10.2.4 Uekuli – Nuha (Link No. 15)

(1) Route Description (see Figure 10-2-8)

At present, Poso and Kolonadale are connected by a 128.8 km mountain road via Tentena. The planned route will reduce the existing length by 50 km or more, establishing a Trans-Sulawesi east route. This new road will become an important element contributing to the integration of Kabupaten Poso and the promotion of wayside agriculture and tourism. When connected with Malili of South Sulawesi, this road will become a substitute for the existing Trans-Sulawesi road. In addition, this route has more topographically flat sections, and is more useful when compared with the existing Trans-Sulawesi mountain route connecting Tentena and Paso. This route is also important for promotion of regional development because it connects the ports of Malili, Kolonadale, and Poso. The current state of the planned route can be divided roughly into the following five sections:

1) Uekuli - Malino

In the Uekuli to Malino section, the road is constructed utilizing mountain ridges. The vertical alignment consists of consecutive slopes. The adjacent area being developed by settlers. Land of relatively gentle gradient is used for cultivation of cassava, while steeper slopes are used for cultivation of cacao.

The Buyuntaripa - Malino road runs through a highland and is finished as a kabupaten road with simple pavement at a width of 3.5 m. In certain locations, the road alignment includes a steep slope. Adjacent land is used for paddy fields, pastures, and fruit farms by settlers.

2) Malino – Towi

The section from Malino to Towi (near Kolonadale) was constructed by leveling ground with bulldozers. The road is based on an extremely low standard of design. It is poorly maintained, making entry of vehicles into this section difficult.

The lowland is being developed for paddy fields by settlers, who will utilize the affluent water resources.

3) Towi - Kolonadale

A city road between Towi and Kolonadale is currently under construction. However, this road is based on a lower standard of design, and it will not be utilizable in all weather conditions even when completed. Entry of vehicles into this road is therefore limited. Since a steep limestone ridge connects directly with the shoreline, it is expected that road improvement and widening work will be expensive.

4) Kolonadale - Beteleme

This section has been designated as a provincial road for collectors (tertiary roads). It is finished with a simple pavement of 3.5 m. Except for the topographically steep locations near Kolonadale, the road standard level is relatively good, but the shoulder is narrow. In many areas, wayside flatlands are used for paddy fields. Kolondale is a port city to carry vital goods and to transport agricultural products. It is also a fishing base. Beteleme is a regional collecting and distributing center for agricultural products.

5) Beteleme – Nuha

This section connects Nuha and Beteleme of South Sulawesi, enabling further connection from Nuha to Malili of South Sulawesi with ease by means of a ferry across Lake Matana. This section is finished as a kubupaten road with a simple pavement of 3.5 m.

Location of roads concerned

- Province: Central Sulawesi
- Kabupaten: Poso,
- Kecamatan: Tojo, Petasia, Lembo
- Major cities and settlement: Uekuli, Kolonadale, Beteleme
- Link length 128.8 km

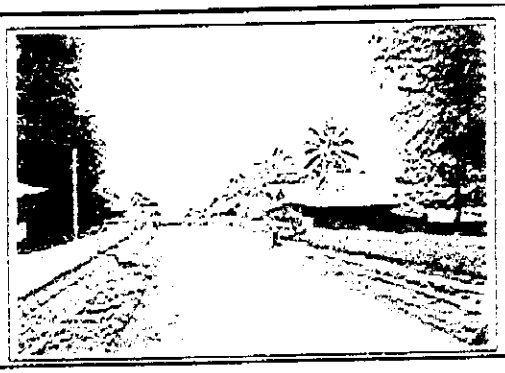
(2) Road Traffic

The future traffic demand of the road link is summarized as indicated in Table 10-2-18.

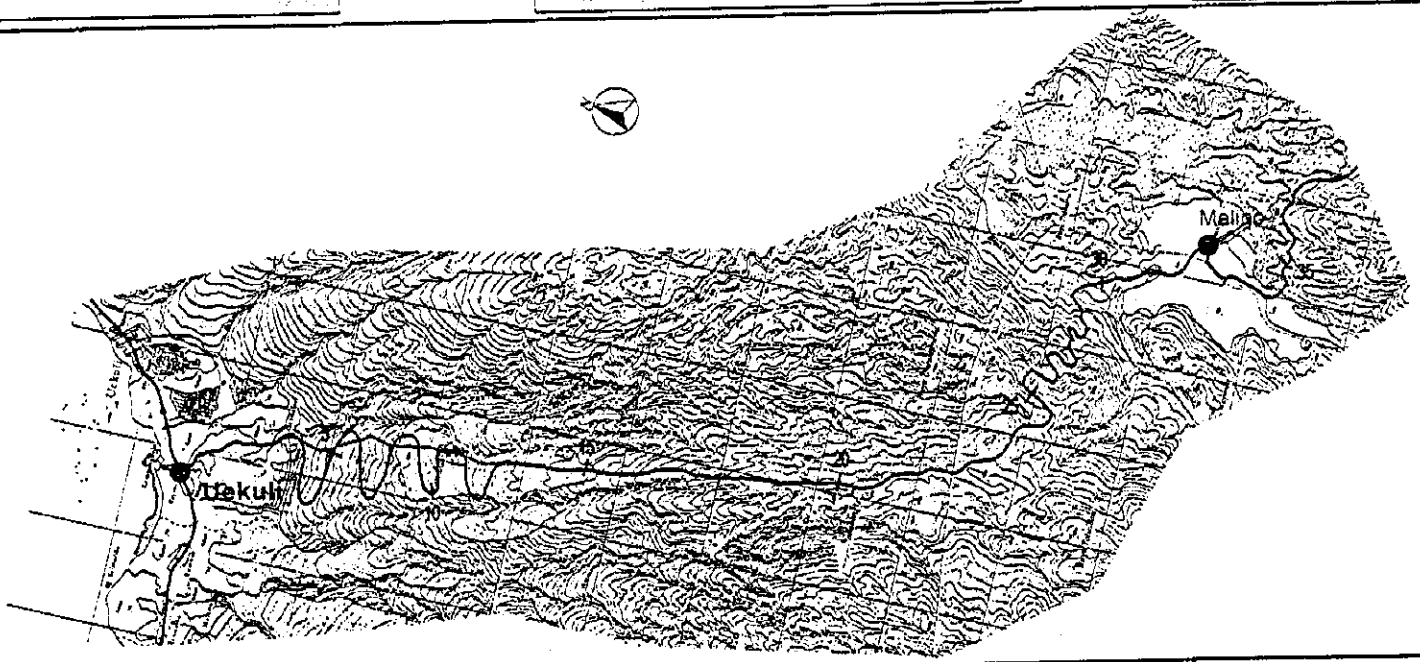
Table 10-2-18 Future Traffic Volume of Uekuli – Nuha (Link No. 15)

	Year 2003 (vehicle/day)	Year 2018 (vehicle/day)
Motorcycle	261	577
Passenger cars	126	352
Buses	242	480
Trucks	396	862
Total	1025	2271

Source: Study Team



Link 15-1



Location Map

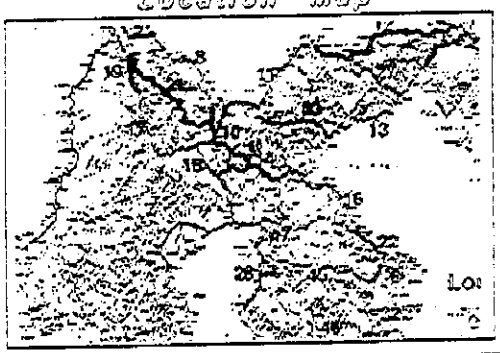
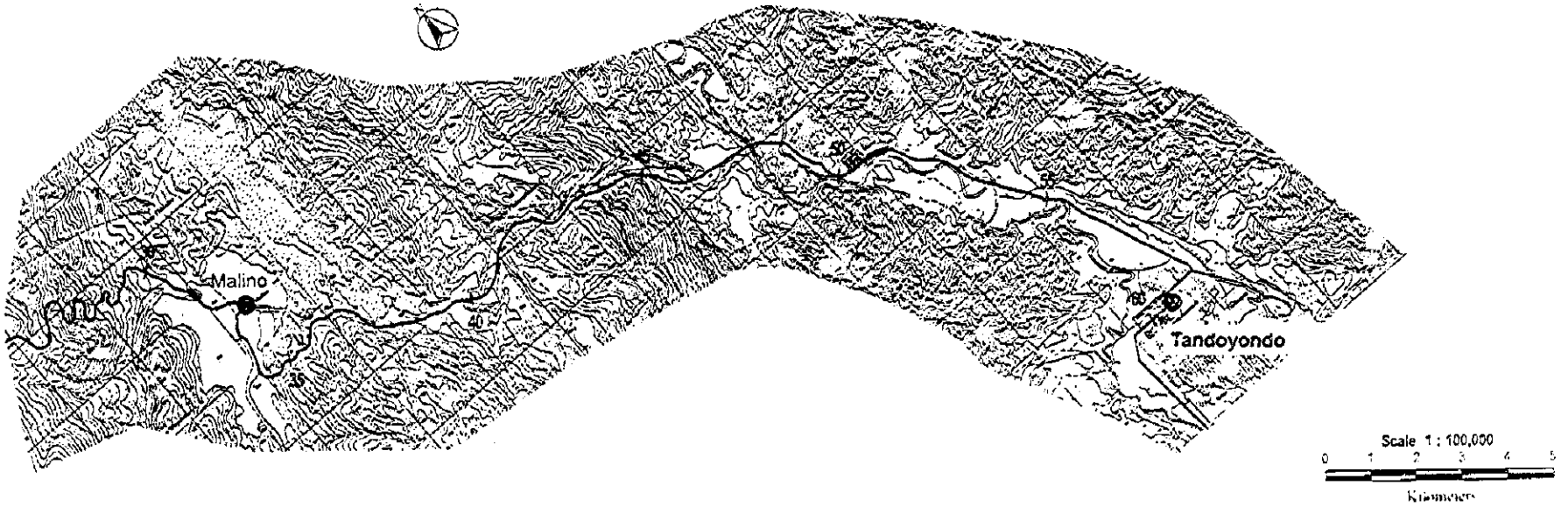


Figure 10-2-12 (1)

Link 15-2



Location Map

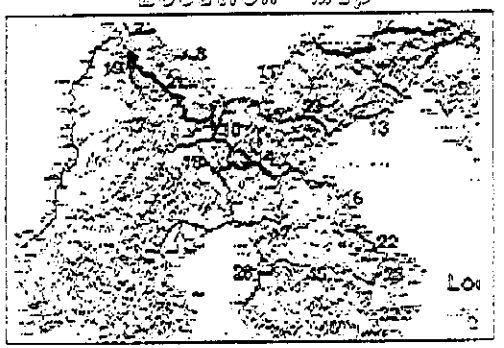
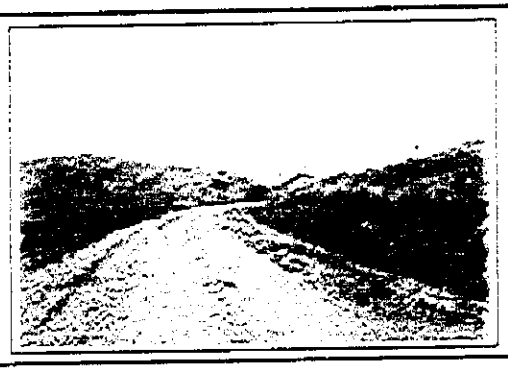
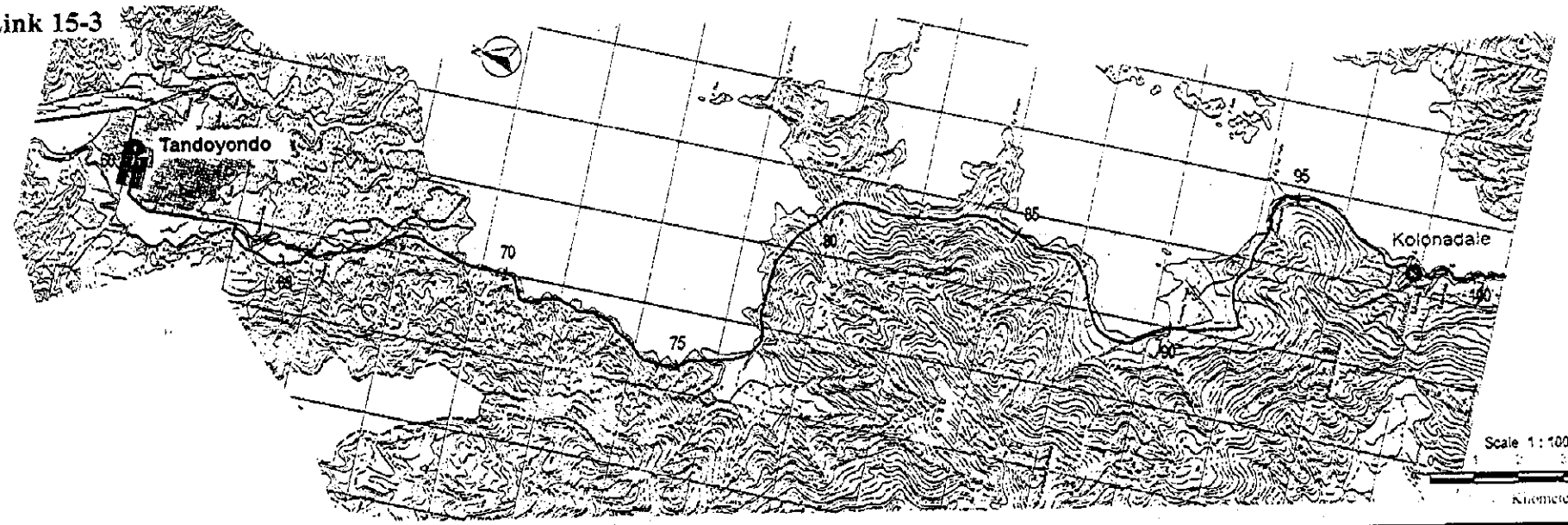
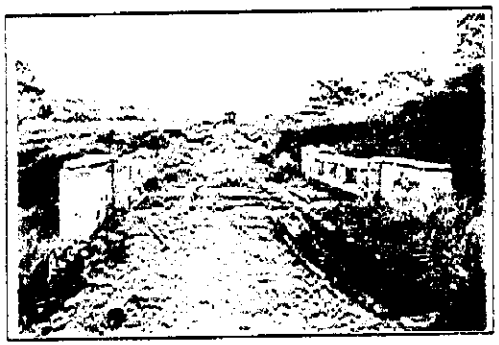


