8. FORMULATION OF ROAD DEVELOPMENT PLANS

8.1 ROAD SPECIFICATIONS AND DESIGN SPEED

Table 8.1 Road specifications and design speed

Item		Unit	Paraná River Coastal Road	Extension of National Road Route 15	Port Access Road
Design speed		km/h	100	80	50
Minimum curve radius		m	460	260	90
Steepest longitudinal gradient	Flat	%	3	4	6
	Rolling	%	4	5	7
	Mountainous	%	6	7	9

8.2 INVESTIGATION OF NUMBER OF LANES, CROSS-SECTION STRUCTURE

(1) Study on number of lanes

For the road in this plan, the number of lanes will be set to two, given the expected maximum volume of 3,500 vehicles/day.

Table 8.2 Number of lanes at each road

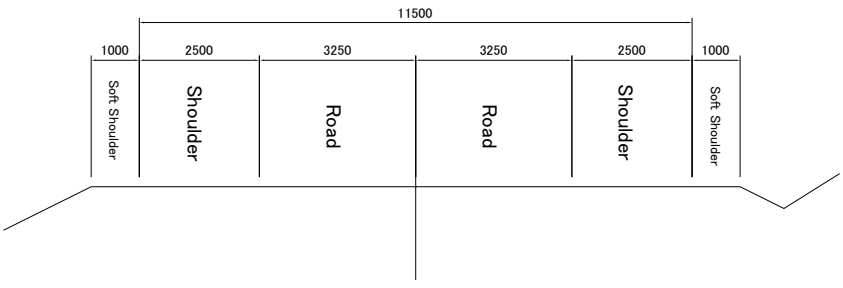
Road name	Planned traffic volume (max.)	No. of lanes
Paraná River Coastal Road	2,930 cars/day	2
Extension of National Road Route 15	1,310 cars/day	2
Port access roads	3,530 cars/day	2

(2) Study on road cross-section structure

1) Earthwork

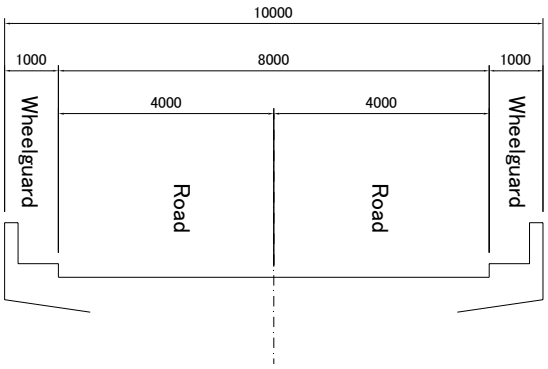
Road width: Large trucks use it with great frequency and the design speed is fast, at V=100 km/h. Therefore, the road width of the road will be set at 3.25 m in accordance with the standards given above.

Shoulder width: Given the characteristics of this road and the possibility of large trucks stopping on the shoulder of the road, due to breakdowns or other trouble, the shoulder width is set at 2.50 m, in accordance with the standards given above.



2) Bridges

For the width of bridges, the standard is for a roadway width of 4.0 m including the shoulder. Looking at the breakdown of this figure, if the road width is set at 3.25 m, the shoulder width would be 0.75 m. This will allow sufficient width for a large truck. Therefore, the road width will be set in accordance with the standard.



8.3 DISCUSSING ALTERNATIVE ROUTES

Possible alternative routes between the following seven districts are compared.

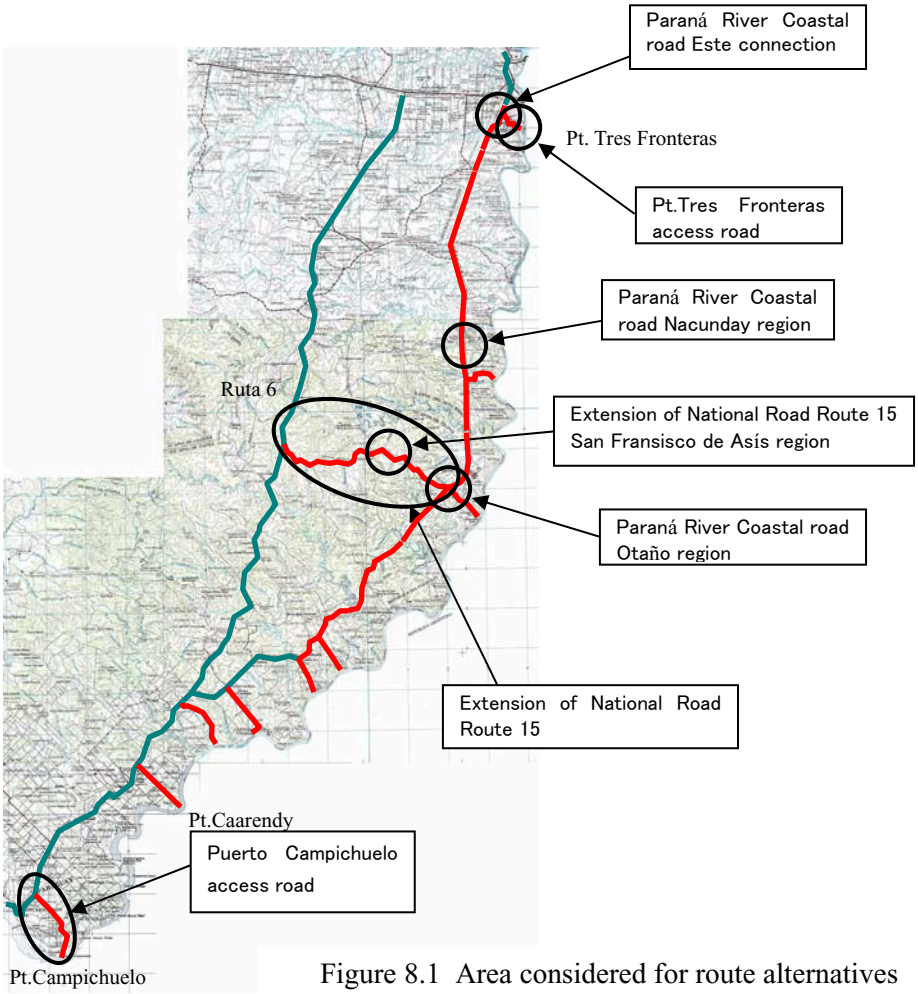


Figure 8.1 Area considered for route alternatives

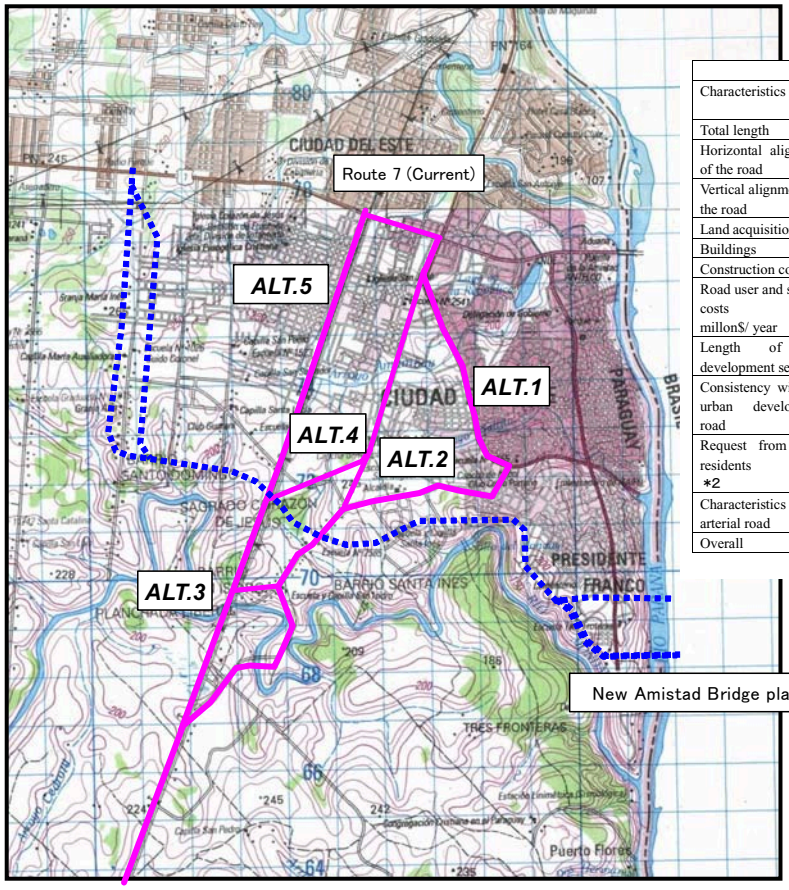
(1) Paraná River Coastal Road

1) Ciudad del Este region

Assuming the construction of the new Amistad Bridge as a prerequisite, the following five alternative routes were deemed possible given the relation of existing roads, and in consideration of this route as a national route within the national highway system plan (Itapúa – Alto Paraná – Canindeyu).

Alternative 1: Upgrading existing roads
Alternative 2: Direct connection to the Alto Paraná – Canindeyu road (1)
Alternative 3: Direct connection to the Alto Paraná – Canindeyu road (2)
Alternative 4: Direct connection to the Alto Paraná – Canindeyu road (3)
Alternative 5: Direct connection with National Road Route 7

Mainly five alternative plans were worked out on how to take the route through Presidente Franco City which is located next to Ciudad del Este, including a plan to use existing roads, a plan to use newly installed roads, and some combinations of the both. We compared and examined the characteristics of each route, and selected the Plan 3.



Characteristics	Plan 1 Existing Route	Plan 2 Existing bridge	Plan 3 Existing road	Plan 4 New installation	Plan 5 High voltage cable
Total length	14.5	11.7	11.3	11.3	11.3
Horizontal alignment of the road	×	△	○	○	○
Vertical alignment of the road	△	△	○	○	○
Land acquisition (km)	0	1.0	2.0	2.2	0
Buildings	10	20	15	5	0
Construction cost	2.5	3.2	4.9	5.1	5.2
Road user and society costs millon$/ year	-1.7	-0.24	0	0	0
Length of the development section	0	4.9	8.6	10.2	10.7
Consistency with the urban development road	○	○	○	×	×
Request from the residents *2	○	△	△	×	×
Characteristics of the arterial road	×	△	○	○	△
Overall	×	△	○	○	△

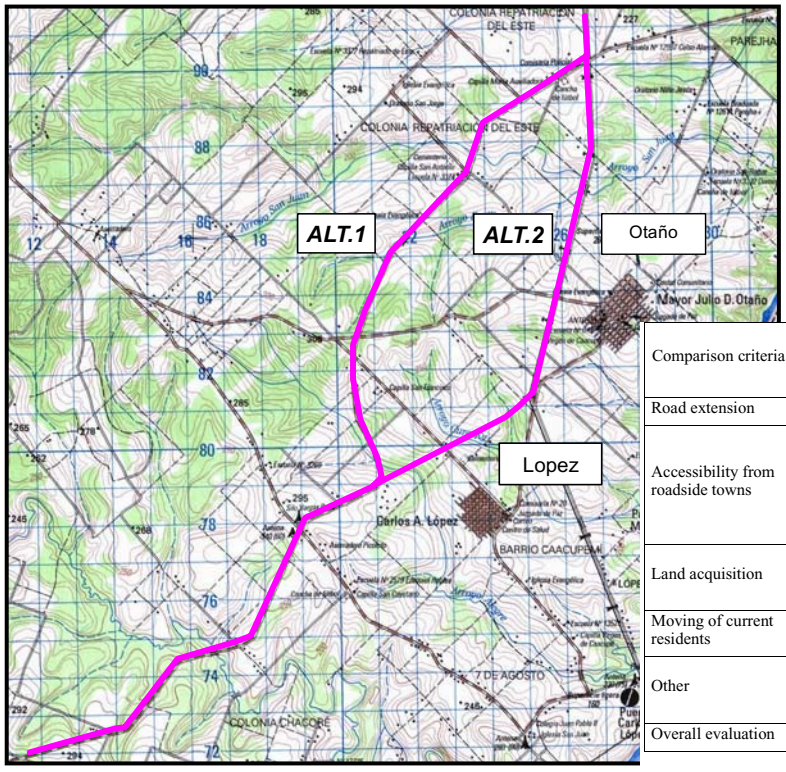
Figure 8.2 Ciudad del Este region alternative routes

2) Otaño region

Two alternative routes were considered in the vicinity of the Mayor Julio de Otaño and Carlos A. López villages, either the road following the high-tension power line rights-of-way, or a road branching off of that road.

Alternative 1: Use existing roads

Alternative 2: Use the high-tension power line rights-of-way



Comparison criteria	Alternative 1 Using existing roads	Alternative 2 Using high-tension power line rights-of-way
Road extension	14.0km	13.8km
Accessibility from roadside towns	Road would be 7.3km from Mayor Julio de Otaño and 5.4km from Carlos A. Lopez urban areas; low accessibility to planned road. Likewise low accessibility between the two towns.	Road would be 1km from Mayor Julio de Otaño and Carlos A. Lopez urban areas, improving accessibility to planned road, and accessibility between the two towns.
Land acquisition	Land acquisition required to change road's horizontal, vertical, and cross-sectional layout.	Some new road construction areas, requiring more land acquisition than Alternative 1.
Moving of current residents	No need to move residents.	A number of residents would need to be moved.
Other		Following hearings, roadside towns would like the road located as close to the urban areas as possible.
Overall evaluation	△	○

Figure 8.3 Otaño region alternative routes

Though there would be some impact on the living environment along the road, this plan focuses on regional accessability and promoting development, and from this standpoint, Alternative 2, the proposal to use the high-tension power line rights-of-way, was selected.

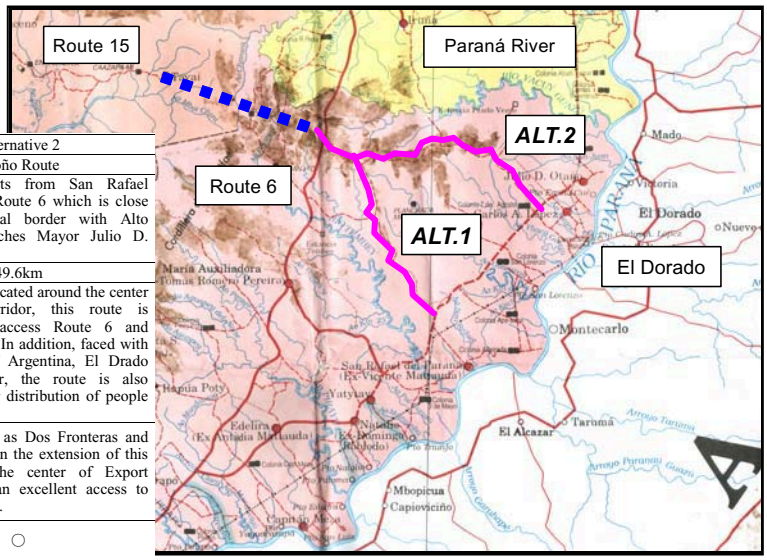
(2) Extension of National Road Route 15

National Route 15 is relatively developed from Villarrica in Guairá state through to Tavai in Caasapá state, but from Tavai until National Road Route 6, the specified road is missing as it has not yet been developed. The planned area for the National Road Route 15 extension in this survey goes from National Road Route 6 through to the presently planned road along the Paraná river, with the following two alternatives that use existing roadways.

Alternative 1: San Rafael del Paraná route

Alternative 2: Otaño route

Alternative 2 connects to Otaño Ferry Terminal at Paraná River and over the ferry terminal is a major city of northern Argentina, El Drado city across the river. This plan will adopt Alternative Plan 2 as an extension route over Route 15. in consideration of distribution of people and the form of network.



Item	Alternative 1 Paraná Route	Alternative 2 Otoño Route
Summary of plan	This route starts from San Rafael intersection close to the provincial border with Alto Paraná on Route 6 and reaches San Rafael de Paraná	This route starts from San Rafael Intersection on Route 6 which is close to the provincial border with Alto Paraná and reaches Mayor Julio D. Otoño
Length	45.0km	49.6km
Road network	Since Paraná is located near the starting point of the Export Corridor, this route is not so favorable as an access road to the Route 6 and the export corridor in terms of networking.	Since Otoño is located around the center of Export Corridor, this route is appropriate to access Route 6 and Export Corridor. In addition, faced with a major city of Argentina, El Drado across the river, the route is also advantageous for distribution of people and goods.
Accessibility to port facilities	This route is favorable access to such ports located on the side of the starting point of Export Corridor as Triunfo Port and Paloma Port.	With such ports as Dos Fronteras and Trocua located on the extension of this route and at the center of Export Corridor, it is an excellent access to ports and harbors.
Overall evaluation	△	○

Figure 8.4 Extension of National Road Route 15 alternative routes

(3) Port access roads

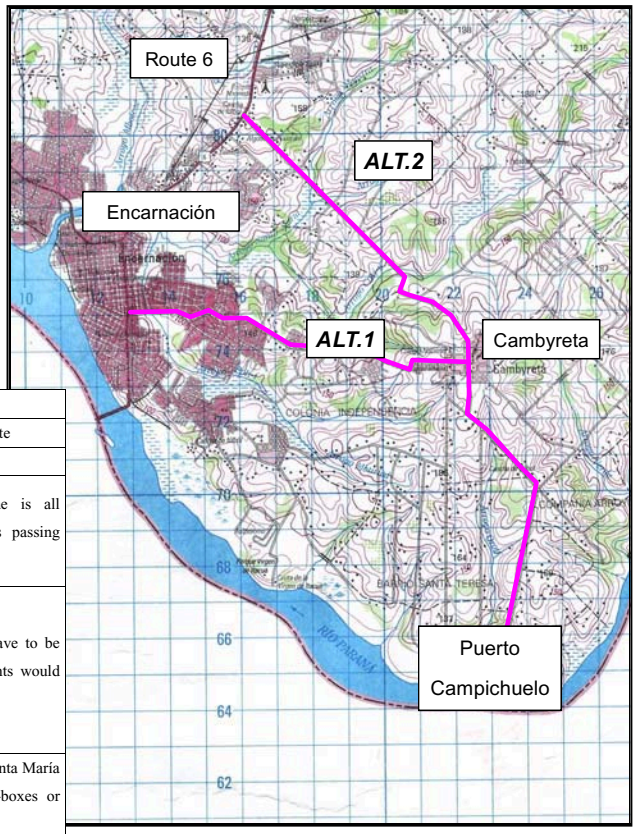
1) Campichuelo port access road

Two possible routes were considered given current road usage patterns.

