APPENDIX-B

IEE MATRIX

&

APPENDIX-C

OVERALL RATING MATRIX BASED ON MULTI CRITERIA ANALYSIS

Appendix B IEE Matrix

B-1 Mamminasa Bypass

Table B-1-1 IEE Matrix of Mamminasa Bypass (South Section)

		Item / Description	Alternative 1 New Route (length 16.8km)					Alternative 2 New Route (length 20.3km)					Alternative 3 Widening existing road (length 9.1km)					Alternative 4 (Zero-Option) Existing road (length 9.1km)				
					Construction Stage					Construction Stage					Construction					Construction		
			Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage	Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage	Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage	Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage
Lingkungan Sosial	1	Migration of Populations Involuntary Resettlement	B-	B-	-	-	-	B-	B-	-	-	-	A-	A-	-	-	-	-				
		a. Number of houses / building to be moved (no)		49	-	-	-		76	-	-	-		493	-	-	-					
		b. Area of land acquisition required (ha)		67	-	-	-		81	-	-	-		27	-	-	-					
	2	Impact on Local Economy (Employment, Livelihood, etc.)	A+	-	B+	B+	A+	A+	-	B+	B+	A+	B+	-	B+	B+	B+	B-				
	3	Utilization of Land and Local Resources	A+	-	-	-	A+	B+	-	-	-	B+	B+	-	-	-	B+	-				
	4	Social Institutions (Social Capital and Local Decision-making institution)	B+	-	-	-	B+	B+	-	-	-	B+	-	-	-	-	-	-				
	5	Existing Social Infrastructure and Services	B+	-	B-	-	B+	B+	-	B-	-	B+	C+	-	B-	-	B+	-				
	6	Vulnerable Social Groups	B-	B-	-	-	-	B-	B-	-	-	-	B-	B-	-	-	-	-				
	7	Equality of Benefits and Losses and Equality in Development process	B-	B-	-	-	B-	B-	B-	-	-	B-	B-	B-	-	-	B-	-				
	8	Local Conflicts of Interests	B-	B-	-	-	B-	B-	B-	-	-	B-	B-	B-	-	-	B-	-				
	9	Gender	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	10	Children's Rights (interruption of children's schooling and increase in the number of children's traffic accidents, etc.)	B-	-	-	-	B-	B-	-	-	-	A-	A-	-	-	-	A-	-				
	11	Cultural Heritage	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	12	Infectious Diseases (HIV/AIDS)	B-	-	B-	B-	-	B-	-	B-	B-	-	B-	-	B-	B-	-	-				
	13	Traffic Jam	A+	-	-	-	A+	B+	-	-	-	B+	B+	-	-	-	B+	A-				
	14	Traffic accidents	B-	-	B-	-	B-	B-	-	B-	-	B-	B-	-	-	-	B-	B-				
Lingkungan Alamiah	15	Geographical Conditions	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	16	Geological Conditions	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	17	Soil Erosion	B-	-	B-	B-	-	B-	-	B-	B-	-	B-	-	B-	B-	-	-				
	18	Fauna Ecology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	19	Flora Ecology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	20	Effects on the Ground Water	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	21	Effect on the Surface Water Body (River, Lakes, etc)	B-	-	-	B-	-	B-	-	-	B-	-	B-	-	-	B-	-	-				
	22	Effect on the Coastal Environment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	23	Oceanographic Changes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	24	Effect on the Natural/Ecological Reserves and Sanctuaries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	25	Localised Climatic Changes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	26	Effect on the Global Warming Issues	C-	-	-	-	C-	C-	-	-	-	C-	C-	-	-	-	C-	B-				
	27	Effect on Drainage and Floods	B+	-	-	-	B+	B+	-	-	-	B+	B+	-	-	-	B+	-				
Polusi	28	Air Pollution	B-	-	-	-	B-	B-	-	-	-	B-	B-	-	-	-	B-	C-				
	29	Water Pollution	B-	-	-	B-	-	B-	-	-	B-	-	-	-	-	-	-	-				
	30	Soil Pollution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	31	Solid Waste and/or Industrial Discharge Management	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	32	Noise and Vibration	B-	-	B-	B-	B-	B-	-	B-	B-	B-	B-	-	B-	B-	B-	C-				
	33	Large Scale Ground Settlement	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	34	Emanating Odour	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	35	Pollution on the Water Bottom/Sludge and Its Effect on the Aquatic Life	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				

Notes: A: Significant changes expected, B: Relatively significant changes expected, C: Not significant but subject to further study, "-": Neglectable impact,
A+, B+, C+ indicates relatively positive changes, A-, B-, C- indicates relatively negative changes.

Table B-1-2 IEE Matrix of Mamminasa Bypass (Middle Section)

		Item / Description	Alternative 1 New Route (length 22km)					Alternative 2 Widening Existing Road (length 28,4km)					Alternatif 4 (Zero-Option) Existing Road (length 29,4 km)				
					Construction Stage					Construction Stage					Construction		
			Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage	Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage	Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage
Social Environment	1	Migration of Populations Involuntary Resettlement	B-	B-	-	-	-	A-	A-	-	-	-	-				
		a. Number of houses / building to be moved (no)		18	-	-	-		699	-	-	-					
		b. Area of land acquisition required (ha)		88	-	-	-		85	-	-	-					
	2	Impact on Local Economy (Employment, Livelihood, etc.)	A+	-	B+	B+	A+	B+	-	B+	B+	B+	-				
	3	Utilization of Land and Local Resources	A+	-	-	-	A+	B+	-	-	-	B+	-				
	4	Social Institutions (Social Capital and Local Decision-making institution)	B+	-	-	-	B+	B-	-	-	-	B-	-				
	5	Existing Social Infrastructure and Services	B+	-	-	-	B+	A-	-	B-	-	A-	-				
	6	Vulnerable Social Groups	B-	B-	-	-	-	B-	B-	-	-	-	-				
	7	Equality of Benefits and Losses and Equality in Development process	B-	B-	-	-	B-	B-	B-	-	-	B-	-				
	8	Local Conflicts of Interests	B-	B-	-	-	B-	B-	B-	-	-	B-	-				
	9	Gender	-	-	-	-	-	-	-	-	-	-	-				
	10	Children's Rights (interruption of children's schooling and increase in the number of children's traffic accidents, etc.)	B-	-	-	-	B-	A-	-	-	-	A-	-				
	11	Cultural Heritage	-	-	-	-	-	-	-	-	-	-	-				
	12	Infectious Diseases (HIV/AIDS)	B-	-	B-	B-	-	B-	-	B-	B-	-	-				
	13	Traffic Jam	A+	-	-	-	A+	A+	-	-	-	A+	B-				
	14	Traffic accidents	B-	-	B-	B-	B-	B-	-	B-	B-	B-	C-				
Natural Environment	15	Geographical Conditions	-	-	-	-	-	-	-	-	-	-	-				
	16	Geological Conditions	-	-	-	-	-	-	-	-	-	-	-				
	17	Soil Erosion	B-	-	B-	B-	-	B-	-	B-	B-	-	-				
	18	Faunal Ecology	-	-	-	-	-	-	-	-	-	-	-				
	19	Flora Ecology	-	-	-	-	-	-	-	-	-	-	-				
	20	Effects on the Ground Water	-	-	-	-	-	-	-	-	-	-	-				
	21	Effect on the Surface Water Body (River, Lakes, etc)	B-	-	-	B-	-	B-	-	-	B-	-	-				
	22	Effect on the Coastal Environment	-	-	-	-	-	-	-	-	-	-	-				
	23	Oceanographic Changes	-	-	-	-	-	-	-	-	-	-	-				
	24	Effect on the Natural/Ecological Reserves and Sanctuaries	-	-	-	-	-	-	-	-	-	-	-				
	25	Localised Climatic Changes	-	-	-	-	-	-	-	-	-	-	-				
	26	Effect on the Global Warming Issues	C-	-	-	-	C-	C-	-	-	-	C-	-				
	27	Effect on Drainage and Floods	B+	-	-	-	B+	B+	-	-	-	B+	-				
Pollution	28	Air Pollution	B-	-	-	-	B-	B-	-	-	-	B-	C-				
	29	Water Pollution	B-	-	-	B-	-	B-	-	-	B-	-	-				
	30	Soil Pollution	-	-	-	-	-	-	-	-	-	-	-				
	31	Solid Waste and/or Industrial Discharge Management	-	-	-	-	-	-	-	-	-	-	-				
	32	Noise and Vibration	B-	-	B-	B-	B-	A-	-	B-	B-	A-	B-				
	33	Large Scale Ground Settlement	-	-	-	-	-	-	-	-	-	-	-				
	34	Emanating Odour	-	-	-	-	-	-	-	-	-	-	-				
	35	Pollution on the Water Bottom/Sludge and Its Effect on the Aquatic Life	-	-	-	-	-	-	-	-	-	-	-				

Notes: A: Significant changes expected, B: Relatively significant changes expected, C: Not significant but subject to further study, "-": Neglectable impact,
A+, B+, C+ indicates relatively positive changes, A-, B-, C- indicates relatively negative changes.

Table B-1-3 IEE Matrix of Mamminasa Bypass (North Section)

		Item / Description	Alternative 1 New Route (2 access, length 9.1km)					Alternative 2 New Route (1 access, length 5.0km)					Alternative 3 Widening existing road (length 3.3km)					Alternative 4 New Route (1 access, length 8.3km)					Alternative 5 (Zero-Option) Existing Road (length 3.3km)				
					Construction Stage					Construction Stage				Construction					Construction						Construction		
			Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage	Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage	Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage	Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage	Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage
Social Environment	1	Migration of Populations Involuntary Resettlement	B-	B-	-	-	-	B1-	B-	-	-	-	A-	A-	-	-	-	B-	B-	-	-	-	-				
		a. Number of houses / building to be moved (no)		33	-	-	-		9	-	-	-		140	-	-	-		20	-	-	-					
		b. Area of land acquisition required (ha)		36	-	-	-		20	-	-	-		10	-	-	-		33	-	-	-					
	2	Impact on Local Economy (Employment, Livelihood, etc.)	A+	-	B+	B+	A+	A+	-	B+	B+	A+	B+	-	B+	B+	B+	A+	-	B+	B+	A+	B-				
	3	Utilization of Land and Local Resources	A+	-	-	-	A+	B+	-	-	-	B+	B+	-	-	-	B+	A+	-	-	-	A+	-				
	4	Social Institutions (Social Capital and Local Decision-making institution)	B+	-	-	-	B+	B+	-	-	-	B+	B+	-	-	-	B+	B+	-	-	-	B+	B-				
	5	Existing Social Infrastructure and Services	B+	-	B-	-	B+	B+	-	B-	-	B+	B+	-	B-	-	B+	B+	-	B-	-	B+	-				
	6	Vulnerable Social Groups	B-	B-	-	-	-	B-	B-	-	-	-	B-	B-	-	-	-	B-	B-	-	-	-	-				
	7	Equality of Benefits and Losses and Equality in Development process	B-	B-	-	-	B-	B-	B-	-	-	B-	B-	B-	-	-	B-	B-	B-	-	-	B-	-				
	8	Local Conflicts of Interests	B-	B-	-	-	B-	B-	B-	-	-	B-	B-	B-	-	-	B-	B-	B-	-	-	B-	-				
	9	Gender	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	10	Children's Rights (interruption of children's schooling and increase in the number of children's traffic accidents, etc.)	B-	-	-	-	B-	B-	-	-	-	B-	B-	-	-	-	B-	B-	-	-	-	B-	-				
	11	Cultural Heritage	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	12	Infectious Diseases (HIV/AIDS)	B-	-	B-	B-	-	B-	-	B-	B-	-	B-	-	B-	B-	-	B-	-	B-	B-	-	-				
	13	Traffic Jam	A+	-	-	-	A+	B+	-	-	-	B+	B+	-	-	-	B+	B+	-	-	-	B+	A-				
	14	Traffic accidents	B-	-	B-	-	B-	-	-	-	-	-	-	-	-	-	-	B-	-	B-	-	B-	C-				
Natural Environment	15	Geographical Conditions	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	16	Geological Conditions	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	17	Soil Erosion	B-	-	B-	B-	-	B-	-	B-	B-	-	B-	-	B-	B-	-	B-	-	B-	B-	-	-				
	18	Faunal Ecology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	19	Flora Ecology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	20	Effects on the Ground Water	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	21	Effect on the Surface Water Body (River, Lakes, etc)	B-	-	-	B-	-	-	-	-	-	-	-	-	-	-	-	B-	-	-	B-	-	-				
	22	Effect on the Coastal Environment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	23	Oceanographic Changes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	24	Effect on the Natural/Ecological Reserves and Sanctuaries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	25	Localised Climatic Changes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	26	Effect on the Global Warming Issues	C-	-	-	-	C-	C-	-	-	-	C-	C-	-	-	-	C-	C-	-	-	-	C-	B-				
	27	Effect on Drainage and Floods	B+	-	-	-	B+	A-	-	-	-	A-	-	-	-	-	-	A-	-	-	-	A-	-				
Pollution	28	Air Pollution	B-	-	-	-	B-	B-	-	-	-	B-	B-	-	-	-	B-	B-	-	-	-	B-	A-				
	29	Water Pollution	B-	-	-	B-	-	B-	-	-	-	-	B-	-	-	-	-	B-	-	-	B-	-	-				
	30	Soil Pollution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	31	Solid Waste and/or Industrial Discharge Management	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	32	Noise and Vibration	B-	-	B-	B-	B-	B-	-	B-	-	B-	B-	-	B-	-	B-	B-	-	B-	B-	B-	B-				
	33	Large Scale Ground Settlement	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	34	Emanating Odour	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	35	Pollution on the Water Bottom/Sludge and Its Effect on the Aquatic Life	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				

Notes: A: Significant changes expected, B: Relatively significant changes expected, C: Not significant but subject to further study, "-": Neglectable impact,
A+, B+, C+ indicates relatively positive changes, A-, B-, C- indicates relatively negative changes.

B-2 Trans-Sulawesi Mamminasata Section

Table B-2-1 IEE Matrix of Trans-Sulawesi Mamminasata Section (A Section)

		Item / Description	Alternative 1 Existing Road Widening (Length: 20.0km)					Alternative 2 (Zero-Option) Existing Road (Length: 20.0km)				
					Construction Stage					Construction		
			Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage	Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage
Social Environment	1	Migration of Populations Involuntary Resettlement a. Number of houses / building to be moved (no) b. Area of land acquisition required (ha)	A-	A- 487 44	- - -	- - -	- - -	-				
	2	Impact on Local Economy (Employment, Livelihood, etc.)	B+	-	-	-	B+	B-				
	3	Utilization of Land and Local Resources	B+	-	-	-	B+	-				
	4	Social Institutions (Social Capital and Local Decision-making institution)	-	-	-	-	-	B-				
	5	Existing Social Infrastructure and Services	B-	-	-	-	B-	-				
	6	Vulnerable Social Groups	B-	B-	-	-	B-	-				
	7	Equality of Benefits and Losses and Equality in Development process	B-	B-	-	-	B-	-				
	8	Local Conflicts of Interests	B-	B-	-	-	B-	-				
	9	Gender	-	-	-	-	-	-				
	10	Children's Rights (interruption of children's schooling and increase in the number of children's traffic accidents, etc.)	C-	-	-	-	C-	-				
	11	Cultural Heritage	C-	-	-	-	C-	-				
	12	Infectious Diseases (HIV/AIDS)	B-	-	B-	B-	-	-				
	13	Traffic Jam	A+	-	-	-	A+	A-				
	14	Traffic accidents	B-	-	B-	B-	B-	A-				
Natural Environment	15	Geographical Conditions	-	-	-	-	-	-				
	16	Geological Conditions	-	-	-	-	-	-				
	17	Soil Erosion	B-	-	B-	B-	-	-				
	18	Fauna Ecology	C-	-	C-	-	-	-				
	19	Flora Ecology	C-	-	C-	-	-	C-				
	20	Effects on the Ground Water	-	-	-	-	-	-				
	21	Effect on the Surface Water Body (River, Lakes, etc)	B-	-	-	B-	-	-				
	22	Effect on the Coastal Environment	-	-	-	-	-	-				
	23	Oceanographic Changes	-	-	-	-	-	-				
	24	Effect on the Natural/Ecological Reserves and Sanctuaries	-	-	-	-	-	-				
	25	Localised Climatic Changes	-	-	-	-	-	-				
	26	Effect on the Global Warming Issues	C-	-	-	-	C-	C-				
	27	Effect on Drainage and Floods	-	-	-	-	-	-				
Pollution	28	Air Pollution	B-	-	-	-	B-	B-				
	29	Water Pollution	B-	-	C-	B-	-	-				
	30	Soil Pollution	-	-	-	-	-	-				
	31	Solid Waste and/or Industrial Discharge Management	-	-	-	-	-	-				
	32	Noise and Vibration	B-	-	C-	B-	B-	B-				
	33	Large Scale Ground Settlement	-	-	-	-	-	-				
	34	Emanating Odour	-	-	-	-	-	-				
	35	Pollution on the Water Bottom/Sludge and Its Effect on the Aquatic Life	-	-	-	-	-	-				

Legend: A: Significant changes expected, B: Relatively significant changes expected, C: Not significant but subject to further study, "-": Neglectable impact, A+, B+, C+ indicates relatively positive changes, A-, B-, C- indicates relatively negative changes.

Table B-2-2 IEE Matrix of Trans-Sulawesi Mamminasata Section (B Section)

		Item / Description	Alternative 1 New Road (already planned) (Length: 7.0km)					Alternative 2 (Zero-Option) Existing Road (Length: 11.5km)				
					Construction Stage					Construction		
			Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage	Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage
Social Environment	1	Migration of Populations Involuntary Resettlement a. Number of houses / building to be moved (no) b. Area of land acquisition required (ha)	A-	A- 241 28	- - -	- - -	- - -	-				
	2	Impact on Local Economy (Employment, Livelihood, etc.)	B-	-	-	-	B-	B-				
	3	Utilization of Land and Local Resources	B+	-	-	-	B+	-				
	4	Social Institutions (Social Capital and Local Decision-making institution)	-	-	-	-	-	-				
	5	Existing Social Infrastructure and Services	B+	-	-	-	B+	B-				
	6	Vulnerable Social Groups	B-	B-	-	-	B-	-				
	7	Equality of Benefits and Losses and Equality in Development process	B-	B-	-	-	B-	-				
	8	Local Conflicts of Interests	B-	B-	-	-	B-	-				
	9	Gender	-	-	-	-	-	-				
	10	Children's Rights (interruption of children's schooling and increase in the number of children's traffic accidents, etc.)	C-	-	-	-	C-	-				
	11	Cultural Heritage	C-	-	C-	C-		-				
	12	Infectious Diseases (HIV/AIDS)	B-	-	B-	B-	-	-				
	13	Traffic Jam	B+	-	-	-	B+	A-				
	14	Traffic accidents	B-	-	B-	B-	B-	A-				
Natural Environment	15	Geographical Conditions	-	-	-	-	-	-				
	16	Geological Conditions	-	-	-	-	-	-				
	17	Soil Erosion	B-	-	B-	B-	-	-				
	18	Fauna Ecology	C-	-	C-	C-	-	-				
	19	Flora Ecology	C-	-	C-	C-	-	C-				
	20	Effects on the Ground Water	-	-	-	-	-	-				
	21	Effect on the Surface Water Body (River, Lakes, etc)	B-	-	-	B-	-	-				
	22	Effect on the Coastal Environment	-	-	-	-	-	-				
	23	Oceanographic Changes	-	-	-	-	-	-				
	24	Effect on the Natural/Ecological Reserves and Sanctuaries	-	-	-	-	-	-				
	25	Localised Climatic Changes	-	-	-	-	-	-				
	26	Effect on the Global Warming Issues	C-	-	-	-	C-	C-				
	27	Effect on Drainage and Floods	B+	-	-	-	B+	-				
Pollution	28	Air Pollution	B-	-	-	-	B-	B-				
	29	Water Pollution	B-	-	C-	B-	-	-				
	30	Soil Pollution	-	-	-	-	-	-				
	31	Solid Waste and/or Industrial Discharge Management	-	-	-	-	-	-				
	32	Noise and Vibration	B-	-	C-	B-	B-	B-				
	33	Large Scale Ground Settlement	-	-	-	-	-	-				
	34	Emanating Odour	-	-	-	-	-	-				
	35	Pollution on the Water Bottom/Sludge and Its Effect on the Aquatic Life	-	-	-	-	-	-				

Legend: A: Significant changes expected, B: Relatively significant changes expected, C: Not significant but subject to further study, "-": Neglectable impact,
A+, B+, C+ indicates relatively positive changes, A-, B-, C- indicates relatively negative changes.

Table B-2-3 IEE Matrix of Trans-Sulawesi Mamminasata Section (C Section)

		Item / Description	Alternative 1 New Road (Length: 8.6km)					Alternative 2 New Road (Length: 7.6km)					Alternative 3 (Zero-Option) Existing Road (Length: 8.7km)				
					Construction Stage					Construction Stage					Construction		
			Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage	Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage	Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage
Social Environment	1	Migration of Populations Involuntary Resettlement	B-	B-	-	-	-	A-	A-	-	-	-	-				
		a. Number of houses / building to be moved (no)		90	-	-	-		170	-	-	-					
		b. Area of land acquisition required (ha)		33	-	-	-		29	-	-	-					
	2	Impact on Local Economy (Employment, Livelihood, etc.)	A+	-	B+	B+	A+	A+	-	B+	B+	A+	B-				
	3	Utilization of Land and Local Resources	A+	-	-	-	A+	A+	-	-	-	A+	-				
	4	Social Institutions (Social Capital and Local Decision-making institution)	B+	-	-	-	B+	B+	-	-	-	B+	B-				
	5	Existing Social Infrastructure and Services	B+	-	B-	-	B+	B+	-	B-	-	B+	B-				
	6	Vulnerable Social Groups	B-	B-	-	-	-	B-	B-	-	-	-	-				
	7	Equality of Benefits and Losses and Equality in Development process	B-	B-	-	-	B-	B-	B-	-	-	B-	-				
	8	Local Conflicts of Interests	B-	B-	-	-	B-	B-	B-	-	-	B-	-				
	9	Gender	-	-	-	-	-	-	-	-	-	-	-				
	10	Children's Rights (interruption of children's schooling and increase in the number of children's traffic accidents, etc.)	B-	-	-	-	B-	A-	-	-	-	A-	-				
	11	Cultural Heritage	C-	-	-	-	C-	C-	-	-	-	C-	-				
	12	Infectious Diseases (HIV/AIDS)	B-	-	B-	B-	-	B-	-	B-	B-	-	-				
	13	Traffic Jam	A+	-	-	-	A+	A+	-	-	-	A+	A-				
	14	Traffic accidents	B-	-	B-	B-	B-	B-	-	B-	B-	B-	B-				
Natural Environment	15	Geographical Conditions	-	-	-	-	-	-	-	-	-	-	-				
	16	Geological Conditions	-	-	-	-	-	-	-	-	-	-	-				
	17	Soil Erosion	B-	-	B-	B-	-	B-	-	B-	B-	-	-				
	18	Fauna Ecology	C-	-	C-	C-	-	C-	-	C-	C-	-	-				
	19	Flora Ecology	C-	-	C-	C-	-	C-	-	C-	C-	-	-				
	20	Effects on the Ground Water	-	-	-	-	-	-	-	-	-	-	-				
	21	Effect on the Surface Water Body (River, Lakes, etc)	B-	-	-	B-	-	B-	-	-	B-	-	-				
	22	Effect on the Coastal Environment	-	-	-	-	-	-	-	-	-	-	-				
	23	Oceanographic Changes	-	-	-	-	-	-	-	-	-	-	-				
	24	Effect on the Natural/Ecological Reserves and Sanctuaries	-	-	-	-	-	-	-	-	-	-	-				
	25	Localised Climatic Changes	-	-	-	-	-	-	-	-	-	-	-				
	26	Effect on the Global Warming Issues	C-	-	-	-	C-	C-	-	-	-	C-	B-				
	27	Effect on Drainage and Floods	B+	-	-	-	B+	B+	-	-	-	B+	-				
Pollution	28	Air Pollution	B-	-	-	-	B-	B-	-	-	-	B-	B-				
	29	Water Pollution	B-	-	C-	B-	-	B-	-	C-	B-	-	-				
	30	Soil Pollution	-	-	-	-	-	-	-	-	-	-	-				
	31	Solid Waste and/or Industrial Discharge Management	-	-	-	-	-	-	-	-	-	-	-				
	32	Noise and Vibration	B-	-	C-	B-	B-	B-	-	C-	B-	B-	B-				
	33	Large Scale Ground Settlement	-	-	-	-	-	-	-	-	-	-	-				
	34	Emanating Odour	-	-	-	-	-	-	-	-	-	-	-				
	35	Pollution on the Water Bottom/Sludge and Its Effect on the Aquatic Life	-	-	-	-	-	-	-	-	-	-	-				

Legend: A: Significant changes expected, B: Relatively significant changes expected, C: Not significant but subject to further study, "-": Neglectable impact,
A+, B+, C+ indicates relatively positive changes, A-, B-, C- indicates relatively negative changes.

Table B-2-4 IEE Matrix of Trans-Sulawesi Mamminasata Section (D Section)

		Item / Description	Alternative 1 Existing Road Widening (Length: 22.0km)					Alternative 2 (Zero-Option) Existing Road (Length: 22.0km)				
					Construction Stage					Construction		
			Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage	Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage
Social Environment	1	Migration of Populations Involuntary Resettlement a. Number of houses / building to be moved (no) b. Area of land acquisition required (ha)	A-	A- 665 22	- - -	- - -	- - -	-				
	2	Impact on Local Economy (Employment, Livelihood, etc.)	B-	-	-	-	B-	B-				
	3	Utilization of Land and Local Resources	B+	-	-	-	B+	-				
	4	Social Institutions (Social Capital and Local Decision-making institution)	-	-	-	-	-	-				
	5	Existing Social Infrastructure and Services	B-	-	-	-	B-	-				
	6	Vulnerable Social Groups	B-	B-	-	-	B-	-				
	7	Equality of Benefits and Losses and Equality in Development process	B-	B-	-	-	B-	-				
	8	Local Conflicts of Interests	B-	B-	-	-	B-	-				
	9	Gender	-	-	-	-	-	-				
	10	Children's Rights (interruption of children's schooling and increase in the number of children's traffic accidents, etc.)	C-	-	-	-	C-	-				
	11	Cultural Heritage	C-	-	C-	C-	-	-				
	12	Infectious Diseases (HIV/AIDS)	B-	-	B-	B-	-	-				
	13	Traffic Jam	B+	-	-	-	B+	B-				
	14	Traffic accidents	B-	-	B-	B-	B-	B-				
Natural Environment	15	Geographical Conditions	C-	-	C-	-	-	-				
	16	Geological Conditions	-	-	-	-	-	-				
	17	Soil Erosion	B-	-	B-	B-	-	-				
	18	Fauna Ecology	-	-	-	-	-	-				
	19	Flora Ecology	C-	-	C-	C-	-	C-				
	20	Effects on the Ground Water	-	-	-	-	-	-				
	21	Effect on the Surface Water Body (River, Lakes, etc)	B-	-	-	B-	-	-				
	22	Effect on the Coastal Environment	-	-	-	-	-	-				
	23	Oceanographic Changes	-	-	-	-	-	-				
	24	Effect on the Natural/Ecological Reserves and Sanctuaries	-	-	-	-	-	-				
	25	Localised Climatic Changes	-	-	-	-	-	-				
	26	Effect on the Global Warming Issues	C-	-	-	-	C-	C-				
	27	Effect on Drainage and Floods	-	-	-	-	-	-				
Pollution	28	Air Pollution	C-	-	-	-	C-	C-				
	29	Water Pollution	B-	-	C-	B-	-	-				
	30	Soil Pollution	-	-	-	-	-	-				
	31	Solid Waste and/or Industrial Discharge Management	-	-	-	-	-	-				
	32	Noise and Vibration	B-	-	C-	B-	B-	B-				
	33	Large Scale Ground Settlement	-	-	-	-	-	-				
	34	Emanating Odour	-	-	-	-	-	-				
	35	Pollution on the Water Bottom/Sludge and Its Effect on the Aquatic Life	-	-	-	-	-	-				

Legend: A: Significant changes expected, B: Relatively significant changes expected, C: Not significant but subject to further study, "-": Neglectable impact, A+, B+, C+ indicates relatively positive changes, A-, B-, C- indicates relatively negative changes.

B-3 Hertasning Road

Table B-3-1 IEE Matrix of Hertasning Road (D Section)

		Item / Description	Alternative 1 Existing Road Widening (Length: 4.5km)					Alternative 2 (Zero-Option) Existing Road (Length: 4.5km)				
					Construction Stage					Construction		
			Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage	Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage
Social Environment	1	Migration of Populations Involuntary Resettlement a. Number of houses / building to be moved (no) b. Area of land acquisition required (ha)	A-	A- 160 11	- - -	- - -	- - -	-				
	2	Impact on Local Economy (Employment, Livelihood, etc.)	B+	-	-	-	B+	B-				
	3	Utilization of Land and Local Resources	B+	-	-	-	B+	C-				
	4	Social Institutions (Social Capital and Local Decision-making institution)	-	-	-	-	-	-				
	5	Existing Social Infrastructure and Services	B+	-	-	-	B+	B-				
	6	Vulnerable Social Groups	B-	B-	-	-	B-	-				
	7	Equality of Benefits and Losses and Equality in Development process	B-	B-	-	-	B-	-				
	8	Local Conflicts of Interests	B-	B-	-	-	B-	-				
	9	Gender	-	-	-	-	-	-				
	10	Children's Rights (interruption of children's schooling and increase in the number of children's traffic accidents, etc.)	C-	-	-	-	C-	-				
	11	Cultural Heritage	C-	-	C-	C-	-	-				
	12	Infectious Diseases (HIV/AIDS)	B-	-	B-	B-	-	-				
	13	Traffic Jam	B+	-	-	-	B+	B-				
	14	Traffic accidents	B-	-	B-	B-	B-	C-				
Natural Environment	15	Geographical Conditions	-	-	-	-	-	-				
	16	Geological Conditions	-	-	-	-	-	-				
	17	Soil Erosion	B-	-	C-	B-	-	C-				
	18	Fauna Ecology	C-	-	C-	C-	-	-				
	19	Flora Ecology	C-	-	C-	C-	-	-				
	20	Effects on the Ground Water	-	-	-	-	-	-				
	21	Effect on the Surface Water Body (River, Lakes, etc)	C-	-	-	C-	-	-				
	22	Effect on the Coastal Environment	-	-	-	-	-	-				
	23	Oceanographic Changes	-	-	-	-	-	-				
	24	Effect on the Natural/Ecological Reserves and Sanctuaries	-	-	-	-	-	-				
	25	Localised Climatic Changes	-	-	-	-	-	-				
	26	Effect on the Global Warming Issues	-	-	-	-	-	-				
	27	Effect on Drainage and Floods	C+	-	-	-	C+	C-				
Pollution	28	Air Pollution	C-	-	-	-	C-	-				
	29	Water Pollution	B-	-	C-	B-	-	-				
	30	Soil Pollution	-	-	-	-	-	-				
	31	Solid Waste and/or Industrial Discharge Management	-	-	-	-	-	-				
	32	Noise and Vibration	B-	-	C-	B-	C-	-				
	33	Large Scale Ground Settlement	-	-	-	-	-	-				
	34	Emanating Odour	-	-	-	-	-	-				
	35	Pollution on the Water Bottom/Sludge and Its Effect on the Aquatic Life	-	-	-	-	-	-				

Legend: A: Significant changes expected, B: Relatively significant changes expected, C: Not significant but subject to further study, "-": Neglectable impact, A+, B+, C+ indicates relatively positive changes, A-, B-, C- indicates relatively negative changes.

B-4 Abdullah Daeng Sirua Road

Table B-4-1 IEE Matrix of Abdullah Daeng Sirua Road (A Section)

		Item / Description	Alternative 1 Use of Existing Road with			Alternative 2 Existing Road Widening (Length: 1.3km)					Alternative 3 (Zero-Option) Existing Road (Length: 1.3km)				
								Construction Stage					Construction		
			Overall Evaluation	Preparation of control measurement	Post-control Stage	Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage	Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage
Social Environment	1	Migration of Populations Involuntary Resettlement a. Number of houses / building to be moved (no) b. Area of land acquisition required (ha)	- 	- - -	- - -	A-	A- 196 3	- - -	- - -	- - -	-				
	2	Impact on Local Economy (Employment, Livelihood, etc.)	-	-	-	B+	-	B+	-	B+	-				
	3	Utilization of Land and Local Resources	C-	C-	C-	-	-	-	-	-	C-				
	4	Social Institutions (Social Capital and Local Decision-making institution)	-	-	-	-	-	-	-	-	-				
	5	Existing Social Infrastructure and Services	-	-	-	B+	-	B-	-	B+	-				
	6	Vulnerable Social Groups	-	-	-	B-	B-	-	-	B-	-				
	7	Equality of Benefits and Losses and Equality in Development process	-	-	-	B-	B-	-	-	B-	-				
	8	Local Conflicts of Interests	-	-	-	B-	B-	-	-	B-	-				
	9	Gender	-	-	-	-	-	-	-	-	-				
	10	Children's Rights (interruption of children's schooling and increase in the number of children's traffic accidents, etc.)	C-	C-	C-	C-	-	-	-	C-	C-				
	11	Cultural Heritage	-		-	C-	-	C-	C-	-	-				
	12	Infectious Diseases (HIV/AIDS)	-	-	-	B-	-	B-	-	-	-				
	13	Traffic Jam	C+	A-	C+	B+	-	-	-	B+	A-				
	14	Traffic accidents	B-	B-	C-	B-	-	B-	-	B-	B-				
Natural Environment	15	Geographical Conditions	-	-	-	-	-	-	-	-	-				
	16	Geological Conditions	-	-	-	-	-	-	-	-	-				
	17	Soil Erosion	-	-	-	-	-	-	-	-	-				
	18	Faunal Ecology	-	-	-	-	-	-	-	-	-				
	19	Flora Ecology	-	-	-	-	-	-	-	-	-				
	20	Effects on the Ground Water	-	-	-	-	-	-	-	-	-				
	21	Effect on the Surface Water Body (River, Lakes, etc)	-	-	-	-	-	-	-	-	-				
	22	Effect on the Coastal Environment	-	-	-	-	-	-	-	-	-				
	23	Oceanographic Changes	-	-	-	-	-	-	-	-	-				
	24	Effect on the Natural/Ecological Reserves and Sanctuaries	-	-	-	-	-	-	-	-	-				
	25	Localised Climatic Changes	-	-	-	-	-	-	-	-	-				
	26	Effect on the Global Warming Issues	C-	-	C-	C-	-	-	-	C-	C-				
	27	Effect on Drainage and Floods	-	-	-	B+	-	-	-	B+	-				
Pollution	28	Air Pollution	B-	B-	B-	B-	-	C-	-	B-	B-				
	29	Water Pollution	-	-	-	-	-	-	-	-	-				
	30	Soil Pollution	-	-	-	-	-	-	-	-	-				
	31	Solid Waste and/or Industrial Discharge Management	C-	C-	C-	-	-	-	-	-	C-				
	32	Noise and Vibration	B-	-	B-	B-	-	B-	-	B-	B-				
	33	Large Scale Ground Settlement	-	-	-	-	-	-	-	-	-				
	34	Emanating Odour	-	-	-	-	-	-	-	-	-				
	35	Pollution on the Water Bottom/Sludge and Its Effect on the Aquatic Life	-	-	-	-	-	-	-	-	-				

Notes: A: Significant changes expected, B: Relatively significant changes expected, C: Not significant but subject to further study, "-": Neglectable impact, A+, B+, C+ indicates relatively positive changes, A-, B-, C- indicates relatively negative changes.

