Office of the National Economic and Social Development Board
Office of the Prime Minister

FINAL REPORT

GLOBAL TRANSPARK AT U TAPHAO AIRPORT

VOLUME II : IMPLEMENTATION PLAN

Global Transpark Consultants

January 1998

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PREFACE

This study provides a plan by which the GTP at U Taphao can be developed and implemented. The study was conducted by the Global Transpark Consultants study team under contract to the Office of the National Economic and Social Development Board (NESDB).

A brief summary of the entire study and its findings is presented in a separately bound Executive Summary. The detail study results are presented in a four-volume master report. The four separately bound master report volumes are:

1. **Business Plan** - GTP business elements, including the market for GTP services, how to organize for GTP implementation and operation, what Government needs to do to implement, how the GTP should be organized, and whether or not the GTP makes sense from the financial and economic perspectives.

2. **Implementation Plan** - Focuses on the physical layout plan, the engineering, and the site's physical improvements. Includes appendices with backup information.

3. **Initial Environmental Examination** - An examination of existing environmental conditions at U Taphao as well as the probable environmental effects of the GTP.

4. **Business Plan Appendices** - Separately bound backup information related to the Business Plan - Volume 1.

The report volume that you are now reading is the "Implementation Plan."

TABLE OF CONTENTS

Preface i
Table of Contents iii
List of Exhibits v
List of Appendices vii
Acknowledgements ix
Glossary xi
Introduction and Summary xiii

Section Page

1. OVERVIEW OF EXISTING CONDITIONS AND SUPPORTING INFRASTRUCTURE
   - 1.0 Overview 1-1
   - 1.1 Inventory of Existing Conditions 1-1
   - 1.2 History of Aviation Acitivity 1-1
   - 1.3 Transportation Facilities 1-3
   - 1.4 Utilities 1-5
   - 1.5 Soil Conditions 1-5

2. GTP LAYOUT AND LONG TERM PLAN
   - 2.0 Introduction 2-7
   - 2.1 Summary of Activity Forecasts 2-7
   - 2.2 Feasibility and Master Plan, Rayong - Louis Berger International, May 1991 2-15
   - 2.3 GTC 1997 Layout 2-19

3. AIRFIELD FACILITIES
   - 3.0 Introduction 3-25
   - 3.1 Runway 3-25
   - 3.2 Parallel and Crossover Taxiways 3-27
   - 3.3 Navigation 3-27
   - 3.4 Air Traffic Control Personnel and Procedures 3-35
   - 3.5 Aircraft Fueling Service 3-35
   - 3.6 Aircraft Rescue and Fire Fighting Facility 3-36
   - 3.7 Security 3-36
   - 3.8 Airport Maintenance Facilities 3-37
   - 3.9 Roadways 3-37
   - 3.10 Utilities 3-38

4. CARGO, INDUSTRIAL AND SERVICE FACILITIES
   - 4.0 Introduction 4-41
   - 4.1 Aircraft Used for Air Cargo 4-41
   - 4.2 Air Cargo Complex 4-42
   - 4.3 Civilian Passenger Complex 4-44
   - 4.4 Thai Airways Maintenance Facility 4-45
   - 4.5 Industrial Park for Industries Desiring Access to Air Cargo 4-45
   - 4.6 Staff Residence and Recreational Facilities 4-45

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4.7 GTP Authority Headquarters 4-45
4.8 Expansion Area for Industrial Facilities 4-46

5. CAPITAL IMPROVEMENT PROGRAM
5.0 Introduction 5-47
5.1 Site Preparation 5-47
5.2 Roadway 5-47
5.3 GTP Administrative Office and Communications Center 5-49
5.4 Water Supply 5-49
5.5 Sanitary Sewer 5-49
5.6 Air Cargo/Warehouse/Customs Facility 5-50
5.7 Electrical Service 5-50
5.8 Security 5-50
5.9 Airfield Improvements 5-50
5.10 Emergency Generators 5-51
5.11 Communications 5-51
5.12 Opening Day Facilities Costs 5-51

LIST OF EXHIBITS

Section		Page
1.	OVERVIEW OF EXISTING CONDITIONS AND SUPPORTING INFRASTRUCTURE	
1.1-1	Exisiting Facilities at U Taphao Airport	1-2
1.3-1	Eastern Seaboard Roadway Network	1-4
2.	GTP LAYOUT AND LONG TERM PLAN	
2.1-1	Cargo Forecasting Method	2-10
2.1-2	Estimated Weekly Operations, Years 1-7	2-12
2.1-3	Boeing Intra-Asia Air Cargo Forescasts	2-13
2.1-4	Estimated Annual Air Cargo by Type, Years 1-20	2-13
2.1-5	Weekly and Annual Air Cargo Operations, Years 1-20	2-14
2.2-1	Louis Berger 1991 Layout	2-16
2.2-2	Louis Berger 1991 Layout ICAO Obstacle Limitation Surfaces	2-18
2.3-1	GTC 1997 Layout	2-20
2.3-2	GTP Long Term Plan	2-21
2.3-3	GTC 1997 Layout ICAO Obstacle Limitation Surfaces	2-22
4.	CARGO, INDUSTRIAL AND SERVICE FACILITIES	
4.1-1	Capacities of Freighters Currently in Service	4-41
4.1-2	Widebody Passenger Aircraft Offer Substantial Air Cargo Capacity	4-42
4.2-1	Estimated Annual Air Cargo by Type, Years 1-20	4-43
5.	CAPTIAL IMPROVEMENT PROGRAM	
5.0-1	Initial Capital Improvements	5-48
5.12-1	Opening Day Capital Improvements	5-52

LIST OF APPENDICES

1-1 Infrastructure Program
1-2 Infrastructure Investigation
1-3 Property Boundary Survey

2-1 List of Cargo Industry Contacts

3-1 Airport Facilites: Department of Aviation
3-2 Aircraft Rescue and Fire Fighting Facility
3-3 Security
3-4 GTP Entrance Road Improvements

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The Consultants also wish to thank all of the members of the Global Transpark Subcommittee, individually and collectively, for their oversight to the project.

THAILAND'S GLOBAL TRANSPARK SUBCOMMITTEE

Dr. Phisit Pakkasem
Chairman, Thailand's Global Transpark Subcommittee

Adm. Taweesuk Cheeppensuk RTN
Commander-in-Chief, Royal Thai Fleet and
Chairman, U Taphao Airport Executive Committee

Mr. Sansern Wongcha-um
Deputy Secretary-General, NESDB

Mr. Preecha Chavalittumrong
Deputy Director-General, Customs Department

Mr. Chakramon Phasukavanich
Deputy Secretary-General, Board of Investment

Mr. Bhisit Kuslasayanon
Executive Vice-President,
Thai Airways International Public Co. Ltd

Mrs. Sopar Rojnuckrin
Deputy Managing Director, Airports Authority of Thailand

Dr. Tongchat Hongladaromp
Chairman, Board of Directors of the Industrial Estates Authority of Thailand

Mr. Jothin Pamon-montri

Mr. Sivaporn Dardarananda
Chairman, United Standard Terminal Public Co. Ltd.

Mr. Sunthorn Arunanondchai
President and CEO, C.P. Land., Co., Ltd.

Mr. Dhongchai Lamsam
President, Loxley Public Co. Ltd.

Mr. Pairoj Piempongsant
President and CEO, Ban Chang Group Public Co. Ltd.

Mr. Paul F. Wedel
Executive Director, Kenan Institute Asia

Mr. Somchet Taeracoop
Deputy Secretary-General, NESDB
GTP Study Project Director

Dr. Pornchai Rujiprapa
Sen. Economic Advisor for Secretary-General, NESDB
GTP Study Deputy Project Director

Dr. Suwat Wanisubut
Policy and Plan Analyst 9, NESDB
GTP Study Project Manager

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GLOSSARY

AADT	Average Annual Daily Traffic
AAT	Airport Authority of Thailand
ACN	Aircraft Classification Number
ALP	Airport Layout Plan
ARFF	Aircraft Rescue and Fire Fighting Facility
ATA	Airport-to-Airport
ATCT	Air Traffic Control Tower
CAD	Commercial Aviation Department
CAT	Communication Authority of Thailand
CL	Low Plastic Clay
DME	Distance Measuring Equipment
DOA	Department of Aviation
DVOR	Doppler VHF Omnidirectional Range
EGAT	Electricity Generation Authority of Thailand
EPZ	Export Processing Zone
ESB	Eastern Sea Board
FAA	Federal Aviation Administration
GPS	Global Positioning System
GTP	Global Transpark
HSR	High Speed Rail
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
ILS	Instrument Landing System
iped	liters per capital per day
NDB	Nondirectional Radio Beacon
NESDB	National Economic and Serial Development Board
OBTM	Outer Bangkok Toll Motorway
OD	Origin-Destination
OESB	Office of the Eastern Seaboard
OPS	Operations
PAPI	Precision Approach Path Indicator
PAT	Port Authority of Thailand
PCN	Pavement Classification Number
RTN	Royal Thai Navy
RVR	Runway Visual Range
SC	Clayey Sand
SM	Medium Silty
SBIA	Second Bangkok International Airport
SRT	State Railroad of Thailand
TAT	Telephone Organization of Thailand
VFR	Visual Flight Rules
VOR	VHF Omnidirectional Range
WTP	Water Treatment Plant

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NOTE:

It should be noted that this report is based on prices that prevailed in July 1997. At that time there were large fluctuations in the value of the Baht. For Study purposes the following exchange rate was used:

1.00 US$=30 Baht

The area of ground measurement used in this report is the Rai - this is 40m by 40m and therefore:

1.00 Acre=2.52 Rai

IMPLEMENTATION PLAN

INTRODUCTION AND SUMMARY

Introduction

The *Implementation Plan* was undertaken by the National Economic and Social Development Board (NESDB) to provide a layout plan and opening day budget for the Global Transpark (GTP) at U Taphao Airport. The major reports developed in completion of this study are titled: *Implementation Plan*, *Business Plan*, *Initial Environmental Examination*, and *Executive Summary*. The *Implementation Plan* and *Initial Environmental Examination* fulfill the requirements of a grant to the Government of Thailand by the US Trade and Development Agency for "A Feasibility Study on U Tapao Airport Improvement / Global Transpark."

Summary of the Implementation Plan

When a limited number of investments in capital projects are made, the U Taphao Airport will be an excellent and efficient facility for the GTP. Following are the present and anticipated conditions at the U Taphao Airport:

- The airport presently supports five scheduled commercial passenger flights per week and a number of unscheduled charter flights. The passenger terminal is a long distance from the aircraft apron, so passengers must be carried by bus between the aircraft and the terminal. The terminal size is adequate for existing demand, but needs to be replaced if passenger activity increases appreciably. In December and January, there may be up to 30 charter aircraft parked as long as a week on the west military apron, occupying space that the Royal Thai Navy would like to use for military aircraft.

- The runway is 3,505-meters-long by 60-meters-wide, with 305-meter stopways on each end. The runway was designed to handle military aircraft such as the B-52. It presently handles L-1011 and DC-9 aircraft as well as the Navy's aircraft, including the A-7. The runway and supporting taxiway system presently show no signs of pavement failure. Fully loaded (maximum takeoff weight) aircraft that may operate on the present runway include: B747-200, B767, B757-200, B737, B727, and MD-11.

- There is equipment at the airport for a Category I precision instrument approach to support an all-weather, scheduled commercial operation, but minor repairs are needed before the approach can be certified.

- The Royal Thai Navy has designated some 3,500 rai (1,388 acres) east of the runway for GTP development, a future passenger terminal and transient parking apron. That area has direct access to the runway and to Sukhumwit Highway (Route 3) and high strength taxiways providing access to aircraft parking stalls. Thai Airways' 150 rai (59.5 acres) aircraft maintenance facility is located on the east side of the runway near the highway and the north runway end.

- Cargo projections indicate 80 departures per week in the near term. This equates to 20 aircraft operations per week day (an operation is one aircraft landing or taking off). The existing single runway has sufficient capacity to accommodate anticipated military,

scheduled passenger, and charter activity well into the future.

- Even with some land reserved for military u[illegible]ere is ample land area east of the runway to develop a cargo complex larger than tha[illegible] Don Muang; a large passenger terminal complex; a large apron for aircraft parkin[illegible] large industrial complex for industries desiring to be near the cargo complex; administrative, residential, and service facilities; and a second runway if needed in the future.

- Government might someday want to construct a second instrument runway that separates the military and commercial traffic to assure that both can operate without delaying the other. Two runways would also allow continued operations when one runway is being required. There is a 280-meter mountain located immediately north of the Sukhumwit Highway and north of the area where the GTP facilities would be located. A new runway would need to be parallel to and no more than 305 meters east of the existing runway to provide a precision instrument approach that avoids the mountain and is consistent with International Civil Aviation Organization (ICAO) and US Federal Aviation Administration (FAA) standards. If a new runway were located further to the east, portions or all of the mountain would need to be removed, the industrial area would be bisected by the runway, and the Air Traffic Control Tower would need to be relocated to a point between the runways.

Recommended Long Term Development Plan for the GTP

The long-term development plan identifies general areas for all activities anticipated to occur in the future. The Development Plan includes:

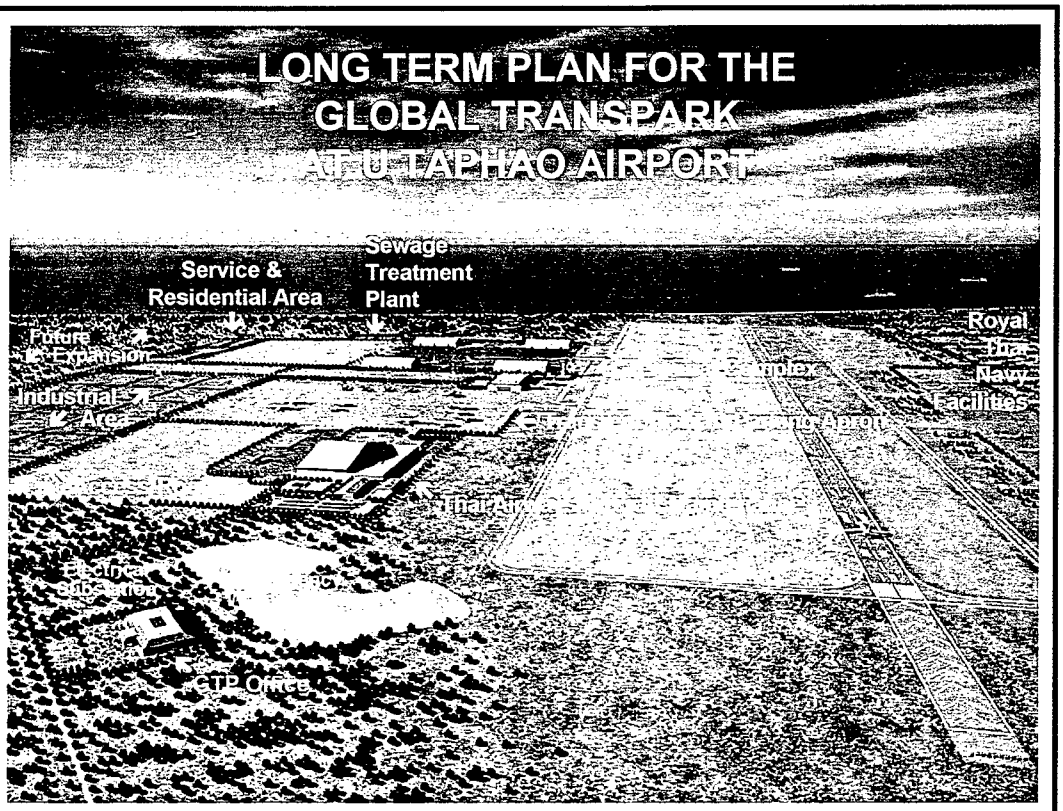
- A **cargo processing area** that can accommodate up to 200,000 square meters of cargo facilities and up to 20 parked widebodied aircraft. (For comparison, there presently are 105,000 square meters of international cargo facilities at Bangkok International Airport). The area is sufficiently large to accommodate specialized cargo facility designs such as "just in time" storage and distribution facilities; express cargo facilities; and the automated cargo distribution centers. The cargo area also includes ample area for vehicular parking. There is ample room away from the flight line to accommodate long-term storage facilities or bonded warehouses.

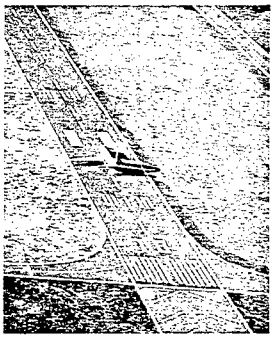
- An area on the flight line for an **Aircraft Rescue and Fire Fighting (ARFF) station** and a future replacement for the existing **Air Traffic Control Tower (ATCT)** if needed.

- A **passenger terminal development area** that can accommodate up to 30 gates. There is ample space allocated for immigration and customs processing and for vehicle parking.

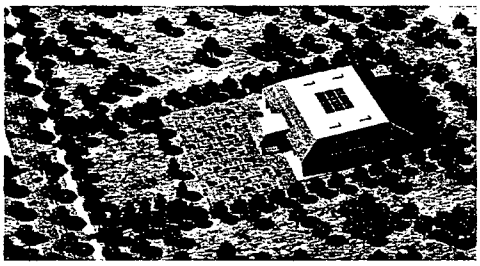
- A **transient aircraft parking apron** that can accommodate up to 16 widebody aircraft.

- An area reserved for **a second transport runway**, 3,500-meters-long by 60-meters-wide, with a precision instrument approach.



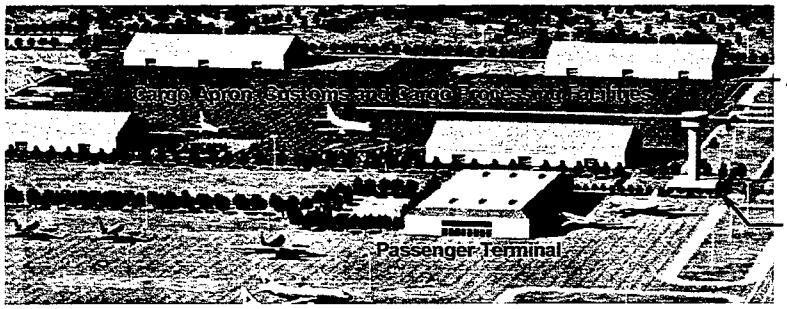


Precision Instrument Runway



GTP Administrative Office and
Communications Center

GTP Terminal Complex



- Up to 2,500 rai (992 acres) for development of **value-added processing facilities** and other industries needing to be close to the air cargo services.

- Areas for location **of services and utilities** such as a structural fire station, sewage and water treatment plants, power and communications distribution systems, and an airport maintenance facility.

- An area for ultimate development of **employee residential and recreational facilities.**

- A **GTP administration building** located close to the gate which may also serve as a welcoming center.

- An expandable **roadway system** serving all areas of the airport.

This plan should be considered as a flexible guideline for long term development. The exhibit on the previous page illustrates the long-term development plan.

Recommended Opening Day Requirements

The recommended minimum improvements required for the opening day of the GTP are:

- **Site Preparation** – Removal of remaining metal revetments site clearing and grading to provide drainage.

- **Cargo Handling Facilities** – For efficiency purposes, the initial cargo processing and warehousing facility will be 17,500 square meters (8,000 for cargo processing, 5,000 for a multipurpose warehouse and 4,500 for the exclusive use of Thai Customs). This is sufficient to process the 67,000 metric tonnes of cargo anticipated after ten years at the GTP. The three functions could be housed in separate buildings. If a specific cargo carrier has agreed to operate at the GTP when it is opened, portions of the warehousing and/or processing facilities will be customized to that operator's specifications. Otherwise the layout will resemble the general purpose facilities used by Thai Airways, TAGS, and Customs at Bangkok International Airport.

- **Airfield Improvements** – Airfield improvements will include a single lighted taxiway with standard guidance signs connecting the runway with the cargo area and the Thai Airways maintenance facilities. Improvements to the existing navigation aids and communications equipment are also included.

- **Administration & Communications Center** – A 5,000-square-meter GTP Administration Building will be constructed near the entrance to Sukhumwit Highway. The Building will also contain a communication center with equipment required for the fiber optic distribution system.

- **GTP Roads** – Access roads will be provided from Sukhumwit Highway to the Thai Airways maintenance facility, cargo area, and sewage treatment plant.

- **Utilities** – An **electrical substation and distribution system** will be installed by the electrical utility company. The cost will be recovered through monthly service charges. A **water distribution system** including an elevated tank and pumps will be installed. A **sewage treatment plant** with a capacity of 110,000 liters per day will be constructed near the southern boundary of the GTP. Emergency generators for the airport and GTP will be installed.

- **Security and Lighting** – A chain link fence will be installed to control access to the GTP flight line and to bonded warehouses. High light masts will be used to light the roadway, the cargo apron, the Administration Building, and the sewage treatment plant.

The following table summarizes estimated opening day capital improvement costs:

Opening Day Capital Improvements

Construction Item	Construction Cost (Baht **)
Site Preparation	156,688,000
Roadway	149,500,000
Administration Facilities	49,500,000
Water Supply *	23,408,000
Sanitary Sewer *	9,774,000
Air Cargo Warehouse and Customs Facility *	270,502,000
Electrical Service *	3,900,000
Security and Lighting	27,300,000
Airfield Improvements	204,141,000
Emergency Generators	19,744,000
Communications *	4,225,000
Opening Day Construction Costs	**918,681,000**
Design and Administration Fees	45,934,000
Construction Management Fees	73,494,000
Total Capital Improvement Costs	**1,038,109,000**

* All or a portion of these costs can be recovered through user fees. These items, totaling 311,809,000 baht, or about 34 percent of Opening Day Construction Costs, could be privatized.

** Cost estimates as of 1 September 1997.

CHAPTER 1

PROJECT DESCRIPTION

1.0 Overview
1.1 Inventory of Existing Conditions
1.2 History of Aviation Activity
1.3 Transportation Facilities
1.4 Utilities
1.5 Soil Conditions

CHAPTER 1

OVERVIEW OF EXISTING CONDITIONS AND SUPPORTING INFRASTRUCTURE

1.0 Introduction

The proposed GTP site is at U Taphao Airport on the Eastern Seaboard of Thailand. It is located 195 kilometers southeast of Bangkok, and 35 kilometers west of Rayong. The airport at U Taphao is well suited to accommodate the needs of the GTP. The airport's existing facilities and availability of unused land provide the GTP with a unique opportunity. Large cargo carriers can use the existing airport immediently providing the unitial services needed of a global transpark. The availability of transportation and utility resorces will aid in promoting industrial usage of the GTP and the surounding area. This, in combination with the rapidly increasing need for goods and services from Thailand and Asia, will make the GTP a suscess.

1.1 Inventory of Existing Conditions

The U Taphao Airport contains a total area of 16,700 rai. A majority of this area is used by the Royal Thai Navy for military use and is concentrated west of the existing 3,500-m runway. The east side of the airport is currently unused and is an ideal site for commercial development. Exhibit 1.1-1 shows a layout of existing facilities at U Taphao Airport. A report entitled U Taphao Air Base Inventory by Louis Berger International, 1991 provides an excellent description and current conditions of all facilities on the base.

The Royal Thai navy has designated some 3,500 rai east of the runway for GTP development, transient aircraft parking and a future passenger terminal. Currently on the site is a nearly completed maintenance facility for use by Thai Airways. This facility is located on 150 rai along the north end of the runway.

The east side of the airport was used for ammunition and aircraft storage when the base was originally designed. The remaining facilities consist of a network of service roads and taxiways. An updated inventory of these facilities was conducted for this report. The results of this inventory survey are in Appendix 1-2.

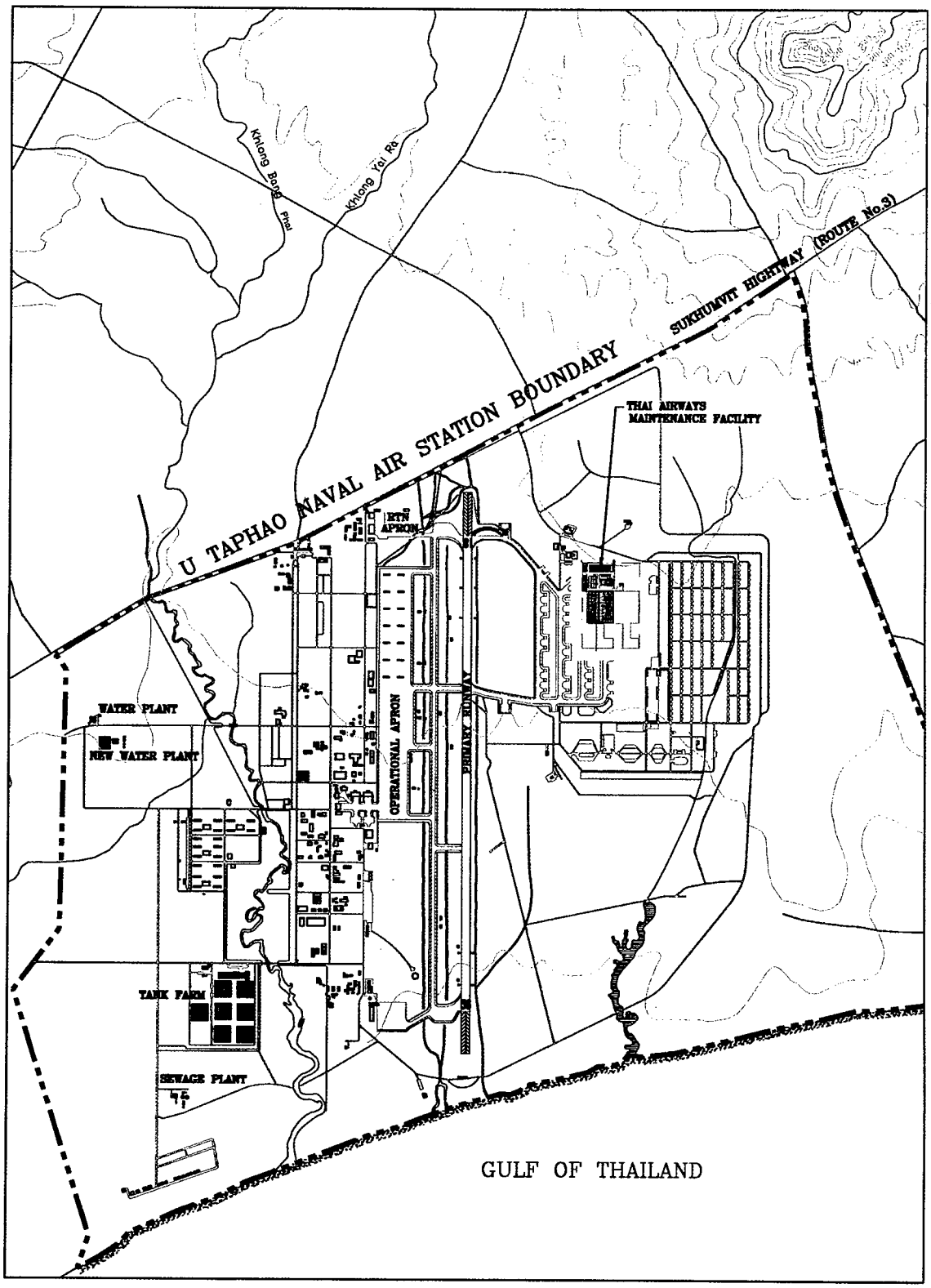
A property boundry survey was conducted along the eastern property line of the airport. A catalog of property owners and lot sizes can be found in Appendix 1-3.

1.2 History of Aviation Activity

Currently the aviation activity at U Taphao is minimal. The existing capacity of the runway can easily accommodate the current and projected military and civilian flight operations.

Military operations number 55 daily on an average day during the peak month. This same average day will yield 5 commercial operations consisting of 4 charter and one scheduled flight.

Exhibit 1.1-1
Existing Facilities at U Taphao Airport



This relates to approximately 22,000 annual operations. The capacity of the airfield is approximately 210,000 operations per year. It is clear that the existing airfield could easily accommodate aviation activity associated with the GTP. In 1996, there were approximately 153,000 passenger operations and 5,400 cargo operations for a total of approximately 159,000 operations at Bangkok International Airport.

1.3 Transportation Facilities

1.3.1 Roadway Network

The intermodal nature of the GTP relies on the existence of a good roadway network. This network exists on the Eastern Seaboard, as shown in Exhibit 1.3-1. Detailed descriptions of the roadways' existing serviceability and future scheduled improvements are given in Appendix 1-1.

There are three main access corridors in the Eastern Seaboard that will serve the major users of the GTP. They are as follows:

- The GTP and industries in the Bangkok/Northern Bangkok area;

  This corridor will be served by Routes 1 & 2 north of Bangkok, the Outer Bangkok Toll Motorway (OBTM) and the proposed Route 36 to the GTP.

  The GTP and industries in the central Eastern Seaboard area as far north as Route 304;

  This corridor will be served by Routes 331 and 304.

- The GTP and industries in the southern coastal region of the Eastern Seaboard.

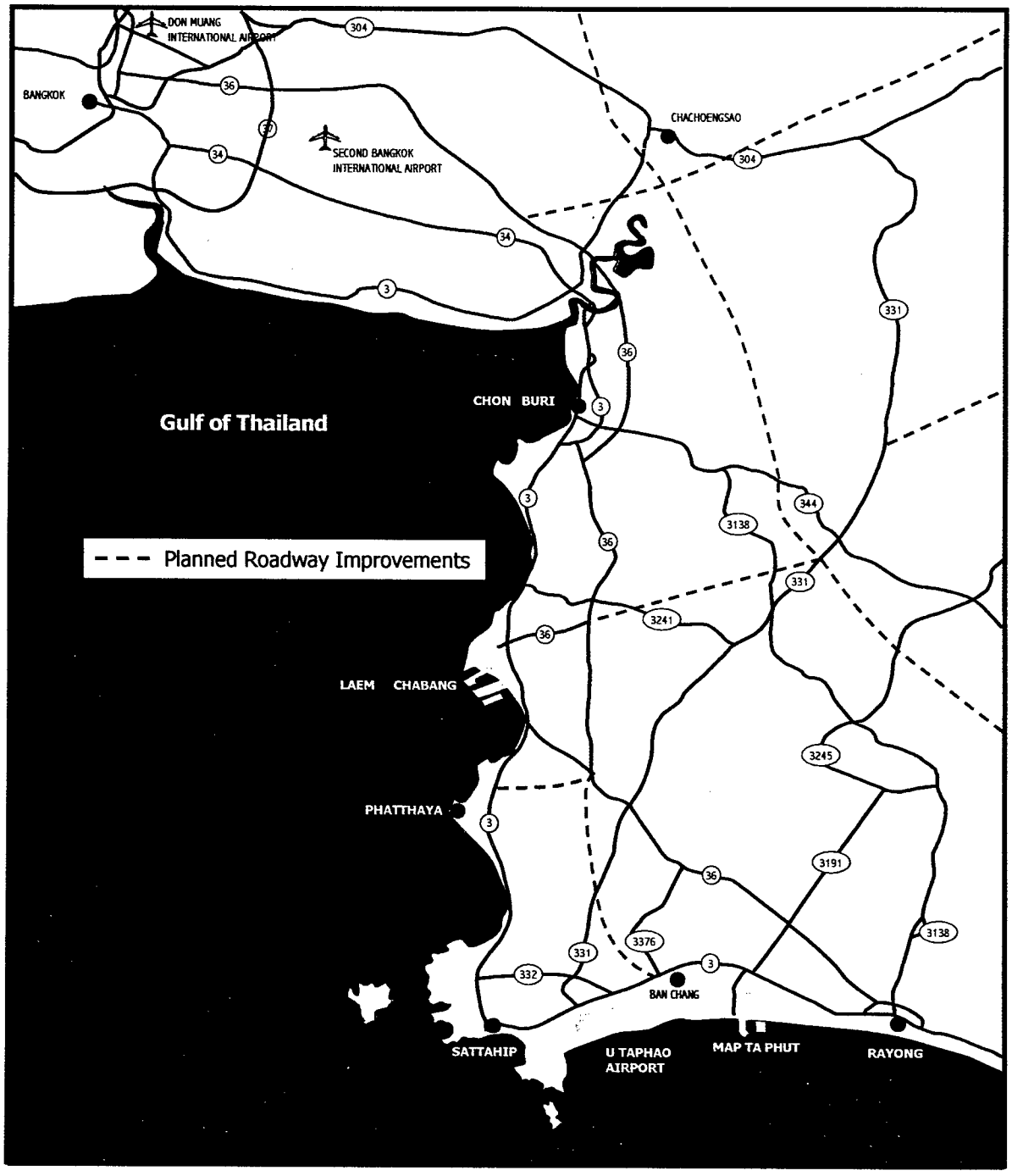
  This corridor will be served by Route 3 (Sukhumvit Road)..

The planned improvements to these routes, with the recommendations of this study, include:

- Routes 1, 2 and 36 are all scheduled to be upgraded to toll motorways. Route 36 and the OBTM will be new motorways. Construction is progressing on both of these routes. Route 36 is currently nearing the completion of the Bangkok-Chon Buri section and funding is available for the Chon Buri-Phatthaya section. The design is completed for the Phatthaya-Ban Chang section, which terminates at an intersection with Route 3 less than 2 kilometers from the GTP. This will provide excellent access to the GTP. The existing planned improvements to these roadways will adequately support the development of the GTP. No further improvements are recommended in this study.

- Route 331 is currently being widened to a dual-lane divided highway. Future plans have indicated further widening to 6 lanes. This is determined to be adequate for the development of the GTP.

Exhibit 1.3-1
Eastern Seaboard Roadway Network



- Route 3 has been upgraded to a dual-lane divided roadway from Chon Buri to Chanthaburi and plans are to complete this upgrading to Trat. The Master Plan shows an entrance road to the GTP from Route 3. From this point, GTP users can access any of the three corridors described above. The GTP will have direct access to all three of these corridors and no other new roads or additional improvements are foreseen. Further detailed analysis can be found in Appendix 1-1.

1.3.2 Railway Network

An existing single-track rail line currently extends from Rayong to Sattahip, passing just north of the GTP site. The typical GTP user will be air freight-intensive and, consequently, will not place rail access as a major factor when considering location. However, GTC proposes a long-term plan for modal integration at the GTP which will include a rail spur that will tie to the existing Bangkok/Map Ta Phut main line from the GTP. The construction of the spur is not included in the immediate development period and should only be considered when adequate multi-modal traffic develops at the GTP. Further detailed analysis of the railway network can be found in Appendix 1-1.

1.3.3 Port Facilities

As is the case with rail access, the typical GTP user will be air freight-dependent, so port access will not have a significant impact on the development of the GTP and therefore is not a major priority. However, the GTP will promote modal integration, and long-term port capacity in the ESB will become important. The ESB has two major ports that have adequate capacity to serve the GTP-induced port demand: one at Sattahip and one at Laem Chabang. The port at Map Ta Phut could also accommodate this demand, although it is primarily a petrochemical port. Further detailed analysis of port facilities can be found in Appendix 1-1.

1.4 Utilities

1.4.1 Water Resources

Three existing water reservoirs serve the area between Sattahip and Rayong where the GTP will be located. Their capacity is as follows:

Existing Water Reservoir	Capacity
Nong Pla Lai Reservoir	150 million cubic meters
Dok Rai Reservoir	75 million cubic meters
Khlong Bangphai Reservoir	12 million cubic meters

This water capacity can be obtained from the raw water distribution line that parallels Route 3. This line is a 600-mm raw water transmission line that has a flow of 500 cubic meters per hour and a pressure head of 36.90 meters. It is managed by the East Water Co. No recommended improvements to raw water infrastructure are recommended at this time. The existing facilities can adequately serve the GTP raw water needs. Further detailed information on water resources can be found in Appendix 1-1.

1.4.2 Electrical Power Supply

The Eastern Seaboard receives its electrical power supply by an extensive system of power generation plants and distribution sub-stations operated by two authorities. The Electrical Generation Authority of Thailand (EGAT) and Provincial Electric Authority (PEA) each operate separate electrical sub-stations in the vicinity of U Taphao Airport. Their combined present capacity is roughly 5,800 MW. Connection with these existing facilities would provide sufficient capacity for the expected demand of the GTP. Further detailed information on electrical power supply can be found in Appendix 1-1.

1.4.3 Telecommunications

Two telecommunications authorities currently provide service to the Eastern Seaboard the Telephone Organization of Thailand (TOT) and Communication Authority of Thailand (CAT). TOT has plans to build a telephone junction in the requested area of U Taphao Airport on about 2 rai in 1997. This junction will be linked to Map Ta Phut Teleport by optical fiber cable on existing TOT and PEA's poles. This junction will provide for 1,536 telephone numbers with the other communication lines. This plan is in TOT's budget and expected to be completed in 1998. The telecommunications system in the area has the capacity to accommodate the GTP for some years into the future. No improvements are recommended at this time. Further detailed information on telecommunications can be found in Appendix 1-1.

1.4.4 Natural Gas

Natural gas can be conveniently supplied to the GTP through the major gas facilities and the gas transmission lines serving the Map Ta Phut operations. The need for providing the gas service infrastructure to the site is not apparent at this time since heavy, energy intensive industry is not anticipated. Provision of gas service to the site would require the installation of approximately 11 kilometers of transmission line from Map Ta Phut. GTC recommends that investment in this facility in the initial development stage is not warranted but should be considered on an industry specific, as-needed basis.

1.5 Soil Conditions

The GTP site is located in the area of existing U Taphao Airport in Amphur Sattahip, Chon Buri, in the Eastern Seaboard Region of Thailand. The area is geologically classified as the Eastern Upland. The general soil condition is residual deposit of loose to medium silty/clayey sand (SM/SC) underlained by dense to very dense clayey sand (SC) and low plastic clay (CL), which are founded on the very dense decomposed rock at the depth more than 15 to 20 meters. The loose to medium silty/clayey sand with natural water content of about 10 percent has thickness in the range of six to eight meters. The thickness of intermediate layer of dense to very dense clayey sand (SC) and low plastic clay (CL) with natural moisture content of 10 to 20 percent are in the range of nine to 14 meters. The ground water levels as recorded in March are in the range from 1.60 to 2.80 meters below the existing ground. In term of foundation design, the shallow foundation of load intensity of not more than 10 to 15 t/m^2, pile foundation 8 to 10 meters long should be used to transfer the foundation load to the dense/very dense clayey sand layer to achieve less settlement.

CHAPTER 2

GTP LAYOUT AND LONG TERM PLAN

2.0	Introduction
2.1	Summary of Activity Forecasts
2.2	Feasibility and Master Plan, Rayong - Louis Berger International, May 1991
2.3	GTC 1997 Layout

CHAPTER 2

GTP LAYOUT AND LONG TERM PLAN

2.0 Introduction

Activity forecasts are the primary building blocks used in this Master Plan. They aid in quantifying the level of activity that can be expected over a planning period. This in turn, allows us to determine the facility requirements and the approximate time when they are needed. The following section contains a summary of activity forecasts pertinent to this Master Plan.

Based on the facility requirements needed to support the forecast activity, a GTP layout was conceptually designed that encompasses the needs of the GTP, the Royal Thai Navy and the airfield users.

2.1 Summary of Activity Forecasts

Typically, airport forecasts emphasize the results of trend analysis (the past) and consider what is likely to happen in the future that might alter the trend. For the Global Transpark, only future events will shape levels of activity. Hence, a realistic set of development stages is the best way to anticipate air cargo volume and operations. A description of this detailed forecasting process, as well as data involved in economic analysis, can be be found in VOL I: *Business Plan*, section 5.2.

The forecasts developed for the GTP acknowledge that several sources of air cargo activity could stimulate demand of air cargo lift at U Taphao. They include:

- Diversion of existing air cargo activity from Don Muang to U Taphao airports;
- Use of the GTP as an express document/package handling center by one or more integrated carrier;
- Use of the GTP as a transit point for air cargo destined for or shipped from other Indochina airports in Laos, Cambodia, Vietnam and Burma;
- Development of U Taphao as a regional hub for express and conventional air cargo; and
- Support of GTP and Eastern Seaboard industrial activity that will require extensive use of air freight, including the handling of substantial time sensitive manufacturing inputs as well as the distribution of product to world markets.

2.1.1 Timing

The stages of development portray a likely buildout of the Global Transpark over a ten year period, beginning immediately. Many factors could intervene to hasten, delay or modify the actual development of the facility. Much will depend on four critical events:

- Satisfactory reform of customs procedures;
- Relaxation of open skies provisions to accommodate increased frequencies at U Taphao Airport and the ability for carriers to self handle their own cargo;
- Use of U Taphao Airport by an integrated carrier to serve local and regional demand; and
- Development of Express Distribution Centers and attraction of new industries committed to advanced logistics practice.

Any or all of these sources of air cargo demand could ultimately be present at U Taphao; however, use of the facility by integrated carriers for express operations is an important prerequisite to the full development of the GTP.

2.1.2 Components of Demand Described

Air cargo activity at the GTP can be described in terms of who is carrying the cargo and what types of cargo is carried. The matter of who and what are important because an integrated carrier operation is fundamentally different from conventional all cargo and passenger operations.

2.1.2.a Who are the carriers?

For each stage of development, levels of operations were estimated for the following types of carriers:

Integrated Carriers. The integrated carriers provide full logistics support from pick up to delivery. Their products are generally express or time-definite and are offered at premium prices. The largest integrated carriers are: Federal Express, UPS, DHL, and TNT. Federal Express and UPS tend to use their own aircraft. For this reason, they are particularly attractive candidates for the GTP, since they eventually, as the market grows, will become less dependent upon the use of commercial lift at Don Muang Airport.

Dedicated All Cargo Carriers. These conventional all cargo carriers generally provide airport-to-airport (ATA) services on a point-to-point basis. Many offer round-the-world itineraries, stopping at a particular airport one or several times a week. There are also charter and niche market operators who will provide seasonal all cargo services in specific markets. Perishable foods and flowers may be carried to market this way.

Major Air Carrier Freighters. In Asia, several of the major carriers operate a fleet of freighters, usually 747 aircraft. These aircraft are used in combination with passenger aircraft to provide timely cargo services. Most air carriers offer ATA services, however, some carriers, such as JAL, KAL, and Lufthansa are offering time definite services as well as some pick up and delivery. The development of the GTP may offer an opportunity for carriers to partner. For example, a major air carrier freighter could pick up European destined cargo at U Taphao, and carry it on behalf of an integrated carrier.

Major Air Carrier Passenger Aircraft. A number of long haul passenger services stop in Bangkok. However, they carry mostly in transit passengers on their way to beyond points. U Taphao could serve as an in transit point, where large 747 type aircraft could stop and take on cargo destined for beyond markets.

2.1.2.b Types of cargo carried

For purposes of estimating demand for warehouse space, ground handling services, and certain GTP revenues, air cargo volumes were further subdivided as follows:

Express Cargo, including all local time definite air cargo either originating or destined for Thailand or connecting at U Taphao for other countries.

Transit On-Board Cargo, which is air cargo that is on the aircraft and destined for an airport other than U Taphao.

Airport-to-Airport (ATA), which includes all cargo brought to the airport for shipment and picked up at the airport, usually by a freight forwarder or an agent.

Connecting (Warehouse), which is air cargo brought into U Taphao, unloaded off an aircraft and reloaded onto another airplane for delivery elsewhere.

2.1.3 Estimates of Air Cargo Activity

Table 1, 2 and 3 of Exhibit 2.1-1 represent a detailed planning effort that considers a likely scenario of aviation activity possible at the GTP given requisites and conditions outlined within VOL I: *Business Plan.* Extensive interviews were conducted with major cargo handlers within Thailand and southeast Asia as well as the United States. A list of these contacts is in Appendix 2-1.

Exhibit 2.1-2 shows a summary of weekly operations by carrieer in the associated stage of development for years one through seven.

