 7.5 percent per year to 5 percent per year. The substantial proportion of truck traffic and the 5 percent rate is applied to traffic all the way to Ghimbi. The traffic forecasts from Lekempty north (count station 29) are based the 1971 data only as there is no previous count station history of traffic to and from Ghimbi. The growth rate of 5 percent was derived from a linear regression forecast for the Guder-Lekempty section. Exhibit 2.5 shows the historical mix of traffic on this section.

e. Modjo to Awash River Bridge

This is a 23 kilometer section in the Alemgena District with a traffic forecast derived from count station 2 data. Segment 06001 represents this section. This is a relatively heavily traveled section as it is the access to the agricultural schemes in the Shashamane District. The forecast traffic for 1972 is 239 cars, 87 buses, 152 trucks and 40 truck-trailers. The projected growth rate is 4 percent annually.

There are only two minimum package programs presently in existence, and one demonstration area. There are ten observation areas to the south of this section. However, there is no schedule of bringing the observation areas into production, so generated traffic from these projects is unknown. The 4% is from regression analysis.

Exhibit 2.6 shows the historical traffic mix on this section. Note that car traffic has been increasing in importance while truck, bus and truck-trailer traffic has been decreasing in importance. This only implies that as the area grows as a recreation center that more car traffic will be evident. Other vehicle traffic is still increasing, but not as quickly.

f. Addis Ababa to Ghimbi River Bridge

This is a 183-kilometer section serving the primary coffee region in the country; it includes segments 07001 to 07009. Forecasts are based on count stations 6, 11, 19, and 22. The growth rate for the entire section is 7.5 percent per year. Traffic falls off rapidly as the distance from Addis increases. Near Addis, the 1972 projection is 512 cars, 358 buses, 210 trucks and 15 truck-trailers. Beyond count station 6 the forecast (1972) is 250 cars, 222 buses, 119 trucks and 11 truck-trailers. The next significant decrease occurs at Welkite, where traffic is projected to be 52 cars, 106 buses, 51 trucks and 5 truck-trailers. Examination of Exhibit 2.7 shows that as the distance from Addis increases, the car and bus traffic falls off and commercial truck traffic assumes a greater importance.

g. Nazreth to Assela

This is a 176-kilometer section on route 8, consisting of segments numbered 08001 through 08006. Count stations 16a and 31 were used to forecast traffic on this section. Exhibit 2.8 shows the historical vehicle mix. As can be expected, the car traffic near Nazreth is high due both to the urban activity and the location of the popular resort Sodere, south of town. In 1975 the Assela-Dodola Road will also open, generating more traffic on the route.

The 1972 traffic projection for the 17 km south of Nazreth is 389 cars, 138 buses, 109 trucks, and 8 truck-trailers. Beyond this distance

the 1972 forecast drops to 101 cars, 60 buses, 49 trucks and 2 truck-trailers. The forecast for these latter segments is based on the 1971 traffic count at station 31, counts prior to that year being non-existent. The entire section is presumed to grow at the rate of 7.5 percent per year.

h. Addis Ababa to the Kersa River Bridge

This is a short section of Route 9 which falls in the Alemgena Maintenance District. It is identified as segment number 09001. Data from count station 6c (south) was used for the forecast on this segment. The traffic mix has been erratic with a relatively constant percentage of cars, but with buses and trucks varying over time. Exhibit 2.9 illustrates the historical mix. The segment traffic growth has been inconsistent and therefore the station time-trend regression growth rate of 5.0 percent was used. The 1972 forecast mix is 115 cars, 86 buses, 88 trucks and 3 truck-trailers. There is a minimum package program observation area located at Butajira, but even when production begins the generated vehicles will not be a significant percentage of the forecast traffic.

i. Tarmaber-Molale

This is a 75-kilometer side route off of Route 1. It consists of two sections, 14001 and 14002. No IHA traffic count has been taken on this section; therefore the data in the GRS survey was used. On the basis of this survey, it was estimated that 6 cars, 2 buses and 6 trucks would use the route each day in 1972. A growth rate of 3.5 percent per year was used. This is the time-trend system growth rate as derived by regression analysis. On route 14 there is a junction to the village of Mehal Meda. Again, the GRS survey was used. The traffic is assumed to be very low, that is, 1 car, 1 bus and 1 truck per day.

j. Debre Berhan to Ankober

This is Route 16 off of Route 1 north of Addis. It consists of one segment 44 kilometers long. Ankober is a town of approximately 10,000 people. No count station data exists for these segments. The

GRS survey was used as a base, and the 1972 estimated traffic is 8 cars, 2 buses and 6 trucks per day. The system growth rate of 3.5 percent was used.

k. Debre Berhan to Jihur

This is a 31-kilometer side route off of Route 1 north of Addis. The section is identified as segment 28001. The GRS survey did not count any traffic on this route. As the road serves many towns a traffic count similar to Route 16001 was assumed.

l. Tarmaber to Seladengie

This is a 22-kilometer route (49) off of Route 1 north of Addis Ababa. It is comprised of 3 segments numbered 49001 to 49003. No count station exists to indicate traffic on the route. The GRS survey indicated 24 light vehicles traveling this section per day during the day-light hours. Experience has shown that bus traffic always exists on a traversable route and therefore 2 buses per day were added to the GRS count.

m. Access Roads in the Alemgena District

- Koka Dam, segment number 04101. This is a 14-kilometer segment off of Route 4 near Nazreth. No official count exists. Based on the Consultants' field efforts, traffic of 25 cars per day was estimated. No significant bus or truck traffic was observed.
- Sodere, segment number 03101. A 6-kilometer access road to the Sodere recreation area. No actual count was available, but the difference between count station 16 south to Assela and count station 31 south to Assela was used as an indication of traffic to Sodere. The estimate for 1972 is 100 cars, 5 buses, 7 trucks and 0 truck-trailers.
- Debre Libanos Road segment, number 03201. No IHA or GRS estimates of traffic are available for this 6-kilometer segment. Minimal traffic of 4 cars, 2 buses and 3 trucks per day was the estimate made for 1972.

EXHIBIT 2.1

IHA TRAFFIC COUNT STATIONS
1971

Route No.	Count Station No.	Station Location	Direction or Count leg
04	1	Akaki	Addis Ababa
	2 a	Modjo	a) Debre Zeit
	b		b) Nazreth
	c		c) Shashamane
01	3	Sendafa	Addis Ababa
03	4	Chancho	Addis Ababa
05	5	Menagesha	Addis Ababa
07	6 b	Alemgena	b) Addis Ababa
	a		a) Ghion
	c		c) Butajira
20	7	W. of Dire Dawa	Cota
04	8 b	Dengego	b) Dire Dawa
	a		a) Harer
	c		c) Kulubi
04	9	E. of Harer	Jigiga
03	10 a	Fitche Jct.	a) Chancho
	b		b) Dejen
	c		c) Fitche
07	11	Ghion	Alemgena
01	12 a	Combolcia	a) Debre Berhan
	b		b) Dessie
	c		c) Bati
06	13 a	Wondo	a) Dilla
	b		b) Kebremengist
	14 a	Yergalem Jct.	a) Shashamane
	b		b) Wondo
	c		c) Yergalem

EXHIBIT 2.1
(Continued)

Route No.	Count Station No.	Station Location	Direction or Count leg
06	15 c	Sodo Jct.	c) Shashamane
	a		a) Yergalem
	b		b) Sodo
06	15 - A a	Kofole Jct.	a) Meki
	A b		b) Shashamane
	A c		c) Kofole
04	16 c	Nazreth	c) Modjo
	b		a) Wlenchiti
	a		b) Assela
02	17	Bati	Asseb
01	18	N. of Dessie	Quiha
07	19	N. of Welkite	Jimma
05	20	Guder	Lekempty
01	21	Debre Berhan	Sendafa
07	22	S. of Welkite	Ghion
03	23	Debre Markos	Dejen
	24	Dangla	Debre Markos
	25	Bahir Dar	Dangla
04	26 a	Kobo	a) Kulubi
	b		b) Asbe Teferi
	c		c) Deder
43	27 a	Toba	a) Agaro
	b		b) Bedele
07	28 a	Jimma	a) Welkite
	b		b) Agaro
	c		c) Bonga
05	29 a	Arjo Jct.	a) Lekempty
	b		b) Ghimbi
	c		c) Arjo
	30	Lakempty	Guder

EXHIBIT 2.1
(Continued)

Route No.	Count Station No.	Station Location	Direction or Count leg
08	31	Melkasa	Assela
04	32 a	Mieso	a) Awash
	b		b) Asbe Teferi
01	101 b	Nefasit	b) Asmara
	a		a) Massawa
	c		c) Decamere
	102 b	Maaday Jct.	b) Asmara
	a		a) Massawa
	c	(109 Km. from Asmara)	c) Gurgurssum
	103 c	Edaga Jct.	c) Asmara
	b	(112 Km. from Asmara)	b) Massawa
	a		a) Arkiko
	d		d) Grar
10	104 a	Decamere	a) Asmara
	b		b) Senafe
	c		c) Nefasit
	d		d) Decamere
03	105 a	7 Km. S.W. of Asmara	a) Asmara
	b		b) Adi Ugri
	c		c) Himberti
11	106 a	Merera Rd. Jct.	a) Asmara
	b	(Keren road)	b) Keren
	c		c) Merera
	107 b	Jct. 1 km. from Akordat	b) Keren
	a		a) Barentu
	c		c) Akordat

Route No.	Count Station No.	Station Location	Direction or Count leg
11	108 a	Jct. near Teseney	a) Barentu
	b		b) Teseney
	c		c) Sebderat
01	109 a	2 Km W. of Decamere	a) Asmara
	b		b) Decamere
	c		c) Terramini
03	110 a	Adi Abun	a) Asmara
	b		b) Axum
	c		c) Adwa
	d		d) Adigrat
	110-A	Jct. near Enda Selasse	Axum
01	111 b	Adigrat	b) Senafe
	a		a) Quiha
	c		c) Adwa
	d		d) Adigrat
03	112	Debarek	Gonder
	113 a	Jct. S. of Azezo	a) Gonder
	b		b) Addis Zemen
	c		c) Gorgora
	113-A a	Jct. near Addis Zemen	a) Gonder
	A b		b) Bahir Dar
	A c		c) Addis Zemen
01	114 b	Quiha	b) Adigrat
	a		a) Maychew
	c		c) Mekele

EXHIBIT 2.2

HISTORICAL TRAFFIC MIX ON SEGMENTS 01001 TO 01013

Station 3 AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	29.29	26.60	23.57	20.54
67.	100.00	23.05	33.44	18.51	25.00
68.	100.00	24.92	33.93	18.02	23.12
69.	100.00	30.98	36.34	13.90	18.78
70.	100.00	22.64	27.03	25.68	24.66
71.	100.00	20.94	28.47	20.47	30.12

Station 21 AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	15.77	26.15	24.62	33.46
67.	100.00	18.40	28.47	21.18	31.94
68.	100.00	20.24	31.35	18.25	30.16
69.	100.00	15.55	35.71	16.81	31.93
70.	100.00	15.13	30.25	37.39	17.23
71.	100.00	16.36	30.00	21.21	32.42

EXHIBIT 2.3

HISTORICAL TRAFFIC MIX ON SEGMENTS 03001 - 03006

Station 4 AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	21.77	38.78	38.78	0.68
67.	100.00	32.35	40.44	26.47	0.74
68.	100.00	37.20	37.20	23.67	1.93
69.	100.00	36.52	41.30	21.74	0.43
70.	100.00	26.46	44.97	26.98	1.59
71.	100.00	36.84	36.03	26.72	0.40

Station 10A AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	17.20	36.56	45.16	1.08
67.	100.00	20.56	42.06	35.51	1.87
68.	100.00	25.27	46.15	27.47	1.10
69.	100.00	25.62	44.63	29.75	0.0
70.	100.00	31.20	40.80	28.00	0.0
71.	100.00	27.85	32.28	39.24	0.63

EXHIBIT 2.4

HISTORICAL TRAFFIC MIX PERCENTAGES ON SEGMENTS 04001 - 04012

Station 1 AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	53.64	20.31	21.49	4.56
67.	100.00	49.75	21.44	24.09	4.72
68.	100.00	56.08	18.44	19.13	6.39
69.	100.00	64.01	16.74	13.72	5.53
70.	100.00	61.67	13.11	20.57	4.66
71.	100.00	57.95	16.63	20.54	4.88

Station 2b and 16c AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	52.04	23.68	20.29	4.00
67.	100.00	49.16	25.74	21.49	3.61
68.	100.00	59.14	21.78	16.12	2.96
69.	100.00	56.70	22.40	16.63	4.27
70.	100.00	57.32	17.96	19.89	4.84
71.	100.00	50.89	23.77	20.96	4.38

Station 16b and 32a AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	54.44	11.83	30.18	3.55
67.	100.00	50.00	10.42	33.33	6.25
68.	100.00	51.50	17.96	25.15	5.39
69.	100.00	48.95	5.79	28.95	16.32
70.	100.00	43.37	13.78	37.76	5.10
71.	100.00	37.16	19.03	40.18	3.32

EXHIBIT 2.5

HISTORICAL TRAFFIC MIX PERCENTAGES ON SEGMENTS 05001 - 05013

Station 20 and 30 AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	22.97	22.97	52.70	1.35
67.	100.00	24.53	32.08	41.51	1.89
68.	100.00	31.46	28.09	39.33	1.12
69.	100.00	30.39	37.25	31.37	0.98
70.	100.00	38.14	23.26	38.14	0.47
71.	100.00	35.33	22.63	40.65	0.92

Station 29a AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	0.0	0.0	0.0	0.0	0.0
67.	0.0	0.0	0.0	0.0	0.0
68.	0.0	0.0	0.0	0.0	0.0
69.	0.0	0.0	0.0	0.0	0.0
70.	100.00	39.47	14.47	46.05	0.0
71.	100.00	39.63	10.14	49.31	0.46

Station 5 AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	35.21	31.05	32.76	0.98
67.	100.00	44.30	27.96	26.45	1.29
68.	100.00	44.57	31.43	22.67	1.33
69.	100.00	41.90	35.89	20.70	1.50
70.	100.00	40.45	28.54	30.27	0.74
71.	100.00	36.84	28.31	32.67	2.18

EXHIBIT 2.6

HISTORICAL TRAFFIC MIX PERCENTAGES ON SEGMENT 06001

Station 2c AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	37.16	21.96	32.43	8.45
67.	100.00	36.47	22.06	31.47	10.00
68.	100.00	48.04	19.13	24.57	8.26
69.	100.00	44.90	20.70	26.11	8.28
70.	100.00	53.39	14.96	25.35	6.30
71.	100.00	48.10	17.84	26.65	7.41

EXHIBIT 2.7

HISTORICAL TRAFFIC MIX PERCENTAGES
ON SEGMENTS 07001 - 07009

Station 6b AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	48.12	29.34	21.60	0.94
67.	100.00	42.17	34.00	22.62	1.20
68.	100.00	45.27	36.77	16.89	1.08
69.	100.00	46.13	36.43	15.75	1.69
70.	100.00	47.57	30.01	20.88	1.54
71.	100.00	45.41	26.68	26.07	1.84

Station 6a and 11 AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	45.17	31.96	21.58	1.30
67.	100.00	39.58	39.71	19.52	1.20
68.	100.00	40.68	40.80	17.02	1.50
69.	100.00	39.30	41.05	17.54	2.11
70.	100.00	42.12	32.32	23.65	1.91
71.	100.00	40.06	29.81	27.65	2.48

Station 22 AADT Welkite - Ghion

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	17.20	50.96	30.57	1.27
67.	100.00	17.46	61.90	19.05	1.59
68.	100.00	21.82	50.91	24.55	2.73
69.	100.00	30.29	49.71	17.71	2.29
70.	100.00	28.26	39.86	29.71	2.17
71.	100.00	27.24	38.43	31.72	2.61

EXHIBIT 2.8

HISTORICAL TRAFFIC MIX ON
SEGMENTS 08001 THROUGH 08006

Station 16a AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	56.79	20.37	20.37	2.47
67.	100.00	50.70	30.00	18.60	0.70
68.	100.00	58.87	25.05	14.82	1.25
69.	100.00	66.67	19.16	13.22	0.96
70.	100.00	62.18	14.71	22.06	1.05
71.	100.00	64.30	15.13	19.62	0.95

Station 31 AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	0.0	0.0	0.0	0.0	0.0
67.	0.0	0.0	0.0	0.0	0.0
68.	0.0	0.0	0.0	0.0	0.0
69.	0.0	0.0	0.0	0.0	0.0
70.	0.0	0.0	0.0	0.0	0.0
71.	100.00	40.57	28.30	25.47	0.94

EXHIBIT 2.9

HISTORICAL TRAFFIC MIX ON
SEGMENT 09001

Station 6c AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	36.55	33.50	29.44	0.51
67.	100.00	38.73	32.37	28.32	0.58
68.	100.00	41.07	36.31	19.64	2.98
69.	100.00	42.67	40.00	16.67	0.67
70.	100.00	43.40	25.11	30.64	0.85
71.	100.00	36.58	28.42	33.68	1.32

Cement Quarry Road, segment number 0301. No counts of any type are available for this 23-kilometer section. However, assuming some car and bus traffic for employees and truck traffic for haulage, an estimate of 3 cars, 2 buses and 10 trucks per day was made for 1972.

Alem Ketema Road, segment number 03101. A 20-kilometer segment of road off of Route 3 north of Addis. The road presently provides dry weather access to numerous towns to the north of the junction of this road with Route 3. The GRS survey encountered the equivalent of seven heavy vehicles. It was assumed that this traffic was split into 4 buses and 3 trucks. Also, an additional 4 cars per day were estimated in the 1972 base forecasts.

2.12 Combolcia District

a. Route 1, Shoa Province Boundary to the Tigre Province Boundary

This is 297-kilometer section made up of 14 segments, numbers 01014 to 01037, varying in length from 6 to 32 km. Count stations 12, 18 and 114 provide the historical traffic flows on this route. The counts from station 114 south to Dessie and 18 north to Quiha were averaged to help compensate for traffic fall-off to towns between Quiha and Dessie. For forecasting purposes, the section is divided into three subsections. Exhibit 2.10 illustrates the historical traffic mix on this route.

The first traffic projection on this route is from the Alemgena District boundary to Combolcia, a distance of 37 km. Segments 01014, 01015 and 01016 comprise this subsection. The projection is derived from the count station 12a (south) data. The 1972 base projection is 14 cars, 37 buses, 29 trucks and 35 truck-trailers. This is after making adjustments for diversion of traffic off of this subsection due to the opening of the Awash-Tendaho Road. Traffic on the route is assumed to grow at the 7.5 percent per year rate.

EXHIBIT 2.10

HISTORICAL PERCENTAGE TRAFFIC MIX ON SECTIONS IN THE COMBOLCIA DISTRICT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
SEGMENTS 01014 - 01016					
Station 12a AADT					
66.	100.00	14.12	13.56	28.25	44.07
67.	100.00	12.93	17.24	31.90	37.93
68.	100.00	11.41	22.82	16.78	48.99
69.	100.00	11.69	22.08	18.18	48.05
70.	100.00	14.21	21.86	16.94	46.99
71.	100.00	15.27	22.66	15.76	46.31
SEGMENTS 01017 - 01018					
Station 12b AADT					
66.	100.00	22.02	28.44	29.36	20.18
67.	100.00	23.85	39.23	23.08	13.85
68.	100.00	21.28	42.55	20.21	15.96
69.	100.00	17.35	44.90	19.39	18.37
70.	100.00	14.29	23.13	16.33	46.26
71.	100.00	23.13	37.31	18.66	20.90
SEGMENTS 01019 - 01037					
Stations 18 and 114 AADT					
66.	100.00	20.50	22.50	35.50	21.50
67.	100.00	18.69	28.97	33.64	18.69
68.	100.00	21.78	30.20	29.21	18.81
69.	100.00	17.20	26.88	29.57	26.34
70.	100.00	28.52	27.08	32.49	11.91
SEGMENTS 02001 - 02004					
Station 12c AADT					
66.	100.00	9.09	6.36	25.45	59.09
67.	100.00	7.64	9.03	33.33	50.00
68.	100.00	7.29	12.50	12.50	67.71
69.	100.00	9.82	18.75	16.07	55.36
70.	100.00	17.27	20.91	24.55	37.27
71.	100.00	12.93	14.97	17.69	54.42
SEGMENTS 02004 - 02006					
Station 17 AADT					
66.	100.00	9.09	5.05	23.23	62.63
67.	100.00	7.26	4.84	23.39	64.52
68.	100.00	8.49	8.49	12.26	70.75
69.	100.00	5.08	11.86	12.71	70.34
70.	100.00	8.79	10.44	27.47	53.30
71.	100.00	9.50	7.26	13.41	69.83

To the north of Combolcia, count station 12b (north) was used to project traffic to Dessie, a distance of 22 km. This subsection, segment numbers 01017 and 01018, is estimated to carry 34 cars, 57 buses, 32 trucks and 40 truck-trailers in 1972. The growth rate is 3.5 percent a year. This is lower than the section south of Combolcia due to the lack of commercial activity such as that which exists on the section serving Addis Ababa. One minimum package program is currently in existence, and 3 agricultural areas are under observation. The percentage increase due to these programs in the next five years is not significant as the total traffic generated by the schemes, assuming all were brought into existence, would not exceed 6 trucks per day by 1977/78.

The next subsection is from Dessie north to the Combolcia District boundary, 17 km south of Maychew. The length is 245 kilometers and count stations 114 (south) and 18 (north) were averaged to provide the historical traffic data base. This subsection has an extremely long length and an IHA survey should be taken periodically to determine the extent of turn-off traffic at the major towns such as Korem, Woldia, Kobo, Wichale and Hayk. These towns all have significant populations (over 3,000) and can be expected to generate commercial bus and truck traffic. Segments 01019 through 01037 make up this section. The 1972 base projection is 30 cars, 32 buses, 54 trucks and 22 truck-trailers. The growth rate on this subsection is 3.5 percent. From historical data the station had a poor time-trend. The car, bus and truck vehicle-kilometers as a percentage of the total system kilometers is declining. Truck-trailer traffic is relatively constant as a percentage of the system, but with a decline in 1970 and 1971.

b. Combolcia-Asseb (Route 2)

This is a 463-kilometer section consisting of segments 02001 through 02013. The total length is broken up into 3 major subsections, consisting of segments 02001 to 04, 02005-06, and 02007-02013 respectively. The first is between Combolcia and Bati, the second between Bati and the junction with the new Awash-Tendaho

Road and the third is from this junction to Asseb. Count station data at station 12c (east) and station 17 were used in conjunction with an estimate of traffic coming from Awash to provide the total section forecast. The diversion due to the new route has been taken into account. Exhibit 2.10 shows the historical mix of traffic on these segments.

The first subsection, segments 02001-02004, is 41 km long. Traffic in 1972, after allowance for the diversion, is assumed to be 9 cars, 9 buses, 10 trucks and 0 truck-trailers. The bus traffic on this segment occurs due to the Combolcia-Bati service. Only 2 buses per day are assumed to run from Combolcia to Asseb. The growth rate used for projections is 7.5 percent.

The next subsection covers the 106 km from Bati to the Route 2 intersection with the Awash-Tendaho Road. Segments 02005-02006 comprise this subsection. Traffic is forecast in 1972 at 7 cars, 2 buses, 8 trucks and 0 truck-trailers. The growth rate is 7.5 percent. There are no traffic generating activities along this route.

Segments 02007-02013 comprise the next subsection, from the junction to Asseb. The 1972 projection on this stretch is 15 cars, 14 buses, 32 trucks and 120 truck-trailers. Obviously, most of this traffic comes off of the Awash-Tendaho Road. The assumed growth rate for projections is 7.5 percent. There are no economic activities along this subsection to generate traffic. The following discussion describes the diversionary effects of the Awash-Tendaho Highway.

c. Diversion Effects of the Awash-Tendaho Road

The Awash-Tendaho highway is currently scheduled to open in the last quarter of 1973. The opening of this highway will divert traffic currently using the Addis Ababa-Combolcia-Asseb route to the Addis-Awash-Tendaho route. The World Bank and the General Road Study both estimated the volume of traffic that would be diverted. Although the GRS origin-destination survey did not completely bear out the Bank estimates, total traffic volumes were quite similar by both agencies. Using these estimates as a base and modifying the numbers on the basis of the Consultants' field trips, the effect of the

new Addis-Asseb route was re-estimated. The following table shows the IBRD estimated effects.

Projected - 1972 Combolcia - Bati		IBRD Diversion Factors	Diverted	Remainder
Cars	15	50%	8	7
Buses	14	90%	12	2
Trucks	32	75%	24	8
Truck-Trailers	89	95%	85	4

However, the Consultants observed on field trips that 2 to 3 large buses and 5 to 7 small buses operated out of Combolcia towards Asseb. The large buses traveled the entire distance to Asseb while the small buses served the small villages between Combolcia and Bati. It was also assumed that the tanker-trucks and truck-trailers would all use the new Addis-Awash-Asseb route. Based on these assumptions, the following revisions were made to the vehicles traveling on the Addis-Combolcia-Asseb route.

Revised 1972 Projections

Section 10	From - To	Cars	Buses	Trucks	Truck-Trailers
01001	Addis Area	111	13	72	23
01002-01007	Addis-Sendafa	54	99	53	21
01008-01016	Sendafa-Combolcia	24	87	29	35
02001-02004	Combolcia-Bati	9	9	10	0
02005-02006	Bati-Tendaho	7	2	8	0
02007-02013	Tendaho-Asseb	15	14	32	120

The loss of traffic on the old route must be added to the traffic forecast on the new Addis-Awash-Tendaho route; the affected sections are 04001 to 04012. That is, Addis to Awash. The additions are 15 cars, 14 buses, 32 trucks and 89 truck-trailers. It is also assumed

that the new route will induce some new traffic from the Nazreth-Awash area. This traffic is assumed to be the equivalent of 30 truck-trailers. The total of 120 truck-trailers is the high forecast for the truck-trailer traffic from Tendaho to Asseb in 1972, and is therefore used.

d. Asseb-Asseb Airport; Segment 02101

No traffic data is available for this segment. Based on the scheduled flight activity, a 1972 base estimate of 35 cars, 2 buses and 2 trucks is generated.

2.13 Adigrat District

a. Route 1, Welo District Boundary to Eritrea District Boundary

This section is made up of 23 segments covering 257 kilometers; segments number from 01038 through 01060. There are three main subsections. The first is from the Welo Boundary to Quiha, segments 01038-01046. The second, segments 01047 to 01056, is from Quiha to Adigrat. The third is from Adigrat north to the Eritrea district boundary. As in previous cases these subsections are for the purpose of forecasting only. Exhibit 2.11 illustrates the traffic mix on segments in the Adigrat District.

