

(3) Recommendation

It is recommended that the new sewerage organization shall be integrated into PDAM, considering the importance of O&M cost saving and seriousness of shortage of sanitary engineers and technical staffs.

4. Training

Well-scheduled and appropriate trainings are very important for a successful operation of a new sewerage system.

There are basically two major courses of sewerage training :

- Training for management
- Training for Technical Staff

Some training can be done on the job, while others off the job. There are also oversea trainings and local ones. There are also training for new staff as well as middle and top management.

If a new organization for sewerage system is to be established, appropriate training courses should be scheduled on a good timing.

The recommended training courses are shown in Table F.5.1.

Table F.1.1 Functions for Sewerage Organization

Section	Function
(a) Administration	(1) Administrative (2) Personnel (3) Contracting (4) Purchasing (5) Warehouse (6) Others not included in other sections
(b) Finance/Accounting	(1) Treasury, Asset Control (2) Payment (3) Billing (4) Book Keeping (5) Budgeting (6) Financial Planning
(c) Public Relations	(1) Customers relations (2) Public relations (3) Motivation for new customers
(d) Planning	(1) Survey (2) Review of master plan (3) Technical Planning (4) Bidding and evaluation (5) Record keeping
(e) Construction	(1) Design and Cost Estimating (2) Bidding Documents (3) Supervising (4) Commissioning (5) Record Keeping
(f) O/M of Treatment Plant and Pumping Stations	(1) Operation of Treatment Plant (2) Operation of Pumping Stations (3) Maintenance (4) Repair (5) Water Analysis (6) Record Keeping
(g) O/M of collection systems	(1) O/M of large pipes (2) O/M of small pipes (3) O/M of manholes and others (4) Repair
(h) House connection & disconnection	(1) House connection (2) House disconnection (3) Record Keeping
(i) Environmental Monitoring	(1) Monitoring the Sewerage facilities (2) Monitoring the rivers (3) Monitoring the sea (4) Analysis of environmental conditions

Table F.2.1 Qualification of PDAM Staff
(Existing)

Job Description	Bachelor level	College level	High School level	Midle School level	Elementary School level	Total
Control Committee	-	-	-	-	-	-
Directors/vice-directors	11	4	8	-	-	23
Administration Division	4	2	24	6	11	47
Financial Division Kuta/ Sanur Units	1	1	16	2	2	22
Accounting Division	2	-	25	-	-	27
Customers Division	1	1	18	8	2	30
Production Division	1	0	17	-	-	18
Nusa Dua Unit	-	-	16	3	9	18
Maintenance Division	-	-	16	13	20	49
Transmission/ Distribution Division	1	1	12	19	17	40
Technical Planning Division	-	-	14	-	-	14
Security	-	-	-	9	28	37
Water Treatment in Belusung	1	2	19	3	-	25
Total	22	11	185	63	79	365

Table F.2.2 Water Tariff of PDAM

Category	Group	Amount(m ³)	Price (Rp.)
a. Social	A	Average	125 m ³
b. Social	B	Constant (0 to 10) 11 to 20 21 to 30 >30	1200 160 m ³ 240 m ³ 320 m ³
c. Non-trade	C	Constant (0 to 10) 11 to 20 21 to 30 >30	1900 240 m ³ 320 m ³ 480 m ³
d. Non-trade	D	Constant (0 to 10) 11 to 20 21 to 30 >30	2400 240 m ³ 320 m ³ 520 m ³
e. Trade	E ₁	Constant (0 to 10) 11 to 20 20 to 30 >30	4000 400 m ³ 800 m ³ 800 m ³
f. Trade	E ₂	Constant (0 to 20) >20	12800 1280 m ³
g. Industry	F ₁	Constant (0 to 20) >20	9600 960 m ³
h. Industry	F ₂	Constant (0 to 20) >20	16000 1600 m ³
i. Public tap	G	Average	125 m ³
j. Harbor	H		2400 m ³
k. Irrigation			500 m ³
l. Meter for A & G		Each Administration cost	200 month 200 month
m. Meter f. Irrigation			30000 month

Note : See Category in next page.

Table F.2.3 Water Consumption by the Category

Category	Customer Number	m3	Rp.	Average Water Charge/m3	Water Consumption Per Customer (m3/No.)
Social A	70	3.835	601,875	156.94	54.8
Social B	30	21.699	6,911,000	318.49	723.3
Non-trade C	191	36.157	16,780,160	464.09	189.3
Non-trade D	21853	752.321	314,591,420	418.16	34.4
Small trade E1	2657	91.509	67,289,400	735.35	34.4
Small trade E2	18	1.467	1,894,040	1,291.10	81.5
Large trade E1	279	22.060	20,637,140	935.50	79.1
Large trade E2	61	187.439	300,293,100	1,602.08	3,072.8
Public tap G	171	9.051	1,433,075	158.33	52.9
Harbour H	1	2.220	5,359,000	2,413.96	2,220.0
Irrigation	20	34.838	17,873,500	513.05	1,741.9
Without meter	25	3.525	6,242,800	1,771.01	141.0
Total		1,166.121	759,906,510	10,778.06	8,425.4

