III. PROJECT DESCRIPTION

A. Conceptual Road Alignment and Design

1. Alignments

Two conceptual alignments are shown in Figure RP9-1 and described briefly below:

(i) Option 1, which was first put forward as the 366-km Toll Motorway (TM) 36[1] in the JICA-assisted *Toll Highway Development Study in the Kingdom of Thailand* (1991) and was repeated in a 1993 paper prepared for NESDB's *Metropolitan Regional Structure Planning Study*,[2] would be an outer belt motorway about 50-100 km from Bangkok. Key features of the alignment for Option 1 are that: (a) the section from Route 4 to Suphan Buri would be developed east of the Nong Pla Duk-Suphan Buri railway line, and (b) the section between Ang Thong and Sing Buri will need to be planned considering the crossing points of the Chao Phraya River (Routes 32 and 311).[3]

(ii) Option 2 presents an alternative alignment, running more directly in a northeasterly direction from Route 4 to Ayutthaya, and more directly toward Chonburi and the Eastern Seaboard in a southeasterly direction. Relative to Option 1, Option 2 would offer the benefit of somewhat shorter travel distances to the Northeastern and ESB regions, although it would require slightly longer travel distances to the Northern region and perhaps more importantly it would not well serve a number of the medium-sized cities traversed by Option 1 (e.g., Ang Thong, Lop Buri, Saraburi), even though a supplemental Suphan Buri link is part of the proposal; also, part of the Option 2 alignment may be too close to the proposed Outer Bangkok Ring Road.[4]

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[1]From Wat Phleng to Bang Pakong.

[2]Rod Strickland, ADB Transport Advisor, *Metropolitan Regional Structure Planning Study: Development of Transport Planning Strategy*, prepared for the Office of the National Economic and Social Development Board, October 1993, Figure 4-1 (unpaginated).

[3]Regarding the alignment in the eastern part of the route, the section leading from Nakhon Nayok and the ESB is planned to avoid crossing the Bang Pakhon River.

[4]For reference purposes, it should be noted that DOH has some planned road improvements in the area of the proposed project (in addition to the motorway set out in Option 1); these are mainly smaller in scale than envisaged by the RP9 Project, however. For example, DOH has noted that it has widened Route 321 from Nakhon Pathom to Suphan Buri (from two lanes to a two-lane dual carriageway), and that some sections from Suphan Buri north to Chai Nat have been widened already to a two-lane dual carriageway; east of Suphan Buri, construction has just been finished on Route 329 to Pa Mok (with

Final route choice can only be made in a feasibility-level assessment, but should include consideration of natural conditions (e.g., rivers, soil qualities), the social environment (e.g., resettlement impacts; avoidance of temples, schools, and hospitals), and the natural environment (e.g., avoidance of national parks and other sensitive areas), as well as of course traffic and economic considerations.

2. Road Design and Features

Key features of the Option 1 proposal for the entire route from Ban Pong to Chachoengsao, as determined in the *Toll Highway Development Study in the Kingdom of Thailand*, include the following:

(i) a total length of 365.8 km of four-lane motorway, 207.8 km of which would have a design speed of 120 kph and 158.0 km of which would have a design speed of 100 kph;

(ii) seven junctions, eight interchanges, three service areas, and three parking areas are planned; and

(iii) 22 structures crossing DOH roads and four railway crossings, including 3,100 m of bridging over rivers (but no tunnels), would be required.

The length of the Project portion, from Ban Pong to Lop Buri, is estimated at 186 km, slightly more than half of the full envisaged alignment.

A similar detailed assessment has not been undertaken for Option 2, which seems somewhat less favored at this stage for the reasons mentioned above, although it has the merit of a railway linkage to Ayutthaya. The route length of the full alignment for Option 2, however, has been estimated at about 236 km and it would also be four lanes, at least in the initial stage; the length of the Project portion of the alignment has been scaled at 108 km.

A typical cross section of the planned four-lane motorway is shown below:

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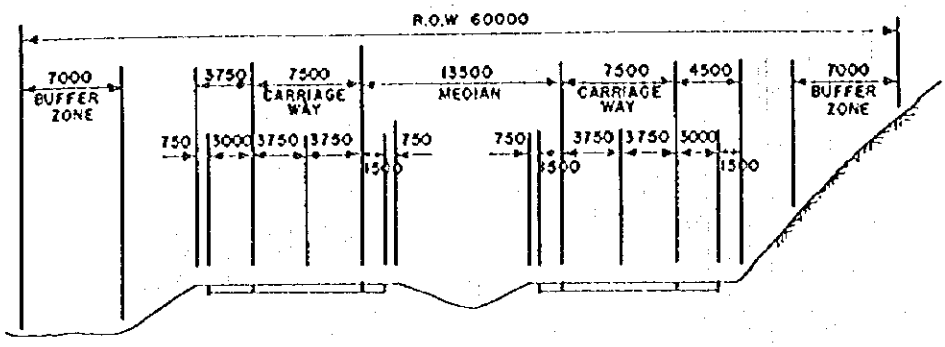
further extension to Suphan Buri planned), a new two-lane facility, which can be widened further if traffic warrants.



B. Other Project Components

1. Truck Terminal Subproject

Truck terminals typically include: (i) facilities for vehicles (e.g., stopping places, parking area, marshalling yard, gasoline station, repair shop, wash, weighing station); (ii) facilities for freight handling (e.g., temporary storage areas); (iii) facilities for people (e.g., lodging, restaurant, medical clinic); and (iv) data processing facilities (e.g., telephone, fax machine). Figure RP9-2 presents a concept diagram of freight movement in a regional truck terminal.

A three-phase approach may be proposed to attract consignors to use the regional truck terminal:

(i) The first phase would involve offering some part of the terminal facilities (mainly storage space) to be rented out by the consignors as chartered space and allow temporary control of handling operations, such as cargo sorting and inventory control by consignors themselves.

(ii) The second phase would entail making use of trucking companies in motivating prospective consignors to take advantage of the latter's local delivery service through the regional truck terminal.

(iii) The third and final stage would provide complete services in local distribution operation on behalf of the consignors, which include merchandise storage, inventory control, and delivery transport service.[1]

[1]See Japan International Cooperation Agency, *Feasibility Study on the Project of the Regional Truck Terminals, Progress Report II*, September 1987, p. 4-13.

At this still conceptual stage, it is assumed that a small-to-medium-sized regional truck terminal would be constructed at Ban Pong, i.e., consisting of 35 berths and 30,000 m^2.[1]

2. Railway Freight Transport Improvement Subproject

The railway freight transport improvement subproject calls for a number of related measures to increase rail's market share in the WSB. These measures, targeted with an understanding of the kind of traffic suited for rail (e.g., containerized cargoes), include:

(i) a more modernized approach to intermodal transport;

(ii) aggressive responses to specific opportunities;

(iii) procurement of new locomotives and wagons (i.e., freight cars), to alleviate chronic motive power and rolling stock shortages; and

(iv) upgraded container handling capacity (e.g., through inland clearance depot/ICD development).[2]

Also, the Completion of a Missing Link to Connect the Southern Line with the Northern and Northeastern Lines (Project RW2) should be considered; specifically, this project would provide a missing link between Suphan Buri, the terminus of the Nong Pla Duk-Suphan Buri Line (which is linked to the Southern Line), and the Northern Line, which may be reached via Saraburi.

C. Schedule/Phasing

The project schedule is envisaged as follows:

1998-1999: Development Survey

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[1]See Japan International Cooperation Agency, *The Study on the Regional Development Plan for the Lower Northeast and the Upper East Regions in the Kingdom of Thailand, Final Report, Volume 9, Transportation*, prepared for the National Economic and Social Development Board, September 1993, p. 5-32 [proposing a similar regional truck terminal]. A total of 35 berths implies about 670,000 tons of cargo capacity; see the previous source at 5-10, indicating the magnitude of demand for a proposed 35-berth terminal at Chiang Mai.

[2]I.e., Project ID4.

2000-2001: Detailed Design
2002-2005: Construction of Road[1]
2002-2004: Construction of Truck Terminal
2002-2005: Implementation of Railway Freight Improvements

D. Institutional Arrangements

For the proposed Development Study (i.e., feasibility study of the Project; see Section V below), the Office of the National Economic and Social Development Board (NESDB) or the Department of Highways (DOH) would act as the chief counterpart agency. The counterpart agency would organize a Steering Committee including representatives of the Land Transport Department (LTD), the State Railway of Thailand (SRT), the National Housing Authority (NHA), and other agencies that would be directly concerned with implementation of the Project.

IV. PROJECT ASSESSMENT

A. Overall

The Project would benefit the overall national economy as well as the regional economy, as set out in the Eighth National Economic and Social Development Plan. Of particular importance, the Project will promote decentralization away from central Bangkok (with all the associated social benefits of doing so) while addressing infrastructural bottlenecks to the nation's economic growth; it will link the WSB with the Northern, Northeastern, and Central regions of the country. In addition, the Project would provide specific benefits to rural and urban communities in the Project influence area,[2] as well as to road users and shippers. It is further expected that the mobility of low-income persons will be enhanced by the Project, helping to alleviate poverty and provide employment opportunities for women along the corridor.

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[1]For reference purposes, the phasing proposed for Option 1 put forward in the 1991 *Toll Highway Development Study in the Kingdom of Thailand* was 1991 to 1995 for the 41.3 km from Ratchaburi to Ban Pang and 2001 to 2010 for the 324.5 km from Ban Pong to Chachoengsao.

[2]Provinces within the influence area of the corridor include Ratchaburi, Nakhon Pathom, Ayutthaya, Suphan Buri, Saraburi, and Lop Buri.

Total Project cost is estimated broadly in the range of 13-20 billion Baht. More specific assessments of the Project components are presented below, along with an assessment of intrasectoral and intersectoral linkages.

B. Outer-Outer Orbital Route

1. Cost

The estimated cost (1996 values) of the Option 1 alignment is 20 billion Baht for the full aligment; the estimated cost of the Option 2 alignment is 13 billion Baht for the Project portion, or 24 billion Baht for the full alignment.[1]

2. Traffic

Traffic on the proposed RP9 road was (conservatively) estimated to average 14,472 motor vehicles per day/MVPD (and 22,576 passenger car units per day/PCU) in the year 2005 (i.e., the first year of operation), of which 72.6 per cent was assumed to consist of so-called normal traffic (i.e., trips that would be made with or without the Project) and 27.4 per cent was assumed to be traffic induced by the improved highway infrastructure provided by the Project. This estimate, which must be refined in a subsequent detailed study, was made by (i) taking the forecast 2010 traffic on Toll Motorway 36 in the *Toll Highway Development Study* (17,698 MVPD), but then converting to 2005 by assuming annual traffic growth rates as forecast by the WSB Study for one-digit roads in the region, i.e., 10.1 per cent until 2001, 9.2 per cent from 2002 to 2006, and 7.5 per cent from 2007 to 2011, compared to 9.7 per cent from 1990 to 2000 and 7.1 per cent until 2010 in the *Toll Highway Development Study*; (ii) assuming the same ratio of normal to induced traffic forecast in the previous study; and (iii) assuming a ratio of 1.56 PCU to MVPD, as was derived for one-digit roads in the WSB based on 1994 traffic. However, if one were to assume that (say) 25 per cent additional traffic would be generated because of the proposed Ban Pong Industrial/Distribution Development Initiative, which is not an unreasonable assumption, the forecast traffic in 2005 would be 18,090 MVPD

[1]Derived based on cost estimates in the 1991 *Toll Highway Development Study in the Kingdom of Thailand*, scaling up for inflation and adjusting for other factors (e.g., bridging). These cost estimates are quite consistent with the estimated cost of 98.5 million Baht per km for construction of a four-lane motorway on flat land in the Central Region as reported in Wilbur Smith Associates, Inc., Asian Engineering Consultants Corp., Ltd., and PADECO Co., Ltd., *Consultant's Services for Long-Term Strategic Study of Highway Planning and Investment, Final Report, Volume 1*, 1996, p. B3-2-19 [e.g., the full Option 1 alignment would be costed at 36 instead of 37 billion Baht of these cost estimates were applied].

and 28,220 PCU. In either case, the warrant for a four-lane road would be met (i.e., 8,000 MVPD based on DOH practice or 14,000 PCU as recommended in certain recent studies).

3. Economic and Financial Assessment

Economic and financial assessment of this proposed complex Project is beyond the scope of the current multisectoral regional master planning study. The Study Team notes, however, that the RP9 highway is part of the 4,300 km motorway system set out in the 1991 *Toll Highway Development Study*, which found overall economic and financial rates of return of 23.1-35.4 per cent and 12.5-14.2 per cent for the total system, of which the Project highway would be among the most viable components.