Exhibit 2.1-1
Cargo Forecasting Method
Table 1

Year	Operator	Freq. (per week)	AC Type	Max. Payload (metric Tonne)	Load Factor (%)	Transit (on board) (%)	Connecting (warehouse) (%)	ATA (%)	O-D Express (%)
1	Carrier 1	5	MD-11	50.82	50	75		5	20
2	Carrier 1	5	MD-11	50.82	55	75		5	20
2	All Cargo	2	B747-200	89.29	50	75		25	
3	Carrier 1	5	B727	20.69	60			20	80
3	Carrier 2	5	B767	38.11	60	75		8.3	16.6
3	All Cargo	3	B727	20.69	50			100	
3	All Cargo	3	B747-200	89.29	50	75		25	
4	Carrier 1	10	B727	20.69	40		40	12	48
4	Carrier 1	15	B727	20.69	25			20	80
4	Carrier 2	5	B767	38.11	50	75		8.3	16.6
4	All Cargo	3	B727	20.69	50			100	
4	All Cargo	3	B747-200	89.29	50	75		25	
4	Maj. Carrier	2	B747-200	89.29	70		40	30	30
5	Carrier 1	10	B727	20.69	60		40	12	48
5	Carrier 1	15	B727	20.69	30			20	80
5	Carrier 2	10	B757	21.32	50			33	66
5	All Cargo	3	B727	20.69	50			100	
5	All Cargo	3	B747-200	89.29	50	75		25	
5	Maj. Carrier	2	B747-200	89.29	70		40	30	30
6	Carrier 1	12	A310	31.76	50		40	12	48
6	Carrier 1	30	B727	20.69	25			20	80
6	Carrier 2	10	B757	21.32	50			33	66
6	All Cargo	3	B727	20.69	50			100	
6	All Cargo	4	B747-200	89.29	50	75		25	
6	Maj. Carrier	3	B747-200	89.29	70		40	30	30
6	Pass.	3	B747-200	89.29	15	60		20	20
7	Carrier 1	12	A310	31.76	60		40	12	48
7	Carrier 1	40	B727	20.69	25			20	80
7	Carrier 2	10	B757	21.32	50			33	66
7	All Cargo	3	B727	20.69	50			100	
7	All Cargo	4	B747-200	89.29	50	75		25	
7	Maj. Carrier	5	B747-200	89.29	70		40	30	30
7	Pass.	5	B747-200	89.29	15	60		20	20

Exhibit 2.1-1 (continued)
Cargo Forecasting Method
Table 2

Year	Operator	Freq. (per week)	AC Type	Max. payload (metric Tonne)	Load Factor (%)	Transit (on board) (Met. tonne)	Connecting (warehouse) (Met. tonne)	O-D ATA (Met. tonne)	O-D Express (Met. tonne)
1	Carrier 1	5	MD-11	50.82	50	95.28		6.35	25.41
2	Carrier 1	5	MD-11	50.82	55	104.81		6.99	27.95
2	All Cargo	2	B747-200	89.29	50	66.97		22.32	
3	Carrier 1	5	B727	20.69	60			12.41	49.66
3	Carrier 2	5	B767	38.11	60	85.75		9.49	18.98
3	All Cargo	3	B727	20.69	50			31.03	
3	All Cargo	3	B747-200	89.29	50	100.45		33.48	
4	Carrier 1	10	B727	20.69	40		33.10	9.93	39.72
4	Carrier 1	15	B727	20.69	25			15.52	62.07
4	Carrier 2	5	B767	38.11	50	71.46		7.91	15.82
4	All Cargo	3	B727	20.69	50			31.03	
4	All Cargo	3	B747-200	89.29	50	100.45		33.48	
4	Maj. Carrier	2	B747-200	89.29	70		50.00	37.50	37.50
5	Carrier 1	10	B727	20.69	60		49.66	14.90	59.59
5	Carrier 1	15	B727	20.69	30			18.62	74.48
5	Carrier 2	10	B757	21.32	50			35.19	70.37
5	All Cargo	3	B727	20.69	50			31.03	
5	All Cargo	3	B747-200	89.29	50	100.45		33.48	
5	Maj. Carrier	2	B747-200	89.29	70		50.00	37.50	37.50
6	Carrier 1	12	A310	31.76	50		76.23	22.87	91.47
6	Carrier 1	30	B727	20.69	25			31.03	124.14
6	Carrier 2	10	B757	21.32	50			35.19	70.37
6	All Cargo	3	B727	20.69	50			31.03	
6	All Cargo	4	B747-200	89.29	50	133.94		44.65	
6	Maj. Carrier	3	B747-200	89.29	70		75.01	56.25	56.25
6	Pass.	3	B747-200	89.29	15	24.11		8.04	8.04
7	Carrier 1	12	A310	31.76	60		91.47	27.44	109.76
7	Carrier 1	40	B727	20.69	25			41.38	165.52
7	Carrier 2	10	B757	21.32	50			35.19	70.37
7	All Cargo	3	B727	20.69	50			31.03	
7	All Cargo	4	B747-200	89.29	50	133.94		44.65	
7	Maj. Carrier	5	B747-200	89.29	70		125.01	93.76	93.76
7	Pass.	5	B747-200	89.29	15	40.18		13.39	13.39

Exhibit 2.1-1 (continued)
Cargo Forecasting Method
Table 3

Year	Operator	Freq. (per week)	Aircraft Type	Max. Payload (metric Tonne)	Load Factor (%)	TOTAL (per week) (Met. tonne)	TOT. w/o Transit (per week) (Met. tonne)	TOTAL (per year) (Met. tonne)	TOT. w/o Transit (per year) (Met. tonne)
1	Carrier 1	5	MD-	50.82	50	127.04	31.76	6,606	1,652
2	Carrier 1	5	MD-	50.82	55	139.75	34.94	7,267	1,817
2	All Cargo	2	B747-200	89.29	50	89.29	22.32	4,643	1,161
3	Carrier 1	5	B727	20.69	60	62.07	62.07	3,228	3,228
3	Carrier 2	5	B767	38.11	60	114.22	28.47	5,940	1,480
3	All Cargo	3	B727	20.69	50	31.03	31.03	1,614	1,614
3	All Cargo	3	B747-200	89.29	50	133.94	33.48	6,965	1,741
4	Carrier 1	10	B727	20.69	40	82.76	82.76	4,303	4,303
4	Carrier 1	15	B727	20.69	25	77.59	77.59	4,034	4,034
4	Carrier 2	5	B767	38.11	50	95.19	23.73	4,950	1,234
4	All Cargo	3	B727	20.69	50	31.03	31.03	1,614	1,614
4	All Cargo	3	B747-200	89.29	50	133.94	33.48	6,965	1,741
4	Maj. Carrier	2	B747-200	89.29	70	125.01	125.01	6,500	6,500
5	Carrier 1	10	B727	20.69	60	124.14	124.14	6,455	6,455
5	Carrier 1	15	B727	20.69	30	93.10	93.10	4,841	4,841
5	Carrier 2	10	B757	21.32	50	105.56	105.56	5,489	5,489
5	All Cargo	3	B727	20.69	50	31.03	31.03	1,614	1,614
5	All Cargo	3	B747-200	89.29	50	133.94	33.48	6,965	1,741
5	Maj. Carrier	2	B747-200	89.29	70	125.01	125.01	6,500	6,500
6	Carrier 1	12	A310	31.76	50	190.56	190.56	9,909	9,909
6	Carrier 1	30	B727	20.69	25	155.17	155.17	8,069	8,069
6	Carrier 2	10	B757	21.32	50	105.56	105.56	5,489	5,489
6	All Cargo	3	B727	20.69	50	31.03	31.03	1,614	1,614
6	All Cargo	4	B747-200	89.29	50	178.58	44.65	9,286	2,322
6	Maj. Carrier	3	B747-200	89.29	70	187.51	187.51	9,751	9,751
6	Pass.	3	B747-200	89.29	15	40.18	16.07	2,089	836
7	Carrier 1	12	A310	31.76	60	228.68	228.68	11,891	11,891
7	Carrier 1	40	B727	20.69	25	206.90	206.90	10,759	10,759
7	Carrier 2	10	B757	21.32	50	105.56	105.56	5,489	5,489
7	All Cargo	3	B727	20.69	50	31.03	31.03	1,614	1,614
7	All Cargo	4	B747-200	89.29	50	178.58	44.65	9,286	2,322
7	Maj. Carrier	5	B747-200	89.29	70	312.52	312.52	16,251	16,251
7	Pass.	5	B747-200	89.29	15	66.97	26.79	3,482	1,393

Exhibit 2.1-2
Estimated Weekly Operations, Years 1-7

Year (s)	Stages of Development	Integrated Carrier			Major Carrier Freighter	Passenger Long Haul	Total Weekly Departures
		Carrier # 1	*Carrier #2*	*All Cargo*			
1	Diversion from	5	0	0	0	0	5
2	Don Muang	5	0	2	0	0	7
3	Direct Express Service	5	5	6	0	0	16
4	Initial Global	25	5	6	2	0	38
5	Transpark	25	10	6	2	0	43
6	Full Global	42	10	7	3	3	65
7	Transpark	52	10	7	5	5	79

Source: Global Transpark Consultants

Exhibit 2.1-3
Boeing Intra-Asia Air Cargo Forecasts

Growth Scenario	Average Annual Growth 1995-2115
High	10.2%
Medium	9.0%
Low	7.4%

Source: Boeing Commercial Airplane Group. World Air Cargo Forecasts, 1996/1997.

The Boeing forecasts shown in Exhibit 2.1-3 were used to extend the stages of development beyond the initial period. The high growth scenario (10.2 percent) was assumed through year 10 of GTP's growth. This is the period when we would expect a continued buildup of logistics-centered industries on or near the GTP. The medium rate of 9.0 percent growth was assumed for the period 10-15 years, and a rate of 7.4 percent was used for the remaining forecast period, years 16-20. It should be noted that while 7.4 percent is considered the low growth scenario, this is a fairly aggressive growth rate. Exhibits 2.1-4 and 2.1-5 show the estimated annual volumes of air cargo anticipated through the 20 year planning period.

Exhibit 2.1-4
Estimated Annual Air Cargo by Type, Years 1-20
(metric tonnes)

Year	Transit (On Board)	Connecting (Warehouse)	ATA	Express	Totals	Totals w/o Transit
1	4,955		330	1,321	6,606	1,652
2	8,932		1,524	1,453	12,140	3,165
3	9,683		4,494	3,569	17,851	8,164
4	8,940	4,322	7,040	8,066	28,392	19,457
5	5,224	5,182	8,878	12,581	31,867	26,665
6	8,218	7,864	11,911	18,214	46,282	38,034
7	9,054	11,257	14,916	23,546	58,813	49,754
8	9,978	12,405	16,437	25,947	64,783	54,800
9	10,995	13,670	18,114	28,594	71,389	60,389
10	12,117	15,065	19,961	31,511	78,670	66,547
11	13,208	16,421	21,758	34,347	85,747	72,534
12	14,396	17,899	23,716	37,438	93,462	79,062
13	15,692	19,509	25,850	40,807	101,873	86,176
14	17,104	21,265	28,177	44,480	111,040	93,931
15	18,644	23,179	30,713	48,483	121,032	102,384
16	20,023	24,894	32,985	52,071	129,985	109,958
17	21,505	26,737	35,426	55,924	139,603	118,095
18	23,096	28,715	38,048	60,063	149,933	126,833
19	24,805	30,840	40,863	64,507	161,027	136,218
20	26,641	33,122	43,887	69,281	172,943	146,298

Source: Global Transpark Consultants

Exhibit 2.1-5
Weekly and Annual Air Cargo Operations, Years 1-20

Year	Weekly Departures	Annual Departures
1	5	260
2	7	364
3	16	832
4	38	1,976
5	43	2,236
6	65	3,380
7	79	4,108
8	88	4,562
9	97	5,027
10	107	5,540
11	116	6,038
12	127	6,582
13	138	7,174
14	150	7,820
15	164	8,523
16	176	9,154
17	189	9,831
18	203	10,559
19	218	11,340
20	234	12,179

Source: Global Transpark Consultants

The estimation procedures suggest that in 20 years the GTP could be handling 173,000 metric tonnes of cargo per year or 33 operations per day. Of this, the mix of cargo would be approximately 41 percent express, 25 percent ATA, 19 percent connecting and 15 percent transit.

2.1.4 Sensitivity to Time

The stages of development postulated for the GTP anticipate a rapid buildup of the GTP within the first ten years. This aggressive growth posture was taken for several reasons. First, the GTP will benefit from the synergy of a regional hub and industrial complex. The integrated carriers are now positioning themselves throughout Asia and making important decisions that will influence the flow of cargo across a network of regional hubs. A decision to locate at U Taphao guarantees a larger service network to support the GTP. Delay in starting the GTP could result in selection of another site as a gateway to Southeast Asia.

If for some reason, establishment of a regional hub at U Taphao materializes later than year 6, the growth curve for cargo will flatten out. For example, if the GTP does not get started until year 9, the delay will diminish cargo by 20 to 25 percent over the planning period.

2.1.5 Conclusions

The estimates of development are informative and help to put the air cargo element of the GTP in perspective. The following summarizes the results of the analysis:

- The Global Transpark, as envisioned, will require a relatively small number of air cargo operations per day. Estimates of operations are well within the capability of the existing runway.

- Attracting an integrated carrier to the GTP is very important. Use of the U Taphao Airport by such a carrier as a regional hub will greatly increase the service options and prospects for intra-Asia industrial activity and global trade.

- Expansion of air cargo activity, as estimated in the development stages, will be guided by:

  - The timing and substance of customs and bilateral reform;
  - The rate at which demand for express and time definite air cargo services develops in Thailand and Southeast Asia;
  - Successful efforts to attract industries to the Eastern Seaboard that require logistics support;
  - Economic development in China and decisions by the carriers on how best to serve this market; and
  - Whether neighboring countries offer carriers a competitive and attractive option for location of a regional hub.

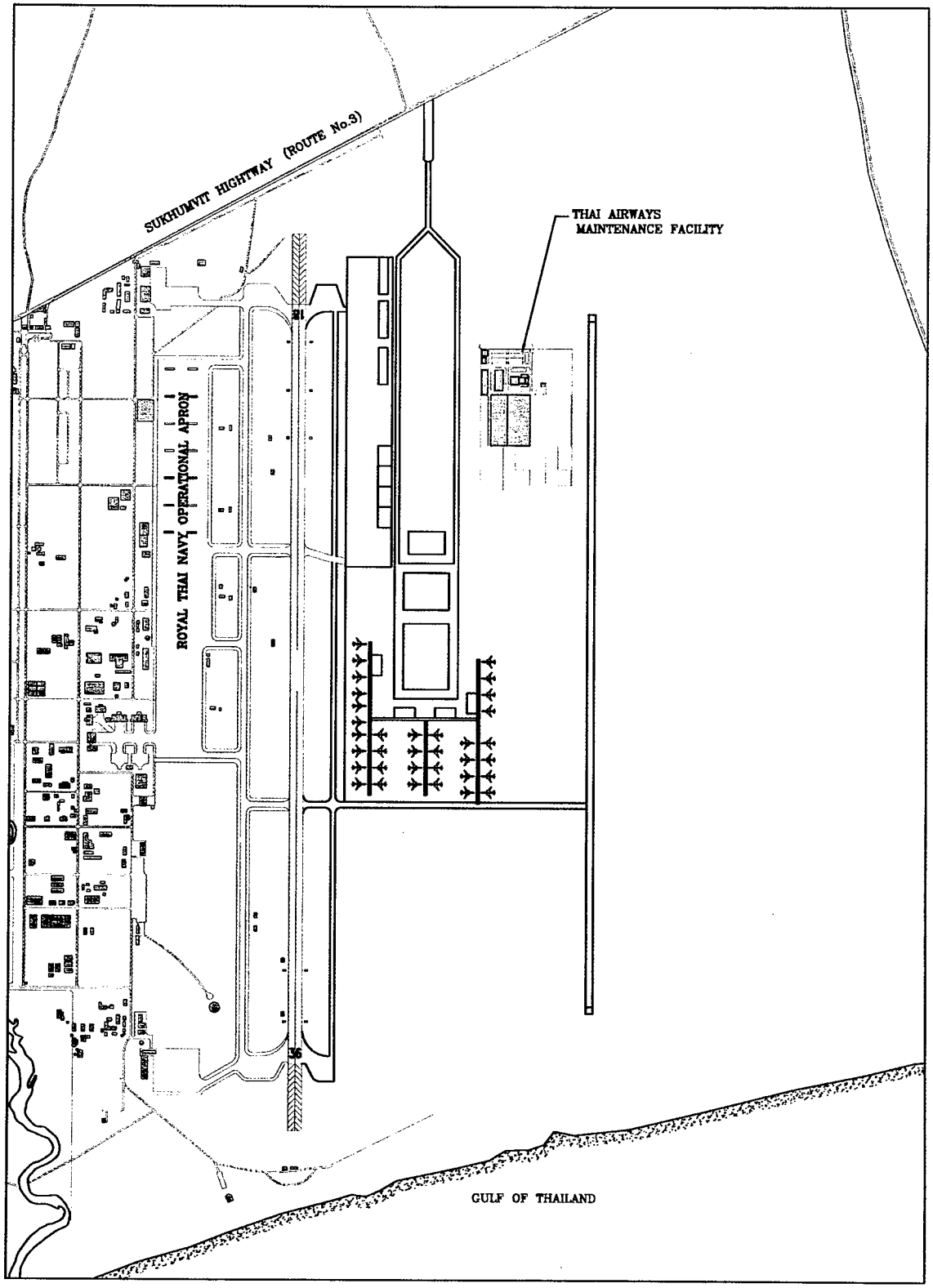
- Given the high degree of uncertainty, the GTP management team will need an active planning and response team as well as an aggressive carrier and industry recruitment program.

2.2 Feasibility and Master Plan, Rayong - Louis Berger International, May 1991

Exhibit 2.2-1 is a proposed layout of the airfield and industrial facilities as developed in *Feasibility and Master Plan, Rayong - U Taphao International Airport.*[1] This 1991 Layout was developed to serve as the second Bangkok International Airport and as a global transpark. It depicts the development of a second air carrier runway.

[1] Louis Berger International, Inc. May 1991. Feasibility and Master Plan, Rayong-U Taphao International Airport.

Exhibit 2.2-1
Louis Berger 1991 Layout



2.2.1 Capacity versus Demand

The capacity of the 1991 Layout by Louis Berger was calculated using methodology published in the Airport Capacity and Delay Advisory Circular (AC150/15060-5) published by the U.S. Federal Aviation Administration. Assuming a fleet mix consistent with most international airports, that capcity would be:

Hourly Capacity (operations per hour)	
Visual Flight Rules	111
Instrument Flight Rules	105
Annual Service Volume (operations per year)	315,000

A facility of this size would be suitably designed for the demand of a second Bangkok airport, allowing simultaneous IFR operations. This would exceed the present capacity at Bangkok International Airport (Don Muang). The air service demand for a global transpark would be considerably less then the design capacity shown above. The year 20 air service demand for the GTP is forecasted to approximately 12,000 operations per year with approximately 10 aircraft operations in the peak hour.

2.2.2 Examination of Louis Berger 1991 Layout

Upon examination of the 1991 Layout, the GTC noted that a mountain prevented the use of the widely spaced second runway as an air carrier runway. This mountain, named Khao Krok Tabaek, reaches a maximum height of 274 meters above sea level. It violates the approach slope clearance zones of both FAA and ICAO standards. Exhibit 2.2-2 depicts these approach slope violations.

2.2.3 Removal of Mountain Violating Approach Slope

It has been suggested that removal of the offending portion of the mountain is a remedy for the approach slope violation. Using the 1991 Layout, it was calculated that approximately 275,000 cubic meters of the mountain is in violation of the approach slope minimums. Removal of this quantity of rock could approximately cost 82,500,000 baht. GTC can not recommend this as a viable option.

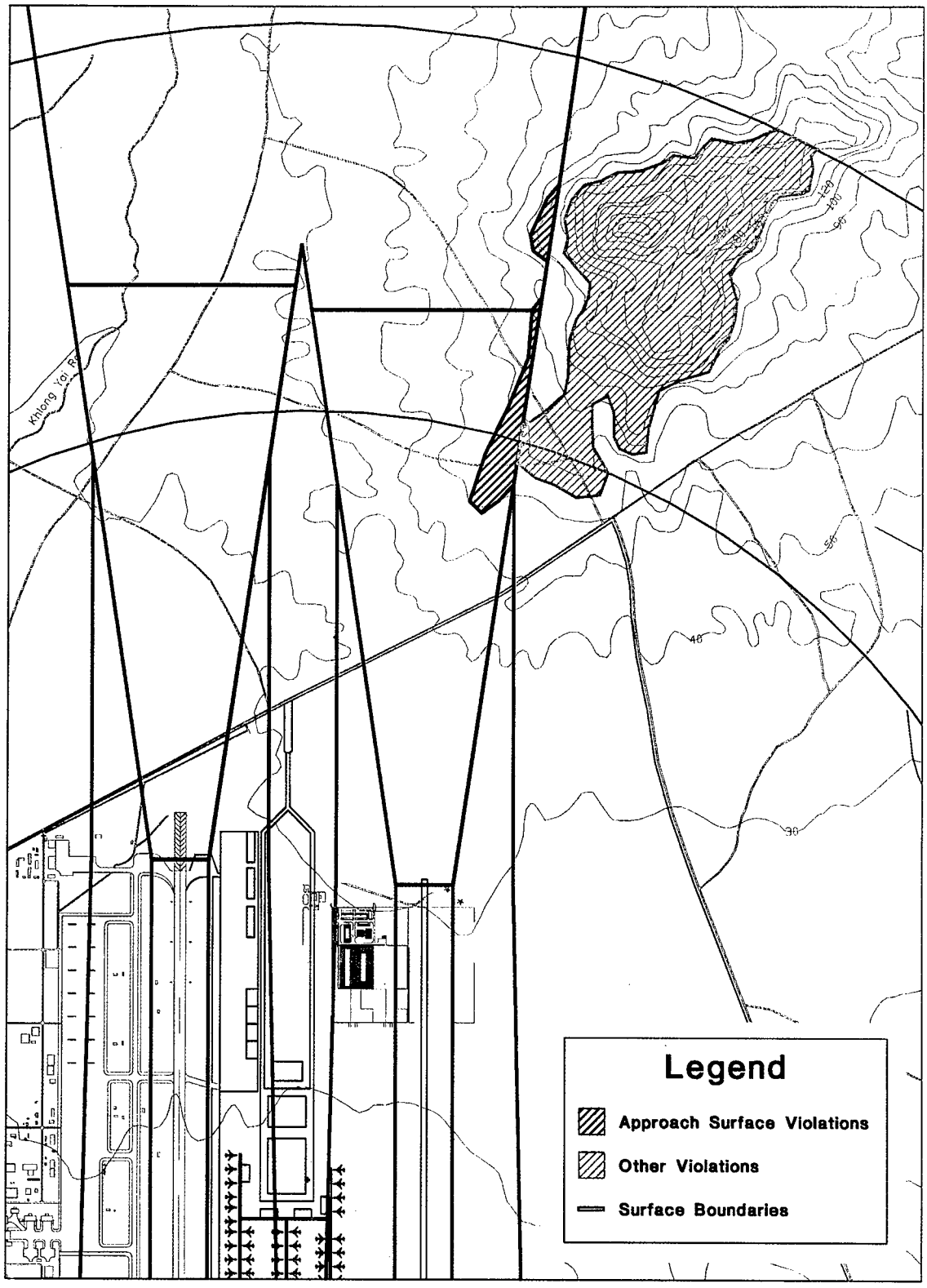
2.2.4 1991 Layout, Site Limitations

A widely spaced runway layout does not maximize the available land for use by the GTP. As presented in the 1991 Layout, the area between runways can accommodate only the existing Thai Airways maintenance facility, a cargo area, and other needed aviation related facilities. Industrial facilities and the expansion area would have to be located east of the future second runway. This would, in effect, cut the Transpark in two sections, inhibiting the operational efficiency of the facility. Connection between the industrial facilities and the cargo operation would be difficult. Cargo would have to be transported around or across a runway.

If a widely separated runway is constructed, the air traffic control tower would need to be relocated to a point central to the two runways.

Exhibit 2.2-2

Louis Berger 1991 Layout ICAO Obstacle Limitation Surfaces



2.2.6 1991 Layout, Building Limitations

According to FAA and ICAO standards, object free zones are created around every runway. This means that no buildings can be built with in this clear area surrounding the runway. It is possible for a closely spaced set of runways to share this object free zone. However, under the 1991 Layout each runway must have a separate object free zone there-by reducing the available land for development.

2.3 GTC 1997 Layout

The GTC have developed a layout for the U Taphao Airport with a building layout specifically designed to accommodate the Global Transpark (Exhibit 2.3-1,2). This layout includes the existing Thai Airways maintenance facility, facilities and space for expansion of the Global Transpark, and future facilities including a closely spaced runway, a passenger terminal, an air traffic control tower, and an aircraft rescue and fire fighting station. Included in this Master Plan are large scale Airport Layout Plans (ALP).

2.3.1 Capacity Versus Demand

The capacity of a closely spaced runway (between 212m and 755m) is as follows according to FAA, Airport Capacity and Delay Advisory Circular AC:150/5060-5:

Hourly Capacity (operations per hour)	
Visual Flight Rules	105
Instrument Flight Rules	59
Annual Service Volume (operations per hour)	285,000

This configuration allows for simultaneous VFR operations. IFR operations would be limited to one runway at a time; however, with the infrequent occurrence of IFR conditions, the overall capacity does not substantially differ from a widely space configuration. The air service demand for a GTP would be considerably less than the design capacity shown above. The year 20 air service demand for the GTP is forecasted to be approximately 12,000 operations per year with approximately 10 aircraft operations in the peak hour.

2.3.2 GTC 1997 Layout and the Mountain

The closely spaced runway in this 1997 Layout can accommodate a precision instrument approach that avoids the mountain to the north. The mountain does not interfere with the approach slope. Exhibit 2.3-3 depicts the ICAO approach surfaces.

2.3.3 GTC 1997 Layout Optimizes Available Space

This layout allows for improved conductivity among GTP facilities. Cargo can easily be transported from warehouse to industrial areas with a minimum of transportation or infrastructure costs. Adjacent to cargo facilities that will first be opened will be adequate land to expand as the need for the GTP grows.

Exhibit 2.3-1

GTC 1997 Layout

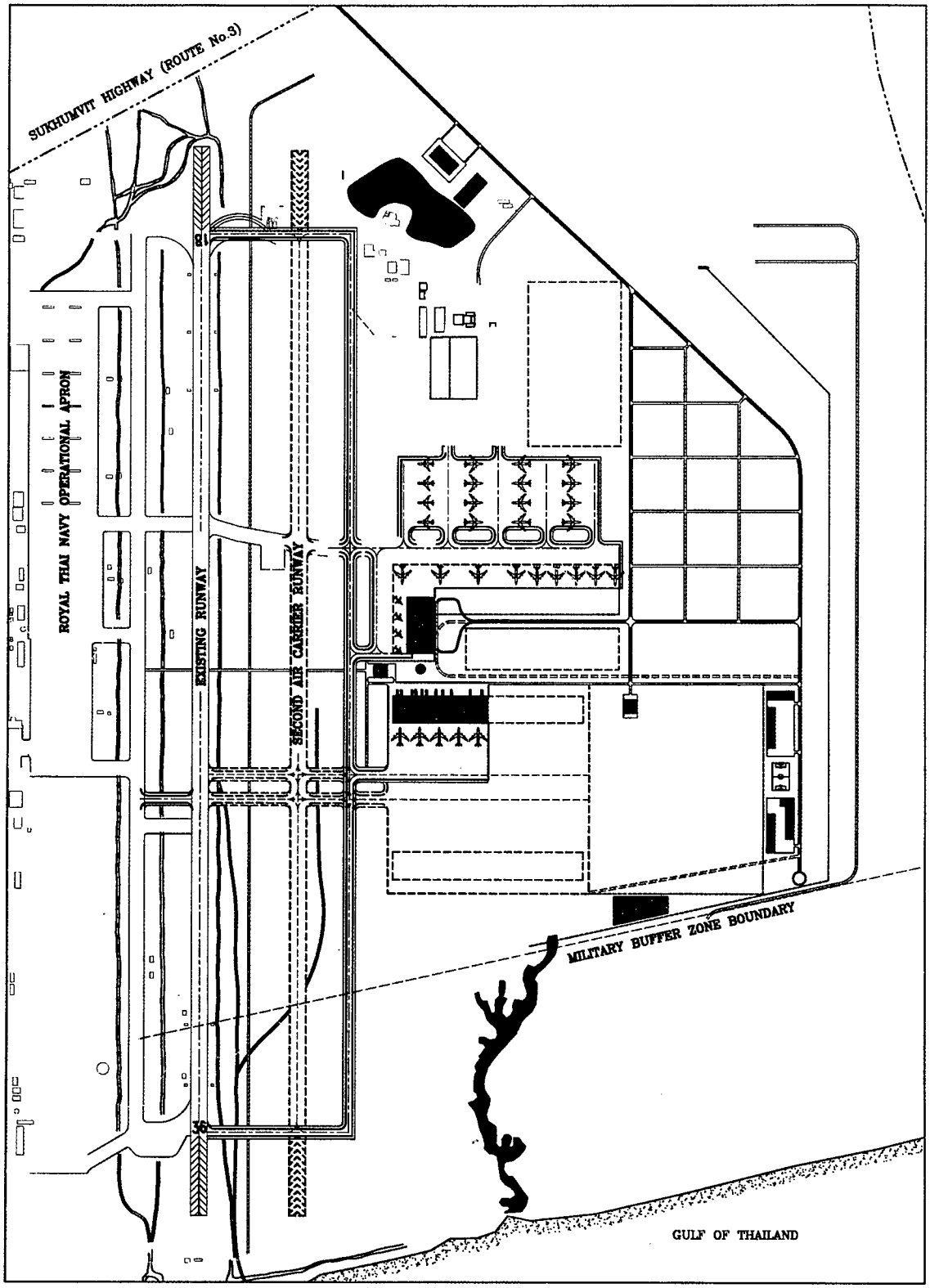


Exhibit 2.3-2

GTP Long Term Plan

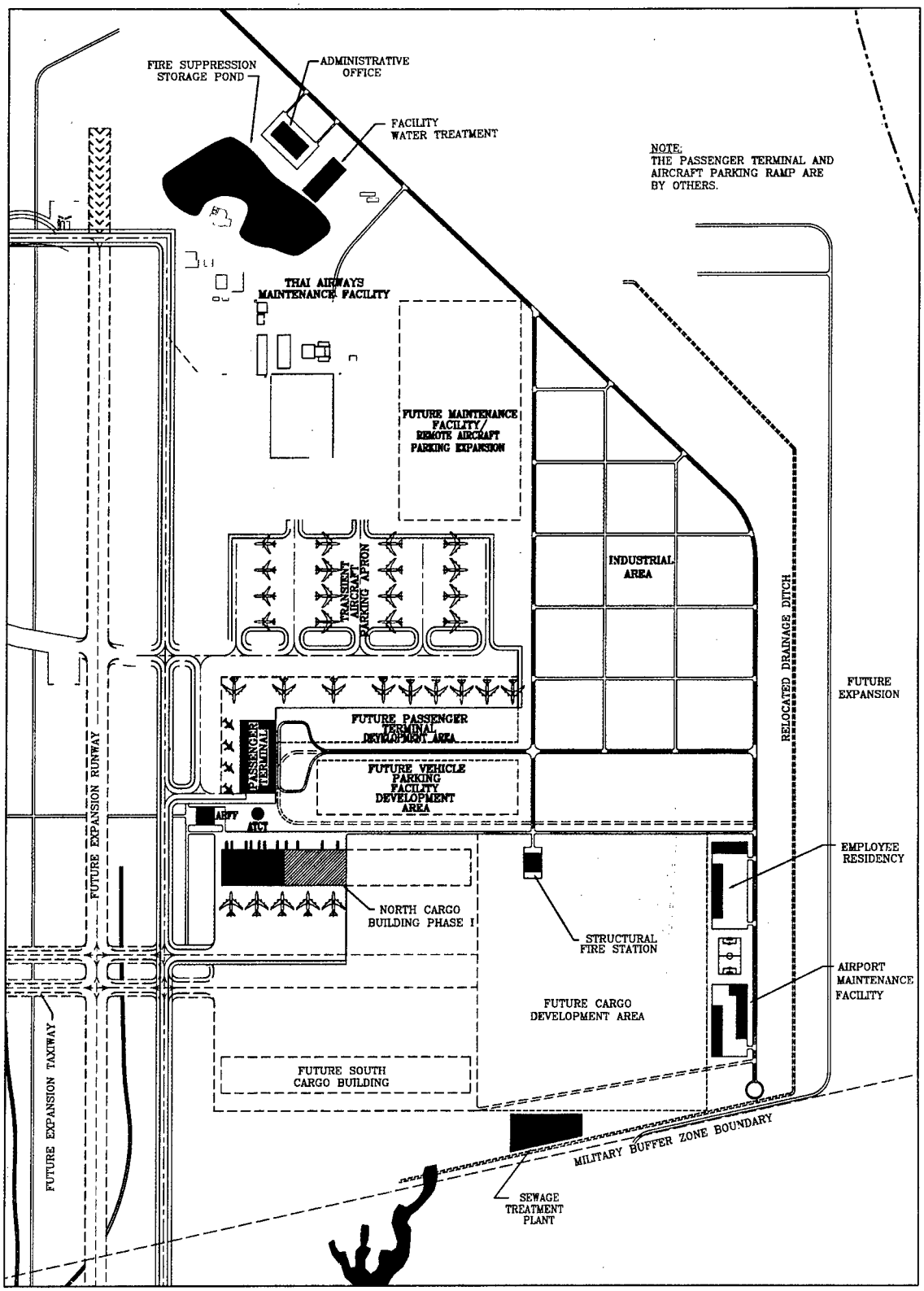
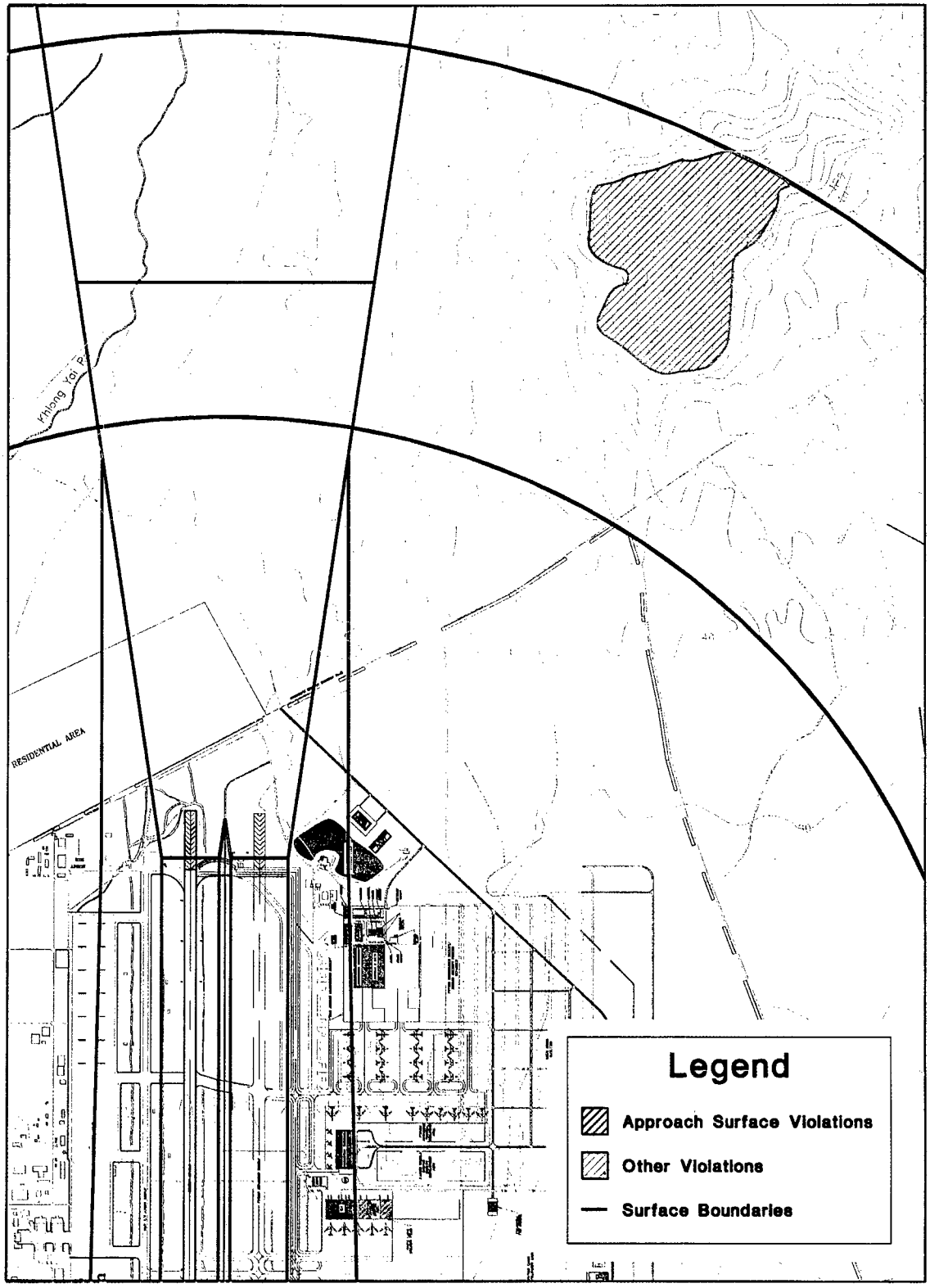


Exhibit 2.3-3

GTC 1997 Layout ICAO Obstacle Limitation Surfaces



2.3.4 Transient Aircraft Parking Apron

One of the main features of this 1997 Layout is the adequately sized transit aircraft parking apron. This facility is currently needed to relieve the Royal Thai Navy's apron from the seasonal influx of charter aircraft. In peak season, 30-40 aircraft are in need of transit parking for durations of one or more weeks. This transit aircraft parking apron would also be used by the Thai Airways Aircraft Maintenance facility. It is ideally located to serve as relief parking for the Thai Airways facility. This long term layout includes area for a future passenger terminal to be located on the east side of the runway; this transit aircraft parking apron can also serve aircraft using the passenger terminal.

CHAPTER 3

AIRPORT FACILITIES

3.0	Introduction
3.1	Runway
3.2	Parallel and Crossover Taxiways
3.3	Navigation
3.4	Air Traffic Control Personnel and Procedures
3.5	Aircraft Fueling Service
3.6	Aircraft Rescue and Fire Fighting (ARFF) Facility
3.7	Security
3.8	Airport Maintenance Facilities
3.9	Roadways
3.10	Utilities

CHAPTER 3

AIRFIELD FACILITIES

3.0 Introduction

U Taphao Airport has adequate runways and taxiways (airside facilities) available today to accommodate the expected demand for air cargo service. Additional apron and taxiway facilities will be added as demand increases. The following sections discuss these facilities and recommend minor improvements for various facilities to maintain safe and reliable air operations. This chapter discusses the airfield facilities that would be developed and operated by the entity responsible for airport operation.

3.1 Runway

The existing runway was constructed in 1966 for use by the United States Air Force's B-52 Heavy Bombers. The pavement is constructed of approximately 46-cm Portland cement concrete and was recently overlain with asphalt concrete. The runway is 3,505 meters long and 60 meters wide.

When considering future development sites, the air cargo carrier's decision-making process relies heavily on a potential airfield's pavement characteristics. Careful comparison of an aircraft's pavement requirements to the airfield's ability to provide for these requirements is made. U Taphao Airport's pavement infrastructure is a great asset to the success of the GTP. The following runway dimensions and pavement characteristics are important to potential users of the GTP.

3.1.1 Runway Length

A number of variables determine the required runway length for air carrier operations. A simplified approach is to review the length of pavement, airport reference temperature and elevation within the operational characteristics of the aircraft in use. The following table depicts the required runway length for various aircraft. The aircraft below are the typical and forecasted aircraft of the major air cargo carriers.

Aircraft type	Runway length required (m)*
747-200F	3,500
767	2,500
757-200	2,300
737	2,700
727	3,100
MD-11	3,400

*Calculations made under the following assumptions:
- runway elevation 18 meters
- airport reference temperature 33.3 Celsius
- aircraft at maximum takeoff weight
- no headwind or runway gradient

- typical engine type
- planning purposes only

U Taphao's 3,505-meter runway is adequate in length to handle operations of the above aircraft.

3.1.2 Runway Strength

Aircraft operations cause stress and eventual deterioration to airfield pavements. This normal deterioration is a function of the pavement's strength and the aircraft load placed upon it. A schedule of expected pavement repair and replacement can be determined and planned for in a normal pavement lifespan. If a pavement is subjected to higher loads than those for which it is designed, rapid deterioration or failure of the surface will occur.

The aircraft classification number - pavement classification number (ACN-PCN) method was introduced to easily quantify the amount of loads placed on a pavement by an aircraft. By comparing the aircraft's ACN value to the pavement's PCN value, a relative comparison can be made as to the pavement's useful lifecycle. This method is for relative planning terms. Pavement design and evaluation require detailed engineering analyses. A full pavement analysis is needed in order to completely determine a pavement's true strength and lifecycle.

U Taphao's existing runway is 3,505 meters long and 60 meters wide. In addition, each runway end contains a 305-meter asphalt stopway. The stated runway strength is reported as PCN 59/F/B/X/T (see Appendix 3-1)[2]. The T modifier denotes that a technical analysis was performed in determining this value. The date and extent of this analysis is not known.

The taxiway currently runs parallel to the runway on the west side. A series of cross taxiways connect the runway/taxiway system. The PCN values range from 33/R/B/X/U to 50/R/B/X/U. The U modifier denotes that these values were generated by observing aircraft operations that did not cause observable deterioration to the pavement. The use of this method of analysis may explain the low values given for these surfaces. Currently, such aircraft as L-1011s and DC-9s maintain scheduled operations with no observable deterioration to the pavement. A detailed engineering analysis is needed to determine the true strength of the pavement. This analysis would likely yield a significantly higher value and corresponding pavement strength.

The operational aprons also possess a low reported PCN value. These values range from 33/R/B/X/U to 35/R/B/X/U. As with the taxiways, these values are from observation of aircraft operations. The date and extent of this analysis is not given. A detailed engineering analysis would likely give a significantly higher value and corresponding pavement strength. Currently such aircraft as L-1011s and DC-9s maintain scheduled operations with no observable deterioration to the pavement.

At this time no improvement to the pavement system is necessary. Only a further detailed analysis of the pavement would yield a more accurate determination. If these

[2] Thailand Department of Aviation. August 1996. Airport Improvement Program.

reported values become a concern of a potential air carrier, a detailed analysis is recommended.

3.2 Parallel and Crossover Taxiways

Construction of a taxiway parallel to the runway and several crossover taxiways are recommended to allow aircraft to enter and exit the runway without interfering with other aircraft using the runway. This will provide a more safe and efficient operation of the airport. The parallel taxiway should be constructed at a sufficient distance from the existing runway to allow for construction of a second runway between the taxiway and the existing runway.

3.3 Navigation

A critical concern to the air cargo industry is the ability of an airport to be capable of 24-hour all-weather operations. To some in the air express industry, this capability is a deciding factor when choosing a location for their air cargo operation. To some extent, many in the industry feel an instrument landing system (ILS) Category I approved approach is the minimum acceptable approach in poor weather conditions. U Tapaho's ILS Category I approach is currently not certified by the Department of Aviation. GTC recommends replacement of a minor but critical component needed for re-certification under Department of Aviation standards.

Airfield lighting is a key concern for flight operations during poor weather conditions, as well as during night operations. Air cargo carriers rely heavily on the ability to conduct operations safely at night. FedEx's hub operations are conducted entirely at night. To these types of attract air cargo activities to U Taphao, a reliable, fully operational lighting system must be in place. GTC recommends that minor replacements must be made to runway and taxiway edge lighting to achieve 100 percent operational status.

Equally important is the lack of reliable emergency power back up. The one operational emergency generator housed in the electrical vault is undersized to handle all lighting systems during a power outage. Currently, it is reported that during a power failure the emergency power generator is not capable of illuminating the taxiway lighting while also supplying power for the runway and approach lights. GTC recommends the addition of another emergency generator to fill this void in emergency back-up power.

The following sections outline in detail the results of a field investigation of the operational status of various navigational equipment currently in place at U Taphao Airport. Each facility was investigated in regard to its safe operation under the Department of Aviation's requirements. The continued safe operation of these facilities was considered both during the initial GTP stages of development as well as after a significant increase in operations.

3.3.1 Doppler VHF Omnidirectional Range (DVOR)

Located on the airfield is a Doppler VHF omnidirectional range with distance measuring equipment (DVOR-DME). This equipment is used both for enroute aircraft navigation as well as instrument landing approaches. Two instrument approaches use this facility as their primary navigational aid. They are the

VOR/DME 18 and VOR/DME 36 approaches. These are considered non-precision instrument approaches. As of June 1997 both approaches were reported to be currently certified for use by the Department of Aviation. Details of these published approaches are given in the Appendix 3-1.

The DVOR/DME operating at U Taphao Airport has been given the three letter identifier BUT. It operates on frequency 110.8 Mhz and is a Toshiba TW 1193F model installed in 1982. Inspection of this facility found it to be in good working order. An adequately sized back-up generator is located on site. Back-up power of navigational equipment is essential due to a relatively frequent occurrence of power outages. Switch gear for the generator was said to be in good working order, and a two-hour battery back up is also maintained to allow for a dual source of emergency power.

At this time no immediate improvements are needed for the DVOR/DME. As with all navigational equipment, an inspection and maintenance schedule should be implemented for the facility's continued safe operation. This should be directed toward both electronic navigational equipment and electrical generator back up. Technically qualified personnel should be employed to conduct this routine inspection and repair.

3.3.2 Instrument Landing System (ILS)

An instrument landing system (ILS) with distance measuring equipment (DME) is installed at the airfield. However, it is currently not within certification standards of the Department of Aviation. Currently at U Taphao, this equipment is used as the primary navigational instrument for the ILS/DME 18 approach. It is classified as a precision approach and provides the pilot with both lateral and vertical guidance allowing the pilot to align the aircraft with the runway centerline when landing. DME is incorporated to provide information on distance from the runway. It replaces the need for a more traditional device called an outer marker. Details of this approach are given in Appendix 3-1.

The ILS/DME at U Taphao Airport has been given the four letter identifier IBUT and operates on frequency 109.5 MHz. It is a Toshiba TW1324B model. Inspection of the ILS facility found it to be in good working order. However, the associated distance measuring equipment (DME) was inoperable and in need of replacement. This consists of a bank electronic equipment housed in the ILS glideslope facility. Replacement of this equipment will allow the ILS/DME approach to meet Department of Aviation certification standards. A back-up electrical generator of adequate size appeared to be in good working order. A two-hour battery back up is also installed for a dual source of power for the glideslope and DME equipment.