Alternative 1: Encarnación urban route

Alternative 2: Encarnación urban area detour route

This plan selects Alternative 2, despite the higher project cost, as it avoids the urbanized area and thus does not raise environmental problems.



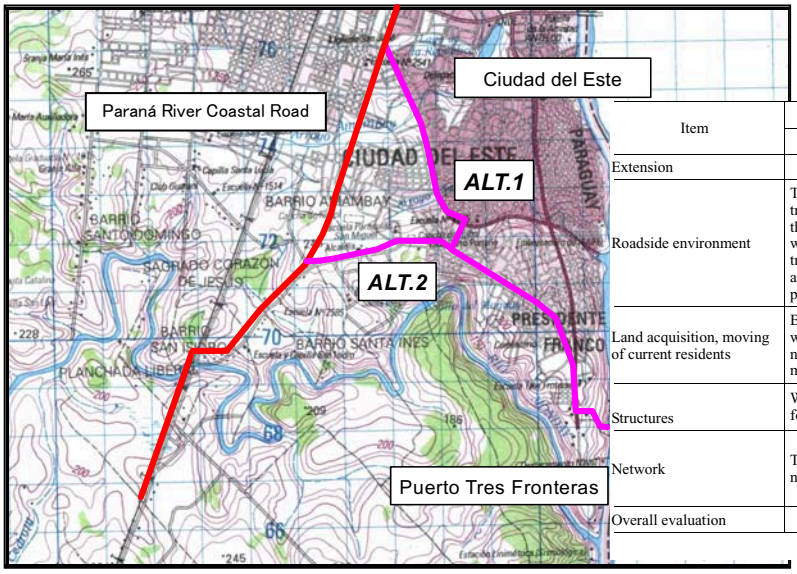
Item	Alternative 1 Urban area route	Alternative 2 Urban area detour route
Extension	19.0km	21.0km
Roadside environment	Area roughly 10km around Encarnación is being built up, so road would require some environmental measures.	Area through to front line is all agricultural, so large trucks passing through poses no problems.
Land acquisition, moving of current residents	Road for above-mentioned section is narrow and roadside areas are being built up, so work to widen the road would raise many problems, including compensation for residents who would have to move.	Though some land would have to be purchased, almost no residents would have to be moved.
Structures	Road follows ridgeline, so almost no need for structures.	Route would cross Arroyo Santa María and tributaries, requiring C-boxes or bridges.
Overall evaluation	△	○

Figure 8.5 Puerto Campichuelo access road alternative routes

2) Tres Fronteras port access road

Access to the Tres Fronteras port is currently via the four-lane road making up the city beltway (Alternative 1). The survey also explored the alternative possibility of upgrading existing roads to connect directly to the Paraná River coastal road. (Alternative 2) Alternative 1 uses existing roads, and

as the existing roads are adequately developed, construction costs would be low. However, this route passes through heavily urbanized areas, and would entail both increased transportation costs for heavy freight vehicles, and might lead to environmental problems along the roadway. Meanwhile, Alternative 2 would access the port directly from the Paraná River coastal road, thus avoiding already built-up areas and likewise avoiding roadway environmental problems. The choice plan assumes it Alternative 2.



Item	Alternative 1	Alternative 2
	Using present roads	Paraná River coast road connection
Extension	5.8km	10.2km
Roadside environment	This route is currently used for transport to the port, but it passes through heavily urbanized areas, and would entail both increased transportation costs for large trucks, and might lead to environmental problems along the roadway.	Would use existing roads, but areas along this route are also quite built up, and the road would likely have a impact.
Land acquisition, moving of current residents	Basically, upgrade of current road would allow large trucks to use it, so no land acquisition or resident moving would be needed.	Basically, upgrade of current road would allow large trucks to use it, so no land acquisition or resident moving would be needed.
Structures	Would use existing road, so no need for new structures.	Would use existing road, so no need for new structures.
Network	There is not construction of a new network to use an existing way.	Because an existing way is improved, an existing way accesses it with Parana coast road. Therefore a new network is built.
Overall evaluation	○	△

Figure 8.6 Puerto Tres Fronteras access road alternative routes

8.4 PAVING PLAN REVIEW

(1) Stone-paved areas

- Surface and foundation: Asphalt mixture
- Upper roadbed: Size-graded crushed rock
- Lower roadbed: Crusher run

1) Type 1 pavement composition

- Design traffic volume category: L traffic
- Design CBR: 4
- Target T_A: 14

Construction type	Equivalence conversion factor	Thickness (cm)	T_A
Surface	1	5	5
Upper roadbed	0.35	15	5.25
Lower roadbed	0.25	15	3.75
Total		35	14

$\geqq T_A' = 14$

2) Type 2 pavement composition

- Design traffic volume category: A traffic
- Design CBR: 4
- Target T_A: 18

Construction type	Equivalence conversion factor	Thickness (cm)	T_A	
Surface	1	5	5	
Upper roadbed	0.35	20	7	
Lower roadbed	0.25	25	6.25	
Total		50	18.25	$\geqq T_A' = 18$

3) Type 3 pavement composition

- Design traffic volume category: B traffic
- Design CBR: 4
- Target T_A: 24

Based on these conditions, pavement composition will be as follows.

Construction type	Equivalence conversion factor	Thickness (cm)	T_A	
Surface	1	10	10	
Upper roadbed	0.35	15	5.25	
Lower roadbed	0.25	35	8.75	
Total		60	24	$\geqq T_A' = 24$

4) Pavement type for each project section

The pavement type for each project section is given in Table 8.3.

(2) Shoulder pavement

Road shoulder pavement will use the following materials as specified by MOPC.

- Asphalt mixture: 3cm
- Crusher run: 23cm

(3) Pedestrian walkway pavement

Pedestrian walkways will be paved to match the walkway pavement already in use in each town or village.

Table 8.3 Pavement type for each section

Section	Beginning	End	Km	Pavement type
M-1	Natalio	Tembey River	12.7	Type 2
M-2	Tembey River (incl. Puente)	Gurapay Stream	24.2	Type 2
M-3	Gurapay Stream	Intersección con R15E	22.6	Type 2
M-4	Intersección con R15E	Yacuy Guazú River	15.1	Type 3
M-5	Yacuy Guazú River (inc. puente)	Ñacunday River	29.8	Type 3
M-6	Ñacunday River (inc. Río)	Los Cedrales	43.4	Type 3
M-7	Los Cederales	Presidente Franco	7.6	Type 3
M-8	Presidente Franco	Super Carreterra	9.5	Type 3
PAR-0	Corredor Principal	Campichuelo	21.0	Type 1
PAR-1	Corredor Principal	Paredón	12.1	Type 1
PAR-2	Corredor Principal	Caarendy	15.5	Type 1
PAR-3	Corredor Principal	Don Joaquín	18.4	Type 2
PAR-4	Corredor Principal	Paloma	10.6	Type 1
PAR-5	Corredor Principal	Triunfo	11.0	Type 1
PAR-6	Corredor Principal	Dos Fronteras	15.9	Type 1
PAR-7	Corredor Principal	Trocua	8.8	Type 1
PAR-8	Corredor Principal	Tres Fronteras	5.4	Type 3
R15E-1	National Road Route 6	Frutika	20.9	Type 1
R15E-2	Frutika	Corredor Principal	28.7	Type 1

8.5 EXAMINATION OF A DRAINAGE PLAN

(1) Lateral drainage system

The number of pipe culverts in each section is shown in Table 8.4.

(2) Vertical drainage system

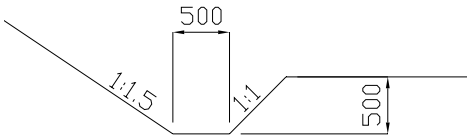
A vertical drainage system is classified into the following work items:

-Earth gutter on toe of slope (Filling and cut sections)

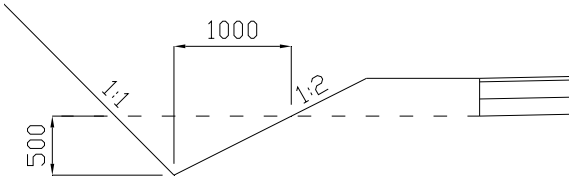
-Stone gutter on toe of slope (Point nearest to flow end)

The earth gutter on toe of slope shall have the following shape.

Filling section



Cut section



A point nearest to flow end may cause erosion due to an increasing flow rate and a faster flow velocity. Consequently, we decided to employ stone gutters, so that a drainage canal can be reinforced.

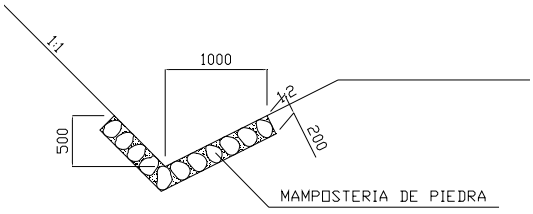


Table 8.4 List of pipe culverts

Project	Component			Station	Pipe diameter	Number of installments
Main Corridor	M-1	Beginning	Natalio	NO. 0 + 0	φ1.0	3
		End	Rio Tembey	NO. 12 + 93		
	M-2	Beginning	Rio Tembey (inc.bridge)	NO. 12 + 93	φ1.0	7
		End	Ao. Gurapay	NO. 35 + 989		
	M-3	Beginning	Ao. Gurapay	NO. 35 + 989	φ1.0	9
		End	Intersection with R15E	NO. 59 + 315		
	M-4	Beginning	Intersection with R15E	NO. 59 + 315	φ1.0	9
		End	Rio Yacuyguazu	NO. 72 + 285		
	M-5	Beginning	Rio Yacuyguazu(inc.bridge)	NO. 72 + 285	φ1.0	11
		End	Rio Nacunday	NO. 97 + 56		
	M-6	Beginning	Rio Nacunday (inc.Rio)	NO. 97 + 56	φ1.0	13
					φ1.0×2	1
		End	Los Cedrales	NO. 140 + 72	φ1.0×3	1
	M-7	Beginning	Los Cederales	NO. 140 + 72	φ1.0	0
		End	Prte. Franco	NO. 147 + 500		
	M-8	Beginning	Prte. Franco	NO. 147 + 500	φ1.0	4
		End	Super Carreterra	NO. 157 + 575		
Port Access Road	PAR-0	Beginning	Main Corridor	NO. 0 + 0	φ1.0	5
		End	Pt. Campichuelo	NO. 19 + 660	φ1.0×2	1
	PAR-1	Beginning	Main Corridor	NO. 0 + 0	φ1.0	9
		End	Pt. Paredon	NO. 11 + 0	φ1.0×2	1
	PAR-2	Beginning	Main Corridor	NO. 0 + 0	φ1.0	8
		End	Pt. Caarendy	NO. 15 + 600		
	PAR-3	Beginning	Main Corridor	NO. 0 + 0	φ1.0	10
		End	Pt. Don Joaquin	NO. 16 + 750		
	PAR-4	Beginning	Main Corridor	NO. 0 + 0	φ1.0	10
		End	Pt. Paloma	NO. 10 + 490		
	PAR-5	Beginning	Main Corridor	NO. 0 + 0	φ1.0	0
		End	Pt. Triunfo	NO. 11 + 800		
	PAR-6	Beginning	Main Corridor	NO. 0 + 0	φ1.0	3
		End	Pt. Dos Fronteras	NO. 5 + 650		
	PAR-7	Beginning	Main Corridor	NO. 0 + 0	φ1.0	5
		End	Pt. Torocua	NO. 8 + 720		
	PAR-8	Beginning	Main Corridor	NO. 0 + 0	φ1.0	0
		End	Pt. Tres Fronteras	NO. 7 + 900		
Route15 Extension	R15E-1	Beginning	Route6	NO. 0 + 0	φ1.0	0
		End	Frutika	NO. 24 + 800		
	R15E-2	Beginning	Frutika	NO. 24 + 800	φ1.0	19
		End	Main Corridor	NO. 54 + 430		

8.6 SETTLING ON BRIDGE MAINTENANCE PLAN

On the subject roads, constructs such as bridges (concrete, wooden, and steel bridges), box culverts and pipe culverts had been build up as many as listed in Table 8.5 and Table 8.6. Among these existing constructs, those on the road from the Natalio to Otoño were built up around 1986 for the maintenance of these roads and are in relatively good conditions. In this Section, we consider the maintenance plan for the existing constructs including thirty-four existing bridges and other constructs that are equal to or larger than box culverts of 2 meter or longer. Constructs such as box culverts shorter than 2 meters as well as concrete pipes will be separately considered as the drainage plan.

Table 8.5 Number of Bridges Classified by Types

length	Main Corridor			Port Access Road			Total		
	Wooden Br.	Concrete Br.	Steel Br.	Wooden Br.	Concrete Br.	Steel Br.	Wooden Br.	Concrete Br.	Steel Br.
Less than15m	11	8	0	4	1	1	15	9	1
15m to less than 30m	2	2	0	0	0	0	2	2	0
30m to less than 50m	1	2	0	0	0	0	1	2	0
50m or longer	0	2	0	0	0	0	0	8	0
Total	14	14	0	4	1	1	18	15	1

Table 8.6 Number of Culverts Classified by Types

Types		Main Corridor	Port Access Road	Extension of National Road Route 15	Total
Box Culverts		5	1	0	6
Pipe Culverts		12	42	6	60
	Simple	(10)	(40)	(3)	(53)
	Double	(1)	(2)	(0)	(3)
	Triple	(1)	(0)	(3)	(4)

(1) Policy of Bridge Maintenance Plan

・The sound existing bridges will be utilized to the full.

The sound existing bridges having a roadway of 7.0 meters or wider (3.25 x 2 + 0.25 x 2) will be utilized and those having less than 7.0 meters wide will be reconstructed. As to such bridges within the city and its vicinities that used to have a heavy traffic of pedestrians, sidewalk widening will be considered.

・All the wooden bridges will be rebuilt.
・The replacing structures will have the flow capacities that are equivalent to or higher than the existing structures to be replaced.
・The scale (such as flow sections) of the structures will be determined based upon the hydrologic and hydraulic analyses.
・Among other existing structures, the bridges that are recommended reconstruction from the comprehensive viewpoints including their locations and/or flows of the rivers will be rebuilt.

(2) Setting Up Design Conditions

1) Applicable Design Standard

The geometric design standard of the roads and the bridge design standard will comply with the standards by AASHTO (American Association of State Highways and Transportation Officials). This is because, in the Republic of Paraguay, the geometric design standard of roads applies correspondingly with "A Policy on Geometric Design of Highways and Streets" by AASHTO, and the bridge design standard applies with "Standard Specifications for Highway Bridges" by AASHTO. As to affects of earthquakes and other conditions such as temperature fluctuation, the loads and ranges that reflect the local conditions will be set up.

2) Composition of Bridge Width

The width of the bridges will be composed as follows based upon the consultation with MOPC:

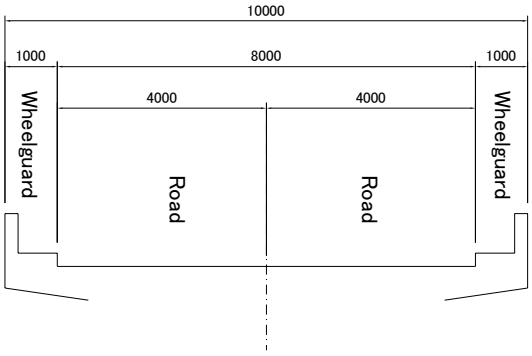


Figure 8.7 Standard Cross Section

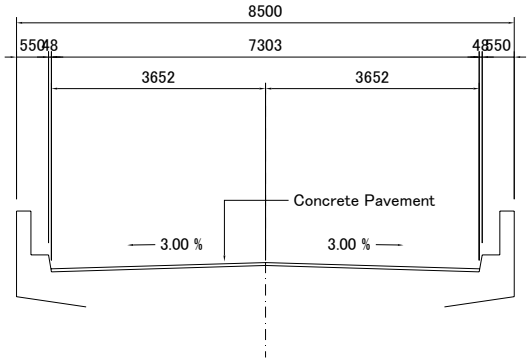


Figure 8.8 Width Composition of Reusable Bridge

(3) Bridge Maintenance Plan

The bridge maintenance plan, based upon the policy and design conditions mentioned above, will be as follows: For details, refer to Table 8.7 Detailed Bridge Maintenance Plan

Table 8.7 Detailed Bridge Maintenance Plan

Maintenance Method	No. of Bridges	Remarks
Reuse of existing structures	12	Detailed research will be required.
Rebuilding of existing bridges	20	
Building of new bridges	2	When no existing bridge is available or the route(s) are changed.