4. Other Impacts

Potential adverse environmental impacts, some of which may require mitigation, include air quality, noise and vibration, water resource and aquatic ecology, terrestrial ecology, socioeconomic, and cultural/aesthetic/archeological impacts. Beneficial environmental impacts are also expected, especially to the extent that the Project promotes decentralization away from congested Bangkok.[1] An Initial Environmental Examination checklist is attached.

Concerning social impacts, it is envisaged that the mobility of low-income persons will be enhanced by the Project, helping to alleviate poverty and provide employment opportunities for women along the corridor.

C. Truck Terminal

While the Land Transport Department puts a higher priority on developing truck terminals at sites other than the WSB (e.g., Bangkok, Chiang Mai, Nakhon Ratchasima, Khon Kaen, Nakhon Sawan), the proposed truck terminal site at Ban Pong is an attractive one, as it is situated at the crossroads of major east-west arteries. Indeed, LTD officials have suggested that Ratchaburi province may be an appropriate site for

[1]The proposed Development Study (see Section V) will include an initial environmental examination as well as an environmental impact assessment, with mitigation measures to be formulated for any significant adverse environmental impacts. Environmental issues to be considered will include environmental law, an environmental examination, targets of environmental conservation, mitigation measures, and overall environmental impact examination.

development of a truck terminal in 5-10 years, which fits in with the proposed implementation schedule (see Section IIIC above). The cost of a medium-size regional truck terminal is estimated at about 200 million Baht in 1996 values.

The benefits from the proposed truck terminal project would likely include:

(i) relief from traffic congestion in the urban area and contribution to the process of urban (re)vitalization;

(ii) consolidation of small-scale forwarders and truckers in order to enable them to effectively use line-haul and delivery trucks and other common facilities necessary for general cargo transport;

(iii) a higher level of transport services in scheduled operation of line-haul trucks and delivery trucks;

(iv) centralization of transport demand and supply information for quick response to customer needs;

(v) an increase not only in the productivity of cargo transport but also in the quality of transport services, and eventually in the value added to the trucking industry; and

(vi) modernization of the management of the trucking industry and working conditions of drivers and assistants, which may contribute to an increase in tax revenues and worker welfare, and a reduction in traffic accidents.[1]

Based on an assessment of only savings in the fixed and running cost of 10-wheel line-haul trucks, and the savings in cargo handling costs, an economic analysis of truck terminals in five Thai regional cities found economic rates of return in the range of 13.5-38.0 per cent;[2] an economic return in this range may also be expected from

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[1]See, e.g., Japan International Cooperation Agency, *Feasibility Study on the Project of the Regional Truck Terminals, Progress Report II*, September 1987, p. 5-24.

[2]See citation in previous footnote, p. 5-35.

implementation of a well-prepared Ban Pong truck terminal project.[1]

D. Railway Freight Transport Improvement

The railway freight transport improvement component of the Project will have to be specified in more detail at the feasibility stage before meaningful cost estimates can be made. However, the railway component is expected to offer the potential for viability, partly because of the mode's greater energy efficiency and less severe environmental impacts than road transport, but also because SRT has moved aggressively toward a market-oriented outlook in recent years and is improving its ability to compete with road transport.

E. Linkages with Other Projects

The Project involves important linkages with other projects, including the following:

(i) RP10, North-South Links;

(ii) UD1, WSB Urban Planning;

(iii) ID4, Inland (Clearance) Deport); and

(iv) RW1-RW4, various railway projects.

These linkages, both intrasectoral and intersectoral, are expected to produce even greater benefits than envisaged by the conservative approach adopted above.

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[1]It is also worth noting that a study of a truck terminal in Greater Bangkok found economic rates of return of 15.6-20.2 per cent and financial rates of return of 10.3-18.1 per cent. See Japan International Cooperation Agency, *The Study on Greater Bangkok Truck Terminal in the Kingdom of Thailand, Final Report, Volume 2, Main Text*, prepared for the Department of Land Transport, September 1992, pp. 10-22, 11-26. Also, the substantial benefits from truck terminals in terms of reducing transport costs and urban traffic congestion are well established in Japan. For example, three years after the development of two major truck terminals in Tokyo, travel by line-haul (i.e., 10-ton) trucks within the Tokyo area decreased by 37 per cent and travel by distribution (i.e., 4-ton) trucks was reduced by 12 per cent.

V. RECOMMENDED ACTION(S)

It is strongly recommended that a Development Study be carried out with technical cooperation from JICA or other international agency, with the Study to involve a feasibility-level assessment of integrated transport and land use development in the corridor linking Ban Pong in Ratchaburi province with the northern part of the Extended Bangkok Metropolitan Region (i.e., to the Ayutthaya-Lop Buri area). The Development Study would include encompass a motorway, improved railway services, a truck terminal, and new towns.

The objectives of the proposed study of integrated transport and land use development in the corridor between Ban Pong and the Extended Bangkok Metropolitan Region would be to:

(i) review relevant proposals in the transport and related sectors made in studies sponsored by JICA and others;

(ii) formulate an integrated transport development plan for the corridor between Ban Pong and the northern part of the Extended Bangkok Metropolitan Region, including consideration of motorway, railway, and truck terminal proposals;

(iii) formulate urban development plans for cities in the corridor; and

(iv) conduct a feasibility study for the corridor.[1]

[1]The following tasks will be carried out: (i) review of relevant proposals in the transport and related sectors made in studies sponsored by JICA and others; (ii) collection and analysis of relevant data, including traffic surveys; (iii) traffic demand forecasting, including forecasting of traffic from the North and Northeast to the Western Seaboard and from the Western Seaboard to the Eastern Seaboard; (iv) intermodal analyses, considering various alternatives for motorway, rail, and truck terminal development; (v) detailed specification of alternative transport system proposals; (vi) formulation of related urban development plans for satellite communities; (vii) initial environmental examination and environmental impact assessment; (viii) social and Women in Development (WID) impact assessment; (ix) survey of natural conditions; (x) topographic survey; (xi) preliminary design; (xii) study of operation and maintenance system; (xiii) construction plan; (xiv) estimation of project cost; (xv) economic and financial analysis; (xvi) preparation of implementation program; and (xvii) overall evaluation and recommendation.

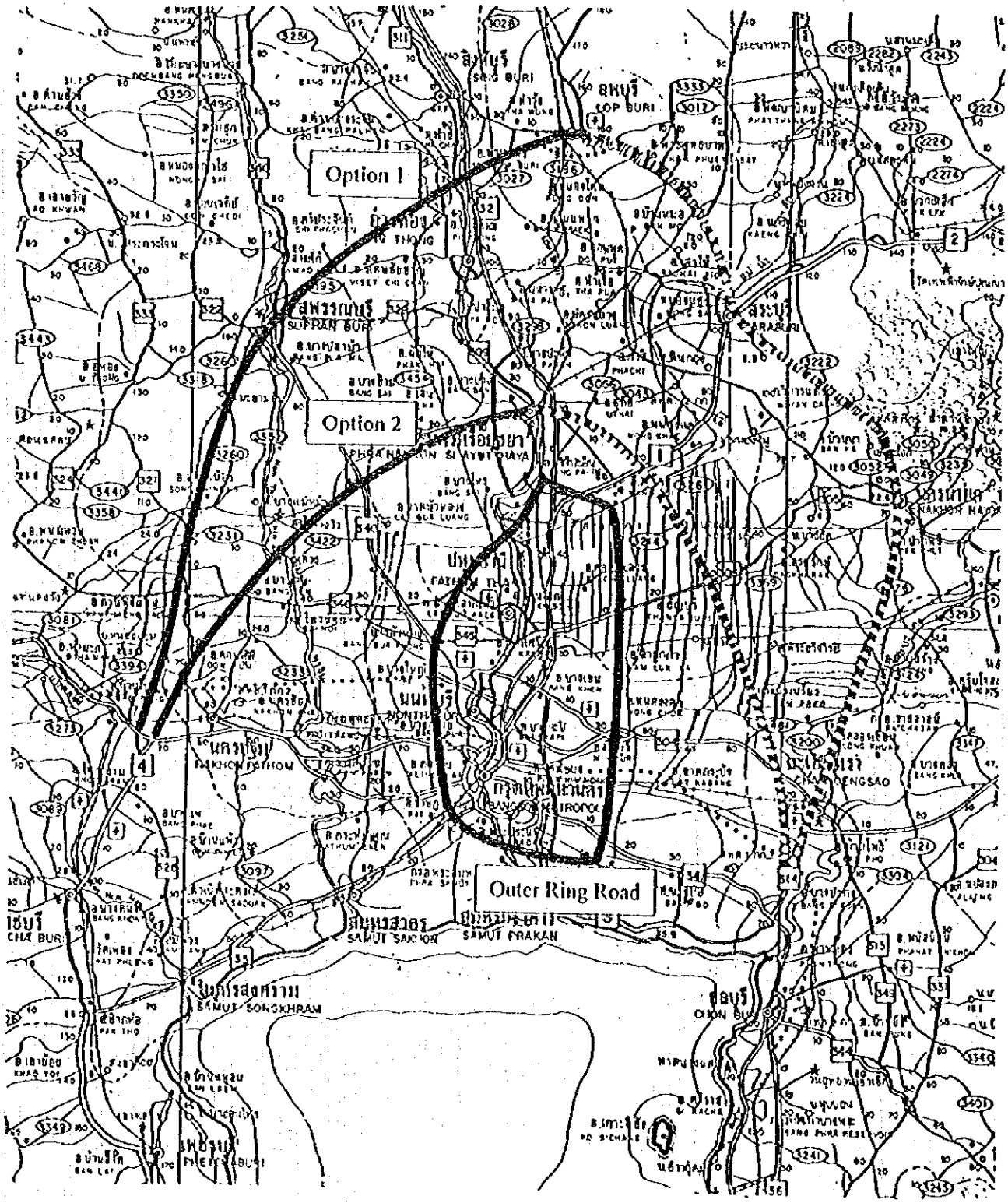
Table RP9.1 Road Freight Transport by Origin and Destination, 1994

Units: '000 tons

Origin Region	Destination Region							
	BMA	Northern	Northeastern	Central	Eastern	Western	Southern	Total
BMA	10,063	13,944	18,981	4,599	5,541	7,828	4,063	65,019
Northern	27,244	12,132	382	8,565	666	1,564	328	50,881
Northeastern	14,404	206	14,491	5,656	6,358	1,338	212	42,665
Central	23,154	9,085	8,890	5,481	6,508	1,514	769	55,401
Eastern	24,992	1,824	3,027	376	17,556	429	74	48,278
Western	48,389	6,279	2,816	598	671	2,985	178	61,916
Southern	4,908	215	180	95	469	160	13,901	19,928
Total	153,154	43,685	48,767	25,370	37,769	15,818	19,525	344,088