The first subsection, segments 01038-01046, is covered by count stations 18 (north) and 114 (south). The historical data from these stations is averaged annually to produce the forecast data base. There are no significant activities along this subsection that would generate traffic above the projected 3.5 percent per year. The 1972 base projection is 30 cars, 37 buses, 54 trucks, and 22 truck-trailers.

The second subsection, segments 01047-01056, is 136 km long, from Quiha to Adigrat. Stations 114b (north) and 111a (south) were averaged to produce the traffic data base on this subsection. There are 11 segments in this subsection. The 1972 traffic base is 13 cars, 8 buses, 31 trucks and 17 truck-trailers per day. There are, at present, two minimum package program demonstration areas along this subsection, one at Quiha and the other at Adigrat. If both of

EXHIBIT 2.11

HISTORICAL PERCENTAGE TRAFFIC MIX ON SEGMENTS IN THE ADIGRAT DISTRICT

SEGMENTS 01038 - 01046
(See COMBOLCIA DISTRICT, SECTION 2.12)

SEGMENTS 01044 - 01056

Station 111a and 114b AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	20.31	10.16	47.66	21.09
67.	100.00	14.49	8.70	47.83	28.99
68.	100.00	18.52	11.11	42.59	27.78
69.	100.00	14.17	14.17	42.50	29.17
70.	100.00	13.71	10.48	46.77	29.03
71.	100.00	30.43	10.87	45.65	13.04

SEGMENTS 01057 - 01060
(See ASMARA DISTRICT, SECTION 2.14)

SEGMENTS 03060 - 03056

Station 110a AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	20.00	16.00	52.00	12.00
67.	100.00	19.15	17.02	55.32	8.51
68.	100.00	15.38	23.08	50.00	13.46
69.	100.00	15.09	22.64	50.94	11.32
70.	100.00	12.86	18.57	61.43	7.14
71.	100.00	11.46	22.92	58.33	7.29

SEGMENTS 15001 - 15005

Station 111c AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	16.67	33.33	50.00	0.00
67.	100.00	14.29	42.86	28.57	14.29
68.	100.00	31.25	31.25	37.50	0.00
69.	100.00	22.22	55.56	22.22	0.00
70.	100.00	14.29	28.57	57.14	0.00
71.	100.00	25.00	41.67	33.33	0.00

EXHIBIT 2.11
(Continued)

SEGMENTS 01101 through 01102

Station 114c AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	45.00	27.50	27.50	0.00
67.	100.00	44.12	26.47	26.47	2.94
68.	100.00	42.86	31.43	22.86	2.86
69.	100.00	50.00	28.57	19.05	2.38
70.	100.00	48.84	27.91	20.93	2.33
71.	100.00	50.98	13.73	31.37	3.92

SEGMENT 03401

Station 110c AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	29.73	32.43	35.14	2.70
67.	100.00	34.69	38.78	24.49	2.04
68.	100.00	30.65	40.32	24.19	4.84
69.	100.00	30.77	52.31	15.38	1.54
70.	100.00	31.31	56.57	12.12	0.00
71.	100.00	23.96	41.67	34.38	0.00

SEGMENTS 03055 through 03051

Station 110b AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	24.44	8.89	53.33	13.33
67.	100.00	25.81	11.29	48.39	14.52
68.	100.00	21.67	20.00	46.67	11.67
69.	100.00	27.14	20.00	42.86	10.00
70.	100.00	33.61	27.05	34.43	4.92
71.	100.00	17.91	34.33	44.78	2.99

these schemes go into production there will be an addition of 6 trucks per day in 1978, 4 per day in 1977 and 2 per day from 1973 through 1976. However, the traffic growth in this region has been decreasing. In fact, the time-trend regression analysis has a high negative correlation, implying that the traffic will continue to decrease over time. For the purposes of ranking it was assumed that traffic will grow at the modes rate of 1 percent per year.

The third subsection is from Adigrat to the Eritrea boundary. It is 27 km long and consists of 4 segments, 01057 to 01060. The average of stations 104b (south) and 111b (north) is used to generate the data base for this subsection. No traffic generating schemes appear to be planned in this area. Again, traffic has been declining in this region due to the regional problems. A one percent per year growth rate is applied to the 1972 base forecast of 30 cars, 17 buses, 41 trucks and 18 truck-trailers.

b. Route 3, Eritrea District Boundary to Begemdir District Boundary

This section is composed of 3 traffic subsections and 14 segments. It is 179 km long and is the major route from the Adigrat-Asmara regions to Gonder. The first subsection, composed of five segments (03060 through 03056) links the Eritrea boundary with Adi Abun. The second, segments 03055 to 03051, is from Adi Abun to Enda Selasse. The third subsection is 55 km long (segments 03050 through 03047) and is from Enda Selasse to the Tekeze River Bridge.

The traffic forecast for the first subsection is derived from the historical data from count station 110a (north). One minimum package program observation area is located on Route 3 to the north of this subsection. Estimated 1972 traffic is 20 cars, 27 buses, 60 trucks, and 12 truck-trailers. The area growth rate of one percent per year is applied to this base traffic. Only bus traffic has shown any substantial growth. Car traffic has been erratic and all types of truck traffic have decreased.

Traffic on the second subsection, segments 03055 through 03051, is estimated at 21 cars, 17 buses, 34 trucks and 7 truck-trailers.

This subsection is between Axum and Enda Selasse, and the heavy car and bus traffic on the previous subsection of route 3 continues. Two minimum package programs exist in the area served by the subsection of road. The truck traffic has been decreasing while bus traffic has remained constant in recent years. Growth is estimated at one percent per year until the regional problems are solved.

The third subsection, segments 03050 through 03047, covers Enda Selasse to the Adigrat District boundary, a distance of 54 km. The traffic from count station 110-A was used for forecasting purposes. There is a count station gap between Enda Selasse and Debarek on route 3, as station 110-A counts traffic to the north and station 112 counts traffic to the south, leaving a 193 km road section without a count from either direction. GRS survey data was used as a guide to the volume and was found to be consistent with the 110-A station data. The projected 1972 base traffic is 13 cars, 17 buses, 41 trucks and 8 truck-trailers. The growth rate is estimated at 7.5 percent. There is a minimum package program observation area south of this subsection at Debarek.

c. Route 15, Adigrat to Adi Abun.

This is a 103-kilometer section covered by count stations 110d (east) and 111c (west). Traffic is low, less than 20 vehicles in 1971, and truck traffic is declining. It consists of segments 15001 through 15005. The 1972 base forecast is 4 cars, 8 buses, 7 trucks and 0 truck-trailers. The growth rate is 1 percent per year.

d. Segments 01101 and 01102, Quiha to Mekele

This is a 10-kilometer section linking Mekele with Route 1. Count station 114c counts the traffic to Mekele on this route. Traffic in 1971 was 49 vehicles. The estimated 1972 base traffic is 22 cars, 13 buses, 11 trucks and 1 truck-trailer. Traffic is assumed to grow at the low system rate of 3.5 percent per year.

e. Segment 01201, Mekele to Maimekden

This is a second connection from Route 1 to Mekele, a

distance of 18 kilometers. No count data is available so the assumption is made that the traffic is the same range as the Quiha to Mekele route. The traffic entering Mekele from Maimekden is originating in the north while the traffic from Quiha is coming from the south.

f. Segment 03401, Adi Abun to Adwa.

This is a 5-kilometer spur from Route 3 south to Adwa. Count station 110c counts this traffic. Base forecast traffic in 1972 is 27 cars, 40 buses, 19 trucks and 1 truck-trailer. Traffic in 1971 was 96 vehicles. The assumed growth rate on this spur is 7.5 percent per year.

2.14 Asmara District

a. Route 1, Adigrat District Boundary to Asmara and Massawa

This is a 268-kilometer section comprised of segments 01061 through 01072. There are five major traffic subsections in this section, each of which is described below. Exhibit 2.12 illustrates the traffic mix on these segments.

The first subsection is from the provincial boundary on Route 1 south of Senafe to Decamere, it consists of segments 01061 through 01065, and count stations 111b (north) and 104b (south) provide the data base. The average of these stations was taken. The subsection has shown declining car, truck and truck-trailer traffic in recent years. For forecasting purposes, the low system growth rate of 3.5 percent a year is applied to an estimated 1972 base of 36 cars, 19 buses, 46 trucks and 23 truck-trailers. The regional growth rate of 1 percent was not used as this is the main route from the port of Massawa and Asmara to Addis, and is not as affected by regional conditions as the other routes in the region.

The second subsection is from Decamere to Asmara. This is a single segment, No. 01066, 40 km long, and is measured by count station 109a (north). An estimated 270 cars, 76 buses, 316 trucks and 41 truck-trailers is the 1972 base. A total of 565 vehicles traveled the

EXHIBIT 2.12

HISTORICAL TRAFFIC MIX ON SEGMENTS 01061 THROUGH 01066

Station 109a AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	37.23	8.27	50.61	3.89
67.	100.00	39.79	9.81	45.62	4.77
68.	100.00	37.10	10.25	48.59	9.36
69.	100.00	35.02	9.66	50.74	4.58
70.	100.00	38.74	10.26	45.53	5.46
71.	100.00	42.12	16.99	36.11	4.78

Station 104b and 111b

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	28.32	14.45	41.04	16.18
67.	100.00	24.75	13.64	39.90	21.72
68.	100.00	31.69	18.03	31.15	19.13
69.	100.00	28.76	18.58	34.07	18.58
70.	100.00	21.79	5.13	48.72	24.36
71.	100.00	27.43	15.19	45.15	12.24

HISTORICAL TRAFFIC MIX ON SEGMENTS 01065 AND 01066

SEGMENT 01066

Station 101b AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	53.56	3.10	28.17	15.17
67.	100.00	60.32	3.17	24.76	11.75
68.	100.00	61.63	3.21	24.57	10.59
69.	100.00	51.65	3.31	31.81	13.23
70.	100.00	54.57	4.57	28.85	12.02
71.	100.00	38.80	5.08	40.42	15.70

EXHIBIT 2.12
(Continued)

SEGMENT 01065

Station 104a AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	34.34	15.66	42.42	7.58
67.	100.00	35.32	16.92	36.82	10.95
68.	100.00	38.89	16.67	34.72	8.80
69.	100.00	38.82	15.53	37.89	7.76
70.	100.00	42.27	15.45	35.57	6.71
71.	100.00	30.24	21.31	39.52	8.93

SEGMENTS 01068 through 01072

Station 101a and 102b

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	50.37	3.10	33.53	13.00
67.	100.00	55.21	2.80	29.86	12.13
68.	100.00	56.51	6.61	28.82	8.06
69.	100.00	47.48	10.42	31.79	10.31
70.	100.00	46.18	12.48	32.61	8.73
71.	100.00	39.13	12.80	39.38	8.70

SEGMENTS 10001 through 10003

Station 101c and 104c AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	28.17	8.45	59.15	4.23
67.	100.00	30.51	11.86	45.76	11.86
68.	100.00	25.93	8.64	59.26	6.17
69.	100.00	21.24	7.08	68.14	3.54
70.	100.00	27.55	6.12	63.27	3.06
71.	100.00	41.96	9.79	47.55	0.70

segment in 1971. The growth rate has been high and an annual forecast rate of 7.5 percent per year is used. Exhibit 2.12 illustrates the traffic mix on the above two subsections. Note the declining percentage of cars and the increasing percentage of trucks as the distance from Asmara increases.

The third subsection is from Asmara towards Massawa. Due to the proximity to Asmara, the traffic forecast on the first 25 km east of Asmara is much higher than the subsequent portions of the section. This segment is identified as 01067. Traffic for 1972 is 253 cars, 18 buses, 133 trucks and 58 truck-trailers per day. The growth is estimated at 3.5 percent per year.

The fourth subsection covers the 90 km beginning 25 km east of Asmara, on Route 1 to Massawa. Count station data from station 101a (east) and 102b (west) have been averaged to provide the data base. The 1972 base is 235 cars, 48 buses, 169 trucks and 56 truck-trailers per day. The growth rate used for forecasting is 3.5 percent per year. Exhibit 2.12 shows the declining percentage of cars and the corresponding increase in percentage of buses and trucks.

b. Route 3, Asmara to the Provincial Boundary.

This is a 115-kilometer section going south from Asmara on Route 3. As there is only one significant turn-off, located at Adi Ugri, and the traffic turning off route 3 is low, the data from station 105 (south) and 110 (north) was used. Traffic was estimated to decline from north to south on an empirical basis due to the large difference between station counts. The section is comprised of segments 03061 through 03072. The growth rate estimated for the next 5 years is 3.5 percent per year. There is one minimum package program demonstration area at Adi Ugri, midway in the section. The base 1972 traffic estimate is 190 cars, 90 buses, 119 trucks and 12 truck-trailers near Asmara, and 90 cars, 22 buses, 60 trucks and 12 truck-trailers near Adi Ugri. This heavy traffic plus the estimated growth will make the contribution of the agricultural scheme insensitive to the ranking.

c. Route 10, Nefasit to Decamere.

This section consists of 3 segments, 10001 through 10003, and is 40 km long. Count stations 104c (north) on Route 10 and 101c (south) from Nefasit were averaged. Car and truck-trailer traffic has declined in recent years. Truck traffic has been constant and bus traffic has increased slightly. Traffic is low, with 16 cars, 5 buses, 130 trucks and 2 truck-trailers estimated in 1972. A 3.5 percent growth rate is assumed for forecasting purposes.

d. Route 11, Asmara to Sebderat

This section consists of segments 11001 through 11012 and is 125 km in length. For forecasting purposes it is divided into four subsections. Due to the regional problems the growth on this entire section has been negative. Exhibit 2.13 illustrates the declining car and bus mix along the route. Truck traffic has been increasing in importance.

The first subsection covers the first 41 km west of Asmara on Route 11. It is identified as segment 11001. Local traffic to and from Asmara makes the count on this subsection high, especially for cars and buses. The 1972 base estimate is 103 cars, 60 buses, 78 trucks and 34 truck-trailers. The assumed growth rate is 3.5 percent per year.

The next subsection consists of segments 11002 through 11009. Count station data from station 107a (east) is used as the traffic forecasting base. The traffic growth is unstable with cars, trucks and truck-trailers showing a decline. The 1972 base forecast is 21 cars, 39 buses, 48 trucks and 23 truck-trailers. A one percent per year growth rate is applied to this base. This subsection covers the length from 41 km east of Asmara to Akordat.

The third subsection, segments 11010 and 11011, covers the 176 km from Akordat to Teseney Junction. Count station data from station 107 (west) and 108 (east) were averaged to provide the historical data base. The 1972 base forecast is 11 cars, 17 buses, 28 trucks and 15 truck-trailers. The estimated growth rate is one percent per year.

EXHIBIT 2.13

HISTORICAL PERCENTAGE TRAFFIC MIX ON ROUTE 11

SEGMENT 11001

Station 106a AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	37.95	14.87	26.67	20.51
67.	100.00	36.57	20.57	28.57	14.86
68.	100.00	37.57	23.76	25.41	13.26
69.	100.00	37.09	24.00	26.91	12.00
70.	100.00	42.31	16.67	33.01	8.01
71.	100.00	30.34	24.15	34.98	10.53

SEGMENT 11002 through 11009

Station 107a AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	19.29	15.00	34.29	31.43
67.	100.00	25.35	18.31	32.39	23.94
68.	100.00	21.33	16.00	33.33	29.33
69.	100.00	22.22	18.89	37.78	21.11
70.	100.00	24.44	21.11	35.56	18.89
71.	100.00	3.23	19.35	45.16	32.26

SEGMENTS 11010 and 11011

Station 108a AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	21.32	16.18	35.29	27.21
67.	100.00	21.90	22.86	35.24	19.05
68.	100.00	15.00	19.17	42.50	23.33
69.	100.00	10.77	26.15	41.54	21.54
70.	100.00	12.03	28.57	42.11	17.29
71.	100.00	6.12	28.57	46.94	18.37

EXHIBIT 2.13
(Continued)

SEGMENT 11012

Station 108c AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	23.08	7.69	69.23	38.46
67.	100.00	33.33	16.67	33.33	16.67
68.	100.00	0.00	0.00	66.67	33.33
69.	100.00	11.11	55.56	11.11	22.22
70.	100.00	20.00	20.00	60.00	0.00
71.	0.00	0.00	0.00	0.00	0.00

The fourth subsection, segment 11012, is 25 kilometers long from Teseney Junction to Sebderat. As the majority of traffic turns off of Route 11 to Teseney, the traffic on segment 11012 is very low. The 1972 base forecast is 3 cars, 3 buses, 6 trucks and 1 truck-trailer.

e. Teseney Junction to Teseney. (See Exhibit 2.14)

This is a single 6-kilometer section consisting of one segment, 11101. The 1972 traffic count at station 108b to Teseney was 78 vehicles. The car and truck-trailer traffic is declining while the bus and truck volume has slightly increased. The 1972 base forecast is 14 cars, 14 buses, 34 trucks and 14 truck-trailers, with an assumed annual growth rate of 1 percent per year.

f. Route 17, Adi Ugri to Areza.

This is a 42-kilometer section composed of five segments, 17001 through 17005. No traffic counts have been taken at this junction and the GRS field survey recorded no traffic on the section. As a result of the Consultants' own field efforts it was estimated that the traffic was minimal. Traffic count data at the old station 107a showed that little traffic at the Barentu-Teseney-Adi Ugri junction could be attributed to this road. As a result of the field investigations the 1972 base estimate is 4 cars, 2 trucks, 2 buses, and 0 truck-trailers. The one percent annual growth rate is used for forecasting purposes.

g. Route 50, Terramini to Decamere.

This is a 30-kilometer section of road composed of two segments, 50001 and 50002, linking Routes 1 and 3 south of Asmara. No traffic counts exist and the GRS field survey indicated one heavy vehicle in forty minutes. Expanded to twelve-hour day, this would be the equivalent of 18 vehicles. However, due to the declining traffic and the Consultants' own field work the 1972 base estimate is 4 cars, 8 buses and 4 trucks per day. The annual growth rate is 1 percent.

h. Route 12, Massawa to Agip. (See Exhibit 2.14)

This is a 6-kilometer section, segment 12001, going south

EXHIBIT 2.14

HISTORICAL PERCENTAGE TRAFFIC MIX ON SEGMENTS IN THE ASMARA DISTRICT

SEGMENT 11101

Station 108b AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	21.74	10.87	43.48	23.91
67.	100.00	26.98	17.46	39.68	15.87
68.	100.00	15.63	15.63	46.88	21.88
69.	100.00	11.54	21.79	46.15	20.51
70.	100.00	12.82	25.64	44.87	16.67
71.	0.00	0.00	0.00	0.00	0.00

SEGMENT 12001

Station 103a AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	29.03	12.90	52.82	5.24
67.	100.00	36.25	20.62	35.62	7.50
68.	100.00	29.88	18.29	42.07	9.76
69.	100.00	31.79	18.50	39.31	10.40
70.	100.00	44.95	19.19	27.27	8.59
71.	100.00	54.38	16.92	25.98	2.72

SEGMENTS 01301

Station 102c AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	24.44	72.22	3.33	0.00
67.	100.00	23.33	73.33	2.22	1.11
68.	100.00	77.40	12.07	8.36	2.17
69.	100.00	69.34	15.68	13.59	1.39
70.	100.00	70.48	14.46	12.65	2.41
71.	100.00	51.65	13.19	31.32	3.85

out of Massawa. Count station 103a (south) provides the historical data base for the traffic projection. Bus and truck traffic has been relatively constant over time. The 1972 base forecast is 95 cars, 44 buses, 90 trucks and 16 truck-trailers. The assumed annual growth is one percent.

i. Massawa - Gurgussum. (See Exhibit 2.14)

This is an 8-kilometer section, segment 01301, to the north of Massawa off Route 1. Count station 102c (north) provided the data base. Traffic has been erratic and the 1972 base forecast is 129 cars, 57 buses, 26 trucks and 4 truck-trailers. The one percent yearly growth rate is used.

2.15 Gonder District

a. Route 3, Tigre Provincial Boundary to Bahir Dar.

This is a 411-kilometer section consisting of 24 segments, 03023 through 03046. There are six traffic forecasting subsections in this section. Along the route there are four Minimum Package Programs in existence, with 1 approved demonstration area and one observation area. The MPP's are located near lake Tana.

An examination of Exhibit 2.15 illustrates the changing traffic mix on this route. Car traffic is only significant near towns. Bus traffic is a fairly constant percentage of the total along the entire section. Inter-urban truck-traffic is also constant, being distorted only near towns. Truck-trailer traffic is erratic on various sections and also varies considerably from year to year.

The first subsection is from the Tigre Provincial boundary to five km north of Debarek and is composed of segments 03038 through 03046. Only bus traffic has shown any consistent growth. Total volume on this subsection has been erratic, with car and truck-trailer traffic declining in importance and buses and trucks growing. The estimated 1972 base is 11 cars, 15 buses, 36 trucks and 6 truck-trailers. The 3.5 percent annual growth rate is applied to this base to provide the forecast. Count station 110a (south) was used as the historical base for projections.

EXHIBIT 2.15

HISTORICAL PERCENTAGE TRAFFIC MIX ON ROUTE 3, GONDER DISTRICT

SEGMENTS 03038 through 03046

Station 110A AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	14.29	28.57	57.14	0.00
67.	100.00	36.36	18.18	36.36	9.09
68.	100.00	25.00	41.67	33.33	0.00
69.	100.00	28.57	35.71	35.71	0.00
70.	100.00	27.78	33.33	38.89	0.00

SEGMENTS 03035 through 03037

Station 112 AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	13.64	22.73	50.00	13.64
67.	100.00	15.56	22.22	46.67	15.56
68.	100.00	13.89	33.33	38.89	13.89
69.	100.00	11.90	26.19	50.00	11.90
70.	100.00	13.64	29.55	47.73	9.09
71.	100.00	14.29	28.57	46.43	10.71

SEGMENTS 03032 through 03034

Station 113a AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	54.69	10.94	30.47	3.91
67.	100.00	56.30	15.97	23.53	4.20
68.	100.00	56.90	17.24	24.14	1.72
69.	100.00	57.89	16.45	23.68	1.97
70.	100.00	51.67	20.00	26.67	1.67
71.	100.00	48.66	21.39	28.88	1.07

EXHIBIT 2.15
(Continued)

SEGMENTS 03029 through 03031

Station 113a and 113Ab

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	55.70	8.86	31.65	3.80
67.	100.00	49.55	17.12	28.83	4.50
68.	100.00	46.96	19.13	31.30	2.61
69.	100.00	47.80	18.87	29.56	3.77
70.	100.00	42.86	21.43	33.33	2.38
71.	100.00	55.22	20.40	23.38	1.00

SEGMENTS 03026 through 03028

Station 113Ab AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	0.00	0.00	0.00	0.00	0.00
67.	100.00	28.57	32.14	35.71	3.57
68.	100.00	25.00	28.13	37.50	9.38
69.	100.00	27.91	6.98	37.21	27.91
70.	100.00	26.32	31.58	39.47	2.63
71.	100.00	17.50	55.00	22.50	5.00

SEGMENTS 03024 through 03025

Station 113Ac AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	0.00	0.00	0.00	0.00	0.00
67.	100.00	29.63	33.33	33.33	3.70
68.	100.00	24.24	27.27	36.36	12.12
69.	100.00	27.50	7.50	35.00	30.00
70.	100.00	31.03	34.48	31.03	5.17

The second subsection is 102 km long and consists of 3 segments; 03037, 03036 and 03035. The subsection ends 4 km north of Gonder and the traffic count is provided by station 112 (south). Car, bus and truck traffic has been relatively constant and truck-trailer traffic has declined slightly. A 7.5 percent growth rate is applied, to the 1972 forecast of 9 cars, 16 buses, 26 trucks and 8 truck-trailers.

Segments 03032, 03033 and 03034 make up the third subsection. It is 10 km long, from 4 kilometers north to 6 kilometers south of Gonder. The subsection is used heavily by local travelers. Therefore, the traffic counts from station 113a (north) were assumed to be representative of traffic north of Gonder. The 1972 estimate is 103 cars, 31 buses, 46 trucks and 5 truck-trailers. The 3.5 percent growth rate is used for forecasting purposes.

The fourth subsection is 44 kilometers long, consisting of segments 03029, 03030 and 03031 from Azezo junction halfway to Adis Zemen. Historical data from count stations 113b (east) and 113a (west) were averaged to provide the historical data base. The 1972 forecast is 51 cars, 17 buses, 27 trucks and 3 truck-trailers. The estimated growth rate is 3.5 percent per year. One of the MPP's is currently in existence in this area.

The next subsection is from segment 03026 through 03028. That is, from Adis Zemen to a point 34 kilometers west. Traffic count data from 113-Ab (west) reflected a significant decrease in traffic as the distance from Azezo junction increased. As data from station 113-A has been relatively constant, the 1971 count was used as a base. This is 10 cars, 7 buses, 16 trucks and 1 truck-trailer. The 3.5 percent annual growth rate is used.

The last subsection is from Adis Zemen to the Gonder Provincial Boundary, a distance of 95 kilometers. It consists of 3 segments; 03023, 03024 and 03025. Count station data from 113-A south to Bahir Dar was used as a forecasting base. One MPP is in existence. The 1972 base forecast is 10 cars, 7 buses, 13 trucks and 4 truck-trailers. The traffic mix has been erratic and the traffic volumes by vehicle type

have not demonstrated any trends. However, the total traffic volumes bear an acceptable relationship to time. Therefore, the 3.5 percent annual growth rate is used.

b. Route 27, Gonder Airport to Gorgora.

This is a five-segment section, 27001 through 27005, 35 kilometers in length. Count station 113 to Gorgora provides the data base. Only bus traffic has increased; other traffic has declined or has been erratic. The 1972 base traffic forecast is 24 cars, 13 buses, 10 trucks and 0 truck-trailers. The 1 percent annual growth is used due to the relatively stable total volume over the recent years.

c. Route 33, Gonder to Setit.

This is a 35-kilometer section consisting of two segments, 33001 and 33002. No count data is available. The GRS survey counted 1 vehicle in ten hours. There is an agricultural scheme being planned along this route to the northwest of Gonder. Traffic forecasts were not available as of the time of this study. Discussion with the contractor and the Consultants' field survey provided the 1972 base forecast of 4 cars, 1 bus and 1 truck per day. The one percent growth rate is used. More accurate traffic estimates will be available in mid-1972. At that time the maintenance recommendation should be reviewed.