Table 8.8 Detailed Bridge Maintenance Plan

Compo-nent	Basin No.	No	River Name	Area (ha)	Length (m)	Culvert Box n	b(m)	h(m)	Bridges L(m)	B(m)	H.W.L(m)	Remarks
M-1	1	3+250	Aro.Pai Curuzu(1)	1,310	5,300	2 -	4.500 ×	2.850		—		**Reuse**
	2	5+553	Aro.Pai Curuzu(2)	850	4,300	2 -	4.500 ×	2.850		—		**Reuse**
M-2	3	12+093	Rio Tembey	116,140	153,700		—		70.000	8.500	134.400	**Reuse**
	4	22+768	M-2-1			1 -	3.000 ×	3.000		—		**Reuse**
	5	23+623	M-2-2			1 -	3.000 ×	3.000		—		**Reuse**
	6	27+777	Aro. San Rafael	1,140	3,500	2 -	4.500 ×	2.800		—		**Reuse**
M-3	7	35+989	Rio Guarapay	32,840	48,700		—		48.000	8.500	166.200	**Reuse**
	8	47+616	Aro.Yhaca Guazu	23,770	35,700		—		48.000	8.500	173.200	**Reuse**
	9	55+137	Aro.Alegre	2,240	7,900	2 -	4.500 ×	2.800		—		**Reuse**
M-4	10	56+642	Aro.Cure-Ky	1,160	4,700	2 -	3.500 ×	3.000		—		Reconstruction
	11	64+430	Aro.Emilia	2,466	8,250	2 -	4.500 ×	3.000		—		Reconstruction
	12	64+562	Aro.San Juan	8,660	18,700		—		20.000	10.000	155.320 *1	Reconstruction
	13	70+447	Aro.Yhaca-Mi	6,810	19,600		—		20.000	10.000	164.689	Reconstruction
M-5	14	72+250	Rio Yacuy Guazu	73,000	117,500		—		75.000	10.000	173.200	Reconstruction
	15	83+566	Aro.Diamante	2,250	6,300	2 -	4.500 ×	3.000		—		Reconstruction
	16	88+291	Aro.Imperial	3,940	14,300		—		15.000	10.000	163.100 *1	Reconstruction
	17	89+425	Aro.Imperial Afluen.1	1,750	8,300	2 -	4.000 ×	3.000		—		Reconstruction
	18	90+000	Aro.Imperial Afluen.2	370	3,400	1 -	3.500 ×	3.000		—		Reconstruction
	19	94+240	Aro.Carpincho	5,580	15,100		—		20.000	10.000	147.800 *1	Reconstruction
M-6	20	97+048	Rio Nacunday	243,820	237,600		—		100.000	10.000	154.419	Construction
	21	99+782	Rio Nacunday Afluente	490	3,400	1 -	3.500 ×	3.000		—		Reconstruction
	22	111+462	Aro.Pira Pyta Afluen.2	1,390	5,400	2 -	3.500 ×	3.000		—		Reconstruction
	23	114+575	Aro.Pira Pyta	16,730	25,900		—		20.000	10.000	188.700 *1	Reuse of Existing Pier
	24	117+337	Aro.Pira Pyta Afluen.3	3,550	9,800		—		16.000	8.000	192.300 *1	**Reuse**、Widening of Wid
	25	126+177	Aro.Y-Tuti	9,310	14,200		—		25.700	8.000	199.400 *1	**Reuse**、Widening of Wid
	26	134+683	Aro.Yta Coty	7,210	14,900		—		15.000	10.000	199.000 *1	Reconstruction
M-7	27	146+413	M-7-1			2 -	2.000 ×	2.000		—		**Reuse**
M-8	28	149+845	Rio Monday	701,300	241,100		—		150.000	10.000	176.000	Construction
	29	155+910	Aro.Amambay			2 -	3.500 ×	3.000		—		Reconstruction
PORT ACCESS ROAD												
PAR-0	30	Par 0-2.7	Aro.Maestora	1,350	5,900	2 -	4.000 ×	3.000		—		Reconstruction
	31	Par 0-3.2	Aro.Pe	920	3,400	2 -	3.000 ×	3.000		—		Reconstruction
	32	Par 0-6.2	Aro.Curi-Y①	6,700	16,900		—		15.000	10.000	124.000 *1	Reconstruction
PAR-3	33	Par 3-9.0	Aro.Pora	1,850	6,600	2 -	4.000 ×	3.000		—		Reconstruction
PAR-6	34	Par 6-11.7	Aro Cure-ky	860	102,000	1 -	2.500 ×	2.500		—		Reconstruction

(Note) Area : Catchments Area
Length: River Length
*1 is presumed height than topographical map.

8.7 EXAMINATION OF AN ASSOCIATED FACILITIES OF A ROAD

(1) Safety facilities

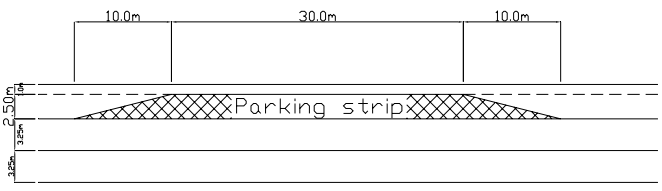
We decided to install the following items for safety facilities, referring to the results of current road research and the service status of existing national highways.

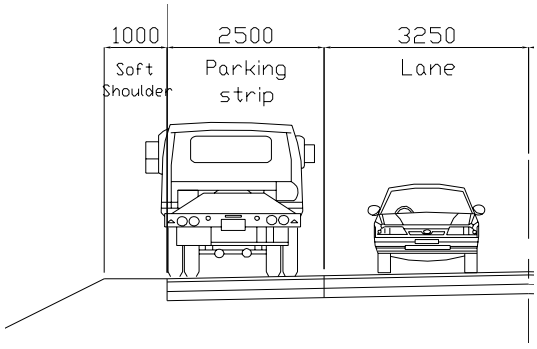
- Guardrail
- Pavement markings
- Road signs
- Shoulder pavement

(2) Other facilities

1) Parking strip

Parking strips shall be provided in order to move a vehicle from a lane to a passing place when the car fails to operate and a driver wants to take a rest. A parking strip shall be placed every 1 km.





2) Facilities for measuring vehicle specifications

The facilities shall be provided to measure a vehicle's weight and regulate illegal vehicles, with the aim of preserving road structure or preventing traffic dangers.

3) Rest facilities

It is necessary to place rest facilities at reasonable spacing for safe and comfortable travels. These rest facilities are designed to answer a driver's call of nature, reduce his or her fatigue and tension from continuous running or meet the requirements of feed water and refueling for cars. It is recommended that individual municipalities or private organizations should place the facilities. One rest facility should be placed every about 50km.

Figure 8.9 Image of rest facilities

9. SETTING UP A PLAN FOR THE USE OF CAARENDY PORT

9.1 NECESSITY OF DEVELOPMENT OF CAARENDY PORT FACILITIES

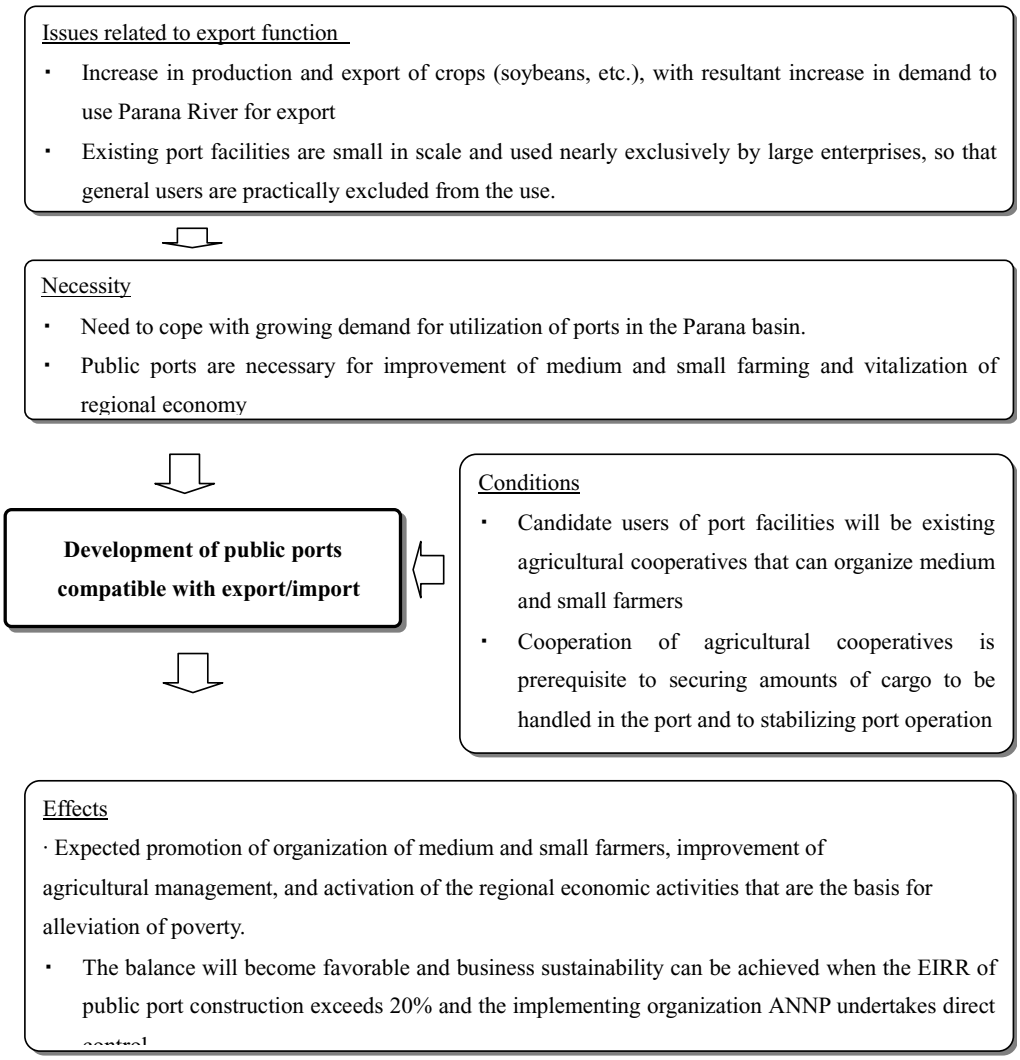


Figure 9.1 Necessity of developing Caarendy Port

9.2 CALCULATION OF NECESSARY SIZE OF CAARENDY PORT

(1) Estimation of the amount of cargo to be handled

Caarrendy Port will handle exports of soybeans and wheat produced in the direct hinterland (La Paz, Pirapo, Unidas agricultural cooperatives: Itapúa Province) and imports of fuels and agricultural chemicals.

Table 9.1 Projected amount of Cargo to be handled in Caarendy Port (2015)

	Cargo	Amount (thousand liters)	Remarks
Export	Soybeans, wheat	200	About 40% of annual export
Import	Fuels	15,000	About 50% of annual purchase
	Fertilizer	24	About 50% of annual purchase (container cargo)
	Agricultural chemicals	1,240	

(2) Study on the required facility size

Table 9.2 Facility size of Caarendy port

Name of facility		Size	Remarks
Site area		14 ha	Vacant lot (owned by Pirapo agricultural cooperative)
Berthing facilities	Length	30 m	Compatible with barges (with two loading ports)
	Depth	-3.5 m	
Soybean handling facilities	Weighing station (scales)	One unit	Compatible with 80 tons (actual)
	Unloading site	Two sites	Compatible with loading at peak time (80 vehicles/day)
	Silo	1,600 tons	Compatible with two fleets (16 barges for one fleet)/month
	Loading shooter	One unit	For loading no barges, 500 t/hr (actual)
Petroleum products storage tank		5,000 kiloliters	Transport amount per fleet
Cargo sorting site		4,500 m^2	Compatible with 140 TEU containers storage
Others	Gate, peripheral fence, office, restroom, dining room, warehouse, yard road, lighting, water supply system, incoming transfer system, etc.		

9.3 SETTING UP A PLAN OF ARRANGEMENT OF FACILITIES AT CAARENDY PORT

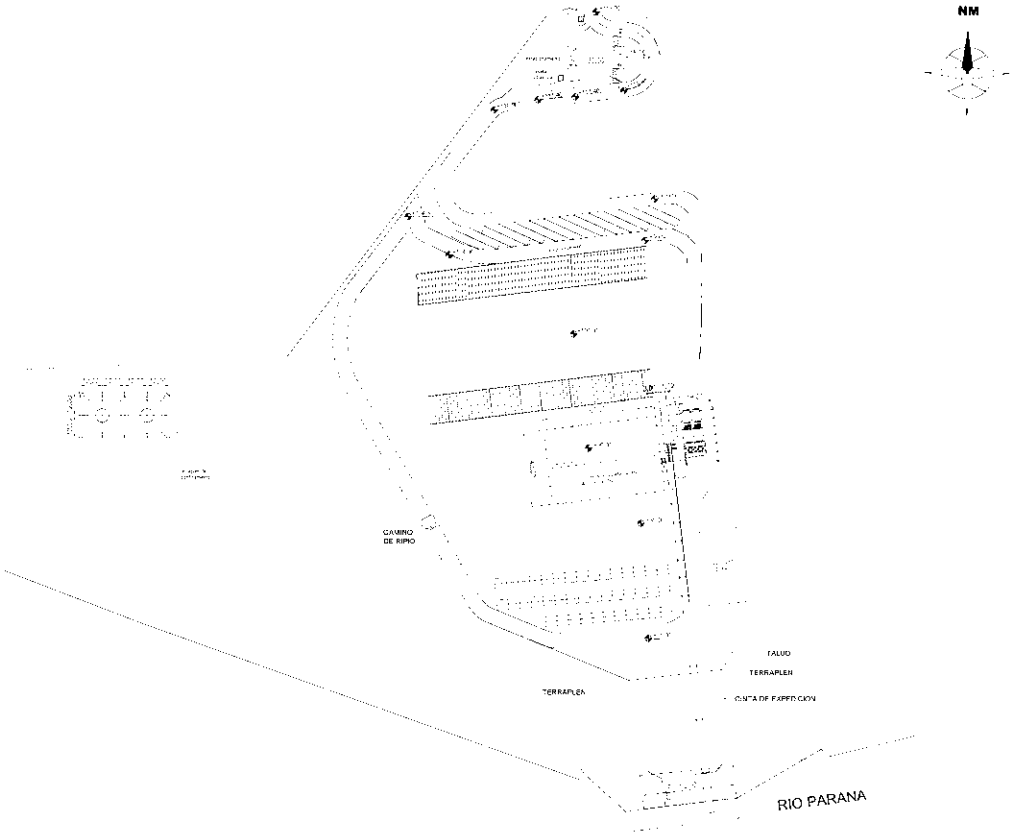


Figure 9.2 Schematic Drawing of Arrangement of Facilities

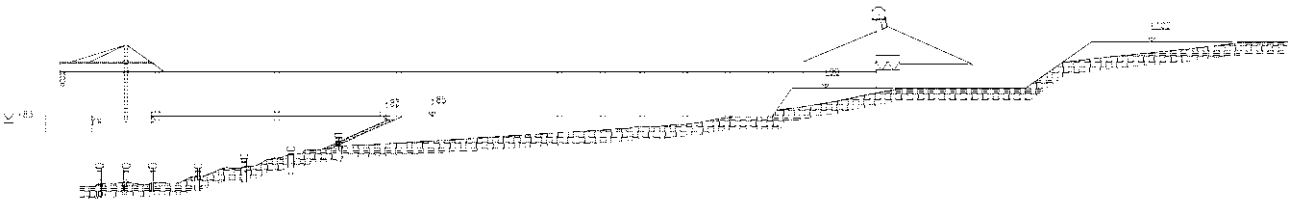


Figure 9.3 Cross-section Drawing of Facilities

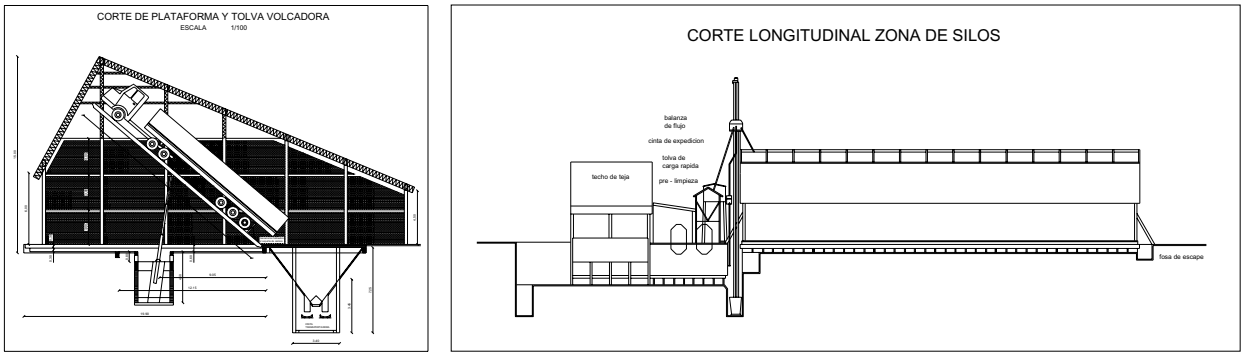


Figure 9.4 Cross-section Drawing of facilities

9.4 CALCULATION OF APPROXIMATE PROJECT COST

Table 9.3 Items of the Approximate Project Cost

(US$ thousand)

		Total	6,177
I Construction cost			
	1. Silo, reception desk, weighing apparatus, washer		2,000
		101. Stockpile; 18,000 t, reception desk, conveyer for shipment of 500 t/h, etc.	
		102. Machines (conveyer in the silo, elevator, etc.)	
	2. Land reclamation		682
		201. Land excavation and reclamation	
	3. Internal road, waiting area(space for transportation)		318
		301. Pavement (stone), (filling up openings of stone pavements), etc.	
	4. Wharf, pier		520
		401. Wharf, connecting bridge, fender beam	
	5. Facilities to store, load and unload fuel (combustible material)		263
		501. Tank, pipe, pump, protection facilities	
	6. Warehouse, office, other adjunct facilities		262
		601. Warehouse: 800 m^2	
		602. Office, dining hall and others	
	7. Electric facilities		102
		701. Electricity reception room, transformer, distribution board	
	8. Water system for drinking and fire extinction		50
		801. Well, pump, pipe	
	9. Material-handling machine		300
		901. One crane, two forklifts	
II. Construction expenses			680
III. Engineering fee			1,000

month

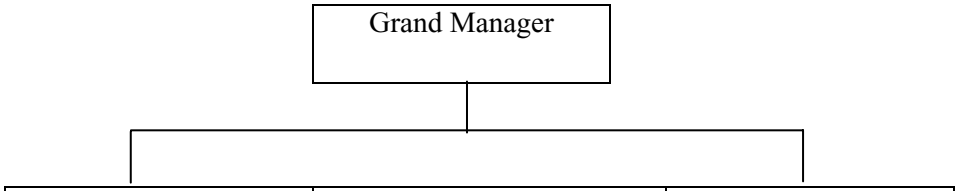
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Basic design																														
Environment impact assessment																														
Detailed design																														
Construction																														

Figure 9.5 Schedule of Caarendy Port Project

9.5 OPERATION PLAN FOR CAARENDY PORT

(1) Organization for Caarendy Port Operation

Organization for Caarendy Port operation is elaborated in cooperation with ANNP staff referring to several examples in ports managed by ANNP. Total 26 staff members will be assigned to this operation under the condition of cargo volume and port facilities proposed in this study.