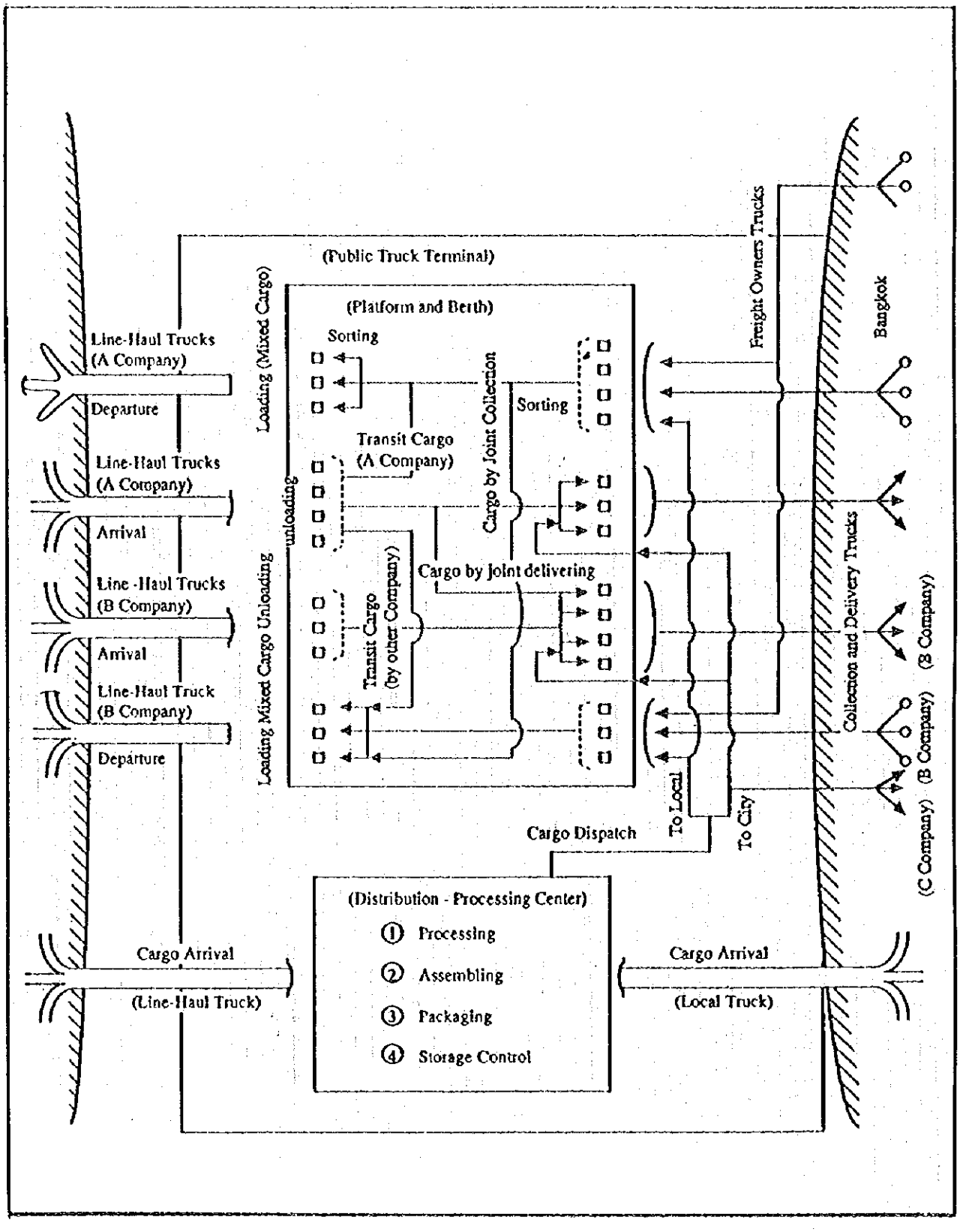
Source: Transport Management Information System Sub-Division, Ministry of Transport and Communications

Figure RP9.1 Project Location and Alternative Alignments



Source: Department of Highways (base map)

Figure RP9.2 Freight Movement in a Regional Truck Terminal



Source: Nippon Koei Co., Ltd. *The Study on the Regional Development Plan for the Lower Northeast and the Upper East Regions in the Kingdom of Thailand, Final Report, Transportation Report*, September 1993, F-4.3

Checklist of Initial Environmental Examination (Project No. RP9)

Environmental Parameters Affected by the Project Implementation	Impacts on the Environment	Recommended Feasible Mitigation Measures	Magnitude of Impacts			
			No Significant Effect	Significant Effect		
				Small	Moderate	Major
1. Air Pollution	1. Nuisances and health hazards to neighbors, travelers and wildlife.	1. Sprinkling water/chemicals during construction; control of motor vehicle emissions during operation.		x		
2. Noise and Vibration	2. Nuisances to neighbors, travelers and wildlife.	2. Usage of low noise and vibration construction equipment; selection of proper times for construction.		x		
3. Terrestrial Ecology	3. Alteration of wildlife habitats and loss of biodiversity from tree cutting.	3. Replanting precious vegetation; providing passageways for wildlife.		x		
4. Aquatic Ecology	4. Water pollution and river bed condition changes caused by earthworks, fecal contamination and machine operation (oil and grease spills) related to new bridge construction.	4. Setting up machinery maintenance areas and construction camps away from the river; providing measures to prevent river bank erosion.		x		
5. Historical/Cultural Property	5. Loss of cultural properties from road construction and increased possibility of these properties being stolen.	5. Rerouting, relocation of properties, if applicable.	x			
6. Environmental Aesthetics	6. Loss of scenic value.	6. Careful planning to minimize and offset losses.		x		
7. Highway Runoff Pollution	7. Impacts on aquatic ecology caused by surface runoff containing sufficient petroleum "drippage" plus spilled materials.	7. Design of proper drainage system to minimize the pollution.				
8. Highway Spills of Hazardous Materials	8. Serious health/safety hazards to neighbors and travelers.	8. Careful planning of traffic control and competent emergency cleanup.	x			
9. Human Resettlement	9. Relocation of roadside residents.	9. Rerouting (bypass); adequate compensation for affected residents.	x		x	

RP12A AND WT8: KANCHANABURI-TAVOY/DAWEI LINKAND TAVOY/DAWEI DEEP-SEA PORT PROJECT (THAILAND-MYANMAR TRANSPORT CORRIDOR PROJECT)

I. BACKGROUND

Consistent with the recent trend toward subregional economic cooperation among the countries of the Greater Mekong Subregion, Projects RP12A and WT8 would open up a new corridor between Thailand and Myanmar, linking the Upper WSB and the Bangkok Metropolitan Region with a new Andaman deep-sea port at Tavoy/Dawei, at a direct distance of about 250 km west of Bangkok. Since at present Phuket (862 km from Bangkok by road) is the only Thai deep-sea port on the Andaman Sea, it is expected that the new port would serve as an outlet for Thailand-based seaborne cargo, competitive with existing ports in the Gulf for shipping to countries situated west of Thailand. To create further demand for the port and to engender regional development (in Myanmar as well as in the Thai WSB), the proposed Thailand-Myanmar Corridor Project further envisages the establishment of industrial estates in the vicinity of Tavoy/Dawei.

II. PROJECT CONCEPT/RATIONALE

The Thailand-Myanmar Transport Corridor Project would provide an integrated east-west transport corridor in the Upper WSB and its "twin region" in Myanmar. The rationale for the Project, in general terms, would be to:

(i) facilitate exchange and development between and among Thailand and Myanmar in the "twin regions" of the WSB and (Myanmar's) Tenasserim/Tanintharyi Division;

(ii) promote the foreign trade of the countries with the rest of the world, particularly with western-situated countries (e.g., the Indian Subcontinent, the Middle East, Europe);

(iii) advance industrial development in both countries;

(iv) support rural development and increase earnings of low-income groups, thereby reducing cross-border migration (see the Sector Report on Social Development); and

(v) promote tourism in both countries.

The Project is viewed as a "win-win" undertaking, i.e., offering net benefits for both countries. The particular corridor promoted here is viewed as the one offering the most benefits of the three corridors proposed as part of Project RP12 (i.e., Projects RP12A, 12B, and 12C) because it is closest to Bangkok, the largest metropolitan area in the two countries; RP12A would provide the shortest distance between Bangkok and the new port. In addition, there is considerable economic development potential in this corridor, with plentiful supplies of electricity and water, well-developed agro-industry, and a beautiful landscape. The RP12A alignment in particular would provide east-west transport links to the supplement Thailand's strong north-south links, and which could be connected with the Bangkok-Phnom Penh-Ho Chi Minh City-Vung Tau Road, the most advanced on the list of priority projects promoted under the Greater Mekong Subregional cooperation scheme.[1] Further, the Corridor would offer Myanmar a gateway to Association of Southeast Asian (ASEAN) countries. The corridors are also consistent with Thailand's proposal to establish a Subcontinental Economic Cooperation (SEC) group comprising Thailand, Myanmar, Sri Lanka, Bangladesh, and India, with the group intended to capitalize upon the transition toward market-oriented economies in the subcontinental countries.

From the point of view of Myanmar, the Tavoy/Dawei Deep-Sea Port Project would also have the benefit of providing the country with its first deep-sea port. The country's largest port, at Rangoon/Yangon, is a river port that recently reached its practical capacity of five million tons, with annual traffic growth rates in the order of 25-30 per cent. There is now a project underway to develop additional capacity at Thilawa, about 10 km downstream of Yangon, but this too is unlikely to be sufficient to serve the country's growing foreign trade requirements. The Government is considering developing a deep-sea port at Kyaukpyu, on Rambyie Island off the Arakan/Rakhine Coast, which offers an excellent site for a deep-sea port but which is isolated from central Myanmar by poor transport links although the Government has been actively working to remedy the situation.[2] The hinterland of the proposed Tavoy/Dawei Deep-Sea Port Project would generally be quite different than that of a Kyaukpyu Deep-Sea Port, however, as the latter port would be located about 350 km northwest from Yangon (air distance).

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[1]Detailed design work on improving the Phnom Penh-Ho Chi Minh City segment of this road commenced in April 1996.

[2]E.g., by constructing the Irrawaddy/Ayeyarwady River Bridge near Prome/Pyay.

Also from the viewpoint of Myanmar, it is expected that the Project would generate considerable economic development benefits from the establishment of industrial estates that would provide a large number of jobs for local residents. More broadly, the Project will contribute to the regional development of Lower Myanmar.

III. PROJECT DESCRIPTION

A. Tavoy/Dawei Deep-Sea Port

Considering the role of Tavoy/Dawei port as a facility for transshipment for Thailand, as an industrial port associated with industrial activities in the region, and as a regional port supporting developing in Lower Myanmar (i.e., the country's "WSB"), and considering the time likely required for port traffic to develop, a staged approach to port development is recommended, with port extensions to be implemented as warranted by traffic growth. Therefore, the initial stage facilities would include: (i) one 260 m multi-purpose berth for 40,000 dwt vessels, (ii) two secondary berths totaling 260 m for 5,000 dwt vessels, (iii) a small-craft basin, (iv) a 30,000 m^2 open-stage yard, (v) 5,000 m^2 of multipurpose shed, and (vi) other basic facilities/utilities (e.g., an operation building). As port demand builds up with the expected development of the Myanmar economy, additional berth space will be required, about 3,300 m based on an assumed port capacity of 10 million tons per year and a berth production rate of 3,000 tons/year/meter.

Figure RP12A/WT8.1 shows seven potential port sites in the Tavoy/Dawei area considered in a preliminary study, while Table WT8.1 presents a preliminary evaluation of the suitability of the various sites considering natural water depth, natural protection, backup area inshore, effect of tidal currents, environmental issues, road access, industrial zone access, potential for large-scale expansion, distance to Tavoy/Dawei City, and land reclamation potential. The highest-ranked site (E) is located on Nyain Byin Bay, about 30 km south of Tavoy/Dawei, while the second-ranked site (A) is the most northerly of the options, situated in the northern part of Maungmagan Bay.

B. Kanchanaburi-Tavoy/Dawei Link

Figure RP12A/WT8.2 presents two alternative routes for the cross-border road linking Kanchanaburi with Tavoy/Dawei.[1] Both routes would follow an existing alignment that

[1]Worth noting, Ratchaburi would be linked to Kanchanaburi via RP2, Links between Ratchaburi and Other Provincial Capitals (i.e., Kanchanaburi, Samut Songkram).

runs for 36 miles (58 km) between Tavoy/Dawei and Myitto. For the section between Myitto and Thailand's National Highway 323, two alternative (newly built) routes have been proposed:

(i) "Alternative Route 1," which would follow a footpath or cart-road established during World War II, would run east along the Tennasarim/Tanintharyi River, ascend the slope of Mt. Khao Yao and cross the peak of Mt. Bilanktaung in the vicinity of Ban Bong Ti; from Ban Bong Ti, there is an existing low-volume alignment connecting with National Highway 323 that could be upgraded. Alternative Route 1 would cross the Kwai River, indicating a requirement for field inspection to examine bridge points.

(ii) "Alternative Route 2" would make use of a now-abandoned logging road established by the Thai private sector. It would run north to Kataungni, ascend along the western ridge of Mt. Bilanktaung and cross the mountain peak northwest of Mt. Khao Ro Rae. On the Thai side, the road would lead to Ban Mae Nam Noi, where a bridge crossing would be necessary; from Ban Mae Nam Noi there is an existing low-volume alignment connecting with National Highway 323 that could be upgraded.

Alternative Route 1 would involve a 125 km alignment, consisting of 80 km of new road in mountainous terrain in Myanmar, and 45 km in Thailand requiring only 10 km of new road. Alternative Route 2 would require 50 km of new road in Myanmar, with 15 km in hilly terrain, and 70 km of new road in Thailand. Both routes would traverse mountainous areas composed of granite and would therefore require special attention for slope protection works.