Table B-4-2 IEE Matrix of Abdullah Daeng Sirua Road (C Section)

		Item / Description	Alternative 1 Existing Road Widening (Length: 0.8km)					Alternative 2 (Zero-Option) Existing Road (Length: 0.8km)				
					Construction Stage					Construction		
			Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage	Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage
Social Environment	1	Migration of Populations Involuntary Resettlement a. Number of houses / building to be moved (no) b. Area of land acquisition required (ha)	B-	B- 65 1	- - -	- - -	- - -	-				
	2	Impact on Local Economy (Employment, Livelihood, etc.)	C+	-	C+	-	C+	-				
	3	Utilization of Land and Local Resources	C+	-	-	-	C+	C-				
	4	Social Institutions (Social Capital and Local Decision-making institution)	-	-	-	-	-	-				
	5	Existing Social Infrastructure and Services	B+	-	B-	-	B+	-				
	6	Vulnerable Social Groups	B-	B-	-	-	B-	-				
	7	Equality of Benefits and Losses and Equality in Development process	C-	C-	-	-	C-	-				
	8	Local Conflicts of Interests	C-	C-	-	-	C-	-				
	9	Gender	-	-	-	-	-	-				
	10	Children's Rights (interruption of children's schooling and increase in the number of children's traffic accidents, etc.)	C-	-	-	-	C-	-				
	11	Cultural Heritage	C-	-	C-	C-	-	-				
	12	Infectious Diseases (HIV/AIDS)	B-	-	B-	-	-	-				
	13	Traffic Jam	B+	-	-	-	B+	B-				
	14	Traffic accidents	C-	-	C-	-	C-	B-				
Natural Environment	15	Geographical Conditions	-	-	-	-	-	-				
	16	Geological Conditions	-	-	-	-	-	-				
	17	Soil Erosion	-	-	-	-	-	-				
	18	Fauna Ecology	-	-	-	-	-	-				
	19	Flora Ecology	-	-	-	-	-	-				
	20	Effects on the Ground Water	-	-	-	-	-	-				
	21	Effect on the Surface Water Body (River, Lakes, etc)	-	-	-	-	-	-				
	22	Effect on the Coastal Environment	-	-	-	-	-	-				
	23	Oceanographic Changes	-	-	-	-	-	-				
	24	Effect on the Natural/Ecological Reserves and Sanctuaries	-	-	-	-	-	-				
	25	Localised Climatic Changes	-	-	-	-	-	-				
	26	Effect on the Global Warming Issues	C-	-	-	-	C-	C-				
	27	Effect on Drainage and Floods	-	-	-	-	-	-				
Pollution	28	Air Pollution	B-	-	C-	-	B-	C-				
	29	Water Pollution	C-	-	C-	-	-	C-				
	30	Soil Pollution	-	-	-	-	-	-				
	31	Solid Waste and/or Industrial Discharge Management	-	-	-	-	-	-				
	32	Noise and Vibration	B-	-	C-	-	B-	C-				
	33	Large Scale Ground Settlement	-	-	-	-	-	-				
	34	Emanating Odour	-	-	-	-	-	-				
	35	Pollution on the Water Bottom/Sludge and Its Effect on the Aquatic Life	-	-	-	-	-	-				

Notes: A: Significant changes expected, B: Relatively significant changes expected, C: Not significant but subject to further study, "-": Neglectable impact, A+, B+, C+ indicates relatively positive changes, A-, B-, C- indicates relatively negative changes.

Table B-4-3 IEE Matrix of Abdullah Daeng Sirua Road (D Section)

		Item / Description	Alternative 1 New Road (Length: 4.5km)					Alternative 2 New Road on PDAM Row (Length: 4.5km)					Alternative 3 Existing Road Widening (Length: 5.1km)					Alternative 4 (Zero-Option) Existing Road (Length: 5.1km)				
					Construction Stage					Construction Stage					Construction					Construction		
			Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage	Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage	Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage	Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage
Social Environment	1	Migration of Populations Involuntary Resettlement	B-	B-	-	-	-	A-	A-	-	-	-	A-	A-	-	-	-	-				
		a. Number of houses / building to be moved (no)		15	-	-	-		50	-	-	-		120	-	-	-					
		b. Area of land acquisition required (ha)		15	-	-	-		7	-	-	-		6	-	-	-					
	2	Impact on Local Economy (Employment, Livelihood, etc.)	B+	-	B+	B+	B+	B+	-	B+	-	B+	B+	-	B+	-	B+	-				
	3	Utilization of Land and Local Resources	A+	-	-	-	A+	B+	-	-	-	B+	B+	-	-	-	B+	-				
	4	Social Institutions (Social Capital and Local Decision-making institution)	B+	-	-	-	B+	B+	-	-	-	B+	B+	-	-	-	B+	-				
	5	Existing Social Infrastructure and Services	B+	-	B-	-	B+	B+	-	B-	-	B+	B+	-	B-	-	B+	-				
	6	Vulnerable Social Groups	B-	B-	-	-	B-	B-	B-	-	-	B-	B-	B-	-	-	B-	-				
	7	Equality of Benefits and Losses and Equality in Development process	B-	B-	-	-	B-	B-	B-	-	-	B-	B-	B-	-	-	B-	-				
	8	Local Conflicts of Interests	B-	B-	-	-	B-	B-	B-	-	-	B-	B-	B-	-	-	B-	-				
	9	Gender	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	10	Children's Rights (interruption of children's schooling and increase in the number of children's traffic accidents, etc.)	C-	-	-	-	C-	C-	-	-	-	C-	C-	-	-	-	C-	-				
	11	Cultural Heritage	C-	-	C-	C-	-	C-	-	C-	C-	-	C-	-	C-	C-	-	-				
	12	Infectious Diseases (HIV/AIDS)	B-	-	B-	B-	-	B-	-	B-	-	-	B-	-	B-	-	-	-				
	13	Traffic Jam	B+	-	-	-	B+	B+	-	-	-	B+	B+	-	-	-	B+	B-				
	14	Traffic accidents	B-	-	B-	-	B-	B-	-	B-	-	B-	A-	-	-	-	A-	C-				
Natural Environment	15	Geographical Conditions	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	16	Geological Conditions	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	17	Soil Erosion	B-	-	B-	B-	-	B-	-	B-	-	-	B-	-	B-	-	-	-				
	18	Fauna Ecology	C-	-	C-	C-	-	C-	-	C-	-	-	C-	-	C-	-	-	-				
	19	Flora Ecology	C-	-	C-	C-	-	C-	-	C-	-	-	C-	-	C-	-	-	-				
	20	Effects on the Ground Water	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	21	Effect on the Surface Water Body (River, Lakes, etc)	B-	-	-	-	-	B-	-	-	-	-	B-	-	-	-	-	-				
	22	Effect on the Coastal Environment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	23	Oceanographic Changes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	24	Effect on the Natural/Ecological Reserves and Sanctuaries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	25	Localised Climatic Changes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	26	Effect on the Global Warming Issues	C-	-	-	-	C-	C-	-	-	-	C-	C-	-	-	-	C-	B-				
	27	Effect on Drainage and Floods	B+	-	-	-	B+	-	-	-	-	-	-	-	-	-	-	C-				
Pollution	28	Air Pollution	B-	-	C-	C-	B-	B-	-	C-	-	B-	B-	-	C-	-	B-	C-				
	29	Water Pollution	B-	-	-	B-	-	-	-	-	-	-	-	-	-	-	-	-				
	30	Soil Pollution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	31	Solid Waste and/or Industrial Discharge Management	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	32	Noise and Vibration	B-	-	B-	B-	B-	B-	-	B-	-	B-	B-	-	B-	-	B-	B-				
	33	Large Scale Ground Settlement	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	34	Emanating Odour	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	35	Pollution on the Water Bottom/Sludge and Its Effect on the Aquatic Life	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				

Notes: A: Significant changes expected, B: Relatively significant changes expected, C: Not significant but subject to further study, "-": Neglectable impact,
A+, B+, C+ indicates relatively positive changes, A-, B-, C- indicates relatively negative changes.

Table B-4-4 IEE Matrix of Abdullah Daeng Sirua Road (E Section)

		Item / Description	Alternative 1 Existing Road Widening (Length: 1.2km)					Alternative 2 (Zero-Option) Existing Road (Length: 1.2km)				
					Construction Stage					Construction		
			Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage	Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage
Social Environment	1	Migration of Populations Involuntary Resettlement a. Number of houses / building to be moved (no) b. Area of land acquisition required (ha)	C-	C- 0 4	- - -	- - -	- - -	-				
	2	Impact on Local Economy (Employment, Livelihood, etc.)	C+	-	C+	-	C+	C-				
	3	Utilization of Land and Local Resources	-	-	-	-	-	C-				
	4	Social Institutions (Social Capital and Local Decision-making institution)	-	-	-	-	-	-				
	5	Existing Social Infrastructure and Services	B+	-	B-	-	B+	-				
	6	Vulnerable Social Groups	C-	C-	-	-	C-	-				
	7	Equality of Benefits and Losses and Equality in Development process	C-	C-	-	-	C-	-				
	8	Local Conflicts of Interests	C-	C-	-	-	C-	-				
	9	Gender	-	-	-	-	-	-				
	10	Children's Rights (interruption of children's schooling and increase in the number of children's traffic accidents, etc.)	C-	-	-	-	C-	-				
	11	Cultural Heritage	C-	-	C-	C-	-	-				
	12	Infectious Diseases (HIV/AIDS)	B-	-	B-	B-	-	-				
	13	Traffic Jam	B+	-	-	-	B+	B-				
	14	Traffic accidents	C-	-	C-	-	C-	C-				
Natural Environment	15	Geographical Conditions	-	-	-	-	-	-				
	16	Geological Conditions	-	-	-	-	-	-				
	17	Soil Erosion	-	-	-	-	-	-				
	18	Fauna Ecology	C-	-	C-	-	-	-				
	19	Flora Ecology	C-	-	C-	-	-	-				
	20	Effects on the Ground Water	-	-	-	-	-	-				
	21	Effect on the Surface Water Body (River, Lakes, etc)	-	-	-	-	-	-				
	22	Effect on the Coastal Environment	-	-	-	-	-	-				
	23	Oceanographic Changes	-	-	-	-	-	-				
	24	Effect on the Natural/Ecological Reserves and Sanctuaries	-	-	-	-	-	-				
	25	Localised Climatic Changes	-	-	-	-	-	-				
	26	Effect on the Global Warming Issues	C-	-	-	-	C-	C-				
	27	Effect on Drainage and Floods	C+	-	-	-	C+	C-				
Pollution	28	Air Pollution	B-	-	C-	C-	B-	C-				
	29	Water Pollution	C-	-	-	C-	-	-				
	30	Soil Pollution	-	-	-	-	-	-				
	31	Solid Waste and/or Industrial Discharge Management	-	-	-	-	-	-				
	32	Noise and Vibration	B-	-	C-	B-	B-	C-				
	33	Large Scale Ground Settlement	-	-	-	-	-	-				
	34	Emanating Odour	-	-	-	-	-	-				
	35	Pollution on the Water Bottom/Sludge and Its Effect on the Aquatic Life	-	-	-	-	-	-				

Notes: A: Significant changes expected, B: Relatively significant changes expected, C: Not significant but subject to further study, "-": Neglectable impact, A+, B+, C+ indicates relatively positive changes, A-, B-, C- indicates relatively negative changes.

Table B-4-5 IEE Matrix of Abdullah Daeng Sirua Road (F Section)

		Item / Description	Alternative 1 New Road (Length: 7.0km)					Alternative 2 Existing Road Widening (Length: 7.0km)					Alternative 3 (Zero-Option) Existing Road (Length: 7.0km)				
					Construction Stage					Construction Stage					Construction		
			Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage	Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage	Overall Evaluation	Pre-construction Stage	Roadway Construction	Bridge Construction	Post-construction Stage
Social Environment	1	Migration of Populations Involuntary Resettlement	B-	B-	-	-	-	A-	A-	-	-	-	-				
		a. Number of houses / building to be moved (no)		10	-	-	-		114	-	-	-					
		b. Area of land acquisition required (ha)		24	-	-	-		8	-	-	-					
	2	Impact on Local Economy (Employment, Livelihood, etc.)	A+	-	B+	-	A+	B+	-	B+	-	B+	C-				
	3	Utilization of Land and Local Resources	A+	-	-	-	A+	B+	-	-	-	B+	C-				
	4	Social Institutions (Social Capital and Local Decision-making institution)	B+	-	-	-	B+	B+	-	-	-	B+	-				
	5	Existing Social Infrastructure and Services	B+	-	-	-	B+	B+	-	-	-	B+	-				
	6	Vulnerable Social Groups	B-	B-	-	-	B-	B-	B-	-	-	B-	-				
	7	Equality of Benefits and Losses and Equality in Development process	B-	B-	-	-	B-	B-	B-	-	-	B-	-				
	8	Local Conflicts of Interests	B-	B-	-	-	B-	B-	B-	-	-	B-	-				
	9	Gender	-	-	-	-	-	-	-	-	-	-	-				
	10	Children's Rights (interruption of children's schooling and increase in the number of children's traffic accidents, etc.)	C-	-	-	-	C-	C-	-	-	-	C-	-				
	11	Cultural Heritage	C-	-	C-	C-	-	C-	-	C-	C-	-	-				
	12	Infectious Diseases (HIV/AIDS)	B-	-	B-	-	-	B-	-	B-	-	-	-				
	13	Traffic Jam	-	-	-	-	-	-	-	-	-	-	B-				
	14	Traffic accidents	B-	-	-	-	B-	B-	-	B-	-	B-	C-				
Natural Environment	15	Geographical Conditions	-	-	-	-	-	-	-	-	-	-	-				
	16	Geological Conditions	-	-	-	-	-	-	-	-	-	-	-				
	17	Soil Erosion	B-	-	B-	-	-	B-	-	B-	-	-	-				
	18	Fauna Ecology	C-	-	C-	-	-	C-	-	C-	-	-	-				
	19	Flora Ecology	C-	-	C-	-	-	C-	-	C-	-	-	-				
	20	Effects on the Ground Water	-	-	-	-	-	-	-	-	-	-	-				
	21	Effect on the Surface Water Body (River, Lakes, etc)	-	-	-	-	-	-	-	-	-	-	-				
	22	Effect on the Coastal Environment	-	-	-	-	-	-	-	-	-	-	-				
	23	Oceanographic Changes	-	-	-	-	-	-	-	-	-	-	-				
	24	Effect on the Natural/Ecological Reserves and Sanctuaries	-	-	-	-	-	-	-	-	-	-	-				
	25	Localised Climatic Changes	-	-	-	-	-	-	-	-	-	-	-				
	26	Effect on the Global Warming Issues	C-	-	-	-	C-	C-	-	-	-	C-	-				
	27	Effect on Drainage and Floods	-	-	-	-	-	-	-	-	-	-	-				
Pollution	28	Air Pollution	B-	-	C-	-	B-	B-	-	C-	-	B-	C-				
	29	Water Pollution	-	-	-	-	-	-	-	-	-	-	-				
	30	Soil Pollution	-	-	-	-	-	-	-	-	-	-	-				
	31	Solid Waste and/or Industrial Discharge Management	-	-	-	-	-	-	-	-	-	-	-				
	32	Noise and Vibration	B-	-	C-	-	B-	B-	-	C-	-	B-	B-				
	33	Large Scale Ground Settlement	-	-	-	-	-	-	-	-	-	-	-				
	34	Emanating Odour	-	-	-	-	-	-	-	-	-	-	-				
	35	Pollution on the Water Bottom/Sludge and Its Effect on the Aquatic Life	-	-	-	-	-	-	-	-	-	-	-				

Notes: A: Significant changes expected, B: Relatively significant changes expected, C: Not significant but subject to further study, "-": Neglectable impact,
A+, B+, C+ indicates relatively positive changes, A-, B-, C- indicates relatively negative changes.

Appendix C Overall Rating Matrix based on Multi Criteria Analysis

C-1 Mamminasa Bypass

Table C-1-1 Overall Rating Matrix of Mamminasa Bypass (South Section)

Evaluation Items	Weight				5 grades assessment				Converted score (Relative evaluation, average = 100)				Weighted score（* weight)			
					Alternative 1	Alternative 2	Alternative 3	Zero Option	Alternative 1	Alternative 2	Alternative 3	Zero Option	Alternative 1	Alternative 2	Alternative 3	Zero Option
	Level 1	Level 2	Level 3	Composite weight	New route (16.8km)	New route (20.3km)	Widening road (9.1km)	Exsisting road (9.1km)	New route (16.8km)	New route (20.3km)	Widening road (9.1km)	Exsisting road (9.1km)	New route (16.8km)	New route (20.3km)	Widening road (9.1km)	Exsisting road (9.1km)
Total				**1.00**	**3.95**	**2.97**	**2.97**	**2.72**	**124.84**	**92.49**	**94.28**	**88.39**	**123.20**	**92.38**	**90.04**	**94.38**
Engineering Aspect	**0.40**			**0.40**	**4.50**	**3.75**	**3.00**	**2.50**	**132.62**	**108.26**	**86.99**	**72.13**	**50.84**	**43.04**	**34.06**	**32.06**
1 Road Alignment			0.30	0.12	5	5	4	3	117.65	117.65	94.12	70.59	14.12	14.12	11.29	8.47
2 Construction Feasibility/ Flood			0.30	0.12	3	3	2	5	92.31	92.31	61.54	153.85	11.08	11.08	7.38	18.46
3 Traffic Demand			0.20	0.08	5	3	3	1	166.67	100.00	100.00	33.33	13.33	8.00	8.00	2.67
4 Road Network			0.20	0.08	5	4	3	1	153.85	123.08	92.31	30.77	12.31	9.85	7.38	2.46
Economical and Financial Aspect	**0.30**			**0.30**	**4.25**	**2.50**	**3.25**	**2.00**	**139.98**	**82.17**	**108.04**	**69.81**	**40.78**	**23.81**	**32.20**	**23.21**
5 Cost (Construction & Maintenance)			0.30	0.09	2	1	3	5	72.73	36.36	109.09	181.82	6.55	3.27	9.82	16.36
6 Economic Effectiveness			0.30	0.09	5	3	3	1	166.67	100.00	100.00	33.33	15.00	9.00	9.00	3.00
7 Impacts on Regional Economy			0.20	0.06	5	3	4	1	153.85	92.31	123.08	30.77	9.23	5.54	7.38	1.85
8 Others			0.20	0.06	5	3	3	1	166.67	100.00	100.00	33.33	10.00	6.00	6.00	2.00
Environmental Aspect	**0.30**			**0.30**	**3.11**	**2.67**	**2.67**	**3.67**	**101.91**	**87.05**	**87.82**	**123.22**	**31.59**	**25.53**	**23.78**	**39.11**
Social Environment		**0.50**		**0.15**	**4.00**	**3.00**	**2.00**	**3.33**	**130.01**	**95.67**	**64.50**	**109.81**	**18.72**	**13.49**	**8.62**	**19.17**
9 Migration of Populations Involuntary Resettlement			0.50	0.08	3	2	1	5	109.09	72.73	36.36	181.82	8.18	5.45	2.73	13.64
10 Existing Social Infrastructure and Services			0.25	0.04	4	4	2	4	114.29	114.29	57.14	114.29	4.29	4.29	2.14	4.29
11 Traffic Jam			0.25	0.04	5	3	3	1	166.67	100.00	100.00	33.33	6.25	3.75	3.75	1.25
Natural Environment		**0.30**		**0.09**	**3.00**	**2.67**	**3.33**	**4.00**	**91.09**	**80.83**	**102.20**	**125.89**	**7.98**	**7.15**	**9.18**	**11.70**
12 Flora, Fauna and Ecosystem			0.40	0.04	2	2	3	5	66.67	66.67	100.00	166.67	2.40	2.40	3.60	6.00
13 Geographical Conditions, Geological Conditions			0.30	0.03	3	2	3	5	92.31	61.54	92.31	153.85	2.49	1.66	2.49	4.15
14 Effect on the Natural/Ecological Reserves and Sanctuaries			0.30	0.03	4	4	4	2	114.29	114.29	114.29	57.14	3.09	3.09	3.09	1.54
Pollution		**0.20**		**0.06**	**2.33**	**2.33**	**2.67**	**3.67**	**84.64**	**84.64**	**96.76**	**133.95**	**4.89**	**4.89**	**5.98**	**8.24**
15 Air Pollution			0.50	0.03	2	2	3	4	72.73	72.73	109.09	145.45	2.18	2.18	3.27	4.36
16 Noise and Vibration			0.30	0.02	2	2	2	3	88.89	88.89	88.89	133.33	1.60	1.60	1.60	2.40
17 Water Pollution			0.20	0.01	3	3	3	4	92.31	92.31	92.31	123.08	1.11	1.11	1.11	1.48

Table C-1-2 Overall Rating Matrix of Mamminasa Bypass (Middle Section)

Evaluation Items	Weight				5 grades assessment			Converted score (Relative evaluation, average = 100)			Weighted score（* weight)		
					Alternative 1	Alternative 2	Zero Option	Alternative 1	Alternative 2	Zero Option	Alternative 1	Alternative 2	Zero Option
	Level 1	Level 2	Level 3	Composite weight	New route (22.0km)	Widening road (28.4km)	Exsisting road (29.4km)	New route (22.0km)	Widening road (28.4km)	exsisting road (29.4km)	New route (22.0km)	Widening road (28.4km)	exsisting road (29.4km)
Total				**1.00**	**3.87**	**2.81**	**2.47**	**127.99**	**91.34**	**80.67**	**127.85**	**88.47**	**83.69**
Engineering Aspect	**0.40**			**0.40**	**4.25**	**2.63**	**1.88**	**146.88**	**90.10**	**63.02**	**57.17**	**35.25**	**27.58**
1 Road Alignment			0.30	0.12	5	3	1	187.50	93.75	18.75	22.50	11.25	2.25
2 Construction Feasibility/ Flood			0.30	0.12	2	2	5	66.67	66.67	166.67	8.00	8.00	20.00
3 Traffic Demand			0.20	0.08	5	3	1	166.67	100.00	33.33	13.33	8.00	2.67
4 Road Network			0.20	0.08	5	3	1	166.67	100.00	33.33	13.33	8.00	2.67
Economical and Financial Aspect	**0.30**			**0.30**	**4.25**	**3.25**	**1.75**	**139.64**	**104.75**	**55.61**	**40.14**	**31.30**	**18.56**
5 Cost (Construction & Maintenance)			0.30	0.09	2	3	5	63.16	78.95	157.89	5.68	7.11	14.21
6 Economic Effectiveness			0.30	0.09	5	4	1	157.89	126.32	15.79	14.21	11.37	1.42
7 Impacts on Regional Economy			0.20	0.06	5	3	1	187.50	93.75	18.75	11.25	5.63	1.13
8 Others			0.20	0.06	5	4	1	150.00	120.00	30.00	9.00	7.20	1.80
Environmental Aspect	**0.30**			**0.30**	**3.11**	**2.56**	**3.78**	**97.46**	**79.18**	**123.37**	**30.53**	**21.92**	**37.55**
Social Environment		**0.50**		**0.15**	**4.33**	**2.67**	**3.67**	**121.82**	**73.64**	**104.55**	**18.20**	**9.41**	**17.39**
9 Migration of Populations Involuntary Resettlement			0.50	0.08	4	1	5	120.00	30.00	150.00	9.00	2.25	11.25
10 Existing Social Infrastructure and Services			0.25	0.04	4	2	5	109.09	54.55	136.36	4.09	2.05	5.11
11 Traffic Jam			0.25	0.04	5	5	1	136.36	136.36	27.27	5.11	5.11	1.02
Natural Environment		**0.30**		**0.09**	**2.67**	**3.00**	**4.00**	**82.22**	**92.22**	**125.56**	**7.20**	**8.28**	**11.52**
12 Flora, Fauna and Ecosystem			0.40	0.04	2	3	5	60.00	90.00	150.00	2.16	3.24	5.40
13 Geographical Conditions, Geological Conditions			0.30	0.03	2	2	5	66.67	66.67	166.67	1.80	1.80	4.50
14 Effect on the Natural/Ecological Reserves and Sanctuaries			0.30	0.03	4	4	2	120.00	120.00	60.00	3.24	3.24	1.62
Pollution		**0.20**		**0.06**	**2.33**	**2.00**	**3.67**	**88.33**	**71.67**	**140.00**	**5.13**	**4.23**	**8.64**
15 Air Pollution			0.50	0.03	2	2	4	75.00	75.00	150.00	2.25	2.25	4.50
16 Noise and Vibration			0.30	0.02	2	1	3	100.00	50.00	150.00	1.80	0.90	2.70
17 Water Pollution			0.20	0.01	3	3	4	90.00	90.00	120.00	1.08	1.08	1.44

Table C-1-3 Overall Rating Matrix of Mamminasa Bypass (North Section)

Evaluation Items		Weight				5 grades assessment					Converted score (Relative evaluation, average = 100)					Weighted score（* weight)				
						Alternative 1	Alternative 2	Alternative 3	Alternative 4	Zero Option	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Zero Option	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Zero Option
		Level 1	Level 2	Level 3	Composite weight	New route (9.1km)	New route (5.0km)	New route (8.3km)	Widening road (3.3km)	Existing road (3.3km)	New route (9.1km)	New route (5.0km)	New route (8.3km)	Widening road (3.3km)	Existing road (3.3km)	New route (9.1km)	New route (5.0km)	New route (8.3km)	Widening road (3.3km)	Existing road (3.3km)
Total					**1.00**	**3.83**	**3.18**	**3.10**	**3.14**	**2.53**	**119.12**	**99.62**	**98.84**	**97.04**	**85.37**	**116.68**	**100.19**	**94.95**	**98.73**	**89.45**
Engineering Aspect		**0.40**			**0.40**	**4.50**	**3.50**	**3.25**	**3.75**	**2.25**	**131.94**	**101.39**	**94.44**	**108.33**	**63.89**	**51.11**	**40.22**	**36.89**	**43.56**	**28.22**
1	Road Alignment			0.30	0.12	4	4	3	5	2	111.11	111.11	83.33	138.89	55.56	13.33	13.33	10.00	16.67	6.67
2	Construction Feasibility/ Flood			0.30	0.12	4	3	3	3	5	111.11	83.33	83.33	83.33	138.89	13.33	10.00	10.00	10.00	16.67
3	Traffic Demand			0.20	0.08	5	4	4	4	1	138.89	111.11	111.11	111.11	27.78	11.11	8.89	8.89	8.89	2.22
4	Road Network			0.20	0.08	5	3	3	3	1	166.67	100.00	100.00	100.00	33.33	13.33	8.00	8.00	8.00	2.67
Economical and Financial Aspect		**0.30**			**0.30**	**4.00**	**3.25**	**3.50**	**3.00**	**2.00**	**121.53**	**101.39**	**111.81**	**90.97**	**74.31**	**34.58**	**30.17**	**33.92**	**26.42**	**24.92**
5	Cost (Construction & Maintenance)			0.30	0.09	1	2	3	1	5	41.67	83.33	125.00	41.67	208.33	3.75	7.50	11.25	3.75	18.75
6	Economic Effectiveness			0.30	0.09	5	4	4	4	1	138.89	111.11	111.11	111.11	27.78	12.50	10.00	10.00	10.00	2.50
7	Impacts on Regional Economy			0.20	0.06	5	3	3	3	1	166.67	100.00	100.00	100.00	33.33	10.00	6.00	6.00	6.00	2.00
8	Others			0.20	0.06	5	4	4	4	1	138.89	111.11	111.11	111.11	27.78	8.33	6.67	6.67	6.67	1.67
Environmental Aspect		**0.30**			**0.30**	**3.00**	**2.78**	**2.56**	**2.67**	**3.33**	**103.90**	**96.09**	**90.26**	**91.82**	**117.93**	**30.98**	**29.80**	**24.14**	**28.76**	**36.32**
Social Environment			**0.50**		**0.15**	**4.00**	**3.67**	**2.67**	**3.67**	**3.67**	**116.71**	**104.30**	**74.88**	**104.30**	**99.81**	**16.44**	**16.14**	**9.53**	**16.14**	**16.74**
9	Migration of Populations Involuntary Resettlement			0.50	0.08	3	4	1	4	5	88.24	117.65	29.41	117.65	147.06	6.62	8.82	2.21	8.82	11.03
10	Existing Social Infrastructure and Services			0.25	0.04	4	4	4	4	5	95.24	95.24	95.24	95.24	119.05	3.57	3.57	3.57	3.57	4.46
11	Traffic Jam			0.25	0.04	5	3	3	3	1	166.67	100.00	100.00	100.00	33.33	6.25	3.75	3.75	3.75	1.25
Natural Environment			**0.30**		**0.09**	**2.67**	**2.33**	**2.67**	**2.00**	**3.00**	**103.56**	**92.57**	**104.48**	**79.75**	**119.63**	**9.21**	**8.32**	**9.28**	**7.28**	**10.92**
12	Flora, Fauna and Ecosystem			0.40	0.04	2	2	2	2	3	90.91	90.91	90.91	90.91	136.36	3.27	3.27	3.27	3.27	4.91
13	Geographical Conditions, Geological Conditions			0.30	0.03	2	3	3	2	3	76.92	115.38	115.38	76.92	115.38	2.08	3.12	3.12	2.08	3.12
14	Effect on the Natural/Ecological Reserves and Sanctuaries			0.30	0.03	4	2	3	2	3	142.86	71.43	107.14	71.43	107.14	3.86	1.93	2.89	1.93	2.89
Pollution			**0.20**		**0.06**	**2.33**	**2.33**	**2.33**	**2.33**	**3.33**	**91.41**	**91.41**	**91.41**	**91.41**	**134.34**	**5.34**	**5.34**	**5.34**	**5.34**	**8.65**
15	Air Pollution			0.50	0.03	2	2	2	2	4	83.33	83.33	83.33	83.33	166.67	2.50	2.50	2.50	2.50	5.00
16	Noise and Vibration			0.30	0.02	2	2	2	2	3	90.91	90.91	90.91	90.91	136.36	1.64	1.64	1.64	1.64	2.45
17	Water Pollution			0.20	0.01	3	3	3	3	3	100.00	100.00	100.00	100.00	100.00	1.20	1.20	1.20	1.20	1.20

C-2 Trans-Sulawesi Mamminasata Section

Table C-2-1 Overall Rating Matrix of Trans-Sulawesi Mamminasata Section (A Section)

Evaluation Items	Weight				5 grades assessment		Converted score (Relative evaluation, average = 100)		Weighted score (* weight)	
					Alternative 1	Zero Option	Alternative 1	Zero Option	Alternative 1	Zero Option
	Level 1	Level 2	Level 3	Composite weight	Widening road (20km)	Existing road (20km)	Widening road (20km)	Existing road (20km)	Widening road (20km)	Existing road (20km)
Total				**1.00**	**3.83**	**3.01**	**114.08**	**85.92**	**107.97**	**92.03**
Engineering Aspect	**0.40**			**0.40**	**4.25**	**3.00**	**119.44**	**80.56**	**44.95**	**35.05**
1 Road Alignment			0.30	0.12	5	4	111.11	88.89	13.33	10.67
2 Construction Feasibility/ Flood			0.30	0.12	2	5	57.14	142.86	6.86	17.14
3 Traffic Demand			0.20	0.08	5	1	166.67	33.33	13.33	2.67
4 Road Network			0.20	0.08	5	2	142.86	57.14	11.43	4.57
Economical and Financial Aspect	**0.30**			**0.30**	**4.25**	**2.25**	**133.33**	**66.67**	**38.00**	**22.00**
5 Cost (Construction & Maintenance)			0.30	0.09	2	5	57.14	142.86	5.14	12.86
6 Economic Effectiveness			0.30	0.09	5	2	142.86	57.14	12.86	5.14
7 Impacts on Regional Economy			0.20	0.06	5	1	166.67	33.33	10.00	2.00
8 Others			0.20	0.06	5	1	166.67	33.33	10.00	2.00
Environmental Aspect	**0.30**			**0.30**	**3.00**	**3.78**	**89.46**	**110.54**	**25.02**	**34.98**
Social Environment		**0.50**		**0.15**	**3.33**	**3.67**	**96.30**	**103.70**	**12.08**	**17.92**
9 Migration of Populations Involuntary Resettlement			0.50	0.08	1	5	33.33	166.67	2.50	12.50
10 Existing Social Infrastructure and Services			0.25	0.04	4	5	88.89	111.11	3.33	4.17
11 Traffic Jam			0.25	0.04	5	1	166.67	33.33	6.25	1.25
Natural Environment		**0.30**		**0.09**	**3.33**	**4.00**	**94.63**	**105.37**	**8.47**	**9.54**
12 Flora, Fauna and Ecosystem			0.40	0.04	4	5	88.89	111.11	3.20	4.00
13 Geographical Conditions, Geological Conditions			0.30	0.03	3	5	75.00	125.00	2.03	3.38
14 Effect on the Natural/Ecological Reserves and Sanctuaries			0.30	0.03	3	2	120.00	80.00	3.24	2.16
Pollution		**0.20**		**0.06**	**2.33**	**3.67**	**77.46**	**122.54**	**4.47**	**7.53**
15 Air Pollution			0.50	0.03	2	4	66.67	133.33	2.00	4.00
16 Noise and Vibration			0.30	0.02	2	3	80.00	120.00	1.44	2.16
17 Water Pollution			0.20	0.01	3	4	85.71	114.29	1.03	1.37

Table C-2-2 Overall Rating Matrix of Trans-Sulawesi Mamminasata Section (B Section)

Evaluation Items	Weight				5 grades assessment		Converted score (Relative evaluation, average = 100)		Weighted score (* weight)	
					Alternative 1	Zero Option	Alternative 1	Zero Option	Alternative 1	Zero Option
	Level 1	Level 2	Level 3	Composite weight	New route (7km)	Existing road (11.5km)	New route (7km)	Existing road (11.5km)	New route (7km)	Existing road (11.5km)
Total				**1.00**	**3.87**	**3.01**	**114.45**	**85.55**	**108.48**	**91.52**
Engineering Aspect	**0.40**			**0.40**	**4.25**	**2.75**	**122.92**	**77.08**	**46.62**	**33.38**
1 Road Alignment			0.30	0.12	5	3	125.00	75.00	15.00	9.00
2 Construction Feasibility/ Flood			0.30	0.12	2	5	57.14	142.86	6.86	17.14
3 Traffic Demand			0.20	0.08	5	1	166.67	33.33	13.33	2.67
4 Road Network			0.20	0.08	5	2	142.86	57.14	11.43	4.57
Economical and Financial Aspect	**0.30**			**0.30**	**4.25**	**2.50**	**128.87**	**71.13**	**36.39**	**23.61**
5 Cost (Construction & Maintenance)			0.30	0.09	2	5	57.14	142.86	5.14	12.86
6 Economic Effectiveness			0.30	0.09	5	3	125.00	75.00	11.25	6.75
7 Impacts on Regional Economy			0.20	0.06	5	1	166.67	33.33	10.00	2.00
8 Others			0.20	0.06	5	1	166.67	33.33	10.00	2.00
Environmental Aspect	**0.30**			**0.30**	**3.11**	**3.78**	**91.58**	**108.42**	**25.46**	**34.54**
Social Environment		**0.50**		**0.15**	**3.33**	**3.67**	**96.30**	**103.70**	**12.08**	**17.92**
9 Migration of Populations Involuntary Resettlement			0.50	0.08	1	5	33.33	166.67	2.50	12.50
10 Existing Social Infrastructure and Services			0.25	0.04	4	5	88.89	111.11	3.33	4.17
11 Traffic Jam			0.25	0.04	5	1	166.67	33.33	6.25	1.25
Natural Environment		**0.30**		**0.09**	**3.33**	**4.00**	**94.63**	**105.37**	**8.34**	**9.66**
12 Flora, Fauna and Ecosystem			0.40	0.04	3	5	75.00	125.00	2.70	4.50
13 Geographical Conditions, Geological Conditions			0.30	0.03	4	5	88.89	111.11	2.40	3.00
14 Effect on the Natural/Ecological Reserves and Sanctuaries			0.30	0.03	3	2	120.00	80.00	3.24	2.16
Pollution		**0.20**		**0.06**	**2.67**	**3.67**	**83.81**	**116.19**	**5.04**	**6.96**
15 Air Pollution			0.50	0.03	3	4	85.71	114.29	2.57	3.43
16 Noise and Vibration			0.30	0.02	2	3	80.00	120.00	1.44	2.16
17 Water Pollution			0.20	0.01	3	4	85.71	114.29	1.03	1.37

