

THE APPLICATION FORM FOR JAPAN'S GRANT AID

- 1. DATE OF ENTRY : July 2000
- 2. APPLICANT : The Ministry of Water Resources (MOWR),  
His Majesty's Government of Nepal (HMGN)
- 3. PROJECT TITLE : *Establishment of effective Water Utilisation System, Training and Development of Groundwater Project in Nepal.*
- 4. SECTOR : Agriculture/Irrigation
- 5. PROJECT TYPE : 1. Equipment Supply  
2. Facilities Construction  
3. Establishment of effective method of water utilisation and training
- 6. TARGET SITE : Region: Birganj, Biratnagar and other Terai Districts covered, by DOI, Groundwater Resources Development Project, Field Offices (Refer to Appendix-1)
- 7. REQUESTED AMOUNT : Cost of completion of job under item no. 5  
(About Japanese Yen 610.39 Million)

8. DESIRED FISCAL YEAR OF IMPLEMENTATION:  
 Survey: Not applicable  
 Implementation: F. Y. 2000/01

9. IMPLEMENTING AGENCY:  
 Ministry/Agency of: Water Resources/ Department of Irrigation  
 Person In Charge (full name): Mr. R. L. Kafastha  
 (Affiliation): Director General  
 Address : Jawalakhel, Lalitpur  
 Telephone No. 537136, 537312, 224953 Fax : Int. 977-1-537169

10. OUTLINES OF THE IMPLEMENTING AGENCY

(i) Outline  
 The Department of Irrigation (DOI) was established in 1953. Before that, the Public Works Department looked after the development of irrigation infrastructure. As of 1993, the DOI had constructed 220 new irrigation schemes and provided assistance in the rehabilitation of more than 500 farmer-developed and managed irrigation schemes. The declared command area is 451,300 hectares.

The DOI has one central, five regional, seventy-five district, and twenty project offices with total 2,355 staff members, including technical occupations.

(ii) Authorities and Duty  
 The DOI is responsible for planning, implementation, operation and maintenance of irrigation and drainage development projects throughout the Kingdom. It is also responsible for planning and implementation of river training projects throughout the Kingdom.

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(iii) Personnel

- (a) Total number of staff on DOI main office: 200  
(b) Total number of staff in DOI Provincial Field Office
- |            |           |           |           |
|------------|-----------|-----------|-----------|
| Biratnagar | Lahan     | Birganj   | Butwal    |
| Lamahi     | Dhangadhi | Nepalgunj | Jafeshwor |

(IV) Budget (Unit: 1,000 NRs.) [ August / 1998 ]

	96/97	97/98	98/99	99/00
Annual budget (x 1000)	3,064,265	3,040,829	3,272,844	3,917,518
Number of staff members	2,355	2,355	2,355	2,355

(V) Organization chart (Refer to Appendix-2, 3 and 4)

## I. PROJECT DESCRIPTION

### 1. Background (Please describe in detail)

#### (1) Current situation of the Sector

Irrigation plays a key role in the development of agricultural sector, which has remained the backbone of the country's economy. Although agriculture sector contributes the most to gross national production, the development in irrigation has been less than expected, the agriculture sector has still to rely largely on rainfall. Frequent drought and excessive rain have hampered the actual growth of agricultural production on one hand, while on the other, the rapid population growth has led to a situation of full import for meeting the growing demand. In this context, it has become essential to emphasize on the irrigation development for increased agricultural production from the limited land with the use of surface and ground water resources available in the country.

Department of Irrigation have developed irrigation facilities in 534,102 ha of land during the eighth plan period. Target of the total irrigation area will thus reach 616,502 ha by the end of the Ninth Plan Period (2002) in which 14.14 % (87,174) is from ground water resources

#### (2) Problems to be solved in the Sector

65% of the irrigated area of the country is in Terai Area, which is a granary of the country. But especially in winter season, most of the surface water in Terai area is dried up. In that time the irrigation from groundwater resources is very important. The target of the irrigation area for the ground Water Resources Development Board under Department of Irrigation during Ninth plan period is 30,000 ha. Under such circumstances, the major problems in the sector are:

- Lack of the financial resource for undertaking implementation of underground water development and maintenance of the facility.

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- b. Lack of proper materials for maintenance and spare parts for water well drilling equipment and
- c. Lack of the financial resource for expansion of the drilling.

(3) Necessity and importance of implementation in the sector, which lead to the formulation of the project.

Unavailability of conditioned drilling equipment and sufficient spare parts are causing prevention of water well drilling works. Therefore we cannot make sufficient water wells and as a result, Irrigated area has not enough and cannot satisfy the requirement.

(4) Relations between the Sector and the Project.

The proposed project can help to proceed irrigation with underground water efficiently.

(5) Reasons why Japan's Grant Aid is requested for this particular Project.

The government of Japan has been successfully rendering Nepal the technical and financial assistance in implementing water resources development Projects. Equipments, which shall be rehabilitated or replaced, were supplied to Nepal under Japan's Grant Aid from 1981 to 1984. Therefore, the proposed project is being requested as a continuation of the fruitful co-operation between the two governments.

