

**PUTRAJAYA LAKE USE AND
NAVIGATION MASTER PLAN
AND
LAKE AND WETLAND
EMERGENCY RESPONSE PLAN**

**FINAL REPORT
(2nd Revision)**

August 2001

Prepared for:



PERBADANAN PUTRAJAYA

Pusat Pentadbiran Kerajaan Persekutuan Putrajaya
62675 Putrajaya, Malaysia
Tel: 03-8925 0025 Fax: 03-8925 9144

Prepared by:

HIJAS KASTURI ASSOCIATES SDN
Menara Promet, 23rd Floor, Jalan Sultan Ismail
50250 Kuala Lumpur
Tel: 03-2141 8840 Fax: 03-2148 0154

In association with:



PELORUS SERVICES SDN. BHD.

SU 969, Jalan BB7, Taman Bandar Baru 2
78300 Masjid Tanah, Melaka
Tel: 06-384 1131 Fax: 06-384 3737

**BURCHILL PARTNERS
PTY LIMITED**



Evandale Place, 142 Bundall Road
Surfers Paradise Qld Australia 4217
Tel: +61 7 5574 0511 Fax: +61 7 5574 0011
Email: bp@burchillpartners.com.au

TABLE OF CONTENTS

	<u>Page</u>
Table of Contents	i -vii
List of Tables	viii - ix
List of Figures	x - xi
List of Drawings	xii - xiii
Executive Summary	Exec 1 – 16

PART A - BACKGROUND

1.0	INTRODUCTION	A - 1
2.0	PURPOSE AND SCOPE OF THE PUTRAJAYA LAKE USE AND NAVIGATION MASTER PLANS AND EMERGENCY RESPONSE PLAN	A - 1
3.0	REFERENCE PLANNING AND DESIGN DOCUMENTATION	A - 2
4.0	PUTRAJAYA AND THE PUTRAJAYA LAKE SYSTEM	A - 2
4.1	PUTRAJAYA MASTER PLANNING	A - 2
4.2	PHYSICAL FEATURES OF THE PUTRAJAYA LAKE SYSTEM	A - 4
	4.2.1 General Description	A - 4
	4.2.2 Geology	A - 5
	4.2.3 Hydraulic Engineering	A - 5
	4.2.4 Primary Lake Edge Landform	A - 6
	4.2.5 Upstream Wetlands	A - 6
	4.2.6 Dam	A - 7
4.3	CLIMATIC FACTORS	A - 8
4.4	LAKE ECOLOGY AND WATER QUALITY	A - 9
4.5	LAKE USE	A - 9
5.0	LAKESIDE LAND USE	A - 10
5.1	BACKGROUND	A - 10
5.2	CENTRAL WETLANDS	A - 10
5.3	NORTHERN REACH	A - 11
5.4	CENTRAL REACH	A - 11
5.5	SOUTHERN LAKE BODY	A - 12
5.6	EASTERN REACH	A - 12

	<u>Page</u>
PART B - ANALYSIS	
6.0 IDENTIFICATION AND ANALYSIS OF PUTRAJAYA LAKE USE AND FORESHORE POTENTIALS	B - 1
6.1 GENERAL	B - 1
6.2 IDENTIFICATION AND ANALYSIS OF LAKE USE POTENTIALS	B - 1
6.2.1 Activity Categories	B - 1
6.2.2 Water Activity Locational Requirements	B - 2
6.2.3 Complementary/Conflicting Water Activities	B - 7
6.3 LAND/WATER ACTIVITY INTER-RELATIONSHIPS	B - 8
6.4 ASSESSMENT OF WATER ACTIVITY SUITABILITY	B - 10
6.5 WATER ACTIVITY MANAGEMENT	B - 10
6.6 WATER ACTIVITY INFRASTRUCTURE REQUIREMENTS	B - 12
6.7 LAKE "CARRYING CAPACITY"	B - 13
7.0 WATER TRANSPORTATION	B - 14
7.1 GENERAL	B - 14
7.2 REFERENCE REPORTS	B - 18
7.3 PROJECTED TRAVEL BEHAVIOUR FOR PUTRAJAYA	B - 18
7.3.1 Land Based Public Transport System	B - 18
7.3.2 Water Transport Travel Survey Database	B - 22
7.3.3 Travel Demand Forecasting Model	B - 25
7.4 SERVICE REQUIREMENTS	B - 30
7.5 BENCHMARKING WITH SIMILAR FERRY SERVICES	B - 30
PART C - PUTRAJAYA LAKE USE MASTER PLAN	
8.0 LAKE USE MANAGEMENT ZONING	C - 1
8.1 PRESENT LAKE ZONING	C - 1
8.2 PROPOSAL FOR MODIFIED LAKE USE MANAGEMENT ZONING	C - 1
8.3 COMPARISON OF PRESENT AND PROPOSED LAKE USE MANAGEMENT ZONING	C - 3
9.0 DESIGNATED ACTIVE RECREATIONAL LAKE AREAS	C - 7
10.0 PERMISSIBLE WATER CRAFT AND WATER ACTIVITIES	C - 8
10.1 CATEGORISATION OF PUTRAJAYA LAKE WATER CRAFT	C - 8
10.2 PERMISSIBLE WATER ACTIVITIES WITHIN LAKE USE MANAGEMENT ZONES	C - 9
11.0 INTEGRATED FORESHORE AND LAKE USES	C - 13
11.1 INTRODUCTION	C - 13
11.2 SHARED USE OF PUBLIC PROMENADE WITH WATERFRONT COMMERCIAL DEVELOPMENT	C - 13
11.2.1 General Description	C - 13
11.2.2 Waterfront Promenade	C - 14
11.2.3 Public Ownership Of The Promenade	C - 14

	<u>Page</u>	
11.3	COMMERCIAL LAND USE AND LAKE INTERFACE OPPORTUNITIES	C - 15
11.4	FIXED FLOATING RESTAURANTS	C - 17
11.5	TAMAN WAWASAN HOTEL FACILITY CONCEPT	C - 17
11.6	PRECINCT 5 AQUATIC CENTRE AND FESTIVAL AMPHITHEATRE WATERFRONT CONCEPT	C - 18
11.7	PUBLIC LAKE SWIMMING ENCLOSURE	C - 22
11.8	LAKE EDGE ATTRACTIONS	C - 23
11.9	ROWING	C - 23
11.10	CENTRAL WETLAND RECREATIONAL AND LAKE MANAGEMENT CENTRE CONCEPT	C - 25
11.11	FORESHORE FISHING	C - 25
11.12	SPECIAL EVENTS	C - 29
12.0	LAKE MANAGEMENT, MAINTENANCE AND EMERGENCY RESPONSE FACILITIES	C - 30
12.1	LAKE USE MANAGEMENT CENTRES	C - 30
12.2	CENTRAL ADMINISTRATION AND EMERGENCY RESPONSE CENTRE	C - 35
12.3	AQUATIC RECREATION CENTRE	C - 36
12.4	LAKE MAINTENANCE AND SERVICES CENTRE	C - 36
12.5	DAM CONTROL CENTRE	C - 39
12.6	LAKE MANAGEMENT AND ADMINISTRATIVE CENTRE	C - 40
12.7	CENTRAL WETLANDS RECREATION & LAKE MANAGEMENT CENTRE	C - 40
12.8	SPECIAL LAKE EVENTS AND LAKESIDE SPECTATOR MANAGEMENT CENTRE	C - 40
13.0	LAKE EDGE TREATMENTS	C - 41
13.1	LAKE EDGE TREATMENT REVIEW	C - 41
13.2	REVISED EDGE DESIGNATIONS	C - 42
13.3	ISSUES	C - 43
13.4	NEW LAKESHORE EDGE TREATMENTS MASTER PLAN AND EDGE TYPOLOGY GUIDELINES	C - 45
13.5	LAKE EDGE PLANTING	C - 46
13.6	MAXIMUM LAKE BED LEVEL FOR SATISFACTORY NAVIGATION CLEARANCE	C - 48
13.7	LAKE EDGE TREATMENT CONSTRUCTION METHODOLOGIES	C - 49
14.0	INTEGRATED LAKE USE MASTER PLAN	C - 50

PART D - PUTRAJAYA LAKE NAVIGATION MASTER PLAN

15.0	LAKE BATHYMETRY RELEVANT TO NAVIGATION	D - 1
15.1	BACKGROUND	D - 1
15.2	LAKE 1A BATHYMETRY	D - 1
15.3	LAKE 1B BATHYMETRY	D - 2
16.0	VESSEL DESIGN/PERFORMANCE CRITERIA	D - 3
16.1	BACKGROUND	D - 3
16.2	SMALL POWERED BOATS	D - 4

	<u>Page</u>
16.3 PERFORMANCE CONSIDERATIONS FOR HIGHER SPEED AND LARGER VESSELS	D - 5
16.3.1 Applicable Vessel Categories	D - 5
16.3.2 Wake, Wash and Shoreline Considerations	D - 5
16.3.3 Speed Considerations	D - 6
16.3.4 Vessel Noise	D - 7
16.3.5 Air Quality	D - 9
16.3.6 Stopping and Manoeuvrability	D - 9
16.3.7 Water Draught	D - 9
16.3.8 Air Draught	D - 9
16.4 POWERED LEISURE BOATS	D - 10
16.5 FERRY AND TOUR BOATS	D - 10
16.6 CRUISE BOATS	D - 12
16.7 CATEGORISATION AND SPECIFICATION OF POWERED BOATS	D - 15
16.8 STAGE 2 TECHNICAL DESIGN / PERFORMANCE SPECIFICATION	D - 18
17.0 PRELIMINARY SCHEMATIC DESIGN OF WATER BASED FACILITIES	D - 19
17.1 BACKGROUND	D - 19
17.2 FERRY AND TOUR BOAT TERMINALS	D - 19
17.3 CASUAL BERTHS	D - 23
17.4 MARINA	D - 24
17.5 DAM SPILLWAY ACCESS CONTROL BOOM	D - 24
18.0 PUTRAJAYA LAKE NAVIGATION CONSIDERATIONS	D - 26
18.1 BACKGROUND	D - 26
18.2 NAVIGATIONAL AIDS, MARKERS AND SIGNAGE	D - 29
18.3 EDUCATION REGULATION, SURVEILLANCE AND POLICING	D - 33
18.4 RECOMMENDATION	D - 34
19.0 STAGE 2 INTEGRATED NAVIGATION MANUAL	D - 35
19.1 TERMS OF REFERENCE	D - 35
19.2 LAKE BATHYMETRY	D - 35
19.3 LAKE NAVIGATION CHART	D - 36
19.4 GENERAL NAVIGATION HANDBOOK FOR LAKE USERS	D - 36
19.5 NAVIGATION MANAGEMENT MANUAL	D - 36
19.6 SUPPLEMENTARY CODES OF PRACTICE	D - 39
20.0 INTEGRATED LAKE NAVIGATION MASTER PLAN	D - 40

	<u>Page</u>
<hr/>	
PART E - PUTRAJAYA LAKE MANAGEMENT	
<hr/>	
21.0 MANAGEMENT VISION	E - 1
22.0 MANAGEMENT ISSUES	E - 2
22.1 MANAGEMENT FRAMEWORK	E - 2
22.2 WATER QUALITY MANAGEMENT	E - 3
22.3 LOW FLOW MANAGEMENT	E - 5
22.4 ECOLOGICAL MANAGEMENT	E - 6
22.5 FISHERIES MANAGEMENT I	E - 8
22.6 RECREATION MANAGEMENT	E - 13
22.7 PUBLIC SAFETY AND SECURITY	E - 14
22.8 LAKE NAVIGATION MANAGEMENT	E - 15
22.9 DAM AND FLOOD MANAGEMENT	E - 15
22.10 MAINTENANCE OF LAKE FACILITIES	E - 16
22.11 LANDSCAPE MANAGEMENT	E - 17
22.12 COMMUNITY INFORMATION AND CONSULTATION	E - 17
22.13 EDUCATION AND RESEARCH ACTIVITIES	E - 19
23.0 PRELIMINARY LAKE MANAGEMENT ORGANISATIONAL STRUCTURE	E - 20
23.1 LAKE WETLANDS DIVISION	E - 20
23.2 LAKE USE AND NAVIGATION UNIT	E - 23
23.2.1 Function	E - 24
23.2.2 Responsibilities	E - 24
23.2.3 Personnel	E - 25
24.0 OPERATING REVENUE	E - 26
25.0 STAGE 2 LAKE MANAGEMENT PLAN	E - 27
25.1 TERMS OF REFERENCE	E - 27
25.2 SCOPE OF LAKE MANAGEMENT PLAN	E - 27
25.3 CONTENT OF LAKE MANAGEMENT PLAN	E - 30
25.4 INTEGRATED MANAGEMENT SYSTEM	E - 32
25.4.1 Background	E - 32
25.4.2 Purpose	E - 34
25.4.3 Integration	E - 35
25.4.4 Logging and Replay	E - 35
25.4.5 Database Collection	E - 35
25.5 SECURITY, SAFETY, COMMUNICATION AND ELECTRONIC SURVEILLANCE PLAN FOR PUTRAJAYA LAKE AND ITS IMMEDIATE WATERFRONT	E - 40
25.5.1 General	E - 40
25.5.2 Execution	E - 40
25.5.3 Logistic Support	E - 42

	<u>Page</u>	
26.0	BRIEF FOR STAGE 2 TRAINING PROGRAMS & STANDARDS	E - 43
26.1	INTRODUCTION	E - 43
26.2	SCOPE	E - 43
26.3	OBJECTIVE	E - 44
26.4	PARTICIPATING STANDARDS	E - 44
26.5	RECOMMENDED PROGRAMS AND STANDARDS	E - 44
26.5.1	Boat Operators Course [5 days]	E - 44
26.5.2	Boat Operator Refresher [4-6h]	E - 50
26.5.3	Lake Helmsman [20 days]	E - 50
26.5.4	Lake First Aid & CPR [3 days]	E - 53
26.5.5	Lake Safety, Survival & Rescue Techniques [2 days]	E - 54
26.5.6	Lake Fire Fighting [2 days]	E - 56
26.5.7	Lake Oil Spill Response [2 days theory, 1 day practical]	E - 58
26.6	FUTURE OFFERING OF COURSES	E - 60
26.7	COURSE VENUE AND FACILITIES	E - 60
26.8	SCHEDULE OF COURSES	E - 60
26.9	QUALIFICATION OF INSTRUCTORS	E - 60
26.10	EXAMINATIONS	E - 60
26.11	CERTIFICATION	E - 60
26.12	EXEMPTIONS	E - 61

PART F - EMERGENCY RESPONSE PLAN

27.0	RISK ASSESSMENT FOR PUTRAJAYA LAKE AND WETLAND ATTRIBUTES AND ACTIVITIES	F - 1
27.1	INTRODUCTION	F - 1
27.2	THE PUTRAJAYA LAKE AND WETLANDS SYSTEM	F - 1
27.3	LAKE SYSTEM COMPONENTS	F - 2
27.3.1	Background	F - 2
27.3.2	Wetlands	F - 2
27.3.3	The Drainage System	F - 3
27.3.4	Land Abutting the Lake	F - 4
27.4	ZONING OF THE LAKE	F - 4
27.5	ENVIRONMENTAL POLLUTANTS OF CONCERN	F - 5
27.6	ENVIRONMENTAL IMPACTS AND CONTROLS	F - 5
27.7	RISK ASSESSMENT CRITERIA	F - 5
27.8	THE APPROACH TO RISK MANAGEMENT	F - 6
27.9	COMMUNICATION	F - 7
27.9.1	Background	F - 7
27.9.2	Internal Communication	F - 7
27.9.3	External Communication	F - 7

	<u>Page</u>
27.10 RISK MANAGEMENT PROCESS	F - 12
27.10.1 Purpose of the Risk Management Process	F - 12
27.10.2 The Risk Management Process	F - 12
27.10.3 Risk Assessment	F - 13
27.10.4 Risk Analysis	F - 14
27.10.5 Risk Handling	F - 17
27.10.6 Risk Handling Process	F - 19
27.11 ANTICIPATED RISKS	F - 21
27.11.1 Background	F - 21
27.11.2 Risk Levels	F - 21
27.11.3 Components Affected by Risk	F - 22
27.11.4 Overlapping Levels of Risk and Priority for Response	F - 22
27.11.5 Level and Nature of Risk Table	F - 23
27.12 POLLUTION RISK	F - 26
27.13 ACTIONS THAT CAN BE TAKEN TO MITIGATE RISKS	F - 26
27.14 LOCATIONS FOR EMERGENCY RESPONSE FACILITIES	F - 29
27.14.1 Proposed Emergency Response Facility Locations	F - 29
27.14.2 Justifications for Emergency Response Facility Locations and Basic Equipment Required	F - 29
27.15 LIFEGUARD STATIONS	F - 30
27.16 EMERGENCY RESPONSE NEEDS	F - 31
28.0 BRIEF FOR PUTRAJAYA LAKE & WETLAND EMERGENCY RESPONSE PLAN	F - 33
28.1 INTRODUCTION	F - 33
28.1.1 General	F - 33
28.1.2 Purpose	F - 34
28.1.3 Scope	F - 34
28.2 PUTRAJAYA LAKE & WETLAND EMERGENCY RESPONSE PLAN FRAMEWORK	F - 35
28.3 ORGANIZATION OF THE PUTRAJAYA LAKE & WETLAND ERP	F - 36
28.4 EMERGENCY RESPONSE PLAN	F - 36
28.5 PUTRAJAYA LAKE & WETLAND EMERGENCY RESPONSE PLAN CONTENTS	F - 37

APPENDIX - REFERENCE PLANNING AND DESIGN DOCUMENTATION & DRAWINGS

TABLE A1 - REFERENCE PLANNING AND DESIGN DOCUMENTATION

TABLE A2 - REFERENCE PLANNING AND DESIGN DRAWINGS

PART A

BACKGROUND

1.0 INTRODUCTION

Hijjas Kasturi Associates Sdn in collaboration with sub-consultants Pelorus Services Sdn Bhd and Burchill Partners have been appointed by Perbadanan Putrajaya to prepare and to produce the Putrajaya Lake Use and Navigation Master Plan and the Lake and Wetland Emergency Response Plan. There are 2 stages of work in this preparation of the Masterplan and the Emergency Response Plan and Perbadanan Putrajaya has given authorization to commence with the first stage.

The consultancy services are to be undertaken in accordance with the *Design Brief, Scope of Works and Scope of Services* included as an attachment to the Perbadanan Putrajaya letter of appointment dated 6 November 2000.

2.0 PURPOSE AND SCOPE OF THE PUTRAJAYA LAKE USE AND NAVIGATION MASTER PLANS AND EMERGENCY RESPONSE PLAN

The planning and development implementation of Putrajaya as the new Federal Government Administrative Centre for Malaysia is viewed by many worldwide as a spectacular urban project of international standard.

The manmade Putrajaya Lake will be the most significant visual and landscape feature of the new city unifying its central precincts and surrounding topography.

The physical attributes of Lake Putrajaya including its edge treatments, its water quality and the diversity of community leisure and commercial activities it supports, as well as the visual setting and view corridor opportunities created for buildings and public open space that address the water, will be critical in defining the ultimate character and the national symbolism of Putrajaya.

The Lake Use and Navigation Master Plans and the Emergency Response Plan are intended to serve as a prime reference for Perbadanan Putrajaya; the developers of sites having lake frontage; lake based commercial operators; relevant Government agencies and authorities; and the community of Putrajaya including residents, workers and visitors; providing guidelines for appropriate shoreline development, water use, navigation and best practice in all relevant aspects of lake management.

3.0 REFERENCE PLANNING AND DESIGN DOCUMENTATION

There is an enormous volume of previous technical studies and design reports, as well as development planning and detailed design currently in progress, which are relevant to the formulation of Putrajaya Lake Use and Navigation Master Plans.

The documents as summarized in **Appendix 1** have been collated and critically reviewed in order to sieve out:

- i. all pertinent technical data;
- ii. all constraints and opportunities previously identified or fixed by virtue of the progress of development to date; and
- iii. all valuable concepts that have previously been formulated.

4.0 PUTRAJAYA AND THE PUTRAJAYA LAKE SYSTEM

4.1 PUTRAJAYA MASTER PLANNING

In 1995, a Master Plan was approved by the Federal Government of Malaysia for development of the Federal Government Administrative Centre of Putrajaya, strategically located between Kuala Lumpur and the new Kuala Lumpur International Airport and close to the heart of the Nation's main 21st century development hub - the Multimedia Super Corridor.

Putrajaya occupies an area of 4,400 hectares and is planned to ultimately accommodate a resident population of 335,000, of whom approximately 70% are envisaged to be government employees and their families.

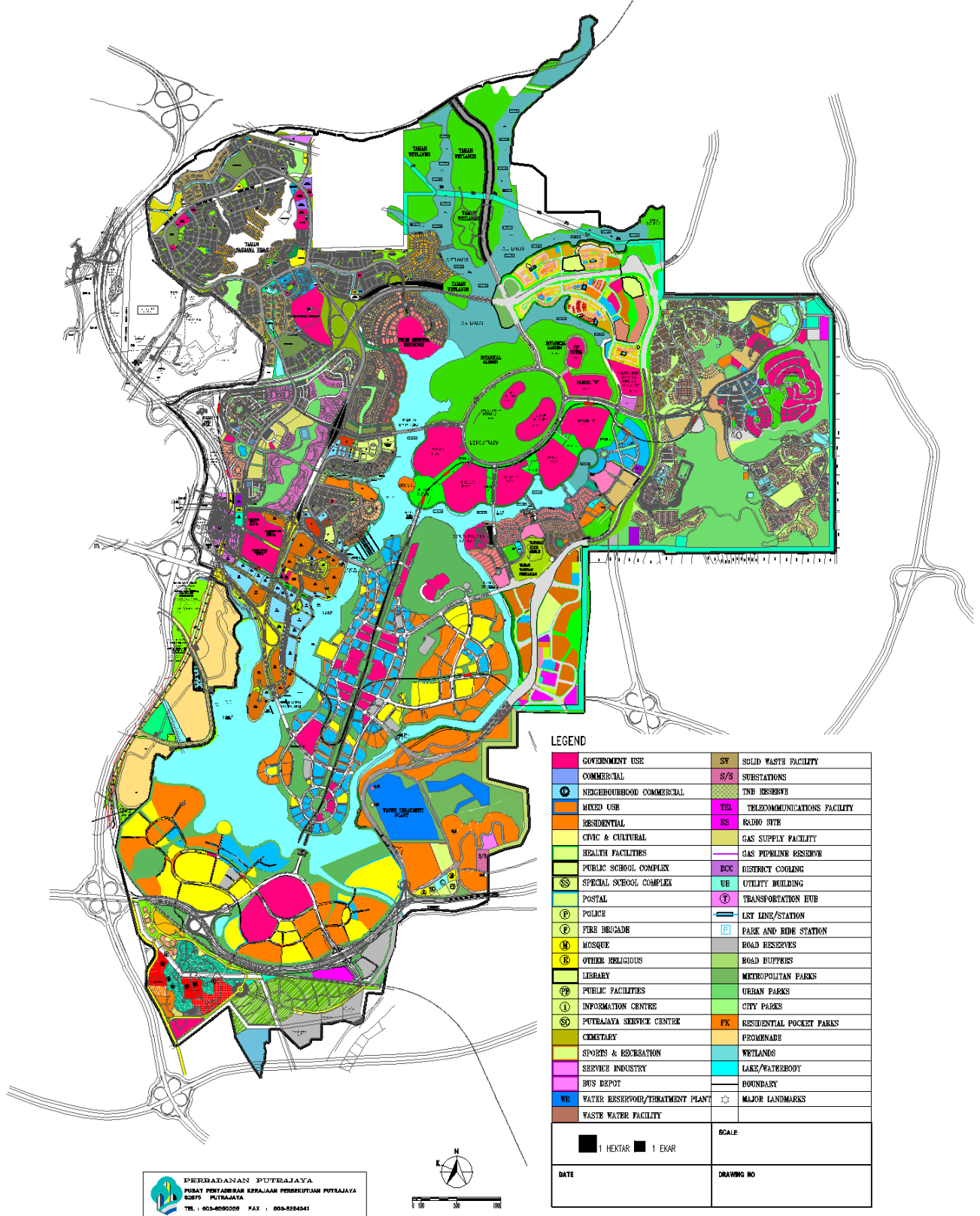
The landform of the Putrajaya site is characterised by undulating hills with topography ranging between 20m and 80m elevation; and the three main river valleys of Sungai Chuau, Sungai Bisa and Sungai Limau Manis.

Flooding of the Sg. Chuau and Sg. Bisa valleys will create a lake system within the heart of the City occupying more than 600 hectares, which represents almost 14% of the total area of the Administrative Centre and 37% of the planned total allocation of open space within Putrajaya.

Planning for the Federal Government Administrative Centre at Putrajaya is based on a City-in-a-Garden concept, which places high value on a natural setting created by an integrated system of parks, water bodies, wetlands, forest and open spaces.

The Putrajaya Master Plan including the configuration of the Putrajaya Lake system is illustrated in **Figure 4.1**.

Figure 4.1 - Putrajaya Master Plan



4.2 PHYSICAL FEATURES OF THE PUTRAJAYA LAKE SYSTEM

4.2.1 General Description

The Putrajaya lake system occupies more than 600 hectares including manmade wetlands and small-perched lakes located on the major incoming tributaries immediately above the main body of the lake. The lake system has a total upstream catchment of 51 square kilometres.

Upper North, West and East Wetlands, Upper East and Central Wetlands, and Upper Sg. Bisa Wetlands Parks have been established above the main lake with the aim of reducing gross pollutants, suspended solids and nutrients and otherwise improving the physical and bacteriological quality of water discharging to the primary lake from its principal catchments.

The 390 hectare primary Putrajaya Lake was created by inundating the valleys of Sungai Chuau and Sungai Bisa. It is characterised by a deep main basin at the south (approximately 9 to 13 metres deep) and a narrow arm of the lake approximately north of the dam (2 to 7 metres deep). The design full supply level of Putrajaya Lake is EL 21.0 metres, corresponding to a water volume of 26.5 million cubic metres.

The lake is in its second phase of construction. The first phase (Phase 1A) of 110 hectares has been completed and filled behind a temporary dam and the second phase of the lake (Phase 1B) which will cover an additional area of about 310 hectares has not yet been inundated pending completion of the main dam at the southernmost end of the lake. The whole lake is expected to be ready for inundation commencing 1 July 2001 with filling proceeding into year 2003.

The western arm of the primary lake between the northern weir and the dam in the south generally varies in width between 140 metres and 800 metres, while the narrower eastern arm of the lake following the eastern shoreline of the core island is generally about 100 metres in width.

The distance between the northern most weir below the Central Wetlands waterbody and the dam wall in the far south is approximately 6 kilometres in a straight line, or approximately 9 kilometres by way of a midstream navigation path.

The total length of the shoreline of the main lake is 38 kilometres.

4.2.2 Geology

As detailed in the Development Proposal Reports for the lake Phases 1A and 1B, the geology of the area generally comprises:

- i. Bedrock of Hawthorden schist and phyllite extending north and east from near the southern end of the core island.
- ii. Bedrock of Kenny Hill formation sandstone and shale extending south and west from the lower end of the core island.
- iii. Residual soils in the form of firm to hard clayey silts and silty clays generally overlying bedrock.
- iv. Alluvium in low-lying valleys consisting of soft humic clays and silts with depths ranging from 0.3m to 10m.

4.2.3 Hydraulic Engineering

Principal hydraulic engineering features of the primary Putrajaya Lake relevant to this Lake Use study are outlined below:

- | | | | |
|-------|--|---|-----------|
| i. | Lake standing water level | : | EL21.0m |
| ii. | Maximum water depth | : | 13m |
| iii. | Average water depth | : | 6.6m |
| iv. | Dam crest level | : | EL24.0m |
| v. | Maximum flood level during Probable
Maximum Flood | : | EL22.9m |
| vi. | Flood level during 1 in 100 year flood | : | EL21.5m |
| vii. | Spillway type | : | Labryinth |
| viii. | Spillway crest length | : | 292m |
| ix. | Spillway crest level | : | EL21.0m |

Previous studies have not quantitatively and reliably assessed the performance of the lake level during drought periods of various recurrence intervals. It has been estimated (*Development Proposal Report and Building Erection for Main Dam, Phase 1B, May 2000*) that over a drought period of approximately 90 days, the maximum drop in the level of the lake would be about 1.2m, comprising 0.5m through evaporation and 0.7m due to seepage losses through the dam. However this analysis is based on the assumption that there is no water abstraction for :

- i. Irrigation of parks and other uses; and
- ii. Maintenance of minimum flows necessary to sustain the well being of the upstream wetlands in drought periods and/or release of riparian (compensation) flows from the lake to the downstream river system.

A present study commissioned by Perbadanan Putrajaya for the development of an Irrigation Master Plan has determined at an interim stage that with conservation measures and a combination of various sources of water, the irrigation of shrubs only during a 1 in 50 year drought can be achieved with only a 0.14m drawdown of the lake.

There is still a need to reliably assess the combined effect of all lake inflows and outflows in wet, normal and dry hydrological years and to establish anticipated drawdown levels and associated recurrence intervals.

4.2.4 Primary Lake Edge Landform

The well defined valley edges of the Phase 1A lake area have generally required relatively minor cutting and filling to create the required lake edge land form prior to inundation.

Within the Phase 1B lake area, the pre-existing topography around the lake edge has generally contained slopes of less than 10%.

The eastern arm of the lake around the east of the core island involves earthworks in cut with the exception of the lower 1 km section which is constructed within fill batters. Almost all of the remaining Phase 1B Lake Shoreline is formed by filling.

The engineered landform around the lake shoreline generally comprises a constructed 1 in 4 batter rising from the lake bed to a 5m wide submerged bench at EL20.0m, and a further 1 in 4 batter rising to a 20m wide public promenade at EL22.5m which is 1.5m above the normal lake surface level. The treatment of lake edges is addressed in Section 13.0.

Most recent hydrological analyses in conjunction with the main dam spillway design have revised earlier predicted flood levels, and a 1 in 100 year flood level of EL21.5m has been determined. It is noted that promenade levels around the perimeter of the presently inundated Phase 1A lake body appear to have been set at EL23.0m, whereas the design of earthworks surrounding the future Phase 1B southern extension of the lake including the core island, is based upon a promenade platform level at EL22.5m.

4.2.5 Upstream Wetlands

The wetlands upstream of the primary lake incorporate a system of cells separated by weirs which:

- i. maximise pollutant capture
- ii. maximise flood detention
- iii. increase available area for plant colonisation
- iv. facilitate maintenance, including management of weeds and insects

Each cell is planted with both emergent and submerged aquatic plants.

Each wetland weir incorporates an outlet conduit and inlet structure with trash rack for trapping gross pollutants.

The Central Wetlands area incorporates an attractive water body with four small islands, which has an open water area of approximately 30 hectares.

A weir separating the Central Wetlands from the primary lake has been designed as a curved free overflow structure to resemble a small waterfall.

4.2.6 Dam

The main dam at the south-eastern end of the primary lake is constructed with a clay core, with rockfill upstream and downstream of core. The embankment spanning the valley of Sg. Chuau has a crest level of EL 23.5m with an additional 0.5m high upstream wavewall. The crest of the dam excluding the spillway at its western end has a total length of approximately 740m and a trafficable width for pedestrians and authorised vehicles of approximately 4m, within a total embankment crest width of 8m.

An approximately 120m long pedestrian bridge is proposed over the front of the spillway to link the dam crest and a Dam Control Centre on the western abutment.

The dam and its spillway are designed to withstand a Probable Maximum Flood with a peak inflow rate of 1,187m³/s, which compares with the calculated inflow rate for a 1 in 100 year flood of 368m³/s.

An attractive intake tower near the eastern abutment houses pipework and valve controls for a low level 1.0m diameter emergency release pipe and three higher level draw-offs - at EL 11.0m, EL 14.27m and EL 18.5m for selective draw-off and riparian release.

Comprehensive details of the dam are contained within the *Development Proposal Report and Building Erection for Main Dam, Phase 1B*, of July 2000.

4.3 CLIMATIC FACTORS

Climatic factors relevant to the aquatic environment of Putrajaya Lake and activities upon the lake, as previously detailed in Development Proposal Report for the Lake Phases 1A and 1B, include the following:

i. *Rainfall*

The mean annual rainfall recorded at Putrajaya is about 2,000mm. The rainfall pattern reflects the annual monsoon cycles. The northeast monsoon occurs from December to March with the highest rainfall recorded around November/December. The southwest monsoon occurs from June to September. The period of lowest rainfall is around June/July.

ii. *Air Temperature*

The mean annual air temperature is approximately 27°C with monthly mean air temperatures ranging from around 26°C in December to 28°C in May. The mean monthly minimum and maximum air temperatures range from about 20°C to 36°C in February, to about 22°C to 35°C in May.

iii. *Relative Humidity*

Consistently high relative humidity is experienced throughout the year ranging from 81% in February to 86% in November.

iv. *Evaporation*

The average annual evaporation over open water is approximately 1,700mm. There is no significant variation in evaporation throughout the year.

v. *Surface Winds*

Wind data collected at Subang Airport shows mild wind conditions with calm periods occurring more than one third of the time, with no strongly dominant wind direction. The average wind speed is low at about 2.5m per second.

vi. *Sunshine*

The average daily duration of sunshine averages about 6 hours, from a low of 4 hours in November to 7.5 hours in February.

4.4 LAKE ECOLOGY AND WATER QUALITY

Despite being an artificial lake system, Putrajaya Lake will be a significant ecological resource within the region. It will be a viable fresh water ecosystem with a high level of biodiversity, reflecting both natural and introduced components.

The quality of water in the lake, which is intended to be suitable for body contact, water sports and recreational activities, is a planning, design and operational management issue of paramount importance.

Although the wetlands upstream of the primary lake will play a key role in maintaining a high standard of water quality through pollutant capture, it is significant that approximately 39% of catchments inflow to the lake is from the immediate lake perimeter without passing through wetlands.

When upstream inflows are inadequate, re-circulation by pumping from the main lake bodies may be required to assist in increasing the effective retention time of water within the Upper North Wetland and also to augment dry weather flows into the Lower East and Upper Bisa Wetlands, in order to sustain these wetland eco-systems.

A pumping station at the Central Wetlands has been provided to re-circulate water to wetland cells immediately upstream. Another pumping station below the wetlands weir at Precinct 16 is able to re-circulate water from the primary lake to some Upper Sg. Bisa wetland cells.

4.5 LAKE USE

The Putrajaya Lake has been planned to cater for multi-functional uses, including recreation, fishing, water sports and water transport. The lake and its foreshores will also form Putrajaya's most popular resource for informal recreation.

5.0 LAKESIDE LAND USE

5.1 BACKGROUND

Drawing 5.1 shows present land use zoning proposals for land associated with various sections of the overall lake body. Some areas in the north are already fully developed or being developed while others are in various stages of planning from conceptual to detailed guidelines.

It is important that the use of the lake be appropriate to the amenity, character and use of the adjoining lakeside land development. Lakeside land use falls broadly into three categories:

- i. Public Parks;
- ii. Commercial/Mixed Use; and
- iii. Residential.

Public parks offer opportunities for viewing and access for major water activity events and more active recreational pursuits, while Commercial interfaces with ferries, tour boats and marinas and has potential to activate the lakeside with outdoor eating, retail, cultural, recreational and tourist activities. On the other hand, residential areas need a quieter environment and provide foreshore activation in the form of walking, jogging, cycling, fishing and the like.

While the current master plan constrains buildings directly interfacing with the lake edge by requiring a minimum 20 metre wide public promenade, it may be appropriate and still in keeping with this overall philosophy, to allow carefully designed structures at various locations to activate the lakeside and provide more varied lifestyle opportunities.

5.2 CENTRAL WETLANDS

Extensive parks have been established in Precinct 13, which provide opportunities for ecologically and environmentally orientated recreation pursuits. The network of access roads provides recreational trail opportunities for walking, jogging and equestrian use.

Portions of Precinct 10 and Precinct 11 and the majority of Precinct 12 residential communities have direct interface with the wetlands and benefit from the landscape enhancement and recreational opportunities it provides.

Taman Botani in Precinct 1 has extensive frontages to the Central Wetlands waterbody and provides a very scenic backdrop.

A suitably controlled point of access to this waterbody could provide for non-motorised or electric motorised fishing and recreational boating.

5.3 NORTHERN REACH

This section of the primary lake is characterised by major landmark public buildings in a tranquil lake setting. The projection of the Putra Mosque into the lake provides a main hard-edged built form pivotal landmark which contrasts with the soft landscape settings of the Prime Minister's Residence and the Prime Minister's Department, as well as the extensive Taman Botani Park.

The existing marine police facility and the proposed adjoining Boat Club development provide controlled boating access to this part of the lake.

Taman Botani and Dataran Putra are major tourist attractions and together with the Boat Club are potential tour boat destinations. The various landmark public buildings, Putra Bridge, public parks and weir (which could be floodlit at night) also provide major points of interest for tour boats.

5.4 CENTRAL REACH

Precincts 2, 3 and 4 provide a major formal urban design interface with the eastern side of this arm of the main lake.

At the northern end Precinct 2 provides an Arts and Culture Quarter flanked by a Formal State Garden and a Water Garden, and an Entertainment/Mixed Use Quarter opening onto a major linear lakeside park, with the spectacular Putra Bridge link to Dataran Putra in Precinct 1.

Centrally, Precinct 3 accommodates a major cultural and religious complex which connects from the Grand Mosque projecting into the lake via courtyard spaces to Dataran Putra. This is flanked to the north and south by major linear lakeshore park.

At the southern end, mixed-use development is proposed fronting onto the lake shore promenade.

Along the western side the lake provides landscape and recreation amenity for the residential communities of Precinct 8 and Precinct 9 north and south of a central major commercial zone. The frontage to this zone offers opportunities for activating this section of the lake shore.

5.5 SOUTHERN LAKE BODY

Precinct 4 provides a formal urban design interface in this arm of the lake with a semi-circle of commercial sites either side of the bridge and a radial park sector connecting from Dataran Khazanah to the lakeside.

Further west, a residential neighbourhood projects on a peninsula into the lake and is flanked by linear lakeside parks.

Along the south side of the lake in Precincts 6 and 5, a mix of residential and commercial uses is proposed in association with a Convention Centre and Sports Academy.

The southern lake body is best suited to a wide range of water based leisure and recreational activities with opportunities for integration with complementary land uses. The analysis of lake use and foreshore potentials and their integration for particular water oriented activities within the southern lake body are addressed in Sections 6.0 and 11.0 respectively.

Development proposals for the Dam provide for visitor access to the Control Centre and access to the dam wall for spectator viewing of water activities.

To the west, this arm of the lake extends into Cyberjaya residential precincts.

5.6 EASTERN REACH

This narrower more river like section of the lake passes through a relatively contained valley of predominantly residential use (Precincts 17, 18 and 19) with park nodes at intervals.

To the north the lake turns to the east and west and is overviewed from the north by a series of Government Department complexes in landscape settings, from the southwest by the steep hillside parklands of Taman Wawasan, and from the southeast by the Deputy Prime Minister's Residence.

To the south where the lake comes relatively close to the main Central Boulevard, lakeside commercial retail and mixed uses are proposed. The setting for this commercial is more riverside in scale than lakeside.

PART B

ANALYSIS

6.0 IDENTIFICATION AND ANALYSIS OF PUTRAJAYA LAKE USE AND FORESHORE POTENTIALS

6.1 GENERAL

Putrajaya Lake has the potential to support a wide range of water oriented and foreshore activities.

Generically, potential waterway functions (which can be subdivided into a myriad of sub-categories) include:

- i. Public leisure / recreation;
- ii. Water sports training and competition;
- iii. Leisure boating;
- iv. Other private recreation;
- v. Commercial recreation;
- vi. Public transport;
- vii. Commerce and industry;
- viii. Public displays and events;
- ix. Environmental purposes.

6.2 IDENTIFICATION AND ANALYSIS OF LAKE USE POTENTIALS

6.2.1 Activity Categories

Aside from the aesthetic enhancement provided by the incorporation of a water body, there is significant potential for lifestyle enhancement through water associated activities.

It is well recognised that waterways represent a high value amenity asset and that appropriate planning and implementation for active use of this asset can create wide ranging public benefits.

Potential water based activities can be primarily subdivided into water craft and non-water craft categories. The former can be further categorised as motorised and non-motorised watercraft activities.

i. Non-Water Craft Activities

Such activities include swimming, snorkelling, scuba diving and beach paddling, together with lakeside picnic and sandy beach activities including beach related sports such as beach volley ball, nature walks, and shore based fishing.

ii. Water Craft Activities*Non-Motorised Craft*

Non-motorised craft can be further subdivided into sailing and self-propelled craft.

Sailing craft applicable to a lake situation would typically include mono-hull and catamaran sailboats under 5 metres long, sailboards and model yachts.

Self propelled craft range from peddle powered hire leisure craft, canoes, kayaks, and leisure rowboats, to dragon boats and international competition rowing skiffs.

Motorised Craft

Motorised craft include powered model boats, jet skis, ski boats, powered pleasure craft, fishing craft, racing boats and commercial vessels.

In the context of Putrajaya Lake, powered pleasure craft would typically be confined to trailerable sized vessels. Racing boats, if considered permissible, would be confined to the junior sports and hydroplane classes. Commercial vessels may include longer vessels involved in tourism and ferry transport activities.

6.2.2 Water Activity Locational Requirements

The factors primarily influencing water activity locational requirements tend to be:

- a. area requirements; and
- b. inter-relationship with surrounding uses.

i. Area Requirements

Area requirements for activities on land or water, are specific to each activity.

In many cases, lake activities are constrained as a consequence of limitations in available area. The relatively large size of the Putrajaya Lake system facilitates a significant range of opportunities.

The following **Table 6.1** provides a summary of activities, indicative lake area requirements and remarks with respect to their suitability and “fit” within Putrajaya waterways.

Table 6.1 - Water Activity Area Requirements

ACTIVITY	LAKE AREA REQUIREMENTS	REMARKS
(a) Non-Water Craft		
Swimming - Recreational	Up to 50m from shore. Width of area dependent on planning requirements.	Reasonable limitation of 50m from waters edge to provide an adequate open space yet limit distance for general safety and supervision.
- Competition	5 hectares.	Typical triathlon swimming course would be 800m long (400m out and back)
Shore-based Fishing	Nominal area.	Usually confined to the immediate area surrounding a jetty or headland from which fishing is permitted.
Snorkelling	Similar requirements to swimming.	
Scuba Diving	As above for training only.	Inherent lack of visibility and lack of underwater scenic features within lakes inhibit interest.
(b) Water Craft Activities		
<u>Non-motorised</u>		
Self-Propelled Water Craft	Limit to around 200m from water edge for practical supervision. Width limited by planning requirements.	Usually confined to hire boat activities associated with public beach areas.
Rowing/Canoe/Kayak/ Dragon Boat Racing/Raft Racing	2,300m x 135m.	Rowing course to international standards usually has min. 6 x 13.5m lanes with 27m (11m min.) wide circulation lanes each side of the course. Course lengths are up to 2000m plus 22m min. before start line and 100m min. beyond finish line. Courses should generally be oriented north/south. Other watercraft racing events can be configured within the rowing course area.
Small Yachts and Sail Boards	Circular area of 1.5 km diameter preferred for international Olympic mono-hull classes.	Course areas of much smaller diameter would be satisfactory for normal club small leisure craft sailing races and sailing tuition, particularly considering the region's characteristically light winds.

ACTIVITY	LAKE AREA REQUIREMENTS	REMARKS
Model Yachts	100m x 100m adjacent to shore.	Considered a maximum requirement for both racing and recreational sailing.
Sailing Tuition	Areas required for tuition would be easily accommodated within the designated activity area.	
Fishing	No specific limits.	Non-motorised fishing boats typically comprise small rowed craft.
<u>Motorised</u>		
Powered Model Boats	100m x 100m adjacent to shore.	Practical maximum for visual control of craft.
Ski Boats	25m x 200m slalom ski course, 50m x 250m ski jump course.	Logically these courses would be located side by side with some overlap if required to reduce combined overall width.
Jet Skis	Events course 400m x 800m.	Noise associated with jet ski activities requires due consideration if such craft are to be permitted within lake areas.
Powered Pleasure Craft		Destination orientated.
Junior Sports Racing Boats	Courses are oblong or triangular in shape to suit the venue with lap distances of 1.5 to 2.5km.	Dependent on available area.
Towed Rides and Parasailing	Practical minimum for Para-sailing 1km x 0.4km.	
Fishing	No specific limits.	Not to obstruct general lake navigation.
Tuition	Basic boat handling and license testing can be confined to 50m x 50m.	
Water Transport, Sight Seeing, Dinner Cruises etc	Dependent on user requirements and locations of interest.	
Raft Racing	Typically up to 2km long and up to 100m width.	Would probably use the same course designated for rowing.

ii. Other Locality Requirements/Constraints

Aside from required access to the lake and area parameters that may restrict the location of various activities, **Table 6.2** sets out other specific constraints that further define locality suitability.

Table 6.2 - Other Locality Requirements/Constraints

ACTIVITY	LOCALITY REQUIREMENTS / CONSTRAINTS
(a) Non-Water Craft	
Shore-Based Fishing	Fish habitat area with sufficient fish stock Casting area clear of aquatic growth and excessive snags Convenient landside parking and access to foreshore fishing locations
Swimming – Recreational	Associated recreational land area and amenities Clean water Shallow, gently sloping lake bed Firm, clean (preferably sand) lake bed Area restricted from vessel activities
Swimming - Competition	Clean water Associated amenities Area restricted from other activities
Snorkelling, Scuba Diving	Access to amenities Clear water Underwater scenic features/aquatic life
(b) Water Craft	
<u>Non-motorised</u>	
Self-Propelled Water Craft	Launching, retrieving, and possibly land storage area
Canoe/Kayak/Rowing/Dragon Boat Racing and Training	Club amenities Designated and buoyed course area for competition Lake side vessel storage
Small Yachts and Sail Boards	Club amenities Designated and buoyed course area for competition Boat storage area Boat rigging area Surrounding area of relatively low impedance to wind
Model Yachts	Amenities Designated buoyed area in calm water Spectator viewing

ACTIVITY	LOCALITY REQUIREMENTS / CONSTRAINTS
Fishing	Boat launching and retrieving area Amenities Fish habitat area with sufficient fish stock Possible associated boat storage area
<u>Motorised</u>	
Powered Model Boats	Amenities Designated buoyed area in calm water Spectator viewing
Water Skiing	Boat launching ramp Private boat owner trailer parking Possible lake edge storage for commercial operators and/or private craft Designated water area with buoys for slalom course and jump structure for ski jumping
Jet Skiing	Designated area where high speed and significant noise is acceptable Amenities Launching ramp Trailer parking for private owners Possible lake edge storage for hire craft
Powered Leisure Craft	Amenities Launching ramp or marina berthing Designated areas of high speed, significant noise generating craft are permitted Trailer parking for private owners Possible lake edge storage for hire craft Self driven or professional skippering
Power Boat Racing	Launching ramp Trailer parking area Amenities Designated, restricted buoyed area where significant noise generation is permitted
Parasailing and Towed Rides	Amenities Lake edge storage for commercial operators Designated area for activities
Fishing	Launching ramp Amenities Trailer parking for private owners Possible lake edge storage for hire craft and/or private craft Fish habitat area with sufficient fish stock

6.2.3 Complementary/Conflicting Water Activities

As part of the process of determining appropriate locations for various water activities, an assessment needs to be made of the complementary or conflicting interrelationships of such activities, as summarised in **Table 6.3**.

Table 6.3 - Complementary/Conflicting Water Activities

ACTIVITY	COMPLEMENTARY ACTIVITIES	CONFLICTING ACTIVITIES
(a) Non Water Craft		
Shore-Based Fishing	Fishing from boat, picnicking/passive beach activity, non-motorised passive leisure craft activity.	Swimming, snorkelling, scuba diving, skiing, jet skiing, parasailing and towed rides, competition boating activities.
Recreational Swimming	Snorkelling, scuba diving, beach activities, possibly passive self-propelled leisure craft activities.	Motorised craft, sail craft, commercial craft and competition activities. (Water area to be restricted from all other activities.)
Competition Swimming/ Snorkelling/ Scuba Diving	Recreational swimming.	Water craft activities, fishing and competition swimming.
(b) Water Craft		
<u>Non Motorised</u>		
Self-Propelled Water Craft	Non competition watercraft activities, possibly recreational swimming, and fishing.	Competition activities.
Canoe/Kayak/ Rowing/Dragon Boat Racing and Training		(Course area to be restricted from all other activities during racing.)
Small Yachts and Sail Boards	Fishing and passive leisure craft activities.	Swimming, snorkelling, scuba diving, other competition and training activities, water skiing.
Model Yachts		(Preferable to restrict area from other activities.)
Fishing	Shore-based fishing and fishing from motorised vessels, non-competition sailing and passive leisure craft activities.	Non-passive leisure craft activities, swimming, snorkelling, and scuba diving.

ACTIVITY	COMPLEMENTARY ACTIVITIES	CONFLICTING ACTIVITIES
<u>Motorised</u>		
Powered Model Boats		(Preferable to restrict area from other activities.)
Water Skiing	Non-course pleasure skiing may be tolerated with other non-competition leisure boating activities other than sailing.	(Restrict all other activities during competition and training in course area.)
Jet Skiing	Non-competition jet skiing may be compatible with other active motorised boating activity.	Swimming, snorkelling, scuba diving, non-motorised craft activities, all other activities restricted from course area during training and competition. Jet skis in shared waterways are notoriously dangerous.
Powered Pleasure Craft	Fishing, non-competition sailing, parasailing and towed rides, non-competition jet skiing and water skiing.	Swimming, snorkelling, scuba diving.
Power Boat Racing		Course area restricted from all other activities.
Parasailing and Towed Rides	Jet skiing, motorised leisure craft activities.	Competition activities, swimming, snorkelling, scuba diving.
Fishing	Non-competition sailing, non-motorised and motorised leisure boat activities.	Swimming, snorkelling, scuba diving, competition activities, water skiing, parasailing and towed rides and jet skiing.
Ferries, Tour Boats, Cruise Boats		Restricted from areas during competitions, swimming, snorkelling and scuba diving, designated model boat areas, and sailing tuition areas.

6.3 LAND/WATER ACTIVITY INTER-RELATIONSHIPS

For any well planned waterfront, priority attention should be given to the interrelationship of land and water activities, with the objective of enhancing public enjoyment and adding value to real estate.

Table 6.4 addresses opportunities and constraints with respect to land and water activity inter-relationships.

Table 6.4 - Land/Water Activity Inter-Relationships

ACTIVITY	LAND/WATER ACTIVITY INTER-RELATIONSHIPS
Swimming, Snorkelling and Scuba Diving	<p>Creation of near shore water related activity enhances water-land interrelationship and emphasises leisure lifestyle attributes.</p> <p>Needs to be associated with recreational orientated land activity away from formal, business, commercial or serene activity areas.</p>
Shoreside Fishing and Fishing from Boats	<p>Preference towards passive activity areas.</p> <p>Activates lake and foreshore public assets and promotes healthy leisure time relaxation pursuits.</p>
Skiing, Jet Skiing, Power Boat Racing, Model Power Boats	<p>Can generate comparatively high noise levels and should therefore be located away from noise sensitive areas. Commercial skiing operations and jet ski hire can assist in promoting a vibrant recreational waterfront activity area.</p>
Parasailing and Towed Rides	<p>Commercial operations usually associated with a resort oriented waterfront precinct and can assist in promoting a vibrant waterfront activity area. Parasailing can also be operated in an urban waterfront environment where participants wear normal clothing and do not get wet.</p>
Powered Leisure Boating	<p>Powered leisure boating that does not involve specific activities such as fishing or skiing, tends to be sight seeing and destination orientated. Relevant destinations include beach and picnic areas and possibly waterfront commercial areas where vessels can tie up and dine out.</p>
Sightseeing, Floating Restaurants	<p>Aside from the waterfront scenic attractions and places of interest requirements, such activities require a terminal area that can generate a reasonable tourism orientated passenger throughput.</p>
Water Transport	<p>Requires appropriately located terminals to suit user requirements and to provide enhanced convenience relative to other transport modes. May have a significant tourism function for the informal movement of visitors.</p>
Canoeing, Kayaking, Rowing and Dragon Boat Racing	<p>Recreation activities tend to be associated with passive recreational areas and enhance the activity within such areas.</p> <p>Sporting activities tend to be associated with clubs which include storage and launching facilities and with staged events.</p>
Self-Propelled Craft	<p>Pedal-powered craft, like recreational canoeing and kayaking enhance activity within passive waterfront recreational areas. Such craft are most suited to "off the beach" hire operators.</p>
Small Yacht Sailing and Model Yacht Sailing	<p>Usually associated with club facilities with possible tuition opportunities. Small yacht hire usually associated with "off the beach" hire operations in more popular waterfront recreational areas.</p>

6.4 ASSESSMENT OF WATER ACTIVITY SUITABILITY

Having regard to the status of Putrajaya as a national symbol as well as the size and environmental circumstances of Putrajaya Lake and the character and mix of surrounding land use, the suitabilities of various water activities are summarised in **Table 6.5**:

Table 6.5 - Putrajaya Lake Activity Suitabilities

CATEGORY	WATER ACTIVITY
A - Desirable (within normal operating controls)	Sight seeing/Guided tours (approved commercial operators) Dinner cruises
B - Desirable with locational restrictions	Fishing Swimming Snorkelling Scuba diving Water transport Water tours/Water cruises Canoeing, kayaking, rowing, dragon boats, rafting Self propelled craft (approved hire operators) Sailing (leisure, tuition and racing) Small powered boats (club hired and self driven)
C - Desirable with locational and specific operational restrictions	Skiing (commercial operators) Parasailing (commercial operators) Towed rides (commercial operators) Powered leisure boats (club hired and professionally skippered) Powerboat tuition Powered model boats
D - Undesirable unless specifically limited and controlled	Powered leisure boats (self skippered) Power boat racing
E - Undesirable	Jet skiing Floating helipad

6.5 WATER ACTIVITY MANAGEMENT

Activities on Putrajaya Lake should be managed with reference to clear guidelines and regulations in a manner that encourage:

- i. compatibility with neighbouring land use;
- ii. compatibility with foreshore facilities
- iii. enjoyment for visitors to Putrajaya and its resident community;
- iv. healthy recreational pastimes;
- v. development of water based sports;
- vi. environmental responsibility;
- vii. social responsibility; and
- viii. public health and safety.

Guidelines and regulations appropriate to various lake activities are outlined in **Table 6.6**.