Table F.3.1 Proposed Sewerage System

Area	Denpasar	Sanur	Kuta	Nusa Dua	Total
Service Area (ha)	2,663	726	648	136	4,173
Population (2010)	284,100	27,800	21,580	1,540	335,020
Population Density (person/ha) (2010)	107	38	33	12	80
Wastewater (m ³ /d)	75,304	16,846	18,400	4,220	114,770
Sewer (km)	473.7	118.5	84.6	6.5	683.3
Pumping Station	2	4	4	1	11
Treatment Plant	1	0	1	1	3

Table F.4.1(1) Recommended Training Courses

I Administration and Finance

- A. General
 - 1. Organization and Sewerage Enterprise
 - 2. Role of Head of Finance and Administration Department
 - 3. Office Management
- B. Billing Operations
 - 1. Bills Preparation
 - 2. Bookkeeping Practices
 - 3. Bill Collection
- C. Warehousing and Inventory Control
 - 1. Stock Levels
 - 2. Materials Request and Ordering
 - 3. Material Receipt and Quality Control
 - 4. Inventory
 - 5. Payment of Materials
- D. Budgeting
 - 1. Revenues Budgeting
 - 2. Cost Budgeting
- E. Cash Flow
 - 1. Revenues
 - 2. Expenditures
 - 3. Investments
- F. Reporting Systems
 - 1. Financial
 - 2. Billing Operations
- G. Sewerage Tariff
 - 1. Tariff Structure
 - 2. Calculations

Table F.4.1(2) Recommended Training Courses

II Management of Sewerage Operations

- A. Wastewater Collection Systems
 - 1. Sanitary Sewers (Separate System)
 - 2. Storm Sewers
 - 3. Combined Sewers (Combined System)
- B. Pattern of Sewerage System
 - 1. Interceptor Pattern
 - 2. Other Patterns (zone, fan, radial)
- C. Maintenance
 - 1. Preventive Maintenance
 - 2. Corrective Maintenance
 - 3. Periodic Inspection
- D. Cleaning of Sewer
 - 1. Rodding
 - 2. Balling
 - 3. Flushing
 - 4. Jetting
 - 5. Vacuum equipment
- E. Wastewater Treatment
 - 1. Wastewater Characteristics
 - 2. Treatment Processes (primary, secondary, tertiary)
- F. Pumping Stations
 - 1. Operation and Maintenance
 - 2. Pump Station Failure
 - 3. Typical Operating Problems
- G. Safety
 - 1. Hazards
 - 2. Preventive Measures

Table F.4.1(3) Recommended Training Courses

III Wastewater Treatment

- A. Characteristics of Wastewater
 - 1. Physical
 - 2. Chemical
 - 3. Biological
- B. Treatment Processes
 - 1. Preliminary Treatment
 - 2. Sedimentation
 - 3. Biological Treatment
 - 4. Stabilization Ponds
 - 5. Oxidation Ponds
 - 6. Tertiary Treatment
- C. Sewer Outfalls
- D. Sludge management
 - 1. Sludge Characteristics
 - 2. Sludge Treatment
 - 3. Sludge Disposal

Table F.4.1(4) Recommended Training Courses

IV. Maintenance of Sewer system

- A. General
 - 1. Maintenance Organization
 - 2. Maintenance Tools and Equipment
- B. Maintenance
 - 1. Preventive Maintenance
 - 2. Correction Maintenance
 - 3. Periodic Inspection
- C. Sewer Cleaning
 - 1. Rodding
 - 2. Balling
 - 3. Flushing
 - 4. Jetting
 - 5. Bucket Machine
- D. Property Connection
 - 1. Removal of Blockage
 - 2. Cleaning of Inspection Chambers
- E. Pumping Stations
 - 1. Types of Pumping Stations
 - 2. Operation and Maintenance
 - 3. Pump Station Failure
 - 4. Typical Operating Problems
- F. Safety
 - 1. Hazards
 - 2. Preventive Measures

Table F.4.1(5) Recommended Training Courses

V Health and Safety in Sewerage Environment

- A. Personnel
 - 1. Medical Examination
 - 2. Procedures
 - 3. Use of Protective Respiratory Equipment
 - 4. Elementary First Aid
 - 5. Rescue Techniques
- B. Health
 - 1. Potential hazards
 - 2. Precautions to be Taken
- C. Preventive Measures
 - 1. Protective Clothing and Safety Equipment
 - 2. Precaution Against Potential Hazards
 - 3. Design of Sewers and Treatment Plants to Eliminate Hazards
 - 4. Identification of Hazards in the Environment
- D. Emergency Procedures for Sewers, Treatment Plant, and Pumping Section
- E. Other Topics
 - 1. Permit to Work Systems
 - 2. Safety of Persons other than Employees