2.16 Debre Markos District.

a. Route 3, Dejen to Bahir Dar.

This section is 335 kilometers long, is composed of segments 03007 through 03022, and consists of three forecasting subsections. Except for two existing MPP's and two demonstration areas no exceptional traffic generating activity is foreseen. Traffic is heaviest near Dejen on the Addis Ababa end and declines as Bahir Dar is approached.

The first subsection, segments 03007 and 03008, is 70 kilometers long from Dejen to Debre Markos. Data from count stations 10 (west) and 23 (east) were averaged to provide the base traffic. Growth trends

for all types of traffic were related to time and therefore the time-trend regression analysis for the station was used. This generated a 1972 base forecast of 54 cars, 46 buses, 42 trucks and 1 truck-trailer. The growth rate was calculated at 8.0 percent per year.

Segments 03009 through 03016, a distance of 187 kilometers from Dangla to Debre Markos, make up the next subsection. The traffic base is provided by count station 24 (south). As counts base only been taken for 3 years it was difficult to examine trends. Neither was it possible to have confidence in the station's percentage of the system total VKM. Based on a simple curve fitting on the three data points, a 1972 base forecast was generated. This forecast is 29 cars, 34 buses, 39 trucks and 1 truck-trailer per day. The system growth rate of 3.5 percent per year is used for forecasting.

The third and last subsection is from Dangla to Bahir Dar, a distance of 100 kilometers. Segments 03017 through 03022 make up this subsection. Count station 25 provided a two year data base. An annual growth rate of 3.5 percent is applied to the 1972 base of 31 cars, 39 buses, 30 trucks and 1 truck-trailer. The 1971 traffic figures were used as a basis for the 1972 forecast. See Exhibit 2.16.

b. Route 23, Dejen to Bichena.

This is a 31-kilometer section identified as segment 23001. No counts of traffic have been taken by the IHA. On the basis of the GRS survey and the Consultants' field work an estimated 10 cars, 11 buses, and 8 trucks per day are expected to use the route in 1972. There is one existing demonstration MPP at Dejen, and one proposed at Bichena. Due to this activity, a growth rate of 10 percent a year is used for forecasting.

c. Route 51, Bahir Dar to Tis Abat.

This is a thirty-kilometer section, segment 51001, providing access to the Blue Nile falls. No IHA traffic count is available and GRS survey data was used to provide an estimate of 40 cars, 3 buses, and 5 trucks per day.

EXHIBIT 2.16

HISTORICAL TRAFFIC MIX PERCENTAGES ON SEGMENTS 03007 - 03022

SEGMENTS 03007 - 03008

Station 10B and 23

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	28.00	36.00	35.60	0.40
67.	100.00	29.80	40.40	28.81	0.99
68.	100.00	30.77	39.01	40.11	1.10
69.	100.00	42.51	32.40	24.72	0.37
70.	100.00	56.48	20.44	22.86	0.22
71.	100.00	37.59	23.86	36.87	1.69

SEGMENTS 03009 - 03016

Station 24 AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	0.00	0.00	0.00	0.00	0.00
67.	0.00	0.00	0.00	0.00	0.00
68.	100.00	37.97	29.11	32.91	0.00
69.	0.00	0.00	0.00	0.00	0.00
70.	100.00	29.20	30.97	39.82	0.00
71.	100.00	23.30	29.61	46.12	0.97

SEGMENTS 03017 - 03022

Station 25 AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	0.00	0.00	0.00	0.00	0.00
67.	0.00	0.00	0.00	0.00	0.00
68.	0.00	0.00	0.00	0.00	0.00
69.	0.00	0.00	0.00	0.00	0.00
70.	100.00	28.57	29.87	28.57	0.00
71.	100.00	30.39	38.24	29.41	1.96

2.17 Jimma District.

a. Route 7, Ghibi River Bridge to 45 Kilometers West of Bonga Junction.

This section consists of three forecasting subsections and segments 07010 through 07022. This route serves a major coffee growing region of the country and has some of the greatest agricultural potential. There are 2 MPP's in existence and one demonstration area. There are 13 observation areas in the Jimma maintenance district. The uncertainties or lack of ultimate markets for agricultural surplus, the choice of Routes 5 or 7 to move the products, the timing of new MPP's, and the relatively small percentage increase in traffic which existing MPP's generate all make a detailed analysis of future traffic infeasible within the scope of the study. Traffic along Route 7 has shown continuous importance in the system in terms of vehicle-kilometers. Exhibit 2.17 illustrates the historical mix of traffic on this section.

The first subsection covers the 149 kilometers from the Ghibi River bridge to Jimma, segments 07010 through 07015. Traffic has been erratic due to the fluctuations in agricultural output. The total traffic was significantly correlated to time and the average of stations 19 (west) and 28a (east) was used. The forecasts as derived by regression analysis are used for this subsection. The 1972 base forecast is 58 cars, 42 buses, 60 trucks and 4 truck-trailers per day. The station regression analysis produced an annual growth rate of 7 percent per year.

The second subsection is beyond Jimma, segments 07016 through 07020, a distance of 105 kilometers. Station 28a (west) provided the historical data. Only one year's count, 1971, is available and this data was used as the 1972 base forecast. This is 40 cars, 30 buses, 33 trucks and 1 truck-trailer. The 7 percent growth is used. Only two MPP observation areas are beyond Jimma on the route, and even when or if these schemes go into production the traffic volume generated will not be a significant percentage of the projected traffic.

EXHIBIT 2.17

HISTORICAL MIX OF TRAFFIC ON SEGMENTS
07010 THROUGH 07022

Station 19 and 28a

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	15.73	44.94	38.20	1.12
67.	100.00	23.08	47.69	27.69	1.54
68.	100.00	30.43	15.22	50.00	4.35
69.	100.00	40.00	25.00	32.50	2.50
70.	100.00	38.11	22.43	37.03	2.43
71.	100.00	34.98	24.49	37.86	2.67

Station 28c AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	0.00	0.00	0.00	0.00	0.00
67.	0.00	0.00	0.00	0.00	0.00
68.	0.00	0.00	0.00	0.00	0.00
69.	0.00	0.00	0.00	0.00	0.00
70.	0.00	0.00	0.00	0.00	0.00
71.	100.00	39.68	29.10	31.22	0.00

The third subsection, segments 07021 and 07022, extends 45 kilometers beyond Bonga. The Consultants' own field work indicated that Bonga was a significant traffic break. The 1972 base forecast and growth rate was derived from the Bonga-Mizan Teferi feasibility study. This indicates 8 cars, 3 buses and 5 trucks per day, and a growth rate of 10 percent per year.

b. Route 43, Jimma - Bedele.

This section extends 145 kilometers north of Jimma to Bedele and consists of segments 43001 through 43009. For forecasting purposes the section is divided into 2 subsections. The road serves a major coffee producing area. Traffic is relatively heavy and the mix consists of roughly 50 percent cars, 25 percent buses and 25 percent trucks. Exhibit 2.18 shows the mix.

The first subsection from Jimma 95 kilometers north to Toba consists of sections 43001 through 43005. Count stations 27a (south) and 28b (north) were averaged to provide the historical traffic base. Traffic growth has been erratic and only car traffic has shown any growth trends. The 1972 forecast is 131 cars, 70 buses, 77 trucks and 8 truck-trailers per day. The 3.5 percent growth rate is used.

Segments 43006 through 43009, a distance of 50 kilometers, make up the second subsection. Station 27b north to Bedele provides the count data. Data exists only for 1970 and 1971. The 1971 data was used as the 1972 base forecast. This is a forecast of 57 cars, 16 buses, 33 trucks and 3 truck-trailers. The 3.5 percent growth rate as derived from the previous subsection is used.

c. Bonga Spur; Segment 07201.

This is a four-kilometer segment from Bonga to Route 7. The forecast traffic is the differential of traffic on the Jimma-Bonga section and on the Bonga-west section. This is 32 cars, 27 buses and 28 trucks per day in 1972. The estimated annual growth rate is 3.5 percent.

EXHIBIT 2.18

HISTORICAL TRAFFIC MIX ON SEGMENTS
43001 THROUGH 43009

Station 27a and 28b AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	0.00	0.00	0.00	0.00	0.00
67.	100.00	36.53	9.13	54.34	4.57
68.	100.00	62.99	15.75	18.90	2.36
69.	100.00	45.05	27.93	22.52	4.50
70.	100.00	50.46	25.23	22.31	1.86
71.	100.00	46.55	30.98	26.28	1.47

Station 27b AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	0.00	0.00	0.00	0.00	0.00
67.	0.00	0.00	0.00	0.00	0.00
68.	0.00	0.00	0.00	0.00	0.00
69.	0.00	0.00	0.00	0.00	0.00
70.	100.00	51.72	14.94	32.18	1.15
71.	100.00	50.89	14.29	29.46	2.68

d. Ghimbo Access Road.

This is a 10-kilometer segment, 07101, from Route 7 to Ghimbo. The 1972 traffic forecast was estimated from the Consultants' field surveys. This consists of 5 cars, 2 buses and 15 trucks per day. The 3.5 percent yearly growth rate is used for forecasting.

2.18 Shashamane District.

a. Route 6, Awash River Bridge to Dilla.

This is a 275-kilometer section which is heavily used by all types of traffic. It serves both popular resorts and agricultural areas. For forecasting purposes it was necessary to divide the section into five subsections. The entire section is made up of segments 06002 through 06008. See Exhibit 2.19 for the historical vehicle mix on these segments.

Subsection one covers the 40 kilometers from the Awash River Bridge to Meki. Count station 2a south to Shashamane provided the data base. Traffic is heavy and the 1972 base forecast is 239 cars, 37 buses, 132 trucks and 40 truck-trailers. All types of traffic have shown a constant growth over time and a 4.0 percent annual growth rate was derived from the station regression analysis. The mix of traffic has also been constant, with a mix of 48 percent cars, 20 percent buses, 25 percent trucks and 7 percent truck-trailers.

The second subsection, segments 06003 and 06004, covers the 115 kilometers from Meki to Shashamane. Both the traffic mix and traffic growth have been erratic but regression analysis provided a good time-trend correlation. Historical data was derived from station 15c (north) and the linear regression forecast was used as a base. This forecast for 1972 is 173 cars, 152 buses, 154 trucks and 7 truck-trailers, with an annual growth rate of 6 percent.

The next subsection, segments 06005 and 06006, is 65 kilometers long from Shashamane to Yergalem Junction. Count stations 15a south to Wondo and 14a north to Shashamane were averaged to provide the data base. Percentage growth per year for all types of traffic is erratic

EXHIBIT 2.19

HISTORICAL PERCENTAGE TRAFFIC MIX ON SEGMENTS IN THE SHASHAMANE DISTRICT

SEGMENT 06002

Station 2a AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	44.18	23.53	25.03	7.26
67.	100.00	46.58	20.72	26.06	6.64
68.	100.00	54.25	19.45	20.09	6.21
69.	100.00	44.76	23.69	20.71	10.83
70.	100.00	54.94	14.08	25.14	5.85
71.	100.00	50.19	19.77	23.06	6.98

SEGMENTS 06003 - 06004

Station 15c AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	33.33	32.12	33.33	1.21
67.	100.00	33.33	30.70	34.80	1.17
68.	100.00	47.80	27.20	23.63	1.37
69.	100.00	41.46	28.89	28.39	1.26
70.	100.00	21.55	38.28	38.49	1.67
71.	100.00	40.32	27.19	30.88	1.61

SEGMENTS 06005 - 06006

Station 14a and 15a

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	31.52	31.13	34.63	2.72
67.	100.00	33.61	32.22	33.06	1.11
68.	100.00	47.38	27.62	23.59	1.41
69.	100.00	40.46	28.42	29.05	2.07
70.	100.00	37.87	30.14	29.98	2.01
71.	100.00	42.94	25.53	29.59	1.93

EXHIBIT 2.19
(Continued)

SEGMENT 06007

Station 14b AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	57.14	25.00	16.33	1.53
67.	100.00	45.12	32.32	21.95	0.61
68.	100.00	53.51	27.19	17.98	1.32
69.	100.00	53.25	24.68	19.48	2.60
70.	100.00	48.51	26.87	23.13	1.49
71.	100.00	54.66	21.86	21.46	2.02

SEGMENT 06008

Station 13a AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	24.68	45.45	28.57	1.30
67.	100.00	26.00	49.00	24.00	1.00
68.	100.00	34.62	39.74	24.36	1.28
69.	100.00	30.00	45.00	21.25	3.75
70.	100.00	26.81	36.96	34.78	1.45
71.	100.00	31.62	32.35	33.82	2.21

SEGMENTS 41001 - 41004

Station 15b AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	24.00	32.00	42.67	1.33
67.	100.00	24.49	36.73	37.76	1.02
68.	100.00	33.33	33.33	32.50	0.83
69.	100.00	31.97	35.25	31.97	0.82
70.	100.00	36.02	31.42	32.18	0.38
71.	100.00	39.21	26.43	33.48	0.88

EXHIBIT 2.19
(Continued)

SEGMENTS 44001 - 44004

Station 13b AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	25.71	31.43	34.29	8.57
67.	100.00	21.74	30.43	45.65	2.17
68.	100.00	28.00	32.00	34.00	6.00
69.	100.00	23.88	40.30	32.84	2.99
70.	100.00	30.56	26.39	37.50	5.56
71.	100.00	31.94	18.06	41.67	8.33

SEGMENT 06101

Station 14c AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	55.60	29.46	14.94	0.00
67.	100.00	45.30	36.75	17.95	0.00
68.	100.00	50.92	39.11	9.96	0.00
69.	100.00	50.00	37.76	11.89	0.35
70.	100.00	47.39	35.89	16.72	0.00
71.	100.00	54.12	31.54	13.98	0.36

but the mix of traffic has been stable with about 40 percent cars, 29 percent buses, 29 percent trucks and 2 percent truck-trailers. Both the regression analysis and the share of system total projected a high growth rate of 7.5 percent per year. The base 1972 forecast is 120 cars, 89 buses, 85 trucks and 6 truck-trailers.

The 18-kilometer subsection from Yergalem Junction to Wondo, segment 06007, is the fourth subsection. Count station 14b south to Wondo provides the forecasting data base. Annual percentage growth has been erratic but there is still a fairly high correlation of traffic to time. The station also has contributed a relatively stable percentage of VKM to the system total. The 1972 base forecast is 158 cars, 79 buses, 56 trucks, and 5 truck-trailers. The annual growth rate is 7.5 percent. There is one MPP in existence and five observation areas to the south of Wondo. Traffic figures are high on this segment due to the local traffic.

The last subsection, segment 06008, covers the 37 kilometers from Wondo to Dilla; count station 13a south to Dilla provides the traffic base. Annual percentage growth for all types of vehicles is unstable, but again the time-trend regression analysis provides a significant correlation. Forecasts by all methods were similar and the 1972 base forecast is 39 cars, 56 buses, 35 trucks and 3 truck-trailers. The estimated growth rate is 7.5 percent per year.

b. Route 41 Shashamane to Sodo.

This route is 140 kilometers long, and consists of segments 41001 through 41004. The only count station covering this section is at Shashamane, 15b to Sodo. Traffic is high as the section provides access to the WADU agricultural scheme and the entire agricultural region. The station time-trend regression analysis showed high correlation against time for all vehicle types except truck-trailers. The annual growth rate for this section is 8.0 percent a year. Exhibit 2.19 shows the vehicle mix. The 1972 base traffic forecast is 91 cars, 71 buses, 54 trucks and 1 truck-trailer. This high traffic reflects the area development which has taken place in the last 3 years. The Hosaina-Sodo

road feasibility study was examined for traffic forecasts, but it was the general finding of this study that local traffic generated would be light and most traffic would be diverted through traffic. As the Hosaina-Sodo road was not approved, traffic patterns in the area will not change.

c. Route 9, Sodo to Arbaminch.

This is a 100-kilometer section, made up of segments 09030 through 09034. For forecasting purposes the GRS survey data was used as the Shashamane-Sodo section forecast was not considered applicable to this section. The Consultants' own field work was used in conjunction with the GRS survey. The 1972 base forecast is 5 cars, 7 buses and 3 trucks; the growth rate is 3.5 percent. No MPP's are in existence but 1 demonstration and observation area are underway.

d. Route 8, Dodola to Goba.

This is a 117-kilometer section consisting of segments 08025 through 08028. There is no acceptable traffic count station data for the section. The GRS survey work was utilized to provide a forecast base, with the section divided into two subsections.

The first of these subsections, segments 08025 and 08026, is the 37 kilometers from Dodola to the vicinity of Adaba. Traffic is low and the 1972 estimate is 10 cars, 9 buses and 10 trucks. The original estimated growth rate was 3 percent a year, but has been revised to 7.5 percent to include the one Minimum Package Program and one observation area.

The second section, segments 08027 and 08028, extends the remaining 80 kilometers to Goba. The traffic estimate is based on the GRS survey and the 1972 forecast is 2 cars, 2 buses and 2 trucks. The Consultants' own field work verified this low count. The 7.5 percent rate is used for forecasting purposes.

e. Route 44, Wondo to Negele.

This is a 262-kilometer section from Wondo to Negele consisting of segments 44001 through 44005. The section is divided into

two subsections, one from Wondo to Kebremengist and the second from Kebremengist to Negele. There are 3 MPP observation areas along the section, but there is no schedule for their implementation.

The first subsection is 138 kilometers long and has a historical traffic count provided by station 13b to Kebremengist. Annual traffic growth is unstable, as is the historical vehicle mix. See Exhibit 2.19. All the forecasting methods produced similar forecasts. The 1972 base estimate is 20 cars, 23 buses, 27 trucks and 4 truck-trailers. The annual growth rate as determined by the station time-trend regression is 5.0 percent, but a 7.5 percent rate was applied to include the potential agricultural schemes.

The second section is identified as segment 44005. It is 124 km in length and runs from Kebremengist to Negele. No accurate count data is available but the Consultants' own field trips indicated a traffic fall-off beyond Kebremengist. The 1972 base estimate is 4 cars, 4 buses and 6 trucks; a growth rate of 3.5 percent annually is used.

f. Yergalem Spur; Segment 06101.

This is a 6-kilometer spur off of Route 6 to the town of Yergalem. Count station 14c measures the traffic in this direction. Traffic mix has been unstable, but the section has accounted for a fairly constant percentage of total vehicle kilometers. Car, bus, and truck volumes have significant time-trends. The 1972 base forecast is 185 cars, 128 buses and 148 trucks. Based on the past growth, the 7.5 percent annual growth rate is used.

g. Route 40, Shashamane to Dodola.

Route 40 from Shashamane to Dodola is 101 kilometers long and consists of three segments; 40001, 40002, and 40003. For forecasting purposes the section is divided into 3 subsections. There is one MPP centered near Dodola, and 2 observation areas to the east of Dodola.

The first subsection, segment 40001, is 20 kilometers long and covers Kofole to Shashamane. Count station 15-A (west) provides the

historical traffic data. The station was new in 1971, and only one year of data exists. The 1971 count was used as the 1972 base forecast. This is a forecast of 125 cars, 63 buses, 64 trucks and 6 truck-trailers. The 7.5 percent growth rate is used.

The second subsection, segment 40002, extends 16 kilometers west of Kofole where a change in surface occurs. The 1971 data from station 15-A (east) is used as a forecast for 1972. This is 67 cars, 26 buses, 32 trucks and 2 truck-trailers. Again, the 7.5 percent growth rate is used.

The next 65 kilometers along route 40, segment 40003 to Dodola, is the third subsection. Based on the Consultants' field trips it was obvious that a traffic fall-off occurs when the surface becomes rough. The 1972 traffic estimate is 55 cars, 20 buses and 25 trucks. The growth rate is 7.5 percent annually.

2.19 Dire Dawa District.

a. Route 4, Awash River Bridge to Jijiga.

Route 4 in the Dire Dawa District extends 405 kilometers and is composed of 29 segments, 04015 through 04043. The section is divided into 6 traffic forecasting subsections. The route provides the primary access to the east and southeastern portions of the country. Traffic is generally less than 200 vehicles per day, except near towns such as Dengego and Harer. Exhibit 2.20 shows that traffic mix is consistent on rural roads in the area. Near towns, the proportion of cars increases.

Subsection one extends 75 kilometers from the Awash River Bridge to 2 kilometers east of Mieso. The average of data from count stations 16b (east) and 32a (west) is used as a forecasting base. Only one year's data existed for station 32 west, but this one year's data indicated that traffic fall-off was not exceptional along the subsection. The 1972 base estimate is 97 cars, 26 buses, 72 trucks and 1 truck-trailer. Traffic mix was erratic but volumes were significantly correlated with time. The 7.5 percent annual growth rate was used for forecasting purposes.

EXHIBIT 2.20

HISTORICAL PERCENTAGE TRAFFIC MIX ON SEGMENTS IN THE DIRE DAWA DISTRICT

SEGMENTS 04043 - 04022
(See ALEMGENA DISTRICT SECTION)

SEGMENTS 04023 - 04031

Station 26b and 32b AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	0.00	0.00	0.00	0.00	0.00
67.	0.00	0.00	0.00	0.00	0.00
68.	0.00	0.00	0.00	0.00	0.00
69.	0.00	0.00	0.00	0.00	0.00
70.	100.00	33.33	26.39	40.28	0.00
71.	100.00	37.96	19.59	36.73	0.82

SEGMENTS 04032 - 04033

Station 8c and 26a

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	34.78	34.78	28.99	1.45
67.	100.00	28.47	37.23	32.85	1.46
68.	100.00	32.30	31.68	35.40	0.62
69.	100.00	30.60	35.07	33.58	0.75
70.	100.00	36.10	25.63	38.27	0.00
71.	100.00	38.01	22.88	38.38	0.74

SEGMENTS 04035 - 04036

Station 8a AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	44.58	32.08	22.17	1.18
67.	100.00	44.44	31.07	24.04	0.45
68.	100.00	50.90	29.86	18.44	0.80
69.	100.00	56.64	22.61	20.33	0.41
70.	100.00	60.38	17.14	22.10	0.38
71.	100.00	57.45	23.33	19.01	0.22

EXHIBIT 2.20
(Continued)

SEGMENTS 04037 - 04043

Station 9 AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	39.09	25.45	32.73	2.73
67.	100.00	32.69	29.81	36.54	0.96
68.	100.00	38.86	33.71	26.29	1.14
69.	100.00	40.34	27.27	31.25	1.14
70.	100.00	36.72	27.68	35.03	0.56
71.	100.00	37.09	21.85	39.74	1.32

SEGMENTS 04401 - 04402

Station 8b AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	43.19	32.05	24.18	0.58
67.	100.00	42.10	31.80	25.37	0.74
68.	100.00	47.65	30.63	20.91	0.81
69.	100.00	54.15	24.37	20.94	0.54
70.	100.00	59.46	18.09	22.28	0.17
71.	100.00	59.63	20.54	19.69	0.14

SEGMENTS 20003 - 20004

Station 7 AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	100.00	57.66	0.00	42.34	0.00
67.	100.00	55.47	11.68	32.85	0.00
68.	100.00	54.36	16.11	29.53	0.00
69.	100.00	44.36	16.54	39.10	0.00
70.	100.00	48.91	13.14	37.96	0.00
71.	100.00	40.26	11.69	48.05	0.00

EXHIBIT 2.20
(Continued)

SEGMENT 04301

Station 26c AADT

Year	Total	Cars	Buses	Trucks	Tr/Tr.
66.	0.00	0.00	0.00	0.00	0.00
67.	0.00	0.00	0.00	0.00	0.00
68.	0.00	0.00	0.00	0.00	0.00
69.	0.00	0.00	0.00	0.00	0.00
70.	100.00	70.69	15.52	13.79	0.00
71.	100.00	68.18	16.67	15.15	0.00

The second subsection is from Mieso to Asbe Teferi, segments 04023 and 04024, a distance of 25 kilometers. The 1972 base forecast is 54 cars, 24 buses, 42 trucks and 1 truck-trailer. The 3.5 percent growth rate is used for forecasting.

The third subsection, segments 04025 through 04031, extends from Asbe Teferi to Kobo. The 1971 counts from station 32b (southeast) and station 26b (southwest) were averaged to provide the 1972 traffic base. This forecast is 44 cars, 21 buses, 32 trucks and 1 truck-trailer. The 3.5 percent growth rate is used for forecasting.

The fourth subsection, segments 04032 and 04033, covers a distance of 60 kilometers from Kobo to Dengego. The average of count stations 26a (northeast) and 8c (southwest) was taken to provide the forecasting base. Car and truck traffic have good growth trends over time, but bus traffic seems to be declining. The 1972 base forecast is 66 cars, 33 buses, 63 trucks and 2 truck-trailers. Growth has been slow and a rate of 3.5 percent per year is used.

The fifth subsection, segments 04035 through 04036, covers the 45 kilometers from Dengego to Harer. There is heavy inter-town traffic. Station 8a southwest to Harer at Dengego provides the forecasting base. As bus and truck-trailer traffic has been declining, the high forecast was not acceptable. Total volume was significantly correlated to time and the station time-trend regression forecast was used. The 1972 base forecast is 292 cars, 117 buses, 106 trucks and 2 truck-trailers. A low 3.5 percent annual growth rate is used.

The sixth subsection is 90 kilometers long from Harer to Jijiga, and is made up of segments 04037 through 04043. Count station 9, two kilometers east of Harer, provided the traffic base. Traffic mix as well as annual percentage growth has been unstable. See Exhibit 2.20. The 1972 forecast is 65 cars, 50 buses, 55 trucks and 2 truck-trailers. A 3.5 percent growth rate is used.

b. <u>Dengego-Dire Dawa; Segments 04401 and 04402.</u>

This is a 21-kilometer section that consists of 2 segments. Traffic is very heavy on the section, with car traffic increasing and bus

and truck traffic declining. Annual percentage growth is erratic by vehicle type, but total traffic has a good time-trend growth. The section also has a relatively constant percentage of the system total vehicle-kilometers. The 1972 estimate is 401 cars, 216 buses, 169 trucks and 4 truck-trailers per day. The 7.5 percent annual growth rate is used.

c. Route 20, Dire Dawa to Erer.

Segments 20003 and 20004 make up this section. This is a heavily used section, especially in the dry season when it provides a shorter route to Mieso from Dire Dawa. Count station 7 provides traffic data on this section. Car traffic is declining, while truck traffic is increasing. The annual percentage growth by vehicle type is erratic. See Exhibit 2.20. Total volume is highly correlated with time. A growth rate of 3.5 percent per year is applied to the 1972 base forecast of 81 cars, 21 buses and 66 trucks per day.

d. Route 35, Juni to Gelemso.