Table 6.6 - Water Activity Management Controls

ACTIVITY	MANAGEMENT CONTROLS
Sightseeing, Guided Tours and Dinner Cruises	By approved operators only who are required to maintain high standards of vessel safety and amenity and that are designed and operated in accordance with predetermined performance criteria.
Fishing	By licence in designated areas. No cleaning of fish at lake edge. Fishing from boats undertaken using approved hire boats only.
Swimming, Snorkelling and Scuba Diving	Restricted to designated lake swimming enclosures and filtered swimming lagoon areas only (except for competition distance swimming.)
Water Transport	By approved operators only who are required to maintain high standards of vessel safety and amenity in accordance with predetermined performance criteria.
Canoeing, Kayaking, Rowing and Dragon Boats	Sport activities and training undertaken within organised clubs and associations in designated areas. Recreational canoeing, kayaking provided by approved operators in designated areas with high safety standard requirements. All competition events subject to prior application and permit.
Self-Propelled Craft	By approved hire operators in designated areas only.
Sailing	Preferably within an organised club situation that can control safety standards, provide on the water tuition and safety patrolling in designated areas. Model yachts also affiliated to same club facilities. All competition events subject to prior application and permit.
Skiing	Club and/or approved commercial operator in a designated area only. All competition events subject to prior application and permit.
Parasailing and towed Rides	Approved commercial operator in designated areas only.
Powered Model Boats	Within organised club within designated area only. Noise emission limits may be necessary.
Powered Leisure Boats	Hire boats only, speed limited for self drive. Restrict areas of use to minimise conflicts with other activities and to maintain security and safety. Vessels to comply with predetermined design and performance criteria.
Powerboat Racing and Jet Skiing	Due to high noise and safety conflicts with other activities, restrict to (infrequent) special events only.
<u>Note:</u> In general, the use of privately owned vessels will not be permitted within Putrajaya Lake.	

6.6 WATER ACTIVITY INFRASTRUCTURE REQUIREMENTS

Table 6.7 sets out share-based infrastructure requirements applicable to various lake activities.

Table 6.7 - Water Activity Infrastructure Requirements

ACTIVITY	INFRASTRUCTURE REQUIREMENTS
Sightseeing, Guided Tours, Dinner Cruises	Ticketing and terminal areas; carparking and setdown areas. Location and facilities within lake system to slip and undertake periodic maintenance, refuelling and sewage pump out.
Fishing	Licence, gear hire and bait sales centre facilities with convenient carparking. Boat hire area with electric motor recharging, storage, launching and cleaning area. Convenient structures (headlands, jetties) for shore-based fishing with convenient carparking, public toilet amenities, and cleaning area.
Swimming	Swimming enclosure with soft (beach) edges, gentle (sandy) bottom slopes, comparatively shallow water, clean water, safety patrols, associated picnic/park areas with amenities and convenient carparking.
Snorkelling and Scuba Diving	Permit; clean water with good visibility, underwater scenic features and aquatic life. Possible ozone chlorination system to maintain aquatic life and water quality. Amenities.
Water Transport	Appropriately located terminals with associated carparking and setdown/pick-up areas depending on terminal function. Location within lake system to slip and undertake periodic maintenance. Convenient access to refuelling and sewage pump out facilities.
Canoeing, Kayaking, Rowing, Dragon Boats	Sport and training orientated activities require club facilities with boat storage and launching, an accurately buoyed course for competition with pontoon and land based start, finish and timing facilities. Recreational canoeing and kayaking requires hire area and possible boat storage area.
Self-Propelled Craft	Hire area and possible boat storage area.
Sailing	Club facilities including boat storage, rigging and launching area. Model sailing to preferably include a small shaded foreshore area within or near to amenities.
Skiing	Ticketing/terminal area with associated boat berthing amenities, possible club facilities with boat storage and launching. Competition and training requires accurately buoyed slalom course, jump course and jump structure in designated ski area.
Parasailing and Towed Rides	Ticketing/terminal area with associated boat berthing and amenities. Convenient access to controlled refuelling facilities.
Powerboat Tuition	Sufficient floor area (preferably within a boat club) to conduct maritime classes. Boat berthing for vessels used for on-the-water boat handling lessons and testing.
Powered Model Boats	Designated (buoyed) course area and associated foreshore area (preferably shaded).
Powered Leisure Boats	Launching facilities, storage facilities, controlled refuelling facilities if petrol powered, recharging if electric.
Power Boat Racing	Policed, designated course area. Launching and servicing area on race day.
Jet Skiing	Launching area. Access to refuelling facilities.

6.7 LAKE “CARRYING CAPACITY”

Comparisons with other inland waterways indicate that Putrajaya Lake will be able to sustain a level of activity commensurate with likely demands for usage of the water body.

As a useful comparison, a section of the waterways of the Gold Coast in Australia which is similar to Putrajaya Lake in form, length of shoreline, water area and urbanized landuse currently comfortably supports the activities of approximately 40 commercial cruise boats, tour boats and ferries; 50 watersports operations and 50 special events annually; and is also heavily utilised by many thousands of recreational and commercial vessels.

In the planning of facilities for the primary lake under Sections 11.0 and 12.0, an indicative provision has been made for the future berthing of approximately 170 vessels within a floating marina and dry stack storage, which equates to a navigable space of approximately 2 ha per boat (excluding the area of Lake Use Management Zone 3). This space allocation compares with approximate water area requirements ranging from 0.2 ha/vessel to 0.6 ha/vessel as set out in the *Putrajaya Volume 3 User Guidelines. December 1999, Table 3.6.1 derived from Donald Adie, MARINAS - A Working Guide to their Development and Design, 1984.*

In any event, the growth of boating on Putrajaya Lake is likely to be slow and related also to progressive growth in the city’s population. As it is also proposed that the introduction of boats to Putrajaya Lake be strictly regulated by Perbadanan Putrajaya, there will be ample opportunity to monitor and control the level of boating activity.

7.0 WATER TRANSPORTATION

7.1 GENERAL

The scale of Putrajaya Lake and the Putrajaya Master Plan provide potential for the establishment of a commercially viable water transport commuter and tourism service.

Water transport provides an opportunity to showcase Putrajaya from the perspective of views offered from the water for tourists, and has the potential to fulfill a range of other leisure and educational functions. A ferry service can link residential, commercial, cultural and recreational areas providing a scenic and more leisurely way of commuting. Land based access to ferry terminals can be accomplished by a number of modes including walking, bicycle, motor cycle, car and integration with other public transport.

Comprehensive land based public transport is planned and currently being implemented for Putrajaya. Within the city centre, mobility is to be enhanced by monorail and bus services.

A centralised monorail system is proposed bisecting the longitudinal and transverse axes of the central core area. The rail extends to the west providing a connection to the regional rail (ERL) which connects the city of Kuala Lumpur to the International Airport.

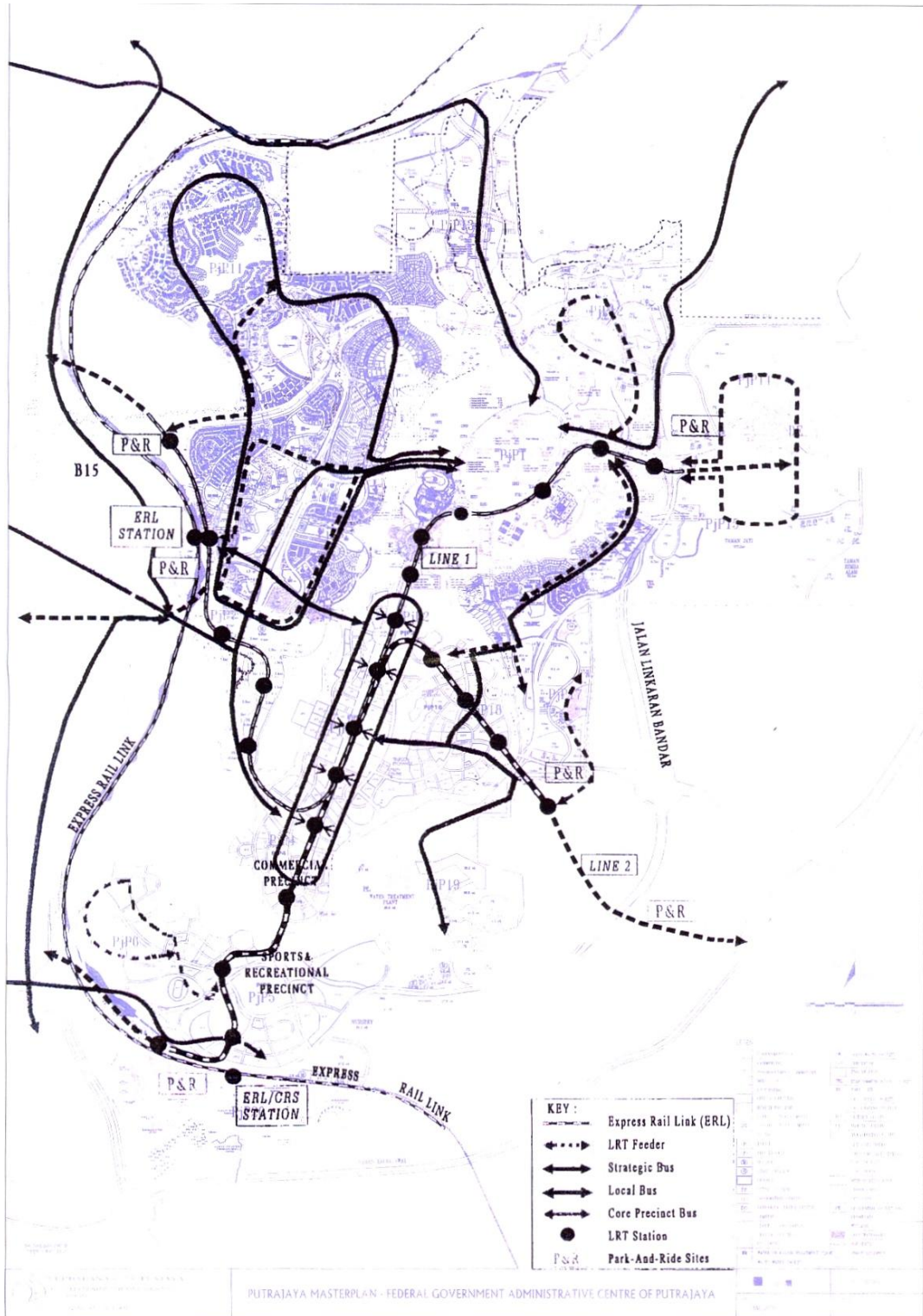
Previous reports have identified the requirement for comprehensive bus services for:

- i. transport of Government employees;
- ii. chartered buses to new work locations;
- iii. long distance public buses; and
- iv. local bus services.

The local bus services are proposed to be progressively implemented. An inner city bus is also proposed. The objectives of the local buses is twofold, being to support monorail ridership via a feeder services and provide alternate public transport to areas not serviced by rail. Bus stops, holding areas, terminals and taxi stands are also being provided as part of the total infrastructure. The bus routes being implemented will be well established prior to implementation of the monorail. Bus holding bays for tourist buses are also proposed throughout the core and surrounding areas providing accessibility to key tourist attractions and the waterfront.

Preliminary planned details of the public transport system for the city centre and adjoining immediate lake foreshore area are shown in the following **Figure 7.1**

Figure 7.1 – Putrajaya Indicative Land Based Public Transport Strategy



The Putrajaya ridership goal of 70% public transport usage to the core area is supported by the establishment of park and ride facilities at the periphery of Putrajaya linked to the monorail services. Public transport provides a service from all residential precincts to popular key destinations.

Drawing 7.1 shows the area coverage of proposed bus routes and rail transit stations. The diagram is based on a 300 metre walking distance from monorail stations and a similar average distance from bus stops, assuming the bus stops are frequently spaced.

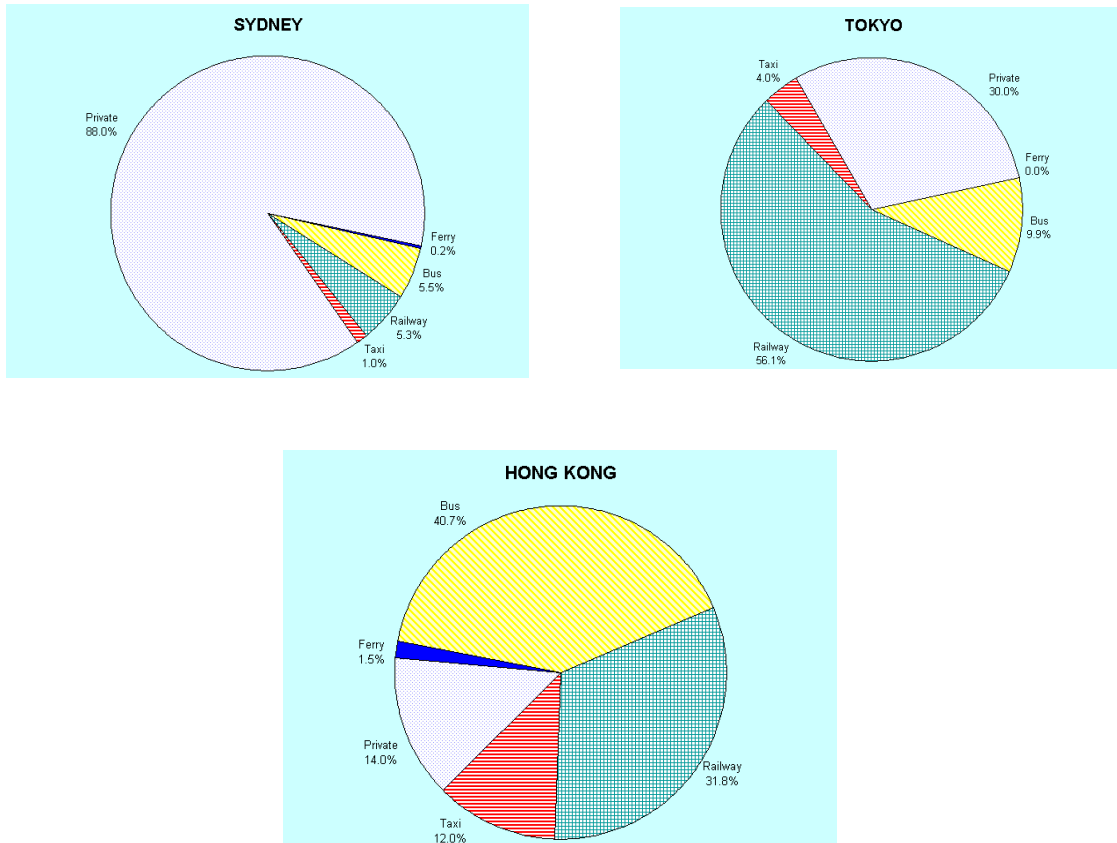
As illustrated by Drawing 7.1, the proposed public transport coverage within the core area and the immediate lake periphery is very comprehensive. Generally public transport either by bus or monorail is available to most areas within convenient walking distances.

The analysis does highlight fringe areas on the lakefront that are serviced by public transport to a lesser extent, being most distant from proposed bus routes. These areas represent potential markets to attract commuters to ferry transport.

Benefits derived by the provision of a water transport mode include opportunities for: -

- i. A convenient alternative commuter transport link;
- ii. Additional transportation corridors to infill gaps between the routes of other transport modes;
- iii. Convenient linkages with other transportation modes; and
- iv. A highly desirable tourist experience providing access between various lakeside attractions and a tour service throughout the navigable lake area.

Worldwide, water transport occupies only a relatively small share of the overall transport picture, as illustrated for some example cities in the following **Figure 7.2**.

Figure 7.2 - Water Transport: Mode Share For Example Waterfront Cities

Typically ferry transport is higher in cities where large harbours or links between islands can provide overwhelming advantages to land based transport by lower and reliable travel times at competitive rates.

Examples of water transport in Malaysia include the Penang Ferry between Georgetown and Butterworth, which carries vehicles as well as passengers. Although patronage declined with the opening of the Penang Bridge, subsequent increased demand demonstrates the acceptance of ferry transport where other options are less convenient or economical by virtue of traffic congestion or higher toll charges.

Brisbane, Australia is an example of an inland water transport service of a scale similar to Putrajaya. Within the overall public transport travel market in Brisbane, ferry transport accounts for 2.5% of the total number of persons using public transport. The structure of the network extends downstream and upstream of the city's commercial core connecting to residential areas. Typically, terminal activity at the two stops servicing the city core is the highest.

The Putrajaya Lake system is favourably configured within the city to provide an opportunity for convenient intra-city water transportation, both for general commuting and scenic tours.

The central city core, located on an island surrounded by a navigable waterway, is ideally suited to capitalise on water transportation as a viable alternative transport mode. Travel demands associated with commuters residing beside or close by the lake edge with destinations in the central commercial core area form the ideal target market for water transport. Extension of the travel experience with connections to other modes such as bus, monorail and park and ride, provide further opportunities for increased patronage.

7.2 REFERENCE REPORTS

Three previous transportation study references for Putrajaya have been reviewed as follows:

- i. Putrajaya Bus Services to 2005 - May 1999 prepared by M S Atkins Malaysia Sdn Bhd*
- ii. Putrajaya Review of Master Plan Transport Study - April 1997 prepared by the MVA Consulting Sdn Bhd*
- iii. Transport Design Guide for Putrajaya - March 1998*

In each of the studies no reference or allowance is made for ferry transport.

7.3 PROJECTED TRAVEL BEHAVIOUR FOR PUTRAJAYA

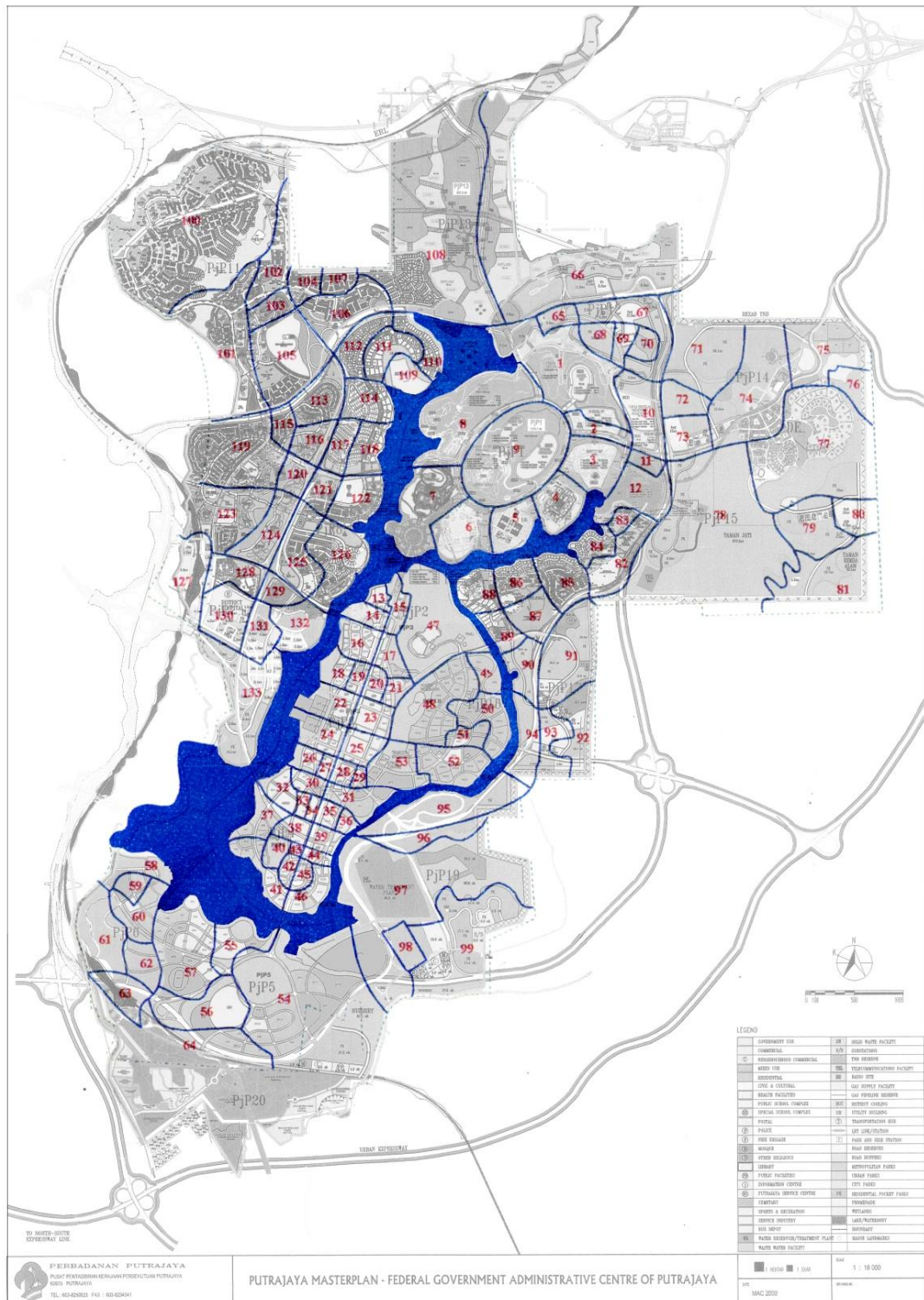
7.3.1 Land Based Public Transport System

Information contained within the *Putrajaya Review of Master Plan Transport Study - April 1997* has been analysed to examine the projected ultimate total travel behaviour for Putrajaya and investigate potential travel markets and demand forecasting for water transport.

The Review of the Master Plan Transport Study established Travel Analysis Zones for Putrajaya. Each zone generally represents areas of similar land use and activities. Zone boundaries are derived from either natural physical boundaries, changes in land use, roads or other transport corridors.

Figure 7.3 shows the Traffic Analysis Zones considered in the *Master Plan Transport Study*.

Figure 7.3 - Putrajaya Traffic Analysis Zones



The study provided production and attraction estimates for each zone for the daily and peak hour travel volumes. The daily trip ends production and attraction for each zone are illustrated in the following **Figure 7.4**.

**Figure 7.4 Putrajaya Future Transportation - Daily Trip Ends
Production and Attraction**

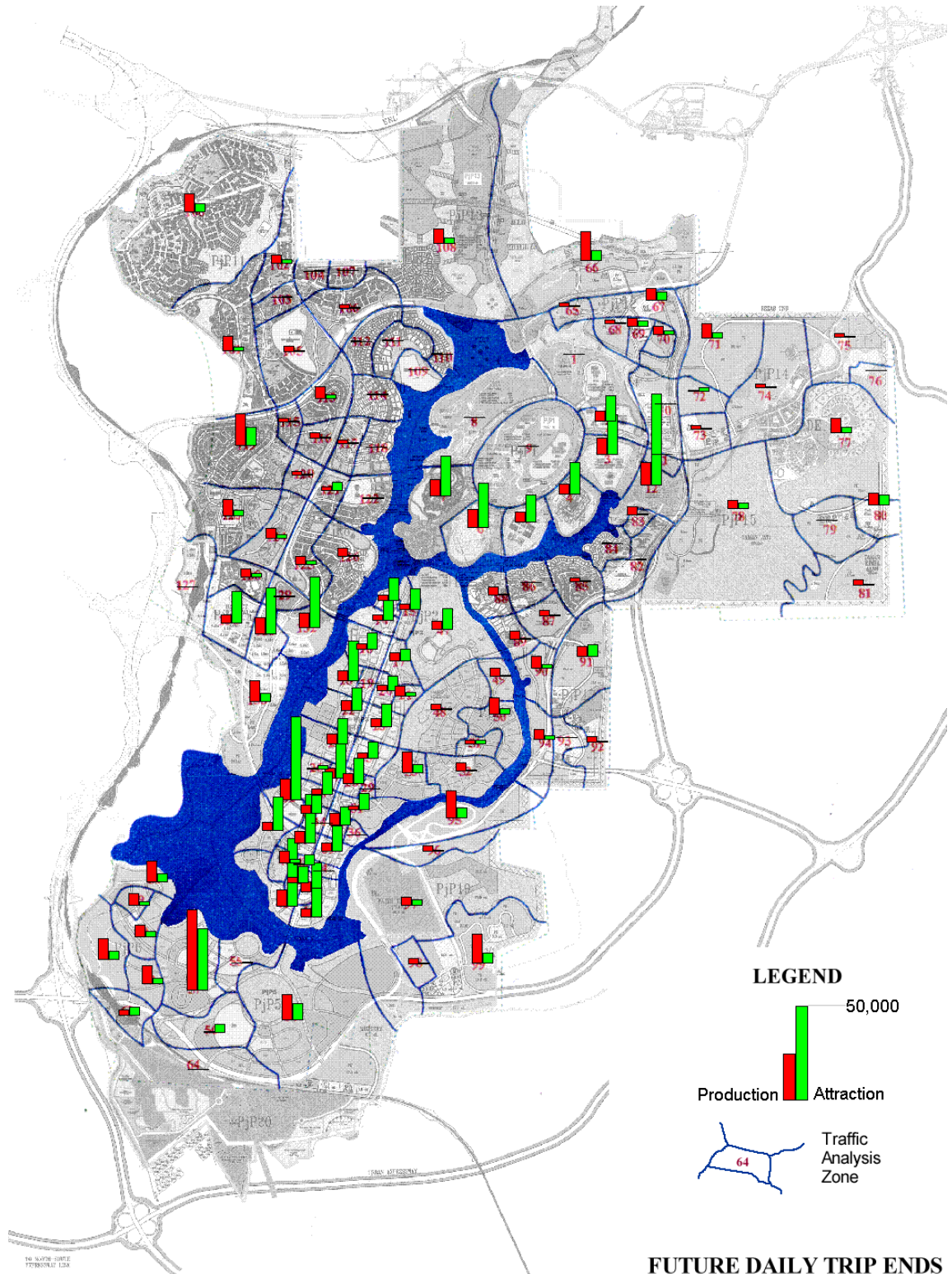
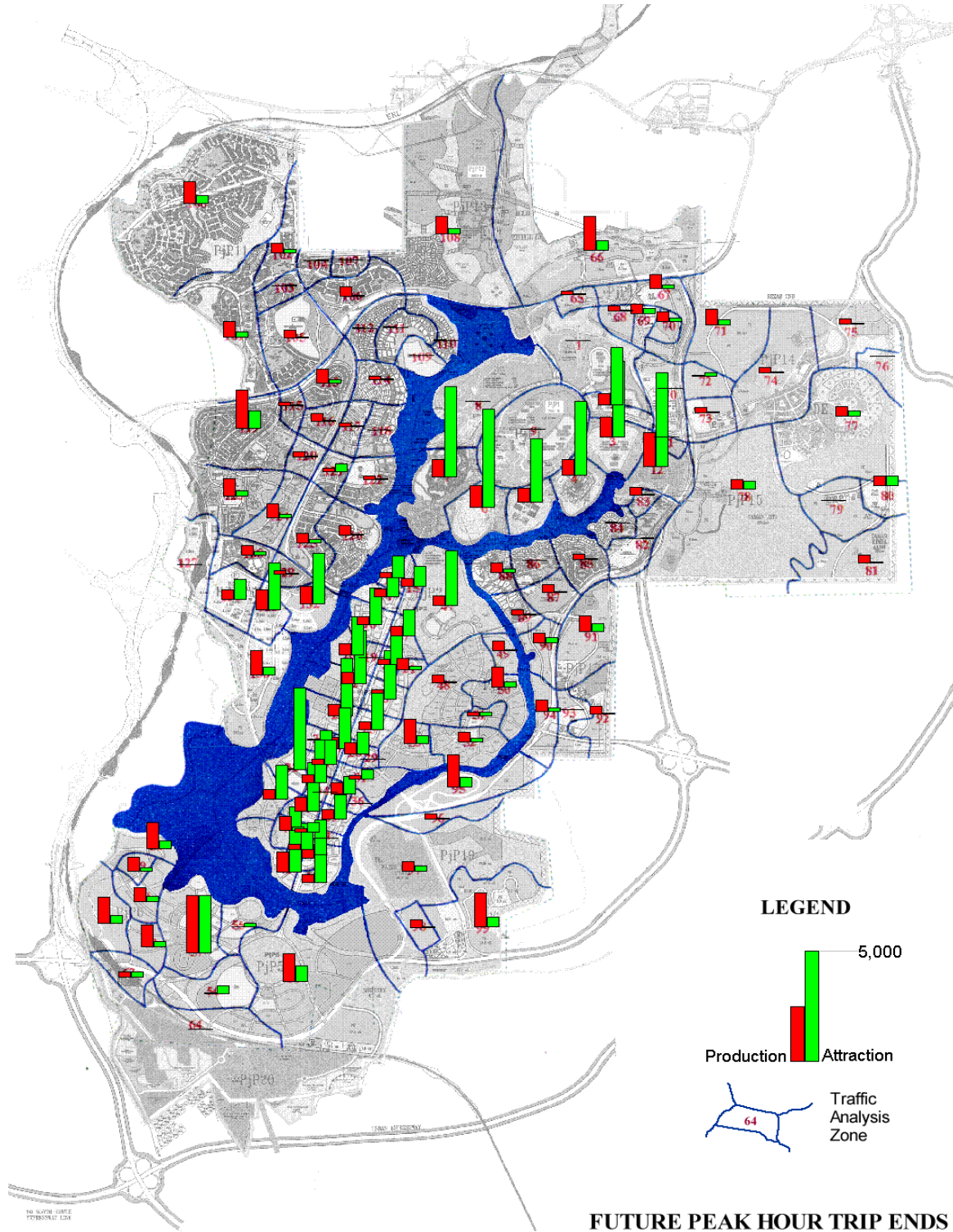


Figure 7.5 shows the peak hour trip ends production and attraction.

**Figure 7.5 - Putrajaya Future Transportation - Peak Hour
Trip Ends Production and Attraction**



Differences between the peak hour and daily trip ends relate to the higher concentration of home based work trips during the peak hour compared to daily trips.

The following is noted from an analysis of origins and destinations of travel patterns for Putrajaya:

- i. The landuse surrounding the waterfront comprises a mixture of commercial, residential, mixed use, cultural, government and recreational precincts. The travel demand within the immediate surrounding lakeside precincts shows a number of opportunities for water transport to play a significant part in the transport network for Putrajaya.
- ii. Figures 7.4 and 7.5 do not highlight specific areas where an obvious demand for a line-haul type ferry service would be required. A line haul service would be indicated by a singularly high travel production on one side of the lake adjacent to a corresponding high demand for employment on the opposite side.

However, a number of primarily residential areas exist across the lake from work centres and recreational and cultural attractions. In these instances employees residing opposite places of their employment could be readily attracted to ferry transport.

- iii. Further integration with the overall public transport system is possible by positioning ferry terminals in close proximity to monorail transit stations. Ferry terminals can also operate successfully with a park and ride facility provided at the terminal. Transfer to water transport, from bus or rail, complement the public transport network, providing choices for passengers.

7.3.2 Water Transport Travel Survey Database

The methodology used for forecasting ridership for a water based transportation system has been to adopt a public transport computer based travel demand forecasting model. The ability to apply the traditional four-step travel demand forecasting process depends upon the availability of comprehensive base survey information. An historical database on water transport travel behaviour is necessary to predict future ridership. Without an existing water transport service in operation within Putrajaya, no calibration for a transport demand model is possible.

Water transport is also different from other modes of transport because it can be an enjoyable experience as well as a travel necessity. Riders can be attracted for purely recreational purposes. Leisure trips are difficult to analyse because of a lack of sources of available data.

Analysis of the feasibility of water transport within Putrajaya has been initially explored by determining the strategic positioning of terminal facilities for both water transport and passenger accessibility. Proximity to public transport stops, employment and recreational activity centres as primary attractions and residential precincts as productions, were investigated to determine optimum siting of potential terminal locations.

Terminals for commuter services are proposed at locations along both the eastern and western waterways. The locations have been chosen on the basis of the following criteria:

- i. Proximity to residential development
- ii. Proximity to employment centres and commercial centre attractions
- iii. Integration with land based public transport services
- iv. Ability to service recreational and tourist activities, therefore providing a multi-use facility.

The following **Drawing 7.2** shows the preliminary water transport network for Putrajaya as used in the travel forecasting analysis (with the subsequent addition of a terminal on the Cyberjaya waterfront and other minor routing changes).

Following selection of the prospective network, the development of a planning model involved:

- i. obtaining a sound database for estimating the numbers of passengers likely to use the service;
- ii. accurate prediction of potential water transport travel forecasts; and
- iii. optimising the prospective network with respect to the number of vessels, capacity and frequency of service.

No comparable water transport ridership data is available for Putrajaya. An explanatory model has been developed from other available sources. The relationship between travel demand for work based trips, as a function of population and other socio-economic factors such as age and income has been considered. Relevant applicable data from the ferry transport system in Brisbane, Australia has been obtained and with modification used as a base dataset for Putrajaya. Census statistical data of demographic information surrounding ferry terminals adjacent to the Brisbane River was also used to correlate passenger ridership with socio-economic parameters.

To assist in understanding the potential ridership of a water transport service within Putrajaya, Origin/Destination survey data from the Brisbane CityCat ferry service has been analysed, in combination with the demographic data surrounding Brisbane River ferry terminals obtained from government statistical records.

Based on this quite detailed analysis, an explanatory model was then developed for each terminal. The following chart within **Figure 7.6** shows the outcome developed between the number of employed persons within terminal catchments and the number of water transport users.

Figure 7.6 - Ferry Use Explanatory Model

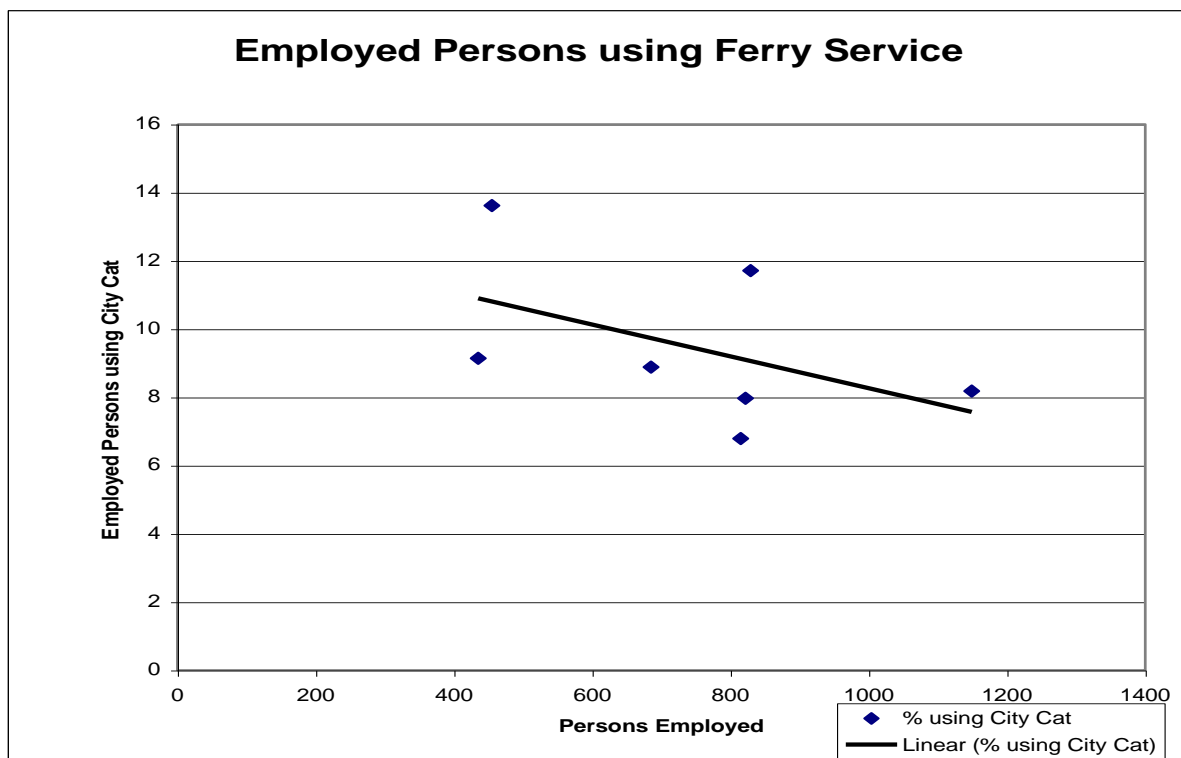


Figure 7.6 provides a trend line forecast, compiled using a least squares regression, which allows the prediction of water transport on the basis of workforce/population and employment.

Projection of the trend line allows prediction of ridership for higher populations. The falling slope of the trend line demonstrates how the number of potential passengers decreases as the number of employed persons increases. This is consistent with the observation that the average percentage of potential water transport passengers will decrease as the distance from the terminal increases due to longer working distances to the terminal and as passengers are attracted to alternative modes of transport such as bus services plying adjacent streets.

7.3.3 Travel Demand Forecasting Model

Several demographic and land use differences have been taken into account between Putrajaya and the above derived data, in predicting passenger trip generation volumes for potential water transport in Putrajaya.

This primarily relates to the physical characteristics of population density and proximity to ferry terminals, public transport mode share, car ownership, family size and employed persons per family. Factors were developed from the demographic and socio-economic differences between the base ridership datasets for Brisbane and Putrajaya.

Drawing 7.3 illustrates integration of the proposed water transport service with the public transport proposed for bus and rail services. Bus lay-by stops and park and ride facilities are also shown.

A catchment area was calculated for each terminal based on a walking distance of 350 metres as used in the data set developed from the Brisbane surveys.

For each terminal catchment, the proportion of contributing Traffic Analysis Zones was calculated. The Traffic Analysis Zones used in the Putrajaya Review of Master Plan Transport Study provided the population and government and commercial office floor space applicable to each zone. Public open space areas were deleted from the proportion of the contributing Traffic Analysis Zones.

The following **Table 7.1** shows the Traffic Analysis Zones (TAZ) within the influence of each ferry terminal as well as the derivation of home based population or employment attraction contributing to each terminal, based on a 350m catchment radius.

**Table 7.1 – Derivation of Resident Population and Employment Attractions
Contributing to Ferry Terminals**

Ferry Term.	TAZ	Land Use	Zone Area (sq.m)	Contributing Area (sq.m)	% of Area Contributing	% of Zone Contributing	Zone pop / emp	Contributing pop / emp
1	5	com	181250	68750	65%	38%	5414	1329
	6	com	331250	37500	35%	11%	6804	272
2	88	res	156250	6250	5%	4%	2783	6
	89	res	118750	118750	86%	100%	3580	3079
	90	res	168750	12500	9%	7%	2880	18
3	50	res	218750	87500	63%	40%	6572	1656
	51	res	87500	31250	23%	36%	1289	107
	52	res	262500	20000	14%	8%	3185	36
4	31	com	168750	81250	54%	48%	3338	865
	53	res	250000	68750	46%	28%	9316	1200
5	46	com	156250	93750	100%	60%	5754	3452
6	57	com	525000	100000	100%	19%	8532	1621
		res					16431	3122
7	58	res	131250	75000	66%	57%	9449	3555
	59	res	75000	18750	17%	25%	5281	224
	60	res	225000	18750	17%	8%	3830	52
		com					690	9
8	26	com	75000	37500	24%	50%	824	99
	30	com	75000	50000	32%	67%	4670	1001
	32	com	93750	68750	44%	73%	18179	5839
9	131	res	162500	62500	29%	39%	2748	311
		com					8763	991
	132	res	237500	87500	41%	37%	1119	170
		com					9858	1495
133	res	593700	62500	30%	11%	9132	301	
10	122	res	262500	106250	74%	41%	1233	374
	126	res	362500	37500	26%	10%	3438	89
11	7	com	462500	100000	100%	22%	7802	1716
	13	com	50000	12500	7%	25%	4811	84
	15	com	112500	68750	41%	61%	2400	600
	47	com	568750	87500	52%	15%	4362	340

Production and attraction models were subsequently developed for each of the proposed Putrajaya ferry terminals. The models used formulas previously developed from home interview surveys conducted in Kuala Lumpur for the SMURT study. The production and attractions were calculated for home-based work trips only. This is consistent with the data input into the surveys and the primary trip purpose generally applicable for water transport users. Other trip purposes such as recreation were factored into the survey data set.

The explanatory model in Figure 7.6 developed from the Brisbane survey data set was used to determine the productions and attractions for each terminal.

A gravity model has been adopted for the trip distribution, which is the most widely used trip distribution model, using the productions and attractions calculated for each terminal. The model explicitly relates flows between zones to inter-zonal impedance to travel. The assumption behind the gravity model is that the number of trips produced by zone i and attracted to zone j is proportional to:

- i. the number of trips produced by zone i;
- ii. the number of trips attracted to zone j; and
- iii. the impedance function of the relative spatial separation between the zones.

Travel time, including boarding and alighting have been used as the measure of impedance in this model. The average travel speed between terminals and the time required at stops for manoeuvring, passenger boarding and alighting have been incorporated.

The gravity model is singularly constrained to productions. In the singularly constrained gravity model, the flow between zones is calculated from the following equation:

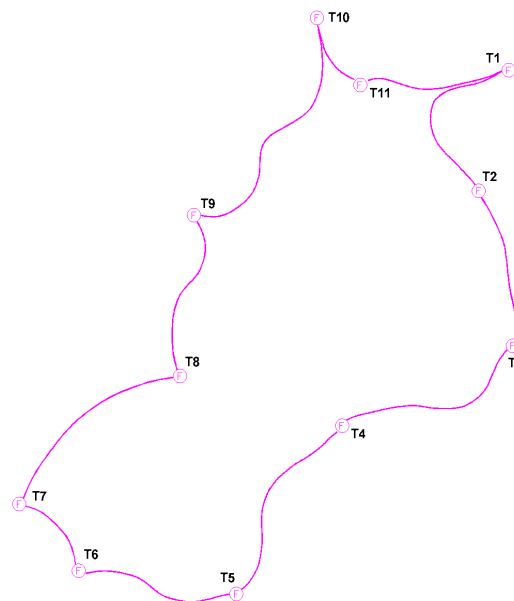
$$T_{ij} = P_i \frac{A_j f(c_{ij})}{\sum_{\text{all zones } z} A_z f(c_{iz})} \quad (\text{constrained to productions})$$

- where:
- T_{ij} = the forecast flow produced by zone i and attracted to zone j
 - P_i = the forecast number of trips produced by zone i
 - A_j = the forecast number of trips attracted to zone j
 - c_{ij} = the impedance between zone i and zone j
 - $f(c_{ij})$ = the friction factor between zone i and zone j

The origin/destination matrices developed for water transport for Putrajaya are production constrained to reflect the limiting use of the services in the residential areas. This accounts for the disproportionate attractions calculated for terminals within the city centre. At these locations the density of office space calculated surrounding each terminal supports all modes of transport including the ferry service. Corresponding to the Brisbane survey dataset, the water transport ridership was based on the number of employed persons – production being the limiting factor. Where terminals provided direct access to other public transport modes in the city centre such as the monorail, conservative results were used by ignoring the increased attraction to these terminals resulting from their convenient integration with the Putrajaya public transport system.

Figure 7.7 schematically represents the ferry service network and terminal numbering system used for this preliminary analysis. (It should be noted that subsequent to this analysis, terminal T7 has been deleted at the request of Precinct 6 planners and an additional terminal has been included opposite terminal T9).

Figure 7.7 - Water Transport Network



The production and attraction models, derived from the planned land use, identified higher ferry terminal activity within the Central reach of the lake west of the core island. Terminals T5, T6, T7, T8, and T9 achieved the highest results apart from Terminal 11, which is linked to the public transport network. Similarly, the routes between Terminals T5, T6, T7, T8 and T9 captured the highest ridership.

Initial input data into the travel-forecasting model comprised two circulatory routes rotating around the island in different directions (clockwise and anti-clockwise). The results of the initial analysis utilising the public transport utility module of the EMME/2 transportation planning software package, are shown in the following **Table 7.2**.

Table 7.2 – Ridership between Terminals as a Proportion of Total Ridership

RIDERSHIP BETWEEN TERMINALS (both directions)		PERCENTAGE OF TOTAL RIDERSHIP
T1	T2	5.40%
T2	T3	5.00%
T3	T4	6.00%
T4	T5	8.50%
T5	T6	13.00%
T6	T7	14.80%
T7	T8	15.80%
T8	T9	12.90%
T9	T10	6.60%
T10	T11	6.50%
T11	T1	5.50%
TOTAL		100.00%

Table 7.2 reflects the increased number of passengers using the service where trip productions and attractions at the terminals are highest. The ridership potential in these areas is higher due to the increased travel demand between residential and employment centres and lower travel time offered.

Terminal activity is shown in the following **Table 7.3** as a percentage of the total number of system passengers.

Table 7.3 – Terminal Activity as a Proportion of Total Ridership

TERMINAL ACTIVITY	PASSENGERS BOARDING/ALIGHTING AS PERCENTAGE OF TOTAL RIDERSHIP
T1	10.90%
T2	6.70%
T3	4.00%
T4	5.50%
T5	11.90%
T6	12.90%
T7	9.20%
T8	20.10%
T9	10.03%
T10	1.10%
T11	7.70%
TOTAL	100%

The above analysis is based on the ultimate development of Putrajaya. Initial establishment of a ferry service could focus upon the areas above showing the highest demand. A service plying the south west quadrant of the waterway surrounding the Putrajaya central core provides the best opportunity for commuter travel demand for a regular ferry service.

Service Frequency and Fares

For water transport to achieve commuter ridership potential, service frequency and fares compared with alternative transportation options are vital issues. The envisaged frequency of vessels departing terminals is generally consistent with the suburban bus services with frequencies at 20 – 30 minute intervals. The higher frequency being adopted during peak hours.

Unlike bus or rail travel however, passenger ridership numbers are less sensitive to travel time (within reasonable tolerances), as passengers experience the more relaxed benefits of ferry travel.

7.4 SERVICE REQUIREMENTS

Service requirements to provide successful alternative water based commuter transport mode and a vibrant tourism service include: -

- i. Desirable standard of vessels
- ii. Convenient transport/scenic routes
- iii. Suitable terminal locations
- iv. Desirable standard of terminal facilities
- v. Convenient time tabling
- vi. Acceptable fares

7.5 BENCHMARKING WITH SIMILAR FERRY SERVICES

Brisbane's CityCat ferry service in Queensland, Australia has similarities with Putrajaya in regard to demographics, and key vessel attributes.

Similarities can also be seen with the SuperCat ferries operating on the Parramatta River in Sydney.

Relevant data in regard to the Brisbane CityCat service is as follows: -

- i. Cruise speed between terminals (in unrestricted speed areas): 23 knots
- ii. Approaching and departing Dock Modes: 5 knots – 0 knots
- iii. Travel route: 15km
- iv. Travel route time: 55 minutes
- v. Number of terminal stops: 13
- vi. Average terminal load/unload time: 2 minutes
- vii. Frequency of service: morning/evening peaks 20 minutes, other times 30 minutes

The Brisbane CityCat route, with 13 terminals has a round trip distance of 26km requiring four operating vessels to provide a 30 minutes interval between (same direction) ferries. Six vessels are utilised during peak periods to provide 20 minute scheduling.

PART C

PUTRAJAYA LAKE USE MASTER PLAN

8.0 LAKE USE MANAGEMENT ZONING

8.1 PRESENT LAKE ZONING

A zoning for the Putrajaya Lake System is contained within the *Formulation of Regulations and Guidelines for the Control of Activities and Use of the Lake and Other Water Bodies in Putrajaya – Volume 4 – Planning and Environmental Guidelines*, February 2000.

Presently, seven zones have been established together with a schedule of permissible and non-permissible land based and water based activities applicable to each zone. These zones are illustrated and broadly categorised in terms of their presently envisaged water uses in **Drawing 8.1**.

The present zoning system has been useful, particularly in guiding the planning of appropriate water edge land uses. However, the present zoning system is less applicable to the planning of management functions within the lake and the formulation of integrated lake use strategies.

8.2 PROPOSAL FOR MODIFIED LAKE USE MANAGEMENT ZONING

A modified Lake Use Management Zoning Plan is proposed as illustrated and broadly categorised in **Drawing 8.2**.

Key features of this proposed Lake Use Management Zoning Plan are as follows:

Zone 1:

All wetland areas of similar character, function and management requirements are incorporated within a single management zone. This zone contains sensitive ecological areas which are important to the well being of the downstream main lake, and accordingly public access to these water areas should be severely restricted.

Zone 2:

The new Lake Use Management Zoning Plan proposal differentiates between the highly vegetated cells of the upper wetlands and the substantial wetland water body situated immediately upstream of the weir which separates the wetlands from the primary lake. It is proposed that this body of water with lush wetland vegetation within its western arm, the Wetland Parklands to its north, a number of central islands, and Tama Botani to the south, be established as a tranquil recreation zone and environmental reserve in which there is controlled public access to some areas of foreshore for non-motorised and electric motorised boating, fishing, canoeing, and other non-intrusive activities.

Zone 3:

The area of the main dam north of Bridge 10 interfaces with the Prime Minister's Residence.

The bridge, the Marine Police facility immediately south of the bridge and the adjoining Boat Club clearly demarcate this section of water from the rest of the main lake to the south. Because of security and privacy sensitivities associated with land use around this section of the lake, a Permit Controlled Access Zone is proposed in which boating access would be by permit, including authorised tour boats, dining and special function cruises, and water sports activities on extended courses organised by the Boat Club. The Zone would not be accessible to general boating traffic or public water taxis.

Zone 4:

The area of the primary lake extending south from Zone 3 and around all but the lower portion of the core island is proposed as a General Navigation Zone, being generally unrestricted for private and commercial boating with the exception of special advertised sporting, public display and festivity events. Fishing would be permissible outside of restricted transport navigation corridors and terminals.

The present Lake Zoning Plan places restrictions on navigation access to the waterways which front the Deputy Prime Minister's Residence for security and privacy reasons. Because of the totally enclosed nature of Putrajaya Lake, the ease of accessibility by land to this area, and the disposition of the waterway relative to the more elevated Deputy Prime Minister's Residence, public navigation within this section of the lake is not considered to diminish to any significant extent security or privacy for the Deputy Prime Minister's Residence. This issue has been addressed with relevant agencies responsible for security within Putrajaya, resulting in agreement that general navigation within this area of the lake can be permitted.

Zone 5:

The southern portion of the primary lake extending west from the dam wall to Bridge 8 offers the widest areas of water suitable for motorised and non-motorised water sports and activities, together with general private and commercial boating, subject to appropriate segregation of potentially conflicting activities.

Zone 6:

An arm of the main lake at its south-western edge extends north parallel to the boundary of Cyberjaya.

It is proposed that this zone be set aside for passive recreation and general navigation with restricted fish habitat areas within wetland environments at the upper reaches where stormwater will generally enter the lake. This proposal provides a desirable fish breeding habitat within the main lake body and sets aside an area beyond the limits of the Active Recreation Zone well suited to boat fishing outside of restricted fish habitat sectors which may be designated within this zone.

8.3 COMPARISON OF PRESENT AND PROPOSED LAKE USE MANAGEMENT ZONING

A comparison of present Lake Zoning and the proposal outlined in Section 9.2 for modified Lake Use Management Zoning together with an outline of principal management issues relevant to each zone are given in the following **Table 8.1**.

Table 8.1: Comparison of Present and Proposed Lake Use Management Zones and Related Management Issues

PRESENT ZONES		PROPOSED ZONES			MANAGEMENT ISSUES WITHIN PROPOSED ZONES
Zones	Descriptions	Zones	Descriptions	Reasons for Changes	
A	Upper North East and West, Lower East Central and Upper Sg. Bisa Wetlands Precincts 1, 10, 11, 12, 13	1	All wetland areas in A & G but excluding the substantial Central Wetlands water body upstream of the Main Weir in A. Precincts 1, 11, 12, 13 and 16	All wetland areas of similar character, function and management requirements are incorporated in a single management zone.	<ol style="list-style-type: none"> 1. Incoming water quality. 2. Wetland maintenance: <ul style="list-style-type: none"> • trash removal • siltation and hydraulic by-passing • weed control • insect control • water quality monitoring • low inflow and back-up water recirculation 3. Interface with landside tourism and recreation activities. 4. Restricted public access. 5. Wetland eco-system education and research.
G	Mini Wetlands upstream of main Lake in Precincts 1 and 16				
		2	The 30 ha water body in A situated immediately upstream of the weir separating the Central Wetlands from the primary lake Precincts 1, 10, 12 and 13	This substantial water body is proposed as a separate zone because of its capacity for use for controlled boating and fishing activities	<ol style="list-style-type: none"> 1. Incoming stormwater quality. 2. Wetland and waterbody maintenance: <ul style="list-style-type: none"> • weed control • insect control • water quality monitoring • water recirculation pumping station 3. Fisheries. 4. Landscape and edge condition of foreshores and islands. 5. Controlled access for limited tranquil boating, fishing and recreation. 6. Recreational facilities. 7. Public safety and security. 8. Emergency response. 9. Community consultation and involvement. 10. Education and research.

PRESENT ZONES		PROPOSED ZONES			MANAGEMENT ISSUES WITHIN PROPOSED ZONES
Zones	Descriptions	Zones	Descriptions	Reasons for Changes	
B	Primary Lake between Central Weir & Northern Limits of Core Island Precincts 1, 4, 10, 16 and part of Precinct 8.	3	Area of primary lake in Zone B, which is north of Bridge 10. Precincts 1 and 10	This part of the lake is designated as a separate zone because of its security and privacy sensitivity involving strict controls on boating access.	<ol style="list-style-type: none"> 1. Incoming stormwater quality. 2. Water body maintenance: <ul style="list-style-type: none"> • aquatic plants • water quality monitoring 3. Fisheries. 4. Landscape and edge condition of foreshores. 5. Controlled boating access (by permit). 6. Controlled recreational use (by permit). 7. Public safety and security. 8. Emergency response. 9. Community consultation and involvement.
C	Bulk of Primary Lake Formed by inundation of Sg. Chua Valley Precincts 2, 3, 4, 5, 6, 7, 8 and Cyberjaya.				
D	Excavated channel between Sg. Bisa Valley and lower Lake body Precincts 1, 4, 17, 18 and 19				
E	Dam Area Area within 50 metres of the Main Dam and spillway	4	Area of primary lake downstream of Bridge 10 and extending both sides of the Core Island down to Bridge 8 and the open water body north of the Dam. Part of B, Part of C and all of D. Precincts 1, 2, 3, 4, 16, 17, 18, 19	These areas have been included in a single general navigation zone because of their common and inter-related potential for recreational tourism and public transport boating and other lake activities.	<ol style="list-style-type: none"> 1. Incoming stormwater quality 2. Waterbody maintenance: <ul style="list-style-type: none"> • aquatic plants • water quality monitoring • water recirculation pumping station 3. Fisheries. 4. Landscape and edge condition of foreshores. 5. Integrated recreational, sporting, private boating, public boating and special event lake uses. 6. Recreational facilities. 7. Public safety and security. 8. Emergency response. 9. Community consultation and involvement.