Management Section		Operation Section		Assistance Section	
1.Secretary	1	1.Measurement	2	1.Patrol	6
2.Sub-secretary	1	2.in charge of Crane	2	2.maintenance of building	1
3.in charge of Silo	1	3.in charge of belt-conveyor	1	3.Building Clening	1
4.Accountant	1	4. Maintenance of belt conveyor	1	4.Grand cleaning	1
5.Mesurement	1	5.in charge of pier	1	5.Driver	1
6.Information	1	6.in charge of fuel	1		
7.Documentation	1				

*Figures in right side show the number of staff members

Figure 9.6 Organization for Operation of Caarendy Port

(2) Alternatives for Operation in Caarendy Port

Considering the organization and functions to be expected mentioned previously, alternatives for operation will be examined in this section. Under the premise that Caarendy Port will be constructed by the Japanese grant aid cooperation, alternatives for operation are studied to utilize facilities sufficiently after construction. In this situation project execution agency will be limited to ANNP, so ANNP has to be engaged in port operation after the construction.

3 alternatives are examined following;

1) Direct operation-A : Staff members of ANNP will operate the port directly.
2) Direct operation-B : ANNP conduct outsourcing for each staff for operation, and ANNP will manage total operation

3) Contract out to Private : ANNP will possess whole facility, and contract out some part of operation to private sector, and receive a part of revenue from private sector

Among 3 alternatives mentioned above, 3) “Contract out to private” is not suitable to Japanese Grant Aid Cooperation. From the reason mentioned below, study team would like to recommend 2) for Caarendy Port operation.

- ANNP has not so much experts for grain treatment in ANNP-managing ports where cargoes except grains are treated mainly.
- It is impossible to assign the all staff members necessary to operation Caarendy Port
- Relatively easy to control the employ in accordance with the circumstance.

(3) Consideration on usage of Caarendy Port by small-scaled Farmers

Almost all small-scaled farmers in Itapúa and in Alto Paraná are obliged to sell their products to disadvantage with major commercial agents. Operation of Caarendy Port as a public port will make small-scaled farmers possible to use the port, and will make it possible to expand the grain export of Paraguay. However, small-scaled farmers have many problems that they can not solve individually in the matter of production and forwarding. At the present some agricultural corporations (Pirapo, Unidas, La Paz etc. are executing or are planning to buy crops from small-scaled farmers. Consequently, ANNP should take some system of port operation in which agricultural corporations will take part in, and ANNP will aid to free usage of port by small-scaled farmers to expand the grain export of Paraguay. Merits generated by cooperation work with agricultural corporations are described as following;

- To avoid decreasing of purchase price of products
- To transfer Know-how of agricultural production
- To receive the financing service to be a member of agricultural corporation

10. ENVIRONMENTAL AND SOCIAL CONSIDERATION

10.1 INITIAL ENVIRONMENTAL EXAMINATION

Implementation of the initial study on the environment was re-commissioned to a local consultant, CIALPA. The results are summarized below.

1. Regarding the land-use classification, farmland under mechanized cultivation accounts for 50% or more.
2. The green spaces left in the farmland along the route have no valuable flora and fauna. Since vulnerable species are observed, however, conservation of the existing space is meaningful when considering the ecosystem as a whole.

3. The neighboring national parks are free from any direct impact, but it is necessary to consider appropriate measures against water pollution during the work period.
4. A door-to-door survey identified the traffic problem as the top-ranked issue, followed by lack of the employment opportunities. In this context, many residents place great hope in this project.
5. There is an indigenous population residing in the vicinity, but most of them are not exposed to direct effects. However, their existence should be taken into account in the route plan, etc.
6. During the dry season, damage from sand or dust blown up by vehicles is substantial.

10.2 SCREENING

After IEE study completed, when route plan alternatives were presented, the screening on the each project component was conducted, then integrated screening was done using each component screening. Table 10.1 shows the result of the integrated screening. The project was categorized “B” referring to JICA’s Guidelines for Environmental and Social Considerations.

10.3 STAKEHOLDER MEETING

During the period from October 21 to 23 2005, workshops in which residents participated were held in four cities, Natalio, Mayor Otaño, Ñacunday, Los Cedrales along the planned route. The study team disclosed the plan and explained the necessity of residents participation. The residents introduced the region and history, pointing out various issues. In certain communities, most participants had cars. In others, most did not. In spite of these regional differences, bad condition of roads was presented as a critical issue. In Otaño and Ñacunday located away from the route, a request was presented to bring the route nearer to the regional center. Also presented was the expectation for promotion of tourism and creation of employment by taking the completion of project as a good opportunity.

On January 28 and 29 2006, workshops with residents were held in two cities, Mayor Otaño and Los Cedrales. The study team disclosed the project, explained the necessity of participation by residents, and reported on the progress of the project. Subsequently, discussions were held on the objectives of road plans and how residents could participate and benefit. The method to provide the land for roads was also discussed, and a strong request was presented in regard to the necessity of access improvement from residents.

In order to obtain the letter of consent to be attached to the basic environmental questionnaire from local communities, interviews were conducted, from January 20 to 30 2006, with two governors and mayors or representatives, along the route. There, the project was outlined and letters of consent could be obtained.

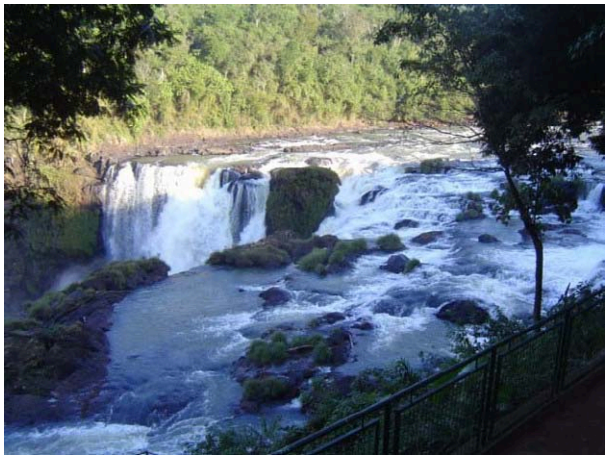
At a stage when the project was put into shape, workshops with residents were held again for explanation of the route, road structure, road functions, etc. and for an exchange of opinions. From May 3 to May 24, meetings were held with residents of Natalio, Carlos A Lopez, Mayor Otaño, Ciudad del

Este, Presidente Franco, Domingo M. de Irala, and a consensus was reached on route selection, road structure, necessity to secure the land for the roads, and the importance of traffic safety.

Table 10.1 Screening Sheet on Whole Project

Impact element		Evaluat.	Contents of negative impact
Social Impact	1.Involuntary resettlement	B	In M-4, M-8 involuntary resettlement will occur.
	2.Local economy	B	New Highway will affect local economy in the region.
	3.Utilization of land and local resources	B	Land use will be changed, as the result of development of a highway.
	4.Social institution	B	Society will be changed as the result of development of a highway.
	5.Existing social infrastructures	B	Some influences on schools, churches and cemetery are considered.
	6.Vulunerable social groups	B	No direct impact to indigenous peoples considered.
	7.Equality of benefits and losses	B	There will be one group who use the highway much and another group who don't use so much.
	8.Gender	D	No negative impact is considered
	9.Children's rights	D	No negative impact is considered
	10.Cultural heritage	D	No negative impact is considered
	11.Local conflict	D	No negative impact is considered
	12.Public hygiene	D	No negative impact is considered
	13. Infectious diseases HIV/AIDS	B	There will be some cases.
	14.Water usage	D	No negative impact is considered
	15.Accident	B	Traffic accidents will increase because of traffic volume increase and high velocity.
Natural Impact	16.Climate change	D	No negative impact is considered
	17.Ecosystem and Biodiversity	B	Some impacts on existing natural forests can be considered.
	18.Special topography	D	No negative impact is considered
	19.Soil erosion	D	No negative impact is considered
	20.Underground water	D	No negative impact is considered
	21.Hydrographic condition	D	No negative impact is considered
	22.Coastal	D	No negative impact is considered
	23.Climate	D	No negative impact is considered
	24.Landscape	B	Newly construction of roads and bridges will change land scape.
Pollution	25.Air pollution	D	No negative impact is considered
	26.Water pollution	B	The construction of bridges and the port will cause some pollution on rivers
	27.Soil pollution	D	No negative impact is considered
	28.Waste	D	No negative impact is considered
	29.Noise/Vibration	B	Noise will increase in sections where right of way is narrow. But there will not be big problem because of small traffic volume.
	30.Land subsidence	D	No negative impact is considered
	31.Stench	D	No negative impact is considered
	32.Bottom material quality	D	No negative impact is considered

Picture 1 Falls in Ñacunday national park



Picture 2 Falls in Monday city park

Picture 3 Workshop in Natalio

Picture 4 Workshop in P.Franco

10.4 LEGAL PROCEDURE ON ENVIRONMENTAL ASPECT

The Law 294/93 of "Evaluation of Environmental Impact" establishes the obligatory nature of the Study of Environmental Impact (EIA) for all public or deprived work projects that by nature, magnitude or location could cause alterations to the Environment. The conditions that determine if a EIA for certain projects is required are established in the regulating instrument, that in its Article fifth, numeral 11 mentions that the EIA's for road works will be subject to the procedures and norms of the construction of the same ones.

The MOPC has a division in charge of the environment, which acts as a negotiation contact point with SEAM concerning the environmental impact assessment for the project. A document for this purpose, in the form of the basic environment questionnaire, will be prepared as provided for in the Law No.14.281/96. This will be submitted to SEAM. This document is required to contain a description of the region and roadside area as well as an outline of the project. On the basis of the IEE, the draft of a basic environmental questionnaire will be prepared and submitted, via the MOPC environment

division to SEAM for its response. Depending on the response from SEAM, an environmental impact assessment may not be necessary. If one is required, the level of assessment will vary.

10.5 PRINCIPAL ENVIRONMEBTAL CONSERATION MEASURES

(1) Social environmental impact

Involuntary resettlement of residents must be avoided as much as possible. If unavoidable, however, efforts must be made for consensus through in-depth discussions between the project implementing agent and the residents. For other social impacts, the way to solution must be found through negotiations among the parties concerned. In the design phase, due attention must be paid to preventing traffic accidents.

(2) Impact on the natural environment

It is essential to conserve the ecosystem and biodiversity as much as possible on the basis of the recognition that the currently existing green spaces are valuable. When green space of a certain size exists on both sides of the road, it will be necessary to provide a culvert or other structures to allow animals to cross under the road rather than over it.

(3) Pollution

Although no severe impact leading to pollution is expected, in the design phase, it is necessary to consider ways to largely reduce noise and vibration. For bridge construction in places of scenic beauty such as the Ñacunday River, Monday River, etc., it is necessary to consider appropriate measures to prevent turbid water.

Ⅲ IMPLEMENTATION PLANNING

11. ROAD PRELIMINARY DESIGN

11.1 ROAD DESIGN FOR THE PARANÁ RIVER

Road construction was completed in a section of Natalio-Otaño within this section on the basis of a road detail design conducted in 1980. Concrete bridges and box culverts were placed at individual rivers crossing the section.

(1) Horizontal alignment design

- A horizontal alignment of this section was basically adapted to that of an existing road.
- An existing small curve section that did not meet the design standard was improved based on a curve radius meeting the standard for a design velocity of V=100km/h (minimum curve radius R=460m).
- Alignments of crossing structures such as bridges and box culverts are fully available in the future, so they were adapted to the alignment of the existing road.
- A horizontal alignment of this section was adapted to that of an existing road that was constructed on a high-voltage cable site.
- This section passes through an area crowded with private houses, so it was planned to form a horizontal alignment that minimizes obstructions without higher priority to road alignments.

(2) Vertical alignment design

- A vertical alignment was designed basically in conformance to a current road height.
- An existing steep slope section that did not meet the design standard was improved to a gentle and vertical inclination meeting the standard for a design velocity of V=100km/h (Steepest vertical inclination I=6.0%).
- This road is a high grade road in which a design velocity V=100km/h was adopted, so importance was placed on an alignment for easy running while special consideration was being given to impacts on surroundings.
- Alignments of crossing structures such as bridges and box culverts are fully available in the future, so they were adapted to the alignment of the existing road.
- This section passes through an area crowded with private houses, so a vertical alignment of the section was designed to conform to current ground where possible without consideration for easy running.

11.2 DESIGHN FOR EXTENSION OF NATIONAL ROAD ROUTE 15

In the part of National Road Route 6 to Furtika of this section, stone pavement was completed by MOPC. The subsequent section of Furtika to Main Corridor forms an earthen road.

(1) Horizontal alignment design

- Stone pavement was improved in this section as described above, so a horizontal alignment of the section was designed to conform to that of an existing road where possible.
- An existing small curve section that did not meet the design standard was improved to a curve radius meeting the standard for a design velocity of V=80km/h (minimum curve radius R=260m.

(2) Vertical alignment design

・This section includes an existing road, so a horizontal alignment was designed basically in conformance to a current road height.

・An existing steep inclination section that did not meet the design standard was improved to a gentle and vertical inclination meeting a design velocity of V=100km/h (Steepest vertical inclination I=7.0%).

11.3 ROAD DESIGN FOR PORT ACCESS

A Port Access Road has all 9 routes, all which start at Main Corridor and end at entrances to individual ports. Most of the access road forms an earthen road, but the access road at the following 3 points was paved partially or totally.

- Pt.Paredon : The section of a starting point to an about 4.0km point forms a stone pavement. The subsequent section forms an earthen road.
- Pt.Triunfo : The full section forms a stone pavement.
- Pt.Tres Fronteras : The full section forms a asphalt or stone pavement.

(1) Horizontal alignment design

・Existing roads were improved for all routes of the access road.

・An existing small curve section that did not meet the design standard was improved to a curve radius meeting the standard for a design velocity of V=50km/h (minimum curve radius R=90m).

(2) Vertical alignment design

・A vertical alignment of the section was designed to conform to current ground where possible.

・An existing steep inclination section that did not meet the design standard was improved to a vertical inclination meeting a design velocity of V=50km/h (Steepest vertical inclination I=9.0%).