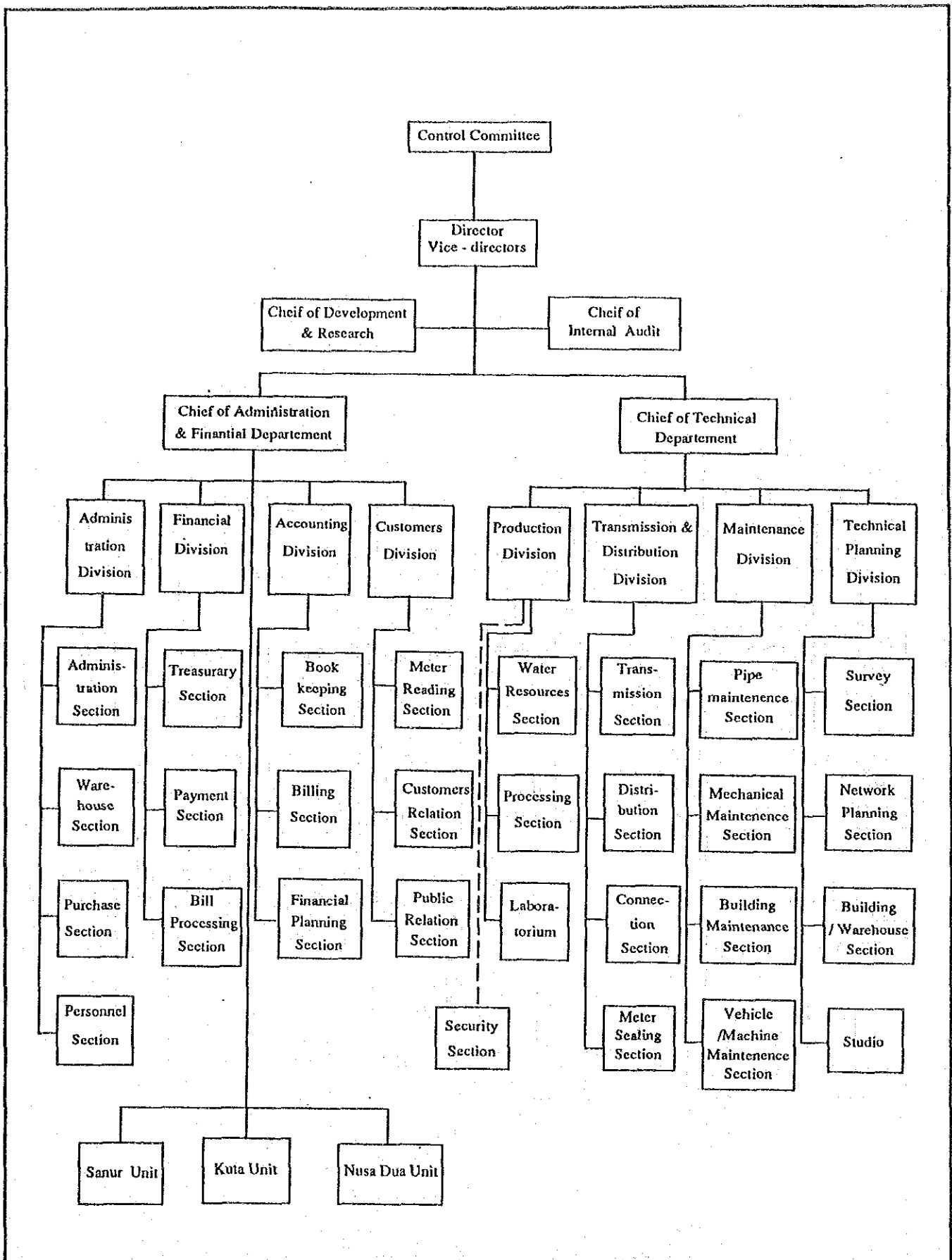


FIG. F.2.1

ORGANIZATION STRUCTURE OF PDAM (EXISTING)