PRESENT ZONES		PROPOSED ZONES			MANAGEMENT ISSUES WITHIN PROPOSED ZONES
Zones	Descriptions	Zones	Descriptions	Reasons for Changes	
		5	The open water body forming the southern portion of the lake extending from the Dam to Bridge 8. Part of Zone C Precincts 4, 5, 6, 7 and 19	This more open part of the lake is proposed as a separate zone because of the wider range of active recreational boating and other activities requiring more sophisticated management and control.	<ol style="list-style-type: none"> 1. Incoming stormwater quality 2. Waterbody maintenance: <ul style="list-style-type: none"> • aquatic plants • water quality monitoring 3. Fisheries. 4. Landscape and edge condition of foreshores. 5. Integrated recreational, sporting, private boating, public boating, special event and water display lake uses. 6. Recreational facilities. 7. Lake management facilities. 8. Public safety and security. 9. Emergency response. 10. Community consultation and involvement.
		6	The portion of Zone C Main Lake which extends north west with Cyberjaya Precinct 7	This zone is set aside for more passive recreation and general navigation with restricted fish habitat areas in its upper reaches.	<ol style="list-style-type: none"> 1. Incoming stormwater quality 2. Wetland and waterbody maintenance: <ul style="list-style-type: none"> • weed control • insect control • water quality monitoring 3. Fisheries. 4. Landscape and edge condition of foreshores. 5. Integrated private and public boating lake uses. 6. Public safety and security. 7. Emergency response. 8. Community consultation and involvement.
F	Water Detention Ponds for flood control Precinct 14			This area has been excluded from proposed Lake Management Zoning because of its remote location, separate drainage catchment and different functions relative to the Putrajaya Lake system.	

9.0 DESIGNATED ACTIVE RECREATIONAL LAKE AREAS

Although the “carrying capacity” of Putrajaya Lake is anticipated to be relatively high compared to foreseeable demand, there will be a need to establish "designated lake activity areas" particularly for active recreational pursuits so as to minimise potential conflicts.

Drawings 9.1 and **9.2** illustrate options for the location of non-motorised and motorised active recreational activities as set out in Section 6.2.2 which require the most significant allocations of space.

A proposed Active Recreational Water Use Plan is shown on **Drawing 9.3**. This plan designates areas for particular activities in a manner which generally separates conflicting non-motorised and motorised water uses, which allocates adequate space for world standard competition events, and which adequately provides exciting spectator opportunities.

A boat club within Precinct 5 at the southern end of the main lake providing both public and private club facilities together with a public aquatic centre, is the focus for all active recreational water uses.

Generally, the proposed Active Recreational Water Use Plan envisages that powerboat activities will operate east of the club facility while non-motorised activities will be located to the west and north, including a designated sailing course; a rowing, canoeing and dragon boat racing course and training areas; and off-beach boat hire facilities close to the public aquatic centre.

A water ski course including a fixed slalom and ski jump is proposed within the lake adjacent to the main dam. The dam crest, to which there is provision for convenient public access would provide an excellent spectator viewing platform and is consistent with current planning for public use of the dam and its surrounds.

In most cases, designated lake activity areas are not intended to be exclusive and are commonly shared by generally compatible activities, even during the course of some competitive events.

From experience elsewhere however, general boating rules are not always sufficient to avoid conflicts, and in some cases, particularly those involving special events, it may be necessary to buoy off designated areas and exclude potentially conflicting activities or traffic from the area. For example, during some special events, usage of course areas should be restricted to craft participating in the events.

10.0 PERMISSIBLE WATER CRAFT AND WATER ACTIVITIES

10.1 CATEGORIZATION OF PUTRAJAYA LAKE WATER CRAFT

The general potentials of a range of watercraft for use on Putrajaya Lake are identified and analysed within Section 6.0. As outlined in Section 6.2.1, watercraft are generally divided into non-motorised craft and motorised craft.

For the purpose of the Putrajaya Lake Use and Navigation Master Plans, watercraft are categorised as follows:

i. Non-Motorised Craft

Non-motorised craft suitable for use on Putrajaya Lake are detailed in **Table 10.1**.

Table 10.1 - Non-Motorised Craft Suitable for Putrajaya Lake

CRAFT TYPE	USAGE
Model yachts	With associated land based facility
Sail boards	Private use or personal hire
Mono-hull and catamaran sail boats (under 5m length)	Club use or personal hire
Pedal powered leisure craft	Personal hire
Leisure row boats	Personal hire
Canoes and kayaks	Club use or personal hire
Sport rowing skiffs	Club use Sporting events
Dragon boats	Club use Sporting events

ii. Motorised Craft

A broad categorisation of motorised craft suitable for use on Putrajaya Lake is detailed in **Table 10.2**, for which more detailed general design and performance characteristics are contained in Part D, Section 16.0.

Table 10.2 - Motorised Craft Suitable for Putrajaya Lake

CRAFT TYPE	USAGE
Model power boats	With associated land based facility
Small powered boats	Self-drive hire for lake outings or fishing
Powered leisure boats	Self-drive hire (with appropriate licence) or skippered hire
Commercial recreation boats	Towed rides, parasailing, water skiing etc within designated areas and under strict licencing controls.
Ferries and Tour boats	Commuter service/informal visitor movement between areas of attraction/ guided lake circuit tours
Cruise boats	Large group tours with food service/dinner cruises
Marine police/Emergency response boats	High speed operating under strict discipline
Special purpose maintenance vessels	Barges/aquatic plant harvesters, etc
Special event power racing craft	Jet skis trailered in for special events Junior sports and hydroplane class racing boats trailered in for special events

10.2 PERMISSIBLE WATER ACTIVITIES WITHIN LAKE USE MANAGEMENT ZONES

With reference to the proposed Lake Use Management Zoning Plan shown on Drawing 8.2, and to the Section 6.0 analysis of lake use potentials, **Table 10.3** summarises proposed permissible water craft activities within each Lake Use Management Zone.

Table 10.3 - Permissible Water Craft Within Lake Use Management Zones

LAKE USE MANAGEMENT ZONE	PERMISSIBLE WATER CRAFT	PERMISSIBLE WATER ACTIVITIES
Zone 1	No recreational vessels permitted.	No public access or recreational activities permitted.
Zone 2	Model yachts/model power boats Sail boards Pedal powered leisure craft Canoes, kayaks Row boats Small electric powered boats	Controlled water access Model boat use Small water craft hire and use Fishing from boats Foreshore fishing within designated locations Organised fishing competitions, model boating or other environmentally appropriate events
Zone 3	Canoes, kayaks, rowing skiffs, and dragon boats for sporting events. Tour boats and Cruise boats. Vessels to comply with predetermined design and performance criteria. Water police and Emergency response boats. Lake maintenance vessels.	Aquatic sporting events with prior permit. Tour and Cruise boat commercial operations by permit. Foreshore fishing within designated areas.
Zone 4	Canoes, kayaks, rowing skiffs, dragon boats for club activities and events. Small powered boats complying with predetermined design and performance criteria. Powered leisure boats complying with predetermined design and performance criteria. Ferries and Tour boats complying with predetermined vessel design and performance criteria. Cruise boats complying with predetermined vessel design and performance criteria. Junior sports racing boats (permissible only for special events).	Sports rowing and paddling training and events (permissible with a club permit but better suited to Zone 5 for other than competitions). Small powered hire boating. Powered leisure boating by hire - self driven (by licence) or professionally skippered. Ferry and Tour boat commercial operations. Cruise boat commercial operations within the western arm. Fishing from boats outside of restricted transport navigation corridors and terminals.

PART C
PUTRAJAYA LAKE USE MASTER PLAN

LAKE USE MANAGEMENT ZONE	PERMISSIBLE WATER CRAFT	PERMISSIBLE WATER ACTIVITIES
	<p>Jet skis (permissible only for special events).</p> <p>Marine police and Emergency response boats.</p> <p>Lake maintenance vessels.</p>	<p>Foreshore fishing within designated areas.</p> <p>Special advertised sporting, public display and festivity events by permit.</p>
Zone 5	<p>Model yachts/model power boats.</p> <p>Pedal powered leisure craft.</p> <p>Small yachts and sail boards.</p> <p>Canoes, kayaks, row boats.</p> <p>Rowing skiffs, dragon boats.</p> <p>Small powered boats complying with predetermined design and performance criteria.</p> <p>Powered leisure boats complying with predetermined design and performance criteria.</p> <p>Powered parasailing and towed ride boats.</p> <p>Powered ski boats.</p> <p>Ferries and Tour boats complying with predetermined vessel design and performance criteria.</p> <p>Cruise boats complying with predetermined vessel design and performance criteria.</p> <p>Junior sports racing boats (only for special events).</p> <p>Jet skis (only for special events).</p> <p>Marine police and Emergency response boats.</p> <p>Lake maintenance vessels.</p>	<p>Model sailing and power boating within designated areas.</p> <p>Pedal powered leisure craft hire within designated areas.</p> <p>Sailing within designated areas.</p> <p>Leisure canoeing, kayaking and row boating hire.</p> <p>Sports rowing and paddling training and competition events.</p> <p>Small powered hire boating.</p> <p>Powered leisure boating by hire - self driven (by licence) or professionally skippered.</p> <p>Parasailing and towed ride commercial operations within designated areas.</p> <p>Water skiing by commercial operations within designated areas.</p> <p>Ferry and Tour boat commercial operations.</p> <p>Cruise boat commercial operations. Special jet ski or boat racing events by permit.</p> <p>Permanent water display features within designated area.</p> <p>Special advertised sport, public display and festivity events by permit.</p> <p>Marina berthing.</p> <p>Fishing from boats.</p> <p>Foreshore fishing within designated areas.</p> <p>Special fishing competitions by permit.</p>

PART C
PUTRAJAYA LAKE USE MASTER PLAN

LAKE USE MANAGEMENT ZONE	PERMISSIBLE WATER CRAFT	PERMISSIBLE WATER ACTIVITIES
Zone 6	<p>Canoes, kayaks, row boats.</p> <p>Small powered boats complying with predetermined design and performance criteria.</p> <p>Powered leisure boats complying with predetermined design and performance criteria.</p> <p>Marine police and Emergency response boats.</p> <p>Lake maintenance vessels.</p>	<p>No public access or recreational activities permissible within designated fish habitat sectors.</p> <p>Leisure canoeing, kayaking and row boating.</p> <p>Sports rowing and paddling training.</p> <p>Small powered hire boating.</p> <p>Powered leisure boating by hire - self driven (by licence) or professionally skippered.</p> <p>Fishing from boats.</p> <p>Foreshore fishing within designated areas.</p> <p>Special fishing competitions by permit.</p>

11.0 INTEGRATED FORESHORE AND LAKE USES**11.1 INTRODUCTION**

The review of lakeside land use in Section 5.0 identified a number of locations where commercial, recreational and mixed-use developments have been proposed in close association with the lakeshore.

This Section 11.0 further analyses these opportunities in relation to lake use, foreshore character and lifestyle opportunities involving interfacing of the lake with various commercial centres, and also in the formulation of specific development concepts which integrate lake and foreshore activities.

11.2 SHARED USE OF PUBLIC PROMENADE WITH WATERFRONT COMMERCIAL DEVELOPMENT**11.2.1 General Description**

While the provision of a mandatory 20m setback from the water edge for all building development is valuable in ensuring continuous promenade access for the public, there is a risk that in some situations this setback may serve to isolate public activities from full appreciation and enjoyment of the lake foreshore. At worst, the promenade could become a sterile strip separating the water edge from commercial, retail and dining activities.

Carefully planned and designed water edge development can create exciting mixes of building and marine architecture and public activity as illustrated in **Figure 11.1**.

Figure 11.1 - Water Edge Development



11.2.2 Waterfront Promenade

The promenade at areas of waterfront commercial development should be designed to provide interest and variety in its form and landside uses. The space separating the water and building development should be activated to encourage participation and enjoyment for the public by way of enticing hard and soft landscape treatments and also by opportunities for shared use of the public promenade with waterfront commercial development.

Drawing 11.1 illustrates options for activation of the waterfront promenade with the following limited forms of shared commercial development:

- i. Alfresco dining spilling onto the promenade from premises at the setback building line. This form of building frontage and public space activation has become common and popular in many areas of Malaysia's major cities.
- ii. Alfresco dining spilling from restaurant frontages and extending to the water edge, with public access maintained through the centre. This is an arrangement which has proved successful and popular at the Boat Quay development in Singapore.
- iii. Construction of commercial building at or over the water edge with pedestrian access being maintained within the promenade around the development, with due allowance also for service vehicle access. Generally such buildings would be less permanent in form than development set back behind the promenade, be limited to single storey height, and must be sensitively located and architecturally designed having regard to their positional (affecting views to the water) and aesthetic impacts. The value of restaurant floor space, which is also a measure of the enjoyment of patrons, increases with increased access to attractive views and direct proximity to water.

The incorporation of fixed floating restaurants is a variation of this option involving similar aesthetic impact and servicing considerations.

11.2.3 Public Ownership of the Promenade

In all of the above cases, public ownership of the promenade should be retained and tenure for use of public promenade (or lake bed in the case of structures built over or floating upon the lake) would be provided through leasehold arrangements with Perbadanan Putrajaya.

Lease conditions (rental, term and special conditions) should be structured to suit the scale and nature of each particular use. For example, a small waterfront café use involving non-permanent structures would have very different tenure requirements to a larger commercial building.

For a large waterfront café or restaurant involving long term building structures, a lease term of up to 25-30 years may be considered appropriate, in order to allow the lease reasonable time to amortise his capital investment and on the basis that the lease would not be transferable to another party.

The issue of transferable leases could also be considered (particularly in the case of smaller café style developments involving reduced terms of 3-10 years).

Leases should be appropriately conditioned to manage usage and development of a site including provisions which:

- i. stipulate and set conditions on allowable usage of a site;
- ii. require continued maintenance of the lease area and improvements;
- iii. set out conditions with respect to ownership of improvements in a lease area upon expiry of the lease; and
- iv. establish requirements where applicable for the maintenance of public access through the lease area.

11.3 COMMERCIAL LAND USE AND LAKE INTERFACE OPPORTUNITIES

Drawing 11.2 shows various locations where commercial and mixed-use land use is proposed in close association with the lakeshore and summarises the waterfront character interface opportunities of each. A range of different interface characters is proposed to create a variety of identity areas and offer varied lifestyle opportunities.

Commercial Area 1

The existing planning for this prestigious Arts and Culture Quarter proposes an elegant formal lakeside promenade which is appropriate to the character of the Quarter and its relationship with the formal Putra Bridge and the Putra Mosque. The adjacent major water garden will further enhance this setting and extend the range of visitor/tourist activities associated with the lake.

Commercial Area 2

Planning for the Entertainment District proposes mixed use developments including a City Services Centre with a Sports Centre fronting a formal promenade which links south to a major urban lakeshore park with formal pedestrian boardwalks radiating to the district street pattern.

Commercial Area 3

The eastern slopes of Taman Wawasan provide an attractive setting for a lakeshore lowrise hotel with a swimming lagoon beach. This opportunity is further described in the following Section 9.4.

Commercial Area 4

This major commercial area in Precinct 7 has the potential to activate the lakeshore in a way that contrasts with the more formal parkland and promenade frontage of the core island opposite.

Buildings should be in the range of 3 to 6 storey height to the waterfront with activated facades such as a 3 storey festival retail centre, hotels and offices with restaurants opening out on the ground floor.

The promenade hard area should permit outdoor dining and kiosks and be accented with boardwalks and hard edge nodes. One storey structures for restaurants, dining and ferry terminals may be permitted on leases with strict controls.

The potential effect is for building frontages and promenade activity to create vibrant night time water reflections.

Commercial Area 5

This mixed use area in Precinct 4 occupies a unique location between two bridges and may offer the opportunity to activate the lakeshore promenade with sheltered dining areas directly on the water edge while still permitting through pedestrian access.

Commercial Area 6

This formal semicircle of commercial sites on either side of the bridge is complemented by a formal promenade with projecting quay parks. Buildings should encourage pedestrian entrances and public orientated activities at ground level to activate the promenade which could contain a series of shade structures and kiosks to give accent and rhythm to the foreshore.

Commercial Area 7

Planning for this area proposes commercial, shopping complex and mixed use development fronting a continuation of the promenade from Commercial Area 5 around to the east, where the lake becomes more riverine in scale.

This frontage could vary from others by being more riverside in character with boardwalks and a series of light playful structures for restaurants, outdoor eating and arts and craft tourist activity directly onto the water edge in selected locations.

Commercial Area 8

This extensive area along the lakeshore in Precincts 5 and 6, which is under planning review, offers a major opportunity to create an active water and boating recreation node in association with major commercial, retail and hotel development, which is further described in the following Section 9.5.

11.4 FIXED FLOATING RESTAURANTS

Floating restaurants permanently moored to the foreshore provide a special opportunity for nautical theming and desirable lakeside dining.

The planning and design of any floating restaurant should be closely integrated with adjacent landside development to ensure that architecture, foreshore activities and access are complementary. In particular, consideration must be given to service vehicle access.

Locations most suitable for the incorporation of a floating restaurant are likely to be Commercial Areas 5, 6 and 4 as identified in Section 11.3.

Conditions of planning and building approvals and conditions of site leasing, together with rigorous Perbadanan Putrajaya policing of these conditions should ensure that there are no discharges, other than clean stormwater runoff, direct to the lake from any water edge commercial developments.

In the case of floating restaurants, a pumped or vacuum sewerage facility will be necessary to discharge wastes to the on-shore reticulation system.

11.5 TAMAN WAWASAN HOTEL FACILITY CONCEPT

At the direction of Perbadanan Putrajaya, a preliminary low rise hotel concept has been formulated for a steep site in the southeast corner of Taman Wawasan, centred around a large filtered swimming lagoon and set back into the hillside from the lake and several lake edge stormwater retention ponds. The concept also incorporates separate public access to a lakeside beach.

This formative concept, which would require further technical and financial feasibility assessment, is illustrated in **Drawing 11.3**.

11.6 PRECINCT 5 AQUATIC CENTRE AND FESTIVAL AMPHITHEATRE WATERFRONT CONCEPT

Precinct 5 has evolved as Putrajaya's core boating and water recreation node and a focus for water oriented staged events, attractions and festivities.

The Precinct 5 Waterfront is strategically located, facing Putrajaya Lake's largest expanses of water, but with close views also to the Core Island. It is highly accessible with 3 monorail stations and a park-and-ride centre in close proximity. There is a nexus between Precinct 5's water recreational and sporting activities and the proposed Sports Academy immediately south. Precinct 5's lively waterfront commercial, high standard hotel accommodation and festivity activities are strongly complementary with the nearby Convention Centre. There is also a nexus with the urban waterfront promenade and active commercial development across Bridge 6 on the opposite southern shoreline of the Core Island.

A preliminary waterfront development concept has been prepared for Precincts 5 & 6 which is intended to provide a comprehensive and well integrated complement of facilities catering for aquatic recreation and sports, boating, waterfront leisure, dining and festivity events.

Drawings 11.4 and 11.5 depict a potential integrated arrangement of waterfront activity and foreshore land-uses.

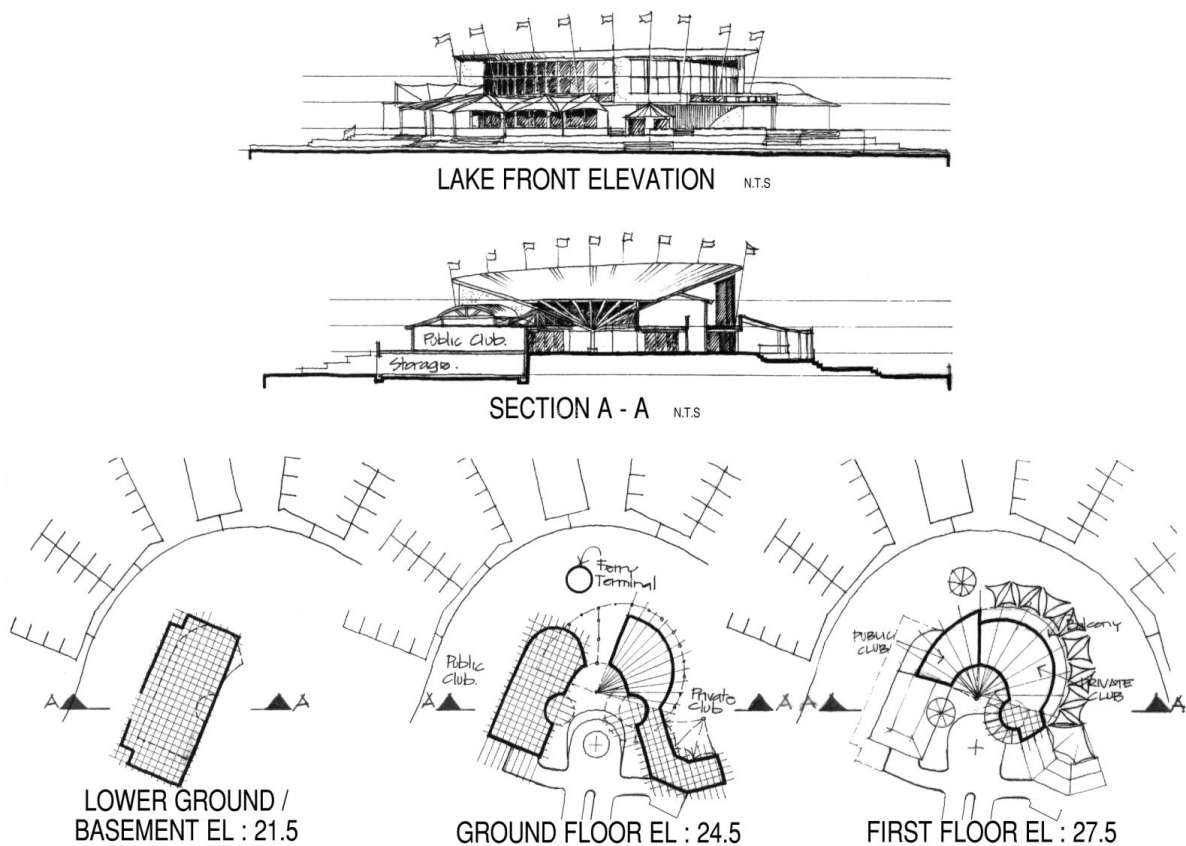
Key features are:-

- i. A lakeside beach recreation node for activities such as beach volleyball and leisure craft launching, together with beach side lawn areas which can also serve as staging areas for major aquatic sporting events, including rowing in particular.
- ii. A lake swimming enclosure.
- iii. Space allocation for a possible future adjoining filtered swimming lagoon and recreation park.
- iv. Public aquatic recreational and sporting facilities integrated with public club amenities.
- v. A marina providing casual mooring, cruise boat berthing, and general berthing for commercial recreation boats and public and private club boat hire. Generally the movement of motorised boats would be to the east and non-motorised boats to the west of the Boat Club facility to avoid crossover conflicts on lake routings.

PART C
PUTRAJAYA LAKE USE MASTER PLAN

- vi. Public and private boat club facilities. The public club and basement level leisure craft storage are envisaged to be oriented towards the western cove with its public recreational activities and public marina accommodating generally smaller powered boats. The private club with extensive second storey floor space would be oriented towards the festival amphitheatre and private marina accommodating generally larger and more prestigious vessels. Indicative features of the proposed Boat Club facility are illustrated in **Figure 11.2**.

Figure 11.2 - Indicative Boat Club Building Bulk and Form



- vii. A commercial ferry and tour boat berthing terminal.
- viii. Pedestrian linkages to the nearby Sports Academy.
- ix. An open space festival amphitheatre capable of comfortably accommodating 25-30,000 people with views to a water display area. The amphitheatre would be articulated by the variety of its interfacing with landside commercial development, a central festivity piazza, water features, terracing and other elements of urban design to create sub-areas of individual identity within the overall amphitheatre space.
- x. A water display area ultimately capable of accommodating water based attractions such as floating musical fountains, laser projection water screens, fireworks and a floating theatrical stage. The primary intent of such shows would be to create an experience that will attract tourists and visitors and for the celebration of nationally significant events.
- xi. Multiple use of the festival amphitheatre and water display area as a water stadium for the staging of public aquatic displays such as water skiing displays, etc.
- xii. A retail and entertainment commercial corridor behind the festival amphitheatre linking the Boat Club to the hotel node.
- xiii. Pedestrian linkages from the foreshore developments to the nearby Convention Centre, commercial mixed-use and community facility nodes, three monorail stations and the Bridge 6 lake crossing.
- xiv. A resort style hotel and associated facilities nominally 350 - 400 rooms. Drawing 11.5 includes an illustration of the indicative bulk and form of such a hotel.

Infrastructure requirements to support the festival amphitheatre and water display area concept include the following:

- i. A strategically located central control room would be required, possibly within the Boat Club facility.
- ii. A floating stage complete with canopy would require the provision of an umbilical cord to the Control Room with power and control connectors at a safe location near the water edge.
- iii. Typical power loading for the stage would be two 60 amp 3-phase outlets for audio and four 60 amp 3-phase outlets for lighting.
- iv. The stage could be “garaged” at the Lake Maintenance and Services Centre when not in use.

- v. The advantages of a floating stage are that it can be towed to different areas within the amphitheatre water space depending upon the “intimacy” of the performance, or to different areas of the lake if there are performances other than at the amphitheatre.
- vi. For large performances a concert audio system would be provided, with amplifiers and drive racks located in the Control Room.
- vii. All cabling for speakers and sound mixing would be located within conduits designed and installed as part of the amphitheatre facility, eliminating unsightly and potentially hazardous cabling being strewn over the amphitheatre area during performances.
- viii. By deploying a large number of speakers in a distributed fashion, speech intelligibility is greatly improved and the volume of each speaker is reduced as it only needs to cover a smaller area. A state-of-the-art distributed audio system would be utilised that would be discreetly camouflaged in lighting poles, loud speakers that look like rocks and other features integral to the landscape design, thereby also minimising the risk of noise pollution to other areas.
- ix. Utilisation of water screens, lasers and special effects can also be combined to tell various stories. Story lines may be serious, e.g. a Vision 2020 show or the history of Malaysia, or humorous attracting a younger audience and promoting a family environment. Three water screens are envisaged to maximise viewing angles. As water screens are best-viewed perpendicular to the audience, the two outer screens would be offset at approximately 15 degrees to the centre one. Water screens would consist of an array of different jets and sprays whose activation would be way of a computer controller, which in turn would be synchronised to a soundtrack. Behind each water screen float would be a barge in which there would be an array of equipment including lasers, 35mm film projectors, special effects lighting, etc, also synchronised to a master control system to create a cohesive show.
- x. A suite of shows with meaningful and appropriate content could be developed for selection by a central processor to provide variety for patrons, with different shows at 30 minute or hourly intervals, if appropriate.

The most important priority at this stage of precinct development is to ensure that designs can accommodate all possible applications of technology for public entertainment facilities for CCTV systems and live telecasting.

11.7 PUBLIC LAKE SWIMMING ENCLOSURE

Although pebble beaches are proposed at a number of foreshore park locations around Putrajaya Lake, only one beach with sand to and beyond the water's edge is to be provided and only at this location is lake swimming to be encouraged.

Drawing 11.6 illustrates the sand beach and public swimming enclosure indicated on Drawing 11.5 at Precinct 6, within a cove immediately west of the proposed Boat Club.

A public swimming enclosure is proposed comprising a floating pontoon walkway and offshore landing, which facilitates pedestrian access to the furthest and deepest swimming area, together with a floating boom which establishes the limits of the enclosure.

The offshore pontoon landing could be provided with an attractive shelter for the comfort of adults supervising swimming children, and serves as a safe swimming destination.

The sand beach adjacent to the swimming enclosure would facilitate beach hire of leisure watercraft and could be designed to accommodate other beach recreational activities such as beach volleyball.

High quality landscaped foreshore parklands are proposed, incorporating areas of canopy shade trees and attractive shade structures, together with open lawn areas for active recreation and as staging areas for aquatic sporting events.

To remain an attractive public asset, artificial sand beaches within the lake environment will require a high level of on-going maintenance.

Although water quality at the southern end of Putrajaya Lake is likely to be relatively highest within the lake system, physical and micro-biological water quality will fluctuate in response to stormwater inflows (including many drainage outlets direct to the lake) and other environmental factors, which will require vigilant monitoring and public health management at the Precinct 5 swimming enclosure.

It is also critical that stormwater drainage from all local catchments be directed to the lake away from the Precinct 5 aquatic sports cove.

11.8 LAKE EDGE ATTRACTIONS

In order to expand the Putrajaya Lake experience as widely as possible for visitors and tourists, the opportunity exists to create points of interest at strategic locations around the lake in the form of monuments, statues, works of art, etc. Whether any such creations can reach the iconic status of the Little Mermaid in Copenhagen or the Merlion in Singapore is problematical, however the lake edges of Putrajaya provide a great opportunity to showcase the history, cultures and artistic talents of Malaysia for both land based and water based tourism.

Such attractions could be lit at night by way of intelligent lighting systems and audio tracks could be developed for each individual display. These displays could be connected to tour boats by way of radio control. Tour boats could activate the displays and an audio track synchronised with the lighting could be heard from the boat's own audio system. All displays around the lake could be inter-connected to a central control system so that on VIP occasions the entire lake precinct could be controlled from a central location.

Consideration should be given in current precinct design and implementation to the deployment of an appropriate communications backbone to facilitate function and operation monitoring from a central location.

11.9 ROWING

The sport of rowing presents a special opportunity within Putrajaya to promote a healthy recreational pastime and to develop competitive skills and experience within a sport that is well suited to Putrajaya Lake.

In particular, the opportunity exists to promote and develop the sport of rowing within schools and universities situated in the demographic catchment of Putrajaya, and to utilise Putrajaya Lake with its backdrop of spectacular urban development for regional, national and international competitive events.

With this aim in mind, the proposed aquatic centre focused around a public club facility within Precinct 5, together with the cove to its immediate west, have been planned with particular emphasis on the staging of rowing events. Infrastructure support for promotion and training in the sport of rowing as well as similar canoeing, kayaking and dragon boat sports would also be available at the existing Boat Club within Precinct 10 and a less formal school and club "boat shed" facility which could be located at the north-eastern foreshore of Lake Use Management Zone 6 (Passive Recreation & General Navigation Zone) within Precinct 7, adjacent to the main arterial road connection between Putrajaya and Cyberjaya. This facility could incorporate a pebble launching beach and landscaped informal open space.

Drawing 11.7 illustrates key features of a competition rowing course, including a Finish Tower and hillside terraced spectator viewing facilities to be incorporated into the landscape design of the Precincts 5 and 6 cove east of the Boat Club. However the viability of this course has been threatened by alterations to the alignment of lake edges in the vicinity of Precinct 8 near Bridge 8, and further complicated by pylons supporting the monorail bridge to the north which are located within the lake close to each shoreline. A proposal, as outlined in **Drawings 11.8, 11.9, 11.10** and **11.11**, has been provided to Perbadanan Putrajaya to assist in making adjustments to the position of the lake edge within Precinct 7, at the southern abutment of Bridge 8, and at the cove in Precincts 5 and 6 west of the Boat Club, in order to accommodate a 7 lane international standard rowing course.

The close proximity of the Precinct 7 park to the rowing course will facilitate excellent spectator viewing close to the competition Start line, which should be given due consideration in the planning of this parkland area.

Other spectator vantage points as indicated on **Drawing 11.12** are available along the 20m promenade within Precinct 7 and within foreshore parks on the Core Island generally from the north of the Monorail Bridge to the south of Bridge 8. Footpaths on Bridge 8 could also offer spectator viewing.

The Monorail Bridge could provide an excellent vantage point for high-level television coverage of the starting line, while Bridge 8 could similarly facilitate high level telecasting of the progress of competition races.

The form of the Aquatic Centre cove and associated facilities have been formulated with a view to the logistical requirements of competition rowing and provision for spectacular finish line viewing. The Finish Tower would be an architectural landmark of three storeys, incorporating:

- i. Ground floor: regatta control, toilets etc;
- ii. First floor: judges, timing equipment, etc;
- iii. Second floor: commentary; and,
- iv. Roof: platform for TV cameras.

In general, the Finish area should also accommodate Competition Management and Venue Management areas within the Boat Club; seating for VIP's, the media, teams and spectators; a Media Centre; VIP and hospitality areas; a scoreboard and video board (if applicable); and first aid and rescue services. The adjacent marina provides an ideal facility for victory ceremonies, media interviews, umpire's boats, and rescue boats.

Spectator drop-off, bus parking and monorail public transport facilities are all conveniently available.

Moveable starting line and timing hut pontoons together with lane marking buoys, etc can be stored within the Lake Maintenance and Services Centre.

More detailed planning and design for rowing and other events should be undertaken in accordance with the FISA international governing body regulations, to ensure that a course of international standard is not inadvertently compromised in the finalisation of precinct and lake edge infrastructure.

11.10 CENTRAL WETLAND RECREATIONAL AND LAKE MANAGEMENT CENTRE CONCEPT

As indicated in Section 8.2, the substantial Central Wetlands waterbody situated immediately above the primary lake is proposed as a tranquil water recreation zone and environmental reserve, in which there is controlled public access to some areas of foreshore for non-motorised and electric motorised boating, fishing, canoeing and other non-intrusive activities.

Drawing 11.13 indicates the location of a proposed Central Wetlands Recreational and Lake Management Centre with access from Precinct 12, which provides for boat berthing, beach leisure craft hire, and fishing within the tranquil environment of this waterbody.

11.11 FORESHORE FISHING

Fishing by boat or from foreshores on Putrajaya Lake has been identified as a desirable leisure activity to be encouraged and supported for the benefit of the Putrajaya community. Fisheries within the Putrajaya Lake system will be managed to support species of fish desirable to anglers.

In addition to proposed access for fishing hire boats within proposed Lake Use Management Zones 2, 4, 5 and 6 as designated on Drawing 8.2, foreshore access is also be available to these zones by way of foreshore parks and the public promenade for fishing activities.

In general, the form of the lake edge incorporating a 5m wide bench submerged 1m below the normal standing water level of the lake may not be conducive to shore based angling because the bench is likely to support profuse aquatic plant growth, resulting in the “snagging” of fishing lines.

It is proposed that indiscriminate foreshore fishing not be permitted and that in conjunction with land use planning, provision be made for fishing at suitable designated locations around the lake edge by way of:

- i. Aesthetically engineered promontories extending from the normal promenade shoreline over the submerged bench to provide access to deeper water. These promontories could be created as formal landscape edge treatments or as “natural” promontory landforms. (Refer Section 13.4 and Drawings 13.9, 13.10 and 13.11.)
- ii. Jetties or other structures extending from the shoreline to deeper water.

Designated foreshore fishing areas should be within reasonable walking distance of a public car parking facility and should be provided with public toilets; facilities for cleaning fish including taps and an apron area with drainage to the sewerage system; and regularly emptied refuse disposal facilities. All designated foreshore fishing areas should be located within waterfront parklands.

It is important that the habitat value of Putrajaya Lake be maximised as this increases fisheries productivity. It may be desirable to provide artificial fish shelter structures at strategic sites around the lake, including at locations where foreshore fishing is envisaged. These shelters may comprise concrete pipes, logs or large timbers etc, placed before inundation or later dropped in the lake so as to create voids, which are used by fish for shelter. Such structures also support plant and algae growth and become the focus of communities of organisms; much like a coral reef becomes the focus of marine communities in the ocean.

Submerged artificial habitat intended to support foreshore fishing should ideally be located within the reach of a line cast out by a fisherman from the bank. This will increase the fishing success rate. These “snag” areas could be marked by buoys or signposts upon the surface of the water to indicate their location, for the benefit of boaters and fishermen. The top of these structures should allow a minimum of 4.0m navigation clearance to mean surface level.

Drawing 11.14 shows 16 designated park foreshore public fishing areas and 3 areas suitable for foreshore fishing competitions, together with indicative locations for artificial fish shelter structures and a suggested detail of a typical shelter.

The following areas have been identified as being suitable for significant fishing competitions which may attract many hundreds of anglers, depending largely upon the value of prizes offered:

- i. A length of Central Wetlands foreshore adjacent to the proposed Central Wetlands Recreational and Lake Management Centre within Precinct 12. It is anticipated that this area could comfortably accommodate approximately 250 competition anglers. Competition events would be supported by the permanent Central Wetlands Recreational Centre.
- ii. The landscaped water edge within Precinct 1 extending both sides of Bridge 1 and looking across the lake to Taman Wawasan and the Deputy Prime Minister's Residence. With appropriate organisation, it might be possible to arrange for the use of adjacent Government Department carparking facilities by participants and spectators, for competitions held on non-working days. It is envisaged that this site could potentially accommodate approximately 450 competition anglers. Consideration could be given to the provision of additional permanent public amenities along the foreshore promenade east and west of Bridge 1, which could be further supplemented by temporary portable amenities to cater for major competition events.
- iii. The north eastern foreshore of the proposed Lake Use Management Zone 6 (Passive Recreation and General Navigation Zone) within Precinct 7, adjacent to the main arterial road connection between Putrajaya and Cyberjaya north of Bridge 8. Depending upon the ultimate delineation of open water and wetlands towards the northern end of this section of the lake, it is envisaged that this area could comfortably accommodate 250 competition anglers. This area currently contains an Indian temple and is also suggested as the site for an informal rowing boatshed facility for use by rowing and other aquatic sports clubs and/or by schools. Consideration needs to be given in the planning of adjacent main roads and/or the adjacent Precinct 7 residential area, to the availability of road access and car parking space. Consideration should also be given to a reduction in the width of the submerged earthworks bench along the foreshore of this location.

Proposed fishing competition areas should be provided with primary infrastructure including road access, power supply, sewerage and water supply reticulation, sufficient to cater for peak competition use. In addition to permanent carparking, toilets, fish cleaning areas (with discharge to sewer), shelters, electric barbeques, etc catering for normal public use, supplementary facilities may be required for major competitions including spillover carparking areas, additional mobile public amenities and temporary stands, pavilions, shelters, food and beverage stalls, etc.

An indication of the facilities to be provided of each designated fishing area is given in **Table 11.1**.

Issues relating to the management of lake fisheries are addressed in Section 22.5.

Table 11.1: Designated Fishing Area Facilities

Fishing Types	Designated Fishing Areas		Facilities									Remarks
	Precinct	Waterfront Landuse	Approx. Competition Anglers	Car Parking (paved spill-over & shared)	Power Points	Wash-room/Toilet Facilities	Fish Cleaning Facilities	Picnic /BBQ Area/ Cooking Grill	Kiosks	Shaded Seating Area /Benches	Drinking Fountains	
Competition Fishing	Precinct 12/ Taman Wetlands	Central Wetlands Recreational Centre	250	310	3	3	3	3	3	3	3	<ul style="list-style-type: none"> Require suitable area and utility service connections for supplementary temporary portable toilet facilities, pavilions, kiosks etc.
	Precinct 1	Foreshore at Bridge 1	450	500	3	3	3	3	×	3	3	
	Precinct 7	Waterfront Park	250	300	3	3	3	3	×	3	3	
Park Foreshore Fishing	Precinct 1	Taman Botani	N/A	3	3	3	3	3	×	3	3	<ul style="list-style-type: none"> Usually confined to the immediate area surrounding a jetty or headland from which fishing is permitted. Casting area clear of aquatic growth and excessive snags Convenient landside parking and pedestrian access. Complementary Activities - Fishing from boat, picnicking/passive beach activity, non-motorised passive leisure craft activity.
		Floating Café, Taman Botani	N/A	3	3	3	3	×	3	3	3	
	Precinct 2	Taman Wawasan	N/A	3	3	3	3	3	×	3	3	
	Precinct 18	Public Park	N/A	3	3	3	3	3	×	3	3	
		Public Promenade and Open Space	N/A	3	3	3	3	3	×	3	3	
	Precinct 19	Lake Maintenance and Services Park/Open Space	N/A	3	3	3	3	3	×	3	3	
	Precinct 5	Under-Bridge Café/Open Space	N/A	3	3	3	3	×	×	3	3	
	Precinct 4	Lake Front Park	N/A	3	3	3	3	3	3	3	3	
		Sanctuary Haven	N/A	3	3	3	3	3	×	3	3	
	Precinct 8b	Public Park (in between Bridges 8 & 11)	N/A	3	3	3	3	3	×	3	3	
Precinct 8a	Edge of Active Commercial Waterfront	N/A	3	3	3	3	3	×	3	3		
Precinct 13/ Taman Wetlands	Swan Area	N/A	3	3	3	3	×	×	3	3		

11.12 SPECIAL EVENTS

Putrajaya Lake will be a stage for many water oriented sporting, cultural, entertainment and festivity events, requiring integration with foreshore facilities for marshalling, event organisation, water craft launching, spectator viewing and amenities, parking, public transport, and the media.

In the planning and design of lakeside Precincts, it is important to ensure that adequate provision is made for areas of open space at the water edge strategically positioned in regard to the staging of water activities, with primary infrastructure capable of meeting the needs of such events. Although many special events will involve the provision of supplementary temporary infrastructure in the form of viewing stands and other structures, tents and pavilions, media broadcasting, food and beverage stalls, additional public toilets, litter receptacles and spill-over car parking; it is essential that primary infrastructure including power supply, telecommunications, sewerage and water supply reticulation, and transport access be designed for peak loads associated with major public events.

12.0 LAKE MANAGEMENT, MAINTENANCE AND EMERGENCY RESPONSE FACILITIES

12.1 LAKE USE MANAGEMENT CENTRES

As outlined in more detail in Section 18.0, the management of Putrajaya Lake involves a number of functions which require teams of people with different skills and experience, and also a range of different infrastructure facilities at different geographical locations.

These management functions and their dependence on various infrastructure facilities to be established around the lake system are outlined in **Table 12.1**.

Table 12.1 - Management Functions and Dependence on Infrastructure Facilities

Management Functions	Infrastructure Facilities
Wetlands Management	Taman Wetlands Management Centre with convenient land access to all wetland areas; facilities for monitoring water quality; facilities for storage and maintenance of specialist wetland equipment, staff amenities, etc.
Water Quality Management Low Flow Management Ecological Management Fisheries Management Technical Education & Research Management	These functions principally depend upon a centre with laboratory and other monitoring facilities, with reasonably convenient accessibility to various lakeside centres for monitoring and sampling of sites throughout the lake system. Could be integrated with Taman Wetlands Management Centre.
Aquatic Plant Management Management of Lake Edges & Infrastructure (beaches, lake structures, etc) Vessel Servicing & Maintenance	Lake Maintenance and Services Centre with direct lake frontage and facilities for boat fuelling and sewerage pump-out; berthing of special purpose aquatic plant harvesting and maintenance vessels; harvested weed transfer facilities; vessel haul-out and maintenance facilities; equipment storage and maintenance, etc.
Recreation Management (including informal lake recreation activities, commercial recreation activities, club and other organised water sports, water sports events) Leisure Boating Management	Aquatic Recreation Centre on the primary lake at the heart of water recreation and boating activities, including marina facilities; storage and public hire of water sport equipment; boat club facilities. Primary management centre could be integrated within Boat Club complex. Secondary recreation centre on the Central Wetlands water body, including hire craft and equipment storage facilities.
Water Based Displays & Entertainment	These activities are dependent upon a control room situated with a commanding view of the Festival Amphitheatre and water display area, for the control of technical aspects of performances. Could be integrated within the Boat Club complex or within a separate Festival Amphitheatre management centre within the adjacent commercial development.

Management Functions	Infrastructure Facilities
Water Transport Management (including ferries, tour boats and cruise boats) Special Lake Events Management Fishing Management (Licencing, etc) Public Relations/Community Information/Community Education Commercial Leasing General Administration	Central Administration and Management Centre situated close to the epicentre of all lake activities. Secondary Special Events and Lakeside Spectator Management Centre within Precinct 4 foreshore parklands.
Emergency Response Water Safety Water Security	Existing Water Police facility with particular focus on security of property and criminal activities. Central Emergency Response Centre situated on the primary lake near the epicentre of lake activities, with berthing for emergency response facilities, communications centre and support facilities. Central Wetlands Recreation Centre could provide surveillance and emergency response for Central Wetlands water body, including communications centre and emergency response vessel berthing.
Public Information Lake Tourism Public Education Public Liaison (comments, complaints, etc) Public Services (e.g. fishing licences)	Lake Information Centre at a prominent shop front location within a main Core Islands City Services Centre, including public counters, publication displays, lake education displays, etc. Taman Wetlands Visitor and Interpretative Centre, and Freshwater Aquatic Centre. Dam Visitors Centre.
Flood Management Dam Management	Dam Management Centre at the main dam with access to lake edge and a casual vessel berthing facility.
Foreshore Landscape Management	Integrated with facilities for landscape maintenance of all Putrajaya public open spaces.

Proposed locations of lakeside Perbadanan Putrajaya Lake Use Management Centres are indicated on **Drawing 12.1**.

The management functions, infrastructure components and land take associated with individual Lake Use Management Centres are set out in **Table 12.2**. In each case the calculated land take excludes the area of the former lake front public promenade.

Table 12.2 – Perbadanan Putrajaya Lake Management Centre Functions, Infrastructure Components and Land Take

LAKE USE MANAGEMENT CENTRES	MANAGEMENT FUNCTIONS	INFRASTRUCTURE COMPONENTS	SITE AREA	LAND TAKE
<p>1. Central Administration and Emergency Response Centre (Precinct 7)</p>	<p>Water Transport Management (including ferries, tour boats and cruise boats)</p> <p>Special Lake Events Management</p> <p>Fishing Management (Licencing, etc)</p> <p>Public Relations/Community Information/Community Education</p> <p>Commercial Leasing</p> <p>General Administration</p> <p>Emergency Response</p> <p>Water Safety</p> <p>Water Security</p>	<p>Central Administration and Emergency Response Building Complex</p> <p>Communications Centre</p> <p>Emergency response boat berthing for up to 4 boats</p> <p>Casual berthing terminal</p> <p>Above ground and underground car parking</p>	<p>Approx. 1.2 ha (3.1 acres)</p>	<p>1.1 ha (2.7 acres)</p>
<p>2. Aquatic Recreation Centre (Precinct 5 & 6)</p>	<p>Recreation Management (Including informal lake recreation activities, commercial recreation activities, club and other organised water sports, water sports events)</p> <p>Leisure Boating Management</p> <p>Festival Amphitheatre Water Based Displays & Entertainment</p>	<p>Intended to provide a comprehensive and well-integrated complement of facilities catering for aquatic recreation and sports, boating, waterfront leisure, dining and festivity events.</p> <p>The facilities to include:</p> <ul style="list-style-type: none"> • public and private boat clubs • floating marina (nominally 120 berths) and cruise boat terminal • commercial ferry and tour boat berthing terminal • open plaza festival amphitheatre accommodating 25,000 to 30,000 people, fronting active waterfront commercial • lakeside beach • lake swimming enclosure - 1,000m² (0.25 acres) approximately • provision for future filtered swimming lagoons 	<p>Approx. 2.7 ha (6.8 acres) excluding Boat Club site and adjacent car park</p>	<p>Approx. 2.4 ha (5.8 acres)</p>

PART C
PUTRAJAYA LAKE USE MASTER PLAN

LAKE USE MANAGEMENT CENTRES	MANAGEMENT FUNCTIONS	INFRASTRUCTURE COMPONENTS	SITE AREA	LAND TAKE
		<ul style="list-style-type: none"> • lakeside lawn area for active recreation and staging for aquatic sports competitions • rowing course Finish Tower and public viewing • resort style hotel (nominally 350 rooms) • provision for future water displays • above ground and underground car parking 		
3. Lake Maintenance and Services Centre (Precinct 19)	Aquatic Plant Management Management of Lake Edges & Infrastructure (beaches, lake structures, etc) Vessel Servicing & Maintenance	Vessel haul-out and maintenance facility Boat ramp for the launching of boats Maintenance pontoon to facilitate on water maintenance activities Berthing for special purpose lake maintenance vessels Two storey dry boat storage buildings - storage capacity approximately 40 small boats up to 5m in length, and forklift boat launching Refuelling and sewerage pump-out pontoon - spill containment booms, pollution clean-up and fire-fighting equipment Underground fuel storage tanks Car and trailer parking	Approx. 1.9 ha (4.7 acres)	Nil
4. Dam Control Centre (Precinct 5)	Public Information Lake Tourism Public Education Public Liaison (comments, complaints, etc) Public Services (e.g. fishing licences) Flood Management Dam Management	Dam Management & Visitors Centre at the main dam with access to lake edge Casual berthing Car parking Anchored floating boom and buoys to prevent navigation in the vicinity of the spillway	Approx. 0.65 ha (1.6 acres) already designated within land controlled by Perbadanan Putrajaya	Nil

PART C
PUTRAJAYA LAKE USE MASTER PLAN

LAKE USE MANAGEMENT CENTRES	MANAGEMENT FUNCTIONS	INFRASTRUCTURE COMPONENTS	SITE AREA	LAND TAKE
5. Lake Management and Administrative Centre (Precinct 3)	Public Information Lake Tourism Public Education Public Liaison (comments, complaints, etc) Public Services (e.g. fishing licences)	Lake Information Centre at a prominent shop front location within a main Core Island City Service Centre, including counters, publication displays, lake education displays facilities, casual berthing, etc	Floor space only within already committed City Services Centre	Nil
6. Central Wetlands Recreational & Lake Use Management Centre (Precinct 12)	Recreation Management Emergency Response Water Safety Water Security	Central Wetlands Recreational and Lake Management Centre with pedestrian access from Precinct 12. Management and leisure craft storage building Kiosk Pier Small boat marina - nominally 9 berths Pebble beach Fishing headland Public Car Parking	Nominally 0.4 ha (1.0 acre) within existing Open Space	Nil
7. Special Events & Lakeside Spectator Management Centre (Precinct 4)	Special lake events staging area Special events equipment storage Lakeside spectator management	Management building incorporating communications/media sub-centre/ rowing course central timing hut/equipment storage Kiosk Public amenities Car parking with park spillover Casual berthing Special purpose boat ramp	Approx. 0.25 ha (0.8 acres) within existing Open Space	Nil

12.2 CENTRAL ADMINISTRATION AND EMERGENCY RESPONSE CENTRE

A Central Administration and Emergency Response Centre is proposed at the southern tip of the Precinct 7 peninsula, which is strategically situated to provide visual surveillance and provide quick response to the area of water with the greatest concentration of activities and with the greatest risk of emergency events.

A preliminary layout of this facility is depicted on **Drawing 12.2**.

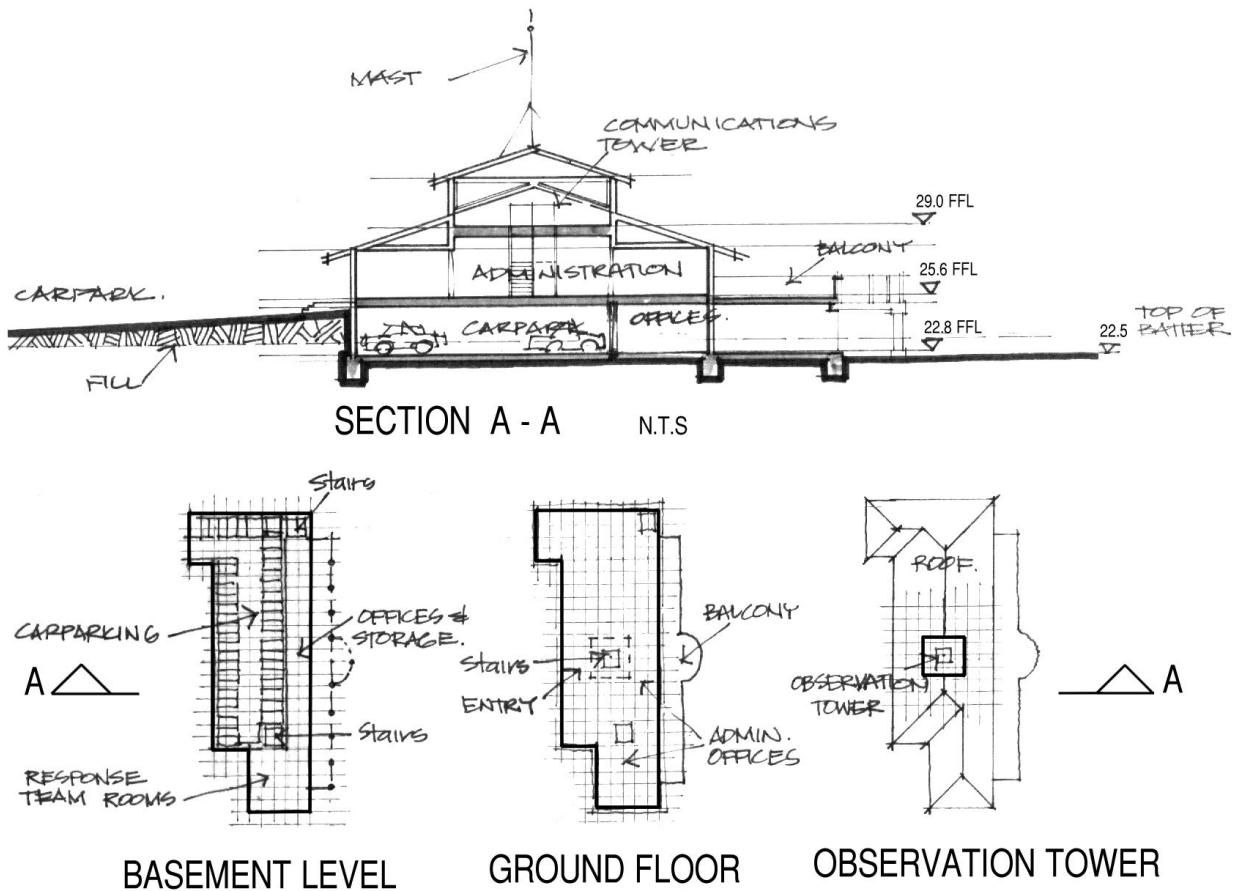
Continuity of public promenade access can be conveniently maintained between the eastern and western shorelines of the peninsula behind the facility.

A “key hole” harbour is envisaged to accommodate emergency response vessels.

A landside building would accommodate an administration complex and a central communications facility linked to all other management centres, the Marine Police and other emergency services agencies, and all large vessels operating within the lake.

Indicative features of the Central Administration and Emergency Response Centre building are illustrated in **Figure 12.1**.

Figure 12.1 - Indicative Central Administration and Emergency Response Centre Building Bulk and Form



A Plot Brief for the Central Administration and Emergency Response Centre site is contained in **Drawing 12.3**.

12.3 AQUATIC RECREATION CENTRE

Physical characteristics of the Aquatic Recreation Centre are outlined in Section 11.6 and a Plot Brief for the site is contained in **Drawing 12.4**.