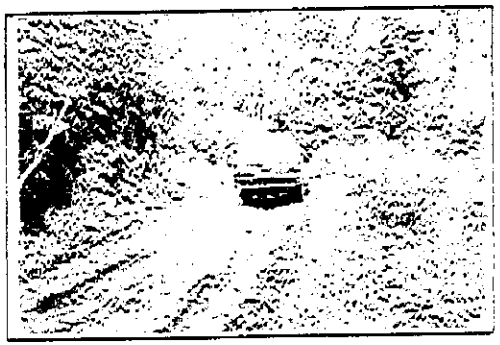
Figure 10-2-12 (2)



Link 15-3







Location Map

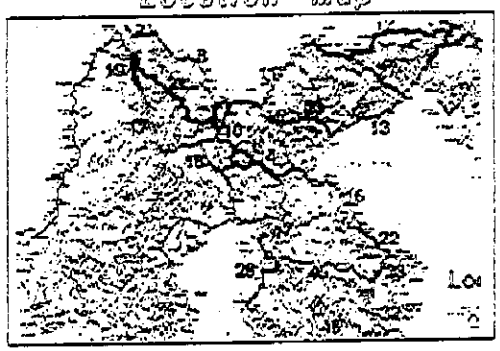


Figure 10-2-12 (3)

Link 15-4

Location Map

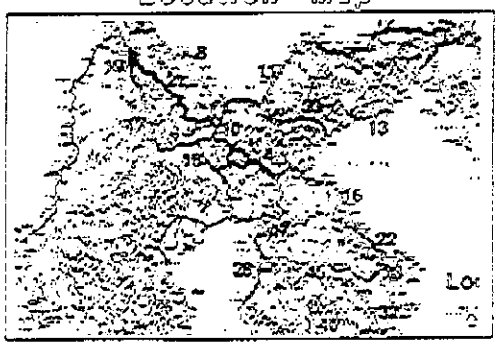
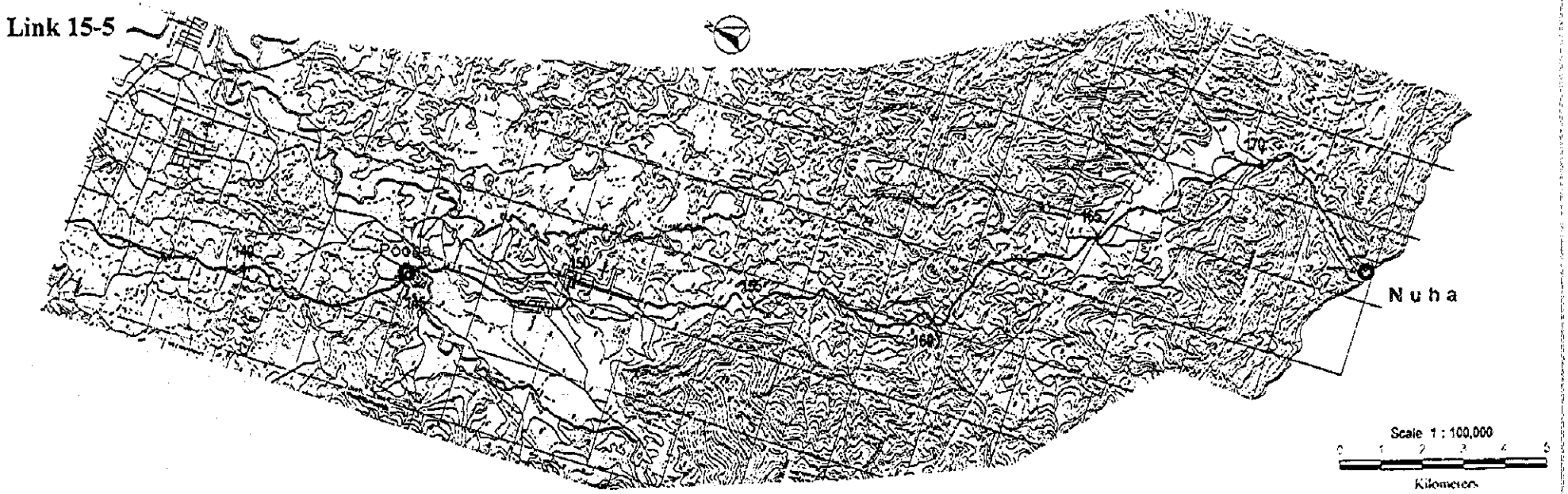


Figure10-2-12 (4)



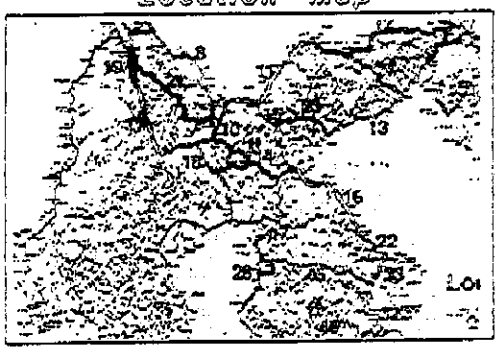
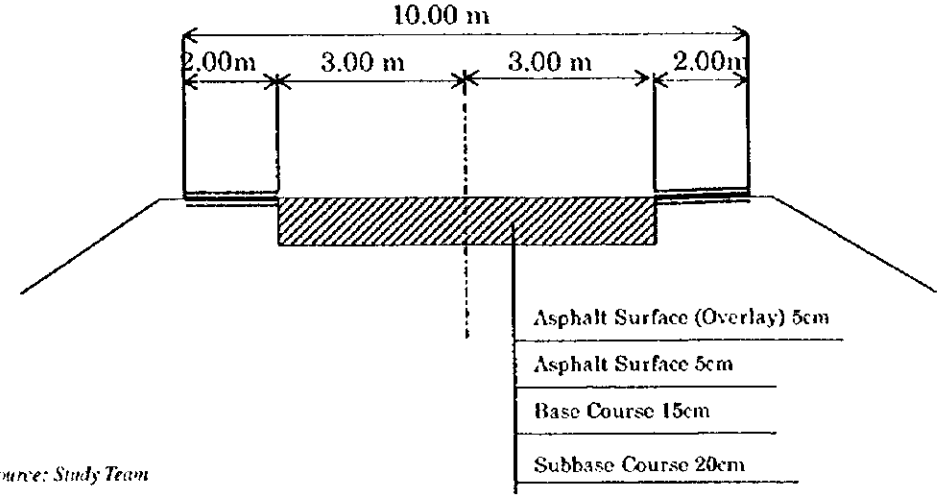


Figure 10-2-12 (5)

(3) Typical Cross Section and Pavement (Link No. 15)

The total width will be 10 m (or 8 m in mountainous area), including 6.0 m for the pavement of carriage way and 2.00 m for shoulders in flat sections.



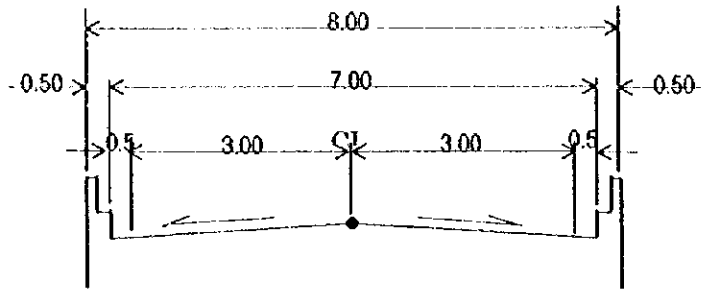
Source: Study Team

Figure 10-2-13 Typical Cross Section for Link No. 15

The pavement will be of A type of a surface thickness of 5 cm, asphalt treated base cpurse, 15 cm and subbase course, 25 cm. The plan also calls for an additional surface course of 5 cm as an overlay in seven years after road construction. The pavement thickness was decided based on the future traffic demand.

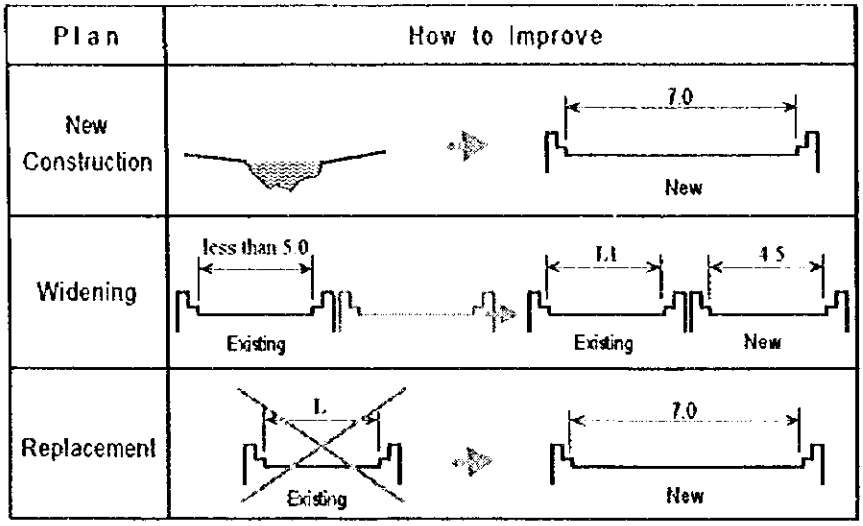
(4) Preparatory Engineering of Bridges (Link No. 15)

The minimum effective width of bridge is defined as 7.0 m according to the typical cross section of road. Existing bridges of less than 5.0 m wide are to be widened. However, in consideration of economical improvement, when the bridge has sufficient durability in spite of narrow width, the bridge is not to be replaced but a new bridge with width of 4.5 m will be constructed parallel to existing one.
On the other hand, bridges of insufficient durability will be replaced (reconstructed) even if width is sufficient.
For roads of link No.8 ,15 ,16 ,22 ,32 and 33, typical cross section of bridge is shown in Figure 10-2-14 and Figure 10-2-14 shows the concept of bridge improvement plan.



Source: Study Team

Figure 10-2-14 Typical Cross Section of New Bridge for Road Link No.8 ,15 ,16 ,22 ,32 and 33



Source: Study Team

Figure 10-2-15 Bridge Improvement Plan for Road Link No. 8 ,15 ,16 ,22 ,32 and 33

Existing bridge condition and bridge improvement plan on the road of link No.15 are listed in Table 10-2-19.

Quantity of bridge improvement on the road link No.15 is summarized in Table 10-2-20.

Table 10-2-19 Existing Bridge and Bridge Improvement Plan for Road Link No.15

Road Link No.	Bridge No.	Location From	Location Km	Length (m)	Nos. Span	Width (m)	Type of Super-structure	Improvement Plan
15	1	Uekuli	1.00	5.0	1	3.5	Concrete Plate	Widening
15	2	Uekuli	2.50	5.0	1	3.5	Concrete Plate	Widening
15	3	Uekuli	19.20	5.0	1	3.5	Concrete Plate	Widening
15	4	Uekuli	19.90	6.0	1	3.5	Concrete Plate	Widening
15	5	Uekuli	22.60	10.0	1	3.5	Concrete Plate	Widening
15	6	Uekuli	26.10	10.0	1	3.5	Concrete Plate	Widening
15	7	Uekuli	30.70	5.0	1	3.5	Wooden Girder	Replace

Source: Bina Marga

Table 10-2-20 Summary of Quantity of Bridge Improvement for Road Link No.15

	LINK NAME		ROAD LENGTH	QUANTITY OF BRIDGE CONSTRUCTION (m^2) CLASSIFICATION BY SPAN LENGTH : L(m)			
			(km)	L<=10m	10m<L<=20m	20m<L<=30m	L>30m
15	UEKUULI-NUHA						
	UEKULI	MALINA	26.4	214	0	0	0
	MARINA	TANDOYONDO	29.0	235	80	572	0
	TANDOYONDO	KOLONADALE	22.3	181	62	440	0
	KOLONADALE	BETEREME	34.7	247	0	0	0
	BETUREME	NUHA	16.4	133	45	323	0
	TOTAL 15		128.8	1,010	187	1,334	0

Source: Bina Marga

(5) Preparatory Engineering of Slope Protection Works (Link No.15)

Slope protection works are constructed to protect the slopes from erosion or weathering by covering them with vegetation or structures and also to stabilize the slopes by means of drainage works or retaining structures. The following types of slope protection works are adopted for the pre-feasibility route considering the terrain and geology, as shown in Table 10-2-21.