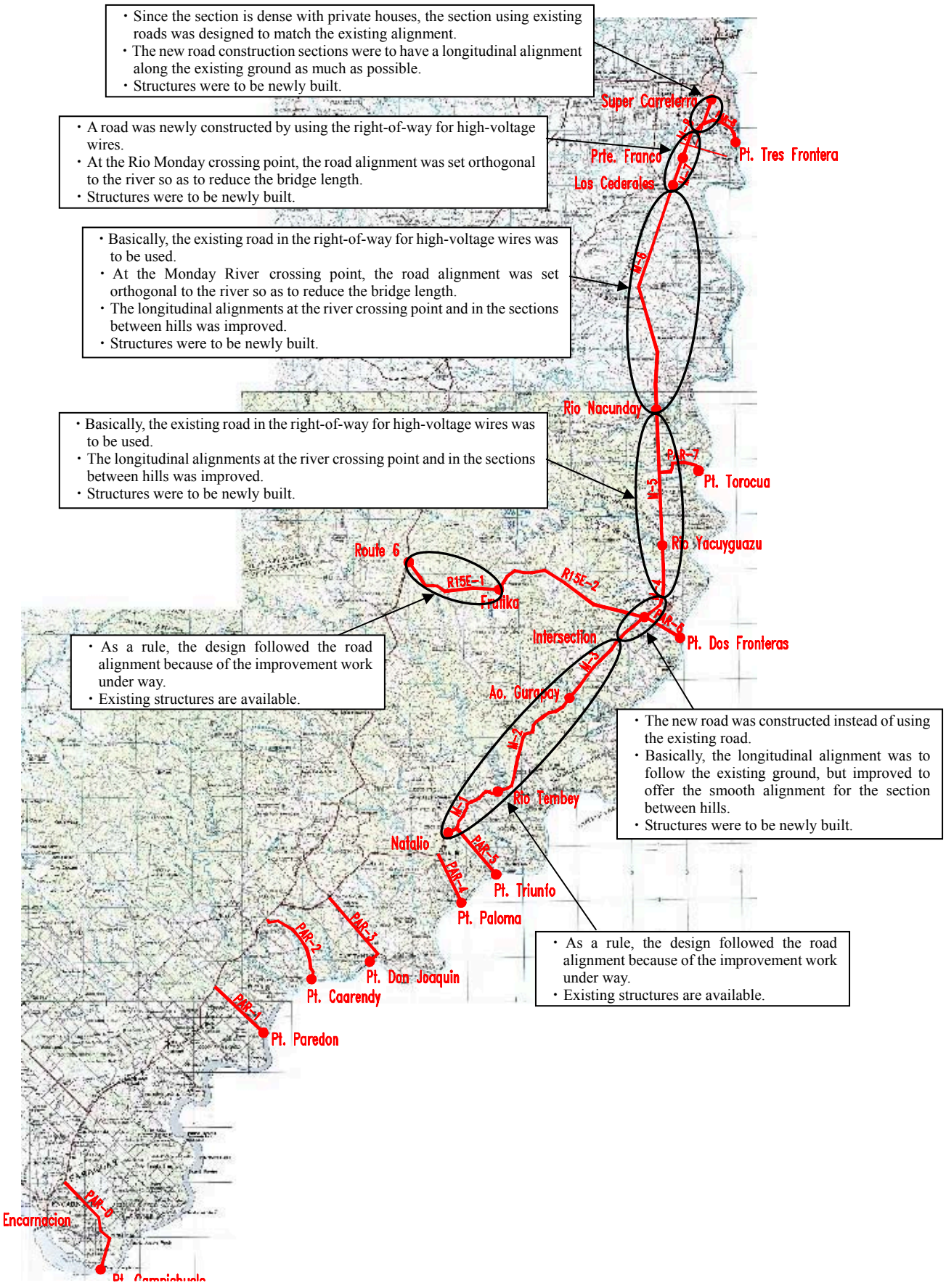


Figure11.1 Outline of alignment design

12. PRELIMINARY DESIGN OF STRUCTURE

12.1 OPTIMUM BRIDGE TYPES

Bridge type shown in Table 12.1 is adapted to small-scale bridges less than 30m in consideration with the cost, construction and past experiences in Paraguay. Optimum bridge types of 3 Bridges with more than 30m at Monday River, Ñacunday River and Yacuy Guazu River will be decided through further comparison study. Accordingly, PC Continuous Composite Girder is adapted to these 2 bridges because the result of the examination was same as in case of Monday River Bridge.

Table 12.1 Bridge Categorization of the Objective Road

Bridge Length L(m)	Type of Bridge
10 meters< L < 15 meters	Reinforced Concrete Bridge
15 meters< L < 30mters	Pre-stressed Concrete Bridge

12.2 PRELIMINARY DESIGN OF BRIDGES

(1) Superstructure

The adopted superstructure types of the proposed bridges are shown in Table 12.2.

Table 12.2 Superstructure Types of the Proposed Bridges

Component	Basin No	Station No	River Name	Length (m)	Width (m)	Type of Bridge
M-4	12	64+562	San Juan Stream	20.00	10.00	PC Simple Composite Girder
M-3	13	70+447	Yhaca Mi Stream	20.00	10.00	PC Simple Composite Girder
	14	72+250	Yacuy Guazu River	75.00	10.00	PC 3 Span Composite Girder
	16	88+291	Imperial Stream	15.00	10.00	PC Simple Composite Girder
	19	94+240	Carpincho Stream	20.00	10.00	PC Simple Composite Girder
M-6	20	97+048	Ñacunday River	100.00	10.00	PC 4 Span Composite Girder
	23	114+575	Pira Pyta Stream	20.00	10.00	PC Simple Composite Girder
	26	134+683	Yta Coty Stream	15.00	10.00	PC Simple Composite Girder
M-8	28	149+845	Monday River	150.00	10.00	PC 6 Span Composite Girder
PAR-0	32	0.0+6.2	Curi-Y Stream	15.00	10.00	PC Simple Composite Girder

The cross section of a bridge is shown in Figure 12.1. The simple composite pre-stressed girder with a 1/17 height to span length ratio is the most economic. In this study, 1.0m, 1.15m and 1.45m girder heights will be adopted, corresponding to the 15.0m 20.0m and 25.0m span lengths respectively. The number of girders used is 4 main girders for the 2-lane roadway (width 10 m), with a 2.35m and 2.5m space between girders.

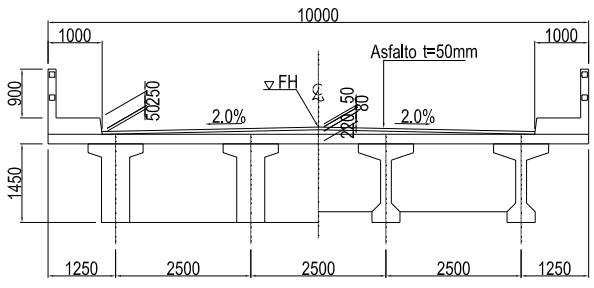


Figure 12.1 The cross section of a bridge

(2) Substructure

1) Subsoil Characteristics

The subsoil at the planned bridge site consists of silt to clay type sand layer and rock. The bearing layer for foundations is planned based on the soil layer at a depth of 1.0 m to 5.0m from the ground surface with an "N" value of over 30 according to the standard penetration test.

2) Foundation Type

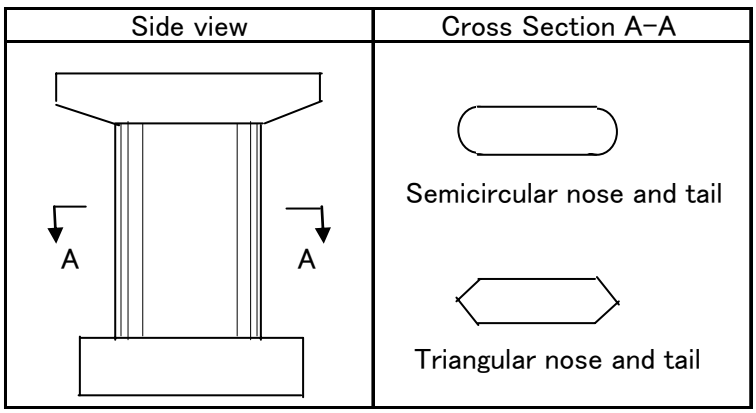
Concerning the determination of the foundation type, the conditions of superstructure, subsoil, construction method, etc., should be previously analyzed with accuracy, in order to select the most economical and reliable foundation. At present, a soil stratum with "N" value of over 30 has been taken as the bearing stratum, taking into consideration the economical aspects, ease of construction, water table level, width of work, etc. A spread foundation will be used when the solid stratum reaches around 4.0m of depth, and in case it gets deeper, a pile foundation will be used. According to the geological survey, the solid stratum reaches around 4.5m of depth in the study area. Therefore, a spread foundation will be adopted.

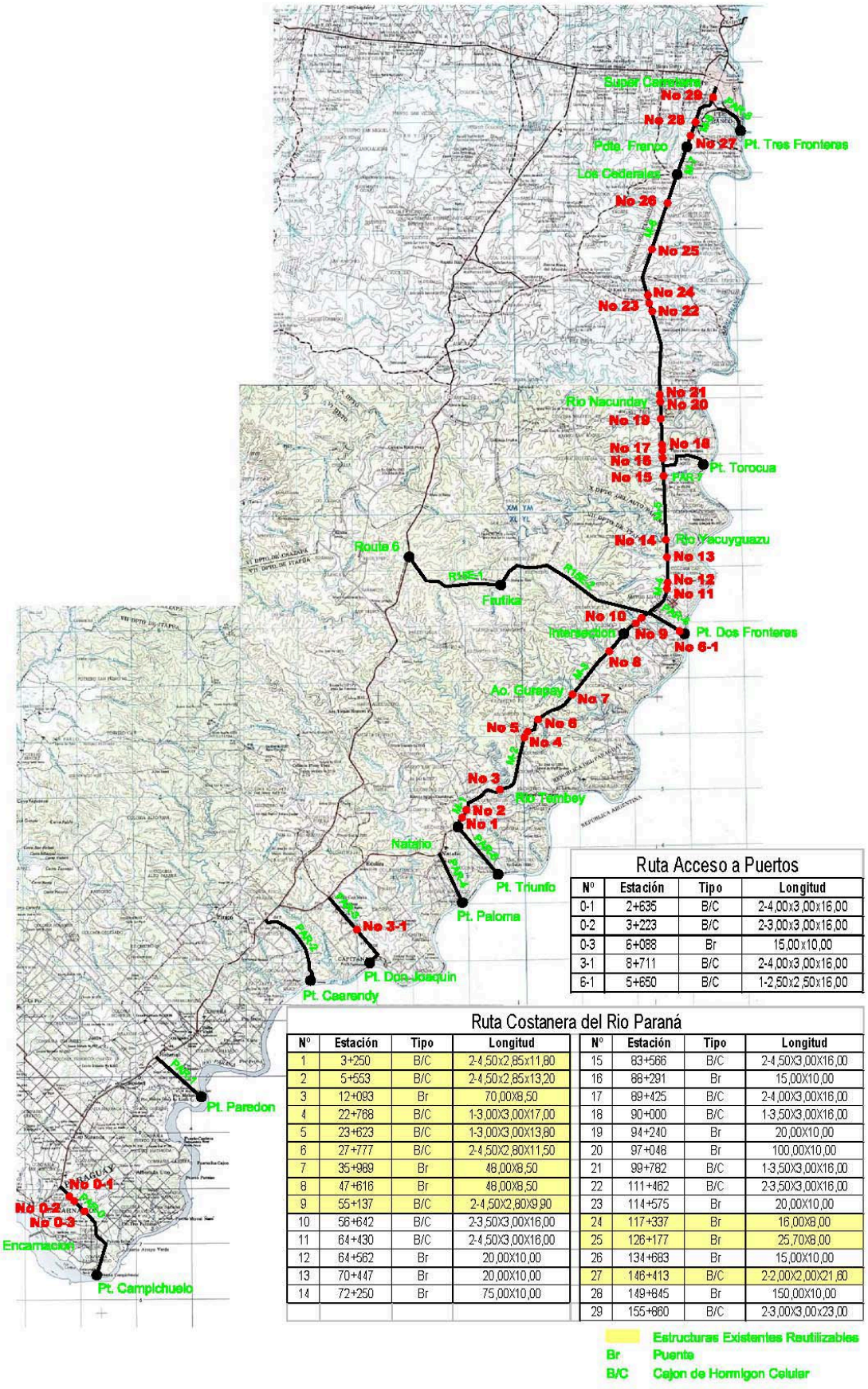
3) Abutments

The type of abutment chosen for a given bridge varies depending on the bearing subsoil condition of the site, height of abutment and economic priorities. Since the planned heights of abutments are 5.0 to 12.0m, a cantilever type abutment will be adopted.

(3) Pier Type

Since Paraguay has no seismic effects, it allows the adoption of smaller piers. Concerning the type of pier it should also be aesthetically pleasing and economize the use of materials as much as possible. The structural type of piers should be determined to satisfy the surrounding conditions as well as the structural requirements. The type of pier in this study is determined based on the above description. The wall type pier will be adopted as shown in Figure, for river flow is not disturbed by the pier.





Ruta Acceso a Puertos

Nº	Estación	Tipo	Longitud
0-1	2+635	B/C	2-4,00x3,00x16,00
0-2	3+223	B/C	2-3,00x3,00x16,00
0-3	6+088	Br	15,00x10,00
3-1	8+711	B/C	2-4,00x3,00x16,00
6-1	5+650	B/C	1-2,50x2,50x16,00

Ruta Costanera del Rio Paraná

Nº	Estación	Tipo	Longitud
1	3+250	B/C	2-4,50x2,85x11,80
2	5+553	B/C	2-4,50x2,85x13,20
3	12+093	Br	70,00X8,50
4	22+768	B/C	1-3,00X3,00X17,00
5	23+623	B/C	1-3,00X3,00X13,80
6	27+777	B/C	2-4,50X2,80X11,50
7	35+989	Br	48,00X8,50
8	47+616	Br	48,00X8,50
9	55+137	B/C	2-4,50X2,80X9,90
10	56+642	B/C	2-3,50X3,00X16,00
11	64+430	B/C	2-4,50X3,00X16,00
12	64+562	Br	20,00X10,00
13	70+447	Br	20,00X10,00
14	72+250	Br	75,00X10,00

Nº	Estación	Tipo	Longitud
15	83+566	B/C	2-4,50X3,00X16,00
16	88+291	Br	15,00X10,00
17	89+425	B/C	2-4,00X3,00X16,00
18	90+000	B/C	1-3,50X3,00X16,00
19	94+240	Br	20,00X10,00
20	97+048	Br	100,00X10,00
21	99+782	B/C	1-3,50X3,00X16,00
22	111+462	B/C	2-3,50X3,00X16,00
23	114+575	Br	20,00X10,00
24	117+337	Br	16,00X8,00
25	126+177	Br	25,70X8,00
26	134+683	Br	15,00X10,00
27	146+413	B/C	2-2,00X2,00X21,60
28	149+845	Br	150,00X10,00
29	155+660	B/C	2-3,00X3,00x23,00

Estructuras Existentes Reutilizables
Br Puente
B/C Cajon de Hormigon Celular

Figure 12.2 Location of Proposed Bridges

13. ESTIMATION FOR DEVELOPMENT COSTS

13.1 METHOD

The construction cost is derived from the quantity and construction unit price calculated in the outline designs for roads and structures. The project cost is calculated by adding costs for technical support, land acquisition, compensation and reserves onto the construction cost.

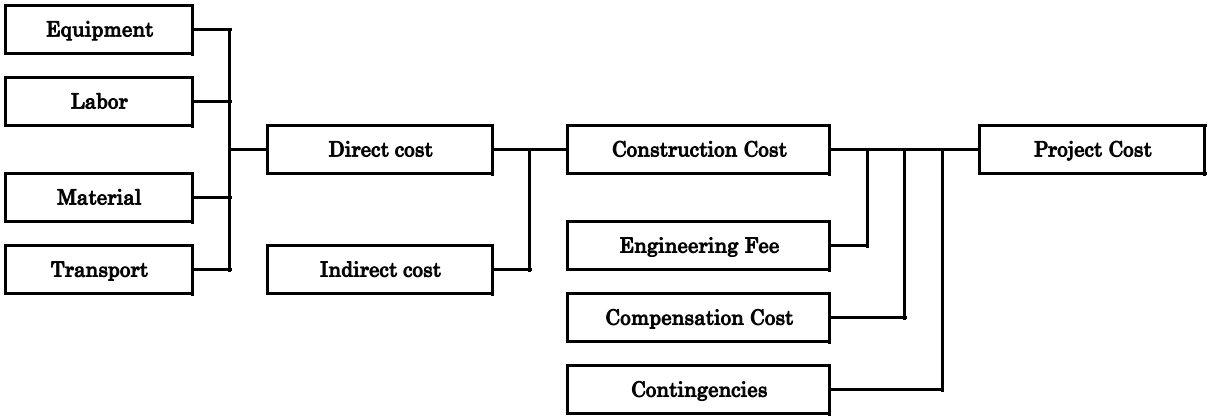


Figure 13.1 Cost Estimate Process

13.2 TOTAL PROJECT COST

The project cost is calculated for each of the Paraná River Coastal Road, Extension of National Road Route 15, and Port Access Road.

Table 13.1 Summary of Project Costs (million US$)

Description \ Segment	Parana Coast road	National Highway No.15 Extension road	Sub total	Harbor Access Road	Total
Distance (km)	157.6	54.4	212.0	107.6	319.6
①Earth moving	14.8	1.7	16.5	3.1	19.6
Site clearing(Heaby)	0.8	0.0	0.8	0.0	0.8
Site clearing(Normal)	0.7	0.1	0.8	0.4	1.2
Cut	8.6	0.6	9.2	1.0	10.2
Embankment	0.0	0.0	0.0	0.0	0.0
Drainage	0.7	0.2	0.9	0.5	1.4
Segregation space	0.1	0.0	0.1	0.0	0.1
Appurtenances	3.0	0.5	3.5	0.8	4.3
Environmental Preservation Measures	0.2	0.0	0.2	0.0	0.2
Parking	0.6	0.2	0.8	0.4	1.2
②Asphart Pavement	51.8	10.5	62.3	24.1	86.4
③Box Clvert	0.6	0.0	0.6	0.3	0.9
④Bridge	5.0	0.0	5.0	0.2	5.2
(1) Construccion Cost ①+②+③+④	**72.1**	**12.2**	**84.3**	**27.8**	**112.1**
(2) Engineering Fee (1)× 13%	**9.4**	**1.6**	**11.0**	**3.6**	**14.6**
(3) Conpensation	**1.6**	**0.3**	**1.9**	**0.5**	**2.4**
(4) Contingencies (1)～(3)× 10%	**8.3**	**1.4**	**9.7**	**3.2**	**12.9**
(5) Project Cost	**91.4**	**15.4**	**106.8**	**35.1**	**141.9**
(million US$/km)	**0.58**	**0.28**	**0.50**	**0.33**	**0.44**

13.3 MAINTENANCE COST

Maintenance cost is two types of maintenance works: periodical repair and maintenance work and routine maintenance work.

(1) Periodical repair and maintenance work

- Earthroad: leveling off after rainfall, compaction repair, cleaning
- Stone pavement: gap filling repair work, cleaning
- Asphalt pavement: cleaning

(2) Routine maintenance work

- Earthroad, stone pavement: none
- Asphalt pavement: road marking, repavement

The frequency of maintenance work is considered as follows taking also the record of maintenance work by the MOPC.