12.4 LAKE MAINTENANCE AND SERVICES CENTRE

The Lake Maintenance and Services Centre is a key facility necessary to efficiently perform a number of critical “back of house” functions without detracting from the aesthetics and amenity of the waterways or its neighbouring landside development.

The facility needs to be located:

- i. in relatively close proximity to the lake's boating hub; and
- ii. in an area that will not generate conflict between the movement of motorised vessels and the activities of non-motorised craft.

By virtue of its integral land and water working relationships, the Lake Maintenance and Services Centre must of necessity alienate direct public access to the lake foreshore, requiring the public promenade to be diverted around the facility.

The selected site is within Precinct 19 across the lake from the Core Island Precinct 4 to the west and from the dam to the south.

A conceptual layout and indicative imagery for the proposed Lake Maintenance and Services Centre are illustrated in **Drawing 12.5**. The Centre is further illustrated in **Drawing 12.6** by way of sectional views and a perspective sketch.

Key features of the proposed facility are as follows:

- i. Heavily landscaped perimeter buffers are proposed to shelter utilitarian activities of the centre from the Core Island and from the water generally and to accommodate continuity of public promenade access around the facility adjacent to the road.
- ii. A "key hole" harbour cut into the land further camouflages the lake maintenance and services components of the centre comprising:
 - a. A slipway vessel haul-out and maintenance facility. Vessels operating within Putrajaya Lake will require periodic maintenance to their hulls, mechanical systems and superstructures. In the case of larger boats, such maintenance can only practically be undertaken within the confines of the lake. Slipping is proposed by way of a simple and relatively economical wheeled trailer and hoist system to convey vessels from the water up the boat ramp to the maintenance building.
 - b. The boat ramp also facilitates the launching of boats, including vessels intended for long-term operation in the lake and for visiting boats in the course of special events.
 - c. A maintenance pontoon to facilitate on-water maintenance activities.

- d. Berthing for special purpose lake maintenance vessels including aquatic weed harvesters, barges, etc.
- e. A facility for mechanical offloading of harvested aquatic plant material and transfer to trucks for disposal at a land-based composting centre.
- f. Forklift launching and retrieval of vessels housed within dry-boat storage structures and for storage of other floating facilities such as rowing course pontoons, etc.
- g. A re-fuelling pontoon for dry boat storage and maintenance vessels.

A mechanically operated fuel spill containment boom enables the harbour to be isolated from the lake in the event of a fuel spillage or other similar pollution threatening event.

The harbour would be constructed with full depth vertical revetment walls.

- iii. Two 2-storey dry boat storage buildings which would provide storage capacity for approximately 40 small boats up to 5m in length, supplementary to the main marina facility in Precinct 5. It is likely to be some time before the need will arise for this facility.
- iv. A refuelling and sewerage pump-out pontoon adjacent to the lake shoreline which would serve the refuelling needs of all vessels accommodated within the primary lake. The facility has been planned for ease of access and one-way navigation.

Containment of any fuel spillage would be facilitated by mechanically operated floating booms from an offshore pontoon fitted with a skirt to prevent any leakage of floating pollutants between the pontoon floatation units.

It is envisaged that the refuelling pontoon would be fitted with bowsers and pumps dispensing fuels of the types required by vessels operating within the primary lake, and also situated to facilitate multiple refuelling of vessels at peak times. Pumps for fuelling large vessels would be equipped with a long reach filling pipe to reach either side of such boats.

Strict safety procedures would be established and clearly signed at all installations for the refuelling of vessels, to minimise the risks of fire and pollution. In addition to standard procedures for land based refuelling, these procedures would include:

- a. Turning off onboard electrical power and any gas appliances.
- b. Closing of vessel hatches prior to refuelling.
- c. Avoidance of spillage and monitoring of filling rate to avoid overfilling.
- d. Opening of hatches after refuelling to ventilate the vessel.

Fire fighting and pollution cleanup equipment would be readily available at the fuelling installation. Typical pollution containment and clean up equipment, in addition to the containment boom, would include:

- a. Sorbent booms - 30m
- b. Sorbent pads - 450mm x 450mm (200 off)
- c. Oil absorbent material for cleaning spillage on pontoons - 20kg
- d. Waste disposal bin

Large powered leisure boats, ferries, tour boats and cruise boats with on-board toilets would be equipped with sewerage holding tanks which would be regularly pumped out at this facility, with wastes being discharged to the onshore sewerage reticulation system.

- v. Underground fuel storage tanks located within an onshore hardstand with turn-around area for fuel supply trucks.
- vi. Gross pollutant and chemical waste traps to intercept all wash-down and stormwater run-off from working and hardstand areas.
- vii. An administration and security building.
- viii. Staff and visitor car parking as well as trailer parking for towed vessels.

A Plot Brief for the Lake Maintenance and Services Centre is contained in **Drawing 12.7**.

12.5 DAM CONTROL CENTRE

Features of the proposed Dam Control Centre are outlined in a report entitled *Kebenaran Merancang Dan Pendirian Bangunan Bagi Kerja-Kerja Pembinaan Empangan Utama Fasa 1B, Pusat Pentadbiran Kerajaan Persekutuan Putrajaya*.

A Plot Brief for the Dam Control Centre site, based on the development concept prepared by Arkitek Urbanisma, is contained in **Drawing 12.8**.

12.6 LAKE MANAGEMENT AND ADMINISTRATIVE CENTRE

The Plot Brief for the proposed Lake Management and Administrative Centre situated within the larger Precinct 3 City Services Centre building is contained in **Drawing 12.9**.

12.7 CENTRAL WETLANDS RECREATION & LAKE MANAGEMENT CENTRE

Physical characteristics of the Central Wetlands Recreation and Lake Management Centre are outlined in Section 11.10 and a Plot Brief for the site is contained in **Drawing 12.10**.

12.8 SPECIAL LAKE EVENTS AND LAKESIDE SPECTATOR MANAGEMENT CENTRE

Precinct 4 (Waterfront 3) contains a large lakefront park with a foreshore length of approximately 225m facing southwest towards the Precinct 5 Boat Club and festivity amphitheatre.

This public open space has the potential to supplement Precinct 5 as a viewing area for major water oriented festivities, such as fireworks displays; and other water based events such as water ski displays; and also in staging major special sporting events, such as powerboat races, triathlons, etc. The swimming leg of triathlon events could very suitably be staged between the Precinct 5 Aquatic Centre and this site.

A Special Events and Lakeside Spectator Management Centre is proposed to be located within these parklands, containing a modest management building incorporating communications and media support facilities and equipment storage space. The building would also serve as the central competition rowing course timing hut.

Associated facilities would include a kiosk for general park users and for special events, public amenities, limited “grass-cell” parking, a casual berth, and a boat ramp which would be used only as a supplementary facility in staging major events.

The parklands could accommodate public car parking for major events.

An indicative layout for the Special Events and Lakeside Spectator Management Centre is shown on **Drawing 12.11** and a Plot Brief for the site is contained in **Drawing 12.12**.

13.0 LAKE EDGE TREATMENTS

13.1 LAKE EDGE TREATMENT REVIEW

The current focus of planning on opportunities for active Putrajaya Lake-use including conventional motorised activities has a direct impact on requirements for edge treatment at the shoreline where the land meets the water.

The current direction towards active recreational, tourist and transport use is considered a positive move and will more fully utilise the amenity potential of the Putrajaya Lake and waterfront.

As a static water body with minimal use only a minor amount of surface rippling (mainly from wind) would occur. This could easily be dissipated at the shoreline by a naturally graded bank with marginal planting or a formal hard edge.

Under the original master plan, there were only two basic lake edge treatments:

- i. A soft graded bank with a 1 in 4 consistent profile; and
- ii. Hard edges of various designs related more to adjacent land use and architectural and Urban Design considerations than water activity.

The proposed introduction of general boating, ferries and cruise boats requires that existing and previously proposed shoreline treatments be reviewed based on the impacts of these functions.

The increased volume of water traffic will result in a significant increase in wave action, which if unchecked will erode the shoreline. This has subsequently resulted in the need to provide a minimal degree of protection for those edges that will be exposed to wave action. This minimum protection will need to be installed to both existing and proposed work.

Existing and designed hardedges will resist erosion and are generally unaffected by the revised lake function except for where ferry and casual moorings are proposed. However the standard untreated bank at a 1 in 4 slope will need to be reviewed.

Existing and previously proposed lake edge treatments are depicted on **Drawing 13.1**.

13.2 REVISED EDGE DESIGNATIONS

The change in functional requirements of the lake edge has resulted in the following revised edge designations:

- i. **Formal Hard Edges:** Vertical or battered formed walls that have a profiled or decorative applied surface treatment. The main structural component of these walls will typically be reinforced concrete.

Formal Hard Edges include:

- a. full height vertical edge walls;
 - b. low height formal edge walls;
 - c. stepped and terraced edge walls;
 - d. particular vertical wall requirements applicable to ferry and tour boat, cruise boat, and casual moorings.
- ii. **Protected or Revetted Edges:** Edges formed by loose laid and free standing natural materials such as boulders, quarry stone, gabions, bakau piles or rocks. A revetted edge should be the minimal required treatment for this type of edge protection.
- iii. **Soft Edges:** Natural soil edge where the slope profile runs into the water with no protective barrier for wash and wave action. This edge treatment should typically be located in areas of Wetland or limited boating activity zones.
- iv. **Promontory:** Promontories are localised variations in the shoreline that allow the promenade to extend onto the 5m wide submerged bench. The purpose of promontories is to add edge variation and also allow better access to deeper water for fishing.

13.3 ISSUES

There are three issues related to the revised shoreline Master Plan:

- i. The impact of the revised Master Plan requirements on completed work.
- ii. The impact of the revised Master Plan requirements on work out to tender or under approvals review.
- iii. The impact of the revised Master Plan requirements on areas under design or currently undersigned.

Issues (i) and (ii) are essentially the same and concern mitigation measures for installing the minimum protected revetted edge onto the existing shoreline profile.

Table 13.1 sets out the status (as at February 2001) of shoreline works and recommended mitigation measures.

Table 13.1: Current Status of Shoreline Works and Recommended Mitigation Measures (as of February 2001)

LAKE 1A			LAKE 1B		
Area	Mitigation Work To Existing		Area	Work Designed or Out to Contract	
	Hard Edge	Soft Edge		Hard Edge	Soft Edge
	Drg	Drg		Drg	Drg
I. Works Completed			I. Works Completed		
1. Precinct 1 – Government	N/A	13.5/13.6	1. Precinct 2 – Commercial	N/A	13.5/13.6
2. Precinct 8a – Residential	N/A	13.5/13.6	2. Precinct 8a – Residential	N/A	13.5/13.6
3. Precinct 10 – Residential	N/A	13.6/13.7(B)	3. Precinct 16 – Residential	N/A	13.5/13.6
4. Precinct 16 – Residential	N/A	13.5/13.6	4. Precinct 17 – Residential	13.3/13.4	13.5/13.6
II. Works Designed/Awaiting Approval To Proceed			II. Works Designed/Awaiting Approval To Proceed		
1. Precinct 12 – Residential			1. Precinct 3 – Civil & Cultural	N/A	13.5/13.6
			2. Precinct 4 – Commercial	13.3/13.4	13.5/13.6
			3. Precinct 5 – Commercial	13.3/13.4	13.5/13.6
			4. Precinct 17 – Residential	13.3/13.4	13.5/13.6
			5. Precinct 18 – Residential		13.5/13.6
			III. Concept Plan/Undersigned		
			1. Precinct 17 - Residential	13.3/13.4	13.5/13.6
			2. Precinct 19 – Residential	ALL	ALL
			3. Cyberjaya Shoreline	N/A	13.7(A)

13.4 NEW LAKESHORE EDGE TREATMENTS MASTER PLAN AND EDGE TYPOLOGY GUIDELINES

Drawing 13.2 depicts the proposed New Lakeshore Edge Treatments Master Plan.

Typology guidelines for various forms of lake edge treatment are set out in Drawings as follows:

- | | |
|----------------------|---|
| Drawing 13.3 | Typical Formal Edge Treatments (Full Height Vertical Wall and Steps, Lower Promenade & Vertical Wall) |
| Drawing 13.4 | Typical Formal Edge Treatments (Boardwalk and Steps & Terraces) |
| Drawing 13.5 | Typical Basic Lake Edge Rock Revetment Profiles |
| Drawing 13.6 | Standard Protected Edge Variations |
| Drawing 13.7 | Soft Edge Guideline |
| Drawing 13.8 | Bank and Shoreline Variation Zone |
| Drawing 13.9 | Headland Promontory Edge Variations |
| Drawing 13.10 | Typical Promontory Plan |
| Drawing 13.11 | Headland Promontory Variation |
| Drawing 13.12 | Sand and Pebble Beach |
| Drawing 13.13 | Boat Launching Beach |

Where areas are under design or undersigned, designs should be amended/reviewed consistent with the revised shoreline Master Plan and the Edge Typology Guidelines. In these situations the minimum shoreline protection details outlined on Drawings 13.5 and 13.6 should be applied. Further enhancement should be at the detailed designers discretion.

For those areas currently under design there is also an opportunity to vary the shoreline location to create promontories within a 15m zone between the edge of the 20m promenade and the outer edge of the submerged bench as detailed on Drawing 13.8. Within this zone there is also the opportunity to create promontories or boulder revetted protected edges as detailed on Drawing 13.9, 13.10 and 13.11.

13.5 LAKE EDGE PLANTING

Appropriate lake edge planting can enhance landscape interest and variety, soften the aesthetic impact of revetted water edges, and assist in reducing the risk of erosion to soft edges by stabilising banks and attenuating wave action.

Marginal and aquatic species appropriate for Putrajaya lake edge planting are detailed in the following **Table 13.2**.

Table 13.2: Suitability Guideline for Marginal and Aquatic Plants

Plant Species	Common Name	0.3-1.8m Above the Normal Waterline	Fringe/Water Margin	0-0.3m Average Water Depth	0.3-0.6 Average Water Depth	0.6-1m and Greater Water Depth
Trees, Palms and Large Shrubs						
<i>Alstonia spatulata</i>	Pulai		✓	✓		
<i>Cyrtostachys renda</i>	Sealing Wax Palm	✓				
<i>Dellinia suffruticosa</i>	Simpoh Ayer	✓				
<i>Eugenia aqua</i>	Kelat		✓			
<i>Eugenia longifolia</i>	Kelat		✓			
<i>Ficus microcarpa</i>	Jawi Jawi	✓				
<i>Koompassia malaccensis</i>	Kempas	✓	✓			
<i>Melaleuca cajupute</i>	Gelam		✓			
<i>Pandanus helicopus</i>	Rassau/Screw Pine		✓	✓		
<i>Pometia pinnata</i>	Kasai	✓				
<i>Saraca thaipingensis</i>	Yellow Saraca		✓			
<i>Shorea platycarpe</i>	Shorea	✓				
Reeds, Grasses, Sedges and Tubers						
<i>Alocasia macrorrhiza</i>			✓			
<i>Colocasia osculentum</i>	Keladi		✓	✓		
<i>Colocasia gigantla</i>	Keladi	✓	✓			
<i>Crinum asiaticum</i>	Bakong	✓	✓			
<i>Cyperus alternifollus</i>			✓	✓		
<i>Cyperus hafpan</i>	Para Air		✓	✓		
<i>Eleocharis dulcis</i>					✓	
<i>Eleocharis variegata</i>			✓	✓		
<i>Eriocaulon longifollum</i>	Rumput Butang		✓	✓		
<i>Fimbristylis globulosa</i>	Rumput Sadang			✓		
<i>Fimbristylis millacea</i>	Rumput Tahl Kerbau		✓	✓		
<i>Fuirena umbellata</i>	Rumput Kelutut		✓	✓		
<i>Hanguana malyana</i>					✓	✓
<i>Lepironla articulata</i>	Rumput Kercut					✓
<i>Ludwegia suffruticosa</i>					✓	
<i>Phillybrum lanuginosum</i>			✓	✓		
<i>Phragmites Karka</i>			✓	✓	✓	
<i>Scirpus grossus</i>	Rumput Menderong				✓	✓
<i>Scirpus mucronatus</i>	Rumput Kumbah				✓	✓
<i>Thalia geniculata</i>	Water Canna			✓		
<i>Typha angustifollum</i>					✓	✓
Submerged with Anchored Leaves						
<i>Nelumbo nucifera</i>	Teratai/Lotus				✓	✓
<i>Nymphaea pubescens (Pink)</i>	Telepok				✓	✓

13.6 MAXIMUM LAKE BED LEVEL FOR SATISFACTORY NAVIGATION CLEARANCE

A maximum lakebed level of EL 17.4m is indicated to provide adequate navigation clearance throughout the main lake system generally (i.e. beyond the constraints of the normal edge profile), and within areas closer to the lake edge at vessel berthing facilities.

This level is derived from a presumed low water level of EL 19.8m, less allowance for vessel draught of 1.4m, with clearance between the underside of such a boat or its propellers of 1.0m.

At 1.0m clearance between the underside of a vessel and the lake bed allows for:

- i. some margin of safety in the case of unexpectedly larger vessels;
- ii. siltation which might occur in some instances on the lake bed; and
- iii. adequate depth between the lake bed and vessel propellers to minimise the mobilisation of silts with consequent surface turbidity as a result of propeller turbulence.

A maximum bed level of EL 17.4m also provides 3.6m of water depth at the lake's Standing Water Level of EL 21.0m. This is a minimum desirable depth to limit light penetration to the bed and growth of aquatic plants. A warm tropical lake environment will be generally conducive to plant growth on the bed but undesirable from lake management and navigation aspects.

Adoption of an appropriate seasonal low water level for determining the navigational clearance relative to the lakebed level requires careful consideration. A level for this purpose should correspond to the low water level expected under drought conditions at an average return period no less than 1 in 5 years. The determination of this low water level needs to take into account the effects of drought season stream inflows; evaporation; extraction from the lake for irrigation or any water recirculation through the upstream wetland system which might be necessary in drought circumstances to maintain its well being; seepage beneath the dam; and any requirements for the controlled release of water from the lake as compensation flow to the downstream Sg. Langat system.

13.7 LAKE EDGE TREATMENT CONSTRUCTION METHODOLOGIES

The present non-inundated condition of the lower Lake 1B area facilitates economical construction of lake edge treatments in the dry.

While proposed edge treatments at the perimeter of Lake 1A could be carried out from the shore and/or with the use of a barge, it is suggested that consideration be given to more economical and precise construction in the dry in accordance with the following methodology:

- i. Construction of a by-pass channel around the existing temporary Lake 1A dam or through the impounding Lake 1A embankment on the east side of the Core Island, to facilitate/controlled lowering of Lake 1A by approximately 1.3m by release of water into the Lake 1B area.
- ii. The timing for lowering of Lake 1A to be co-ordinated with the construction and inundation programme for Lake 1B.

14.0 INTEGRATED LAKE USE MASTER PLAN

Drawing 14.1 contains the Integrated Lake Use Master Plan which brings together on plan the various aspects of spatial lake use control applicable to all envisaged water based activities.

Segments of the Integrated Lake Use Master Plan have been combined with land use at a higher level of detail in the following Drawings:

Drawing 14.2	Precincts 12 & 13
Drawing 14.3	Precincts 1, 8A & 10
Drawing 14.4	Precincts 1, 2, 16, 17 & 18
Drawing 14.5	Precincts 17 & 18
Drawing 14.6	Precincts 4 & 19
Drawing 14.7	Precincts 4, 5 & 6
Drawing 14.8	Precincts 2, 3 & 7

PART D

PUTRAJAYA LAKE NAVIGATION MASTER PLAN

15.0 LAKE BATHYMETRY RELEVANT TO NAVIGATION

15.1 BACKGROUND

As indicated in Section 13.5, a maximum lakebed level of EL17.4m is suggested to provide adequate navigation clearance throughout the main lake system generally, providing for a water depth of 3.6m at the lake standing water level of EL21.0m.

15.2 LAKE 1A BATHYMETRY

Hydrographic survey has recently been undertaken by Pelorus Services for the presently inundated Lake 1A area, the results of which are illustrated on **Drawing 15.1**.

It can be seen from Drawing 15.1 that most of the lake body is within the depth range of 3.0m to 4.0m or deeper, with a significant exception being the area immediately south and southwest of the Prime Minister's Residence which is in the range of 2.0m to 3.0m in depth.

This hydrographic survey data is reformatted in **Drawing 15.2** to identify areas of lakebed above and below the suggested maximum level for general navigation of EL17.4m, and also areas above and below EL18.0m, identifying areas for safe navigation at a reduced minimum depth of 3.0m at the standing lake water level.

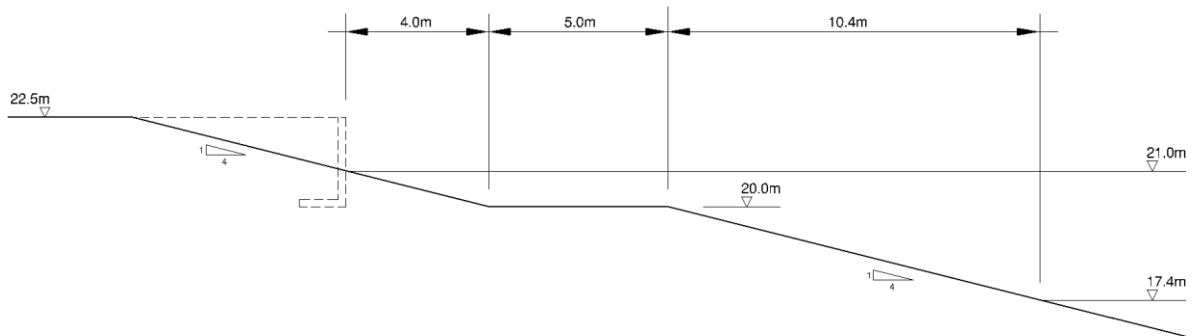
The plans on Drawing 15.2 highlight the greater navigable area at a reduced lakebed clearance of 3.0m and again indicate constraints to navigation in the vicinity of the Prime Minister's Residence.

The Lake 1A area above Bridge 10 comprises Lake Use Management Zone 3, in which only authorised tour boats and cruise boats would be permitted to operate - the Prime Minister's Residence and the weir below the Central Wetlands being envisaged as points of interest for such operations. These vessels would be of shallow draught, and with appropriate navigation aids traffic can be safely directed around the eastern edge of the more shallow area near the Prime Minister's Residence.

15.3 LAKE 1B BATHYMETRY

As indicated in Section 4.2.4 the landform around the shoreline of the Lake 1B area has generally been engineered to create a uniform edge profile as depicted in **Figure 15.1**.

Figure 15.1 - Lake 1B Typical Edge Profile



On the basis of the typical Lake 1B edge profile, the suggested minimum navigation depth of 3.6m is assured at a distance of approximately 20m from the water edge.

Earthworks construction of the lake arm between Putrajaya Precinct 7 and Cyberjaya, designated as Lake Use Management Zone 6 is currently under construction, and although we are advised that water depths within this area will be shallow, no more quantitative information is currently available. Edge profiles and lake bed levels will be required to complete the picture of Putrajaya Lake navigational bathymetry based on as-constructed survey prior to lake inundation.

16.0 VESSEL DESIGN / PERFORMANCE CRITERIA**16.1 BACKGROUND**

As summarised in Section 10.0, a wide variety of watercraft will operate within the Putrajaya Lake system in conjunction with some periods of high recreational lake usage.

In general, the majority of powered boats on Putrajaya Lake will fall within the following categories:

- i. *Small Powered Boats*, most generally being utilised for public hire.
- ii. *Powered Leisure Boats*, being larger vessels catering for hire by groups and for corporate or official use.
- iii. *Commercial Recreation Boats* used for parasailing, water-skiing and other commercial water recreational activities.
- iv. *Ferries* which are sometimes also referred to as water taxis or water buses and which operate a scheduled service between dedicated ferry terminals for the use of commuters, and by tourists moving between locations of interest.
- v. *Tour Boats* which would primarily cater to tourists in providing a tour of the lake with commentary on its features and areas of special interest.
- vi. *Cruise Boats* catering for large groups and capable of providing meal service.

The waterways are relatively narrow in some locations and in close proximity to noise sensitive residential land uses. Certain areas of soft edge treatment will be sensitive to excessive wave generation by passing boats.

All bridges spanning reaches of the lake have a clear height of 8m or more above the standing water level of EL 21.0m, with the exception of the Putra Bridge which has a clear height of only 5 metres. All bridges to the south and west of the Core Island provide wide clear spans for navigation. The Putra Bridge incorporates three more limited navigable spans of 25m each, while Bridges 1 and 4 east of the Core Island provide clear spans of 33.5m and 28m respectively, which are adequate for navigation but more restrictive for large vessels than the western bridges.

It is proposed that vessel design and performance criteria be developed to ensure that all vessels permitted to operate on Putrajaya Lake satisfy objectives of the Lake Use and Navigation Master Plans, particularly in regard to:

- i. Safety for all users of the lake;
- ii. Minimal noise nuisance;
- iii. Minimal effects of boat wake upon other lake users and the shoreline;
- iv. Minimal motor exhaust emissions; and
- v. Low, managed risk of water pollution as a consequence of fuel spills etc.

16.2 SMALL POWERED BOATS

It is envisaged that small powered boats will be available for public hire on a self drive basis for leisure outings and fishing, ranging in length from 3.5m to 5m with a maximum occupancy of 6 persons.

Within the Central Wetlands *Zone 2: Controlled Access Tranquil Recreation Zone*, it is proposed that any powered boats be limited to electric motors with a maximum speed of 4 knots.

Within the primary lake, the potential operating range of small powered boats is significantly greater than within the Central Wetlands Zone 2 waterbody.

Power options for motorised small craft within the primary lake include:

- i. Electric motors (preferred); or
- ii. Modern 4 stroke engines satisfying the most stringent international marine engine exhaust emission standards.

With further Research and Development it is technically feasible to convert small marine engines for use of gas fuel - either LPG or compressed natural gas (CNG), however it is not recommended that such innovations be pioneered for Putrajaya.

It is proposed that small powered boats on the primary lake be speed limited to 6 knots.

Based on the above performance criteria, the maximum permissible motor size for small powered boats should be 9.9 hp.

16.3 PERFORMANCE CONSIDERATIONS FOR HIGHER SPEED AND LARGER VESSELS

16.3.1 Applicable Vessel Categories

Powered leisure vessels, ferries and tour boats, by virtue of their size and speed potential are subject to some common performance considerations, as outlined below.

16.3.2 Wake, Wash and Shoreline Considerations

Boat wake is a reaction to the resistance in the water created by vessel movement. The components of boat wake are the visible wash which occurs on the surface of the water and a pressure wave, which depending on its magnitude may be converted to a destructive wash upon reaching an adjacent shoreline. While some hull designs may significantly minimise boat wash, not all so effectively minimise the effect of pressure waves.

Wash characteristics experienced at the shoreline will depend on a number of factors, including:

- i. The wash generated by a vessel (which will itself depend on factors such as hull size and form, vessel loading as it affects displacement, vessel speed and operating water depth);
- ii. Vessel distance from the shore; and
- iii. The physical transformation of waves as they approach the shoreline due to refraction, diffraction, shoaling and friction (itself dependent on factors such as bed profile, wave period, angle of approach and distance from the travelling vessel).

Wash becomes most significant when a vessel operates at “critical” speed. Critical speed represents the maximum wave resistance and results in the maximum wake generation.

For boats with a planing hull design, critical speed occurs in the transition from displacement to planing operation. Accordingly, operating at critical speed should be avoided. Also for planing hulls, a significant wake is created as the vessel drops off the plane into its displacement mode. The management of boat wash created in dropping off the plane is largely a matter of operating discipline, to ensure that slowing through the critical speed occurs well away from other lake users.

Both advanced hull design and operational controls can be used to prevent unacceptable wake generation.

Powered leisure boats, ferries and tour boats to be operated on Putrajaya Lake should be required to demonstrate that their design (by reputable and comprehensive model testing) or proven operating performance, have acceptable wake (wash and pressure wave) characteristics at, and between, all normal service speeds.

16.3.3 Speed Considerations

For a given situation, critical speed depends on both vessel speed and water depth.

Table 16.1 shows the critical speed applicable to a range of water depths, together with speeds corresponding to 75% and 125% of the critical speed. It is desirable, if possible for vessels to operate at speeds below 75% of critical speed or greater than 125% of critical speed to minimise discomfort to other water users and shoreline impacts.

Table 16.1 - Critical Vessel Speeds at Varying Water Depths

Water Depth (m)	Critical Speed (Knots)	75% of Critical Speed (Knots)	125% of Critical Speed (Knots)
3.0	10.6	8.0	13.3
3.5	11.4	8.6	14.3
4.0	12.2	9.2	15.3
5.0	13.6	10.2	17.0
6.0	14.9	11.2	18.6

This table suggests that vessels within Putrajaya Lake should be operated at speeds less than about 9 knots or faster than about 15 knots.

Broadly, the selection of maximum permissible speeds must include consideration of:

- i. Safety for all water users;
- ii. Amenity and peaceful enjoyment of the waterways; and
- iii. Protection of the physical environment.

It is considered that vessel speeds to a maximum of 20 knots would be satisfactory within Putrajaya Lake, subject to vessels meeting other critical design and performance criteria.

16.3.4 Vessel Noise

A number of factors contribute to the occurrence and characteristics of noise emitted from watercraft, including:

- i. vessel type (small powered boat, speed boat, large powered leisure boat, cruise boat, ski boat, jetski);
- ii. vessel design (engine type, propeller type, etc);
- iii. type of vessel exhaust (above water or below water);
- iv. vessel speed;
- v. vessel activity (passing, turning, taking-off, towing skiers, or trick manoeuvres such as wake jumping);
- vi. vessel engine maintenance (poorly maintained engines may produce more noise);
- vii. number of vessels passing at the one time (cumulative effect);
- viii. water slap (speed boats and jet skis can skip at fast speed causing the hull to slap on the water); and
- ix. boat wake which slaps against the hulls of other boats.

The intensity of sound is inversely related to the square of the distance from the source. Thus for each doubling of distance from the source, the intensity of sound is reduced by one quarter.

The sound intensity level is a logarithmic function measured in decibels (dB).

World Health Organisation recommended noise exposure limits are set out in **Table 16.2**.

Table 16.2 - WHO Recommended Noise Exposure Limits

Recommended Noise Exposure Limits (dB(A))	Remarks
Less than 75 (8-hr exposure per day)	No identifiable risk of hearing damage. Higher levels at prolonged exposure cause hearing impairment and loss.
Less than 45 (background noise)	For good speech intelligibility indoor.
55 or less	Desirable daytime outdoor noise levels which will not likely cause annoyance in community.
45 or less	Desirable night-time outdoor noise levels.
35 or less (bedroom noise limit)	No likelihood of sleep disturbance.

Noise guideline standards for the Multimedia Super Corridor derived from existing Department of Environment guidelines limit noise levels within residential areas to 50dB(A) during the day and 40dB(A) at night-time.

Assuming a minimum clear separation of 60m between any significant noise generating vessel and residential areas near to the lake, the maximum permissible sustained vessel sound level at its source would be 85dB in order to satisfy a 50dB noise exposure limit at the closest edge of any residential area.

It should also be recognised in precinct planning that noise travels in straight lines, and intervening landscape vegetation can significantly attenuate the transmission of sound from the lake to residential areas.

In Australia, the Queensland Government's noise regulations with reference to power boats, state that the noise from the engine or exhaust of a power boat is reasonable if it is not intrusive in a habitable room of an affected noise sensitive place after 7:00 pm and before 7:00 am. It is worth noting that the CityCat ferry service operating on the Brisbane River in Queensland and the RiverCat service operating on the Parramatta River in Sydney are much quieter than, say, a bus or truck at a given distance.

No major problems are foreseen in setting achievable design/performance standards for suitably quiet vessels.

16.3.5 Air Quality

It is envisaged that emissions from marine engines would be required to comply with the standards of air emissions for diesel and petrol engines as prescribed in the *Environmental Quality (Control Of Emissions From Diesel Engines) Regulations 1996* and the *Environmental Quality (Control Of Emissions From Petrol Engines) Regulations 1996*, respectively.

Reference to the European regulations governing maximum exhaust emissions for diesel engines is becoming increasingly common in the public transport sector. With the use of low sulphur fuel, diesel powered vessels should be able to comply with the stringent Euro III emission standards.

Clean fuels, such as natural gas and electricity should be encouraged within Putrajaya. The experience and technology exists to convert heavy, medium and light duty diesel engines to 100% gas fuelled, involving closed loop, lean burn computer control operation, with no reduction in fuel efficiency.

16.3.6 Stopping and Manoeuvrability

Having regard to the shared use of waterways, powered leisure vessels, ferries and tour boats will need to operate safely particularly in terms of emergency stopping distances and manoeuvrability.

While it is difficult to attempt to specify stopping and manoeuvrability criteria in quantifiable terms, the Brisbane CityCats incorporate an emergency propeller shaft brake which is claimed to be able to stop these vessels travelling at a speed of 20 knots within their own 25 metre boat length.

16.3.7 Water Draught

A maximum lakebed level of EL 17.4 metres has been proposed, presuming a low water level of EL 19.8 metres, less allowance for vessel draft of 1.4 metres, with clearance between the underside of such a boat or its propellers of 1.0 metres.

16.3.8 Air Draught

A maximum air draught of 7.5 metres will provide for safe navigation beneath all bridges spanning Putrajaya Lake with the exception of the Putra Bridge for which a safe air draught of 4.5 metres is applicable.

16.4 POWERED LEISURE BOATS

It is envisaged that power leisure boats will range in length from 5m to 13m with passenger capacities of between 5 and 20 persons.

Powered leisure boats may be displacement or planing vessels, with a significant proportion likely to be capable of planing at the maximum proposed speed of 20 knots.

Powered leisure boats would be owned by public and private corporations and by Boat Clubs, in all cases being registered for operation within Putrajaya Lake. Certain powered leisure boats may be available for self-drive hire by individuals holding appropriate boat licences, and would otherwise be available through Boat Clubs for charter with a skipper, by private or corporate groups for sightseeing tours, fishing or general outings on the lake.

Engine sizes for powered leisure boats will depend upon the size, hull form and speed characteristics of each vessel, but are likely to be in the approximate range of 80 hp to 200 hp.

16.5 FERRY AND TOUR BOATS

It is envisaged that during Putrajaya's early years, the functions of ferries and tour boats may be combined within a single operation, providing a limited commuter service to and from residential catchments and workplaces during peak hours; and more significantly, a transport service for visitors to Putrajaya between one point of interest to another as well as the tourist option for a complete circuit tour. Vessels could operate with an informative commentary on places of interest during the non-peak hour periods of commuter use.

Subject to demand, the functions of ferries and tour boats could ultimately be separated, with vessels tailored to suit the particular requirements of each operation.

Key attributes for ferry and tour vessels operating within the confines of Putrajaya Lake include:

- i. Low wake characteristics;
- ii. Low noise characteristics;
- iii. High standard of exhaust emissions;
- iv. Ability to operate within water and air draught constraints;
- v. High levels of comfort, amenity and visibility;

- vi. High levels of manoeuvrability;
- vii. High standards of safety in emergency situations;
- viii. Efficient berthing and passenger loading and unloading at terminals;
- ix. Speed capability to achieve optimum travel times;
- x. Efficient hull design to minimise fuel costs and wake generation; and
- xi. Efficient passenger occupancy.

The ferry service circuit depicted on Drawing 14.2 involves a distance of approximately 15 km.

As an indication of travel time and excluding en-route terminal stops, a full circuit would take approximately 25 minutes at a constant speed of 20 knots. Allowing for an average passenger loading and unloading time of 2 minutes at each of the eventually, proposed 12 terminals, together with reduced terminal approach and departure speeds and some areas of speed limitation, it is anticipated that a full lake circuit would take approximately 60 minutes at an unrestricted service speed of 20 knots.

On this basis, two vessels would be required to achieve 30 minutes intervals between same direction ferries. Additional ferries would be required to provide services in a counter direction.

The following general design/performance criteria specific to an initially combined ferry and tour boat service on Putrajaya Lake are envisaged.

i. **Principal Dimensions**

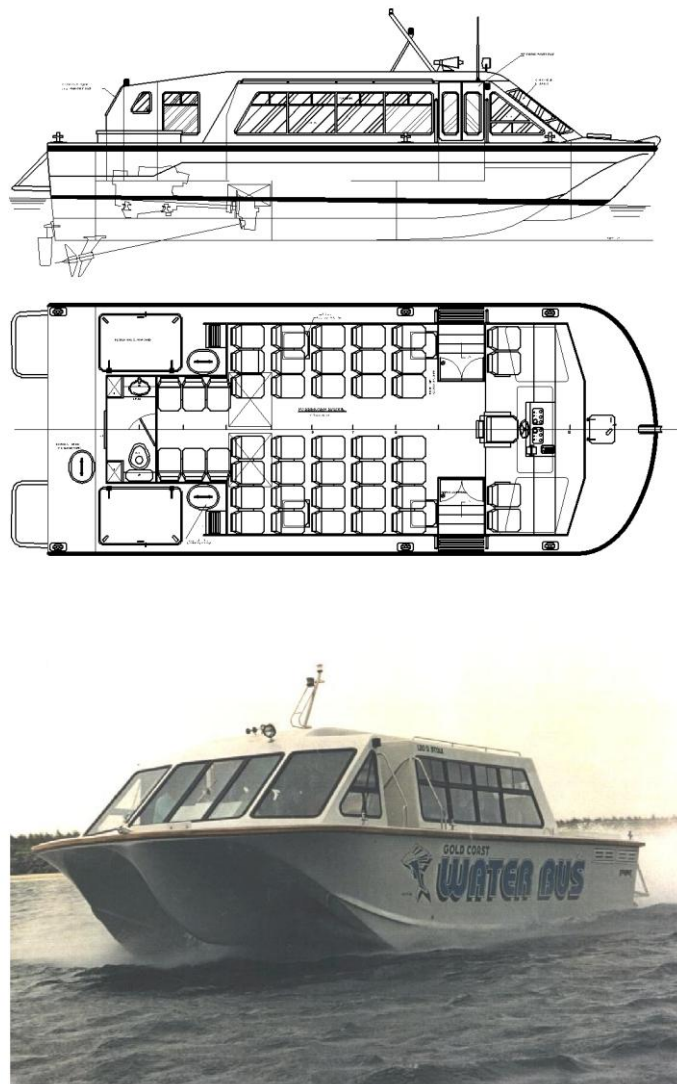
- Overall length: approx. 12-13m
- Breadth: max 5 metres
- Water draught loaded (including propulsion): max 1.4m
- Air Draught: max 4.5m

ii. **Passenger Capacity: 40-50 persons**

iii. **Service Speed: max 20 knots**

Details of an indicative ferry style are illustrated in **Figure 16.1**.

Figure 16.1 - Indicative Ferry/Tour Boat Style (11.3m Stolcraft Water Bus)



16.6 CRUISE BOATS

In addition to the service provided by ferries and tour boats, it is likely that there will ultimately be a significant market for more elegant and formal cruises on Putrajaya Lake to cater for special functions such as visiting corporate or government dignitaries, including meal service.

Also, dinner cruises on Putrajaya Lake would be particularly attractive with the lights and reflections of various areas of intense waterfront development and floodlit landmark architectural features. Cruises would generally return to the original point of departure with perhaps one intermediate stopover at an en-route attraction. The marina within Precinct 5 is proposed to be the home base for cruise boats. The indicative marina layout shown on **Drawing 11.5** includes a cruise boat terminal with berthing for up to four vessels.

PART D
PUTRAJAYA LAKE NAVIGATION MASTER PLAN

Vessels appropriate to cruise services would be of relatively low speed displacement design, with passenger carrying capacities of approximately 100 or more, designed to maximise viewing opportunities for patrons.

The following general design/performance criteria applicable to cruise boats operating on Putrajaya Lake are envisaged:

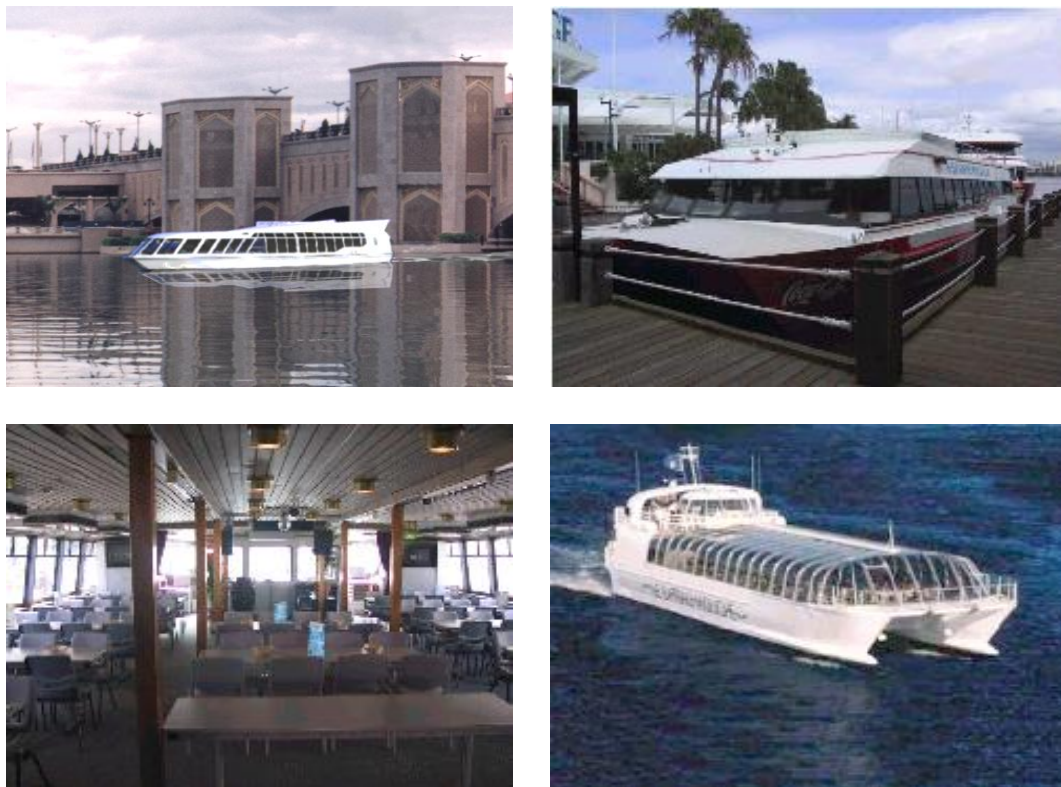
i. **Principal dimensions**

- Overall length: approx max 25m
- Breadth: approx max 8m
- Water draught loaded: max 1.4m

ii. **Passenger capacity** 100 - 150 seating capacity

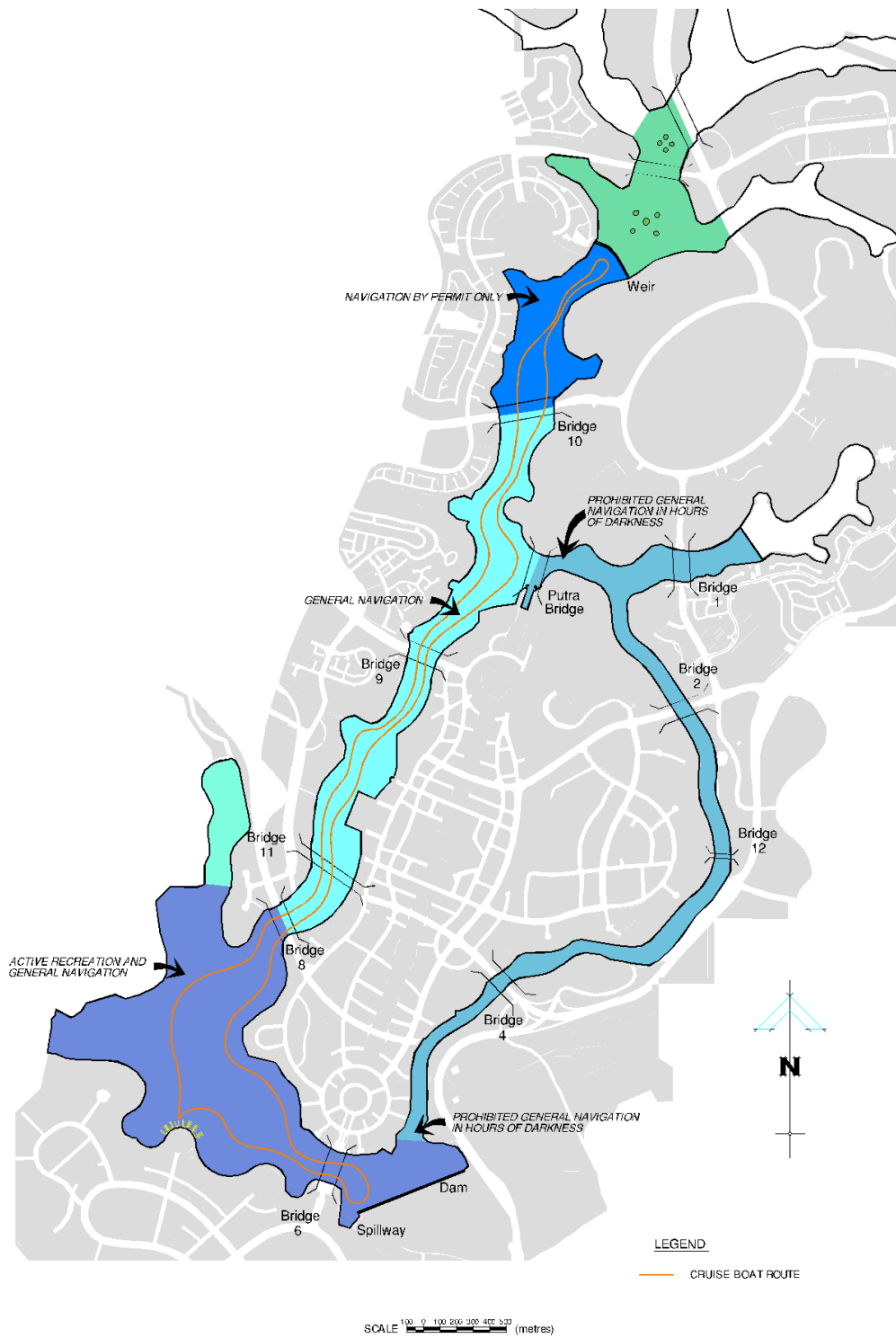
Indicative cruise boat styles are illustrated in **Figure 16.2**.

Figure 16.2 - Indicative Cruise Boat Styles



A possible route for cruise boat tours departing from the cruise boat terminal at the Precinct 5 Aquatic Recreation Centre marina is depicted on **Figure 16.3**. The length of this route is 14.9 kilometres, resulting in a cruise time of 1¾ hours at an average speed of 5 - 6 knots.

Figure 16.3 - Indicative Cruise Boat Tour Routing



Perhaps more than any other lake activity, cruise boats represent an opportunity to stamp a “trade-mark” of style for Putrajaya on its single most significant landscape asset. Cruise boat designs may be nostalgic, cultural, fun or high-tech, but in all instances they should also be elegant and functional. In particular, cruise boats may offer the opportunity to showcase state-of-the-art marine technologies of relevance to Malaysia and in keeping with the modern and environmentally conscious themes of Putrajaya.

Figure 16.4 depicts the first commercial *Solar Sailor* which features four sources of power: solar, wind, battery and a back-up LPG gas generator that can operate alone or in combination.

Figure 16.4 - Innovative High-Tech Cruise Boat Design



Fully loaded with 100 passengers, the 21m long *Solar Sailor* has a service speed of 5 knots on solar power alone, and 10-12 knots on LPG

16.7 CATEGORISATION AND SPECIFICATION OF POWERED BOATS

Table 16.3 summarises information contained in Section 10.0 regarding the categorisation of watercraft, and preceding discussion under Section 16.0 in regard to the preliminary specification of categories of powered boats, together with additional operational remarks.

Table 16.3 - Categorisation and Preliminary Specification of Powered Boats

BOAT TYPE	SPECIFICATION	OPERATIONAL REMARKS
1. Small Powered Boats	<ul style="list-style-type: none"> ● Length: below 5m ● Preferably Electric Motorised (only electric for Central Wetlands) ● 4 stroke petrol (preferably fuel-injection) satisfying stringent emission standards ● 9.9 hp maximum ● Speed limited to 6 knots maximum (4 knots for Central Wetlands) 	Boats registered by Perbadanan Putrajaya or Boat Association. Basic Training Requirement - Boat Operators' Course. Details of prerequisites for training and licensing to be provided in Stage 2.
2. Powered Leisure Boats	<ul style="list-style-type: none"> ● Length: 5m - 13m ● Electric, Gas or 4 stroke petrol motor (preferably fuel-injection) satisfying stringent emission standards ● Nominally 80 hp - 200 hp ● Speed 20 knots maximum 	Boats registered by Perbadanan Putrajaya. Full Training Requirement - Helmsman Course. Helmsman/Skipper to hold valid Licence (requirements to be prepared in Stage 2).
3. Commercial Recreation Boats	<ul style="list-style-type: none"> ● Length: nominally 6m - 9 m ● 4 stroke petrol motor (preferably fuel-injection) satisfying stringent emission standards ● 200 - 300 hp ● Speed 25-30 knots in deep water within designated areas 	Boats registered by Perbadanan Putrajaya. Commercial activity under strict licencing control by Perbadanan Putrajaya. Full Training Requirement - Helmsman Course. Helmsman/Skipper to hold valid Licence (requirements to be prepared in Stage 2). Pre-requisites for training and licencing to be prepared in Stage 2.

PART D
PUTRAJAYA LAKE NAVIGATION MASTER PLAN

BOAT TYPE	SPECIFICATION	OPERATIONAL REMARKS
4. Ferries and Tour Boats	<ul style="list-style-type: none"> ● Length: 12m to 13m ● Capacity: 40 - 40 passengers ● Gas, diesel or 4 stroke petrol engines satisfying stringent safety and emission standards ● Nominally up to 250 hp ● Propulsion: waterjet or propeller ● Speed 20 knots maximum 	<p>Boats registered by Perbadanan Putrajaya. Boat Specification - stringent design and performance criteria to be prepared in Stage 2. Full Training Requirements - Helmsman Course. Pre-requisites for training and licencing to be provided in Stage 2.</p>
5. Cruise Boats	<ul style="list-style-type: none"> ● Length: 25m maximum ● Gas or diesel satisfying stringent safety and emission standards ● Nominally up to 600 hp ● Propulsion: waterjet or propeller ● Speed 9 knots maximum 	<p>Boats registered by Perbadanan Putrajaya. Boat Specification - design and performance criteria to be prepared in Stage 2. Full Training Requirements - Helmsman Course. Pre-requisites for training and licencing to be provided in Stage 2.</p>
6. Marine Police and Emergency Response Boats	<ul style="list-style-type: none"> ● Length: nominally 6m - 7.5m ● 4 stroke petrol motor (preferably fuel-injection) satisfying stringent emission standards ● 200 - 300 hp ● Speed up to 30 knots 	<p>Special training requirements to be formulated in Stage 2.</p>
7. Lake Maintenance Vessels	<ul style="list-style-type: none"> ● Subject to special purpose functions and design ● Speed 9 knots maximum 	<p>Vessels registered by Perbadanan Putrajaya. Full training requirement - Helmsman Course. Helmsman/Skipper to hold valid Licence (requirements to be prepared in Stage 2).</p>

16.8 STAGE 2 TECHNICAL DESIGN / PERFORMANCE SPECIFICATION

The Stage 2 scope of work will further define technical design/performance parameters for ferry and tour boat vessels including more detailed specifications covering the complex issues of wake generation, as well as power and performance, survey, certificates, quality control, launching, trials and commissioning, structural specifications, outfitting, pumping and piping, deck equipment, navigation and communication's equipment, safety equipment, electrical systems, machinery, and instrumentation.

17.0 PRELIMINARY SCHEMATIC DESIGN OF WATER BASED FACILITIES

17.1 BACKGROUND

Preliminary schematic designs have been prepared for principal water based facilities as a useful reference for more detailed precinct planning and future detailed design of individual development sites that incorporate such facilities.

In particular, these preliminary schematic designs, read in conjunction with the proposed New Lake-shore Edge Treatments Master Plan set out in Drawing 13.2, are important in providing guidance in regard to earthworks variations necessary to the standard lake edge profile at various facilities.

17.2 FERRY AND TOUR BOAT TERMINALS

Drawings 17.1 and 17.2 depict ferry and tour boat *Type One* and *Type Two* proposals respectively.

The *Type One* option which is generally preferred, allows for close berthing to the lake edge. This is considered more aesthetically desirable and less likely to create obstruction to navigation which could occur in the case of the *Type Two* berthing arrangement.

As a public transport facility, all pedestrian ramps and gangways are designed to satisfy criteria applicable to wheelchair access.

It is envisaged that within non-commercial centres, ferry terminals will facilitate a commuter service for local residents within easy walking distance and may also serve as a minor transit centre with provision for a bus stop, taxi rank, drop off and pick up zone, as well as limited Short Term and Long Term Parking.

There should be discretion applied to the requirements of such facilities having regard to land use and land based transport facilities at each terminal location.

At commercial centres, which would generally operate as destinations for ferry passengers, dedicated parking is not envisaged, although the detailed planning of such precincts should take account of pedestrian movements to and from ferry terminals, the proximity of land based transit and tour bus facilities particularly in regard to tourists, and the availability of public toilets etc.

Drawing 17.3 illustrates a possible arrangement for ferry terminal landside facilities at non-commercial centres, incorporating provision for sheltered waiting, toilet amenities; a bus stop, taxi stand, bicycle parking and short and long term car parking.