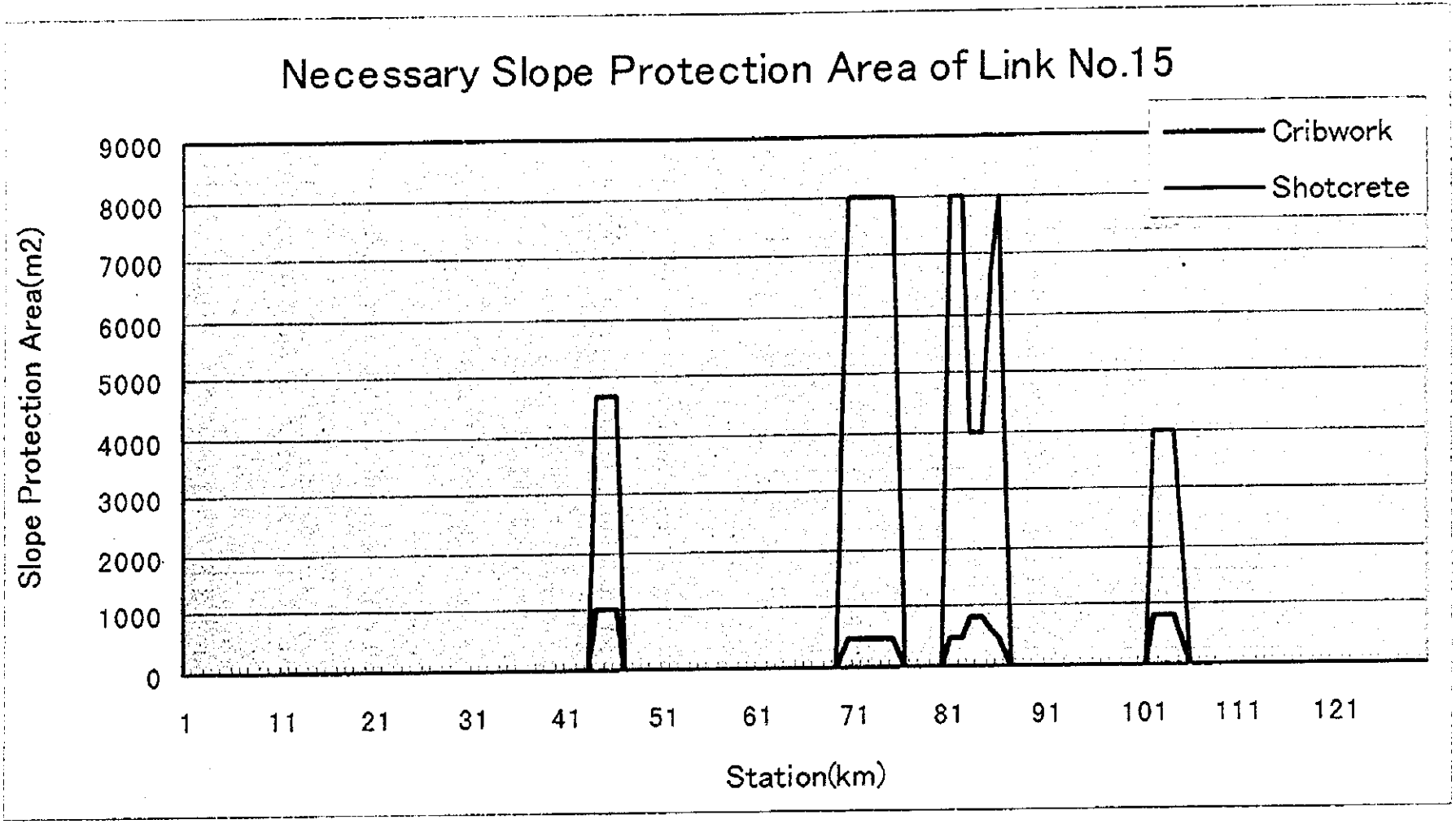
Necessary length of slope protection works for each link is shown in Figure 10-2-10.

2) Quantities of Slope Protection

Table 10-2-21 Quantities of Slope Protection

	Cut			Fill
	Sprayed Concrete Cribwork(m^2)	Shotcrete (m^2)	Stone Masonry (m^2)	Mat Gabion (m^2)
Quantity	12,745	114,707	7,809	12,578

Source: Study Team



Source: Study Team

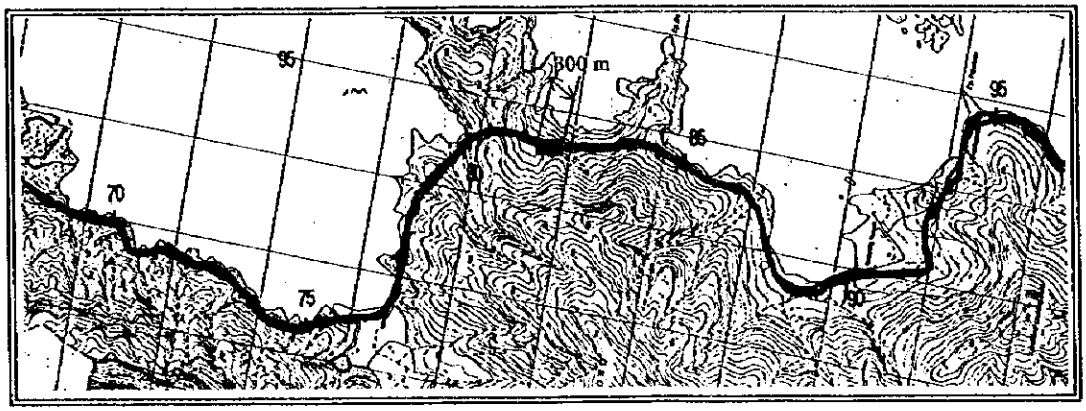
Figure 10-2-16 Necessary Slope Protection Area

(6) Preparatory Engineering of Tunnel (Link No. 15)

Tunnels are commonly constructed for the purpose of:

- Securing and improving horizontal and vertical alignment of the road
- Preventing disasters such as landslide, rockslide due to erosion, etc.
- Saving time and cost by reducing of distance
- Protecting of natural and social environment.

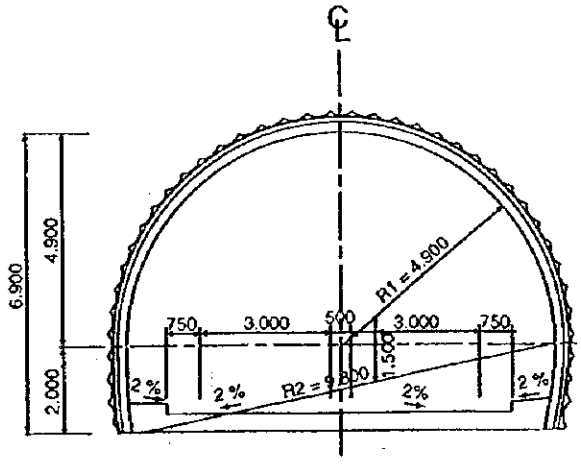
In the study area, existing road runs through tip of ridge cape. A tunnel of 300 m in length was planned for this route to minimize road length, improve alignment and counter potential disasters.



Source: Study Team

Figure 10-2-17 Tunnel Location Map for Link No. 15

Tunnel cross section was decided based on the detailed tunnel design as shown in Figure 10-2-18



Source: Study Team

Figure 10-2-18 Tunnel Cross Section

(7) Cost Estimation (Link No. 15)

1) Estimated Project Cost

Cost items consist of preparation works, pavement, earth work, drainage, bridge, slope protection, tunnel and safety facilities works. The engineering service cost is estimated at 20% of the total cost of direct and indirect cost. A contingency allowance has been included in 10 % of total construction and engineering cost. Table 10-2-22 shows the result of estimated project cost.

2) Implementation Plan

As shown in Figure 10-2-19, the construction period was proposed to be 5 years consisting of one year for preparation of project for fund raising plan, 1.5 years for detailed design of the roads and 2.5 years for construction. Also, the investment plan is set in accordance with the construction plan.

(8) Economic Analysis (Link No. 15)

1) Economic Project Costs
The economic investment costs are estimated in constant 1998 prices. The financial investment costs in terms of market price include the component of taxes. The economic costs for economic analysis are obtained by subtracting the portion of transfer payment such as taxes from financial costs. The financial and economic costs (initial investment and maintenance costs) are summarized in Table 10-2-23.

Table 10-2-23 Initial Investment and Maintenance Costs

(Million Rp.)

	Economic Prices
Initial Investment Cost (Construction)	340,777
Routine Maintenance Cost Per Year	234
Periodic Maintenance Cost Per Year	36,299

Source: Study Team

The maintenance cost of the proposed road follows the engineering study results of the cost estimates, Besides, the maintenance cost of the proposed road in the case of "without the improvement of the proposed road" is treated as a negative cost.

2) Economic Benefits
Benefits are classified into two types, one is the direct benefit and the other is the indirect benefit or intangible benefit.
The direct benefits which would be realized from the implementation of the Project are defined as the savings in travel costs, composed of the vehicle operating cost and vehicle time cost when comparing the "With" and "Without" project conditions.

Table 10-2-22 Total Construction Cost for Uekuuli - Nuha Road (Link No. 15)

Rate: 1US$ = 10,600 Rp. = 140 Yen

Item	Unit	Quantity	Unit Price			Total Price			
			Foreign (US$)	Financial (Rp)	Economic (Rp)	Foreign (US$)	Local Financial (Rp)	Local Economic (Rp)	Financial Total (Mill. Rp)
1. Preparation Works									
Cleaning and Grubbing	m^2	720,818	0.23	1,867	2,099	165,788	1,345,767,206	1,512,996,982	3,103
2. Pavement									
Road Asphalt Concrete + Sub Base (Type A)	m	112,400	39,50	436,896	392,152	4,439,800	49,107,110,400	44,077,884,800	96,169
Road Asphalt Concrete + Sub Base (Type B)	m	16,400	31,76	351,336	315,832	520,864	5,761,910,400	5,179,644,800	11,283
Road Asphalt Concrete + Sub Base (Type C)	m	0	16.15	188,584	175,452	0	0	0	0
Transport for Pavement Material (L = 43 km)	m^3	217,210	4.06	30,255	35,298	881,264	6,571,714,615	7,667,000,384	15,913
Sub-2						5,841,928	61,440,735,415	56,924,529,984	123,365
3. Earth Work									
Excavation (Common)	m^3	640,736	0.92	7,407	8,213	589,477	4,745,931,552	5,262,364,768	10,994
Excavation (Sound Rock)	m^3	72,082	4.12	33,605	36,492	296,978	2,422,315,610	2,630,416,344	5,570
Disposal Soil (L = 5 km)	m^3	71,282	1.20	8,610	10,050	85,538	613,736,298	716,382,090	1,520
Sub-3						971,993	7,781,983,460	8,609,163,202	18,084
4. Drainage									
Pipe Culvert (D = 100 cm)	m	1,288	44.35	634,758	554,426	57,123	817,568,304	714,100,688	1,423
Box Culvert (B = 2.0 m, H = 2.0 m)	m	644	325.89	3,064,762	2,510,606	209,873	1,973,706,728	1,616,830,264	4,198
U-Ditch (U = 30 cm)	m	42,949	1.71	41,910	36,720	73,443	1,799,992,590	1,577,087,280	2,578
Sub-4						340,439	4,591,267,622	3,908,018,232	8,200
5. Slope Protection									
Sprayed Concrete Cribwork	m^2	12,745	14.68	127,197	88,984	187,097	162,125,765	1,134,101,080	3,604
Shotcrete Work	m^2	114,707	11.82	101,390	67,157	1,355,837	11,630,142,730	7,703,377,999	26,002
Stone Masonry	m^2	7,809	6.91	116,286	109,711	53,960	908,077,374	856,733,199	1,480
Mat Gabion	m^2	12,578	9.20	72,584	61,374	115,718	912,961,552	771,962,172	2,140
Sodding	m^2	50,313	0.08	3,238	2,851	4,025	162,913,494	143,442,263	206
Sub-5						1,716,637	13,776,220,915	10,609,616,713	33,432
6. Tunnel	m	300	3,500.00	22,400,000	17,920,000	1,050,000	6,720,000,000	5,376,000,000	17,850
7. Bridges									
L<=10 m	m^2	1,010	206.20	2,233,568	1,843,094	208,265	2,255,903,764	1,861,525,361	4,464
10 m<L<=20 m	m^2	187	287.55	2,506,242	2,008,820	53,771	468,667,319	375,649,382	1,039
20 m<L<=30 m	m^2	1,334	313.65	2,643,773	2,102,930	418,411	3,526,793,797	2,805,309,257	7,962
30 m<L	m^2	0	345.02	2,908,151	2,313,224	0	0	0	0
Sub-7						680,447	6,251,364,880	5,042,484,000	13,465
8. Safety Facilities Works									
Guard Railing	m	12,880	11.30	168,012	143,025	145,544	2,163,994,560	1,842,162,000	3,707
Traffic Sign	each	429	27.98	426,548	373,259	12,013	183,131,275	160,252,531	310
Line Marking	m	128,800	0.42	4,231	3,518	54,096	544,952,800	453,118,400	1,118
Sub-8						211,653	2,892,078,635	2,455,532,931	5,136
9. Mobilization & Temporally Works (20 % of Total Cost)						2,100,326	22,263,459,083	19,369,209,402	44,527
10. Sub-Total						13,079,211	127,062,877,216	113,807,551,446	267,162
11. Engineering Cost (20 % of 10)						3,528,548	24,935,074,173	19,948,059,338	62,338
12. Contingency (10 % of 10 + 11)						1,660,776	15,345,695,139	13,375,561,088	32,950
Ground Total Cost (10+ 11 + 12)						18,268,535	167,343,646,528	147,131,171,872	362,450

Source: Study Team

Item	Unit	Quantity	1999	2000	2001	2002	2003	Total
1. Preparation of Project								
2. Survey and Design	km	128.8						
3. Construction								
Earth Work	m^3	712,818.0						
Slope Protection	m^2	-						
Tunnel	m	300.0						
Bridges	m	2,531.0						
Pavement	km	128.8						
Foreign (US$)				970,351	2,933,425	4,797,669	9,567,090	18,268,535
Local Financial Cost (Rp)				6,857,145,398	25,154,045,750	41,278,531,407	95,512,923,975	168,802,646,529
Local Economic Cost (Rp)				5,485,716,318	22,614,906,234	33,907,216,817	85,123,332,604	147,131,171,973
Total Financial Cost (Mill. Rp)				17,143	56,248	92,134	196,924	362,449
Total Economic Cost (Mill. Rp)				15,771	53,709	84,763	186,534	340,778

Source: Study Team

Figure 10-2-19 Implementation Schedule for Uekuuli - Nuha Road (Link No. 15)

The benefit of vehicle operating costs is estimated as a difference of vehicle operating costs between "With" Project" case and "Without" Project" case. The vehicle operating cost is derived from the obtained daily vehicle-kilometers and the unit vehicle operating cost by vehicle type. In addition, a promotion of traffic safety and saving in accident costs are anticipated.

In this economic analysis, the above mentioned direct benefit, e.g. the vehicle operating cost saving is computed as a quantified benefit. The calculation of direct benefits are made for the planning year of 2003 and 2018.
As a result, the saving in vehicle operating cost is summarized as shown in Table 10-2-24.

Table 10-2-24 Estimated Economic Benefits

(Million Rp. at 1998 price)

Year	Benefit of Saving in VOC
2004	74,180
2018	237,264

Source: Study Team

3) Economic Cost-Benefit Analysis

The analysis follows the conventional discounted cash flow method in determining the economic internal rate of return (EIRR), the net present value (NPV) and the benefit cost ratio (B/C). (NPV and B/C are calculated at a discount rate of 15 percent.) The project life is assumed to be 20 years after the completion of the construction.

The benefits in the intermediate years were interpolated and those beyond 2018 were assumed to be fixed. The total economic project costs and benefits streams are presented in Table 10-2-25. The efficiency measures were calculated and the summary is as follows:

Table 10-2-25 Economic Analysis for Link No. 15

(Million Rp.)