As with the port, a staged development plan is recommended for construction of the cross-border road. In the initial stage, a minimum design requirement should be applied, with the preliminary assessment suggesting a 6 m (2 x 3 m) wide carriageway and a design speed varying from 40 to 80 kph depending on the terrain. In the second stage, a proper international highway would be developed, with a carriageway width of 14 m (4 x 3.5 m) and a design speed varying from 70-100 kph. Asphalt pavement is envisaged even in the initial stage, considering the heavy rainfall in the area traversed by the Project road; double bituminous surface treatment is deemed the minimum requirement.

C. Related Industrial Development Projects

The preliminary study proposed the establishment of a Tavoy/Dawei Industrial Complex, which would include an export processing zone (EPZ), a general industrial estate, and a

heavy industrial estate. The heavy industrial estate and EPZ are proposed to be located in the immediate hinterland of the deep-sea port, while the general industrial estate is proposed to be developed in the vicinity of Tavoy/Dawei city or along the cross-border highway. Industries expected to locate in the Tavoy/Dawei area include garment and apparel, plastic shoes, electric/electronic parts, automobile parts, and toy and sporting goods in the EPZ; marine-based food products, wood products, and non-metallic mineral products (construction material) in the general industrial estate; and gas-based chemical products in the heavy industrial estate. The general and EPZ-type industrial estate would require 400-600 ha (2,500-3,800 rai), while the heavy industrial estate would require 500 ha (3,100 rai).

IV. PROJECT ASSESSMENT

A. Traffic

Demand for transport between Thailand and Myanmar has been sporadic, as borders open and close, but has remained at relatively low levels.[1] However, the recorded trade reported greatly understates actual trade (i.e., recorded plus unrecorded trade),[2] and more importantly greatly understates the potential trade between the two countries as a result of comparative advantages and complementarities,[3] which are likely to become increasingly important after Myanmar joins the Association of Southeast Asian Nations (ASEAN). In this context, the proposed Thai-Myanmar Industrial Complex at Tavoy/Dawei is important, with the preliminary study finding that it could generate 5-10 million tons per year of port traffic, the largest portion representing industrial materials or products coming from Thailand's Upper WSB or the Bangkok Metropolitan Region.

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[1]Customs Department data for 1993 and 1994 (the latest available) indicate that cross-border transport demand between Thailand and Myanmar was (i) about 150,000 tons per year at Ranong, 61 per cent exports (mainly forest products) and 39 per cent imports (mainly cement); and (ii) about 40,000 tons per year each at Mae Sot in Tak province, just north of Kanchanaburi, and at Mae Sai in Chiang Rai province.

[2]The Asian Development Bank has (conservatively) estimated that unrecorded trade in the Greater Mekong Subregion accounts for 50 per cent or more of total trade (i.e., unrecorded trade equals 100 per cent of recorded trade). Other estimates of the ratio of unrecorded to recorded trade in the subregion are much higher, however (e.g., unrecorded timber exports from Cambodia in 1993 were estimated at 960,000 tons compared to only 90,000 tons of recorded exports).

[3]For reference purposes, recorded two-way trade between Thailand and Cambodia increased by a factor of 16.8 between 1991 and 1992 (from 59,026 tons to 991,964 tons), a time when prior constraints on trade were eased substantially (data from Ministry of Transport and Communications).

In addition to the Thailand-Myanmar cross-border trade (and domestic traffic in the corridors),[1] potential traffic in the corridor includes "global" trade, particularly to western-situated countries. Table 9.5.17 attached to the main text presents data on the proportion of value of Thailand's foreign trade attributable to western-situated countries in 1988 to 1994. One finding was that 19.1 per cent of the value of Thailand's trade in 1994 was with western-situated countries; 19.1 per cent of the tonnage of Thailand's sea trade in 1994 (60.56 millions tons) was equal to 11.57 million tons, suggesting the possibility of substantial cross-border traffic between Thailand and Myanmar if a suitable deep-sea port could be constructed on Myanmar's Andaman Sea coast, particularly if it were a free port; the preliminary study (very conservatively) estimated this potential demand at 1.0 million tons per year.[2] Indeed, prospects for growth in trade with western-situated counties are deemed excellent between now and 2011; consider, for example, that in 1995 Thai investors were reportedly ranked third in foreign investment in India (after the United States and Israel) compared to their ranking of 13th in 1991.

In summary, while any forecast of future cross-border traffic would be highly speculative, the potential of such traffic in the future is considerable. The preliminary study forecast port demand of the order of 7.0-13.0 million tons per year,[3] with most of this demand involving cross-border traffic of industrial goods or products from the Upper WSB and Bangkok; assuming 80 per cent of this tonnage moves on the new cross-border road, and assuming 8.4 tons per truck (consistent with current loads in Thailand and Myanmar, including some empty or reduced-load backhauls), the estimated port tonnage implies daily truck traffic on the cross-border road of 1,826 to 3,392 per day. However, in order to achieve maximum cross-border traffic, construction of any

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[1]Note, however, that the relatively low population density in the corridors between Thailand and Myanmar may mean that domestic traffic will be relatively light, at least in the foreseeable future. Consider, for example, that the population of the Tenasserim/Tanintharyi Division of Myanmar was only 1.187 million in 1994. Growth rates in domestic traffic may be substantial, however; as indicated in a previous section, growth rates in road traffic in Kanchanaburi province (reflecting socioeconomic factors), for example, are forecast to be 11.4 per cent from 1997 to 2001, 10.4 per cent from 2002 to 2006, and 8.8 per cent from 2007 to 2011.

[2]Estimated by assuming (i) 20 million tons per year of seaborne trade from Bangkok Port; (ii) distribution of this tonnage to countries/regions based on value; and (iii) 100 per cent of the cargo to the Indian subcontinent, 50 per cent of the cargo to the Middle East, and 20 per cent of the cargo to Europe would shift to the planned Tavoy/Dawei port.

[3]In addition to the 5.0-10.0 million tons of throughput estimated for the Tavoy/Dawei Industrial Complex and the 1.0 million tons estimated for traffic diversion from the existing Bangkok Port, the preliminary study also estimated 1.0-2.0 million tons of throughput locally generated in Myanmar's Tanintharyi Division.

proposed cross-border links between Thailand and Myanmar (i.e., the hardware) should be accompanied by measures to address the non-physical barriers that currently impede the free movement of goods and persons across borders in the Greater Mekong Subregion (i.e., the software); it is therefore encouraging that a recent Asian Development Bank sponsored regional technical assistance project has begun to address this issue.[1]

B. Costs

Further engineering and economic studies, as well as a comprehensive feasibility study, costing US$1-2 million is required to reliably estimate the cost and assess the viability of the proposed port, road, and industrial projects comprising the Thailand-Myanmar Transport Corridor Project.

C. Implementation Schedule

The following implementation schedule is envisaged:

1997:	Engineering and economic study of port, road, and industrial projects
1998:	Comprehensive feasibility analysis
1999-2000:	Detailed studies, project financing, and market research
2001-2005:	First-phase construction
2006-2011:	Second-phase construction (if warranted by traffic)

D. Implementation Arrangements

Implementation of the Project will require a consensus to be reached by the Thai and Myanmar Governments. Agencies involved with implementation on the Thai side would include the National Economic and Social Development Board, the Department of Highways, the Industrial Estate Authority of Thailand, and perhaps the Harbour Department; agencies involved on the Myanmar side would include the Ministry of National Planning and Economic Development, Public Works under the Ministry of

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[1]PADECO Co., Ltd., *Technical Assistance for the Greater Mekong Subregion for the Mitigation of Non-Physical Barriers to Cross-Border Movement of Goods and People, Completion Report,* prepared for the Asian Development Bank and the Governments of the six Greater Mekong countries (including Thailand and Myanmar), October 1996.

Construction, the Myanmar Port Authority, and the Ministry of Industry. Critical factors required for the successful completion of the project would include (i) cooperation between the countries in the establishment of a Joint Committee; (ii) the removal of barriers to transport and trade between the two countries; (iii) successful transformation of Myanmar from a centrally-planned to a more market-oriented economy; and (iv) due attention to problems such as drainage, landslides, erosion, and the prevention of damage to the natural environment during construction of the Project road. An Initial Environmental Examination checklist is attached.

V. RECOMMENDED ACTION(S)

It is urged that the recommended engineering and economic studies of the port, road, and industrial projects be undertaken. One way to proceed in the current international political environment would be to formulate a Joint Committee to endorse the terms of reference for the engineering and economic studies and to raise funds for the study from the Thai technical cooperation program; engagement of international consultants to assist the study would also be recommendable.

Table RP12A/WT8.1 Evaluation Matrix of Possible Port Sites

Evaluation Points \ Alternative Port Sites	A	B-1	B-2	C	D	E	F
1) Natural Water Depth	○	×	×	○	◎	◎	○
2) Natural Protection	×	×	×	×	◎	○	×
3) Backup Area Inshore	◎	○	×	×	×	○	×
4) Effect of Tidal Currents	○	○	○	○	○	○	×
5) Environmental Issues	×	×	×	○	○	○	○
6) Access to Road	○	○	○	○	×	○	×
7) Access to Industrial Zone	○	○	◎	◎	○	○	○
8) Large-scale Expansion	◎	○	○	×	×	◎	○
9) Distance to Tavoy City	○	◎	◎	○	×	×	×
10) Land Reclamation	◎	◎	◎	○	○	○	×
Recomendation	2			3	4	1	

◎ Excellent

○ Good

× Poor

Checklist of Initial Environmental Examination (Project No. RP12A/WTS)

Environmental Parameters Affected by the Project Implementation	Impacts on the Environment	Recommended Feasible Mitigation Measures	Magnitude of Impacts			
			No Significant Effect	Significant Effect		
				Small	Moderate	Major
1. Air and Noise Pollution	1. Nuisances and health hazards to neighbors and wildlife.	1. Use of construction equipment with low air and noise emissions; selection of proper times for land clearing and facility construction.		x		
2. Terrestrial Ecology (Soil Erosion/Flooding)	2. Alteration of wildlife habitats, loss of biodiversity, and potential risk of soil erosion/flooding from tree cutting associated with new road construction in mountainous terrain.	2. Minimization of the amount of tree cutting, replanting precious vegetation, and providing flood prevention measures (i.e., slope protection).			x	
3. Water Quality and Aquatic Ecology	3. Water pollution and sea bed condition changes caused by deep-sea port construction works (e.g., shoreline erosion and dredging), fecal contamination, and machine operation (oil and grease spills).	3. Setting up of machinery maintenance areas and construction camps away from the shoreline; provision of measures to prevent shoreline erosion.		x		
4. Historical/Cultural Properties	4. Loss of historical/cultural properties.	4. Investigation of these properties and provision of appropriate preservation measures.		x		
5. Human Resettlement	5. Relocation of residents.	5. Consideration of alternative site selection and adequate compensation for affected residents.		x		
6. Environmental Aesthetics	6. Loss of scenic value.	6. Careful planning to minimize and offset losses.		x		