## 2 Objectives and Outline of the Project.

(1) Objective of the Project

(i) Short-term Objectives.

Rig machines received under this grant will used for Drilling for underground water development.

(ii) Medium and Long-term Objectives

There is a great demand for underground water development from the people. As Nepal has limited land, which is suit to cultivate, Nepal shall develop the land as much as possible to satisfy the requirement of food. Underground water development has efficient not only for agriculture but also for public health. Therefore as the long-term objectives, the proposed project can be efficient to sustain the nation's economy and people's life.

(iii) Please fully describe the relation between the project and objectives and how the project will contribute to the accomplishment of the objectives. The Rig Machines received under this grant will be utilized to meet short-term objectives.

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## (2) Outline of the Project

(please give a full description of each facility and equipment and their detailed specification)

- Equipment Supply (supply of Rig Machine)
- Facilities Construction
- Establishment

List of facilities, equipment and material is given in *Appendix 5*

The present machine depository with working area is as follows.

Machinery depository	Working area
a. Biratnagar	Jhapa, Morang and Sunsari Districts.
b. Lahan	Siraha and Shaptari Districts.
c. Parwanipur	Bara, Parsa, Chitwan and Rautahat Districts.
d. Butwal	Nawalparasi, Rupandehi and Kapilvastu Districts
e. Lamahi	Dang District.
f. Nepalgunj	Banke and Bardiya Districts
g. Dhangadhi	Kailali and Kanchanpur Districts
h. Mahottari	Dhanusha and Sarlahi Districts

- (3) Cost Estimates (Please describe in detail all the premises on which the cost estimates are based such as basic unit prices, inflation rate, foreign exchange rate, and so on. Please attach detailed tables of estimated costs of each facility and item of equipment. If estimated in local currency, please mention the latest exchange rate of the currency to the US \$ or the Japanese Yen)

Cost of Rig Machines with spare parts (the project cost) : Yen-610.39 millions

## 4. Benefit, Effect and Publicity of the Project

(1) Population that will benefit directly from the project population of Terai District ( i.e. 8,628,078: CBS 1991)

(2) Population that will benefit indirectly from the Project

Population of whole country: 21,84,3068 (1998) estimated according to growth rate.

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(3) Area that will benefit from the Project

Jhapa, Morang, Sunsari, Siraha, Dhanu:ba, Shaptari, Udayapur, Bara, Parsa, Mahottari, Sarlahi, Chitwan, Parsa, Rupandehi, Rautahat, Nawalparasi, Kapilvastu, Dang, Banke, Bardiya, Kailali, and Kanchanpur Districts (i.e. 34,019 sq. km.)

(4) Economic and Social Effects of the Project (Please describe in details)

(i) Current situation

Water well drilling equipment, which received under former Japan's grant made good Economic and Social Effects. Results of their works are as per attached sheets *Appendix 6* But after more than 10 years operation, Water well drilling equipment is insufficient conditions to proceed its work due to poor maintenance caused by shortage of spare parts and wear and tear more than 10 years.

(ii) Expected Effect of the Project

With making conditions and capability of water well drilling equipment in sufficient the Project will help upgrade the social and economic status of the people.

(5) Publicity (How many people are expected to note the benefit or positive effect of the project implemented with Japan's grant aid when it is completed ?)

It is expected that all the people in the working area would note the benefit and positive effect of the project.

5. Request of Other Donors

(1) Is there any request made to other donors for assistance closely related to this project ?

No

(2) If Yes, Please fill in below

6. Priority

(Please describe priority of this project among other projects for which requests are made to Japan)

Nepal government has given high priority to implement the Project.

7. Ministry and Agency in charge of the Project

(1) Outline of Implementing Agency (Please describe in detail)

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(The Agency in charge of the execution of the Project)

(i) Organization Chart of the Agency (in general)

Please see the attached organization chart of the Department of Irrigation *Appendix 2*

Organisation Chart of Implementing Field offices is attached in *Appendix 3*

(ii) Authorities and duties of the agency.

DOI is responsible for planning, implementation, operation and maintenance of Irrigation and drainage development projects throughout the kingdom.

(iii) Personnel (please mention the no of staff, workers and employees of the agency and the responsible department, division and section in-charge of the project )

(iv) Budget (Revenue and Expenditure)

(If mentioned in local currency, please state the latest foreign exchange rate or the currency to the US \$ or in Japanese Yen)

DOI budget for the fiscal year 1999/00 NRs. 3,917,518,000.00

Current Exchange Rate: US\$ 1.00 = NRS. 71.10

(2) Outline of Supervising Ministry (please describe in detail)

The supervising ministry is the Ministry of Water Resources (MOWR), under which DOI has been functioning.

(i) Organisation Chart of the Ministry (in general)

(Please mark the responsible department and division in charge of the project and implementing agency)

Please see the attached organisation chart of the Ministry of Water Resources *Appendix 4*

(ii) Authorities and Duties of the Ministry

MOWR has the sole responsibility of planning, implementation and management of water resources development of the country.