Table C-2-3 Overall Rating Matrix of Trans-Sulawesi Mamminasata Section (C Section)

Evaluation Items	Weight				5 grades assessment			Converted score (Relative evaluation, average = 100)			Weighted score（* weight)		
					Alternative 1	Alternative 2	Zero Option	Alternative 1	Alternative 2	Zero Option	Alternative 1	Alternative 2	Zero Option
	Level 1	Level 2	Level 3	Composite weight	New route (8.6km)	New route (7.6km)	Existing road (8.7km)	New route (8.6km)	New route (7.6km)	Existing road (8.7km)	New route (8.6km)	New route (7.6km)	Existing road (8.7km)
Total				**1.00**	**3.95**	**4.00**	**3.01**	**106.45**	**107.56**	**85.99**	**105.18**	**105.06**	**89.76**
Engineering Aspect	**0.40**			**0.40**	**4.50**	**4.50**	**2.25**	**119.89**	**119.89**	**60.23**	**46.64**	**46.64**	**26.73**
1 Road Alignment			0.30	0.12	5	5	2	125.00	125.00	50.00	15.00	15.00	6.00
2 Construction Feasibility/ Flood			0.30	0.12	3	3	5	81.82	81.82	136.36	9.82	9.82	16.36
3 Traffic Demand			0.20	0.08	5	5	1	136.36	136.36	27.27	10.91	10.91	2.18
4 Road Network			0.20	0.08	5	5	1	136.36	136.36	27.27	10.91	10.91	2.18
Economical and Financial Aspect	**0.30**			**0.30**	**4.25**	**4.50**	**3.00**	**106.35**	**113.85**	**79.81**	**31.07**	**33.77**	**25.15**
5 Cost (Construction & Maintenance)			0.30	0.09	2	3	5	60.00	90.00	150.00	5.40	8.10	13.50
6 Economic Effectiveness			0.30	0.09	5	5	2	125.00	125.00	50.00	11.25	11.25	4.50
7 Impacts on Regional Economy			0.20	0.06	5	5	2	125.00	125.00	50.00	7.50	7.50	3.00
8 Others			0.20	0.06	5	5	3	115.38	115.38	69.23	6.92	6.92	4.15
Environmental Aspect	**0.30**			**0.30**	**3.11**	**3.00**	**3.78**	**93.11**	**88.95**	**117.94**	**27.47**	**24.66**	**37.88**
Social Environment		**0.50**		**0.15**	**3.67**	**3.33**	**3.67**	**101.22**	**88.72**	**110.05**	**14.20**	**11.39**	**19.41**
9 Migration of Populations Involuntary Resettlement			0.50	0.08	2	1	5	75.00	37.50	187.50	5.63	2.81	14.06
10 Existing Social Infrastructure and Services			0.25	0.04	4	4	5	92.31	92.31	115.38	3.46	3.46	4.33
11 Traffic Jam			0.25	0.04	5	5	1	136.36	136.36	27.27	5.11	5.11	1.02
Natural Environment		**0.30**		**0.09**	**3.33**	**3.33**	**4.00**	**94.55**	**94.55**	**110.91**	**8.39**	**8.39**	**10.21**
12 Flora, Fauna and Ecosystem			0.40	0.04	3	3	5	81.82	81.82	136.36	2.95	2.95	4.91
13 Geographical Conditions, Geological Conditions			0.30	0.03	3	3	5	81.82	81.82	136.36	2.21	2.21	3.68
14 Effect on the Natural/Ecological Reserves and Sanctuaries			0.30	0.03	4	4	2	120.00	120.00	60.00	3.24	3.24	1.62
Pollution		**0.20**		**0.06**	**2.33**	**2.33**	**3.67**	**83.57**	**83.57**	**132.86**	**4.87**	**4.87**	**8.25**
15 Air Pollution			0.50	0.03	2	2	4	75.00	75.00	150.00	2.25	2.25	4.50
16 Noise and Vibration			0.30	0.02	2	2	3	85.71	85.71	128.57	1.54	1.54	2.31
17 Water Pollution			0.20	0.01	3	3	4	90.00	90.00	120.00	1.08	1.08	1.44

Table C-2-4 Overall Rating Matrix of Trans-Sulawesi Mamminasata Section (D Section)

Evaluation Items		Weight				5 grades assessment		Converted score (Relative evaluation, average = 100)		Weighted score (* weight)	
						Alternative 1	Zero Option	Alternative 1	Zero Option	Alternative 1	Zero Option
		Level 1	Level 2	Level 3	Composite weight	Widening road (22km)	Existing road (22km)	Widening road (22km)	Existing road (22km)	Widening road (22km)	Existing road (22km)
Total					**1.00**	**4.03**	**3.09**	**115.83**	**84.17**	**109.88**	**90.12**
Engineering Aspect		**0.40**			**0.40**	**4.50**	**3.00**	**123.91**	**76.09**	**47.10**	**32.90**
1	Road Alignment			0.30	0.12	5	4	111.11	88.89	13.33	10.67
2	Construction Feasibility/ Flood			0.30	0.12	3	5	75.00	125.00	9.00	15.00
3	Traffic Demand			0.20	0.08	5	1	166.67	33.33	13.33	2.67
4	Road Network			0.20	0.08	5	2	142.86	57.14	11.43	4.57
Economical and Financial Aspect		**0.30**			**0.30**	**4.25**	**2.50**	**128.87**	**71.13**	**36.39**	**23.61**
5	Cost (Construction & Maintenance)			0.30	0.09	2	5	57.14	142.86	5.14	12.86
6	Economic Effectiveness			0.30	0.09	5	3	125.00	75.00	11.25	6.75
7	Impacts on Regional Economy			0.20	0.06	5	1	166.67	33.33	10.00	2.00
8	Others			0.20	0.06	5	1	166.67	33.33	10.00	2.00
Environmental Aspect		**0.30**			**0.30**	**3.33**	**3.78**	**94.71**	**105.29**	**26.39**	**33.61**
Social Environment			**0.50**		**0.15**	**3.33**	**3.67**	**96.30**	**103.70**	**12.08**	**17.92**
9	Migration of Populations Involuntary Resettlement			0.50	0.08	1	5	33.33	166.67	2.50	12.50
10	Existing Social Infrastructure and Services			0.25	0.04	4	5	88.89	111.11	3.33	4.17
11	Traffic Jam			0.25	0.04	5	1	166.67	33.33	6.25	1.25
Natural Environment			**0.30**		**0.09**	**3.67**	**4.00**	**99.26**	**100.74**	**8.84**	**9.16**
12	Flora, Fauna and Ecosystem			0.40	0.04	4	5	88.89	111.11	3.20	4.00
13	Geographical Conditions, Geological Conditions			0.30	0.03	4	5	88.89	111.11	2.40	3.00
14	Effect on the Natural/Ecological Reserves and Sanctuaries			0.30	0.03	3	2	120.00	80.00	3.24	2.16
Pollution			**0.20**		**0.06**	**3.00**	**3.67**	**88.57**	**111.43**	**5.47**	**6.53**
15	Air Pollution			0.50	0.03	4	4	100.00	100.00	3.00	3.00
16	Noise and Vibration			0.30	0.02	2	3	80.00	120.00	1.44	2.16
17	Water Pollution			0.20	0.01	3	4	85.71	114.29	1.03	1.37

C-3 Hertasning Road

Table C-3-1 Overall Rating Matrix of Hertasning Road (D Section)

Evaluation Items	Weight				5 grades assessment		Converted score (Relative evaluation, average = 100)		Weighted score（* weight)	
					Alternative 1	Zero Option	Alternative 1	Zero Option	Alternative 1	Zero Option
	Level 1	Level 2	Level 3	Composite weight	Widening road (4.5km)	Exsisting road (4.5km)	Widening road (4.5km)	Exsisting road (4.5km)	Widening road (4.5km)	Exsisting road (4.5km)
Total				**1.00**	**3.56**	**2.75**	**115.36**	**84.64**	**112.76**	**87.24**
Engineering Aspect	**0.40**			**0.40**	**3.75**	**2.00**	**130.00**	**70.00**	**51.73**	**28.27**
1 Road Alignment			0.30	0.12	3	2	120.00	80.00	14.40	9.60
2 Construction Feasibility/ Flood			0.30	0.12	4	2	133.33	66.67	16.00	8.00
3 Traffic Demand			0.20	0.08	5	1	166.67	33.33	13.33	2.67
4 Road Network			0.20	0.08	3	3	100.00	100.00	8.00	8.00
Economical and Financial Aspect	**0.30**			**0.30**	**3.25**	**2.25**	**121.67**	**78.33**	**35.00**	**25.00**
5 Cost (Construction & Maintenance)			0.30	0.09	1	5	33.33	166.67	3.00	15.00
6 Economic Effectiveness			0.30	0.09	4	1	160.00	40.00	14.40	3.60
7 Impacts on Regional Economy			0.20	0.06	4	1	160.00	40.00	9.60	2.40
8 Others			0.20	0.06	4	2	133.33	66.67	8.00	4.00
Environmental Aspect	**0.30**			**0.30**	**3.67**	**4.00**	**94.43**	**105.57**	**26.03**	**33.97**
Social Environment		**0.50**		**0.15**	**3.00**	**3.33**	**93.65**	**106.35**	**11.79**	**18.21**
9 Migration of Populations Involuntary Resettlement			0.50	0.08	1	5	33.33	166.67	2.50	12.50
10 Existing Social Infrastructure and Services			0.25	0.04	4	3	114.29	85.71	4.29	3.21
11 Traffic Jam			0.25	0.04	4	2	133.33	66.67	5.00	2.50
Natural Environment		**0.30**		**0.09**	**4.67**	**5.00**	**96.30**	**103.70**	**8.60**	**9.40**
12 Flora, Fauna and Ecosystem			0.40	0.04	4	5	88.89	111.11	3.20	4.00
13 Geographical Conditions, Geological Conditions			0.30	0.03	5	5	100.00	100.00	2.70	2.70
14 Effect on the Natural/Ecological Reserves and Sanctuaries			0.30	0.03	5	5	100.00	100.00	2.70	2.70
Pollution		**0.20**		**0.06**	**3.33**	**3.67**	**93.33**	**106.67**	**5.64**	**6.36**
15 Air Pollution			0.50	0.03	3	3	100.00	100.00	3.00	3.00
16 Noise and Vibration			0.30	0.02	2	3	80.00	120.00	1.44	2.16
17 Water Pollution			0.20	0.01	5	5	100.00	100.00	1.20	1.20

C-4 Abdullah Daeng Sirua Road

Table C-4-1 Overall Rating Matrix of Abdullah Daeng Sirua Road (A Section)

Evaluation Items		Weight				5 grades assessment			Converted score (Relative evaluation, average = 100)			Weighted score（* weight)		
						Alternative 1	Alternative 2	Zero Option	Alternative 1	Alternative 2	Zero Option	Alternative 1	Alternative 2	Zero Option
		Level 1	Level 2	Level 3	Composite weight	Wth traffic control (1.3km)	Widening road (1.3km)	Existing road (1.3km)	Wth traffic control (1.3km)	Widening road (1.3km)	Existing road (1.3km)	Wth traffic control (1.3km)	Widening road (1.3km)	Existing road (1.3km)
Total					**1.00**	**3.55**	**3.80**	**2.55**	**107.44**	**118.04**	**74.52**	**110.18**	**113.59**	**76.23**
Engineering Aspect		**0.40**			**0.40**	**3.75**	**4.25**	**1.50**	**116.17**	**135.97**	**47.86**	**47.96**	**52.96**	**19.07**
1	Road Alignment			0.30	0.12	4	3	2	133.33	100.00	66.67	16.00	12.00	8.00
2	Construction Feasibility/ Flood			0.30	0.12	5	5	1	136.36	136.36	27.27	16.36	16.36	3.27
3	Traffic Demand			0.20	0.08	2	5	1	75.00	187.50	37.50	6.00	15.00	3.00
4	Road Network			0.20	0.08	4	4	2	120.00	120.00	60.00	9.60	9.60	4.80
Economical and Financial Aspect		**0.30**			**0.30**	**3.00**	**3.25**	**2.25**	**106.25**	**116.67**	**77.08**	**31.50**	**33.00**	**25.50**
5	Cost (Construction & Maintenance)			0.30	0.09	3	1	5	100.00	33.33	166.67	9.00	3.00	15.00
6	Economic Effectiveness			0.30	0.09	3	4	2	100.00	133.33	66.67	9.00	12.00	6.00
7	Impacts on Regional Economy			0.20	0.06	3	4	1	112.50	150.00	37.50	6.75	9.00	2.25
8	Others			0.20	0.06	3	4	1	112.50	150.00	37.50	6.75	9.00	2.25
Environmental Aspect		**0.30**			**0.30**	**3.89**	**3.89**	**3.89**	**99.91**	**101.48**	**98.61**	**30.72**	**27.63**	**31.66**
Social Environment			**0.50**		**0.15**	**3.00**	**2.67**	**3.33**	**99.72**	**93.33**	**106.94**	**15.72**	**11.63**	**17.66**
9	Migration of Populations Involuntary Resettlement			0.50	0.08	4	1	5	120.00	30.00	150.00	9.00	2.25	11.25
10	Existing Social Infrastructure and Services			0.25	0.04	2	3	4	66.67	100.00	133.33	2.50	3.75	5.00
11	Traffic Jam			0.25	0.04	3	4	1	112.50	150.00	37.50	4.22	5.63	1.41
Natural Environment			**0.30**		**0.09**	**5.00**	**5.00**	**5.00**	**100.00**	**100.00**	**100.00**	**9.00**	**9.00**	**9.00**
12	Flora, Fauna and Ecosystem			0.40	0.04	5	5	5	100.00	100.00	100.00	3.60	3.60	3.60
13	Geographical Conditions, Geological Conditions			0.30	0.03	5	5	5	100.00	100.00	100.00	2.70	2.70	2.70
14	Effect on the Natural/Ecological Reserves and Sanctuaries			0.30	0.03	5	5	5	100.00	100.00	100.00	2.70	2.70	2.70
Pollution			**0.20**		**0.06**	**3.67**	**4.00**	**3.33**	**100.00**	**111.11**	**88.89**	**6.00**	**7.00**	**5.00**
15	Air Pollution			0.50	0.03	3	4	2	100.00	133.33	66.67	3.00	4.00	2.00
16	Noise and Vibration			0.30	0.02	3	3	3	100.00	100.00	100.00	1.80	1.80	1.80
17	Water Pollution			0.20	0.01	5	5	5	100.00	100.00	100.00	1.20	1.20	1.20

Table C-4-2 Overall Rating Matrix of Abdullah Daeng Sirua Road (C Section)

Evaluation Items		Weight				5 grades assessment		Converted score (Relative evaluation, average = 100)		Weighted score（* weight)	
						Alternative 1	Zero Option	Alternative 1	Zero Option	Alternative 1	Zero Option
		Level 1	Level 2	Level 3	Composite weight	Widening road (0.8km)	Existing road (0.8km)	Widening road (0.8km)	Existing road (0.8km)	Widening road (0.8km)	Existing road (0.8km)
Total					**1.00**	**4.00**	**2.90**	**117.62**	**82.38**	**117.05**	**82.95**
Engineering Aspect		**0.40**			**0.40**	**4.75**	**1.75**	**146.43**	**53.57**	**57.90**	**22.10**
1	Road Alignment			0.30	0.12	4	2	133.33	66.67	16.00	8.00
2	Construction Feasibility/ Flood			0.30	0.12	5	2	142.86	57.14	17.14	6.86
3	Traffic Demand			0.20	0.08	5	1	166.67	33.33	13.33	2.67
4	Road Network			0.20	0.08	5	2	142.86	57.14	11.43	4.57
Economical and Financial Aspect		**0.30**			**0.30**	**3.25**	**3.50**	**94.05**	**105.95**	**27.00**	**33.00**
5	Cost (Construction & Maintenance)			0.30	0.09	1	5	33.33	166.67	3.00	15.00
6	Economic Effectiveness			0.30	0.09	4	3	114.29	85.71	10.29	7.71
7	Impacts on Regional Economy			0.20	0.06	4	3	114.29	85.71	6.86	5.14
8	Others			0.20	0.06	4	3	114.29	85.71	6.86	5.14
Environmental Aspect		**0.30**			**0.30**	**4.00**	**3.44**	**112.38**	**87.62**	**32.14**	**27.86**
Social Environment			**0.50**		**0.15**	**3.33**	**2.33**	**125.71**	**74.29**	**16.29**	**13.71**
9	Migration of Populations Involuntary Resettlement			0.50	0.08	2	5	57.14	142.86	4.29	10.71
10	Existing Social Infrastructure and Services			0.25	0.04	4	1	160.00	40.00	6.00	1.50
11	Traffic Jam			0.25	0.04	4	1	160.00	40.00	6.00	1.50
Natural Environment			**0.30**		**0.09**	**5.00**	**5.00**	**100.00**	**100.00**	**9.00**	**9.00**
12	Flora, Fauna and Ecosystem			0.40	0.04	5	5	100.00	100.00	3.60	3.60
13	Geographical Conditions, Geological Conditions			0.30	0.03	5	5	100.00	100.00	2.70	2.70
14	Effect on the Natural/Ecological Reserves and Sanctuaries			0.30	0.03	5	5	100.00	100.00	2.70	2.70
Pollution			**0.20**		**0.06**	**3.67**	**3.00**	**111.43**	**88.57**	**6.86**	**5.14**
15	Air Pollution			0.50	0.03	3	2	120.00	80.00	3.60	2.40
16	Noise and Vibration			0.30	0.02	4	3	114.29	85.71	2.06	1.54
17	Water Pollution			0.20	0.01	4	4	100.00	100.00	1.20	1.20

Table C-4-3 MCA Matrix of Abdullah Daeng Sirua Road (D Section)

Evaluation Items	Weight				5 grades assessment				Converted score (Relative evaluation, average = 100)				Weighted score（* weight)			
					Alternative 1	Alternative 2	Alternative 3	Zero Option	Alternative 1	Alternative 2	Alternative 3	Zero Option	Alternative 1	Alternative 2	Alternative 3	Zero Option
	Level 1	Level 2	Level 3	Composite weight	New route (4.5km)	New route on PDAM (4.5km)	Widening road (5.1km)	Existing road (5.1km)	New route (4.5km)	New route on PDAM (4.5km)	Widening road (5.1km)	Existing road (5.1km)	New route (4.5km)	New route on PDAM (4.5km)	Widening road (5.1km)	Existing road (5.1km)
Total				**1.00**	**3.75**	**4.05**	**3.94**	**2.48**	**105.09**	**113.90**	**110.40**	**70.61**	**107.31**	**113.14**	**106.78**	**72.77**
Engineering Aspect	**0.40**			**0.40**	**4.25**	**4.50**	**4.25**	**2.00**	**113.27**	**119.94**	**112.24**	**54.55**	**46.17**	**48.30**	**44.61**	**20.92**
1 Road Alignment			0.30	0.12	4	4	3	2	123.08	123.08	92.31	61.54	14.77	14.77	11.08	7.38
2 Construction Feasibility/ Flood			0.30	0.12	5	5	5	1	125.00	125.00	125.00	25.00	15.00	15.00	15.00	3.00
3 Traffic Demand			0.20	0.08	5	5	5	1	125.00	125.00	125.00	25.00	10.00	10.00	10.00	2.00
4 Road Network			0.20	0.08	3	4	4	4	80.00	106.67	106.67	106.67	6.40	8.53	8.53	8.53
Economical and Financial Aspect	**0.30**			**0.30**	**3.00**	**3.75**	**4.00**	**2.00**	**91.23**	**115.80**	**124.89**	**68.07**	**26.42**	**34.26**	**36.68**	**22.65**
5 Cost (Construction & Maintenance)			0.30	0.09	1	2	3	5	36.36	72.73	109.09	181.82	3.27	6.55	9.82	16.36
6 Economic Effectiveness			0.30	0.09	4	5	4	1	114.29	142.86	114.29	28.57	10.29	12.86	10.29	2.57
7 Impacts on Regional Economy			0.20	0.06	3	4	4	1	100.00	133.33	133.33	33.33	6.00	8.00	8.00	2.00
8 Others			0.20	0.06	4	4	5	1	114.29	114.29	142.86	28.57	6.86	6.86	8.57	1.71
Environmental Aspect	**0.30**			**0.30**	**4.00**	**3.89**	**3.56**	**3.44**	**110.76**	**105.97**	**94.06**	**89.21**	**34.73**	**30.57**	**25.50**	**29.20**
Social Environment		**0.50**		**0.15**	**4.00**	**3.33**	**2.33**	**2.33**	**133.33**	**111.11**	**77.78**	**77.78**	**20.00**	**15.00**	**10.00**	**15.00**
9 Migration of Populations Involuntary Resettlement			0.50	0.08	4	2	1	5	133.33	66.67	33.33	166.67	10.00	5.00	2.50	12.50
10 Existing Social Infrastructure and Services			0.25	0.04	4	4	3	1	133.33	133.33	100.00	33.33	5.00	5.00	3.75	1.25
11 Traffic Jam			0.25	0.04	4	4	3	1	133.33	133.33	100.00	33.33	5.00	5.00	3.75	1.25
Natural Environment		**0.30**		**0.09**	**4.33**	**4.67**	**5.00**	**5.00**	**90.20**	**98.04**	**105.88**	**105.88**	**7.94**	**8.79**	**9.64**	**9.64**
12 Flora, Fauna and Ecosystem			0.40	0.04	3	4	5	5	70.59	94.12	117.65	117.65	2.54	3.39	4.24	4.24
13 Geographical Conditions, Geological Conditions			0.30	0.03	5	5	5	5	100.00	100.00	100.00	100.00	2.70	2.70	2.70	2.70
14 Effect on the Natural/ Ecological Reserves and Sanctuaries			0.30	0.03	5	5	5	5	100.00	100.00	100.00	100.00	2.70	2.70	2.70	2.70
Pollution		**0.20**		**0.06**	**3.67**	**3.67**	**3.33**	**3.00**	**108.76**	**108.76**	**98.51**	**83.97**	**6.79**	**6.79**	**5.86**	**4.57**
15 Air Pollution			0.50	0.03	4	4	3	2	123.08	123.08	92.31	61.54	3.69	3.69	2.77	1.85
16 Noise and Vibration			0.30	0.02	3	3	3	2	109.09	109.09	109.09	72.73	1.96	1.96	1.96	1.31
17 Water Pollution			0.20	0.01	4	4	4	5	94.12	94.12	94.12	117.65	1.13	1.13	1.13	1.41

Table C-4-4 MCA Matrix of Abdullah Daeng Sirua Road (E Section)

Evaluation Items	Weight				5 grades assessment		Converted score (Relative evaluation, average = 100)		Weighted score（* weight)	
					Alternative 1	Zero Option	Alternative 1	Zero Option	Alternative 1	Zero Option
	Level 1	Level 2	Level 3	Composite weight	Widening road (22km)	Existing road (22km)	Widening road (22km)	Existing road (22km)	Widening road (22km)	Existing road (22km)
Total				**1.00**	**3.68**	**2.80**	**117.17**	**82.83**	**115.35**	**84.65**
Engineering Aspect	**0.40**			**0.40**	**4.00**	**2.00**	**133.57**	**66.43**	**52.11**	**27.89**
1 Road Alignment			0.30	0.12	4	3	114.29	85.71	13.71	10.29
2 Construction Feasibility/ Flood			0.30	0.12	3	2	120.00	80.00	14.40	9.60
3 Traffic Demand			0.20	0.08	5	1	166.67	33.33	13.33	2.67
4 Road Network			0.20	0.08	4	2	133.33	66.67	10.67	5.33
Economical and Financial Aspect	**0.30**			**0.30**	**3.25**	**2.50**	**116.90**	**83.10**	**32.49**	**27.51**
5 Cost (Construction & Maintenance)			0.30	0.09	1	5	33.33	166.67	3.00	15.00
6 Economic Effectiveness			0.30	0.09	4	3	114.29	85.71	10.29	7.71
7 Impacts on Regional Economy			0.20	0.06	4	1	160.00	40.00	9.60	2.40
8 Others			0.20	0.06	4	1	160.00	40.00	9.60	2.40
Environmental Aspect	**0.30**			**0.30**	**3.78**	**3.89**	**101.03**	**98.97**	**30.75**	**29.25**
Social Environment		**0.50**		**0.15**	**4.33**	**3.33**	**115.87**	**84.13**	**16.79**	**13.21**
9 Migration of Populations Involuntary Resettlement			0.50	0.08	5	5	100.00	100.00	7.50	7.50
10 Existing Social Infrastructure and Services			0.25	0.04	4	3	114.29	85.71	4.29	3.21
11 Traffic Jam			0.25	0.04	4	2	133.33	66.67	5.00	2.50
Natural Environment		**0.30**		**0.09**	**3.67**	**5.00**	**84.26**	**115.74**	**7.50**	**10.50**
12 Flora, Fauna and Ecosystem			0.40	0.04	3	5	75.00	125.00	2.70	4.50
13 Geographical Conditions, Geological Conditions			0.30	0.03	4	5	88.89	111.11	2.40	3.00
14 Effect on the Natural/Ecological Reserves and Sanctuaries			0.30	0.03	4	5	88.89	111.11	2.40	3.00
Pollution		**0.20**		**0.06**	**3.33**	**3.33**	**102.96**	**97.04**	**6.47**	**5.53**
15 Air Pollution			0.50	0.03	3	2	120.00	80.00	3.60	2.40
16 Noise and Vibration			0.30	0.02	3	3	100.00	100.00	1.80	1.80
17 Water Pollution			0.20	0.01	4	5	88.89	111.11	1.07	1.33

Table C-4-5 MCA Matrix of Abdullah Daeng Sirua Road (F Section)

Evaluation Items		Weight				5 grades assessment			Converted score (Relative evaluation, average = 100)			Weighted score（* weight)		
						Alternative 1	Alternative 2	Zero Option	Alternative 1	Alternative 2	Zero Option	Alternative 1	Alternative 2	Zero Option
		Level 1	Level 2	Level 3	Composite weight	New route (7.0km)	Widening road (7.0km)	Existing road (7.0km)	New route (7.0km)	Widening road (7.0km)	Existing road (7.0km)	New route (7.0km)	Widening road (7.0km)	Existing road (7.0km)
Total					**1.00**	**4.49**	**3.68**	**2.59**	**127.76**	**101.72**	**70.52**	**130.25**	**98.21**	**71.54**
Engineering Aspect		**0.40**			**0.40**	**5.00**	**4.00**	**2.00**	**141.67**	**110.00**	**48.33**	**58.00**	**44.00**	**18.00**
1	Road Alignment			0.30	0.12	5	3	1	166.67	100.00	33.33	20.00	12.00	4.00
2	Construction Feasibility/ Flood			0.30	0.12	5	4	1	150.00	120.00	30.00	18.00	14.40	3.60
3	Traffic Demand			0.20	0.08	5	4	1	150.00	120.00	30.00	12.00	9.60	2.40
4	Road Network			0.20	0.08	5	5	5	100.00	100.00	100.00	8.00	8.00	8.00
Economical and Financial Aspect		**0.30**			**0.30**	**4.25**	**3.25**	**2.00**	**131.25**	**99.38**	**69.38**	**38.25**	**28.58**	**23.18**
5	Cost (Construction & Maintenance)			0.30	0.09	2	1	5	75.00	37.50	187.50	6.75	3.38	16.88
6	Economic Effectiveness			0.30	0.09	5	4	1	150.00	120.00	30.00	13.50	10.80	2.70
7	Impacts on Regional Economy			0.20	0.06	5	4	1	150.00	120.00	30.00	9.00	7.20	1.80
8	Others			0.20	0.06	5	4	1	150.00	120.00	30.00	9.00	7.20	1.80
Environmental Aspect		**0.30**			**0.30**	**4.22**	**3.78**	**3.78**	**110.36**	**95.79**	**93.85**	**34.00**	**25.64**	**30.36**
Social Environment			**0.50**		**0.15**	**4.33**	**2.67**	**3.00**	**131.67**	**80.83**	**87.50**	**19.31**	**10.22**	**15.47**
9	Migration of Populations Involuntary Resettlement			0.50	0.08	4	1	5	120.00	30.00	150.00	9.00	2.25	11.25
10	Existing Social Infrastructure and Services			0.25	0.04	5	4	3	125.00	100.00	75.00	4.69	3.75	2.81
11	Traffic Jam			0.25	0.04	4	3	1	150.00	112.50	37.50	5.63	4.22	1.41
Natural Environment			**0.30**		**0.09**	**4.00**	**4.67**	**5.00**	**86.90**	**102.38**	**110.71**	**7.71**	**9.19**	**10.09**
12	Flora, Fauna and Ecosystem			0.40	0.04	3	4	5	75.00	100.00	125.00	2.70	3.60	4.50
13	Geographical Conditions, Geological Conditions			0.30	0.03	4	5	5	85.71	107.14	107.14	2.31	2.89	2.89
14	Effect on the Natural/Ecological Reserves and Sanctuaries			0.30	0.03	5	5	5	100.00	100.00	100.00	2.70	2.70	2.70
Pollution			**0.20**		**0.06**	**4.33**	**4.00**	**3.33**	**112.50**	**104.17**	**83.33**	**6.98**	**6.23**	**4.80**
15	Air Pollution			0.50	0.03	5	4	3	125.00	100.00	75.00	3.75	3.00	2.25
16	Noise and Vibration			0.30	0.02	3	3	2	112.50	112.50	75.00	2.03	2.03	1.35
17	Water Pollution			0.20	0.01	5	5	5	100.00	100.00	100.00	1.20	1.20	1.20

C-5 Evaluation Standard

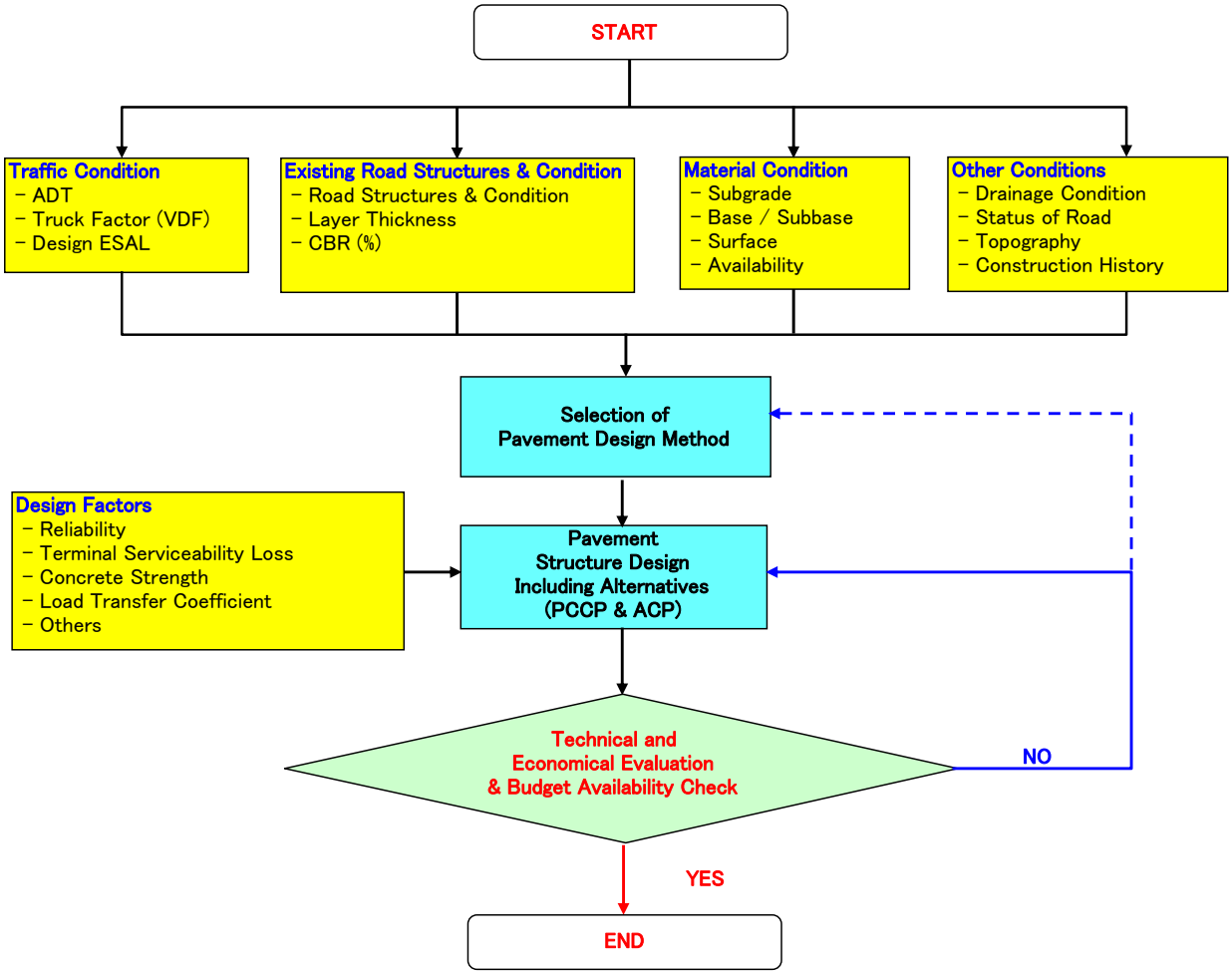
	Evaluation Items	Point 1	Point 2	Point 3	Point 4	Point 5
Engineering Aspect						
1	Road Alignment	Low adequency	Relatively low adequency	Middle adeqiency	Adequency is relatively high	High adequency
2	Construction Feasibility/ Flood	Low construction Feasibility	Relatively low construction feasibility	Middle construction feasibility	Relatively high construction feasibility	High feasibility
3	Traffic Demand	Does not match to the demand at all	Scarecely match to the demand	A little match to the demand	Relatively match to the demand	Match to the demand
4	Road Network	Low function	Relatively low function	Middle function	Relatively high function	High function
Economical and Financial Aspect						
5	Cost (Construction & Maintenance)	High cost	Relatively high cost	Middle cost	Relatively low cost	Low cost
6	Economic Effectiveness	Low effectiveness	Relatively low effectiveness	Middle effectiveness	Relatively high effectiveness	High effectiveness
7	Impacts on Regional Economy	Low impact on regional economy	Relatively low impact on regional economy	Middle impact on regional economy	Relatively high impact on regional economy	High impact on regional economy
8	Others	Low economic impact	Relatively low economic impact	Middle economic impact	Relatively high economic impact	High economic impact
Environmental Aspect						
Social Environment						
9	Migration of Populations Involuntary Resettlemen	More than 99 households	More than 49 and less than 100 households	More than 29 and less than 50 households	more than 9 and less than 30 households	Less than 10 housekokds
10	Existing Social Infrastructure and Services	No improvement on existing social infrastructure and service	Few improvement on existing social infrastructure and service	Middle improvement on existing social infrastructure and service	Reratively high improvement on existing social infrastructure and service	High improvement on existing social infrastructure and service
11	Traffic Jam	No resolution on traffic jam	Few resolution on traffic jam	Middle resolution on traffic jam	Relativery good resolution on traffic jam	Good resolution on traffic jam
Natural Environment						
12	Flora, Fauna and Ecosystem	High impact on ecosystem	Relatively high impact on ecosystem	Middle impact on ecosystem	Relatively low impact on ecosystem	Low impact on ecosystem
13	Geographical Conditions, Geological Conditions	High impact on geographical or	Relatively high impact on geographical or	Middle impact on geographical or	Relatively low impact on geographical or	Low impact on geographical or
14	Effect on the Natural/Ecological Reserves and San	Large scale impact on concervation area	Relatively large scale impact on concervation	Relatively small scale impact on concervation	Small scale impact on concervation area	No impact on concervation area
Pollution						
15	Air Pollution	Worse air pollution	Relatively worse air pollution	Same air pollution as before	Improve air pollution a little	Improve air pollution
16	Noise and Vibration	Worse noise and vibration level	Relatively worse noise and vibration level	Same noise and vibration level as before	Improve noise and vibration level a little	Improve noise and vibration level
17	Water Pollution	Worse water contamination	Relatively worse water contamination	Same water contamination as before	Improve water contamination a little	Improve water contamination