Figure RP12A/WT8.1 Possible Port Sites

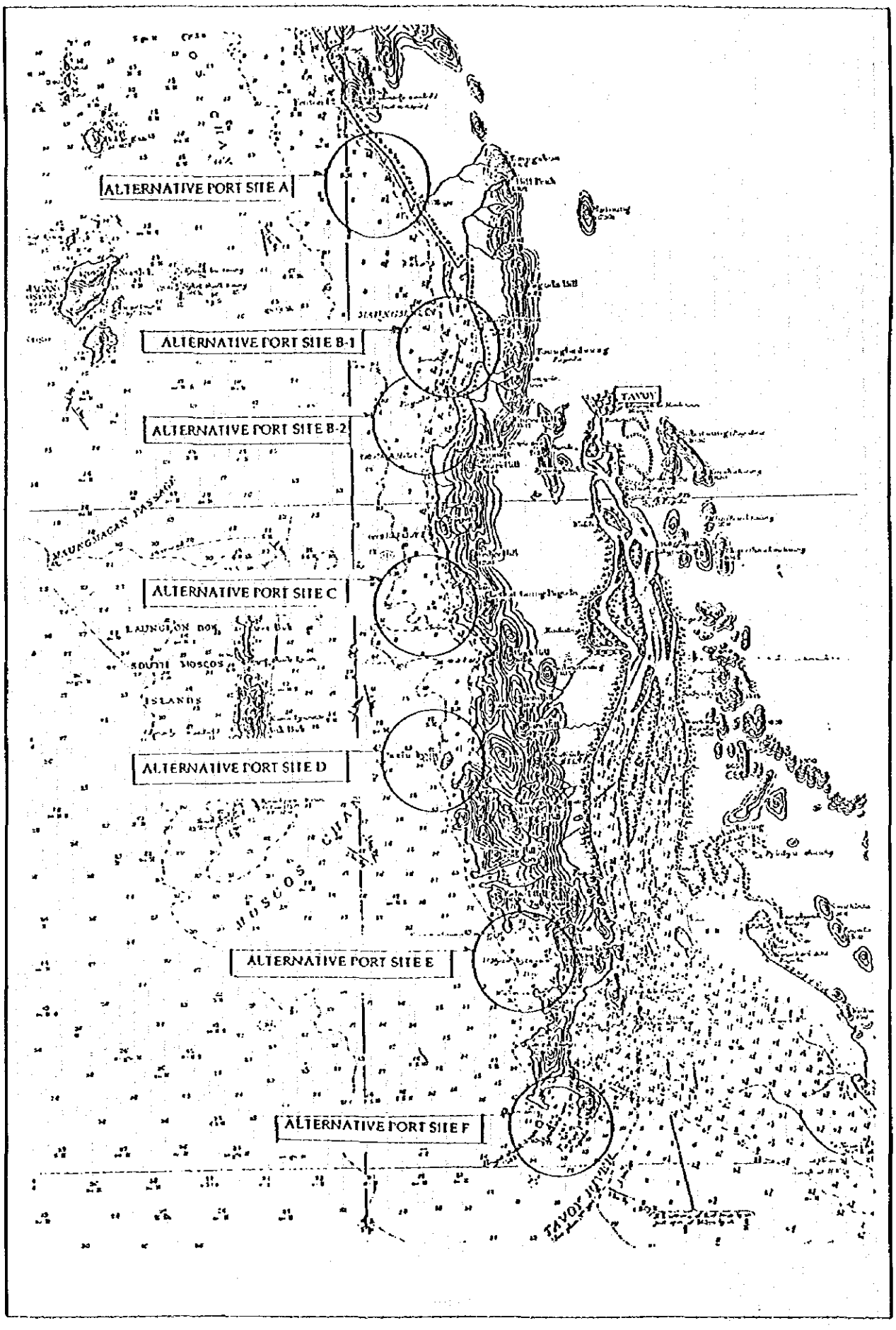
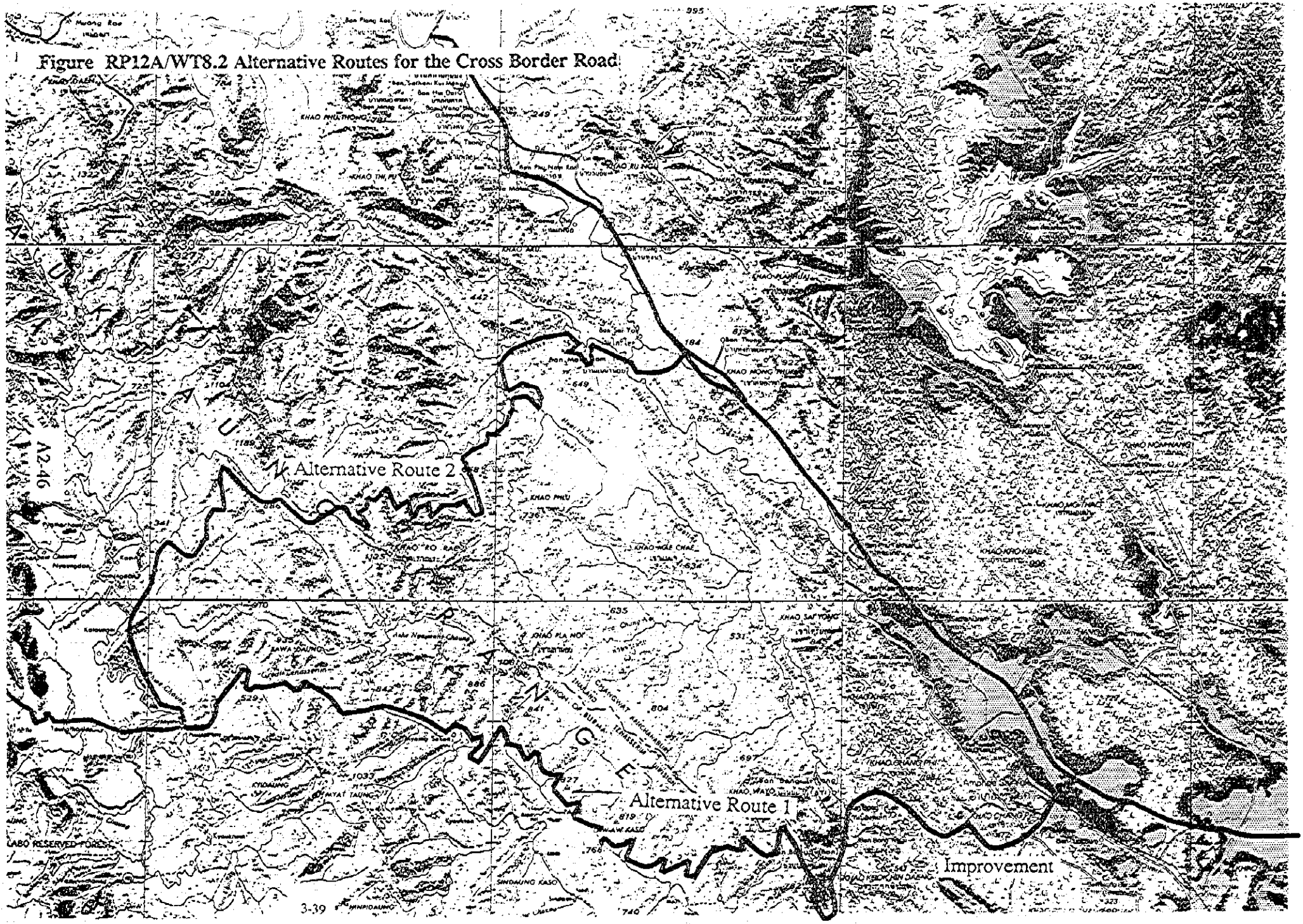


Figure RP12A/WT8.2 Alternative Routes for the Cross Border Road



RT3: ROAD SAFETY PROJECT

I. BACKGROUND

Road safety is a significant transport (and public health) problem in the WSB, with an average of 630 fatalities per year from 1992 to 1994 according DOH data (Table 9.5.7 in the text), or about 5.8 per cent of the Kingdom's total during that period; Chumphon had the highest number of road traffic fatalities in the WSB, an average of 187 per year.[1] The rate of traffic-related deaths per 10,000 vehicles in the WSB from 1992 to 1994, 8.8, was somewhat lower than the Kingdom-wide average during the period (about 12.0), but still was many times higher than rates in developed countries (e.g., 1.8 in Japan, 2.3 in Australia).[2] The scale of the problem is illustrated by recent research in Thailand, which indicates that 10-15 per cent of all hospital beds in the country are occupied by traffic accident casualties, and that 30 per cent of total hospital beds in provincial hospitals and up to 50 per cent of total hospital beds along major highways are occupied by traffic accident victims. Moreover, the problem is likely to worsen in the WSB as motorization rates, now 59 motor vehicles (excluding motorcycles) per 1,000 population (and as high as 75 per 1,000 in Ratchaburi) increase to over 100 per 1,000 population, as has been the experience of most developed countries.

There is cause for optimism, however, in the experience of developed countries, which has demonstrated that road safety problems can be addressed effectively and casualty rates reduced with coordinated implementation of appropriate policy interventions. The case of Japan, a developed country that shares a number of transport system characteristics with Thailand, is particularly instructive.[3]

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[1] Data for 1995 became available too late for inclusion in this report.

[2] Moreover, the numbers are believed to be higher in Thailand because accident records are neither accurate nor complete. Data (1995) from the public health authorities, presented in the chapter on public health (Chapter 3) of Volume 2 of this study on the social environment, show higher levels of road fatalities, with 336 in Kanchanaburi, 137 in Ratchaburi, 19 in Samut Songkram, 178 in Phetchaburi, 384 in Prachuap Khirikhan, and 254 in Chumphon. Road accidents were the single leading cause of death in Chumphon, the second-leading cause of death in Kanchanaburi, Phetchaburi, and Prachuap Khirikhan, the fifth-leading cause of death in Samut Songkram, and the seventh-leading cause of death in Ratchaburi.

[3] In 1970 the Japanese Diet enacted the Traffic Safety Policies Act, which required the formulation of a comprehensive traffic safety program. By 1977, the number injured in traffic accidents decreased up to 60 per cent from the 1970 peak; by 1979, the number of traffic accident fatalities decreased to half of the 1970 peak.

II. PROJECT CONCEPT/RATIONALE

Most road safety problem and issue areas must be addressed at the national level (e.g., road safety administration and coordination, driver training/testing, vehicle regulations/inspection) and are therefore beyond the scope of this multisectoral regional development planning study,[1] but certain issues can be effectively addressed at the regional level and are therefore the focus of the RT3 project. These issues include accident "blackspot" (i.e., high accident-location) improvement, road user publicity and campaigns, pedestrian and bicyclist safety, and emergency medical services, each of which is addressed by the project components presented in the following section.

III. PROJECT DESCRIPTION

The Project would consist of the following components:

(i) A detailed study of accident blackspots would be undertaken and engineering countermeasures recommended and implemented to address the specific problems found (e.g., lack of road markings, need for delineators to give drivers a clear indication of the road alignment). Table RT3.1 lists the 26 accident blackspots in the WSB identified in a 1996 DOH survey and provides information on the number and types of accidents at each location. Of the 26 hazardous locations identified, 19 (73 per cent) were in Chumphon Province, five (19 per cent) in Kanchanaburi Province, and two (8 per cent) in Prachuap Khirikhan Province.

(ii) Road user publicity and campaigns would be undertaken, including (i) campaigns for improving road courtesy, (ii) driver and pedestrian education, and (iii) education for government-employed drivers. The programs should be based on scientific data, focused on target groups (e.g., vulnerable road users), integrated with enforcement, and supported with training on methods for design and implementation. The Japanese example, in which traffic safety education is

[1] A World Bank-sponsored study is now underway to prepare a Road Safety Master Plan that will guide road safety activities in Thailand in future years.

adapted to different levels (from pre-schoolers to the elderly) is instructive, and could be applied.

(iii) Pedestrian and bicyclist safety measures may include the design of NMV (nonmotorized vehicle)-friendly intersections and "community roads" (i.e., pedestrian-oriented ways) in residential districts.

(iv) Finally, countermeasures concerning emergency medical services—consisting of the provision of first aid and medical care at the accident site, the transportation of the victim to the hospital, and the subsequent provision of more definitive treatment—are of vital importance. Such measures may address the essential features of an emergency medical service, including an effective notification and communication network, central control and coordination of the activities of the service, effective vehicles, a system of training and evaluation of staff performance, and clear and appropriate documentation of the operations and care provided.[1]

The Project would be implemented on a continuing basis, with participating agencies to include the Highway Police Division of the Royal Thai Police Department (under the Ministry of Interior), National Safety Council, the Department of Highways, the Ministry of Public Health, and the Ministry of Education.

IV. PROJECT ASSESSMENT

A budget of about 25 million Baht per year is estimated for this Project, which may be considered of a pilot nature; that is to say, it is expected that successful approaches demonstrated in the WSB could be replicated elsewhere in Thailand, thereby multiplying the benefits of the Project. A precise economic assessment of the Project is difficult to present, however, partly because of the need for more research into accident costing in

[1]The merits of two alternative philosophies of emergency medical care should be considered, i.e., (i) to provide immediate first aid and emergency care at the scene of the accident, then to transport the injured person to the hospital as fast as possible for definitive treatment (e.g., as in Australia, New Zealand, and the United Kingdom) and (ii) to carry out skilled care at the site of the accident with appropriate treatment (e.g., as in France and Germany); given the limited resources available in Thailand and the WSB, it may be appropriate as a first step to upgrade hospital emergency departments rather than ambulance services, since rapid transport to an underequipped, understaffed emergency department is of little value.

Thailand.[1] But given indications that road accident costs in Asian developing countries may amount to 2-3 per cent of GDP, and considering that these costs are likely to increase with advancing motorization, the benefits of the Project are likely to outweigh its modest costs. Also worth noting, the Project has synergies with all road sector projects, as well as with certain public health projects (e.g., PH3, Emergency Medical Service Upgrading; PH5, Health Promotion Upgrading).