This section is 64 kilometers long and consists of 6 segments. It extends from the junction of Routes 4 and 35 to the town of Gelemso, and provides access to an agricultural area. No IHA traffic data exists and the GRS road survey was used as a guide to the traffic volume. The Consultants' own field work verified that traffic was low on this section. The 1972 base forecast is 5 cars, 2 buses, and 3 trucks per day. The annual growth rate is estimated at 3.5 percent.

e. Route 30, Jijiga to Dogehbur

This is a one segment, 30001, section extending 171 kilometers south from Jijiga. No IHA traffic count exists. The GRS road survey and the Consultants' field trips indicated low traffic. The GRS survey was used to provide a 1972 forecast of 5 cars, 2 buses and 3 trucks per day.

f. Kobo to Deder.

This is a 12-kilometer spur from Route 4 south to Deder from Kobo. The segment number is 04301. The new traffic count

station, number 26, at Kobo provides a one-year count in this direction. The 1971 traffic count was used as the 1972 base forecast. This forecast is 86 cars, 11 buses and 10 trucks daily. A 3.5 percent growth rate is used.

Section 3.0

COMPUTER PROGRAMS

3.1 Input Data for Highway Maintenance Programs to Calculate VOC, Net Benefits and Present Value Net Benefit

Item	Columns	Description
Segment 1. D	1-5	Identification
Condition Rating	6, 7	Surface Condition
KDS	11, 12, 13	Distance
CAR	15-18	Car Daily Traffic
BUS	20-23	Bus Daily Traffic
Truk	25-28	Truck Daily Traffic
TTRL	30-33	Truck/Trailer D/Traffic
CCAR	34-37	Cost Increment Cars
CBUS	38-41	" " Buses
CTRUK	42-45	" " Trucks
CTTRL	46-49	Cost Increment Truck/Trailer
PER	50, 51, 52	Annual Traffic Increase
CMAI	54-57	Maint. Cost per km.
XINT	59, 60, 61	Opportunity Cost of Capital
LIFE	62, 63	Life of Segment

3.2 Program to Calculate Segment and Summation of Segments; Vehicle Operating Cost, Maintenance Cost, Net Benefit and Present Value Net Benefit

```
// FOR
* IOCS (CARD, 1132 PRINTER)
* ONE WORD INTEGERS
* LIST ALL
        DIMENSION VCST (20), CCST (20), XNBE (20), PVBE (20),
        K (20)
   60 WRITE (3, 100)
  100 FORMAT (1H1, 25X, 'PRIORITY RANKING')
   50 N=1
      SVBE=O
      SNBE=O
      SVCT=O
      SCST=O
      K (N)=N
      READ (2, 1)SN, NYR, KDS, CAR, BUS, TRUK, TTRL, CCAR,
      CBUS, CTRK, CTTR, PER, CMAI, 1, XINT, LIFE, LYR
    1 XINT, LIFE, LYR
```

```
 1 FORMAT (F5.0, 14, 1X,  13, 1X, F4.0, 1X, F4.0, 1X, F4.0, 1X,F4.0
   4F4.2, F4.2,
  1 F4.0, 1X, F3.2, 12, 13)
   XINT=.10
 3 FORMAT  (//10X, 'SEGMENT',  F7.0, 5X, "START YEAR',
   16, 5X, 'STOP YEAR 1', 2X, II)
   WRITE (3, 3) SN, NYR, LYR
   WRITE (3, 4)
 4 FORMAT (// 3X,  'YEAR',  4X,  'VEHICLE OP', 4X'MAINTENANCE'
   4X,  'NET BENEFIT',
        3X'PRESENT VALUE')
   IF (LIFE) 90, 60, 80
80 CDST=CAR* (CCAR/LIFE)*N*KDS*365.
   BDST=BUS* (CBUS/LIFE)*N*KDS*365.
   TDST=TRUK *(CTRK/LIFE)*N*KDS*365.
   RDST=TTRL* (CTTR/LIFE)*N*KDS*365.
   GO TO 70
10 N=N+L
   K (N)=N
   IF (N-LIFE) 20, 20, 30
20 CDST=CAR*(CCAR/LIFE)*N* (  (1.+PER)**(N-1)  )*KDS*365.
   BDST=BUS* (CBUS/LIFE)*N* (  (1.+PER)**(N-1)  )*KDS*365.
   TDST=TRUCK*(CTRK/LIFE)*N*( (1.+PER)**(N-1) )*KDS*365.
   RDST=TTRL*(CTTR/LIFE)*N*( (1.+PER)**(N-1) *KDS*365.
70 VCST (N)=CDST+BDST+TDST+RDST
   VCST (N)=VCST (N)*1.
   SVCT=SVCT=VCST (N)
   CMAI=CMAI*1.
   CCST (N)=CMAI*KDS*1.1
   SCST=SCST=CCST (N)
   XNBE (N)=VCST (N)-CCST (N)
   SNBE=SNBE+XNBE (N)
   PVBE (N)=XNBE (N)*(1./(1.+XINT)**(N))
   SVBE=SVBE+PVBE (N)
   GO TO 10
30 WRITE (3, 2)(K(M),  VCST(M), CCST(M), XNBE(M), PVBE(M),
   M=1, LIFE)
 2 FORMAT (3X, 13, 4F15.2)
 5 FORMAT (5X, '----------
 1---------')
 WRITE (3, 5)
12 FORMAT (1X, 'TOTAL',  4F15.2)
   WRITE (3, 12) SVCT, SCST, SNBE, SVBE
   GO TO 50
90 CALL EXIT
                    END
```

Program to Calculate Incremental Vehicle Operating Cost per Year

```
 // FOR
*IOCS (CARD, 1132 PRINTER, DISK)
*ONE WORD INTEGERS
*EXTENDED PRECISION
*LIST ALL
      DIMENSION CCAR (24), CBUS(24), CTRUK(24), CTRTL(24)
      TOTAL=O
      READ (2. 1)(CCAR (I), CBUS (I), CTRUK(I), CTRTL(I), I=1, 24)
    1 FORMAT (4F2. 2)
    2 FORMAT (F5. O, 12, 3X, 13, 4F5. O)
      WRITE (3, 5)
    5 FORMAT (1H1, 3X, 'SEGMENT', 9X, 'CAR', 9X, 'BUS', 7X,
      'TRUCK', 4X, '=TRAILER'
     1,6X, 'OPERATION COST')
      CTRTL (24)=1, 15
   20 READ (2, 2)SN, N, KDS, CAR, BUS, TRUK, TTRL
      IF (SN)10, 10, 15
   15 IF (N) 20, 20, 30
   30 CDST=CCAR (N)*CAR*KDS* 365.
      BDST=CBUS (N)*BUS*KDS* 365.
      TDST=CTRUK (N)*TRUK*KDS*365.
      RDST=CTRTL (N)*TTRL*KDS*365.
      VCST=CDST+BDST+TDST+RDST
      TOTAL=TOTAL+VCST
      WRITE (3, 3)SN, CDST, BDST, TDST, RDST, VCST
    3 FORMAT (5X, F6. 0, 4F12. 2, F20. 2)
      GO TO 20
   10 WRITE (3, 4) TOTAL
    4 FORMAT (10X, 'SUM OF VEHICLE OPERATION COST----', F20. 2)
      CALL EXIT
                        END
```

3.4 Priority Ranking Input Data

Item	Columns	Description
BSEGM	1-5	Beginning Segment
ESEGM	7-11	END Segment
BENF	15-25	Net Benefit
PVALU	35-45	Present Value Net Benefit

3.5 Priority Ranking Program

```
// FOR
*IOCS (CARD, 1132, PRINTER, DISK)
*ONE WORD INTEGERS
*LIST ALL
*EXTENDED PRECISION
      DIMENSION BSEGM(99), ESEGM(99), BENF(99), PVALU(99)
      K=O
      J=O
      WRITE (3, 3)
      WRITE (3, 4)
```

```
101 READ (2, 1) BS, ES, BNF, X
        IF (X)100, 30, 100
100 K=K+1
    BSEGM(K) = BS
    ESEGM(K) = ES
    BENF(K)  = BNF
    PVALU(K) = X
    TO TO 101
 30 LC=K
 11 J=J+1
    N=J
    X=PVALU(J)
    BS=BSEGM(J)
    ES=ESEGM(J)
    BNF=BENF(J)
    M=J+1
    DO  10  I=M, K
    IF  (X)50, 60, 60
 50 IF (PVALU(I))70, 20, 20
 70 Y=-1.*X
    X=-1.*PVALU(I)
    IF (Y-Z)10, 20, 20
 60 IF (PVALU (I))10, 80, 80
 80 IF (X-PVALU(I))20, 10, 10
 20 N=1
    X=PVALU (I)
   BS=BSEGM(I)
   ES=ESEGM(I)
   BNF=BENF(I)
 10 CONTINUE
   PVALU (N)=PVALU(J)
   BSEGM(N)=BSEGM(J)
   ESEGM(N)=ESEGM(J)
   BENF(N)  =BENF(J)
   PVALU(J)=X
   BSEGM(J)=BS
   ESEGM(J)=ES
   BENF(J)  =BNF
   IF (J-LC)11, 40, 40
 40 PVALU(K)=PVALU(N)
   BSEGM(K)=BSEGM(N)
   ESEGM(K)=ESEGM(N)
   BENF(K)  =BENF(N)
   WRITE (3, 2)(BSEGM(L), ESEGM(L), BENF(L), PVALU(L), L=1, K)
  1 FORMAT (F5. 0, F6. 0, 3X, F13. 2, 7X, F13. 2)
  2 FORMAT (//  7X, 2F9. 0, 2F20. 2)
  3 FORMAT (1H1, 30X, 'PRIORITY RANKING', //)
  4 FORMAT (15X, 'SEGMENT', 11X, 'NET BENEFITS', 7X,
   'PRESENT VALUE')
   CALL EXIT

   END
```

Section 3.1

INPUT DATA FOR HIGHWAY MAINTENANCE PROGRAMS TO CALCULATE VOC, NET BENEFITS AND PRESENT VALUE NET BENEFIT

Item	Columns	Description
Segment I. D.	1-5	Identification
Condition Rating	6, 7	Surface Condition
KDS	11, 12, 13	Distance
CAR	15-18	Car Daily Traffic
BUS	20-23	Bus Daily Traffic
TRUK	25-28	Truck Daily Traffic
TTRL	30-33	Truck/Trailer Daily Traffic
CCAR	34-37	Cost Increment Cars
CBUS	38-41	Cost Increment Buses
CTRUK	42-45	Cost Increment Trucks
CTTRL	46-49	Cost Increment Truck/Trailer
PER	50, 51, 52	Annual Traffic Increase
CMAI	54-57	Maintenance Cost per KM
XINT	59, 60, 61	Opportunity Cost of Capital
LIFE	62, 63	Life of Segment

Section 3.2

PROGRAM TO CALCULATE SEGMENT AND SUMMATION OF SEGMENTS; VEHICLE OPERATING COST, MAINTENANCE COST, NET BENEFIT AND PRESENT VALUE NET BENEFIT

```
// FOR
*IOCS(CARD,1132 PRINTER)
*ONE WORD INTEGERS
*LIST ALL
      DIMENSION VCST(20),CCST(20),XNBE(20),PVBE(20),K(20)
      WRITE(3,100)
  100 FORMAT(1H1,25X,'PRIORITY   RANKING')
   50 N=1
      SVBE=0.
      SNBE=0.
      SVCT=0.
      SCST=0.
      K(N)=N
      READ(2,1)SN,NYR,KDS,CAR,BUS,TRUK,TTRL,CCAR,CBUS,CTRK,CTTR,PER,CMAI
     1,XINT,LIFE,LYR
    1 FORMAT(F5.0,I4,1X, I3,1X,F4.0,1X,F4.0,1X,F4.0,1X,F4.0,4F4.2, F4.2,
     1  F4.0,1X,F3.2,I2,I3)
      XINT=.10
    3 FORMAT    (//10X,'SEGMENT',F7.0,5X,'START YEAR',    I6,5X,'STOP YEAR
     1',2X,I1)
      WRITE(3,3)SN,NYR,LYR
      WRITE(3,4)
    4 FORMAT(// 3X,'YEAR',4X,'VEHICLE OP',4X'MAINTENANCE',4X,'NET BENEFI
     1T',3X'PRESENT VALUE')
      IF(LIFE)90,80,80
   80 CDST=CAR*(CCAR/LIFE)*N*KDS*365.
      BDST=BUS*(CBUS/LIFE)*N*KDS*365.
      TDST=TRUK*(CTRK/LIFE)*N*KDS*365.
      RDST=TTRL*(CTTR/LIFE)*N*KDS*365.
      GO TO 70
   10 N=N+1
      K(N)=N
      IF(N-LIFE)20,20,30
   20 CDST=CAR*(CCAR/LIFE)*N*((1.+PER)**(N-1))*KDS*365.
      BDST=BUS*(CBUS/LIFE)*N*((1.+PER)**(N-1))*KDS*365.
      TDST=TRUK*(CTRK/LIFE)*N*((1.+PER)**(N-1))*KDS*365.
      RDST=TTRL*(CTTR/LIFE)*N*((1.+PER)**(N-1))*KDS*365.
   70 VCST(N)=CDST+BDST+TDST+RDST
      VCST(N)=VCST(N)*1.
      SVCT=SVCT+VCST(N)
      CMAI=CMAI*1.
      CCST(N)=CMAI*KDS*1.1
      SCST=SCST+CCST(N)
      XNBE(N)=VCST(N)-CCST(N)
      SNBE=SNBE+XNBE(N)
      PVBE(N)=XNBE(N)*(1./(1.+XINT)**(N))
      SVBE=SVBE+PVBE(N)
      GO TO 10
   30 WRITE(3,2)(K(M),VCST(M),CCST(M),XNBE(M),PVBE(M), M=1,LIFE)
    2 FORMAT(3X,I3,4F15.2)
    5 FORMAT(5X,'-----------------------------------------------------
     1------')
      WRITE(3,5)
   12 FORMAT(1X,'TOTAL',4F15.2)
      WRITE(3,12)SVCT,SCST,SNBE,SVBE
      GO TO 50
   90 CALL EXIT
      END
```

Exhibit 3.3

PROGRAM TO CALCULATE INCREMENTAL VEHICLE OPERATING COST PER YEAR

```
// FOR
*IOCSTCARD,1132 PRINTER
*ONE WORD INTEGERS
*EXTENDED PRECISION
*LIST ALL
      DIMENSION CCAR(24),CBUS(24),CTRUK(24),CTRTL(24)
      TOTAL=0
      READ(2,1)(CCAR(I),CBUS(I),CTRUK(I),CTRTL(I),I=1,24)
    1 FORMAT(4F2.2)
    2 FORMAT(F5.0,I2,3X,I3,4F5.0)
      WRITE(3,5)
    5 FORMAT(1H1,3X,'SEGMENT',9X,'CAR',9X,'BUS',7X,'TRUCK',4X,'+TRAILER'
     1,6X,'OPERATION COST')
      CTRTL(24)=1.15
   20 READ(2,2)SN,N,KDS,CAR,BUS,TRUK,TTRL
      IF(SN)10,10,15
   15 IF(N)20,20,30
   30 CDST=CCAR(N)*CAR*KDS*365.
      BDST=CBUS(N)*BUS*KDS*365.
      TDST=CTRUK(N)*TRUK*KDS*365.
      RDST=CTRTL(N)*TTRL*KDS*365.
      VCST=CDST+BDST+TDST+RDST
      TOTAL=TOTAL+VCST
      WRITE(3,3)SN,CDST,BDST,TDST,RDST,VCST
    3 FORMAT(3X,F6.0,4F12.2,F20.2)
      GO TO 20
   10 WRITE(3,4)TOTAL
    4 FORMAT(10X,'SUM OF VEHICLE OPERATION COST------',F20.2)
      CALL EXIT
      END
```

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Section 3.4

PRIORITY RANKING INPUT DATA

Item	Columns	Description
BSEGM	1-5	Beginning Segment
ESEGM	7-11	End Segment
BENF	15-25	Net Benefit
PVALU	35-45	Present Value Net Benefit

Exhibit 3.5

PRIORITY RANKING PROGRAM

```
// FOR
*IOCS(CARD,1132 PRINTER,DISK)
*ONE WORD INTEGERS
*LIST ALL
*EXTENDED PRECISION
      DIMENSION BSEGM(99),ESEGM(99),BENF(99),PVALU(99)
      K=0
      J=0
      WRITE(3,3)
      WRITE(3,4)
  101 READ(2,1)BS,ES,BNF,X
      IF(X)100,30,100
  100 K=K+1
      BSEGM(K)=BS
      ESEGM(K)=ES
      BENF(K)=BNF
      PVALU(K)=X
      GO TO 101
   30 LC=K
   11 J=J+1
      N=J
      X=PVALU(J)
      BS=BSEG (J)
      ES=ESEGM(J)
      BNF=BENF(J)
      M=J+1
      DO 10 I=M,K
      IF(X)50,60,80
   50 IF(PVALU(I))70,20,20
   70 Y=-1.*X
      Z=-1.*PVALU(I)
      IF(Y-Z)10,20,20
   60 IF(PVALU(I))20,80,80
   80 IF(X-PVALU(I))20,10,10
   20 N=I
      X=PVALU(I)
      BS=BSEGM(I)
      ES=ESEGM(I)
      BNF=BENF(I)
   10 CONTINUE
      PVALU(N)=PVALU(J)
      BSEGM(N)=BSEGM(J)
      ESEGM(N)=ESEGM(J)
      BENF(N)=BENF(J)
      PVALU(J)=X
      BSEGM(J)=BS
      ESEGM(J)=ES
      BENF(J)=BNF
      IF(J-LC)11,40,40
   40 PVALU(K)=PVALU(N)
      BSEGM(K)=BSEGM(N)

      ESEGM(K)=ESEGM(N)
      BENF(K)=BENF(N)
      WRITE(3,2)(BSEGM(L),ESEGM(L),BENF(L),PVALU(L),L=1,K)
    1 FORMAT(F5.0,F6.0,3X,F13.2,7X,F13.2)
    2 FORMAT(// 7X,2F9.0,2F20.2)
    3 FORMAT(1H1,30X,'PRIORITY  RANKING',//)
    4 FORMAT(15X,'SEGMENT',11X,'NET BENEFITS',7X,'PRESENT-VALUE')
      CALL EXIT
      END
```

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Section 4.0

FORECAST OF VEHICLE FLEET

4.1 Synopsis

A forecast of the vehicle fleet in Ethiopia was required for two primary reasons. First, so that the system vehicle-kilometers as generated by the system AADT forecast (see Section V) could be cross-checked against the system vehicle-kilometers generated by the forecast of the vehicle fleet. Secondly, the fleet forecast and associated vehicle import projections were needed to provide a base for determining future "road user charge" revenues. In the subsequent paragraphs the methodology used in forecasting the fleet is described. Actually, three techniques were used, but the high forecast was adopted as it provided the best cross-check with independent oil refinery forecasts of gasoline and diesel fuel consumption, and with the projection of system vehicle-kilometers.

4.2 Vehicle Fleet Forecast Methodology

Exhibit 4.1 illustrates the overall forecast of the vehicle fleet in Ethiopia. The forecasts are generated for passenger cars, all types of trucks and all types of buses. This technique, rather than forecasting more specific types, was employed because it permitted the use of a vehicle historical data base which was not dependent on suspect cumulative registration data. Analysis of the registration data and the import data brought many discrepancies to light. For example, the import of all trucks from 1963 to 1971 was 9571 units. The cumulative registration between 1917 and 1971 is 10,103 units, implying that only 532 trucks are pre-1963. Also, a year-by-year analysis of the GRS forecast as compared with import data shows many discrepancies; usually with a smaller number of vehicles being registered than were shown as imported. As the registration data is supplied sporadically by municipalities, it is not to be relied on. Estimates from officials in Addis Ababa who are responsible for vehicle registration state that possibly as high as 25% of the vehicles in the city are not registered.

EXHIBIT 4.1

HISTORICAL AND FORECAST VEHICLE FLEET

		Cars	Buses	Trucks*	Total
Actual	1963	18,934	1,320	3,945	24,199
	1964	21,673	1,465	4,594	27,732
	1965	23,676	1,557	5,194	30,427
	1966	25,810	1,652	5,865	33,327
	1967	27,674	1,765	6,184	35,623
	1968	29,000	1,837	6,712	37,549
	1969	31,767	1,943	7,258	40,968
	1970	32,205	2,056	7,334	41,595
	1971	33,046	2,191	7,968	43,205
Forecast	1972	34,565	2,395	8,382	45,342
	1973	37,122	2,575	9,012	48,705
	1974	39,912	2,770	9,695	52,377
	1975	42,934	2,985	10,477	56,396
	1976	46,265	3,215	11,252	60,732
	1977	50,063	3,460	12,110	65,633
	1978	54,274	3,730	13,055	71,059
		Annual Growth Rates (%)			
	1970-78	6.75%	7.75%	7.5%	6.8%
	1975-78	8.0%	7.75%	7.5%	8.07%

* Includes land rovers, pickups and trucks, all sizes.

Exhibit 4.2 shows the importation of vehicles since 1963, by type. Again, the breakdown of vehicle types was based on data availability. Using the import data, the registration data for 1963 (when all vehicles were required to reregister) and a correction factor for government and diplomatic imports, a new series was developed. Exhibit 4.3 shows this new series for the historical vehicle fleet. The following assumptions are made in developing this historical base.

a. Imports of cars and trucks are increased by 10 percent to allow for government and diplomatic importation.

b. An average life for trucks of 8 years was assumed due to the fact that for these calculations light, medium and heavy trucks are mixed.

Import data is not sufficient for an adequate time series by type, and vehicle registration data is inconsistent as to mix within a type of vehicle. The annual percentage growth for each vehicle type has also been erratic, but with a definite downward trend. Examination of Exhibit 4.4 shows the effect of the new customs taxes on vehicles, especially on the import of cars.

This new series does not deviate dramatically from the existing data base developed by the GRS for registrations of passenger cars. The number of buses is lower due to the fact that bus additions have proven much lower than expected. Conversely, the total truck fleet is higher due to the higher than estimated importation of vehicles. If the actual import figures (1968-71) were used with the GRS technique, total trucks would be 8,176 as compared to 7,968 generated by that study. Similarly, if all trucks had a 10-year life then the total would be 8,887 trucks existing in 1971 as compared to the 7,963, an 11.5 percent difference. As subsequent sensitivity analysis will be used to test the study results, further detailed analysis was not felt to be warranted.

The overall forecast as previously shown in Exhibit 4.1 was developed using multiple forecasting techniques. The first method was to develop the linear relationship of vehicle fleet to time. Another method was to relate total vehicles to monetary gross domestic product.

EXHIBIT 4.2

MOTOR VEHICLES IMPORTED 1963 TO 1971 (UNITS)

Description	1963	1964	1965	1966	1967	1968	1969	1970	1971
Passenger Cars									
Weight over 1,000 kilos						2,274	3,903	1,740	2,200*
Weight under 1,000 kilos						762	771	1,957	1,200*
Total Passenger Cars	2,158	3,299	2,633	3,304	3,058	3,036	4,674	3,697	3,400
Mirco and Mini Buses						49	18	17	42
Omnibuses						76	152	122	180
Total Buses	118	155	112	126	155	125	170	139	222
Other Vehicles:									
Ambulances						30	5	14	6
Land Rover Type				390	366	376	622	422	664
Trucks:									
Capacity over 1,500 k.						347	238	294	600
Capacity under 1,500 k.						430	394	164	140
Subtotal, Trucks			545**	810**	590	777	632	458	740
Total, Other Vehicles	563	1,038	1,068	1,200	956	1,183	1,259	894	1,410

* 1971 estimate based on 1.2-year import data.
** Includes ambulances.

Source: Customs Head Office, Ministry of Finance.

EXHIBIT 4.3

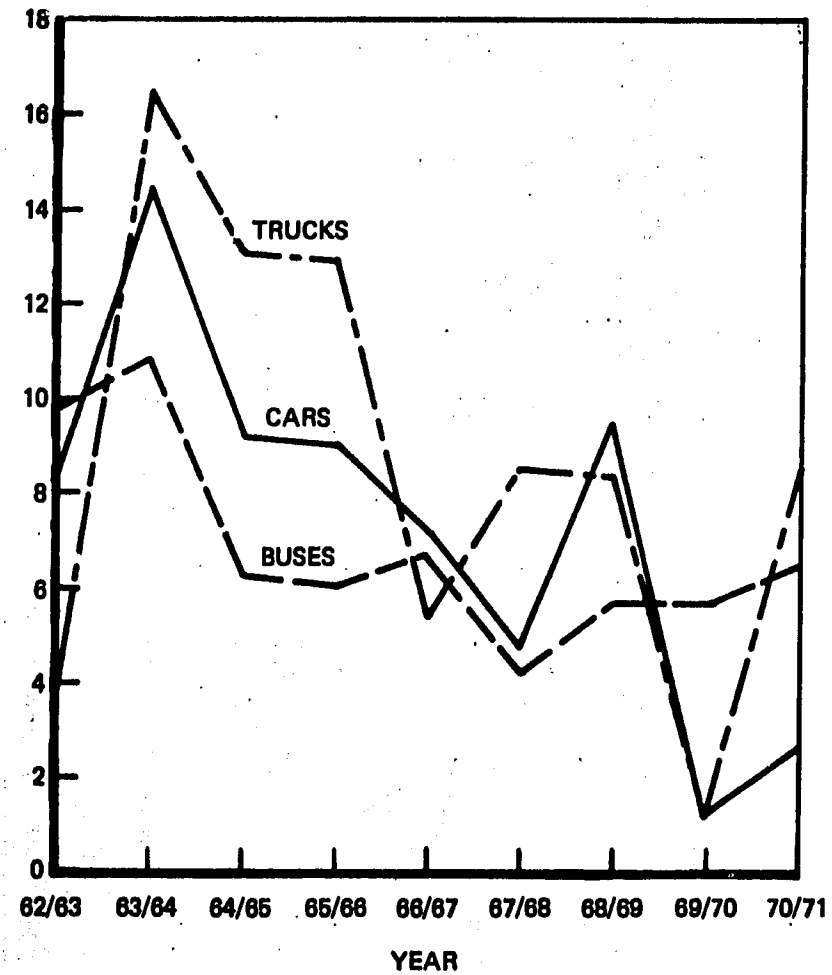
VEHICLE FLEET ANALYSIS, 1962-1971

		1963	1964	1965	1966	1967	1968	1969	1970	1971
Passenger Cars:										
In use end of last year		17,458	18,934	21,673	23,676	25,810	27,674	2,900	31,767	32,205
Imported		2,158	3,299	2,633	3,304	3,058	3,036	4,674	3,697	3,400
Government correction factor (10%)		216	330	263	330	306	303	467	370	340
Scrapped*		898	890	893	1,500	1,500	2,013	2,374	3,629	2,899
In use end of this year	17,458	18,934	21,673	23,676	25,810	27,674	29,000	31,767	32,205	33,046
Percent growth per year		8.45	14.46	9.24	9.01	7.22	4.79	9.54	1.37	2.61
Buses:										
In use end of last year		1,202	1,320	1,465	1,557	1,652	1,765	1,832	1,943	2,056
Imported		118	155	112	126	155	125	170	189	222
Scrapped (added 10 years before)		--	10	20	31	42	53	64	76	87
In use end of this year	1,202	1,320	1,465	1,557	1,652	1,765	1,837	1,943	2,056	2,191
Percent growth per year		9.8	10.98	6.27	6.1	6.84	4.07	5.77	5.84	6.56
Trucks - All Types										
In use end of last year		3,801	3,945	4,594	5,194	5,865	6,184	6,712	7,258	7,334
Imported		563	1,038	1,068	1,200	956	1,183	1,259	894	1,410
Government correction factor (10%)		56	104	107	120	96	118	126	89	141
Scrapped (8 years average life)**		475	493	574	649	733	773	839	907	917
In use end of this year	3,801	3,945	4,594	5,194	5,865	6,184	6,712	7,258	7,334	7,968
Percent growth per year		3.78	16.45	13.06	12.91	5.43	8.53	8.13	1.04	8.64
Total Vehicles	22,461	24,199	27,822	30,427	33,327	35,623	37,549	40,698	41,595	43,205
Percent growth per year		7.73	14.97	9.36	9.53	6.88	5.40	8.94	1.67	3.87

* 1963-1968 use GRS figures; 1969-1971 use imports plus adjustment factor.
** Assume linear age distribution as imports are relatively stable.