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

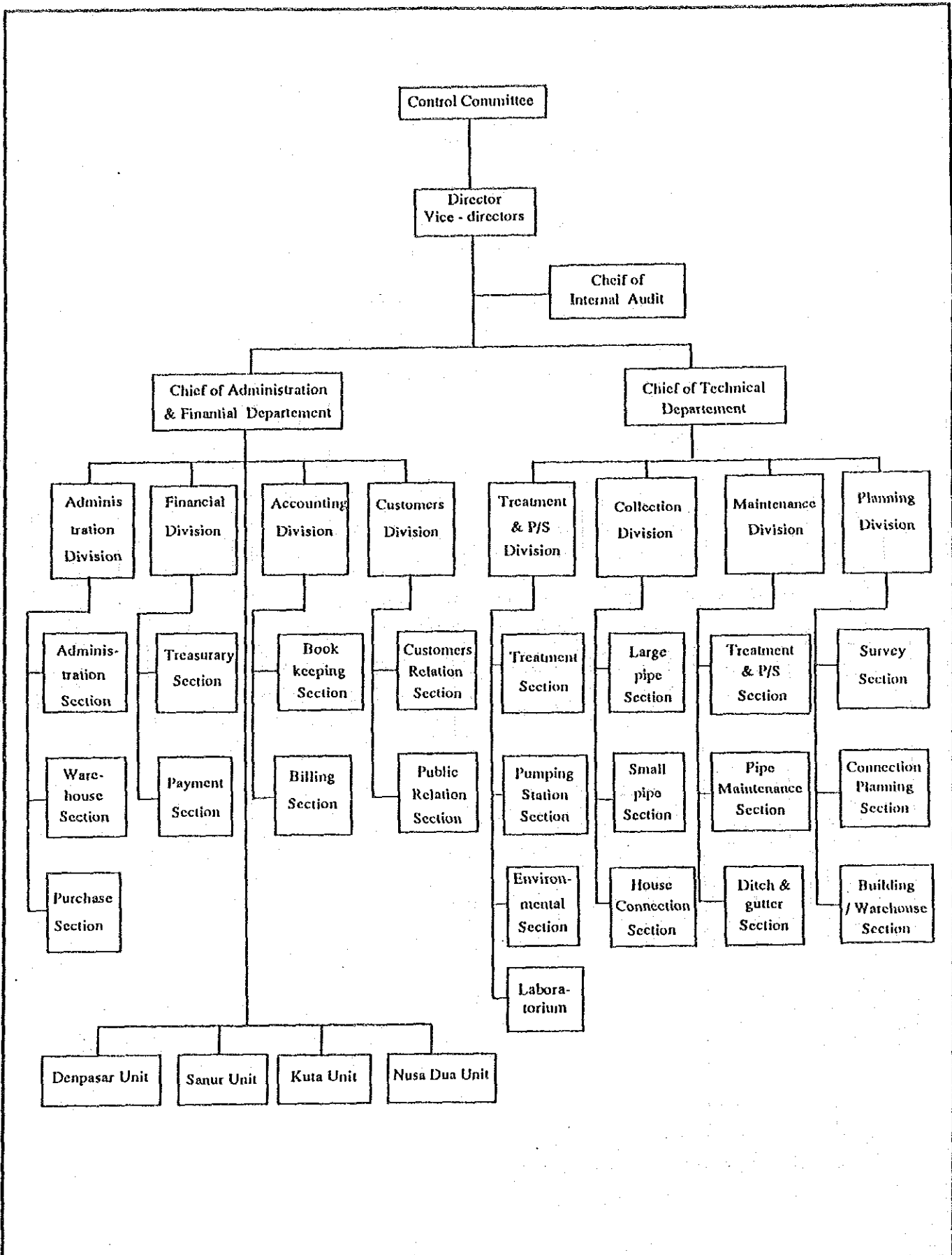
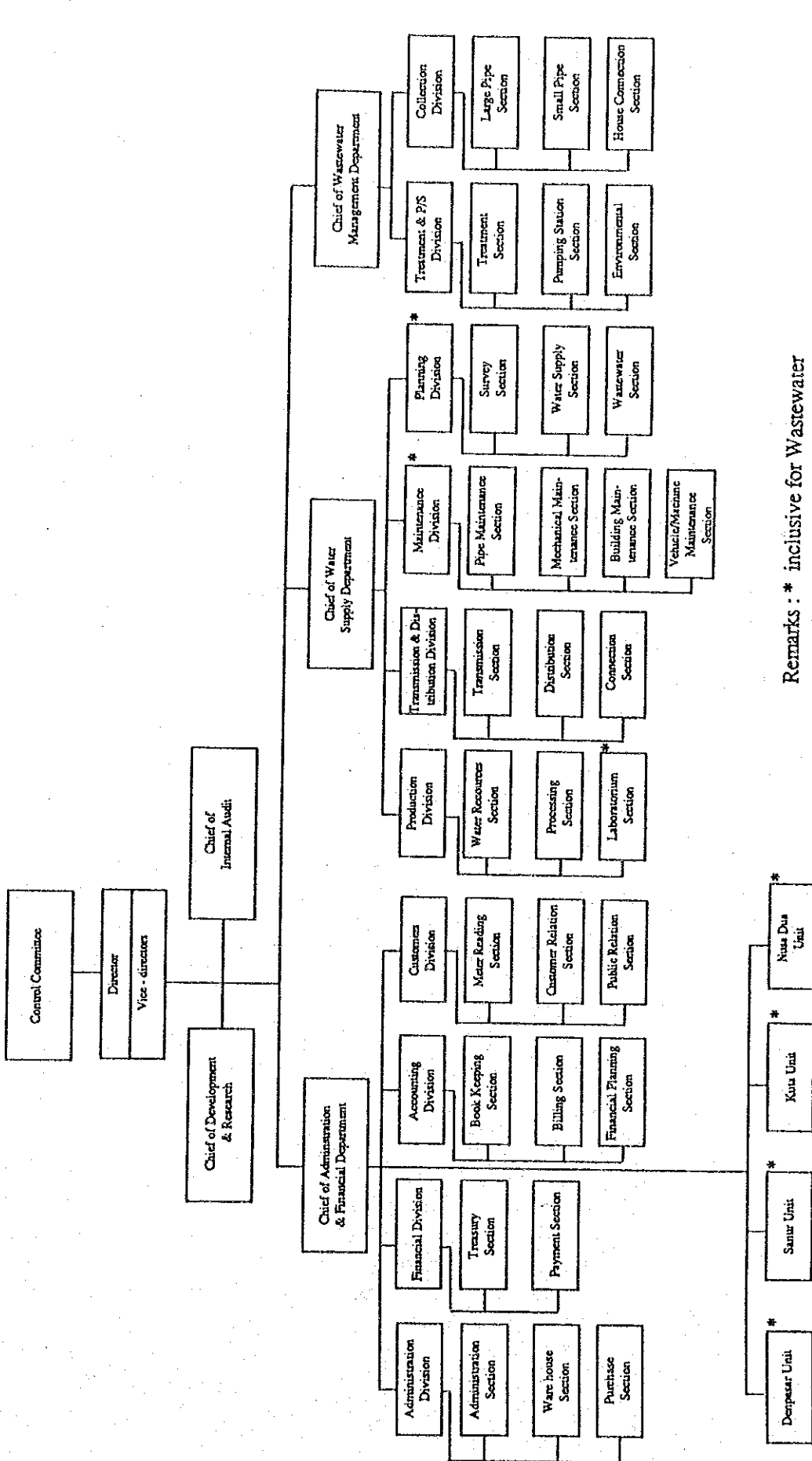