The ILS localizer facility appeared in good condition. Adequate generator and battery back-up power appear to be in working condition. Minor improvements to the localizer antenna are recommended for its continued safe operation. Metal conduits to house exposed wires should be installed.

GTC recommends immediate replacement of the DME associated with the ILS. This should allow for the ILS/DME 18 approach to be re-certified by the Department of Aviation. Minor improvements to the localizer antenna are also suggested.

As with all navigational equipment, an inspection and maintenance schedule should be implemented for the facility's continued safe operation. This should be directed toward both electronic navigational equipment and electrical generator back up. Technically qualified personnel should be employed to conduct this routine inspection and repair.

3.3.3 Nondirectional Radio Beacon (NDB)

A nondirectional radio beacon (NDB) is located on the airfield. This equipment transmits a uniform signal in all directions, allowing pilots to crudely determine their position relative to the airport. It operates at U Taphao on frequency 414 KHz. This equipment was installed over 20 years ago. This method of navigation is rapidly becoming obsolete. Currently, no approaches at U Taphao use this facility for navigation.

Due to its age and lack of maintenance, this facility is in poor condition and is frequently out of operation. When operating, it is used primarily for training by the Royal Thai Navy. The commercial aviation industry does not rely on this technology for primary navigation. For this reason no improvements are recommended for this facility.

3.3.4 Global Positioning System (GPS)

In recent years, the commercial aviation industry has looked at global positioning system (GPS) as a new technology in instrument navigation. This system uses signals from geostationary satellites to determine the instruments longitude, latitude and elevation. It could be used as a primary instrument in an approved precision approach.

This technology is currently in place at numerous airports in the United States and will likely be adopted globally. It offers many advantages over ILS. It needs significantly less development of ground facilities and offers highly accurate and reliable positioning. It also provides enroute navigation.

Many members of the air cargo community inquired about GPS use in Thailand. This technology should be considered in any long-term planning of navigational needs at U Taphao Airport.

3.3.5 Runway Visual Range (RVR)

The runway visual range (RVR) equipment measures the visibility along the runway being utilized for an instrument approach. Each instrument approach has minimum visibility requirements before the approach can be executed. The only accurate way to measure this visibility is with this instrument. RVR visibility data is usually provided for runways offering ILS Category I precision approach capabilities.

At U Taphao Airport, RVR's are located at each end of the runway. Currently these instruments are not operating. It was reported that this equipment has not been functioning for at least 10 years. It is our recommendation that this equipment be replaced or brought into working order.

3.3.6 Precision Approach Path Indicator (PAPI)

Precision approach path indicators (PAPIs) are located at each end of the runway at U Taphao. Used by both visual and instrument approaches, PAPIs consist of a row of special lights that allow a set angle of glideslope to be illuminated for a landing pilot. It was reported that all PAPIs were in good working order. No improvements are needed at this time.

3.3.7 Approach Lighting

A precision approach Category I lighting system is installed at the approach end of runway 18. It was noted that the current lighting configuration meets the Department of Aviation's criteria for an ILS Category I approach.

It was reported that all lights are in good working order. Two concerns arise regarding the safe operation of these approach lights. First, as with all airfield lighting, adequate emergency power is not provided. Second, the control switch is not located in the air traffic control tower (ATCT). This control switch concern is addressed in more detail in the ATCT section.

At the approach end of runway 36 a simple approach lighting system (SALS) is in operation. This system, if in good working order, should be adequate as long as a precision approach is not installed. With improvements to the emergency power and control switch, the current approach lighting system should meet Department of Aviation criteria. An inspection and maintenance schedule should be implemented for the facility's continued safe operation.

3.3.8 Lighting Aids

Runway edge lights are installed along runway 18/36. These are white and omnidirectional. It is reported that only 70 percent are in good working order and that they were installed in 1966 with the airport. This incorporated a redundant electrical wiring circuit. It is recommended that all malfunctioning lights be repaired or replaced and an inspection of the complete electrical system be performed. Technically qualified personnel should be employed to conduct this routine inspection and repair.

Taxiway edge lights are installed along all existing taxiways. Reportedly, only 70 percent are in good working order. As with the runway edge lights, these need to be repaired or replaced.

Threshold lights and runway end identifier lights are located at the ends of runway 18/36. These reportedly are in good working order. No improvements are recommended. An inspection and maintenance schedule should be implemented for the lighting aids continued safe and reliable operation.

3.3.9 Air Traffic Control

Currently at U Taphao Airport, the Royal Thai Navy operates the Air Traffic Control Tower (ATCT). Continued air traffic control services of this type will be important to attract the air cargo industry to the GTP. Air traffic control is especially critical in this special environment. Commercial passenger, commercial cargo and military aircraft with a wide variety of operational characteristics will require 24-hour all-weather operation. The ATCT and its personnel are currently well equipped to handle this task. Minor improvements to communication equipment and the installation of a reliable source of emergency back-up power are recommended to maintain safe operation. The ATCT facilities are adequately sized to handle both initial GTP operations as well as the anticipated growth of the GTP far into the future.

As with most airports throughout the world, during times of national emergencies the government's use of the airfield is given priority over commercial needs. This will also be the policy at U Taphao Airport. It is expected that at all other times commercial air transport needs and military training needs will hold equal priority with no disruption of service to either. U Taphao currently maintains regularly scheduled flights of several airlines as well as unscheduled charter operations.

The following sections are the results of a field investigation of U Taphao's air traffic control and its associated systems. Members of the Royal Thai Navy were interviewed and were very helpful toward this evaluation.

3.3.9.a Air Traffic Control Tower

The existing Air Traffic Control Tower (ATCT) located at U Taphao has excellent visibility throughout all portions of the airfield. The ATCT control cab located on the sixth floor of the tower offers unrestricted views of the surrounding airspace. Its current location allows adequate visibility to safely conduct the initial air operations of the GTP.

Many systems involved in airfield flight operations converge in the ATCT. It is essential to safe and efficient operations that this facility be properly maintained and staffed. The systems incorporated in the operation of the ATCT are the following:

- Ground-to-Air Radio Communication
- Ground-to-Ground ATCT and Emergency Communication
- Weather Data Information
- Airfield Lighting Control
- Emergency Back-Up Power Supply

The most critical component of the ATCT is its personnel and their ability to conduct safe and reliable air operations. This ability is a function of the staff's training and experience. For this reason, continued training in air traffic control procedures that are internationally recognized by the commercial air transport community must by maintained.

3.3.9.b Ground-to-Air Radio Communication

Air traffic control communication is accomplished through three types of service. Each type of service has several radios, operating on various frequencies, dedicated to it. They are divided as follows:

Type of Service	Frequency
Tower Control	118.1 Mhz
	126.2 Mhz
Approach Control	119.9 Mhz
	238.3 Mhz
Ground Control	121.9 Mhz

This arrangement of type of radio service and frequency is appropriate for this type of airfield and facility. It is organized within FAA and Thailand's Department of Aviation's standards.

As reported by the ATCT staff, minor improvements in ground-to-air radio communication are needed. A radio communication reception problem referred to as "bleed-over" occurs regularly. This consists of one radio frequency communication interfering with another radio frequency communication. In effect, only one radio frequency can used at a time rendering all others useless during transmission. This reduces the operational capability of the ATCT significantly. This "bleed-over" effect is commonly caused by improper alignment of the various antenna, causing interference across frequencies. It is recommended that a qualified radio transmission technician inspect the antenna array located on top of the ATCT cab and make the necessary modification to the existing hardware. In addition to these modifications, replacement of several communication radios should be considered. The scheduled inspection and replacement of communication equipment should be performed to insure reliable and safe operation.

3.3.9.c Ground-to-Ground Communication

During an aircraft's departure, enroute navigation and arrival flight regime, the aircraft's flight plan is recorded by computer located in Bangkok's Area Control Center. This facility must be in contact with U Taphao's ATC personnel for each commercial air operation. This data transmission between U Taphao's controllers and Bangkok Center would best be facilitated if a direct computer connection could be established. A computer connection established directly in the ATCT cab would greatly reduce the potential for delays and errors in the communication process. The installation of a secured cellular phone connection between the facilities would greatly increase the system's reliability. It is recommended that these improvements be made for increased reliability and speed of flight data transmission process.

3.3.10 Weather Information

Weather information at U Taphao is generally available to an air traffic controller from three sources.

- Observed at the Airfield
- Recorded by Weather Radar
- Received from Bangkok Center

Currently, meteorologists at U Taphao observe a variety of atmospheric parameters. Some instruments are not currently operational and are in need of replacement. These include runway visual range (RVR) instruments to record visibility levels accurately and a wind direction indicator to record wind speed. These instruments' displays should be readily available to the controller for instantaneous readings. It is recommended that this equipment be installed to increase the ability of an air traffic controller to reliably report airfield condition to pilots.

U Taphao's airport inventory does include color weather radar. Weather radar allows meteorologists and air traffic controllers at U Taphao at track severe weather movements through their airspace. It gives detailed information on a storm's movement and intensity. The weather radar at U Taphao in not operational on a consistent basis due to a lack of spare parts. This equipment should be investigated as to its serviceability. A point of investigation could be the availability of real time weather images from Bangkok Center's radar coverage to be received in U Taphao's ATCT via computer connection.

Reporting current weather conditions to Bangkok Center is accomplished through a computer connection. This same connection allows interested pilots to receive weather information throughout the world. Two recommendations are made regarding this service. First, this computer connection should be made available to the controllers in the ATCT cab. This would better facilitate aiding enroute pilots in their weather concerns. Second, weather information regarding various military installations throughout the world can not be received. This apparently could be remedied by Bangkok Center subscribing to an additional weather service data base.

3.3.11 Airfield Lighting Control

The control of airfield lighting from the ATCT is a critical component of the safe operation of an airfield. Many weather conditions such as fog, haze and storm conditions warrant the activation of the airfield lighting system during daylight. During dusk and dark conditions, various light intensity settings should be controlled from the tower. A disoriented pilot is often able to better locate the airfield if the airfield lighting is pulsated by the controller. These require positive control from the ATCT. Currently, only very limited control of the airfield lighting can operated from the ATCT. The main Category I approach lights for runway 18 as well as the runway light intensity settings can not be activated from the ATCT. This condition should be improved immediately by the installation of adequate control switches within the ATCT. These devices should also be able to provide the controller with the operational status of the entire airfield lighting system at any given time.

3.3.12 Emergency Back-Up Power Supply

The most important component of the operation of a safe and reliable airfield is the ability of the controller to maintain communication with the pilot. In order for this

function to be dependable, a reliable source of emergency back-up power must be supplied. Reportedly power outages of 1 to 2 hours occur approximately 2 times per month. With this frequency of power outages, complete assurance of emergency back-up power is mandated. The emergency generator currently dedicated to the ATCT is reportedly under-powered and unreliable. The switch gear that activates the operation of the generator is apparently in need of replacement. The immediate repair or replacement of the generator and associated switch gear is recommended. This improvement would greatly increase the safety of the airfield during power outages and increase the reliability of the system as a whole.

Power outages also affect runway lighting and all other visual aids. The operating emergency generator currently dedicated to airfield lighting is underpowered to restore power to all visual aids on the airfield.[3]

The following are the operational standards pertaining to a precision approach category I runway by International Civil Aviation Organization (ICAO) Aerodrome Design Manual (from annex 14 and annex 10):

Visual and Navigational Aids Requiring Power	Maximum Switch-over time
Approach lighting system	15 seconds
Runway Edge	15 seconds
Runway Threshold	15 seconds
Runway End	15 seconds
Essential Taxiway	15 seconds
ILS Localizer	10 seconds
ILS Glide Path	10 seconds
ILS Middle Marker	10 seconds

All existing and future visual and navigational aids should be made to meet these standards.

3.3.13 Radar Guidance

The separation and guidance of aircraft can greatly be enhanced through the use of radar by a controller. Horizontal, vertical and longitudinal separation of aircraft can be optimized by the use of radar. This significantly increases the operational capacity of the airspace and associated airport.

Bangkok Area Control Center's radar coverage of 200 nm includes almost all portions of U Taphao's airspace. Radar coverage from Bangkok is reportedly approximately 2,000 feet (610 meters) above ground level at U Taphao airfield. There is no radar coverage below 2,000 feet (610 meters).

The Royal Thai Navy is currently in the process of installing a secondary radar service at U Taphao. Its exact capabilities are not known, but it is expected to aid controllers in their airspace management. It is scheduled for operation by the end of 1997.

[3] International Civil Aviation Organization. July 1990. International Standards and Recommended Practices, Aerodromes, Annex 14, Vol. I.

The possibility of real-time images of Bangkok's radar coverage of U Taphao being transferred via computer connection to U Taphao's ATCT should be investigated. It has potential to be a cost-effective improvement to the controller's capabilities. The need for complete radar control of U Taphao's airspace is not required for the initial development of the GTP.

3.4 Air Traffic Control Personnel and Procedures

The most critical component of the ATCT is its personnel and their ability to conduct safe and reliable air operations. This ability is a function of the staff's training and experience. Currently, ICAO procedures and standards are followed for all commercial aircraft, and FAA tactical guidelines are followed for military aircraft. These procedures are expected to apply to all GTP air traffic. The procedures currently in place can easily accommodate the initial and forecasted GTP air traffic. However, to maintain proficiency, re-currency training of personnel should be budgeted. When air cargo operations begin, the hours of ATCT operation will need to be extended through the night.

3.5 Aircraft Fueling Service

Aircraft fueling is currently accomplished on the military apron by a combination of hydrant systems and fuel trucks. The fuel farm, located approximatly 2 kilometers southwest of the existing operations apron, consists of 5 major tanks. Their combined volume is approximatly 7.5 million liters. Louis Berger's, U-Taphao Air Base Inventory 1991, found all tanks to be in use and in good condition. A hydrent system is used to transport this fuel to 3 usable pump houses located along the operations apron. Fuel trucks are used to transport fuel to the aircraft.

Fuel lines are in place that connect the fuel farm to the east side of the runway. This was uses to fuel aircraft on the far side of the runway. Presently these lines are not in use and are expected to be in disrepair beyond servicability.

The following table depicts the maxium fuel requirement of typical aircraft to be used at the Transpark. There actual fuel requirements may be subtantially less depending on specific payload and stage length.

Aircraft Type	Max Fuel Capacity (l)
727	33,876
737	23,820
757	42,680
767	91,380
MD-11	146,313
747	189,270

3.5.1 Short Term Fueling Service

The demand of fueling services will be minimal during the first stages of the Transpark. During the first years of operation it is expected that only 5 to 10 flight per week will occur. This fuel service demand could be meet by fuel trucks. A

typical fuel load of such a truck is approximately 30,000 liters. This fuel could be brought from the west operations apron and trucked to the east apron of the Transpark's. A typical fuel demand of an aircraft could be handled by one or two fuel trucks.

3.5.2 Long Term Fueling Service

The long term plan for the east side of the runway includes an extensive aircraft transit apron, relocated passenger terminal as well as growth in Transpark aircraft activity. This could include additional scheduled passenger aircraft and in-excess of 200 weekly cargo flights. Frequently, aircraft with short dwell times need quick fuel service. This situation could tax the capabilities of a truck fueling system. At aviation activities approaching this level, a hydrant fuel system should be investigated. This would consist of fuel lines connecting with the west side of the runway or a fuel farm located on the east side of the runway. It is anticipated that this decision would be driven by market forces and possibly developed privately.

3.6 Aircraft Rescue and Fire Fighting (ARFF) Facility

The level of protection provided by the ARFF facilities is based on the ICAO standards for international commercial airport facilities. The ICAO standard categorizes airports based on the over-all length of the longest airplanes and their maximum fuselage width that normally use the airport. Using the formulas and tables found in the ICAO standards it was determined that U Taphao GTP will be a Category 9 airport, due to the size of the largest aircraft that are currently using and will be using the facility. Currently at U-Taphao Naval Air Base the ARFF facilities are listed as category 9. This requires at least three fire fighting vehicles supported by the proper equipment and gear. Personnel must be trained in all matters of emergency response, as well as in the containment of hazardous materials. Summaries of ICAO standards are given in Appendix 3-2.[4]

The first stages of aircraft activity associated with the Transpark will be minimal. The existing ARFF facilities will be sufficient. All aircraft forcasted to use the Transpark are within the Category 9 criteria. Expansion of the existing facility is not needed in the short term. However, short term improvements are needed to maintain the Category 9 readiness. Several vehicles are in need of general maintenance. Budget should be allocated for their maintenance and replacement expenses.

Long term planning for the ARFF facilities follows that of the Transpark. When civil aviation activity is concentrated on the east side of the runway, new ARFF facilities should be developed on the east side of the runway as well. This future facility could be supplemental to the existing facility or replace it. The facility should also be able to provide structural fire suppression. The current master plan allows space for it's development when needed.

3.7 Security

Security is of great importance. This Transpark has a unique security requirements. The following is a list of several to be planned.

[4] Ibid.

1. Defense of a strategic military base.
2. protection of airport facilities.
3. Protection of aircraft
4. enforcement of economic trade area
5. protection of cargo and manufactured goods
6. provide a safe working environment

A sound airport security program will be the result of detailed advanced planning. All facilities have varying degrees of vulnerability to identified security hazards. The degree of risk from each specific hazard depends upon such variables as the type of facility or area involved, value, physical layout and protective measures that have been established. It does not appear that it is economically feasible or physically possible to establish the same degree of protection for all facilities. The degree of protection warranted is dictated by its criticality and relative vulnerability, and qualified by the effect of the protective measures on its operational effectiveness.

Design guidlines and a discussion of security planning methods as endorced by FAA regulations are included in Appendix 3-3. A detailed security review and plan should be conducted in conjunction with final design of Transpark facilities.

3.8 Airport Maintenance Facilities

This facility will consist of workshops to repair and maintain the facilities in the GTP. They will include vehicle repair, carpentry, metalwork, electrical, mechanical, painting, ventilation and grounds maintenance. This maintenance facility is located at a remote area in the southeastern corner of the GTP because such facilities are also used to store supplies such as replacement equipment and pavement repair materials.

3.9 Roadways

The inter-modal aspect of a Transpark demands that good land-side connections be established. What this means for the area within the boundaries of the Transpark is a good road system that connects all facilities and is flexible to expand to meet changing needs. The first stages of the transpark will only require road way access to a cargo facility allowing for quick access to roadway networks outside the Transpark. However, as the functional abilities of the Transpark increase to include packaging, warehousing and even light assembly and manufacturing, a well developed roadway system inside the Transpark will become essential. An appropriate level of planning has been conducted to produce a conceptual roadway layout that both develops an initial roadway connection and allows for future expansion.

3.9.1 Roadway Entrance

The roadway entrance will connect with Sukhumvit Highway 3. This entryway will ultimately serve as a four-lane intersection allowing for safe and efficient travel for a variety of sized vehicles. In the first phases of Transpark development this entrance can be of minimal design. It is possible for the existing entrance for the Thai Maintenance facility to be used jointly with the initial Transpark. This entrance will first be used by construction equipment for development of the cargo facilities. After initial operations begin, relocation of the main entrance should be considered. This

new location, depicted in opening day facilities, would better serve the ultimate growth potential of the Transpark.

3.9.2 Main Roadway

The main roadway will ultimately serve as a heavily used corridor. This corridor will lead to the cargo facilities and ultimately a passenger terminal. This roads location has been planed to accommodate growth and allow access to the center of the Transpark. This roadway should be the first developed. It will serve as construction access to the cargo facilities. This roadway should initially be designed as a two lane road. Utility lines and utility easements should be offset enough to allow for the quick and easy expansion to 4 lane service. Building offset lines should be planned for with every building constructed. Conceptual main roadway designs for various phases are located in Appendix 3-4.

3.9.3 Industrial Access Roads

Associated with further development of the Transpark are land parcels planned for industrial use. This could include packaging facilities, light assembly and value added facilities. This area is laid out much like other industrial parks located on the Eastern Seaboard. A grid of parcels can accommodate modular expansion and maximize available land. This grid of parcels needs a grid of access roads service it. Efficient transport of goods from this area to cargo loading areas is what makes Transpark unique among other industrial parks. These roads could be developed by private developers in the future. A simple two lane road network could accommodate a high level of industrial activate in this area.

3.9.4 Service Roads

Support function of the Transpark include facilities such as a sewerage treatment plant, Maintenance building as well as staff and recreational areas. Access to these facilities is planned through the development of service roads. This roads should be designed as minimal service. A single lane may be appropriate in accessing remote facilities. All weather access to these areas may require drainage and culvert design to insure serviceability.

3.10 Utilities

A major concern among industries on the Eastern Seaboard is access to a reliable utility infrastructure. Potential users view availability of reliable titles as a major factor when determining where they locate their facilities. Users will not locate at the GTP unless they believe reliable utilities are assured.

This section of this report gives guidance regarding the utility demands of potential users as well as the most cost effective and reliable means to provide them. Appendix 1-1 contains a detailed investigation of existing utility resources of the Eastern Seaboard, both existing and proposed.

3.10.1 Water Supply

3.10.1.a Raw Water Supply

Raw water is needed for structural fire suppression purposes only unless a light industry locates on the project which requires raw water in its manufacturing process. This water can be obtained from the raw water distribution line that parallels Route 3. This line is a 600-mm raw water transmission line that has a flow of 500 cubic meters/hour and a pressure head of 36.90 m. It is managed by the East Water Co. The raw water will be stored in a pond adjacent to the Welcome Center, and a pump will be installed to provide pressure to the fire suppression distribution system.

A water meter, a storage pond of at least 3000 m^3 and a booster pump capable of an output of 8 cubic meters/minute at a 35-meter head will need to be constructed to provide fire protection. The cost for these improvements is included in the initial development phase.

3.10.1.b Clear Water Supply

The nearest clear water distribution line comes from the Ban Chang Water Treatment Facility, which has a water treatment capacity of 600-m^3 per hour. This treatment plant is located 10 km from the site. The water supply for the project can be provided by the Ban Chang WTP distribution line that parallels Route 3. Connections to both the 200 mm and 300 mm diameter PVC distribution lines to be installed at the northeast corner of the project boundary should be adequate for the study period. Additional water supply can be provided through a connection with the planned 600 mm diameter pipe at the junction of main entrance road. The GTP is estimated to have a treated water demand of 12.5 cubic meters/hour in 2001, 20.1 cubic meters/hour in 2006 and 52.2 cubic meters/hour in 2016.

This water will be stored in elevated tanks and pumped into the CIP distribution system. The cost of these improvements and installation of water line is included in the initial development of stage of the GTP.

3.10.2 Sanitary Sewer

GTC recommends that a package treatment plant be installed capable of handling 110,000 liter/day. It is anticipated that this capacity will handle at least the initial phases of development. If industrial users, such as heavy food processing, develops, a 380,000 liter/day sewage treatment plant should be considered. The proposed location of the treatment facility is shown on the Master Plan Drawing.

3.10.3 Electrical Service

Electrical power should be supplied by the local public utility. Two sources of power need to be provided. There are two electrical substations near the U Taphao Airport. The first one is Sattahip 2 (115-22kv) and is owned by Electricity Generation Authority of Thailand (EGAT). The Sattahip 2 facility primarily supplies electricity to the naval base at Sattahip. This substation could also serve the airport and the Thai

Airways Maintenance Facility currently under construction. The second one is Banchang (115-22kv) and is part of the Provincial Electric Authority (PEA) planning. This substation serves the Banchang district and nearby communities.

The GTP site is near the Navy's Sattahip 2 substation as well as the Ban Chang substation, which is part of PEA's system. The transmission lines should be constructed from these two substations to provide the highest reliability. The electrical power may not be reliable if the new substation is only connected to the Sattahip 2 substation. Increased security from power interruptions and voltage drops and fluctuations can be provided if the substation is tied to both the Sattahip and Ban Chang grids.

Connecting to the Ban Chang substation as the primary source buying electrical power from PEA, with EGAT's Sattahip 2 substation providing backup power, would make a more dependable electrical power supply.

Certain tenants may need to install emergency, diesel-powered generators for critical activities. This element will not be included in the cost estimates for the development of the GTP. These costs should be borne by the businesses requiring emergency backup power.

Electrical poles on both sides of Sukhumvit Route 3 could be used for the installation of electrical transmission lines to the GTP. The power line from Sattahip 2 substation and Ban Chang substation can be hung on these poles to the main entrance road of the project, then connected to the GTP's 22 kV transformer and distributed to the user. The cost of these will be paid by both agencies (except for the transformer to the user). The request for electrical service must be applied for early enough for the electrical suppliers to include the necessary improvements in their budgets.

3.10.4 Emergency Generators

In addition to the increased reliability of electrical service connection from dual sources, emergency generators may also be required. Adequate emergency generator power is needed at three specific locations: cargo facility, cargo apron, and sanitary sewer plant.

3.10.5 Communications

The Telephone Organization of Thailand (TOT) has planned to build the telephone junction in the requested area of U Taphao Airport on about 2 rai in this year, 1997. This junction will be linked to Map Ta Phut Teleport by optical fiber cable on the existing TOT and PEA's poles. This junction will be serviced for 1536 telephone numbers with the other communication lines. This plan is in TOT's budget and expected to be completed in 1998. In addition, the Communication Authority of Thailand (CAT) has installed junctions for 3,000 international lines at Sri Racha which will make 2 million additional numbers available. The telecommunications system in the area has the capacity to accommodate the GTP for some years into the future. A distribution system within the Transpark using fiberoptic lines will be installed from the communication center to all facilities.

CHAPTER 4

CARGO, INDUSTRIAL AND SERVICE FACILITIES

4.0	Introduction
4.1	Aircraft Used for Air Cargo
4.2	Air Cargo Complex
4.3	Civilian Passenger Complex
4.4	Thai Airways Maintenance Facility
4.5	Industrial Park for Industries Desiring Access to Air Cargo
4.6	Staff Residence and Recreational Facilities
4.7	GTP Authority Headquarters
4.8	Area Reserved for the Royal Thai Navy

CHAPTER 4

CARGO, INDUSTRIAL AND SERVICE FACILITIES

4.0 Introduction

This chapter discusses the cargo, industrial, and service facilities that would likely be the responsibility of the GTP operating agency. Most of these facilities can produce revenues through leases or user fees. Their cost, then, could be recovered by the operator or they could be constructed on leased land by the private sector.

4.1 Aircraft Used for Air Cargo

There are three major kinds of aircraft which serve as air freighters: widebody jets, narrowbody jets, and narrowbody turboprop aircraft. Exhibit 4.1-1 shows typical payloads for widebody and narrowbody freighters. Boeing 727s and McDonnell Douglas DC8s are the most commonly used freighters for domestic lift within the United States. Freighters used on North Atlantic and Pacific routes are usually widebody aircraft with payloads ranging from 40 to 107 metric tonnes. The 747F (freighters), DC-10s and MD-11s are the dominant intercontinental freighters.

Most international air freight travels in the baggage compartment of passenger aircraft. The widebody aircraft that typically serve these routes offer substantial freight capacity. This capacity is increasing with the latest generation of aircraft. For example, the A330/340 passenger aircraft have much greater cargo capacity per available seat than its predecessors, offering 32 lower deck containers. A passenger 747, with almost double the seats, has a cargo capacity of 16 tonnes, accommodating 30 lower deck containers. Exhibit 4.1-2 estimates cargo capacity in the belly of widebody passenger aircraft, used for intercontinental service.

Exhibit 4.1-1
Capacities of Freighters Currently in Service
(metric tonnes)

Aircraft	Estimated Freighter Payload
B747-200	89
DC-10	54
MD-11	51
A300	47
DC-8	41
B767	38
A310	32
B727	21
B757	21

Source: SH&E, Inc.

Exhibit 4.1-2
Widebody Passenger Aircraft Offer
Substantial Air Cargo Capacity
(metric tonnes)

Aircraft	Passenger Aircraft Cargo Capacity
B747-Combi	38
MD-11	19
A340-300	17
B747-400	17
B747-200	16
DC-10	15
A340-200	14
B767-300	12
A300	9
B767-200	9
A310	8
B757-200	3

Source: SH&E, Inc.

4.2 Air Cargo Complex

An integrated air cargo processing facility will be constructed to accommodate express packages, as well as standard air cargo. An aircraft parking apron and a truck loading dock will be provided. The sorting and packing equipment installed will depend on the requirements of specific users. The size and configuration of this facility will be determined through negotiations with the potential users. However, the area shown on the plan is sufficient to accommodate a variety of facility configurations.

This facility will be provided with a back-up electrical generator to be used in the event of a power outage. A state-of-the-art communication system with connections to the industrial estates in the Eastern Seaboard Region and other cargo facilities within, as well as outside of Thailand, will be provided. The facility would have the capability for refrigeration, frozen and clean storage, and processing. The size of these facilities would depend on the needs of each potential user.

4.2.1 Short-term Air Cargo Complex

Exhibit 4.2-1 depicts the projected cargo demand at U Taphao. Detailed findings and forecasts can be found in VOL 1: *Business Plan*, Chapter 5. These forecasts outline the needed capacity of the cargo facility. It is by this schedule that a facility can be modularly designed and constructed to meet anticipated demand.

Exhibit 4.2-1
Estimated Annual Air Cargo by Type, Years 1-20
(metric tonnes)

YEAR	Transient (On Board)	Connecting (Warehouse)	ATA	Express	TOTALS	TOTALS w/o Transient
1	4,955		330	1,321	6,606	1,652
2	8,932		1,524	1,453	12,140	3,165
3	9,683		4,494	3,569	17,851	8,164
4	8,940	4,322	7,040	8,066	28,392	19,457
5	5,224	5,182	8,878	12,581	31,867	26,665
6	8,218	7,864	11,911	18,214	46,282	38,034
7	9,054	11,257	14,916	23,546	58,813	49,754
8	9,978	12,405	16,437	25,947	64,783	54,800
9	10,995	13,670	18,114	28,594	71,389	60,389
10	12,117	15,065	19,961	31,511	78,670	66,547
11	13,208	16,421	21,758	34,347	85,747	72,534
12	14,396	17,899	23,716	37,438	93,462	79,062
13	15,692	19,509	25,850	40,807	101,873	86,176
14	17,104	21,265	28,177	44,480	111,040	93,931
15	18,644	23,179	30,713	48,483	121,032	102,384
16	20,023	24,894	32,985	52,071	129,985	109,958
17	21,505	26,737	35,426	55,924	139,603	118,095
18	23,096	28,715	38,048	60,063	149,933	126,833
19	24,805	30,840	40,863	64,507	161,027	136,218
20	26,641	33,122	43,887	69,281	172,943	146,298

Source: Global Transpark Consultants

For initial planning purposes, the optimal industry standard productivity rate of 10 tonnes (annual) per square meter of one-story floor space was used. Since there is an economy of scale and a facility should be constructed to accommodate growth without expansion for a reasonable period of time, the initial facility will have a floor space of 8,000 square meters. A facility of this size will accommodate 80,000 tonnes per year. Therefore, the cargo facility will accommodate projected demand for the first 10 years of operation.

The most important factor in determining the size of the facility is average import cargo dwell time, because it is directly proportional to the amount of area required for import cargo storage. Keeping the dwell time low will also reduce the capital investment in the size of the facility. The target of three days for non-express cargo as the average import cargo dwell time has been used to determine the size of the facility. This time goal is comparable to times at other regional cargo facilities. The cargo facility will use uniform loading devices.

The facility will have 5,000 square meters dedicated to multi-purpose warehouse usage and 4,500 square meters for exclusive use by customs. These areas will be more closely defined in the upcoming design phase, when actual users are committed.

The initial aircraft parking apron will accommodate three aircraft and associated loading/processing equipment. The area of the parking apron will be 62,500 square meters to allow for proper clearances and turning radii for the aircraft. Since most express air cargo operations occur at night, the aircraft parking apron will be illuminated with high-mast lighting.

The initial vehicular parking area will be 20,000 square meters to allow full access along the roadside of the facility. Loading docks will be constructed so that cargo can be loaded directly into trucks. Similarly, cargo arriving from the eastern seaboard industrial/commercial facilities can be transferred directly from the truck to the cargo processing facility.

4.2.2 Long-term Air Cargo Complex

In the eleventh year of operation, an additional 4,000 to 6,000 square meters of floor space will be constructed to accommodate the anticipated cargo demand through year 20. The area productivity is dependent on many factors such as distribution, type of aircraft, customs procedures, and freight forwarder participation.

There is ample room for future air cargo expansion, with 404 rai allocated for this purpose. The vision of a fully developed GTP incorporates the idea of global logistics management. In physical terms, this relates to centralized warehousing of world-wide air cargo goods. If this vision becomes reality, this planned cargo expansion area will be a great resource for Thailand as an air cargo hub.

4.3 Civilian Passenger Complex

Currently, the civilian passenger complex at U Taphao Airport is located on the west side of the runway, adjacent to the Royal Thai Navy's facilities. Scheduled service and charter aircraft use these facilities regularly. The number of passengers fluxuates based on tourist trends and affect seasonal and yearly totals. Recently less than 50,000 passengers per year are typical. Peak hour passenger use of the terminal is less than 300 passengers. Charter flights typically involve aircraft with a 1-week layover. This results in as many as 30 to 50 aircraft parked at U Taphao for as long as a week at a time.

4.3.1 Short-term Civilian Passenger Complex

In the short term, it is anticipated that civilian passenger activity will remain on the west side of the existing runway. The financial resources needed for a new passenger facility are not warranted at this time.

4.3.2 Long-term Civilian Passenger Complex

In the 1997 GTP Layout, land has been allocated for a future civilian passenger complex located on the east side of the runway. This area is sized to accommodate a passenger terminal that could handle approximately two million passengers per year.

Relocating the civilian passenger complex is based on the rate of increase in transient aircraft parking. As future transient aircraft parking increases, the already limited space on the west side of the runway will need to be relocated to the east side. It is

anticipated that the development of transient aircraft parking space will proceed quickly, as much demand already exists. The relocation of transient aircraft parking will move the need for a civilian passenger terminal from the west side to the east side of the runway. Further rationale could include desire of the Navy to locate all civilian activity on the east side of the runway.

4.4 Thai Airways Maintenance Facility

The Thai Airways Maintenance Facility is scheduled for completion in early 1998. This facility will employ as many as 500 people and handle a wide variety of aircraft maintenance. Thai Airways expects to use this facility for heavy maintenance and scheduled aircraft inspections. The main aircraft hangar would accommodate up to 3 aircraft, and an additional 5 aircraft could park on adjacent aprons. This facility is expected to meet the needs of Thai Airways through about 2010.

The 1997 GTP Layout sets aside land adjacent to this facility for further development of the maintenance facility. This area would accommodate either an expanded Thai Airways facility or another tenant interested in developing a similar facility.

4.5 Industrial Park for Industries Desiring Access to Air Cargo

An area of 350 rai has been established for industries such as electronics manufacturers, just-in-time warehousing, and bonded storage companies that want to be located conveniently to the air cargo facilites. Transportation between the industrial and cargo facilities will be by truck initially. An automated guide-vail system could be installed later if justified. If needed in the future, the industrial park can be expanded to the east and north.

4.6 Staff Residence and Recreational Facilities

Since this facility will be operational on a 24-hour basis, an apartment complex will be constructed for the staff and their families. The apartments would have adequate water, a sanitary sewer, electrical and telephone service. The rental fees would be structured to be available to all workers. Adjacent to the residents facility, a recreational facility will be constructed for the use of the staff and their families.

4.7 GTP Authority Headquarters

It is very important that the first impression of U Taphao be extremely positive and attract the user. Therefore, a four-lane, tree-lined, divided access highway will be constructed from Sukhumvit Highway into the airport. The first facility that a user will see will be the Welcome Center. This facility will contain a display of the U Taphao GTP with details of facilities and information of site availability. The center will house the administrative, operational and security staffs for the GTP, and have adequate space for meetings and conferences to promote the facility. The area will be attractively landscaped to further enhance the users' impression of U Taphao.

The Administration Building should have direct communication links with the industrial estates, transportation companies and other shipping facilities in the Eastern Seaboard Region.

4.8 Area Reserved for the Royal Thai Navy

At the request of the Royal Thai Navy, an area has been reserved in the northeast corner of the GTP for future Navy use. The Navy also specifies that nothing may be built within one kilometer of the water's edge for security purposes.

CHAPTER 5

CAPITAL IMPROVEMENT PROGRAM

5.0	Introduction
5.1	Site Preparation
5.2	Roadway
5.3	GTP Administrative Office and Communications Center
5.4	Water Supply
5.5	Sanitary Sewer
5.6	Air Cargo/Warehouse/Customs Facility
5.7	Electrical Service
5.8	Security
5.9	Airfield Improvements
5.10	Emergency Generators
5.11	Communications
5.12	Opening Day Facilities Costs

CHAPTER 5

CAPITAL IMPROVEMENT PROGRAM

5.0 Introduction

The Government of Thailand will fund the construction of the opening day facilities described herein and shown on the enclosed plan. The opening day facilities are sufficient to accommodate the anticipated type and volume of air cargo at U Taphao Airport. Exhibit 5.12-1 identifies these facilities that could be financed through user fees or built by the private sector. The following descriptions are general in nature. More detailed facility requirements can be found in previous sections. Where applicable, the projects are identified by number on Exhibit 5.0-1, the layout plan of opening day facilities.

5.1 Site Preparation

SP-1 Remove metal revetments - There are numerous metal, earth-filled revetments that were constructed in the 1960's during the Vietnam War. These revetments need to be dismantled and possibly sold as salvage. The earth contained in the revetments can be used to grade the site in preparation for building sites.

SP-2 Clear and grub site - The unpaved areas of the site are covered with grass, brush and other types of vegetation. This material will be removed and burned on site. Any trees of marketable quality will be saved. Organic material that is not marketable or cannot be burned will be stockpiled in undeveloped areas of the airport.

SP-3 Grade site to drain - There are numerous places on the site that retain stormwater and do not drain well. The entire area will be graded so to facilitate drainage and make the entire site attractive to potential users and investors.

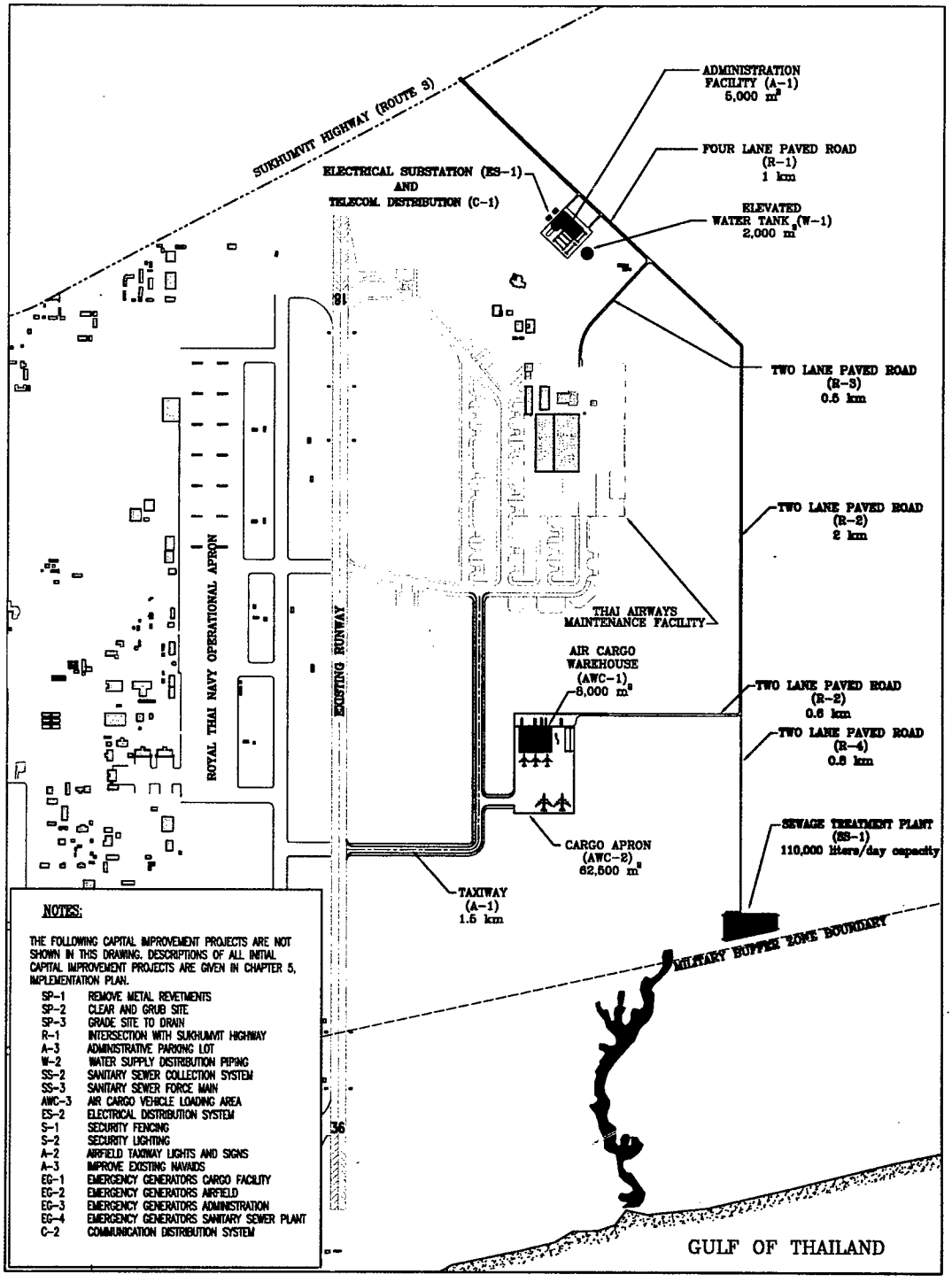
5.2 Roadway

R-1 Intersection with Sukhumvit Highway - The main entrance to the GTP will be on Sukhumvit Highway. It is important that potential users and investors have a good first impression of the GTP. The intersection between the entrance road and Sukhumvit Highway will be constructed to facilitate traffic movements to ease congestion and improve safety for cars and trucks (see Appendix 1-1).

R-2 Roadway to the cargo area - This roadway will lead from Sukhumvit highway to the air cargo/customs/warehouse facility complex. This roadway will be a four-lane facility with a raised median with a closed drainage system (see Appendix 3-4).

R-3 Roadway to Thai Airways Maintenance Facility- This roadway is from the entrance roadway to the Thai Airways facility. This roadway will be similar to the entrance roadway described in R-2.

Exhibit 5.0-1
Initial Capital Improvements



R-4 Roadway to sewage treatment plant - This roadway is from the entrance roadway to the sewage treatment plant on the south side of the GTP property. This roadway will be a two-lane paved road without a closed drainage system.

5.3 GTP Administrative Office and Communications Center

A-1 Administration building - This facility will house the administrative, operational and security staff of the GTP. It will also serve as a welcoming center to show potential investors and users the advantages of the GTP. The initial facility will have 5,000 square meters of floor space for offices, operational control room, security facilities, communication center, conference room and display area.

A-2 Entrance Roadway to Administrative Building - This roadway leads from the main roadway to the cargo area to the administration facility parking lot. This road will be similar to the entrance road, i.e. a four lane facility with a raised median.

A-3 Parking Lot - A paved parking lot of sufficient size to accommodate 100 cars will be constructed adjacent to the administrative office.

A-4 Landscaping - The entire area around the administrative office will be landscaped with trees and shrubs to make a pleasing and favorable impression on potential users, investors and visitors to the GTP.

5.4 Water Supply

W-1 Elevated storage tank and pumps - There are water lines adjacent to the roadways along the boundaries of the GTP, but the lines do not have sufficient capacity and pressure to accommodate the demand to the GTP in addition to the demand of the surrounding area. This deficiency can be overcome by constructing a 2,000 cubic meter elevated water tank with pumps to supply the requisite volume and pressure. The combination of the elevated tank and pumps will provide the necessary fire protection of 1,500 gallons per minute at 120 pounds per square inch for a minimum of 2-hour duration.

W-2 Distribution piping - A looped pipeline system will be installed along the roadways leading to each facility. Tees will be installed at 150-meter intervals for the connection of fire hydrants in the future. Fire hydrants will be installed in the vicinity of each facility. Connections to future facilities will be made by wet taps.

5.5 Sanitary Sewer

SS-1 Sewer treatment plant - A 110,000 liters/day capacity concrete, extended aeration, primary/secondary sewer treatment plant will be constructed near the southern boundary of the property.

SS-2 Sewer collection system, gravity - Gravity flow pipes will be constructed from each facility to a lift station adjacent to the roadways.

SS-3 Sewer collection system, force main - Since the site is relatively flat, lift stations will be constructed to transmit the sewage from the facilities to the sewage treatment plant.

5.6 Air cargo/Warehouse/Customs Fa ty

AWC-1 Building - This facility will have 8,000 square meters for cargo processing, 5,000 square meters for a multi-purpose warehouse and a 4,500 square meter area for the exclusive use for Thai Customs. For planning purposes, all three areas are combined in one building, but they could be housed in separate buildings without affecting the budget presented herein.

AWC-2 Aircraft Parking Apron - The 62,500 square meter aircraft parking apron is of sufficient size and configuration to accommodate the number of aircraft expected to use the GTP for the first 10 years.