V. RECOMMENDED ACTION(S)

It is recommended that the Government proceed with implementation of the Project. Given the valuable lessons of the Japanese experience in promoting road safety, consideration should be given to a request for a short-term Japanese Expert to provide policy and programming advice to facilitate implementation of RT3.[2]

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[1]An accident costing study is recommended to allow policymakers to better justify their road safety budgets by weighing the expenditures to be made against the expected value of the lives to be saved. One technically defensible methodology is the "value of risk change" approach, under which the value of preventing one fatality is defined as the aggregate amount that all affected individuals in society would be willing to pay for marginal risk reductions for themselves and their loved ones. Another technically defensible method is the "gross output" or "human capital" approach under which accidents are costed by estimating the sum of real resource costs (e.g., vehicle and property damage, medical expenses) and the present value of the victim's future economic output; pain and suffering may also be included.

[2]Project-type technical cooperation—which generally entails the acceptance of participants for training, the dispatch of experts, and the provision of equipment—may also be considered for facilitating national (as opposed to regional) efforts for road safety. Successful project-type technical cooperation has been implemented previously in the road safety sector by JICA in the Philippines and the People's Republic of China.

Table RT3.1 Accident Blackspots in the WSB (1996)

Route	Location	AADT	Km	Number of Accidents	Number of Fatalities	Number of Injuries	Accident Type												Province
							1	2	3	4	5	6	7	8	9	10	11	12	13	
4	Tha Sae/Chumphon	8,101	499	43	23	21	0	0	0	0	0	0	0	23	0	0	0	0	0	Chumphon
4	Ratchaburi	18,759	104	19	2	8	0	0	1	0	0	1	0	3	0	0	0	14	0	Ratchaburi
4	Pranburi	14,413	255	19	0	12	0	0	10	0	0	0	0	8	0	0	0	1	0	Prachuap Khirikhan
323	Ban Pong	32,282	13	18	1	12	0	0	7	0	0	0	0	4	0	0	0	7	0	Ratchaburi
327	Prathomporn Intersection	15,254	501	17	1	4	0	0	8	0	0	1	0	8	0	0	0	0	0	Chumphon
1001	Chumphon River Mouth	6,615	5	16	6	10	0	0	7	0	0	1	0	7	0	0	0	0	1	Chumphon
327	Entrance to Chumphon	19,459	2	15	1	19	0	0	5	0	0	0	0	10	0	0	0	0	0	Chumphon
327	Toward Chumphon	19,459	1	3	4	10	0	1	4	0	0	0	0	8	0	0	0	0	0	Chumphon
4	Ratchaburi	18,759	102	13	1	19	0	0	3	0	0	0	0	2	0	0	0	8	0	Ratchaburi
4001	Chumpon River Mouth	6,615	6	11	3	30	1	0	3	0	0	0	0	6	0	0	0	0	1	Chumphon
4	Chumphon Jorporror Monument	3,008	505	9	0	6	0	0	3	0	0	0	0	4	0	0	0	2	0	Chumphon
325	Damnoen Saduak	9,030	38	5	2	5	0	0	4	0	0	0	0	1	0	0	0	0	0	Ratchaburi
4	Thasae	8,101	497	5	0	3	0	0	3	0	0	0	0	2	0	0	0	0	0	Chumphon
4	Bang Saphan	9,491	399	4	6	0	0	0	1	0	1	0	1	1	0	0	0	0	0	Prachuap Khirikhan
4	Chumphon (423+600)	9,491	446	4	3	3	0	0	1	0	0	0	0	3	0	0	0	0	0	Chumphon
4	Thasae Chumphon	8,101	489	4	3	2	0	0	2	0	0	0	0	2	0	0	0	0	0	Chumphon
41	Chumphon	9,051	32	4	3	1	0	0	1	0	0	0	0	3	0	0	0	0	0	Chumphon
41	Chumphon	9,051	29	4	2	36	0	0	2	0	0	1	0	0	0	0	1	0	0	Chumphon
41	Lang Suan Chumphon	7,642	92	4	7	5	0	0	2	0	0	1	0	0	0	0	0	1	0	Chumphon
4	Bang Saphan	9,491	422	4	1	1	0	0	1	0	0	0	0	0	0	0	1	2	0	Chumphon
3169	Highway - Seaside	3,634	10	3	3	2	0	0	2	0	0	1	0	0	0	0	0	0	0	Chumphon
3089	Km. 0.28 Ban Phon	4,639	0	3	2	2	1	0	1	0	0	0	0	1	0	0	0	0	0	Ratchaburi
4139	Thalay Hill	1,604	1	3	0	5	0	1	1	0	0	0	0	1	0	0	0	0	0	Chumphon
4096	Thako River Mouth	1,096	1	3	0	4	0	0	1	0	0	0	0	1	0	1	0	0	0	Chumphon
4139	Thalay Hill	1,347	4	3	0	4	0	0	1	0	0	0	0	2	0	0	0	0		Chumphon
4096	Thako River Mouth	910	12	2	1	1	0	0	1	0	0	0	0	1	0	0	0	0		Chumphon

Note: Accident Types:

1=Motorcycle → Person
2=Motorcycle → Bicycle → Tricycle
3=Motorcycle → Automobile
4=Motorcycle → Property
5=Motorcycle-only accident
6=Automobile → Person
7=Automobile → Bicycle → Tricycle
8=Automobile → Automobile
9=Automobile → Train
10=Automobile → Animal/Animal Cart
11=Automobile-only accident
12=Automobile → Property
13=Others

Source: Department of Highways

WT1: PRACHUAP DEEP-SEA PORT EXTENSION PROJECT[1]

I. BACKGROUND

As set out in the Industry Sector Report and in the Final Report of the JICA-assisted *Feasibility Study on Bang Saphan Industrial Estate in the Kingdom of Thailand*, a large industrial city is planned for Bang Saphan in Prachuap Khirikhan province, including facilities for the iron/steel industry and general industry. In addition, a major deep-sea port (Prachuap) has already been developed by the private-sector Sahaviriya Group at Bang Saphan, including a 490 m long main berth 15 m below MSL and a 245 m long secondary berth 10 m below mean sea level (MSL).

Key features of the facilities at Prachuap Port are outlined briefly below:

(i) The natural water depth in the vicinity—a seabed contour of -15 m below MSL (mean sea level) lies as close as 900 m to the coast line—offers the potential for developing a deep-sea port capable of accommodating cargo vessels ranging from 50,000 to 100,000 dwt (deadweight tons).

(ii) At present, the port consists of a 490 m long main berth 15 m below MSL and a 245 m long secondary berth 10 m below MSL; maximum berthing capacity is 45,000 dwt at the main berth and 7,000 dwt at the secondary berth. Tidal operation is required to receive vessels above 30,000 dwt, however.

(iii) The port configuration is rather tightly spaced for large vessels maneuvering inside the breakwater-protected basin.

(iv) Cargo handling is mainly by ship derrick cranes assisted by onshore mobile cranes.

[1]This Project Profile follows and draws upon the more detailed work performed in Nippon Koei Co., Ltd. and Japan Industrial Location Center, *Feasibility Study on Bang Saphan Industrial Estate in the Kingdom of Thailand, Final Report*, prepared for the Industrial Estate Authority of Thailand, Ministry of Industry, January 1997.

II. PROJECT CONCEPT/RATIONALE

Since Bang Saphan appears to be the most suitable site in the WSB for deep-sea port development (see Figure 9.5.20, which presents water depths in the region), Prachuap Port is expected to play a major role not only for the development of the Bang Saphan (Free Trade) area, but for a larger hinterland including other parts of the WSB region, thereby accelerating decentralization in Thailand. The Project will also promote development in the ESB, to which it will be linked through the proposed Gulf of Thailand "Inland Navigation" project (WT5). The conceptualization of these impacts, engendered by various linkages, is presented in the Main Volume, which suggests application of a multiple access spatial development model to the WSB, with Bang Saphan serving as the region's deep-sea port hub.

III. PROJECT DESCRIPTION

A. Port Development

The WT1 project follows the recommendations of the JICA Bang Saphan team, which has put forward three possible port expansion plans, but selecting "Plan C" as its optimum plan to serve forecast demand; this optimum plan is shown in Figure WT1.1.

Regarding the *general cargo berth zone*, the optimum plan has the following features:

(i) the existing breakwater will be expanded southward, slightly in the direction of the seaside;

(ii) along the existing north-south shoreline, reclamation of about 200 m of land will be undertaken with the southern waterfront to serve as the general cargo berth zone;

(iii) land reclamation around the point will project out to the sea in an east southeasterly (ESE) direction;

(iv) general cargo berths will be developed along the northern waterfront of the ESE reclamation;

(v) south of the ESE reclamation, a commercial dock could be developed; and

(vi) a ro-ro ferry terminal, which does not require deep berth depth , could be provided along the northern part of the north-south reclamation.

In addition to the general cargo berth, a *mineral bulk berth zone* should also be developed to unload bulk cargo of 8.6 million tons in 2006 and 14.8 million tons in 2011. Unlike general cargo, mineral bulk freight will be transported by large bulk carriers, most likely 60,000 dwt ("Panamax") or 140,000 dwt ("Cape-size") vessels.[1] The plan calls for one Cape-size berth to be constructed off the existing Prachuap Port; a 1.2 km long trestle would be required to link the mineral cargo berth with a water depth of -19 m draught to the shore conveyor system as shown in Figure WT1.1.

B. Schedule/Phasing

As the required investment in the proposed port is large, and considering the uncertainty of the port demand, particularly of the industrial estate-related general cargo, phase-wise development of the port is proposed, with 1,200 m of general cargo berth in Phase I (to 2001) and 1,740 m of general cargo berth in Phases II and III of this Study (i.e., to 2011).

D. Implementation Arrangements

Prachuap Port is operated by Prachuap Port Co., Ltd., a subsidiary of the Sahaviriya Group specialized in port management and operations. The Sahaviriya Group developed the existing port mainly targeting shipment of seaborne cargo related to the operation of the Sahaviriya Industrial Complex at Bang Saphan. However, substantial volumes of non-Sahaviriya cargo have already been handled at the port, and the portion of this cargo is expected to increase as a coastal shipping network in the Gulf of Thailand is more fully developed (see Project WT5, Gulf of Thailand Inland Navigation Project).

Considering the foregoing, the JICA Bang Saphan Study put forward two general scenarios for the development of Prachuap Port:

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[1]Assuming 140,000 dwt vessels call at Prachuap port carrying an average of 100,000 tons per vessel, the number of ship calls would be 86 in 2006 and 148 in 2011.

(i) Prachuap Port Co., Ltd., under the financial support of the Sahavirya Group, would invest in all the port development; or

(ii) IEAT or another governmental body would participate in the future port development, particularly the development of a common-use port zone, in return for which they would receive investment returns in proportion to their participation.[1]

Irrespective of port development scenario, it has been proposed that port operation be undertaken by one entity, most likely by Prachuap Port Co., Ltd. However, a critical issue to be resolved if the operator of the port is also a major (but not the sole) user of the port, relates to the fair treatment of vessels from enterprises with no connection to that operating the port. In this context, it is considered desirable that public investment be invited and the port operated under a public-private partnership.

IV. PROJECT ASSESSMENT

A. Project Cost

The JICA Bang Saphan team estimated the total cost of the Project to be of the order of 6.095 billion Baht (US$244 million equivalent), comprised of 3.420 billion Baht for the general cargo port (2.016 billion Baht in Phase I and 1.044 billion Baht in Phase II) and 2.675 billion Baht for the bulk cargo port (1.445 billion Baht in Phase I and 1.230 billion Baht in Phase II).

B. Traffic

The JICA Bang Saphan Study has forecast traffic at Prachuap Port to increase from 2.3 million tons in 1995, to 6.3 million tons in 2001, to 12.7 million tons in 2006, and to 22.8 million tons in 2011; details of this forecast are presented in Table WT1.1, including projections separately for steel-related cargo, industrial estate cargo, and locally based general cargo. The overall annual average traffic growth rates implied by these forecasts are 18.0 per cent between 1995 and 2001, 15.3 per cent between 2001 and 2006, and

[1] IEAT-financed port facilities could be leased to Prachuap Port Co., Ltd., which would undertake terminal operation on behalf of the governmental body.

12.4 per cent between 2005 and 2011, or about 15.4 per cent per annum between 1995 and 2011.