(iii) Budget (Revenue and Expenditure)

(If mentioned in local currency, please state the latest foreign exchange rate of the currency to the US \$ or in Japanese Yen)

Budget of the MOWR in fiscal year 1999/00 NRS 5,965,000.00 (for administrative purpose only )

Current Exchange Rate : US\$ 1.00 = NRs, 71.10

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## 8. Preparation

### (1) Project Site

#### a. Address of the Sites

Biratnagar, Lahan, Mahottari, Janakpur, Parwanipur, Chitawan, Butwal, Lamahi (Dang) Nepalgunj & Dhangadhi of Terai region.

#### b. Total Area of the Site

Area of Terai Belt.

### (2) Electricity, Water Supply, Telephone, Drainage and other Facilities

(Please describe the extent to which above mentioned incidental facilities have been provided )

All Ground water field offices have above mentioned facilities.

### (3) Is there any information, statistics and data regarding geographical, geological meteorological, oceanographic situations, etc.

(if any, please attach those information )

## 9. Capabilities of the implementing Agency

(Please describe the capabilities of the agency to manage, sustain, and operate the Project )

### (1) Current Situation

DOI has been successfully planning, implementing, managing and operating various irrigation by ground water.

### (2) Problems of the Agency

Lack of budget to maintain machinery and procure materials.

### (3) Improvement plan (If any, Please describe in detail the contents of such a plan that will enable the Agency to handle the Project more effectively and efficiency )

In order to proceed sufficient water well drilling works Rig machine sufficient spare parts, materials and machines for replacement should be supplied to the agency.

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## 10. Operation and Management of the Project

(1) Personnel (Please fill in the number of personnel)

	Current	When the project is completed
Supervising Ministry	106	Do
Implementing Agency	204	Do
Directly Responsible Personnel	140	Do

(2) Budget (Please fill in the budget below tables)

(if mentioned in local currency, please refer to the latest foreign exchange rate of the currency to the US \$ or Japanese Yen )

(Nepal Rupees, 000 )

NRs 1,000	2 year ago 1998/99	1 year ago 1998/99	Now 1999/00
Supervising Ministry (for administrative Purpose only)	52,60	56,12	56,12
Implementing Agency Direct budget of the Project	110,060	128,500	125,766

(In the case where additional budget is needed for the implementation of the project, please answer the following question)

(i) Has the additional budget been already allocated ? Not applicable

(ii) If no, how and when will the additional budget be allocated ? Not applicable

### 3. Technical Abilities of Local Staff

(i) Please describe technical abilities of local staff operating the Project.

The staff of the implementing Agency are experienced in related field . However some technical supervision will be needed to repair the machinery.

Operation and Maintenance report is presented in *Appendix -6*

(ii) Please describe in detail educational background of those who are in charge of the operation and facilities and equipment see attached sheets . *Appendix 7*

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## 11. List of the of Related Projects:

(Please fill in below if there is a project executed by another donor country or international organization in related areas.)

Bhairawa- Lumbini Ground water Development Project- World Bank

1. Irrigation line of credit, Groundwater Irrigation Project -World Bank
2. NISP, Ground water Irrigation Project - World Bank.
3. Agriculture perspective plan- Asian Development Bank
4. Community Groundwater Irrigation Sector Project - Asian Development Bank.
5. Community Shallow Tubewell Irrigation Project – IFAD

## 12. Technical Assistance

(1) Has technical assistance been extended to this Project ? No

(2) Is technical assistance needed for the implementation of this Project ? Yes

(3) If no, please describe the reasons why technical assistance is not needed

(4) If yes. Please fill in below

(i) Short- time experts: Mechanical engineer 1 persons

(Water well drilling machine : 2 )

(ii) Long- term experts : NO

(iii) Acceptance of Trainees : Yes

(iv) Project- type technical Co-operation : NO

(v) Japan overseas co-operation volunteers : NO

(vi) Development survey programme : No

(5) Has an official request for technical assistance been already made ? No

(iv) If no, please describe the reason why the official request has not yet been made.

The implementing Organization simply needs rig machines, it's accessory spare parts and few days training about the handling of the rig machines.

(v) When will the request be made to the Embassy of Japan? Not applicable

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## II. GENERAL DEVELOPMENT PLAN

1. Title of the plan (please attach the whole volume of the latest general development plan )

Ninth Five year plan (1997 -2002)

2. Economic and Social situation

(Please mention the basic statistics of economic fundamentals)

(1) GNP

NRs 128,902.00 Million at market prices 1991/1992

(2) National Income, Sector by sector

NRs. Million (1997/98)

Agriculture, Forestry & Fisheries	110823
Mining & Quarrying	1618
Manufacturing	26442
Electricity, Gas & Water	4424
Construction	27382
Trade, Restaurants & Hotels	34309
Transport, communication storages	22497
Financial and Real Estate	29632
Community and Social Services	26074
GDP at Factor Cost	283200
Indirect Tax less subsidy	8,265 (1991/92)
GDP at Market Price	126,186 (1991/92)
Import of Goods and Nfs.	108,227 (1996/97)
Total Consumption	244650 (1996/97)
Total Investment	70401 (1996/97)
Gross Fixed Capital Formation	58693 (1996/97)
Change in stock	11708 (1996/97)
Export of Goods and Nrs.	73758 (1996/97)
Gross Domestic Savings	35932 (1996/97)
Net Factor income	4661 (1996/97)
Net Current Transfer	1009 (1996/97)
Gross National Savings	41602 (1996/97)
GNP (at market price)	128,902 (1991/92)