AWC-3 Vehicle loading area - A 20,000 square meter vehicular parking area will be constructed on the north side of the building for loading and unloading of trucks.

5.7 Electrical Service

ES-1 Substation - The electrical utility company will install the substation, but the capital costs will be funded by the government. The costs will be recovered through credits on monthly service charges.

ES-2 Distribution system - The electrical utility company will install the wiring, poles, transformers, switches, etc. and recover the costs through monthly service charges.

5.8 Security

S-1 Fencing - A 3 meter high chain link security fence will be installed around the perimeter of the GTP. Gates will be installed to control access to critical areas. For estimating purposes, the gates will be manned by security guards rather than having automated entry card readers in the opening years to keep costs to a minimum.

S-2 Lighting - High mast lights will be erected along the roadways to provide an acceptable level of illumination for the vehicles using the roadway. The air cargo area will be illuminated to allow for night-time cargo operations. The administrative office area will be illuminated to provide for security of the staff that are required to work at nighttime. The sewage treatment plant will also be illuminated for security purposes.

5.9 Airfield Improvements

A-1 Taxiway pavement - A taxiway connecting the existing runway and the air cargo area will be constructed to allow for aircraft movements.

A-2 Taxiway lights and signs - High intensity stake-mounted taxiway lights will be installed along the taxiway and edge of the aircraft parking apron. Lighted guidance signs will be placed at decision points along the taxiway.

A-3 Improve existing navaids - Some of the existing airfield lighting equipment and navaids will be updated and made more reliable. The Distance Measuring Equipment (DME) on the Instrument Landing System (ILS) will be replaced. The switching equipment in the air traffic control tower will be replaced to allow the controllers to have direct access to the airfield lighting system. The existing antennae on the air traffic control tower will be re-oriented to prevent interference with other communication equipment.

5.10 Emergency Generators

EG-1 Cargo Facility - A self-starting, automatic switching electrical generator will be installed at the air cargo/customs/warehouse facility to provide uninterrupted electrical service in the event of a power failure. Most express operations occur at night and loss of time is unacceptable.

EG-2 Airfield - It is imperative that the airfield lights and navaids are operational at all times because air cargo is schedule dependent. A self-starting, automatic switching electrical generator will be installed at the airfield electrical vault.

EG-3 Administration - The GTP will operate on a 24-hour/day-365 day/year schedule. Therefore it is imperative that the control center have a constant supply of electricity. A manual-start, manual switching electrical generator will be installed at the administrative building.

EG-4 Sanitary Sewer Plant. A manually started, manually switched electrical generator will be installed at the sanitary sewer plant. This generator will supply electrical power to the sewer treatment plant, the lift stations and the water supply pumps.

5.11 Communications

C-1 Communication Center - A fiber-optic communication line will be installed into the administrative office. A communication center will be provided within or adjacent to the administration building. This center will contain switching equipment, monitors and distribution equipment for the entire GTP. This center will provide reliable communication between facilities in the GTP to parties throughout the region, Thailand, Asia and the world.

C-2 Distribution System - A distribution system using fiber-optic lines will be installed from the communication center to all facilities within the GTP. The system will be sized to accommodate future expansion as the number of users increase.

5.12 Opening Day Facilities Costs

The costs in Exhibit 5.12-1 are based on preliminary planning documents and should not be construed to be detailed engineering cost estimates. However, the costs are of sufficient accuracy for budgetary purposes. All costs are expressed in United States Dollars due to the recent fluctuations in the conversion rate for Thai Bahts.

Exhibit 5.12-1 summarizes estimated opening day capital improvement costs:

Exhibit 5.12-1
Opening Day Capital Improvements

Construction Item	Construction Cost (Baht **)
Site Preparation	156,688,000
Roadway	149,500,000
Administration Facilities	49,500,000
Water Supply *	23,408,000
Sanitary Sewer *	9,774,000
Air Cargo Warehouse and Customs Facility *	270,502,000
Electrical Service *	3,900,000
Security and Lighting	27,300,000
Airfield Improvements	204,141,000
Emergency Generators	19,744,000
Communications *	4,225,000
Opening Day Construction Costs	**918,681,000**
Design and Administration Fees	45,934,000
Construction Management Fees	73,494,000
Total Capital Improvement Costs	**1,038,109,000**

* All or a portion of these costs can be recovered through user fees. These items, totaling 311,809,000 baht, or about 34 percent of Opening Day Construction Costs, could be privatized.

** Cost estimates as of 1 September 1997.

APPENDIX 1-1

INFRASTRUCTURE PROGRAM

APPENDIX 1-1

INFRASTRUCTURE PROGRAM

1-1.0 Introduction

The objective of this portion of the study is to identify the infrastructure needed to implement the GTP concept. In order to accomplish this, GTC collected and verified the inventory of the existing and proposed infrastructure facilities. The area of influence each type of infrastructure facility or service has on the GTP at U Taphao varies according to the nature and function of the infrastructure segment. For instance, roads can transport goods going through the GTP from most of Thailand and the neighboring countries so these roads must be investigated. However, the area of study for the raw water distribution system need only go to the nearest supply line if overall capacity is adequate.

1-1.0.1 Study Areas

The following discussion presents the factors influencing the study areas for the proposed infrastructure.

Roadway and Rail Network. The concept of the GTP dictates that the roadway network study area be quite extensive. It will extend from the site westward to the Tonkin Gulf, north through Nong Kai to Laos PDR and east to the Andaman Sea. A separate study area for the road and rail network system will cover the Eastern Seaboard area and as far north as Don Muang Airport.

Water Supply. The area to be considered for water supply sources is defined by the location of the source of the water, the existing and proposed reservoirs and distribution lines for raw and treated water.

Electrical Distribution. The area inventoried includes most of the eastern seaboard. This area is adequate to identify the ability of the system to service the power requirements of the GTP and the connection points. It is recommended that two separate connections be provided in order to provide a back-up electrical supply source. Some businesses and industries may also require an on-site diesel driven emergency power unit. The airport lighting and Navaid systems will require an emergency generator.

Sanitary Sewage Facilities. It is anticipated that this will be accommodated on site with the construction of a new sewage treatment plant and collection system. Industrial wastewater is assumed to receive pre-treatment (to meet existing standards for effluent) at the generating industry prior to entry into this collection system.

Natural Gas. The location of the nearest gas distribution trunk line capable of supplying heavy industry with the required volume of gas is the determining factor in the size of the study area. Since the GTP at U Taphao will not be conducive to the development of heavy industry requiring extensive use of natural gas, the provision of this service is not considered crucial to the development of the project.

1-1.0.2 On-Site Infrastructure

For purposes of this study, no utilities will exist on site east of the runway except those that will be constructed to serve the Thai Airways Maintenance Facility. Likewise, there are no usable roadways (without improvement) nor rail spur to the site. A right-of-way corridor from the nearby railway for a rail spur should be included in the long-term development plans.

Electrical service to the project site could be supplied from the Navy's substation. The Electrical Generating Authority of Thailand supplying 115-33/22kV service owns this substation. The new Thai Airways Maintenance Facility is being supplied by this facility.

The developed area on the site is on fill. The undeveloped area will require filling because it is low and wet. It is estimated that 1 to 1.5 meters will be required to bring the undeveloped areas up to the existing elevation of the developed areas. The site of the new Thai Airways Maintenance Facility was raised on an additional 1-meter fill.

1-1.1 Summary Recommendations

The results presented in this section represent the recommendations for ground transportation and utility infrastructure improvements. They are based on the analysis of the existing and planned infrastructure programs and the needs of the GTP.

1-1.1.1 Roadway Access

The primary service regions for the GTP include:

- The GTP and industries in the Bangkok/Northern Bangkok area;
- The GTP and industries in the central Eastern Seaboard area as far north as Route 304; and
- The GTP and industries in the southern coastal region of the Eastern Seaboard.

Each of these areas are served by the following highways:

- GTP – Bangkok/Northern Bangkok is served by Routes 1 & 2 north of Bangkok, the Outer Bangkok Toll Motorway (OBTM), also known as Outer Ring Road, and the proposed Route 36 to the GTP.
- GTP – Central Eastern Seaboard Region is served by Routes 331 and 304.
- GTP – Coastal Eastern Seaboard Region is served by Route 3.

The planned improvements to these routes including the recommendations of this study include:

- Routes 1, 2 and 36 are all scheduled to be upgraded to toll motorways. Route 36 and the OBTM will be new motorways. Construction is progressing on both of these routes. Route 36 is currently nearing the completion of the Bangkok-Chon Buri section and funding is available for the Chon Buri-Phatthaya section. The design is completed for the Phatthaya-Ban Chang section, which terminates at an intersection with Route 3 less than 2 kilometers

from the GTP. This will provide excellent access to the GTP. The existing planned improvements to these roadways will adequately support the development of the GTP. No further improvements are recommended in this study.

- Route 331 is currently being widened to a dual divided highway. Future plans have indicated further widening to 6 lanes. This is determined to be adequate for the development of the GTP.

- Route 3 has been upgraded to a dual -lane divided roadway from Chon Buri to Chanthaburi and plans are to complete this upgrading to Trat. The master plan shows an entrance road to the GTP from Route 3 (Sukhumvit Road). From this point, GTP users can access any of the three corridors described above. The GTP will have direct access to all three of these corridors and no other new roads or additional improvements are foreseen.

1-1.1.2 Rail Access

The typical GTP user will be airfreight-intensive and, consequently, will not place rail access as a major location decision factor. However, GTC proposes a long-term plan for modal integration at the GTP, which will include a rail spur. To tie to the existing Bangkok/Map Ta Phut main line from the GTP. The construction of the spur is not included in the immediate development period and should only be considered when adequate multi-modal traffic develops at the GTP.

1-1.1.3 Port Development

As is the case with rail access, the typical GTP user will be airfreight-dependent, so port access will not have a significant impact on the development of the GTP and therefore is not a major priority. However, the GTP will promote modal integration, and long-term port capacity in the ESB will become important. The ESB has two major ports that have adequate capacity to serve the GTP-induced port demand: one at Sattahip and one at Laem Chabang. The port at Map Ta Phut could also accommodate this demand, although it is primarily a petrochemical port.

1-1.1.4 Airport System

Thailand has two ongoing international passenger gateway projects: 1) the expansion of Don Muang Airport and 2) the Second Bangkok International Airport Project. The GTP project completes Thailand's long-term airport strategy by providing a gateway facility for air cargo activities.

1-1.1.5 Water Resources

The GTP water plan is limited to tapping into the existing water lines along Route 3 for both clear and raw water. Water to accommodate the daily demand and emergency reserve will be stored in an elevated storage tank on site. Sewage will be stored in a retentional pond on the site. It is believed that groundwater will adequately maintain the level of the pond to satisfy fire suppression needs. Raw water from the pipeline will only be needed when the natural supply is inadequate to maintain a

sufficient supply or emergency conditions arise such that the capacity of the storage pond is surpassed.

1-1.1.6 Electrical Power

For the short-term, it is recommended that power be supplied from the Sattahip sub-station. For the long-term, dual sources are recommended that will include lines from both the Sattahip and Ban Chang sub-stations. Both the short and long-term electrical supply facilities will need to be supplemented with emergency power generators managed by the GTP operating company. This is particularly important for 24-hour GTP operations and telecommunications.

1-1.1.7 Wastewater Treatment

The GTP master plan prescribes that the GTP operating company construct and manage a wastewater treatment facility to handle effluent from the GTP tenants. This is recommended to be a package plant with a 380 cm/day capacity and will handle primarily domestic-type was Special treatment facilities for industrial, hazardous or toxic wastes will need to be ermined on a case-by-case basis. However, since the nature of the GTP does not lend itself to heavy industry, it is anticipated that these facilities will not be needed.

1-1.1.8 Telecommunications

The Telecommunications Organization of Thailand (TOT) has budgeted the funds to construct a fiber optic link between the GTP and a satellite teleport at Map Ta Phut. This link is to have a capacity for over 1500 telephone lines, which should be sufficient for operations well into the next century. TOT will construct a communications center at the GTP on two rai.

1-1.1.9 Natural Gas

It is recommended that a two-stage approach be adopted for the provision of natural gas service to GTP tenants. In the short-term, GTC anticipates low or zero demand for natural gas by GTP tenants. This demand could be met by truck delivery. In the long-term, if demand warrants it, an 11-km pipeline could be built between the GTP and the main natural gas line at Map Ta Phut.

1-1.2 Roadway Network

This section presents information on the highway network, which leads from the ESB to the neighboring countries and the ESB roadway network.

1-1.2.1 Eastern Seaboard Roadway Network to U Taphao.

The existing routes to U Taphao from all regions of Thailand can utilize the main highways as shown in Exhibit 1-1.2-1 hereinafter called the ESB roadway network. There are three main access corridors in the ESB that serve specific geographic areas. These corridors are defined as:

1. Bangkok / North Bangkok to GTP;
2. Central Eastern Seaboard as far north as Route 304 to GTP; and
3. Southern Coastal Eastern Seaboard to GTP.

These comprise the main routes that will serve as access to the GTP. The highways in these corridors provide access to a majority of the existing and planned industrial parks and areas identified for industrial development that will form the major users of the GTP facilities and services.

The following provides a brief description of the roads and planned improvements of the major roads, which will provide access to the GTP. When available, average annual daily traffic (AADT) counts for 1996 are given. All traffic counts were obtained from the report of the Traffic Engineering Division, Department of Highways, Ministry of Transport and Communication entitled, "Average Annual Daily Traffic on Highways, 1996." Roadway capacity of one lane is typically 1500 vehicles per hour (vph). However, when roadside distractions, close obstacles and frequent turning movements (without turning lanes) are present, the capacity is significantly reduced. Therefore, for all roads other than limited and controlled access motorways, the capacity of one lane of roadway is assumed to be 1000 vph. The capacities given were based on this figure.

1-1.2.1.a Bangkok/North Bangkok ESB Corridor

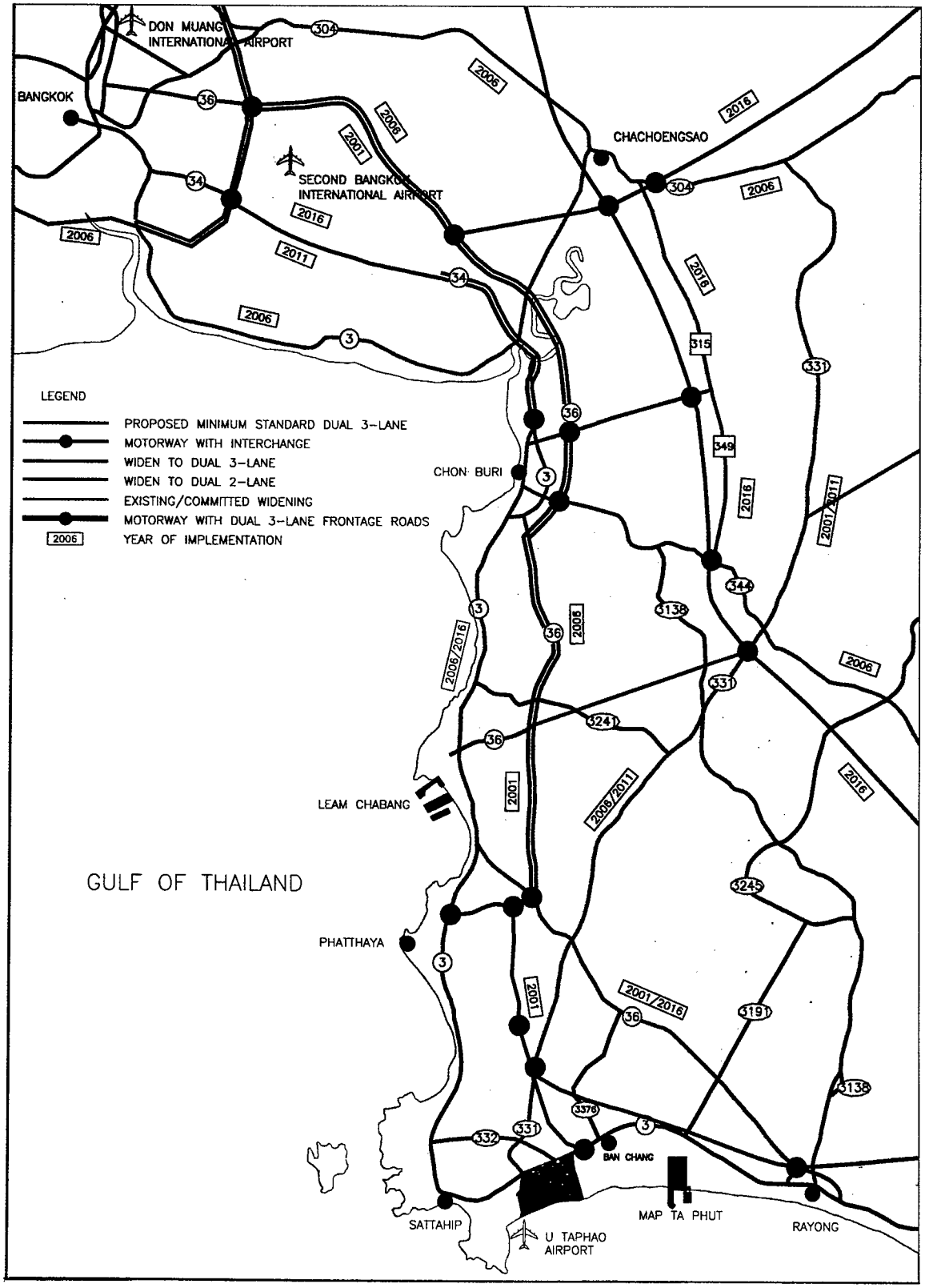
Beginning in the area north of Bangkok, the highways in this corridor include Route 1 (or Route 32) and Route 2. These routes will absorb traffic from all areas north of Bangkok including the numerous industrial parks immediately north of Bangkok proper. From there, the traffic will need to bypass Bangkok on the Outer Bangkok Toll Motorway (OBTM). Parts of this route have been completed and the remainder either is under construction or will be constructed in the near future. From the OBTM, GTP-bound traffic will take Route 36 to Route 3 and the GTP. Traffic originating in southern and southwestern Bangkok will use Route 34 to access Route 3.

Routes 1 and 2 are included in the Department of Highway's proposed Toll Motorway network. Route 32 is a motorway that is parallel to Route 1 from Chainat to near Bang Sai.

Route 36, formerly a two-lane road beginning near Bang Lamung, just north of Phatthaya and Rayong, this new Bangkok-Chon Buri-Phatthaya road is designated as Route 36 and will be a toll motorway. This route includes the OBTM currently under construction. The OBTM will divert through-traffic around Bangkok relieving some of the load on the inner-city motorways.

Role: This road will represent the major access road for all traffic going between the GTP and all of northern, southern and western Thailand, Myanmar and placeswest, Southern China and Northern Laos.

Exhibit 1-1.2-1
Eastern Seaboard Roadway Network



Description: The DOH 1996 Annual Report[1] shows that this route designation will be used for that portion forming the OBTM only and that the toll motorway from Bangkok to Chanthaburi will be designated as Route 3. Some discrepancies exist between this report and earlier reports that designate the whole route as Route 36. For purposes of this study, The Bangkok Outer Ring Road and the proposed toll motorway that will start at the ring road to Chanthaburi will be referred to as Route 36.

Planned Improvements: This route is currently under construction. It will be a new route and will not replace any existing routes. The section from Bangkok to Chon Buri is under construction and may be completed by the end of 1997. Design has been completed for the Chon Buri-Map Ta Phut section and funding is available for Chon Buri-Phatthaya section. Construction of this section is expected to begin shortly. The construction of the new motorway may negate or delay the need to carry out planned improvements to other parallel routes. The new motorway will be at least dual-lanes and for the most part, dual 3-lanes. In certain areas around Bangkok, the motorway will be 8-10 lanes with a dual 3-lane frontage road.

Route 34 leads from Bang Na, the end of one of Bangkok's First Stage Expressway, eastward to Bang Pakong. This roadway has been widened and is currently comprised of sections from 8-10 lanes. Together with Route 3, which joins at Bang Pakong, it is the main access road to eastern Thailand. The road is a motorway with dual 3-lane frontage roads from Bangkok to the Chon Buri Bypass. The road from Bang Na to Chon Buri was widened to 10 lanes in 1996.

Role: This road, along with Route 36, will serve as the main road for traffic between the GTP and Bangkok as well as for all traffic from the north coming through the Bangkok road network.

Description: Bangkok to Chon Buri Highway between Sri Nakharindra Road in Bangkok to Chon Buri is a divided highway and follows the alignment of the existing DOH road 343 from the end of Bangkok's Second Stage Expressway. It passes north of the proposed site for the Second Bangkok International Airport (SBIA) at Nong Ngu Hao, then turns southeast to join the new Chon Buri-Phatthaya Road. The Chon Buri Bypass is currently a four-lane divided highway.

Planned Improvements: There are no known plans in the immediate future for significant upgrade of this facility.

Route 3, Sukhumvit Highway, is the original road from Bangkok to the eastern region. Route 3 extends from Bang Na east of Bangkok to Trat, mostly following the coast. The region to the east of the airport is served by the continuation of Route 3 to Rayong, Chanthaburi, and Trat. From Chanthaburi, Route 317 extends north to Route 33, linking to Kampuchea through Aranya Prathet. This route will serve as the main access route for traffic coming from within, through and around Bangkok.

[1] 1996 Annual Report, Department of Highways, Ministry of Transport and Communications

The interest in this road is limited to that segment beginning at Laem Chabang. All other north-south traffic to or from the GTP will use Route 36 or 331. It is also probable that some portion of the traffic from Laem Chabang will also use the latter route.

Role: Route 3 is a major access road to the GTP from Phatthaya and Laem Chabang and will continue to serve this function for the near future. From Phatthaya to Rayong and beyond, the road is a dual-lane facility. The road will be adequate for the short term and well into the next century. At this time, a review of the adequacy of the segment from Phatthaya to GTP should be conducted.

Description: Route 3 from Chon Buri to Chanthaburi is a dual-lane road. The busiest section of Route 3 is on the segment from the Bang Na junction to the Khlong Dan Bridge. This segment had an AADT of nearly 82,000 vpd in 1996, which is an average of 41,000 vehicles per 12-hour period. However, if you consider the fact that the majority of the traffic occurs in the daylight hours, the daylight traffic would be more in the 60 to 70 percent range or 49,200 to 57,400 vpd. This would result in a peak hour (assuming the peak hour to represent 200 percent of the average hourly) traffic volume of 8,200 to 9,600 vph. This would indicate that the road would need to have at least 10 lanes in this section to accommodate this demand. The second busiest section is the Chon Buri bypass with nearly 60,000 vpd. This volume of traffic requires a minimum 8-lane roadway. Another section exhibiting traffic volumes requiring 8 lanes is the Chon Buri Junction to Talat San Suk section. All other sections require 4 to 6 lanes.

Planned Improvements: The road from Chanthaburi to Trat will be upgraded to a dual-lane road. Current plans are to widen the road to dual 3-lanes from Chon Buri to Phatthaya. However, the need for this widening may be offset by the construction of the Route 36 motorway from Chon Buri to the Phatthaya exit.

Future requirements are difficult to ascertain at this time due to a lack of information regarding the diversion of traffic to the new motorway. Some sections may need to be upgraded to dual 3-lane divided roads as demand increases.

1-1.2.1.b Central Eastern Seaboard as far north as Route 304 to GTP

This corridor is defined by Route 331 from the intersection with Route 304 to Route 332. Route 332 intersects Route 3 opposite the entrance road to the GTP.

Route 331, formerly a two-lane road between Sattahip and Route 304 at Phanom Sarakham, together with Route 36, provides an alternative, less trafficked, route to Route 3 between Phatthaya and U Taphao.

Role: This route will play a major role in providing access to the GTP. All traffic from northeast Thailand, Laos and Vietnam traffic through Laos will use this route. This corridor also includes major industrial estates from the GTP north to Route 304 who will find use of the cargo services at the GTP useful.

Description: This route is currently being upgraded to a dual 2-lane roadway. This route from the junction of Route 3 to Sattahip experiences less than 6,500 vpd.

Planned Improvements: The long-term strategic plan calls for this road to be upgraded to a dual 3-lane highway from Route 304 to Route 3 by the year 2001. This will provide adequate access to the GTP in the future.

Route 332 will be used by most traffic using Route 331 because it provides a shorter route. It is recommended that this route be widened to a dual-lane divided highway in the near future (5-10 years) so that congestion does not become a problem. Before any decision is made on the timing of the widening, it is suggested that traffic studies be conducted before and after the opening of the GTP to determine actual traffic volumes and vehicle mix. These studies will highlight the changes in traffic activity on all area roadways.

Route 36, upon completion, will divert most traffic away from Route 332. However, if we assume that this route will be completed to Route 3 just east of the GTP, widening of Route 332 may not be necessary (for GTP traffic). The decision to widen this road and the timing must be carefully considered by DOH.

1-1.2.1.c Southern Coastal Eastern Seaboard to GTP

This corridor is defined by Route 3 and will provide access from all points in Thailand east of the GTP, Southern Kampuchea (Cambodia) and Vietnam. The role, description and improvements are as described in the preceding section but it should be noted that this highway is part of a proposed inter-regional highway that will extend to Hat Tien, Vietnam.

1-1.2.1.d Eastern Seaboard Roadway Network Improvement - Recommendations

The planned improvements for the highways in these corridors appear to be sufficient to provide the access required for the development and growth of the GTP. There remains only the questions regarding the timing and, in certain cases, the need for certain improvements. The needed improvements are summarized below:

Route 36 – This route is satisfactory as planned, but delays in the completion of the route should be avoided. The opening of this route may have a profound impact on the timing and magnitude of the proposed improvements to area roadways, primarily Route 3 and Route 332.

Route 3 – The planned improvements to this road are adequate. However, DOH should review the proposed timing and improvements to this route with the completion schedule of Route 36. It should be noted that some funding previously committed to the upgrading of this road has been diverted to the new motorway so it is obvious that they have already considered the impact of the new motorway on Route 3.

Route 331 – Currently being widened to a dual-lane divided highway, Route 331 is planned to receive another widening to 6 lanes by 2001[2]. It is recognized that this schedule will not be realized, but that some delay (perhaps up to 5 years) will not significantly impact the development and growth of the GTP.

1-1.2.1.e Minimum Standards

For the main highways of the national system the minimum standards are for these highways to be dual-lane divided highways. Exhibit 1-1.2-1 shows the road network to the Eastern Seaboard. The planned network and size of roads is adequate to serve the area, but the implementation should be moved ahead as soon as possible. In addition, the improvements to Route 3 in front of the airport and access road to the GTP are proposed as shown in Exhibit 1-1.2-2. Details of this road and the typical sections are included in the appendix.

1-1.2.1.f Traffic Assessment

The roads that will experience the greatest impact of increased traffic generated by the operation of the GTP will be those roads in the immediate vicinity. Routes 3 and 331 will receive most of this traffic until the new toll motorway, Route 36, is completed to the intersection with Route 3 approximately 1.5 km east of the GTP. When this highway is opened, a large part of the traffic from the Bangkok area will be diverted from Route 3 and to a lesser extent, Route 331. It is expected that origin/destination traffic from the general vicinity of Phatthaya south to the GTP will continue to use Route 3. Traffic from the Laem Chabang area will use the new toll motorway.

The analysis of the traffic impact is presented in the Exhibit 1-1.2-3. More detail is presented in the appendix for this section. The analysis that the additional traffic generated by the implementation of the GTP will not create the need for any significant road improvements. The improvements currently planned will handle the increased loadings. The only improvements required involve the addition of turning lanes at the entrance to the GTP on Route 3, as shown in Exhibit 1-1.2-2.

Since these roads will be minimum dual 2-lane divided highways, no capacity problems are expected.

[2] "Recommended Long-Term Strategic Plan (1996-2016), Kingdom of Thailand, Ministry of Transport and Communications, Department of Highways, Wilbur Smith Associates.

Exhibit 1-1.2-2
Airport Entrance Road at Sukhumvit
Recommended Improvements

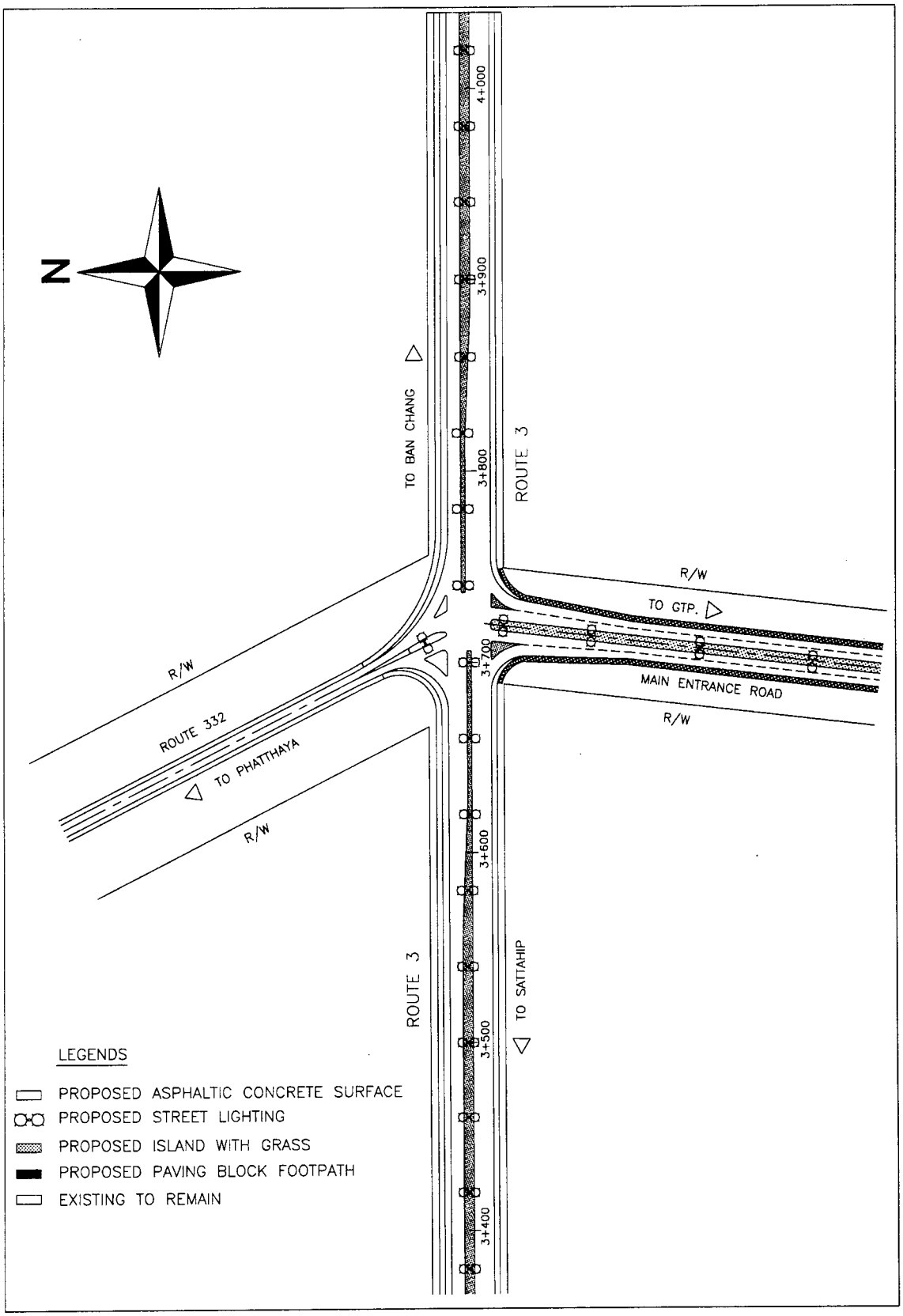


Exhibit 1-1.2-3
(4 Tables)
Motor Vehicle Traffic Forecasts

Table 1
Daily Through Traffic Forecasts without Rt 36 (vehicles per day)

	Year			
	1996	2000		
	Total	*Cars/Trucks/Busses*	*Freight*	*Total*
Rt 3 Phattahya-Sattahip	16,511	16,190	6,808	22,998
Rt 3 (Sattahip-Ban Chang)	17,695	15,494	15,562	31,056
Rt 331	7,690	10,770	7,159	17,929
		2005		
Rt 3 (Phattahya-Sattahip)		20564	12,106	32,670
Rt 3 (Sattahip-Ban Chang)		19681	27,672	47,353
Rt 331		13680	12,730	26,410
		2015		
Rt 3 (Phattahya-Sattahip)		24,780	19,496	44,276
Rt 3 (Sattahip-Ban Chang)		23,715	44,566	68,281
Rt 331		16,485	20,501	36,986

Table 2
Daily Through Traffic Forecasts by Route with Rt 36 (vehicles per day)

	Year			
	2000	2005	2015	Capacity (VPD)
Rt. 36	NC	37,291	52,420	90,000
Rt 3 (Phattahya-Sattahip)	22,998	19,602	26,566	60,000
Rt 3 (Sattahip-Ban Chang)	31,056	28,412	40,969	60,000
Rt 331	17,929	21,128	29,589	60,000

Table 3
Daily Traffic Forecasts by Route with Rt 36 and GTP Traffic (vehicles per day)

	Year			
	2000	2005	2015	Capacity (VPD)
Rt. 36	NC	45,702	67,334	90,000
Rt 3 (Phattahya-Sattahip)	24,253	20,426	28,696	60,000
Rt 3 (Sattahip-Ban Chang)	32,312	29,236	43,099	60,000
Rt 331	20,440	21,952	31,719	60,000

Table 4
Forecast of Daily Trips (GTP-Traffic)

	Year		
	2000	2005	2015
Employees	50,10	8,069	20,928
Air Cargo	11	174	377
By Space	2,457	2,457	3,713
Total Daily Trips	5,021	8,243	2,1305
Total Motorcycle Trips	749	1,229	3,177

1-1.2.2 Routes To/From Neighboring Countries

1-1.2.2.a National Toll Motorway Network[3]

These highways represent the highest level of highway development in Thailand. An extensive network has been planned and the network is being developed continuously. The motorway network includes:

- Route 1 - Chiang Rai to Outer Bangkok Toll Motorway (Route 36), or OBTM forms part of the northwestern and western GTP corridors
- Route 2 - Nong Khai to Nakhon Ratchasima and then OBTM forms part of the northern corridor
- Route 21 - from Ubon Ratchathani to Nakhon Ratchasima where it will intersect with Route 2, is not part of the GTP Corridor network. It is however, the major access to the GTP until the new Laem Chabang-Northeastern Thailand highway (Inter-regional Highway) is constructed.
- Route 35 - from Nakhon Ratchasima to Chon Buri
- Route 34 - from Aranyapathet to OBTM intersecting with Route 35
- Route 36 - Current plans are for the new motorway to be constructed from the OBTM to the Eastern Seaboard to also be designated Route 36. For this study, the OBTM and the motorway from the OBTM through Rayong and to Chanthaburi will be termed Route 36. This route will play a very important role in providing access to the GTP and the ESB in general.
- Route 4 - from Hat Yai to OBTM, Route 4 forms part of the southern corridor. Other motorways that will aid in getting traffic through and around Bangkok are Routes 32, 31, and 33.

All of these toll motorways will help provide the access necessary for the GTP to develop. Exhibit 1-1.2-4 presents the major roadways in the Thailand highway system.

1-1.2.3 Conclusions – Roadway Network

The roadway sections discussed above include those deemed to have the greatest impact on travel times to/from the GTP and on the most likely users. The greater part of the traffic from the major air cargo generators will take one of three routes to U Taphao. One of the routes is Route 331 from the junction of Route 304, down Route

[3] Ibid.

331 to Route 3 to the GTP access road. If Route 332 is under capacity, this could provide an alternative and a shorter route than the Route 331-3 routing. Another is Route 36 from Bangkok and Route 331 and 332 to the GTP. The last is Route 3 to/from Phatthaya and Laem Chabang. Laem Chabang traffic could also use the new motorway (Route 36 when completed) to Route 331 and 332 to the GTP. Of these three, Route 36 (to become a major motorway) and Route 331 are the more predominant.

Laem Chabang and Phatthaya to U Taphao (Route 3) traffic will most certainly use Route 3 from Phatthaya to the gate of the GTP. The road has recently been upgraded to a dual 2-lane divided highway. This will adequately handle the anticipated traffic and not act as a detriment to the development and growth of the GTP.

Route 36 will be the major route to/from and around (Outer Ring Road) Bangkok. The plans for this route will be sufficient for the development and growth of the GTP.

Highway 331 from Highway 304 to Route 3 will be one of the most important highways serving the GTP since it runs through the heart of the existing and proposed industrial development areas of the ESB. The Route is scheduled to be fully upgraded to a dual 3-lane facility by the year 2011 and is currently being widened to a dual-lane divided highway.

From Northeastern Thailand, Laos and Vietnam – The routing from these areas would include Route 2 from Vientiane and Northern Vietnam. This route is scheduled for upgrading to a motorway with dual, 3-lane frontage road by 2016. Route 2 would feed the traffic to Route 304 south of Nakhon Ratchasima and then to Route 331 to the GTP.

Another route would begin at Mukdahan on Route 212, a north-south roadway that parallels to the Thai-Laotian border. From there, the traffic would need to progress to Ubon Ratchathani and Route 24 (until a new road, scheduled for completion in 2016[4], from Ubon Rachathani to Si Sa Ket and then south back to Route 24). Route 24 intersects with Route 304 south of Nakhon Ratchasima that will take the traffic to Route 331 and the GTP.

1-1.2.4 Summary

The roadway network that will adequately serve the potential users is under construction or scheduled for construction with one exception, Route 105 from Myanmar to Tak. It is not anticipated that immediate action should be taken to upgrade this road since significant activity from Myanmar is not expected at this time. The planned improvements for the new toll motorway Route 36 and the Inter-regional Highway from Laem Chabang to Mukdahan will have major impact on the improvement of the access to the GTP. The implementation and construction of these routes should move ahead as scheduled or sooner, if possible. All other routes are adequate as planned with regard to their capacities.

[4] "Recommended Long-Term Strategic Plan (1996-2016), Kingdom of Thailand, Ministry of Transport and Communications, Department of Highways, Wilbur Smith Associates,

The most important routes in the network are: Route 36, Route 331 and Route 304. Of these roads, Routes 331 and 304 require the most attention although the completion of the construction of Route 36 to Route 3 will reduce the need for improvements to these routes as scheduled.

Both routes are in the process of being upgraded and plans are to widen these routes to dual three-lane highways and several sections are in the process of being widened to dual two-lane roadways. It is recommended that these two routes continue with the current plans to upgrade them to dual two-lane highways with the earliest possible completion date. Planning for their widening to dual three-lane highways should progress at a reasonable but at a faster pace than currently planned.

Another less important improvement, but still worthy of consideration, is the upgrade of Route 332 between Route 331 and Route 3. This route begins in the west at Route 3, intersecting Route 331 and continuing on to Sukhumvit Road opposite the entrance road to the GTP. The Long-Term Strategic Plan calls for this road to be upgraded to a dual three-lane road. It is recommended that planning be undertaken to upgrade the section from Route 331 to Sukhumvit Road to a dual two-lane highway.

The only actions needed to improve the roadway network is to expedite the improvements that are already recommended with particular emphasis on Routes 331, 304 and 332. This is especially relevant since it was revealed that the Ford and General Motor manufacturing plants will each require that approximately 1,500 trucks per day will be necessary to support their manufacturing activities. The Average Annual Daily Traffic Volumes[5] (AADT) on this road in 1996 ranged from 1,439 to nearly 8,000 vehicles. Heavy trucks accounted for nearly half the volume on some parts of the road.

The roadway improvements planned will, when implemented, provide the GTP with the access required in order to be the competitive with other air cargo facilities. The planned improvements to the highway network have been well studied and the recommendations have taken into consideration the high growth potential of the Eastern Seaboard.

1-1.3 Railway Network

1-1.3.1 Role Of The Railway System in the Development of the GTP

The value, size and weight (or volume) of the cargo typically dictate the nature of the cargo handled by the railway system. Rail cargo is typified by commodities that have a low cost to weight ratio. Other cargo may have a low ratio, but is too large for other modes of transportation.

Conversely, a high cost to weight (or volume) ratio typifies commodities shipped via air. It is logical then to rationalize that only a small portion of cargo shipped by one mode would then be shipped by the other. An exception to this statement would involve the shipment of large quantities of commodities via rail to a holding facility (warehouse) in order to make the item readily available for on-call air shipment to the

[5] Average Annual Daily Traffic on Highways 1996, Ministry of Transport and Communications, Department of Highways, Traffic Engineering Division.

final destination. These commodities or products could be high value items (computer parts, designer clothing or sub-assemblies) or low value items that require emergency delivery such as machinery components or sub-assemblies for product manufacturing. If a manufacturing plant cannot function because of the lack of a critical part for any of its processing equipment or it lacks all the parts of the product it is manufacturing, daily operating losses can be in the range of $US 1 million for some of the larger plants.

It is this last function that the GTP can serve, and rail service is then a requirement for the full development of the Global Transpark concept.

Rail Spur Line to GTP - There is a convenient rail line that passes the site just north of Sukhumwit Road, and a spur from that line would be fairly easy to construct. However, since most of the manufacturing and warehousing will occur in other areas in the ESB and beyond, the necessity for this spur in the initial development phase is not realized at this time. A rail corridor for this spur should be reserved so that it could be inexpensively and expeditiously constructed.

Spur Line - It may be necessary in the future to provide a railway spur to the project connecting from the track to Map Ta Phut at a point next to the bridge of Route No. 3 crossing the railway. For this purpose, a corridor of land needs to be reserved.

Railway Improvements to Neighboring Counties - The railway system should be extended to the border of Myanmar at Sangkhlaburi and Mae Sai because in the future it can be linked with the railway system of Myanmar at Ye, Taunggyi, respectively. This extension to Mae Sai will provide a convenient point for the goods from three countries, Myanmar, Laos and Southern China to be sent to/from this point. Responsibility for the construction of this line lies with the State Railway of Thailand (SRT).

1-1.3.2 Thailand Rail Projects Underway

At present, two lines connect the ESB I area with Bangkok (the Bangkok - Map Ta Phut line) and the ESB I area to the Northeast region (Chachoengsao-Kaeng Khoi). The SRT is upgrading the rail to double tracks in two lines from Bangkok-Chachoengsao - Sri Racha and Chachoengsao - Klong Sip Kao - Kaeng Khoi, which will be finished in 2000. A new line (Map Ta Phut - Rayong) is also planned.

1-1.3.3 Planned Thailand Rail Projects

1-1.3.3.a Rail Projects Planned Under ESB II[6]

The high speed rail line, with an estimated development cost of B 38,000 million, will require a 6-year development period. The project is currently under study.

[6] The Eastern Seaboard Development Program, March, 1997; Office of the Eastern Seaboard Development Committee, Office of the National Economic and Social Development Board.

Exhibit 1-1.3-1
Rail Projects Planned Under ESB II Development Program

Location	Cost *(million Baht)*	Estimated Completion Date	Agency
Laem Chabang Area			
Hua Mark-Chachoengsao-Si Racha	8,600	2000	SRT
Chachoengsao-Klong 10-Kaeng Koi	NA	1998	SRT
Map Ta Phut Area			
Si Racha-Map Ta Phut	NA	1998	SRT
Rayong-Map Ta Phut	NA	1998	SRT
Phatthaya City			
Ko Lan Port Project	69.0	1996	PWD
Regional			
Bangkok-Nong Ngu Hao-Rayong HSR	37,565	2002+	SRT/Priv.

1-1.3.3.b Other Railway Planning

Double Tracking - SRT is planning a double tracking of the overall SRT network. Because of its huge investment cost for the implementation, double tracking will not be carried out for the railway lines in the ESB in the near future.

High Speed Train Project - High speed train project has been studied by the Office of the National Economic and Social Development Board (NESDB) to connect Bangkok and the ESB. The project is expected to promote the development of the ESB extensively. The train is planned to be operated between Huai Khwang in Bangkok and Rayong, passing by the Second Bangkok International Airport, Bang Pakong, Chon Buri, Si Racha, Phatthaya, Khao Chi Chan and Map Ta Phut. The line is 190.9 km in length and is electrified with standard gauge. Travel time between Bangkok and Rayong will be 103.6 minutes at a maximum speed of 160 km/h.

NESDB expects this project to be implemented on a BOT basis. A potential private investor is now said to show interest in the project.

The Investment Plan for the high-speed rail (HSR) connection between Bangkok and Rayong has been completed. In the initial development stage, the lack of HSR service will not significantly affect the attractiveness of the GTP for industrial development although it would be a good selling point. In the long run, the HSR would have significant impact if:

The Second Bangkok International Airport is not constructed and U Taphao was developed as the second airport;
The ESB develops such that it will justify an international service with frequent service to major international airports; and
Evidence of the level of development of other industrial estates in the area suggests that this absence of the HSR had no significant impact on the decisions to locate business and industry in the estates.

Future industrial development areas identified by RTG are further inland than the proposed HSR route and will not benefit greatly from its presence although some benefits may be realized in the attraction of new industry to the area. HSR will not have any significant impact on the successful implementation on the GTP.

1-1.3.4 Status Of Selected Railway Lines

Chachoengsao-Laem Chabang Spur - Completed in 1989, the total length of this line is 132 km and was locally financed.

Si Racha - Laem Chabang Spur - Completed in 1994, the total length is 9 km and was partly financed by the 14th OECF loan. Containers from/to Laem Chabang Port are being transported on this line.