C. Economic and Financial Assessment

It is well established that properly prepared port projects tend to offer satisfactory rates of return. A random sampling of port appraisal reports prepared by the World Bank between 1986 and 1988 indicates economic internal rates of return (EIRRs) ranging from 20 to 33 per cent, with mean and median EIRRs of about 27 per cent. Broadly consistent with this evidence, the World Bank has reported an average re-estimated EIRR (weighted by costs) of 22 per cent for projects in the port sector between 1968 and 1980. Port projects generally also offer reasonable financial internal rates of return (FIRRs), with World Bank experience indicating that re-estimated FIRRs are usually higher than appraisal projection, in some cases reaching 20 per cent or more; however, port projects are subject to cyclical variations in performance tied to variations in regional and world trade.[1]

D. Linkages with Other Projects

The Prachuap Port potentially relates to several of the transport projects identified in this Report, including:

(i) RP1—Roads to Support Specific Industrial Developments (e.g., Bang Saphan);
(ii) RP3—Pathiu-Route 4 and Pathiu-Bang Saphan Links;
(iii) RP10—North-South Links with the BMA;
(iv) RP11—Chumphon-Ranong Links;
(v) WT5—Gulf of Thailand "Inland Navigation" Project;
(vi) WT9—Ranong/Phangnga Port Development;
(vii) RW1—Improvement of the Southern Main Line;
(viii) RW4—Development of Spur Lines to Major Industrial Estates;
(ix) RW5—Freight Transport Improvement; and
(x) AT1—Aggressive Marketing of Chumphon (Pathiu) Airport.[2]

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[1]See PADECO Co., Ltd., *Regional Technical Assistance on Promoting Subregional Cooperation Among Cambodia, the People's Republic of China, Lao PDR, Myanmar, Thailand and Viet Nam - Subregional Transport Sector Study*, prepared for the Asian Development Bank, October 1994, p. 45.

[2]Additionally, the WT1 project relates to the various feeder port proposals, which would feed into the

Linkages with projects in other sectors are also vitally important, including (most prominently) the Bang Saphan Free Trade Area project (TR1), the Industrial Core and Satellite project (ID3), and the High Value-Added Industrial Estate project (ID6).

V. RECOMMENDED ACTION(S)

The JICA Bang Saphan Team set out a number of recommended actions, including the following:

(i) the proposed port expansion project should be implemented at the earliest possible date;

(ii) a basic design for port facilities and inland facility configuration, as well as an institutional framework, should be finalized as quickly as possible;

(iii) the Bang Saphan area, including the industrial estate, should be designated as a free trade area; and

(iv) due consideration should be paid to environmental protection (an Initial Environmental Examination checklist is attached).

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deep-sea port at Bang Saphan.

Table WT1.1 Present and Forecast Cargo Demand at Prachuap Port

Units: tons

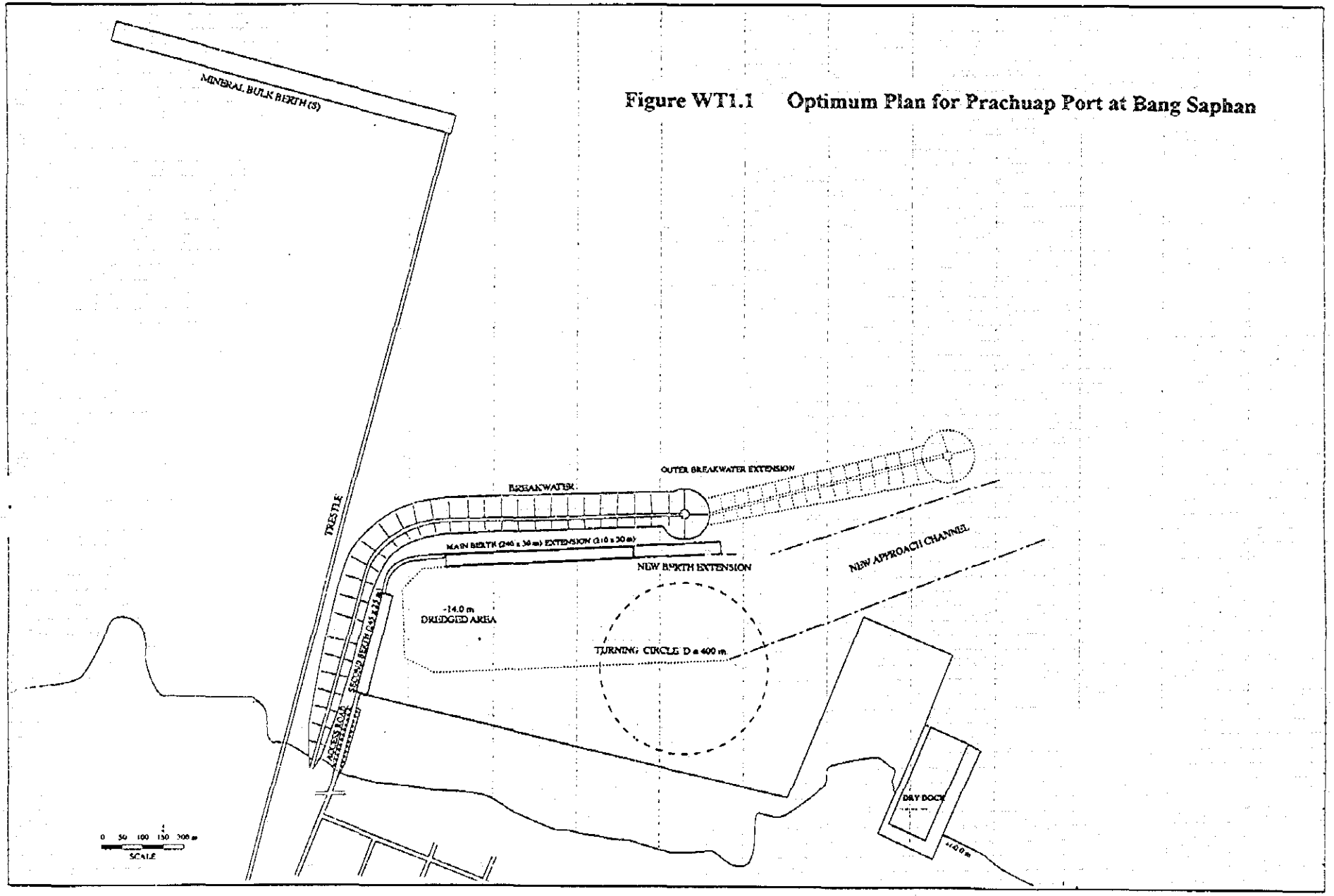
Type of Cargo	1995	2001	2006	2011
Steel-Related General Cargo	1,800	4,980	3,150	4,080
Industrial Estate General Cargo	-	470	1,020	2,640
Locally Based General Cargo	500	805	1,030	1,310
General Cargo Total	2,300	6,225	5,200	8,030
Bulk Cargo	-	-	7,500	14,780
Total	2,300	6,225	12,700	22,810

Note: Steel related cargo will decrease in 2006 because iron making will start and import of slabs will stop.
Source: JICA and Industrial Estate Authority of Thailand, *Feasibility Study on Bang Saphan Industrial Estate in the Kingdom of Thailand*, Final Report, January 1997, p. 80.

Checklist of Initial Environmental Examination (Project No. WT1)

Environmental Parameters Affected by the Project Implementation	Impacts on the Environment	Recommended Feasible Mitigation Measures	Magnitude of Impacts			
			No Significant Effect	Significant Effect		
				Small	Moderate	Major
1. Air and Noise Pollution	1. Nuisances and health hazards to neighbors and wildlife.	1. Use of construction equipment with low air and noise emissions; selection of proper times for land clearing and facility construction.		x		
2. Terrestrial Ecology	2. Alteration of wildlife habitats and loss of biodiversity caused by tree cutting.	2. Minimization of the amount of tree cutting and replanting precious vegetation.		x		
3. Water Quality and Aquatic Ecology	3. Water pollution and sea bed condition changes caused by deep-sea port construction works (e.g., shoreline erosion and dredging), fecal contamination, and machine operation (oil and grease spills).	3. Setting up of machinery maintenance areas and construction camps away from the shoreline; providing measures to prevent shoreline erosion.			x	
4. Historical/Cultural Properties	4. Loss of historical/cultural properties.	4. Investigation of these properties and provision of appropriate preservation measures.		x		
5. Human Resettlement	5. Relocation of residents.	5. Consideration of alternative site selection and adequate compensation for affected residents.		x		
6. Environmental Aesthetics	6. Loss of scenic value.	6. Careful planning to minimize and offset losses.		x		

Figure WT1.1 Optimum Plan for Prachuap Port at Bang Saphan



WT5: GULF OF THAILAND INLAND NAVIGATION PROJECT

I. BACKGROUND

The establishment of a coastal shipping network within the Gulf of Thailand, connecting various WSB ports with the emerging deep-sea port at Laem Chabang, has been under consideration for a number of years, by both public and private sector organizations. It began to receive momentum in 1993 when the *Feasibility Study for Construction of Chumphon Port* found that the cost of marine transport by ro-ro (roll-on, roll-off) ferry would be 23 per cent cheaper than the cost of land transport.[1] Two years later the Khi Dha Group obtained a license from the Ministry of Transport and Communications to construct facilities and operate ro-ro cargo ferry services connecting Chumphon with Laem Chabang and Laem Chabang with Samut Sakhon; they planned to commence their "Siam Sea Link" operation in April 1997, first using Bang Saphan rather than Chumphon, to take advantage of existing facilities at the former location. The Project proposed here would build upon the initial Siam Sea Link operation to establish a full-scale coastal shipping network in the Gulf of Thailand, as depicted in Figure WT5.1.

II. PROJECT CONCEPT/RATIONALE

The Project is consistent with the water transport development strategy of the Eighth Plan "to link inland water transport with the southern and eastern coasts, to promote water transport as one measure to ease traffic congestion in Bangkok and its perimeters and also to promote water transport as part of multimodal transport." The Project is also consistent with the strategy of the Eighth Plan "to expand water transport infrastructure in terms of quality and quantity to support national and regional economic development, to promote the participation of the private sector, and to develop a water transport

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[1] Southeast Asia Technology Co., Ltd., *Feasibility Study for Construction of Chumphon Port, Final Report*, prepared for the Harbour Department, September 1993, p. 7-3 and p. A-31 [The total cost of land transport between Sri Racha in the Eastern Seaboard and Pathomphon Junction in Chumphon was estimated to be 167.9 million Baht per year while that for marine transport between the two points was estimated to be 129.6 million Baht per year (73.7 million Baht for shipping cost, 26.4 million Baht for land transport, 20.2 million Baht for ship depreciation, 6.7 million Baht for port operation, and 2.6 million Baht for channel improvement)]. This finding is consistent with the results of a market survey conducted by the Khi Dha Group, in which 48 of 50 potential customers expressed interest in such a Gulf of Thailand coastal shipping service.

services network." In addition, over the longer term the project is expected to prove a boon to the Thai shipping industry, which the Office of the Maritime Promotion Commission has been actively fostering. And while the project is classified as interregional, it could have subregional and global impacts, as Laem Chabang begins to serve as a gateway to Indochina and the world.[1]

The stated rationale for Khi Dha's Siam Sea Link project is to provide a "Bangkok Bypass" solution, in order to (i) establish in Thailand a proven and efficient transport mode, (ii) provide an alternative to congested and polluted roads and delayed deliveries, (iii) extend the unit load concept and reduce unnecessary handling costs, (iv) reduce the risk of damage to goods in transport, (v) improve the utilization of road vehicles, and (vi) reduce the environmental impacts of road transport.

III. PROJECT DESCRIPTION

Key features of the Siam Sea Link proposal, the first step in building a full-scale coastal shipping network in the Gulf of Khi Dha plan, are set out overleaf:
While the Harbour Department is already assisting the Khi Dha Group with its current plan, additional ro-ro cargo ferry routes are likely to be feasible and should be considered for support, with the ultimate objective of establishing an "inland navigation" network in the Gulf of Thailand. Samut Songkram would be one candidate ro-ro ferry port to be included within the network, especially considering its advantages relative to Samut Sakhon in terms of its greater land availability and the proposed Free Trade Area at Samut Songkram; these advantages are deemed significant, provided that dredging of the Samut Songkram channel to at least -4.0 m and preferably to -5.0 m were economically feasible.[2]

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[1]Bangkok-Marine, a shipping agency in the Thailand-Indochina region, inaugurated a direct route from Thailand to Indochina (Sihanoukville and Ho Chi Minh City) bypassing Singapore in November 1995. Also in late 1995, a number of global shipping alliances commenced making direct calls on Laem Chabang.

[2]Additional landing sites on the Gulf of Thailand may also be possible; for example, one site about 13 km south of Hua Hin appears to warrant investigation, although it is under military control at present.