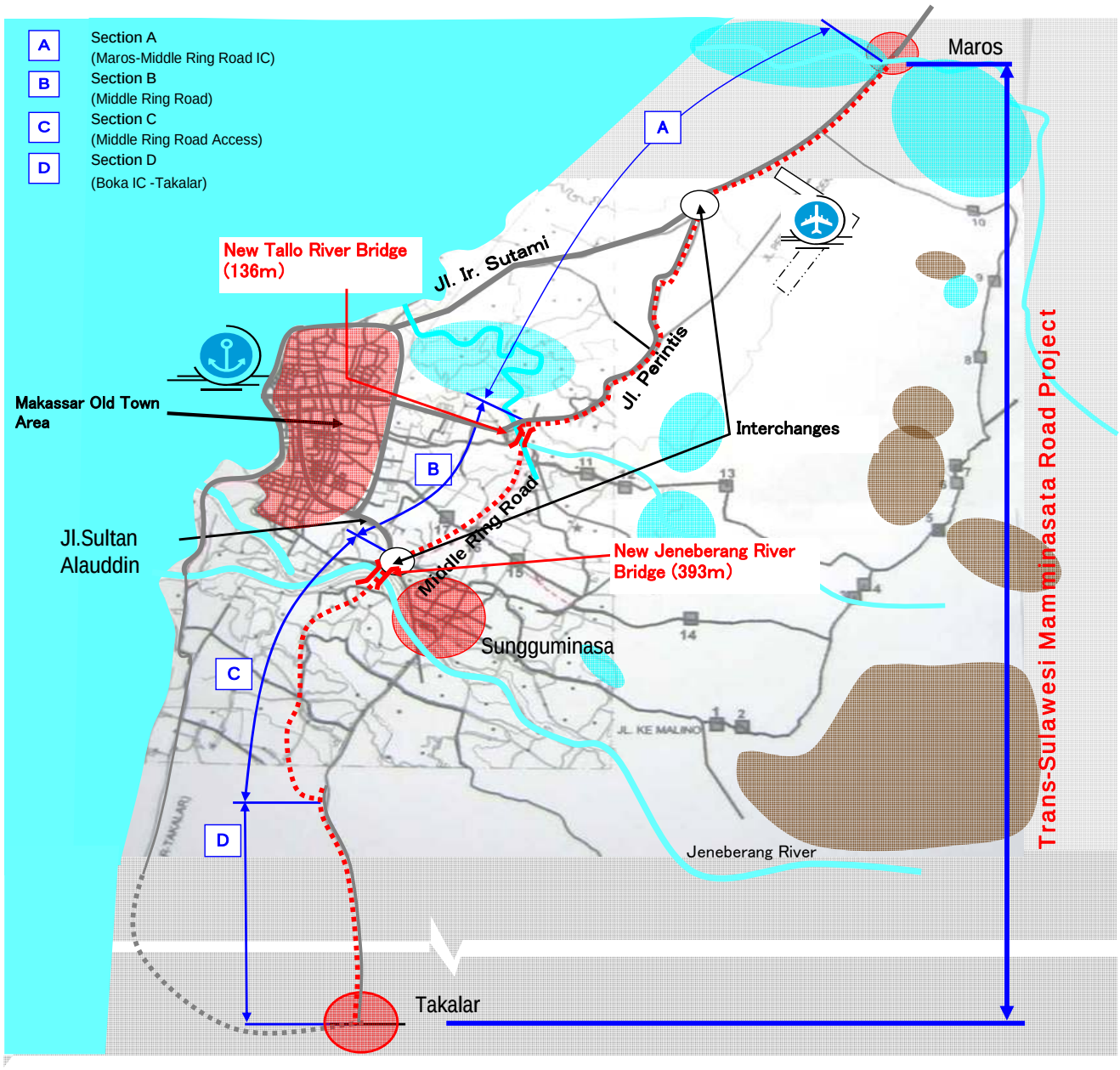
APPENDIX-D

PAVEMENT DESIGN

Appendix D: Pavement Design

Pavement Design Work Flow





Location Map for Trans-Sulawesi Mamminasata Road (Maros-Takalar)

Trans-Sulawesi Mamminasata Road
Cumulative Design Axle Load (Design CESA) Estimation for Pavement Design

Road Section: **Section A** **Maros-IC Jl.Sutami** **Roadway:** **6/2 D**

Traffic Survey Station :
Base Year: 2005 DD/ Pre-construction: 2008 - 2009 Construction: 2009 - 2012
Opening Year : 2012 (3 years)

Project's Lifespan : **20 years** **for PCCP**

TGR (Traffic Growth Rate): As indicated table below

AADT: (Y 2005) at Station No.9	Vehicle Type	Empty (Veh.)	Empty (%)	Loaded (Veh.)	Loaded (%)	Total (Year 2005) (Veh.)	Total (Year 2005) (%)
	Minibus/Pickup	2,373	30%	5,538	70%	7,911	62.1%
	Large Bus	68	10%	610	90.0%	678	5.3%
	Truck (2-Axles)	1,039	30%	2,424	70.0%	3,463	27.2%
	Truck (3-Axles)	205	30%	479	70.0%	684	5.4%
	Total:	3,685		9,051		12,736	100.0%

Vehicle Damage Factors :	Vehicle Type	Empty ESA/Veh.	Empty ESA/day	Loaded ESA/Veh.	Loaded ESA/day	Average ESA/day
	Mini Bus/Pickup	-	-	0.0007	4	0.0005
	Large Bus	0.04	2.7	0.57	348	0.52
	Truck (2-Axles)	0.08	83.1	1.41	3,418	1.01
	Truck (3-Axles)	0.43	88.2	4.66	2,232	3.39

Summary of Design ESA Estimate

Estimated CESA: **Rigid Pavement Design**

Vehicle Type	**20-years ESA (2012 - 2031)**	
Minibus/Pickup	56,197	0.1%
Large Bus	5,387,722	6.0%
Truck (2-Axles)	50,342,735	56.5%
Truck (3-Axles)	33,365,061	37.4%
Total:	**89,151,716**	100.0%

Direction Distribution Factor:

North Bound	South Bound
45%	55%
40,118,272	49,033,444

Lane Distribution Factor: 70%
(Between 60% and 80% for 6/2D) **34,323,411**

Design CESA for Pavement Design
34.3 x 10^6

ESA Estimation Table (for both directions/lanes)

Stage	Year	Minibus / Pickup TGR	Minibus / Pickup AADT	Minibus / Pickup V.D.F	Minibus / Pickup ESA/Year	Large Bus TGR	Large Bus AADT	Large Bus V.D.F	Large Bus ESA	Truck (2-Axles) TGR	Truck (2-Axles) AADT	Truck (2-Axles) V.D.F	Truck (2-Axles) ESA	Truck (3-Axles) TGR	Truck (3-Axles) AADT	Truck (3-Axles) V.D.F	Truck (3-Axles) ESA	Yearly Total AADT	Yearly Total ESA	CESA for Design
M/P	2005		7,911	0.0005	1,334		678	0.52	127,903		3,463	1.01	1,277,850		684	3.39	846,906	12,736	2,253,994	
	2006	6.2%	8,398		1,416	6.2%	720		135,769	7.2%	3,711		1,369,217	7.2%	733		907,460	13,561	2,413,862	
F/S	2007	6.0%	8,897		1,500	6.0%	763		143,848	7.0%	3,968		1,464,377	7.0%	784		970,528	14,412	2,580,253	CESA for
D/D	2008	5.8%	9,412		1,587	5.8%	807		152,176	6.8%	4,238		1,563,808	6.8%	837		1,036,427	15,294	2,753,999	Pre-Opening
C1	2009	5.6%	9,943		1,677	5.6%	852		160,759	6.6%	4,519		1,667,645	6.6%	893		1,105,246	16,207	2,935,327	Period
C2	2010	5.5%	10,492		1,769	5.5%	899		169,633	6.5%	4,814		1,776,376	6.5%	951		1,177,308	17,156	3,125,086	
C3	2011	4.6%	10,969		1,850	4.6%	940		177,351	5.6%	5,081		1,874,965	5.6%	1,004		1,242,648	17,994	3,296,814	19,359,335
C4/OM1	2012	4.5%	11,462		1,933	4.5%	982		185,314	5.5%	5,360		1,977,900	5.5%	1,059		1,310,870	18,863	3,476,017	Opening
OM2	2013	4.4%	11,971		2,019	4.4%	1,026		193,542	5.4%	5,652		2,085,498	5.4%	1,116		1,382,181	19,765	3,663,240	
OM3	2014	4.4%	12,496		2,107	4.4%	1,071		202,039	5.4%	5,956		2,197,906	5.4%	1,176		1,456,681	20,700	3,858,733	
OM4	2015	4.4%	13,041		2,199	4.4%	1,118		210,848	5.4%	6,276	7,515	2,315,714	5.4%	1,240		1,534,759	21,674	4,063,520	
OM5	2016	3.8%	13,539		2,283	3.8%	1,160		218,902	4.8%	6,578		2,427,332	4.8%	1,299		1,608,734	22,577	4,257,251	
OM6	2017	3.8%	14,048		2,369	3.8%	1,204		227,133	4.8%	6,891		2,542,873	4.8%	1,361		1,685,310	23,505	4,457,684	For Flexible
OM7	2018	3.7%	14,568		2,457	3.7%	1,249		235,537	4.7%	7,215		2,662,388	4.7%	1,425		1,764,519	24,457	4,664,900	Pavement
OM8	2019	3.7%	15,101		2,547	3.7%	1,294		244,157	4.7%	7,551		2,786,455	4.7%	1,492		1,846,746	25,439	4,879,905	Design
OM9	2020	3.6%	15,647		2,639	3.6%	1,341		252,972	4.6%	5,530		2,040,437	4.6%	1,092		1,352,317	23,609	3,648,364	(2012 - 2021)
OM10	2021	3.6%	16,204		2,733	3.6%	1,389		261,977	4.6%	5,782		2,133,481	4.6%	1,142		1,413,982	24,516	3,812,173	40,781,789
OM11	2022	3.5%	16,772		2,828	3.5%	1,437		271,173	4.5%	6,043		2,229,701	4.5%	1,194		1,477,753	25,446	3,981,455	
OM12	2023	3.5%	17,353		2,926	3.5%	1,487		280,555	4.5%	6,312		2,329,146	4.5%	1,247		1,543,661	26,399	4,156,288	
OM13	2024	3.4%	17,944		3,026	3.4%	1,538		290,122	4.4%	6,590		2,431,861	4.4%	1,302		1,611,736	27,374	4,336,746	
OM14	2025	3.4%	18,547		3,128	3.4%	1,590		299,870	4.4%	6,878		2,537,890	4.4%	1,358		1,682,008	28,373	4,522,896	
OM15	2026	3.3%	19,161		3,231	3.3%	1,642		309,796	4.3%	7,174		2,647,273	4.3%	1,417		1,754,502	29,395	4,714,803	
OM16	2027	3.3%	19,786		3,337	3.3%	1,696		319,895	4.3%	7,480		2,760,047	4.3%	1,477		1,829,244	30,439	4,912,523	For Rigid
OM17	2028	3.2%	20,421		3,444	3.2%	1,750		330,164	4.2%	7,795		2,876,245	4.2%	1,540		1,906,255	31,506	5,116,108	Pavement
OM18	2029	3.2%	21,066		3,553	3.2%	1,805		340,597	4.2%	8,119		2,995,897	4.2%	1,604		1,985,555	32,594	5,325,602	Design
OM19	2030	3.1%	21,722		3,663	3.1%	1,862		351,190	4.1%	8,453		3,119,028	4.1%	1,670		2,067,162	33,705	5,541,043	(2012 - 2031)
OM20	2031	3.1%	22,386		3,775	3.1%	1,919		361,936	4.1%	8,796	10,533	3,245,661	4.1%	1,737		2,151,089	34,838	5,762,461	89,151,716
Total CESA for Flexible Pavement Design:					23,285				2,232,422				23,169,984				15,356,097		40,781,789	
Total CESA for Rigid Pavement Design:					56,197				5,387,722				50,342,735				33,365,061		89,151,716	

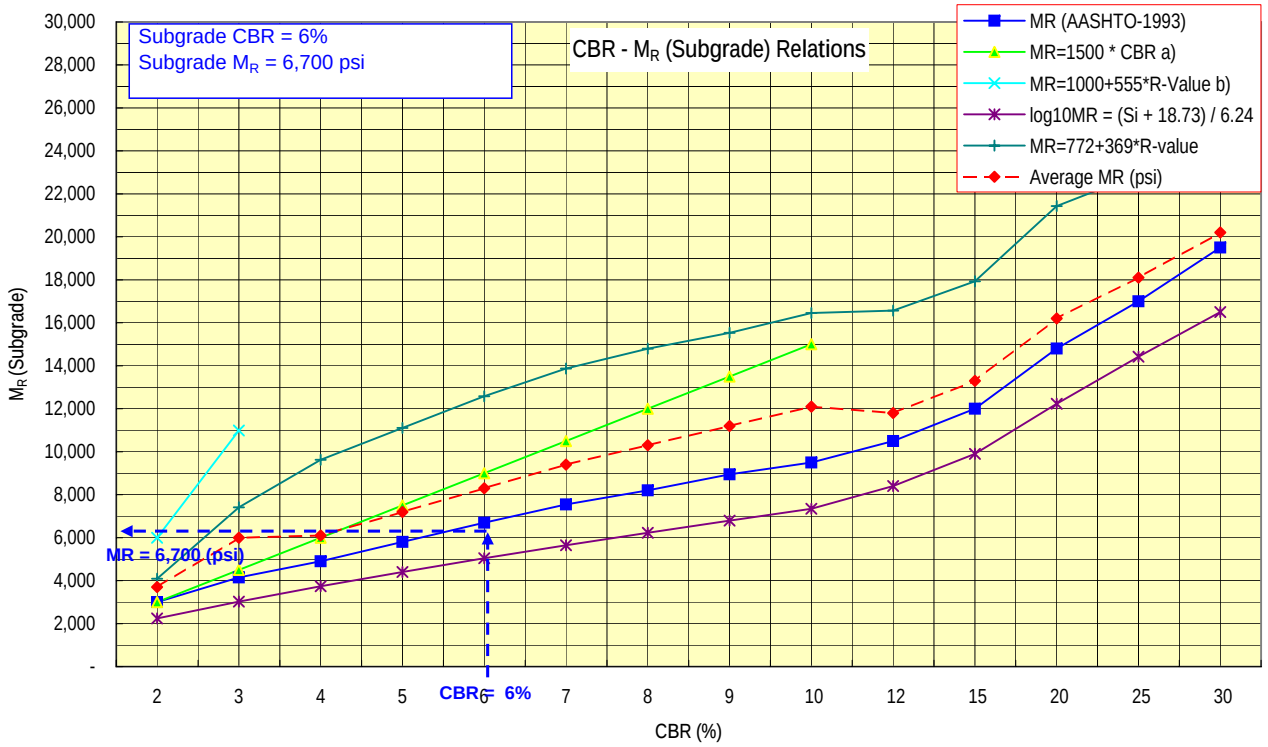
Source: JICA Study Team

Relation of Module (psi) of Subgrade

CBR-M_R (Subgrade) Relations

CBR (%)	AASHTO				AI	Average M_R (psi)	Soil Support Values	R-value
	M_R (AASHTO-1993)	M_R=1500 * CBR [a]	M_R=1000+555* R-Value [b]	log10M_R = (Si + 18.73) / 6.24	M_R=772+369* R-value			
2	3,000	3,000	5,995	2,245	4,093	3,700	3.00	9.00
3	4,150	4,500	10,990	3,025	7,414	6,000	3.80	18.00
4	4,900	6,000		3,740	9,628	6,100	4.30	24.00
5	5,800	7,500		4,406	11,104	7,200	4.75	28.00
6	6,700	9,000		5,040	12,580	8,300	5.10	32.00
7	7,550	10,500		5,645	13,872	9,400	5.40	35.50
8	8,200	12,000		6,230	14,794	10,300	5.65	38.00
9	8,950	13,500		6,795	15,532	11,200	5.85	40.00
10	9,500	15,000		7,345	16,455	12,100	6.00	42.50
12	10,500			8,400	16,565	11,800	6.35	42.80
15	12,000			9,900	17,931	13,300	6.70	46.50
20	14,800			12,235	21,436	16,200	7.35	56.00
25	17,000			14,420	22,912	18,100	7.70	60.00
30	19,500			16,500	24,573	20,200	8.15	64.50

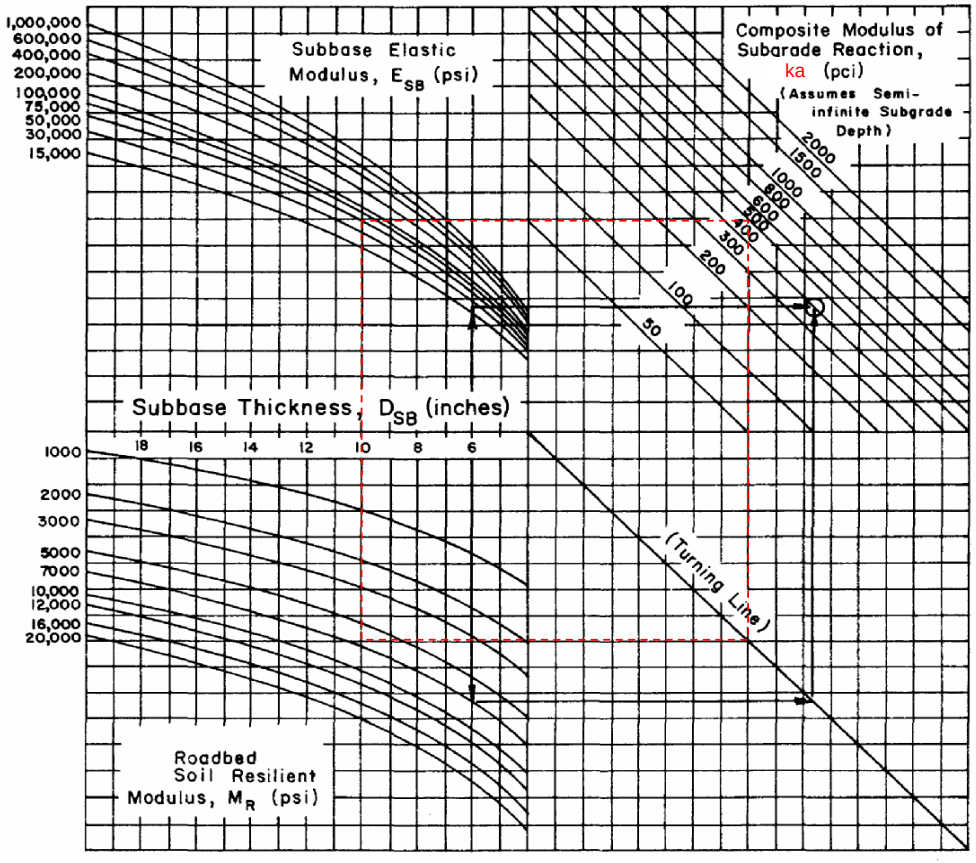
Notes: a) Applicable up to CBR 10
b) Applicable up to R-value less than 20



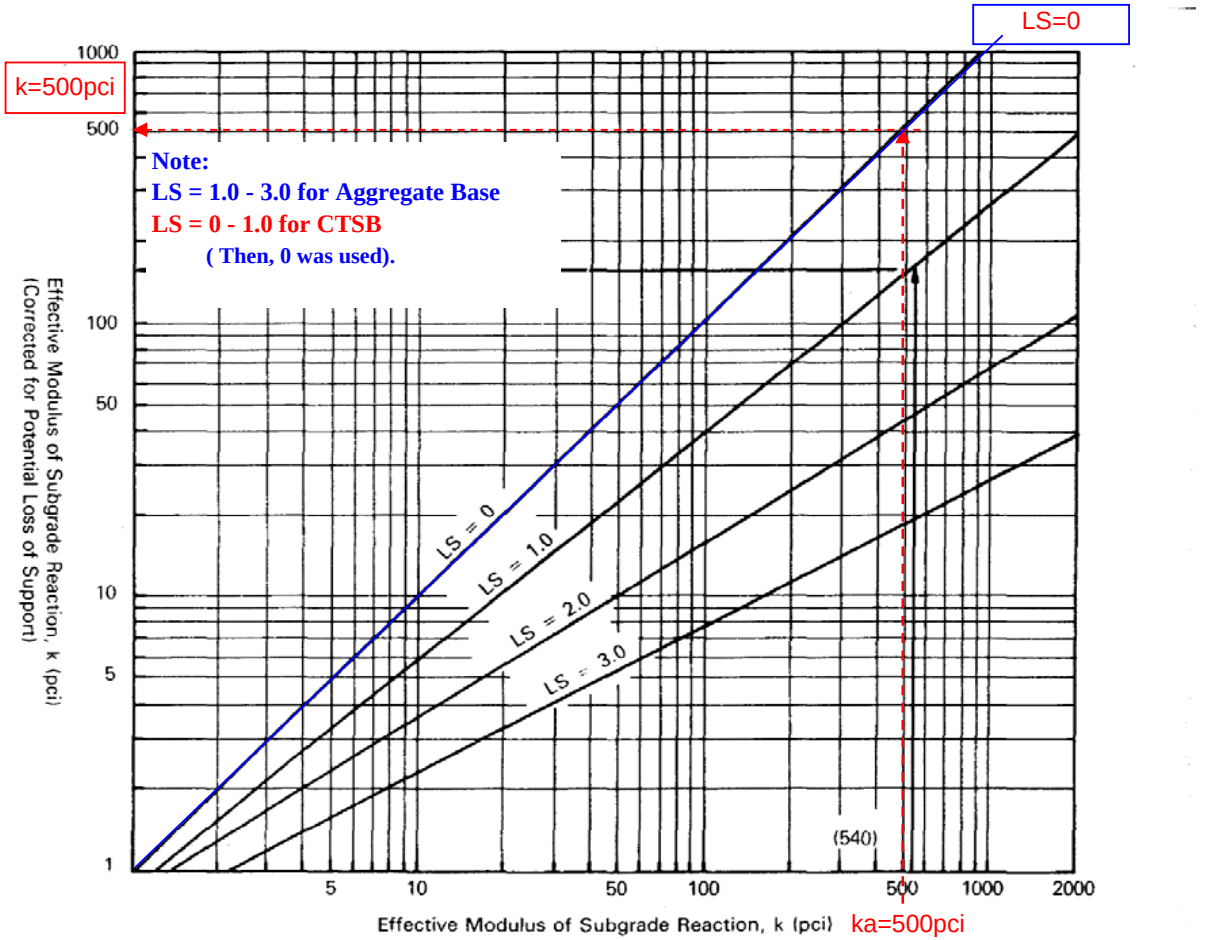
CONDITION:

D_{SB} = 4 inches (CTSB),
+ 8 inches (Aggregate Subbase)
E_{SB} = 50,000 psi

M_R = 6,700 psi (CBR 6%)
Solution: ka = 500 pci



Estimate of Composite Modules of Subgrade Reaction (ka)



Correction of Effective Module (k) of Subgrade Reaction
for Potential Loss of Subbase Support

THE TRANS-SULWESI MAMMINASATA ROAD PROJECT

Section A

Rigid Pavement Design (AASHTO 1993 Design Guide)

RIGID PAVEMENTDESIGN

(Load based on AASHTO)

Design Equation:

$$\log_{10}W_{18} = Z_R*So + 7.35*\log_{10}(D+1) - 0.06 + \{\log_{10}[APSI/(4.5 - 1.5)]\} / \{1 + [(1.624*10^7)/(D+1)^{8.46}]\} + (4.22 - 0.32pt)*\log10\{[Sc' * Cd(D0.75 - 1.132)] / [215.63*J(D0.75-(18.42/(Ec/k)0.25))]\}$$

Design Inputs:

R =	90	%
Z_R =	-1.282	
So =	0.35	
W_{18} =	34.30	x 10^6 *(18 KIP ESAL)*
pt =	2.50	
APSI =	2.00	(4.5-2.5)
S'c =	722	*psi*
Cd =	1.10	
J =	3.20	with Dowel Bars
Ec =	3.40	x 10^6 *psi*
k =	500	pci

(For try&error computation)

7.535	7.536

Ec = 57,000 $(f'c)^{0.5}$ = 3.40 x 10^6 psi

where, fc (28 days) = 3,560 psi

(250 kg/cm^2)

S'c = Sc + z (SDs) = 722 psi

where, Sc (28 days) = 640 psi

(45 kg/cm^2)

z =standard normal variate

1.037 for PS =15 %

1.282 for PS = 10%

SDs = Sc x 10% = 64 psi

Design Conditions (input):

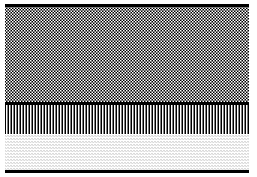
- **Design Period:** 20 years
- **Loading:** Bina Marga Standard
- **Design CESA:** 34.30 x 10^6
- **Concrete Strength at 28 days:**

Compression: 250 kg/cm^2

Flexural: 45 kg/cm^2

Note:

PAVEMENT STRUCTURE



PCC Thickness T= 26.0 cm

CTSB T= 10 cm

Aggregate Base (CBR 60%) T= 20.0 cm

Subgrade CBR = 6.0%

(M_R = 6,700 psi)

Output:

D = **10.09** inches **o.k. !!!**

25.63 cm,

Say **26.0** cm (= 10.2 in.)

Note: Input approx.D and repeat as suggested

(input)

Drainage Coefficient (Cd): 1.10

Load Transfer Coefficient (J): 3.20

THE TRANS-SULWESI MAMMINASATA ROAD PROJECT

Section B

Rigid Pavement Design (AASHTO 1993 Design Guide)

RIGID PAVEMENTDESIGN

(Load based on AASHTO)

Design Equation:

$$\log_{10}W_{18} = Z_R*So + 7.35*\log_{10}(D+1) - 0.06 + \{\log_{10}[APSI/(4.5 - 1.5)]\} / \{1 + [(1.624*10^7)/(D+1)^{8.46}]\} + (4.22 - 0.32pt)*\log10\{[Sc' * Cd(D0.75 - 1.132)] / [215.63*J(D0.75-(18.42/(Ec/k)0.25))]\}$$

Design Inputs:

R =	90	%
Z_R =	-1.282	
So =	0.35	
W_{18} =	20.20	x 10^6 *(18 KIP ESAL)*
pt =	2.50	
APSI =	2.00	(4.5-2.5)
S'c =	722	*psi*
Cd =	1.10	
J =	3.20	with Dowel Bars
Ec =	3.40	x 10^6 *psi*
k =	500	pci

(For try&error computation)

7.305	7.306

Ec = 57,000 $(f'c)^{0.5}$ = 3.40 x 10^6psi

where, fc (28 days) = 3,560 psi

(250 kg/cm^2)

S'c = Sc + z (SDs) = 722 psi

where, Sc (28 days) = 640 psi

(45 kg/cm^2)

z =standard normal variate

1.037 for PS =15 %

1.282 for PS = 10%

SDs = Sc x 10% = 64 psi

Output:

D = **9.196** inches **o.k. !!!**

23.36 cm,

Say **24.0** cm (= 9.4 in.)

Note: Input approx.D and repeat as suggested

Design Conditions (input):

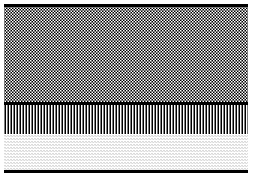
- **Design Period:** **20 years**
- **Loading:** **Bina Marga Standard**
- **Design CESA:** **20.20 x 10^6**
- **Concrete Strength at 28 days:**

Compression: 250 kg/cm^2

Flexural: 45 kg/cm^2

Note:

PAVEMENT STRUCTURE



PCC Thickness T= 24.0 cm

CTSB T= 10 cm

Aggregate Base (CBR 60%) T= 20.0 cm

Subgrade CBR = 6.0%

(M_R = 6,700 psi)

(input)

Drainage Coefficient (Cd): 1.10

Load Transfer Coefficient (J): 3.20

Trans-Sulawesi Mamminasata Road
Cumulative Design Axle Load (Design CESA) Estimation for Pavement Design

Road Section: **Section A** **Maros-IC Jl.Sutami** **Roadway:** **6/2 D**

Traffic Survey Station :
Base Year: 2005 DD/ Pre-construction: 2008 - 2009 Construction: 2009 - 2012
Opening Year : 2012 (3 years)

Project's Lifespan : **10 years** **for ACP**

TGR (Traffic Growth Rate): As indicated table below

AADT: (Y 2005) at Station No.9

Vehicle Type	Empty (Veh.)	Empty (%)	Loaded (Veh.)	Loaded (%)	Total (Year 2005) (Veh.)	Total (Year 2005) (%)
Minibus/Pickup	2,373	30%	5,538	70%	7,911	62.1%
Large Bus	68	10%	610	90.0%	678	5.3%
Truck (2-Axles)	1,039	30%	2,424	70.0%	3,463	27.2%
Truck (3-Axles)	205	30%	479	70.0%	684	5.4%
Total:	3,685		9,051		12,736	100.0%

Vehicle Damage Factors :

Vehicle Type	Empty ESA/Veh.	Empty ESA/day	Loaded ESA/Veh.	Loaded ESA/day	Average ESA/day
Mini Bus/Pickup	-	-	0.0007	4	0.0005
Large Bus	0.04	2.7	0.57	348	0.52
Truck (2-Axles)	0.08	83.1	1.41	3,418	1.01
Truck (3-Axles)	0.43	88.2	4.26	2,041	3.11

Summary of Design ESA Estimate

Estimated CESA: **Flexible Pavement Design**

Vehicle Type	10-years ESA (2012 - 2021)	
Minibus/Pickup	23,285	0.1%
Large Bus	2,232,422	5.6%
Truck (2-Axles)	23,169,984	58.6%
Truck (3-Axles)	14,088,054	35.7%
Total:	**39,513,745**	100.0%

Direction Distribution Factor:

North Bound	South Bound
45%	55%
17,781,185	21,732,560

Lane Distribution Factor: 70%
(Between 60% and 80% for 6/2D) **15,212,792**

Design CESA for Pavement Design
15.2 x 10^6

ESA Estimation Table (for both directions/lanes)

Stage	Year	Minibus / Pickup TGR	Minibus / Pickup AADT	Minibus / Pickup V.D.F	Minibus / Pickup ESA/Year	Large Bus TGR	Large Bus AADT	Large Bus V.D.F	Large Bus ESA	Truck (2-Axles) TGR	Truck (2-Axles) AADT	Truck (2-Axles) V.D.F	Truck (2-Axles) ESA	Truck (3-Axles) TGR	Truck (3-Axles) AADT	Truck (3-Axles) V.D.F	Truck (3-Axles) ESA	Yearly Total AADT	Yearly Total ESA	CESA for Design
M/P	2005		7,911	0.0005	1,334		678	0.52	127,903		3,463	1.01	1,277,850		684	3.11	776,972	12,736	2,184,060	
	2006	6.2%	8,398		1,416	6.2%	720		135,769	7.2%	3,711		1,369,217	7.2%	733		832,525	13,561	2,338,928	
F/S	2007	6.0%	8,897		1,500	6.0%	763		143,848	7.0%	3,968		1,464,377	7.0%	784		890,386	14,412	2,500,111	CESA for
D/D	2008	5.8%	9,412		1,587	5.8%	807		152,176	6.8%	4,238		1,563,808	6.8%	837		950,843	15,294	2,668,415	Pre-Opening
C1	2009	5.6%	9,943		1,677	5.6%	852		160,759	6.6%	4,519		1,667,645	6.6%	893		1,013,979	16,207	2,844,060	Period
C2	2010	5.5%	10,492		1,769	5.5%	899		169,633	6.5%	4,814		1,776,376	6.5%	951		1,080,090	17,156	3,027,869	
C3	2011	4.6%	10,969		1,850	4.6%	940		177,351	5.6%	5,081		1,874,965	5.6%	1,004		1,140,035	17,994	3,194,201	18,757,644
C4/OM1	2012	4.5%	11,462		1,933	4.5%	982		185,314	5.5%	5,360		1,977,900	5.5%	1,059		1,202,623	18,863	3,367,771	Opening
OM2	2013	4.4%	11,971		2,019	4.4%	1,026		193,542	5.4%	5,652		2,085,498	5.4%	1,116		1,268,046	19,765	3,549,105	
OM3	2014	4.4%	12,496		2,107	4.4%	1,071		202,039	5.4%	5,956		2,197,906	5.4%	1,176		1,336,394	20,700	3,738,447	
OM4	2015	4.4%	13,041		2,199	4.4%	1,118		210,848	5.4%	6,276	7,515	2,315,714	5.4%	1,240		1,408,025	21,674	3,936,786	
OM5	2016	3.8%	13,539		2,283	3.8%	1,160		218,902	4.8%	6,578		2,427,332	4.8%	1,299		1,475,891	22,577	4,124,408	
OM6	2017	3.8%	14,048		2,369	3.8%	1,204		227,133	4.8%	6,891		2,542,873	4.8%	1,361		1,546,144	23,505	4,318,518	For Flexible
OM7	2018	3.7%	14,568		2,457	3.7%	1,249		235,537	4.7%	7,215		2,662,388	4.7%	1,425		1,618,813	24,457	4,519,194	Pavement
OM8	2019	3.7%	15,101		2,547	3.7%	1,294		244,157	4.7%	7,551		2,786,455	4.7%	1,492		1,694,249	25,439	4,727,408	Design
OM9	2020	3.6%	15,647		2,639	3.6%	1,341		252,972	4.6%	5,530		2,040,437	4.6%	1,092		1,240,648	23,609	3,536,695	(2012 - 2021)
OM10	2021	3.6%	16,204		2,733	3.6%	1,389		261,977	4.6%	5,782		2,133,481	4.6%	1,142		1,297,221	24,516	3,695,413	39,513,745
OM11	2022	3.5%	16,772		2,828	3.5%	1,437		271,173	4.5%	6,043		2,229,701	4.5%	1,194		1,355,726	25,446	3,859,429	
OM12	2023	3.5%	17,353		2,926	3.5%	1,487		280,555	4.5%	6,312		2,329,146	4.5%	1,247		1,416,191	26,399	4,028,819	
OM13	2024	3.4%	17,944		3,026	3.4%	1,538		290,122	4.4%	6,590		2,431,861	4.4%	1,302		1,478,645	27,374	4,203,655	
OM14	2025	3.4%	18,547		3,128	3.4%	1,590		299,870	4.4%	6,878		2,537,890	4.4%	1,358		1,543,114	28,373	4,384,003	
OM15	2026	3.3%	19,161		3,231	3.3%	1,642		309,796	4.3%	7,174		2,647,273	4.3%	1,417		1,609,623	29,395	4,569,924	
OM16	2027	3.3%	19,786		3,337	3.3%	1,696		319,895	4.3%	7,480		2,760,047	4.3%	1,477		1,678,193	30,439	4,761,472	For Rigid
OM17	2028	3.2%	20,421		3,444	3.2%	1,750		330,164	4.2%	7,795		2,876,245	4.2%	1,540		1,748,844	31,506	4,958,698	Pavement
OM18	2029	3.2%	21,066		3,553	3.2%	1,805		340,597	4.2%	8,119		2,995,897	4.2%	1,604		1,821,596	32,594	5,161,643	Design
OM19	2030	3.1%	21,722		3,663	3.1%	1,862		351,190	4.1%	8,453		3,119,028	4.1%	1,670		1,896,464	33,705	5,370,345	(2012 - 2031)
OM20	2031	3.1%	22,386		3,775	3.1%	1,919		361,936	4.1%	8,796	10,533	3,245,661	4.1%	1,737		1,973,460	34,838	5,584,833	86,396,566
Total CESA for Flexible Pavement Design:					23,285				2,232,422				23,169,984				14,088,054		39,513,745	
Total CESA for Rigid Pavement Design:					56,197				5,387,722				50,342,735				30,609,912		86,396,566	