Sattahip - Map Ta Phut Railway - This project was in April 1994. Total length of the line is 24 km.

Khlong 19 - Kaeng Khoi Line - This line was completed in May 1995. Total length is 80 km and was planned as a bypass to connect the ESB with Northeastern, Eastern, and Northern Thailand without passing through the central part of Bangkok.

1-1.3.5 Rail Access to Neighboring Countries

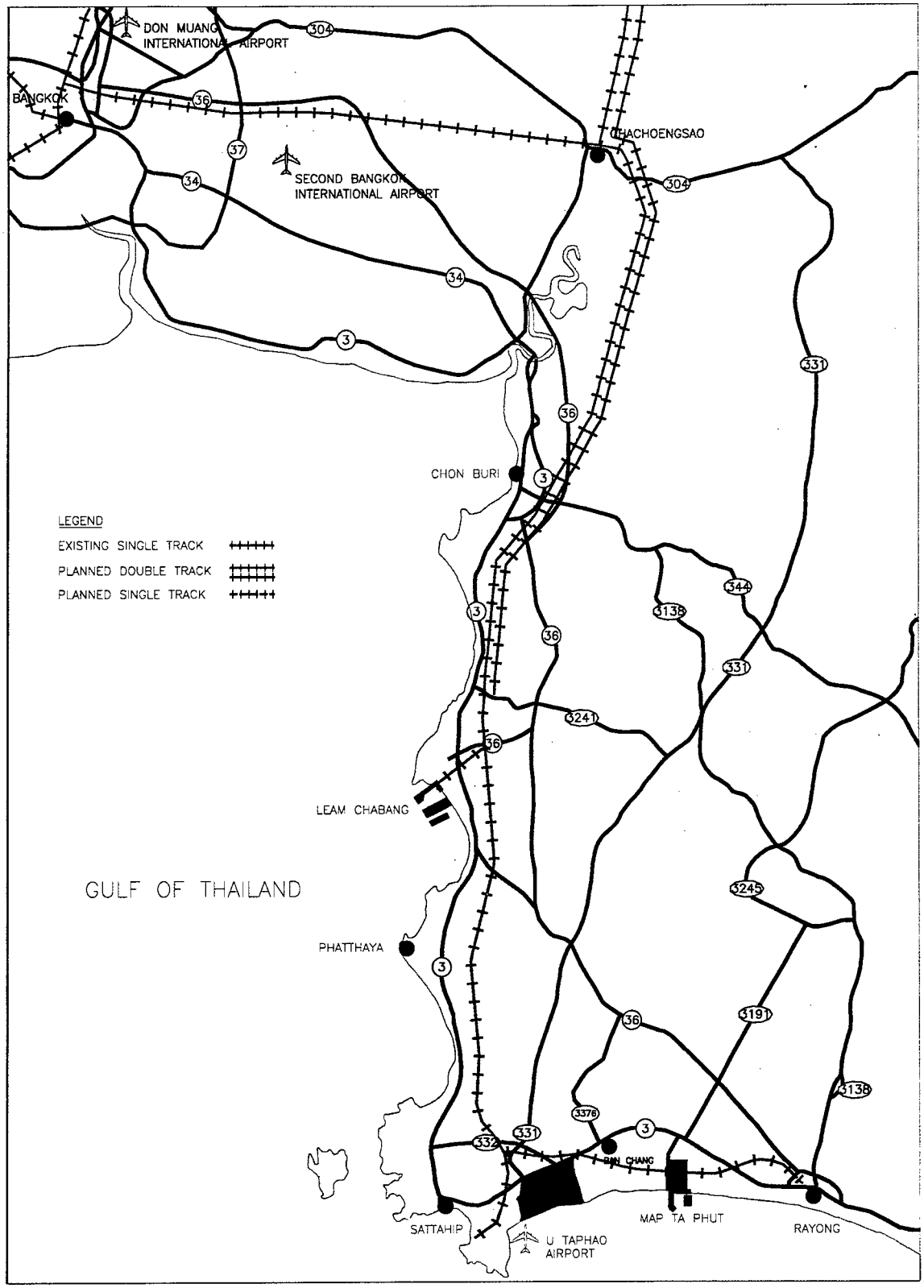
The existing railways leading to neighboring countries are under the jurisdiction of the SRT. The railway routes are located to serve the west, the north, the northeast, the east and the south of Thailand. There are border crossings to Cambodia and Malaysia and approaches to the frontiers of Laos and Myanmar. The border crossing to Cambodia is at Aranyapathet and to Malaysia is at Padding Bazar and Su Ngai Kolok. The approach frontier to Laos is at Nong Khai and to Myanmar is at Saiyok.

The main junction is in Bangkok at Hau Lumphong. The line from Bangkok to U Taphao is called the Eastern Line. It is divided into two lines at Chachoengsao, one line (north) to Kabin Buri goes to Cambodia. The other line (south) goes to Laem Cha Bang, Sattahip and on to Map Ta Phut. Exhibit 1-1.3-2 shows the railway alignment in the vicinity of U Taphao.

1-1.3.6 Summary

The existing and planned railway system of Thailand, once implemented, will adequately serve the GTP and will contribute to its competitiveness with other airports in the region. The only other recommended improvement is to reserve a corridor of land both to and on the site for the future construction of a rail spur from the existing line passing north of the site.

Exhibit 1-1.3-2
Railway Network



1-1.4 Port Development

1-1.4.1 Existing Port Facilities

Most of the large ports in Thailand are managed by the Port Authority of Thailand (PAT). The international ports are located at Khlong Tei in Bangkok, Laem Chabang in Chon Buri; Map Ta Phut in Rayong, Phuket, Songkhla and Suratthani.

The ports closest to the GTP are at Sattahip and Map Ta Phut. Their main function is to support the military mission. The navigable waterway is 11 m in depth, 150 m wide and can berth 20,000 maximum DWT vessels. The port is approximately 10 km from U Taphao Airport.

Map Ta Phut port was built for commercial purposes and serves the Eastern Seaboard. The master plan for the port is divided into three phases. It is currently in the first phase of development which consists of 1 general purpose port for 20,000 DWT vessels, 2 liquid goods ports for 50,000 DWT vessels, 1 port for 2,000-3,000 DWT vessels, 10 m depth, 1,500 m breakwater, warehouse, road, railway and other facilities.

The second phase is planned for 12.50 meter depth to berth vessels of 60,000 DWT and is planned for completion in 1998. The third phase is planned for a depth of 17 m to be able to berth vessels of 150,000 DWT. This phase is scheduled to be completed in 1999. The port is approximately 20 km from U Taphao Airport.

Exhibit 1-1.4-1
Port Projects Planned Under the ESB II Development Program[7]

Location	Cost *(million Baht)*	Estimated Completion Date	Agency
Laem Chabang Area			
Laem Chabang Port Ph. I	NA	1996-1999	NA
Laem Chabang Port Ph. II	NA	2000	NA
Map Ta Phut Area			
Phase III Pier	3,680	1999	IEAT
Phase III pier	3,000	2000	IEAT

Source: Office of the National Economic and Social Development Board.

The existing port at Sattahip has and could continue to provide port facilities for commercial ships providing service to the tenants and users of the GTP. The port is operated by the Royal Thai Navy and is limited in the size of the ships that it can accommodate.

An Office of the Eastern Seaboard (OESB) Report[8] recommends that to manage the international maritime trade and transport, an action plan for a coastal shipping network be formulated in relation with the private participation of Thailand's commercial fleet. In addition, number of coastal ports will also need to be

[7] The Eastern Seaboard Development Program, March, 1997; Office of the Eastern Seaboard Development Committee, Office of the National Economic and Social Development Board.

[8] Ibid.

constructed. This network of ports could conceivably provide alternate transportation of goods for shipment through the GTP.

In discussions with a freight forwarder, it was related that due to the unavailability of cargo space at some airports, freight could reach its final destination quicker if it could be shipped in one or two days to an airport that had available air cargo space. This could be a potential market for port facility/airport intermodal function of the GTP. The airports that could potentially use this procedure are limited to those with heavy air cargo activity and limited capacity for aircraft operations such as Taipei. The development of this potential would require an in-depth and involved market analysis.

1-1.4.2 Conclusions

In order to provide the GTP with full inter-modal transshipment capability, the Sattahip port should be included as a part of the integrated GTP for both cargo and passengers. The port is linked to the airport by the existing roadway and railway systems currently available. The terminal, warehouse, stockyard, loading-unloading facilities and other ancillary facilities should be upgraded to the international standard in the future. It is not forseen that activity in the initial years of the GTP's development will warrant inclusion of these improvements in the initial development phase.

It is effective and economical to develop the ports to open the shipment route to U Taphao via Sattahip port or Map Ta Phut port. Development of the ports along the coast of the Gulf of Thailand will provide the opportunity to ship goods for short distances in large quantities. This potential could possibly serve local heavy industries requiring the import or export of goods or sub assemblies that are required in their manufacturing processes that can be more efficiently handled by sea versus land transport. However, its impact on the use of the cargo facilities at U Taphao could be minimal since goods shipped by sea, like those shipped by rail, are normally not suited for air shipment due to the typical low value to weight ratio.

1-1.5 Airport System

1-1.5.1 Introduction

The airports in Thailand are provided for national defense and commercial purposes. In some cases airports serve both uses, such as Don Muang Airport and U Taphao Airport. The international airports, such as Bangkok, Chiang Mai, Phuket, Hat Yai and Shangri, are managed by the Airport Authority of Thailand (AAT).

Currently, the U Taphao Airport is managed by the co-operation of the Royal Thai Navy (RTN) and the Commercial Aviation Department (CAD). It serves the Navy mission, chartered flight, alternate airport for Don Muang Airport and domestic airline flights of Bangkok Airway from Bangkok to U Taphao and further to Chiang Mai, Phuket, Samui and Huahin.

1-1.5.2 Current Aviation Projects

There are only two aviation-related projects for the ESB known at this time. One is for an air traffic control project estimated at 1,378 million Baht scheduled for implementation from 1996-2000. Current status is unknown at this time. The second project is the subject of this study, the implementation of the Thailand GTP at U Taphao. The U Taphao Airport is promoted to become a gateway for the Southeast Asia Region by establishing the GTP and new Thai Airways Maintenance Facility.[9]

1-1.5.2.a Second Bangkok International Airport

The Second Bangkok International Airport (SBIA) is being developed in conjunction with the construction of a surrounding infrastructure network around the airport.[10] This airport, when completed, will relieve the congestion at Don Muang Airport. The capacity of the Don Muang Airport is limited to the belly cargo capacity of passenger aircraft. It is estimated that this capacity would be exceeded by 2007. If the new airport is not operational, this must be transferred to another airport. The GTP would be the logical alternative if this scenario were to occur.

1-1.5.2.b Improvements at Don Muang Airport

Facilities to increase the cargo capacity of the airport are currently being designed. As mentioned above, this will accommodate the projected cargo activity to the year 2007.

1-1.5.3 Improvements in Air Service

The initiation of air service that could be serviced by the GTP from/to the targated cities, would be beneficial to the industries in these cities and the GTP. Some of the cities could include Chian Grai, Chiang Mai, Mae Hongson, Udonthani, Ubon Ratchathani, Khonkaen, Nakhon Ratchasima, Phuket, Trang, Hatyai, Surat Thani, and Narathiwat. These routes could be serviced by Thai Airways or other concessionaire airline that has the rights.

1-1.6 Water Resources

1-1.6.1 Water Supply Recommendations

The existing water storage volume in approximately 5 years will be 243 x 10^6 m^3 and will total approximately 282 x 10^6 m^3/year in the future when the Khlong Yai reservoir is completed. The water from these reservoirs serves the area from Sattahip to Rayong (an area of about 12 million rai). Exhibit 6.7-1 presents the layout of the water resource and pipe network.

[9] The Eastern Seaboard Development Program, March, 1997; Office of the Eastern Seaboard Development Committee, Office of the National Economic and Social Development Board.

[10] Ibid.

1-1.6.1.a Raw Water Supply

Raw water is needed for fire suppression purposes only unless a light industry locates on the project which requires this water in its manufacturing process. This water can be obtained from the raw water distribution line that parallels Route 3. This line is a 600-mm raw water transmission line that has a flow of 500 m^3/hr and a pressure head of 36.90 m. It is managed by the East Water Co. The raw water will be stored in a pond adjacent to the Welcome Center, and a pump will be installed to provide pressure to the fire suppression distribution system.

A water meter, a storage pond of at least 3000 m^3 and a booster pump capable of an output of 8 m^3/min at a 35-m head will need to be constructed to provide fire protection. The cost for these improvements is included in the initial development phase.

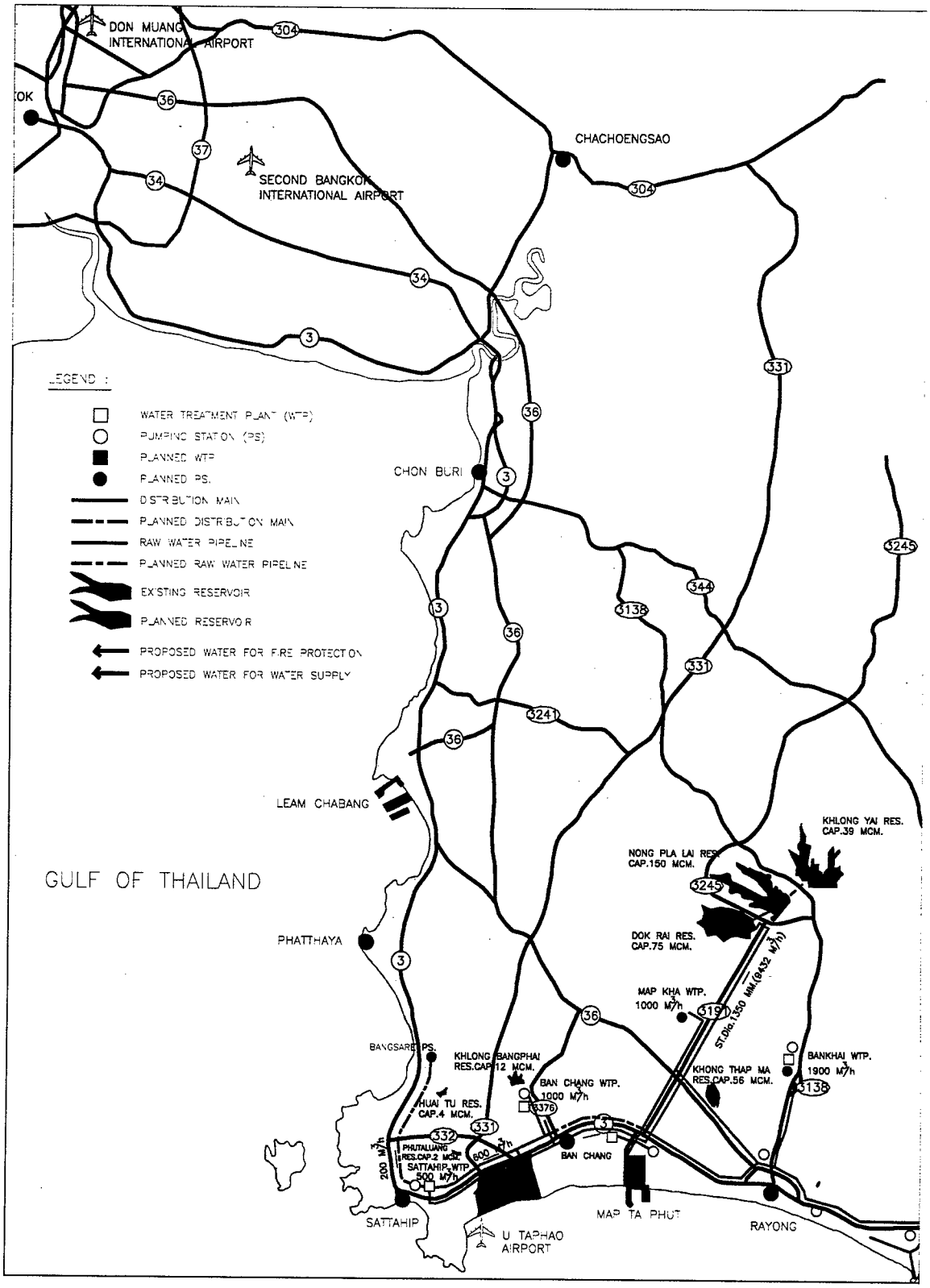
1-1.6.1.b Clear Water Supply

Water Treatment Plant (WTP) - The water treatment plant at Ban Chang is adequate to supply the GTP with clear water to the year 2010. When completed in 1998, it will have a capacity to treat 1000 m^3/hr. The water treatment plant at Sattahip will have a capacity of 500 m^3/hr. The combined outputs of the water plants should be capable of serving the demand in the service area (West Wing) for the forecast period although the estimates show that by the year 2016, the capacity will be marginal. If a treatment plant is necessary sometime in the future, it is proposed to be co-located with the pump for the fire suppression system.

Water Distribution Line - The nearest water distribution line comes from the Ban Chang Water Treatment Facility, which has a water treatment capacity of 600-m^3 per hour. This treatment plant is located 10 km from the site. The water supply for the project can be provided by the Ban Chang WTP distribution line that parallels Route 3. Connections to both the 200 mm and 300 mm diameter PVC distribution lines to be installed at the northeast corner of the project boundary should be adequate for the study period. Additional water supply can be provided through a connection with the planned 600 mm diameter pipe at the junction of main entrance road. The GTP is estimated to have a treated water demand of 12.5 m^3/hr in 2001, 20.1m^3/hr in 2006 and 52.2 m^3/hr in 2016.

The water capacity (peak flow) of the 200-mm diameter PVC distribution line at the probable connection point is 2.55 lps (9.2 m^3/hr) with a pressure of 27.67 m. The 300 mm diameter PVC distribution line will have a flow of 5.23 lps (18.85 m^3/hr) at a pressure of 27.96 m. This flow will not be sufficient to provide the estimated water demand for the GTP. The velocity of the water in the line is low (0.18 mps in the 300 mm diameter line and 0.24 mps in the 200 mm line. It is recommended that the East Water Company investigate the means by which the flow can be increased, either by increasing the pressure in the line or the size of the lines. The required water supply can be provided by constructing the necessary pumping and storage facilities on the site.

Exhibit 1-1.6-1
Water Resources and Distribution Systems



The flow of the planned 600 mm transmission line is 138.89 lps (500 m^3/hr) with a pressure of 39.60 m. When this pipe is installed by the site, a new connection to this source of clear water is recommended.

The water will be stored in storage tanks and further distributed via elevated tank and pump. The cost of these improvements is included in the initial development stage.

1-1.6.2 Existing and Planned Water Supply Systems

1-1.6.2.a Water Reservoirs

According to a March, 1997 OESB Report,[11] 9 sources of water supply in three provinces have been developed. The overall capacity reaches 390 million cubic meters of which, 350 million is available for use.

An ambitious program to develop adequate water supply sources for the southern section of the ESB is being implemented. The sources from which the GTP could receive its water supply are the reservoirs at Klong Bangphai (capacity = 12 million m^3), the Dok Krai Reservoir (capacity = 75 million m^3), and the reservoirs Nong Pla Lai (capacity = 150 million m^3) and Khlong Yai (capacity = 39 million m^3) for a total water storage capacity of 276 million m^3. Reported capacities of these reservoirs vary and could be as high as 280 to 290 million m^3.

The capacity of the existing reservoirs is 86 million m^3 which would allow the development of a maximum of 12 million rai (at 7 m^3 /rai). However, much of this water will be used by other land uses in the area. The Klong Bangphai reservoir is dedicated to use by the Navy (leaving 75 million m^3 for use by the GTP, municipalities, etc.). It would have very little excess capacity for the GTP so the other reservoirs would be the source for the water needs of the GTP.

The naval base currently receives its raw water from the Khlong Bang Pai reservoir, nominal capacity = 8 MCM/year (Military is the only user, 6.6 MCM/year) and Provincial Water Works (PWW). The water supply system for Map Ta Phut comes from the Dok Krai Reservoir via a 26 km, 1,350 mm pipeline.

There are existing and planned reservoirs in the area near U Taphao Airport as shown in Exhibit 1-1.6-1. The effective storage volumes and service areas for the reservoirs are as follows:

[11] The Eastern Seaboard Development Program, March, 1997; Office of the Eastern Seaboard Development Committee, Office of the National Economic and Social Development Board.

Exhibit 1-1.6-2
Reservoir Storage Capacities

Reservoir Name	Effective Storage Volume ($x10^6 m^3$)	Service Area
Phlu Ta Luang	2	Sattahip Naval Base
Huai Tu	4	Royal Initiated project
Khlong Bang Phai	12	Sattahip Naval Base
Dok Rai	75	RID's reservoir serving Map Ta Phut, Banchang and Sattahip
Nong Pla Lai	150	Same as above for Dok Rai
Total	**243**	

The following information was obtained for the main reservoirs that will serve the GTP. It is included here to further substantiate the adequacy or inadequacy of the total water resources that will be available for use in the general vicinity of and at the GTP at U Taphao. The table provides not only the capacity but also the amount of water flowing into the reservoir. It is the amount of water that can be taken out of the reservoir for use in the vicinity to meet the needs of the residents, business and industry.

Exhibit 1-1.6-3
Reservoir Data

	Capacity (MCM)	Avg Ann Inflow (MCM)	Draft Rate (MCM/YR)
Dok Krai (Existing)	75.00	110.17	74.90
Nong Pla Lai (Under Construction)	150.00	127.69	109.40
Khlong Yai	39.00	66.89	49.00
Total	**264.00**	**304.75**	**233.3**

From this table, it is evident that these three reservoirs will have less available water for usage in the area than the capacity of the reservoirs themselves. However in critical periods, it is possible to draw down the water below capacity in order to meet short-term demands.

1-1.6.3 Raw Water Pipe Line Distribution System

A 1,350 mm diameter (2.62 m^3/sec) raw water pipeline has been installed from Dok Rai reservoir to Map Ta Phut. A 900 mm diameter pipeline takes raw water from Map Ta Phut to the Ban Chang Water Treatment Plant (WTP). From there, a 600 mm pipe (500 m^3/hr) that parallels Route 3 passes the U Taphao Airport supplies the Sattahip water treatment plant. The East Water Company manages these water transmission lines and charges 4 Baht/m^3 for the water.

1-1.6.4 Water Treatment Facilities

The Sattahip Naval Base Water Treatment Plant (WTP) is located at the boundary of the U Taphao Airport. The capacity of the WTP is limited to use for Navy compound and existing airport only. The new Thai Airways Maintenance Facility will be supplied by a new clear water pipeline from the Ban Chang WTP. Banchang WTP is

located in Banchang District approximately 10 km from U Taphao Airport. The capacity of the WTP is 100 m^3/hr which is enough to serve the district only. The new 1000 m^3/hr WTP is under construction and is expected to be completed in 1998. This plant is managed by the PWA.

Sattahip WTP is located in Sattahip district approximately 10 km from U Taphao Airport. A new WTP with a capacity of 500 m^3/hr is being constructed and will be completed in 1998. It is also managed by the PWA.

1-1.6.5 Clear Water Distribution System

1-1.6.5.a On-site Water

The only water currently available to the site is that treated by the Navy's WTP on the base and is used for domestic consumption and fire suppression. This source is inadequate for both military and GTP use. In addition, the water treatment plant is old, and its reliability is questionable. Therefore, it is recommended that off-site water supply sources be provided.

1-1.6.5.b Off-site Water

Currently, the nearest water distribution line is at the Ban Chang Water Treatment Facility, which has a capacity of 600 m^3 per hour. This treatment plant is located 10 km from the site. Unfortunately there is no distribution main located near the GTP although the PWA plans to complete one by 1998.

At present, PVC clear water distribution lines of 200 mm and 300 mm diameter are being installed from Banchang WTP along both sides of Route 3 toward Sattahip. Installation of these lines is anticipated for completion in 1998.

1-1.6.6 Planned Water Supply Improvement Projects

The Eastern Seaboard will experience many projects that will improve the quantity and quality of available water. The most relevant of the projects listed in the table is the Bang Chang Water Supply System scheduled for completion in 1998. This will make clear water conveniently available to the project site. Exhibit 1-1.6-4 presents the water supply projects planned under the ESB II development program.[12]

[12] Ibid.

Exhibit 1-1.6-4
Water Supply Projects Planned Under ESB II Development Program[13]

Location	Cost *(million Baht)*	Estimated Completion Date	Agency
Phatthaya City			
Water Supply Expansion Ph III	780	1996	PWA
Regional			
Bang Pakong Dam (30 MCM)	4,322	1999	RID
Sri Yad Dam (325 MCM)	4,016	1999	RID
Klong Yai Dam (41 MCM)	NA	2000	RID
Pra Sae Dam (202 MCM)	4,621	2001	RID
Klong Luang Dam, (98 MCM)	3,717	2001	RID
Chachoengsao – Raw Water Pipeline	1,555	1996	E. Water
Water Supply System	3,317	2000	Private
Chon Buri–Water Supply System	1,652	1998	PWA
Bang Chang - Water Supply System	238	1998	PWA
Sattahip-Bang Sarae-Water Supply System	255	1998	PWA
Rayong-(Map Kho Phase I) Water Supply System	NA	1999	PWA

1-1.6.7 Projected Water Usage

The following table presents the forecast of water usage as estimated in a previous study concerning the joint use of the Royal Thai Naval Base as an international airport. The study was completed in 1991 and did not consider the use of the base as an industrial park. Exhibit 1-1.6-5, presents projected annual water demand by use category for U Taphao International Airport as presented in the study.

Exhibit 1-1.6-5
Projected Annual Water Demand by Use Category[14]
U Taphao International Airport

Use Category	Annual Demand (Million Cubic Meters)		
	Year		
	1990	1995	2005
Military			
Military - U Taphao Air Base	2.3	2.5	3.1
Military - Off-Airport	4.3	4.8	5.8
Military Total	6.6	7.3	8.9
Commercial			
Basic Airport	-	0.1	0.2
Aviation-Related	-	0.3	0.6
Commercial/Industrial	-	-	8.8
Total		**0.4**	**9.6**

The following assumptions were used in the Berger Study (above Exhibit) for water demand forecast.

[13] Ibid.

[14] Feasibility Study and Master Plan for Rayong U-Taphao International Airport, Louis Berger International, Inc. in association with Asian Engineering Consultants Corp., Ltd. and Index International Group Co., Ltd; March, 1991.

- Existing Demand (6.6 MCM) assumed to grow at 2 percent per year through 2005. Commercial Airport demand composed of use by passenger and employees with assumed consumption rates developed for the Bangkok Airport Expansion in 1982, and general land area uses, assumed to be 0.3 cubic meters per rai per day in 1995, increasing to 0.5 in 2005.
- Aviation-related and commercial/industrial uses are expected to be 8 cubic meters per rai per day, with 199 rai of aviation-related use in 1995 and 213 rai in 2005; there will be no commercial/industrial use in 1995 and 3,000 rai in 2005.

The data presented in Exhibit 1-1.6-6 represents a forecast of the total water and clear water demand in the area of influence of the Ban Chang and Sattahip water distribution systems.

Exhibit 1-1.6-6
Total Water Demand Surrounding U Taphao Airport

Item	Description	Annual Demand ($x10^6 m^3$)				Reference
		1990	1995	2000	2005	
1	Airport/related	-	0.4	5	9.6	8 m^3/rai/day
2	Military	10.6	7.9	11.85	12.8	Rayong PWD
3	Sattahip town	1.1	2.82	3.78	4.74	FS & MP
4	Banchang town	0.9	1.26	1.58	1.89	
5	Rayong & Vicinity	10.97	11.75	15.43	19.1	5% growth rate
6	Map Ta Phut /Mapkai	35.8	63.4	77.25	91.1	
8	Bang Sare	-	.0.6	0.8	1.0	RID
9	Royal Initiate Project	-	4	4	4	AICA's report
10	Other			10	13.02	
11	GTP			10.2	228.45	8 m^3/rai/day for year 2000 then 5% annual increase
	Total			**179**	**385.7**	

- Clear Water Demand - The magnitude and type of the development of the GTP at U Taphao are the determining factors in the volume of clear water demand. Since the site will not be conducive to the development of heavy industry, it is not anticipated that heavy treated water usage will be required. The majority of the water used is expected to involve primarily the water needed for domestic purposes.

An analysis of the water usage at the Map Ta Phut Industrial Park shows that the water usage per employee at the park will average 1.41 m^3/day or 1,416 liters/employee/day (lpcd) in September 1994.[15] However, the median consumption was 0.138 m^3/day or 138 lpcd. The average consumption in the Export Processing Zone at Laem Chabang Industrial Estate was .482 m^3/day or 482 lpcd and the median was 73 lpcd.

[15] "Special Assistance for Project Sustainability on Map Ta Phut Industrial/Urban Complex Project and Laem Chabang Industrial Estate Project", SAPS Team for Overseas Economic Cooperation Fund of Japan; February 1995.

Exhibit 1-1.6-7 presents a summary of the data for Laem Chabang and Map Ta Phut water and sewer statistics.

Exhibit 1-1.6-7
Water Usage Statistics - September 1994
Leam Chabang and Map Ta Phut Industrial Estates[16]

	Map Ta Phut General Industrial Zone	Laem Chabang General Industrial Zone	Laem Chabang Export Processing Zone	Average
Total Workers	10,420.00	16,901.00	9,994.00	12,438.33
Water Use - m^3/Mo	130,318.00	129,584.00	13,507.00	91,136.33
Water Use - m^3				
Average	1.4340	0.7969	0.4820	0.90
Maximum	39.9160	2.9143	5.4211	16.08
Minimum	0.0017	0.0000	0.0080	0.00
Median	0.1378	0.3902	0.0731	0.20

Based on the actual water usage at these industrial parks, it is evident that the water usage per industrial park worker ranges widely by type of industrial activity. Probably the more relevant statistic is the median of the daily water usage by the workers. The medians range from 73.1 lpcd to 390 lpcd with a maximum of 39,916 lpcd and a minimum of 1.7 lpcd. The statistic of 0.0000 lpcd is not considered valid due to lack of data presented for the Laem Chabang General Industrial Zone. For purposes of this study, 200 lpcd will be utilized for the estimates of water demand at the GTP, shown in Exhibit 1-1.6-8.

Exhibit 1-1.6-8
Estimates of Clear Water Demand

Item	Description	Projection (Person) m^3/hr				Reference
		1996	2001	2006	2016	
1	Airport/Related					
	Workers	-	1,500	2,416	6,266	Water use =200 lpcd
	cm/hr	-	12.5	20.1	52.2	
	cm/month	-	11,250	18,118	46,994	
2	Military/Sattahip/ Surrounding Area	338	443	567	756	Rayong PWA's MP and FS (1994)
3	Military/Banchang/ Surrounding Area	125	153	188	231	Rayong PWA's MP and FS (1994)
	Total (m^3/hr)	**338**	**13,193**	**21,101**	**1,052**	

[16] Ibid.

1-1.7 Electrical Power Supply

1-1.7.1 Electrical Power Supply for the GTP

Electrical power should be supplied by the local public utility and two sources of power need to be provided. There are two electrical substations near the U Taphao Airport. The first one is Sattahip 2 (115-22kv) and is owned by Electricity Generation Authority of Thailand (EGAT). The Sattahip 2 facility primarily supplies electricity to the naval base. This substation could also serve the airport and the Thai Airways Maintenance Facility currently under construction. The second one is Banchang (115-22kv) and is part of the Provincial Electric Authority (PEA) planning. This substation serves the Banchang district and nearby communities.

1-1.7.1.a Input from Provincial Electric Authority (PEA)

If U Taphao International Airport is to be a commercial airport, another 115 kV/22kV substation should be constructed on site supplied by 115kV transmission lines. The cost of this substation will be paid for by the GTP, but PEA will amortize this cost through a reduction in rates.

The GTP site is near the Navy's Sattahip 2 substation as well as the Ban Chang substation, which is part of PEA's system. The transmission lines should be constructed from these two substations to provide the highest reliability.

The electrical power may not be reliable if the new substation is only connected to the Sattahip 2 substation. Increased security from power interruptions and voltage drops and fluctuations can be provided if the substation is tied to both the Sattahip and Ban Chang grids.

Connecting to the Ban Chang substation as the primary source buying electrical power from PEA, with EGAT's Sattahip 2 substation providing backup power, would make a more dependable electrical power supply.

Certain tenants may need to install emergency, diesel-powered generators for critical activities. This element will not be included in the cost estimates for the development of the GTP. These costs should be borne by the businesses requiring emergency backup power.

1-1.7.1.b Electrical Service

Electrical poles on both sides of Route 3 could be used for the installation of electrical transmission lines to the GTP. The power line from Sattahip 2 substation and Banchang substation can be hung on these poles to the main entrance road of the project, then connected to the GTP's 22 kV transformer and distributed to the user. The cost of these will be paid by both agencies (except for the transformer to the user). The request for electrical service must be applied for early enough for the electrical suppliers to include the necessary improvements in their budgets.

1-1.7.2 Power Availability in the Eastern Seaboard

Thailand's electrical power generation and distribution system is operated by the Electricity Generation Authority of Thailand (EGAT). EGAT will be able to supply the commercial area's power requirements, but advance notice of future requirements should be provided to the authority. The Provincial Electrical Authority (PEA) would install the local distribution system and could be installed either above or below ground (maintenance cost of below ground is approximately 5 times that for above ground installation). Power would be supplied to the site at EGAT's distribution voltage of 230 kV and stepped down at an on-site sub-station (requires 2 rai) to 22 kV for distribution to parcels. [17]

EGAT supplies 4,919.3 MW of electricity. Another 840 MW is generated by private companies. An additional 115 kV transmission line is under construction.

The present capacity of 5,759.3 MW is sufficient for the demand. Some special zones need to be designated in order to ensure the electrical supply for industries. For the future demand, EGAT will increase production capacity by promoting privatization through the Independent Power Producers.

1-1.7.3 Planned Improvements to the Electrical Distribution System

The table on the following page presents planned improvements as presented in the OESB report for the ESB II development phase. [18]

Exhibit 1-1.7-1
Planned Under ESB II (Electrical Distribution System)

Location	Cost *(million Baht)*	Estimated Completion Date	Agency
Laem Chabang Electrical Area	NA	2000	EGAT/PEA
Eastern Seaboard Railway Station	600	1996	EGAT
115 kV Bang Pakong-Chon Buri-Si Racha-Ao Pai	140	1998	PEA
Map Ta Phut	NA	2000	EGAT/PEA
Map Ta Phut 1	NA	1997	PEA
Map Ta Phut 2	NA	1996/96	PEA

Exhibit 1-1.7-2 shows the existing and planned transmission lines and substation system in Central Region Area 2.

[17] Paraphrased from "Feasibility Study and Master Plan for Rayong U-Taphao International Airport", Louis Berger International, Inc. in association with Asian Engineering Consultants Corp., Ltd. and Index International Group Co., Ltd; March, 1991.

[18] The Eastern Seaboard Development Program, March, 1997; Office of the Eastern Seaboard Development Committee, Office of the National Economic and Social Development Board.

Exhibit 1-1.7-2
Existing and Planned Electrical Power Improvements

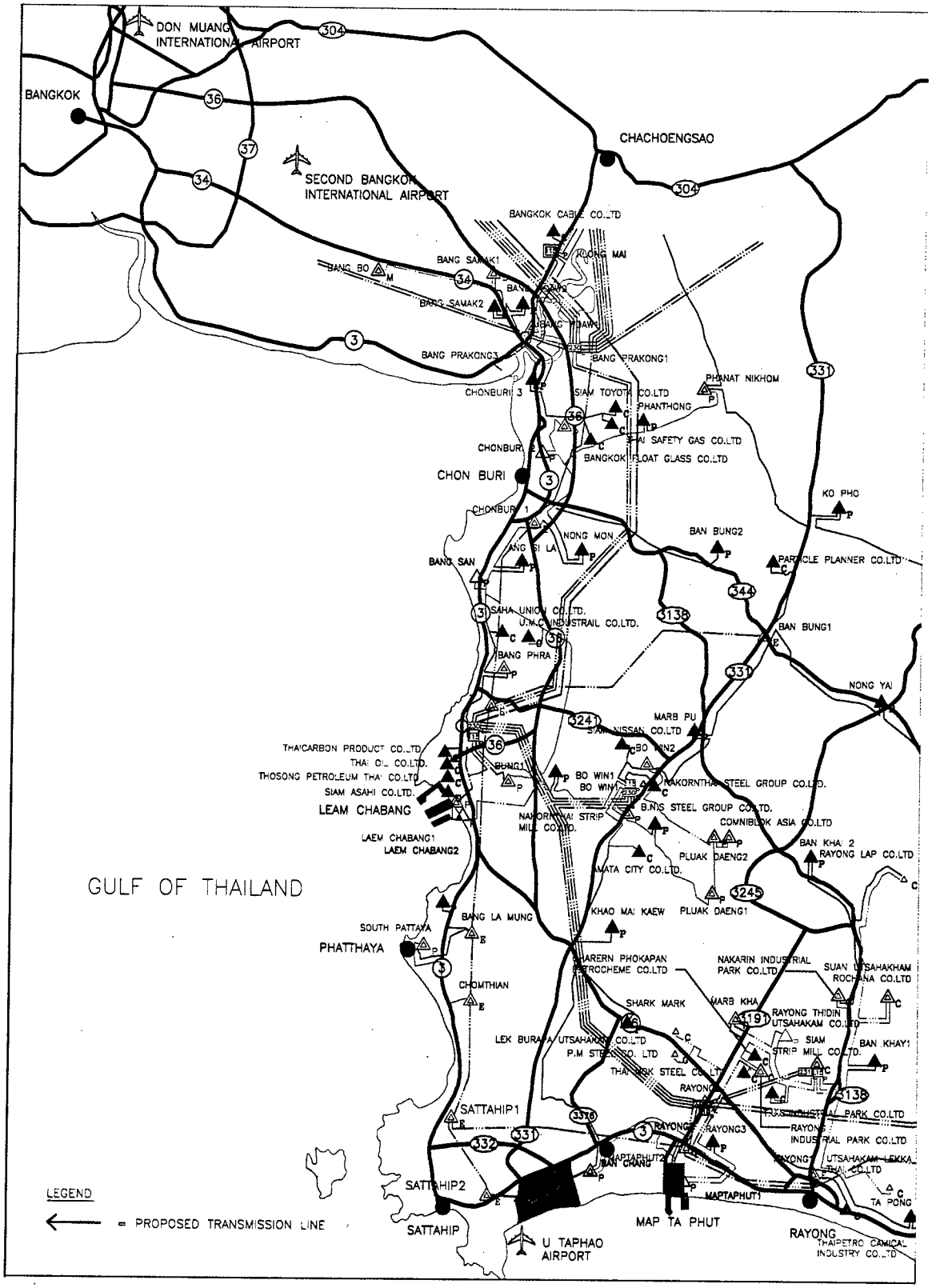


Exhibit 1-1.7-2
Existing and Planned Electrical Power Improvements

P E A L E G E N D

G E N E R A T I O N

EGAT			PEA			Customer			Description
Existing	Under Cons	Planned	Existion	Under Cons	Planned	Existion	Under Cons	Planned	
	115			115					Thermal
									Hydro
			33	33					Solar
									Wind
									Diesel

P E A L E G E N D

S U B S T A T I O N

EGAT			PEA			Customer			Description
Existing	Under Cons	Planned	Existion	Under Cons	Planned	Existion	Under Cons	Planned	
									Switch Stn 500kV
230	230								Switch Stn 230kV
230	230								Termination Stn 230-115/69kV
115	115		115	115					Switch Stn 115kV
									Substation 115-33/22kV
									Substation 69-22/11kV

T R A N S M I S S I O N L I N E

Existing	Under Cons	Planned	Description
			500kV - EGAT
			230kV - EGAT
			115kV - EGAT
			69kV - EGAT
			115kV - PEA
			69kV - PEA

P E A L E G E N D

EXISTING	UNDER CONS	PLANNED	DESCRIPTION
			INDIVIDUAL USER SUB-STATION
			SUB-STATION AS TRANSMISSION LINE DEVELOPMENT PROJECT 1
115	115	115	SWITCHING SUB-STATION AS TRANSMISSION LINE DEVELOPMENT PROJECT 1
			SUB-STATION AS TRANSMISSION LINE DEVELOPMENT PROJECT 2
			SWITCHING SUB-STATION AS TRANSMISSION LINE DEVELOPMENT PROJECT 2
			SUB-STATION AS TRANSMISSION LINE DEVELOPMENT PROJECT 3
115			SWITCHING SUB-STATION AS TRANSMISSION LINE DEVELOPMENT PROJECT 3
			SUB-STATION AS TRANSMISSION LINE DEVELOPMENT PROJECT 4
115			SWITCHING SUB-STATION AS TRANSMISSION LINE DEVELOPMENT PROJECT 4
			SUB-STATION (ADDITIONAL) AS TRANSMISSION LINE DEVELOPMENT PROJECT 4
115			SWITCHING SUB-STATION (ADDITIONAL) AS TRANSMISSION LINE DEVELOPMENT PROJECT 4
			SUB-STATION AS TRANSMISSION LINE DEVELOPMENT PROJECT 5
115			SWITCHING SUB-STATION AS TRANSMISSION LINE DEVELOPMENT PROJECT 5
			SUB-STATION AS TRANSMISSION LINE DEVELOPMENT PROJECT 6
115			SWITCHING SUB-STATION AS TRANSMISSION LINE DEVELOPMENT PROJECT 6

1-1.8 Wastewater Treatment

The base currently has a sewer treatment plant that is underutilized since it was built to accommodate a fully complemented U.S. military installation. Preliminary discussions regarding the possible use of this wastewater treatment plant lead to the conclusion that it would be better to use a system independent of the existing facility since it is old and perhaps undependable. A very long trunk line (4000 + meters) would need to be installed with at least one lift station. The facility will be capable of treating domestic wastewater only. Any industry generating wastewater not compatible with the treatment facility would be required to treat this industrial wastewater prior to sending it to the wastewater treatment facility. Alternatively, the waste generator could provide other procedures to dispose of and treat the industrial wastewater.

Recommendation: It is recommended that a package treatment plant be installed capable of handling 380 m^3/day. This will handle the wastewater treatment demand throughout the period covered by this study. If unexpected growth is experienced, the reserve capacity will be available. The proposed location of the treatment facility is shown on the Master Plan Drawing.

1-1.8.1 Wastewater Generation Rates

In order to determine approximate volumes of wastewater that will be generated at GTP, an analysis of the wastewater generation rates at Map Ta Phut and Laem Chabang Industrial Estates was conducted. The data was not for all tenants of these industrial estates and the accuracy cannot be confirmed. However, the analysis indicates that the generation rates are reasonable compared to GTC's experience in other areas when regional generation rates are considered. Exhibit 1-1.8-1 presents the results of that analysis.

1-1.8.2 Wastewater Projections

To develop an estimate of the wastewater generation at the GTP, the nature of the industrial activities anticipated must be considered. Since there will likely not be any heavy industrial activity requiring high water usage rates and the subsequent high wastewater generation rates, a lower generation rate for the GTP could be utilized.

The Laem Chabang and Map Ta Phut General Industrial Zones have some fairly heavy industrial uses that would not be characteristic of the GTP. It would be more similar to the Export Processing Zone (EPZ) at Laem Chabang. The wastewater generation rates for the EPZ range from 0.4 liters per capita per day (lpcd) to 135.6 lpcd with an average of 28.8 lpcd and a median generation rate of 8.7 lpcd. Therefore, it would seem evident that a daily average generation rate per worker at the GTP should fall between 8.7 lpcd as a minimum and 28.8 lpcd as an average. However, considering that the data presented did not include the wastewater generation rates for all the industries at the EPZ, the actual rates could be higher or lower than those in the table. For purposes of this study, it is assumed that the wastewater generation rate for the GTP will be 1.5 times the rate of the average for the EPZ or 43.2 lpcd. This represents 21.6 percent of the daily water usage factor used to determine the clear water demand. This percentage for the Laem Chabang EPZ is 16.7. This is to be

expected since domestic wastewater would represent a larger portion of the total wastewater generated at an industrial site with lighter industrial uses.

Exhibit 1-1.8-1
Sewage Generation Statistics
Leam Chabang and Map Ta Phut Industrial Estates
September 1994 Statistics

	Map Ta Phut General Industrial Zone	Laem Chabang General Industrial Zone	Laem Chabang Export Processing Zone	Average
Total Workers	372	16,901	9,994	9,089
Sewage (m^3/mo)	8,000	1,260	4	3,088
Sewage Generation Rates – m^3/day				
Average	1.6054	0.2644	0.0004	0.62
Maximum	17.5824	0.5013	0.0004	6.03
Minimum	0.0007	0.0275	0.0004	0.01
Median	0.3657	0.2644	0.0004	0.21
Amount of Water, Sewage Projected by the Factories in Contract Application Forms				
Total Workers	372	16,901	303	5,858.62
Sewage (m^3/mo)	8,000	3,366	144	3,836.65
Sewage Generation Rates – m^3/day				
Average	0.3225	0.0259	0.0288	0.13
Maximum	1.7224	0.1572	0.1356	0.67
Minimum	0.0012	0.0011	0.0004	0.00
Median	0.1140	0.0116	0.0087	0.04

Exhibit 1-1.8-2
Estimates of Wastewater Volume

Description	Projections				Reference
	1996	2001	2006	2016	
					Wastewater
Workers	-	1500	2416	6266	Generation Rate =
m^3/day	-	65	104	271	43.2
m^3/month	-	94,224	3,120	8,130	lpcd

It is recommended that a package treatment plant be installed capable of handling 380 m^3/day. This will handle the wastewater treatment demand throughout the period covered by this study. If unexpected growth is experienced, the reserve capacity will be available. The proposed location of the treatment facility is shown on the Master Plan Drawing.