	Year	Benefits		Costs			Maint. Cost (Without)	Net Cash Flow
		VOC Saving	Total	Invest. Costs	Maint. Cost (With)	Total		
1	1999			0	0	0	0	0
2	2000			15,771	234	16,005	234	-15,771
3	2001			53,709	234	53,943	16,198	-37,745
4	2002			84,763	234	84,997	234	-84,763
5	2003	0	0	186,534	234	186,768	234	-186,534
6	2004	74,180	74,180	0	234	234	234	74,180
7	2005	85,829	85,829	0	234	234	234	85,829
8	2006	97,477	97,477	0	234	234	16,198	113,441
9	2007	109,126	109,126	0	234	234	234	109,126
10	2008	120,775	120,775	0	234	234	234	120,775
11	2009	132,424	132,424	0	234	234	234	132,424
12	2010	144,073	144,073	0	36,299	36,299	234	10,808
13	2011	155,722	155,722	0	234	234	16,198	171,686
14	2012	167,371	167,371	0	234	234	234	167,371
15	2013	179,019	179,019	0	234	234	234	179,019
16	2014	190,668	190,668	0	234	234	16,198	206,632
17	2015	202,317	202,317	0	234	234	234	202,317
18	2016	213,966	213,966	0	234	234	234	213,966
19	2017	225,615	225,615	0	36,299	36,299	16,198	205,514
20	2018	237,264	237,264	0	234	234	234	237,264
21	2019	237,264	237,264	0	234	234	234	237,264
22	2020	237,264	237,264	0	234	234	16,198	253,228
23	2021	237,264	237,264	0	234	234	234	237,264
24	2022	237,264	237,264	0	234	234	234	237,264
25	2023	237,264	237,264	0	234	234	16,198	253,228
				340,777	77,746	418,523	117,364	

Source: Study Team

Efficiency Measures	
EIRR	28.8 %
NPV (Million Rp.)	243,485
B/C	2.39

Source: Study Team

These results indicate that implementation of the Project (road development of link No. 15) is economically feasible.

10.2.5 Tompira – Bungku (Link No. 16)

(1) Route Description

The area covered by the project is expected to be a future center for industries along the Trans-Sulawesi east route. Most of the section is located over the diluvium layer in relatively flat land. Accordingly, adjacent lands are used by settling farmers for palm plantations and paddy fields or to cultivate coconuts. Also active in this area are logging from mountainous regions behind the villages and production of rattan furniture material. This road is designated as a provincial road, with the road alignment maintained at a relatively high level over the entire route. The Tompira - Umpanga section is finished with simple pavement at 3.5 m in width. Bridges constructed along the route are all permanent bridges. The Umpanga - Bungku section is an 8 m wide gravel road. There are many temporary bridges along the route, and no bridges are constructed in locations considered necessary.

Location of roads concerned

- Province: Central Sulawesi
- Kabupaten: Poso
- Kecamatens: Lembo, Bunku Utra, Bungku Tengah
- Major cities and settlement: Tompira, Emida, Umpanga, Bathmole, Bungku
- Link length: 103.9 km

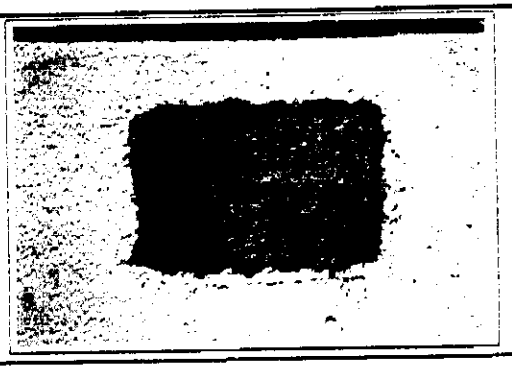
(1) Road Traffic

The future traffic demand of the road link are summerized as indicated in Table 10-2-26.

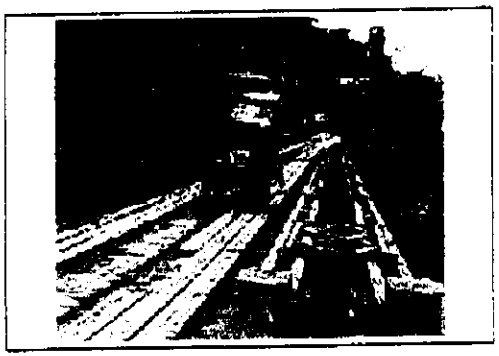
Table 10-2-26 Future Traffic Volume of Tompira – Bungku

	Year 2003 (vehicle/day)	Year 2018 (vehicle/day)
Motorcycle	352	502
Passenger cars	190	285
Buses	349	385
Trucks	602	816
Total	1493	1988

Source: Study Team



Link 16-1



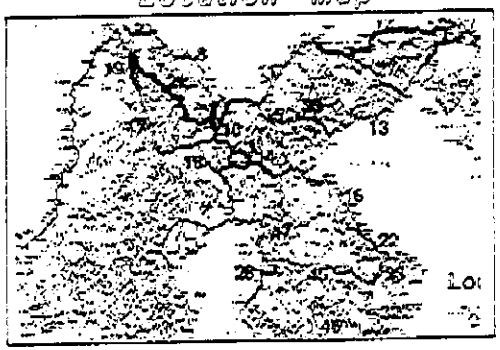
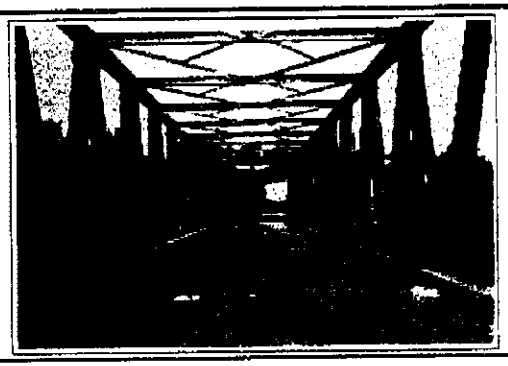
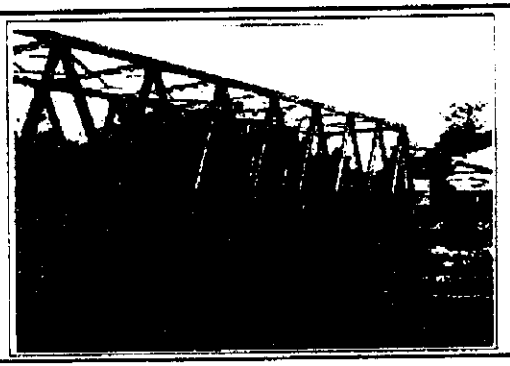


Figure 10-2-20 (1)





Link 16-2

Location Map

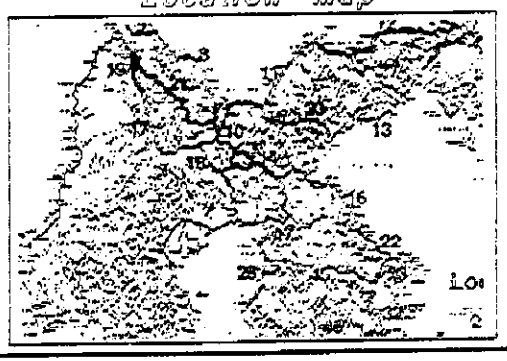
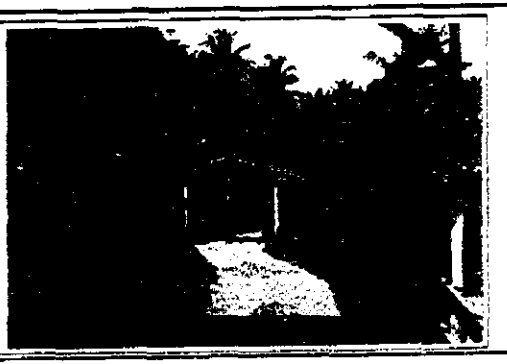
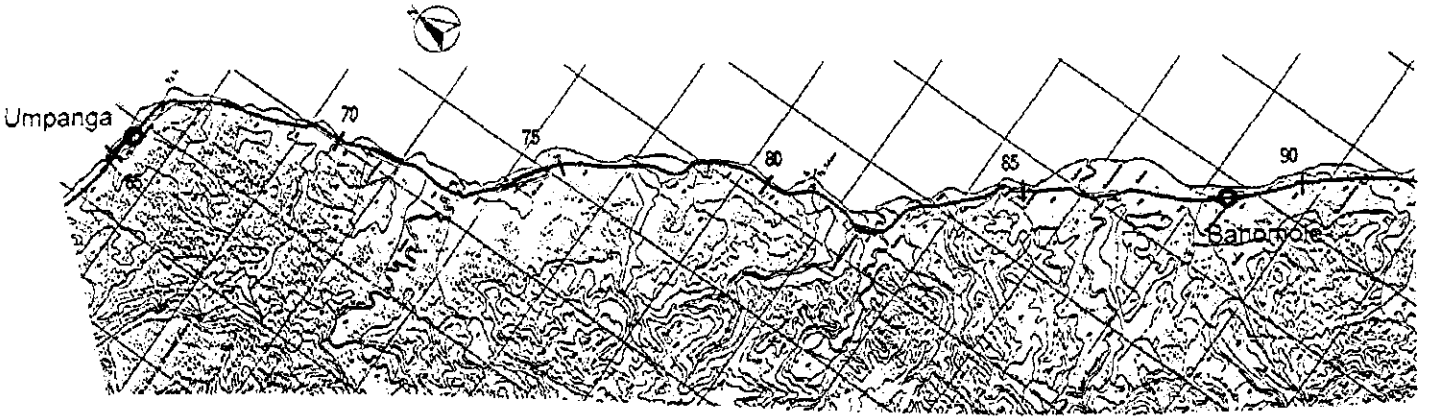


Figure10-2-20 (2)



Link 16-3



Scale 1 : 100,000

0 1 2 3 4 5

Kilometers

Location Map

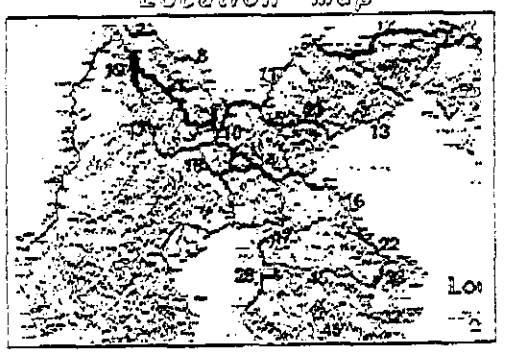
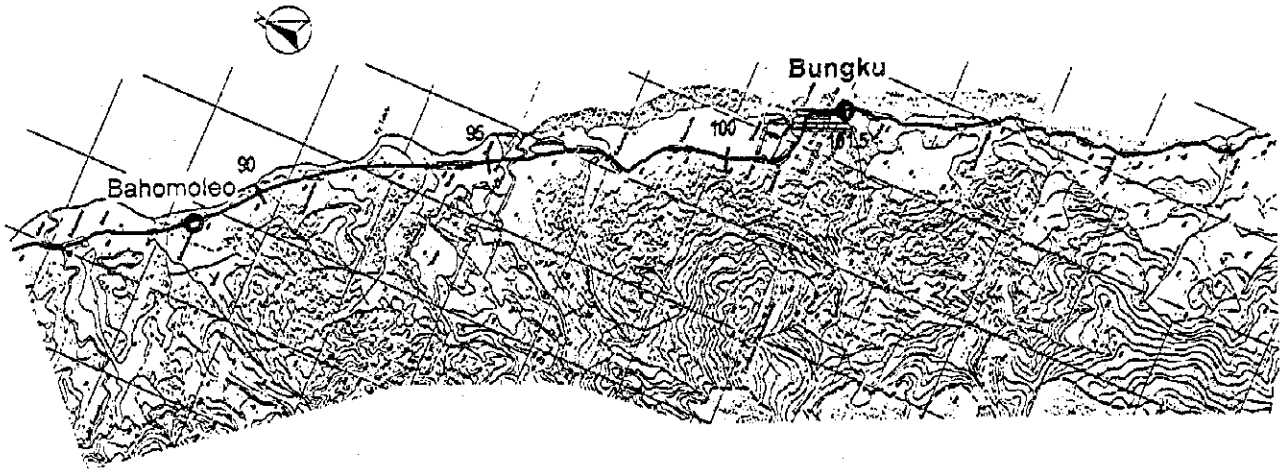


Figure10-2-20 (3)

Link 16-4



Scale 1 : 100,000
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Kilometers

Location Map

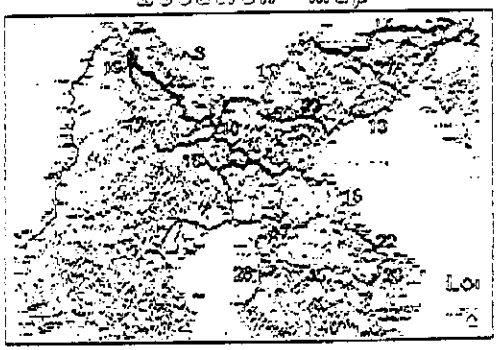
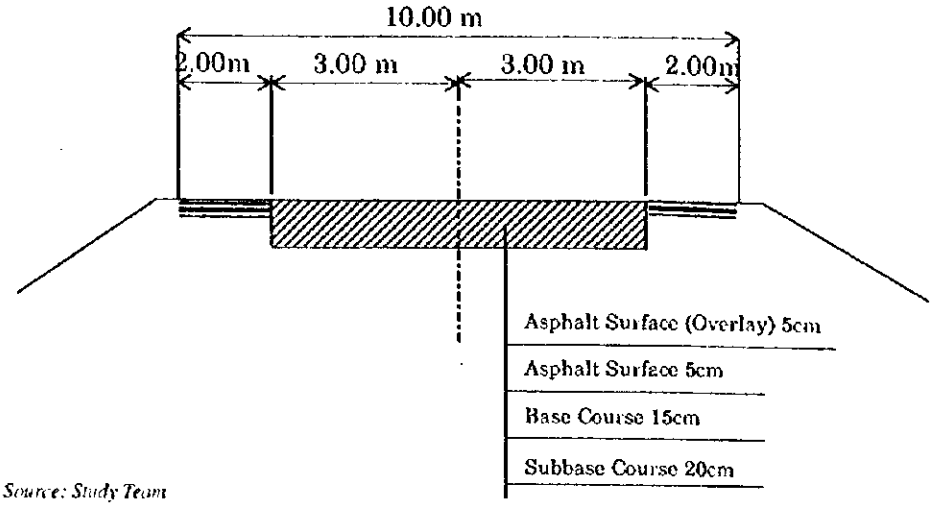


Figure 10-2-20 (4)

(3) Typical Cross Section and Pavement (Link No. 16)

The total width will be 10 m (or 8 m in mountainous area), including 6.0 m for the pavement of carriage way and 2.00 m for shoulders in flat sections.