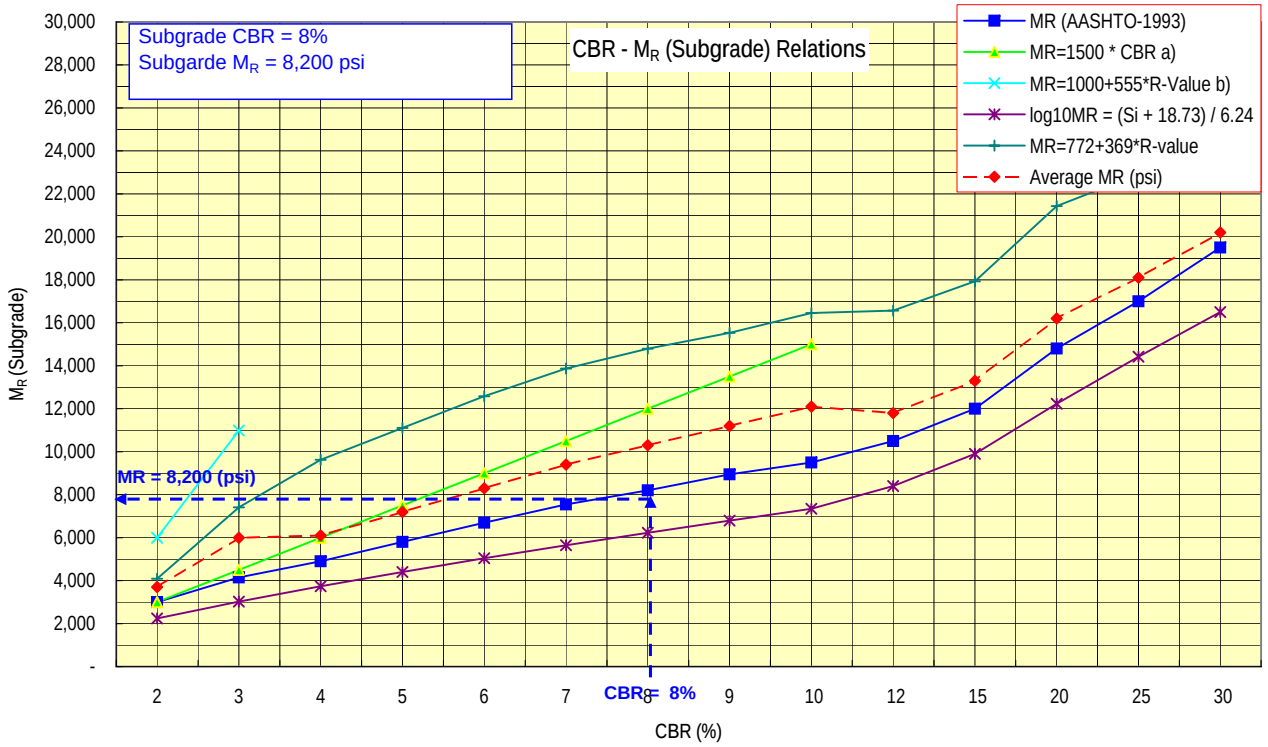
Notes:

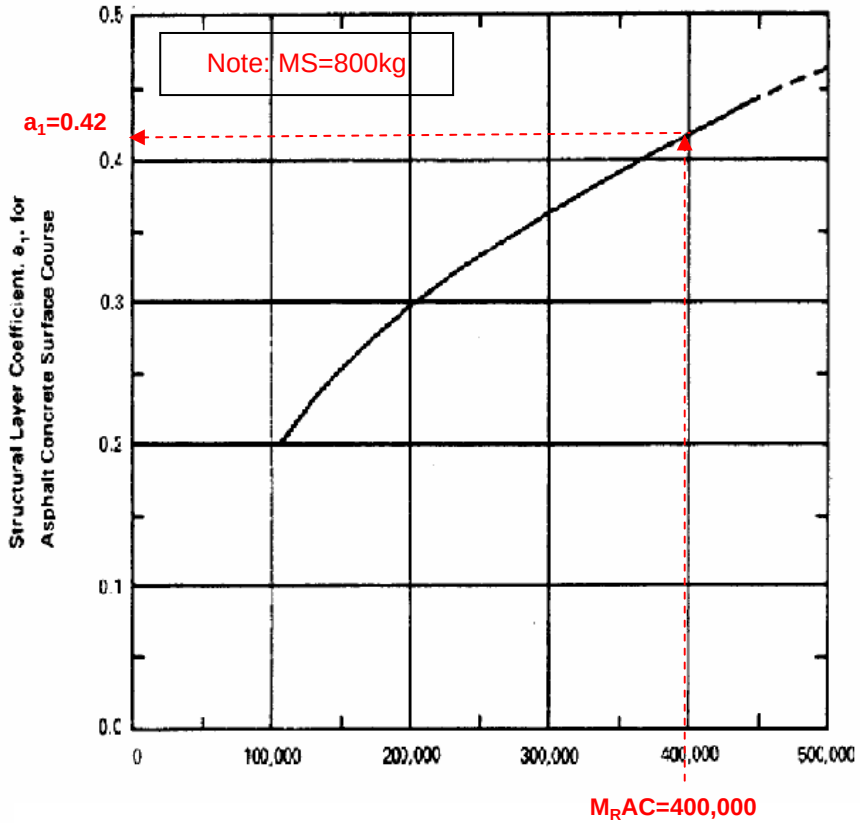
Relation of Module (psi) of Subgrade

CBR-M_R (Subgrade) Relations

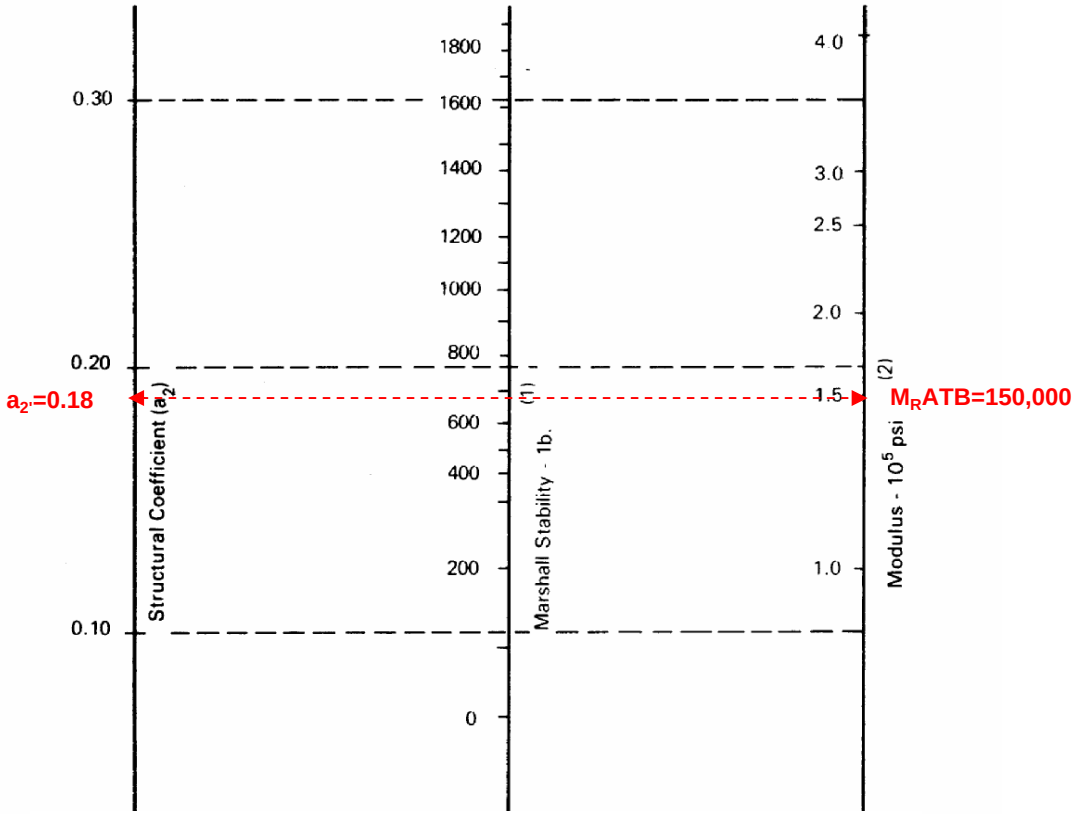
CBR (%)	AASHTO				AI	Average M_R (psi)	Soil Support Values	R-value
	M_R (AASHTO-1993)	M_R=1500 * CBR [a]	M_R=1000+555* R-Value [b]	log10M_R = (Si + 18.73) / 6.24	M_R=772+369* R-value			
2	3,000	3,000	5,995	2,245	4,093	3,700	3.00	9.00
3	4,150	4,500	10,990	3,025	7,414	6,000	3.80	18.00
4	4,900	6,000		3,740	9,628	6,100	4.30	24.00
5	5,800	7,500		4,406	11,104	7,200	4.75	28.00
6	6,700	9,000		5,040	12,580	8,300	5.10	32.00
7	7,550	10,500		5,645	13,872	9,400	5.40	35.50
8	8,200	12,000		6,230	14,794	10,300	5.65	38.00
9	8,950	13,500		6,795	15,532	11,200	5.85	40.00
10	9,500	15,000		7,345	16,455	12,100	6.00	42.50
12	10,500			8,400	16,565	11,800	6.35	42.80
15	12,000			9,900	17,931	13,300	6.70	46.50
20	14,800			12,235	21,436	16,200	7.35	56.00
25	17,000			14,420	22,912	18,100	7.70	60.00
30	19,500			16,500	24,573	20,200	8.15	64.50

Notes: a) Applicable up to CBR 10
b) Applicable up to R-value less than 20

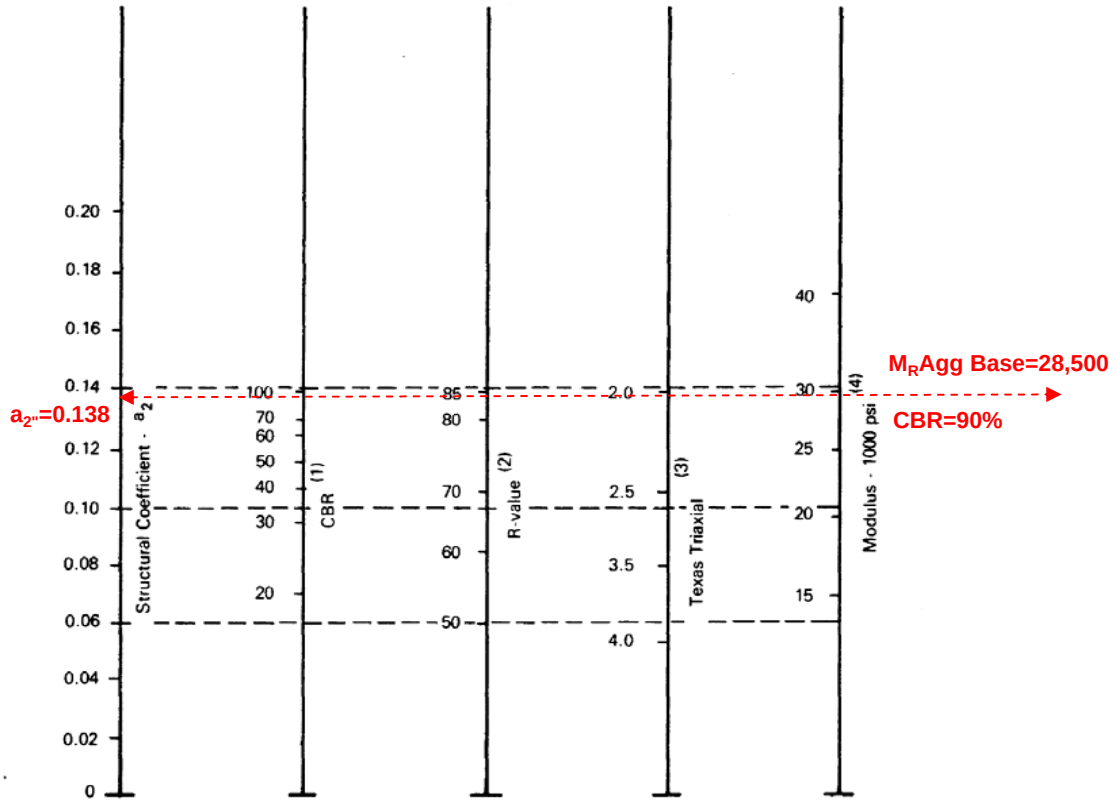




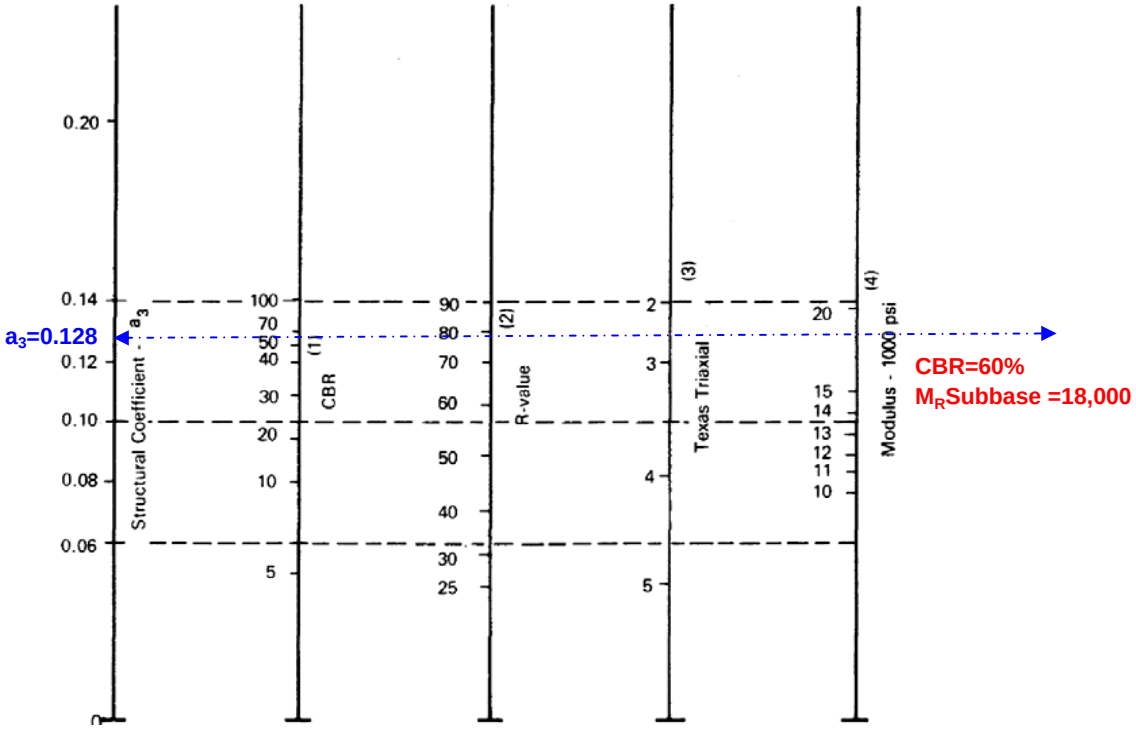
Layer Coefficient of Asphalt Concrete



Layer Coefficient of Asphalt Treated Base



Layer Coefficient of Aggegate Base



Layer Coefficient of Asphalt Treated Base

TRANS-SULAWESI MAMMINASATA ROAD PROJECT

Section A

Flexible Pavement Design (AASHTO 1993 Design Guide)

FLEXIBLE PAVEMENT DESIGN
(Load based on AASHTO)

Design Conditions:
- Design Period: 10 years
- Loading: Bina Marga Standard
- Design ESAL: 15.20 x 10^6

Note:

SN Design Equation:

$$\log_{10} W_{18} = Z_R*So + 9.36*\log_{10}(SN+1) - 0.20 + \{\log_{10}[APSI / (4.2 - 1.5)] / [0.40 + 1094/(SN+1)^{5.19}]\} + 2.32*\log_{10}M_R - 8.07$$

Design Inputs:

R	=	90	%
Z_R	=	-1.282	
So	=	0.45	
W_{18}	=	15.20 x 10^6	*(18KIP ESAL)*
MR	=	8,200	*psi*
DPSI	=	1.70	*(4.2-2.5)*

(For try&error computation)

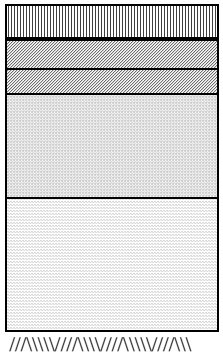
7.182	=	7.181

Output:

SN = 5.110 **o.k. !!!**

Note: Input approx.SN and repeat as suggested

PAVEMENT STRUCTURE



AC Wearing Course
AC Binder
AC Base
Aggregate Base Class A (CBR>90%)
Aggregate Base Class B (CBR>60%)
Subgrade (CBR = 8.0 %)

	Layer Coefficient per cm (Input)	Layer Coefficient per inch	Thickness Product mm (Input)	Thickness Product in inch	Drainage Coefficient
a_1=	0.165	0.42	40	0.66	
a_2=	0.165	0.42	50	0.83	
a2=	0.165	0.42	50	0.83	
$a_{2''}$=	0.055	0.138	200	1.20	1.10
a_3=	0.051	0.128	289 (300)	1.60	1.10
		Total:	629	5.11	
		Total Design SN =		5.112	o.k. !!!
		Required SN =		5.110	

M_R = 1500*CBR(%) if a CBR value < 10% is entered.
Otherwise, M_R = value in from other sources

Input M_R ***or*** CBR

M_R *psi*	CBR (%)
8,200	

Drainage Coefficients (Input)

m_2	Aggregate Base	1.10
m_3	Granular Subbase	1.10

Module of Pavement Materials

Surface	Wearing Course	400,000	psi, MS =	800 kg
	Binder Course	400,000	psi, MS =	800 kg
Base	Asphalt Concrete Base	400,000	psi, MS =	1,000 kg
	Aggregate Base Class A	28,500	psi, CBR>	90%
Subbase	Aggregate Base Class B	18,000	psi, CBR>	60%

Note: JICA Study Team

TRANS-SULAWESI MAMMINASATA ROAD PROJECT

Section B

Flexible Pavement Design (AASHTO 1993 Design Guide)

FLEXIBLE PAVEMENT DESIGN

(Load based on AASHTO)

Design Conditions:
- Design Period: 10 years
- Loading: Bina Marga Standard
- Design ESAL: 9.10 x 10^6

Note:

SN Design Equation:

$$\log_{10} W_{18} = Z_R*So + 9.36*\log_{10}(SN+1) - 0.20 + \{\log_{10}[APSI / (4.2 - 1.5)] / [0.40 + 1094/(SN+1)^{5.19}]\} + 2.32*\log_{10}M_R - 8.07$$

Design Inputs:

R	=	90	%
Z_R	=	-1.282	
So	=	0.45	
W_{18}	=	9.10 x 10^6	*(18KIP ESAL)*
MR	=	8,200	*psi*
DPSI	=	1.70	*(4.2-2.5)*

(For try&error computation)

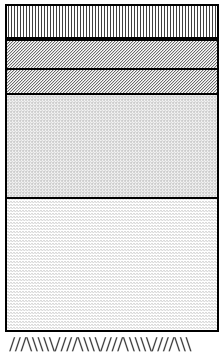
6.959	=	6.958

Output:

SN = **4.746** **o.k. !!!**

Note: Input approx.SN and repeat as suggested

PAVEMENT STRUCTURE



AC Wearing Course
AC Binder
AC Base
Aggregate Base Class A (CBR>90%)
Aggregate Base Class B (CBR>60%)
Subgrade (CBR = 8.0 %)

	Layer Coefficient per cm (Input)	per inch	Thickness Product mm (Input)	in inch	Drainage Coefficient
a_1=	0.165	0.42	40	0.66	
a_2=	0.165	0.42	50	0.83	
a2=	0.165	0.42	50	0.83	
$a_{2''}$=	0.055	0.138	200	1.20	1.10
a_3=	0.051	0.128	223 (250)	1.24	1.10
		Total:	563	4.75	
			Total Design SN =	4.746	o.k. !!!
			Required SN =	4.746	

M_R = 1500*CBR(%) if a CBR value < 10% is entered.
Otherwise, M_R = value in from other sources

Input M_R ***or*** CBR

M_R *psi*	CBR (%)
8,200	

Drainage Coefficients (Input)

m_2	Aggregate Base	1.10
m_3	Granular Subbase	1.10

Module of Pavement Materials

Surface	Wearing Course	400,000	psi, MS =	800 kg
	Binder Course	400,000	psi, MS =	800 kg
Base	Asphalt Concrete Base	400,000	psi, MS =	1,000 kg
	Aggregate Base Class A	28,500	psi, CBR>	90%
Subbase	Aggregate Base Class B	18,000	psi, CBR>	60%

Note: JICA Study Team

TRANS-SULAWESI MAMMINASATA ROAD PROJECT

Section C

Flexible Pavement Design (AASHTO 1993 Design Guide)

FLEXIBLE PAVEMENT DESIGN

(Load based on AASHTO)

Design Conditions:
- Design Period: 10 years
- Loading: Bina Marga Standard
- Design ESAL: 9.10 x 10^6

Note:

SN Design Equation:

$$\log_{10} W_{18} = Z_R*So + 9.36*\log_{10}(SN+1) - 0.20 + \{\log_{10}[APSI / (4.2 - 1.5)] / [0.40 + 1094/(SN+1)^{5.19}]\} + 2.32*\log_{10}M_R - 8.07$$

Design Inputs:

R	=	90	%
Z_R	=	-1.282	
So	=	0.45	
W_{18}	=	9.10 x 10^6	*(18KIP ESAL)*
MR	=	8,200	*psi*
DPSI	=	1.70	*(4.2-2.5)*

(For try&error computation)

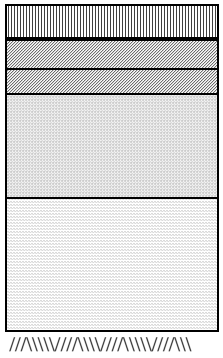
6.959	=	6.960

Output:

SN = **4.748** **o.k. !!!**

Note: Input approx.SN and repeat as suggested

PAVEMENT STRUCTURE



AC Wearing Course
AC Binder
AC Base
Aggregate Base Class A (CBR>90%)
Aggregate Base Class B (CBR>60%)
Subgrade (CBR = 8.0 %)

	Layer Coefficient per cm (Input)	Layer Coefficient per inch	Thickness Product mm (Input)	Thickness Product in inch	Drainage Coefficient
a_1=	0.165	0.42	40	0.66	
a_2=	0.165	0.42	40	0.66	
a2=	0.165	0.42	50	0.83	
$a_{2''}$=	0.055	0.138	200	1.20	1.10
a_3=	0.051	0.128	253 (250)	1.40	1.10
		Total:	583	4.75	
		Total Design SN =		4.747	o.k. !!!
		Required SN =		4.748	

M_R = 1500*CBR(%) if a CBR value < 10% is entered.
Otherwise, M_R = value in from other sources

Input M_R ***or*** CBR

M_R *psi*	CBR (%)
8,200	

Drainage Coefficients (Input)

m_2	Aggregate Base	1.10
m_3	Granular Subbase	1.10

Module of Pavement Materials

Surface	Wearing Course	400,000	psi, MS =	800 kg
	Binder Course	400,000	psi, MS =	800 kg
Base	Asphalt Concrete Base	400,000	psi, MS =	1,000 kg
	Aggregate Base Class A	28,500	psi, CBR>	90%
Subbase	Aggregate Base Class B	18,000	psi, CBR>	60%

Note: JICA Study Team

TRANS-SULAWESI MAMMINASATA ROAD PROJECT

Section D

Flexible Pavement Design (AASHTO 1993 Design Guide)

FLEXIBLE PAVEMENT DESIGN

(Load based on AASHTO)

Design Conditions:
- Design Period: 10 years
- Loading: Bina Marga Standard
- Design ESAL: 4.20 x 10^6

Note:

SN Design Equation:

$$\log_{10} W_{18} = Z_R*So + 9.36*\log_{10}(SN+1) - 0.20 + \{\log_{10}[APSI / (4.2 - 1.5)] / [0.40 + 1094/(SN+1)^{5.19}]\} + 2.32*\log_{10}M_R - 8.07$$

Design Inputs:

R	=	90	%
Z_R	=	-1.282	
So	=	0.45	
W_{18}	=	4.20 x 10^6	*(18KIP ESAL)*
MR	=	8,200	*psi*
DPSI	=	1.70	*(4.2-2.5)*

(For try&error computation)

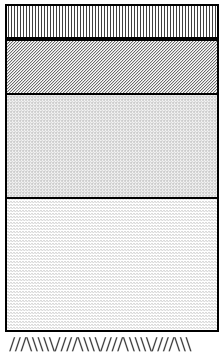
6.623	=	6.622

Output:

SN = 4.225 **o.k. !!!**

Note: Input approx.SN and repeat as suggested

PAVEMENT STRUCTURE



AC Wearing Course
AC Binder
AC Base
Aggregate Base Class A (CBR>90%)
Aggregate Base Class B (CBR>60%)
Subgrade (CBR = 8.0 %)

M_R = 1500*CBR(%) if a CBR value < 10% is entered.
Otherwise, M_R = value in from other sources

Input M_R ***or*** CBR

M_R *psi*	CBR (%)
8,200	

	Layer Coefficient per cm (Input)	Layer Coefficient per inch	Thickness Product mm (Input)	Thickness Product in inch	Drainage Coefficient
a_1=	0.165	0.42	40	0.66	
a_2=	0.165	0.42	60	0.99	
a2=	0.165	0.42	0	0.00	
$a_{2''}$=	0.055	0.138	200	1.20	1.10
a_3=	0.051	0.128	248 (250)	1.37	1.10
		Total:	548	4.22	
		Total Design SN =		4.224	o.k. !!!
		Required SN =		4.225	

Drainage Coefficients (Input)

m_2	Aggregate Base	1.10
m_3	Granular Subbase	1.10

Module of Pavement Materials

Surface	Wearing Course	400,000	psi, MS =	800 kg
	Binder Course	400,000	psi, MS =	800 kg
Base	Asphalt Concrete Base	400,000	psi, MS =	1,000 kg
	Aggregate Base Class A	28,500	psi, CBR>	90%
Subbase	Aggregate Base Class B	18,000	psi, CBR>	60%

Note: JICA Study Team

APPENDIX-E

GEOLOGICAL INVESTIGATION AND ANALYSIS DATA

Appendix E Geological Investigation and Analysis Data

E-1 Geological Investigation for Bridges

E-1.1 Location and Number of Bore Hole Investigation

Table E-2.1 shows a list of the bridges, of which length is more than 20m, subjected to geological investigation.

Table E-1.1 List of Bridge for Bore Hole Investigation (L>20m)

No	Bridge ID No	Route	Bridge Length (m)	Number of Bore Hole	Bridge Name / River Name
1	1-16	Mamminasa Bypass	25	2	Ticcekang River
2	1-19	Mamminasa Bypass	60	2	Pahundukang River
3	1-26	Mamminasa Bypass	25	2	Kaccikang River
4	1-28	Mamminasa Bypass	16	2	Jenemanjalling River
5	1-31	Mamminasa Bypass	154	3	Jeneberang No.1
6	4-1	Abdullah Daeng Sirua	35	2	
7	4-5	Abdullah Daeng Sirua	60	2	Tallo River
8	3-2	Hertasning	20	2	Tallo River
9	2-1	Maros – Middle Ring Road	40	2	
10	2-2	Maros – Middle Ring Road	40	2	
11	2-6	Middle Ring Road, Trans-Sulawesi Mamminasata	136	3	Tallo River
12	2-7	Middle Ring Road	50	2	
13	2-8	Middle Ring Road	50	2	
14	2-9	Middle Ring Road	50	2	
15	2-11	Middle Ring Road Access, Trans-Sulawesi Mamminasata	393	3	Jeneberang No.2
16	2-12	Middle Ring Road Access	35	3	Bayoa River
17	2-14	Middle Ring Road Access	20	2	Barombong River
18	2-18	M R R Access - Takalar	40	3	
19	1-5	Mamminasa By Pass	126	3	Maros

E-1.2 Methodology

(1) Bridges > 20 m

1) Drilling, Sampling and Recording

Mechanical boring was carried out at abutments for the bridge between 20 m and 40 m in length. An additional boring at river center was carried out for the bridge of more than 40 m in length. Sub

surface geological investigation was made by core drilling to identify the type of soil and rock layers, and details of physical and mechanical condition. In the case of that drilling reaches to rock bed at a shallow depth, the core drilling was continued up to 3 m depth in rock bed. Diameter of the bore hole was more than 64 mm.

Core samples were taken at a 1 meter depth interval. All core samples taken were kept in wooden boxed (dimension of 100 cm x 40 cm x 7cm) marked with hole number. Each box was marked with the information of 1). Project Name, 2). Location, 3). Number of drill hole, 4). Drilling depth and 5). Date of drilling.

The following were recorded in standard investigation recording sheets:

(i) Hole number, date of operation and diameter of hole

(ii) Ground Water Level in the hole

(iii) Depth of drilling, progress of drilling and length of recovered sample for each recovery of core barrel and time for each progress of drilling.

(iv) Change in quantity of return water from the hole

(v) Description of judgment on subsurface condition, especially about boundary of each stratum.

(vi) For rock/ bedrock samples, the RQD and the recovery values were calculated as follows:

① RQD (%) = (total length of more than 100 cm core/ length of core run) x 100%
② RECOVERY (%) = (length of core recovered/ length of core run) x 100%

The core drilling used is the rotary-spindle type with water circulation and capable for obtaining core samples. It has drilling capacity up to 100 meters. The equipment consists of:

(i) Hydraulics Bore Machine (Tone UD 5 and Koken OP1 and Toho D2G wire line type).

(ii) Rods (length of 3m, outer diameter 60,4 mm and inner diameter 50,8 mm)

(iii) Casing (cover of pipe length of 1m to 2 m, outer diameter 88.9 mm and inner diameter 77.8 mm).

(iv) The engine is Koyo and Yanmar of 15 Hp and 12 Hp respectively.

(v) Core barrel (single, double), the drilling bite (tungsten or diamond) NMLC type, size of the outer diameter is 73 mm and the inner diameter is 54,70 mm and for the wire line with HQ core barel, the outer diameter is 89 mm and the inner diameter is 65 mm .

(vi) The pump is of piston pump with capacity of more than 100 lt/min and maximum pressure

of more than 25 kg/cm2.

(vii) The test equipment of water pressure / Lugeon test; (single packer of mechanic rubber or pneumatic, water flow meter, manometer and stop watch).

The investigation meets the standards of ASTM D.2113 – 70, ASSHO T.225 – 68, BS 4019 or equivalent.

Drilling procedure used a single core barrel in overburden and double or triple core barrel in rock layers. The core drilling was carried out with tungsten bit. In the case of soft and hard rock a diamond bite and clean water circulation were applied.

The classification of rock type for the geology engineering is based on the classification of Criepi and Dr K. Kikuci, Mr K. Saito & Mr K. Kusunoki, ICOLD, May, 1982. There are four parameters in the classification like: rock class, hardness, core shape and joint international and also weathering and alteration.

Table E-1.2 Classification System of Rock Based on Rock Quality Designation (RQD)

No.	RQD (%)	Rock Quality
1	0 – 25	Very Poor
2	25 – 50	Poor
3	50 – 75	Fair
4	75 – 90	Good
5	90 – 100	Excellent

Table E-1.3 Rock hardness, core shape and joint interval, weathering and alteration

Rock Hardness	Core shape and joint interval	Weathering and alteration
1. Hard rock 2. Medium hard rock 3. Weak rock 4. Very weak rock 5. Decomposed rock	1. Columnar: Joint interval is around 30cm or more. 2. Columnar: Joint interval is approximately 15 to 30cm. 3. Mainly columnar: Joint interval is approximately 5 to 15cm. 4. Short columnar and fragments: Joint interval is approximately less than 5cm. 5. Mainly fragments: Heavily jointed. 6. Mainly sandy – clayey materials. 7. Mainly clayey materials. 8. No core.	1. Fresh/no alteration 2. Slightly weathered/weak alteration 3. Moderately weathered/alteration 4. Highly weathered/alteration 5. Completely weathered/very high alteration

Table E-1.4 Rock mass classification (by CRIEPI)

Class	Description
A	The rock mass is very fresh, and the rock forming minerals and grains undergo neither weathering nor alteration. Joints are extremely tight and their surfaces have no visible sign of weathering. Sound by hammer blow is clear.
B	The rock mass is solid. There is no opening joint and crack (even of 1 mm). The rock forming minerals and grains undergo a little weathering and/ or alteration in partly. Sound by hammer blow is clear.
CH	The rock mass is relatively solid rock. The rock forming minerals and grains undergo weathering except for quartz. The rock is contaminated by limonite, etc. The cohesion of joints and cracks is slightly decreased and rock blocks are separated by firm hammer blow along joints. Clay minerals remain on the separation surface. Sound by hammer blows a little dim.
CM	The rock mass is somewhat soft. The rock forming minerals and grains are somewhat softened by weathering and/ or alteration except for quartz. The cohesion of joints and cracks is somewhat decreased and rock blocks are separated by ordinary hammer blow along joints. Clay materials on the separation surface. Sound by hammer blows is somewhat dim.
CL	The rock mass is soft. Weathering and/ or alteration softens the rock forming minerals and grains. The cohesion of joints and cracks is decreased and rock blocks are separated by soft hammer blow along joints. Sound by hammer blows is dim.
D	The rock mass is remarkably soft. Weathering and/ or alteration softens the rock forming minerals and grains. The cohesion of joints and cracks is almost absent. The rock mass collapses by light hammer blow. Clay materials remain on the separation surface. Sound by hammer blows is remarkably dim

The sketch was taken in the condition when the core was still fresh and all information is recorded in one standard sheet (core log). The information includes: a). The number of the drilling hole. b). The depth of the drilling hole c). Every line consists of depth position

2) Standard Penetration Test (SPT)

The SPT based on ASTM D1586 was conducted with an interval 1.50 meter until where value of N > 50 blows or reached to bedrock layer. During SPT, the soil samples were taken and kept in plastic sack with information. These N-values were recorded in dolling logs.

For rock layers, value of presentation RQD (Rock Quality Destination) for identifying rock strength was observed and recorded in “geological drilling log".

2) Ground Water Measurement

The depth of ground water level at the drilling hole was measured daily using water level sounding before and after the drilling process and also noted in the log book.

3) Soil Sampling and Laboratory Tests

The samples of the soil taken are disturbed sample (DS) in general. Undisturbed samples (UDS) were taken for some points by using flimsy tube stainless steel with the diameter of 73 mm by depressing it into soil by hydraulics until in 50 cm.