- The periodical maintenance for the road surface of stone pavement is set at 20 days in year.
- The periodical maintenance for the road surface of asphalt pavement is set as only cleaning works in order to prevent any impact of rainfall.
- The routine maintenance for earthroad and stone pavement is not set, because it can be covered by periodical maintenance works.
- The routine maintenance for asphalt pavement is set as repavement in every 12 years for all roads, because the thickness of pavement is differently set according to the volume of traffic.

The maintenance cost in each case is listed up in Table 13.2 below.

Table 13.2 Unit Cost of Maintenance Works

No.1

Parana Coast road						①						②	①+②=③
Section of Plan Road				M-1	M-2	M-3	**Sub-Total**	M-4	M-5	M-6	M-7	M-8	**Sub-Total**	**ToTal**
Distance (km) / Description	Existing	Earthen		12.0	23.9	23.3	**59.2**	13.0	24.8	43.0	0.3	4.5	85.6	144.8
		Stone-paved		0.1	0.0	0.0	**0.1**	0.0	0.0	0.0	7.2	2.6	9.7	9.8
	Plan	Asphalt Pavement		12.1	23.9	23.3	**59.3**	13.0	24.8	43.0	7.4	10.1	**98.3**	**157.6**
Situation	Frequency	Pavement Tipe of Plan Road		Tipe2	Tipe2	Tipe2		Tipe3	Tipe3	Tipe3	Tipe3	Tipe3		
Existing	Necessaly	Routine Maintenance Work		167,266	332,417	324,488	**824,171**	254,272	485,626	843,311	48,546	104,565	**1,736,320**	**2,560,491**
Plan	Every 1Years	Routine Maintenance Work		2,007	3,967	3,872	**9,846**	2,153	4,112	7,141	1,233	1,672	**16,311**	**26,157**
	Every 6 Years	Routine Maintenance Work Road Marking		89,077	176,018	171,819	**436,914**	95,537	182,463	316,856	54,715	74,212	**723,783**	**1,160,697**
	Every 12 Years	Routine Maintenance Work Road Marking Road Surface Repair		953,642	1,884,415	1,839,465	**4,677,522**	1,022,801	1,953,416	3,392,199	585,765	794,504	**7,748,685**	**12,426,207**

No.2

Harbor Acceso Road & National Highway No.15 Extension Road												④	⑤	③+④+⑤
Section of Plan Road				P-0	P-1	P-2	P-3	P-4	P-5	P-6	P-7	P-8	**Sub-Total**	Ruto15	**Total**
Distance (km) / Description	Existing	Earthen		19.7	6.6	15.6	16.8	10.5	0.0	5.7	8.7	0.0	**83.47**	28.7	**257.0**
		Stone-paved		0.0	4.4	0.0	0.0	0.0	11.8	0.0	0.0	7.9	**24.1**	20.9	**54.8**
	Plan	Asphalt Pavement		19.7	11.0	15.6	16.8	10.5	11.8	5.7	8.7	7.9	**107.6**	54.4	**319.6**
Situation	Frequency	Pavement Tipe of Plan Road		Tipe1	Tipe1	Tipe2	Tipe2	Tipe1	Tipe1	Tipe1	Tipe1	Tipe3		Tipe1	
Existing	Necessaly	Routine Maintenance Work		133,472	54,303	105,908	233,009	71,217	25,465	38,358	59,200	47,737	**768,669**	239,948	**3,569,108**
Plan	Every 1Years	Routine Maintenance Work		3,264	1,826	2,590	2,781	1,741	1,959	938	1,448	1,311	**17,858**	9,035	**53,050**
	Every 6 Years	Routine Maintenance Work Road Marking		144,816	81,026	114,910	123,381	77,269	86,919	41,618	64,232	58,191	**792,362**	400,931	**2,353,990**
	Every 12 Years	Routine Maintenance Work Road Marking Road Surface Repair		1,550,368	867,449	1,230,201	1,320,889	827,231	930,536	445,553	687,651	622,986	**8,482,864**	4,292,295	**25,201,366**

14. DEVELOPMENT OF THE ROAD MAINTENANCE PLAN

14.1 CURRENT CONDITION OF THE ROAD MAINTENANCE

17 district offices of MOPC conduct maintenance works of National Road and Departmental Road under the control of Road Conservation and Maintenance Division, MOPC at the present. Each district office has to repot its monthly activities to Road Conservation and Maintenance Division, and also sends information of road conditions in its territory once for three months. Road Conservation and Maintenance Division compile these road condition data, and elaborate annual maintenance plan for rods within its district by using SIAMV (Sistema Integral de Administracón del Mantenimiento), a software of road maintenance planning. On the other hand actual budget for road maintenance is executed only 10% of planned budget. Accordingly, road maintenance work is not enough to keep service level of paved road.

In this circumstance, "Road Improvement and Maintenance Project in Paraguay" financed by World Bank is conducted at the present. This project consists of 3 components as following;

1) To establish a strategy for road development
2) To establish the maintenance plan of paved trunk road and improvement of service level on paved road
3) To improve accessibility of local poverty area to paved trunk roads

Among 3 components mentioned above, recommendation on improvement and maintenance of paved trunk road will be done in component (2).

1) To establish 5 years plan (2008-2012) on improvement and maintenance work of road network in Paraguay
2) To prepare the action plan for improvement of service level of paved road a certain level in 1 or 2 years within the 5 years plan for 1500 km paved trunk roads.
3) To conduct concession to private sector to maintain the service level of improved roads for 3-4 years after completion of improvement work mentioned in the previous b.

Improvement and maintenance work proposed in 5 years plan expects to use financial resource from World Bank under the concept of importance of maintenance work. After this finance from World Bank, this type of maintenance work will expect to be done by using domestic budget. On the other hand, project roads in this study will be completed in 2013 when 2nd 5 years plan would start. It is recommendable to adopt the way proposed by World Bank in the "Road Improvement and Maintenance Project in Paraguay", some problems will still remain even in this way regarding following matters;

14.2 INVESTIGATION OF THE ROAD MAINTENANCE PLAN

(1) Investigation of Road Maintenance Cost by using Collected Toll

Maintenance cost for the objective roads in this study is estimated in the Table 14.1 and total maintenance cost for 12 years is estimated to be US$ 28,085,856. In this section, examination will be conducted for affordability of collected toll for this amount of maintenance cost.

Table 14.1 Maintenance Cost for the Objective Roads

year	Routine Maint.	Periodic Maint.	Overlay	Toatl
1	53,050			53,050
2	53,050			53,050
3	53,050			53,050
4	53,050			53,050
5	53,050			53,050
6		2,353,990		2,353,990
7	53,050			53,050
8	53,050			53,050
9	53,050			53,050
10	53,050			53,050
11	53,050			53,050
12			25,201,366	25,201,366
計	530,500	2,353,990	25,201,366	28,085,856

Unit: US$

It is appropriate to install 2 Toll gates on the main corridor along the Paraná River. Traffic volume at these 2 points in 2015 are focused as mentioned in the Table 14.2

Table 14.2 Future Traffic Volume in 2015 at 2 Toll Gates

	Cars	Bus	Truck	Volume/day
Gate-1	1,000	80	340	1,420
Gate-2	1,130	90	620	1,840

Annual amount of toll collected in these 2 points comes up to approximate US$ 730,000- in 2015 based on the focused traffic volume by vehicle type. (toll will be charged at one side on the road) On the other hand, annual operation cost of each toll gate is estimated to be approximate US$ 60,000- based on the cost information from MOPC. Accordingly annual charged toll (US$ 730,000) will cover the annual routine maintenance cost including operation cost of 2 toll gates (total US$ 173,000). However, US$ 8.7 million of total charged toll during 12 years, can not cover at all the total road maintenance cost (US$ 29.2 million) including overlay cost in 12^{th} year.

Consequently, it is impossible to cover the road maintenance cost including overlay cost, but it is enough to cover the routine and periodical maintenance cost by using the collected toll. As it will be impossible to conduct the overlay works with private finance as mentioned in Table 15.2-3, MOPC has to do the work by itself using the domestic budget or finances from some donors.

Table 14.3 Maintenance Cost and Revenue from Toll

	Routine Maint. Annual Cost	Total Maint. Cost during 11 years Not incl overlay	Total Maint. Cost during 12 years incl. Overlay
Maintenance Cost	53,000	583,000	28,085,856
Operation cost of 2 Toll gate	120,000	1,320,000	1,440,000
Total Cost	173,000	4,256,900	29,525,856
	○	○	×
Revenue	730,000	8,030,000	8,760,000

Unit: US$

(2) Road Maintenance

As mentioned above, it is possible to cover the road maintenance cost except overlay cost by using the collected toll. Also it will be possible to contract out the maintenance work with toll collection work to private sector. Following alternatives are considered for the way of maintenance for project roads.

1) Using Budget of MOPC (In this case, a part of budget will be allocated to the project roads within the total budget of the district office)
2) To invest the toll collected by MOPC directly into road maintenance by contracting out to private companies. (In this case, it is necessary to pool the annual surplus over the fiscal year continuously)
3) To contract out all the works except overlay to private companies. Even in this case, it is necessary to conduct further examination regarding payment from private company to MOPC .

Regarding (1) mentioned above, it is very uncertain to confirm the actual budget for maintenance work, and sustainable maintenance work is not sure. (2) is the most steady way for realization of sustainable maintenance work if it would be possible to pool annual surplus over the fiscal year. And (2) will be able to success to the way proposed by World Bank mentioned previously. (3) can have a reliable revenue, but some conflicts between private company and MOPC will occur frequently. Considering above, the way of (2) is recommendable in this study.

15. ECONOMIC AND FINANCIAL ANALYSIS

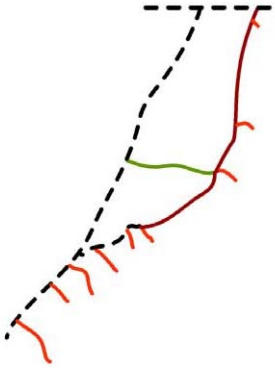
15.1 ECONOMIC ANALYSIS

(1) Benefits Counted in the Economic Analysis

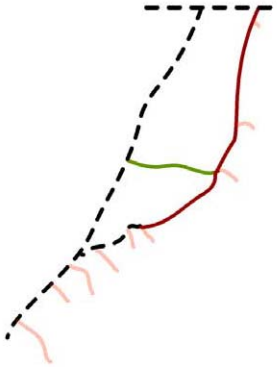
・Saving in export transportation costs
・Saving in local transportation costs
・Saving in transportation costs by diverted transport from National Road Route 6
・Elimination of impassability
・Saving in maintenance cost

(2) Cases for the Economic Analysis

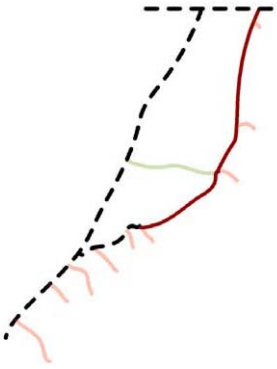
Regarding two proposed projects of the Paraná River Coastal Road and the Extension of National Road Route 15, the present study analyzed four alternative cases, as shown below, to evaluate their respective need and priority in the network development. Port Access Roads and Caarendy Port were individually evaluated.



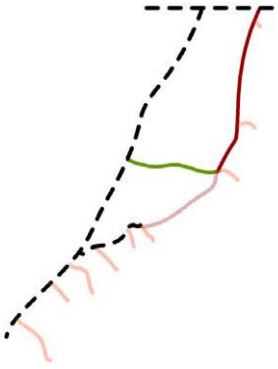
Case I: All road components are implemented



Case II: Components of the coastal road along the Paraná River and Extension of National Road Route 15 (temporary name) are implemented



Case III: Only the component of the coastal road along the Paraná River is implemented



Case IV: Components of northern part of the coastal road along the Paraná River and Extension of National Road Route 15 (temporary name) are implemented

Figure 15.1 Cases for the Economic Analysis

(3) Economic Feasibility of the Project and Its Components

Annual economic costs and benefits are calculated per proposed project. When all the projects are combined (Case I), the economic internal rate of return (EIRR) is estimated to be 14.3%, which is significantly higher than the normal opportunity cost of 11% in Paraguay. This indicates that the implementation of the proposed projects is economically feasible as a whole. The Paraná River road alone (Case III) shows the highest EIRR. In other words, the top priority is assignable to the Paraná River Coastal Road, to be followed by the Extension of National Road Route 15.

EIRRs of individual Port Access Roads vary from 7.8 to 20.6%. The rate is higher in those areas with denser roadside population, indicating the higher need of their implementation by the public sector. However, their combined EIRR exceeds 11%. From the viewpoint of social equity, it is more appropriate to assume the improvement of all proposed access roads and to start implementing one by one in the order of higher EIRRs. The Caarendy Port project shows a significantly high EIRR, mainly because its proximity to grain producing areas is expected to realize the benefit of a substantial saving in operation costs.

Table 15.1 Estimated Economic Indicators of the Project

Case \ Indicators		IRR	NPV	B/C
		%	US$ million	Ratio
			at discount rate of 11%	
Case I	All Roads	14.3%	33.18	1.32
Case II	Coastal Road + Extension of National Road Route 15	15.1%	31.83	1.42
Case III	Coastal Road	15.4%	29.67	1.46
Case VI	Northern Part of Coastal Road + Extension of National Road Route 15	13.6%	14.83	1.26
PAR-0	Campichuelo	8.3%	-1.12	0.77
PAR-1	Paredón	20.6%	2.56	2.05
PAR-2	Caarendy	8.3%	-0.96	0.77
PAR-3	Don Joaquín	13.3%	1.06	1.22
PAR-4	Paloma	11.8%	0.18	1.07
PAR-5	Triunfo	7.8%	-0.52	0.75
PAR-6	Dos Fronteras	14.8%	0.51	1.37
PAR-7	Torocuá	11.9%	0.18	1.09
PAR-8	Tres Fronteras	9.8%	-0.17	0.90
	All Access Roads	11.2%	0.42	1.02
Caarendy Port		22.8%	6.02	2.00

15.2 FINANCIAL ANALYSIS ON CAARENDY PORT

Financial aspects will be examined in this section on the operation of Caarendy Port financed by Japanese Grant Aid.

(1) Operation Cost

Construction cost is ignored because Japanese Gran Aid Cooperation will be expected to realize the project. Operation cost of Caarendy Port consists of 1) Personal cost, 2) Maintenance cost (for building etc.), and 3) other direct cost (water, electricity, gasoline, communication etc.).

1) Personal Cost

As mentioned in the previous part of "Operation Plan", 26 staff members will operate Caarendy Port. Referring to financial data in Concepción Port which ANNP is managing, personal cost in Caarendy Port is estimated in Gs 528,415,200 (Approx. US$ 88,000, @=6,000) per year.

Table 15.2 Estimated Personal Cost in Caarendy Port (2015)

Sector	Annual Cost (Gs)
Management	192,897,600
Maintenance	126,855,600
Assistance	208,662,000
Total	528,415,200

2) Maintenance Cost

Maintenance cost of Caarendy Port including cost for maintenance of building, machines, and restaurant, is estimated to be Gs 160,000,000 (Approx. US$ 27,000, @=6,00) equivalent to 30% of personal cost referring to other ports ANNP mare managing.

3) Other Direct Cost

Other direct cost including water, electricity, communications etc. is estimated to be Gs 131,250,000 (Approx. 22,000, @=6,000) equivalent to 25% of personal cost referring to financial information of other ports ANNP is managing.

4) Total Operation Cost

Total annual operation cost of Caarendy Port will be calculated to add 1), 2) and 3) and to be Gs 819,665,200 (Approx. US$137,000, @=6,000).

Table 15.3 Total Operation Cost

Sector	Annual Operation Cost (Gs)
Personal Cost	528,415,200
Maintenance Cost	160,000,000
Other Direct Cost	131,250,000
Total	819,665,200

(2) Revenue

Revenue on Caarendy Port operation consists machine charge on tonnage of handled cargo, silo storage charge, assurance charge, and miscellaneous charge on valued price of handled cargo.

1) Machine Charge

Gs 3,000 will be charged per 1 ton on exported grain. As to import, Gs 6,000 equivalent to 2 times of amount of export will be charged for cargo except grain.

2) Silo Storage Charge

0.20% and 0.65% of valued price of exported cargo and imported cargo, respectively.

3) Assurerance Charge

0.25% of valued price of exported cargo will be charged.

4) Miscellaneous Charge

For the Caarendy Port operation, 25% of minimum salary of 10 assistant staff will be charged. Gs200,000,000 is estimated to be annual cost for this item.

5) Total Annual Revenue

Total annual revenue is calculated by using unit price mentioned above and volume of cargo and come up to Gs 2,612,014,696.

(3) Profitability

Comparing Annual operation cost to annual revenue calculated mentioned above, Gs1,792,349,496 (Approx.US$298,000, @=6,000) of surplus will be generated and operation will be judge to be profitable. More detailed study will be necessary just before the start of the operation on the unit price and the level of charges.

Table 15.4 Profitability of Caarendy Port Operation

Annual Ope. Cost(Gs)	Annual Revenue(Gs)	Profit/year (Gs)
819,665,200	2,612,014,696	1,792,349,496

15.3 PROJECT IMPACT ANALYSIS

The following six items are also measured or analyzed in this Study.