Source: Study Team

Figure 10-2-21 Typical Cross Section for Link No. 16

The pavement will be of A type of a surface thickness of 5 cm, asphalt treated base cpurse, 15 cm and subbase course, 25 cm. The plan also calls for an additional surface course of 5 cm as an overlay in seven years after road construction. The pavement thickness was decided based on the future traffic demand.

(4) Preparatory Engineering of Bridges (Link No. 16)

Typical cross section of bridge is shown in Figure 10-2-15 and the bridge improvement concept is shown in Figure 10-2-15.

Existing bridge condition and bridge improvement plan on the road of link No.22 are listed in Table 10-2-27.

Quantity of bridge improvement on the road link No.22 is summarized in Table 10-2-28.

Table 10-2-27 Existing Bridge and Bridge Improvement Plan for Road Link No.16

Road Link No.	Bridge No.	Location From	Location Km	Length (m)	Nos Span	Width (m)	Type of Superstructure	Improvement Plan
16	1	Tompira	0.00	7.0	1	4.0	Wooden Girder	Replace
16	2	Tompira	0.40	6.0	1	4.0	Wooden Girder	Replace
16	3	Tompira	4.45	12.7	1	6.2	Wooden Girder	Replace
16	4	Tompira	4.75	12.7	1	6.2	Wooden Girder	Replace
16	5	Tompira	6.80	14.0	2	4.0	Wooden Girder	Replace
16	6	Tompira	8.20	6.5	1	7.0	Concrete Plate	Retain existing
16	7	Tompira	8.80	7.2	1	6.0	Concrete Plate	Retain existing
16	8	Tompira	9.90	14.0	1	7.0	Concrete Girder	Retain existing
16	9	Tompira	11.30	10.0	1	7.0	Concrete Girder	Retain existing
16	10	Tompira	12.40	6.0	1	6.0	Concrete Plate	Retain existing
16	11	Tompira	12.70	13.0	1	7.0	Concrete Girder	Retain existing
16	12	Tompira	15.30	90.0	3	3.0	Bailey	Replace
16	13	Tompira	18.90	7.0	1	6.0	Concrete Plate	Retain existing
16	14	Tompira	19.10	3.0	1	6.0	Concrete Plate	Retain existing
16	15	Tompira	19.30	3.0	1	6.0	Concrete Plate	Retain existing
16	16	Tompira	20.00	3.0	1	6.0	Concrete Plate	Retain existing
16	17	Tompira	20.10	3.0	1	6.0	Concrete Plate	Retain existing
16	18	Tompira	20.70	12.0	2	4.0	Wooden Girder	Replace
16	19	Tompira	21.80	50.0	1	6.0	Steal Truss	Retain existing
16	20	Tompira	29.70	5.0	1	6.0	Concrete Plate	Retain existing
16	21	Tompira	26.70	7.0	2	6.0	Concrete Plate	Retain existing
16	22	Tompira	24.60	3.0	1	6.0	Concrete Plate	Retain existing
16	23	Tompira	25.50	3.0	1	6.0	Concrete Plate	Retain existing
16	24	Tompira	27.60	26.0	4	4.0	Wooden Girder	Replace
16	25	Tompira	28.20	22.5	3	4.0	Wooden Girder	Replace
16	26	Tompira	27.80	3.0	1	6.0	Concrete Plate	Retain existing
16	27	Tompira	27.70	3.0	1	6.0	Concrete Plate	Retain existing
16	28	Tompira	28.00	14.0	1	4.0	Wooden Girder	Replace
16	29	Tompira	29.10	3.0	1	6.0	Concrete Plate	Retain existing
16	30	Tompira	29.55	5.0	1	6.0	Concrete Plate	Retain existing
16	31	Tompira	29.65	5.9	1	6.0	Concrete Plate	Retain existing
16	32	Tompira	29.75	4.0	1	6.0	Concrete Plate	Retain existing
16	33	Tompira	30.65	3.0	1	6.0	Concrete Plate	Retain existing
16	34	Tompira	32.20	8.0	1	4.0	Wooden Girder	Replace
16	35	Tompira	33.30	17.0	1	4.0	Wooden Girder	Replace
16	36	Tompira	36.43	4.0	1	6.0	Concrete Plate	Retain existing
16	37	Tompira	36.93	16.0	1	4.0	Wooden Girder	Replace
16	38	Tompira	37.53	60.0	1	6.2	Steal Truss	Retain existing
16	39	Tompira	37.90	13.0	2	4.0	Wooden Girder	Replace
16	40	Tompira	40.40	11.0	2	4.0	Wooden Girder	Replace
16	41	Tompira	42.70	5.0	1	6.0	Concrete Plate	Retain existing
16	42	Tompira	43.13	22.0	2	4.0	Wooden Girder	Replace
16	43	Tompira	43.65	4.0	1	6.0	Concrete Plate	Retain existing
16	44	Tompira	43.70	4.5	1	6.0	Concrete Plate	Retain existing
16	45	Tompira	46.30	27.0	3	4.0	Wooden Girder	Replace
16	46	Tompira	46.70	10.0	2	4.0	Wooden Girder	Replace
16	47	Tompira	47.80	6.0	1	4.0	Wooden Girder	Replace
16	48	Tompira	47.90	4.0	1	6.0	Concrete Plate	Retain existing
16	49	Tompira	48.00	21.0	3	4.0	Wooden Girder	Replace
16	50	Tompira	48.80	4.0	1	6.0	Concrete Plate	Retain existing
16	51	Tompira	48.90	6.0	1	4.0	Wooden Girder	Replace
16	52	Tompira	49.75	4.0	1	6.0	Concrete Plate	Retain existing
16	53	Tompira	50.45	30.0	3	4.0	Wooden Girder	Replace
16	54	Tompira	51.20	12.0	2	4.0	Wooden Girder	Replace
16	55	Tompira	51.55	45.0	1	6.1	Steal Truss	Retain existing
16	56	Tompira	51.65	4.0	1	6.0	Concrete Plate	Retain existing
16	57	Tompira	53.30	4.5	1	6.0	Concrete Plate	Retain existing
16	58	Tompira	53.40	14.0	2	4.0	Wooden Girder	Replace
16	59	Tompira	54.00	8.0	1	4.0	Wooden Girder	Replace
16	60	Tompira	56.70	4.0	1	6.0	Concrete Plate	Retain existing
16	61	Tompira	57.80	29.0	3	4.0	Wooden Girder	Replace
16	62	Tompira	58.30	4.0	1	6.0	Concrete Plate	Retain existing
16	63	Tompira	61.43	7.0	1	4.0	Wooden Girder	Replace
16	64	Tompira	61.80	22.0	3	4.0	Wooden Girder	Replace
16	65	Tompira	62.70	4.0	1	6.0	Concrete Plate	Retain existing
16	66	Tompira	64.10	4.0	1	6.0	Concrete Plate	Retain existing
16	67	Tompira	64.45	12.0	2	4.0	Wooden Girder	Replace
16	68	Tompira	65.00	45.0	1	7.0	Steal Truss	Retain existing
16	69	Tompira	65.52	28.0	3	4.0	Wooden Girder	Replace
16	70	Tompira	65.53	23.0	3	4.0	Wooden Girder	Replace
16	71	Tompira	65.78	23.0	3	4.0	Wooden Girder	Replace
16	72	Tompira	69.00	29.0	3	4.0	Wooden Girder	Replace
16	73	Tompira	69.63	8.0	1	4.0	Wooden Girder	Replace
16	74	Tompira	70.40	4.5	1	6.0	Concrete Plate	Retain existing
16	75	Tompira	70.60	4.0	1	6.0	Concrete Plate	Retain existing
16	76	Tompira	73.10	20.0	2	4.0	Wooden Girder	Replace
16	77	Tompira	73.50	40.0	5	4.0	Wooden Girder	Replace
16	78	Tompira	73.70	20.0	2	4.0	Wooden Girder	Replace
16	79	Tompira	75.00	25.0	5	4.0	Wooden Girder	Replace
16	80	Tompira	77.00	5.0	1	6.0	Concrete Plate	Retain existing
16	81	Tompira	78.10	55.0	1	6.0	Steal Truss	Retain existing
16	82	Tompira	78.70	8.0	1	4.0	Wooden Girder	Replace
16	83	Tompira	79.20	24.0	3	4.0	Wooden Girder	Replace
16	84	Tompira	80.10	15.0	2	4.0	Wooden Girder	Replace
16	85	Tompira	80.70	4.0	1	6.0	Concrete Plate	Retain existing
16	86	Tompira	82.60	4.0	1	6.0	Concrete Plate	Retain existing
16	87	Tompira	82.90	4.0	1	6.0	Concrete Plate	Retain existing
16	88	Tompira	83.40	4.0	1	6.0	Concrete Plate	Retain existing
16	89	Tompira	88.90	4.0	1	6.0	Concrete Plate	Retain existing
16	90	Tompira	84.70	24.0	3	4.0	Wooden Girder	Replace
16	91	Tompira	85.70	8.0	1	4.0	Wooden Girder	Replace
16	92	Tompira	86.30	30.0	1	0.0	xxx	New Construction
16	93	Tompira	88.10	16.0	2	4.0	Wooden Girder	Replace
16	94	Tompira	88.80	8.0	1	4.0	Wooden Girder	Replace
16	95	Tompira	89.55	3.0	1	6.0	Concrete Plate	Retain existing
16	96	Tompira	89.80	4.0	1	6.0	Concrete Plate	Retain existing
16	97	Tompira	90.45	3.0	1	6.0	Concrete Plate	Retain existing
16	98	Tompira	91.30	3.0	1	6.0	Concrete Plate	Retain existing
16	99	Tompira	92.02	15.0	2	4.0	Wooden Girder	Replace
16	100	Tompira	93.62	28.0	1	0.0	xxx	New Construction
16	101	Tompira	104.85	26.0	1	0.0	xxx	New Construction
16	102	Tompira	106.45	28.0	1	0.0	xxx	New Construction

Source: Bina Marga

Table 10-2-28 Summary of Quantity of Bridge Improvement for Road Link No.16

	LINK NAME		ROAD LENGTH	QUANTITY OF BRIDGE CONSTRUCTION (m^2)			
				CLASSIFICATION BY SPAN LENGTH : L(m)			
			(km)	L<=10m	10m<L<=20m	20m<L<=30m	L>30m
16	TOMPIRA-BUNGKU						
	TOMPIRA	WOSU	55.4	300	600	660	0
	WOSU	BUNGKU	48.5	480	840	2,490	240
	TOTAL 16		103.9	780	1,440	3,150	240

Source: Study Team

(5) Cost Estimation (Link No. 16)

1) Estimated Project Cost

Cost items consist of preparation works, pavement, earth work, drainage, bridge, slope protection and safety facilities works. The engineering service cost is estimated at 20% of the total cost of direct and indirect cost. A contingency allowance has been included in 10 % of total construction and engineering cost. Table 10-2-29 shows the results of estimated project cost.

2) Implementation Plan

As shown in Figure 10-2-22, the construction period was proposed to be 5 years consisting of one year for preparation of project for fund raising plan, 1.5 years for detailed design of the roads and 2.5 years for construction. Also, the investment plan is set in accordance with the construction plan.

(6) Economic Analysis (Link No. 16)

1) Economic Project Costs

The economic investment costs are estimated in constant 1998 prices. The financial investment costs in terms of market price include the component of taxes. The economic costs for economic analysis are obtained by subtracting the portion of transfer payment such as taxes from financial costs. The financial and economic costs (initial investment and maintenance costs) are summarized in Table 10-2-30.

Table 10-2-30 Initial Investment and Maintenance Costs

(Million Rp.)

	Economic Prices
Initial Investment Cost (Construction)	222,633
Routine Maintenance Cost Per Year	189
Periodic Maintenance Cost Per Year	19,565

Source: Study Team

Table 10-2-29 Total Construction Cost for Tompira - Bungku Road (Link No. 16)

Rate: 1US$ = 10,600 Rp. = 140 Yen

Item	Unit	Quantity	Unit Price			Total Price			
			Foreign (US$)	Financial (Rp)	Economic (Rp)	Foreign (US$)	Local Financial (Rp)	Local Economic (Rp)	Financial Total (Mill. Rp)
1. Preparation Works									
Clearing and Grubbing	m^2	333,431	0.23	1,867	2,099	76,689	622,515,677	699,871,669	1,435
2. Pavement									
Road Asphalt Concrete + Sub Base (Type A)	m	103,900	39.50	436,896	392,152	4,104,050	45,393,494,400	40,744,592,800	88,896
Road Asphalt Concrete + Sub Base (Type B)	m	0	31.76	351,336	315,832	0	0	0	0
Road Asphalt Concrete + Sub Base (Type C)	m	0	16.15	188,584	175,452	0	0	0	0
Transport for Pavement Material (L = 43 km)	m^3	163,643	3.27	24,406	28,474	535,577	3,993,876,856	4,659,522,998	9,671
Sub-2						4,639,627	49,387,371,256	45,404,115,798	98,567
3. Earth Work									
Excavation (Common)	m^3	166,715	0.92	7,407	8,213	153,378	1,234,858,005	1,369,230,295	2,861
Excavation (Sound Rock)	m^3	0	4.12	33,605	36,492	0	0	0	0
Disposal Soil (L = 5 km)	m^3	16,672	1.20	8,610	10,050	20,006	143,541,615	167,548,575	356
Sub-3						173,384	1,378,399,620	1,536,778,870	3,217
4. Drainage									
Pipe Culvert (D = 100 cm)	m	1,039	44.35	634,758	554,426	46,080	659,513,562	576,048,614	1,148
Box Culvert (B = 2.0 m, H = 2.0 m)	m	520	325.89	3,064,762	2,510,606	169,300	1,592,143,859	1,304,259,817	3,387
U-Ditch (U = 30 cm)	m	25,969	1.71	41,910	36,720	44,407	1,008,360,790	953,581,680	1,559
Sub-4						259,787	3,260,018,211	2,833,890,111	6,094
5. Slope Protection									
Sprayed Concrete Cribwork	m^2	0	14.68	127,197	88,984	0	0	0	0
Shotcrete Work	m^2	0	11.82	101,390	67,157	0	0	0	0
Stone Masonry	m^3	0	6.91	116,286	109,711	0	0	0	0
Mat Gabion	m^2	0	9.20	72,584	61,374	0	0	0	0
Sodding	m^2	0	0.08	3,238	2,851	0	0	0	0
Sub-5						0	0	0	0
6. Tunnel	m	0	3,500.00	22,400,000	17,920,000	0	0	0	0
7. Bridges									
L<=10 m	m^2	780	206.20	2,233,568	1,843,094	160,838	1,742,183,105	1,437,613,645	3,447
10 m<L<=20 m	m^2	1,440	287.55	2,506,242	2,008,820	414,066	3,608,988,984	2,892,701,124	7,998
20 m<L<=30 m	m^2	3,150	313.65	2,643,773	2,102,930	988,001	8,327,886,403	6,624,231,005	18,801
30 m<L	m^2	240	345.02	2,908,151	2,313,224	82,804	697,956,194	555,173,646	1,576
Sub-7						1,645,709	14,377,014,686	11,509,719,420	31,822
8. Safety Facilities Works									
Guard Railing	m	10,390	11.30	168,012	143,025	117,407	1,745,644,680	1,486,029,750	2,990
Traffic Sign	each	346	27.98	426,548	373,259	9,690	147,727,791	129,272,034	250
Line Marking	m	103,900	0.42	4,231	3,518	43,638	439,600,900	365,520,200	902
Sub-8						170,735	2,332,973,371	1,980,821,984	4,142
9. Mobilization & Temporally Works (20 % of Total Cost)						1,370,539	14,527,717,160	12,639,113,929	29,055
10. Sub-Total						8,336,470	85,886,009,981	76,604,311,781	174,332
11. Engineering Cost (20 % of 10)						2,302,506	16,271,043,219	13,016,834,575	40,678
12. Contingency (10 % of 10 + 11)						1,063,898	10,223,705,320	8,962,114,636	21,501
Ground Total Cost (10+ 11 + 12)						11,702,874	112,380,758,520	98,583,260,992	236,511