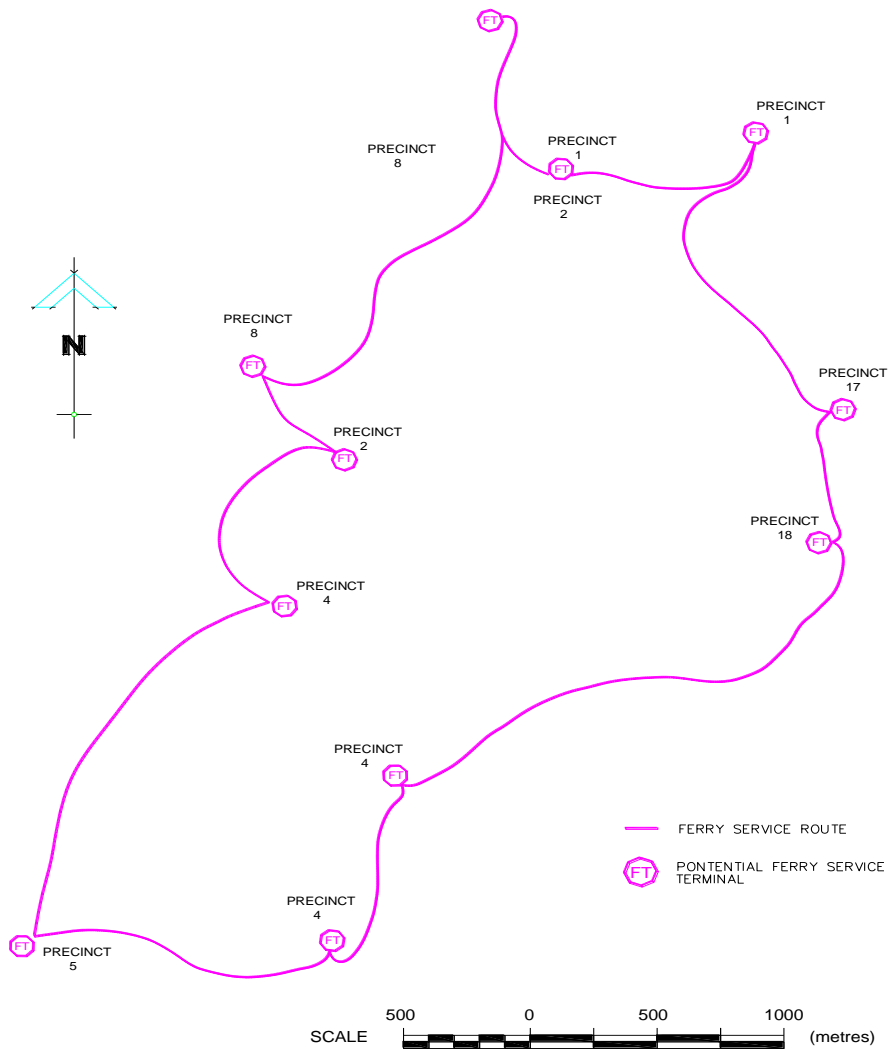
The landside facility as depicted occupies an area of 0.3ha behind the 20m wide public promenade.

The rationale behind the illustrated arrangement of landside terminal facilities is as follows:

- i) In general, it is anticipated that ferry terminals adjacent to residential precincts will attract pedestrian ridership from an immediate catchment defined by a radius of approximately 350m.
- ii) Short Term Parking facilitates waiting by cars to collect ferry passengers, e.g. for passengers who would normally walk to and from their home but might be collected from the ferry terminal in the event of wet weather; and for passengers living beyond a convenient walking distance who may also arrange to be dropped off and collected by car.
- iii) The provision of Short Term Parking and Long Term Parking increases potential ridership by widening the catchment. The indicative layout illustrated in **Drawing 17.3** provides 17 Short Term Parking spaces and 20 Long Term Parking spaces plus 3 extra spaces for Disabled Parking. These are suggested to be minimum provisions where any form of transit facility is justified.
- iv) The demand for Long Term Parking can be regulated by parking charges if and when appropriate.
- v) To some extent it is likely that the number of Long Term Parking spaces will be a limiting factor to increased ferry ridership, however in general it is not intended to promote ferry transport as a commuter service in competition with the public transport infrastructure already committed in the form of bus and monorail services. Nevertheless, in some instances additional Long Term Parking may be justified.
- vi) Because these landside ferry terminal facilities are applicable to predominantly residential areas, provision for tour bus parking is not generally appropriate. It is considered preferable that interfacing between tour buses and ferries/tour boats should occur at areas with specific tourist amenities and provision for tour bus parking, such as terminals at Precinct 5, the south east corner of Precinct 4, Precinct 2, and the Putra Bridge between Precincts 1 & 2.

The location and designation of ferry terminals is indicated in **Figure 17.1**.

Figure 17.1 - Schematic Ferry Service Routing



A checklist of support facilities appropriate to each ferry terminal is set out in **Table 17.1**.

Table 17.1: Checklist for Ferry and Tour Boat Terminal Support Facilities

NO	FERRY TERMINAL	PRECINCT	LANDUSE CATEGORY	SUPPORTIVE FACILITIES										REMARKS
				Public Toilet	Car Parking	Road Access	Lighting & Power Points	Bicycle Racks	Bus / Taxi Drop-off	Waiting Area	Ticketing Vendor Machine	Kiosk	Public Telephone	
1.	FT1	Precinct 1	Putra Bridge	✓	As per existing	As per existing	✓	✗	As per existing	✓	✓	✓	✓	
2.	FT2	Precinct 1	Linear Park	✓	As per existing	As per existing	✓	✗	✗	✓	✓	✗	✓	
3.	FT3	Precinct 17	Local Centre	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	Generally as per Drawing 17.3
4.	FT4	Precinct 18	Local Centre	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	Generally as per Drawing 17.3
5.	FT5	Precinct 4	Residential	✓	Nominal	✓	✓	✓	✗	✓	✓	✓	✓	
6.	FT6	Precinct 4	Park (Khazanah Quay)	✓	✗	✗	✓	✗	✗	✓	✓	✓	✓	To be incorporated within Quay Design
7.	FT7	Precinct 5	Public Amenities	✓	✓	✗	✓	✗	✓	✓	✓	✓	✓	To be incorporated within waterfront design
8.	FT8	Precinct 4	Lake Front Park	✓	✗	✗	✓	✗	✗	✓	✓	✓	✓	To be incorporated within waterfront design
9.	FT9	Precinct 2	Park (Persisir Warisan)	✓	As per existing proposal	As per existing proposal	✓	✗	As per existing proposal	✓	✓	✓	✓	To be incorporated within waterfront design
10.	FT10	Precinct 8	Local Centre	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	To be incorporated within waterfront design
11.	FT11	Precinct 8	Utility Reserve Adjacent to Boat Club	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	To be shared with Boat Club

PART D
PUTRAJAYA LAKE NAVIGATION MASTER PLAN

17.3 CASUAL BERTHS

In addition to ferry and tour boat terminals, provision has been made for a number of casual berthing facilities to be located at strategic locations throughout the lake system to cater for occasional special berthing needs and to provide opportunities for casual berthing at key destinations.

The locations of proposed casual berths (C) which would be owned and managed by Perbadanan Putrajaya, as well as a restricted number of private casual berths (PC), are indicated on **Drawing 17.4** and in **Table 17.2**.

Table 17.2: Casual Berth Location

NO.	CASUAL BERTHS	PRECINCT	LANDUSE CATEGORY	REMARKS
1.	C1	Precinct 1	Floating Café	As per Existing Proposed
2.	PC1	Precinct 16	Deputy Prime Minister's Residence	As per Existing Proposed
3.	C2	Taman Wawasan	Canal Work	As per Existing Proposed
4.	C3	Taman Wawasan	Taman Wawasan Hotel	Current Proposed
5.	C4	Precinct 18	Local Centre (Commercial)	As per Existing Proposed
6.	C5	Precinct 19	Lake Maintenance and Services Centre	Current Proposed
7.	C6	Precinct 5	Promenade Café	As per Existing Proposed
8.	C7	Precinct 5	Hotel Development	As per Existing Proposed
9.	C8	Precinct 4	Special Event and Lakeside Spectators Management Centre	Current Proposed
10.	C9	Precinct 4	Sanctuary Park	As per Existing Proposed
11.	C10	Precinct 7	Central Administration and Emergency Response Centre	Current Proposed
12.	C11	Precinct 3	Orchard Park	As per Existing Proposed
13.	C12	Precinct 2	Lake Management And Administrative Centre	Current Proposed
14.	C13	Precinct 2	<i>Persisir Warisan</i>	As per Existing Proposed
15.	C14	Precinct 2	Formal Stately Promenade	As per Existing Proposed
16.	C15	Precinct 8a	Local Centre (Commercial)	As per Existing Proposed
17.	PC2	Precinct 8a	<i>Istana</i>	As per Existing Proposed
18.	C16	Precinct 8	Boat Club	As per Existing Proposed
19.	PC3	Precinct 10	Prime Minister's Residence	As per Existing Proposed

A typical casual berth arrangement including earthworks benching is illustrated on **Drawing 17.5**.

Because casual berths are not public transport facilities, the design requirements in regard to gangway slopes for wheelchair access do not apply, and hence the length of perpendicular gangway protrusion is considerably less than for the corresponding *Type Two* ferry terminal arrangement.

Casual berths do not particularly require associated landside facilities or additional land take.

17.4 MARINA

Schematic design details of the proposed Precinct 5 marina are illustrated on **Drawings 17.6 and 17.7**.

The appropriate mix of Precinct 5 marina berth sizes will require market analysis prior to design, however as the marina is likely to be developed in stages, flexibility can be built into the planning to enable the overall mix of berth sizes to be adjusted in later stages of construction to accord with the experience of actual market demand.

Design and selection of the floating marina system should ensure the provision of a state-of-the-art facility in regard to: stability, durability, longevity, aesthetics and maintenance costs.

Having regard to Malaysia's climatic conditions, it is recommended that consideration be given to the provision of a tensile roofing structure providing sun and rain shelter for smaller open boats likely to be accommodated within the western portion of the marina.

17.5 DAM SPILLWAY ACCESS CONTROL BOOM

It is proposed to prohibit all lake use activities in the immediate vicinity of the dam spillway for the purpose of public safety.

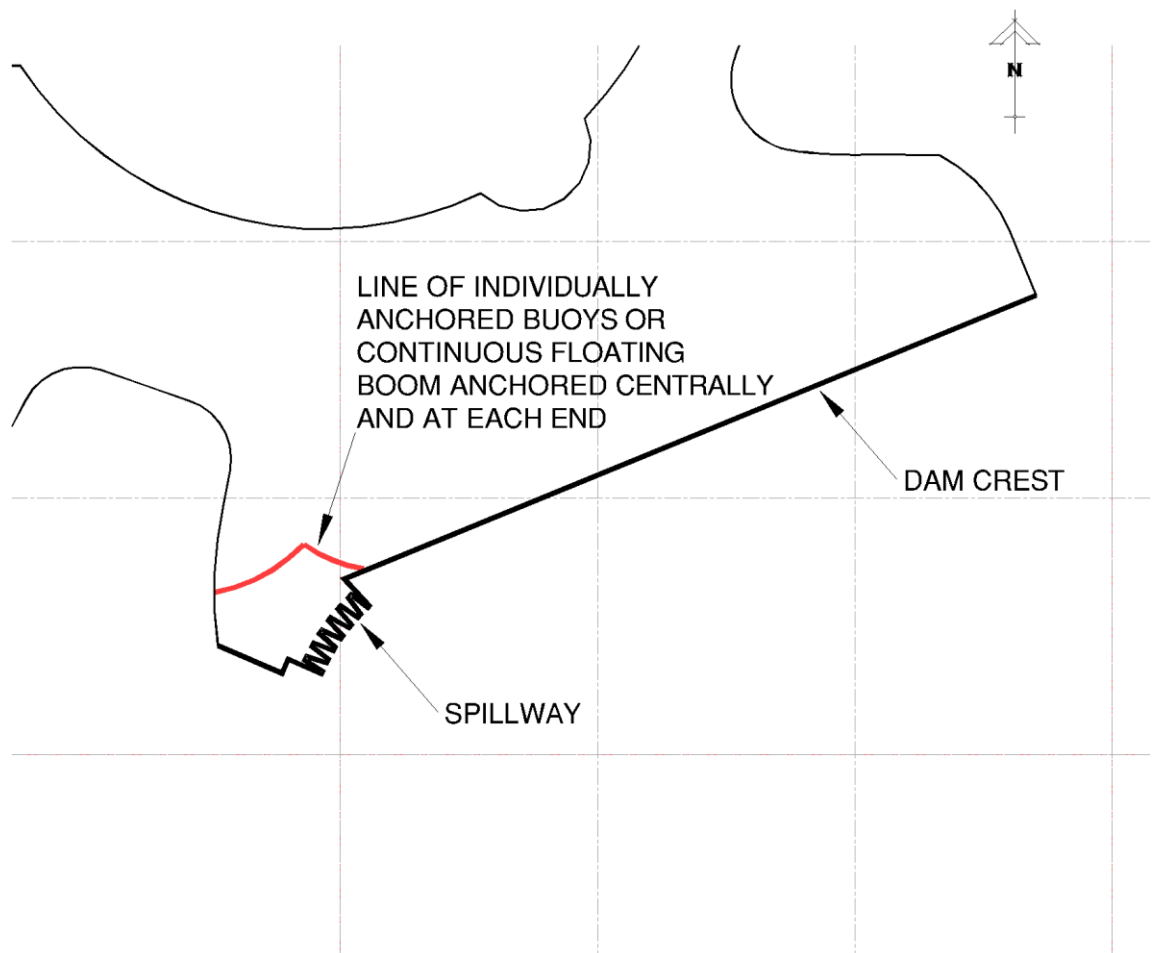
As a deterrent to unauthorised boating access in proximity of the spillway, it is proposed either to individually anchor a series of buoys to demarcate a line of prohibited access; or alternatively to deploy a continuous boom comprising premium grade floats, ropes and buoys, securely anchored to the shoreline at each end and to the lake bed at a central point.

PART D
PUTRAJAYA LAKE NAVIGATION MASTER PLAN

An option also exists to incorporate a proprietary full depth polyethylene net into the design of the access control boom, with a view to prevent the loss of fish stock and fingerlings from the lake over the dam spillway, as a consequence of certain fish species following their natural tendency to migrate downstream. A net of similar size has been in operation for several years on Lake Tinaroo, in Queensland, Australia.

The indicative configuration of a spillway access control boom, subject to hydraulic review by the dam engineers, is illustrated in **Figure 17.2**.

Figure 17.2 - Indicative Spillway Access Control Boom Configuration



18.0 PUTRAJAYA LAKE NAVIGATION CONSIDERATIONS

18.1 BACKGROUND

Navigational use of Putrajaya Lake offers opportunities for enhanced lifestyle, recreation, tourism, transport and an extra dimension of vibrant activity and style for a city of national and international significance. However, navigation must be carefully planned and managed to ensure safety for all users of the lake, to preserve its environmental attributes and to safeguard full enjoyment of the lake for all sections of the community.

Considerations relevant to lake navigation include the following:

- i. **Lake use planning** to minimise conflicts between various water activities and between water activities and land uses, as covered under Part C.
- ii. **Lake “carrying capacity”**, as discussed in Section 6.7, as a means to ensure that the quality of lake enjoyment is not compromised by over-use.

Recreational and commercial activities within the lake generate navigational and environmental issues. Maintaining the eminence and features of Putrajaya Lake and in tandem providing quality recreational capacity is vital. To accomplish and maintain the quality recreational *space standards* have been provided, which provides the maximum number of use (recreational & commercial) units in the available lake space at any one time thus providing ‘satisfactory’ performance to the users.

In the planning of facilities for the primary lake under Sections 11.0 and 12.0, an indicative provision has been made for the future berthing of approximately 170 vessels within a floating marina and dry stack storage, which equates to a navigable space of approximately 2 ha per boat (excluding the area of Lake Use Management Zone 3).

This space allocation compares with approximate water area requirements ranging from 0.2 ha/vessel to 0.6 ha/vessel as set out in the Putrajaya *Volume 3 User Guidelines, December 1999, Table 3.6.1* derived from Donald Adie, *MARINAS - A Working Guide to Their Development and Design, 1984*.

Comparisons with other inland waterways indicate that Putrajaya Lake will be able to sustain a level of activity commensurate with likely demands for usage of the water body.

Section 6.7 provides comparison details made of the waterways of the Gold Coast in Australia which is similar in form and size (almost equivalent both water surface area and length of shoreline) to Putrajaya Lake.

Although the environmental issues may differ as the Gold Coast has unrestricted access and downstream (seaward) compared to constrained limitations of water body in Putrajaya Lake, the inadequacies have been accounted for. Moreover, not all activities are to take place at any one time. The management and regulatory control (to be developed in Stage 2 – Navigation Management Plan) will ensure that the quality of water in the Lake is preserved.

In any event, the growth of boating on Putrajaya Lake is likely to be slow and related also to progressive growth in the city's population. As it is also proposed that the introduction of boats to Putrajaya Lake be strictly regulated by Perbadanan Putrajaya, there will be ample opportunity to monitor and control the level of boating activity.

To start-off daily boating activities, it is strongly recommended that the following strategy (table 3) on the number of watercrafts acceptable in the lake be adhered to:

Table 18.1 : Recommended Boat Numbers

No.	Type	Number
1.	Cruise, Tour & Ferry	Not More Than 5
2.	Motorised Boats (Excluding Ppj Boats)	Not More Than 30
3.	Sailing Boats (Motorised Sailing Boats Classified As Motorised Boats)	Not More Than 50
4.	Non-Motorised Water Sports Crafts (Dinghy, Kayaks, Canoes Etc.)	Not More Than 150

*NOTE - not all activities will take place simultaneously.

An observation period of at least 12 months is to be allowed for stabilization of the water activities in the lake before further recommendation made to increase the utilization number of water crafts.

- iii. **Provision of suitable supporting infrastructure and landside facilities** as covered under Part C and Section 17.0 of Part D.
- iv. **Control of vessel types, design and performance** as covered under Section 16.0, to ensure their compatibility with the physical and environmental characteristics of Putrajaya Lake and its surrounding land uses.
- v. **Navigational aids, markers and signage** as addressed in Section 18.2.
- vi. **Education, regulation, surveillance and policing** in relation to navigational safety; pollution and nuisance; and commercial boating operations; as discussed in Section 18.3.
- vii. **Training of navigation management and commercial marine operations personnel and private lake users** is essential to ensure that staff directly involved in all levels of management and marine operations, as well are appropriately competent in all relevant aspects of navigation. A brief is set out in Section 26.0 for the formulation of Training Programs and Standards, which is to be undertaken as part of the Stage 2 component of this study.
- viii. **Emergency response trained personnel, landside facilities, vessels and equipment** including a highly efficient communications system will be required to respond to emergency lifesaving and other public safety situations as well as circumstances of property and environmental hazard, notwithstanding effective programmes of public education and navigation staff training to minimise the risk of emergency circumstances.

Emergency response infrastructure will also play a significant role in the surveillance and policing of navigation operations and in providing support services for major lake events.

An assessment of risks to be addressed in the management of Putrajaya Lake activities and attributes is contained in Section 27.0, as a prelude to the formulation of an Emergency Response Plan which is to be undertaken as part of the Stage 2 component of this study.

18.2 NAVIGATIONAL AIDS, MARKERS AND SIGNAGE

Navigational markers and signage in a variety of forms will be required to provide information and guidance for lake users and for regulation purposes.

Some navigational lighting will also be required to facilitate safe operation by certain authorised vessels during hours of darkness.

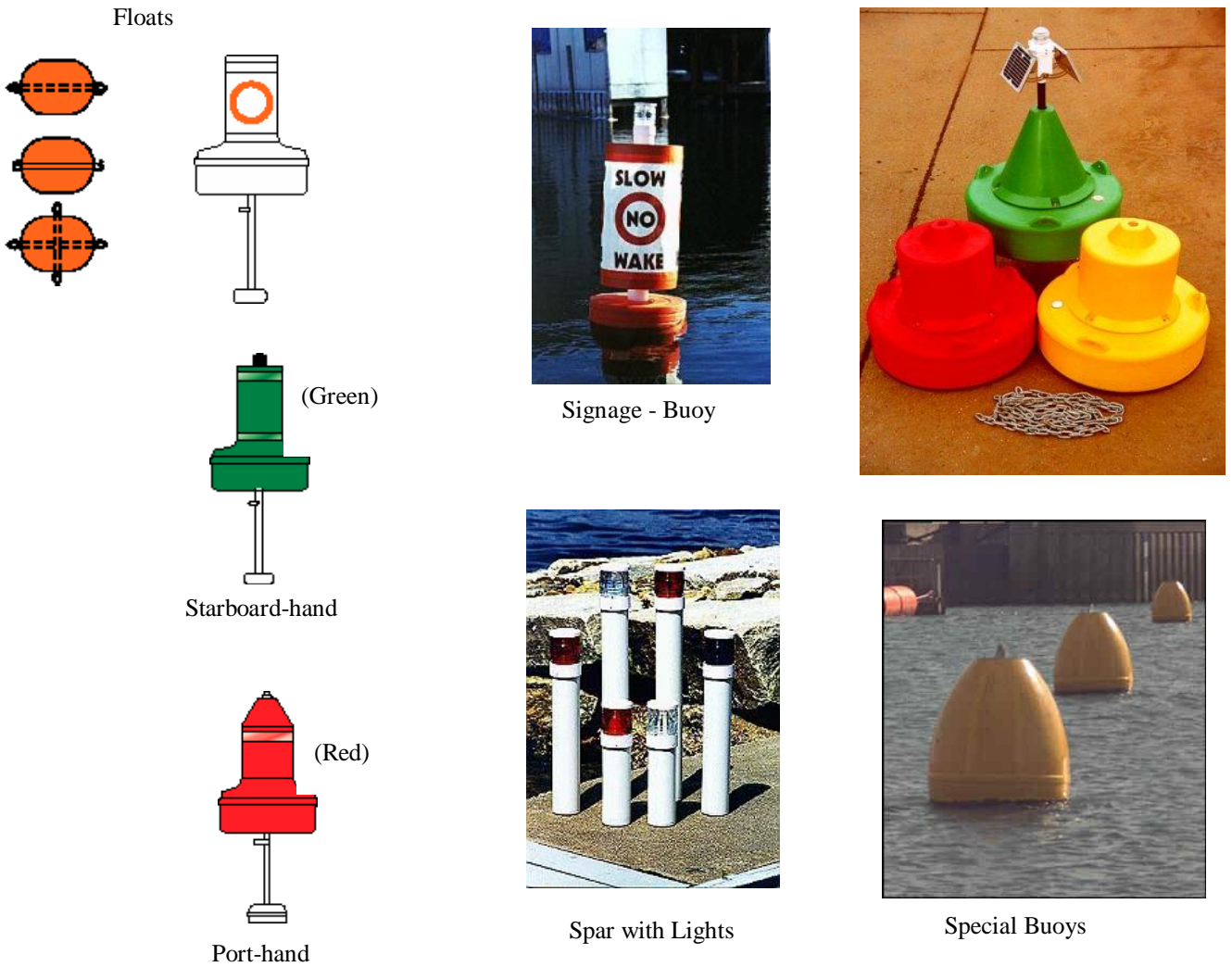
While the lights of buildings and structures along the shoreline can aid navigation in the hours of darkness by generally delineating the water's edge; glaring and gleaming effects due to reflection and mirroring when observed from the water body can inhibit the identification of navigation signage and markers as well as other boats in the vicinity. The diminished ability to distinguish other watercraft as a result of background lights poses a risk to navigation in the hours of darkness.

Specific lighting guidelines in relation to flashing, glare, light trespass, sky glow, light colours and light luminosity will be required. Numerous characteristics and colours of lights for markers, buoys and beacons are used to avoid ambiguity and shore light interference.

Navigational lighting must also be designed to minimise nuisance light pollution of surrounding land development.

Examples of navigational aids and lighting are illustrated in **Figure 18.1**.

Figure 18.1 - Examples of Typical Navigational Aids and Lighting



Some principles and examples of navigational markers and signage are set out in **Figure 18.2**.

Figure 18.2 - Principles and Examples of Markers and Signage

Regulatory Markers

Regulatory or informational markers are used to advise of situations, dangers, or directions. They may indicate hazards, swim areas, speed zones, etc.



Controlled Area:

Type of control is indicated in the circle, such as slow, no wake, anchoring, etc.



Danger:

The nature of danger may be indicated inside the diamond shape, such as rock, wreck, shoal, dam, etc.



Boat Exclusion Area:

Explanation may be placed outside the crossed diamond shape, such as dam, rapids, swim area, etc.



Information:

For displaying information such as directions, distances, locations, etc.

Signage



Swimming
Dibenarkan
Berenang



No swimming
Tidak Boleh
Berenang



Diving
Dibenarkan
Menjunam



No diving
Tidak Boleh
Menjunam



Boat launch
Tempat Lancar
Bot



Motor boating
Bot Berinjin



Row boating
Bot Kayuh



Sail boating
Bot Layar



Position fixing aids may be required at specific locations ashore and in the water to enable watercraft to establish their position. Also electronic navigation aids and instruments, e.g. GPS and magnetic compass, may be appropriate for certain vessels.

A navigation chart should be prepared both in hard/paper and digital/soft copy to provide all information necessary for safe navigation within Putrajaya Lake, including details of navigation markers, lighting and relevant signage.

The digital/soft copy of the navigation chart could also be employed in an Electronic Chart Display Information System as part of the Integrated Navigation Management System.

18.3 EDUCATION, REGULATION, SURVEILLANCE AND POLICING

Resources will be required to provide education, regulation, surveillance and policing in regard to the following navigational issues.

i. Safety

Safety issues include:

- Preparation and dissemination of “Rules of the Road” (Collision Regulations) appropriate to Putrajaya Lake and in accordance with international conventions, as well as public education in regard to their use.
- Provision of safety equipment on boats, marine facilities and also at strategic shore locations, and education of operations personnel and the general public in their use.
- Meteorological monitoring and broadcasting of weather forecasts and warnings for the information of lake users. This could include the provision of navigational warning signals displayed at strategic locations.

ii. Pollution and Nuisance

Public education strategies should be developed to raise the awareness and concern of lake users regarding pollution risks to the water, air and foreshores, as well as respect for the rights of others on water and land to enjoy the lake without the nuisance of excessive noise, pollution or irresponsible behaviour by the drivers or passengers of boats.

iii. Commercial Boating Operations and Special Lake Events

Regulations and management procedures must be established to co-ordinate and manage the activities of commercial boating operators on Lake Putrajaya, and the staging of special events that impact upon lake navigation.

Codes of Practice should be separately developed for General Safe Boating, Public Transport Operators, Commercial Recreational Operators, and major water sports activities such as Rowing.

Commercial recreational operations such as water skiing, parasailing, towed rides, etc; public transport operations including ferries, tour boats and cruise boats; and special lake events; all involve a strong duty of care in regard to public safety by Perbadanan Putrajaya to strictly administer the licencing of commercial operators and event organisers and to monitor their performance.

Continuous surveillance and monitoring of activities will be necessary to ensure that lake navigation activities satisfy the performance objectives of the Lake Use and Navigation Master Plans.

Surveillance and monitoring measures could include:

- i. Visual surveillance from vessels and strategic on-shore locations.
- ii. CCTV images - motion pictures via cameras located strategically on buildings and structures such as bridges.
- iii. Radar - workstation images.
- iv. Automatic Identification System - involving devices attached to vessels which provide positional information of target (GPS etc) upon signal interrogation.
- v. Communication and Security Network - VHF/Walkie-Talkie communication and Security Network Grid.
- vi. System Status and Alarms.
- vii. Meteorological forecasting.
- viii. Environmental monitoring system employing sensors at critical locations within the lake.

18.4 RECOMMENDATION

The management and regulatory control shall be developed to facilitate PPJ with a comprehensive management tool to ensure that the quality of water in the Lake is preserved.

Stage 2 development of Navigation Management Plan is deemed necessary to provide PPJ with management framework, approach, modus operandi and systems to effectively manage the overall activities in the Putrajaya Lake. This covers the operational planning and integrated management of Lake Use, Navigation, Training Programmes and Standards, and Emergency Response Plan. The emphasis will be on the creation of a user-friendly integrated management system of asset monitoring and, navigational and emergency aspects of Putrajaya Lake.

The management practices and procedures include:

- i. Reduce navigation conflicts and conflicts between competing uses;
- ii. Reduce destructive behaviour of lake users;
- iii. Increase the durability of lakefront recreational activities;
- iv. Site management – control of boats in the lake, permits and licensing, hours of operation;
- v. Regulating public behaviour – zoning conflicting uses, site use rotation, restriction on group numbers, reservation system (software), exclusive club membership privileges, recreational and sports association privileges and Putrajaya residents.

19.0 STAGE 2 INTEGRATED NAVIGATION MANUALS**19.1 TERMS OF REFERENCE**

In accordance with the Consultancy Brief, the proposed Stage 2 Scope of Work includes the preparation of an Integrated Navigation Manual, intended to define in more detail guidelines for effective implementation and management of lake navigation, and to produce an information resource for the education of lake users. The proposed scope of work relating to the Integrated Navigation Manual is outlined below.

19.2 LAKE BATHYMETRY

A simplified representation of detailed hydrographic survey recently undertaken within the Putrajaya Lake Phase 1A is discussed in Section 15.2. The hydrographic survey data indicates several large areas and a number of isolated locations providing less than optimum navigational depth. It is not evident from available information as to whether the existing lakebed reflects levels of earthworks construction prior to inundation, or whether they are the result of subsequent siltation due to high levels of sediment run-off during the course of earthworks within upstream catchments.

In the event that some areas of relatively shallower depth are the result of post-inundation sedimentation, these areas may be prone to re-suspension of silts with consequent adverse water turbidity effects as a result of boating traffic, particularly in drought periods when lake water levels are reduced and less navigation clearance is available.

It is therefore proposed that additional survey together with lake bed sampling and testing be undertaken to better assess the need for any lakebed dredging or excavation in order to ensure that navigation can be undertaken safely and without adverse environmental disturbance.

It will also be highly desirable to facilitate the input of navigational expertise into the current earthworks construction programme for the Phase 1B lake area to avoid future problems in relation to proposed lakeside facilities and general navigation and to ensure that all relevant as-constructed survey data is acquired prior to inundation.

19.3 LAKE NAVIGATION CHART

Upon finalisation of Lake Phase 1B earthworks, a lake navigation chart will be produced incorporating the general information contained within the Lake Navigation Master Plan together with details of all necessary navigation aids, markers and signage, in both hard/paper and digital/soft copy, both approved and certified by the Hydrographer of the Navy. This chart will become the definitive navigational reference for Putrajaya Lake.

19.4 GENERAL NAVIGATION HANDBOOK FOR LAKE USERS

A General Navigation Handbook will be prepared as an instrument for public education providing general guidelines in relation to:

- “Rules of the Road” (collision rules) including instruction in regard to navigation aids, markers and signage.
- Proper equipment and crewing, covering safety equipment, crew orientation, emergency procedures and dangers of alcohol.
- Safe boat operation covering licencing, weather alerts, persons overboard, preparing children for boating, boating accidents and licencing.
- Prevention of pollution and nuisance.

This handbook will constitute a lake user’s Code of Ethics and Code of Safe Boating Practice.

19.5 NAVIGATION MANAGEMENT MANUAL

The Putrajaya *Volume 3 - Lake User Guidelines* do not provide sufficient detail in regard to the process, procedures and mechanisms involved for effective management of lake navigation.

The Lake Navigation Management Manual will provide a comprehensive set of guidelines for the implementation and management of all aspects of Putrajaya Lake navigation, for reference by Perbadanan Putrajaya.

Proposed components of this Manual are set out in **Table 19.1**, including reference to the need or otherwise for guidelines that are modified or additional to the existing Lake User Guidelines.

Table 19.1 - Proposed Components of Stage 2 Lake Navigation Manual

Guidelines	Existing	Proposed	Modification Required
a) Vessel Design/Performance Criteria for each Category and Type of Boat (as also outlined in Section 16.8)			
i. Length - max permissible	✓		✓
ii. Width	✓		✓
iii. Water draft - max permissible		✓	
iv. Air draft - max permissible		✓	
v. Capacity (no. of passengers)		✓	
vi. Hull type		✓	
vii. Wake generation		✓	
viii. Speed	✓		✓
ix. Manoeuvrability		✓	
x. Propulsion system		✓	
xi. Engine system - horse power, fuel, safety, noise, exhaust emissions	✓		✓
xii. Classification		✓	
xiii. Survey requirements		✓	
b) Legal Requirements			
i. Boat registration	✓		✓
ii. Identification number		✓	
iii. Competency requirements		✓	
iv. Insurance cover	✓		
v. Operator/lake user responsibilities	✓		✓
vi. Safety equipment - personal floatation devices, navigation lights, extinguishers, sound signals, pollution regulations	✓		✓
vii. Recommended equipment - noise limits, environmental protection		✓	
viii. Inspection of boats		✓	
ix. Fees	✓		✓
c) Operational Requirements			
i. Putrajaya Lake Code of Ethics & Code of Safe Practice (Boating)	✓		✓
ii. Navigation rules - definition, boatmanship, sound signals, rules of the road, meeting, crossing & overtaking		✓	
iii. Designated navigation routes		✓	
iv. Approach guidelines (Kawalan Pelayaran)		✓	
v. Safe distance - lake edges, dam, boats, navigation aids		✓	
vi. Safe speed - (Zone orientated) wake, noise minimisation		✓	
vii. Aids to navigation - markers, lights, buoys, booms		✓	
viii. Signage - statutory, information & warning signals on land		✓	

PART E
PUTRAJAYA LAKE MANAGEMENT

Guidelines	Existing	Proposed	Modification Required
ix. Non-motorised (water sports & water based recreation) - sailing, kayaking, rowing, canoeing, row boating	✓		✓
x. Motorised - small powered boats, leisure boats, commercial recreational vessels, ferries, tour boats, cruise boats, Water Police and Emergency Response boats		✓	
xi. Berthing & Unberthing		✓	
xii. Anchoring		✓	
xiii. Competition & training - water based recreational activities		✓	
xiv. Watersports - zoning, markings		✓	
xv. Fishing		✓	
xvi. Storage locations	✓		✓
xvii. Maintenance schedule		✓	
xviii. Environmental - scheduled wastes & sewage disposal, drainage systems for service area run-off	✓		✓
xix. Emergencies - accidents/collision, grounding, man overboard, fire, etc		✓	
xx. Restrictions and prohibitions		✓	
xxi. Lighting		✓	
d) Boat Preparations			
i. Check lists		✓	
ii. Trailing		✓	
iii. Launching ramps		✓	
iv. Awareness of environmental conditions		✓	
v. Preventative maintenance		✓	
vi. Fuelling		✓	
e) Special Considerations			
i. Dam & weirs		✓	
ii. Wetland/Fish Habitat sectors		✓	
iii. Water level		✓	
iv. Restricted security areas/zones		✓	
f) Special Water Based Activities			
i. Permits & approvals	✓	✓	✓
ii. Races, displays, regattas		✓	
iii. Scuba diving, snorkelling, underwater activities		✓	
iv. International Events		✓	
g) Accidents			
i. Accident Reports		✓	
ii. Assistance from Shore		✓	
iii. First Aid		✓	
iv. Emergency Situations		✓	
v. Rendering Assistance		✓	

19.6 SUPPLEMENTARY CODES OF PRACTICE

In addition to the General Navigation Handbook as outlined in Section 19.4 which would serve as an instrument for general public education, and the guidelines as outlined in Section 19.5 which are to be incorporated in the Navigation Management Manual to serve as a comprehensive reference for Perbadanan Putrajaya, it is also proposed that the following separate codes of practice be prepared for reference by Perbadanan Putrajaya and particular categories of lake users:

- i. Code of Practice for Public Transport Operators
- ii. Code of Practice for Commercial Recreational Operators
- iii. Code of Practice for Lake Events
- iv. Code of Practice for Rowing
- v. Code of Practice for Foreshore and Boat Fishing

20.0 INTEGRATED LAKE NAVIGATION MASTER PLAN

Drawing 20.1 contains the Integrated Lake Navigation Master Plan which brings together on a plan general guidelines developed in Part D in relation to spatial aspects of navigation within the Putrajaya Lake system.

It should be recognised that this drawing contains information only at a master planning level of detail. The definitive reference for lake navigation will be the Putrajaya Lake Navigation Chart, to be prepared in Stage 2 as outlined in Section 19.3.

PART E
PUTRAJAYA LAKE MANAGEMENT

21.0 MANAGEMENT VISION

The Vision for management of Putrajaya Lake encapsulates management goals which in turn shape the outcomes to be achieved as Putrajaya develops and matures. The Vision directs the management strategies that will be implemented to resolve issues and deal with problems that may arise.

Components of the Vision as set out in **Table 21.1** relate to important areas of environment, culture, lifestyle and waterways administration and co-ordination.

Table 21.1 - The Vision for Putrajaya Lake Management

THE VISION	OUTCOMES TO BE ACHIEVED
1. A Healthy Eco-system	<ul style="list-style-type: none"> • Protection of the national and international significance of Putrajaya's functions and values. • Maintenance of water quality and ecological functions of the lake system.
2. Supporting the development of Putrajaya as a commercially vibrant urban entity	<ul style="list-style-type: none"> • Opportunities to enhance the icon value and cultural significance of Putrajaya Lake including water based festivities and national and cultural celebrations. • Opportunities for responsible water based tourism. • Opportunities for responsible commuter and tourist waterborne transport.
3. Lifestyle	<ul style="list-style-type: none"> • Opportunities for responsible recreational uses, including boating and associated water sporting and leisure activities.
4. Collaboration between community, government and commerce.	<ul style="list-style-type: none"> • Cooperative planning and management to achieve optimum outcomes.

22.0 MANAGEMENT ISSUES**22.1 MANAGEMENT FRAMEWORK**

Putrajaya Lake will have a range of values to the community including:

- i. *National Administrative Centre symbolism.* Putrajaya Lake will be one of the most identifiable features of the national Administrative Centre and is central to the design of Putrajaya symbolically and physically. Putrajaya Lake will be in harmony with the landscape and the backdrop of hills, providing a peaceful and serene setting to many buildings and monuments of national significance as well as many spectacular bridge structures. The lake and associated features will also provide a backdrop for public spectators and for televised media coverage of major events and national celebrations.
- ii. *Recreational values.* The lake and its foreshore will constitute one of Putrajaya's most important recreational resources for both informal activities and organised sport. Recreational and sport uses of the lake are likely to include boating, rowing, canoeing, swimming, triathlons and fishing, while foreshore parks will be popular for picnicking, walking, wheel chair access, jogging, cycling, roller skating, roller blading, cross country running, orienteering and foreshore fishing. The lake will provide the setting for many special events of a recreational nature.
- iii. *Tourism and commercial development values.* Lake Putrajaya will be a major tourism attraction in its own right and as a consequence of the beauty, interest and symbolism of its foreshore development. Commercial lake tours will offer a unique and memorable opportunity to view and be informed about building icons such as the mosque, the Prime Minister's Department, the Prime Minister's residence and various other symbols of Federal Government. There is potential for commercial ferry service operations conveniently conveying people between work and home and there are opportunities for other commercial development and activities, particularly associated with tourism.
- iv. *Ecological values.* Putrajaya Lake will be a significant aquatic ecosystem, its ecological values being identified particularly with fisheries, water bird habitat and the full ranges of plant and animal species contributing to its wetlands, perched lakes and main lake environments.
- v. *Educational and scientific values.* The natural, cultural and nationally symbolic features of the lake and its foreshores will be of educational interest to the community at large, as well as for formal teaching by educational institutions. The lake system also presents real opportunities for education and research into fresh water eco-systems.

- vi. *Water resource management values.* The lake system will have an important role in water resource management, particularly in the control of water quality and also as a source of water for landscape irrigation and, to a limited degree, in flood management.

22.2 WATER QUALITY MANAGEMENT

Effective management of water quality within the Putrajaya Lake system can only be achieved in the context of an integrated approach to total catchment planning and management, involving co-ordination with all agencies responsible for landuse, development, stormwater flows and waste discharges.

The Putrajaya Lake system, including its upstream wetlands, will promote the settlement of suspended material, uptake of nutrients and die off of micro-organisms as water flows through the lake. The quality of water will generally improve in moving down the lake and water uses that are most sensitive to water quality are hence best located in the lower reaches of the lake.

The water quality objectives for the management of Putrajaya Lake and the monitoring of achievement of these objectives will be based on the principle of locating uses in zones of appropriate water quality. Thus areas managed as aquatic habitat are located particularly at inlet zones high in suspended solids, nutrients and organic matter necessary to sustain the high productivity of these eco-systems, while swimming areas are located in zones of low bacterial numbers, consistent with the protection of public health.

Water quality management issues include:

- i. *Water Quality Indicators and Guidelines.* Appropriate water quality indicators and guidelines must be established as a basis for managing and monitoring water quality within the various lake zones.
- ii. *Management of turbidity.* Turbidity is a potentially significant factor influencing the perception of water quality and attractiveness, as well as influencing plant growth in the lake including the balance between macrophytes and algae.

The highest peaks in turbidity will be associated with storm events in the catchment and the extent of earthworks associated with construction activity and other land uses which disturb vegetation cover and result in soil erosion and high levels of suspended solids in stormwater runoff.

Because of the general absence of shallow areas within the main body of Putrajaya Lake, increased turbidity as a result of wind-generated re-suspension of lake sediments is unlikely.

- iii. *Management of nutrients.* Phosphorus and nitrogen are the two key nutrients directly affecting the growth of plants in water bodies. Options should be considered for reducing phosphorus and nitrogen inputs and in the management of macrophytes to reduce nutrient release.
- iv. *Management of aquatic plants in relation to water quality.* The benefits and disadvantages of plant growth in relation to other uses and values of the lake is likely to become a complex issue. Algae at low levels will be a natural component of the lake eco-system, but can become a management problem when changes in nutrient balance lead to excessive growth. Blue-green algae (cyanobacteria) in particular causes problems because of its health risks and tendency to form unsightly mats and odour problems. Consequently macrophyte growth within the primary lake can be desirable because it may reduce nutrients available for algal growth.

However, submerged macrophytes may have their problems, particularly where they occur in deeper water away from the lake edge, in relation to the movement of boats and conflicts with other recreational activities.

Cutting of macrophytes may need to be undertaken to reduce recreational conflicts in some areas but this can create further water quality problems through the decomposition of cut material that is not removed from the lake, the release of sedimentary phosphorous during this decomposition process or the leaching of soluble phosphorous from cut stems.

Emergent macrophytes in the form of reed beds have been extensively used within the existing wetlands to achieve a “wetland filter” effect and are desirable as water bird habitat.

- v. *Management of sedimentation.* Hydrographic survey has recently been undertaken of the existing inundated Lake 1A area within the primary lake, which has indicated potential areas of excessive sediment deposits that could be of significance to future lake management.

There is clear evidence of the accumulation of silt deposits at several major points of stormwater entry to the lake, which will require physical removal in the near future.

The primary means of reducing sedimentation in the lake will be by means of an integrated catchment management programme primarily aimed at controlling the rate of soil erosion within the catchments as a result of inappropriate land clearing practices and inadequate control of earthworks during construction.

The sediment load on the lake will be reduced by the effect of the established upstream wetlands and can be further assisted by the installation of modern gross pollutant trap devices installed as part of the stormwater drainage system within developed areas of the catchment.

- vi. *Monitoring of water quality.* Monitoring of water quality in Lake Putrajaya will involve:
 - a. Routine monitoring (or baseline performance monitoring) to determine how the water quality of the lake is performing against management objectives and established long-term trends.
 - b. Monitoring at specific periods and at specific sites from a public health and safety viewpoint, particularly in relation to primary and secondary contact recreation, focused especially on the Precinct 5 Aquatic Centre.
 - c. Intensive monitoring of specific events or at specific parts of the lake with a view to improving the understanding of lake processes.

22.3 LOW FLOW MANAGEMENT

Low flow into and through the lake will be associated with hot dry periods generally between May and September when natural inflows from the upstream catchments are insufficient to balance water losses from evaporation, seepage, irrigation abstraction and release of riparian flows to the downstream river system.

Strategies and policies will be established based upon a hierarchy of priorities including:

- i. Maintenance of the health of wetland vegetation by pumped recirculation of water from the main dam as necessary.
- ii. Progressive restrictions on abstraction of water for irrigation purposes, to a minimum base level necessary to avoid major losses of landscape plantings.
- iii. The diminished aesthetic effect of reduced lake levels.

22.4 ECOLOGICAL MANAGEMENT

Putrajaya Lake will not be an isolated eco-system and will be subject to various influences within its catchment, both physical and biological, particularly in terms of the impact of water quality on the lake.

There are several underlying principles which must be recognised in the ecological management of the lake:

- i. Successful ecological management depends on understanding and managing all physical and biological components of the eco-system.
- ii. The lake relies on external sources of nutrients to sustain its ecology and productivity, with the response to nutrient inputs varying in different parts of the lake according to water depth and associated oxygen level.
- iii. Putrajaya Lake will not be a stable eco-system but will evolve in response to natural fluctuations and continually changing external factors.
- iv. Management of the lake must take account of its regional context, particularly in relation to matters such as wildlife movement and changes in natural range of species.

Small islands within the Central Wetlands perched lake above the northern head of the primary lake are of interest from an ecological management viewpoint because of their potential to provide wildlife refuges which are not accessible by most terrestrial predators.

The degree of ecological management desirable or achievable in the lake will vary with different eco-system components. Habitat management will include the control of undesirable weed growth within wetland areas and around lake foreshores; the discouragement of land access by the public into the main reedbed areas of wetland environments; periodic harvesting of macrophyte growth as necessary to avoid conflicts with other lake uses; stocking of the lake with fish species having a proven satisfactory survival rate to support recreational fishing; removal of undesirable fish species as necessary, and regular monitoring and research of fish populations.

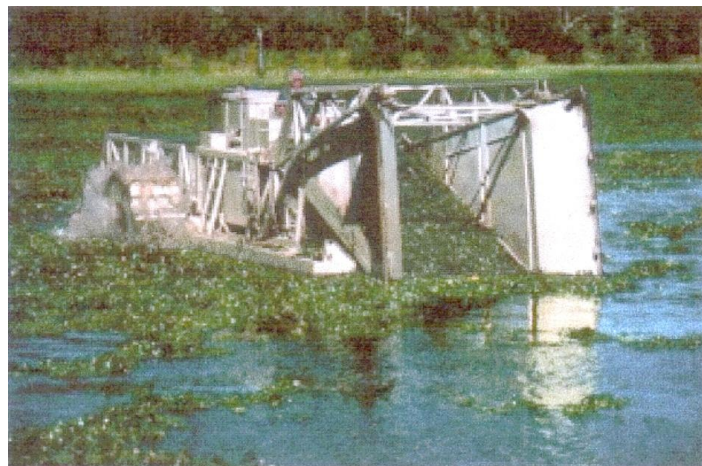
The 5m wide submerged bench around the perimeter of the lake is likely to support prolific growth of submerged macrophytes and emergent macrophytes in the form of reed beds, which depending on their location and personal aesthetic perspectives may be regarded as unattractive, particularly during periods of reduced water level.

A programme of harvesting may need to be implemented within areas where macrophyte growth is conflicting significantly with other lake uses or is deemed to be aesthetically incompatible with adjacent land development.

Where cutting of macrophytes is undertaken, the cut material must be removed from the lake as far as possible.

Figure 22.1 illustrates styles of mechanical aquatic plant harvesters which may need to be employed on Putrajaya Lake.

Figure 22.1 - Mechanical Aquatic Plant Harvesters



Harvested plant material may be mechanically offloaded to a convenient shoreline location for truck collection or disposal, or be transported back to the Lake Maintenance and Services Centre for offloading and transfer.

22.5 FISHERIES MANAGEMENT

The artificial wetlands and the main body of Putrajaya Lake will be colonised in the natural course of events by numerous species of both plants and animals without any human agency. Some of the species that colonise this newly created freshwater habitat will be desirable and some undesirable. Impoundments need to be managed and designed to maximise their recreational fisheries potential.

The species of fish chosen as the target sport fish species for this fishery should be selected from amongst those occurring naturally in the surrounding region. Also the target species should be able to breed in the impoundment, or if unable to breed in dam conditions, be available as fingerlings in sufficient numbers from commercial fish hatcheries in the region.

Some fish will be unable to breed in Putrajaya Lake and to sustain a resident population without a fingerling release program. Some fish can grow to maturity in fresh water, but must migrate to brackish water in order to breed. However, fingerlings of such species may be available from commercial hatcheries, sustaining the local aquaculture industry. Therefore, sufficient fingerlings of these species, if selected, could be sourced commercially to support a stocking program.

The sport fish species selected must be challenging and of interest to the recreational angler, i.e. they must “put up a good fight.” Also, they should be palatable and desirable table fish.

In addition to fin fish species it would be appropriate to examine the establishment or stocking of molluscs and crustaceans that are desirable as food. For example, fresh water mussels and freshwater crayfish. As well as being desirable human food, species such as these provide opportunities for the collection of live bait by anglers and sustenance for higher order consumers such as fin fish.

There is no need to provide supplementary feeding to lake fish stocks. Once completed the lake will receive nutrients from water inflows of rainfall and runoff. For example nitrogen will enter the lake by rain, and nitrogen, phosphorus and other nutrients will enter the lake by way of river inflows and runoff containing sediments and dissolved nutrients. Autotrophic organisms, or producer organisms, will then use sunlight, carbon dioxide, water and the various inorganic ions of these nutrients to create, via photosynthesis, organic compounds. Primary producers such as algae and other water plants provide food for organisms which feed directly upon them called first-order consumers. These include crustaceans, snails, worms, various insects, fish etc. Organisms, which eat first-order consumers, are called second-order consumers, and so on.

The total quantity of living organisms, both plant and animal, in the lake system is a function of the nutrients available in the system. Therefore, the number of game fish species available or capable of being supported by the lake will be set by the level of nutrients in the water body. This has implications for stocking rates etc. If too many fingerlings are added to the system and they have to compete for food, the result will be many very small fish, which grow slowly. If an insufficient number of fingerlings are added to the system and they don't have to compete for food, the result will be fewer but larger fish.

In temperate climates fingerlings are added to the system at the beginning of summer so that they can grow as much as possible before the colder part of the year. This ensures a better survival rate. Fish grow rapidly in the hotter months of the year and slower during the colder months. This is obviously less of a problem in the tropics but is still a consideration. For example at Tinnaroo Dam in the Atherton Tablelands near Cairns in tropical north Queensland, Australia, the Queensland Department of Primary Industries stocks the dam with Barramundi fingerlings in October when they are about 2.5 to 3.0 cm long and then by April the fish are 5cm long. Within 14 months of release the fish are about 58cm long and therefore a legal keeping size in Queensland.

Uncontrolled or excessive weed and algae growth in the lake is a potential problem. The process of nutrient enrichment of water which leads to increased plant and algal growth is a natural process, but excessive growth can lead to toxicity (especially blue-green algal blooms) or oxygen depletion following a vegetation or algal die off when the decomposition of organic matter by bacteria removes dissolved oxygen from the water. All of these things, if extreme, can cause the water body to be less attractive for swimming, boating and fishing.

Pretreatment of stream flow into the lake by means of the series of artificial wetlands should significantly reduce the risk of excessive nutrients accumulating in the lake. Also, a healthy recreational fishery where fish are caught and removed by fishermen is a means of removing nutrients from the system, occasionally supplemented by a weed harvesting programme.

It is likely that numerous types of small feeder fish will be amongst those species that colonise the lake by way of river inflow and the transport of fish eggs on birds and in runoff during flood events, etc. However, it may be desirable to stock the dam with some species of feeder fish from time to time. At Tinnaroo Dam in tropical Queensland, a native fish species called Boney Bream (a type of fresh water sardine) is occasionally released as a food source for Barramundi and other sport species.

Undesirable pest species of fish have already colonised the lake, amongst these are Tilapia, Grass Carp and Big Head Carp. Carp and Tilapia species occur in feral populations throughout Malaysia and indeed the rest of Southeast Asia and Australia. Carp undercut the earth banks of watercourses and impoundments by their feeding activities, which involve sucking up soil and sediment and spitting it out again. This also muddies the water and therefore increases turbidity and dissolved nutrient levels, making the water body less suitable for more desirable fish species. Tilapia are an attractive and highly tasty fish native to Africa. Tilapia, as with Carp, are highly successful in out-competing native species for available food resources. Furthermore, over time Tilapia numbers tend to increase while their average size declines. Gold Fish and other commonly kept aquarium species such as the various Cichlids are likely to establish populations in Putrajaya Lake via colonisation from existing feral populations or from accidental or purposeful releases by people. Accidental release can occur when an ornamental pond overflows into the storm water system or when someone releases a gold fish into a storm water drain. Also, some anglers may use gold fish or other exotic aquarium species as live bait for fishing. Finally, people ignorant of the undesirable consequences may purposely release “pretty” fish into the lake.

The public must be educated not to use non-native fish such as carp or goldfish or cichlids etc as live bait for fishing. Anglers must be educated to kill and remove all pest species of fish when they catch them. Keepers of aquariums and fish ponds must be educated not to accidentally or purposely release pet fish into the lake or its tributary waterways.

Diverse habitats comprising numerous different niches for species to occupy are more productive than less complex systems. Edge treatments and water depth conditions will dictate the type of plants occurring adjacent to the various areas of lake edge. For example reeds and rushes will grow in permanently moist soil and shallow water. Emergent plants such as water lilies will have their roots in the sediments several metres below the water surface where their leaves and flowers float. Some types of weeds such as hyacinth will have floating roots hanging below them and move freely about the surface of the lake. Some weeds will have their roots in the sediment of the lake floor or the 5m wide submerged perimeter bench while the rest of the plant is totally underwater.

Undesirable species of plant have, and are likely to continue to, colonise the lake from either existing feral populations or from aquariums and ponds. Again public education and periodic removal of vegetation are required remedies. For highly productive invasive aquatic species such as water hyacinth removal by mechanised boom scoops on a barge has proven necessary in similar instances throughout the world. Such equipment is commercially available. Removed weed material readily composts into good quality humus, which can be used as a soil conditioner for agriculture or as a medium for mushroom cultivation.

Some native fish need to breed in brackish water. Therefore, when they are in an impoundment such as a dam they will tend to follow the flow of water going over a spillway in a quest for salt water downstream. The loss of these brackish water breeding fish over the spillways of dams is a significant problem world wide. It reduces fish stocks and increases the expense of stocking. The use of fish barrier nets which will not adversely affect the safe passage of flood flows over the dam spillway (which are also commercially available), is the only way to minimise this loss of fish stock.

After the lake is filled it is likely to take several years for the water quality to stabilise. It is then likely to take several years of iterative practice and observation to determine optimum stocking rates - particularly for those target species that will not breed naturally in the lake. Experience with stocking rates will optimise the size, number and growth rate of desirable fish species.

Eels migrate downstream into the ocean to breed and then die. Young eels or elvers then swim back up to the fresh water river or stream their parents migrated from. Once there, they grow to maturity and then repeat the cycle. A fish ladder, comprising a series of resting pools arranged in descending order on or adjacent to the spillway will allow the movement of juvenile eels upstream back into the lake and the headwaters beyond. As long as a constant flow of water is maintained, and there are sufficient and adequately spaced resting ponds, then not only eels but other fish species will be able to travel upstream to the dam and complete their lifecycles. If no fish ladder is in place then those species which migrate downstream to brackish or saline water to breed will depart over the dam spillway – unless they are constantly re-established as juveniles by stocking.