FIG. F.3.1 ORGANIZATIONAL STRUCTURE OF PDAL (INDEPENDENT ALTERNATIVE, PROPOSED)

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR



Remarks : * inclusive for Wastewater

FIG. F.3.2 ORGANIZATIONAL STRUCTURE OF PDAM (INTEGRATION ALTERNATIVE, PROPOSED)
 THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

APPENDIX G

*SUPPLEMENTARY
STUDY*

APPENDIX G SUPPLEMENTARY STUDY

Badung West Sewerage Development Project

1. General

Badung West Sewerage Development Area is included in Catchment Zone B. Catchment zone B is not covered by the urgent sewerage project in the feasibility study, because of its low economic efficiency. The construction costs of collection system of Catchment Zone B consisting of secondary & tertiary sewers, main sewers and lift pump station per served population is at Rp. 483,000, while it of the selected urgent area ranges from Rp. 201,000 to Rp. 300,000 with an average of 263,000.

In this supplementary study, contribution of Badung river water quality improvement by Badung West Sewerage Development Project is studied.

2. Sewerage Service Area

Badung West Sewerage Service Area is selected only the area where the interceptor collection system can cover. An area of 344.9 ha or 44% of Catchment Zone B is covered by Badung West Project. Badung West Project service area is shown in Fig. G.1.

Badung West Project covers a population of 22,448 in 1990 and 28,185 in 2000.

Badung West sewerage service area and served population of each sub-catchment area are shown in Table G.1.

Existing design gray water discharge of interceptor system are estimated at 6,209 m³/d in 1990 and 7,678 m³/d in 2000. The breakdown by sub-catchment are is shown in Table G.1.

3. Sewer Networks

Badung West Project consists of sewer main of 8,190 m with diameter ranging from 350 mm to 1,000 mm and one (1) lift pump station with a capacity of 6.12 m³/min. Length of main sewer by diameter and by earth covering depth is shown in Table.G.2.

Total construction cost of Badung West Project is estimated at to be 14.73 billion Rp. at 1992 price. Its breakdown is shown below.

Sewer Main	13,109.8 million Rp.
Lift Pump Station	1,617.3 million Rp.
Total	14,727.3 million Rp.

Breakdown of main sewer construction cost is shown in Table.G.2.

4. Contribution of Badung River Water Quality Improvement

Badung River water quality in the year 2000 with urgent sewerage development project and with urgent project incorporated in Badung West Project were estimated by using the simulated model proposed in the Master Plan Study. The simulated river water quality in dry and rainy seasons of the year 2000 are shown in Fig. G.2(1) and Fig. G.2(2) respectively, Compared to the existing river water quality.

The simulated Badung River water quality in dry and rainy seasons under the existing, future without project, future with urgent project and future with urgent project incorporated in Badung West Project conditions are summarized below.

Badung River water quality in BOD₅ (mg/l)

Station	4		5		6		Total	
	Dry	Rainy	Dry	Rainy	Dry	Rainy	Dry	Rainy
Existing (1990)	12.5	13.9	29.8	28.7	27.6	27.4	69.9	70.0
Future Without	15.9	17.9	39.0	37.8	41.1	36.9	96.0	92.6
Future with urgent	13.2	14.7	20.1	19.0	23.2	19.2	56.5	52.9
Future with urgent and Badung West	12.8	14.2	18.1	17.2	22.1	17.6	53.0	49.0

5. Conclusion

Urgent sewerage development project is expected to achieve a significant improvement of Badung River water quality at three sites of 4,5 and 6 with 39.5 point of BOD₅ in dry season and 39.7 point in rainy season with an average of 39.6 point.