1-1.9 Telecommunications Systems

The Telephone Organization of Thailand (TOT) has planned to build the telephone junction in the requested area of U Taphao Airport on about 2 rai in this year, 1997. This junction will be linked to Map Ta Phut Teleport by optical fiber cable on the existing TOT and PEA's poles. This junction will be serviced for 1,536 telephone numbers with the other communication lines. This plan is in TOT's budget and expected to be completed in 1998.

In 1996, the TOT installed 20,000 new numbers in the industrial estates of which 11,000 numbers are available. In addition, the Communication Authority of Thailand (CAT) has

installed junctions for 3,000 international lines at Sri Racha which will make 2 million additional numbers available.

There are telephone junctions at Sattahip and Banchang, but the new lines for this project are not installed. Exhibit 1-1.9-1 shows the planned telecommunication updates under ESB II.

Exhibit 1-1.9-1
Telecommunication Update Planned Under ESB II

Location	Cost *(million Baht)*	Estimated Completion Date	Agency
Laem Chabang Area Teleport			
Domestic Telephone	NA	1999	TOT
International Telephone (3000 circuits)	970	1994	TOT
Laem Chabang Telecommunication Center	42	1995	TOT
Map Ta Phut Area Teleport			
Domestic Telephone	NA	2000	TOT
International (3000 circuits)	57	1996	CAT
Map Ta Phut Telecommunication Center	NA	1995	CAT

According to a March, 1997 OESB Report, TOT has already installed 20,000 new lines in the industrial estates, of which 11,000 numbers are available. In addition, the Telecommunication Authority of Thailand (TAT) has installed 3,000 telephone junctions at Sri Racha which will make 2 million additional lines available.

The telecommunications system in the area has the capacity to accommodate the GTP for some years into the future. No improvements are recommended at this time.

1-1.10 Natural Gas

Natural gas is convenient for supply to the GTP with the major gas facilities and the gas transmission lines serving the Map Ta Phut operations (Exhibit a.10-1). The need for providing the infrastructure to provide gas service to the site is not apparent at this time since heavy, energy intensive industry is not anticipated.

The nature of the GTP is such that there may be a need to provide short-term refrigeration or freezer facilities. Should this circumstance occur, it would be due to investment from the private sector and provisions could be made at that time to secure the energy required. It would be the responsibility of the investors to secure the service and incur the cost of the provision of the service. However, the opportunity may present itself to the governing authority of the GTP to entice multiple tenants requiring natural gas availability. In this event, the investment to provide gas to the GTP could be a public/private joint venture.

Provision of gas service to the site would require the installation of approximately 11 kilometers of transmission line from Map Ta Phut. It is felt that investment in this facility in the initial development stage is not warranted but should be considered on an industry specific, as-needed basis.

1-1.11 Conclusions

Based on the information provided and GTE's analysis, we find that the infrastructure in the Eastern Seaboard, in Thailand, and around the GTP is fully capable of supporting the development of the GTP in a competitive environment. The highway and railway networks are in the process of being upgraded to international standards, taking into consideration the local travel demands. The only recommendation GTE presents in this aspect is that all significant projects be carried out at the earliest possible date with high priorities placed on the improvements of Routes 331, 304 and the construction of Route 36.

Our findings concluded that there is sufficient electrical power and natural gas supplies to support the GTP. Water reservoirs, treatment and distribution facilities, and telecommunications are adequate and will not detract from the competitiveness of the GTP. Other services such as wastewater treatment and fire suppression services are to be provided as part of the development plan.

APPENDIX 1-2

INFRASTRUCTURE INVESTIGATION

Infrastructure Investigation of Proposed Global Transpark Site at U-taphao Naval Air Base

Location :- East boundary of U-taphoa Naval Air Base (see map; area No. 2)

Duration :- Jan 29-31, 97 and Feb 5-6, 97

Survey team :- ACT's Personnels by :-
Mr. Attaporn Yodkaew
Mr. Phadungsak Changsakul
Mr. Kriengkrai Petchnoum

Assignment :-
- Supporting environmental study team lead by Mark G. Thompson during Jan 29-31,97
- Survey of existing infrastructure during Jan 29-31, 97
- Supporting environmental study team lead by F. Christopher Purkiss during Feb. 5-6, 97

Contacted Persons at Site :-

1. LCDR Pairoj Klinboon (Naval Air Base Coordinator)
   U-taphao Airport Authority, U-taphao International Airport
   Banchang, Rayong 21130
   Tel. (038) 245196, 466180 ext. 067, 3677, 3676

2. Dr. David A. Doble
   Advisor, Royal Thai Naval Air Division
   U-taphao RTNB, Rayong
   Tel. Office (038) 245193 ; Mobile (01) 3567424
   Home (038) 245186 ext. 6355

Detail of infrastructure survey activities :-

The survey activity of existing infrastructure has been initially planned to cover the whole proposed area of No. 2 (see enclosed map), east of runway which commenced on Jan 29, 97. Advance notice of activities involved at any location and arrangement of navy escort was made and set on daily basis through the coordinating officer prior to begin surveying on each day. Also, extra cost of 1,000 Bht./d as escort fee paying to off-duty officers for helping to escort in the proposed site is necessary. However, the survey activity was called off temporarily during the mission on Jan 31, 97 until further instruction due to the amendment of scope of work as required in the TOR, this results in incomplete surveying.

Partial Results :- Parts of road network, electricity supply and other facilities have been preliminary investigated basing on existing condition and the secondary information appeared in the inventory list (the Feasibility Study and Master Plan of U-taphao Air Base Inventory carried out during July - Sept. 1990 by Louis Berger International, Inc.)

1. Road Network

The road system consists of Outer and Inner perimeter road networks within the boundary of the proposed area which are connecting to other Naval Air Base facilities and numbers of secondary roads serving former locations of "BASE AMMO STORAGE & BOOSTER INSTALLATION FACILITIES", "OPEN AMMO STORAGE" and "B-52 BUNKER" Most of these road are left without maintenance. Sparse vegetation seems to cover all side pavement of the roads, and some are heavily covered road surface with dense vegetation (see table 1- 4 and photo No. 1-13)

1.1 Road Condition :-

Surface condition is appeared to be ranging from good to poor condition varying on each route and location.

1.2 Surface Type : are classified into Dirt surface type (Laterilte) and Asphaltic surface type as follows :-

1.2.1 Dirt surface type

Total distance of Outer and Inner perimeter road networks are poor condition of Dirt-surface with few sections of Asphaltic surface.

1.2.2 Asphaltic surface type

The secondary road networks connecting between and within the former locations of "BASE AMMO STORAGE & BOOSTER INSTALLATION FACILITIES", "OPEN AMMO STORAGE" and "B-52 BUNKER"are mostly in good to fair condition. Only some parts are poor due to lacking of maintenance. (see picture 1-13 and table 1)

2. Electricity Power Supply :-

Overhead low tension lines and under ground cable networks to facilitate street lighting and power supply to the proposed site seem to be disappeared due to villagers involving in scrap metal collection activities. The system was installed in 1963, and left unused after the U.S. force withdrawal from the base many years ago. The only area with temporary power supply is the site of the-being-built aircraft maintenance center of Thai International Airways. Further investigation of transmission and nearby substation for possible future supply will be investigated upon survey activities resumed normal.

3. Water Supply

Basic information recieved during a short investigation indicates that the U-taphao Naval Air Base produces its own water supply just enough for present consumption. Raw water is pumped to the treatment plant on west boundary from the "Phutianand Resevoir" about 4 km. northwest of the base (see enclosed map).

Pending :- Further investigation.

Table No. 1 Existing Condition of Road Network :- Outer & Inner Roads
Location :- Proposed Area on East Side of R/W

Ref. No. of Road	Name of Road	Start Point	Ending Point	Route Alignment	Type of surface	Dimension WxL (meter)	Pavement Condition
66	Outer perimeter	Bridge 8012	North gate	At 250 m. from bridge 8012 around bomb area to the northern gate	Dirt	2.50 x 7500	Poor
67	Inner perimeter	outer perimeter	Parallel 1st street	From inner perimeter run parallel to outer perimeteruntil meet the outer perimeter for 1	Dirt	2.50 x 1280	Poor
68	Inner perimeter	Demolition area	outer perimeter	At about 450 m. from bridge RTN 8013 run to perimeter road	Dirt	2.50 x 1300	Poor
69	Parallel to 10th street	Near A street	Inner perimeter	100 m. from 9th street run to meet inner perimeter road	Dirt	2.50 x 1450	Poor
70	Inner perimeter	Near A street	outer perimeter	At about 600 m. from northern gate run to outer perimeter road	Dirt	3.00 x 1100	Poor
71	Inner perimeter	Runway parallel road	outer perimeter	From the road to taxiway # 2E, passing bridge RTN 8013, end at outer perimeter road	Dirt	3.00 x 1800	Poor

Table No. 1 Existing Condition of Road Network :- Outer & Inner Roads (Continued)
Location :- Proposed Area on East Side of R/W

Ref. No. of Road	Name of Road	Start Point	Ending Point	Route Alignment	Type of surface	Dimension WxL (meter)	Pavement Condition
72	outer perimeter	Localizer	Bridge RTN 8012	From localizer run parallel to beach passing bridge RTN 8012 about 250 m.	Asphalt	6.40 x 1440	Poor
74	Parallel runway to TW #2E	outer perimeter	Taxiway # 2E	From outer perimeter near the shoreline passing TACAN, to Taxiway #2E	Asphalt	6.40 x 2840	Poor
76	Parallel to 1st street	inner perimeter	1st street	From 1st street run parallel to 1 st street to outer perimeter road	Asphalt	4.10 x 960	Poor

Table No. 2 Existing Condition of Road Network :- Base Ammo Storage & Booster Installation Facilities
Location :- Proposed Area on East Side of R/W

Ref. No. of Road	Name of Road	Start Point	Ending Point	Route Alignment	Type of surface	Dimension WxL (meter)	Pavement Condition
88	8th street	D street	Dead end	From 8th street across F street util dead end	Asphalt	6.10 x 500	Fair
89	9th street	Near runway	A street	From the road parallel to the runway, run to end at A street	Asphalt	6.40 x 580	Good
90	9th street	A street	F street	From A street across B, D, and end at F street	Asphalt	8.80 x 950	Poor
92	10th street	A street	Bridge RTN 8014	From A street run across B, D, F street and passing bridge RTN 8014 50 m.	Asphalt	7.30 x 1020	Good
108	Connect 7th and 9th street	7th street	9th street	From 7th street to 9th street	Asphalt	6.40 x 250	Good
109	Connect 7th and 10th street	7th street	10th street	From 7th street to 10th street	Asphalt	7.00 x 390	Good

Table No. 3 Existing Condition of Road Network :- Open Ammo Storage
Location :- Proposed Area on East Side of R/W

Ref. No. of Road	Name of Road	Start Point	Ending Point	Route Alignment	Type of surface	Dimension WxL (meter)	Pavement Condition
75	1st street	A street	Junction	From A street run to the junction	Asphalt	7.40 x 680	Good
76	Parallel to 1st street	inner perimeter	1st street	From 1st street run parallel to 1 st street to outer perimeter road	Asphalt	4.10 x 960	Poor
77	1st street	Junction	L street	From the junction across C, D, E, F, G, H, I, J, K and end at L street	Asphalt	6.10 x 850	Good
78	2nd street	D street	J street	From D street across E, F, G, H, I streets to end at J street	Asphalt	6.20 x 470	Good
79	2nd street	K street	L street	From K street to end at L street	Asphalt	6.20 x 80	Good
80	3rd street	D street	J street	From D street across E, F, G, H, I streets to end at J street	Asphalt	6.20 x 470	Good
81	3rd street	K street	L street	From K street to end at L street	Asphalt	6.20 x 80	Good

Table No. 3 Existing Condition of Road Network :- Open Ammo Storage (Continued)
Location :- Proposed Area on East Side of R/W

Ref. No. of Road	Name of Road	Start Point	Ending Point	Route Alignment	Type of surface	Dimension WxL (meter)	Pavement Condition
82	4th street	D street	J street	From D street across E, F, G, H, I street to end at J street	Asphalt	6.20 x 470	Good
83	4th street	K street	L street	From K street to end at L street	Asphalt	6.20 x 80	Good
84	5th street	B street	L street	From B street across C, D, E, F, G, H, I, J, M, K street and end at L street	Asphalt	6.40 x 780	Good
85	6th street	D street	J street	From C street across D, E, F, G and end at J street	Asphalt	6.20 x 320	Good
86	6th street	M street	L street	From M street across K and end at L street	Asphalt	6.20 x 160	Good
87	7th street	A street	L street	From A street across B, C, D, E, F, G, bridge RTN 8015, M, K to end at J street	Asphalt	6.20 x 1480	Good

Table No. 3 Existing Condition of Road Network :- Open Ammo Storage (Continued)
Location :- Proposed Area on East Side of R/W

Ref. No. of Road	Name of Road	Start Point	Ending Point	Route Alignment	Type of surface	Dimension WxL (meter)	Pavement Condition
95	B street	5th street	10th street	From one end of 5th street run across 7th, 9th and end at 10th street	Asphalt	5.90 x 830	Fair
96	C street	1st street	7th street	From 1st street across 5th, street and end at 7th street	Asphalt	6.80 x 1250	Good
97	D street	1st street	10th street	From 1st street across 5th, 7th, 8th, 9th and end at 10th street	Asphalt	10.40 x 1650	Good
98	E street	1st street	7th street	From 1st street across 2nd, 3rd, 4th, 5th, 6th and end at 7th street	Asphalt	10.40 x 1250	Good
99	F street	1st street	10th street	From 1st street across 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 9th and end at 10th street	Asphalt	10.40 x 1650	Good
100	G street	1st street	7th street	From 1st street across 2nd, 3rd, 4th, 5th, 6th and end at 7th street	Asphalt	10.40 x 1250	Good
101	H street	1st street	5th street	From 1st street across 2nd, 3rd, 4th and end at 5th street	Asphalt	10.40 x 820	Good

Table No. 3 Existing Condition of Road Network :- Open Ammo Storage (Continued)
Location :- Proposed Area on East Side of R/W

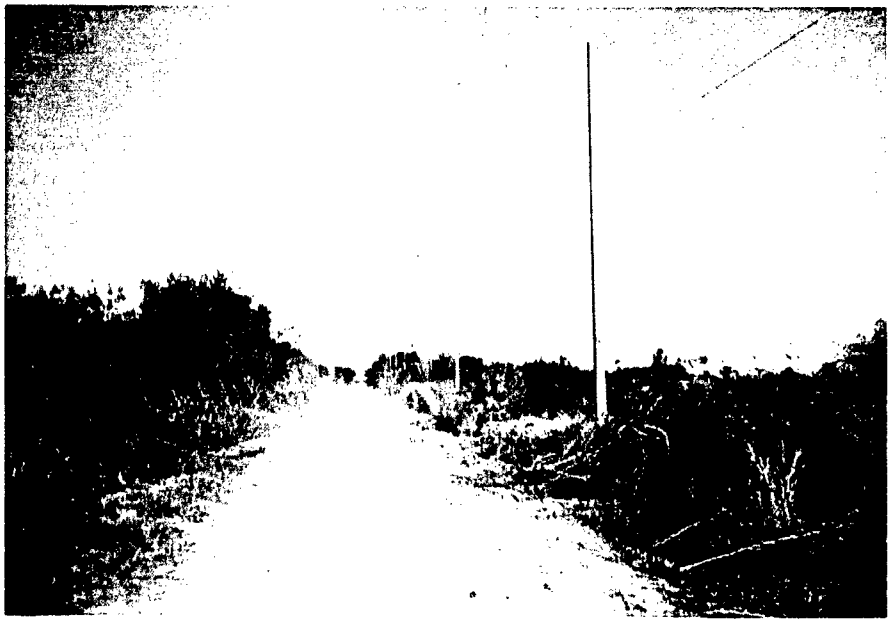
Ref. No. of Road	Name of Road	Start Point	Ending Point	Route Alignment	Type of surface	Dimension WxL (meter)	Pavement Condition
102	I street	1st street	4th street	From 1st street across 2nd, 3rd and end at 4th street	Asphalt	10.40 x 620	Good
103	M street	5th street	7th street	From 5th street across 6th and end at 7th street	Asphalt	10.40 x 420	Good
104	K street	1st street	7th street	From road parallel to 1st street across 2nd, 3rd, 4th, 5th, 6th and end at 7th street	Asphalt	10.40 x 1250	Good
105	J street	1st street	6th street	From 1st street across 2nd, 3rd, 4th, 5th and end at 6th street	Asphalt	6.20 x 1150	Good
106	L street	1st street	7th street	From 1st street across 2nd, 3rd, 4th, 5th, 6th and end at 7th street	Asphalt	10.40 x 1250	Good

Table No. 4 Existing Condition of Road Network :- B-52 Bunker
Location :- Proposed Area on East Side of R/W

Ref. No. of Road	Name of Road	Start Point	Ending Point	Route Alignment	Type of surface	Dimension WxL (meter)	Pavement Condition
91	T/W # 2E to RTN 5166	Taxiway #2E	RTN 5166	From taxiway # 2E run parallel to A street to RTN 5166 (former fuel station)	Asphalt	7.40 x 580	Fair
93	A street	1st street	Revetment	From 1st street to end at revetment	Asphalt	6.80 x 450	Good
94	A street	Revetment	10st street	From revetment run across 7th street and end at 10th street	Asphalt	6.80 x 300	Good

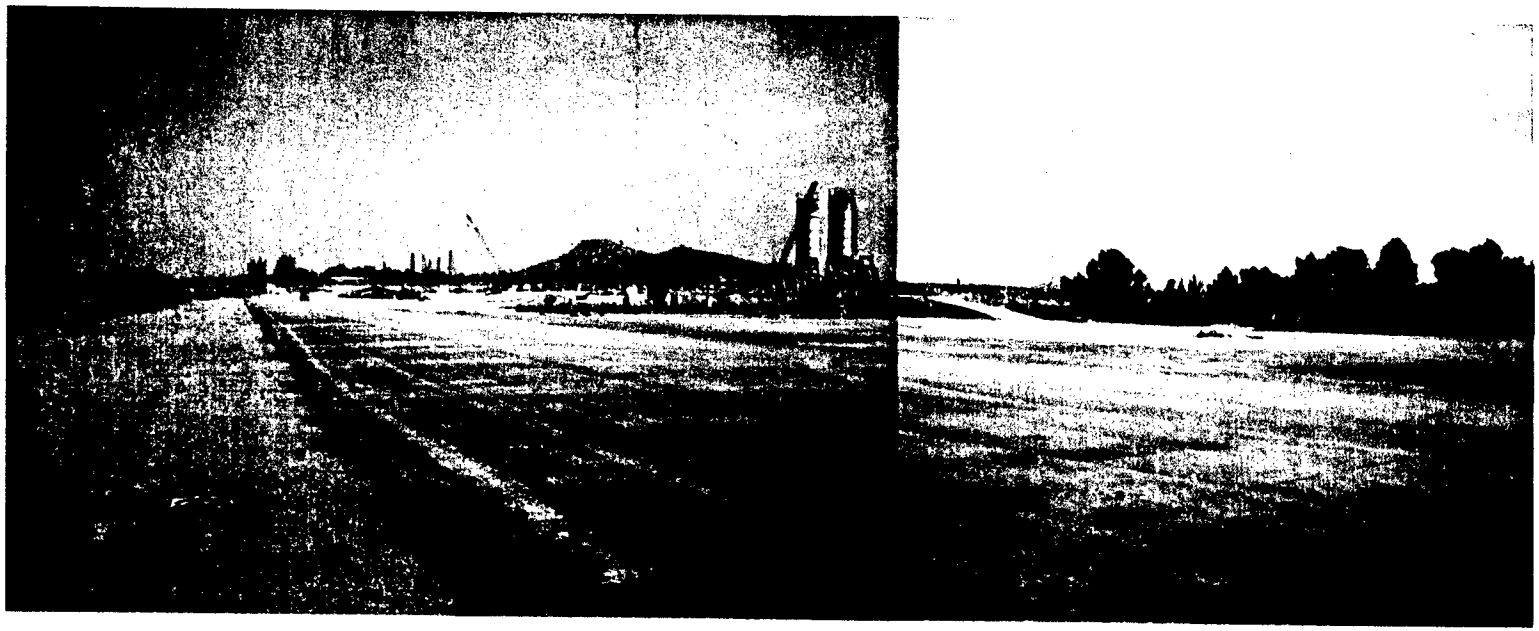
Picture 1 Poor Condition of Outer Perimeter Road East Side of the Project Area

Picture 2 Poor condition of Inner Perimeter Road North East Side of the Project Area



Picture 3 A Part of good condition of Inner Perimeter Road

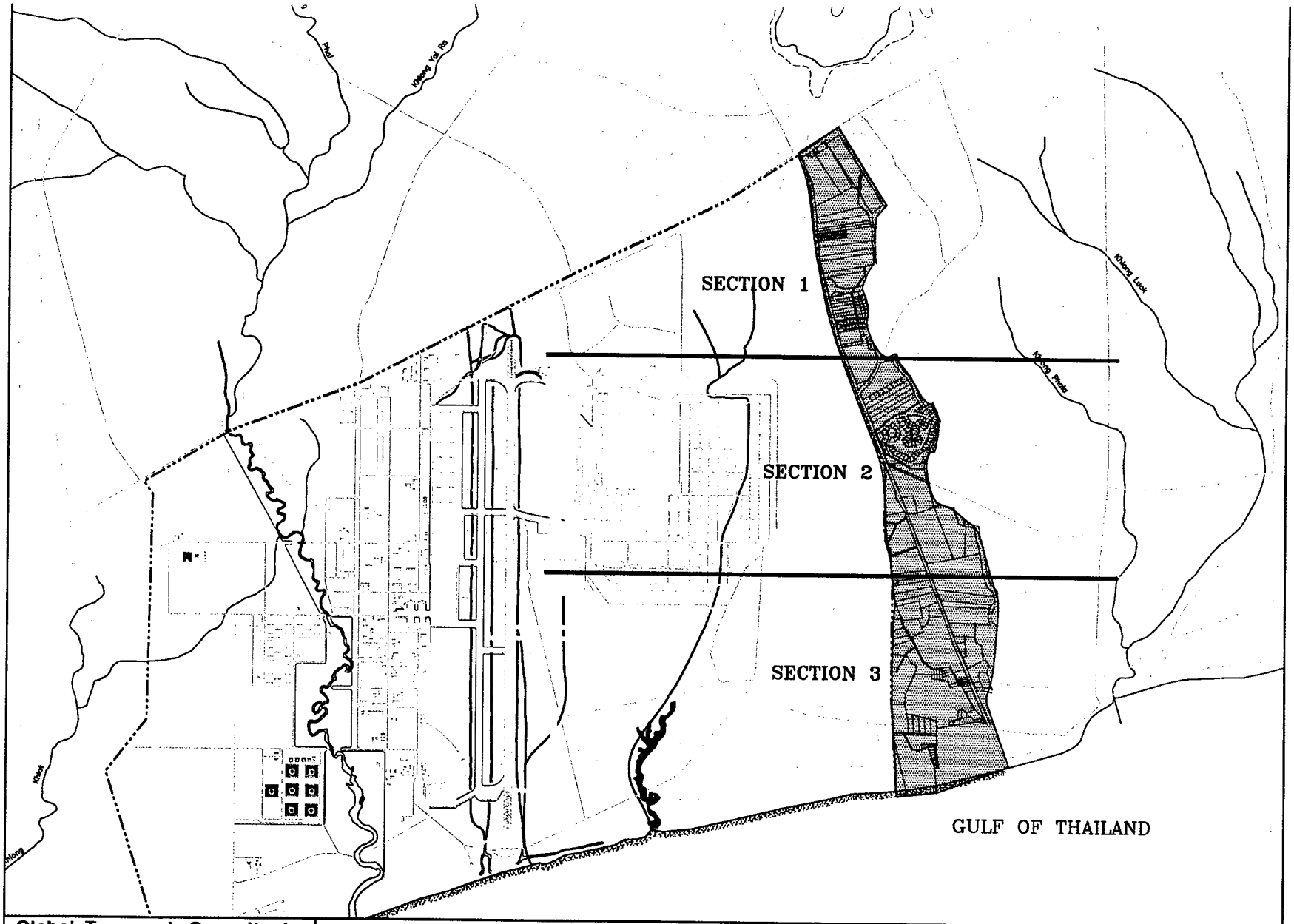
Picture 4 A Part of good condition of Inner Perimeter Road



Picture 5 A street

APPENDIX 1-3

PROPERTY BOUNDARY SURVEY



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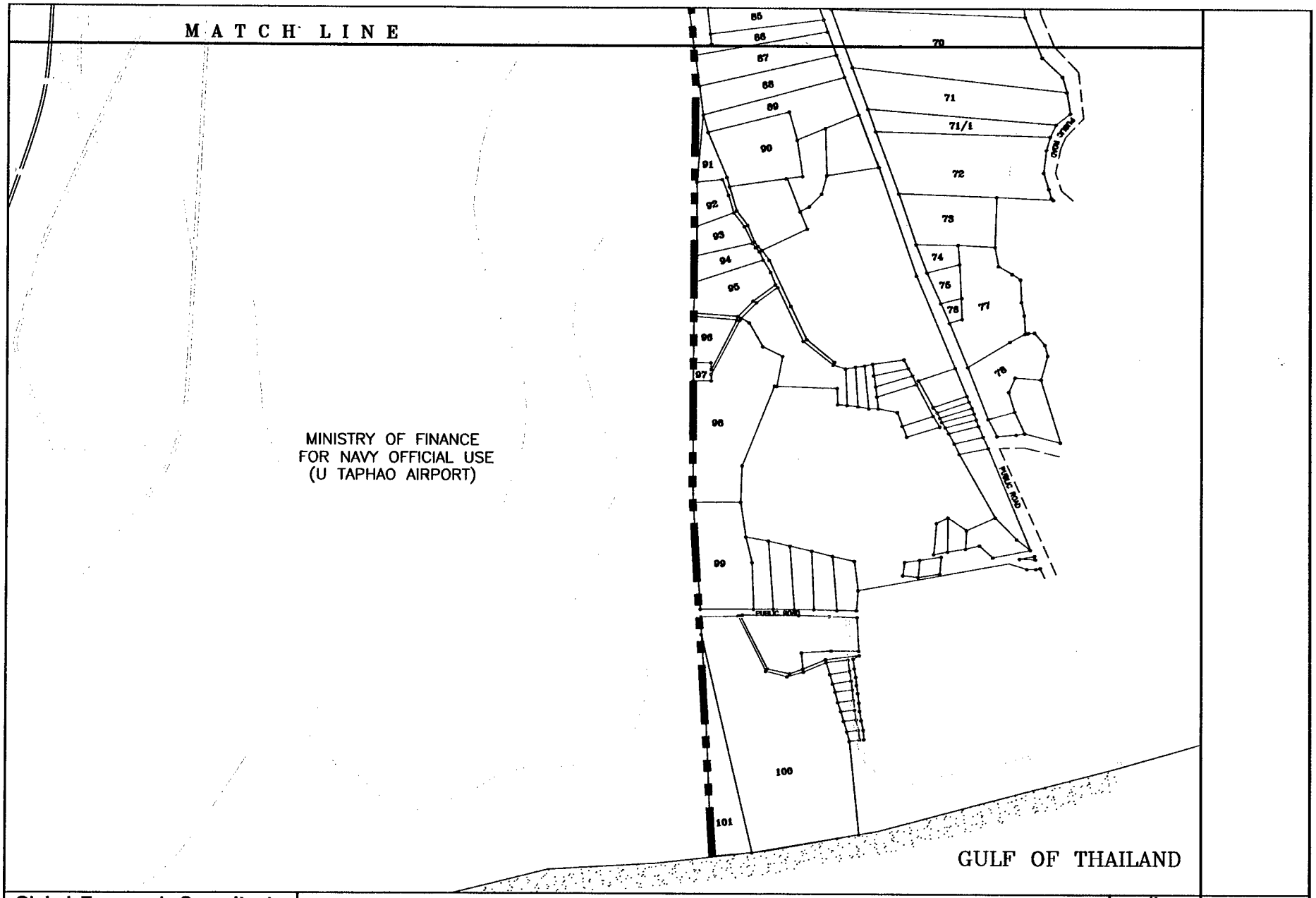
THAILAND GLOBAL TRANSPARK
EAST PROPERTY BOUNDARY SURVEY
AREA MAP

N

SCALE: 1mm = 40m
DATE: January, 1996
0 400 800

U-PROP



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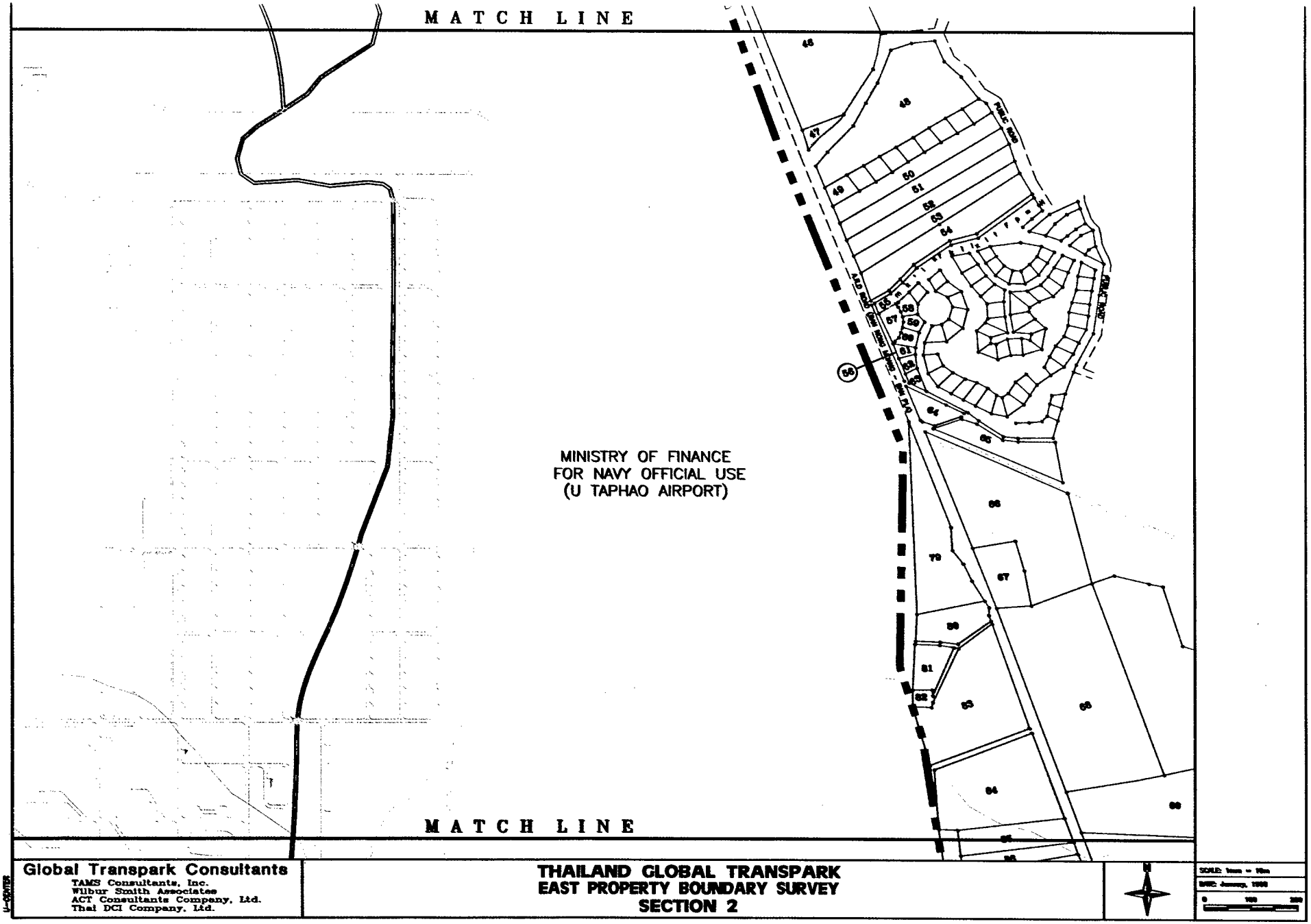
THAILAND GLOBAL TRANSPARK
EAST PROPERTY BOUNDARY SURVEY
SECTION 3

N

SCALE: 1mm = 10m
DATE: January, 1998
0 100 200

U-SOUTH



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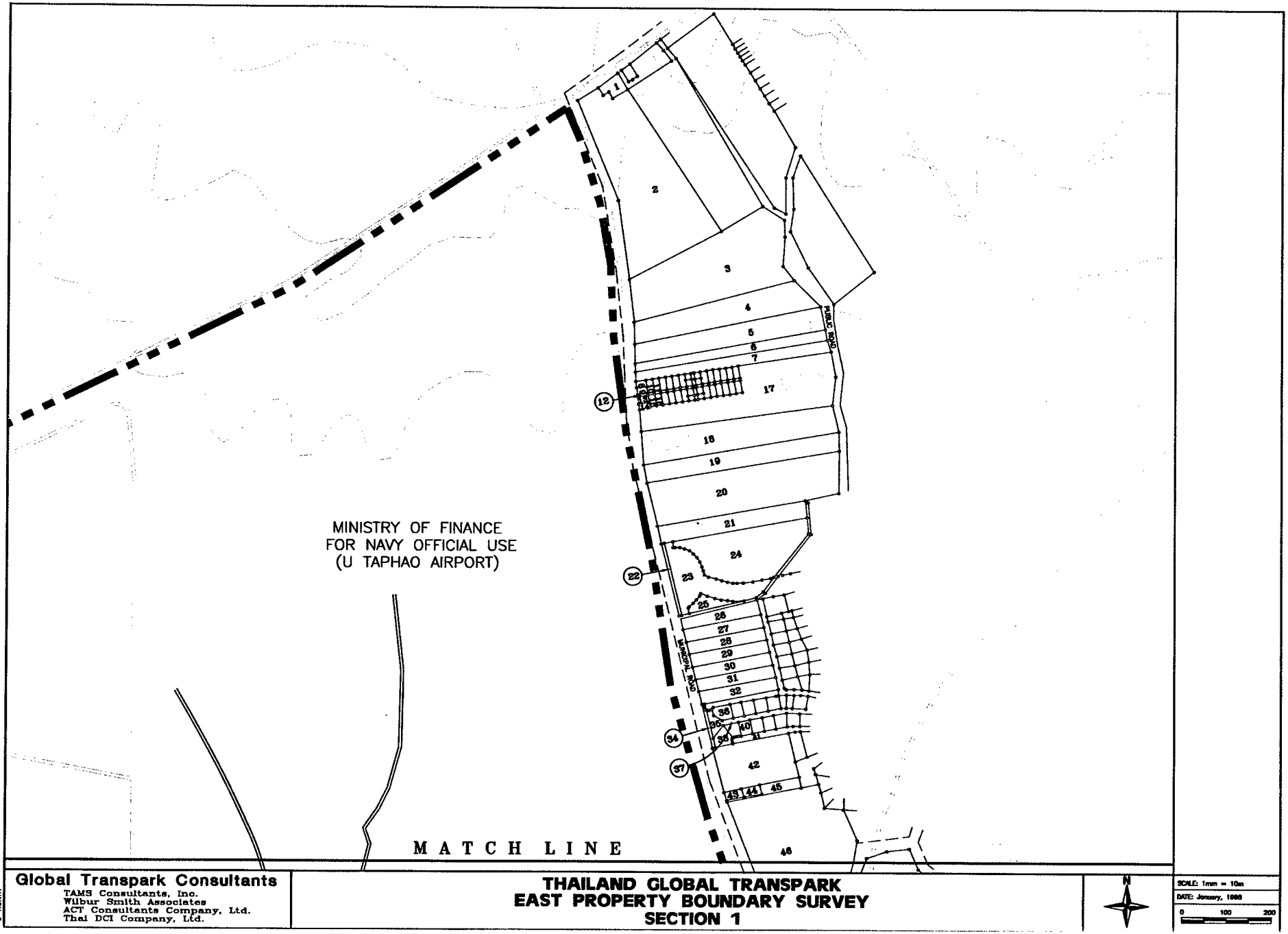
THAILAND GLOBAL TRANSPARK
EAST PROPERTY BOUNDARY SURVEY
SECTION 2



Global Transpark Consultants
TAMS Consultants, Inc.
Wilbur Smith Associates
ACT Consultants Company, Ltd.
Thai DCI Company, Ltd.

THAILAND GLOBAL TRANSPARK
EAST PROPERTY BOUNDARY SURVEY
SECTION 1

N

SCALE: 1mm = 10m
DATE: January, 1996
0 100 200

U-NORTH

NAMING LIST OF LAND OWNERS (บัญชีรายชื่อเจ้าของที่ดิน)

Item Number	Land Documentation		Land Liability	Land Plot Number	Land Plot Survey Number	Area (Rai)	Estimated Price/Rai (Baht)	Land Owner's Name	Address	Remark
	Title Deed Number	Nor Sor 3 Gor Number								
	หลักฐานที่ดิน						ราคาประเมินต่อไร่			
ลำดับที่	โฉนดที่ดิน เลขที่	น.ส. 3 ก. เลขที่	ระวางที่ดิน	เลขที่ดิน	หน้าสำรวจ	เนื้อที่ (ไร่)	(บาท)	รายชื่อเจ้าของที่ดิน	ที่อยู่	หมายเหตุ
1	918		5234 III	1	3984	1-0-38.6	2,400,000	นางเสริมศิริ กังสัมฤทธิ์	351/7-8 ถนนสีลม แขวงสีลม เขตบางรัก กรุงเทพฯ	
2			2004	2	3277	36-2-44.2	2,400,000	ที่มีการครอบครอง		
3	159		2004	3	3415	27-2-08.4	400,000	นายอภิโชติ จิตรานนท์	171/1 แขวงวัดกัลยาณี เขตธนบุรี กรุงเทพฯ	
4			2004	4	3276	13-3-76.9	400,000	น.ส.สวาท มิ่งทองคำ	38 ม. 4 ต.พลา อ.บ้านฉาง จ.ระยอง	
5	7819		2004-1	1	6940	11-3-59	400,000	นายป่วน อาจน้อย	45 ม. 2 ต.พลา อ.บ้านฉาง จ.ระยอง	
6	7099		2004-1	2	6941	5-3-92.0	400,000	นายสมศักดิ์ สำเร็จ	109 ถนนตากสินมหาราช ต.ท่าประดู่ อ.เมืองฯ จ.ระยอง	
7	7820		2004-1	3	6942	6-0-88.0	400,000	นางสุทธา สำเร็จ	173 ถนนตากสินมหาราช ต.ท่าประดู่ อ.เมืองฯ จ.ระยอง	
8		2903	30	79		0-0-73	400,000	นางทองดี ปิ่นโมรา	2 ม.2 ต.พลา อ.บ้านฉาง จ.ระยอง	
9		2904	30	80		0-0-74	400,000	นางทองดี ปิ่นโมรา	2 ม.2 ต.พลา อ.บ้านฉาง จ.ระยอง	
10		2905	30	81		0-0-98	400,000	นางทองดี ปิ่นโมรา	2 ม.2 ต.พลา อ.บ้านฉาง จ.ระยอง	
11		2906	30	82		0-0-98	400,000	นางทองดี ปิ่นโมรา	2 ม.2 ต.พลา อ.บ้านฉาง จ.ระยอง	
12		1382	30	38		1-0-50	400,000	ทางสาธารณาประโยชน์		
13		2939	30	115		0-0-78	400,000	นายปทุม เหมือนแก้ว	17/1 ม.2 อ.เมืองฯ จ.ปทุมธานี	
14		2938	30	114		0-0-79	400,000	นายปทุม เหมือนแก้ว	17/1 ม.2 อ.เมืองฯ จ.ปทุมธานี	
15		2937	30	113		0-0-79	400,000	นายปทุม เหมือนแก้ว	17/1 ม.2 อ.เมืองฯ จ.ปทุมธานี	
16		2936	30	112		0-0-98	400,000	นายปทุม เหมือนแก้ว	17/1 ม.2 อ.เมืองฯ จ.ปทุมธานี	
17		9	30	682			400,000	ที่มีการครอบครอง		
18	น.ส.3 เลขที่ 614/339						400,000	ที่มีการครอบครอง		
19	10357		2004	95	8202	10-3-40.0	400,000	นางทองอยู่ ธรรมศร	49 ม.2 ต.พลา อ.บ้านฉาง จ.ระยอง	
20	7818		5234 III	1	6939	22-3-56	400,000	นางสำนึยง โมกขศักดิ์	49 ม.2 ต.พลา อ.บ้านฉาง จ.ระยอง	
21	7098		2004-3	2	6938	8-0-24	400,000	นางสำนึยง โมกขศักดิ์	49 ม.2 ต.พลา อ.บ้านฉาง จ.ระยอง	
22	7133		2004-3	3	7896	0-2-49	400,000	บ. อิสเทอร์นสตาร์รีสอร์ท จก.	65/14-15 ถนนสุขุมวิท ต.บ้านฉาง อ.บ้านฉาง จ.ระยอง	

NAMING LIST OF LAND OWNERS (บัญชีรายชื่อเจ้าของที่ดิน)

Item Number	Land Documentation		Land Liability	Land Plot Number	Land Plot Survey Number	Area (Rai)	Estimated Price/Rai (Baht)	Land Owner's Name	Address	Remark
	Title Deed Number	Nor Sor 3 Gor Number								
ลำดับที่	หลักฐานที่ดิน โฉนดที่ดิน เลขที่	น.ส. 3 ก. เลขที่	ระวางที่ดิน	เลขที่ดิน	หน้าสำรวจ	เนื้อที่ (ไร่)	ราคาประเมินต่อไร่ (บาท)	รายชื่อเจ้าของที่ดิน	ที่อยู่	หมายเหตุ
23	7978		2004-3	4	7895	8-1-50.0	400,000	บ. อิสเทอร์นสตาร์รีสอร์ท จก.	65/14-15 ถนนสุขุมวิท ต.บ้านฉาง อ.บ้านฉาง จ.ระยอง	
24	7132		2004-3	5	7894	15-0-45	400,000	บ. อิสเทอร์นสตาร์รีสอร์ท จก.	65/14-15 ถนนสุขุมวิท ต.บ้านฉาง อ.บ้านฉาง จ.ระยอง	
25	7134		2004-3	6	7897	1-0-94	400,000	บ. อิสเทอร์นสตาร์รีสอร์ท จก.	65/14-15 ถนนสุขุมวิท ต.บ้านฉาง อ.บ้านฉาง จ.ระยอง	
26		1273	30	14		3-0-17	400,000	นางไพเราะ เปี่ยมพงษ์สานต์	65/9 ม.3 ต.พลา อ.บ้านฉาง จ.ระยอง	
27	7097		2004-3	7	6937	3-0-06	400,000	นายทองคำ ทองนุ่ม	57 ม.2 ต.พลา อ.บ้านฉาง จ.ระยอง	
28		1278	30	19		3-0-16	400,000	นางไพเราะ เปี่ยมพงษ์สานต์	65/9 ม.3 ต.พลา อ.บ้านฉาง จ.ระยอง	
29	7288		2004-3	8	6936	3-0-08	400,000	นางรัญจวน ทองนุ่ม	55 ม.2 ต.พลา อ.บ้านฉาง จ.ระยอง	
30		1276	30	17		3-0-16	400,000	นายเคชา ยังให้ผล กับพวก	60 ม.5 แขวงบางปะกอก เขตราษฎร์บูรณะ กรุงเทพฯ	
31	7096		2004-3	9	6935	3-0-00	400,000	นายวิจารณ์ ทองนุ่ม	63 ม.2 ต.พลา อ.บ้านฉาง จ.ระยอง	
32	7095		2004-3	10	6934	3-0-08	400,000	นางสมศรี สุดใจเพ็ชร	63/1 ม.2 ต.พลา อ.บ้านฉาง จ.ระยอง	
33	6882		2004-3	37	7348	1-1-00.0	400,000	บ. อิสเทอร์นสตาร์เรียลเอสเตท จก.	65/14-15 ถนนสุขุมวิท ต.บ้านฉาง อ.บ้านฉาง จ.ระยอง	
34	7112		2004-3	38	7355	0-1-30	400,000	บ. อิสเทอร์นสตาร์เรียลเอสเตท จก.	65/14-15 ถนนสุขุมวิท ต.บ้านฉาง อ.บ้านฉาง จ.ระยอง	
35	6888		2004-3	39	7354	0-2-58	400,000	บ. อิสเทอร์นสตาร์เรียลเอสเตท จก.	65/14-15 ถนนสุขุมวิท ต.บ้านฉาง อ.บ้านฉาง จ.ระยอง	
36	6887		2004-3	40	7353	0-2-96	400,000	บ. อิสเทอร์นสตาร์เรียลเอสเตท จก.	65/14-15 ถนนสุขุมวิท ต.บ้านฉาง อ.บ้านฉาง จ.ระยอง	
37	6886		2004-3	41	7352	0-1-97	400,000	บ. อิสเทอร์นสตาร์เรียลเอสเตท จก.	65/14-15 ถนนสุขุมวิท ต.บ้านฉาง อ.บ้านฉาง จ.ระยอง	
38	6889		2004-3	50	7356	0-3-25	400,000	บ. อิสเทอร์นสตาร์เรียลเอสเตท จก.	65/14-15 ถนนสุขุมวิท ต.บ้านฉาง อ.บ้านฉาง จ.ระยอง	
39	6890		5234 III	51	7357	0-1-84	400,000	บ. อิสเทอร์นสตาร์เรียลเอสเตท จก.	65/14-15 ถนนสุขุมวิท ต.บ้านฉาง อ.บ้านฉาง จ.ระยอง	
40	6891		2004-3	52	7358	0-0-49	400,000	บ. อิสเทอร์นสตาร์เรียลเอสเตท จก.	65/14-15 ถนนสุขุมวิท ต.บ้านฉาง อ.บ้านฉาง จ.ระยอง	
41	6895		2004-3	58	7362	0-3-72	400,000	บ. อิสเทอร์นสตาร์เรียลเอสเตท จก.	65/14-15 ถนนสุขุมวิท ต.บ้านฉาง อ.บ้านฉาง จ.ระยอง	
42	7094		2004-3	11	6933	10-0-69	400,000	นายสุรพันธ์ จึงเจริญพาณิชย์	303 ถ.เจริญกรุง แขวงป้อมปราบ เขตป้อมปราบศัตรูพ่าย กรุงเทพฯ	
43	6639		2004-3	12	6932	0-1-96	400,000	นายบุญเหลือ ธิโกศรี	64/1 ม.2 ต.พลา อ.บ้านฉาง จ.ระยอง	
44	6638		2004-3	13	6931	0-1-96	400,000	นางสมพร สุทธิศรี	64/1 ม.2 ต.พลา อ.บ้านฉาง จ.ระยอง	