(3) Unemployment Rate : Unknown

(4) Inflation Rate : 7.6% (1994/95)

(5) Growth Rate : GDP at producers prices = 12.72%(1996/97)

(6) Balance of international Payments:

Surplus = NRs. 4,268 millions (as of first 9 months fiscal year 1992/93)

(7) Labour population ( as a whole, and sector by sector)

Economically active population (10 years and above) 1991

Males:	68.7%
Females	45.5%
Both sexes	57%

Distribution of Economically active population by selected Major Occupation and sex, 1991

	Male	Female	Total
Agriculture workers	74.7%	90.5%	81.1%
Service workers	7.8%	3.8%	
Production labour	5.8%	2.0%	
Sales workers	3.9%	1.7%	
Professional /Technical	2.5%	0.7%	
Others	5.0%	1.0%	
Not Station	0.3%	0.3%	0.3%
TOTAL	100	100	100

(8) Debt Service Ratio : 28.1%

(9) Outstanding Debt : NRs. 82,050 million (as of 1992/93 first 9 months)

(10) Major Items of Export and Imports and their value

	NRs. In Million	
A. Export	1991/92	1992/1993 (first 9 months)
1. Carpets (Hand knotted woolen)	7,035	7,349
2. Ready made garments	3,205	2,772
3. Pulses	1,159	864
4. Jute Goods	191	134
B. Import		

Cannot describe due to covering almost every kind of item

(11) Major Trading partner

Export : India, Germany, UK, USA

Import : India, Japan, Singapore

(12) Population and its Growth Rate

Total 21843068 for 1998 (1991 census result)

Males : 10903447 for 1998 (1991 census result)

Females : 10939621 for 1998 (1991 census result)

Growth Rate : 2.39% for 1998

(13) Average Life Expectancy : 54.3% at birth (1991)

(14) Death Rate and Birth Rate

Birth rate 1991: 41.2 (per 1,000)

Death rate 1991 :43.3 ( per 1,000)

(15) Medical Structure

Total number of hospital (1992): 114 (including nursing home)

Hospital beds (1994/95)	3188
Health Posts (1996/97)	754
Health Centres (1996/97)	17
No. of doctors (1996/97)	874

(16) Ten Diseases most afflicting the nation

1. Infective and parasitic diseases
2. Diseases of the respiratory system
3. Diseases of the genitor- urinary system
4. Diseases of the digestive system
5. Diseases of the nervous system and sense organs
6. Diseases of the circulatory system
7. Diseases of the blood and blood forming organs
8. Diseases of the skin and subcutaneous tissue
9. Endocrine, mutational metabolic diseases and immunity
10. Neoplasms

(17) Illiteracy Rate (or Literacy Rate)

Literacy Rate , 1991

Males	54.5%
Females	25.0%
Total:	39.5%

(18) Other Data

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### 3. Outline of Plan

#### (1) Most Important Sectors in the plan

The most important sectors in the plan and their prioritywise share in the proposed allocation is as follows:

Amount NRs. Million

	at 1991/92 price	share %
1. Electricity	23,719	23.5
2. Education & Culture	17,290	15.2
3. Transportation	13,564	12.0
4. Irrigation	11,966	10.5
5. Agriculture	10,946	9.6
6. Drinking water	6,263	5.5
7. Health	5,466	4.8
8. Forestry and Environment	5,372	4.7
9. Local Development	4,010	3.5
10. Communication	3,835	3.4
11. Civil -Aviation	2,631	2.3
12. Housing	2,304	2.0
13. Industry	2,245	2.0
14. Tourism	1,088	1.0
Total	113,479	100.00

#### (2) Basic objectives of the plan

(please describe in details the objectives by using concrete figures the main objectives of the ninth plan are:

- A higher rate of sustainable economic growth : the average rate of GDP will be 6.0
- Poverty alleviation the people living below the poverty line ( subsistence level ) will be reduced by 42%
- Regional Development : Regional imbalance among the development regions, zones and districts, among the geographical locations, between the rural and urban centers will be reduced through proper allocation of development funds and by integrating and co-ordinating the various development programmes.

#### (3) How will the above - mentioned objectives be achieved ?

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(Please mention specific projects and programme to achieve the objectives)

The objectives will be attached by

- a) Agricultural intensification and diversification,
- b) energy development,
- c) Development of rural infrastructures,
- d) Employment generation and human resource development,
- e) reduction in population growth
- f) industry and tourism development
- g) Export promotion and diversification
- h) macro- economic stabilization
- i) administrative reform and
- j) monitoring and evaluation

4. When will the plan be executed and completed ?

The plan was started in July, 1997 and still under execution.

5. Relations between this Project and the general development plan

(Please describe the significance of the project in the general plan)

The general development plan gives high priority to water resources development of the country. The project will contribute development of water resources.