While Badung West Project can only get 3.5 point in dry season and 3.9 point in rainy season with an average of 3.7 point.

Construction costs per Badung River water quality improvement of both the urgent project and Badung West project are Rp. 774.5 million per point and Rp.3,980.3 million per point respectively.

Badung West Project is not expected much contribution to Badung River water quality improvement.

Hence, Badung West Project is not proposed to be integrated in the urgent project.

Table G.1 Sewerage Service Area and Served Population of Badung West Project

Sub-catchment Area	Service Area (ha)	Served Population		Gray water Discharge (m ³ /day)	
		1990	2000	1990	2000
B-1	15.4	860	958	267	312
B-2	22.2	1,237	1,375	282	329
B-3	16	892	993	203	237
B-4	70.4	6,769	8,377	1,857	2,333
B-5	40.8	2,840	3,531	766	975
B-6	40	1,595	1,971	401	523
B-7	8.8	609	889	175	242
B-8	33.7	2,330	3,398	670	743
B-9	56.4	4,460	5,593	1,363	1,698
B-10	41.2	892	1,100	225	285
Total	344.9	22,484	28,185	6,209	7,677

Table G.2 Construction Cost of Main Sewer (Route - B)

Route No.	Diameter (mm)	Earth Covering Depth (m)	Length (m)	Unit Cost (x 1,000 Rp./m)	Construction Cost (million. Rp.)
B - 4	ø 700	5.0	1,080	2,294.7	2,478.3
	ø 700	3.0	100	955.7	95.6
	Sub-Total		1,180		2,573.9
B - 5	ø 800	3.0	440	1,004.8	442.1
B - 6	ø 900	3.0	310	1,093.7	339.0
	ø 900	5.0	1,660	2,469.2	4,098.9
	ø 900	7.0	60	3,474.9	208.5
	Sub-Total		2,030		4,646.4
B - 7	ø 900	3.0	310	1,093.7	339.0
B - 8	ø 900	5.0	780	2,469.2	1,926.0
B - 9	ø 1,000	5.0	180	2,591.8	466.5
	ø 1,000	3.0	320	1,187.3	379.9
	Sub-Total		500		846.4
B - 10	ø 1,000	3.0	1,020	1,187.3	1,211.0
B - 4 - 1	ø 600	3.0	150	501.7	75.3
B - 5 - 2	ø 350	1.5	480	223.8	107.4
B - 9 - 1	ø 350	1.5	220	223.8	49.2
	ø 400	1.5	160	242.3	38.8
	ø 400	3.0	750	348.9	261.7
	ø 400	5.0	90	1,962.0	176.6
	Sub-Total		1,220		526.3
(Siphon)	ø 450 x 2	7.0	80	2,600.0	416.0
Total			8,190		13,109.8