EXHIBIT 4.4

ANNUAL PERCENTAGE INCREASE BY VEHICLE TYPE



A third was to analyze correlations of independent variables to specific vehicle types. The highest of these forecasts was that based on the relationship of the total vehicle fleet to GDP. The forecast was then broken down into the three vehicle types based on historical distribution. The other techniques produced lower forecasts. The linear relationship of vehicles to time implies a vehicle fleet increasing at a decreasing rate, which may be true in the short run, but does not hold for developing countries. Exhibit 4.5 illustrated the difference between this method and the method relating the fleet with monetary GDP. Exhibit 4.6 shows the relationship of the monetary GDP cost versus the total vehicle fleet. Each of the forecasts is described in detail below.

Based on the data for 1961-1969, for monetary GDP and the total vehicle fleet, a linear regression analysis was performed with vehicles as a function of monetary GDP. A very significant correlation was found. However, due to the new import duties imposed on vehicles in 1970, the relationship did not hold true for 1970 and 1971. The regression equation generated a vehicle forecast approximately 5 percent higher than was actually experienced in these years. The forecast was adjusted to reflect this decline in 1970 and 1971 and assumes a continuing low growth rate in 1972 to 1973, followed by a resumption of the old rate of approximately 8.0 percent for the entire fleet from 1973 through 1978. Based on this graph, the total vehicle fleet increases from 41,595 vehicles in 1970 to 71,059 vehicles in 1978, an overall increase of an average of 7 percent per year. The historical distribution of vehicles is shown in Exhibit 4.7. Based on this distribution, the forecast shown in Exhibit 4.1 was developed.

Another attempt to project vehicles by type was to investigate significant independent variables which could be related to specific vehicle types. Passenger cars were highly correlated to GDP per capita in a log-linear relationship. This relationship is illustrated in Exhibit 4.8. The equation, with Y equal to Passenger Cars, is:

$$\text{Log } Y = 0.0033\ (\text{GDP/Capita}) + 3.952$$

The correlation coefficient "r" equals 0.9279

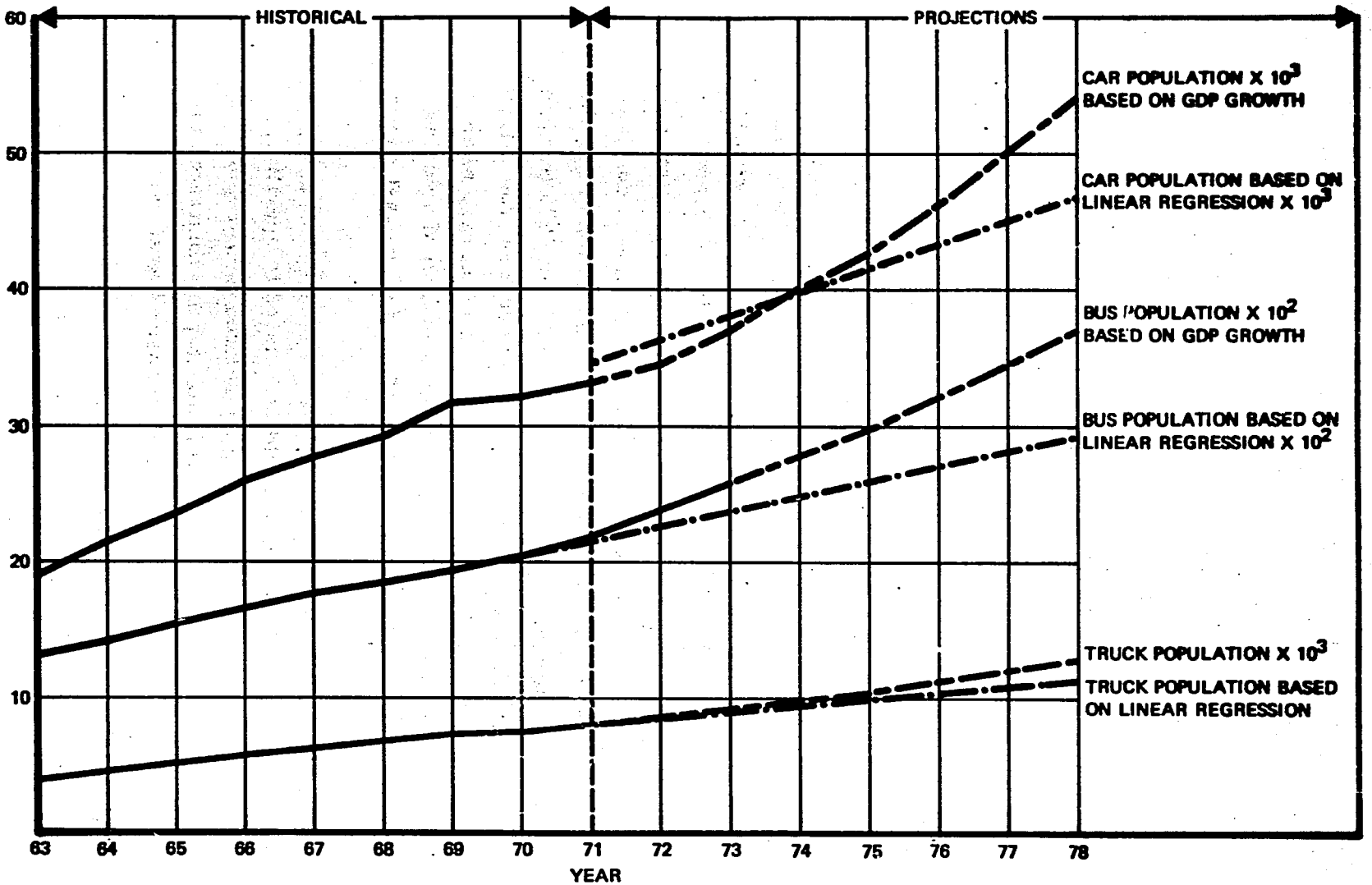


EXHIBIT 4.5 VEHICLE FLEET POPULATION, 1963-1978

EXHIBIT 4.6 VEHICLE FLEET VERSUS MONETARY GDP

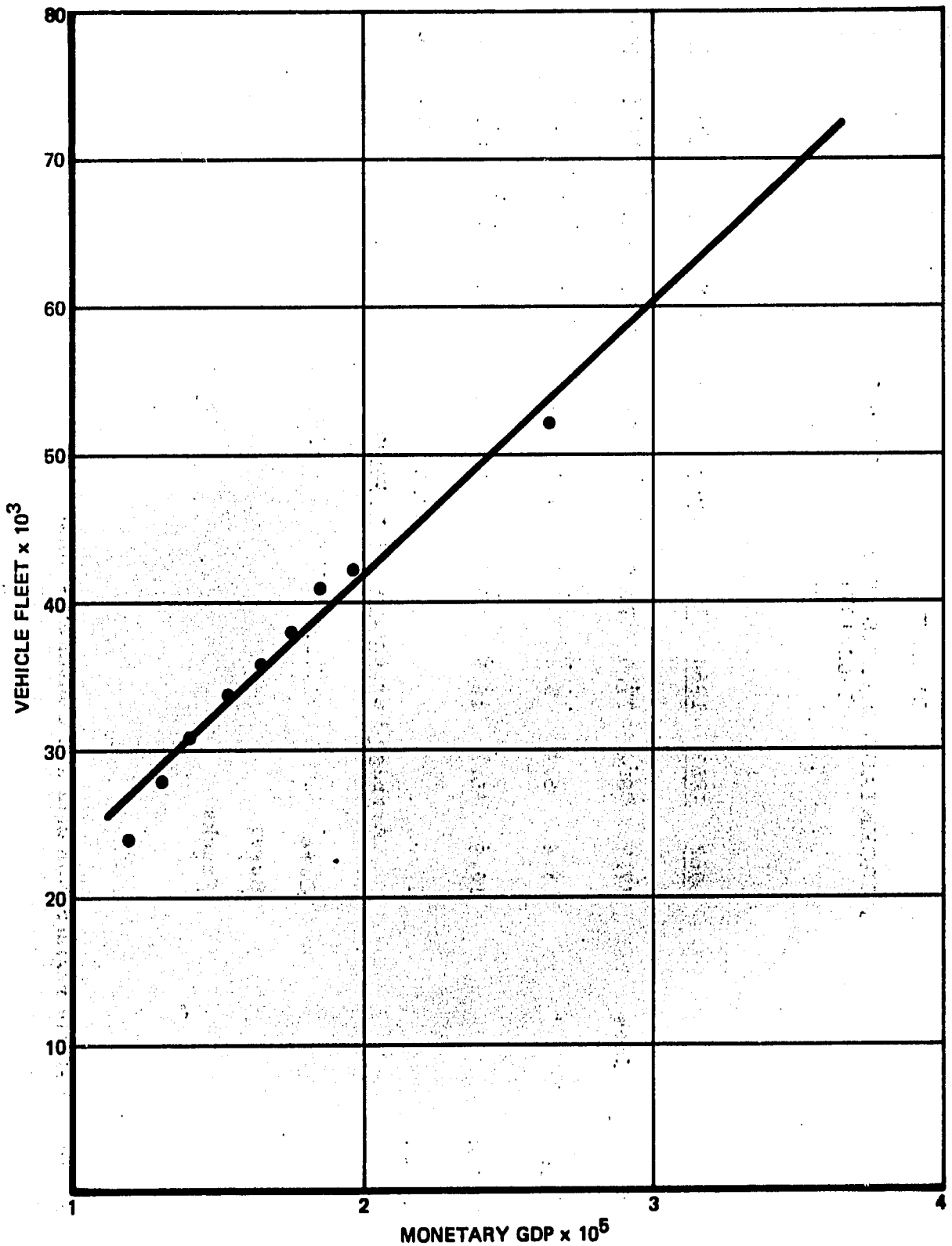


EXHIBIT 4.7

PERCENTAGE DISTRIBUTION OF VEHICLE
1962-1971

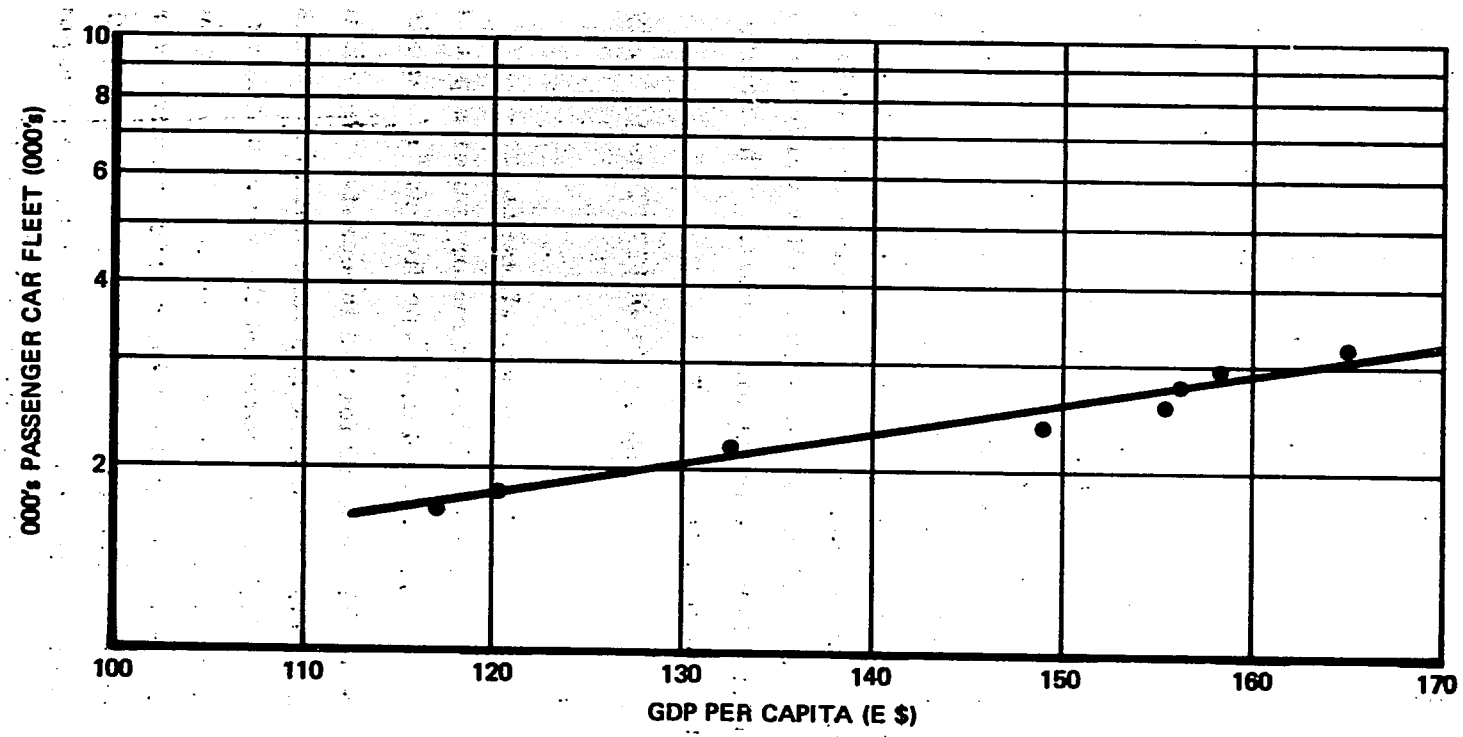
	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Passenger Cars	77.7	78.2	77.9	77.8	77.4	77.7	77.2	77.7	77.4	76.5
Buses	5.4	5.4	5.3	5.1	4.9	4.9	4.9	4.7	4.9	5.1
Trucks	16.9	16.3	16.5	17.1	17.6	17.4	17.9	17.6	17.7	18.4

Average Percentage Distribution

Cars	77.0%
Buses	5.0%
Trucks	18.0%

Source: Vehicle registration data and Consultants' analysis.

EXHIBIT 4.8 GDP PER CAPITA VERSUS THE PASSENGER CAR FLEET



To forecast passenger vehicles it was necessary to forecast GDP/Capita. A simple linear regression of GDP/Capita against time was used. The equation is:

$$Y = 7.033 \text{ (Year)} + 105.83$$

where:

Y = GDP per Capita

Year = Year; 1961 = 1

The correlation coefficient "r" equals 0.9677

This relationship is illustrated in Exhibit 4.9. It is realized that this technique shows GDP/Capita increasing at a decreasing rate. However, as this study is concerned with a 5-year forecast, serious error will not be introduced. The average annual rate from 1971 to 1977 of GDP/Capita under this technique is 3.25 percent. The 1961-1969 rate was 4.125 percent. This technique generated a car fleet approximately 10 percent lower than that previously described.

The truck fleet was significantly correlated to the total of the major truckable imports and exports. The relationship was log-linear and the equation is:

$$\text{Log } Y = 0.00177 \text{ (Tons)} + 3.291$$

where:

Y = Trucks, all types

Tons = Tons of major imports plus exports

The correlation coefficient "r" equals 0.8592

See Exhibit 4.10 for the forecast. The difficulty in using this method is due to the lack of a forecast of the truckable commodities. A recent IBRD report forecast the value of major commodities and the volume of coffee to be exported. The latter forecast has proven to be in error as the 1970 shipments of coffee were 70,760 metric tons as compared to the IBRD projection of 93,006 tons. Consequently, the historical growth rate (1965-1970) of the exports and imports was used. This rate is approximately 6 percent per year. The historical and projected growth is shown in Exhibit 4.11. The maturation curve

EXHIBIT 4.9 GDP PER CAPITA - HISTORICAL AND PROJECTED

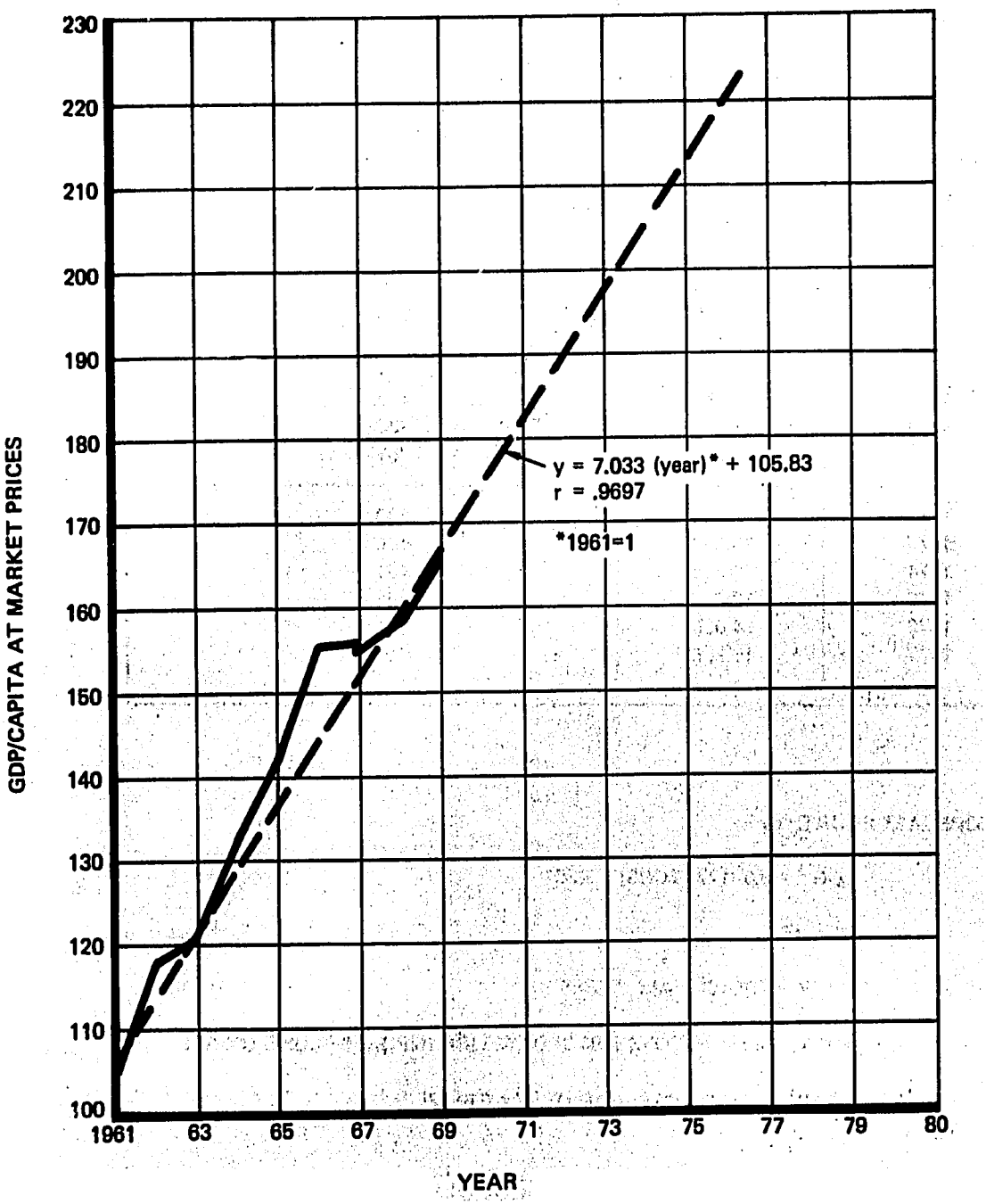


EXHIBIT 4.10 TRUCK FLEET VERSUS MAJOR IMPORTS PLUS EXPORTS

YEAR	TRUCKS	MAJOR IMPORTS PLUS EXPORTS (000'S METRIC TONS)
1962	3,801	156
1963	3,945	180
1964	4,564	240
1965	5,191	246
1966	5,865	278
1967	6,184	312
1968	6,712	271
1969	7,258	273
1970	7,380	326
1971	8,510	361
1972	9,309	383
1973	10,223	406
1974	11,319	431
1975	12,600	456
1976	14,050	484
1977	15,200	511

FORECAST EQUATION:

LOGY = 0.00177 (TONS) + 3.291

WHERE

Y = TRUCKS, ALL TYPES

TONS = METRIC TONS (000'S) OF MAJOR IMPORTS PLUS EXPORTS

CORRELATION COEFFICIENT "r" = 0.8592

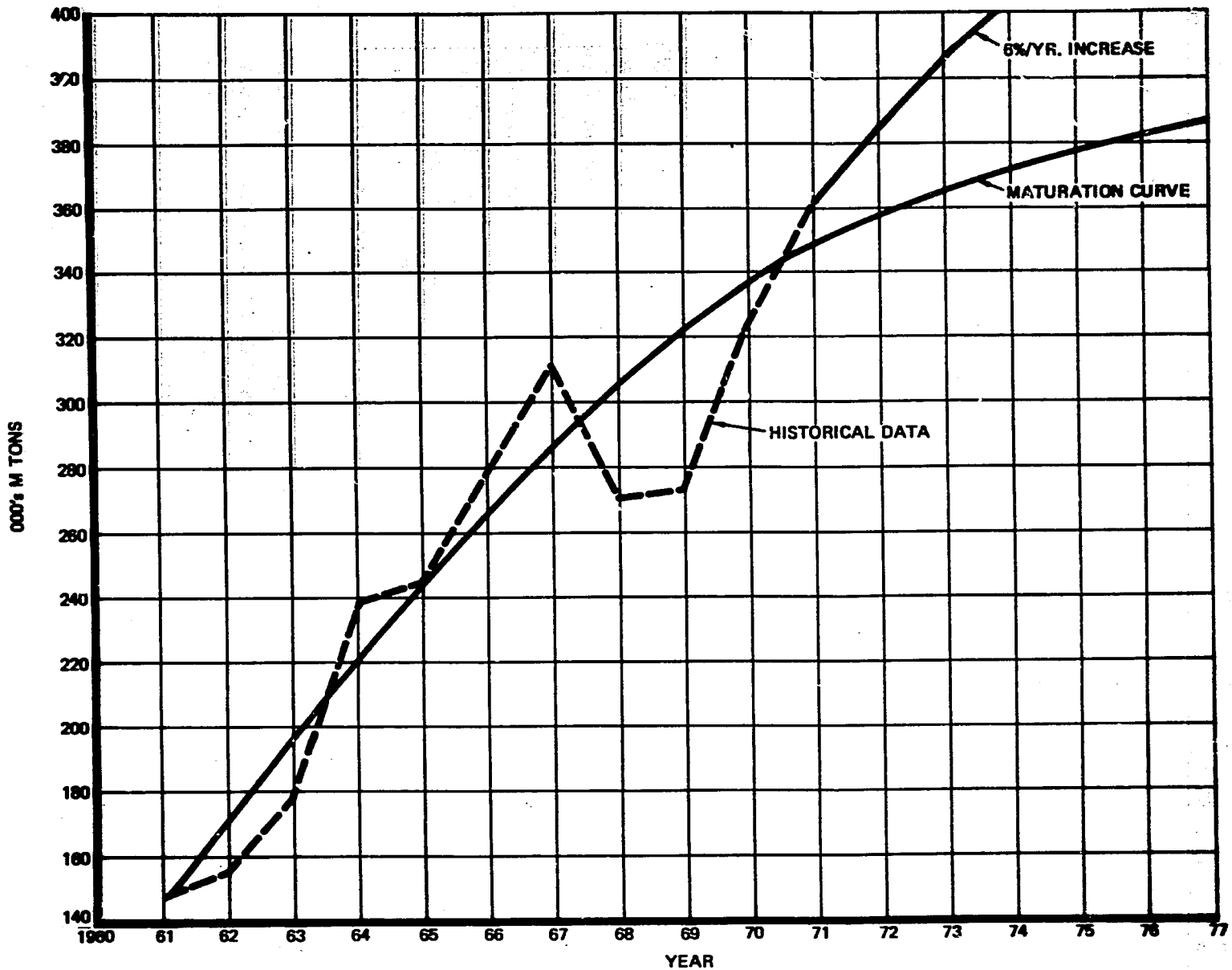


EXHIBIT 4.11 MAJOR IMPORTS + MAJOR EXPORTS VERSUS TIME, 000'S OF METRIC TONS

is illustrated for comparative purposes only. Attempts were made to develop linear and log-linear relationships for the bus fleet. However, none of the readily available independent variables had a good correlation. As shown in the following paragraphs, the bus fleet was significantly related to time.

Exhibits 4.12, 4.13 and 4.14 illustrate the linear time-trend relationship of cars, buses and trucks respectively. In all cases the growth is significantly related to time. The equations and correlation coefficients are shown on the graphs. Although the statistical relationship was excellent, it is felt that these forecasts are low since the growth is increasing at a decreasing rate. This is unlikely in developing countries where increasing per-capita income usually signifies a desire for higher-cost imports.