Source: Study Team

Item	Unit	Quantity	1999	2000	2001	2002	2003	Total
1. Preparation of Project								
2. Survey and Design	km	103.9						
3. Construction								
Earth Work	m^3	16,671.5						
Slope Protection	m^2	-						
Tunnel	m	0.0						
Bridges	m	5,610.0						
Pavement	km	103.9						
Foreign (US$)				633,189	1,458,322	2,580,818	7,030,546	11,702,875
Local Financial Cost (Rp)				4,474,536,885	13,081,263,562	22,939,640,420	71,965,317,651	112,460,758,519
Local Economic Cost (Rp)				3,579,629,508	11,387,698,058	19,058,300,130	64,557,633,296	98,583,260,992
Total Financial Cost (Mill. Rp)				11,186	28,539	50,296	146,489	236,511
Total Economic Cost (Mill. Rp)				10,291	26,846	46,415	139,081	222,634

Source: Study Team

Figure 10-2-22 Implementation Schedule for Tompira - Bungku Road (Link No. 16)

The maintenance cost of the proposed road follows the engineering study results of the cost estimates. Besides, the maintenance cost of the proposed road in the case of "without the improvement of the proposed road" is treated as a negative cost.

2) Economic Benefits

Benefits are classified into two types, one is the direct benefit and the other is the indirect benefit or intangible benefit.

The direct benefits which would be realized from the implementation of the Project are defined as the savings in travel costs, composed of the vehicle operating cost and vehicle time cost when comparing the "With" and "Without" project conditions.

The benefit of vehicle operating costs is estimated as a difference of vehicle operating costs between "With" Project" case and "Without" Project" case. The vehicle operating cost is derived from the obtained daily vehicle-kilometers and the unit vehicle operating cost by vehicle type. In addition, traffic safety will be improved and accident costs reduced.

In this economic analysis, the above mentioned direct benefit, e.g. the vehicle operating cost saving is computed as a quantified benefit. The calculation of direct benefits are made for the planning year of 2003 and 2018.

As a result, the saving in vehicle operating cost is summarized as shown in Table 10-2-31.

Table 10-2-31 Estimated Economic Benefits

(Million Rp. at 1998 price)

Year	Benefit of Saving in VOC
2004	51,919
2018	121,650

Source: Study Team

3) Economic Cost-Benefit Analysis

The analysis follows the conventional discounted cash flow method in determining the economic internal rate of return (EIRR), the net present value (NPV) and the benefit cost ratio (B/C). (NPV and B/C are calculated at a discount rate of 15 percent.) The project life is assumed to be 20 years after the completion of the construction.

The benefits in the intermediate years were interpolated and those beyond 2018 were assumed to be fixed. The total economic project costs and benefits streams are presented in Table 10-2-32. The efficiency measures were calculated and the summary is as follows:

Table 10-2-32 Economic Analysis for Link No.16

(Million Rp.)

	Year	Benefits		Costs			Maint. Cost (Without)	Net Cash Flow
		VOC Saving	Total	Invest. Costs	Maint. Cost (With)	Total		
1	1999			0	0	0	0	0
2	2000			10,291	189	10,480	189	-10,291
3	2001			26,846	189	27,035	189	-26,846
4	2002			46,415	189	46,604	189	-46,415
5	2003	0	0	139,081	189	139,270	189	-139,081
6	2004	51,919	51,919	0	189	189	13,066	64,796
7	2005	56,900	56,900	0	189	189	189	56,900
8	2006	61,881	61,881	0	189	189	189	61,881
9	2007	66,861	66,861	0	189	189	189	66,861
10	2008	71,842	71,842	0	189	189	189	71,842
11	2009	76,823	76,823	0	189	189	13,066	89,700
12	2010	81,804	81,804	0	19,565	19,565	189	62,428
13	2011	86,784	86,784	0	189	189	189	86,784
14	2012	91,765	91,765	0	189	189	13,066	104,642
15	2013	96,746	96,746	0	189	189	189	96,746
16	2014	101,727	101,727	0	189	189	189	101,727
17	2015	106,707	106,707	0	189	189	13,066	119,584
18	2016	111,688	111,688	0	189	189	189	111,688
19	2017	116,669	116,669	0	19,565	19,565	189	97,293
20	2018	121,650	121,650	0	189	189	13,066	134,527
21	2019	121,650	121,650	0	189	189	189	121,650
22	2020	121,650	121,650	0	189	189	189	121,650
23	2021	121,650	121,650	0	189	189	13,066	134,527
24	2022	121,650	121,650	0	189	189	189	121,650
25	2023	121,650	121,650	0	189	189	189	121,650
				222,633	43,288	265,921	81,798	

Source: Study Team

Efficiency Measures	
EIRR	27.3 %
NPV (Million Rp.)	128,508
B/C	2.13

Source: Study Team

These results indicate that implementation of the Project (road development of link No.16) is economically feasible.

10.2.6 Bungku – Border of province (Link No. 22)

(1) Route description

The area covered by the project is located along a severe land configuration of limestone, in which mountain ridges extend directly to the shoreline. In the flat land portion, paddy fields are developed and palms and tapioca are cultivated. Villages are distributed in the flat land near the shoreline and the fishing industry is active. The existing road has been designated as a provincial road running roughly parallel to the shoreline. The sections of road traversing the portions where mountain ridges extend to the shoreline are less than 4 m in width. The road is either gravel or dirt, and bridges are mostly made of wood. Many bridges require improvement. The topography around the road concerned is steep and the road is based on a low standard of design. The road alignment and road surface conditions are poor, making smooth driving of vehicles difficult. Road improvement is essential in order to secure transportation between regions. This road is also a part of the Trans-Sulawesi east route connecting to South and East Sulawesi and will become a critical trunk road in the future.

Location of roads concerned

- Province: Central Sulawesi
- Kabupaten: Poso
- Kecamaten Bunku Tengah Bungku Sulatan
- Major cities and settlement: Bungku, Bahodopi, Betebete, Tongofa, Buleleng
- Link length: 115.0 km

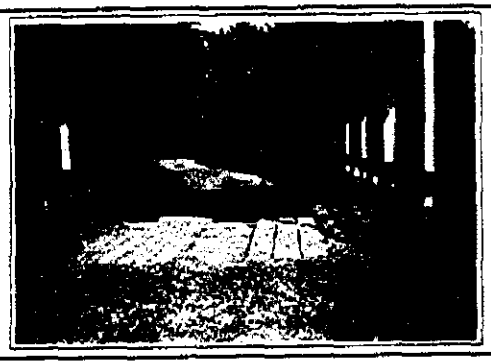
(2) Road Traffic

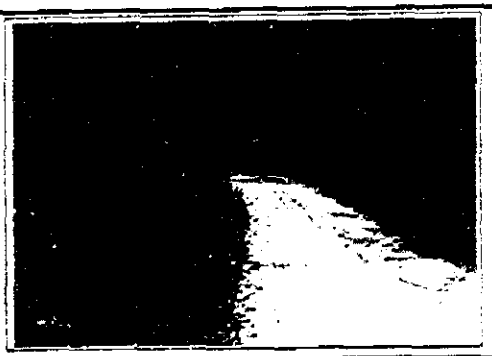
The future traffic demand of the road link are summerized as indicated in Table 10-2-33.

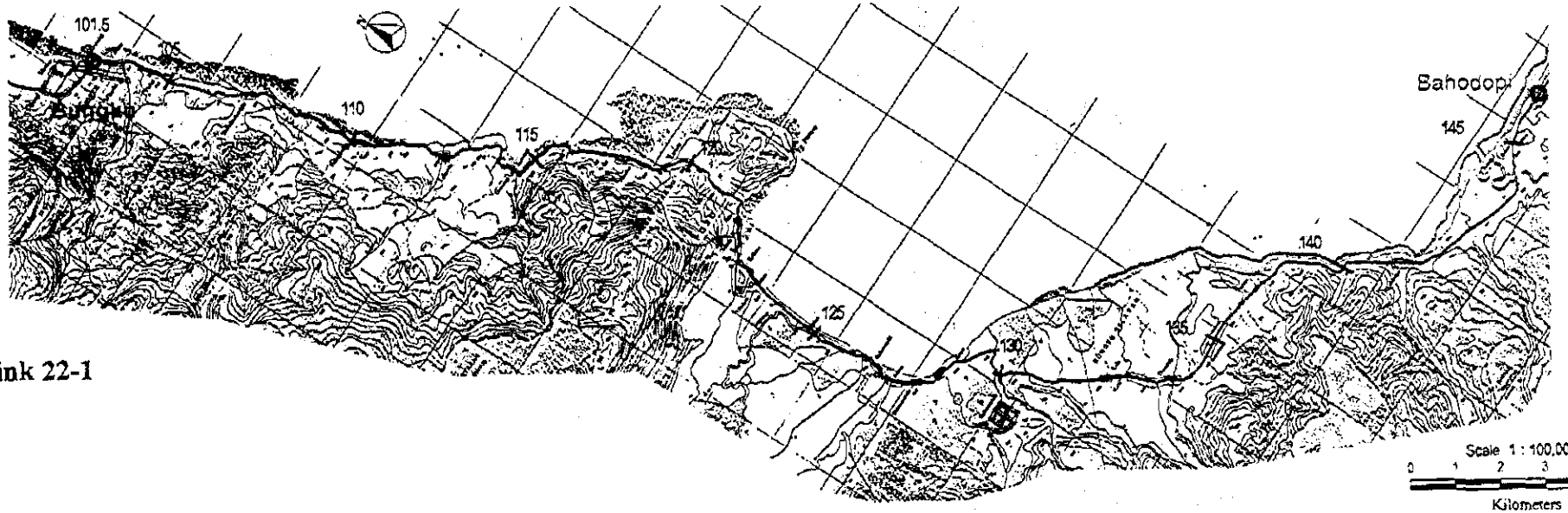
Table 10-2-33 Future Traffic Volume of Bungku - Border of province

	Year 2003 (vehicle/day)	Year 2018 (vehicle/day)
Motorcycle	335	441
Passenger cars	162	224
Buses	333	347
Trucks	569	750
Total	1399	1762

Source: Study Team







Link 22-1

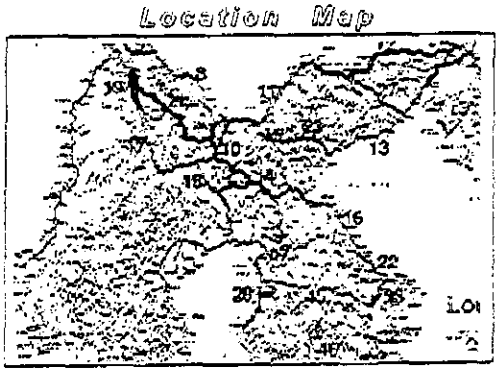
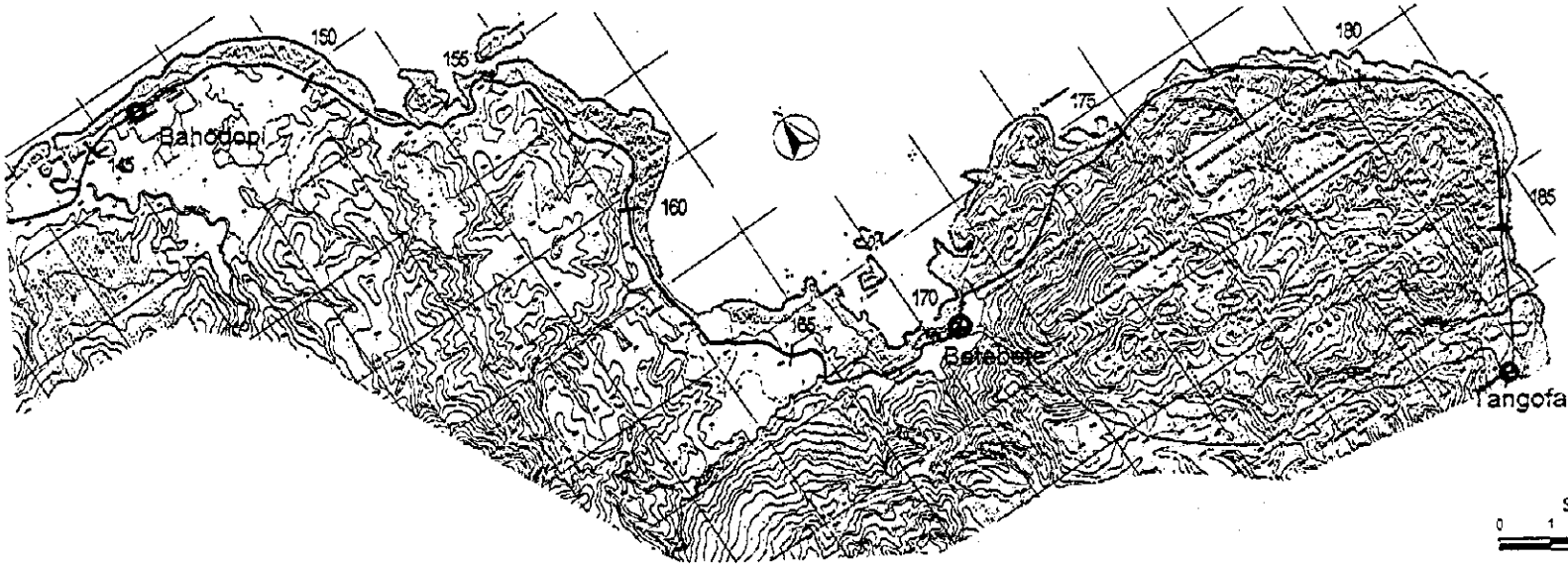