Proposed controls on recreational fishing in Putrajaya Lake are as follows:

- i. Fishing is permitted only within Lake Use Management Zones 2, 4, 5 and 6.
- ii. All desirable sport fish be listed and the necessary bag limits, size limits and open/closed seasons be prescribed by regulation.
- iii. All undesirable fish be listed and the destruction and removal of any undesirable species caught be required of anglers.
- iv. All sport fish are to be caught by hook and line only, no nets or traps permitted.
- v. Bait collection is to be by amateur anglers only, commercial bait collection to be prohibited.

- vi. Baitfish and freshwater shrimp and crayfish may be caught by small nets, scoops and traps set for bait collection or private consumption purposes.
- vii. A limit of 1 litre of baitfish per person per day be set. A limit of 1 litre per person per day be set for freshwater shrimp. A limit of 5 litres per person per day be set for crayfish.
- viii. Molluscs such as freshwater mussels and snails may be collected by hand for use as bait or for private consumption at a limit of one litre per person per day.
- ix. All anglers must be licensed annually and pay the prescribed licence fee. Fees generated by licensing are to be used to subsidise any sport fish stocking program, ongoing monitoring of sport fish levels, and control of pest species of fish and plants.
- x. No commercial fishing to be allowed.
- xi. Fishing not allowed in designated conservation areas.
- xii. A limit of two lines per angler be set.
- xiii. No exotic pest species of fish to be used as bait or to be released into the lake or wetlands.
- xiv. Aquaculture activities prohibited in the lake area.
- xv. No noxious weeds such as *Eichornia*, *Salvinia*, *Pistia*, etc to be released into the lake or wetlands.
- xvi. Poisoning and electro-fishing prohibited.
- xvii. No fishing to be conducted within close proximity of vessel moorings or water ferry terminals.

It will be critical to the well-being of Putrajaya Lake fisheries that other management regulations prohibit the use of lead based anti-foul paint on all lake vessels and that “integrated pest management” is practised for the control of waterborne disease and vectors including the use of organic and biodegradable pesticides in preference to methods that would be toxic to sport fish and other aquatic life.

Healthy fish populations, essentially for recreational fishing, will also serve to keep down mosquito levels as a result of larval predation.

22.6 RECREATION MANAGEMENT

The management of recreation on Putrajaya Lake will be based on the following objectives:

- i. To maximise the opportunities for recreational use of the lake by both Putrajaya residents and visitors to the city, consistent with other management requirements.
- ii. To avoid conflict between recreational activities.
- iii. To protect ecological and other values of the lake from adverse effects of recreational use.
- iv. To maintain the highest practicable standard of public health and safety in respect to recreational use.
- v. To achieve an efficient and administratively simple means of managing recreational activities.

The types of recreational use made of the lake can be categorised as follows:

- i. Informal unorganised activities by the public (e.g. fishing, some boating activities, swimming);
- ii. Regular organised water sport activities by clubs (e.g. rowing and canoeing races and training, triathlons);
- iii. Commercial recreational activities (e.g. towed rides, water skiing, parasailing, etc)
- iv. Special events which do not interfere with general public use of the lake (e.g. fishing competitions); and
- v. Special events requiring closure of parts of the lake (e.g. water skiing exhibitions, major rowing regattas, other major aquatic sporting competitions, powerboat racing events, major public celebration events).

The Central Wetlands waterbody and the primary lake present opportunities to conduct fishing competitions in any of their many popular forms, including:

- i. fly fishing;
- ii. tagged fish competitions;
- iii. competitions for largest fish of particular species, etc;
- iv. catch and release competitions; and
- v. competitions targeting noxious fish.

Generally in fishing competitions, catch and return fishing is encouraged. Any fish less than minimum specified size must be immediately returned to the water. Larger fish will be retained by the angler and measured by the competition organisers. However, throughout competition anglers are regularly informed of the largest fish taken at that time, to prevent smaller fish being taken that are unlikely to win the competition.

Fishing competitions can also be useful in reducing populations of feral fish species.

Fishing competitions differ from other forms of recreational fishing because they result in a high concentration of fishing effort over a short time period, and therefore need to be well managed to avoid adversely affecting fish stocks.

22.7 PUBLIC SAFETY AND SECURITY

Provision for safe use of the lake by the public and also security from the water for high Government officials including the Prime Minister residing close to the lake, are critical management considerations with responsibility residing principally with the Marine Police. However, there are many management responsibilities in the design, operation and maintenance of facilities which are also important from a public safety and security viewpoint.

Specific issues to be addressed include:

- i. *Lifebuoys.* Consideration may be given to the provision of lifebuoys in cabinets at strategic locations around the lake and on bridges, with due regard to the potential risk of theft and vandalism which can lead to a false sense of security and ultimately negate their benefit.
- ii. *Emergency telephones.* Appropriately vandal proof and tamper proof emergency telephones may be the most effective means of summoning assistance from the Marine Police in the event of an emergency.
- iii. *Boat lighting and night activities.* All boats will be required to carry fixed lighting if they are used on the lake at night.
- iv. *Strong wind warnings.* Provision should be made for local electronic media broadcasting of strong wind warnings.
- v. *Flood warnings.* Based on an assessment to be undertaken of principal areas of risk, public access onto the lake or parts of it may be restricted during flood conditions which are considered to be hazardous.

The local electronic media should be used as the primary means of publicising flood warnings.

- vi. *Health warnings.* Health warnings with respect to swimming and other primary and secondary recreation in the lake will be issued at times when there is a significant health risk as a result of biological or chemical pollution.
- vii. *Hazards at sandy beaches.* Sandy beaches will be monitored regularly to detect and remove broken glass, syringe needles and other “sharps” which are hazardous to users.
- viii. *Restrictions on public access.* Certain parts of the lakes and foreshores will be specified as being restricted to general public access by land or water, for safety, security or environmental reasons.

22.8 LAKE NAVIGATION MANAGEMENT

Technical issues in regard to lake navigation management are covered under Part D.

Strategies and policies will need to be carefully developed to address the role of Perbadanan Putrajaya in the management of lake navigation ancillary services and facilities such as marine servicing, the marina and Aquatic Centre activities; and in the management of public water transport including ferry, tour boat and cruise boat operations.

22.9 DAM AND FLOOD MANAGEMENT

The spillway of the main Putrajaya Lake dam has the capacity to pass floods of 1 in 100 annual exceedence probability with only a minimal rise in lake level. Nevertheless, consideration needs to be given to the management of flood impacts within the lake associated with increased flood water levels and some increased flow velocities.

In particular, provisions have been made to restrict public water access to areas of potentially dangerous velocities upstream of the weir within the Central Wetlands water body, and more significantly at the main dam spillway.

22.10 MAINTENANCE OF LAKE FACILITIES

Putrajaya Lake will contain a number of facilities which will require ongoing inspection and maintenance, including:

- i. *The main dam.* Routine maintenance and repair works for the dam and associated assets will be undertaken in accordance with a pre-planned and documented programme and as otherwise necessary.
- ii. *Pumping station facilities.* Routine maintenance and repair works for various water circulation and landscape irrigation pumping station facilities will be required in accordance with a pre-planned and documented programme covering electrical and mechanical components as well as the structural and cosmetic components of these facilities.
- iii. *Bridges.* While responsibility for the maintenance of major road and light rail bridges may be separated from responsibilities for maintenance of lake facilities, a programme for regular inspection and maintenance of other lesser road and pedestrian bridges around the lake foreshores will be required.
- iv. *Jetties.* The maintenance of jetties will include painting, timber treatment and stonework repairs.
- v. *Boat ramps.* Any concrete boat ramps will require regular inspection and maintenance as necessary.
- vi. *Lake walls, revetments and soft edge treatments.* Lake edge treatments will require regular inspection and periodic maintenance, most generally in respect of erosion of non-engineered informal edge treatments.
- vii. *Fixed platforms.* Any public landing platforms (pontoons) and fixed platforms will require regular inspection and maintenance.
- viii. *Beaches and associated assets.* Swimming beaches, swimming and wading enclosures and diving platforms will require regular attention to keep them in a safe and environmentally desirable condition.
- ix. *Buoys.* Buoys may be placed in the lake for management purposes (e.g. to mark hazards, sampling sites, etc) or they may be located for boat moorings or to mark the courses for boating, rowing or other events. Floating booms will most likely be the most appropriate measure to prevent boats from approaching too close to the small weir on the perched lake at the northern head of the main lake and to the spillway of the main dam.
- x. *Emergency telephones.* Arrangements for maintaining emergency telephones in a serviceable condition may need to be negotiated with the relevant telecommunications authority.

- xi. *Picnicking/general user amenities.* Most of the amenities around the lake for general recreational use (e.g. picnic tables, shelters, seats, barbecues, toilets, rubbish bins) will be located in foreshore parks and will be managed as part of these parks.

22.11 LANDSCAPE MANAGEMENT

Management of the landscape of Putrajaya Lake will be important in a visual sense in contributing to the image of the National Administrative Centre and providing a setting for recreational and tourist activities. The important factors which influence visual perception of the lake, particularly in the foreground landscape, are:

- i. the topography of the lake shore, which is varied and interesting;
- ii. the vegetation of the shoreline and adjacent area;
- iii. built elements on the foreshore;
- iv. water quality as observed visually;
- v. human uses of the water and foreshore areas; and
- vi. the presence of other features of interest such as water display attractions and wildlife.

These attributes will vary widely between different parts of the lake, reflecting the various use priorities and the nature of the surrounding development, giving rise to a series of "Landscape Character Zones". The diversity of these zones is of key importance in the total visual experience associated with the lake, whether this is gained by a ferry trip along the lake; by walking, jogging, cycling or driving around it; or as sum of a host of different recreational or viewing experiences on various parts of the lake over an extended period.

Management of the landscape of the lake largely depends on establishing and maintaining this diversity, as well as protecting or enhancing the visual quality of each of the elements.

22.12 COMMUNITY INFORMATION AND CONSULTATION

In order to inform the community about Putrajaya Lake and its management, a range of public information resources including leaflets, more substantial publications, interactive presentations on CD, and internet website displays should be produced.

This information will relate to how people use the lake and concerns they may have in relation to its management. They should contain information on whom to approach for further advice or assistance and how to report any management problems they observe during their use of the lake.

Some possible topics which could be useful in informing the public about lake management issues would include:

- i. Water quality, particularly the responsibility of all Putrajaya citizens and visitors in relation to stormwater quality.
- ii. Wildlife and fisheries management.
- iii. Boat use.
- iv. The landscape of the lake.
- v. Interpretative information for walks in different parts of the foreshore.

In addition, information could be produced giving contacts for reporting all types of problems or accidents that people observe in or around the lake or for making enquires, including:

- i. Boating mishaps, accidents, drownings, etc.
- ii. “Sharps” (broken glass, syringes needles, etc) at swimming beaches.
- iii. Algae blooms
- iv. Oil spills, other pollution.
- v. Dead fish.
- vi. Dead, sick or injured wildlife.
- vii. Domestic pet problems.
- viii. Anti-social behaviour.
- ix. Drifting boats.
- x. Flood debris.
- xi. Damage to emergency telephones.
- xii. Damage to other assets or facilities.
- xiii. Rubbish dumping.
- xiv. Malfunction of equipment (e.g. barbecues, toilets).
- xv. Lake water quality and suitability for swimming.

The community should be encouraged to maintain an ongoing interest in the management of the lake and to report problems or incidents requiring management action.

Being one of Putrajaya’s primary attributes, the lake will be a focus for special group guided tours and VIP visits, which will involve the commitment of resources in management, public information publications and displays, and the availability of suitable vessels in a range of sizes for lake tours.

22.13 EDUCATION AND RESEARCH ACTIVITIES

The use of Putrajaya Lake as an education resource should be encouraged at the school level, by tertiary institutions, and among the wider community.

The publications programme should take account of the potential educational value of the lake in determining the content and priority of publications.

Provision may also be made for the erection of interpretative signs and/or the development of interpretative trails in foreshore areas.

The successful management of Putrajaya Lake will depend on being aware of the present state of the lake in physical and biological terms and understanding the processes taking place in the lake.

Research and monitoring aimed at recording the characteristics of the lake and its uses, and understanding the physical, biological and social processes associated with the lake and its use may include the following types of projects:

- i. Water quality monitoring.
- ii. Biological monitoring and research.
- iii. Recreational use surveys covering the lake in general, or specific areas or activities.
- iv. Visitor perception of the lake in relation to the Nation's Administrative Centre.

Research by other organisations should be encouraged, provided that this does not conflict with other uses or values of the lake.

The results of such studies will ultimately represent a valuable educational resource.

23.0 PRELIMINARY LAKE MANAGEMENT ORGANISATIONAL STRUCTURE

23.1 LAKE AND WETLANDS DIVISION

Robust, long-term arrangements should be formulated and implemented for the management of Putrajaya Lake, involving:

- i. Clear jurisdictional responsibilities.
- ii. Integration within a framework for total catchment management.
- iii. An effective planning, management and regulatory environment to facilitate achievement of the Vision for Putrajaya Lake's uses and values.
- iv. Best practice underpinning planning and implementation.

In considering an organisational structure appropriate for the multi-faceted management of Putrajaya Lake, and Wetlands, regard should be given a series of functions or groups of functions requiring different skills and experience, and handled by different groups of people.

Identified management functions are listed in **Table 23.1** together with the primary role of Perbadanan Putrajaya in each case. In some cases there are significant overlaps in the listed functions.

**Table 23.1 - Lake Management Functions and
Primary Lake Management Roles**

MANAGEMENT FUNCTION	PRIMARY MANAGEMENT ROLES
1. Wetlands	Operational
2. Water Quality	Operational
3. Low Flow	Operational
4. Ecological	Operational
5. Fisheries <ul style="list-style-type: none"> • Resource Management • Recreational Angling • Fishing Competitions 	Operational Operational Operational/Regulatory
6. Recreation <ul style="list-style-type: none"> • Informal Public Activities • Regular Organised Activities by Clubs • Commercial Recreational Activities • Special Events 	Operational Operational Regulatory Operational/Regulatory

MANAGEMENT FUNCTION	PRIMARY MANAGEMENT ROLES
7. Public Safety and Security	Operational
8. Lake General Navigation Management	Operational
9. Public Water Transport, Tour Boat and Cruise Boat Management	Regulatory
10. Vessel Services Management	Operational
11. Dam and Flood Management	Operational
12. Lake Facilities Management	Operational
13. Community Consultation and Public Relations	Operational
14. Education and Research Activities	Operational
15. Administration and Financial Management	Operational
16. Lake Operation & Maintenance	Operational

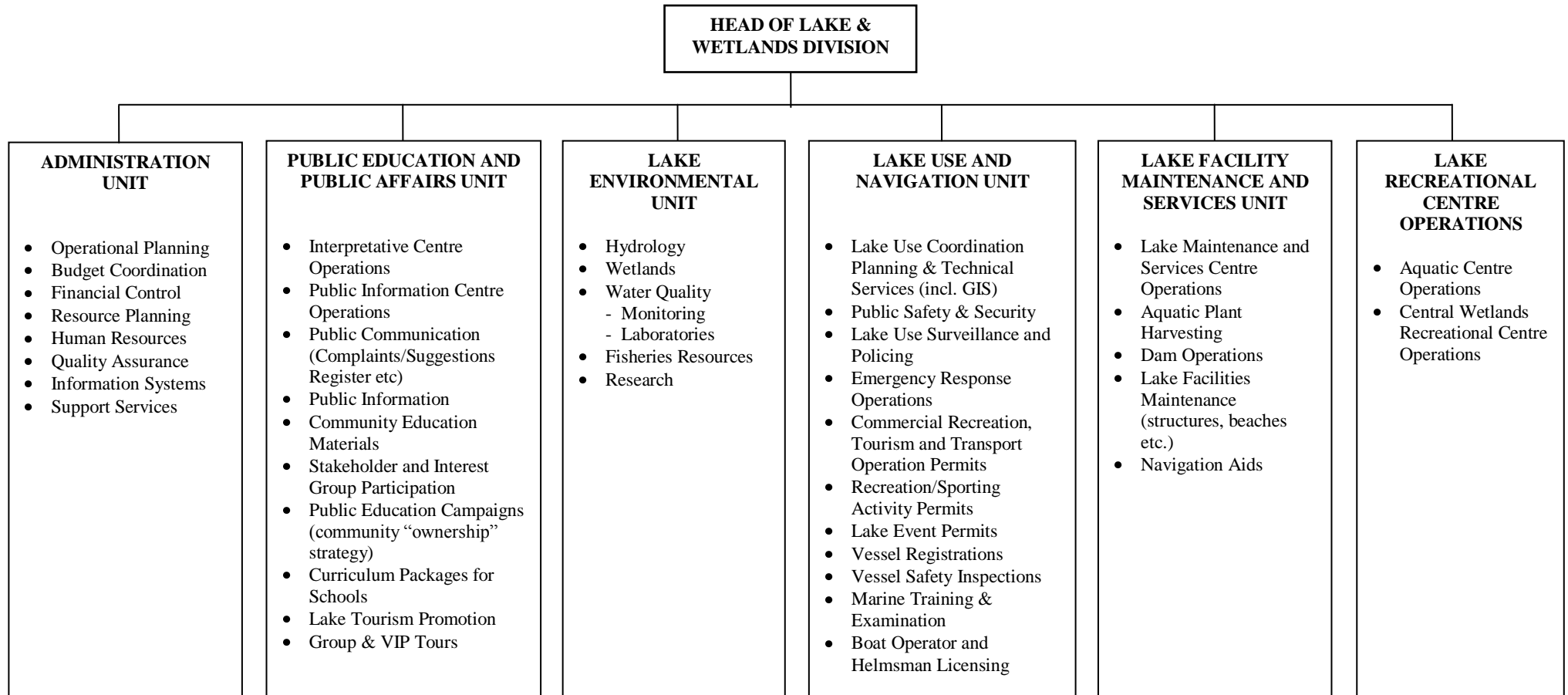
Having regard to the wide ranging but inter-related functions and necessary management skills associated with the management of Putrajaya Lake, it is suggested that the existing Environment Division be reconstituted as the Lake and Wetlands Division with responsibility for all aspects of the lake.

In some or all of the activities listed above in which the primary role is regulatory, it is likely that Perbadanan Putrajaya may also have commercial or organising interests, e.g. in the ownership and management of commercial tourism operations, water transport or marina facilities; or in the organisation of major water based events. In all such cases, it is suggested that commercial aspects of involvement be administered within separate divisions of Perbadanan Putrajaya, to avoid conflicts of interest within the Lake and Wetlands Division in regard to its regulatory functions.

Careful consideration will need to be given to the nature and extent to which Perbadanan Putrajaya might be involved in ownership and operational management of facilities such as boat clubs, non-commercial recreation sites; and other commercial, recreational, tourism and water transport activities.

A suggested organisational structure for the proposed Lake and Wetlands Division is set out in **Figure 23.1**.

Figure 23.1 - Suggested Lake and Wetlands Division Organisational Structure



The early establishment, resourcing and training of the Lake Use and Navigation Unit (existing Lake and Wetland Unit) is critical for safe, steady and assured advancement of the Putrajaya Lake Use and Navigation Master Plans.

23.2 LAKE USE AND NAVIGATION UNIT

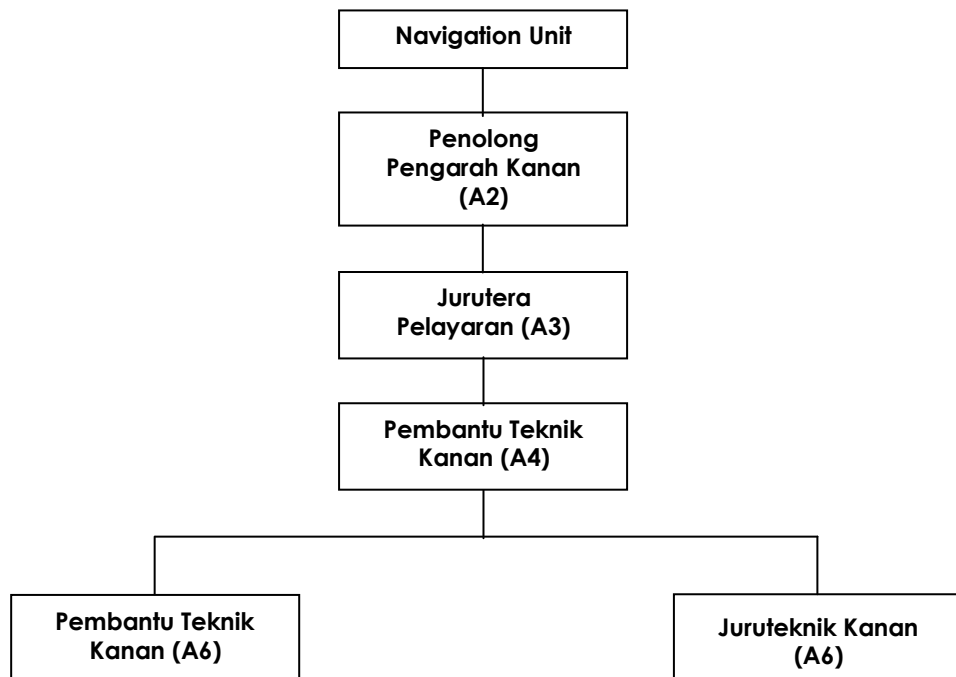
Under the suggested Lake and Wetlands Division organisational structure proposed in Section 23.1, a Lake Use and Navigation Unit is directly responsible for all aspects of navigation.

It has been noted that the present workforce within the Perbadanan Putrajaya Lake Management Unit is inadequate to assume navigational responsibilities, in spite of an essential need for their close involvement in addressing navigational issues in early Lake Use and Navigation activities.

As a high priority, it is recommended that a Lake Use and Navigation Unit be established, whose functions are critical for safe, steady and assured implementation of the Putrajaya Lake Use and Navigation Master Plans.

A suggested Lake Use and Navigation Unit Organisational Structure is set out in **Figure 23.1**.

Figure 23.2 Structure of the LMU – Navigation Unit



23.2.1 Function

The Navigation Unit shall be responsible for the overall lake navigational aspects including boating safety, water based activities, vessel registration and inspection, boat operator and helmsman licensing, marine operational facilities and navigational aids.

This unit shall assist the Lake Management Unit in all navigation operational and support needs, and respond to navigation management requirements of Putrajaya Lake. Navigation management requirements include:

- i. Waterway Laws and Guidelines
- ii. Legal Requirements – Boat Registration, Competency, Insurance, Operator/Lake User responsibilities, Safety Equipment, Inspection of Boats etc.
- iii. Public Safety and Security
- iv. Lake General Navigation
- v. Public Water Transport
- vi. Operational Requirements

Setting up of the Navigation Unit is urgent and critical for the safe and consistent progress of the Putrajaya lake development.

23.2.2 Responsibilities

The Navigation Unit is to give advice on the navigational input which includes boating safety, lake marine operation and water based activities status in relation to environmental and safety aspects.

The Navigation Unit shall also assess the efficiency of day-to-day water based lake activities, procedural modus operandi, control measures and make further recommendation to the Lake Management Unit.

The Navigation Unit shall actively participate in the cross integration of PJC lake management.

23.2.3 Personnel

The Navigation Unit is to have a minimum of three personnel, Navigational Officer assisted by two technicians.

Navigational Officer is to hold a minimum 2nd Mate Foreign Going Certificate (Class 3) of Competency or Master Home Trade Certificate of Competency (Class 4), and have a minimum 3 years working experience onboard water crafts.

The technicians, preferable relevant certificates from Polytechnic and/or equivalent qualifications and have 1 to 2 years experience in boating and/or water based activities. Entrant with Helmsman Certificate would be an added advantage.

24.0 OPERATING REVENUE

Putrajaya Lake primarily represents an investment intended to value add to the civic, commercial and residential functions of Putrajaya and to the financial worth of its real estate.

Accordingly, many of the costs of lake management, operations and maintenance must be considered as being offset against other municipal revenue, including property assessments.

Nevertheless, revenue in respect of some management and operational functions will be available from the following sources:

- i. Commercial leases in respect of a limited number of developments permitted within the public promenade and/or over the lake bed, including restaurants either fixed or floating;
- ii. Commercial boat club licenses;
- iii. Boat registrations for vessels owned by boat clubs or other private or public organisations;
- iv. Marina facility lake bed lease and/or commercial operating license;
- v. Ferry, tour boat and cruise boat commercial licenses;
- vi. Private fishing licenses;
- vii. Private boat operator licenses;
- viii. Private marine training course fees;
- ix. Infringements fines;
- x. Revenue from special lake events.

25.0 STAGE 2 LAKE MANAGEMENT PLAN

25.1 TERMS OF REFERENCE

In accordance with the Consultancy Brief, the proposed Stage 2 Scope of Work includes the preparation of a comprehensive Lake Management Plan to provide the framework, approach, modus operandi and systems necessary to effectively manage all Putrajaya Lake activities. The Lake Management Plan would cover the operational planning and integrated management of lake use, navigation, training programs and standards, and emergency response.

25.2 SCOPE OF LAKE MANAGEMENT PLAN

In the first phase of the Stage 2 work, a management study will be undertaken to define management objectives, strategy options and their impacts. The second phase involves the preparation of a management plan which will document action needed to achieve the desired goals and management objectives.

The first phase will establish the regional significance of the lake, its key values and the anticipated uses and conflicts contributing to both the values and problems anticipated. It will also assess the likely future uses and pressures for the lake and surrounding land. From this information, the study team, with input from wetland configuration, water based activities, supporting infrastructures, risks and, Perbadanan Putrajaya feedback, will put forward a range of nature conservation and remediation measures and management strategies and options.

The second phase of the Stage 2 work will involve the assessment of these options to determine the desired future management measures for the lake and its environs. These measures will need to address all issues and provide for the long-term control and management of the area.

The plan will provide guidelines for the protection, management and accomplishes Perbadanan Putrajaya tasks in administration, control, management and supervision of Putrajaya Lake. The plan will also complement the responsibility of Perbadanan Putrajaya to ensure security, safety and precautionary measures of boating and recreational activities, and lake surface management in the Putrajaya Lake.

The Putrajaya Lake Management Plan will be developed under provisions of the Overview of Planning, Environment and Legislative Aspects, Draft By-Laws and Rules, User Guidelines, Planning and Environmental Guidelines, Waters Act 1920, Selangor Waters Management Authority Enactment 1999, and where relevant Guidelines from Merchant Shipping Ordinance 1952 / Merchant Shipping Act 1998 (awaiting Parliamentary approval), The Port Authorities Act 1963.

Development of the Management Plan with reference made from the abovementioned documents will provide Perbadanan Putrajaya with administrative, control, management and supervision in the following ways:

- i. Distinguishes that Putrajaya Lake necessitates a system of regulation for the water activities to be proposed in the lake in balancing the demands on the use of navigable route and associated infrastructure by water traffic
- ii. To establish a management regime by elevating the overall effectiveness and efficient use of watercourse for water activities, that:
 - a. is coherent with the objectives of other waterway laws (Selangor Waters Management Authority Enactment 1999, Merchant Shipping Ordinance 1952/Merchant Shipping Act 1998, The Port Authorities Act 1963);
 - b. promotes input from pertinent organization or authorities (e.g. Marine Department, Ministry of Transport, etc);
 - c. supplements other relevant laws; and
 - d. reflects a coordinated approach to meeting lake users needs.
- iii. Places responsibility on the PPJ for:
 - a. consultation with inter-governmental bodies, government and public authorities, associate organizations, interested groups and the public(when need arises);
 - b. evaluating, appraising and reviewing current and future demands of water traffic and the use of waterways;
 - c. planning the effective and efficient management of water traffic and associated infrastructure and use of waterways;
 - d. approving proposals for navigation management plans;
 - e. making further recommendations to the Pengarah/Chairman, PPJ.
- iv. Ensures that specific consideration adhered to:
 - a. alternative means that do not involve regulation through navigation management plans;
 - b. water activities infrastructure needs;
 - c. facilitating both recreational and commercial use of waterways;
 - d. the impact of proposed navigation management plans on water based activities need.

A comprehensive plan for Putrajaya Lake will recognize the following policies:

- i. develop strategies to deal with the management of the lake;
- ii. encourage development of the lake in a manner which will preserve the lake, encourage recreation activities, protect the lake, and protect recreation facilities;
- iii. preserve the lake's danger/hazard zones;
- iv. promote water quality;
- v. promote and maintain recreation areas on and surrounding the lake;
- vi. encourage safe boating use of lake;
- vii. conserve and maintain public access to the lake for boating, recreation, fishing and other activities.

The Management Plan will form the foundation for the total implementation of the navigation management within the Putrajaya Lake. The Plan is projected to contain the following documents:

- i. The Navigation Management Plan
- ii. Integrated Navigation Management System & Manual (Software System)
- iii. Operation & Maintenance Manual for Navigation Plan control equipment, aids & facilities
- iv. Implementation schedule and budget for Navigation Master Plan
- v. Training Standards & Programmes Manual

Highlights of the Lake Management Plan are as follows:

- i. The plan to contain a land & lake use map and detailed management guidelines designed to ensure protection of the unique qualities of Putrajaya Lake and surrounding area, while providing recreational opportunities compatible with the area;
- ii. The plan to contain a process for the formation of an advisory committee, to be composed of Perbadanan Putrajaya and Government agencies, that will assist in the monitoring of the lake and implementation of the plan.

25.3 CONTENT OF LAKE MANAGEMENT PLAN

The proposed content of the Lake Management Plan is as follows:

1. *Introduction*
 - 1.1 Purpose of the Plan
 - 1.2 Significance of Putrajaya Lake
 - 1.3 Goals of the Plan
 - 1.4 Definition & Glossary
2. *Putrajaya Lake Integrated Management Policy*
 - 2.1 Background
 - 2.2 Management Function
 - 2.3 Policy Objectives
3. *Objective of Putrajaya Lake Navigation Management*
 - 3.1 Broad Objectives
 - 3.2 Detailed Objectives
4. *Key Issues*
5. *Environmental Issues*
 - 5.1 Putrajaya
 - 5.2 Putrajaya Lake
 - 5.3 Existing Development
 - 5.4 Other Areas of Concern
6. *Lake Management Strategy*
 - 6.1 Overall Management Strategy
 - 6.2 Administration, Management & Control
 - 6.3 Putrajaya Lake Objective & Standards
7. *Management Structure, Responsibilities, Reporting & Framework*
 - 7.1 Putrajaya Lake Management Structure
 - 7.2 Roles and Responsibilities
 - 7.3 Reporting
 - 7.4 Putrajaya Lake Management Framework
 - 7.5 Operating Principles and Methods
 - 7.6 Provision of Facilities and Equipment
 - 7.7 Personnel
8. *Influences on Management*
 - 8.1 Legislative
 - 8.2 Administrative
 - 8.3 Regional Influences
 - 8.4 Visitation Dynamics
 1. General Patterns
 2. The Putrajaya Lake User

9. *Management Areas and Use Area*

- 9.1 Management Areas
- 9.2 Putrajaya Lake Zones
 - Zone 1. Restricted Access Wetland Zone
 - Zone 2. Controlled Access Tranquil Recreation Zone
 - Zone 3. Permit Controlled Access Zone
 - Zone 4. General Navigation Zone
 - Zone 5. Active Recreation And General Navigation Zone
 - Zone 6. Passive Recreation And General Navigation Zone
- 9.3 Areas of Special Concern
 - a. Protected Areas
 - b. Water Activities High Density Area
 - c. Putrajaya Lake Dam & Spillage
 - d. Mooring & Berthing Jetties/Terminal
 - e. Underkeel & Air-Draft Clearance
 - f. Fuelling & Maintenance Site for Boats
 - g. Emergency Response Centres(s) & Sub-centres
 - h. Wetlands
 - i. Other Specialised Structures

10. *General Management Plan*

- 10.1 Natural Resources Management
 - a. Water Quality
- 10.2 Lake Activities Management
 - a. Operations Schedule
 - b. Visitation Capacity
 - c. Recreational Activities
 - i. Powered Boats – Cruises, Water Taxis, Leisure etc.
 - ii. Non-powered Boats – Sailing, Canoeing, Kayaking etc.
 - iii. Powered Model Boats
 - iv. Others – Swimming, Snorkelling, Scuba Diving
 - d. Education Programs – Safety, Environmental
 - i. Training Programs
 - ii. Public Programs
 - iii. Educational Brochures/Leaflets
 - e. Staffing
 - f. Maintenance
- 10.3 Security, Safety, Communication and Electronic Surveillance Plan

11. *Operating Lake Management*

- 11.1 Operational Rules & Procedures
- 11.2 Administration and Support
- 11.3 Quality Control
- 11.4 External Relations
- 11.5 Cooperation with Departments, Services and Other Government Agencies

12. Future Development

- 12.1 Putrajaya Lake Potentials
- 12.2 Putrajaya Lake Development

*13. Management Plan Process**14. Appendices***25.4 INTEGRATED MANAGEMENT SYSTEM****25.4.1 Background**

The management of Putrajaya Lake consists of:

- i. Water Quality Management
- ii. Flood Management
- iii. Low Flow Management
- iv. Ecological Management
- v. Fisheries Management
- vi. Recreation Management
- vii. Lake Use Operational Management
- viii. Public Safety and Security
- ix. Navigation Management
- x. Landscape Management
- xi. Maintenance of Lake Facilities
- xii. Emergency Response Management
- xiii. Community Information and Consultation
- xiv. Education and Research Activities

The above management system forms the Total Management of Putrajaya Lake and its adjacent supporting infrastructures, services and resources. Predominantly all the above management approach is to manage, administer, regulate and control. These management schemes encompass replication of management process, procedures and techniques. On a hypothetical condition, having numerous management groups to carry out analogous tasks will increase the available resources requirements.

An efficient and operative integrated management structure with an aim to cut-down resources requirements without affecting the management effectiveness could only be achieved when the unique requirements of the management process, procedures and techniques be fully integrated into existing (if available) and future policy development and resource management systems.

It is imperative for Perbadanan Putrajaya to acquire an efficient and cost-effective integrated management structure to minimise resources requirements as well as manage, administer, regulate and control virtually every management plan of Putrajaya Lake.

In Stage 2, an Integrated Software system will be developed for Lake Use Operational and Navigation Management, Emergency Response and all other related management scheme of Putrajaya Lake. The design of the software is primarily to administer, regulate and control, management and decision-making support. The main objective of the integrated software system is to assist, improve and support the management approach with minimal resources requirement.

The system shall encompass information related to policy, legislation, strategies and programs, organizational set-up and operational requirements. The management control system will be linked to support the implementation of the manuals. This will be a comprehensive control system for the various activities and facilities within the Putrajaya Lake.

The Integrated Management System and Emergency Response System (ERS) design are to employ an open architecture system, designed to fulfill the needs of a wide range of users. It would employ a variety of application-specific hardware and software modules to collect, integrate, assess and display data in a manner that provides the member of staff with a comprehensive representation of the situation. The configuration of hardware components in the Integrated System to be proposed in Stage 2.

System designs are to be enhanced to incorporate management information and increased functionality making such systems operational necessities. Projected system will typically consists of local or remote sensor sites connected to a local area network (LAN), which is in turn to be connected to a central control centre via communication links. In effect, a wide area network (WAN) if necessary would be established.

The open architecture design makes maximum use of commercial off-the-shelf (COTS) components. Standard personal computers, mini-towers or rack-mountables to be used for processing and display of data. Software applications are to run on the Windows NT Workstation or any other software system (Perbadanan Putrajaya requirements). Sensors and peripheral equipment are to be selected from proven and reliable vendors. These features, combined with compliance to industry standards and approved Quality Assurance procedures would ensure low life-cycle costs, long-term availability of compatible components and the maximum degree of "technology proofing".

25.4.2 Purpose

The primary objective of Management Systems & ERS is to provide a clear and concise real-time representation of activities, interactions etc. in the management area. In general, the information provided must assist to:

- i. Supervise the water traffic (in the lake) within the coverage area;
- ii. Enhance safety of life and property;
- iii. Protect the environment;
- iv. Enhance efficiency of craft movements and utilization;
- v. Distribute related information to crafts and other parties associated with the administration of the lake;
- vi. Provide Search and Rescue assistance;
- vii. Record related data for administrative purposes, registration and maintenance;
- viii. Analysis of incidents and planning;
- ix. Monitoring of activities;
- x. Monitor attributes of integrated management.

Strategic approach of Integrated Management System's (IMS) is to process and present information which enables Lake Command center to obtain a clear and accurate representation of the lake, quickly understand and assess state of affairs, make appropriate decisions and action where necessary.

Additionally the information from the IMS can be provided lake to associated administrative and management divisions and if required to third party organizations. For example, database applications can be incorporated for the collection and distribution of lake related information between Lake Authority, Boating Association, Operators, and other identified departments.

25.4.3 Integration

The open architecture also enables the systems to offer a totally integrated information service that can be linked to all other lake operational areas and functions. Data communications, linking the various applications in the system, could be linked by UHF/VHF Radio, optical fibre cable or dedicated telephone line.

A comprehensive progress monitoring system would be an added advantage which would provide facility integration. The system can be integrated with existing or proposed monitoring system of Perbadanan Putrajaya, e.g. land traffic monitoring system.

25.4.4 Logging and replay

A Logging and Replay facility, deemed necessary, provides facility to record, in real-time, information – situation/condition within the surveillance area, communications and actions and system performance. The playback facility could be used to re-create any situation that occurred and is particularly useful for:

- i. Accident Investigation
- ii. Operator Performance Monitoring
- iii. Training with actual scenarios

25.4.5 Database Collection

Typical user applications of a database are:

- i. Static data – crafts, equipments.... (physical characteristics, owner, etc.)
- ii. Dynamic data (craft movements, planned movements, lake activities etc.)
- iii. Records of incidents (planned or unplanned events, accidents)
- iv. Resource allocation (jetty, landing point, facilities etc.)
- v. Accounting information (charges, time allocated, etc.)

Fig 25.1 Integrated Management System Network Diagram

NETWORK DIAGRAM OF SINGLE SITE

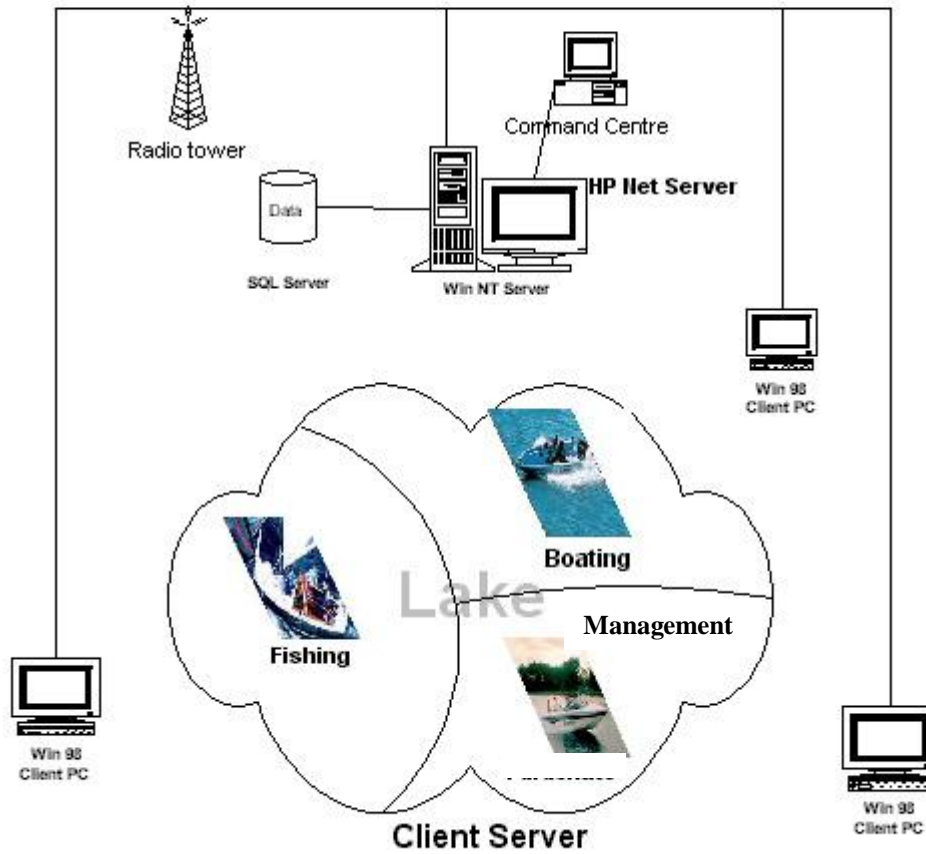


Fig 25.2 Schematic Diagram – Total Integrated Management System

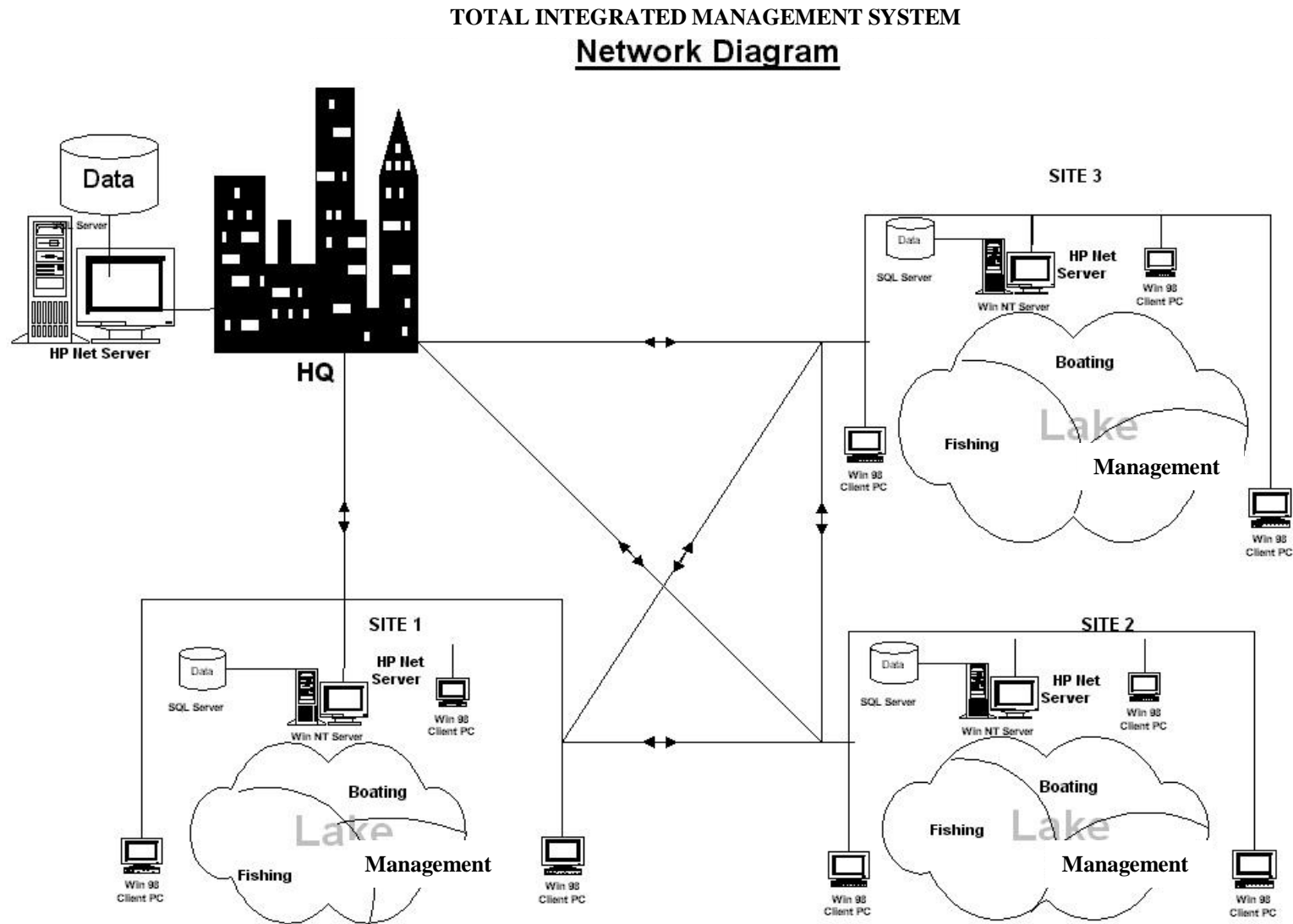


Fig 25.3 Management Links To Various System

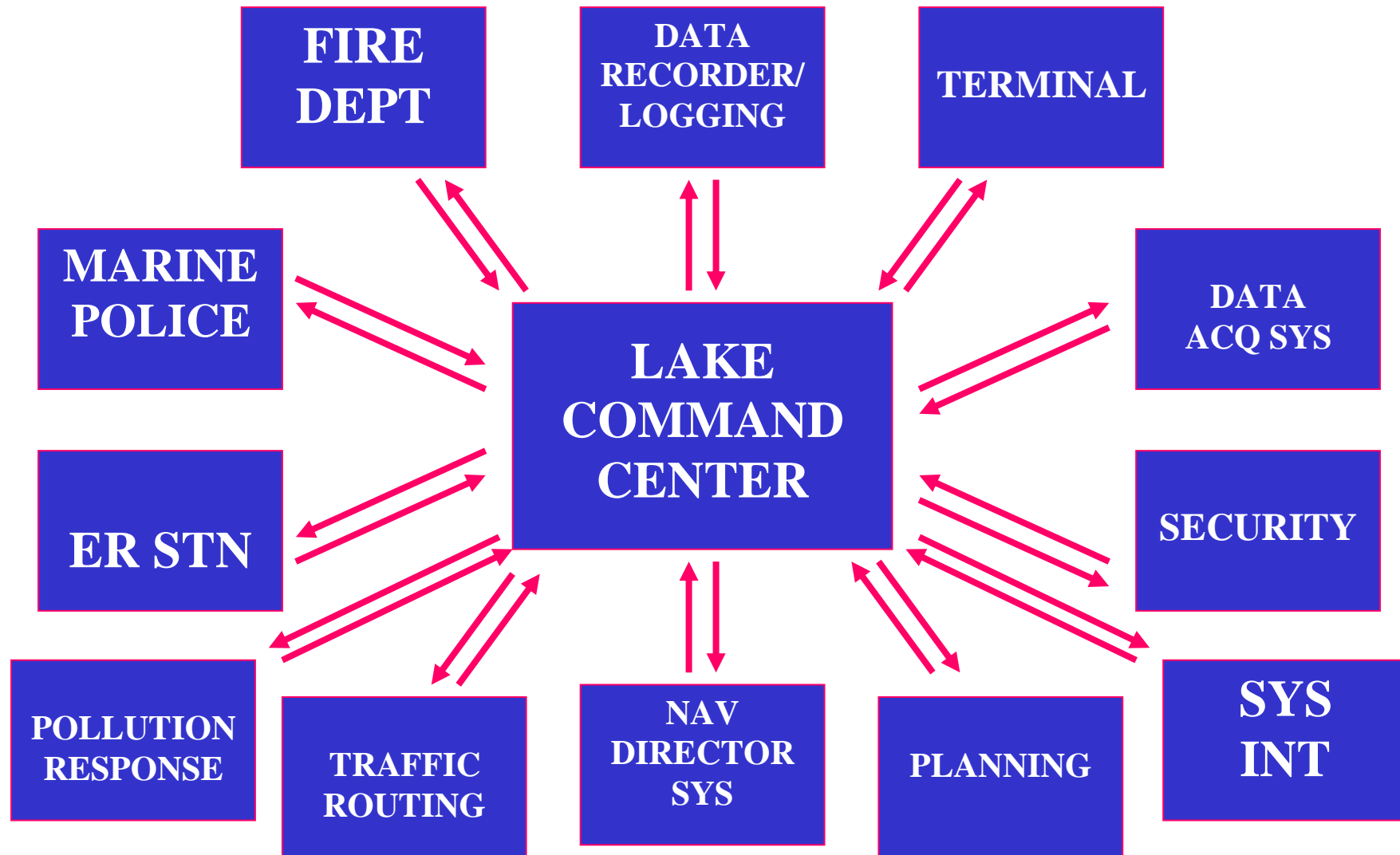
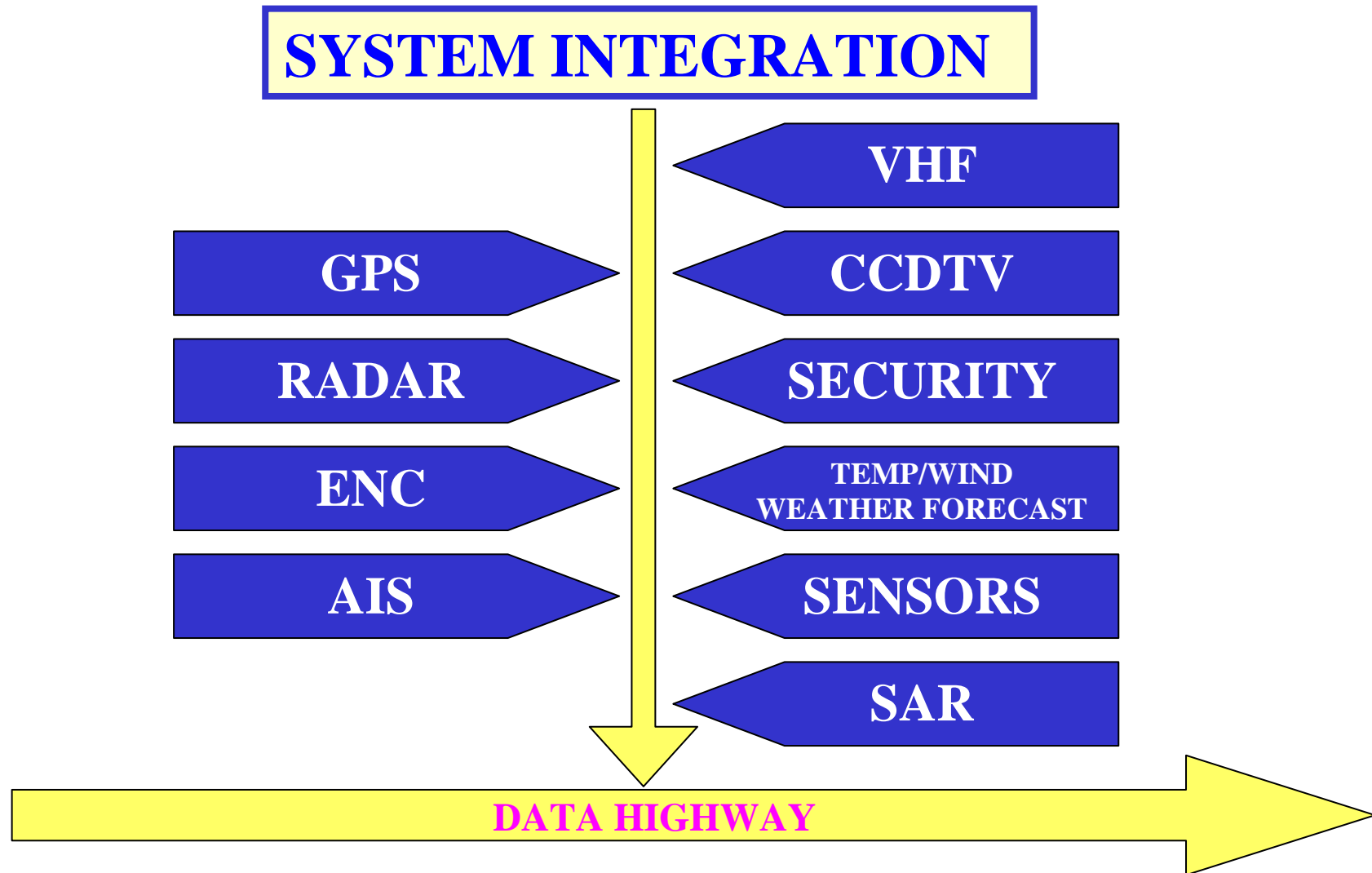


Fig 25.4 Expansion Of Integrated System



**25.5 SECURITY, SAFETY, COMMUNICATION AND ELECTRONIC SURVEILLANCE
PLAN FOR PUTRAJAYA LAKE AND ITS IMMEDIATE WATERFRONT****25.5.1 General**

To exercise command, control and supervise all security activities within the lake area and its immediate waterfront, the overall security plan must be closely coordinated and enforced with a comprehensive communications and electronic (C and E) systems.

This system must be carefully designed so that the controllers capabilities to 'see' and 'hear' can be greatly enhanced electronically. Hence, the controller is in better control of the activities happening within his areas of responsibility.

25.5.2 Execution

General outline:

- i. To design the C and E plan of the Putrajaya lake area and its immediate waterfront.
- ii. The C and E plan will be designed in such a way that it can be integrated with other current and future systems.
- iii. The C and E plan will also be designed accordingly to the various levels of infra-structural development of Putrajaya with **focus** on the lake area and his immediate waterfront.

Details tasking. The C & E plan can be broadly categorized in three main activities:

- i. Communication Operation Centre (COC)
 - ii. Wireless communication
 - iii. Electronic surveillance
- i. COC**
 - a. A COC will be established to control and coordinate all existing and future communication network and electronic surveillance activities.
 - b. The conduct of operation of the COC will also include close monitoring and supervision of its own communication activities.

- c. The COC shall be operational 24 hours daily and must be headed by a Systems engineer. A Standard Operational Manual (SOM) must be produced to outline the operating manual systems and the duties and responsibilities of each and individual operator.
- ii. **Wireless communication.** Wireless communication shall be divided into three main areas:
 - a. Marine communication
 - b. Ground communication
 - c. Ground to air communication
 - iii. **Marine communication.** In general, all watercrafts operating within the lake area shall be provided with communication facilities. This facilities communication may enhance or complement other Vessels Tracking Systems. For this purpose, the watercrafts may be divided into the following grouping:
 - a. Touring water-crafts
 - b. Water taxis
 - c. Individual water-crafts
 - d. Security water-crafts
 - e. Marine police water-crafts
 - f. Search and Rescue (SAR) water-crafts
 - g. Sea plane
 - h. Others crafts
 - e. **Ground communication.** Waterfront operators are normally engaged in various activities namely mooring and unmooring. Theses marina or pier operators shall also be provided with communication facilities.
 - f. **Ground to air communication.** It is anticipated that there may be aircraft operators within Putrajaya. They may be seaplane operators or helicopter operators providing flight services for Putrajaya VIPs, staffs or visitors. Ground to air communication facilities shall be provided to these flight operators.

vi. Electronic surveillance (ES)

- a. As explained, electronic surveillance greatly enhances the controller's capability to 'see' and 'hear'. It directly enables the controller to monitor activities beyond human capabilities.
- b. Indirectly ES is a form of Early-warning Systems (EWS). By 'seeing' the things happening within his area, the controller may then take the appropriate counter action.
- c. Instrument such as infrared sensors, microwave sensors and close-circuit television (CCTV) may record invisible electro-magnetic energy and provide images of things within the controller's areas of responsibility.
- d. Within Putrajaya, two types of electronic surveillance are recommended that is ground-based and airborne.
- f. Ground-based (main system)
- g. Terminal mounted on building/others infra-structure.
- h. Terminal concealed as TNB sub-station
- i. Airborne (back-up system). This system may be mounted /installed in an air-balloon. It may be disguised as a tourist attraction where tourist may have an aerial view of Putrajaya. However, replacement air-balloon must be considered when the operating air-balloon has to be grounded for maintenance.