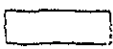
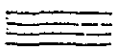
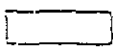


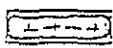

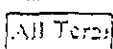


*Blawel*  
Deputy Director General

Appendix

Appendix 1	Project Site location
Appendix 5	Well Construction Using equipments and materials received under Japanese grant assistance
Appendix 6	Organisation chart of the Agency
Appendix 7	Personnel of the Agency
Appendix 8	Organisation chart of the Ministry
Appendix 9	Personnel of the Ministry
Appendix 10	Technical Abilities of Local Staff

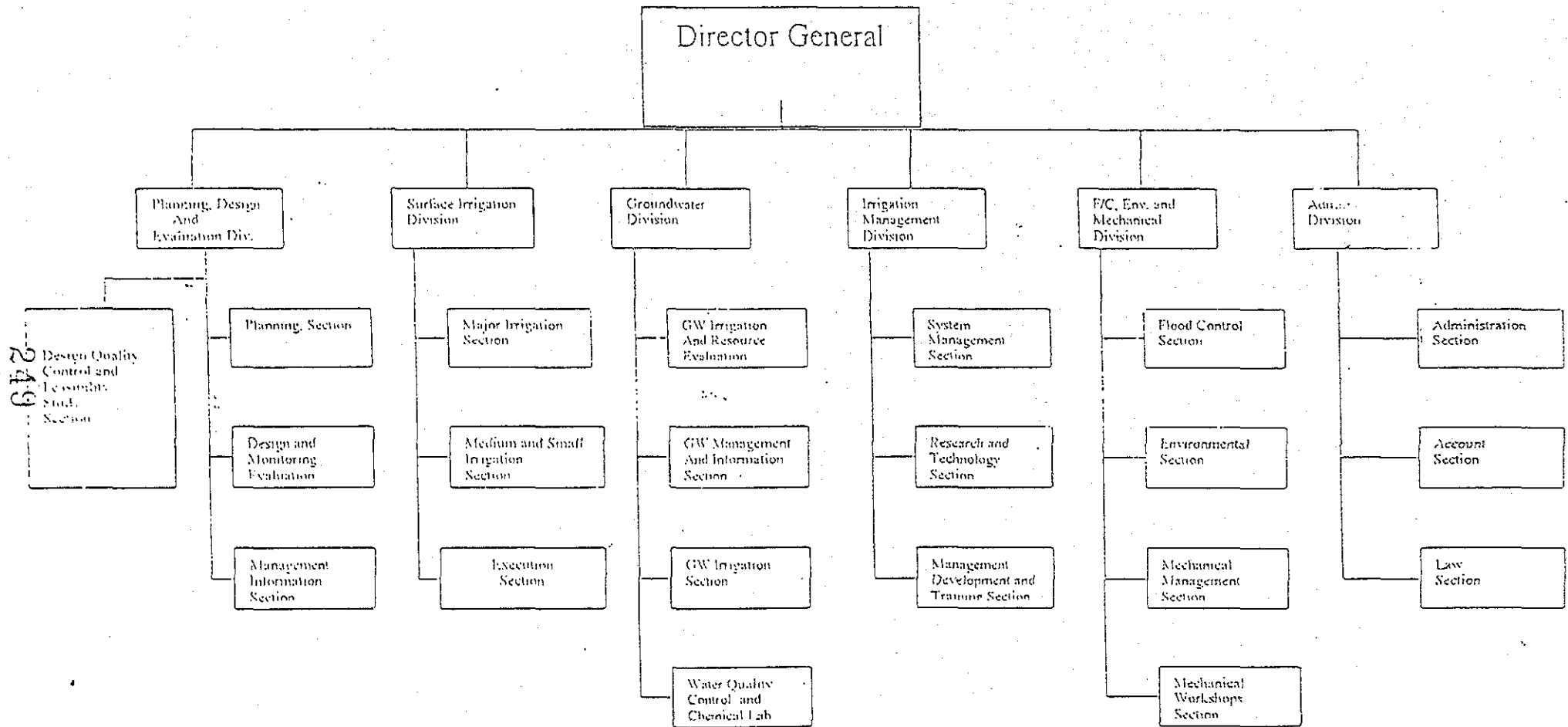


-  Extent of Terai Plan
-  Extent of Inner Terai Valleys
-  NISP (Western, Midwestern & Far Western Region all Districts)
-  CEISP (Eastern & Central Region)
-  CSTIP ( " " " )
-  BLOWP
-  EU (Banke)
-  All Terai Districts APP