The following laboratory tests were conducted:

a. Specific Gravity for soils (AASHTO T. 100 – 03)
b. Moisture content (AASHTO T. 101 – 00)
c. Grain size Analysis (AASHTO T. 88 - 00)
d. Atterberg Limit (AASHTO T. 89 – 02)

4) Rock Sampling and Laboratory Tests

When reached to rock bed at a shallow depth, the core drilling was continued up to 3 m depth in rock bed. These rock samples were brought to Laboratory for testing.

Figure E-1.1 Mechanical Boring Test

(2) Bridges < 20 m

Static Penetrating Tests (SPT) was carried out to identify the foundation soil classification, the bearing capacity and friction of each layer. Used appliance is Dutch Cone Penetrometer with the capacity of 2.5 ton. Reading was made for the pushing pressure bikonus at every 20 cm with the penetrating speed equal to 1 - 2 cm / second. This test was executed until reaching hard rock, with the cone resistance bigger than 150 Kg / cm2 or until 20 m depth.

The major specifications of Dutch Cone Penetration Test (DCPT) with the capacities 2.5 ton the Adhesion Jacket Cone are as follows:

- Cone Area = 10 cm^2
- Angle of Corner trapeze Cone = 60 degree
- Area of cape Cone Jacket = 150 cm^2
- Area of compressor piston = 10 cm^2

The penetration test points were determined based on the plan of abutment or pier locations to obtain correct profile of soil layers for design of bridge abutments, piers and foundations. Local frictions (fs) were read at a deepness interval of 0.2 m.

Figure E-1.2 Dutch Cone Penetration Test

E-1.3 Investigation Results for Major Bridges

(1) Major Bridges > 100 m

Four major bridges exceeding 100m in length exist on the F/S roads. Since accurate geological information is essential for bridge planning and design, three (3) boring test were carried out for each major bridge.

1) Bridge Number 1-5, Maros Bridge, on Mamminasa Bypass

i) Bore Hole 08 at Left Bank

- In depth 0 – 13.0 m, type of material is clay sand, dark brown reddish, soft, plastic and cohesive. Loose at 0 m – 5 m.
- In depth >13.0 m, type of material is limestone, dark gray color, soft to hard and massive at 12.5 m - 15.0 m.

ii) Bore Hole 09 at River Center (River Bed)

- In depth 0 – 7 m, type of material is clay sand, dark brown reddish, soft, plastic and cohesive. Loose at 0 m – 5 m.
- At deepness > 7m, type of material is limestone, dark gray color, soft to hard and massive at 7.0m – 10.0 m.

iii) Bore Hole 10 at Right Bank

- In depth 0 – 13.0 m, type of material is clay sand, dark brown reddish, soft, plastic and cohesive. Loose at 0 m – 5 m.
- In depth >13.0 m, type of material is limestone, dark gray color, soft to hard and massive at 13.0 m – 15.0 m.

Figure E-1.3 shows boring logs for the above three investigations and a geological cross section for the Maros Bridge site.

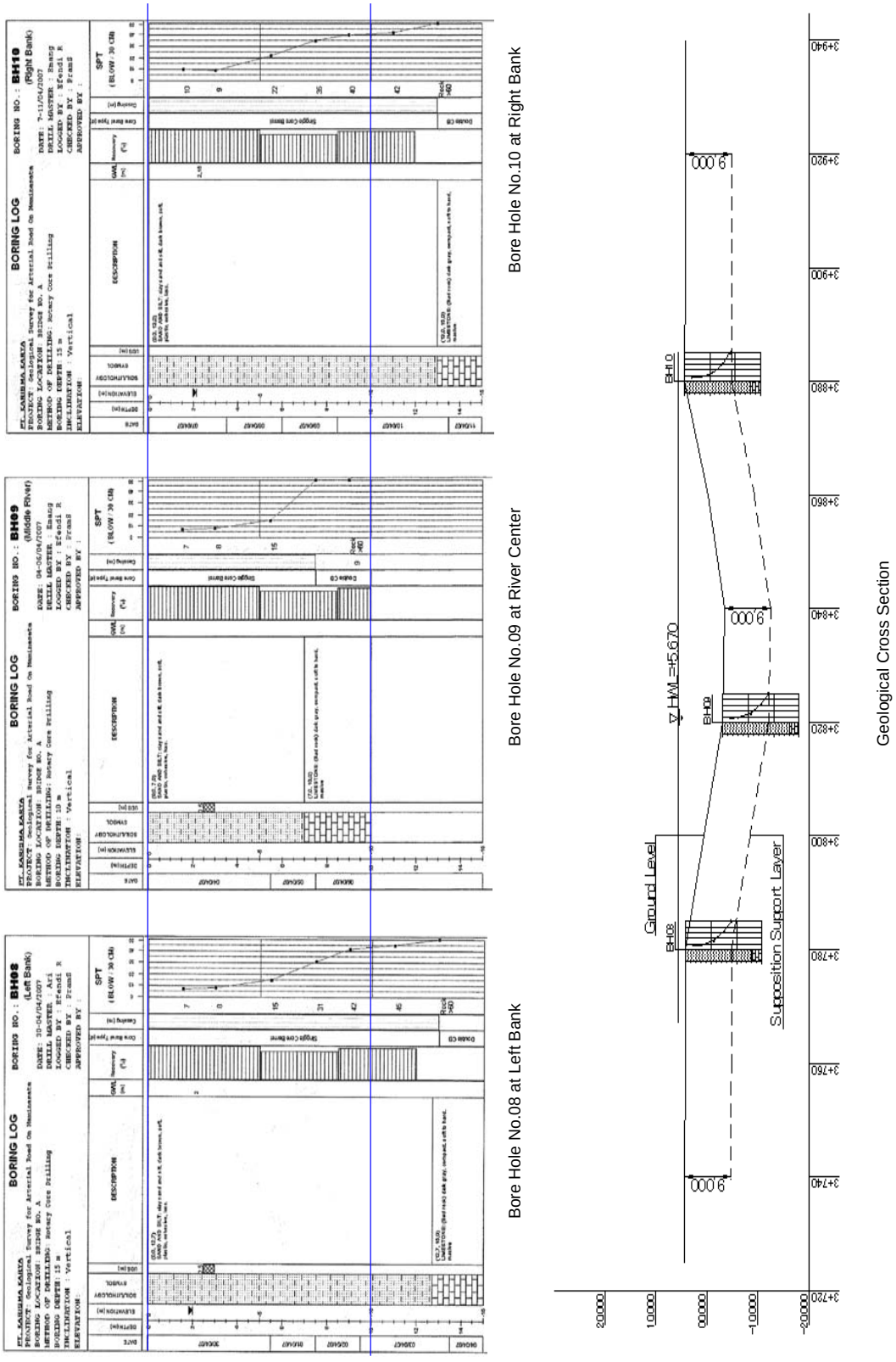


Figure F-1.3 Boring Logs and Geological Cross Section for Maros Bridge on Mamminasa Bypass

Results of laboratory test are follows:

Table E-1.5 Result of Laboratory Test (Maros Bridge)

No.	DESCRIPTION	1	2	3
1.	Sieve Analysis # 4 # 10 # 18 # 40 # 60 # 100 # 200	 97.60 95.85 93.55 90.13 87.83 79.75 64.93	 93.00 77.48 64.50 56.25 54.13 52.10 49.85	 92.13 79.25 67.63 60.50 59.63 58.13 56.50
2.	Water Content (%)	39.53	36.59	31.62
3.	Specific Gravity (gr/cm^3)	2.543	2.559	2,536
4.	Atterberg Limit LL PL PI	 42.12 28.42 13.70	 45.76 31.20 14.56	 45.42 33.52 11.90
5.	UCS Rock Test (kg/cm^2)	274.431	269.05	

Source: JICA Study Team

2) Bridge Number 1-31 (Jeneberang Bridge No.1) on Mamminasa Bypass

i) Bore Hole 01 at Right Bank

- In depth 0 – 1.5 m, represented of top soil, high plasticity, dark brown color, many crop roots, and high consolidation. SPT Value on 1.5 m from ground surface is 12 blows/foot.
- In depth 1.5 – 4.0 m, represented of clay silt, brown color, and high plasticity. SPT Value on this layer t is 38 blows/foot.
- In depth > 4.00 m, represented of a soft to hard soil consist of pebble stone, dark grey color, compact and massive. SPT Value on this layer is 70 blows/foot.

ii) Bore Hole 2 at Left Bank

- In depth 0 – 1.5 m, represented of top soil, dark brown color, many crop roots, high consolidation. SPT Value on 1.5 m from ground surface is 7 blows/foot.
- In depth 1.5 – 6.0 m, represented of clay silt, black color, soft, high plasticity. SPT Value on this layer is 32 blows/foot.
- In depth > 6.0 m, represented of hard soil of pebble stone, dark grey color, compact and uniform. SPT Value on this layer is 60 blows/foot.

iii) Bore Hole 3 at River Center (River Bed)

- In depth 0 – 1.5 meters represented of top soil, dark brown color, many crop roots, high

consolidation. SPT Value on 1.5 meter from ground surface is 7 blows/foot.

- In depth 1.5 – 5.0 m, represented of clay silt, black color, soft, high plasticity. SPT Value on this layer is 25 blows/foot.
- In depth > 5.0 m, represented of hard soil consist of pebble stone, dark grey color, compact and uniform. SPT Value on this layer is 60 blows/foot.

Figure E-1.4 shows boring logs for the above three investigations and a geological cross section for the Jeneberang No.1 Bridge site.

Results of laboratory test are follows:

Table E-1.6 Result of Laboratory Test (Jeneberang No.1 Bridge)

No.	DESCRIPTION	1	2	3
1.	Sieve Analysis # 4 # 10 # 18 # 40 # 60 # 100 # 200	 88.68 66.50 55.18 46.53 42.63 38.40 34.18	 89.70 67.60 56.11 48.52 41.65 38.21 33.98	 91.81 69.76 56.35 45.62 43.77 40.61 34.98
2.	Water Content (%)	67.19	62.42	25.75
3.	Specific Gravity (gr/cm^3)	2.622	2.612	2.631
4.	Atterberg Limit LL PL PI	 55.67 32.19 23.48	 56.21 34.28 21.93	 69.32 42.56 26.76
5.	UCS Rock Test (kg/cm^2)	150.55	152.85	151.80

Source: JICA Study Team

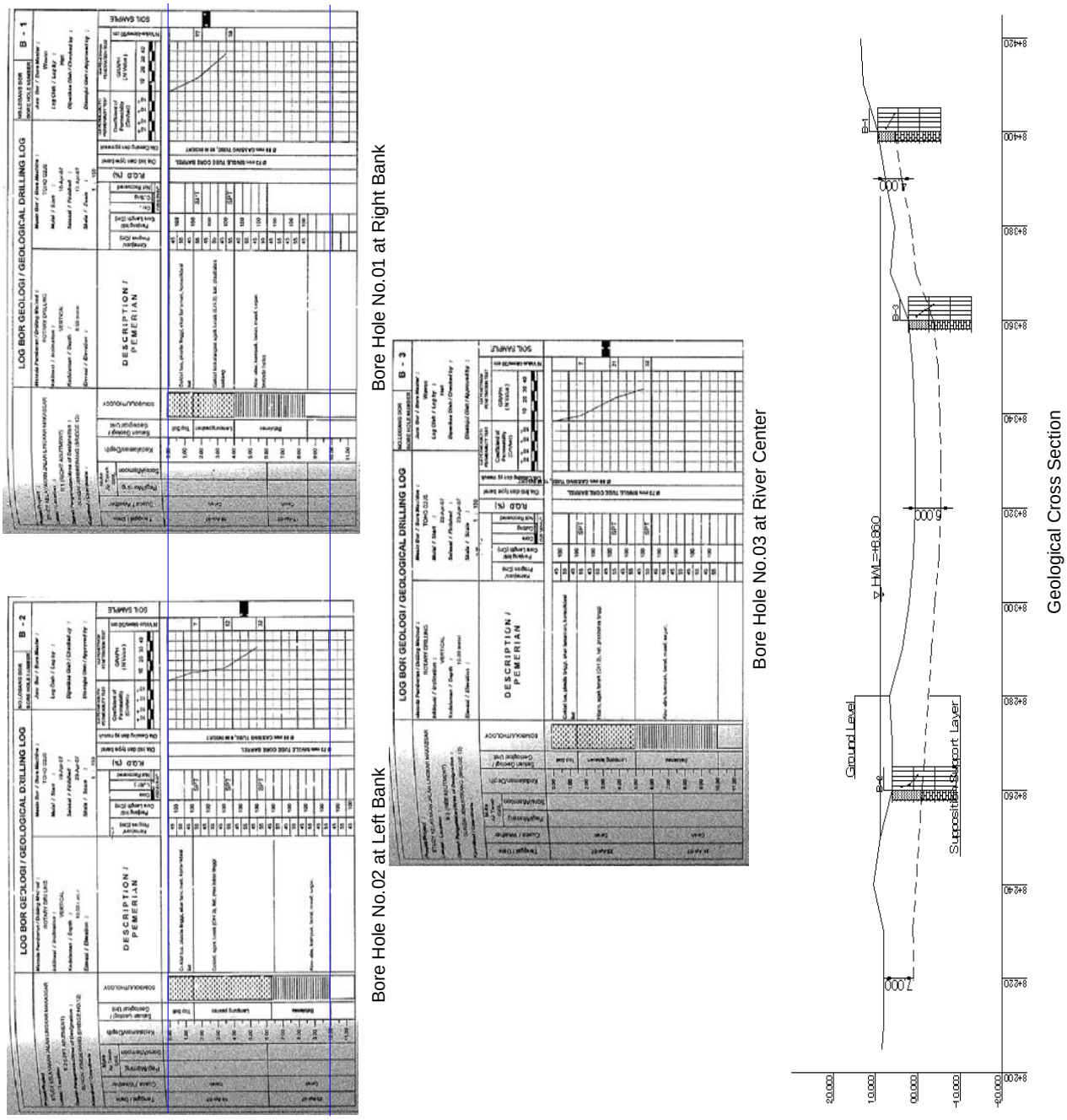


Figure F-1.4 Boring Logs and Geological Cross Section
For Jeneberang No.1 Bridge on Mamminasa Bypass

3) Bridge Number 2-6 (Tallo Bridge) on Trans-Sulawesi Mamminasata Road

i) Bore Hole 13 at Left Bank

- In depth 0 – 4.0 m, represented of top soil, clay sand, dark brown reddish, soft, plastic, cohesive, and loose. SPT Value 4.0 m from ground surface is 40 blows/foot.
- In depth 5.7 -10.0 m, represented of clay stone, dark gray, compact, soft to hard and uniform. SPT Value on 6 meter from ground surface is 50 blows/foot.

ii) Bore Hole 14 at River Bed

- In depth 0 – 3.0 m, represented of top soil and clay sand, dark brown reddish, soft, plastic, cohesive, loose. SPT Value on 3 m from ground surface is 50 blows/foot.
- In depth > 3.0 m, represented of clay stone, dark gray, compact, soft to hard and uniform. SPT Value on 4 m is 50 blows/foot.

iii) Bore Hole 15 at Right Bank

- In depth 0 – 7.5 m, represented of top soil, clay sand, dark brown reddish, soft, plastic, cohesive, loose. SPT Value on 5.0 m from ground surface is 20 blows/foot.
- In depth 7.5 -10.0 m, represented of clay stone, dark gray, compact, soft to hard and uniform. SPT Value on 7.5 m is 50 blows/foot.

Figure E-1.5 shows boring logs for the above three investigations and a geological cross section for the Tallo Bridge site.

Results of laboratory test are follows:

Table E-1.7 Result of Laboratory Test (Tallo Bridge)

No.	DESCRIPTION	1	2	3
1.	Sieve Analysis			
	# 4	99.48	98.95	99.48
	# 10	97.53	96.83	97.53
	# 18	94.13	93.18	94.13
	# 40	84.33	82.38	84.33
	# 60	66.43	63.48	66.43
	# 100	51.93	47.38	51.93
	# 200	41.05	36.23	41.05
2.	Water Content (%)	50.72	52.30	52.69
3.	Specific Gravity (gr/cm^3)	2.495	2.683	2.654
4.	Atterberg Limit			
	LL	52.73	53.14	50.17
	PL	39.02	38.65	38.18
	PI	13.70	14.49	11.99
5.	UCS Rock Test (kg/cm^2)	99.011	99.89	

Source: JICA Study Team

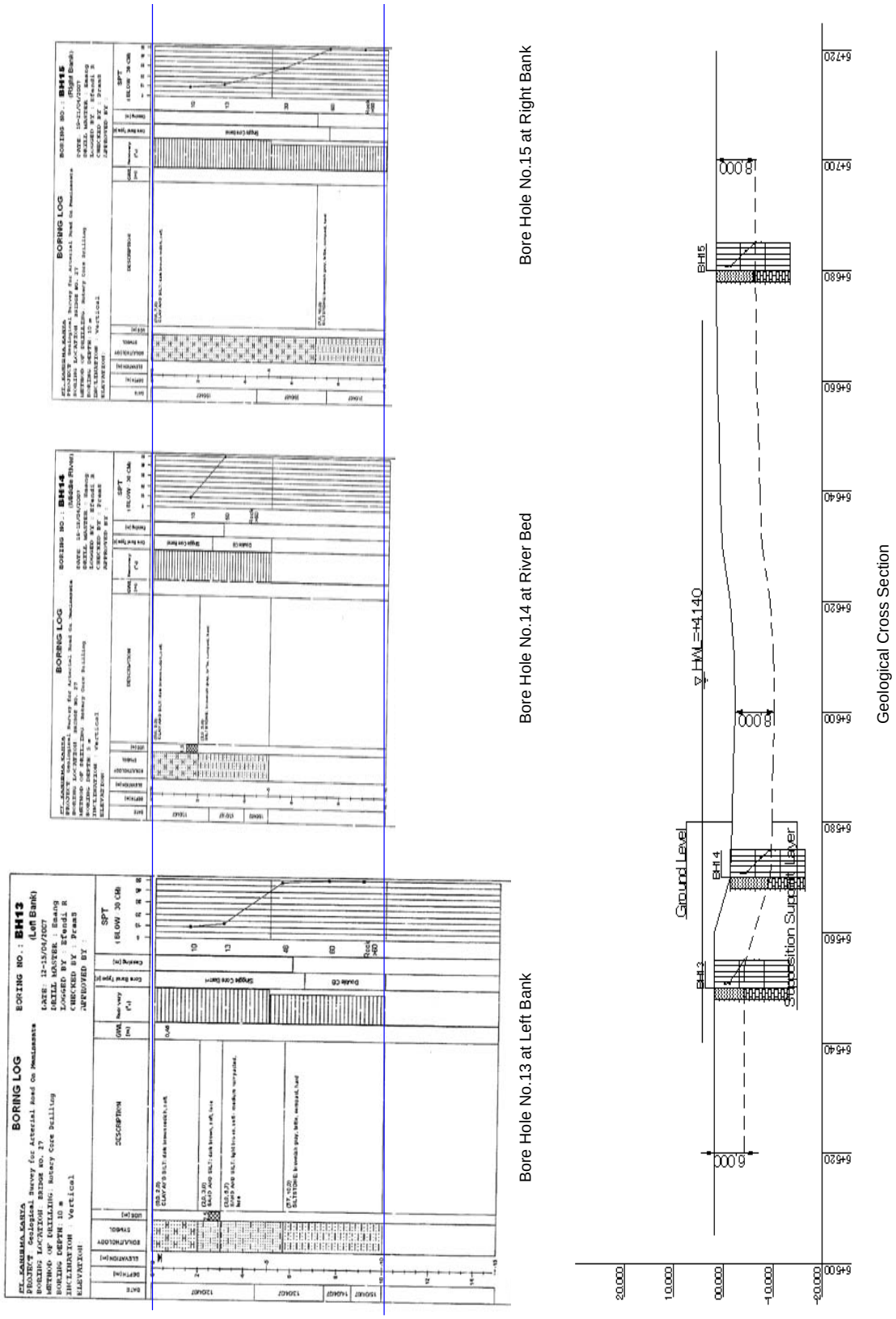


Figure F-1.5 Boring Logs and Geological Cross Section for Tallo Bridge on Trans-Sulawesi Mamminasata Road

4) Bridge Number 2-11 (Jeneberang No.2 Bridge) on Trans-Sulawesi Mamminasata Road

i) Bore Hole 1 at Right Bank

- In depth 0 – 1.5 m, represented of top soil, high plasticity, dark brown color, many crop roots, and high consolidation. SPT Value on 1.5 m from ground surface is 10 blows/foot.
- In depth 1.5 – 6.0 m, represented of clay silt, black color, clay, and high plasticity. SPT Value on this layer is 15 blows/foot.
- In depth 6.0 - 14.0 m, represented of soft to hard soil consist of Pebble stone, dark grey color, compact and uniform. SPT Value on this layer is 41 blows/foot.
- In depth 14.0 m – 23.5 m, represented of soft to hard soil consist of Pebble stone, grey color, compact and uniform. SPT Value on this layer is 50 blows/foot.
- In depth >23.5 m, represented of hard, black, compact and uniform. SPT Value on this layer is 60 blows/foot.

ii) Bore Hole 2 at River Basin

- In depth 0 – 1.5 m, represented of top soil, high plasticity, dark brown color, many crop roots, and high consolidation. SPT Value on 1.5 m from ground surface is 5 blows/foot.
- In depth 1.5 – 6.0 m, represented of clay silt, black color, clay, and high plasticity. SPT Value on this layer is 15 blows/foot.
- In depth 6.0 - 10.0 m, represented of soft to medium hard soil consist of Pebble stone, dark grey color, compact and uniform. SPT Value on this layer is 17 blows/foot.
- In depth 10.0 m – 18.5 m, represented of soft to medium hard soil consist of Pebble stone, grey color, compact and uniform. SPT Value on this layer is 25 blows/foot.
- In depth >27.0 m, represented of hard, black, compact and uniform layer. SPT Value on this layer is 50 blows/foot.

iii) Bore Hole 3 at Left Bank

- In depth 0 – 1.5 m, represented of top soil, high plasticity, dark brown color, many crop roots, and high consolidation. SPT Value on 1.5 m from ground surface is 13 blows/foot.
- In depth 1.5 – 6.5 m, represented of clay silt, black color, clay, and high plasticity. SPT Value on this layer is 13 blows/foot.
- In depth 6.5 - 18.0 m, represented of soft to medium hard soil consist of Pebble stone, dark grey color, compact and massive. SPT Value on this layer is 25 blows/foot.

- In depth 18.0 – 24.0 m, represented of soft to hard soil consist of Pebble stone, grey color, compact and uniform. SPT Value on this layer is 30 blows/foot.
- In depth > 26.0 m, represented of hard, black, compact and uniform layer. SPT Value on this layer is 50 blows/foot.

Figure E-1.6 shows boring logs for the above three investigations and a geological cross section for the Jeneberang No.2 Bridge site.

Results of laboratory test are follows:

Table E-1.8 Result of Laboratory Test (Jeneberang No.2 Bridge)

No.	DESCRIPTION	1	2	3
1.	Sieve Analysis # 4 # 10 # 18 # 40 # 60 # 100 # 200	 98.20 95.08 90.63 84.53 77.33 64.45 44.05	 98.36 94.48 87.54 80.48 72.18 61.69 37.61	 98.54 94.24 88.38 81.84 72.18 59.92 40.96
2.	Water Content (%)	48.67	49.82	48.26
3.	Specific Gravity (gr/cm^3)	2.786	2.657	2.852
4.	Atterberg Limit LL PL PI	 64.96 42.65 22.31	 63.75 41.58 22.17	 66.21 41.55 22.17
5.	UCS Rock Test (kg/cm^2)	160.983	165.50	170.75

Source: JICA Study Team

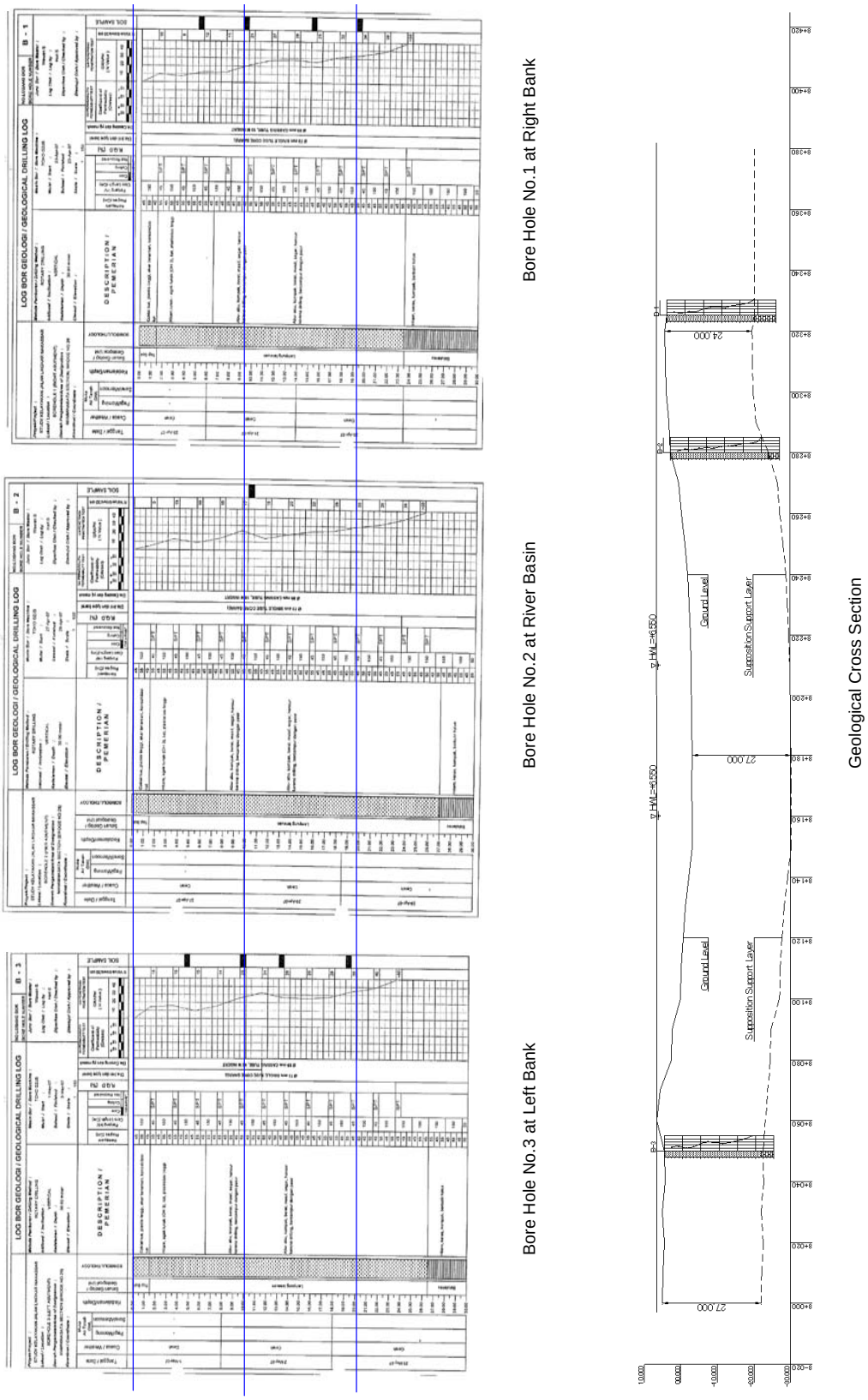


Figure F-1.6 Boring Logs and Geological Cross Section for Jeneberang No.2 Bridge on Trans-Sulawesi Mamminasata Road

(2) Other Bridges > 20 m

1) Bridge Number 1-16 on Ticcekang River (L=25 m), Mamminasa Bypass

i) Bore Hole 1

- In depth 0 – 2.2 m, type of material is clay mixed a little sand, dark brown color, soft consistency, plastic and cohesive. SPT Value on 1.5 m from ground surface is 7 blows/foot.
- In depth > 2.2 m, represented of hard soil consisting of hard clay, dark grey color, compact and uniform. SPT Value on layer is 60 blows/foot.

ii) Bore Hole 2

- In depth 0 – 2.2 m, type of material is clay mixed a little sand, dark brown color, soft consistency, plastic and cohesive. SPT Value on 1.5 m from ground surface is 15 blows/foot.
- In depth > 2.2 m, represented of hard soil consisting of clay stone, dark grey color, compact and massive. SPT Value on this layer is 60 blows/foot.

2) Bridge Number 1-19 on Pahundukang River (L=60 m), Mamminasa Bypass

i) Bore Hole 1

- In depth 0 – 1.5 m, represented of top soil, dark brown color, many crop roots, and high consolidation. SPT Value on 1.5 m from ground surface is 13 blows/foot.
- In depth 1.5 – 6.0 m, represented of clay silt, brown color, medium hard, and high plasticity. SPT Value on this layer is 33 – 40 blows/foot.
- In depth > 8.0 m, represented of a hard soil consisting of Pebble stone, dark grey color, compact and uniform. SPT Value on this layer is 60 blows/foot.

ii) Bore Hole 2

- In depth 0 – 1.5 m, represented of top soil, dark brown color, many crop roots, and high consolidation. SPT Value on 1.5 m from ground surface is 8 blows/foot.
- In depth 1.5 – 8.0 m, represented of clay silt, black color, medium soft, and high plasticity. SPT Value on this layer is 18 – 37 blows/foot.
- In depth > 8.0 m, represented of hard soil consisting of Pebble stone, dark grey color, compact and uniform. SPT Value on this layer is 60 blows/foot.

iii) Bore Hole 3

- In depth 0 – 1.5 m, represented of top soil, dark brown color, many crop roots, and high consolidation. SPT Value on 1.5 m from ground surface that is 17 blows/foot.
- In depth 1.5 – 8.0 m, represented of clay silt, black color, very soft, and high plasticity. SPT Value on this layer is 26 – 40 blows/foot.
- In depth > 8.00 m, represented of hard soil consisting of Pebble stone, dark grey color, compact and uniform. SPT Value on this layer is 60 blows/foot.

3) Bridge Number 1-26 on Kaccikang River (L=25 m), Mamminasa Bypass

i) Bore Hole 1

- In depth 0 – 1.5 m, represented of top soil, dark brown color, many crop roots, and high consolidation. SPT Value on 1.5 m from ground surface is 17 blows/foot.
- In depth 1.5 – 5.5 m, represented of clay silt, brown color, medium soft, and high plasticity. SPT Value on this layer is 23 blows/foot.
- In depth > 5.5 m, represented of hard soil consisting of Pebble stone, dark grey color, compact and uniform. SPT Value on this layer is 60 blows/foot.

ii) Bore Hole 2

- In depth 0 – 1.5 m, represented of top soil, dark brown color, many crop roots, and high consolidation. SPT Value on 1.5 m from ground surface is 18 blows/foot.
- In depth 1.5 – 6.5 m, represented of clay silt, black color, very soft, and high plasticity. SPT Value on this layer is 28 blows/foot.
- In depth > 6.5 m, represented of hard soil consisting of Pebble stone, dark grey color, compact and uniform. SPT Value on this layer is 50 blows/foot.

4) Bridge Number 1-28 Jenemanjalling River (L=16 m), Mamminasa Bypass

i) Bore Hole 1

- In depth 0 – 1.5 m, represented of top soil, high plasticity, dark brown color, many crop roots, and high consolidation. SPT Value on 1.5 m from ground surface is 18 blows/foot.
- I depth 1.5 – 6.2 m, represented of clay silt, black color, clay, and high plasticity. SPT Value on this layer is 25 blows/foot.
- In depth > 6.20 m, represented of hard soil consist of Pebble stone, dark gray color, compact and uniform. SPT Value on this layer is 70 blows/foot.

ii) Bore Hole 2

- In depth 0 – 1.5 m, represented of top soil, high plasticity, dark brown color, many crop roots, and high consolidation. SPT Value on 1.5 m from ground surface is 18 blows/foot.
- In depth 1.5 – 6.5 m, represented of clay silt, black color, medium hard, and high plasticity. SPT Value on this layer is 28 blows/foot.
- In depth > 6.50 m, represented of hard soil consisting of Pebble stone, dark gray color, compact and uniform. SPT Value on this layer is 50 blows/foot.

5) Bridge Number 4-1 (L=35 m), Abdullah Daeng Sirua Road

i) Bore Hole 1

- In depth 0 – 1.5 m, represented of top soil, high plasticity, dark brown color, many crop roots, and high consolidation. SPT Value on 1.50 meter from land surface that is : 15 blows/feet.
- In depth 1.5 – 6.2 m, represented of clay silt, black color, clay, and high plasticity. SPT Value on this layer is 22 blows/foot.
- In depth > 6.2 m, represented of hard soil consisting of Pebble stone, dark gray color, compact and uniform. SPT Value on this layer is 60 blows/foot.

ii) Bore Hole 2

- In depth 0 – 1.5 m, represented of top soil, high plasticity, dark brown color, many crop roots, and high consolidation. SPT Value on 1.5 m from ground surface is 15 blows/foot.
- In depth 1.5 – 6.2 m, represented of clay silt, black color, very soft, and high plasticity. SPT Value on this layer is 22 blows/foot.
- In depth > 6.20 m, represented of hard soil consisting of Pebble stone, dark gray color, compact and uniform. SPT Value on this layer is 50 blows/foot.

6) Bridge Number 4-5 on Tallo River (L=60 m), Abdullah Deng Sirua Road

i) Bore Hole 1

- In depth 0 – 2.0 m, represented of top soil, high plasticity, red brown color, clay, and high consolidation. SPT Value on 1.5 m from ground surface is 30 blows/foot.
- In depth 2.0 – 6.0 m, represented of clay silt, brown color, clay, and high plasticity. SPT Value on this layer is 30 blows/foot.
- In depth 6.0 – 8.5 m, represented of clay silt, brown color, and with some sand. SPT Value

on this layer is 30 blows/foot.

- In depth 8.5 – 10.5m, represented of clay silt, Black color, gravelly, clay. SPT Value on this layer is 30 blows/foot.
- In depth > 10.5 m, represented of soft to hard, stone, and gray color. SPT Value on this layer is 50 blows/foot.

ii) Bore Hole 2

- In depth 0 – 5.0 m, represented of top soil, and dark brown color, Clay. SPT Value on 5.0 meter from land surface is 30 blows/foot.
- In depth 5.0 – 13.0 m, represented of clay, and dark green color. SPT Value on this layer is 50 blows/foot.

7) Bridge Number 3-2 on Tallo River (L=20 m), Hertasning Road

i) Bore Hole 1

- In depth 0 – 1.5 m, represented of top soil, high plasticity, dark brown color, many crop roots, and high consolidation. SPT Value on 1.5 m from ground surface is 12 blows/foot.
- In depth 1.5 – 5.0 m, represented of clay silt, black color, clay, and high plasticity. SPT Value on this layer is 38 blows/foot.
- In depth > 5.0 m, represented of hard soil consist of Pebble stone, dark gray color, compact and uniform. SPT Value on this layer is 50 blows/foot.

ii) Bore Hole 2

- In depth 0 – 1.5 m, represented of top soil, high plasticity, dark brown color, many crop roots, and high consolidation. SPT Value on 1.50 meter from ground surface is 14 blows/foot.
- In depth 1.5 – 6.2 m, represented of clay silt, black color, and high plasticity. SPT Value on this layer is 18 blows/foot.
- In depth > 6.2 m, represented medium hard soil consisting of Pebble stone, dark gray color, compact and uniform. SPT Value on this layer is 40 blows/foot.

8) Bridge Number 2-1 (L=40 m), Trans-Sulawesi Mamminasata Road

i) Bore Hole 1

- In depth 0 – 8.0 m, represented of top soil, clay sand, dark brown reddish, soft, plastic, cohesive, and loose. SPT Value on 5.5 m from ground surface is 15 blows/foot.