4.3 Choice of Forecasts

As is illustrated in Exhibit 4.15 the forecasts for the total fleet are relatively close up to 1974 or 1975. Given the quality of the data it is difficult to make a selection of the forecast values based on these data alone. However, the three techniques produce wide deviations for the specific truck and bus fleet forecasts. The linear correlation of the total fleet with time is low and can be considered a "worst case," as the fleet increases at a decreasing rate. This is not realistic. The car fleet forecasts generated by the relation of monetary GDP to the vehicle fleet and the GDP/capita to the car fleet are within 7 percent of each other in 1978.

Truck fleet forecasts generated by the relation to monetary GDP and correlation with major imports and exports show a greater deviation. The latter method is about 20 percent higher than the former in 1978. However, the correlation with imports and exports produces an average annual growth rate near 11 percent, while the relation with GDP produced an average growth rate of 7.5 percent. The latter is more realistic as the 1962-1971 growth rate averaged 8.7 percent and the 1967-1971 rate was 6.4 percent. There is no immediate justification for the 11 percent rate being used. Therefore, the relationship of the total fleet to monetary GDP is used. This method also generates the high forecast for the total fleet.

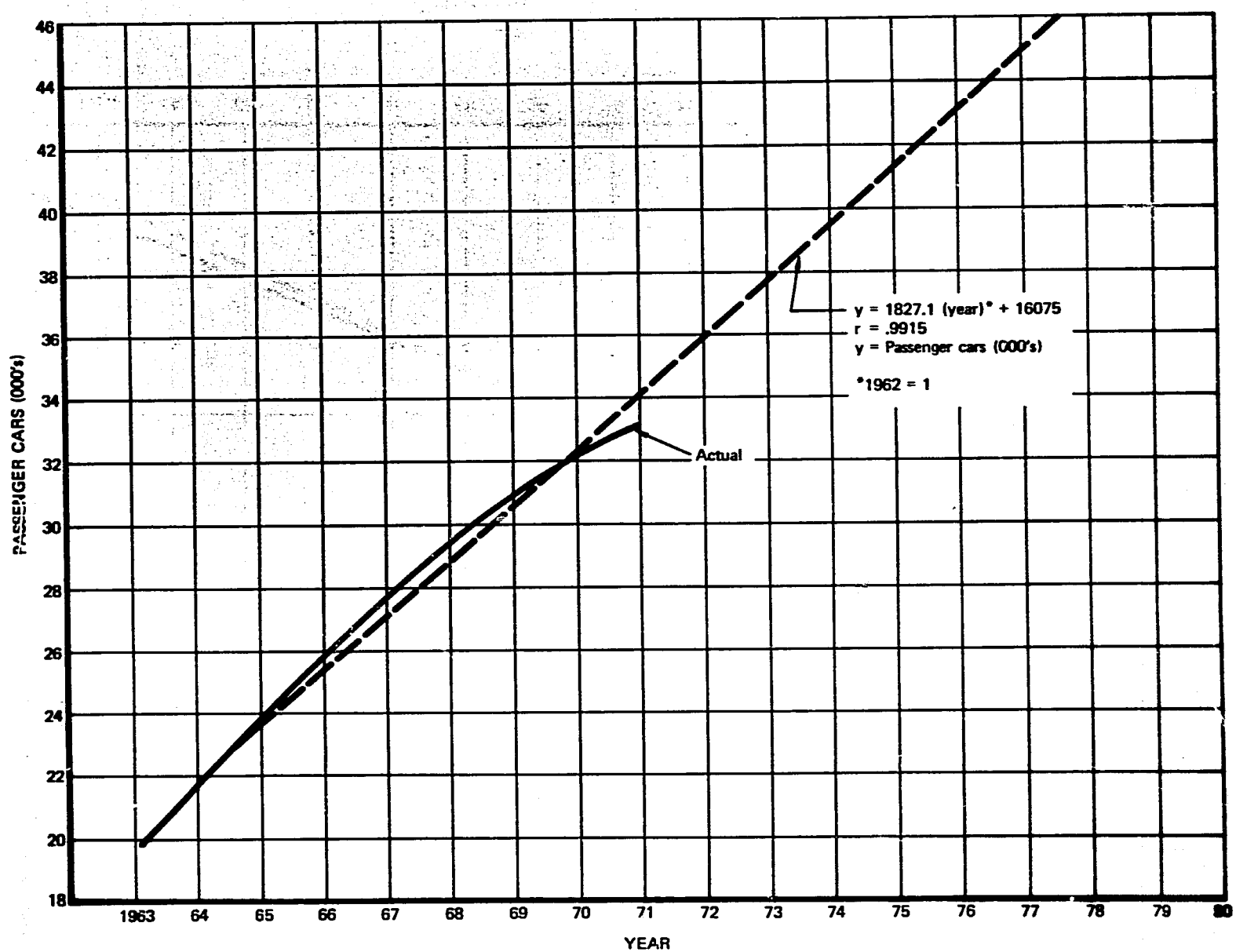


EXHIBIT 4.12 PASSENGER CAR FLEET VERSUS TIME

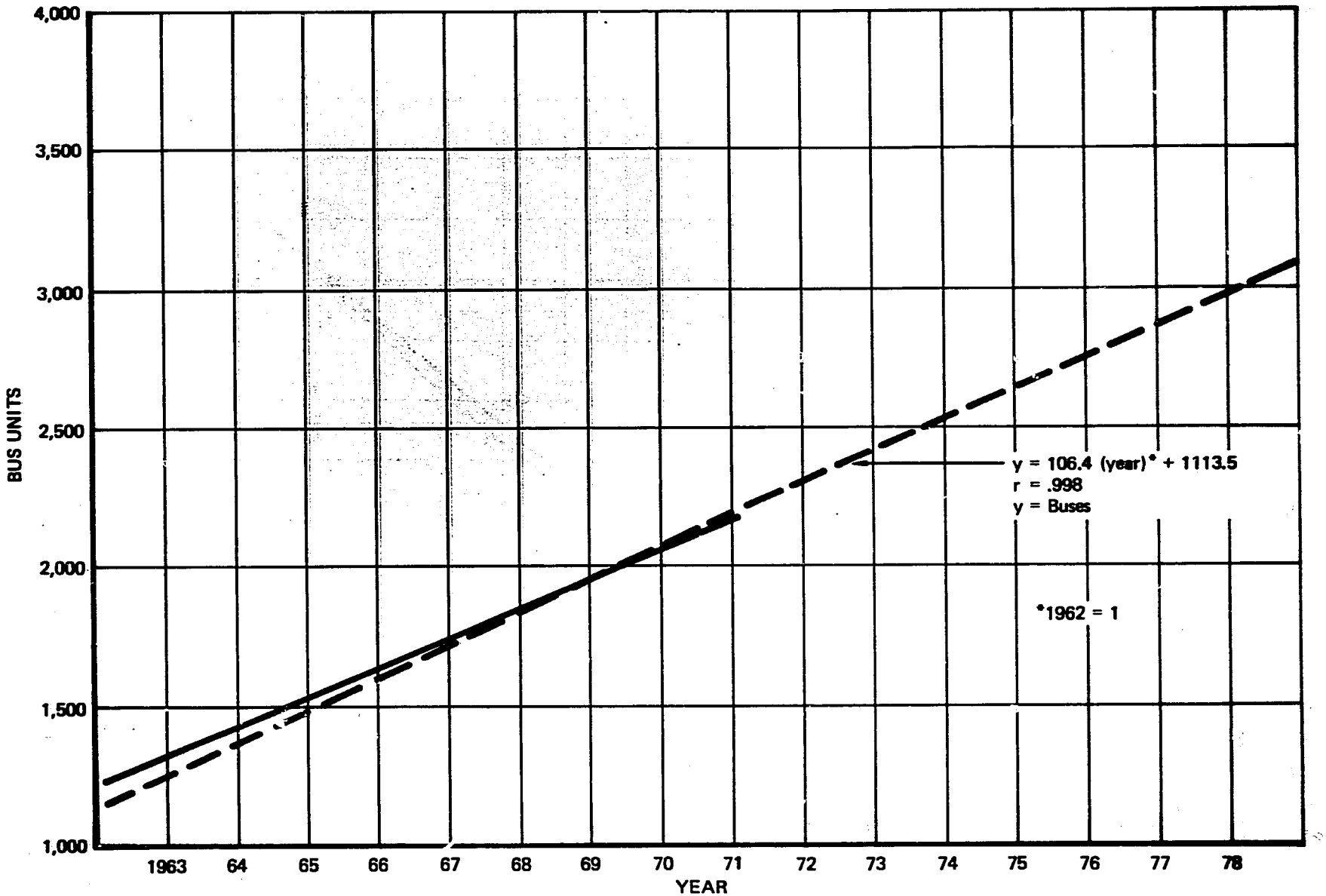


EXHIBIT 4.13 BUS FLEET VERSUS TIME

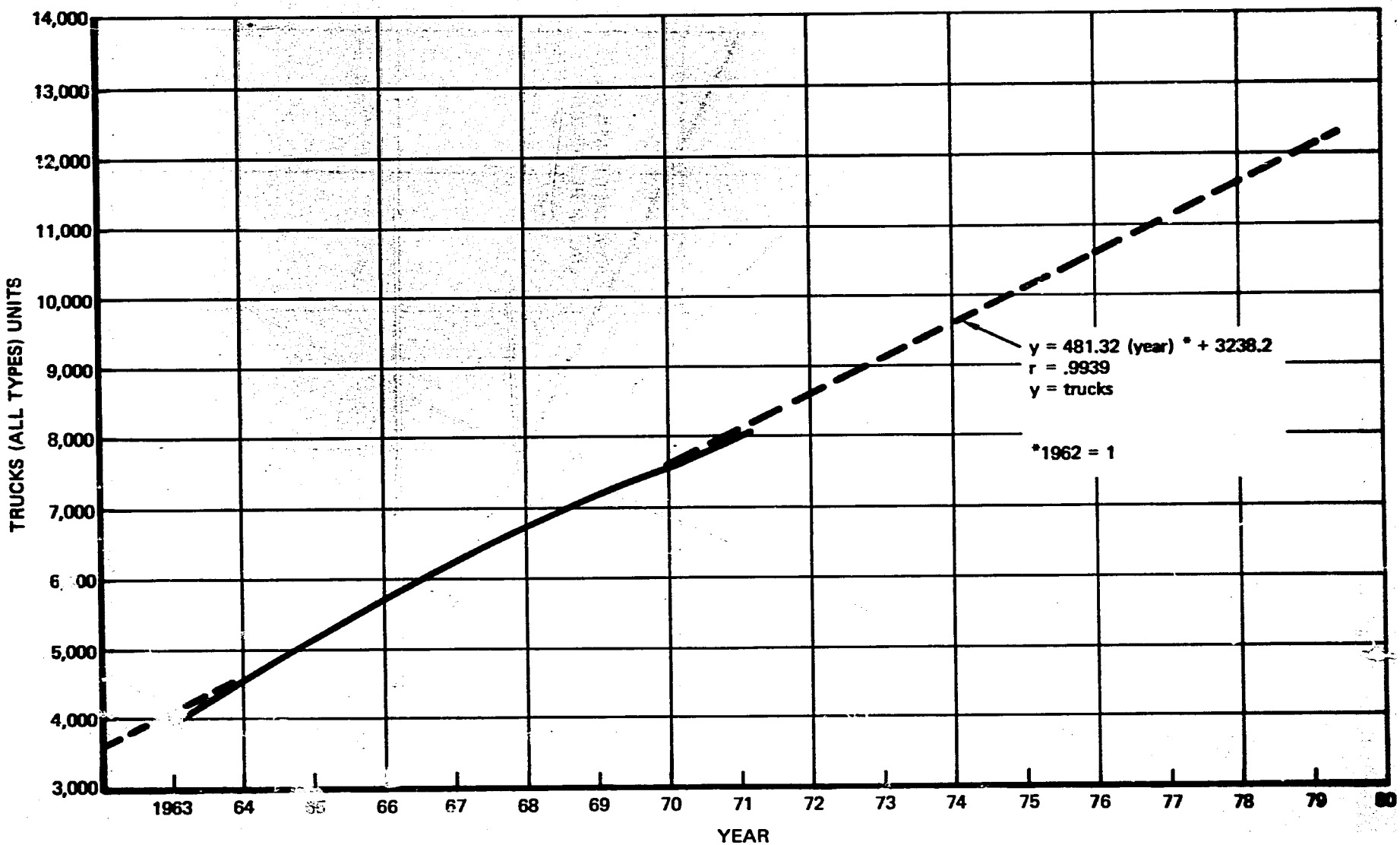
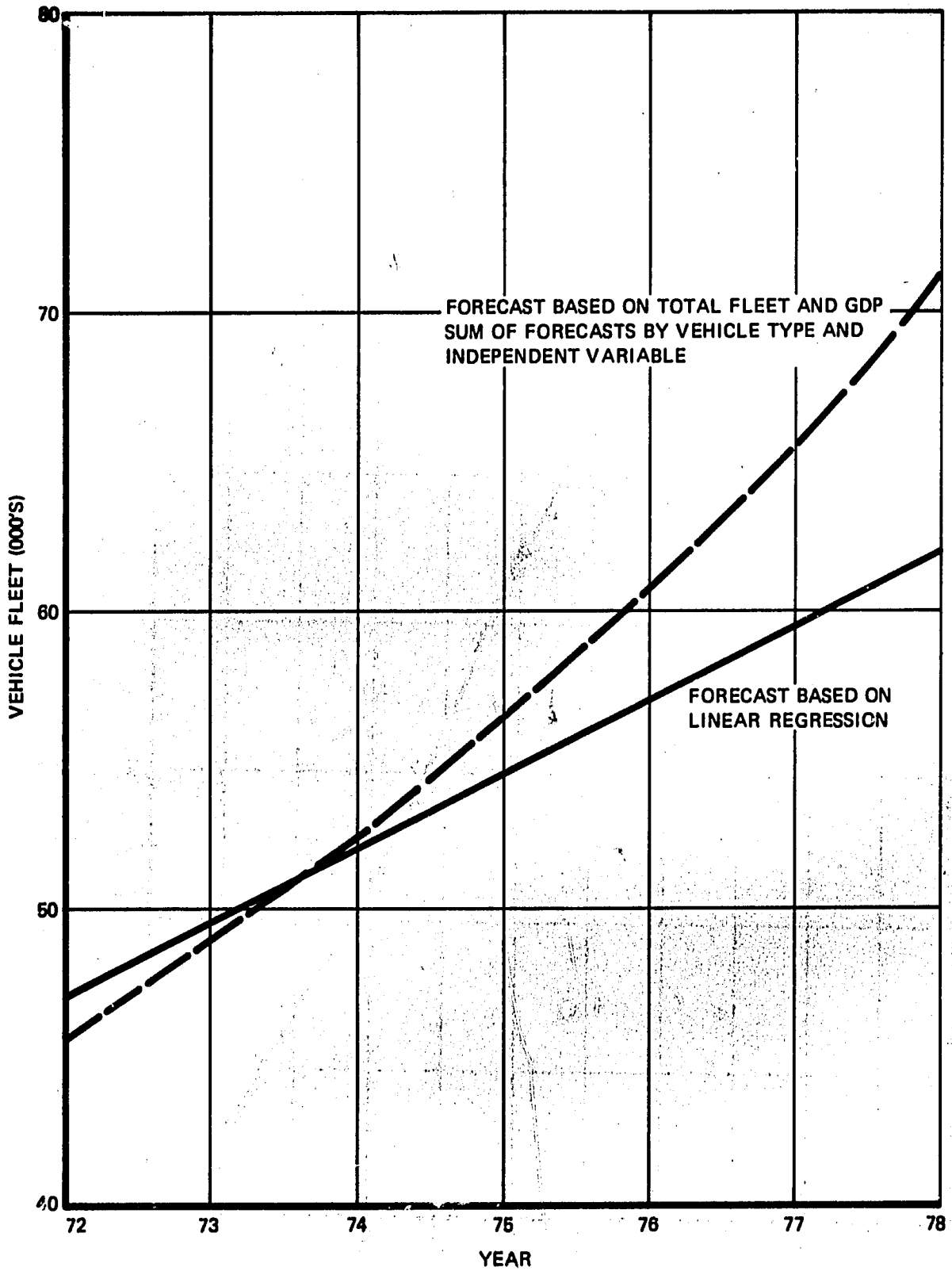


EXHIBIT 4.14 TRUCK FLEET - ALL TYPES VERSUS TIME

EXHIBIT 4.15 COMPARISON OF FORECASTS



As stated earlier, this forecast is cross-checked for accuracy by two techniques. The first is a check of the system vehicle-kilometers forecast from count station data against the vehicle-kilometers derived from the above fleet forecast. The second is a check against the consumption of fuel.

The first cross-check, that against system vehicle-kilometers per day is shown in Exhibit 4.16. As can be seen, the time-trend linear regression forecast (1957-1971) produces a very low forecast. If a curve is fitted to the 1964-1971 data, a higher forecast is obtained. The highest forecast is derived by taking the high forecast of the vehicle fleet and multiplying the specific vehicle types by a forecast of the daily VKM for each type. Exhibit 4.17 shows the forecast of VKM/day by vehicle type. The actual VKM/day for each vehicle type is derived from the count station AADT and the Consultants' derivation of VKM. The annual forecast of VKM/day is multiplied by the annual forecast of vehicle types. It can be seen that this forecast fits the historical pattern better than either of the time-trend forecasts. This technique helps verify the use of the high vehicle fleet forecast.

The second check was to compare the fuel consumption of the forecast vehicle fleet versus the volume of fuel projected by a major refinery in Ethiopia. The car vehicle fleet was difficult to check as all the Consultants' calculations only reflect the use of passenger cars for inter-city travel.

However, as trucks are used mainly for inter-city travel the expected volume of fuel in 1975 can be cross-checked. Assuming an average fuel consumption of .6 liters per kilometer for trucks and daily travel of 72 kilometers, a total volume of fuel per year is calculated to be 1,039,000 barrels of diesel fuel. Using the same method for buses, with the inter-city bus consumption of fuel at .3 liters per kilometer, the total is calculated at 300,140 barrels per year. This is based on a 50-50 split between large and small buses. The total of inter-city diesel fuel consumption is 1,339,140 barrels. In 1975 the refinery's estimate of diesel fuel consumption is 1,970,000 barrels.

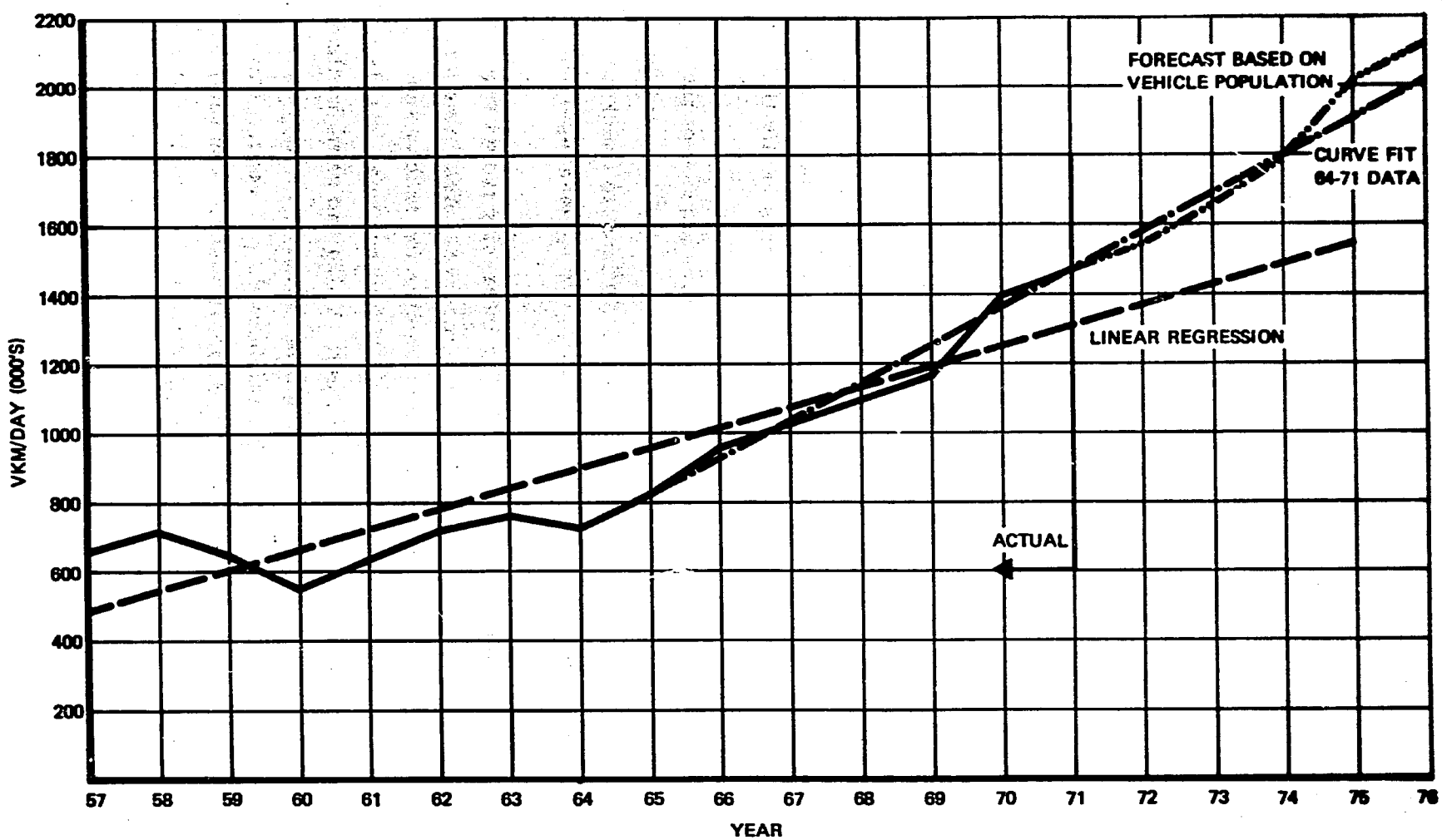


EXHIBIT 4.16 SYSTEM VEHICLE KILOMETERS PER DAY

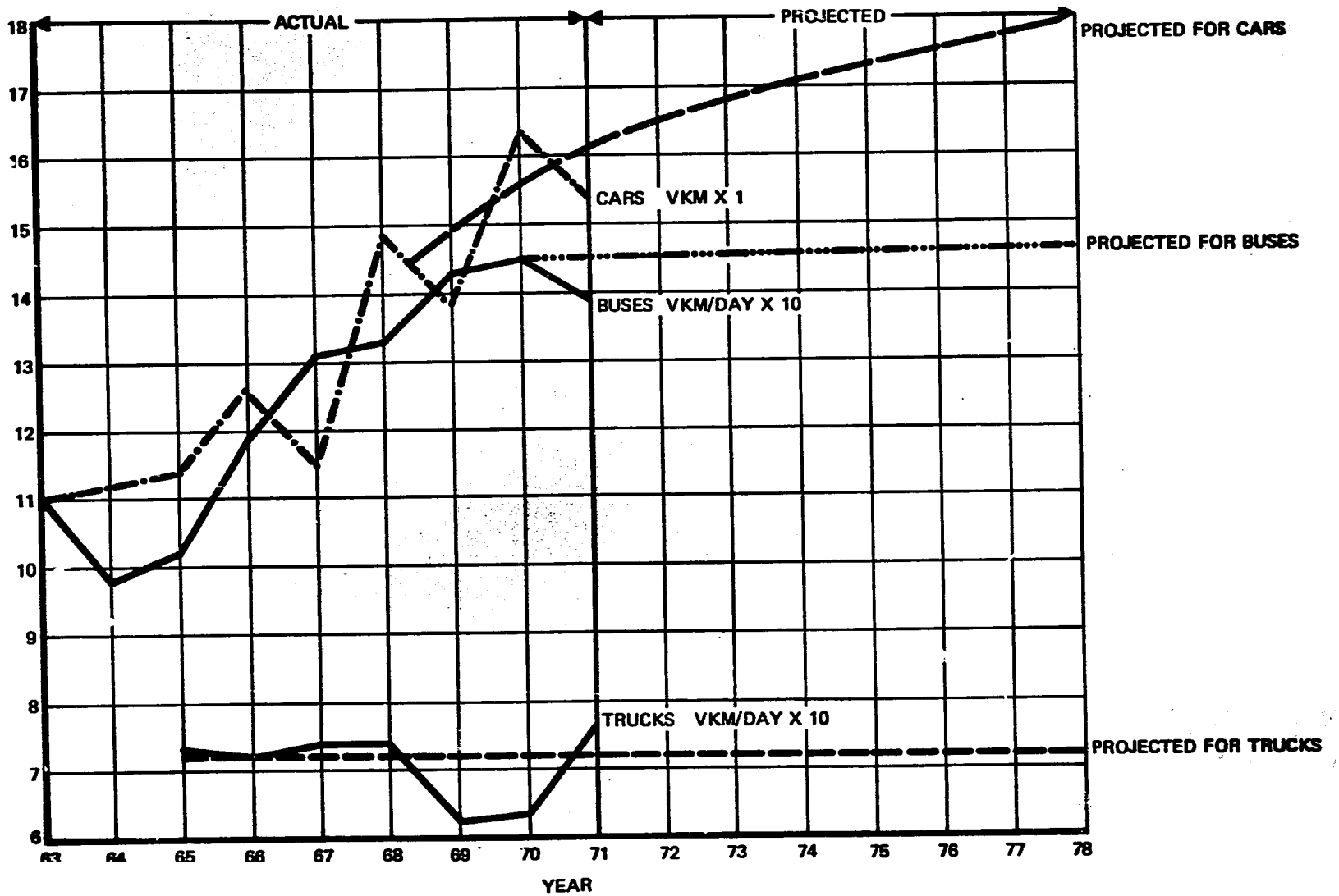


EXHIBIT 4.17 VEHICLE KILOMETERS PER DAY BY VEHICLE TYPE

The latter figure contains fuel consumption for intra-city bus and truck travel, agricultural usage and some industrial usage. In any case, the high vehicle forecast produces these results. Any lower forecasts would, of course, produce lower consumption figures. This is another reason for the selection of the high forecast.

Section 5.0

REVENUES FROM ROAD USER TAXES

Exhibit 5.1 shows the historical importation of motor vehicles into Ethiopia in the period 1965/66 through 1970/71. Prior to 1965/66, the detailed makeup of the number of vehicle types is not available.