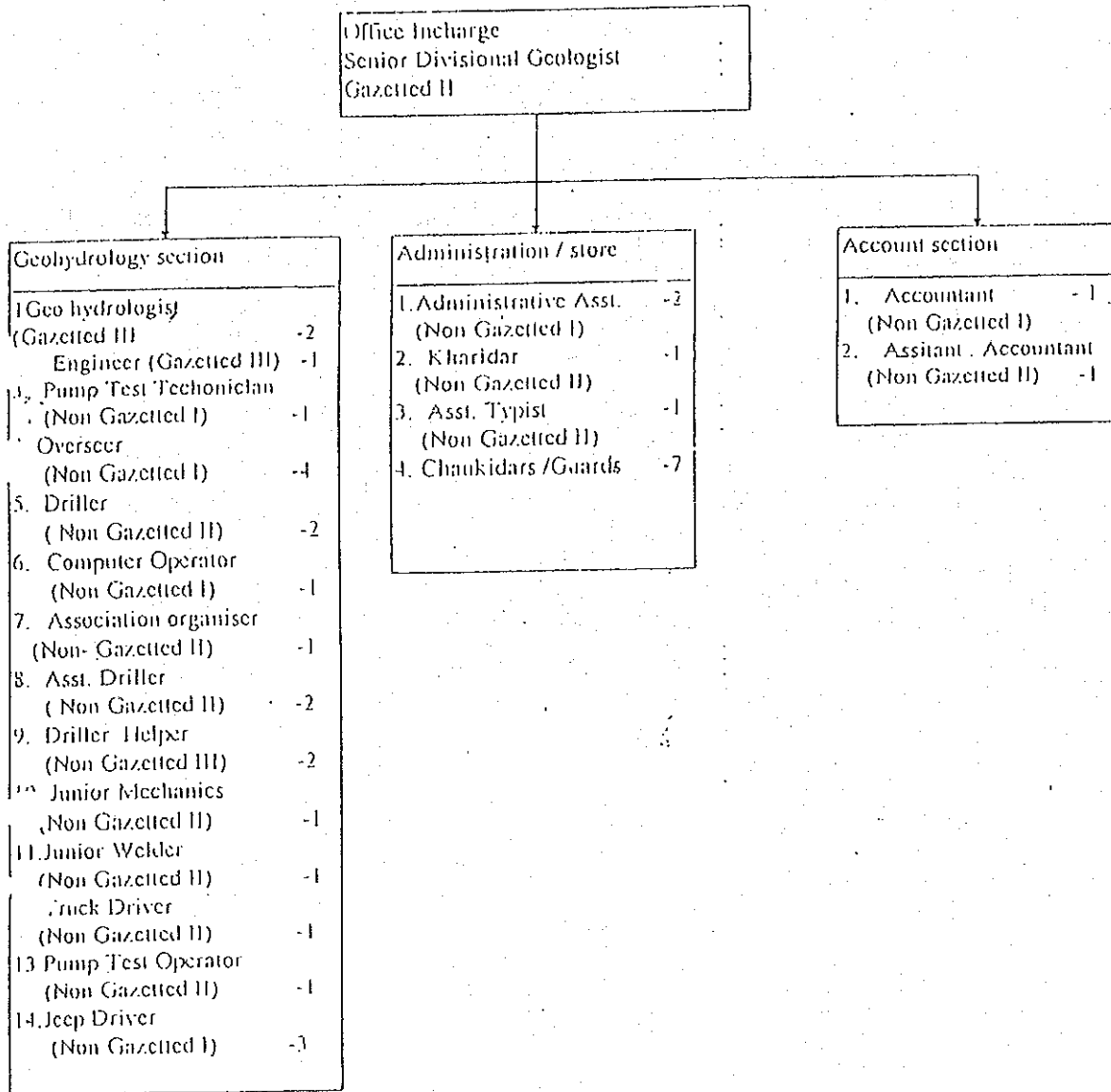


# Organization Chart of Department of Irrigation (DOI)

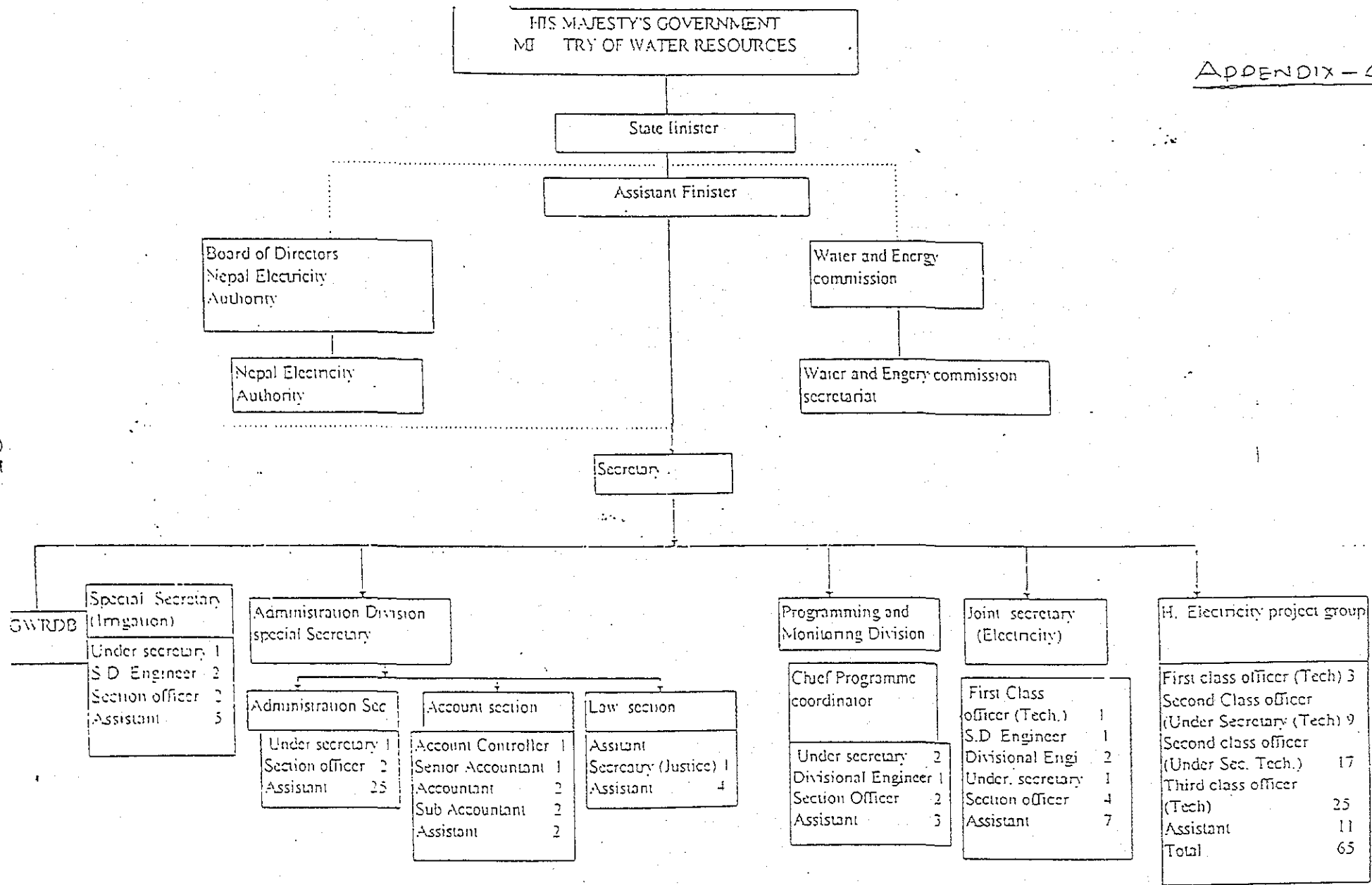
APPENDIX - 2



## TYPICAL ORGANIZATION STRUCTURE OF GROUNDWATER FIELD OFFICE (BIRATNAGAR)



251



Appendix -5

well construction using equipments & materials received under Japanese grant assistance status by 1998/99

Name of districts	No of wells	
	Shallow Tubewells	Deep Tubewells
1. Jhapa /Morang / Sunsari	117	65
2. Siraha/ Saptari	2359	24
3. Dhanusha/ Mahottari	40	46
4. Bara / Parsa/ Rautahat / Sarlahi	250	68
5. Kapilvastu/ Nawalparasi/ Rupandehi	149	341
6. Banke/ Bardiya/ Dang	95	122
7. Kailali / Kanchanpur	1276	153
<b>TOTAL</b>	<b>4286</b>	<b>819</b>

In total 4296 shallow tube wells 819 deep tubewells ,mostly are being used by the farmers for irrigation as well as drinking water purpose and irrigated land from the tubewells has reached approximately 57,174 .Ha . likewise 114200 No of house holds are benefitted directly from the tubewell projects.

Some of the tubewells could not be used yet due to lack of distribution materials like diesel power generators & electricity facilities. Now such tubewells are being used for groundwater investigation and water table monitoring.

It has been areas that the crop yield has gone -up from 1 ton /Ha to 2-3 ton /Ha for paddy and 0.8 ton /Ha to 2-3 ton /Ha for wheat which are the major crops of that areas. Beside of these local varieties and more paying crops like vegetables, maize and other cash crops are also introduced in the irrigated areas.

Operation Condition Report of Existing Equipment in February, 1999  
(Draft)

Project office	Rig Type / Unit	Supply year	Fund (country)	Maintenance and Working Condition