NAMING LIST OF LAND OWNERS (บัญชีรายชื่อเจ้าของที่ดิน)

Item Number	Land Documentation		Land Liability	Land Plot Number	Land Plot Survey Number	Area (Rai)	Estimated Price/Rai (Baht)	Land Owner's Name	Address	Remark
	Title Deed Number	Nor Sor 3 Gor Number								
ลำดับที่	หลักฐานที่ดิน		ระวางที่ดิน	เลขที่ดิน	หน้าสำรวจ	เนื้อที่ (ไร่)	ราคาประเมินต่อไร่ (บาท)	รายชื่อเจ้าของที่ดิน	ที่อยู่	หมายเหตุ
	โฉนดที่ดิน เลขที่	น.ส. 3 ก. เลขที่								
45	7817		2004-3	14	6930	1-1-44.0	400,000	นางลำยอง หิรัญเรือง กับพวก	509 ม.1 ต.สัตหีบ อ.สัตหีบ จ.ชลบุรี	
46	7884		2002-1	1	7179	37-3-21	400,000	นายพากเพียร วิริยะพันธุ์ กับพวก	1024 ถนนพระรามสี่ แขวงทุ่งมหาเมฆ เขตสาธร กรุงเทพฯ	
47		495	44	2		1-2-03.0	400,000	นางประนอม ผ่องแผ้ว	ต.พลา อ.บ้านฉาง จ.ระยอง	
48		496	44	3		14-1-67	400,000	นายพงษ์ศักดิ์ ขวัญพลากร	12 ม.7 ต.มาบตาพุด อ.เมืองฯ จ.ระยอง	
49			2002	67		10-0-84	400,000	ที่มีการครอบครอง		
50	4687		2002	68	5782	9-2-35.0	400,000	นางสมศรี เสาวรส กับพวก	79/44 ม.1 ต.พลา อ.บ้านฉาง จ.ระยอง	
51	4770		2002	69	5848	9-2-51.0	400,000	นายวิชัย สุขสุกนธ์	54/10 ม.4 แขวงสวนหลวง เขตประเวศ กรุงเทพฯ	
52	4769		2002	70	5847	9-1-92.0	400,000	นางเสริม พานทอง	27/11 ม.5 ต.ท่าข้าม อ.บางปะกง จ.ฉะเชิงเทรา	
53	4768		2002	71	5846	9-3-04.0	400,000	นายสาย ทับมี	26 ม.2 ต.พลา อ.บ้านฉาง จ.ระยอง	
54	น.ส.3						400,000	ที่มีการครอบครอง		
55		188	45	11		24-3-70	400,000	บ. อิสเทอร์นสตาร์รีสอร์ท จก.	65/14-15 ถนนสุขุมวิท ต.บ้านฉาง อ.บ้านฉาง จ.ระยอง	
56	7985		2002-1	2	7906	1-0-54	400,000	บ. อิสเทอร์นสตาร์รีสอร์ท จก.	65/14-15 ถนนสุขุมวิท ต.บ้านฉาง อ.บ้านฉาง จ.ระยอง	
57	7130		2002-1	3	7570	1-2-33.0	400,000	บ. อิสเทอร์นสตาร์รีสอร์ท จก.	65/14-15 ถนนสุขุมวิท ต.บ้านฉาง อ.บ้านฉาง จ.ระยอง	
58	7432		5234 III	198	7571	0-3-74	400,000	บ. อิสเทอร์นสตาร์รีสอร์ท จก.	65/14-15 ถนนสุขุมวิท ต.บ้านฉาง อ.บ้านฉาง จ.ระยอง	
59	7434		2002-2	199	7573	0-2-99	400,000	บ. อิสเทอร์นสตาร์รีสอร์ท จก.	65/14-15 ถนนสุขุมวิท ต.บ้านฉาง อ.บ้านฉาง จ.ระยอง	
60	7210		2002-2	200	7574	0-3-40	400,000	บ. อิสเทอร์นสตาร์รีสอร์ท จก.	65/14-15 ถนนสุขุมวิท ต.บ้านฉาง อ.บ้านฉาง จ.ระยอง	
61	7102		2002-2	4	7257	1-1-43.0	400,000	บ. อิสเทอร์นสตาร์รีสอร์ท จก.	65/14-15 ถนนสุขุมวิท ต.บ้านฉาง อ.บ้านฉาง จ.ระยอง	
62	7131		2002-2	5	7891	4-1-76.0	400,000	บ. อิสเทอร์นสตาร์รีสอร์ท จก.	65/14-15 ถนนสุขุมวิท ต.บ้านฉาง อ.บ้านฉาง จ.ระยอง	
63	7213		2002-2	201	7577	0-3-34	400,000	บ. อิสเทอร์นสตาร์รีสอร์ท จก.	65/14-15 ถนนสุขุมวิท ต.บ้านฉาง อ.บ้านฉาง จ.ระยอง	
64	4531		2002	84	5845	2-3-47.0	400,000	นายระพินทร์ ยมจินดา	84/1 ม.5 ต.พลา อ.บ้านฉาง จ.ระยอง	
65	125		2002	1	3362	7-2-60.8	400,000	นายบุญทัน คิดแสวง	61 ม.5 ต.พลา อ.บ้านฉาง จ.ระยอง	
66	126		2002	2	3363	37-2-34.1	400,000	นายไพโรจน์ เปี่ยมพงษ์สานต์	99/3 ม.6 ต.พลา อ.บ้านฉาง จ.ระยอง	

NAMING LIST OF LAND OWNERS (บัญชีรายชื่อเจ้าของที่ดิน)

Item Number	Land Documentation		Land Liability	Land Plot Number	Land Plot Survey Number	Area (Rai)	Estimated Price/Rai (Baht)	Land Owner's Name	Address	Remark
	Title Deed Number	Nor Sor 3 Gor Number								
	หลักฐานที่ดิน									
ลำดับที่	โฉนดที่ดิน เลขที่	น.ส. 3 ก. เลขที่	ระวางที่ดิน	เลขที่ดิน	หน้าสำรวจ	เนื้อที่ (ไร่)	ราคาประเมินต่อไร่ (บาท)	รายชื่อเจ้าของที่ดิน	ที่อยู่	หมายเหตุ
67	79		2002	3	3365	7-2-92.2	400,000	นางอารมย์ เหลืองย่อน	255/2 ถ.ตากสินมหาราช ต.ท่าประดู่ อ.เมือง จ.ระยอง	
68	160		2002	4	3364	56-0-83.5	400,000	นายหมึก ในเมือง	62 ม.5 ต.พลา อ.บ้านฉาง จ.ระยอง	
69	82		2002	6	3316	34-1-56.4	400,000	นายเกษม วิศวพลานนท์	123/29 แขวงลุมพินี เขตปทุมวัน กรุงเทพฯ	
70	81		2002	7	3315	35-0-43.5	400,000	นายเกษม วิศวพลานนท์	123/29 แขวงลุมพินี เขตปทุมวัน กรุงเทพฯ	
71	80		2002	8	3314	9-2-39.9	400,000	นายเกษม วิศวพลานนท์	123/29 แขวงลุมพินี เขตปทุมวัน กรุงเทพฯ	
71/1	9515		2002	20	8195	19-3-09.6	400,000	บ.เจริญสุขวิลเลจ จก.	9 ซ.ศูนย์วิจัย 5 แขวงบางกะปิ เขตห้วยขวาง กรุงเทพฯ	
72	4741		2000	108	5873	27-1-91	400,000	บ.จิรทรัพย์ จก.	1996 ถนนเพชรบุรีตัดใหม่ แขวงบางกะปิ เขตห้วยขวาง กรุงเทพฯ	
73	4750		2000	111	5952	11-3-34.0	400,000	นางปัทมา วงศ์วเรี ถับพวก	25/8 ม.9 แขวงลาดพร้าว เขตลาดพร้าว กรุงเทพฯ	
74	623		2000	2	3875	2-2-74.9	400,000	นายเยนก บูรณะสิน	188-190 ม.6 ต.ท่าสะอ้าน อ.บางปะกง จ.ฉะเชิงเทรา	
75	1296		2000	3	4288	2-2-00.0	400,000	นายบรรพต บูรณะสิน	1306 ถ.มิตรภาพ ต.ในเมือง อ.เมือง จ.นครราชสีมา	
76	1295		2000	4	4287	1-0-00	400,000	นางพยงค์มาศ บูรณะสิน	524 ม.1 ต.สำโรงเหนือ อ.สมุทรปราการ จ.สมุทรปราการ	
77	4850		5234 III	112	5961	16-0-28	400,000	นางถนก สุวรรณ	38/3 ม.5 ต.พลา อ.บ้านฉาง จ.ระยอง	
78	4742		2000	113	5875	9-2-26.0	400,000	นายชวลิต แสนไพศาล	67 ม.1 ต.พลูตาหลวง อ.สัตหีบ จ.ชลบุรี	
79		6336	44	12		12-3-44.0	400,000	นายนิกร พงษ์นาวิน	38 ม.5 ต.พลา อ.บ้านฉาง จ.ระยอง	
80		2010	44	15		8-0-50	400,000	นายจรูญ พรหมเวช	70 ม.3 ต.พลา อ.บ้านฉาง จ.ระยอง	
81							400,000	ที่มีการครอบครอง		
82							400,000	ที่มีการครอบครอง		
83			44	4			400,000	ที่มีการครอบครอง		
84	666		2002	14	3841	24-3-52.3	400,000	น.ส.พรรณนิภา พจรนิรันดร์	734 ม.2 ถนนประชาอุทิศ แขวงห้วยขวาง เขตห้วยขวาง กรุงเทพฯ	
85	646		2002	13		8-0-83.5	400,000	นางสุมาลี คำนวณศิลป์		
86	1057		2002	12	4166	5-0-00	400,000	น.ส.อำไพ การุญ	70 ม.2 ถนนร้านอำไพ ต.ปากน้ำประแส อ.แกลง จ.ระยอง	
87	1058		2002	11	4167	10-2-04.4	400,000	น.ส.อำไพ การุญ	70 ม.2 ถนนร้านอำไพ ต.ปากน้ำประแส อ.แกลง จ.ระยอง	

NAMING LIST OF LAND OWNERS (บัญชีรายชื่อเจ้าของที่ดิน)

Item Number	Land Documentation		Land Liability	Land Plot Number	Land Plot Survey Number	Area (Rai)	Estimated Price/Rai (Baht)	Land Owner's Name	Address	Remark
	Title Deed Number	Nor Sor 3 Gor Number								
ลำดับที่	หลักฐานที่ดิน โฉนดที่ดิน เลขที่	น.ส. 3 ก. เลขที่	ระวางที่ดิน	เลขที่ดิน	หน้าสำรวจ	เนื้อที่ (ไร่)	ราคาประเมินต่อไร่ (บาท)	รายชื่อเจ้าของที่ดิน	ที่อยู่	หมายเหตุ
88	953		2002	10	4096	10-2-05.3	400,000	นางรำพึง ยมจินดา	70 ม.2 ต.ปากน้ำประแส อ.แกลง จ.ระยอง	
89	1033		2002	9	4159	11-2-76.8	400,000	นางสิริมา ชีวะประมง	14/59 ถ.ราชวิถี-นครชัยศรี แขวงบางบำหรุ เขตบางกอกน้อย กรุงเทพฯ	
90			2000-3	1	6925		400,000	ที่มีการครอบครอง		
91			58	5			400,000	ที่มีการครอบครอง		
92			2000-3	5			400,000	ที่มีการครอบครอง		
93		2552					400,000	ที่มีการครอบครอง		
94			2000-3	6	6924	4-0-12	400,000	ที่มีการครอบครอง		
95			2000-3	7	6923	8-1-81.0	400,000	ที่มีการครอบครอง		
96	6633		2000-3	1	6925	13-1-31	400,000	นางอุไร ทองคง	106/2 ม.5 ต.พลา อ.บ้านฉาง จ.ระยอง	
97			58	5			400,000	ที่มีการครอบครอง		
98			2000-3	5			400,000	ที่มีการครอบครอง		
99		2552					400,000	ที่มีการครอบครอง		
100			2000-3	6		4-0-12	400,000	ที่มีการครอบครอง		
101			2000-3	7		8-1-81.0	400,000	ที่มีการครอบครอง		
102			2000-3	10		4-0-53	400,000	ที่มีการครอบครอง		
103			2000-7	14		1-1-62.0	400,000	ที่มีการครอบครอง		
104	187		2000-7	13	3427	27-2-91	400,000	ที่มีการครอบครอง		
105	814		5234 III	5	3979	15-0-56.6	400,000	บ.โชติชลิต จก.	444 แขวงวังใหม่ เขตปทุมวัน กรุงเทพฯ	
106	815		2000	18	815	61-3-41.8	400,000	บ.โชติชลิต จก.	444 แขวงวังใหม่ เขตปทุมวัน กรุงเทพฯ	
107	7802		2000	164	8191	11-0-05	400,000	นางวิจิตรา บวรวัฒนา กับพวก	634 แขวงนครชัยศรี เขตดุสิต กรุงเทพฯ	

APPENDIX 2-1

LIST OF CARGO INDUSTRY CONTACTS

APPENDIX 2-1

LIST OF CARGO INDUSTRY CONTACTS

The following organizations and individuals agreed to meet with the Global Transpark Consultants and generously shared information and opinions about the Asian market for air cargo.

Nuthaweat Santisarum, Managing Director
Atlas Transport Co., LTD.
Thai Airfreight Forwarders Association (TAFA)
117/15-17 Soi Somprasong 3
Petchburi Rd. (Soi 15)
Rajathevea Phyathai
Bangkok 10400, Thailand
(662) 656-2801-20

Sawat Sittiwong, Deputy Director General
Department of Aviation
Rama IV Road
Tung Mahamek
Bangkok 10120, Thailand
(662) 287-4993

Boonruay Chobchai, Director Air Transport Control Division
Department of Aviation
71 Soi Ngarm Duplee
Rama IV Road
Bangkok 10120, Thailand
(662) 286-8154, 287-0320-9

Tony Sloan, General Manager Thailand
DHL Worldwide Express
Grand Amarin Tower, 22nd Floor
1550 New Petchburi Road
Kwaeng Makasan
Khet Rachtavee
Bangkok 10320, Thailand
(662) 207-0636

Amarit Pansiri, Managing Director
Excel Transport International Co., LTD/
Thai Airfreight Forwarders Association (TAFA)
65/1 Sukhumvit 19 (Soi Watthana),
Klongtoey Nua, Klongtoey
Bangkok 10110, Thailand
(662) 254-5370-8

Mark Allen, Vice President
Legal Asia Pacific Division
FedEx
Two Pacific Place, 34/F
88 Queensway
Hong Kong
(852) 2514 0858

Steve E. Cox, Managing Director
Regional Planning & Engineering, South Pacific
FedEx
300 Beach Road
#26-01/06 The Concourse
Singapore 199 555
(65) 390 5500

Alan Miu, Manager
Global Trade Services
FedEx
396 Alexandra Road
#07-00 BP Tower
Singapore 119 954
(65) 371 2828

Ray M. Sluk, Managing Director
Global Trade Services, Asia Pacific Division
FedEx
Two Pacific Place, 34/F
88 Queensway
Hong Kong
(852) 2514 0832

Chusak Chuenprayoth, General Manager Thailand
Lufthansa Cargo
18th Floor, Q-House Asoke Building
66 Sukhumvit 21,
Bangkok 10110, Thailand
(662) 264-2420

Supasak Mahathananant, General Manager-Cargo for Thailand and Indochina
Northwest Airlines, Inc.
Ground Floor Chanin Court
34/1 Soi Tonson
Ploenchit Road
Bangkok 10330, Thailand
(662) 252-0900

Mr. Frank Skilbeck
Skilbeck & Associates
Polar Air Cargo
539/1 Moo Ban Cholnivet, Soi 9 North,
Prachachuen Road
Bangkok 10900, Thailand
(662) 911-0258

Derrick A. Windsor, Vice President - Marketing and Development
TAGS (Thai Airports Ground Services, Inc.)
171 Cargo Terminal 4
Bangkok International Airport
(662) 535-5600 Ext. 210

James Oden, Managing Director
TNT Express Worldwide Co, Ltd
599 Rim Thang Rodphi-Sai Chng Non See Rd.
KlongToey, Bangkok 10110, Thailand
(662) 249-0242-6

Kawin Asawachatroj, Director, Cargo & Mail Department
Samacha Srithongsook, Manager, Cargo Planning & Development Div.
Thai Airways International Public Co., Ltd.
89 Vibhavadi Rangsit Road, Bangkok 10900
(662) 545-1984-9

Mr. Warren Gerig, Country Manager
United Airlines
The Regent House, 9th Floor, 183 Radjamri Road,
Bangkok 10500, Thailand
(662) 253-0559

Vichai Chuensuksawadi, Country Manager
Angsana Soontarakanond, Sales and Marketing Manager
Visid Arkardvipart, Operations Manager
United Parcel Service (UPS)
16/1 Sukhumvit 44/1,
Prakanong, Klongtoey, Bangkok 10110, Thailand
(662) 712-3090-95 Ext. 331

Mark Sobolewski, Director of Engineering and Operations
Asia Pacific Region
United Parcel Service Singapore Pte Ltd
3 Killiney Road
#06-01 Winsland House
Singapore 239519
65-730 6408

William Simpson, Division Manager of Long Range Domestic & International
Anthony Chadwick, International Network Planning
Henry Bukowski, Industrial Engineering Manager, Long Range International
Joh E. Lytle, Industrial Engineering
Tom Scott, Legal Department
Joseph Richardson, Jr, Airport Properties Manager
United Parcel Service Airlines
1400 N. Hurstbourne Pkwy.
Louisville, KY 40223
(502) 329-3281

Jarry Lanier
US Embassy
95 Wireless Road,
Bangkok 10330, Thailand
(662) 205-4000

APPENDIX 3-1

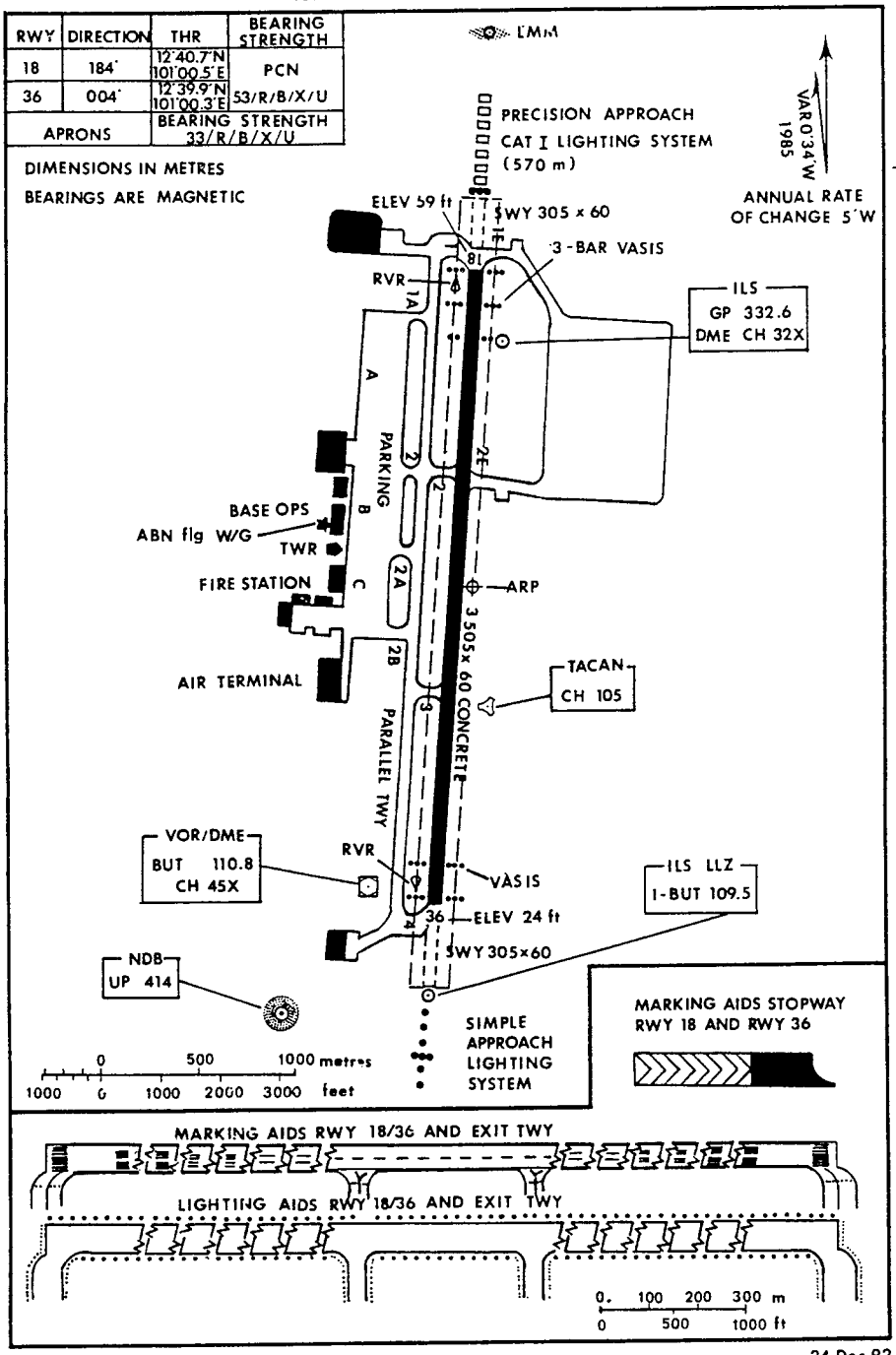
AIRPORT FACILITIES
DEPARTMENT OF AVIATION PUBLICATIONS

AERODROME CHART - ICAO 12°40'40"N 101°00'33"E **ELEV 59 ft** TWR 118.1 RAYONG/U-TAPHAO INTL AIRPORT

RWY	DIRECTION	THR	BEARING STRENGTH
18	184°	12°40.7'N 101°00.5'E	PCN
36	004°	12°39.9'N 101°00.3'E	53/R/B/X/U
APRONS			BEARING STRENGTH 33/R/B/X/U

DIMENSIONS IN METRES

BEARINGS ARE MAGNETIC

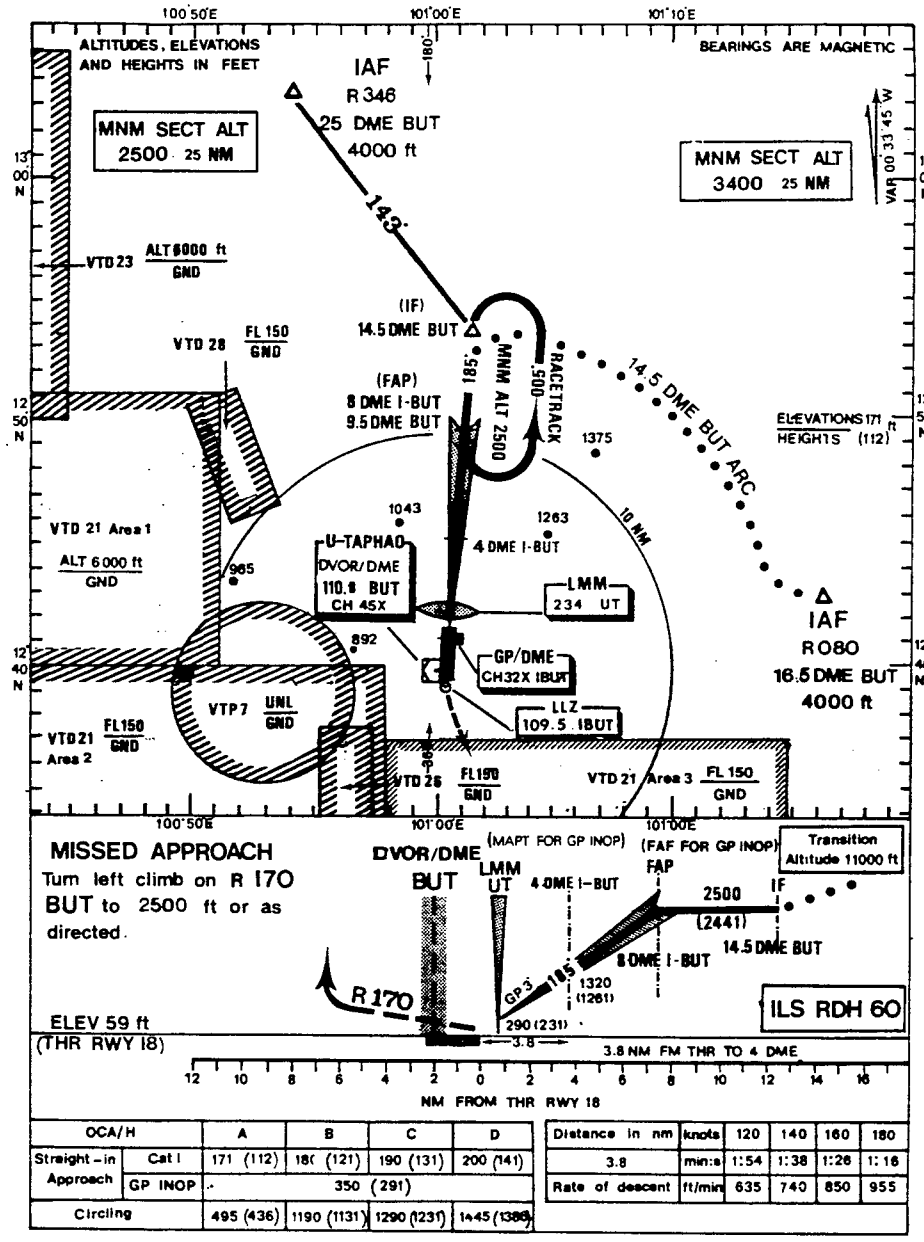


INSTRUMENT APPROACH CHART–ICAO

AERODROME ELEV 59 ft
HEIGHTS RELATED TO AERODROME ELEV

TWR	118.1
	126.2
APP	119.9
	238.3

RAYONG / U-Taphao Intl
ILS/DME
RWY **18**



OCA/H		A	B	C	D
Straight-in Approach	Cat I	171 (112)	180 (121)	190 (131)	200 (141)
	GP INOP	350 (291)			
Circling		495 (436)	1190 (1131)	1290 (1231)	1445 (1386)

Distance in nm	knots	120	140	160	180
3.8	min:s	1:54	1:38	1:26	1:16
Rate of descent	ft/min	635	740	850	955

Department of Aviation

13 Apr 95
No. 26

INSTRUMENT APPROACH CHART - ICAO

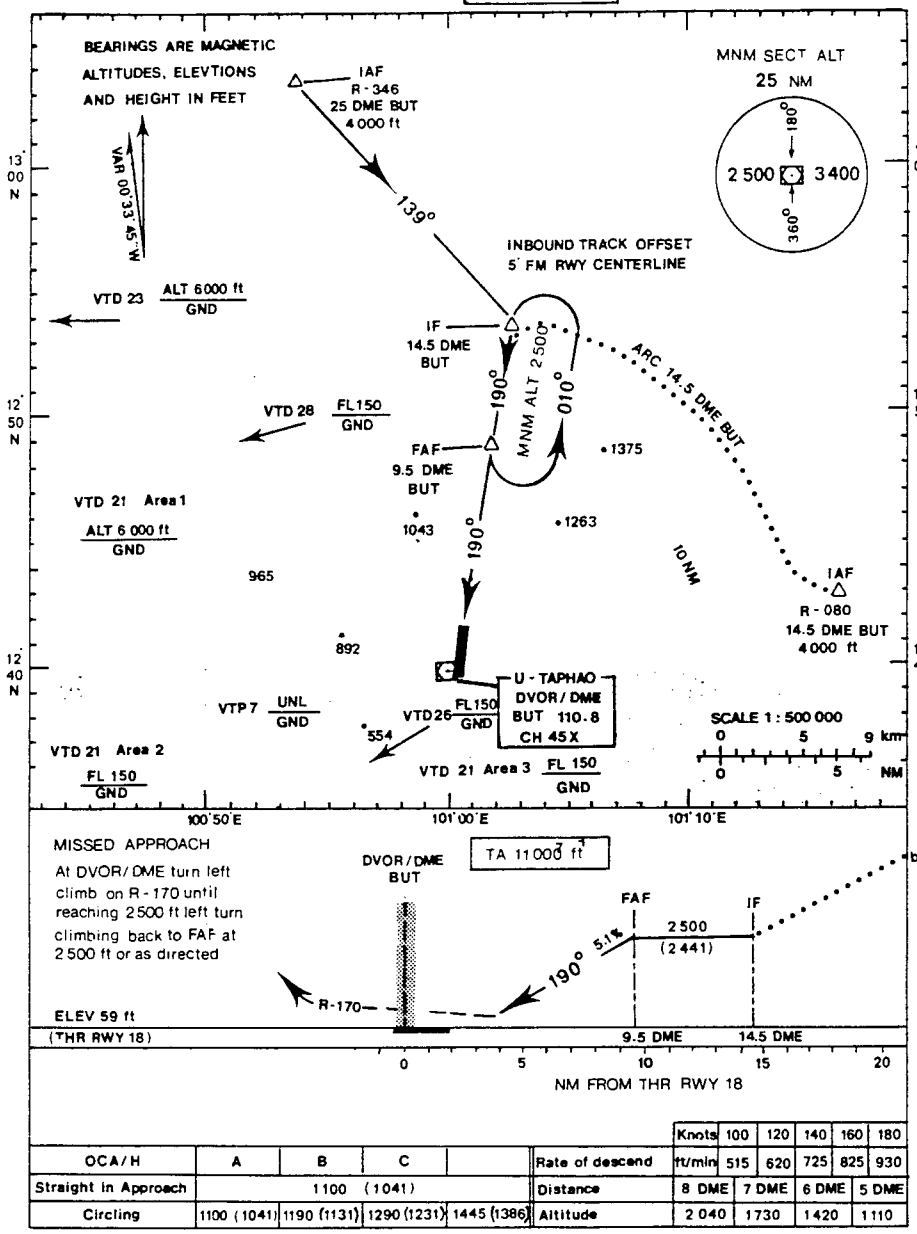
AERODROME ELEV 59 ft

HEIGHTS RELATED TO AERODROME ELEV

APP 119.9, 238.3
TWR 118.1, 126.2
GND

RAYONG / U-Taphao Intl

VOR/DME
RWY 18



MISSED APPROACH

At DVOR/DME turn left climb on R-170 until reaching 2500 ft left turn climbing back to FAF at 2500 ft or as directed

						Knots	100	120	140	160	180
OCA/H	A	B	C		Rate of descend	ft/min	515	620	725	825	930
Straight in Approach	1100 (1041)				Distance		8 DME	7 DME	6 DME	5 DME	
Circling	1100 (1041)	1190 (1131)	1290 (1231)	1445 (1386)	Altitude		2 040	1730	1420	1110	

Department of Aviation

13 Apr 95
No. 26

INSTRUMENT APPROACH CHART - ICAO

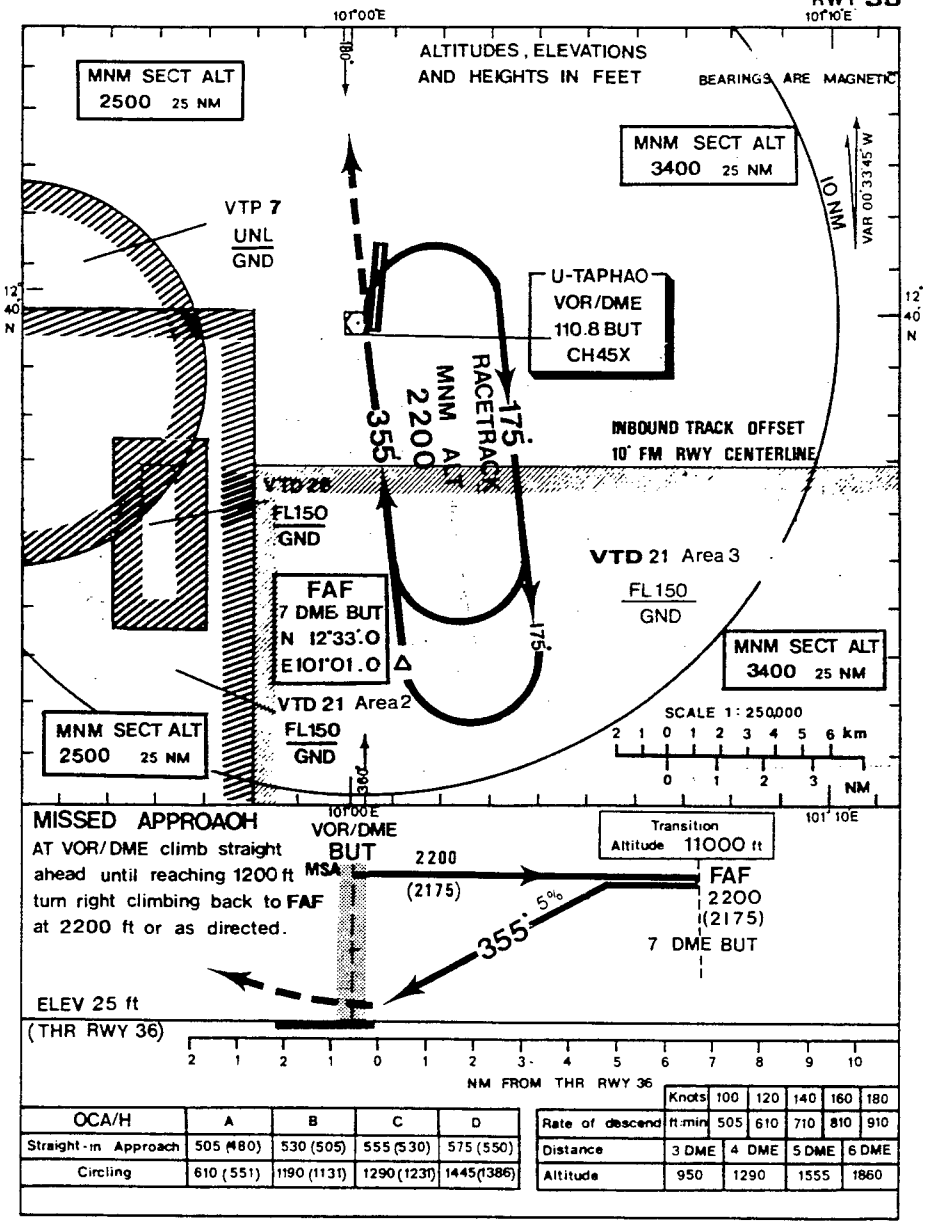
AERODROME ELEV. 59 ft
HEIGHTS RELATED TO THR RWY 36 - ELEV 25 ft

TWR	118.1
	126.2
APP	119.9
	238.3

RAYONG/U-TAPHAO

VOR/DME

RWY 36



MISSED APPROACH

AT VOR/DME climb straight ahead until reaching 1200 ft turn right climbing back to FAF at 2200 ft or as directed.

OCA/H	A	B	C	D
Straight-in Approach	505 (480)	530 (505)	555 (530)	575 (550)
Circling	610 (551)	1190 (1131)	1290 (1231)	1445 (1386)

Knots	100	120	140	160	180
Rate of descend ft/min	505	610	710	810	910
Distance	3 DME	4 DME	5 DME	6 DME	
Altitude	950	1290	1555	1860	

Department of Aviation

13 Apr 95
No. 26

2	REF POINT : Lat 124040N Long 1010033E SITE : 715 m Brg 105.5° from aerodrome control tower.	1	CITY/AERODROME : Rayong/U-taphao International Airport
3	DISTANCE AND DIRECTION FROM CITY : 17 NM W of Rayong	18	FUEL GRADES : Jet A-1, AVGAS 100LL,
4	ELEVATION : 18 m (59 ft)		
5	AERODROME REFERENCE TEMPERATURE : 33.3°C	19	OIL GRADES : Engine Oil - W 120, 2380 : Lubricating Oil - 1 120, Aeroshell : Hydraulic Oil - Hyjet IV, Skydrol LD4
6	MAGNETIC VARIATION : 0°33'45"W	20	OXYGEN AND RELATED SERVICING : Not available
7	TRANSITION ALTITUDE : 11 000 ft		
8	OPERATIONAL HOURS : H24	21	REFUELLING FACILITIES AND LIMITATION : - Jet A-1 delivered by hydrant and small mobile tank truck (308 Gallons per minute) - AVGAS 100LL delivered by pumping from 200 litre tank.
9	AERODROME OPERATOR OR ADMINISTRATIVE AUTHORITY : Royal Thai Naval Air Division		
10	POSTAL ADDRESS : Rayong/U-taphao International Airport, Banchang, Rayong 21130.		
11	TELEGRAPHIC ADDRESSES : Aeronautical : VTBUYDYX Commercial : Rayong/U-taphao International Airport	22	HANGAR SPACE AVAILABLE FOR VISITING AIRCRAFT : Not available
12	TELEPHONE NUMBERS : (TWR) (038) 245190 Dispatcher (038) 245193 Air Terminal (038) 245196, 245593-5 245599-01	23	REPAIR FACILITIES NORMALLY AVAILABLE : Not available
		24	FIRE PROTECTION : Required : Category 8 Available : Category 8
13	OVERNIGHT ACCOMMODATION : Airport hotel not available unlimited in city. (Rayong and Pattaya City)	25	SEASONAL VAILABILITY : All seasons
14	RESTAURANT ACCOMMODATION : All requirements for meals could be met in city and hotels, restaurants in Pattaya.	26	LOCAL FLYING RESTRICTIONS : Flying over gas separation plant in Rayong (Ban Map Ta Phut) is hazardous, aircraft are to avoid area starting from 1241.2N 10108.0E then clockwise along an arc of 2 NM radius from 1243.0N 10109.0E to 1243.0N 10111.0E then direct to 1238.5N 10111.0E from this point make an arc of 5 NM radius from 1243.0N 10109.0E clockwise to 1238.2N 10108.0E then direct to the starting point, altitude 2 000 ft.
15	MEDICAL FACILITIES : First aid station and two ambulances at airport. Queen Sirikit hospital in the airport. Several hospitals in Pattaya city.		
16	TRANSPORTATION AVAILABLE : Buses, Limousines depending on traffic demand.		
17	CARGO HANDLING FACILITIES : Facilities handling weights up to 3 tons. Siting near fire department building.	27	PRE-FLIGHT ALTIMETER CHECK POINT(S) AND ELEVATION : Apron 18 m (59 ft)

28 METEOROLOGICAL DATA

Mean daily maximum and minimum temperatures (Cen)

Temperature	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maximum (A)	31.9	32.0	32.7	33.6	32.9	32.4	32.3	32.1	31.8	31.8	32.1	31.9
Minimum (B)	21.2	23.6	25.4	26.5	26.2	26.2	25.7	25.6	24.8	23.7	22.4	20.8

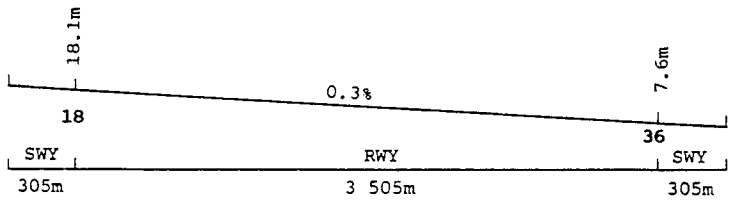
Monthly mean pressure in hPa at approximately the time of maximum(A) and minimum(B) temperatures.

(A)	1010.2	1009.5	1008.5	1006.7	1005.5	1005.2	1005.6	1005.4	1006.2	1007.5	1009.1	1010.6
(B)	1011.5	1010.5	1009.5	1007.7	1006.8	1006.4	1006.9	1006.8	1007.8	1008.9	1010.6	1012.1

Monthly mean relative humidity(%) at approximately the time of maximum(A) and minimum(B) temperatures.

(A)	55	62	64	65	67	68	67	69	72	72	62	54
(B)	86	86	84	84	85	83	84	85	90	92	87	82

29 SLOPES : Longitudinal profiles of runways and clearways.



30 PHYSICAL CHARACTERISTICS

RUNWAY			DIMENSIONS (m)				STRENGTH	SURFACE		
Desig-nation	True Brg	Type	Runway	Stopway	Clearway	Strip	Runway	Runway	Stopway	Runway Friction Calibration
a	b	c	d	e	f	g	h	i	j	k
18/36	184/004	PA1/NPA	3 505 x 60	305 x 60 / 305 x 60		4 170x300	PCN 59/F/B/X/T	Asphaltic Concrete	Asphalt	

REMARKS :

31 MOVEMENT AREAS

Aprons : Apron A - Width 240 m - PCN 36/R/B/X/U)
Apron B - Width 264 m - PCN 33/R/B/X/U) Surface - Concrete
Apron C - Width 210 m - PCN 33/R/B/X/U)

Taxiway : Primary TWY - Overal width 52.5 m, the centre of the TWY is 22.5 m wide and is constructed of concrete with 15 m of asphalt on each side, PCN 48/R/B/X/U, Width 22.5 m

TWY 1 - PCN 53/R/B/X/U
TWY 2 - PCN 33/R/B/X/U
TWY 2B - PCN 41/R/B/X/U
TWY 4 - PCN 50/R/B/X/U
TWY 1A - PCN 39/R/B/X/U
TWY 2A - PCN 33/R/B/X/U
TWY 3 - PCN 45/R/B/X/U
) Width - 22.5 m
) Surface - Concrete

Heliport : Adjacent to TWY 2B, opposite terminal building, take-off & landing area 15.30 m.

VISUAL GROUND AIDS

32 **TAXIING GUIDANCE SYSTEM :** The yellow guide line are painted.

33 **VISUAL AIDS TO LOCATION :** Aerodrome beacon alternating white and green lights are installed adjacent to control tower at 8 revolutions/minute.

34 **INDICATOR AND GROUND SIGNALLING DEVICES :** Illuminated wind direction indicator.

35 **LIGHTING AIDS :**

Approach Lighting :

RWY 18 : Precision Approach Cat I Lighting System (only 570 m).
RWY 36 : Simple Approach Lighting System (SALS)

Visual Approach Slope Indicator System :

RWY 18 : 3 bars VASIS setting angle of 3 degrees. PAPI setting angle of 3 degrees.
RWY 36 : PAPI on the left hand side, 400 m from threshold based on 3 degrees glide slope.

Runway Lighting

Threshold light : Green, bidirectional
End of RWY 18 : Red and Green, bidirectional
End of RWY 36 : Red, bidirectional
Runway Edge Light : White, omnidirectional
Taxiway Light : Blue
Taxiway Guidance Sign : Black back ground yellow legend.

Ground Lighting
Apron Flood Lights
Signal Light Gun (red, green and white)

36 **EMERGENCY LIGHTING AND SECONDARY POWER SUPPLY** : Automatic standby power supply generator is available for airfield lighting and control tower.

37 **OBSTRUCTION MARKING AND LIGHTING :** All obstructions, out side approach and take off area are provided with obstruction lighting, except unlighted hill 273 m 4 km NNE of runway. High tension line distance 840 m from RWY threshold 18, elevation of the high tension line 22 m.

38 **MARKING AIDS :** Runway center line, runway designation numbers, runway threshold, taxi holding positions and taxiway center line are painted.