- Strengthening export competitiveness
- Enhanced regional integration
- Poverty reduction
- Increase of life opportunities and interchange
- Population stability
- Creation of working opportunities in terms of construction works

(1) Strengthening Export Competitiveness by Transport Stabilization

The access to grain exporting ports is nearly impossible on rainy days in the study area. The implementation of all road projects will ensure stable all-weather access to port facilities for exporting soybean and wheat. The improvement of port access roads will reduce the cost of rain-delayed transport (the loss of profit caused by the delay) and the asphalt-paved surface will help cut down the cost of vehicle operation and maintenance. If all the road projects are implemented, the combined saving by such cost reductions is estimated to reach some US$7.9 million per annum. Given the annual export of approximately 2.8 million tons in the study area, the saving will amount to US$2.8 per ton of exported grain. This amount is equivalent to 50% of the current cost of truck transport (see Table 3.3-1). The costs accruing from the risks of delayed transport and vehicle operation are now presumably reflected in the alongside-silo price at the port received by the farmers. Then, the project implementation, by eliminating such risks, will serve to increase the producer price and reduce the FOB export price. Moreover, the project implementation that enables all-weather collection and delivery of grains will boost Paraguay's market reliability as well as contributing to its price competitiveness. The overall export competitiveness will be greatly enhanced by these projects.

(2) Enhanced Regional Integration through IIRSA Transnational Network Formation

Land-locked Paraguay has to rely on the links with neighboring countries for external trade and requires a well-developed transnational transport network to promote its export. The country's structure of external trade in 2004 shows a large proportion of such neighboring countries as Brazil, Argentina and Uruguay, all together accounting for 60% of export and 80% of import (see Table 16.3-1). This indicates the vital importance to Paraguay of transnational transport infrastructure. In the past, the country benefited from the thriving parallel export at such border cities as Ciudad del Este, Encarnación and Pedro Juan Caballero. Brazil and Argentina in these days had the protective trade policy for their own industries, while Paraguay, with no significant domestic manufacturing industries to protect, adopted low tariffs on imports and kept the domestic taxation level low. By taking advantage of this situation, border cities of Paraguay sold electric appliances, liquors, cigarettes and so on to the visitors from Brazil and Argentina and the income from such transactions was of considerable importance in the national economy. In 1995, Paraguay joined the regional Common Market (MERCOSUR) which abolished trade tariffs and promoted free trade among member countries. As a result, the parallel trade quickly dwindled to a negligible level. Given the changed external circumstances, the development and formation of IIRSA transnational transport network has an important bearing on Paraguay centrally located among the Common Market countries. The country will possibly emerge as one of the hubs in the well-developed transnational network.

Table 15.5 Export and Import Structure of Paraguay (2004)

	EXPORT		IMPORT	
	ton	%	ton	%
Brazil	1,448,571.0	25.9	1,337,586.0	38.1
Argentina	396,137.3	7.1	1,390,199.0	39.6
Uruguay	1,691,762.0	30.2	95,475.4	2.7
Chile	33,650.3	0.6	24,455.0	0.7
Bolivia/Peru	21,395.2	0.4	36,795.7	1.0
Middle & South America	1,193,980.0	21.3	46,010.0	1.3
North-America	88,797.1	1.6	39,145.7	1.1
Europe	543,755.8	9.7	245,210.6	7.0
Asia/Oceania	142,252.7	2.5	285,673.6	8.1
Africa/Middle East	32,203.8	0.6	11,674.5	0.3
Others	120.6	0.0	105.2	0.0
Total	5,592,625.8	100.0	3,512,330.7	100.0

Source: OCIT

(3) Road Improvement Impact on Poverty Reduction

By studying the pavement proportion and poverty (extreme poverty) ratio per Department with a correlative analysis, we have come to the relation the extreme poverty index shows a strong correlation. The extension of the rate of paved roads by 10% is expected to provoke a 1.8% decrease of the extreme poverty index. Also, Figure 15.2 shows the estimation of the poverty index and of the

extreme poverty index in urban zones close to and away from paved roads. With the interconnection of urban centers and a paved road, the poverty index and the extreme poverty index would improve between 4.7% - 10.9% and 5.9% - 10.8%, respectively.

The estimation of the benefits of the Road Improvement Project in relation to poverty reduction in the influence area along the road starts with an 8% reduction on poverty and extreme poverty indexes. The forecast carried out based on the 2002 population margin shows an approximate reduction of 9,100 people from the poor population and 9,900 people from the extremely poor population (see Table 15.6).

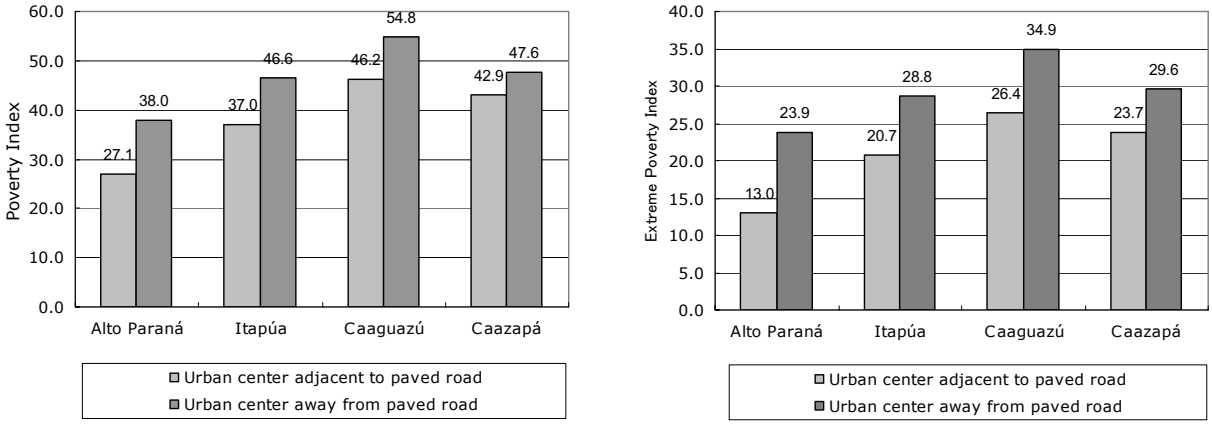


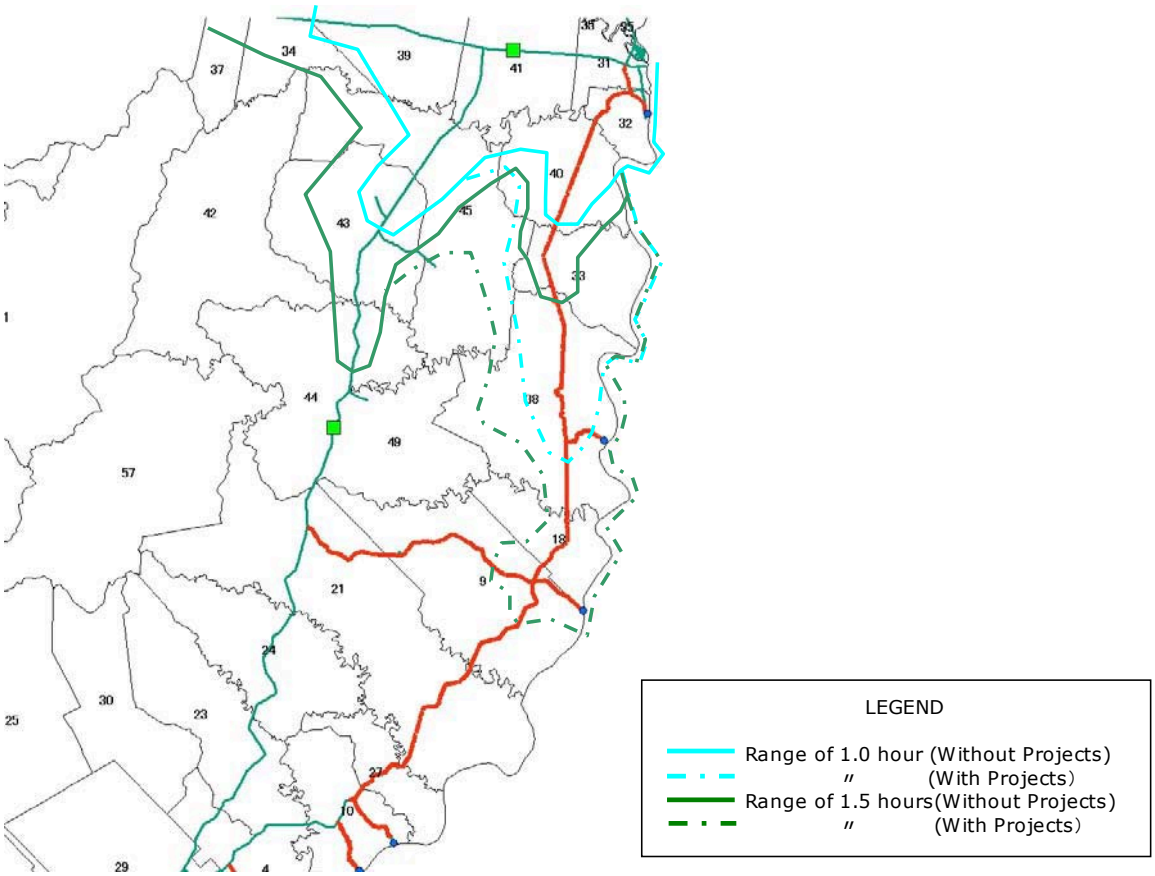
Figure 15.2 Main Road and Poverty/Extreme Poverty Index Ratio

Table 15.6 Estimation of Impact on Poverty Reduction

Department	District	Population (2002)	Poverty Population			Extremely Poverty Population		
			Without Project	With Project	Expected Reduction	Without Project	With Project	Expected Reduction
Alto Paraná	Domingo M. de Irala	6,734	2,949 (43.8%)	2,411 (35.8%)	538	1,751 (26.%)	1,212 (18.%)	539
	Ñacunday	8,403	3,983 (47.4%)	3,311 (39.4%)	672	2,504 (29.8%)	1,832 (21.8%)	672
	Los Cedrales	9,003	2,530 (28.1%)	1,810 (20.1%)	720	1,485 (16.5%)	765 (8.5%)	720
	Total	24,140	9,462 (39.2%)	7,532 (31.2%)	1,930	5,740 (23.8%)	3,809 (15.8%)	1,931
Itapua	Cambyreta	27,808	7,397 (26.6%)	5,172 (18.6%)	2,225	3,977 (14.3%)	1,752 (6.3%)	2,225
	Capitan Meza	10,384	3,717 (35.8%)	2,887 (27.8%)	830	2,118 (20.4%)	1,288 (12.4%)	830
	Carlos Antonio López	17,622	7,895 (44.8%)	6,485 (36.8%)	1,410	4,740 (26.9%)	3,331 (18.9%)	1,409
	Mayor Otaño	12,157	6,370 (52.4%)	5,398 (44.4%)	972	3,829 (31.5%)	2,857 (23.5%)	972
	San Rafael del Paraná	20,434	6,723 (32.9%)	5,088 (24.9%)	1,635	3,964 (19.4%)	2,329 (11.4%)	1,635
	Yatytay	11,415	6,849 (60.%)	5,936 (52.%)	913	4,532 (39.7%)	3,619 (31.7%)	913
	Total	99,820	35,249 (35.3%)	28,094 (28.1%)	7,170	23,161 (23.2%)	15,176 (15.2%)	7,985
Total		123,960	44,711 (36.1%)	35,626 (28.7%)	9,100	28,901 (23.3%)	18,985 (15.3%)	9,916

(4) Increase of Life Opportunities and Interchange

A road improvement comes along with access improvement towards other districts and a wide range of institutions, and better interchange opportunities. The population of areas at a 1 to 1.5 hour distance from Encarnacion and Ciudad del Este will show an important growth in comparison to their current state, as shown in Figure 15.3. Since Ciudad del Este has a higher population density, the comparative study of population index increase before and after a Road Improvement Project implementation, the population at a 1 to 1.5 hour distance from the urban center of this city will show an increase of 15,000 to 29,000 people, corresponding to 3.8% to 6.6%. However, the benefits that would come along with an increase of the region potential are considerable. They would shorten the time needed from Encarnacion or Ciudad del Este to no more than 2 hours, instead of the 3 hours required with the current road infrastructure.



	(A)Without Projects	(B)With Projects	Increment(B-A)
Population within range of 1.0 hour			
Alto Paraná	0	0	0
Itapúa	385,632	400,337	14,705
Caaguazú	0	0	0
Total	385,632	400,337	14,705
Population within range of 1.5 hours			
Alto Paraná	0	0	0
Itapúa	440,835	469,893	29,058
Caaguazú	0	0	0
Total	440,835	469,893	29,058

Figure 15.3 Arriving Population Per Period of Time from Encarnación and Ciudad del Este

(5) Population Stability

Table 15.7 shows the population growth index corresponding to 10 years from 1992 in districts with or without road. Road adjacent districts show a higher population increase than districts away from paved roads. Therefore, we consider that road pavement and the consequent life quality improvement in the area, along with the hiring of personnel would translate into population stability or increase in the area in question.

Table 15.7 Comparison of the Population Increase Index per Paved Road and Unpaved Road Districts

Population Increase Index (2002/1992)			
	District with a Road	District without a Road	Total
Itapua	1.16	1.28	1.20
Alto Paraná	1.44	1.05	1.37
Total	1.32	1.20	1.29

(6) Labor Opportunity Generation in the Construction Works

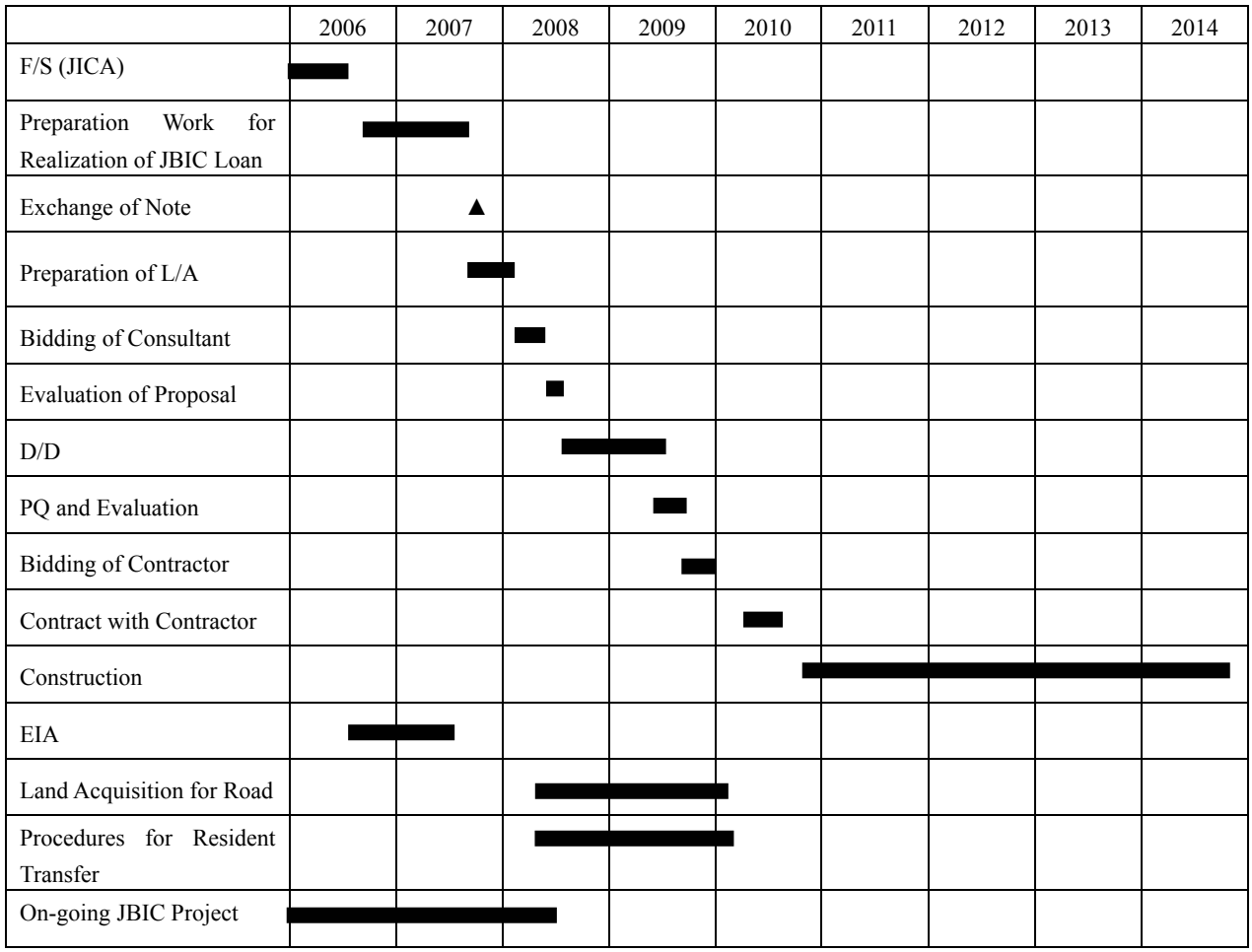
Very important works such as this Project require worker hiring. This personnel gets supplies in part from the population of the area. According to the estimations of the test, in case of all of the road works – excepting the port improvement work – a total of 123,000 people/day would be needed, approximately, for a 4-year work (1,000 days), which would generate permanent jobs for about 120 permanent workers.

16. IMPLEMENTATION PLAN

(1) Implementation Schedule

Several procedures to realize the project are necessary to be completed after this feasibility study in case of using the finance some donor. In case of JBIC (Japan Bank for International Cooperation) loan, detailed design will start at the middle of the year of 2008, the construction work will commence at the second half of the year of 2010. Tentative implementation schedule of road development is shown in Table 16.1. Paraguay side has to complete its responsibility by the time of commencement of construction for the smooth implementation. Especially, it is very important to have completed some procedures such as final confirmation of number of houses to be transferred, topographic survey of houses, and payment of compensation before the contract of contract. Accordingly, it is inevitable to progress the procedure to get the budget for topographic survey and resident transfer in the previous year. However, Paraguay side have to take an action of these procedures paying attention to on-going road development projects financed by some donors.