25.5.3 Logistic Support

A capable company shall be appointed to designed, coordinate, implement and maintain the C and E system. They act as Project Managers and are directly responsible to Perbadanan Putrajaya.

26.0 BRIEF FOR STAGE 2 TRAINING PROGRAMS & STANDARDS**26.1 INTRODUCTION**

Stage 2 preparation of the Management Plan will provide the management structure and guidelines for the implementation and execution of Putrajaya Lake Management. Perbadanan Putrajaya Lake Management Team is likely to form the administration, supervision and enforcement level through the proposed Navigation and Emergency Management Plan to be tabulated in Stage 2 of this project. Additional supporting teams will be recommended from other agencies. These out-sourced teams will support further PPJ Management Plan due to the comprehensiveness of the anticipated work involved.

Various level of staff participation from top, middle and support group is required to execute the Management Plan effectively. Although majority of the support systems are by PPJ, the workforce is expected to be strengthened and balanced to comprise the resources of other agencies within Putrajaya.

The consultants recommend that all the staff members, both from Perbadanan and other agencies, to be trained and exposed to essential aspects for carrying out their respective responsibilities. Perbadanan Putrajaya shall ensure that at the end of the recommended programs, the relevant personnel are certified by locally accredited professionals and/or organization in the relevant fields of expertise. This will ensure that competent and well-trained staff members with adequate knowledge are assigned to manage and control the Putrajaya Lake.

It is also strongly recommended that some of the programs are made mandatory for all lake users. This is to ensure that the standard of safety is valued and maintained throughout the various levels and range of users.

In Stage 2, the consultants are to prepare the necessary comprehensive training programs, standards and notes appropriate for the staff likely to participate in the Lake Management Plan.

26.2 SCOPE

The courses to be designed are to provide the knowledge, skills and attitudes for the personnel that will be responsible for the health, safety, security and environmental protection of Putrajaya Lake. The recommended essential courses will cover the various levels of personnel, namely the managerial, supervisory and operators level.

The range of courses will expose the participants with fundamental elements of health, safety, security, navigation, emergency response principles and environmental protection. They will acquire skills that are used in and are fundamental to the performance of many tasks carried out in a wide range of duties.

26.3 OBJECTIVE

The purpose of the recommended basic training programs and standards is to prepare all PPJ personnel with a substantial exposure required to perform their task in the most professional manner expected of a world class lake management system.

Participants successfully completing the training courses should be fully capable of undertaking all tasks & responsibilities within their field of substantive qualifications to perform effectively the various scope of work designated to them relevant to the immediate needs of the lake.

The participant will be able to act in response to emergency situations in a professional manner, take measures appropriate to his/her own safety and to the safety of others, and carry out his/her responsibilities effectively. The program will also allow sufficient knowledge to be acquired to enable him/her to identify and correct defects, and thereby preventing emergency situations.

26.4 PARTICIPATING STANDARDS

In general, all participants should be technically qualified and have basic tertiary education.

It would be a minimum requirement that those entering for practical exercises to be in good health and physically fit to undertake strenuous activities required of the programs. Candidates are liable for proof of medical/physical fitness if required.

26.5 RECOMMENDED PROGRAMS AND STANDARDS**26.5.1. Boat Operators Course [5 days]*****The Boat*****Standard 1.1 - Boat Capacities**

The course will describe how to determine acceptable loading based on locating and determining a boat's gross load capacity (total weight and # persons) from the boat capacity plate and horsepower recommendations.

Standard 1.2 - Boat Registration Requirements

The course will describe:

1. that all motorized boats and many other boats are required to be registered (check PPJ requirements),
2. requirements for hull identification number,
3. the required certificate of number (registration documentation), and external display of numbers, and
4. other requirements of PPJ.

Standard 1.3 - Boating Terms

The course should describe commonly used boating terms in addition to those terms required to follow the Navigation Rules.

Boating Equipment**Standard 2.1 - Personal Flotation Device Types and Carriage**

The course will describe the types of PPJ approved personal flotation devices (PFDs) and their respective uses, advantages, and disadvantages. The course will also describe the number and types of PFDs that must be carried on the boat according to applicable regulations.

Standard 2.2 – Personal Flotation Device Sizing and Availability

The course will communicate that PFDs must be readily accessible and correctly sized for the persons using them.

Standard 2.3 – Wearing Personal Flotation Devices

The course must inform boat operators of the advisability of wearing PFDs at all times. The course must emphasize the need for boat operators to be alert to changing boating conditions and to inform all persons on board they should be wearing PFDs in dangerous conditions such as high boat traffic, severe weather, dangerous water conditions, dangerous local hazards, distance from shore, operation at night, boating alone, etc. The course will address the difficulty of putting PFDs on in the water.

Standard 2.4 - Personal Flotation Device Serviceability

The course will describe the characteristics of serviceable (good) PFDs and when to replace PFDs due to excessive wear or damage. Special attention must be given to the maintenance of inflatable PFDs as per manufacturer recommendations.

Standard 2.5 - Fire Extinguishers

The course will describe the legal requirements for fire extinguishers on recreational boats, the kind of fire extinguishers needed for different types of fires, the importance of placing fire extinguishers in a readily accessible location, and the need for regular inspection of fire extinguishers.

Standard 2.6 - Backfire Flame Control Device

The course will describe the purpose and maintenance of a backfire flame control device (a required device on all enclosed engines with a carburettor).

Standard 2.7 – Ventilation Systems

The course will discuss the ventilation system requirements for different types of boats.

Standard 2.8 – Navigation Light Equipment

The course will cover the navigation light requirements for recreational boats from applicable sections of Navigation Rules.

Standard 2.9 - Sound Signalling Equipment

The course will describe the types and use of sound producing devices required on recreational boats.

Standard 2.10- Boat Theft Prevention

The course should contain information that addresses actions the boat owner can take to deter or prevent boat theft.

Trip Planning and Preparation**Standard 3.1 - Checking Local Weather And Water Conditions**

The course will describe how to make informed boating decisions based on forecasted local weather and water conditions. It will also describe dangerous weather conditions such as strong wind, storms, lightning, sumatras, mist, fog, and their importance in trip planning.

Standard 3.2 - Checking Local Hazards

The course will describe how to obtain information about local hazards that may impede the operation of a recreational boat.

Standard 3.3 - Filing a Float/ boating Plan

The course will describe the importance of notifying someone of your boating plans and the basic information that should be included.

Standard 3.4 - Boat Preventive Maintenance

The course will communicate the need for regular inspection and maintenance of the boat and its key components (e.g., through-hull fittings, motor, electrical system, fuel system).

Standard 3.5 – Transporting and Trailering

The course will describe procedures to prevent trailering accidents and resulting injury and property damage.

The course will cover safe trailering procedures including: 1) safe towing preparation, 2) road handling factors when pulling a trailer, 3) launching a boat, and 4) retrieving a boat from the water.

Standard 3.6 - Fuelling Procedures

The course will provide information on proper procedures for fuelling, ventilation during fuelling, and protection of the marine environment during fuelling.

Standard 3.7 - Pre-Departure Checklist & Passenger Communication

The course must describe the importance of using a pre-departure checklist and conducting an onboard safety discussion with passengers. Passengers should be informed about the location of PFDs, fire extinguishers, flares, first-aid kit, discharge and management of waste procedures, anchoring procedures, emergency radio operation (if applicable), storm/rough weather procedures, line handling, emergency boat operation, and falls overboard procedure.

Marine Environment**Standard 4.1 – Environmental Laws and Regulations**

The course will describe the environmental laws and regulations concerning littering (e.g. garbage and plastic), waste management plans, and display of information placards (where applicable).

Standard 4.2 - Human Waste Disposal

The course will describe the proper procedure for disposal of human waste from recreational boats and that the whole lake is a no discharge zone. Pump-out station locations will be identified and appropriate signages installed.

Standard 4.3 – Disposal of Toxic Substances

The course will describe procedures for the prevention of spills and improper disposal of toxic substances such as fuels, oils, and cleaning products into the marine environment and the associated fines for non-compliance. The PPJ Act prohibits the discharge of oil or hazardous substances into navigable waters. Powerboats must have the capacity to retain oily mixtures on board and to transfer them to an approved reception facility.

Safe Boat Operation**Standard 5.1 - Operator Responsibilities**

The course will describe a boat operator's ultimate responsibility for safety and all activity aboard the boat.

This responsibility extends to other water users and includes: controlling boat speed, obeying no wake/limited wake restrictions, refraining from careless, reckless, or negligent operations on the water, controlling boat noise, and other general boater courtesy.

Standard 5.2 - Influence of Drugs and Alcohol on Boat Operation

The course will describe the effects of drinking alcohol or using drugs while boating, and the boating laws pertinent to operating a boat while under the influence.

Standard 5.3 - Navigation Rules of the Road

The course will describe safe boating operation and good seamanship, including at least the following navigation rules:

- Definitions relevant to understanding the navigation rules
- Rule of responsibility (to act in a reasonable and prudent manner consistent with the ordinary practices of recreational boating)
- Proper lookout
- Safe speed
- Collision avoidance rules
- Operation within narrow channels
- Sound signals
- Navigation light display and recognition
- Restricted visibility
- Visual distress signals
- Rendering Assistance

Standard 5.4 - Aids to Navigation

The course will describe the PPJ Aids to Navigation and the PPJ Lake Waterway Marking System. The course will provide information about regulatory/informational markers used to advise of situations, dangers, or directions indicating shoals, swim areas, speed zones, etc.

Standard 5.5 - Docking and Mooring

The course will describe common practices for docking and mooring a boat relative to boat size, type of boat, location, weather, and current.

Standard 5.6 - Anchoring

The course will describe the selection of anchors, related ground tackle, and their use for different types of boats in various boating conditions. The course must describe procedures for anchoring, use of anchors as safety devices in emergency situations, and the hazards of stern anchoring. In general, anchoring is prohibited in the lake.

Emergency Preparedness**Standard 6.1 - Rendering Assistance**

The course will explain that, according to the Navigation Rules, boat operators are required to render assistance to a boat in distress to the extent they are able.

Standard 6.2 - Capsizing Emergencies

The course will describe how to prevent and respond to capsizing emergencies. These responses will include at least the following: donning lifejackets, taking a head count, staying with the craft when appropriate, signalling for assistance, using improvised floating aids, and initiation of procedures to recover people in the water.

Standard 6.3 - Falls Overboard Emergencies

The course will describe procedures for preventing and responding to falls-overboard, including the proper response of persons on board for retrieval of a person in the water.

Standard 6.4 - Hypothermia Prevention

The course will describe the conditions under which hypothermia is likely to occur as well as its signs, symptoms, and prevention. Although in tropical waters of Putrajaya, the temperature can be cold in the early morning rain.

Standard 6.5 - Fire Emergency Preparedness

The course will describe procedures to prevent and respond to boating fires such as proper use of fire extinguishers and basic knowledge of fire suppression principles.

Standard 6.6 - Running Aground Prevention and Response

The course will describe how to prevent and respond to running aground for recreational boats.

Standard 6.7 - Accident Reports

The course will describe what kinds of boating accidents require an accident report as well as how, when, and where to file the report.

Standard 6.8 - Boating Accident Report Form

The course will include a sample accident report form, which can be included in the textbook or as a separate handout.

Standard 6.9 - Communication Procedures

The course should describe the protocol and use of VHF marine radios and other equipment for contacting PPJ Authority or other rescue personnel in the event of a boating emergency.

Other Water Activities**Standard 7.1 – Boat Types and Uses**

The course should describe the common types of recreational boats, common hull designs, and their performance in various types of boating situations.

Standard 7.2 – Personal Watercraft and other Jet Propelled Watercraft

The course will state that a Personal Watercraft is defined as a boat and must observe all boating regulations. It must describe the unique characteristics of Personal Watercraft (PWC), including at least the following topics:

- Operational characteristics of PWCs, including steering, stopping and stability of PWC
- Off-throttle steering
- PWC load capacities as per manufacturer recommendations
- Re-boarding a PWC
- The purpose and use of a Lanyard/Cut (Shut) off switch
- The purpose and use of a fuel reserve tank
- Laws and regulations
- Accident prevention
- Noise control
- Hours of operation

Standard 7.3 - Water Skiing

The course will describe procedures to follow when pulling water-skiers or operating in the vicinity of water-skiing or other activities using towed devices.

Standard 7.4 - Diving and Snorkelling

The course will describe how to recognize a diver down flag and the legal requirements for operating a boat in the vicinity of snorkelling or scuba diving activities.

Standard 7.5 – Fishing

The course will inform people who fish from boats that they are boaters and need to follow safe boating practices. Information must be provided about accident risks unique to this group of recreational boaters.

26.5.2 Boat Operator Refresher [4-6 h]**Standard 7.6 - Continuing Education**

The course will outline the need for additional boating safety education and staying informed of changes in boating safety requirements and PPJ revision of rules and regulations.

26.5.3 Lake Helmsman [20 days]**Standard 1- Navigation**

The course to provide the knowledge and skills to the participants with the essential navigational aspects of safe and precise navigation.

To cover the following topics:

- 1.1 PPJ Navigation Chart
- 1.2 Lake Buoyage System
- 1.3 Navigational Marks
- 1.4 The Compass
- 1.5 Plotting Equipment

- 1.6 Shaping a Course
- 1.7 Plotting Positions
- 1.8 Passage Skills

Standard 2 – Deckwork

The course to provide a greater understanding covering the detail aspects of the anticipated work on deck of a vessel including the hands on requirements of a helmsman.

To cover the following topics:

- 2.1 Common Nautical terms
- 2.2 Handling lines and fenders
- 2.3 Line coiling and throwing
- 2.4 Knots - clove hitch, bowline and round turn & two half hitches
- 2.5 Securing to bollards, rings, cleats and stakes
- 2.6 Anchor work

Standard 3 - Helming and Boat Handling

The course to provide a good understanding of the theoretical and practical aspects of helming and boat handling in the waters of PPJ lake.

To cover the following topics:

- 3.1 Loading and weight distribution
- 3.2 Steering
- 3.3 Speed control
- 3.4 Inter-action and canal effect
- 3.5 Turning
- 3.6 Berthing and unberthing, alongside and between buoys/piles
- 3.7 Recovery of man overboard
- 3.8 Anchoring

Standard 4 - Personal Safety

The course to address all the personal safety issues and identifying critical areas in the lake that could pose a danger to personal safety.

To cover the following topics:

- 4.1 Identification of risks exposed in the lake
- 4.2 Use of life jackets and buoyancy aids, including trapped lines and fending off
- 4.3 Avoidance of personal injury
- 4.4 Special risks to children

Standard 5 - Boat Safety

The course to stress on the importance of maintaining the safety of the boat and the various aspects of danger exposed to the boat and methods of securing the safety of the vessel.

To cover the following topics:

- 5.1 Fire hazards. Gas and Petrol
- 5.2 Use of fire extinguishers
- 5.3 Watertight integrity
- 5.4 Recovery after grounding

Standard 6 – Engines

The course to provide the participants with a good basic understanding of the engine maintenance and checks required.

To cover the following topics:

- 6.1 Engine care
- 6.2 Pre-start checks
- 6.3 Running checks
- 6.4 Routine checks

Standard 7 - PPJ Navigation Rules

The course to provide a good understanding of the PPJ navigation rules for the participants to know where, when and how it is applied.

To cover the following topics:

- 7.1 Definitions relevant to understanding the navigation rules
- 7.2 Rule of responsibility (to act in a reasonable and prudent manner consistent with the ordinary practices of recreational boating)
- 7.3 Proper lookout
- 7.4 Safe speed
- 7.5 Collision avoidance rules
- 7.6 Operation within narrow channels
- 7.7 Sound signals
- 7.8 Navigation light display and recognition
- 7.9 Restricted visibility
- 7.10 Visual distress signals

Standard 8 - Care of the Environment

The course to provide the participants with an awareness to the importance of maintaining a pristine environment within the lake and the threat of pollution.

To cover the following topics:

- 8.1 Avoiding damage to boats, banks, flora and fauna
- 8.2 Pollution avoidance
- 8.3 Consideration for other water users

Standard 9 - Responding to an Emergency

The course to provide an overview of the participants responsibilities and expected line of action in responding to an emergency.

To cover the following topics:

9.1 Search and Rescue

9.2 Rendering assistance

26.5.4 Lake First Aid & CPR [3 days]

To provide the lake users with the basic first aid at the lake and to give sufficient practical training so that they will be able to cope quickly and effectively in dealing with emergencies which can occur at the lake and the vicinity.

Standard 1 - Immediate Action

To guide participants on the course of action to take in an emergency situation, including the duties of a first aider and the priorities to set.

Standard 2 - First Aid Kit

To explain and show the contents of the first aid kit and the importance of managing the maintenance of the kit.

Standard 3 - Dressings, Pads and Bandages

To explain the various functions and methods of application.

Standard 4 - Body Structure & Functions

To explain the various parts of the body structure and function so that the participants will appreciate better when dealing with a casualty.

Standard 5 - Examination of Patients

To explain the importance of the procedures required in examining patients before mobilization or treatment. This to include both history of illness and physical examination.

Standard 6 - Toxic Hazards of Chemicals Including Poisoning

To explain on how the toxic substances can affect the body in various ways, the general principles of diagnosis and methods of prevention.

Standard 7 - Spinal Injuries

To explain the specific steps to take in dealing with spinal injuries, especially before mobilization.

Standard 8 - Bleeding

To explain the various types and dangers of bleeding, methods of control and precautions to be exercised.

Standard 9 - Burns, Scalds & Electrical Burns and Electrocution

To explain the methods of treatment and the steps to take in exercising extra precaution against electrical dangers.

Standard 10 - Fractures, Dislocations & Muscular Injuries

To explain the nature of each and methods and precautions when treating.

Standard 11- Medical Care Of Rescued Persons

To explain the anticipated conditions of the rescued person and the suggested methods of treatment for the various emotional and physical states.

Standard 12 - Bites and Stings

To explain the different types and dangers related and the methods of treatment.

Standard 13 - Asthma Attack

To explain the signs and symptoms, the seriousness of the attack and the actions to take.

Standard 14 – Heat Exposure

To explain the danger of heat stroke and the methods of treating.

Standard 15 - Pregnant Women and Children

To explain on the additional precautions to be made with regards to aiding pregnant women and children.

Standard 16 - Cardiac Arrest

To explain the signs, symptoms, dangers associated and actions to take.

Standard 17 - Drowning

To explain the basic techniques of rescuing drowning person and the methods of reviving the person using the various proven techniques of resuscitation specific to the casualty.

Standard 18 - Artificial Resuscitation

To show to participants the various methods of artificial resuscitation available. They are expected to be able to practically apply the methods correctly on a model.

26.5.5. Lake Safety, Survival & Rescue Techniques [2 days]

To provide the participants with the essential knowledge and experience of personal safety, survival and rescue principles and techniques, maximizing the preservation of lives in the event of a lake casualty. Practical training required.

Standard 1 - Introduction, Safety and Survival

The course to explain the importance of participating in the program and the elements of personal safety.

To cover the following topics:

- 1.1 Safety guidance
- 1.2 Definitions of survival and rescue terms
- 1.3 Personal safety devices
- 1.4 Float plan
- 1.5 Safe working practices

Standard 2 – Vessel Safety

The course to emphasize the need to know the safety equipment and practices and maintaining the safety of the vessel.

To cover the following topics:

- 2.1 Safety equipment onboard
- 2.2 Fuel management
- 2.3 Engine checks

Standard 3 - Handling Emergency at Lake and Adjacent Facilities

The course to expose the participants with the handling of emergencies at the lake including the vessel and ashore.

To cover the following topics:

- 3.1 Lake activities
- 3.2 Lake facilities
- 3.3 Anticipated emergencies
- 3.4 Responding to emergencies

Standard 4 - Survival Techniques

The course to cover the principles and practice of survival techniques relevant to the lake.

To cover the following topics:

- 4.1 Principles of survival in the lake
- 4.2 Person overboard procedures
- 4.3 In water survival

Standard 5 - Rescue Techniques

The course to cover the principles and practice of rescue techniques relevant to the lake, including assistance from other agencies.

To cover the following topics:

- 5.1 Procedures before rescue is attempted
- 5.2 Communications
- 5.3 Rescue by boat
- 5.4 Swimming rescue
- 5.5 Helicopter assistance
- 5.6 Care for rescued personnel

26.5.6. Lake Fire Fighting [2 Days]

To provide training to participants in fire prevention and basic fire fighting at the lake with regards to boats or facilities adjacent to the lake. Practical training required.

Standard 1 - Introduction, Safety and Principles

The course to cover the importance of participating in the program and the principles of fire survival.

To cover following topics:

- 1.1 Main aims of course
- 1.2 Safety rules during program
- 1.3 Principles of survival in relation to fire

Standard 2 - Theory of Fire

The course to provide a good understanding on the theory of fire to the participants.

To cover the following topics:

- 2.1 Conditions for fire
- 2.2 Properties of flammable materials
- 2.3 Fire hazards and spread of fire
- 2.4 Classification of fires and appropriate extinguishing agents

Standard 3 - Fire Prevention

The course to explain on the various fire prevention principles with regards to PPJ environment.

To cover the following topics:

- 3.1 Fire prevention principles
- 3.2 PJ vessel construction arrangements
- 3.3 Safe practices

Standard 4 - Fire Detection

The course to provide the fire detection system onboard or adjacent facilities in PPJ.

To cover the following topics:

- 4.1 Fire and smoke detection system
- 4.2 Automatic fire alarm

Standard 5 - Fixed Fire Extinguishing Systems

The course to highlight the various fixed fire fighting systems onboard vessels or at adjacent facilities in PPJ.

To cover the following topics:

- 5.1 Requirements of a fixed system
- 5.2 Types of fixed systems

Standard 6 - PPJ Waterfront Facilities Subjected to Risk of Fire

The course to elaborate on the waterfront facilities that could be subjected to the risk of fire, and its impact to the overall fire fighting requirements.

To cover the following topics:

- 6.1 Critical facilities in lake area
- 6.2 Fire fighting facilities available for lake area

Standard 7 - Fire Fighting Equipment

The course to detail out the fire fighting equipment that is installed on the vessels, the facilities as well as the emergency response centres.

To cover the following topics:

- 7.1 Fire Hoses and Nozzles
- 7.2 Mobile apparatus
- 7.3 Portable fire extinguishers
- 7.4 Fireman's outfit
- 7.5 Breathing apparatus
- 7.6 Resuscitation apparatus
- 7.7 Fire blankets

Standard 8 - Vessel Fire Fighting Organization

The course to explain on the organization of fire fighting team onboard the vessels.

To cover the following topics:

- 8.1 General emergency alarm
- 8.2 Fire control plan and muster list
- 8.3 Communications
- 8.4 Personnel safety procedures
- 8.5 Periodic drills for certain vessels

Standard 9 - Fire Fighting Methods

The course to elaborate on the different fire fighting methods applicable to different kinds of fire.

To cover the following topics:

- 9.1 Knowledge of fire fighting methods
- 9.2 Fire alarm and first actions
- 9.3 Fire fighting

Standard 10 - Fire Fighting Drills

The course to expose the participants on the practical aspect of fire fighting and rescue in confined space.

To cover the following topics and practical:

- 10.1 Small fires
- 10.2 Extensive fires
- 10.3 In smoke filled places

26.5.7. Lake Oil Spill Response [2 days theory, 1 day practical]

To provide training to the various levels of personnel from PPJ or other agencies in responding to an oil spill incident in the lake. Practical training on the deployment of OSR equipment required for the supervisors and operators.

Standard 1 - Source Of Oil into the Lake

This course will examines the various possible sources of oil into the lake in order to place accidental oil spill in perspective. A brief overview of the common oil type and composition, its physical and chemical characteristics such as specific gravity, viscosity and pour point will be covered.

Standard 2 - Fate And Effect Of Oil Spill

Oil spill into the lake will undergo a number of physical and chemical changes, some which lead to its disappearance from the water surface while the other cause it to persist.

This course will discuss the various physical and chemical changes which occurs when oil is spilled on the lake water surface such as the weathering process, spreading, evaporation, dispersion and various other combination processes. It will also discuss the economic impact on lake activities due to its physical properties causing nuisance and hazardous condition and also the biological impact and effect to lake habitats.

Standard 3 - Containment And Recovery

The removal of oil when it is spilled into the water is very important. The first approach is usually to use some form of barrier to stop or minimize the spread of oil so that it can later be removed.

This course also will examines the various techniques of oil containment and recovery methods with particular emphasis on the main design feature and performance of booms and skimmers, and also the proper techniques and mode of operation of such equipment in the various zones of the lake.

Topic will also cover the various types of the boom, skimmers the principle of their deployment, their limitation related to the water state, oil state and the effect of wind etc.

Standard 4 - Dispersant

When oil is spilled into the water, natural dispersion of oil occurs due to wave, wind, turbulence etc. which convert oil into small droplet which then spread through the water column and degraded by micro organization.

This course explain what dispersant is, the various type of dispersant available, know how it works , methods of application on water surface and shoreline, and the environmental considerations involved.

Standard 5 - Sorbent

Sorbents are material which will recover spilled oil through absorption and adsorption. They have the ability to pick up oil and be easily recoverable and disposable. This course will describe the use of natural and synthetic sorbents and their limitation.

Standard 6 - Clean Up Techniques And Strategies

Oil spill usually result in polluting the shoreline despite effort to combat the oil when it is in the water. The clean-up is usually straight forward but the use of inappropriate technique and improper organization can aggravate the damage caused by oil itself.

This course describe priorities and clean-up techniques to be applied successfully for different types of shoreline in the lake.

Standard 7 - Disposal Of Oil And Oily Debris

This course discuss the two basic steps in the disposal process, the initial collection of oil and oily debris, temporary storage and final disposal of this material in an acceptable manner . Also discuss the various option and processes which can be used for final disposal of oil and oily debris.

Standard 8 - Organization Planning And Operation

When an oil spill occurs, proper organization and careful planning is essential if the problem is to be dealt with successfully. This course provides guidance for the preparation of contingency plans of which for the first part outline the overall strategy for oil spill response and the second part provide the guidance for the apportioned procedures to be followed when oil spill occurs. PPJ emergency response plan for oil spill will be discussed in details.

26.6 FUTURE OFFERING OF COURSES

Distance learning that includes Internet courses, tele-conferencing, and interactive video and self-study programs for the theoretical aspects can all be considered in the near future.

26.7 COURSE VENUE AND FACILITIES

The above courses are recommended to be conducted in Putrajaya. Facilities that should be provided includes classrooms, audio visual aids and a safe water area for the practical exercises. PPJ is recommended to have its own training center and its own facilities and equipment for the training. This includes the use of available boats, life saving appliances and the oil spill response equipment. The fire fighting ground of the Bomba can be utilized for the fire fighting practicals.

Rationale – Putrajaya will provide the best live-in environment with regards to the actual water areas, location for the conduct of the wide ranging activities and the actual facilities and infrastructures exposed to the participants.

26.8 SCHEDULE OF COURSES

A training program schedule should be prepared to indicate to the PPJ personnel and the public on the dates and duration of the courses offered.

26.9 QUALIFICATION OF INSTRUCTORS

The minimum qualification and experience of instructors will be detailed out for each program in stage 2.

26.10 EXAMINATIONS

The examinations must be well designed and comprehensive in covering PPJ's standards. An examination syndicate is to be formed, comprising of PPJ lake senior personnel and relevant professionals from appropriate agencies. The exams can assess the participants knowledge equally well as an independent exam or as an exam at the end of a course.

26.11 CERTIFICATIONS

It is recommended that PPJ, the organization that has the pool of competent professionals as consultants and trainers; issue certificates to the participants that have satisfactorily participated in the program with a minimum of 90% attendance and passed the exams.

26.12 EXEMPTIONS

It is anticipated that there will be users of the lake who are already possessing the relevant qualifications obtained from other organizations be it in Malaysia or other countries. As PPJ lake has its uniqueness, it is recommended that PPJ will have an examination syndicate that will provide part or in whole exemptions for all other certificate holders. A bridging program and specific written and/or oral examination is recommended for these users.

PART F
EMERGENCY RESPONSE PLAN

**27.0 RISK ASSESSMENT FOR PUTRAJAYA LAKE AND WETLAND
ATTRIBUTES AND ACTIVITIES****27.1 INTRODUCTION**

The lake and wetlands system within the Master Plan for Putrajaya has been planned with the objectives of achieving aesthetic and multi-functional use in line with the “City in a Garden” concept. The water quality of the lake and wetlands is aimed to be clean enough for body contact, water sporting and recreational activities. The activities in the lake should have great recreational values and undertaken in a safe and healthy environment.

27.2 THE PUTRAJAYA LAKE AND WETLANDS SYSTEM

The waterfront of the Lake adjoins various land uses proposed under the Putrajaya Master Plan. Six Land Use Classes have been identified within the Master Plan, these being Residential, Government Institutions, Open Spaces, Commercial, Services Industry and Infrastructure. A listing of the potential types of development activities that may be associated within these six classes of land uses have also been identified. It is critical therefore that activities in and around the Lake are regulated to ensure compatibility with land uses identified in the Master Plan. Priority should be given to the protection of the quality of water, protection of lake shoreline, preservation of aquatic habitats and generally enhancing the waterfront environment.

In line with Perbadanan Putrajaya’s policy, the Lake has been an integral part of the community. It is a showpiece but one that will also be available for the activities of the community. A review of the types of activities and works that are likely to be allowed has indicated that fishing, boating (both motorised and non-motorised), restaurants, swimming and other related recreational activities, construction of floating and fixed structure, and other activities and works on and along the water front, that are compatible with Perbadanan’s policy for the Lake, will be encouraged. Such activities, if left unmanaged, have the potential to adversely affect the lake. Legislative controls need to be instituted to ensure that the Perbadanan is able to manage the lake in a manner that is compatible with the objectives and purposes of an integrated management plan for the lake and Master Plan for Putrajaya.

27.3 LAKE SYSTEM COMPONENTS

27.3.1 Background

In the context of the development within the area managed by Perbadanan Putrajaya, the main components of the lake system include the **wetlands, the primary lake, the drainage system** (and its associated **riparian park** and **flood detention basins**), and the **land abutting the lake** (which constitutes the lake catchment area along the waterfront).

The function and influence of each of these components to the lake system is discussed in the Putrajaya *Volume 1 – Overview of Planning, Environmental and Legislative Aspects* document. Nevertheless an extract on the wetlands, drainage system and land abutting the lake are discussed briefly in the following paragraphs, as areas of the primary lake has already been covered to some extent in this report.

27.3.2 Wetlands

Wetlands have been developed in the upper reaches of the lake system which receives inflows from the Sg. Chuau and its tributaries namely, the Sg. Bisa and the three other unnamed streams. The six wetlands areas consist of the Upper North Wetland (39.1 hectares), Upper West Wetland (30.3 hectares), Upper East Wetland (14.9 hectares), Lower East Wetland (10.1 hectares), Upper Bisa wetland (21.1 hectares) and the Central Wetland (47.8 hectares). These wetland areas may be seasonally, intermittently or permanently submerged or inundated with water that is static or flowing.

These artificial wetlands, which are located in the upper reaches of the lake system, have been designed to trap and remove in-flowing pollutants that are carried by runoff from the surrounding catchment. Pollutants levels in runoff are expected to be reduced within the wetlands as a result of physical settling of particles, chemical precipitation and adsorption of inorganics and organics, biological uptake of nutrients by plants, and uptake and decomposition of organics by animals and microbes.

The role and function of the wetlands in the overall development of the lake system is critical in ensuring that pollutant loads discharged into the primary lake are not excessive as to cause its water quality to deteriorate and render it aesthetically unacceptable and unusable. In this regards, the wetlands have been designed to achieve a level of efficiency for removal of pollutants, with emphasis given to the effects

of nutrients and suspended sediment. Ensuring that the functions of the wetlands are sustained is an important consideration in any proposal for development of such areas for various use. It is necessary that inputs of pollutants into the lake, derived from natural and human-related sources, are regulated and effectively controlled.

27.3.3 The Drainage System

The drainage system has been designed to match the operating and 1% AEP water levels, within the wetlands and the primary lake. Based on the *Putrajaya Lake Management Guide* report, about 40 per cent of the catchment runoff is expected to drain directly into the lake.

The drainage system will comprise a network of trunk drains which will be used to collect stormwater from contributing major and minor drains. The trunk drainage system, which is to be designed to cater to a 1 in 100 year storm event, will follow the existing drainage paths of the natural topography and discharge into rivers or the lake or detention ponds. *The Drainage Master Plan Study* for Putrajaya has identified some 58 km of trunk drains.

The major drainage system may comprise of an underground network, open channel system, overland flow paths or a combination to cater to a 1 in 100 year storm event. Minor drains consist of the network of street gutters, inlets, channels and pipes and are designed to meet a 1:2 to 1:10 year storm event.

The drainage systems is important in relation to overall management of lake quality as pollutants in runoff have the potential to be discharged into the lake via the drainage system. In view of this, it has been proposed in the Drainage Master Plan that Gross Pollutant Traps (GPTs) be installed at the end of drainage systems. The function of the GPTs is to remove gross solids such as trash and coarse sediment. These GPTs are normally designed with screens or racks to remove trash and sedimentation basin to collect coarse solids and sediment. Fine suspended sediment and trash smaller than the designed screen size may not be removed. In view of this, effective controls of pollutant inputs into drains is an important consideration in the management of lake water quality.

The drainage system within the Putrajaya development has been designed to be largely below ground, using pipes or conduits, with open channels likely to be confined to green belt areas. Even so, these open channels are likely to be dry most of the time except during rains or storm events. Hence the potential for trunk drains to be used for any recreational purpose is most unlikely.

27.3.4 Land Abutting The Lake

The lake has a long shoreline which generally follows the natural topography to the designed standing water level (EL 21.0 m) except where substantial modifications to the land abutting the lake have been made through excavation and reclamation. However, it is to be noted that the shoreline may change as a result of flood events that may cause water level in the lake to rise above EL 21.0 m. The general design of the main dam allows for a 0.5 m rise in the water level for 1 in 100 year flood event. However, the rise for the same events is 1.5 m in the case of the lake created by the temporary dam.

The land area that is within this “flood zone” will vary around the lake since this depends on the steepness of the banks of the lake. A wider area will be inundated where the banks are gently sloping as opposed to areas which are steeper. All developments are expected to be above the flood zone except for the developments such as beaches, boat ramps, jetties and others. For the most of the lake, the flood zone is likely to be a buffer where natural vegetation will be allowed to be established for the protection of the shoreline against erosion.

27.4 ZONING OF THE LAKE

The exercise of zoning of the lake has been approached taking into account the following considerations:

- i. The physical structure and organization of the lake which consists of its various components. These include the wetlands, the open water body, the collector drains and streams, and the water bodies constituting the retention basins;
- ii. The bathymetry of the lake, indicating the shallow and deep areas. This is important for example in the terms of the type and nature of boating activities that may be allowed; and
- iii. The designated land uses adjacent to the lake which dictates that activities undertaken near the lake should be compatible to the land uses proposed for the Putrajaya development.

The zones of opportunities and constraints have already been discussed in detail in the other sections of this report.

27.5 ENVIRONMENTAL POLLUTANTS OF CONCERN

Various pollutants of concern have been identified that have potential to affect the quality of water of the lake or its aesthetic value. These include inorganic nutrients, sediment, heavy metals, toxic chemical, oils and hydrocarbons, solid wastes and aquatic weeds. The other issues on the general concerns of the pollutants and the likely sources of such pollutants that have potential affecting the water quality is already covered in other documents available with Perbadanan Putrajaya.

27.6 ENVIRONMENTAL IMPACTS AND CONTROLS

Based on the analyses, the potential environmental impacts likely to affect the lake has been identified in Volume 1 – Overview of Planning, Environmental and Legislative Aspects of the Formulation of Regulations and Guidelines for the Control of Activities and Use of the Lake and other Water Bodies in Putrajaya document. The types of activities that are likely to be undertaken in or around the lake have also been identified in this document. Based on a general assessment of the activities and the types of pollutants or damage that is likely to result, the potential impacts have also been identified.

It is to be noted that controls may be by the way of prohibition of such an activity if it is thought that such activities are likely to have major impacts on the lake. In some cases, the activity may need to be restricted or controlled to certain areas of the lake or regulated in some other form. Conditions may be imposed on other activities and these are identified in the guidelines that have been drawn in this document.

27.7 RISK ASSESSMENT CRITERIA

The most difficult problem in creating acceptable risk criteria is the poor perception of risk by the general population. Communities, in general, are very inconsistent in their approach to, and understanding of risks. In many cases, the levels of risk are beyond the normal realm of everyday life. The uniqueness of Putrajaya Lake and the Wetlands will require an assessment of its own taking into consideration the host of factors that have direct impact on the risks posed.

Each activity will expose a risk unique to itself. Apart from the mixing of compatible activities, other important criteria to consider are the competency of the lake users, the standard of safety and design of the facilities and crafts, and the environmental elements such as lake water conditions and weather.

For the suitability of various water activities in the Lake and Wetlands, the consultants have used the Suitability Classifications namely:

- Category A – Desirable (with normal operating controls)
- Category B – Desirable with locational restrictions
- Category C – Desirable with locational and specific operational restrictions
- Category D – Undesirable unless specifically limited and controlled
- Category E – Undesirable

27.8 THE APPROACH TO RISK MANAGEMENT

The Risk Management Process will enable personnel within PPJ to identify potential problems, document these problems and handle them as necessary. It provides a simple analytical flowchart that is to be used to assess, strategize and evaluate potential risk, to determine if and when particular risks require action and who will manage the risk. The plan will provide determination factors for low-level and high-level management handling, triggers, and frequency of reviews. It also offers enablers to encourage communication throughout the project, and will illustrate a cyclical flow process framework for continuous risk management.

The four primary steps of the Risk Management Process are:

- i. Risk Identification - Stage 1, taking into consideration anticipated basic activities and facilities in or near lake.
- ii. Risk Assessment - Stage 1, based on identified risk with approved broad concept of development.
- iii. Risk Analysis - Stage 2, to be executed upon obtaining more detailed information on overall lake development.
- iv. Risk Handling - Stage 2, after analysing more detailed information on approved development.

However, a comprehensive approach involving six elements in the risk management process is to be adopted to enhance the risk recognition process; consisting of: anticipation, identification, assessment, analysis, control hierarchy and review. The risk/hazard identification process is to be conducted through the 4M concepts: Man, Machine, Maintenance and Medium.

The involvement of these processes towards the development of the emergency response manual will require the inputs from Perbadanan Putrajaya's risk management team. The lake risk management system will need to be integrated with that of the existing or yet to be developed risk management system ashore.

27.9 COMMUNICATION

27.9.1 Background

Effective Risk Management requires open communication among all levels of the organization. It is imperative that all tiers of project management create and sustain an environment and culture that enhances risk communication internally and externally to the organization.

The PPJ staff will often communicate with personnel external to the lake project about activities status, unresolved issues, schedules, as well as other relevant project-related topics. Sharing risk information is a part of PPJ's approach to internal and external communication because it keeps personnel informed and aware of potential problems. External communication is also used to elicit additional information that is needed to identify and/or understand risks or to acquire additional resources or assistance when mitigating risks.

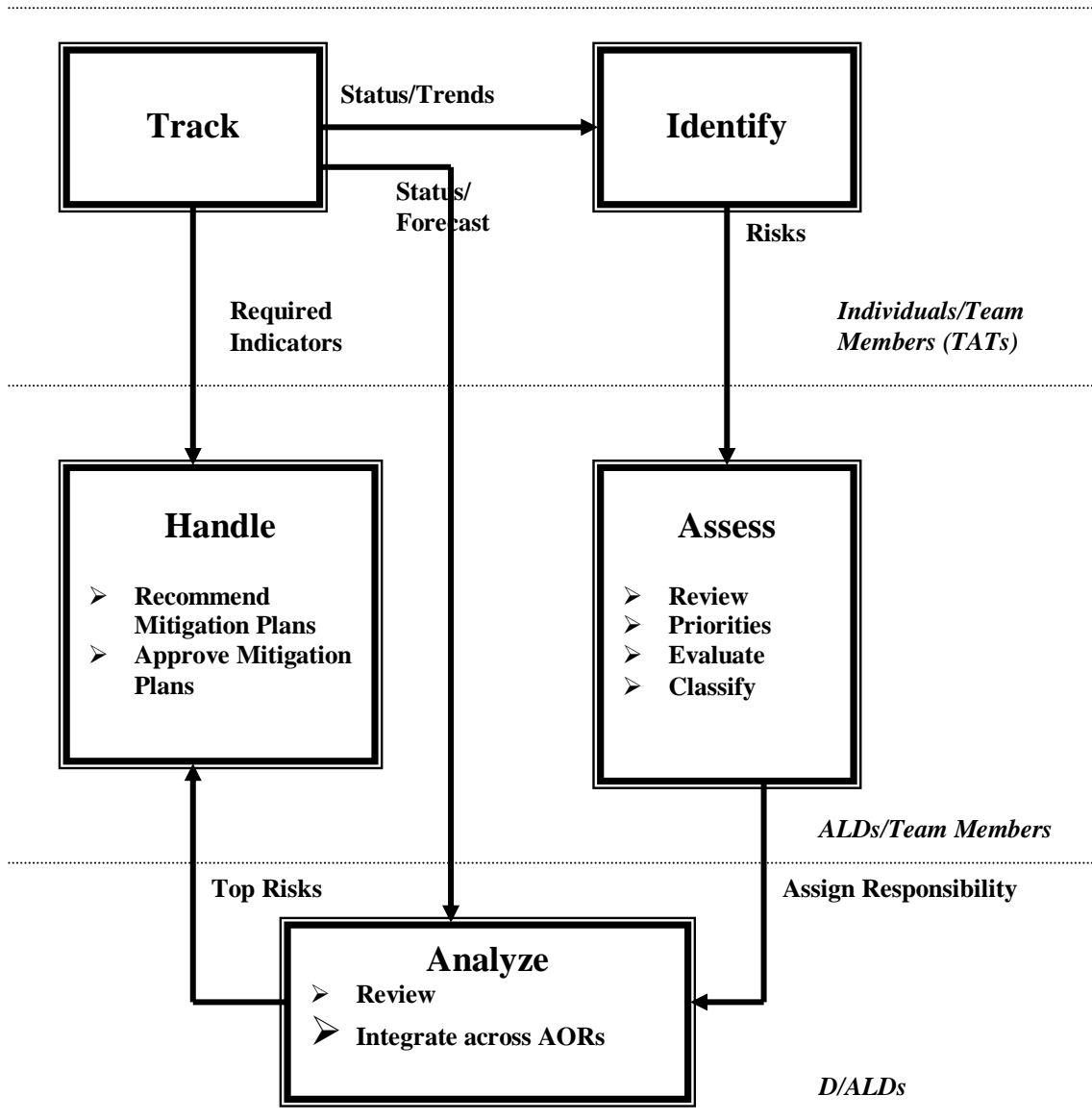
The paths for communicating risk information flow between the PPJ staff and its support contractors, Industry Teams and their subcontractors. Risk Management communication, at a minimum, requires:

- i. A free flow of information within and between all parties and project levels.
- ii. Formal, informal and impromptu communication.
- iii. PPJ and other project personnel to remain objective and professional.

27.9.2 Internal Communication

Internal communication will be considered any data or information flow to and from those directly or indirectly working for PPJ Lake project. Included among those groups are the private and public sectors and their contractors. **Figure 27.1** illustrates the Internal Risk Communication Flowchart.

Figure 27.1: Internal Risk Communication Flowchart



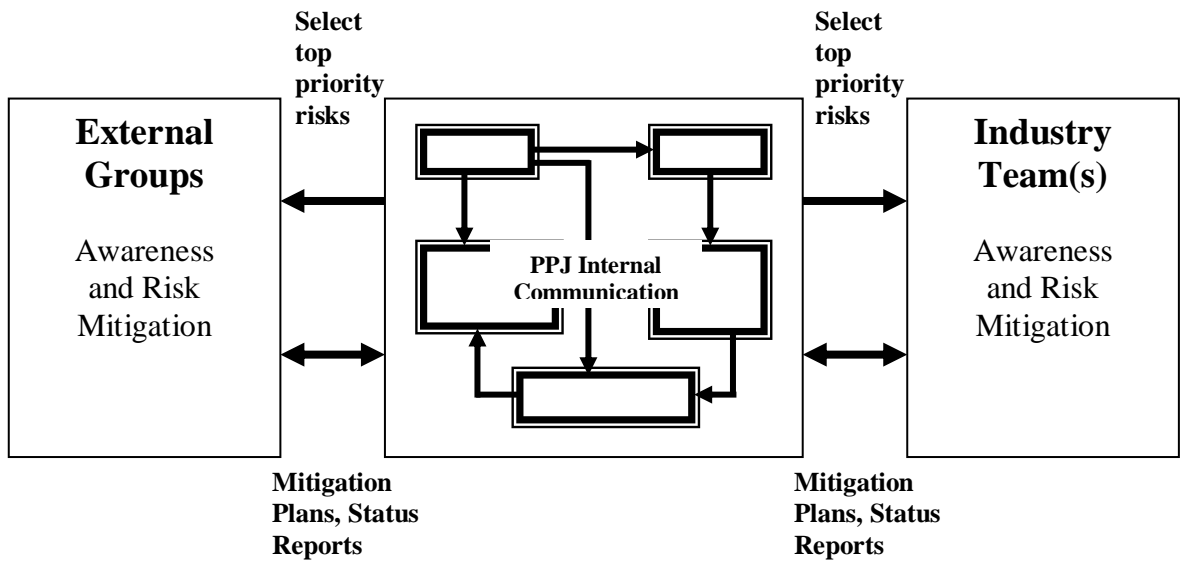
D – Director
AOR – Area Of Responsibility
RMST – Risk Management Steering Team

ALDs – Assistant Lake Directors
TATs – Technical Assessment Teams

27.9.3 External Communication

External communication will be considered any data or information flow to or from PPJ’s contractors and their subcontractors and the other private and public organizations’ personnel. Industry Teams are required to identify risk through functional design deliverables. In addition, Industry Teams may communicate risks to the Technical Assessment Teams (TATs) who will then submit the risks to their Area Of Responsibility (AOR) for analysis in accordance with the Risk Management Process. PPJ may also choose to communicate project risks to Industry when appropriate for awareness and risk mitigation through meetings and project documentation. **Figure 27.2** depicts the External Risk Communication Flowchart.

Figure 27.2: External Risk Communication Flowchart



It is important to bridge internal and external communication gaps to mitigate risk. Constant communication will:

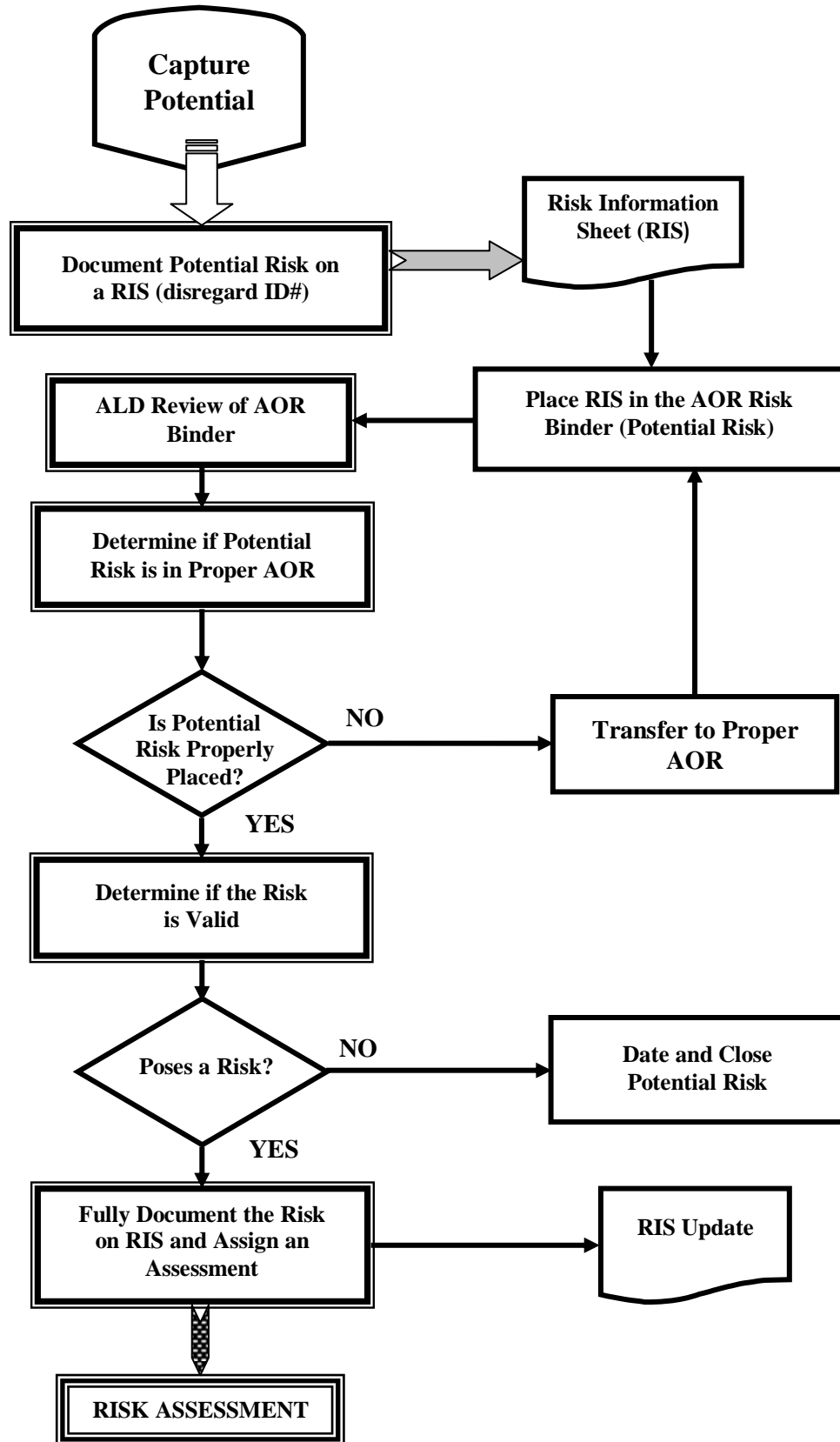
- i. Alleviate confusion.
- ii. Keep project personnel, senior management, and Industry Teams informed.
- iii. Bring about consistent expectations across the project.
- iv. Enable everyone to see the “big picture.”
- v. Allow Industry, Government and PPJ personnel to solve problems together when appropriate.
- vi. Bring potential issues to light early.

PPJ will have its own Lake and wetlands project management structure and also describes particular methods of communication, such as required reports and planning documentation. These methods and meetings organized by project management will open the doors for communication. Since meetings and regular discussions are ongoing, information and feedback on risk activities, current risks, and emerging risks will be exchanged both internally and externally to the project as part of the continuous Risk Management Process.

Communication occurs formally as well as informally. Communication is the key function in the continuous risk management model that links all steps in the Risk Management Process together and draws upon the participation of all personnel.

Figure 27.3 illustrates the Risk Identification Flow Process.

Figure 27.3 The Risk Identification Flow Process



27.10 RISK MANAGEMENT PROCESS

27.10.1 Purpose of the Risk Management Process

The purpose of the Risk Management Process is to structure and define a method of identifying and managing risk, and developing and selecting options for handling these risks. The process is intended to be a simple and unambiguous tool for those personnel involved with the response activities.

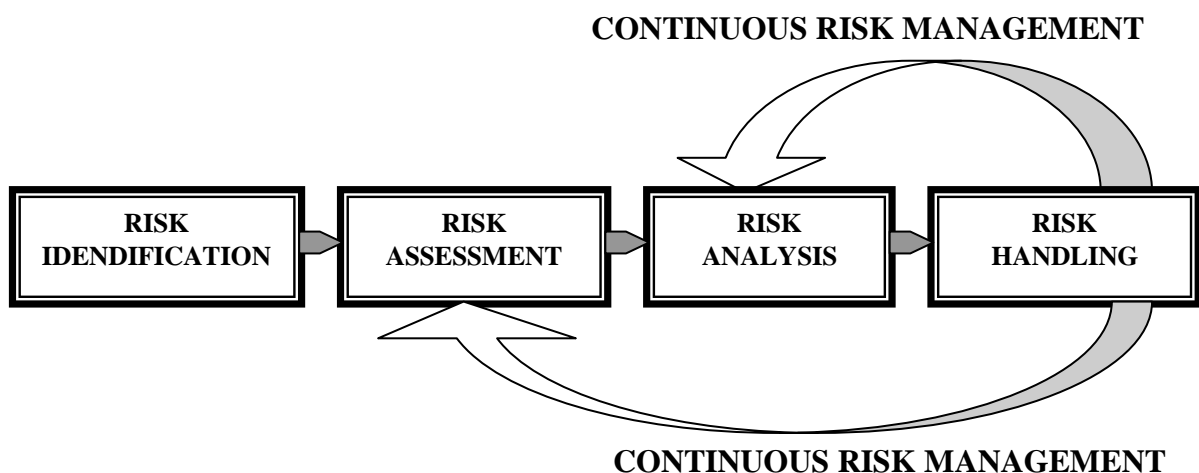
27.10.2 The Risk Management Process

The PPJ risk management process will follow a four-step methodology:

- i. Risk Identification,
- ii. Risk Assessment,
- iii. Risk Analysis, and
- iv. Risk Handling;

as depicted in **Figure 27.4** the Risk Management Flow Process.