Diralnagar	TONE TRD-300 1 unit	1981	Japanese grant	<ul style="list-style-type: none"> <li>• Drilling program will be started within a few days after the completion of repair work.</li> <li>• 8 nos. of Deep Tube Well(DTW) will be constructed in this fiscal target year.</li> <li>• Drilling rig is utilizable condition, but the performance of equipment has been decreased year by year.</li> <li>• Spare parts made in India are used without considering the quality.</li> </ul>
Lahan	TONE TRD-300 1 unit	1981	Japanese grant	<ul style="list-style-type: none"> <li>• Actual drilling works in the site with good condition according to the fiscal target.</li> <li>• 8 nos. of Deep Tube Well(DTW) will be constructed in this fiscal target year.</li> <li>• Drilling rig is utilizable condition, but the performance of equipment has been decreased year by year.</li> <li>• Spare parts made in India are used without considering the quality.</li> </ul>
	TONE TRD-100 1 unit	1981	Japanese grant	<ul style="list-style-type: none"> <li>• This unit will be utilized for surface water irrigation development plan of APP.</li> <li>• Drilling rig is utilizable condition, but minor maintenance is required.</li> <li>• Spare parts made in India are used without considering the quality.</li> </ul>
Mahattari	TONE TRD-300 1 unit	1981	ADB	<ul style="list-style-type: none"> <li>• Drilling program will be started within two(2) weeks after the completion of repair work.</li> <li>• 8 nos. of Deep Tube Well(DTW) will be constructed in this fiscal target year.</li> <li>• Drilling rig is utilizable condition, but the performance of equipment has been decreased year by year.</li> <li>• Spare parts made in India are used without considering the quality.</li> </ul>