Exhibit 5.2 and 5.3 show the total customs duty revenues by type of vehicle. The latter exhibit also shows what the total revised revenue would have been if the new 1970/71 duty rates were applied to past data.

Exhibit 5.4 shows the forecast of customs duty revenues by vehicle type. The forecasts of the vehicle imports are described in Economics Appendix Section 4.0. The CIF prices are derived from Exhibit 5.5.

Exhibit 5.6 shows the calculation of the projected transaction and municipality taxes. These are based on the number of vehicles imported and the CIF prices.

Exhibit 5.7 shows the forecast sales tax revenue by vehicle type and the total for the years 1972-1978. These revenues are based on the 2 percent sales tax applied to the dealer list price for typical vehicles.

Exhibit 5.8 reflects the total projected revenue from the sale of numbered plates. This projection is based on the forecast total fleet and a number-plate fee of E$9.00. Exhibit 5.9 contains the historical data from 1966/67 through 1970/71 for drivers licenses. The latter exhibit also shows the breakdown between the IEG Ministry of Communication revenues and the municipal revenues from this source.

Drivers licenses are forecast on the basis of a time-trend regression analysis. The actual and forecast data are shown on Exhibit 5.9 where the forecast equation is also shown. Exhibit 5.10 indicates the actual distribution of licenses in Ethiopia in 1970/71. Based on the forecast of licenses and an average of the first and second class license fees, the revenue forecast from this source was calculated. Exhibit 5.11 shows this calculation.

EXHIBIT 5.1

NUMBER OF VEHICLES IMPORTED PER YEAR

Type of Vehicle	1963	1964	1965	1966	1967	1968	1969	1970
Passenger Cars	2,158	3,299	2,633	2,866	3,058	3,036	4,674	3,697
Buses, All Sizes	116	154	112	114	155	125	170	139
Trucks, Ambulances, Pickups and Light Delivery Vans	546	568	570	726	590	777	632	458
Land Rovers, Jeeps and Similar Vehicles	317	470	523	362	366	376	622	422
Road Tractors	36	39	18	36	54			
Motor Cycles	114	60	68	123	246			
Bicycles	2,373	1,752	1,037	3,068				
Trailers	338	145	24	329				

Source: Customs Head Office, Ministry of Finance.

EXHIBIT 5.2

CUSTOMS DUTIES RECEIVED FROM VEHICLE IMPORTS
(E$000's)

Vehicle Type	1965/66	1966/67	1967/68
Passenger Cars	5,165	5,664	5,101
Buses (All Sizes)	509	667	1,090
Lorries and Trucks	1,804	2,045	1,360
Land Rover Type Vehicles	1,050	569	494
Pickups and Light Delivery Vans	21	275	222
Vans, Lorries and Special-Purpose Trucks	311	623	7
Motorcycles	35	88	101
Total	8,895	9,931	8,375

Source: Ministry of Finance, Customs Office.

EXHIBIT 5.3

CUSTOMS DUTIES RECEIVED FROM VEHICLE IMPORTS
(E$)

Vehicle Type	1968/69	1969/70	1970/71
Passenger Cars, Weight Under 1000 Kilos	3,758,922	6,592,719	2,947,560
Passenger Cars, Weight Over 1000 Kilos	2,261,616	2,398,497	5,945,366
Land Rovers	1,030,992	1,819,350	1,319,594
Microbuses	257,152	85,302	78,200
Omnibuses	335,844	747,992	613,660
Lorries, Capacity Under 1500 Kilos	2,645,360	2,824,586	1,476,164
Lorries, Capacity Over 1500 Kilos	613,843	310,828	558,306
Total Duty (Old Duty)	10,903,729	14,713,274	12,938,850
Total Duty (New Duty)*	11,968,603	19,562,750	14,232,800

* New 1970/71 rates.

Source: Ministry of Finance, Customs Office.

EXHIBIT 5.4

PROJECTED REVENUE FROM CUSTOMS DUTIES ON IMPORTED VEHICLES

	1972	1973	1974	1975	1976	1977	1978
A. Passenger Cars Under 1000 Kilos. Duty Per Vehicle: 50% of E$2,000 = E$1,000; 85% of 1,015 = 863; Total E$1,863							
Number of Units	3,035	3,498	3,796	3,744	3,942	4,647	4,683
Total Duty, E$	5,654,205	6,516,774	7,071,948	6,975,072	7,343,946	8,657,361	8,724,429
B. Passenger Cars Over 1000 Kilos. Duty Per Vehicle: 50% of E$2,000 = E$1,000; 85% of 2,649 = 2,252; Total E$3,252							
Number of Units	1,635	1,884	2,044	2,016	2,122	2,503	2,521
Total Duty, E$	5,317,020	6,126,768	6,647,088	6,556,032	6,900,744	8,139,756	8,198,292
C. Land Rovers. CIF Price E$6,500; Duty E$3,250							
Number of Units	674	832	740	890	921	785	1,065
Total Duty, E$	2,190,500	2,704,000	2,405,000	2,892,500	2,993,250	2,551,250	5,362,500
D. Micro/Mini Buses. CIF Price E$9,200; Duty E$4,600							
Number of Units	64	67	60	68	77	74	88
Total Duty, E$	294,400	308,200	276,000	312,800	354,200	340,400	404,800

EXHIBIT 5.4
(Continued)

	1972	1973	1974	1975	1976	1977	1978
E. Omnibuses. CIF Price E$25,000; Duty E$5,000							
Number of Units	258	268	247	273	308	296	352
Total Duty, E$	1,290,000	1,340,000	1,235,000	1,365,000	1,540,000	1,480,000	1,760,000
F. Lorries, Capacity Under 1500 Kilos. CIF Price E$15,000; Duty E$7,500							
Number of Units	216	267	237	284	294	251	440
Total Duty, E$	1,620,000	2,002,500	1,777,500	2,130,000	2,205,000	1,882,500	3,300,000
G. Lorries, Capacity Over 1500 Kilos. CIF Price E$19,600; Duty E$1,960							
Number of Units	545	673	598	719	745	635	861
Total Duty, E$	1,068,200	1,319,080	1,172,080	1,409,240	1,460,200	1,244,600	1,687,560
Total Duty, E$	17,434,325	20,317,322	20,584,616	21,640,644	22,797,340	24,295,867	29,437,581
% Increase	--	16.54%	1.31%	5.13%	5.34%	6.57%	21.16%

Source: Consultants' analysis.

EXHIBIT 5.5

CIF VALUES
(E$)

Year	Cars Under 1000 Kilos	Cars Over 1000 Kilos	Microbus	Omnibus	Land Rover	Trucks, by Capacity: Under 1500 Kilos	Trucks, by Capacity: Over 1500 Kilos
1964	3,180	2,560	NA	NA	NA	NA	NA
1965	3,228	5,820	NA	NA	NA	NA	NA
1966	3,254	5,120	NA	NA	5,506	NA	NA
1967	3,357	5,166	NA	NA	5,697	NA	NA
1968	2,969	4,674	NA	NA	5,462	12,304	17,689
1969	3,213	5,342	10,494	22,095	5,483	14,338	13,057
1970	3,694	5,531	9,478	24,605	5,850	18,002	18,992
1971	3,436	4,840	9,199	25,147	6,253	13,929	19,591
CIF Price Assumed for 1972-1978	3,015	4,649	9,200	25,000	6,500	15,000	19,600

NA--Not Available.

Source: Customs Office, Ministry of Finance and Consultants' calculations.

CALCULATION OF TRANSACTION (15%) AND MUNICIPALITY (1%) TAXES BASED ON CIF PRICE

	1972	1973	1974	1975	1976	1977	1978
A. Passenger Cars Under 1000 Kilos. CIF Price E$3,015; Tax E$482.40							
Number of Units	3,035	3,496	3,796	3,744	3,942	4,647	4,683
Total Tax, E$	1,464,084	1,687,435	1,831,190	1,806,106	1,901,621	2,241,713	2,259,079
B. Passenger Cars Over 1000 Kilos. CIF Price E$4,649; Tax E$743.84							
Number of Units	1,635	1,884	2,044	2,016	2,122	2,053	2,521
Total Tax, E$	1,216,178	1,401,395	1,520,409	1,499,581	1,578,428	1,861,832	1,875,221
C. Land Rovers. CIF Price E$6,500; Tax E$2,040							
Number of Units	674	832	740	890	921	785	1,065
Total Tax, E$	700,960	865,280	796,600	925,600	957,840	816,400	1,107,600
D. Microbuses. CIF Price E$9,200; Tax E$1,472							
Number of Units	64	67	60	68	77	74	88
Total Tax, E$	94,208	98,624	88,320	100,096	113,344	108,928	129,536

EXHIBIT 5.6
(Continued)

	1972	1973	1974	1975	1976	1977	1978
E. Omnibuses. CIF Price E$25,000; Tax E$4,000							
Number of Units	258	268	247	273	308	296	352
Total Tax, E$	1,032,000	1,072,000	988,000	1,092,000	1,232,000	1,184,000	1,408,000
F. Lorries, Capacity Under 1500 Kilos. CIF Price E$15,000; Tax E$2,400							
Number of Units	216	267	237	284	294	251	440
Total Tax, E$	518,400	640,800	568,800	681,600	705,600	602,400	1,056,000
G. Lorries, Capacity Over 1500 Kilos. CIF Price E$19,600; Tax E$2,548							
Number of Units	545	673	598	719	745	635	861
Total Tax, E$	1,709,120	2,110,528	1,875,328	2,254,784	2,336,320	1,991,360	2,700,096
Total Taxes, E$	6,734,950	7,876,062	7,668,647	8,359,767	8,825,153	8,806,633	10,535,532

Source: Consultants' analysis.

EXHIBIT 5.7

PROJECTED REVENUE FROM SALES TAX
(2% OF LIST PRICE)

Year		Small Car	Large Car	Land Rover	Microbus	Omnibus	Light Lorry	Heavy Lorry	Total Tax
1972	Number Units	3,035	1,635	674	64	258	216	545	
	Tax/Vehicle, $	143	238	280	619	1,820	384	831	
	Total Tax, E$	434,005	389,130	188,720	39,616	469,560	82,944	452,895	2,056,870
1973	Number Units	3,498	1,884	832	67	268	267	673	
	Tax/Vehicle, $	143	238	280	619	1,820	384	831	
	Total Tax, E$	500,214	448,392	232,960	41,473	487,760	102,528	559,263	2,372,590
1974	Number Units	3,796	2,044	740	60	247	237	598	
	Tax/Vehicle, $	143	238	280	619	1,820	384	831	
	Total Tax, E$	542,828	486,472	207,200	37,140	449,540	91,008	496,938	2,311,126
1975	Number Units	3,744	2,016	890	68	273	284	719	
	Tax/Vehicle, $	143	238	280	619	1,820	384	831	
	Total Tax, E$	535,392	479,808	249,200	42,092	496,860	109,056	597,489	2,509,897
1976	Number Units	3,942	2,122	921	77	308	294	745	
	Tax/Vehicle, $	143	238	280	619	1,820	384	831	
	Total Tax, E$	563,706	505,036	257,880	47,663	560,560	112,896	619,095	2,666,836
1977	Number Units	4,747	2,503	785	74	296	251	635	
	Tax/Vehicle, $	143	238	280	619	1,820	384	831	
	Total Tax, E$	664,521	595,714	219,800	45,806	538,720	96,384	527,685	2,688,630
1978	Number Units	4,683	2,521	1,065	88	352	440	861	
	Tax/Vehicle, $	143	238	280	619	1,820	384	831	
	Total Tax, E$	669,669	599,998	298,200	54,472	640,640	168,960	715,491	3,147,430

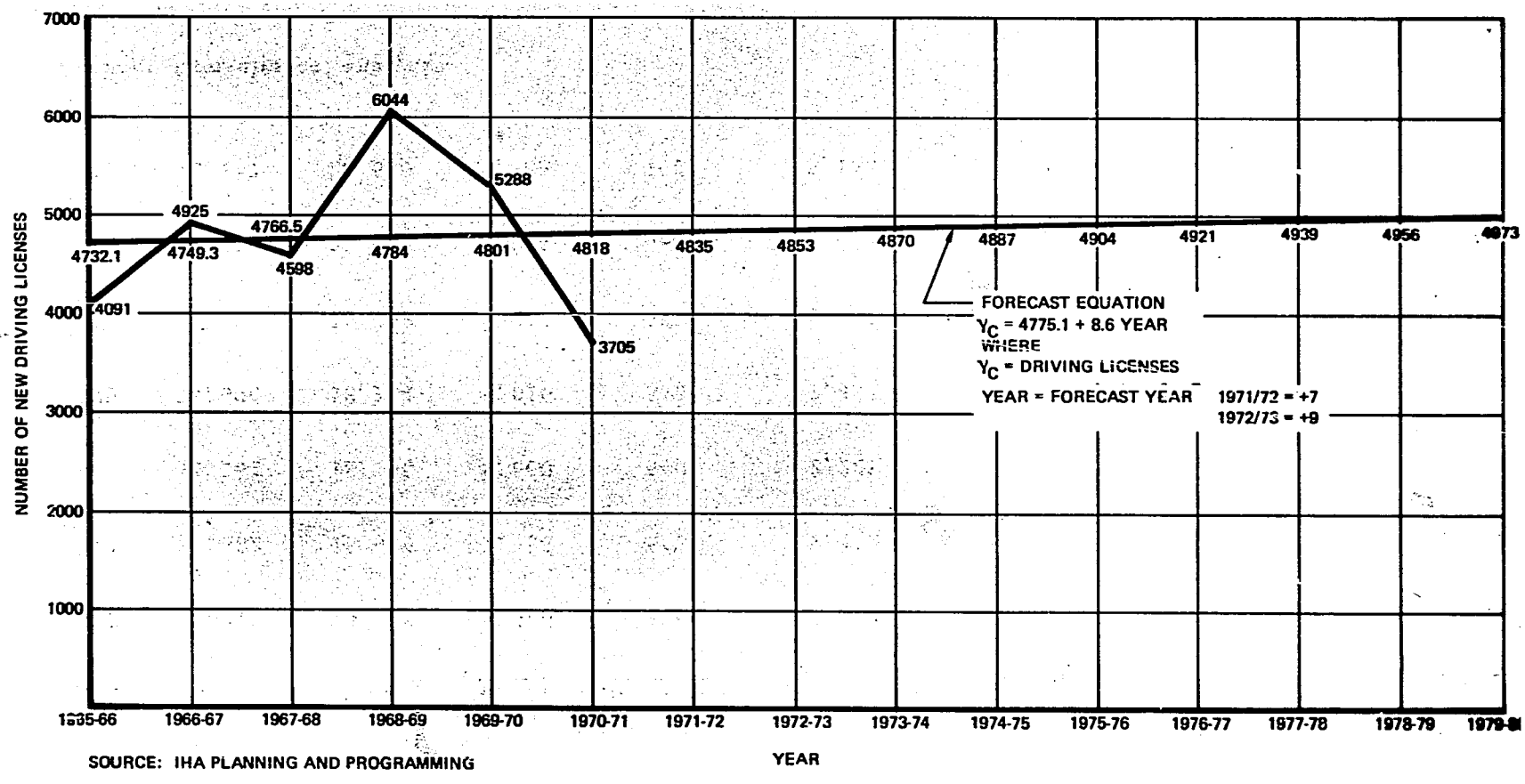
Source: Consultants' analysis.

EXHIBIT 5.8

PROJECTED REVENUE FROM ISSUE OF PERMANENT NUMBER PLATES
(E$9.00/Plate)
Ethiopian Dollars

Year	Small Car <1000 K.	Large Car >1000 K.	Land Rover	Microbuses	Omnibuses	Light Lorries <1500 K.	Heavy Lorries >1500 K.	Trailer	Total
1972	27,315	14,715	6,066	576	2,322	1,944	4,905	135	57,978
1973	31,482	16,956	7,488	603	2,412	2,403	6,057	135	67,536
1974	34,164	18,396	6,660	540	2,223	2,133	5,382	135	69,633
1975	33,696	18,144	8,010	612	2,457	2,556	6,471	135	72,081
1976	35,478	19,098	8,289	693	2,772	2,646	6,705	135	75,816
1977	41,823	22,527	7,065	666	2,664	2,259	5,715	135	82,854
1978	42,147	22,689	9,585	792	3,168	3,960	7,749	135	90,225

Source: Consultants' analysis.



SOURCE: IHA PLANNING AND PROGRAMMING

EXHIBIT 5.9 HISTORICAL AND FORECAST NUMBER OF DRIVERS LICENSES

Province	1st Class	2nd Class	3rd Class	4th Class	5th Class	6th Class	Total
Harerge	16	310	70	42	1	--	439
Sidamo	4	148	29	17	2	17	217
Begemdir	--	20	6	1	--	5	32
Tigre	1	20	14	3	2	--	40
Arussi	--	164	33	29	1	3	230
Shoa	9	1,555	210	111	103	9	1,997
Eritrea	38	180	39	2	--	--	259
Keffa	1	217	55	63	1	--	337
Wollega	--	35	10	6	3	1	55
Welo	--	21	4	3	1	--	29
Gojjam	--	55	12	3	--	--	70
Total	69	2,725	482	280	114	35	3,705

Source: Statistical Office, Statistical Abstract 1969, 1970.

EXHIBIT 5.11

ESTIMATED INCOME FROM THE ISSUANCE OF NEW DRIVER LICENSES
Based on Representative Fee of E$27.00*

	Year	No. of New Licenses**	Income E$
Actual	1965-66	4,091	110,457
	1966-67	4,925	132,975
	1967-68	4,598	124,146
	1968-69	6,044	163,188
	1969-70	5,288	142,776
	1970-71	3,705	100,035
Forecast	1971-72	4,835.3	130,553
	1972-73	4,852.5	131,017
	1973-74	4,869.7	131,481
	1974-75	4,886.9	131,946
	1975-76	4,904.1	132,410
	1976-77	4,921.3	132,875
	1977-78	4,938.5	133,339
	1978-79	4,955.7	133,803
	1979-80	4,972.9	134,268

*Assumption: Taking the average of class 1 and 2 as representative.

**Source: Negarit Gazeta, 28th year - No. 9, 22 February, 1969
Legal Notice No. 362/1961.

Source: IHA Planning and Programming.

The historical data for revenue from the annual inspection and registration fees is shown in Exhibit 5.12. The historical percentage split between the municipalities and the Ministry of Communications is also shown. This split is approximately 50-50, but in 1969/1970 there is a deviation. Investigation disclosed that all municipal data has not been received for that year, accounting for the difference. 1970/71 municipal data was entirely lacking. Exhibit 5.13 is the forecast of revenues from this source. The fees were averaged for large and small buses and for trucks with a capacity greater than 1500 kilos and those with a capacity under 1500 kilos. The fees used are shown in the exhibit column headings, and are applied against the forecast fleet.

Revenue from fuel taxes is based on a time-trend forecast of the total taxable volume and related revenues. Forecasts are also available from oil industry sources but, as previously noted, the volumes sold and the volumes taxed were quite different in the past. Exhibit 5.14 shows the detailed breakdown of revenue from fuel taxes for 1968/69 through 1971/72. Exhibit 5.15 shows the 1965/66 to 1971/72 history of fuel tax revenues and the annual percentage increase. Note the erratic growth. The exhibit also shows the forecast revenue and total volume. Once again, it should be noted that this is a conservative forecast of fuel tax revenues, based on a time-trend regression analysis. Sales of benzine and diesel fuel were also highly correlated to variables such as vehicle fleet and gross domestic product. However, these forecasts produced tax revenue with unrealistically high growth rates when compared to past actual receipts.

EXHIBIT 5.12

REVENUE FROM MOTOR VEHICLE INSPECTION AND REGISTRATION

Year	Municipality $	Municipality %	Ministry of Communications $	Ministry of Communications %	Total E$
1966/67	799,000	50.5	774,959	49.5	1,573,959
1967/68	964,000	52.0	880,465	48.0	1,844,465
1968/69	1,053,000	53.0	905,906	47.0	1,958,906
1969/70	1,113,000	40.0	1,687,628	60.0	2,800,628
1970/71	NA		1,689,898		

NA = Not Available.

Source: Ministry of Communications

EXHIBIT 5.13

PROJECTED REVENUE FROM ANNUAL INSPECTION AND REGISTRATION FEES

Year	Passenger Cars $44/Vehicle	Buses $149/ Vehicle	Trucks $188/Vehicle	Total
1972	1,520,860	356,855	1,575,816	3,453,531
1973	1,633,368	383,675	1,694,256	3,711,299
1974	1,756,128	412,730	1,822,660	3,991,518
1975	1,889,096	444,765	1,969,676	4,303,537
1976	2,035,660	479,035	2,115,376	4,630,071
1977	2,202,772	515,540	2,276,680	4,994,992
1978	2,386,868	555,770	2,454,340	5,396,978

Source: Consultants' analysis.

EXHIBIT 5.14

REVENUE FROM FUEL TAXES

Year	Benzine		Diesel		Gasoil		Total	
	Liters	Tax, E$	Liters	Tax, E$	Liters	Tax, E$	Liters	Tax, E$
1968/69	67,525,204	15,193,172	3,715,572	687,381	89,259,882	16,513,142	160,500,658	32,393,695
1969/70	77,212,539	17,372,822	2,419,317	447,545	90,590,963	19,767,248	170,223,019	34,587,615
1970/71	83,599,426	18,809,871	1,353,704	250,435	105,649,113	19,545,086	190,602,243	38,605,398
1971/72	86,350,178	19,428,792	845,283	156,377	118,692,958	21,958,198	205,888,419	41,543,367

Source: Ministry of Finance, Excise Tax Department, August 1972.

EXHIBIT 5.15

PAST AND PROJECTED REVENUE FROM FUEL TAXES

Year	Tax (E$000's)	Percent Increase	Volume (000's liters
1965/66	20,622	--	--
1966/67	25,281	22.59	--
1967/68	25,382	0.40	--
1968/69	32,394	27.63	160,500
1969/70	34,588	6.77	170,223
1970/71	38,605	11.61	190,602
1971/72	41,543	7.61	205,888
Forecast:			
1972/73	45,290		220,939
1973/74	48,812		236,593
1974/75	52,334		252,247
1975/76	55,856		267,901
1976/77	59,378		283,556
1977/78	62,900		299,200

Revenue Growth Rate 1968/69-71/72: 8.5% per year.

Revenue Growth Rate 1972/73-77/78: 6.5% per year.

Source: Ministry of Finance and Consultants' calculations.