Key Features of the Siam Sea Link Proposal

- Phase I of the Siam Sea Link plan is for a single route from Laem Chabang to Bang Saphan with an expected start date of 1 April 1997 with two 142 m ro-ro vessels capable of carrying 90 ten-wheeled trucks or 77 ten-wheeled trucks and 10 semi-trailers. Two sailings in each direction will be provided, with the service aimed at the driver-accompanied market. Existing port facilities at Laem Chabang and Bang Saphan will be utilized but pontoons and ramps would be installed by Siam Sea Link, with such installation to be carried out in the 3-4 months prior to commencement of operations. The sailing time between Laem Chabang and Bang Saphan would be about nine hours.

- Phase II of the plan would be to undertake a Laem Chabang-Samut Sakhon route, with operations envisaged to start in January 1998; 2.5 sailings per day are planned, with 3.5-4 hours per sailing.

- Phase III would involve service to Khanom (in Nakhon Si Thammarat province on the Southern Seaboard) commencing in July 1998, and to Chumphon (after construction of a new port at Khao Pho Bae (see Figure 9.5.21 relating to Project WT2, the Chumphon Feeder Port Project) beginning in January 2000. The sailing time on this route (to Khanom) would be 17.5 hours.

- Services would be added in accordance with demand. One early scenario formulated by Khi Dha involved four vessels on the Samut Sakhon-Laem Chabang route and seven on the Chumphon/Bang Saphan-Laem Chabang route.

- The largest volume is expected on the short route (i.e., Laem Chabang-Samut Sakhon), mainly containers into and out of Laem Chabang; in contrast, the traffic on the longer routes is expected to be mainly intra-Thailand traffic with only a small proportion of import-export traffic.

Source: The Khi Dha Group (1996)

IV. PROJECT ASSESSMENT

A. Cost

The cost of the Siam Sea Link proposal has been estimated at about 1.7-1.8 billion Baht between 1996 and 2004, including about 1.16 billion Baht in the first three years;[1] an relatively minimal additional cost is to be provided by the Harbour Department for dredging at Samut Sakhon. Further investment of the order of 4.0 billion Baht by the Khi Dha Group or other private-sector investors may be required for establishment of a more well-developed coastal shipping network in the Gulf of Thailand within the study period horizon, i.e., until 2011; complementary public-sector investment, amounting to perhaps less than 10 per cent of the private-sector investment, may be required to "leverage" the total investment.

B. Traffic

Traffic potential on the Siam Sea Link proposal may be (conservatively) estimated to be of the order of 1.5-1.6 million tons on each route, i.e., Bang Saphan or Chumphon-Laem Chabang and Samut Sakhon.[2] Note that the JICA-assisted *Feasibility Study on Bang Saphan Industrial Estate in the Kingdom of Thailand* reported that traffic at Prachuap Port at Bang Saphan was already 2.3 million tons in 1995 and forecast it to increase to 6.3 million tons in 2001, 12.7 million tons in 2006, and 22.8 million tons in 2011 (see Table WT1.1); while not all of this traffic will be suitable for ro-ro ferry transport (e.g., export traffic from Bang Saphan to overseas points via Laem Chabang) or traveling via Laem Chabang, it is forecast that 3.4 million tons in 2001, 3.2 million tons in 2006, and 5.2 million tons in 2011 would be suitable for such transport (see Table WT5.1).[3]

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[1] Vessels with a capital cost of US$25-40 million each will be chartered rather than purchased.

[2] The former was estimated by multiplying 7 one-way voyages per day, by 365 days per year, by 90 trucks per vessel (capacity), by 0.8 (to account for less-than-capacity loads), and by 8.5 tons per truck (average payload, counting main haul and back-haul trips, from trucking industry studies); the latter was computed by multiplying 8 one-way voyages (4 round trips) per day, by 365 days per year, by 75 trucks per vessel (capacity, considering draft limitations in the Tha Chin River), and by 0.8 (to account for less-than-capacity loads) by 8.5 tons per truck (average payload, counting main haul and back-haul trips, from trucking industry studies). The estimate derived here for the Ban Saphan/Chumphon-Laem Chabang route is consistent with the traffic potential estimated by the 1993 Chumphon port feasibility study, which forecast total freight traffic potential at the new Chumphon port to be about 1.6 million tons per year, i.e., 510 trucks per day multiplied by 365 days per year (assuming 8.5 tons per truck, consistent with trucking industry studies).

[3] As indicated in the notes to Table WT5.1, steel related general cargo is forecast to decrease in 2006 because ironmaking will start and the import of slabs will stop.

C. Economic Assessment

An indication of the economic rates of return possible from investment in developing a coastal shipping network in the Gulf of Thailand is provided by the 1993 Chumphon ro-ro port study, which found an economic return of 18.2 per cent for the port considered (Laem Kho Thian). While the same study found a rate of return of only 6.4 per cent if traffic were 20 per cent less than forecast, the rate of return could be higher than estimated if the additional traffic materializes (e.g., in the case of Chumphon, by opening a corridor to Ranong/Phangnga; or from the development of Bang Saphan), or even if only normal traffic growth occurs, as the 1993 study assumed constant traffic levels throughout its 25-year forecasting horizon, while the present WSB study forecasts traffic at the region's coastal ports to increase 21 per cent per year until 2006 and 15 per cent thereafter (see Section 5.2.3).

D. Linkages with Other Projects

The Project involves important linkages with other projects, including the following:

(i) WT1, Prachuap Port Extension;

(ii) WT2-WT4, various feeder port projects; and

(iii) TR1, Free Trade Areas (e.g., at Bang Saphan and Samut Songkram).

These linkages, both intrasectoral and intersectoral, are expected to produce even greater benefits than envisaged by a conservative approach.

V. RECOMMENDED ACTION(S)

Many of the actions required for Project implementation should and will be undertaken by the private sector. However, consistent with Government policy and the dictates of economic efficiency, the Government should actively facilitate and promote the development of the proposed coastal shipping network in the Gulf of Thailand. Specific actions that may be considered to further this objective include:

(i) consideration of the potential for transshipment at Bang Saphan and the need for a fuel (coal, oil, and gas) storage facility in the Project area;

(ii) improvement of road access and dredging of the access channel to ports used for coastal shipping in the Gulf of Thailand;

(iii) favorable action on applications for Board of Investment privileges related to coastal shipping operations in the Gulf; and

(iv) consideration for relaxing, at least in the near term, various rules and regulations that deter foreign investment for establishing an expanded coastal shipping network in the Gulf.[1]

The Committee for the Development of the Eastern Seaboard, which has appointed a Subcommittee chaired by the Secretary General of the Maritime Promotion Commission with the task to formulate plans to develop coastal shipping, is urged in its deliberations to consider the specific actions listed above.

[1]E.g., the current requirement for Ministerial permission for foreign vessels to trade in Thai territorial waters (Thai Vessels Act, Article 6, Section 47) and the current restriction of foreign ownership of vessels trading in Thai territorial waters to 30 per cent.

Table WT5.1 Potential Ro-Ro Ferry Traffic Between Bang Saphan and Laem Chabang

Units: Tons

Type of Cargo	2001	2006	2011
Steel-Related General Cargo	2,310	1,560	2,450
Industrial Estate General Cargo	270	600	1,480
Locally Based General Cargo	805	1,030	1,310
General Cargo Subtotal	3,385	3,190	5,240
Bulk Cargo	0	0	0
Total	3,385	3,190	5,240

Notes: (1) It was assumed that 58 per cent of the steel-related general cargo traffic at Bang Saphan (see Table WT1.1) would be outward domestic traffic in 2001, 62 per cent in 2006, and 75 per cent in 2011; it was also assumed that 80 per cent of this outward domestic steel-related general cargo would go to Laem Chabang and be amenable to ro-ro ferry transport. In addition, it was assumed that the steel-related general cargo inward traffic would all be international, most likely from Australia, and therefore not amenable to ro-ro ferry transport.

(2) It was assumed that 72 per cent of the industrial estate general cargo traffic would be inward in 2001, 73 per cent in 2006, and 70 per cent in 2011; 80 per cent of this inward traffic was assumed to be domestic traffic moving to Laem Chabang and amenable to ro-ro ferry transport. In addition, it was assumed that the outward traffic would all be export traffic (i.e., to foreign countries), and therefore not amenable to ro-ro ferry transport.

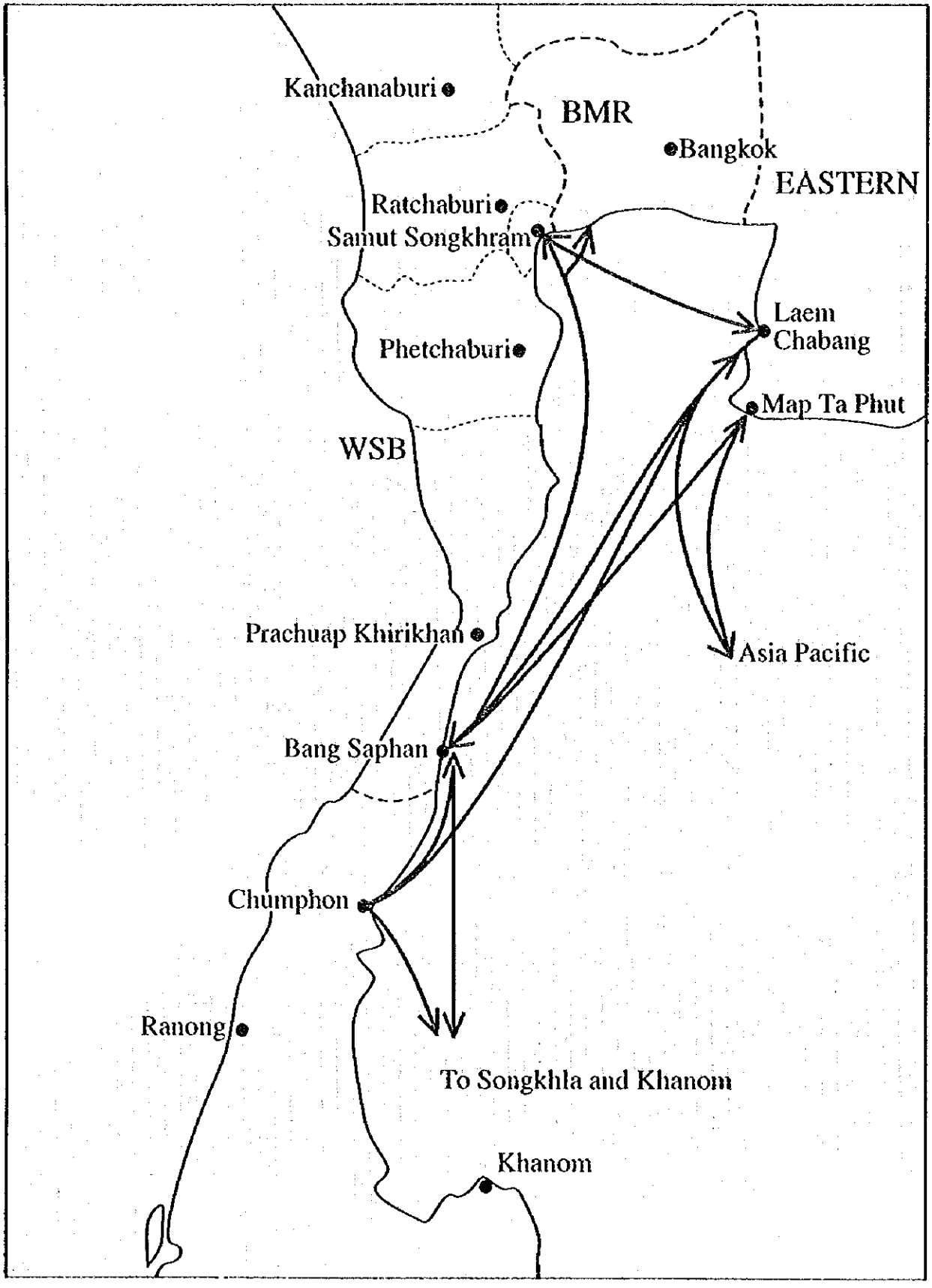
(3) It was assumed that 100 per cent of the locally based general cargo would be amenable to ro-ro ferry transport.

(4) It was assumed that 0 per cent of the bulk cargo would be amenable to ro-ro ferry transport.

(5) Steel related cargo is forecast to decrease in 2006 because ironmaking will start and import of slabs will stop.

Source: The Study Team in consultation with the JICA Bang Saphan team

Figure WT5.1 Shipping Lanes in the Gulf of Thailand



Source: The Study Team