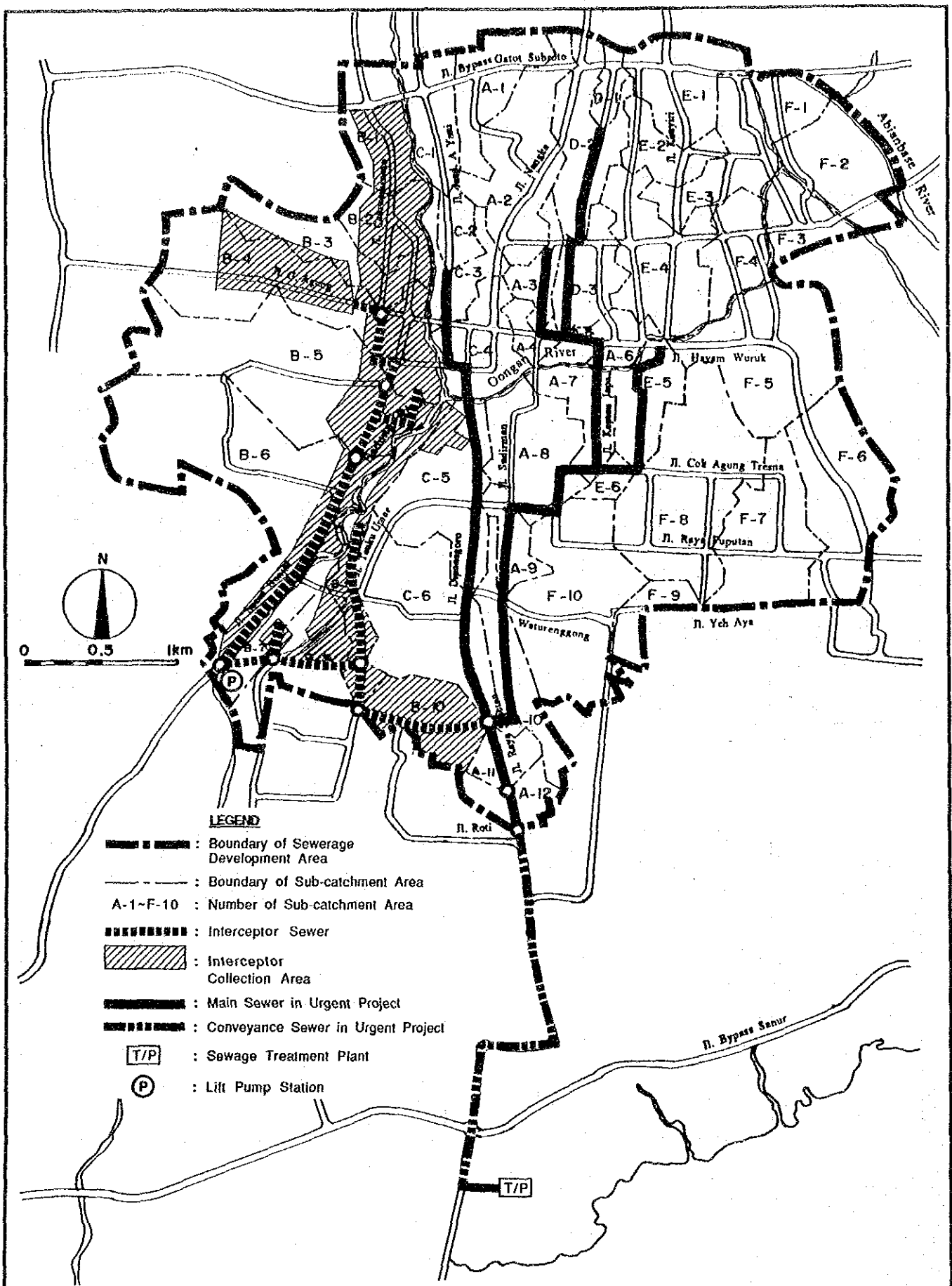


FIG. G.1

BADUNG WEST SEWERAGE DEVELOPMENT AREA

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

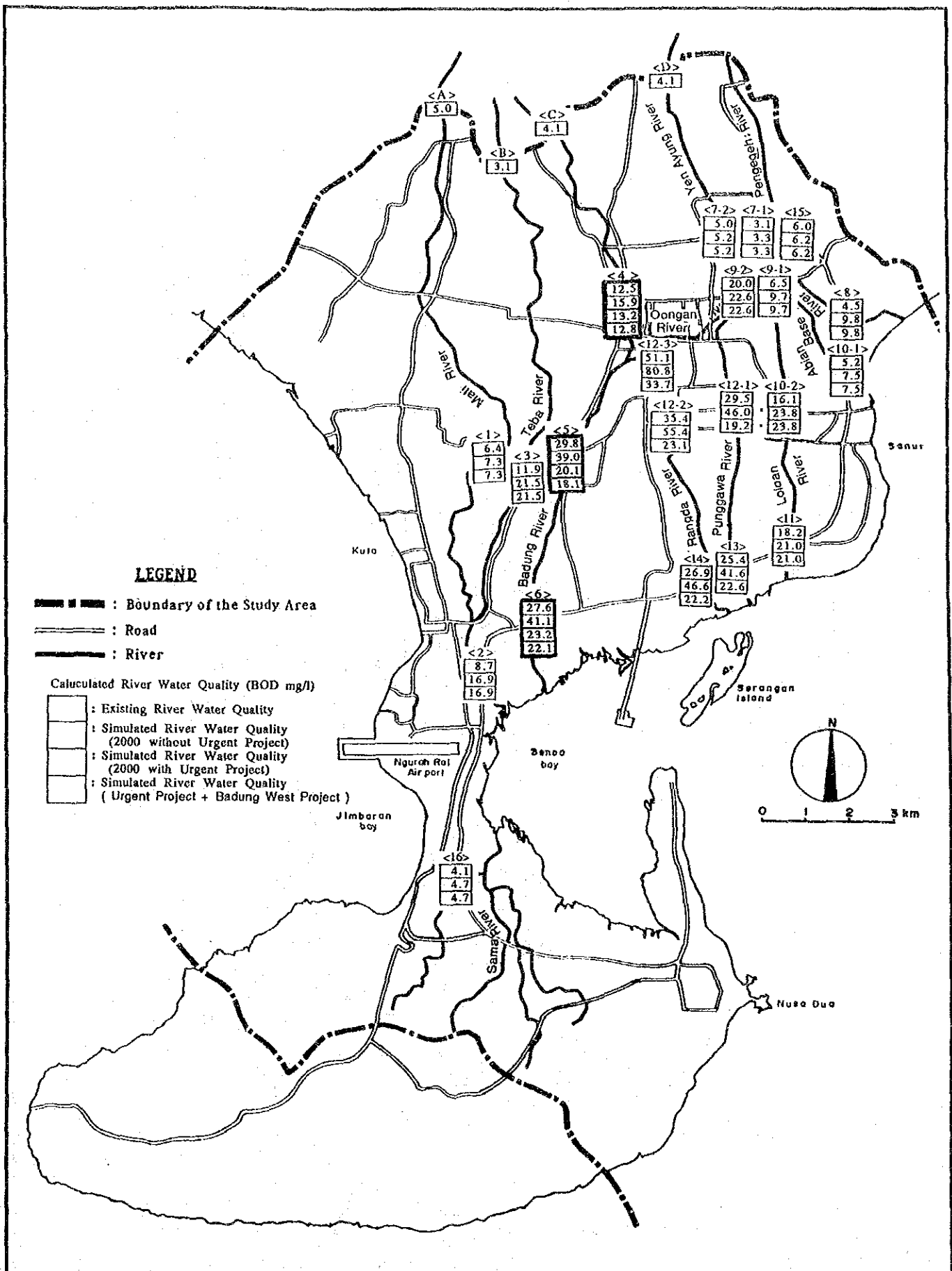


FIG. G.2(1)

SIMULATED RIVER WATER QUALITY IN 2000 (DRY SEASON)