ADMINISTRATIVE APPENDIX

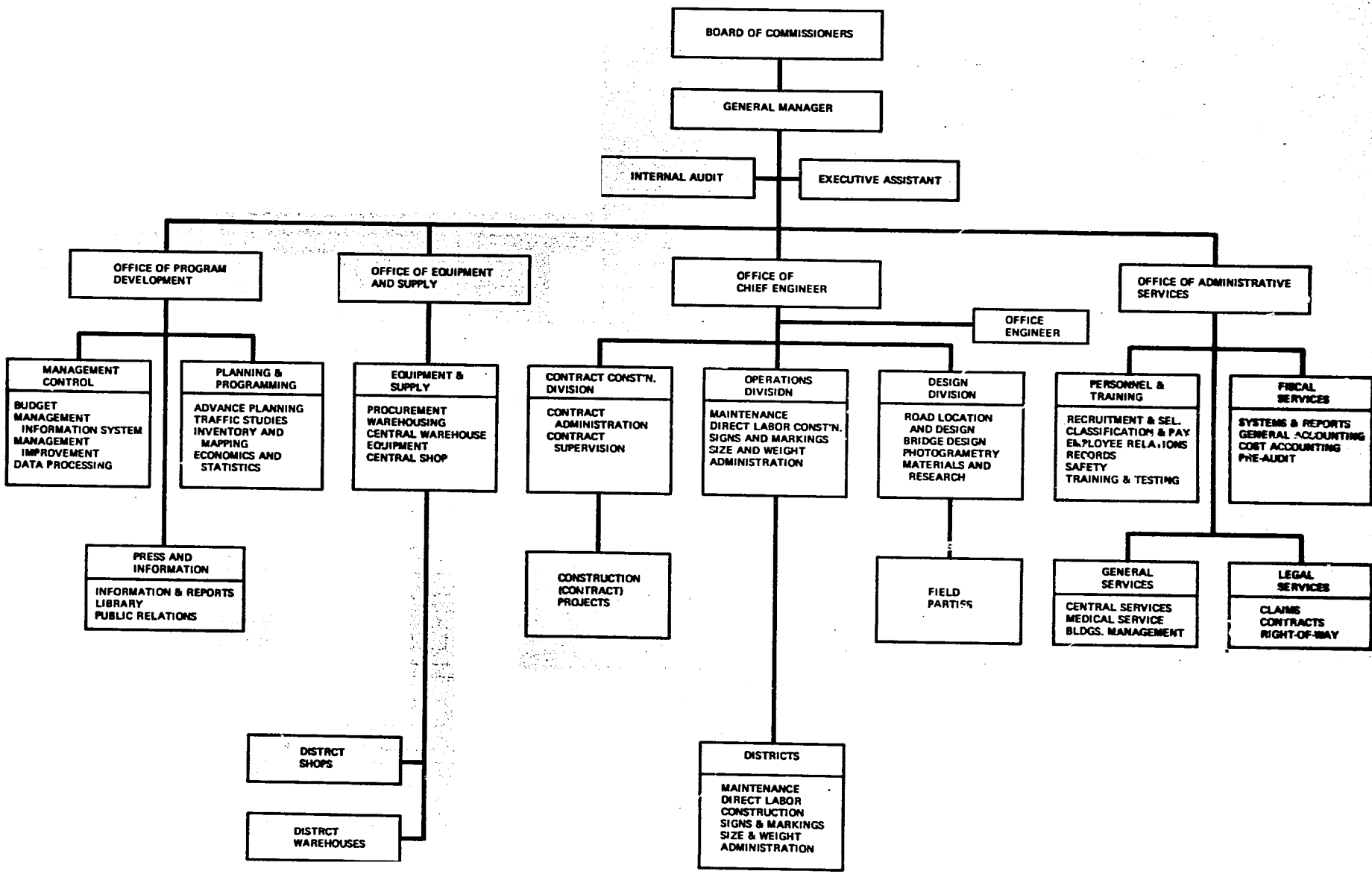


EXHIBIT II-2 ORGANIZATIONAL DIAGRAM, EXISTING OPERATIONS DIVISION

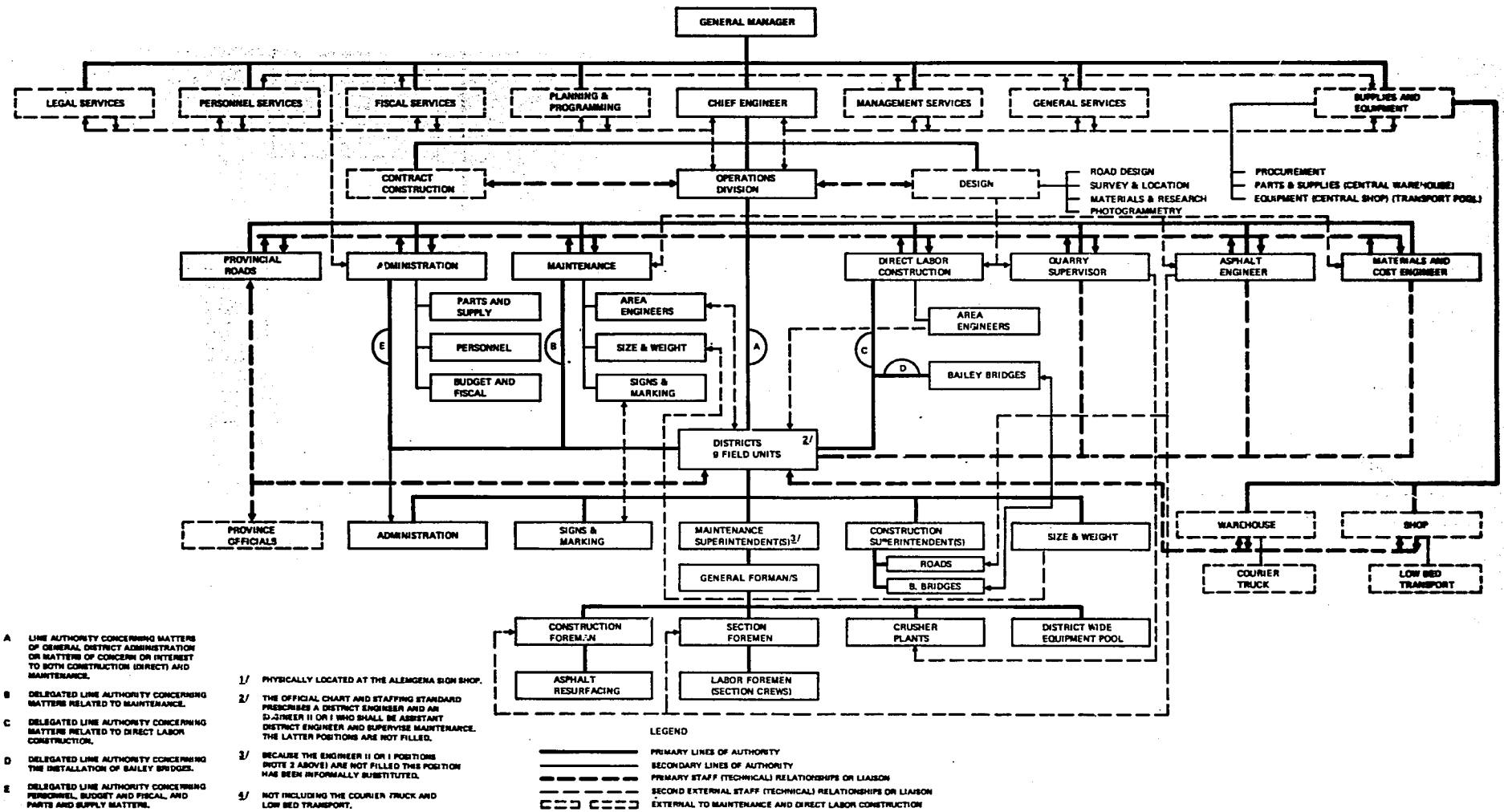


EXHIBIT II-3 PROPOSED ORGANIZATIONAL DIAGRAM, OPERATIONS DIVISION

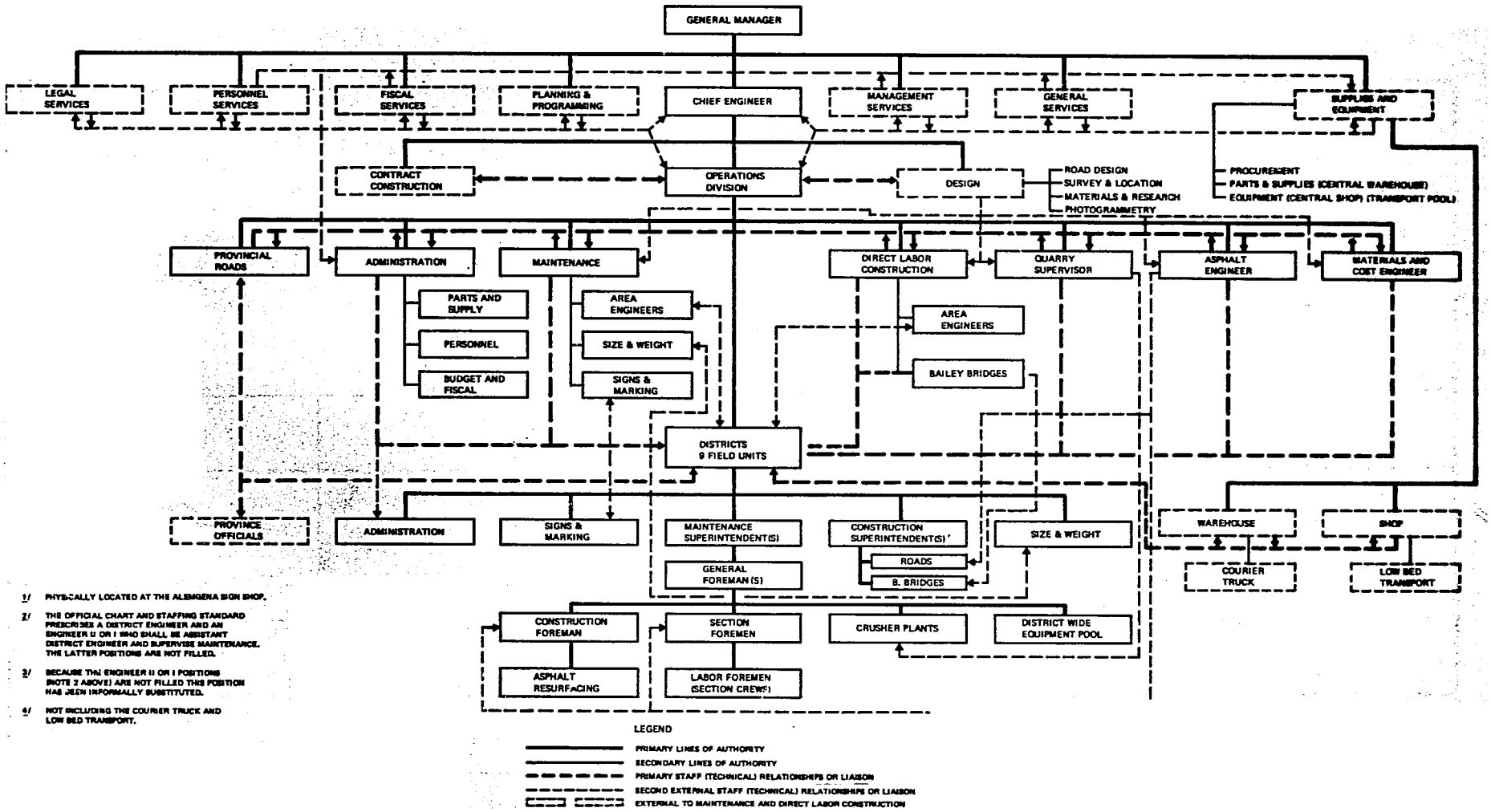


EXHIBIT II-5 EXISTING ORGANIZATIONAL STRUCTURE, SUPPLIES AND EQUIPMENT DIVISION

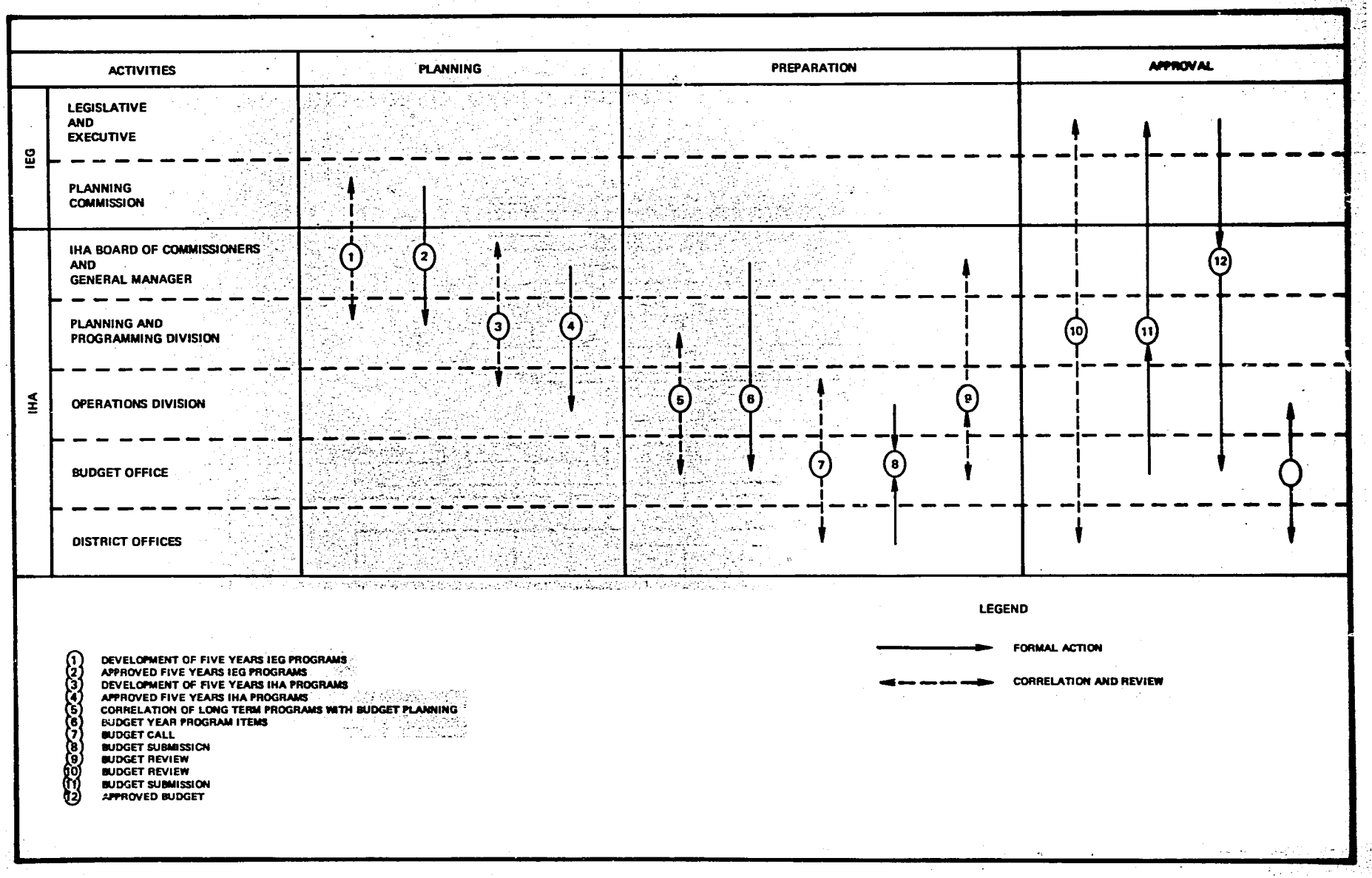


EXHIBIT XIV-1 ROAD MAINTENANCE BUDGET PROCESS

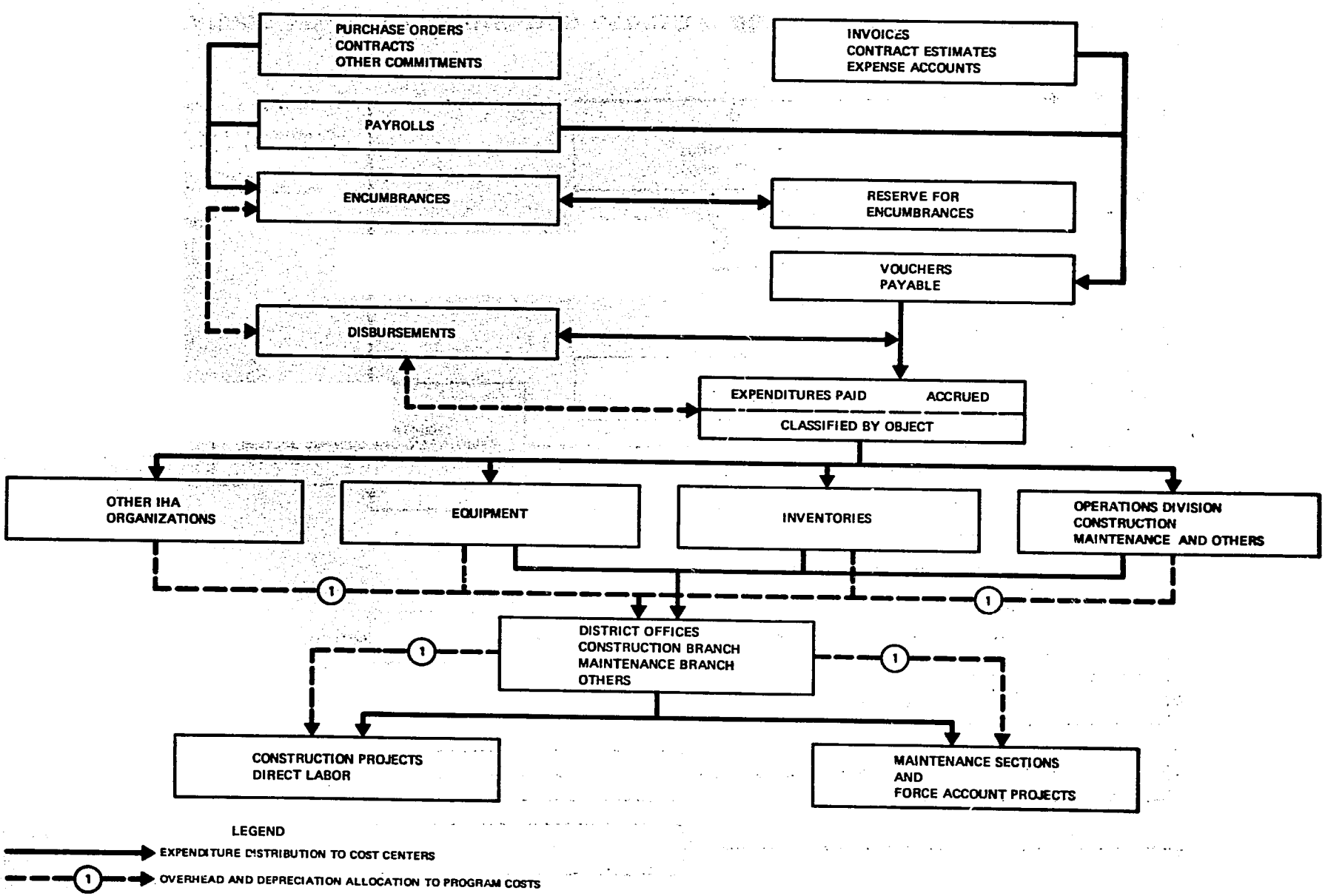


EXHIBIT XIV-4 IHA GENERAL LEDGER CONTROL AND DISTRIBUTIONS TO RESPONSIBILITY CENTERS, EXISTING

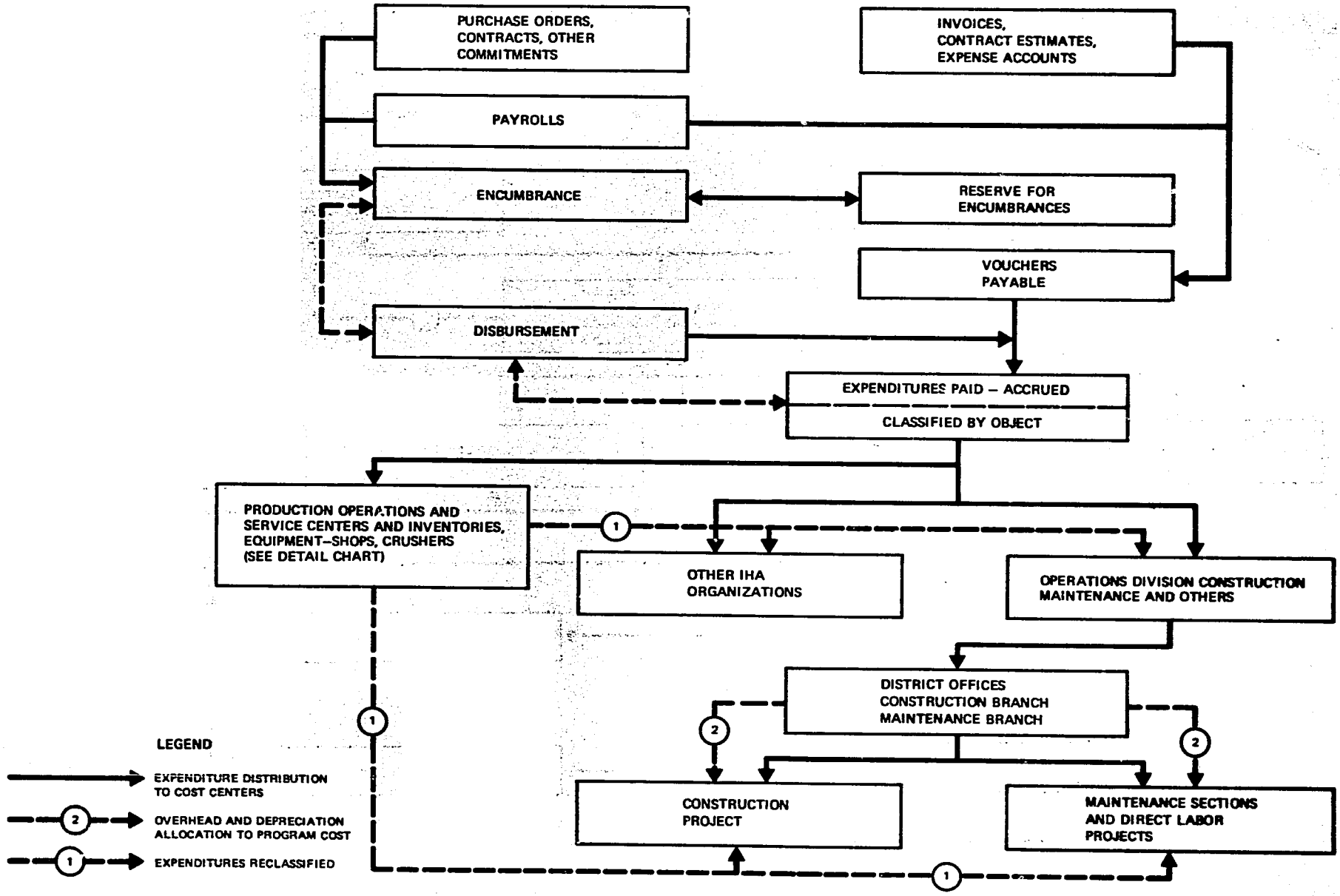
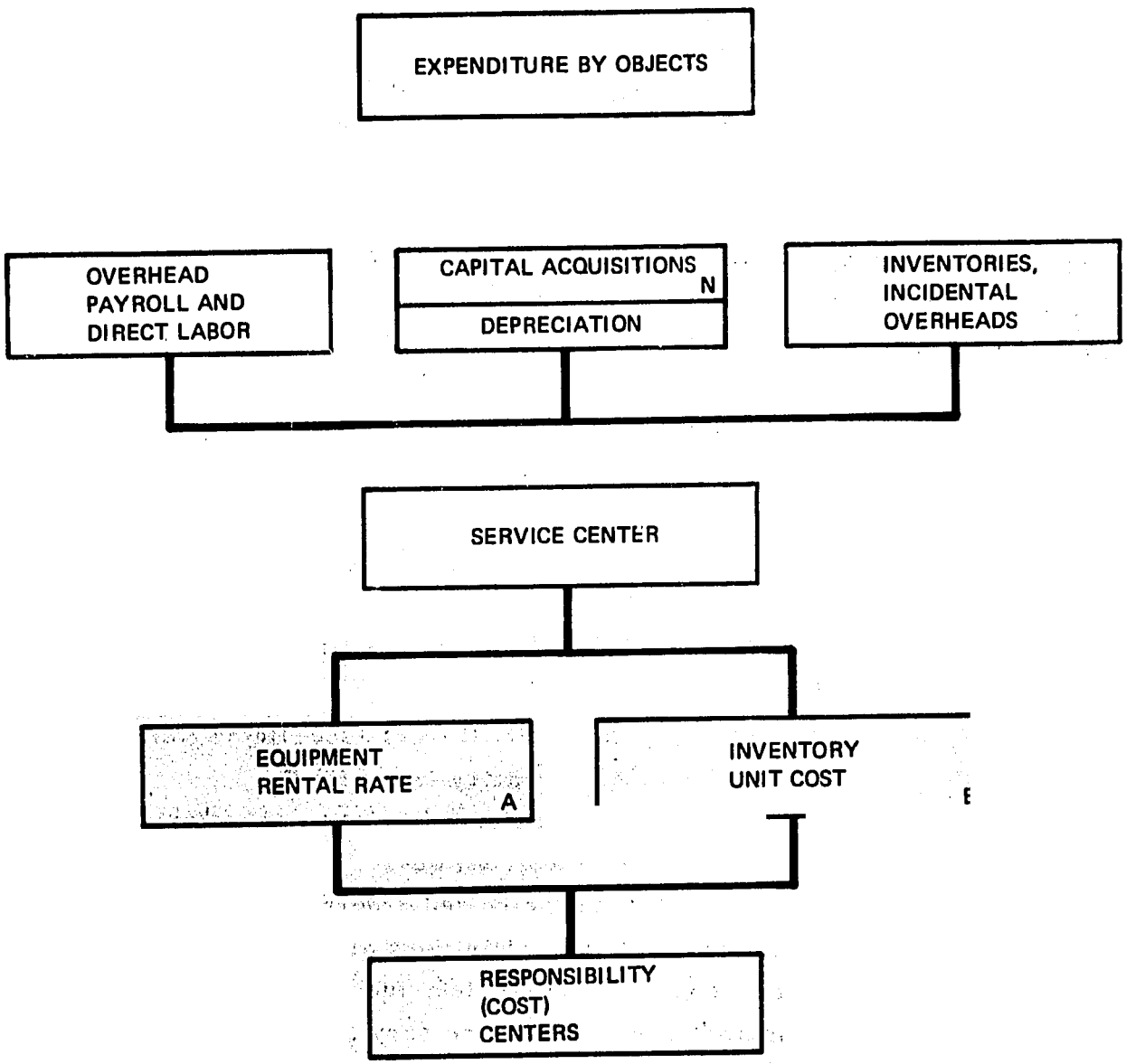


EXHIBIT XIV-5 RECOMMENDED LEDGER CONTROL AND RESPONSIBILITY CENTERS

EXHIBIT XIV-6

RECOMMENDED RECLASSIFICATION OF EXPENDITURES THROUGH SERVICE CENTER OPERATIONS



N COST OF RESOURCE CONSUMED (EXPENDITURE RECLASSIFICATION ONLY UNDER REPLACEMENT RESERVE OPTION)

A ASSUMES COST DETERMINATIONS FOR EQUIPMENT USE

B ASSUMES COST DETERMINATIONS FOR INVENTORY ISSUES

ADMINISTRATIVE APPENDIX

Discussion of a Capital Equipment Working Fund for the IHA

Capitalization of fixed assets would be required at the original or extended life cost or at the value of existing inventory at the time of its transfer to the equipment working fund (EWF). Additionally, capitalization would be required at the estimated delivered cost of undelivered orders and authorized additional fixed asset acquisitions at the time the fund is created. Fixed assets would include:

1. All items and classes of equipment held for lease to user programs.
2. All items and classes of equipment held incidental to the EWF operation, such as shop and service equipment, auxiliary heavy tools and miscellaneous over-the-road items.
3. All items and classes of furniture and fixtures held incident to the EWF operation.
4. Fund receipts or absolute receivables would need to be provided as an advance to cover:
   a. Accrued depreciation of all fixed asset items transferred from existing IHA inventory to the EWF.
   b. Estimated cost of undelivered orders and authorized additional fixed asset acquisitions.
   c. Estimated cost of undelivered orders and authorized additional inventory acquisitions or other assets, including spare parts, accessories, fuel and lubricants held for maintenance, repair and servicing of lease equipment.
   d. Estimated cost of undelivered orders and authorized additional acquisitions of incidental materials and supplies for general EWF use, including a small tools allowance.
   e. Estimated costs of undistributed, indirect and overhead items of expense incidental to the EWF operation for the time lag between incurrance of expense and recovery through user charges.

Fund reserves would need to be established for the accrued depreciation of fixed assets transferred to the EWF and for other assets held for servicing of lease equipment at their inventory value when transferred to the EWF.

The fund balance at the time of its capitalization would need to include cash transferred and or cash withdrawal rights against IEG funds. Cash flow from IEG would appropriately be set by agreement with the EWF to ensure that advance of the authorized amount would be at a rate minimizing its impact on IEG fund resources and at the same time permitting fulfillment of EWF objectives.

It should be noted that an IEG policy decision to advance funds to a and create an EWF in the IHA would require consideration of factors such as:

1. An assessment of the immediate and long term impact on IEG's fiscal position.
2. Understanding that IEG fund resources must finance:
   a. The expired life (accrued depreciation) of existing IHA inventory of fixed assets transferred to the EWF.
   b. The cost of additional fixed assets authorized for capitalization by the EWF.
   c. The cost of depreciation of EWF fixed asset inventory through EWF charges to annual user programs.
3. Understanding that EWF operates in competition with IHA employees, vendors and contractors for available IHA fund resources.
4. Controls required to assure that the authorized level of EWF capitalization is not exceeded.
5. Controls required to assure that the EWF remains solvent and operates consistently without gain or loss.
6. IEG controls to assure that EWF cash and reserves are available and used only for EWF purposes, including investment of reserves.

7. A determination that EWF expenditures for capital replacements be authorized within the management framework of the IHA or controlled through IEG review at the Finance Ministry of legislative level, much in the same manner as justification of annual budget requests.
8. The real cost of the IEG of failure to provide for IHA equipment replacements essential to a sound road maintenance program.
9. The advantages accruing to the IHA through a controlled equipment management program associated with an EWF operation.