Figure 10-2-23 (1)

Link 22-2



Location Map

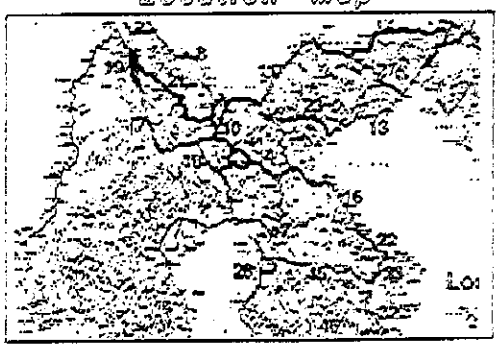


Figure 10-2-23 (2)

Link 22-3

Location Map

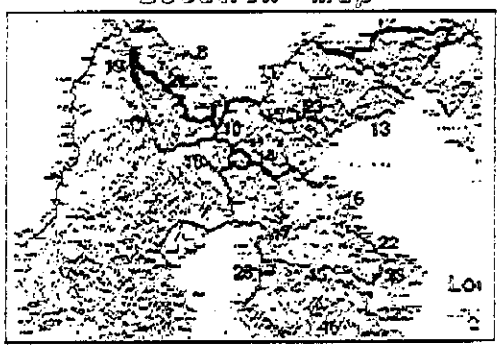
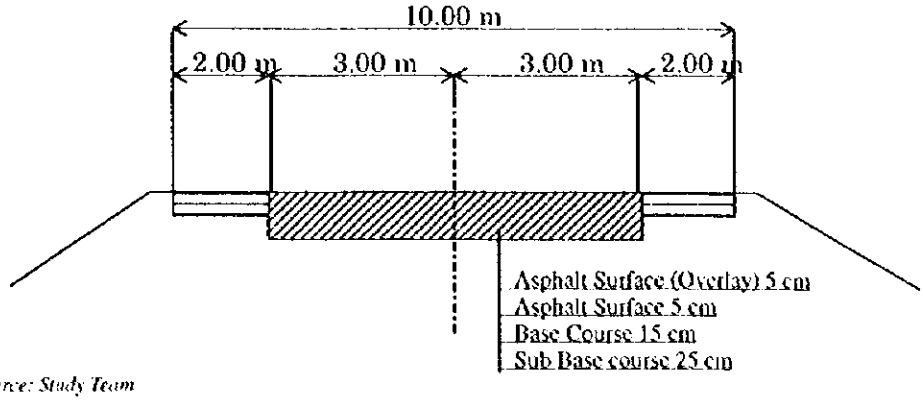


Figure 10-2-23 (3)

(3) Typical Cross Section and Pavement (Link No. 22)

The total width will be 10 m (or 8 m in mountainous area), including 6.0 m for the pavement of carriage way and 2.00 m for shoulders in flat sections.



Source: Study Team

Figure 10-2-24 Typical Cross Section for Link No. 22

The pavement will be of A type of a surface thickness of 5 cm, asphalt treated base cpurse, 15 cm and subbase course, 25 cm. The plan also calls for an additional surface course of 5 cm as an overlay in seven years after road construction. The pavement thickness was decided based on the future traffic demand.

(4) Preparatory Engineering of Bridges (Link No. 22)

Typical cross section of bridge is shown in Figure 10-2-14 and the bridge improvement concept is shown in Figure 10-2-15.

Existing bridge condition and bridge improvement plan on the road of link No.22 are listed in Table 10-2-34.

Quantity of bridge improvement on the road link No.22 is summarized in Table 10-2-35.

Table 10-2-34 Existing Bridge and Bridge Improvement Plan for Road Link No.22

Road Link No	Bridge No	Location From	Location Km	Length (m)	Nos Span	Width (m)	Type of Super structure	Improvement Plan
22	1	Pohara	120.6	5.0	1	4.0	Wooden Girder	Replace
22	2	Pohara	123.8	5.0	1	4.0	Wooden Girder	Replace
22	3	Pohara	124.3	5.0	1	4.0	Wooden Girder	Replace
22	4	Pohara	124.6	3.0	1	4.0	Wooden Girder	Replace
22	5	Pohara	125.8	5.0	1	4.0	Wooden Girder	Replace
22	6	Pohara	127.8	5.0	1	4.0	Wooden Girder	Replace
22	7	Pohara	129.7	5.0	1	4.0	Wooden Girder	Replace
22	8	Pohara	130.2	15.0	1	4.0	Wooden Girder	Replace
22	9	Pohara	133.0	5.0	1	4.0	Wooden Girder	Replace
22	10	Pohara	134.2	5.0	1	4.0	Wooden Girder	Replace
22	11	Pohara	134.4	5.0	1	4.0	Wooden Girder	Replace
22	12	Pohara	134.7	5.0	1	4.0	Wooden Girder	Replace
22	13	Pohara	135.2	10.0	1	4.0	Wooden Girder	Replace
22	14	Pohara	136.7	8.0	1	4.0	Concrete Plate	Widening
22	15	Pohara	137.9	5.0	1	4.0	Concrete Plate	Widening
22	16	Pohara	140.3	120.0	6	3.0	Bailey	Replace
22	17	Pohara	141.1	30.0	3	3.0	Wooden Girder	Replace
22	18	Pohara	142.1	20.0	2	3.0	Wooden Girder	Replace
22	19	Pohara	143.2	5.0	1	3.0	Wooden Girder	Replace
22	20	Pohara	143.6	15.0	1	3.0	Wooden Girder	Replace
22	21	Pohara	143.9	5.0	1	3.0	Wooden Girder	Replace
22	22	Pohara	144.0	10.0	1	3.0	Wooden Girder	Replace
22	23	Pohara	147.1	10.0	1	3.0	Wooden Girder	Replace
22	24	Pohara	148.3	5.0	1	3.0	Wooden Girder	Replace
22	25	Pohara	149.7	10.0	1	3.0	Wooden Girder	Replace
22	26	Pohara	150.1	5.0	1	3.0	Wooden Girder	Replace
22	27	Pohara	152.2	10.0	1	3.0	Wooden Girder	Replace
22	28	Pohara	152.6	5.0	1	3.0	Wooden Girder	Replace
22	29	Pohara	152.6	5.0	1	3.0	Wooden Girder	Replace
22	30	Pohara	153.1	5.0	1	3.0	Wooden Girder	Replace
22	31	Pohara	154.5	5.0	1	3.0	Wooden Girder	Replace
22	32	Pohara	155.3	5.0	1	3.0	Wooden Girder	Replace
22	33	Pohara	156.8	30.0	3	4.0	Wooden Girder	Replace
22	34	Pohara	158.9	15.0	1	4.0	Wooden Girder	Replace
22	35	Pohara	160.4	30.0	3	4.0	Wooden Girder	Replace
22	36	Pohara	161.3	30.0	3	4.0	Wooden Girder	Replace

Source: Bina Marga

Table 10-2-35 Summary of Quantity of Bridge Improvement for Road Link No.22

	LINK NAME		ROAD LENGTH (km)	QUANTITY OF BRIDGE CONSTRUCTION (m^2) CLASSIFICATION BY SPAN LENGTH : L(m)			
				L<=10m	10m<L<=20m	20m<L<=30m	L>30m
22	BUNGKU-S.E						
	BUNGKU	LABOTA	43.9	952	390	720	720
	LABOTA	LAFEU	51.1	1,108	454	838	838
	LAFEU	S.E	20.0	480	240	0	0
	TOTAL 22		115.0	2,540	1,084	1,558	1,558

Source: Study Team

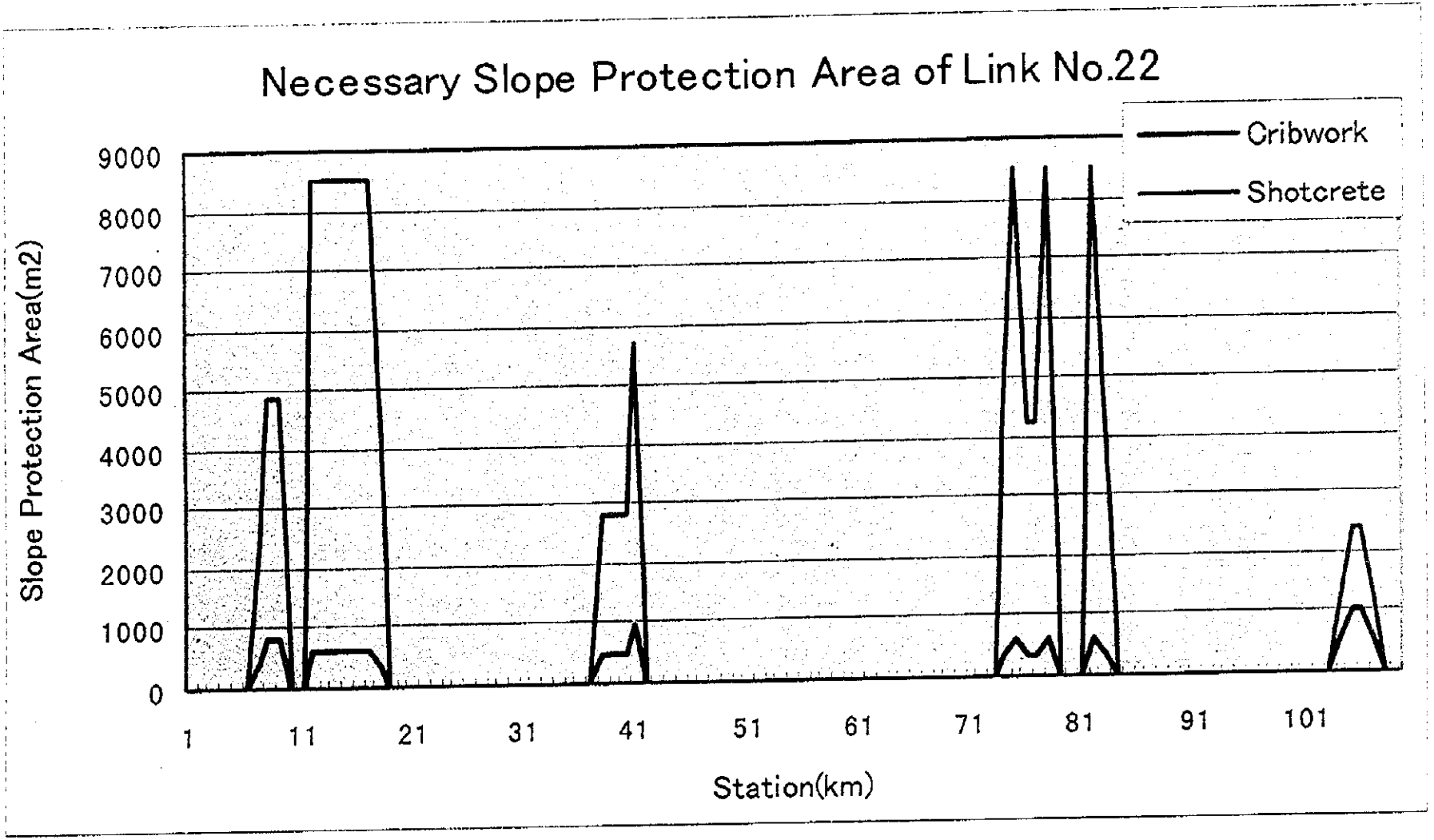
(5) Preparatory Engineering of Slope Protection Works (Link No. 22)

Slope protection works are constructed to protect the slopes from erosion or weathering by covering them with vegetation or structures and also to stabilize the slopes by means of drainage works or retaining structures. The following types of slope protection works are adopted for the pre-feasibility route considering the terrain and geology, as shown in Table 10-2-36.
Necessary length of slope protection works for each link is shown in Figure 10-2-25.

Table 10-2-36 Quantities of Slope Protection

	Cut			Fill
	Sprayed Concrete Cribwork(m^2)	Shotcrete (m^2)	Stone Masonry (m^2)	Mat Gabion (m^2)
Quantity	14,646	131,812	8,974	14,454

Source: Study Team



Source: Study Team

Figure 10-2-25 Necessary Slope Protection Area

(6) Preparatory Engineering of Tunnel (Link No. 22)

Tunnels are commonly constructed for the purpose of:

- Securing and improving horizontal and vertical alignment of the road
- Preventing disasters such as landslide, rockslide due to erosion, etc.
- Saving time and cost by reducing of distance
- Protecting of natural and social environment.

This road will be constructed along a coastal cliff. At station No.115 km, and between 175～180 km, there is high risk of landslide and rockslide due tu erosion, both of which can occure without warning. To prevent this, tunnels were planned at locations No. 115 km and 175 km.