- In depth 9.0 – 12.0 m, sandstone , bad rock, dark gray color, compact, medium hard, and non-uniform. SPT Value on this layer is 40 blows/foot.

ii) Bore Hole 2

- In depth 0 – 8.0 m, represented of top soil, clay sand, dark brown reddish, soft, plastic, cohesive, and loose. SPT Value on 5 me from ground surface is 15 blows/foot.
- In depth 9.0 – 12.0 m, sandstone, hard rock, dark gray color, compact, medium hard, and non-uniform (9.0 – 12 m). SPT Value on this layer is 40 blows/foot.

9) Bridge Number 2-2 (L=40m), Trans-Sulawesi Mamminasata Road

i) Bore Hole 1

- In depth 0 – 8.0 m, represented of top soil, clay sand, dark brown reddish, soft, plastic, cohesive, and loose. SPT Value on 8 m from ground surface is 30 blows/foot.
- In depth 8.5 – 12.0 m, limestone, bad rock, dark gray color, compact, hard, and massive.

ii) Bore Hole 2

- In depth 0 – 8.0 m, represented of top soil, clay sand, dark brown reddish, soft, plastic, cohesive, and loose. SPT Value on 8 m from ground surface is 30 blows/foot.
- In depth 8.0 – 12.0 m, limestone, bad rock, dark gray color, compact, hard, and massive.

10) Bridge Number 2-7 (L=50 m), Trans-Sulawesi Mamminasata Road

i) Bore Hole 1

- In depth 0 – 4.0 m, represented of top soil, clay sand, dark brown reddish, soft, plastic, cohesive, and loose. SPT Value on 8 m from ground surface is 10 blows/foot.
- In depth 4.0 -10.0 m, represented of clay stone, dark gray, compact, hard and uniform. SPT Value on 10 m is 50 blows/foot.

ii) Bore Hole 2

- In depth 0 – 4.5 m, represented of top soil, clay sand, dark brown reddish, soft, plastic, cohesive, and loose. SPT Value on 4.5 m from ground surface is 9 blows/foot.
- In depth 4.5 -10.0 m, represented of clay stone, dark gray, compact, hard and uniform. SPT Value on 10 m depth is 50 blows/foot.

11) Bridge Number 2-8 (L=50 m), Trans-Sulawesi Mamminasata Road

i) Bore Hole 1

- In depth 0 – 7.0 m, represented of top soil, clay, and dark brown reddish. SPT Value on 7.0 m from ground surface is 30 blows/foot.
- In depth 7.0 - 9.0 m, represented of clay stone, and dark gray. SPT Value on 9.0 m is 50 blows/foot.
- In depth 9.0 – 13.0 m, represented of clay stone, and dark gray. SPT Value on 13.0 m is 50 blows/foot.

ii) Bore Hole 2

- In depth 0 – 4.0 m, represented of top soil, clay, and dark brown reddish. SPT Value on 4.0 m from ground surface is 30 blows/foot.
- In depth 4.0 - 6.0 m, represented of clay stone and dark gray. SPT Value on 6.0 m 50 blows/foot.
- In depth 6.0 – 13.0 m, represented of clay stone, and dark gray. SPT Value on 13.0 m is 50 blows/foot.

12) Bridge Number 2-9 (L=50 m), Trans-Sulawesi Mamminasata Road

i) Bore Hole 1

- In depth 0 – 7.0 m, represented of top soil, clay, and dark brown reddish. SPT Value on 7.0 m from ground surface is 30 blows/foot.
- In depth 7.0 -9.0 m, represented of clay stone, dark gray. SPT Value on 9.0 m is 50 blows/foot.
- In depth 9.0 – 13.0 m, represented of clay stone, and dark gray. SPT Value on 13.0 m is 50 blows/foot.

ii) Bore Hole 2

- In depth 0 – 4.0 m, represented of top soil, clay, and dark brown reddish. SPT Value on 4.0 m from ground surface is 30 blows/foot.
- In depth 4.0 - 6.0 m, represented of clay stone, and dark gray. SPT Value on 6.0 m is 35 blows/foot.
- In depth 6.0 – 13.0 m, represented of clay stone, and dark gray. SPT Value on 13.0 m is 50 blows/foot.

13) Bridge Number 2-12 on Bayoa River (L=35 m), Trans-Sulawesi Mamminasata Road

i) Bore Hole 1

- In depth 0 – 2.2 m, type of material consists of clay mixed a little sand, dark brown color, soft consistency, plastic and cohesive. SPT Value on 1.5 m from ground surface is 7 blows/foot.
- In depth > 2.2 m, represented of hard soil consisting of clay stone, dark grey color, compact and massive. SPT Value on this layer is 60 blows/foot.

ii) Bore Hole 2

- In depth 0 – 2.2 m, type of material consists of clay mixed a little sand, dark brown color, soft consistency, plastic and cohesive. SPT Value on 1.5 m from ground surface is 15 blows/foot.
- In depth > 2.2 m, represented of hard soil consisting of clay stone, dark grey color, compact and massive. SPT Value on this layer is 60 blows/foot.

iii) Bore Hole 3

- In depth 0 – 2.0 m, type of material consists of clay mixed a little sand, dark brown color, soft consistency, plastic and cohesive. SPT Value on 1.5 m from ground surface is 17 blows/foot.
- In depth > 3.2 m, represented of hard soil consisting of clay stone, dark grey color, compact and massive. SPT Value on this layer is 60 blows/foot.

14) Bridge Number 2-14 on Barombong River (L=20 m), Trans-Sulawesi Mamminasata Road

i) Bore Hole 1

- In depth 0 – 3.2 m, type of material consists of clay mixed a little sand, brownish gray color, soft and consistency. SPT Value on 3.0 meter from ground surface is 15 blows/foot.
- In depth 3.2 – 9.7 m, represented soft to medium hard soil consisting of clay stone, dark grey color, compact and massive. SPT Value on this layer is 19 blows/foot.
- In depth > 9.7 m, represented hard, brownish gray, compact and massive. SPT Value on this layer t is 50 blows/foot.

ii) Bore Hole 2

- In depth 0 – 3.6 m, type of material consists of clay mixed a little sand, brownish gray color, soft and consistency. SPT Value on 3.0 m from ground surface is 10 blows/foot.
- In depth 3.6 – 8.4 m, represented medium hard soil consisting of clay stone, dark grey color,

compact and uniform. SPT Value on this layer is 20 blows/foot.

- In depth > 8.4 m, represented of hard, gray, compact and massive. SPT Value on this layer is 50 blows/foot.

15) Bridge Number 2-18 (L=40 m), Trans-Sulawesi Mamminasata Road

i) Bore Hole 1

- In depth 0 – 1.2 m, type of material consists of clay mixed a little sand, dark brown color, soft, consistency, plastic and cohesive. SPT Value on 1.2 m from ground surface is 8 blows/foot.
- In depth 1.2 - 3.0 m, type of material consists of clay mixed a little sand, gray color and very soft. SPT Value on 3 m from ground surface is 2 blows/foot.
- In depth 3.0 – 8.6 m, type of material consists of clay mixed a little sand, dark gray color, and sandstone. SPT Value on 7 m is 25 blows/foot.

ii) Bore Hole 2

- In depth 0 – 2.0 m, type of material consists of clay mixed a little sand, dark brown color, gray, soft and consistency. SPT Value on 2.0 m from ground surface is 11 blows/foot.
- In depth 2.0 - 6.0 m, type of material consists of clay mixed a little sand, and gray color. SPT Value on 6 m is 25 blows/foot.
- In depth 6.0 – 10.0 m, type of material consists of clay mixed a little sand, and dark gray, and sandstone. SPT Value on 7 m is 10 blows/foot.

iii) Bore Hole 3

- In depth 0 – 3.0 m, type of material consists of clay mixed a little sand, gray, sandstone, soft and consistency. SPT Value on 3.0 m is 25 blows/foot.
- In depth 3.0 - 5.0 m, type of material consists of clay mixed a little sand, and gray color. SPT Value on 4 m is 12 blows/foot.

E-2 Road Alignment Soil Survey

E-2.1 General

The road alignment soil survey was conducted for the four F/S roads. The survey is comprised of test pits excavation for observation and sampling, laboratory tests (CBR, soil classification, etc.) and Dynamic Cone Penetrometer (DCP) tests. The quantity of survey by the F/S roads is summarized in the following stable.

Table E-2.1 List of Soil Survey for the F/S Roads

No.	Name of Roads Section		Length (km)		Quantity		
			Total	Survey	Test Pit	CBR Lab	DCP
1	Mamminasa bypass I		26	26	14	14	82
	II		19	19	11	11	66
2	Trans-Sulawesi Roads Mamminasata Section	Maros - MRR	23	23	12	12	70
		Middle Ring Road	7	5	5	5	22
		MRR - Access	9	9	5	5	25
		MRR Access - Takalar	22	22	10	10	68
3	Hertasning Road		15	8	3	3	25
4	Abdullah Daeng Sirua Road		18	18	8	8	23

E-2.2 Methodology

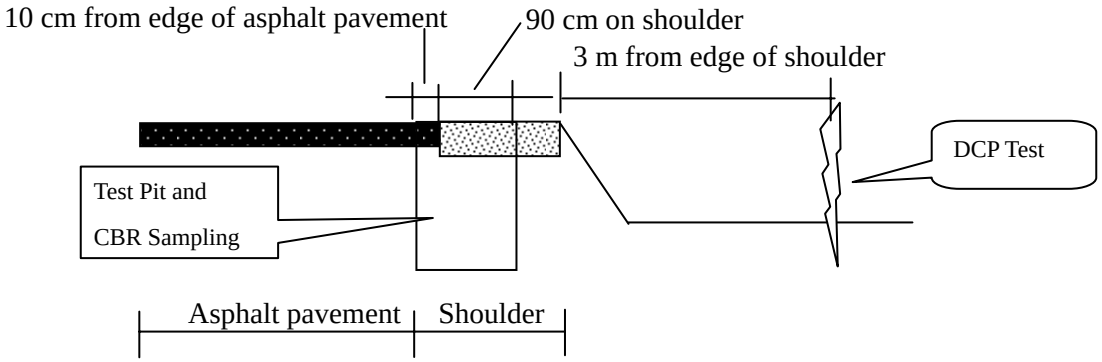
(1) Subgrade Soil Survey

1) General

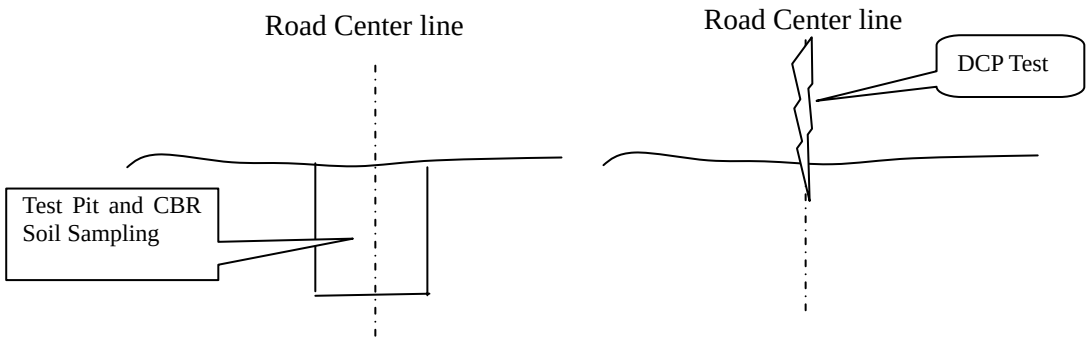
The subgrade survey, including CBR test, DCP test and laboratory test were carried out to obtain the data of sub-soil conditions of the study route. The test pits was excavated at 2 km along the study route and the DCP test was carried out three points per 1 km.

Locations of the test pit and DCP test points are as follows:

i). For road widening



ii). For new road



2) Test Pit Excavation

Location of the test pit is 10 cm outside from the edge of asphalt pavement and dimension is 90 cm square on shoulder for road widening. For new road, test pit is excavated at the centre line of the study road. Minimum size of test pit is 1.0 m x 1.0 m and 1.0 m depth. The test pit is excavated up to subgrade layer. Thickness, type and condition of existing pavement layers and subgrade soil layers were observed and recorded.

3) Undisturbed Sampling for Laboratory CBR Tests

Undisturbed soil was sampled for the CBR test. The CBR mould was pushed into test pit base, and then brought them to Laboratory for testing.

4) Disturbed Sampling for Physical Soil Tests

Sampling for physical soil test is carried out for disturbed soil. The sample is kept in plastic bags, and then brought to laboratory for testing.

5) Laboratory Tests

Laboratory tests consist of:

- Soaked CBR Test (AASHTO T. 193 - 00)
- Specific Gravity Test (AASHTO T. 100 – 03)
- Moisture Content (AASHTO T. 101 – 00)
- Grain Size Analysis (AASHTO T. 88 – 00)
- Atterberg Limit Test (AASHTO T. 89 – 02)

5) Dynamic Cone Penetrometer (DCP)

DCP test, common in Indonesia since year 1985 / 1986, is carried out to know CBR value of subgrade required for pavement design. The test covers up to 100 cm depth of subgrade. Investigation interval is at 300 meters.

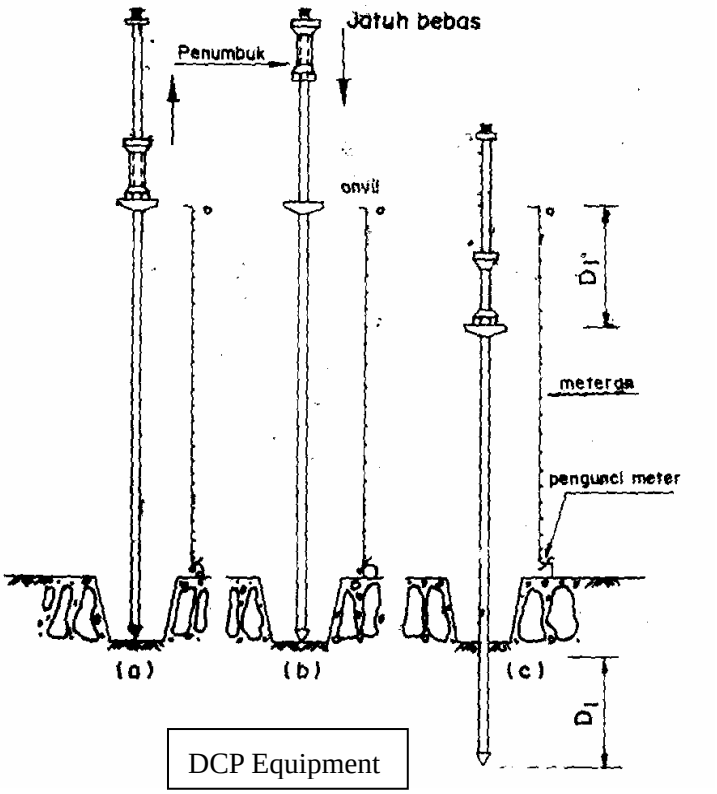
The standard DCP test procedures are as follows:

1. DCP equipment is set out at vertical position at the ground.
2. Measure bar is set out zero (0).
3. Test is started by lifting hammer shift up to top and drop down by gravity. Penetration depth by every blow is recorded.
4. These operations are continued until they meet one of the following criteria:

   - Sum up the penetrating deepness minimum = 100 cm

   - Blow optimum = 40 times to every penetration 5 cm.

Sketch of DCP equipment and operation method is as follows:



DCP Equipment

Result of test is calculated to obtain:

1) Penetratingly is Scale Penetrometer (SPP) expressed in cm / blow

2) Penetrating Resistance Scale (SPR) is number of blow required for 1 cm penetration:

SPR = 1 / SPP

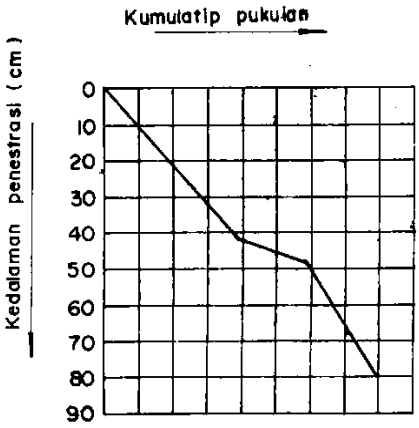


Figure E-2.1 Sample of Graphics Result of DCP Test

Correlation between depths vs. blow sum up of DCP with the CBR values depends on angle of corner cone. There are 2 angle types of angular cone appliance DCP; namely 60^o and 30^o. Correlations are given in the following graphs:

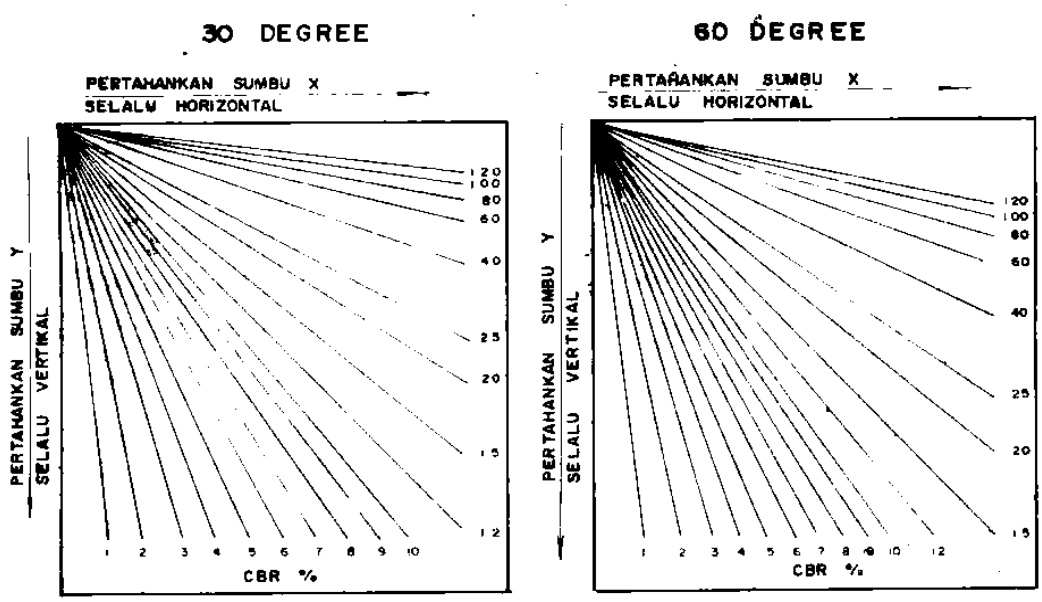


Figure E-2.2 Correlation Graphs between DCP Angle Cone and Field CBR.

Figure E-2.3 DCP Test for Road Widening

Figure E-2.4 DCP Test for New Road

E-2.3 Survey Results of the F/S Roads

(1) Maros – Middle Ring Road (Section A) of Trans-Sulawesi Road

This section is from Maros (Barandasi Village / Km 31+200) to Makassar (Tamalanrea Village / Km. 8+200) with 23 km in length.

Results of subsoil survey for subgrade are as follows:

1) Test Pit Excavation Results

No	Station Point	Layer Thickness (cm)		
		Asphalt	Base	Sub grade
1	0+000	20	45	35
2	2+000	18	62	20
3	4+000	18	52	32
4	6+000	18	52	30
5	8+000	20	50	30
6	10+000	15	45	40
7	12+000	18	52	30
8	14+000	15	55	30
9	16+000	18	52	30
10.	18+000	15	45	40
12.	20+000	15	45	40
13.	22+000	15	45	40

2) Laboratory Test Results

Number of Test Pit					TP 1	TP 2	TP 3	TP 4	TP 5	TP 6	TP 7	TP 8	TP 9	TP 10	TP 11	TP 12
Station					0+000	2+000	4+000	6+000	8+000	10.000	12+000	14+000	16+000	18+000	20+000	22+000
Depth					0.60-0.90	0.60-0.90	0.60-0.90	0.60-0.90	0.60-0.90	0.60-0.90	0.60-0.90	0.60-0.90	0.60-0.90	0.60-0.90	0.60-0.90	0.60-0.90
Description of Soil					Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY
PROPERTIES	1	MOISTURE CONTENT	Wn	%	28.48	34.15	33.80	34.94	31.39	27.62	42.31	48.59	37.97	47.73	49.07	41.04
	2	SPECIFIC GRAVITY	Gs	t / m3	2.607	2.668	2.579	2.545	2.527	2.625	2.55	2.550	2.668	2.548	2.548	2.646
	3	ATTERBERG LIMIT														
	3.1.	Liquid Limit	LL	%	45.20	61.28	52.63	52.46	55.59	44.52	57.51	46.93	58.37	53.31	58.37	59.45
	3.2.	Plastic Limit	PL	%	30.77	51.62	36.34	33.98	41.38	26.23	40.82	33.70	46.48	42.70	46.48	49.44
	3.3.	Plasticity Index	PI	%	14.43	9.66	16.29	18.48	14.21	18.29	16.50	13.23	11.89	10.61	11.89	10.01
	4	GRAINSIZE ANALYSIS														
		% Pass #4		%	99.43	94.25	86.75	99.08	100	88.40	99.90	92.60	99.10	99.50	99.10	94.25
		#10		%	98.55	90.00	76.78	96.95	98.73	86.65	97.53	86.97	96.30	95.30	96.30	90.00
		#18		%	96.55	84.13	71.58	94.53	94.60	83.95	93.55	82.17	89.65	88.37	89.65	84.13
		#40		%	84.18	73.70	65.45	87.50	76.85	72.88	83.30	70.30	71.58	73.57	71.58	73.70
		#60		%	75.90	67.73	60.63	78.63	68.78	63.53	70.05	59.47	60.90	63.20	60.90	67.73
		#100		%	70.03	64.55	55.28	67.58	62.25	56.80	61.68	47.67	51.98	54.07	51.98	64.55
		#200		%	65.30	62.25	50.90	58.40	57.13	52.95	55.80	38.47	44.55	46.17	44.55	62.25
	5	C B R		%	3.18	7.36	3.49	3.18	6.23	3.37	5.72	3.14	17.50	7.43	17.50	3.02

3) Dynamic Cone Penetrometer (DCP) Test Results

POINT NO.	STATION	CBR VALUE (%)	POINT NO.	STATION	CBR VALUE (%)	POINT NO.	STATION	CBR VALUE (%)
1	00+000	0.6	26	08+333	1.1	51	16+666	2.6
2	00+333	0.8	27	08+666	3.9	52	16+999	1.1
3	00+666	0.9	28	08+999	2.0	53	17+333	1.0
4	00+999	0.8	29	09+333	5.0	54	17+666	3.6
5	01+333	0.9	30	09+666	3.5	55	17+999	2.2
6	01+666	5.9	31	09+999	2.1	56	18+333	6.9
7	01+999	6.1	32	10+333	2.1	57	18+666	1.1
8	02+333	5.3	33	10+666	5.2	58	18+999	1.6
9	02+666	5.9	34	10+999	4.4	59	19+333	4.2
10	02+999	1.7	35	11+333	1.7	60	19+666	4.3
11	03+333	1.7	36	11+666	2.0	61	19+999	2.0
12	03+666	1.7	37	11+999	2.6	62	20+333	1.7
13	03+999	2.7	38	12+333	0.8	63	20+666	1.9
14	04+333	3.6	39	12+666	2.0	64	20+999	1.4
15	04+666	2.5	40	12+999	3.8	65	21+333	1.1
16	04+999	6.5	41	13+333	2.0	66	21+666	2.7
17	05+333	4.1	42	13+666	1.2	67	21+999	2.0
18	05+666	0.9	43	13+999	1.6	68	22+333	1.7
19	05+999	4.8	44	14+333	1.2	69	22+666	1.7
20	06+333	1.6	45	14+666	2.1	70	22+999	1.8
21	06+666	1.1	46	14+999	2.4			
22	06+999	2.5	47	15+333	5.2			
23	07+333	2.8	48	15+666	2.3			
24	07+666	2.6	49	15+999	0.8			
25	07+999	2.5	50	16+333	1.7			

(2) Middle Ring Road (Section B) of Trans-Sulawesi Mamminasata Road

This section is from Perintis Kemerdekaan Road (Km. 8+200) to Mallengkeri Terminal (Sultan Alauddin Road). This section is new construction of 7 km in length.

Results of subgrade soil survey are as follows:

1) Test Pit Excavation Results

No	Station Point	Layer Thickness (cm)		
		Layer I	Layer II	Layer III
1	0+000	SILT : 100		
2	2+000	Asphalt : 12	Base : 25	Silt : 63
3	4+000	18	52	32
4	6+000	18	52	30
5	8+000	20	50	30

2) Laboratory Test Results

Number of Test Pit					TP 1	TP 2	TP 3	TP 4	TP 5
Sta					0+000	2+000	4+000	6+000	8+000
Depth					0.60 - 0.90	0.60 - 0.90	0.60 - 0.90	0.60 - 0.90	0.60 - 0.90
Description of Soil					Silty Clay	Silty Clay	Silty Clay	Sandy SILT	Gravelly SAND
PROPERTIES	1	MOISTURE CONTENT	Wn	%	34.51	41.23	25.42	36.34	41.38
	2	SPECIFIC GRAVITY	Gs	t / m3	2.652	2.681	2.530	2.597	2.665
	3	ATTERBERG LIMIT							
	3.1.	Liquid Limit	LL	%	45.12	52.13	34.98	41.28	34.23
	3.2.	Plastic Limit	PL	%	31.9	33.28	25.12	32.87	22.12
	3.3.	Plasticity Index	PI	%	13.22	18.85	9.86	8.41	12.11
	4	GRAINSIZE ANALYSIS							
		% Pass	#4	%	98.13	98.87	98.36	98.70	98.83
			#10	%	95.23	96.13	94.54	96.23	95.54
			#18	%	90.54	90.46	89.93	92.10	89.96
			#40	%	85.12	85.82	83.54	86.46	82.79
			#60	%	78.23	77.89	75.12	78.99	76.85
			#100	%	69.55	70.20	69.49	69.81	68.68
			#200	%	50.95	50.60	50.59	51.24	51.58
	5	C B R	%		3.10	3.18	3.21	3.27	2.98

3) Dynamic Cone Penetrometer (DCP) Test Results

POINT NO.	STATION	CBR VALUE (%)
1	00+000	3.8
2	00+333	swamp
3	00+666	swamp
4	00+999	0.8
5	01+333	3.2
6	01+666	1.6
7	01+999	3.2
8	02+333	2.1
9	02+666	2.1
10	02+999	1.2
11	03+333	7.6
12	03+666	0.6
13	03+999	0.8
14	04+333	1.0
15	04+666	1.0
16	04+999	1.1
17	05+333	0.9
18	05+666	2.1
19	05+999	2.7
20	06+333	2.0
21	06+666	2.0
22	06+999	0.6

(3) Middle Ring Road Access (Section C) of Trans-Sulawesi Mamminasata Road

This section is from Mallengkeri Terminal (Sultan Alauddin Road) to Boka Village on Sungguminasa - Takalar road. This is new road section of 9 km in length. Results of subgrade soil survey are as follows:

1) Test Pit Excavation Results

No	Station Point	Layer Thickness (cm)		
		Layer I	Layer II	Layer III
1	0+000	Top soil, : 20 cm	Clay : 80 cm	
2	2+000	Top soil, : 20 cm	Clay : 80 cm	
3	4+000	Top soil, : 20 cm	Silty Clay : 80 cm	
4	6+000	Top soil, : 20 cm	Silty Clay : 80 cm	
5	8+000	Top soil, : 20 cm	Silty Clay : 80 cm	
6	9+000	Top soil, : 20 cm	Silty Clay : 80 cm	

2) Laboratory Test Results

Number of Test Pit					TP 1	TP 2	TP 3	TP 4	TP 5	TP 6
Stasiun					0+000	2+000	4+000	6+000	8+000	10+000
Depth					0.60 - 0.90	0.60 - 0.90	0.60 - 0.90	0.60 - 0.90	0.60 - 0.90	0.60 - 0.90
Description of Soil					CLAY	CLAY	CLAY	CLAY	CLAY	CLAY
PHYSICAL PROPERTIES	1	MOISTURE CONTENT	Wn	%	53.64	45.22	63.45	34.67	18.97	35.67
	2	SPECIFIC GRAVITY	Gs	t / m3	2.673	2.668	2.551	2.624	2.641	2.54
	3	ATTERBERG LIMIT								
	3.1.	Liquid Limit	LL	%	50.15	65.40	56.58	64.46	54.97	45.72
	3.2.	Plastic Limit	PL	%	28.30	45.81	39.24	46.92	38.73	32.46
	3.3.	Plasticity Index	PI	%	21.85	15.59	17.34	17.54	16.24	13.26
	4	GRAINSIZE ANALYSIS								
		% Pass	#4	%	98.66	98.80	98.16	98.87	98.37	98.20
			#10	%	96.42	95.71	95.34	96.29	93.91	93.65
			#18	%	91.96	90.30	90.75	92.09	88.46	85.45
			#40	%	86.29	85.43	84.67	86.40	83.50	81.05
			#60	%	81.41	81.10	77.82	79.02	77.05	74.56
			#100	%	73.59	72.73	70.22	69.37	68.58	65.58
			#200	%	54.99	53.50	52.12	51.20	51.25	52.35
	5	C B R	%		2.87	2.98	2.76	2.81	3.07	1.87

3) Dynamic Cone Penetrometer (DCP) Test Results

POINT NO.	STATION	CBR VALUE (%)
1	00+000	2.2
2	00+333	1.9
3	00+666	1.5
4	00+999	1.1
5	01+333	1.1
6	01+666	2.6
7	01+999	1.3
8	02+333	2.5
9	02+666	1.7
10	02+999	1.4
11	03+333	1.8
12	03+666	4.5
13	03+999	1.5
14	04+333	4.5
15	04+666	2.5
16	04+999	2.2
17	05+333	2.1
18	05+666	4.0
19	05+999	3.1
20	06+333	1.9
21	06+666	1.3
22	06+999	2.2
23	07+333	2.2
24	07+666	2.5
25	07+999	2.5

(4) Middle Ring Road Access (Boka Village) – Takalar (Section D) of Trans-Sulawesi Mamminasata Road

This section is from Boka Village to Takalar Town. This section is wending of 20 km of the existing national road. Results of subgrade soil survey are as follows:

1) Test Pit Excavation Results

No	Station Point	Layer Thickness (cm)		
		Asphalt	Base	Sub grade
1	0+000	20	40	40
2	2+000	20	40	40
3	4+000	10	35	55
4	6+000	10	20	70
5	8+000	10	20	70
6	10+000	10	20	70
7	12+000	12	20	68
8	14+000	20	20	60
9	16+000	20	20	60
10.	18+000	15	20	65

2) Laboratory Test Result

Number of Test Pit					TP 1	TP 2	TP 3	TP 4	TP 5	TP 6	TP 7	TP 8	TP 9	TP 10
Stasiun					0+000	2+000	4+000	6+000	8+000	10+000	12+000	14+000	16+000	18+000
Depth					0.60 - 0.90	0.60 - 0.90	0.60 - 0.90	0.60 - 0.90	0.60 - 0.90	0.60 - 0.90	0.60 - 0.90	0.60 - 0.90	0.60 - 0.90	0.60 - 0.90
Description of Soil					CLAY	CLAY	CLAY	CLAY	CLAY	CLAY	CLAY	CLAY	CLAY	CLAY
PHYSICAL PROPERTIES	1	MOISTURE CONTENT	Wn	%	34.51	41.23	25.42	36.34	41.38	45.32	33.21	31.62	34.12	25.34
	2	SPECIFIC GRAVITY	Gs	t / m3	2.63	2.56	2.62	2.53	2.67	2.54	2.67	2.53	2.61	2.63
	3	ATTERBERG LIMIT												
	3.1.	Liquid Limit	LL	%	45.12	52.13	34.98	41.28	34.23	45.72	32.18	43.12	NP	NP
	3.2.	Plastic Limit	PL	%	31.9	33.28	25.12	32.87	22.12	31.25	22.17	23.98	NP	NP
	3.3.	Plasticity Index	PI	%	13.22	18.85	9.86	8.41	12.11	14.47	10.01	19.14	NP	NP
	4	GRAINSIZE ANALYSIS												
		Gravel		%	23.86	18.95	34.21	20.88	25.48	28.90	32.89	43.25	32.55	54.28
		Sand		%	65.82	70.43	60.75	69.88	71.25	67.85	56.75	49.85	65.10	42.88
		Silt - Clay		%	10.32	10.62	5.04	9.24	3.27	3.25	10.36	6.9	2.35	2.84
	5	C B R	%		0.85	0.82	0.75	0.95	0.88	0.85	0.95	0.78	0.9	0.96

3) Dynamic Cone Penetrometer (DCP) Test Results

POINT NO.	STATION	CBR VALUE (%)	POINT NO.	STATION	CBR VALUE (%)	POINT NO.	STATION	CBR VALUE (%)
1	00+000	1.9	27	08+666	2.2	53	17+333	2.0
2	00+333	1.8	28	08+999	2.0	54	17+666	1.3
3	00+666	2.7	29	09+333	2.0	55	17+999	1.9
4	00+999	1.8	30	09+666	1.8	56	18+333	0.8
5	01+333	1.8	31	09+999	3.3	57	18+666	2.0
6	01+666	3.2	32	10+333	2.2	58	18+999	1.7
7	01+999	3.1	33	10+666	1.8	59	19+333	2.5
8	02+333	1.8	34	10+999	1.9	60	19+666	2.8
9	02+666	3.6	35	11+333	1.7	61	19+999	3.1
10	02+999	3.2	36	11+666	0.9	62	20+333	5.2
11	03+333	1.9	37	11+999	4.1	63	20+666	2.8
12	03+666	0.8	38	12+333	2.1	64	20+999	0.8
13	03+999	1.9	39	12+666	1.8	65	21+333	2.8
14	04+333	2.9	40	12+999	2.7	66	21+666	2.0
15	04+666	2.4	41	13+333	1.0	67	21+999	2.0
16	04+999	3.0	42	13+666	1.3	68	22+333	1.8
17	05+333	2.2	43	13+999	2.7	69	22+666	2.0
18	05+666	1.3	44	14+333	2.5	70	22+999	2.0
19	05+999	1.6	45	14+666	2.2	71	21+333	1.1
20	06+333	0.8	46	14+999	0.8	72	21+666	2.7
21	06+666	1.8	47	15+333	1.8	73	21+999	2.0
22	06+999	1.9	48	15+666	2.1	74	22+333	1.7
23	07+333	1.9	49	15+999	1.7	75	22+666	1.7
24	07+666	1.8	50	16+333	1.8	76	22+999	1.8
25	07+999	2.2	51	16+666	1.8			
26	08+333	1.4	52	16+999	1.7			

(5) Mamminasa Bypass I

This section is from Maros (Barandasi Village / Km 31+200) to Romang River at Paccelekang in Kabupaten Gowa. Section length is 26 km and new road construction. Results of subgrade soil survey are as follows:

1) Test Pit Excavation

No	Station Point	Layer Thickness (cm)		
		Layer I	Layer II	Layer III
1	0+000	Top soil silty sand 25 cm	Silty : 15 cm	Silty clay : 60 cm
2	2+000	Top soil silty sand 40 cm	Silty : 60 cm	
3	4+000	Top soil, silty sand 40 cm	Clay : 20 cm	Silty clay : 40 cm
4	6+000	Top soil, silty sand 40 cm	Clay : 20 cm	Silty clay : 40 cm
5	8+000	Top soil, silty sand 40 cm	Clay : 30 cm	Silty clay :30 cm
6	10+000	Top soil, silty sand 25 cm	Clay : 15 cm	Silty clay :65 cm
7	12+000	Top soil, silty sand 25 cm	Clay : 15 cm	Silty clay :65 cm
8	14+000	Top soil, silty sand 25 cm	Clay : 15 cm	Silty clay :65 cm
9	16+000	Top soil, silty sand 40 cm	Clay : 30 cm	Silty clay :30 cm
10	18+000	Top soil, silty sand 35cm	Clay : 70 cm	
11	20+000	Top soil, silty sand 40 cm	Clay : 60 cm	
12	22+000	Top soil, silty sand 40 cm	Clay : 60 cm	
13	24+000	Top soil, silty sand 25 cm	Clay : 75 cm	
14	26+000	Top soil, silty sand 30 cm	Clay : 70 cm	