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

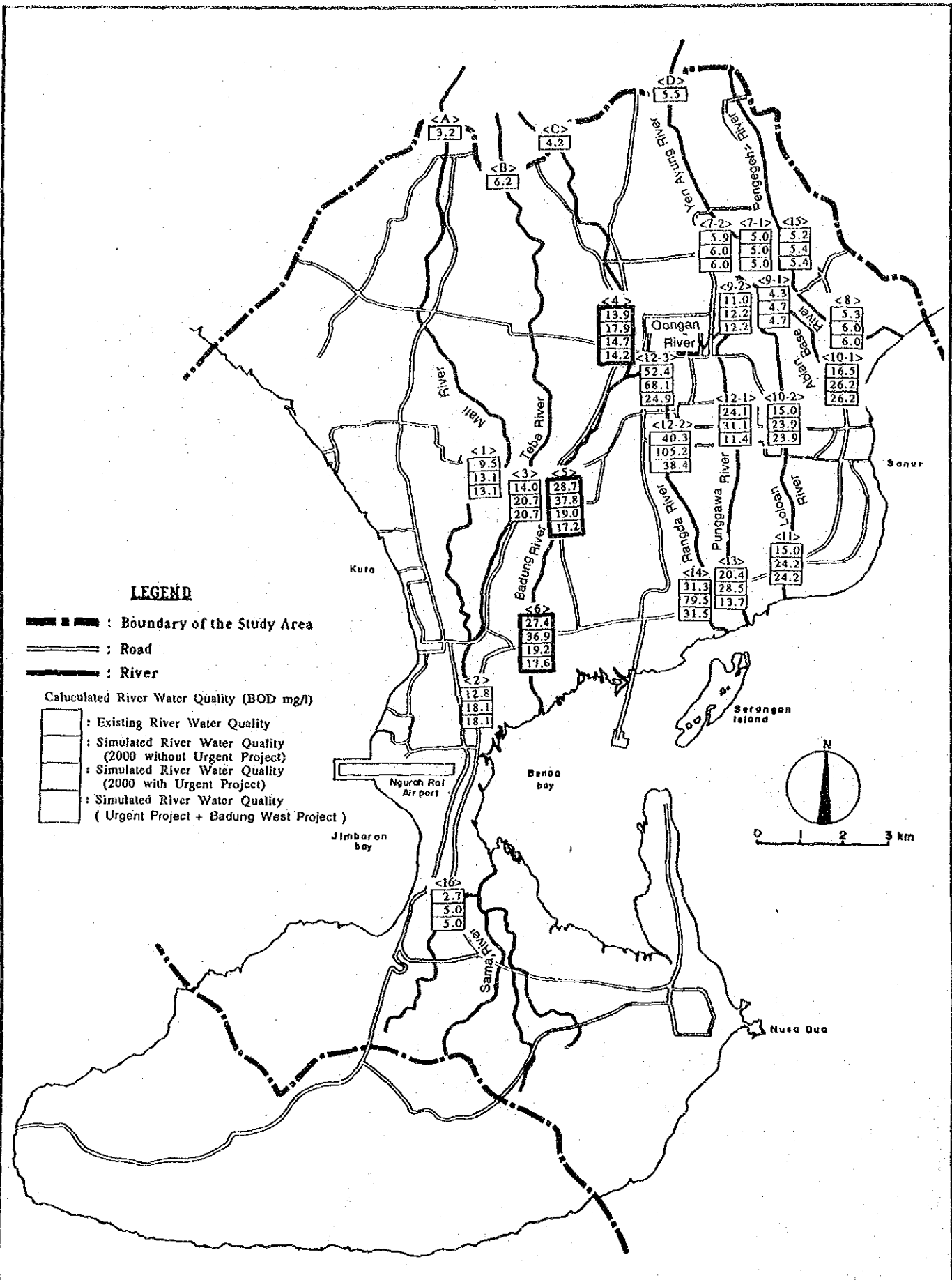


FIG. G.2(2) SIMULATED RIVER WATER QUALITY IN 2000 (RAINY SEASON)

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