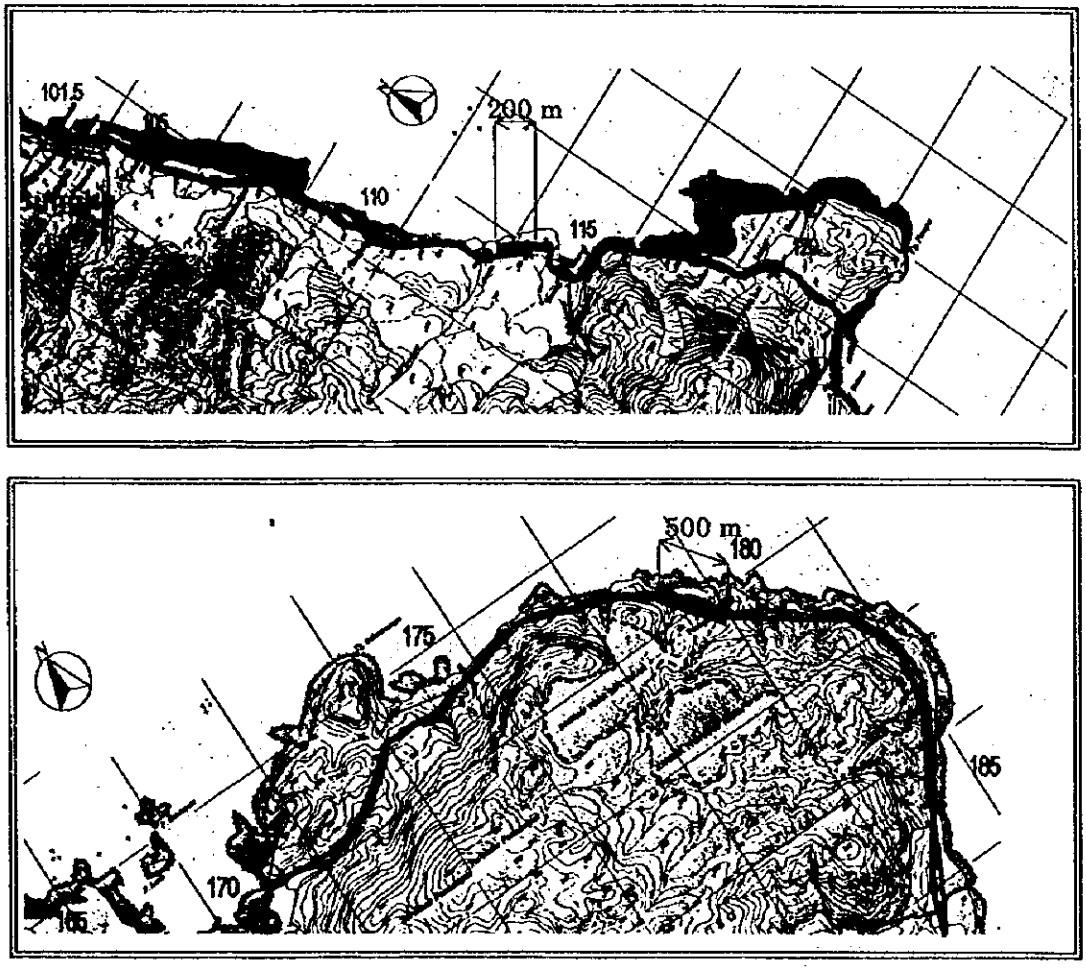
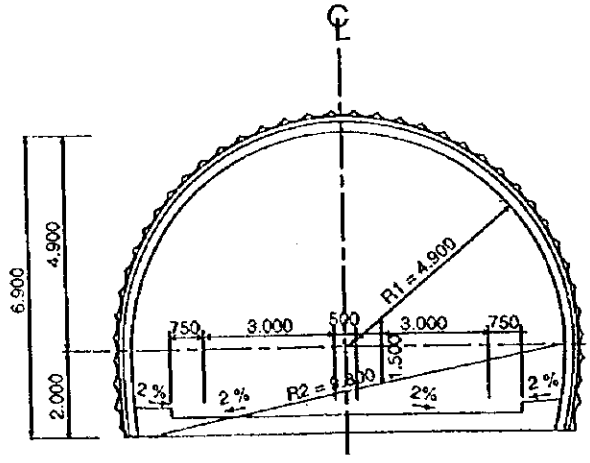


Figure 10-2-26 Tunnel Location Map for Link No.22

Tunnel cross section was decided based on the tunnel design as shown below.



Source: Study Team

Figure 10-2-27 Tunnel Cross section

(7) Cost Estimate (Link No. 22)

1) Estimated Project Cost

Cost items consist of preparation works, pavement, earth work, drainage, bridge, slope protection, tunnel and safety facilities works. The engineering service cost is estimated at 18% of the total cost of direct and indirect cost. A contingency allowance has been included in 10 % of total construction and engineering cost. Table 10-2-37 shows the result of estimated project cost.

2) Implementation Plan

As shown in Figure 10-2-28, the construction period was proposed to be 5 years consisting of one year for preparation of project for fund raising plan, 1.5 years for detailed design of the roads and 2.5 years for construction. Also, the investment plan is set in accordance with the construction plan.

Table 10-2-37 Total Construction Cost for Bungku - S.E. Road (Link No. 22)

Rate: 1US$ = 10,600 Rp. = 140 Yen

Item	Unit	Quantity	Unit Price			Total Price			
			Foreign (US$)	Financial (Rp)	Economic (Rp)	Foreign (US$)	Local Financial (Rp)	Local Economic (Rp)	Financial Total (Mill. Rp)
1. Preparation Works									
Clearing and Grubbing	m^2	946,235	0.23	1,867	2,099	217,634	1,766,620,745	1,986,147,265	4,074
2. Pavement									
Road Asphalt Concrete + Sub Base (Type A)	m	115,000	39.50	436,896	392,152	4,542,500	50,243,040,000	45,097,480,000	98,394
Road Asphalt Concrete + Sub Base (Type B)	m	0	31.76	351,336	315,832	0	0	0	0
Road Asphalt Concrete + Sub Base (Type C)	m	0	16.15	188,584	175,452	0	0	0	0
Transport for Pavement Material (L = 43 km)	m^3	181,125	3.62	27,014	31,516	656,125	4,892,820,188	5,708,290,219	11,848
Sub-2						5,198,625	55,135,860,188	50,805,770,219	110,242
3. Earth Work									
Excavation (Common)	m^3	851,612	0.92	7,407	8,213	783,483	6,307,890,084	6,994,289,356	14,613
Excavation (Sound Rock)	m^3	94,623	4.12	33,605	36,492	389,847	3,179,805,915	3,452,982,516	7,312
Disposal Soil (L = 5 km)	m^3	94,624	1.20	8,610	10,050	113,548	814,708,335	950,966,175	2,018
Sub-3						1,286,878	10,302,404,334	11,398,238,047	23,943
4. Drainage									
Pipe Culvert (D = 100 cm)	m	1,150	44.35	634,758	554,426	51,003	729,971,700	637,589,900	1,271
Box Culvert (B = 2.0 m, H = 2.0 m)	m	575	325.89	3,064,762	2,510,606	187,387	1,762,238,150	1,443,598,450	3,749
U-Ditch (U = 30 cm)	m	28,750	1.71	41,910	36,720	49,163	1,204,912,500	1,055,700,000	1,726
Sub-4						287,553	3,697,122,350	3,136,888,350	6,746
5. Slope Protection									
Sprayed Concrete Cribwork	m^2	14,646	14.68	127,197	88,984	215,003	1,862,927,262	1,303,259,664	4,142
Shotcrete Work	m^2	131,812	11.82	101,390	67,157	1,558,018	13,364,418,680	8,852,098,484	29,879
Stone Masonry	m^2	8,974	6.91	116,286	109,711	62,010	1,043,550,564	984,546,514	1,701
Mat Gabion	m^2	14,454	9.20	72,584	61,374	132,977	1,049,129,136	887,099,796	2,459
Sodding	m^2	57,816	0.08	3,238	2,851	4,625	187,208,208	164,833,416	236
Sub-5						1,972,633	17,507,233,850	12,191,837,874	38,417
6. Tunnel	m	700	3,500.00	22,400,000	17,920,000	2,450,000	15,680,000,000	12,544,000,000	41,650
7. Bridges									
L<=10 m	m^2	2,540	206.20	2,233,568	1,843,094	523,756	5,673,262,932	4,681,459,818	11,225
10 m<L<=20 m	m^2	1,084	287.55	2,506,242	2,008,820	311,700	2,716,766,707	2,177,561,124	6,021
20 m<L<=30 m	m^2	1,558	313.65	2,643,773	2,102,930	488,669	4,118,999,052	3,276,365,684	9,299
30 m<L	m^2	1,558	345.02	2,908,151	2,313,224	537,535	4,530,898,958	3,604,002,253	10,229
Sub-7						1,861,660	17,039,927,649	13,739,388,879	36,774
8. Safety Facilities Works									
Guard Railing	m	11,500	11.30	168,012	143,025	129,950	1,932,138,000	1,644,787,500	3,310
Traffic Sign	each	383	27.98	426,548	373,259	10,726	163,510,067	143,082,617	277
Line Marking	m	115,000	0.42	4,231	3,518	48,300	486,565,000	404,570,000	999
Sub-8						188,976	2,582,213,067	2,192,440,117	4,586
9. Mobilization & Temporally Works (20 % of Total Cost)						2,513,484	26,642,933,658	23,179,352,283	53,286
10. Sub-Total						15,977,443	150,354,315,841	131,174,063,034	319,718
11. Engineering Cost (20 % of 10)						4,222,654	29,840,085,697	23,872,068,558	74,600
12. Contingency (10 % of 10 + 11)						2,020,010	18,019,440,154	15,504,613,159	39,432
Ground Total Cost (10+ 11 + 12)						22,220,107	198,213,841,692	170,550,744,751	433,750

Source: Study Team

Item	Unit	Quantity	1999	2000	2001	2002	2003	Total
1. Preparation of Project								
2. Survey and Design	km	115.0						
3. Construction								
Earth Work	m^3	946,235.0						
Slope Protection	m^2	-						
Tunnel	m	700.0						
Bridges	m	6,740.0						
Pavement	km	115.0						
Foreign (US$)				1,161,230	3,861,924	7,108,092	10,088,859	22,220,105
Local Financial Cost (Rp)				8,206,023,567	31,930,121,737	59,633,424,017	98,444,272,371	198,213,841,692
Local Economic Cost (Rp)				6,564,818,853	28,692,596,200	48,973,667,161	86,319,662,536	170,550,744,751
Total Financial Cost (Mill. Rp)				20,515	72,867	134,979	205,386	433,747
Total Economic Cost (Mill. Rp)				18,874	69,629	124,319	193,262	406,084

Source: Study Team

Figure 10-2-28 Implementation Schedule for Bungku - S.E. Road (Link No. 22)

(8) Economic Analysis (Link No. 22)

1) Economic Project Costs

The economic investment costs are estimated in constant 1998 prices. The financial investment costs in terms of market price include the component of taxes. The economic costs for economic analysis are obtained by subtracting the portion of transfer payment such as taxes from financial costs. The financial and economic costs (initial investment and maintenance costs) are summarized in Table 10-2-38.

Table 10-2-38 Initial Investment and Maintenance Costs

(Million Rp.)

	Economic Prices
Initial Investment Cost (Construction)	406,084
Routine Maintenance Cost Per Year	209
Periodic Maintenance Cost Per Year	21,446

Source: Study Team

The maintenance cost of the proposed road follows the engineering study results of the cost estimates. Besides, the maintenance cost of the proposed road in the case of "without the improvement of the proposed road" is treated as a negative cost.

2) Economic Benefits

Benefits are classified into two types, one is the direct benefit and the other is the indirect benefit or intangible benefit.

The direct benefits which would be realized from the implementation of the Project are defined as the savings in travel costs, composed of the vehicle operating cost and vehicle time cost when comparing the "With" and "Without" project conditions.

The benefit of vehicle operating costs is estimated as a difference of vehicle operating costs between "With" Project" case and "Without" Project" case. The vehicle operating cost is derived from the obtained daily vehicle-kilometers and the unit vehicle operating cost by vehicle type. In addition, traffic safety will be improved and accident costs reduced.

In this economic analysis, the above mentioned direct benefit, e.g. the vehicle operating cost saving is computed as a quantified benefit. The calculation of direct benefits are made for the planning year of 2003 and 2018.

As a result, the saving in vehicle operating cost is summarized as shown in Table 10-2-39.

Table 10-2-39 Estimated Economic Benefits

(Million Rp. at 1998 price)

Year	Benefit of Saving in VOC
2004	53,331
2018	128,080

Source: Study Team

3) Economic Cost-Benefit Analysis

The analysis follows the conventional discounted cash flow method in determining the economic internal rate of return (EIRR), the net present value (NPV) and the benefit cost ratio (B/C). (NPV and B/C are calculated at a discount rate of 15 percent.) The project life is assumed to be 20 years after the completion of the construction.

The benefits in the intermediate years were interpolated and those beyond 2018 were assumed to be fixed. The total economic project costs and benefits streams are presented in Table 10-2-40. The efficiency measures were calculated and the summary is as follows:

Table 10-2-40 Economic Analysis for Link No. 22

(Million Rp.)

	Year	Benefits		Costs			Maint. Cost (Without)	Net Cash Flow
		VOC Saving	Total	Invest. Costs	Maint. Cost (With)	Total		
1	1999			0	0	0	0	0
2	2000			18,874	209	19,083	14,462	-4,621
3	2001			69,629	209	69,838	209	-69,629
4	2002			124,319	209	124,528	209	-124,319
5	2003	0	0	193,262	209	193,471	209	-193,262
6	2004	53,331	53,331	0	209	209	209	53,331
7	2005	58,670	58,670	0	209	209	14,462	72,923
8	2006	64,010	64,010	0	209	209	209	64,010
9	2007	69,349	69,349	0	209	209	209	69,349
10	2008	74,688	74,688	0	209	209	209	74,688
11	2009	80,027	80,027	0	209	209	209	80,027
12	2010	85,366	85,366	0	21,655	21,655	14,462	78,173
13	2011	90,705	90,705	0	209	209	209	90,705
14	2012	96,045	96,045	0	209	209	209	96,045
15	2013	101,384	101,384	0	209	209	14,462	115,637
16	2014	106,723	106,723	0	209	209	209	106,723
17	2015	112,062	112,062	0	209	209	209	112,062
18	2016	117,401	117,401	0	209	209	14,462	131,654
19	2017	122,741	122,741	0	21,655	21,655	209	101,295
20	2018	128,080	128,080	0	209	209	209	128,080
21	2019	128,080	128,080	0	209	209	14,462	142,333
22	2020	128,080	128,080	0	209	209	209	128,080
23	2021	128,080	128,080	0	209	209	209	128,080
24	2022	128,080	128,080	0	209	209	14,462	142,333
25	2023	128,080	128,080	0	209	209	209	128,080
				406,084	47,908	453,992	104,787	

Source: Study Team

Efficiency Measures	
EIRR	17.5 %
NPV (Million Rp.)	42,357
B/C	1.20

Source: Study Team

These results indicate that implementation of the Project (road development of link No.22) is economically feasible.