2) Laboratory Test Results

Number of Test Pit					TP 1	TP 2	TP 3	TP 4	TP 5	TP 6	TP 7	TP 8	TP 9	TP 10	TP 11	TP 12	TP 13
Station					2+000	4+000	8+000	10+000	12+000	14+000	16+000	18+000	20+000	22+000	24+000	26+000	28+000
Depth					0.60-0.90	0.60-0.90	0.60-0.90	0.60-0.90	0.60-0.90	0.60-0.90	0.60-0.90	0.60-0.90	0.60-0.90	0.60-0.90	0.60-0.90	0.60-0.90	0.60-0.90
Description of Soil					Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY
PHYSICAL PROPERTIES	1	MOISTURE CONTENT	Wn	%	41.3	40.28	45.62	32.87	40.36	31.65	60.92	21.04	38.25	32.28	48.29	45.12	58.19
	2	SPECIFIC GRAVITY	Gs	t / m3	2.546	2.570	2.505	2.624	2.697	2.64	2.546	2.652	2.58	2.64	2.610	2.580	2.56
	3	ATTERBERG LIMIT															
	3.1.	Liquid Limit	LL	%	44.35	49.47	65.14	27.23	51.85	47.23	67.23	36.03	NP	62.13	55.23	45.34	54.23
	3.2.	Plastic Limit	PL	%	28.72	34	34.95	21.57	41.72	37.97	46.98	24.55	NP	23.48	34.12	21.85	31.28
	3.3.	Plasticity Index	PI	%	15.62	15.47	30.19	5.66	10.13	9.25	20.25	11.49	NP	38.65	21.11	23.49	22.95
	4	GRAINSIZE ANALYSIS															
		%pass	# 4		94.68	95.23	97.63	99.1	99.73	78.18	100.00	67.00	100.00	87.56	86.51	98.56	89.47
			# 10		87.43	89.2	92.43	96.85	97.68	57.90	99.17	50.88	98.52	72.51	72.43	84.81	76.55
			# 18		82.08	82.83	84.9	94.85	90.78	53.63	95.63	41.95	96.24	60.23	61.11	76.63	64.23
			# 40		76.95	69.25	74.05	92	74.53	51.83	74.83	35.13	72.14	51.46	59.22	62.41	51.68
			# 60		72.93	61.7	69.7	89.63	65.1	48.80	55.57	31.83	56.25	44.58	48.21	52.12	40.85
			# 100		65.58	57.03	66.95	80.23	58.23	45.43	43.3	28.70	45.25	38.45	38.39	40.57	32.11
			# 200		55.45	53.65	65.13	55.35	53.23	42.18	35.65	25.33	36.25	24.56	27.48	29.88	21.69
	5	C B R	%		3.28	3.49	3.49	3.9	3.44	6.77	11.94	2.93	0.42	0.33	0.25	0.41	0.32

3) Dynamic Cone Penetrometer (DCP) Test Results

POINT NO.	STATION	CBR VALUE (%)	POINT NO.	STATION	CBR VALUE (%)	POINT NO.	STATION	CBR VALUE (%)
1	00+000	0.6	29	08+280	2.8	57	17+333	1.1
2	00+320	2.0	30	08+560	1.8	58	17+666	2.3
3	00+575	4.5	31	08+900	0.8	59	17+999	1.9
4	00+700	4.9	32	09+210	0.8	60	18+333	2.0
5	01+020	1.2	33	09+340	0.8	61	18+666	2.1
6	01+340	5.0	34	09+720	2.4	62	18+999	0.8
7	01+900	2.5	35	10+050	2.0	63	19+333	2.1
8	02+340	4.7	36	10+360	1.3	64	19+666	4.5
9	02+600	3.9	37	10+700	1.6	65	19+999	2.4
10	02+930	2.6	38	11+080	1.2	66	20+333	2.9
11	03+260	4.8	39	11+480	1.5	67	20+666	1.4
12	03+580	4.1	40	11+780	3.8	68	20+999	3.4
13	03+700	1.3	41	12+000	4.9	69	21+333	2.5
14	03+880	1.5	42	12+340	0.8	70	21+666	2.6
15	04+000	2.0	43	12+680	0.5	71	21+999	2.0
16	04+300	3.9	44	13+000	0.5	72	22+333	2.8
17	04+600	2.9	45	13+360	2.0	73	22+666	2.0
18	05+000	1.2	46	13+640	1.8	74	22+999	1.9
19	05+330	0.9	47	13+960	0.8	75	24+333	2.4
20	05+520	1.5	48	14+300	1.2	76	24+666	2.1
21	05+800	2.0	49	14+640	0.9	77	24+999	2.1
22	06+140	2.1	50	14+990	2.1	78	25+333	3.1
23	06+480	1.2	51	15+340	1.3	79	25+666	3.0
24	06+780	1.8	52	15+640	0.6	80	25+999	2.4
25	07+100	1.7	53	15+960	0.8	81	26+333	2.5
26	07+320	1.8	54	16+333	1.3	82	26+666	0.5
27	07+680	1.2	55	16+666	0.9			
28	07+960	2.5	56	16+999	0.7			

(6) Mamminasa ByPass II

This section is from Boka Village to Romang River at Paccelekang in Kabupaten Gowa. Length is 26 km and new construction.

Results of subgrade soil survey are as follows:

1) Test Pit Excavation Results

No	Station Point	Layer Thickness (cm)		
		Layer I	Layer II	Layer III
1	0+000	Top soil silty sand 40 cm	Silty : 60 cm	
2	2+000	Top soil sandy silty 30 cm	Silty : 10 cm	Clayey silt : 60 cm
3	4+000	Top soil sandy silty 30 cm	Silty : 10 cm	Clayey silt : 60 cm
4	6+000	Top soil sandy silty 30 cm	Clayey silt : 70 cm	
5	8+000	Top soil sandy silty 40 cm	Clayey silt : 60 cm	
6	10+000	Top soil sandy silty 40 cm	Clayey silt : 60 cm	
7	12+000	Top soil sandy silty 40 cm	Clayey silt : 60 cm	
8	14+000	Top soil sandy silty 40 cm	Clayey silt : 60 cm	
9	16+000	Top soil sandy silty 40 cm	Clayey silt : 60 cm	
10	18+000	Top soil sandy silty 40 cm	Clayey silt : 50 cm	Clay : 10 cm
11	20+000	Top soil sandy silty 40 cm	Clayey silt : 60 cm	

2) Laboratory Test Results

Number of Test Pit					TP 1	TP 2	TP 3	TP 4	TP 5	TP 6	TP 7	TP 8	TP 9	TP 10	TP 11
Station					0+000	2+000	4+000	6+000	8+000	10+000	12+000	14+000	16+000	18+000	20+000
Depth					0.60-0.90	0.60-0.90	0.60-0.90	0.60-0.90	0.60-0.90	0.60-0.90	0.60-0.90	0.60-0.90	0.60-0.90	0.60-0.90	0.60-0.90
Description of Soil					Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY
PHYSICAL PROPERTIES	1	MOISTURE CONTENT	Wn	%	58.150	42.120	48.290	32.280	38.250	52.120	45.950	42.140	43.550	40.200	59.280
	2	SPECIFIC GRAVITY	Gs	t / m3	2.56	2.580	2.610	2.64	2.58	2.67	2.62	2.63	2.58	2.64	2.62
	3	ATTERBERG LIMIT													
	3.1.	Liquid Limit	LL	%	42.69	56.58	61.23	64.2	59.92	55.81	55.42	49.32	50.13	44.16	61.14
	3.2.	Plastic Limit	PL	%	20.31	39.15	28.53	37.16	21.45	38.93	32.12	31.29	27.89	34.24	23.65
	3.3.	Plasticity Index	PI	%	25.97	17.42	32.69	27.05	38.47	16.88	23.3	18.03	22.23	9.92	37.49
	4	GRAINSIZE ANALYSIS													
		Gravel		%	12.85	1.50	10.66	5.65	0	0.00	0.00	3.12	0.00	0.00	0.00
		Sand		%	15.89	12.85	21.89	15.56	8.78	5.12	2.65	5.75	5.25	1.65	14.56
		Silt - Clay		%	71.26	85.65	67.45	78.79	91.22	94.88	97.35	91.13	94.75	98.35	85.44
	5	C B R		%	5.98	6.85	7.01	5.18	5.02	6.08	5.85	6.03	6.18	5.99	6.18

3) Dynamic Cone Penetrometer (DCP) Test Results

POINT NO.	STATION	CBR VALUE (%)	POINT NO.	STATION	CBR VALUE (%)
1	00+000	2.5	34	10+999	2.1
2	00+333	2.0	35	11+333	3.0
3	00+666	3.1	36	11+666	4.0
4	00+999	2.0	37	11+999	1.8
5	01+333	3.2	38	12+333	2.0
6	01+666	2.8	39	12+666	1.0
7	01+999	1.8	40	12+999	1.1
8	02+333	1.4	41	13+333	0.8
9	02+666	2.0	42	13+666	2.3
10	02+999	1.6	43	13+999	2.0
11	03+333	2.0	44	14+333	1.8
12	03+666	2.2	45	14+666	3.0
13	03+999	2.8	46	14+999	2.2
14	04+333	1.3	47	12+999	1.1
15	04+666	1.0	48	13+333	0.8
16	04+999	1.8	49	13+666	2.3
17	05+333	0.8	50	13+999	2.0
18	05+666	0.8	51	14+333	1.8
19	05+999	1.7	52	14+666	3.0
20	06+333	1.8	53	14+999	2.2
21	06+666	1.9	54	15+333	2.4
22	06+999	2.7	55	15+666	2.4
23	07+333	1.7	56	15+999	1.7
24	07+666	1.9	57	16+333	2.2
25	07+999	2.0	58	16+666	1.8
26	08+333	1.8	59	16+999	3.3
27	08+666	2.7	60	17+333	2.6
28	08+999	1.0	61	17+666	2.8
29	09+333	1.0	62	17+999	4.6
30	09+666	1.7	63	18+333	2.1
31	09+999	2.3	64	18+666	1.9
32	10+333	1.8	65	18+333	2.1
33	10+666	2.0	66	18+666	1.9

(7) Abudullah Daeng Sirua Road

This section is from A.P. Pettarani Road to Mamminasa Bypass at Paccelekang in Kabupaten Gowa. Length is 18 km (new construction or widening). Results of subgrade soil survey are as follows:

1) Test Pit Excavation Results

No	Station Point	Layer Thickness (cm)		
		Layer I	Layer II	Layer III
1	0+000	Asphalt : 20 cm	Base : 30 cm	Gravel : 50 cm
2	6+000	Asphalt : 10 cm	Base : 30 cm	Gravel : 60 cm
3	8+000	Asphalt : 10 cm	Base : 30 cm	Silt : 60 cm
4	10+000	Sandy gravel : 20 cm	Sandy silt : 80 cm	
5	12+000	Sandy gravel : 20 cm	Clay : 20 cm	Sandy silt : 60 cm
6	14+000	Top soil 20 cm	Clayey silt : 80 cm	
7	16+000	Top soil 20 cm	Clayey silt : 80 cm	
8	18+000	Top soil 20 cm	Clayey silt : 80 cm	

2) Laboratory Test Results

Number of Test Pit					TP 1	TP 2	TP 3	TP 4	TP 5	TP 6	TP 7	TP 8
Station					0+000	6+000	8+000	10+000	12+000	14+000	16+000	18+000
Depth					0.60 - 0.90	0.60 - 0.90	0.60 - 0.90	0.60 - 0.90	0.60 - 0.90	0.60 - 0.90	0.60 - 0.90	0.60 - 0.90
Description of Soil					CLAY	CLAY	CLAY	CLAY	CLAY	CLAY	CLAY	CLAY
PHYSICAL PROPERTIES	1	MOISTURE CONTENT	Wn	%	33.605	42.345	27.255	35.360	43.135	33.605	42.345	27.255
	2	SPECIFIC GRAVITY	Gs	t / m3	2.673	2.636	2.655	2.522	2.663	2.671	2.684	2.635
	3	ATTERBERG LIMIT										
	3.1.	Liquid Limit	LL	%	42.69	56.58	61.23	64.2	59.92	55.81	55.42	49.32
	3.2.	Plastic Limit	PL	%	26.31	39.15	38.53	47.16	38.47	38.93	32.12	31.29
	3.3.	Plasticity Index	PI	%	16.38	17.43	22.7	17.04	21.45	16.88	23.3	18.03
	4	GRAINSIZE ANALYSIS										
		Gravel		%	34.85	65.15	10.85	25.65	18.92	0	0	5.1
		Sand		%	55.28	34.12	5.19	38.19	56.98	7.54	21.87	10.05
		Silt - Clay		%	9.87	0.73	83.96	36.16	24.1	92.46	78.13	84.85

3) Dynamic Cone Penetrometer (DCP) Test Results

POINT NO.	STATION	CBR VALUE (%)	POINT NO.	STATION	CBR VALUE (%)
1	00+000	2.0	29	09+333	2.0
2	00+333	3.7	30	09+666	2
3	00+666	5.8	31	09+999	1.2
4	00+999	12.8	32	10+333	1.6
5	01+333	8.8	33	10+666	3.2
6	01+666	2.2	34	10+999	4.9
7	01+999	0.8	35	11+333	1.6
8	02+333	3.0	36	11+666	1.7
9	02+666	0.8	37	11+999	1.7
10	02+999	0.9	38	12+333	1.2
11	03+333	1.1	39	12+666	2.1
12	03+666	5.1	40	12+999	2.0
13	03+999	4.9	41	13+333	2.0
14	04+333	8.0	42	13+666	2.0
15	04+666	1.8	43	13+999	7.9
16	04+999	3.9	44	14+333	2.0
17	05+333	3.2	45	14+666	1.8
18	05+666	2.8	46	14+999	2.1
19	05+999	6.0	47	15+333	3.1
20	06+333	8.9	48	15+666	1.8
21	06+666	1.6	49	15+999	2.0
22	06+999	1.5	50	16+333	2.4
23	07+333	2.0	51	16+666	4.3
24	07+666	2.4	52	16+999	2.2
25	07+999	2.7	53	17+333	1.2
26	08+333	2.1	54	17+666	1.3
27	08+666	3.2	55	17+999	1.3
28	08+999	2.9			

(8) Hertasning Road (Section D)

This section is from A.P. Pettarani Road to Mamminasa Bypass at Samata in Kabupaten Gowa. Length is 26 km and existing road widening. Results of subgrade soil survey are as follows:

1) Test Pit Excavation Results

No	Station Point	Layer Thickness (cm)		
		Layer I	Layer II	Layer III
1	2+000	Asphalt : 20 cm	Base : 30 cm	Gravel : 50 cm
2	4+000	Asphalt : 15 cm	Base : 15 cm	Gravel : 70 cm
3	6+000	Asphalt : 15 cm	Base : 50 cm	Clay : 40 cm

2) Laboratory Test Results

Number of Test Pit					TP 1	TP 2	TP 3
STATION					2+000	4+000	6+000
Depth					0.60 mtr - 0.90 mtr	0.60 mtr - 0.90 mtr	0.60 mtr - 0.90 mtr
Description of Soil					Sandy GRAVEL	Silty CLAY	Silty CLAY
PHYSICAL PROPERTIES	1	MOISTURE CONTENT	Wn	%	31.820	47.590	44.320
	2	SPECIFIC GRAVITY	Gs	t / m3	2.675	2.657	2.637
	3	ATTERBERG LIMIT					
	3.1.	Liquid Limit	LL	%	44.53	53.99	34.47
	3.2.	Plastic Limit	PL	%	32.06	32.26	24.79
	3.3.	Plasticity Index	PI	%	12.47	21.73	9.69
	4	GRAINSIZE ANALYSIS					
		Gravel		%	54.786	2.142	25.856
		Sand		%	42.769	2.756	2.431
		Silt - Clay		%	2.445	95.102	71.713
		Gravel		%			
	5	C B R	%		1.51	1.91	1.8

2) Dynamic Cone Penetrometer (DCP) Test Results

POINT NO.	STATION	CBR VALUE (%)
1	00+000	2.4
2	00+333	1.1
3	00+666	8.0
4	00+999	11.0
5	01+333	3.2
6	01+666	2.0
7	01+999	2.8
8	02+333	2.6
9	02+666	6.1
10	02+999	2.0
11	03+333	1.8
12	03+666	1.1
13	03+999	10.0
14	04+333	1.3
15	04+666	1.6
16	04+999	5.0
17	05+333	6.0
18	05+666	2.8
19	05+999	2.0
20	06+333	1.3
21	06+666	2.0
22	06+999	1.6
23	07+333	2.6
24	07+666	2.7
25	07+999	1.2

E-3 Road Construction Material Investigation

E-3.1 General

Construction material source survey was carried out to obtain information on available materials for road construction for coarse aggregate, fine aggregate and borrow soil. The JICA Study Team identified several material sources near the F/S roads.

E-3.2 Methodology

(1) Investigation for Possible Material Sources

1) General

Possible material sources for road and bridge construction such as quarry, river bed, sand pit and borrow pit are investigated in consideration of the project locations and environments. Site observation, sampling, recording, laboratory tests and available quantity estimate are made by material source.

Figure E-3.1 Sandy Gravel Quarry

Figure E-3.2 Sand Quarry

Figure E-3.3 Borrow Soil Material Quarry

2) Sampling and tested for Coarse Aggregate

Sampling of the coarse aggregate materials (sandy gravel) was made at river bed and sent to laboratory for testing.

Laboratory tests for the coarse aggregate consist of:

- Sieve Analysis (AASHTO T27 – 99)
- Specific Gravity and Absorption (AASHTO T85 – 91)
- Los Angeles Aberration Test (AASHTO T96 – 02)
- Sodium Soleplate Soundness (AASHTO T 104 – 99)
- Flakiness Index (BS 812 Section 105.1 - 1989)
- Potential Alkali-Silica Reactivity (ASTM C – 289)

3) Sampling and Tested for Fine Aggregate

Sampling of the fine aggregate materials (sand) was conducted at sand quarries and the following laboratory tests were made:

- Sieve Analysis (AASHTO T27 – 99)
- Specific Gravity and Absorption (AASHTO T84 – 00)
- Organic impurities (AASHTO T21 – 00)
- Sand Equivalent (AASHTO T 176 – 02)
- Sodium Soleplate Soundness (AASHTO T 104 – 99)
- Potential Alkali-Silica Reactivity (ASTM C – 289)

4) Laboratory Test for Borrow Soils.

Sampling of borrow materials (soil) was conducted by excavation test pits. The laboratory tests for Soil Samples include:

- Sieve Analysis (AASHTO T88 – 00)
- Atterberg Limit (AASHTO T89 – 02)
- Moisture Density Relations (AASHTO T99 – 01)
- Specific Gravity (AASHTO T100 – 03)
- CBR Test (AASHTO T 193 – 99)

Mechanical boring was made up to 20 m in depth to obtain information on soil layers and layer thickness.

E-3.3 Results of Survey

(1) Coarse Aggregate (Sandy Gravel)

Location of sandy gravel sources are as follows:

(i) Amarrang River at Lekopancing area

(ii) Tabo-tabo River at Lekocaddi Village

(iii) Jeneberang River at Borong Bulu Village

(iv) Jenetallasa River at Madinging village

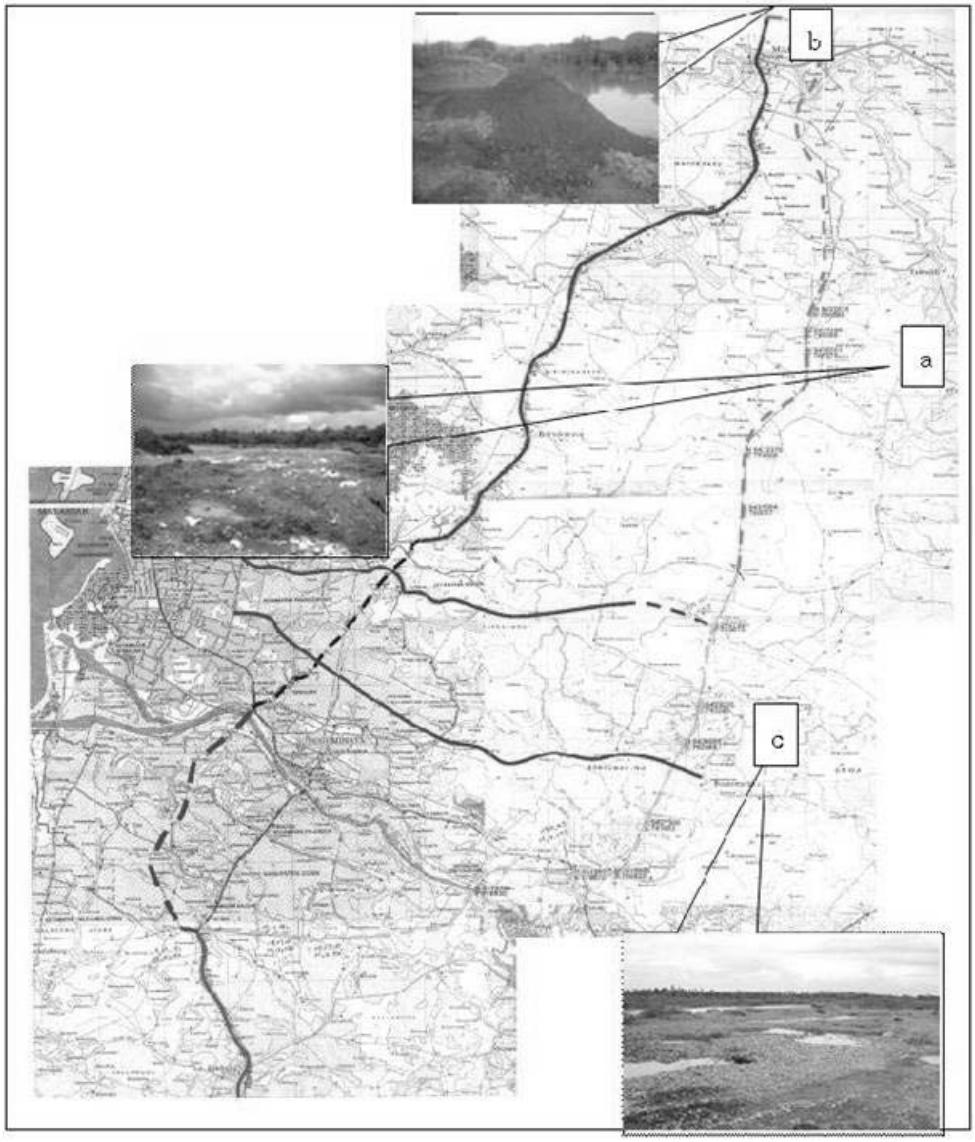


Figure E-3.4 Location Map of Coarse Aggregate Sources

Distance from Makassar and estimated deposit quantity are as shown in the following table:

Table E-3.1 Location and Estimated Deposit Quantity of Coarse Aggregate Materials

No	Name of Quarry	Distance from Makassar	Approximate Deposit Quantity (m^3)	Remarks
1	Lekocaddi Area	55 km	100.000	
2	Lekopancing Area	20 km	250.000	
3	Borong Bulu Area	15 km	250.000	
4	Madinging Village	10 km	200.000	

Summary of laboratory test results are indicated in the following table:

Table E-3.2 Summary of Laboratory Tests for Coarse Aggregate Materials

No	DESCRIPTION			Lekocaddi Area	Lekopancing Area	Borong Bulu Area	Madinging Village
1	SIEVE ANALYSIS						
		SIEVE SIZE				% PASSING	
		50	2	100.00	100.00	100.00	100.00
		37.5	1.5	92.77	83.52	76.79	74.75
		25.4	1	85.02	72.79	60.75	62.37
		19.05	3/4	80.42	68.60	54.68	52.56
		9.5	3/8	68.63	56.95	48.52	46.42
		4.75	# 4	61.44	49.13	45.80	41.90
		2.36	# 8	48.06	29.66	41.49	38.49
		1.18	# 16	44.54	24.03	34.46	33.46
		0.6	# 30	37.80	15.57	21.70	21.54
		0.3	# 50	30.98	14.14	20.47	19.34
		0.15	# 100	24.01	8.79	16.80	15.80
		0.075	# 200	22.15	6.33	14.73	13.73
2	SPECIFIC GRAVITY AND ABSORPTION						
	-Apparent Specific Gravity			2.42	2.86	2.69	2.87
	- Bulk Specific Gravity			2.18	2.64	2.54	2.53
	- SSD Specific Gravity			2.28	2.72	2.60	2.57
	- Water Absorption			4.66	2.95	2.26	2.36
3	LOS ANGELES ABRATION TEST			23.66	22.54	20.08	24.08
4	SODIUM SULPHATE SOUNDNESS			0.36	0.25	0.35	0.33
5	FLAKINESS INDEKS			13.60	12.56	13.53	13.45
6	ORGANIC IMPURITIES			Color No 3	Color No 2	Color No 3	Color No 3
7	POT. ALKALI SILICA RECTIVITY						

(2) Fine Aggregate (sand)

Locations of sand materials (fine aggregate) subjected to investigation are as follows:

(i) Amarrang River at lekopancing area.

(ii) Jeneberang River at Mangasa Village.

(iii) Jeneberang River at Bili-bili area.

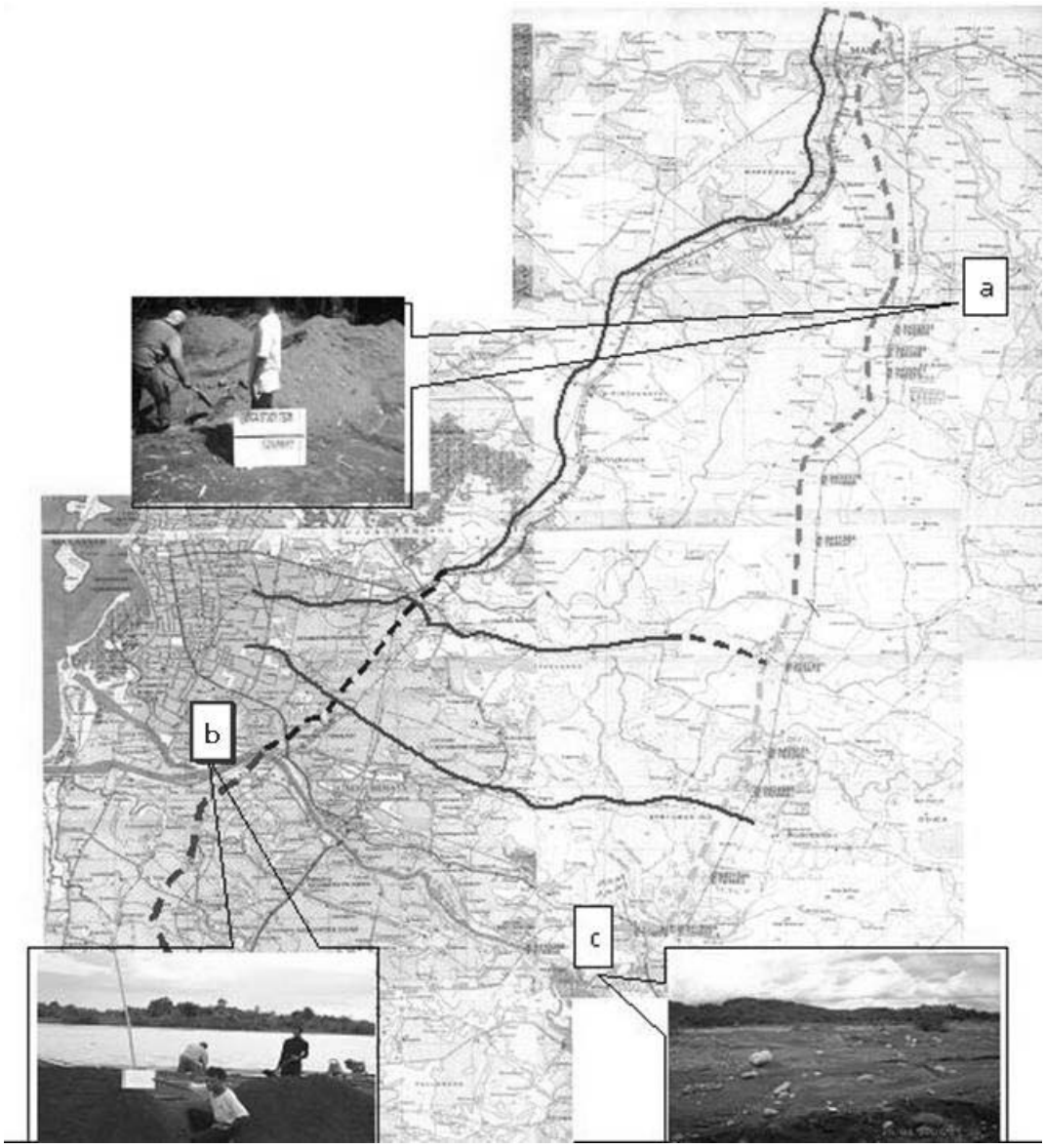


Figure E-3.5 Location Map of Fine Aggregate Quarry

Distance from Makassar and estimated deposit quantity are as shown in the following table:

Table E-3.3 Location and Estimated Deposit Quantity of Fine Aggregate Materials

No	Name of Quarry	Distance from Makassar	Approximate Deposit Quantity (m^3)	Remarks
1	Lekopancing Area	20 km	30.000	
2	Mangasa Village	10 km	50.000	
3	Bili-bili Village	15 km	150.000	

Summary of laboratory test results are indicated in the following table:

Table E-3.4 Summary of Laboratory Tests for Fine Aggregate Materials

NO	DESCRIPTION			Lekopancing Area	Mangasa Village	Bili-bili Area
1	SIEVE ANALYSIS					
		SIEVE SIZE		% PASSING		
		50	2			
		37.5	1.5			
		25.4	1			
		19.05	3/4			
		9.5	3/8	100.00	100.00	100.00
		4.75	# 4	95.46	94.01	92.04
		2.36	# 8	74.19	86.65	80.67
		1.18	# 16	61.02	72.66	72.87
		0.6	# 30	35.33	15.73	17.78
		0.3	# 50	13.21	10.80	12.90
		0.15	# 100	7.21	3.73	3.65
		0.075	# 200	2.52	2.01	2.8
2	SPECIFIC GRAVITY AND ABSORPTION					
	-Apparent Specific Gravity			2.63	2.73	2.84
	- Bulk Specific Gravity			2.46	2.48	2.56
	- SSD Specific Gravity			2.53	2.57	2.68
	- Water Absorption			2.62	3.78	3.2
3	ORGANIC IMPURITIES			Color No 2	Color 2 to 3	Color 2 to 3
4	SAND EQUIVALENT			76	77	78
5	SODIUM SULPHATE SOUNDNESS			0.47	0.65	0.67
6	POT. ALKALI SILICA REACTIVITY					

(3) Borrow Materials (Soil).

Locations of borrow materials (soil) subjected to investigation are as follows:

(i) Carangki Hill (not recommended)

(ii) Moncong Loe Hill.

(iii) Bollangi Hill.

(iv) Sela Village – Kalase'rena Bontonompo.

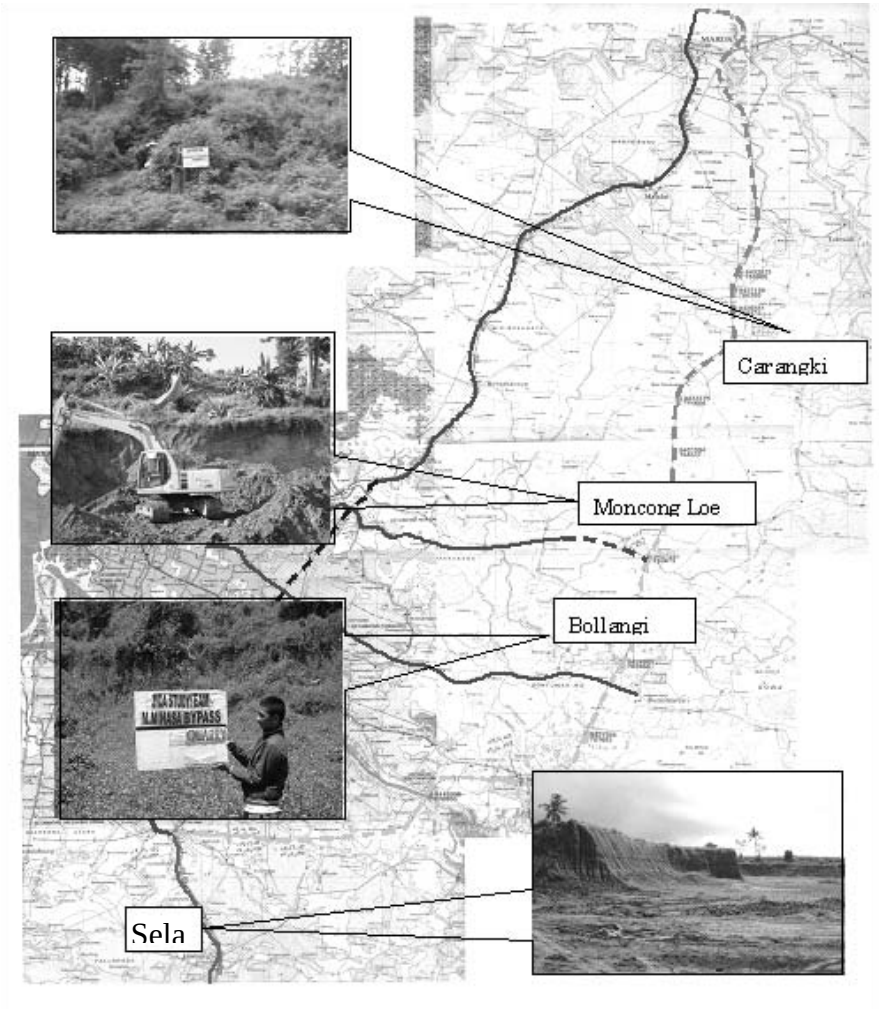


Figure E-3.6 Location Map of Soil Quarry

Distance from Makassar and estimated deposit quantity are as shown in the following table:

Table E-3.5 Location and Estimated Deposit Quantity of Borrow Materials

No	Name of Quarry	Distance from Makassar	Approximate Deposit Quantity (m^3)	Remarks
1	Carangki Hill	18 km	50.000	
2	Moncong Loe Hill	10 km	1,500.000	
3	Bollangi Hill	15 km	100.000	
4	Sela Village	20 km	100.000	

Characteristics of materials (laboratory test), of CBR values are more than 6% and qualified as embankment material, are summarized in the following table:

Table E-3.6 Summary of Laboratory Tests for Borrow Materials

No	DESCRIPTION			Moncongloe Hill	Bollangi Village	Sela Village
1	SIEVE ANALYSIS					
		SIEVE SIZE		% PASSING		
		4.75	# 4	90.93	92.93	96.00
		2.36	# 8	76.08	79.33	88.00
		1.18	# 16	63.25	65.70	77.00
		0.6	# 30	51.98	52.63	65.20
		0.3	# 50	47.60	46.98	52.60
		0.15	# 100	44.48	41.35	39.00
		0.075	# 200	38.85	35.48	25.00
2	ATTERBERG LIMIT					
	- Liquid Limit			37.10	38.26	43.07
	- Plastic Limit			20.28	47.15	23.22
	- Plasticity Index			16.82	8.89	19.85
3	SPECFIC GRAVITY			2.45	2.49	2.55
4	MOISTURE DENSITY RELATIONS					
	Optimum Moisture Content Max Dry density			27.50 1.45	32.8 1.335	24.2 1.452
5	CBR			7.00	12.56	6.25