Figure 27.4: Risk Management Flow Process



These steps will be followed and updated as required, throughout the life of the activities when managing potential risk. The working definition of Risk for the purpose of this report is as follows:

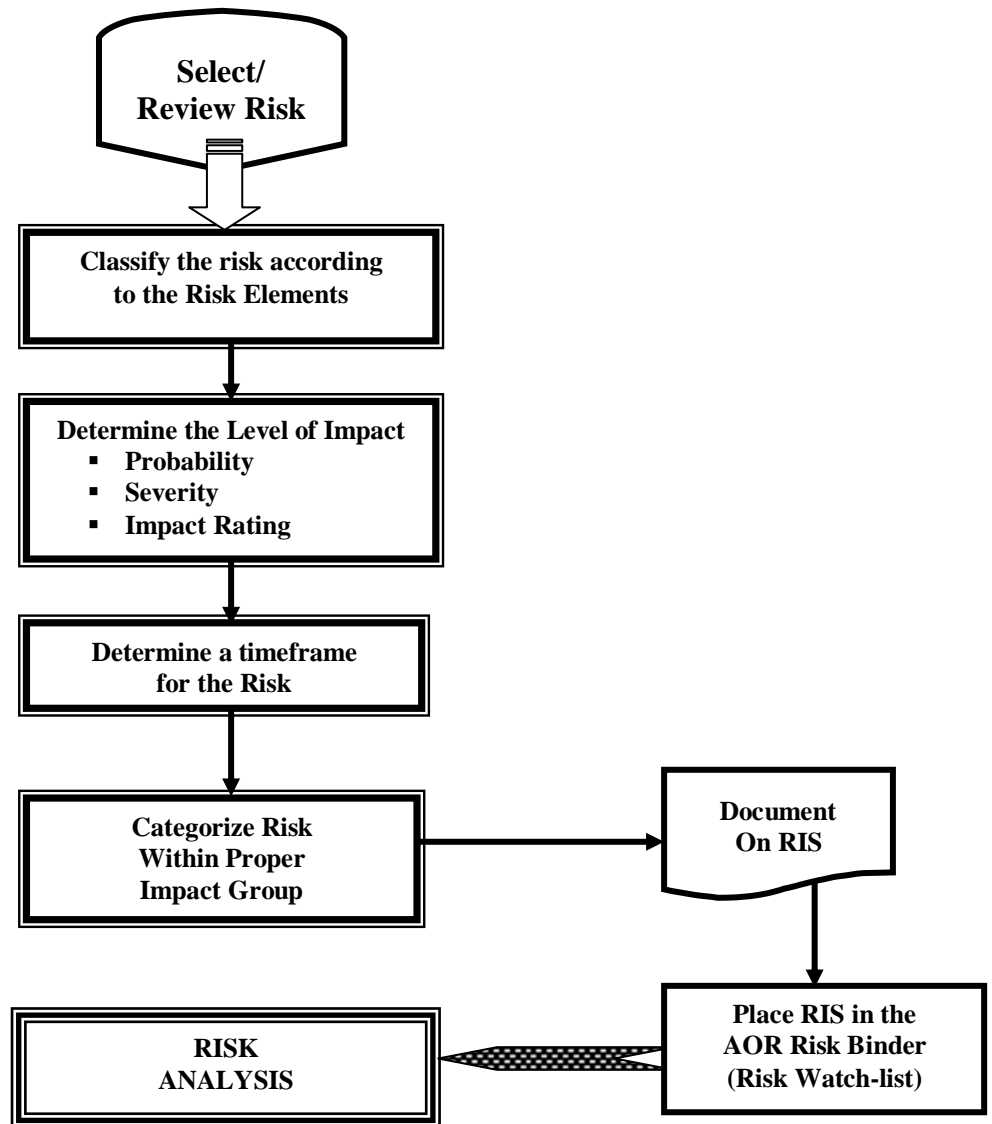
Risk - A risk is any factor that may potentially interfere with the successful conduct of the stipulated activities. By recognizing potential problems, the responsible person can attempt to avoid a problem through proper and decisive action. “A risk is not a problem – a problem has already occurred; a risk is the recognition that a problem might occur.”

27.10.3 Risk Assessment

After identifying a risk, the next step is to lay the groundwork for risk management. This is achieved by assessing risk and segmenting it into definite, understandable characteristics that allow PPJ personnel to weigh its relevance to other risks. This risk assessment process addresses the following:

- i. risk classification,
- ii. probability of risk,
- iii. severity of risk,
- iv. impact of risk,
- v. overall risk rating,
- vi. risk timeframe and
- vii. risk prioritisation.

Figure 27.5 Risk Assessment Flow Process



27.10.4 Risk Analysis

The transition from risk assessment activities to risk analysis activities is gradual, as there is some amount of analysis that occurs during the assessment process. During the assessment process, risks are evaluated to determine their project impact rating and relevant priority. These factors are the foundation for further analysis and evaluation that will be used for risk planning. For the purpose of this report (Stage 1), risk analysis is not covered. However, for understanding the relationship, a brief description is mentioned.

Risk analysis involves an examination of the changes in consequences caused by changes in the risk variables. Sensitivity and “what-if” analysis are examples of the activities that take place during risk analysis.

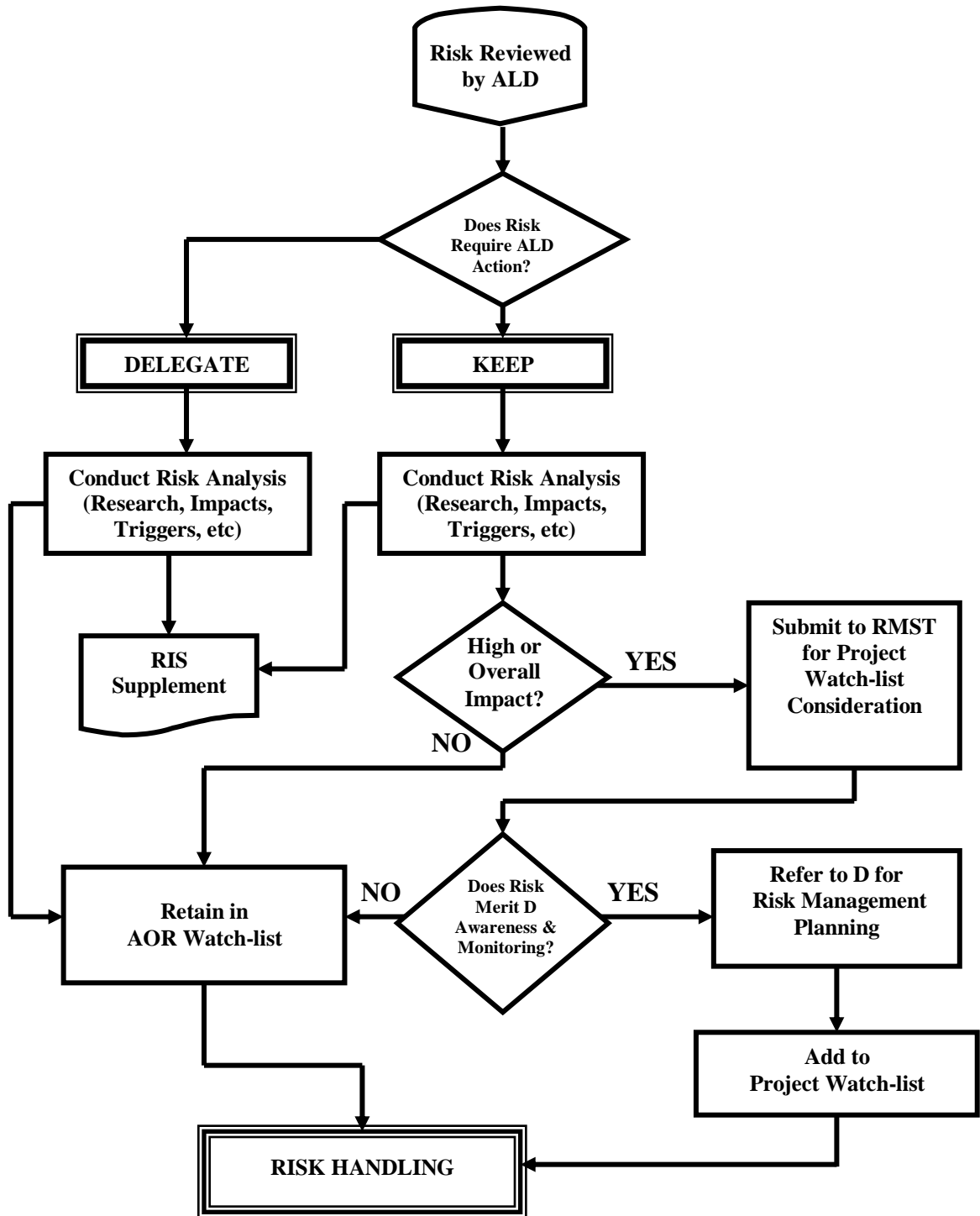
The risk analysis process is as follows:

- i. Review the risk
- ii. The ALC will determine if the risk requires ALC action or intervention. If so, the ALC will keep responsibility and authority. If the risk does not require ALC action or intervention, the ALC will delegate responsibility and authority to the appropriate team member within the AOR.
 - a. Keep: Retain accountability, responsibility, and authority. The ALC has the resources, knowledge, and position required to manage the risk. Part of the task might be accomplished by another, but you keep the responsibility and authority to commit resources and approve actions.
 - b. Delegate: Retain accountability, assign responsibility, and authority. Delegate to maximize effective use of resources and relocate management of the risk closer to the source of expertise or knowledge.
- iii. Determine if the risk has a High Impact. If so, and the ALC is unable to handle the risk at the AOR level, or the risk has an overall impact to the project, refer the risk to the Risk Management Steering Team (RMST) for Project Watch-list consideration. If not, place on the AOR Watch-list.

- iv. Determine if enough resources, knowledge and technical expertise exist to manage the risk. If so, commit resources and plan to handle (next process) the risk. If not, research alternatives before analysing the risk. Additional information may be provided as an attachment to the RIS.
 - a. Research: Investigate the risk until enough information is known to make a decision. Research can range from making a few telephone calls to prototyping a system component.

Figure 27.6 illustrates the Risk Analysis Process .

Figure 27.6: Risk Analysis Flow Process



27.10.5 Risk Handling

Risk Handling is the last critical step of the risk management process. During this process project personnel will make a decision to address and/or take action on the risk issues identified and evaluated in the risk assessment and risk analysis efforts. This process is the basis of mitigating risk and can be achieved by four risk handling methods.

The four methods are:

- i. Assumption (requires no action): *Do nothing*. Risk assumption is an acknowledgement of the existence of a particular risk, and a conscious decision has been made by project personnel to accept the risk without engaging in any special effort to control it. No further resources are expended in managing this risk. These are usually risks that are not significant enough to justify any expenditure and the project is willing to accept the consequences of the risk (accepted risks are usually closed and documented as such).
- ii. Avoidance (requires action): Eliminate or reduce the risk. Risk avoidance requires effort by project personnel which involves a change in the concept, requirements, specifications, and/or practices that reduce and mitigate risk to an acceptable level. By avoiding risk, project personnel will select an alternative that has a lower risk. Risk avoidance should:
 - a. Reduce the impact.
 - b. Reduce the probability of a potential problem.
 - c. Shift the timeframe.
- iii. Control (passive action): Monitor the risk. Risk control does not attempt to eliminate the source of the risk as avoidance does, but seeks to reduce or mitigate risk by continually monitoring and managing the risk in a manner that reduces the likelihood of its occurrence or minimizes its effect on the Deepwater Project. Risks that are controlled usually have:
 - a. Existing unfavorable conditions and need to be monitored for improved conditions.
 - b. The potential for significant impact, but the probability is low.
 - c. A trigger that serves as an early warning to prepare for the consequences (take contingency actions).

Triggers are thresholds for indicators that specify when action may need to be taken to mitigate risk. Triggers are generally used to:

- a. Provide warning of an impending critical event.
- b. Indicate the need for implementing a contingency plan to pre-empt a problem.
- c. Request immediate attention for a risk.

Effective triggers:

- a. Provide early warning, giving relevant personnel enough time to take an appropriate action or to focus extra attention on the risk.
- b. Do not trip unnecessarily.
- c. Are easy to calculate and report.

Triggers are to be documented on a RIS sheet and/or noted under action or an event of a Risk Mitigation Strategy Sheet.

- iv. Transfer: *Share the risk*. Risk Transfer is an action that reallocates the risk during the concept development and design processes from one part of the system to another, thereby reducing the overall system risk; or it is an action that re-distributes risk to appropriate external sources. The type of contract, performance incentives and warranties are means to share risk with the Industry Teams. In addition, risk may be transferred via regular TAT or project meetings with the Industry Teams when applicable.

Depending on the impact of the risk, the ALC or RMST will identify and determine the approach in which to handle a particular risk. The above risk handling alternatives will be formulated by the respective AOR risk managers and developed into a risk handling strategy. The strategy will be documented on the RIS and the status will be updated as necessary.

When mitigating risk, managers should collect and analyse risk data that allows for more precise quantification of risks and for greater precision in dealing with them. Risk mitigation is the process of correcting potential or existing ill conditions of the PPJ Lake Project through risk handling methods of avoidance, assumption, control, and transfer. This often involves the use of research, reviews, risk reduction milestones, development of fallback positions, and similar plans that involve risk reduction by tracking. Risk Mitigation Plans are recorded on the Risk Information Sheet.

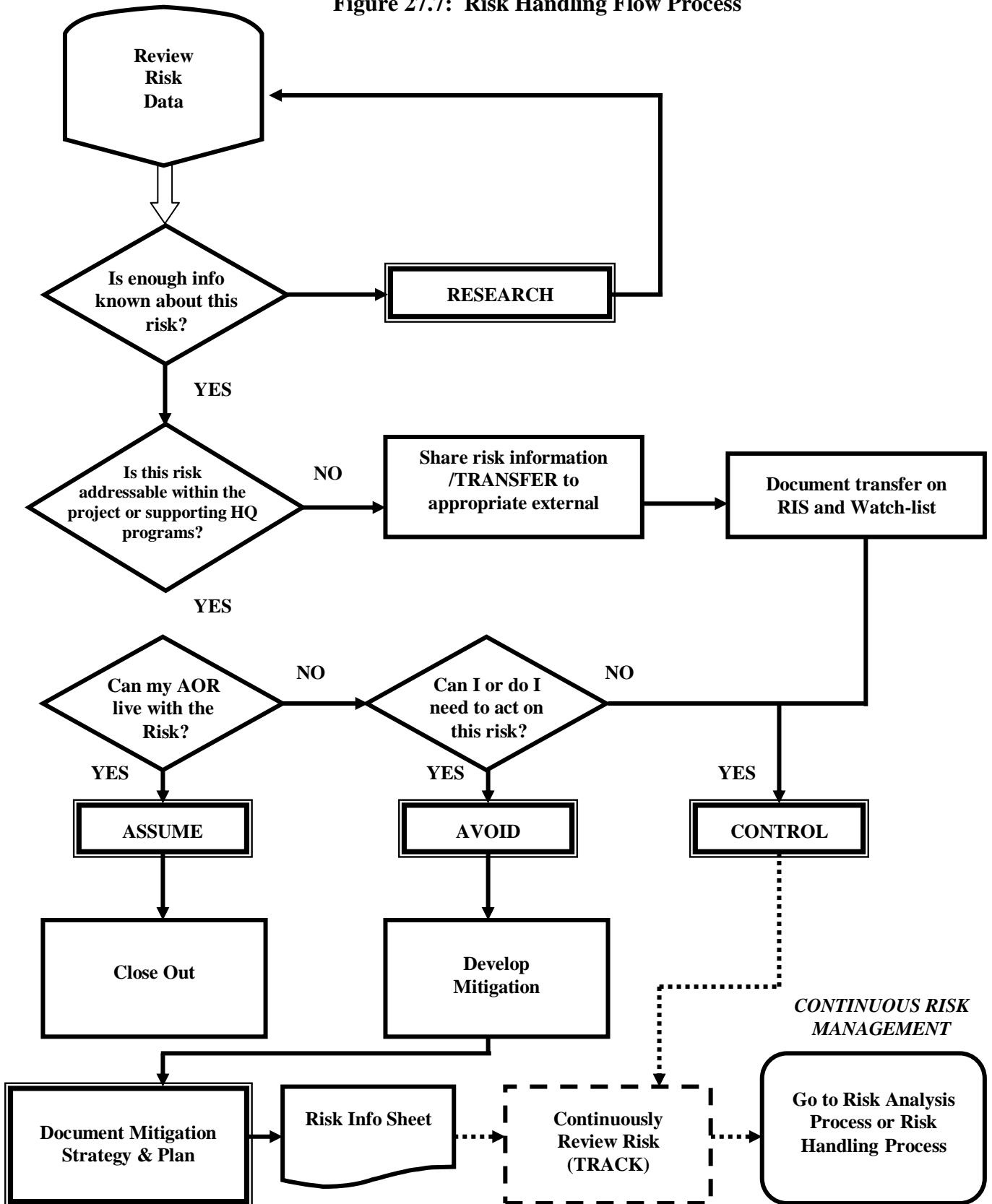
27.10.6 Risk Handling Process

The following describes the Risk Handling Flow Process.

- i. First, review the risk data.
- ii. Determine if enough data is available to make an informed decision and to act on the risk, if so, determine whether to Assume, Avoid, Control, or Transfer the risk. If not, collect more risk data via research or further analysis.
- iii. Document the handling strategy on the RIS, explain handling approach reasoning, and update the status as necessary.
- iv. If the risk is to be mitigated, determine and document the Risk Mitigation Strategy on the Risk Information Sheet, which includes:
 - a. Actions required to mitigate risk.
 - b. Dates to follow-up on actions.
 - c. Tracking indicators and triggers.
- v. Track the risk.

Figure 27.7 illustrates the Risk Handling Process.

Figure 27.7: Risk Handling Flow Process



For risks escalated to the RMST because of high or overall project impact, the RMST will determine a suitable risk manager and a handling approach to mitigate such risk. The RMST will review and evaluate alternative courses of action in terms of management responsibility, the resources required, and probability of project impact. The various risk handling approaches should be weighed against the following criteria:

- a. Feasibility of the approach (both physically and will it meet program requirements).
- b. The expected effectiveness of the approach in reducing project risk.
- c. Cost in terms of Ringgits and other resources.
- d. The time to implement the approach and the ultimate effect on the overall project schedule.
- e. Effects on the system's technical performance.

27.11 ANTICIPATED RISKS

27.11.1 Background

In general the various zones have been divided to have complementary activities. Other so called 'conflicting' activities are only allowed with special precautionary measures. These issues have been addressed in earlier sections. At this juncture however, it is necessary to differentiate the various levels of risk used for the purpose of responding to an emergency. Classification of risks takes into account of 4M Concept, namely - Man, Machine, Maintenance and Medium.

27.11.2 Risk Levels

- i. Risk Level 1 – No threat to injury or life at initial stage
- ii. Risk Level 2 – Threat to injury but no threat to life
- iii. Risk Level 3 – Threat to life
- iv. Pollution Risk (Level P) – Threat to the quality of water

Table 27.1 - Pollution Risk Level

POLLUTION RISK LEVEL	Remarks
Level P1	Clean litter
Level P2	Dirty litter/ rubbish/ sewage /decomposed body/ algae bloom/ floating fish/ plant disease/ pest
Level P3L	Oily water, Oil spill with Low risk (below 50 litres for wetlands and below 100 litres for others)
Level P3H	Oil spill with High risk (50 litres and above for wetlands and 100 litres and above for others)
Level PC	Chemical spill of any amount including pesticides.

27.11.3 Components Affected By Risk

Three broad components subjected to risk is identified below:

- i. Risk to Lake, including flora & fauna: L
- ii. Risk to Lake Users: U
- iii. Risk to Facilities: F

27.11.4 Overlapping Levels Of Risk And Priority For Response

On many occasions, there could be **overlapping levels** of risk for one incident. The higher level is always to be considered. The responder will then be expected to obtain additional information to further comprehend and determine what level of risk suits the incident for that particular moment. The level of risk may also **change with time**; whilst also dependant on the sensitivities of the specific **location**, taking into account the activities being conducted. For security and safety reasons, the urgency for response to Level 1 risk may at times be priority over Level 2 due to its potential long term impact.

27.11.5 Level And Nature Of Risk Table

The following table summarized the various levels of risks for different incidents:

Table 27.2 – Level and Nature of Risk

LEVEL OF RISK	NATURE OF RISK	REMARKS
L1	DISTURBANCE TO LAKE BED	Could cause turbidity and negative impact to environment and water life.
U1	ILLEGAL ACTIVITIES	Public may do activities not allowed in certain zones. Other prohibitive acts onboard crafts or terminals should not be allowed.
U1, F1	INFRINGEMENT ON CONTROLLED AREAS	Affect the security and privacy of designated areas.
U1	NOISE	Affect the lake users, public and the residents in the vicinity.
L1	OVERFISHING	Could disturb balance of fish population and depletion of certain species.
L1	OVERGROWTH OF VEGETATION IN WATER	Could retard water flow especially in the wetlands.
F1	PILFERAGE	Apart from wildlife and public facilities, mainly on life saving and fire fighting appliances/equipment put for the purpose of public use in emergencies.
L1, U1, F1	SABOTAGE	Posing threat to lake, users & facilities.
U1, F1	SECURITY	Security of facilities and personnel.
L1	SILTATION/ SEDIMENTATION	Could affect depth of lake and wetlands.
U1, F1	SUSPICIOUS BEHAVIOUR	A threat to security and safety.
L1	WAKE GENERATION	Affect the lake soft edge, destabilizing shorelines, and disturbing other water activities.
U2	ADVERSE WEATHER	Heavy rain and poor visibility by fog/mist could be main reason for special caution to be exercised when navigating in the lake. Less frequent is also the strong winds that could pose problems to some crafts and lake activities.
U2	ANCHORED VESSELS/CRAFTS (only allowed in emergency)	Can pose hindrance to other crafts and lake users.
U2	BLIND SECTORS	Areas that could be blocked by communication systems or view could pose a challenge to control.

PART F
EMERGENCY RESPONSE PLAN

LEVEL OF RISK	NATURE OF RISK	REMARKS
U2, F2	BOMB THREAT	A threat to safety of personnel and public. A threat to facilities.
U2	CAPSIZING	Could pose danger to personnel on boat and other lake users.
U2, F2	CIVIL DISTURBANCE & DEMONSTRATION	A threat to safety of personnel, public and facilities.
U2, F2	COLLISION/ RAMMING	Between crafts, crafts and facilities such as terminals and navigational marks and those involving personnel.
U2	CONFLICTING USE WITHIN A ZONE	Conflicting activities taking place at one location at the same time. Can pose danger to users.
U2, F2	DAM/WIER FAILURE	Due to public accessibility and facilities near the area, risk exposed to personnel is high unless strict measures are adopted.
U2, F2	DESTRUCTIVE BEHAVIOR	Could be towards people or facilities. Could cause commotion and panic to public.
U2	DRIFTING	By strong current in heavy rain especially in narrow channel and areas near the weirs and spillway.
L2, U2	DROP OF WATER LEVEL	Mainly due to dry season with excessive evaporation. Crafts may get stuck to the lake bed or strike bottom due to false impression as to actual depth of water.
U2	EMBARKING/ DISEMBARKING	Lack of control and safety procedures can cause dangerous situations at embarking/disembarking points for the public.
U2, F2	FLOOD	Affecting public and facilities.
U2	GROUNDING	Vessel with deeper drafts may wander into shallow areas not designed to accommodate its utilization. Could be due to drop in water level.
U2, F2	IGNORANCE	No lake users are allowed to plead ignorance with regards to safe utilization of facilities.
U2, F2	IMPROPER LIGHTING	Lighting is essential for safe operations at facilities frequented by public.
U2	INJURED BY PROPELLER OR STUNTS	Possible injury caused by propellers for those in the waters and also when doing stunts at high speed or considerable height.
U2, F2	LIGHTNING	Lightning could easily strike crafts out in the open waters.
U2	NAVIGATION CONFLICT	Could cause disaster when collision occurs. Could disrupt other activities.

PART F
EMERGENCY RESPONSE PLAN

LEVEL OF RISK	NATURE OF RISK	REMARKS
U2, F2	OVERCROWDING	Overcrowding can cause a host of problems including probable people being pushed into the waters and lake edge.
L2, U2, F2	OVERSPEEDING	Could cause accidents and damage to properties and loss of lives; and damaging to soft lake edge due to wake generation.
U2	PERSON OVERBOARD	Falling of person overboard from vessels or facilities. Can be injured by impact or drowning.
U2	POWER FAILURE	A threat to safety of public.
U2	ROBBERY	Posing danger to public.
U2	THREATENING, HARASSING, OR OBSCENE MESSAGES	A threat to safety of public and lake users.
U2, F2	UNLAKEWORTHY BOATS	Can affect safety of users and others in the vicinity.
U3	DROWNING	Apply to all lake users including non-swimmers and swimmers with fatigue.
U3, F3	ELECTROCUTION	Could be exposed to public or personnel at some facilities.
U3, F3	EXPLOSION	Could occur through impact between vessels, collision between craft and facilities, oil spillages at fueling station or adjacent road accidents.
U3	FALLING FROM HEIGHT	Impact of body and water, and possible submersion especially at terminals and weirs, dam and spillway.
U3, F3	FIRE	Exposed onboard crafts and facilities.
U3, F3	STRUCTURAL FAILURE	Mainly susceptible to overcrowding, utilization exceeding designs standards of structures or landslide. Could cause people to fall in water and drift by current.

27.12 POLLUTION RISK

Pollution sources could come from the water inlets (drains), adjacent roads (road tankers) and access ways, facilities (mainly ferry terminals, repair yard, fueling station and restaurants) and from the watercrafts themselves. *Putrajaya Environmental Management Guide* has elaborated on the environmental legislations, requirements, and management systems in Putrajaya. It is also clearly stated in chapter 6.12 of the document that all project proponents and contractors to identify and prepare plans to respond to any emergencies during the course of the planning and construction of projects.

For pollution risk, reference will need to be made to the emergency response or oil spill contingency plan to be developed for the appropriate response. It is clear that polluting is strictly prohibited in Putrajaya Lake. The detailed response to the various kind of pollution will be covered in Stage 2.

27.13 ACTIONS THAT CAN BE TAKEN TO MITIGATE RISKS

Table 27.3 – Actions That Can Be Taken to Mitigation Risks

MITIGATING ACTIONS	REMARKS
Only competent and well-behaved personnel can utilize the craft in the lake.	Through PPJ or Associations' training programs and regulations.
Lake users to be educated on the overall lake activities, facilities, rules and regulations, and risks involved.	Training programs to be developed and conducted by professionals.
Rules and regulations for all lake users to be developed and disseminated.	To be developed by marine consultants and brochures/ pamphlets prepared & distributed. Homepage to contain relevant information.
Fines and other forms of penalties to be incorporated for lake safety and environment offenders.	Fines rates and penalties compared elsewhere, standardized, instituted and revised as necessary.
Safety procedures required to be developed for all activities.	Input from consultant in Stage 2.
Safety guidelines to be imposed on all facilities.	To be developed by consultant.
Provision of adequate life saving and fire fighting equipment at various strategic locations.	To be detailed out by consultant in Stage 2.
Navigation routing system to be implemented.	The best Navigation routes to be recommended by consultant based on related intensity and variation of activities in/near the lake.
Aids to navigation such as leading lights and buoys to be instituted.	Consultant to provide required specifications.

PART F
EMERGENCY RESPONSE PLAN

MITIGATING ACTIONS	REMARKS
Have emergency response centers near critical areas.	As advised by consultant. Sufficient basic equipment and management to be in place.
Additional safety requirements imposed for night time activities.	Consultant to draw up requirements. Initially allowed for only ferry and cruise boat. For others, such as in special occasion, written permission of PPJ is required. This is accompanied with additional safety measures and control.
Maintaining good maintenance program for all crafts and facilities.	Consultant to recommend maintenance program for each type of craft. The maintenance record will be kept and updated in the INMS system for integrated use. The records are to be entered by specific managers and validated by PPJ.
Develop and implement a vetting procedure by a competent body for all crafts and facilities in different zones of the lake.	Appoint an independent and competent body, such like the classification society to do the vetting.
Lake to have sufficient mooring and berthing facilities.	As advised by consultant, taking into consideration future expansion.
Sewage, waste and oily water pumping station to be effective.	Regular checks made by PPJ enforcement officers. More than one system is recommended.
Develop and implement an effective communication and security system for the lake and its adjacent areas.	Consultant to provide details of suitable system to cover critical areas.
Develop a navigation chart both paper and electronic, that will indicate all critical areas for the safety of navigation and water activities.	Consultant to provide details in Stage 2 and integrate information into INMS.
Provide proper signage system for lake users, both ashore and in the waters.	Specifications to be developed and location identified by consultant.
Develop and implement an intelligent management system integrating the lake-use, navigation and emergency response plans.	The system to be develop by consultant in Stage 2.
Develop a potent enforcement unit in a dynamic management structure to monitor and supervise all activities taking place in the lake.	Consultant to advise on organization structure and functions of the Lake Division.

PART F
EMERGENCY RESPONSE PLAN

MITIGATING ACTIONS	REMARKS
Having a memorandum of understanding with all agencies involved in Putrajaya for cooperation in dealing with emergency response matters, including joint exercises and environment monitoring.	To identify policy issues involved. PPJ to play the leading role in handling all situation except those of national issues that requires PPJ to hand over the leadership role to the government.
Critical areas such as the weir, dam and spillway , ferry terminal, fueling station and repair yard to have a more elaborate safety design and features, and greater supervision. Additional safety and pollution prevention measures in these areas will need to be developed.	To obtain detail designs and specifications addressing the issues. Safety and pollution prevention measures to be developed in Stage 2 of study. Emphasis on these areas to be made.
The sensitive wetlands will require special care with regards to the water quality, and the flora and fauna.	The emergency response plan will have specific coverage for this area. Closer supervision is required in the area.
For special national events with more crowd, back-up enforcement is required from other agencies.	To identify policy issues involved. Apart from support facilities, the police and military personnel assistance is required.
Medical attention centers to be located at/near critical areas.	Areas will be identified in Stage 2. For big events, additional centers to be incorporated.
Training programs required to be developed for all lake users	Consultant to develop training programs with compendium in Stage 2.
Balancing means of the water level in the lake to be provided such as by having upstream storage.	In cases of long drought season or during period of filling in Lake 1B.
Routine monitoring of water quality and water level.	A PPJ unit to be identified to undertake the task.
Regular weather and navigation monitoring and reporting.	Warnings to be made (broadcasted) as necessary. Public educated on the safety procedures.
Continuous supervision of activities through routine patrol surveillance, closed circuit television and radar detection.	Details to be provided by consultant in Stage 2.
Professional management of facilities and water crafts.	Under active and close supervision of PPJ.
Proper stowage and berthing facilities of crafts.	Regular inspection by PPJ.

27.14 LOCATIONS FOR EMERGENCY RESPONSE FACILITIES

27.14.1 Proposed Emergency Response Facility Locations

It is proposed that facilities for emergency response be located as follows:

Position E1: KLCCUH – Wetlands Patrol & Response Sector

Position E2: Marine Police – North Patrol & Response Sector

Position E3: Main ERP Centre – West Patrol & Response Sector

Position E4: Spillway – South-Patrol & Response Sector

27.14.2 Justifications For Emergency Response Facility Locations And Basic Equipment Required

Position E1: Near KLCCUH office and storage facilities. Quite central to the central wetland region with good road access and suitable launching area. This region is the riskiest in terms of possible accident of tankers on the main road. This Centre will cover all other wetland areas. All other maintenance boats, vehicles and facilities of KLCCUH are expected to support in responding to any emergencies.

Type of boat: 4-5 pax (one), 30 HP

6-7 pax inflatable (one), 60 HP

ERP equipment: Life Saving Appliances, First Aid, Skimmer, Oil Boom, Dispersant, Absorbents & ancillaries

Position E2: Existing facility of the marine police can be further exploited to store the rescue and oil spill response equipment. Rescue boat station is already in place. The North Sector can be conveniently covered by this station.

Type of boat: 4-5 pax (one, excluding MP), 60 HP

6-7 pax inflatable (one, excluding MP), 100 HP

ERP equipment: Life Saving Appliances, First Aid, Oil Boom, Dispersants, Absorbents & ancillaries

Position E3: The main ERP Centre is central to the north-south space of the lake and adjacent to the southwest portion of the core island. It is close to the fuel station, repair yard and boat storage facilities situated on the southwest. It is close to the fishing zone which requires monitoring. The launching/recovery area is recommended to be on the southwest side of location so as not to

disturb routine utilization of the lake by other users on the main traffic stretch. The station would cover a broad view of activities within the West Sector. The land area for storage, parking and emergency coordination is most suitable. It is also located close to the hospital and Fire Brigade. The terminal to be large enough to moor the tug and the 12 pax vessel.

Type of boat: 4-5 pax (one), 60 HP
 6-7 pax inflatable (one), 100 HP
 6-7 crew tug, fire fighting & oil spill (one), 200 HP
 12-15 pax/VIP (one), fire fighting capability, 150 HP
 ERP equipment: Life Saving Appliances, First Aid, Skimmer, Oil Boom Dispersants, Absorbents & ancillaries

Position E4: Due to its potential of being the most critical position in the lake; an ERP Centre is recommended to be situated on the western part of the spillway. A launching/recovery facility could be installed. Response to emergency is expected to be most rapid in this area where it is expected that the rate of drift is anticipated to be the fastest. The dam area is exciting to the public and is made accessible to viewers which can be concentrated near the spillway. This Centre will cover the South Sector well. It is not recommended to be the main ERP Centre because of the intensity of activities taking place and the minimal land area suitable for storage of equipment. It is suggested that at least one boat will always be on standby near the intake tower ready for use.

Type of boat: 4-5 pax (two), 80 HP
 6-7 pax inflatable (one), 150 HP
 ERP equipment: Life Saving Appliances, First Aid & Coiled Oil Boom ready for use on each side of spillway, Dispersants, Absorbents & ancillaries. Special connections for oil booms to be fixed along east and west portion of spillway. Lifebuoys with Lights and Rescue Lines placed all along dam area and pedestrian bridge.

27.15 LIFEGUARD STATIONS

To be located at strategic location on all beaches at least one lookout tower for each beach area. Life buoys to be allocated at the whole stretch of beach. Security personnel cum lifeguards to be considered for cost effectiveness. Details of life saving appliances and facilities will be highlighted in Stage 2 of study.

LIFEBUOY & FIRE MONITORS

Throughout the stretch of the lake edge, especially on facilities extending into the waters, life buoys stations are recommended. At ferry terminals and marinas, fire-fighting monitors are to be provided at critical sites. The design of these stations and monitors should blend well with the beauty of the surroundings. Measures to avoid tempering of the equipment will be instituted.

27.16 EMERGENCY RESPONSE NEEDS

The risk assessment conducted in this paper is qualitative in nature and based on the experiences of the consultants involved. The added advantage the consultants have is of the various backgrounds available within the team. Comparative analysis was made where appropriate from the management of other facilities in other parts of the world. Literature review from various sources was made and visits to several marinas were executed.

This study indicated that the anticipated activities in and near the lake will expose the users and facilities to a host of environmental and safety challenges. Without a control system in place, it would not be possible to manage the various activities recommended.

Based from this assessment, there is a need for implementation of an effective emergency response system to address all the risks issues. Some of the factors that determined the need for the emergency response system are:

- i. To protect the natural beauty of the Putrajaya lake.
- ii. To upkeep the image of a national symbol with a world class management system in an intelligent city with life of quality.
- iii. To maintain a healthy and safe environment to all lake users.
- iv. To be prepared for the different levels and types of events taking place in the lake.
- v. To prevent any mishaps or incidents developing into a disaster.
- vi. To save lives.
- vii. To save properties.

For greater effectiveness, an integrated lake use, navigation and emergency response system is to be developed for Putrajaya, where decision making could be done exceptionally faster considering all critical elements in a holistic view of the situation. Despite the false sense of security and the underestimation that some parties have with regards to the size of the lake and the intensity of activities envisaged, the consultants would strongly recommend that concentrated measures be taken to address the issue of emergency response. The multifarious critical issues need to be resolved from the beginning. Redoing and re-patching work of a poor start is very expensive.

The dynamic challenges impacting the lake will require a dynamic emergency response plan. It is necessary that Putrajaya key personnel be exposed to the complex system of integrated management with respect to emergency response existing in other parts of the world. The proactive initial investment would ensure a higher savings in the prevention of disasters. In addition, the public will need to be educated and disciplined by a series of programs. The more detailed input and implementation exercise of developing effective and sophisticated systems is recommended to be done in Stage 2.

28.0 BRIEF FOR PUTRAJAYA LAKE & WETLAND EMERGENCY RESPONSE PLAN**28.1 INTRODUCTION****28.1.1 General**

The Putrajaya Lake potentials study account for the elements of water based activities in the lake, lake foreshore developments, infrastructures and facilities requirements, integration of lake and land use, wetlands and, management and safety aspects.

In addition, a study on associated danger, hazard and threat within Putrajaya Lake, promenade, shoreline and Wetland has been carried out. Risk Assessment for Putrajaya Lake and Wetland Attributes and Activities study, in Para 19.0, provides the probable and anticipated risks, by means of water activities, conservation and environs.

Appropriately a planned strategy is essential to preclude, control and response to probable emergency situations associated with the risks in and around the Lake. A wide-ranging, total processing mechanism is required to make decision, react and respond at shortest time possible. Speedy decision, reaction and response process inhibits the severity degree of catastrophe.

It is recommended that Perbadanan Putrajaya be fully equipped with a comprehensive emergency response plan with the capabilities for quick prevention, act professionally in response and precise coordination on overall emergency preparedness. This involves Lake facilities, infrastructures and the whole range of water-based activities, throughout the process of development and phase of implementation.

Consequently, the following recommendation for the preparation of comprehensive Emergency Response Plan is made taking into account of all necessary safety, precautionary and preventive measures within Putrajaya Lake & Wetland. Putrajaya Lake & Wetland Emergency Response Plan will be developed in the Stage 2.

The system to be developed will be compatible with all existing operating and software systems available in Perbadanan Putrajaya.

28.1.2 Purpose

Putrajaya Lake & Wetland Emergency Response Plan (ERP) establishes a process and structure for the systematic, coordinated, and effective delivery of Perbadanan Putrajaya (PPJ) assistance to address the consequences of any disaster or emergency in and around the Lake & Wetland.

The Putrajaya Lake & Wetland ERP will:

- i. Set forth fundamental policies, planning assumptions, a concept of operations, response and recovery actions, and PPJ related agency responsibilities;
- ii. Describe the array of response, recovery, and mitigation resources available to augment PPJ, agencies and local efforts to save lives; protect public health, safety, and property; and wherever applicable aid affected individuals;
- iii. Organize the types of agencies response assistance that PPJ is most likely to need under Emergency Support Functions (ESFs), each of which has a designated primary agency;
- iv. Describe the process and methodology for implementing and managing PPJ recovery and mitigation programs and support/technical services;
- v. Addressee linkages to other PPJ emergency operations plans developed for specific incidents;
- vi. Provide a focus for interagency and intergovernmental emergency preparedness, planning, training, exercising, coordination, and information exchange; and
- vii. Serve as the foundation for the development of detailed supplemental plans and procedures to implement PPJ response and recovery activities rapidly and efficiently.

28.1.3 Scope

- i. The Putrajaya Lake & Wetland ERP concepts will apply to all disaster or emergency as defined in the ERP, which includes a natural catastrophe; environmental problems; fire or explosion; or any other occasion or instance for which the Plan determines that assistance is needed.

- ii. The ERP will cover the full range of complex and constantly changing requirements following a disaster: saving lives, protecting property, and meeting basic human needs (response); restoring the disaster-affected area (recovery); and reducing vulnerability to future disasters (mitigation). The ERP will not specifically address long-term reconstruction and redevelopment.
- iii. The ERP will apply to all signatory government and independent agencies that may be tasked to provide assistance in a major disaster or emergency. For purposes of the ERP, any reference to government agencies with respect to their responsibilities and activities in responding to an emergency/disaster generally means government departments and agencies, as well as other organization to be directly associated in the ERP.

28.2 PUTRAJAYA LAKE & WETLAND EMERGENCY RESPONSE PLAN FRAMEWORK

- i. The combined emergency management authorities, policies, procedures, and resources of PPJ, government agencies, the private sector (if any), and other sources constitute a disaster response framework for providing assistance following major disaster or emergency.
- ii. Within this framework, the PPJ and Government agencies could provide personnel, equipment, supplies, facilities, and managerial, technical, and advisory services in support of Putrajaya Lake emergency response/assistance efforts. Various Government statutory authorities and policies establish the bases for providing these resources.
- iii. Delegate primary responsibility for coordinating emergency preparedness, planning, management, and disaster assistance functions through Putrajaya Lake & Wetland Emergency Management and assignment of emergency preparedness responsibilities. Other responsibility includes establishing Putrajaya Lake & Wetland emergency/disaster assistance policy.
- iv. Describes the structure for organizing, coordinating, and mobilizing resources to augment response efforts and implementing regulations & emergency operations plans.
- v. ERP may be implemented concurrently with:
 - a. Security, Safety, Communication and Electronic Surveillance Plan;
 - b. Environmental, Oil and Hazardous Substances Pollution Contingency Plan.

- vi. The Putrajaya Lake & Wetland ERP will be further implemented through various operations manuals, field operations guides, and job scope that detail specific agency actions to be taken.
- vii. The Putrajaya Lake & Wetland ERP will state, along with their jurisdictions, emergency operations plans describing who will do what, when, and with what resources. In addition, develops relationship between Putrajaya Lake & Wetland ERP with government agencies and other organizations emergency or contingency plans.
- viii. Preparation of pre-incident planning at all levels to identify operating facilities and resources that might be needed in response and recovery. Contingency planning will assist in targeting a specific issue or event arising during the course of an emergency/disaster and will present alternative actions to respond to the situation. Strategic planning will be used to identify long-term issues such as impact of forecasts and problems.

28.3 ORGANIZATION OF THE PUTRAJAYA LAKE & WETLAND ERP

The Putrajaya Lake & Wetland ERP will consists of the following sections:

- i. The **Basic Plan** will present the policies and concept of operations during an emergency/disaster. It will also summarize Perbadanan Putrajaya planning assumptions, response and recovery actions, and responsibilities.
- ii. **Emergency Support Function (ESF)** will describe the mission, policies, concept of operations, and responsibilities of the primary and support agencies involved in the implementation of key response functions. **ESF's** will include Logistics/Transportation, Communications, Monitoring of Weather and Water Quality, Firefighting, Information and Planning, Resource Support, Health and Medical Services and, Search and Rescue.
- iii. **Support** will describe the concept of operations of related activities required to conduct overall emergency/disaster operations, including Perbadanan Putrajaya Departments, inter-related Government Agencies and Public Affairs.
- iv. **Incident** will describe the concept of operations, and responsibilities in specific events that require a unified response under the Putrajaya Lake & Wetland ERP.

- v. *Appendices* will cover other relevant information, including terms and definitions, acronyms and abbreviations, guidelines for Putrajaya Lake & Wetland ERP changes and revision, and overview of an emergency/disaster operation.

28.4 EMERGENCY RESPONSE PLAN

The Emergency Response Plan will form the foundation for the total implementation of the emergency management within the Putrajaya Lake & Wetland. The Plan is projected to contain the following documents:

- i. The Emergency Response Plan
- ii. Emergency Response Manual
- iii. Integrated Emergency Response & Rescue System & Manual
- iv. Operation & Manual for ER & Rescue Operations with equipment specifications & schedule of maintenance
- v. Implementation schedule and budget for Emergency Response Plan
- vi. Training Standards & Programmes Manual

28.5 CONTENT OF WETLAND EMERGENCY RESPONSE PLAN

The proposed content of the Lake and Wetland Emergency Response Plan is as follows:

Basic Plan

- I. Introduction*
 - A. Purpose
 - B. Scope
 - C. Putrajaya Lake Emergency & Wetland Response Plan Framework
 - D. Organization of the Putrajaya Lake Emergency Response Plan
- II. Policies*
 - A. Authorities
 - B. Resource Coordination and Management
 - C. Outreach/Information Dissemination
- III. Planning Assumptions*
- IV. Concept of Operations*
 - A. General
 - B. Concurrent Implementation of Other Federal Emergency Plans
 - C. Integration of Response, Recovery, and Mitigation Actions
 - D. Organizational Relationships
 - E. Emergency Teams and Facilities
- V. Response and Recovery Actions*
 - A. Initial Actions
 - B. Continuing Actions

VI. Responsibilities

- A. ESF Primary Agencies
- B. ESF Support Agencies
- C. Recovery Agencies
- D. Other Federal Agencies
- E. Planning

Emergency Support Function

- Emergency Support Function — Logistics/Transportation
- Emergency Support Function — Communications
- Emergency Support Function — Monitoring of Weather & Water Quality
- Emergency Support Function — Information and Planning
- Emergency Support Function — Resource Support e.g. Fire-fighting, Oil Spill, Emergency Response etc.
- Emergency Support Function — Health and Medical Services
- Emergency Support Function — Search and Rescue

Recovery Function Annex**Support Annexes**

- Perbadanan Putrajaya Departments
- Government Agencies
- Financial Management
- Logistics Management
- Occupational Safety and Health
- Public Affairs

Incident Annexes**Appendices**

- Appendix A — Terms and Definitions
- Appendix B — Acronyms and Abbreviations
- Appendix C — Putrajaya Lake Emergency Response Plan Changes and Revision
- Appendix D — Overview of an Emergency/Disaster Operation

List of Figures

- Figure 1 — Emergency Response Framework
- Figure 2 — Emergency Planning Relationships
- Figure 3 — Organization of the Putrajaya Lake & Wetland Emergency Response Plan
- Figure 4 — Emergency Support Function Designation Matrix
- Figure 5 — Regional Operations Center Organization
- Figure 6 — Emergency Response Team Organization
- Figure 7 — Emergency Response Team Operations Section Organization
- Figure 8 — Emergency Support Team Organization

REFERENCE PLANNING AND DESIGN DOCUMENTATION

The following documents relating to planning and design of aspects of Putrajaya with relevance to Putrajaya Lake have been provided by Perbadanan Putrajaya and have been reviewed as part of this Lake Use study.

Table A1 - Reference Planning & Design Documentation

Putrajaya Review Of The Masterplan	March 1997
Putrajaya Review of Master Plan Transport Study	April 1997
Putrajaya The Federal Government Administrative Centre Operations And Maintenance Manual Z E Section 5: Surveillance And Maintenance	July 1997 December 1997
Transport Design Guide for Putrajaya	March 1998
Laporan Cadangan Pemajuan Cadangan Pembangunan Taman Botani, Precinct 1, Putrajaya	May 1998
Putrajaya Stormwater Management Design Guidelines	August 1998
Putrajaya Lake Management Guide Final Report Version 1.0	November 1998
Putrajaya Environmental Management Guide	November 1998
Putrajaya Federal Government Administrative Centre Peripheral Areas: Urban Design Analysis And Strategy Volume 2A – Precincts Analysis And Development Plan Precincts 7, 8, 9 & 10	December 1998
Permohonan Kebenaran Merancang Bagi Pendirian Bungunan Untuk Cadangan 'Promenade' (Ch 57.5 Hingga Ch 1875) Yang Mengandungi 'Boardwalk', 5 Buah Wakaf, Mukim Dengkil, Daerah Putrajaya, Selangor Darul Ehsan, Tetuan Senandung Budiman Sdn. Bhd. Final Document	February 1999
Projek Cadangan Pembangunan Promemade Di Precinct 10, Pusat Pentadbiran Kerajaan Persekutuan Putrajaya, Selangor Darul Ehsan.	February 1999
Putrajaya Bus Services to 2005	May 1999
Operations And Maintenance Manual Section 3: Biological (Wetlands And Forebays)	July 1999
Catchment Development And Management Plan For Putrajaya Lake Draft Final Report (Volume 2: Sectoral Report)	October 1999
Operations And Maintenance Manual Of Wetlands	December 1999

Formulation Of Regulations And Guidelines For The Control Of Activities And Use Of The Lake And Other Water Bodies In Putrajaya. Draft Final Report Volume 1 – Overview Of Planning, Environmental And Legislative Aspects Volume 2 – Draft By-Laws And Rules Volume 3 – User Guideline Volume 4 – Planning And Environmental Guidelines	December 1999
Cadangan Pembangunan Promenad Di Precinct 8 (Fasa 1A) Di Atas Pt Lot 1823 Dan 1824, Pusat Pentadbiran Persekutuan Putrajaya, Muim Dengkil, Daerah Putrajaya Yang Mengandungi Gazebo, Tandas Awam, Laluan Siarkaki, Pergola, Papan Tanda, Tempa Duduk, Tempat Membuang Sampah Dan Kerja – Kerja Yang Berkaitan Untuk Tetuan Putrajaya Ventures Sdn. Bhd. Permohonan Kebenaran Merancang Bagi Pendirian Bangunan Laporan Ringkasan Cadangan Pembangunan.	January 2000
Formulation Of Regulations And Guidelines For The Control Of Activities And Use Of The Lake And Other Water Bodies In Putrajaya – Final Report Volume 4: Planning And Environmental Guidelines	February 2000
Formulation Of Regulations And Guidelines For The Control Of Activities And Use Of The Lake And Other Water Bodies In Putrajaya – Final Report Volume 4: Planning And Environmental Guidelines Appendix 4	February 2000
Putrajaya Core Area Detailed Urban Design Development Control Document Volume 2: Precinct 2	February 2000
Development Proposal Report And Building Erection For Main Dam, Phase 1B, Government Administrative Centre, Putrajaya	May 2000 & July 2000
Control Of Activities On The Lake (Perbadanan Putrajaya) By Laws 2000 Arrangement Of By-Laws - Part 1 Preliminary - Part 2 Protection Of The Lake	June 2000
Catchment Development And Management Plan For Putrajaya Lake Volume 1: Main Report	June 2000
The Putrajaya Lake And Wetlands Water Quality Assessment Of Pollutant Sources, Wetland Status, & Management Measures Supplementary Report	June 2000
Pembangunan Tasik Putrajaya Fasa 1A	July 2000
Pembangunan Tasik Putrajaya Fasa 1B	August 2000
Permohonan Kebenaran Merancang Bagi Kelulusan Tatatur	August 2000
Laporan Pemantauan Ikan Ogos 2000 Tasik 1A dan Wetland Putrajaya	September 2000
Investigative Sampling Report Water Quality Monitoring (15/8/2000 through 14/9/2000) Lake 1A and Wetland Putrajaya	October 2000
KLCC monthly Report Plant Monitoring And Management	October 2000
Monthly Fish Sampling Report (September & October 2000) Lake 1A And Wetland Putrajaya	October 2000
Avifauna At Lake And Wetland Area Putrajaya	October 2000

Laporan Ringkas Cadangan Pembangunan	October 2000
Permohonan Kebenaran Merancang Bagi Cancangan Kerja-Kerja Lanskap Untuk Pakej Jalan R1B, R1F, R1G, R1H, R1I, R8, MCO1 Dan MDO1 Laporan Konsep Lanskap	November 2000
Planning Permission for Building Erection Approval Report for Precincts 3, 4, 5, 6 & 18 - Waterfront Promenade Advanced Works for Lake 2 Inundation, Putrajaya Core Island Area	November 2000
Kebenaran Merancang Dan Pendirian Bangunan Bagi Kerja-Kerja Pembinaan Empangan Utama Fasa 1B, Pusat Pentadbiran Kerajaan Persekutuan Putrajaya	December 2000
Conceptual Masterplan Report Cadangan Pembangunan Taman Wetland Fasa 2, Di Sebahagian Presint 11, 12 Dan 13, mukim Dengkil, Daerah putrajaya dan Sepang, Selangor Darul Ehsan	November 2000
Laporan Sokongan Bagi Cadangan Pindaan Ke Atas Pelan Susunatur Presint 1, Yang Telah Diluluskan [No Pelan PPJ/PER/1A-P1/1(1/16)] Yang Mengandungi Kafeteria Terapung, Panggung Terbuka, Souq (Paras 27.5m) Dan Laluan Pejalan Kaki Berbumbung Di Atas PT 16 Dan Sebahagian PT 111 Dan PT 112, Presint 1, Wilayah Persekutuan Putrajaya	Mei 2001

Table A2 - Reference Planning and Design Drawings

Design Drawing	References / Provided By	Date
Putrajaya Boundary	Pelan Warta Persekutuan Putrajaya (Standard Sheet 101-D, 102-C, 109-A, B, D, 110-A, C & 117-C) By Perbadanan Putrajaya	-
Overall Putrajaya Monorail Alignment	By T&T Konsult Sdn Bhd	-
Taman Botani Plan	Laporan Cadangan Pemajuan Cadangan Pembangunan Taman Botani, Precinct 1, Putrajaya By KLCC Bhd	May 1998
Bridge 8 (Jambatan Seri Saujana)	Cadangan Membina Jambatan Seri Saujana (BR 8) di Putrajaya, Mukim Dengkil, Daerah Putrajaya, Selangor Darul Ehsan By PJS1 Consultants Sdn Bhd	June 1999
Cyberjaya Landuse Plan	Pelan Pra Hitungan Untuk Projek Bandaraya Teknologi Maklumat, Fasa 1B, Zon Flagship Cyberjaya, Mukim Dengkil, Daerah Sepang, Selangor Darul Ehsan By Setia Haruman Haruman Sdn Bhd	16 April 1999 & 28 September 2000

Drainage Outlet – Lake 1A (Precinct 1, 2, 8, 10, 11, 12, 13 & 16)	Pembangunan Tasik Putrajaya Fasa 1A	July 2000
Drainage Outlet for Precinct 6, 17, 19 and Cyberjaya	Laporan Cadangan Pemajuan Tasik Fasa 1B Putrajaya By ML Design Sdn Bhd	August 2000
Western Monorail Bridge Crossing	Cadangan Membina dan Menyiapkan Lintasan Monorail Di Atas Tasik Di Putrajaya, Mukim Dengkil, Daerah Putrajaya, Selangor Darul Ehsan By Monorail Malaysia Technology Sdn Bhd	August 2000
Taman Wetland Layout Plan	Cadangan Pembangunan Taman Wetland Fasa 2, Di Sebahagian Presint 11, 12 Dan 13, mukim dengkil, Daerah Putrajaya Dan Sepang Selangor Darul Ehsan By Malik Lip & Associates	November 2000
Drainage Outlet – Precinct 7 and 8 Phase B	Cadangan Pelan Susunatur Di Presint 7 Di Atas Lot PT 23, 24, 127, 128, 130, 153, 25, 88, 2813 dan Di Presint 8 (Fasa 2) Di Ats Lot PT 2807, 2808, 2809, 2810, 2805 dan 2806 Mukim Dengkil, Daerah Putrajaya Selangor Darul Ehsan By AJM Planning & Urban- Design Group Sdn Bhd	19 February 2001
Precinct 17 Layout Plan	By AJC Planning & Development Sdn Bhd	July 1998
Precinct 12 Layout Plan	By RDA Harris Architects Sdn Bhd	30 April 2001
Precinct 18 Layout Plan	By Arkitek Urbanisma Sdn Bhd	May 2001
Precinct 5 Latest Layout Plan	By Arkitek Urbanisma Sdn	25 June 2001
Precinct 19 Layout Plan	By RMA Perunding Bersatu Sdn Bhd	27 June 2001