Table 16.1 Tentative Implementation Schedule of Road Development



(2) Land Acquisition for Road

Land acquisition will be needed for 296.2 km within 315km of the whole distance of the project roads. Total area for land acquisition counts 700ha. Total cost for land acquisition is estimated to be approximate US$ 1.4 million as shown in Table 16.2.

Table 16.2 Road Distance for Land Acquisition etc.

Road Section	Distance (km)	Area (ha)	Cost (US$)
Main Corridor	134.2	362.3	686,832
Port Access Road	107.6	216.2	467,072
Extension of National Road Route 15	54.4	122.2	244,452
Total	296.2	700.7	1,398,356

Land acquisition is inevitable action to be completed for whole line of the road in advance to conduct the project road construction. It is recommended to start the procedure from the road sections that would take long time due to difficulty of acquisition because almost area to be acquired contain no difficulties to progress the procedure.

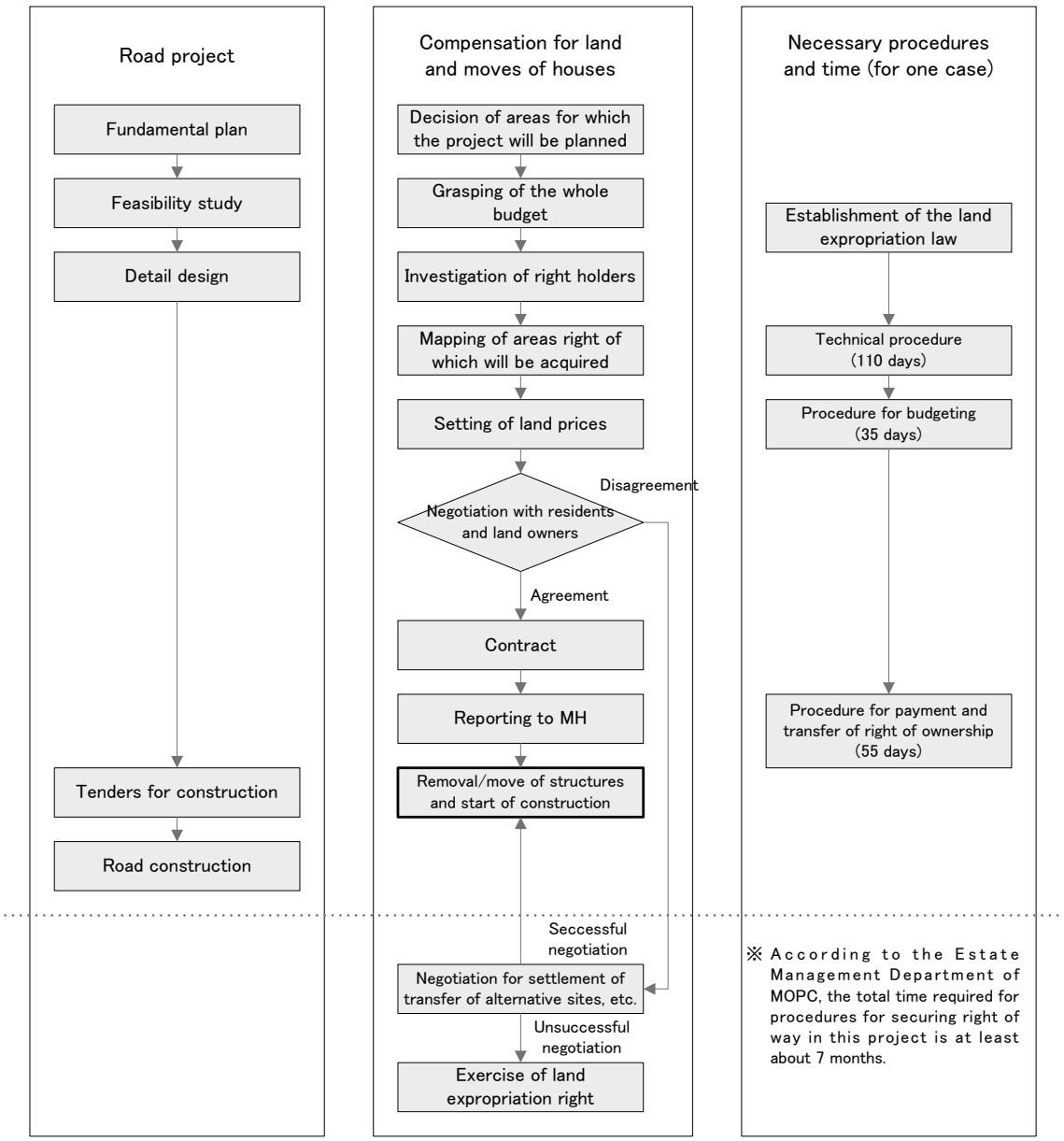


Figure 16.1 Procedure of Compensation for land and accommodation

(3) Resident Transfer

Number of resident transfer within road width (13.5m) with the advance of implementation of the project counts 43 and 45 for the access point to Ciudad del Este along the main corridor and for the whole sections of main corridor, respectively. On the other hand, there exist only 2 for the Extension of National Road Route 15 and for Port Access Roads.

However, number of resident transfer within the right of way (50m in Paraguay) counts 490 (not incl. within road width) as shown in Table 16.3, which means that total number of resident transfer with the advance of this project counts 538. However, almost all of them do not contain any difficulty for the construction work. Further study is necessary to grasp the detailed number of resident transfer and it will be necessary to clear the number at the period of detailed design at latest.

The cost for resident transfer that will be prepared by domestic budget is estimated to be US$ 1.0 million in this study. (This cost should be reviewed and calculated based on precise information same as the number of resident transfer). Since a various procedure such as payment the compensation, preparation of new land to transfer, and devolution etc. will be needed; the executing agency of this project should deal with promptly.

Table 16.3 Number of Resident Transfer

	Road Section	Within Road Width (13.5m)	Within Right of Way (50m)
M-1	Natalio - Otaño	0	12
M-2	Tembey River – Gurapay Stream	0	46
M-3	Gurapay Stream – Intersección con R15E	0	22
M-4	Intersección con R15E – Yacuyguazu River	0	11
M-5	Yacuyguazu River – Ñacunday River	1	0
M-6	Ñacunday River – Los Cedrales	1	7
M-7	Los Cederales – Pdt. Franco	0	5
M-8	Pdt. Franco – National Road Route 7	43	123
	Sub-total	45	226
R15E-1	National Road Route 6 - Frutika	1	0
R15E-2	Frutica - Corredor Principal	0	17
	Sub-total	1	17
PAR-0	Pto. Campichuelo	2	21
PAR-1	Pto. Paredón	0	17
PAR-2	Pto. Caarendy	0	0
PAR-3	Pto. Don Joaquín	0	14
PAR-4	Pto. Paloma	0	17
PAR-5	Pto. Triunfo	0	37
PAR-6	Pto. Dos Fronteras	0	14
PAR-7	Pto. Torocua	0	0
PAR-8	Pto. Tres Fronteras	0	127
	Sub-total	2	247
	Grand-total	48	490

(4) Preparation of Financial Resource

Even in case of loan from some donors or international funds, a part of project cost should be prepared by domestic budget of Paraguay. It is necessary to deal with the big amount from the budget of Paraguay due to large scale of the project.

According to this table, MOPC has to allocate approximate US$ 2 million and US$ 9 million to this project as domestic budget from 2007 to 2009, and from 2010 to 2013 respectively. These budgets can be prepared within MOPC's budget, it will be necessary to progress the procedures for preparation of the budget intentionally, considering the situation that some road development projects financed by several donors are conducted in parallel with this project.

Table 16.4 Financial Plan and Assignment of Fund

Project Cost (PC)	112.1	million US$
DD/Project Cost	3%	
SV/Project Cost	10%	
Contingency/PC	10%	10% of (2.+5.+6.), not incl. Escalation
Unit Price /km	4,439	US$/km
Land Acquisition Cost(315km)	1.40	million US$
IVA	10%	(10% of total of 1.- 6.)

Assignment of Total Project Cost

milliones de US$

	Total	'06	'07	'08	'09	'10	'11	'12	'13	14	Total
1. EIA	0.20	0.10	0.10								0.20
2. Detailed Design	3.36			1.68	1.68						3.36
3. Land Acquisition for Road	1.40			0.70	0.70						1.40
4. Resident Transfer	1.00			0.50	0.50						1.00
5. Construction Work	112.10					8.17	25.77	28.00	28.00	22.17	112.10
6. Supervision	11.21					0.82	2.81	2.80	2.80	1.98	11.21
7. Contingency	12.67			0.17	0.17	0.90	2.86	3.08	3.08	2.42	12.67
8. IVA	14.17			0.30	0.30	0.99	3.14	3.39	3.39	2.66	14.17
Total	156.11	0.10	0.10	3.35	3.35	10.87	34.58	37.27	37.27	29.22	156.11

Local Cost by MOPC

milliones de US$

	Total	'06	'07	'08	'09	'10	'11	'12	'13	14	Total
1. EIA	0.20	0.10	0.10								0.20
2. Detailed Design	0.00										0.00
3. Land Acquisition for Road	1.40			0.70	0.70						1.40
4. Resident Transfer	1.00			0.50	0.50						1.00
5. Construction Work	20.00					1.46	4.60	4.99	4.99	3.95	20.00
6. Supervision	0.00										0.00
7. Contingency	2.26			0.03	0.03	0.16	0.51	0.55	0.55	0.43	2.26
8. IVA	14.17	0	0.00	0.30	0.30	0.99	3.14	3.39	3.39	2.66	14.17
Total	39.03	0.10	0.10	1.53	1.53	2.61	8.25	8.93	8.93	7.04	39.03

Cost by Loan

milliones de US$

	Total	'06	'07	'08	'09	'10	'11	'12	'13	14	Total
1. EIA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Detailed Design	3.36	0.00	0.00	1.68	1.68	0.00	0.00	0.00	0.00	0.00	3.36
3. Land Acquisition for Road	0.00	0.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70
4. Resident Transfer	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
5. Construction Work	92.10	0.00	0.00	0.00	0.00	6.71	21.17	23.01	23.01	18.21	92.10
6. Supervision	11.21	0.00	0.00	0.00	0.00	0.82	2.81	2.80	2.80	1.98	11.21
7. Contingency	10.41	0.00	0.00	0.14	0.14	0.74	2.35	2.53	2.53	1.98	10.41
8. IVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	117.08	0.00	0.00	1.82	1.82	8.26	26.33	28.34	28.34	22.18	117.08

SUMMARY OF COST

	LOCAL	LOAN	TOTAL	LOAN PORTION
	million US$			%
1. EIA	0.20	0.00	0.20	0%
2. Detailed Design	0.00	3.36	3.36	100%
3. Land Acquisition for Road	1.40	0.70	2.10	33%
4. Resident Transfer	1.00	0.50	1.50	33%
5. Construction Work	20.00	92.10	112.10	82%
6. Supervision	0.00	11.21	11.21	100%
7. Contingency	2.26	10.41	12.67	82%
8. IVA	14.17	0.00	14.17	0%
Total	39.03	117.08	156.11	75%

Nota: Porcion de MOPC=100%

17. CONCLUSIONS AND RECOMMENDATIONS

The present study has found that all the projects proposed for the export corridor plan are justifiable for their implementation. Their early construction and operation are recommended for the following two reasons.

1) The road projects are proposed to overcome the weakness of Paraguayan transport infrastructure and to serve as the integral part of the national development planning strategy. The implementation of these projects will improve the transport efficiency, raise the productivity of export commodities and thereby strengthen Paraguay's export competitiveness. Ultimately, these projects will contribute to the economic activation of the country as a whole.
2) As long as the projects are constructed, operated and maintained in the appropriately required manner, their combined economic internal rate of return is estimated to be 14.3%, i.e., their implementation is judged economically feasible. Their implementation will alleviate the problem of poverty and improve the overall living conditions in the country.

(1) Development of Southern Integrative Roads

- Regarding the road along Paraná River and the Extension of National Road Route 15, their respective technical feasibility is justified by paying attention to a number of relevant factors. Namely, routing decisions are made with due caution to minimize the possible environmental disturbance and the relocation of local communities. Longitudinal and cross-sectional designs are made carefully to suit their respective design speed. Roadside structures are designed so as to economize on the costs of construction and maintenance without sacrificing traffic safety. The number of lanes and the pavement structure are determined in close conformity with the projected future traffic demand. The combined economic internal rate of return is estimated to be a little over 15%, sufficient to justify the implementation of these projects. The proposed roads are to serve as crucial part of the arterial network that will integrate the southeastern region of Paraguay and are thus to be named "southern integrative roads". Their earliest possible implementation is advisable for the following reasons.
- The proposed southern integrative roads are expected to complete the arterial network interconnecting the provinces in the southeastern part of Paraguay. In other words, they will play a decisive role in activating regional economic activities and mitigating the problem of regional poverty.
- The proposed roads are expected to function as the Paraguayan link in the transnational highway between the Atlantic and the Pacific Coasts along the IIRSA tropico de Capricornio axis.
- The proposed roads are expected to reduce the transport costs of export commodities. This means that they will contribute, in no uncertain terms, to the improvement of agricultural productivity and the strengthening of export competitiveness, two of the major goals advocated in the national development strategy.

(2) Development of Port Access Roads

- To strengthen the country's export competitiveness, it is vital to link up between the proposed southern integrative roads and the port facilities available along Paraná River. The paving of such feeder roads will realize the all-weather accessibility of the existing river ports and enable the year-round utilization of port facilities for commodity exports. The transport efficiency of grain exports will be accordingly upgraded, while local population will benefit from the convenience of better and easy daily mobility.
- The technical feasibility is justified by heeding the need of minimizing local community relocation in the route selection, making the cross-sectional and longitudinal designs consistent with the design speed, determining the number of lanes and the structure of pavement in accordance with the projected future traffic volume, and so forth.
- There is a recent example of private investment in a port access road regarding Campichuelo Port. The said project was the construction of a new unpaved dirt road. The pavement, with associated structural improvements, of the existing roads requires a sizable outlay of capital, and it is rather unrealistic to expect similar private sector involvement. The economic internal rate of return for the Port Access Roads alone is estimated to be a little over 11%, indicating reasonable benefits to the national economy that accrue from their implementation. Therefore, it is concluded that the public sector investment is justifiably needed for the improvement of Port Access Roads.

(3) Development of Caarendy Port

- It is forecast that the production of soybean, Paraguay's primary export commodity, will be more than twice as large as the present level by the year 2015. Consequently, the country's export that relies on riverine transport will increase by 1.9 times over the same period. Many privately owned and operated port facilities now dot the banks of Paraná River. However, these small-scale facilities will not be able to cope with the expected growth of grain export. A number of actions need be taken to expand the country's cargo-handling capacity to the level sufficient for the future demand.
- Most of the existing port facilities are in the hands of large private companies and operated for their own exclusive use. These companies buy grains only from large farmers. Even if the country's output of soybean and other grains should increase as forecast, the future growth of export would be more likely to end up benefiting large farmers only, and hardly likely to activate the country's economy as a whole.

- The development of Caarendy Port is not simply to handle the future growth of export in line with the country's export promotion policy, but also to serve as a policy instrument for having the small-scale farmers participate in the export promotion, and thereby having the benefits of export growth shared by the regional population as a whole. Accordingly, it is recommended that the proposed port meets the following requirements.

a) The port is operated by some public-sector body in order to have the accruing benefits reach as many people as possible.
b) The port is to have the cargo handling capacity (annual export of 200,000tons) that will not adversely affect the operation of privately owned ports.
c) The port handles the import of fertilizers, fuels and agricultural chemicals, which cannot be done by the existing ports.
d) The port management should take note of the self-organizing needs among local medium- and small-scale farmers. The managing body should work closely with the existing agricultural cooperatives and thereby ensure the sustainability of its port operation.

- The simultaneous development of an access road is desirable.

(4) Recommendations for Expediting Smooth Project Implementation

To ensure smooth implementation of the proposed projects, it is recommended that the Government of Paraguay takes the following steps.

- To put appropriate EIA into effect and expedite the procedure of land appropriation for the right of way acquisition.
- To request and obtain some external development financing of higher concessionality like Japanese yen credit for the purpose of expediting the early project implementation, while allocating the adequate domestic counterpart fund in the government budget.

(5) Recommendations Toward Increasing the Potential Impact of the Proposed Project Implementation

To enhance the positive impact of the proposed projects, it is recommended that the Government of Paraguay proceeds with the following measures.

- To strengthen the linkage of the proposed projects to the IIRSA endeavor and to promote thereby the development of a wider transnational road network with neighboring countries.
- To sustain the appropriately disciplined procedure of operation and maintenance after the completion of the proposed projects.
- To take policy measures that will support the upgrading efforts of the river port facilities and ensure the stability and safety of riverine transport.

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1) Paraguay counterpart team (Key staff only)

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Lic. Carlos Castro	Logistic Plan (MIC)
Ing. Gerardo Paredes	Traffic Investigation /Economic Analysis (DINATRAN)
Ing. Alejandro Castro	Investigation of Natural Condition (MOPC)
Sr. Porfirio Duré	Project Management Plan (MOPC)
Ing. Juan Carlos Balbvoera	Road Design (MOPC)
Ing. Alfredo Ferreira	Structure Design (MOPC)
Ing. Angel Portillo	Port Plan (ANNP)
Ing. Jorge Nuñez	Environment (MOPC)

2) Paraguay project coordination unit

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Ing. Hugo Ojeda	Director, Direction of Road