39 **OBSTRUCTIONS IN APPROACH AND TAKE-OFF AREAS**

DECLARED DISTANCES :

RWY	TORA m	ASDA m	TODA m	LDA m	40
18	3 505	3 810	3 505	3 505	NIL
36	3 505	3 810	3 505	3 505	

41 **DISABLED AIRCRAFT REMOVAL** Capability : 20 tons hydraulic lift jack, tow tractor capable of towing aircraft up to B-747.

RADIO COMMUNICATION AND NAVIGATION FACILITIES

STATION	SERVICE	CALL SIGN or IDENTIFICATION	EM	TRANSMITS		RECEIVES		HOURS (UTC)	COORDINATES	LOCATION		OPERATING AUTHORITY and REMARKS
				kHz	MHz	kHz	MHz			Mag	km	
1	2	3	4	5	6	7	8	9	10	11	12	13
PRACHUAP KHIRI KHAN/Hua Hin	TWR	Hua Hin Tower	A3		122.7		122.7	2230-1430	1238.0N9957.0E			DOA
	APP	Hua Hin Approach	A3		126.2		126.2					
	G/A/G	Hua Hin Ra io	A3J	6667 5520		6667 5520						Primary freq) Upper Sideband Secondary freq)
	NDB	HN	A0/A2	213				H24	1237.6N9957.4E			Coverage restriction between 350° to 190° counter clockwise unusable Beyond 30 NM.
	DVOR/DME	HHN	A9/P0		113.3 CH80X				1238.1N9957.4E			DME: unusable between radial 290°-230° beyond 30 NM below 8 000 ft.
PRACHUAP KHIRI KHAN/ Prachuap Khiri Khan	TWR	Prachuap Tower	A3		121.5* 122.7 236.6 243.0* 257.8		121.5* 122.7 236.6 243.0* 257.8	HJ	1147.0N9949.0E			RTAF *Emergency freq Secondary freq
	NDB	PCK	A0/A2	320				2300-1100	1147.3N9948.6E			
	TACAN	PCK	A2		CH84				1148.1N9948.8E			
RANONG/Ranong	TWR	Ranong Tower	A3		121.5* 122.7		121.5* 122.7	H24	0946.5N9835.2E			DOA *Emergency freq
	APP	Ranong Approach	A3		126.2		126.2					
	GND	Ground Control	A3		121.9		121.9					
	G/A/G	Ranong Radio	A3J	6577 5490		6577 5490						Primary freq) Upper Sideband Secondary freq)
	NDB	RN	A0/A2	375					0947.0N9835.5E			
	DVOR/DME	RAN	A9/P9		113.4 CH81X				0946.7N9835.0E			
RAYONG/Rayong	VOR/DME	RYN	A9/P0		112.5 CH72X			H24	1246.8N10140.3E			DOA
RAYONG/ U-taphao International Airport	TWR	U-taphao Tower	A3		118.1 121.5* 126.2 227.0 243.0*		118.1 121.5* 126.2 227.0 243.0*	H24	1241.0N10101.0E			RTN *Emergency freq
	APP	U-taphao Approach	A3		119.9 238.3 273.3		119.9 238.3 273.3					
	GND	Ground Control	A3		121.9 134.5 275.8		121.9 134.5 275.8					
	NDB	UP	A0/A2	414					1239.7N10059.7E			

RADIO COMMUNICATION AND NAVIGATION FACILITIES

STATION	SERVICE	CALL SIGN or IDENTIFICATION	EM	TRANSMITS		RECEIVES		HOURS (UTC)	COORDINATES	LOCATION		OPERATING AUTHORITY and REMARKS
				kHz	MHz	kHz	MHz			Mag	km	
1	2	3	4	5	6	7	8	9	10	11	12	13
RAYONG/ U-taphao International Airport (Cont'd)	VOR/DME	BUT	A9/P0		110.8 CH45X			H24	1240.0N10100.0E			A. The Cat I ILS/DME installed at U-taphao International Airport for RWY 18, usable range 18 NM. There is no back course. The localizer aerial array is located on the extended runway centre-line at distance of 420m(1 377.9 ft) from the threshold of RWY 36. The antenna array 1.30m(4.3 ft) high is installed on top of wooden platform 3.60m(11.8 ft) high above ground, with an aperture of 40.3m(132.2 ft) B. DME paired with localizer frequency omni-directional, low power (200 watts). C. Glide Path 3° above the horizontal, paired with localizer frequency. The 15m(49.2 ft) glide path aerial mast is offset 120m(393.7 ft) to the east side of runway centre-line and from threshold of RWY 18, 371m(1 217.1 ft). D. Middle Marker 1 050m(3 445 ft) from threshold of RWY 18 along extended runway centre-line.
	ILS-18 LLZ/DME	IBUT	A9/P0		109.5 CH32X				1239.6N10100.2E			
	GP		A9		332.6				1241.5N10100.4E			
	LMM	UT	A2	234					1242.1N10101.0E			
	TACAN	BUT	A2		CH105			2300-1100	1240.5N10100.4E			Military Facility PN 30 min to ATC.
SAKON NAKHON/ Sakon Nakhon	TWR	Sakon Nakhon Tower	A3		121.5* 122.5 236.6		121.5* 122.5 236.6					DOA/RTA *Emergency freq
	APP	Sakon Nakhon Approach			243.0* 123.3 126.2 236.6		243.0* 123.3 126.2 236.6	2300-1230	1711.5N10407.0E			
	GND	Ground Control	A3		121.9		121.9					
	G/A/G	Sakon Nakhon Radio	A3J	6595 5631		6595 5631		HJ				Primary freq) Secondary freq) Upper Sideband
	NDB	BC	A0/A2	310					1711.5N10407.1E			

APPENDIX 3-2

AIRCRAFT RESCUE AND FIRE FIGHTING FACILITY

APPENDIX 3-2

AIRCRAFT RESCUE AND FIRE FIGHTING (ARFF) FACILITY

Introduction

At U Taphao GTP, a modern aircraft rescue and fire fighting (ARFF) facility will be constructed. The level of protection provided by the ARFF facilities is based on the ICAO standards for international commercial airport facilities. The ICAO standard categorizes airports based on the over-all length of the longest airplanes and their maximum fuselage width that normally use the airport. Using the formulas and tables found in the ICAO standards it was determined that U Taphao GTP will be a Category nine airport, due to the size of the largest aircraft that will be using the facility. This requires at least three fire fighting vehicles supported by the proper equipment and gear. The facility will require a communication system to connect directly to the air traffic control tower, training facilities, sleeping quarters and dining facilities for the on-duty staff. The facility will be located on the airfield to provide proper response time to all areas of the airport. Also, a fully equipped ambulance will be provided. Equipment and vehicles will be provided in the event of structural fires. Personnel will be trained in all matters of emergency response, as well as in the containment of hazardous materials.

Types of Extinguishing Agents

Both principle and complimentary agents will be utilized at the GTP. Principle agents produce a permanent control, i.e. for a period of several minutes or longer. Complimentary agents have rapid fire suppression capabilities, but offer transient control which is usually only available during application.

The principle extinguishing agent employed will meet ICAO performance standards of level B foam. The complimentary extinguishing agent will also meet ICAO standards and will be a class B or C dry chemical powder.

Discharge Rates

The recommended discharge rates are those required to obtain a one-minute control time on the practical critical area and have therefore been determined by multiplying the practical critical area by the application rate. The discharge rates of complimentary agents will be selected for the optimum effectiveness of the agent used.
The amounts of water for foam production and the complimentary agents to be provided on the rescue and fire fighting vehicles will be 24,300 liters of water and 450 kilograms of dry chemical powder, with a discharge rate of foam solution of 9000 liters of foam per minute. These amounts have been determined by adding the quantity of extinguishing agents which are required to obtain a one-minute control time in the practical critical area and the quantity of extinguishing agents which are required for continued control of the fire thereafter and/or for possible complete extinguishment of the fire. Control time is the time required to reduce the initial intensity of the fire by 90 percent.

These amounts of extinguishing agents are the minimum amounts of agents to be provided. Wherever possible, it is desirable to provide additional protection, bearing in

mind the recurrent maintenance need of equipment, and/or any unusual operational hazards particular to the airport.

The quantity of foam concentrate separately provided on each vehicle for foam production will be in proportion to the quantity of water provided for that foam concentrate. The amount of foam concentrate will be sufficient to supply at least two full loads of such quantity of water as provided by each individual vehicle. This will be supplied by an at-grade hydrant system along runway and taxiways to ensure rapid replenishment of the water content carried.

The amount of water specified for foam production was predicted on an application rate of 5.5 L/min/m^2 for foam meeting performance level B. These application rates are considered to be the minimum rates at which control can be achieved within one minute.

Supply and Storage of Extinguishing Agents

The quantities of the various extinguishing agents to be provided in the rescue and fire fighting vehicles will be in accordance with Chapter (2) section 2.3 of the ICAO manual. A reserve supply of foam concentrate and complimentary agents equivalent to 200 percent of the quantities of these agents to be provided in the rescue and fire fighting vehicles will be maintained on the airport for vehicle replenishment purposes. This will permit an immediate and complete recharge of the vehicles, if necessary. If a delay in the replenishment of this supply is anticipated, the amount of reserve supply will be increased.

Because partially filled tanks create chemical stability problems when the vehicle is cornering at speed, vehicle foam tanks must be kept full at all times when the vehicles are in operational service.

Critical Area

The critical area is described in the ICAO standard as the area needed for the rescue of the occupants of the aircraft. This differs from other concepts in that, instead of attempting to extinguish the entire fire, this method seeks to control only that area of the fire adjacent to the fuselage. The objective is to safeguard the integrity of the fuselage and maintain tolerable conditions for its occupants until rescue personnel are able to reach them. The size of this controlled area, which has been determined by experimental means, is specified in the ICAO standards and is specific to type and size of aircraft involved.

Response Time

Response time is considered to be the time between the initial call received by the rescue and fire fighting services and when the first responding vehicle(s) is(are) in position to apply fire suppressing agents at a rate of at least 50 percent of the optimal discharge rate as specified by the ICAO and FAA. The operational objective of the rescue and fire fighting services will be to achieve response times of two minutes, but not exceeding three minutes, to the end of each runway or any other part of the movement area in optimum visibility and surface conditions.

Fire Station

All rescue and fire fighting vehicles will be housed in a designated fire station. Satellite fire stations will not be needed to achieve the minimum response times. There will be an airfield fire station that houses the crash rescue vehicles and their complimentary apparatus directly to the southwest of the main terminal. There will also be a fire station located on the east-west access road between the terminal and the employee residency area. This station will house the structural fire fighting vehicles, as well as the ambulances and its complimentary apparatus.

The fire station(s) will be located so that the access for the rescue and fire fighting vehicles is direct and clear, requiring a minimum number of turns.

Communication and Alerting Systems

A discrete and direct communication system will be provided linking the fire station(s) with the control tower. The rescue and fire fighting vehicles will also need to be included in this communication network.

In the case of the structural fire fighting station, the communication link will also need to include local police and airport security. This will allow the station to notify, or be notified by, these other agencies in the event of an accident, either on or off the airfield.

An alerting system for the rescue and fire fighting personnel will be provided at each fire station. This alerting system will have the capability of being operated from the station in which it is located, or from any other fire station and the air traffic control tower.

Number of Vehicles

The minimum number and types of air crash fire rescue vehicles provided at the airport is determined to be at least three (3) vehicles, in accordance with the ICAO standard for a Category nine airport. The sole purpose of these vehicles will be rescue and fire fighting operations on the airfield itself. These vehicles will consist of one rapid intervention vehicle (RIV) and two major crash fire rescue vehicles (CFR). A separate command vehicle is also necessary to oversee the fire rescue operations if an incident were to occur. A squad vehicle used to deliver manpower to the accident scene is also necessary to provide rapid fire suppression and rescue activities. The following will be the general performance specifications for the CFR command vehicle, and manpower squad.

The RIV will have the following specifications:

Angle of Approach:	30 degrees
Angle of Departure:	30 degrees
Interaxle Clearance Angle:	12 degrees
Underaxle Clearance:	33.0 cm underaxle differential housing bowl
Acceleration:	0 to 80 kph in 25 seconds
Top Speed:	105 kph
Gradibility:	Ascend/Descend 60% grade
Wheel Motion:	Maintain tractive effort with simultaneous diagonally opposite wheel motion of 356 mm
Obstacle Climbing Ability:	Negotiates a 457mm wall
Slide Slope Stability (Static):	Roll over point in excess of 53% grade (28 degree angle)

Vehicle Clearance Circle:	Wall-to-wall 28.3 m
Water Capacity:	5678 Liters
Water Pump:	5753 LPM at 1587 kpa Single stage centrifugal
Handline (Foam/Water):	Two preconnect type, one each side
Proportioning System:	Around the pump, preset to either 3% or 6%
Foam Capacity:	750 Liters
Bumper Turret:	Non-aspirating type, 1135 LPM, infinitely variable pattern from straight stream to fully dispersed
Roof Turret:	Non-aspirating type, 1419/2838 LPM discharge rate, infinitely variable pattern from straight stream to fully dispersed.
Complimentary Agent:	227 Kg Dry Chemical

The two Major CFR Vehicles will have the following specifications:

Angle of Approach:	30 degrees
Angle of Departure:	30 degrees
Interaxle Clearance Angle:	12 degrees
Underaxle Clearance:	33.0 cm underaxle differential housing bowl
Acceleration:	0 to 80 kph in <40 seconds
Top Speed:	105 kph
Gradibility:	Ascend/Descend 60% grade
Wheel Motion:	Maintain tractive effort with simultaneous diagonally opposite wheel motion of 356 mm
Obstacle Climbing Ability:	Negotiates a 457mm wall
Slide Slope Stability (Static):	Roll over point in excess of 45% grade (24 degree angle)
Vehicle Clearance Circle:	Wall-to-wall 30.5 m
Water Capacity:	11,356 Liters
Water Pump:	7570 LPM at 1552 kpa Single stage centrifugal
Handline (Foam/Water):	Two preconnect type, one each side
Proportioning System:	Around the pump, preset to either 3% or 6%
Foam Capacity:	1590 Liters
Bumper Turret:	Non-aspirating type, 1135 LPM, infinitely variable pattern from straight stream to fully dispersed
Roof Turret:	Non-aspirating type, 2271/4542 LPM discharge rate, infinitely variable pattern from straight stream to fully dispersed.
Complimentary Agent:	227 Kg Dry Chemical

The command vehicle will need to be a highly mobile vehicle with the following specifications:

- Walk-in command area with communications equipment able to be self sufficient if an accident were to disable normal communication routes.
- The ability to store equipment and supplies for a mass casualty incident.
- Sufficient exterior lighting to illuminate the area around the command vehicle.
- A generator that will be able to handle the electrical load placed on the system.

Other specifications will be added to this vehicle as the specific needs of the airfield are addressed.

The manpower squad will conform to NFPA and IFSTA standards and will have the following specifications:

The manpower squad will be able to have the seating for six to eight fire/rescue personnel and their gear. The squad will also have the ability to carry tools and minor rescue equipment for it's occupants. The manpower squad will be a four wheel drive vehicle capable of traversing non-paved or developed areas. At this time it is being determined if the manpower squad will also be assisting in water rescue activities with the addition of scuba gear and a water rescue craft.

As with any major infrastructure project, the need for conventional structural fire fighting vehicles and apparatus is paramount. These vehicles will be used for, but not limited to, those fires and rescue activities not found on the airfield itself. The obligation of these vehicles would be the protection of the terminal and its adjacent facilities and roadways. These vehicles will include the following types of apparatus:

- Two engines;
- One pumper;
- One ladder truck with ladder to be no less than 100 feet in length;
- One ladder Truck with Ladder to be no less than 100 feet in length with aerial basket;
- One heavy rescue squad;
- One command vehicle;
- Two ambulances;
- One hazardous material vehicle;
- One manpower squad;
- One four-wheel drive rapid intervention vehicle.

The specifications of these vehicles are as follows:

Engines	
Water Capacity:	500gals poly tank
Water Pump:	1500 gals/min
Handline (Foam/Water):	Two preconnect type, cross lays 13/4 inch One preconnect type, rear blitz line 2 ½ inch
Supply Hose:	1000 feet of five inch supply line 1000 feet of 2 ½ inch hose
Proportioning System:	Around the pump, preset to either 3% or 6%
Foam Capacity:	
Roof Turret:	Non-aspirating type, 1000gals/min discharge rate, infinitely variable pattern from straight stream to fully dispersed.
Complimentary Agent:	Dry Chemical
Generator and Lighting:	To Be Determined
Seating Capacity:	5-6 personnel with gear
Miscellaneous:	To be Determined
Pumper	
Water Capacity:	750gal poly tank
Water Pump:	2000 gals/min
Handline (Water):	Two preconnect type cross lays
Supply Hose:	1200 feet of five-inch supply line 1000 feet of 2 1/2"' hose
Hard Suction Supply Line:	Two twelve foot sections of five inch line
Roof Turret:	Non-aspirating type, 1000 gals/min discharge rate, infinitely variable pattern from straight stream to fully discharge

Generator and Lighting:	To be determined
Seating Capacity:	5-6 personnel with gear
Miscellaneous:	To be determined
Ladder Truck	
Ladder Truck:	110 foot ladder
Water Capacity:	500gals poly tank
Water Pump:	2000gals/min
Handline (Foam/Water Supply):	Two preconnect type, cross lays 13/4 inch
Supply Hose:	1000 feet of five inch supply line
Proportioning System:	Around the pump, preset to either 3% or 6%
Foam Capacity:	To be Determined
Ladder Turret:	Non-aspirating type, 1000gals/min discharge rate, infinitely variable pattern from straight stream to fully dispersed.
Complimentary Agent:	Dry Chemical
Generator and Lighting:	To be Determined
Seating Capacity:	Four to Six
Personnel with Gar Cascade Air System:	To be Determined
Miscellaneous:	To be Determined
Ladder Truck w/ 110ft. ladder, aerial basket, 1000lb capacity	
Water Capacity:	500gals poly tank
Water Pump:	2000 gals/min
Handline (Foam/Water):	Two preconnect type cross lays 13/4 inch
Supply Hose:	1000 feet of five-inch supply line
Proportioning System:	Around the pump, preset to either three percent or 6 percent
Foam Capacity:	To be determined
Ladder Turret:	Non-aspirating type, 1000gals/min discharge rate, infinitely variable pattern from straight stream to be fully dispersed.
Complimentary Agent:	Dry Chemical
Generator and Lighting:	To be determined
Seating Capacity:	Four to six personnel with gear
Miscellaneous:	To be determined
Heavy Rescue Squad	
Seating Capacity:	Six to eight personnel with gear
Equipment:	Roadway Extrication, High Angle Rescue, Trench Rescue
Generator:	To be determined
Lighting:	To be determined
Crane:	As necessary
Cascade Air System:	Three bottle H-type with dual fill station
Miscellaneous:	To be determined
Command Vehicle	
Special Characteristics:	Highly mobile, lighting self-sufficient
Seating Capacity:	Four to six personnel
Equipment:	Advanced Communication Equipment

Ambulances	
Type:	Type three box style ambulance
Seating Capacity:	Front: driver and passenger Rear: Paramedic seat, bench w/straps and on removable cot
Equipment:	Advanced Life Support equipment as specified by local standards and ICAO regulation
Miscellaneous:	To be determined

Hazardous Material Vehicle:	
Seating Capacity:	Four to six personnel with gear
Equipment:	HAZMAT Level III as specified by IFSTA
Generator:	To be determined
Lighting:	To be determined
Miscellaneous:	To be determined
Manpower	
Special Characteristics:	Four-wheel drive
Seating Capacity:	Six to Eight
Equipment:	Hand tools
Miscellaneous:	To be determined
Rapid Intervention Vehicle	
Special Characteristics:	Four-wheel drive
Water Capacity:	250gals poly tank
Water Pump:	750 gals/min
Handline (Foam/Water):	Two preconnect type, cross lays 13/4 inch One preconnect type, rear blitz line 2 ½ inch
Supply Hose:	1000 feet of 2 ½ inch hose
Proportioning System:	Around the pump, preset to either 3% or 6%
Foam Capacity:	
Roof Turret:	Non-aspirating type, 750gals/min discharge rate, infinitely variable pattern from straight stream to fully dispersed.
Generator and Lighting:	To be Determined
Miscellaneous:	To be Determined

EXISTING AIRCRAFT RESCUE AND FIREFIGHTING EQUIPMENT

1. Rescue & Fire Fighting Department is under the direction of the Naval Transportation Div., Aviation Station, Naval Aviation Division.

2. The Rescue & Fire Fighting Department is manned by three commissioned officers, 13 naval warrant officers, 10 naval petty officers and 29 privates for a total of 55 men.

3. The Department operates a fleet of 11 motor vehicles complete with military and Department of Aviation's rescue and fire-fighting equipment such as six fire engines, two rescue vehicles, a water truck, an ambulance, a big tow truck, three rescue ships and three rubber lifeboats.

4. The Rescue & Fire Fighting Department is capable of carring out the following rescue and fire fighting service operations:

   4.1 Structural fire fighting;
   4.2 Aircraft fire fighting and rescue service operations;
   4.3 Rescue and assistance in sea rescue service operations.

5. The capacities of fire engines, rescue vehicles, rescue and fire fighting equipment, rescue ships and rubber lifeboats are listed briefly as follows:

Size and type of vehicle / #	Medium size, rapid deployment, Mobile Aircraft Fire Engine #11
Water Tank	3,600-liter capacity
Foam Container	400-liter capacity
Spraying/Pumping Rate	3,600 liters/min
Mounted Spray Gun □	4 1/2"
Spraying Distance	165'
Front Spray Nozzle Size	1 1/2"
Spraying Distance	130'
Water Release Form	Stream-like or droplets
Rotation	90° of left and right rotation
Nozzle's Lifting Capacity	45° of up and down lifting
Protective Underside Nozzle	Applicable with water or foam
Size of Hose	2 1/2" equipped with nozzles
Nozzles Capacity	able to release water in all four directions
Chemical Powder Container *(fully equipped)*	A 135 kg-capacity container
Fire Fghting Capacities	Able to fight the classified types of A/B/C fire

Size and Type of Vehicle / #	Medium size, Aircraft Fire Engine #10
Water Tank	3,700-liter capacity
Foam Container	450-liter capacity
Spraying/Pumping Rate	3,400 liters/min
Mounted Spray Gun □	3 1/2"
Spraying Distance	
Front Spray Hose Size/Length *(with Nozzle)*	1" /150'
Protective Underside Nozzle	Applicable with water or foam
Size of Hose	2 1/2" equipped with nozzles
Nozzle Capacity	Able to release water in five directions, sidewise and from the rear
Chemical Powder Container *(fully equipped)*	A 50 kg-capacity container
Fire Fighting Capabilities	
Officially Stationed at	Chantaburi's Ta Maai Airport

Size & Type of Vehicle /#	Large size, aircraft fire engines # 8 & 9
Water Tank	3,170 US gallons (12,000-liter capacity)
Foam Container	410 US gallons (1,500-liter capacity)
Spraying/Pumping Rate	750/1,500 US gallons/min
Mounted Spray Gun □	6 1/2"
Controlled By All	Hydrolic, electrical systems and wind
Spraying Distance	250'
No. of Front Spray Nozzles	2
Protective Underside Nozzles	Applicable with water or foam
Size of Hose	2 1/2" equipped with nozzles
Nozzle Capacity	Able to release water in all four sidewise directions
Booster Hose Size/Length (equipped with two nozzles)	1" / 150'
CO_2 bottle(s)	Two, 15-pound bottles
Chemical Powder Container	Two 25-pound containers

Type of vehicle / #	Foam-laid Aircraft Fire Engine #6
Water Tank	1,595 US gallons (6,000-liter capacity)
Foam Container	158 US gallons (600-liter capacity)
Spraying/Pumping Rate	700 US gallons /min
Mounted Spray Gun □	2 1/2" (applicable with both foam & water)

Spraying Distance	140'
Size of Pumping Hose	2 1/2" equipped with nozzles
Nozzles Capacity	Capable to release water in all four sidewise directions
Rear Motor for Producing Foam	Included
Foam Spraying Nozzle	Included
Both foams spraying arms capacity	Maximum width of 24 feet covering the runway
Size & Type of vehicle / #	Small Structural Fire Engine #5
Water Tank Capacity	3,000 liters
Pumping Rate	700 US gallons/min
Mounted Spray Gun □	2 1/2"
Spraying Distance	150'
Pumping Tubes	For all four sidewise directions
Pumping Hoses with Two Adjustable Nozzels	Included

Source: Thai Royal Navy

The multi-purpose rescue van #4 is equipped as follows:

1. A hydrolic pump complete with a set of cutting - spreading tools of different sizes;
2. A chain saw with teeth for cutting wood, metal or concrete;
3. A set of gas-operated cutting machines;
4. A drilling, digging, chiseling machine for metal, concrete, asphalt or rock.
5. An emergency generator and a lamp;
6. A blower for smoke and heat ventilation;
7. A set of mobile pumps;
8. Three heat protective suits (up to 2,000° F);
9. Three sets of compressed-air respirators;
10. Three toxic protective suits;
11. A complete set of jacks;
12. Two sets of (0.5 bar) low-pressure air cushion for lifting of a (6-ton max.) weight;
13. A set of (8 bar) high-pressure air cushion for lifting of a (9,12,17 ton max.) weight;
14. A complete set of a 135-kg, chemically operated extinguisher able to fight the classified types of A/B/C fire;
15. Two 15-pound, chemically operated extinguishers;
16. Two (Halon) BCF, 10-pound extinguishers;
17. A (Summers) mobile water pump motor;
18. An operated-by-220 volt-motor, fresh-air compressor;
19. A set of portable First-Aid Kits;
20. A front set of 4-ton, vehicle's pulling motor completely installed with a 30-m sling.

The rapid deployment rescue van #7 is equipped as follows:

1. A hydrolic pump complete with a set of cutting - spreading tools;
2. A blower for smoke and heat ventilation;
3. Three 15-pound, CO_2 primary extinguishers;
4. Three 20-pound, chemically operated primary extinguishers;
5. A fabric bag complete with a set of rescue tools;
6. Five sets of compressed-air respirators for rescue service operations;
7. A complete set of portable respirators for supply of oxygen and phlegm suctions;

8. A set of mobile stretchers complete with locks when operated;
9. Two sets of inflatable appendage casts;
10. Five sets of head covering for rescuees.

AIRCRAFT RESCUE AND FIRE FIGHTING EQUIPMENT SOURCES

The CFR vehicles are available and meet the standards set forth by the ICAO, FAA, and IFSTA manuals from:

Oshkosh Truck - Pierce Manufacturing
2600 America Drive
P.O. Box 2017
Appleton, Wisconsin 54913
USA

The command vehicles and structural fire fighting vehicles are available and meet or exceed the standards set forth by the ICAO, FAA, and IFSTA manuals from:

Laverne Fire Apparatus Company, Inc.
1209 East Birch
Brandon, South Dakota 57005-2003

The ambulances are available and meet the standards set forth by the ICAO and FAA manuals from:

Road Rescue, Inc.
2161 University Avenue
St. Paul, Minnesota 55114
USA

APPENDIX 3-3

SECURITY

APPENDIX 3-3

SECURITY

Security

A sound airport security program will be the result of detailed advanced planning. All facilities have varying degrees of vulnerability to identified security hazards. The degree of risk from each specific hazard depends upon such variables as the type of facility or area involved, value, physical layout and protective measures that have been established. It does not appear that it is economically feasible or physically possible to establish the same degree of protection for all facilities. The degree of protection warranted is dictated by its criticality and relative vulnerability, and qualified by the effect of the protective measures on its operational effectiveness.

Immediate Actions

Under FAR Part 107 of the Federal Aviation Administration (FAA) regulations, each airport operator is required to immediately adopt and put into use facilities and procedures designed to prevent or deter persons and vehicles from unauthorized access to the air operations area. If the following measures do not exist, then they will be implemented immediately:

- Designate air operations areas.
- Post signs or notices which read "Authorized Persons Only" or similar language.
- Lock or control all doors and entrances to the air operations area as fire or safety regulations permit.
- Concentrate law enforcement activities on the airport security matters to the extent possible.
- Illuminate air operations areas to the fullest extent.
- Preclude unauthorized vehicles from entering air operations areas.
- Challenge all persons in air operations areas who appear to have gained unauthorized access.
- Provide escorts for visitors to the air operations areas.
- Advise affected personnel of their security responsibilities.
- Implement other security measures as appropriate and practical.

Airport Security Program

Under Part 107, each airport operator is required (except as to access from non-air operations areas to an air operation area where both areas are adjacent exclusively occupied or controlled by a certificate holder that is required to have a security program under section 121.538) to set forth "a plan for improving or establishing protection against unauthorized access to air operations areas showing a time schedule for each area designated....." Section 107.3 requires that the program include a master security plan, which "identifies separately each air operation area and each other area of the airport, including those areas exclusively occupied or controlled by another person under a lease or other contractual arrangement with the airport operator or owner;" and designates each identified area of the airport "that has no protection or inadequate protection against unauthorized access to the air operations areas."

Master Security Plan

Airport operators are required to submit clear and comprehensive plans. The following items will be covered at minimum.

Description of the Airport - The description will include location, acreage, wooded areas, water areas, parking lots, buildings, etc. Particular attention will be given to all airport operation areas. Maps, plats, schematics and photos will be provided which show the entire airport and the surrounding areas.

Airport Activity - All air carriers that serve the airport will be identified. The scope of the airports operation, such as number of flights and passengers, amount of cargo handled, normal peak and slack periods of operation and other pertinent details will be identified.

Security Responsibilities - The name of the airport operator and person responsible for airport security will be listed. The security responsibilities of other officials involved in the security program will also be provided.

Air Operations Areas - This section will describe and identify separately each airport operations area and other areas of the airport, including those exclusively occupied or controlled by a tenant or lessee. Specific reference will be made to the following:

- Physical security measures that are intended to protect against unauthorized access, including barriers, lighting, locks, alarms, and guards.

- Identification of persons by means of a personal identification system.

- The use of ground vehicles identification.

Security of Air Operations Areas - Air operations areas will be designated by signs which state that entrance into these areas must be authorized. The signs or notices will be of sufficient size and clarity to be readily observed and understood. The signs will be positioned at sufficient locations to designate the perimeters of these areas. Clearly designated and properly secured air operations areas will usually reduce the need for stringent security measures on airport. Bilingual signs will be used where appropriate.

The security of the air operations areas will be the objective of this program. The following measures will be implemented into the security system:

- Identify affected areas.
- Post signs prohibiting unauthorized access.
- Utilize natural or artificial barriers to prevent unauthorized entry.
- Provide lighting so as to sufficiently illuminate aircraft parking areas during the hours of darkness.
- Secure or control doors, gates, and other openings around the perimeter of the air operations areas to minimize the possibility of unauthorized entry.
- Establish an effective locking and key control system.
- Install anti-intrusion devices where appropriate.

- Utilize guard or police services, as necessary.
- Install electronic or other type of surveillance equipment.
- Provide security communications system.

The air operations areas will be separated from non-air operations areas by some medium that is visible and recognizable to the public, such as a fence, barriers or signs.

Identification of Authorized Personnel

Under section 107.9 of FAR Part 107, each airport operator must require all authorized persons to have identification on them prior to accessing any air operations area.

Identification System

Provisions for identification and control of all authorized persons will be included in a document using the following criteria:

- Designate areas where identification is required.
- Type of identification media to be utilized and issuing authority.
- Procedure for checking identification of personnel.
- Details of where, when, and how identification media will be displayed.
- Disposition of lost or damaged media.
- Termination of access authorization (transfers, terminations or suspensions, etc.)
- Production and control of identification media.
- Designated points of entry to controlled areas.
- Job titles of individuals who have authority to issue identification media and/or grant access to controlled areas. (The number of these individuals will be strictly limited.)

In addition to providing for identification, as required by section 107.9, it is recommended that appropriate limitations be placed on the bearer, such as escort privilege and areas of access, and that procedures be established for escorting visitors whose identification media require an escort and for disciplining airport personnel who violate access controls.

Identification Media Standards

Identification cards and badges will meet the following standards:

1. Individual's name.
2. Individual's signature.
3. Employer's name and/or insignia or emblem.
4. Issuing authority's signature.
5. Date of expiration.
6. Height, weight, color of eyes and hair.
7. Date of birth.
8. Preprinted serial number on each identification card for accounting and security control purposes.
9. All information except signatures will be typewritten; no erasures or alterations will be permitted.

I ntification cards will contain only critical information on the front to make it simple f guards and authorized personnel to match the card with the person quickly. The photo, the individual's name and employer's name or insignia will be adequate. Color coding or other indications of access authority will also be displayed on the front of the card. The more detailed information will be contained on the reverse side where it can be reviewed as necessary.

Accountability of Identification Cards

Identification cards and badges must be accounted for and safeguarded to prevent unauthorized persons from obtaining them. Inadequate control of active cards and blank forms can necessitate complete reissuance of new cards. Airport operators will be expected to institute strict accountability procedures for all such cards and badges.

Lost or Stolen Cards

Employees will be required to report the loss of a card or badge immediately to the issuing office. A "Stop List" of missing cards will be made available to responsible personnel. This list must be kept current in order to be effective.

Identification of Ground Vehicles

The number of ground vehicles permitted in the air operations area will be held to a minimum consistent with operational needs. Vehicle control at airports can prevent or deter crimes against air transportation.

Vehicle Identification Standards

All authorized vehicles should display visual identification in such manner as to make them readily recognizable. Regularly assigned vehicles will have permanent type marking, either painted on or affixed by some other means ensuring a similar degree of permanence. Company paint designs, insignias, and other such markings which are clearly visible will be acceptable. Other authorized vehicles will be provided with temporary identification, such as a large decal, a magnetic numbered sign, or other conspicuous devices or markings. An exception to the display requirement is provided in section 107.11 (b) (1) of FAR part 107 which states that any emergency vehicle, while escorted by an authorized vehicle, need not display visual identification.

Accountability and Control

The accountability and control of the vehicle identification media will be consistent with the procedures recommended for personnel identification cards and badges.

Fencing

Security fencing can vary in design, height, and type, depending on the local security needs. Generally, however, the following standards are acceptable:

- Fencing of number 10-gauge, galvanized steel, chain link fabric, which is installed to a height of no less than approximately 3 meters, and which is topped with a three stand (12-gauge) barbed-wire overhang with a minimum of approximately 18 centimeters separation between stands. The overhang installed at a 45-degree angle from the horizontal and extending outward. Installation of a double apron barbed-wire overhang, and fencing in excess of 3 meters, is considered highly desirable when the area to be protected is located in a high-risk area.

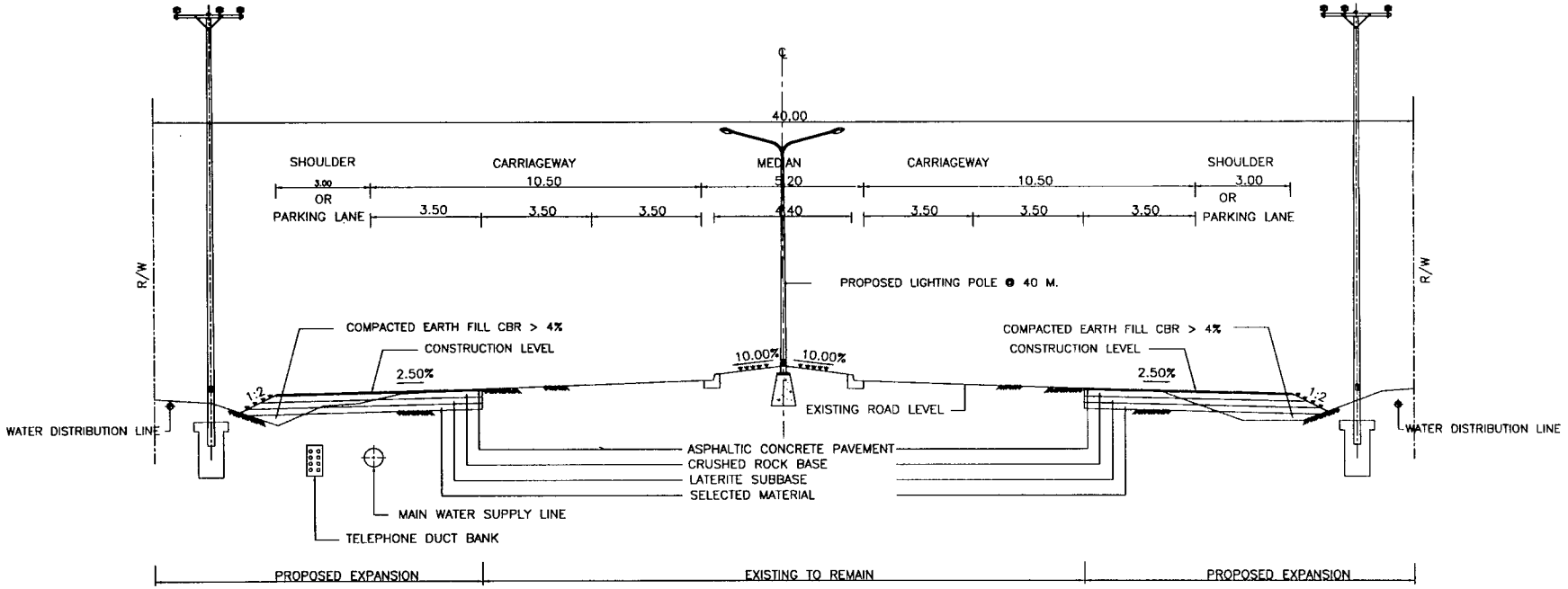
- Fence posts will be installed at no more than 3-meter intervals on center.

- Top and bottom selvages of the fence will have a twisted and barbed finish. The bottom of the fence will be to within 5 centimeters of hard surfacing or stabilized soil; however, in areas where unstable soil conditions are prevalent, the fabric will be installed to extend at least 5 centimeters below the surface or imbedded in concrete curbing.

- All fencing will be grounded. Care will be taken that metallic fencing is not installed when it will interfere with the operations of navigation aids.

APPENDIX 3-4

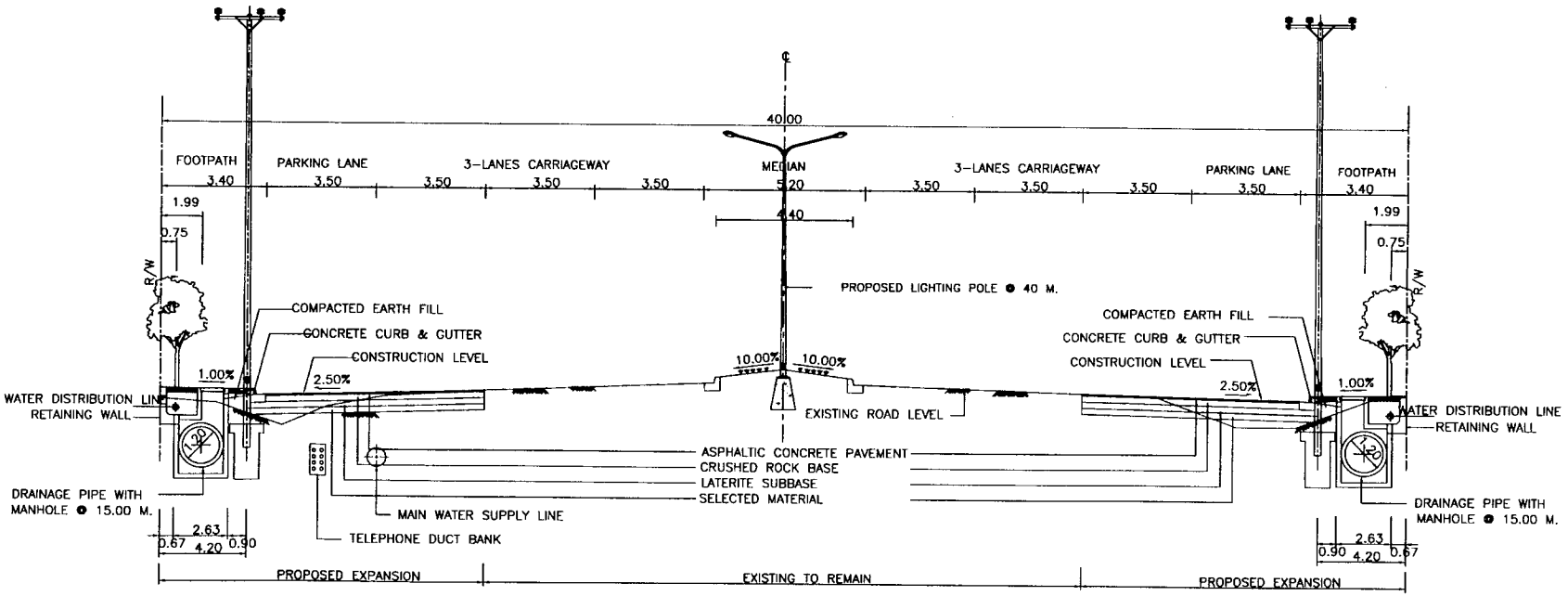
GTP ENTRANCE ROAD IMPROVEMENTS



Global Transpark Consultants TAMS Consultants, Inc. Wilbur Smith Associates ACT Consultants Company, Ltd. Thai DCI Company, Ltd.				DESIGN BY:
				DRAWN BY:
	NO.	BY	DATE	DESCRIPTION
	REVISIONS			APPROVED BY:

APPENDIX 3-4 – TYPICAL SECTION (1-1) OF ROUTE 3 IMPROVEMENT (FIRST STAGE) FROM ROUTE 331 TO ROUTE 332

X-WID-2



Global Transpark Consultants
TAMS Consultants, Inc.
Wilbur Smith Associates
ACT Consultants Company, Ltd.
Thai DCI Company, Ltd.

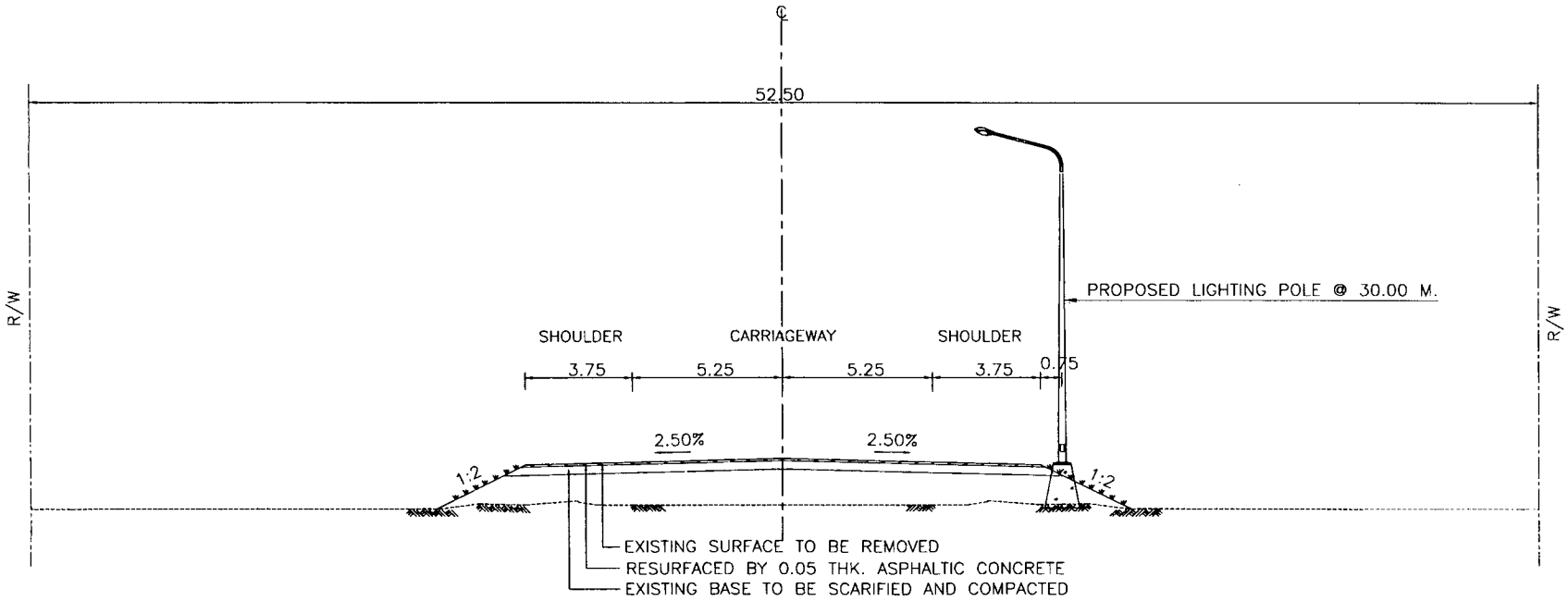
NO.	BY	DATE	DESCRIPTION

REVISIONS

DESIGN BY:
DRAWN BY:
CHECKED BY:
APPROVED BY:

APPENDIX 3-4 – TYPICAL SECTION (1-1) OF ROUTE 3 IMPROVEMENT (ULTIMATE STAGE) FROM ROUTE 331 TO ROUTE 332

X-TOP-2



Global Transpark Consultants

TAMS Consultants, Inc.
Wilbur Smith Associates
ACT Consultants Company, Ltd.
Thai DCI Company, Ltd.

NO.	BY	DATE	DESCRIPTION

REVISIONS

DESIGN BY:
DRAWN BY:
CHECKED BY:
APPROVED BY:

APPENDIX 3-4 – TYPICAL SECTION (2-2) OF ACCESS ROAD TO U TAPHAO AIRPORT

X-STN-2