Butawal	TONE TRD-300 1 unit	1981	Japanese grant	<ul style="list-style-type: none"> <li>• Drilling program will be started within one(1) weeks after the completion of repair work.</li> <li>• 2 nos. of Deep Tube Well(DTW) will be constructed in this fisical target year.</li> <li>• Drilling rig is utilizable condition, but the performance of equipment has been decreased year by year.</li> <li>• Spare parts made in India are used without considering the quality.</li> </ul>
	TONE TRD-100 1 unit	1981	Japanese grant	<ul style="list-style-type: none"> <li>• This unit will be utilized for surface water irrigation development plan of APP.</li> <li>• Drilling rig is utilizable condition, but minor maintenance is required.</li> <li>• Spare parts made in India are used without considering the quality.</li> </ul>
Hepalgunj	TONE TRD-500 1 unit	1981	ADB	<ul style="list-style-type: none"> <li>• Actual drilling works in the site with good condition according to the fisical target.</li> <li>• Drilling rig is utilizable condition, but the performance of equipment has been decreased year by year.</li> <li>• Spare parts made in India are used without considering the quality.</li> </ul>
Dang	TONE TRD-300 1 unit	1981	ADB	<i>(Please fill in the details)</i>
	TONE TRD-100 1 unit	1981	Japanese grant	<i>(Please fill in the details)</i>
Birgunj	TONE TRD-300 1 unit	1981	ADB	<i>(Please fill in the details)</i>
Dhangadhi	TONE TRD-300 1 unit	1981	ADB	<i>(Please fill in the details)</i>

Appendix 7 (a)

Number of personnel Assigned in the Different Division and section in the Department of Irrigation

1. Director General	-1 No.
2. Personal Assistants of DG	-2 Nos.
3. Planning Design & Evaluation Division	-30 Nos.
4. Surface Irrigation Division	-13 Nos.
5. Ground water Division	-19 Nos.
6. Irrigation Management Division	-20 Nos.
7. Flood control, Environment and Technical Division	-19 Nos.
8. Administration Division	-100 Nos.
TOTAL	<hr/> 204 Nos.

well construction using equipments & materials received under Japanese grant assistance status by 1998/99

Name of districts	No of wells	
	Shallow Tubewells	Deep Tubewells
1. Jhapa /Morang / Sunsari	117	65
2. Siraha/ Saptari	2359	24
3. Dhanusha/ Mahottari	40	46
4. Bara / Parsa/ Rautahat / Sarlahi	250	68
5. Kapilvastu/ Nawalparasi/ Rupandehi	149	341
6. Banke/ Bardiya/ Dang	95	122
7. Kailali / Kanchanpur	1276	153
<b>TOTAL</b>	<b>4286</b>	<b>819</b>

In total 4296 shallow tube wells 819 deep tubewells mostly are being used by the farmers for irrigation as well as drinking water purpose and irrigated land from the tubewells has reached approximately 57,174 Ha. likewise 114200 No of house holds are benefited directly from the tubewell projects.

Some of the tubewells could not be used yet due to lack of distribution materials like diesel power generators & electricity facilities. Now such tubewells are being used for groundwater investigation and water table monitoring.

It has been areas that the crop yield has gone up from 1 ton /Ha to 2-3 ton /Ha for paddy and 0.8 ton /Ha to 2-3 ton /Ha for wheat which are the major crops of that areas. Beside of these local varieties and more paying crops like vegetables, maize and other cash crops are also introduced in the irrigated areas.



Appendix 9

Number of Personnel Assigned in the different Divisions in the  
Ministry of water Resources

1. Office of the Secretary

a. Secretary	-1. No
b. Personal Assistants to the Secretary	-2 Nos.
c. Special Secretary	-2 Nos
d. Personal assistants to the Special secretary	-2 Nos.

2. Administrative Division -55 Nos.

3. Planning Division -17 Nos.

4. Electrical Division -11 Nos

5. Irrigation Division -12 Nos.

6. Miscellaneous -8 Nos.

---

Total 106 Nos.

## Appendix 10

### Educational background of personnels in charge of the GWRDP

#### *Project sites office*

1. Biratnagar	-M.E ( Civil)
2. Lahan	-M.Sc.(Geology)
3. Jaleswor	-B.E. (Civil)
4. Parwanipur	-M Sc. (Geology)
5. Butwal	-M. Sc. (Geology)
6. Lamahi	-M.E. (Civil)
7. Nepalgunj	-M.E.(Civil)
8. Dhangadhi	-M.Sc. (Geology)
9. Janakpur	-Ph. D. (Geology)
10. Chitawan	- M.Sc. (Geology)

## Specifications

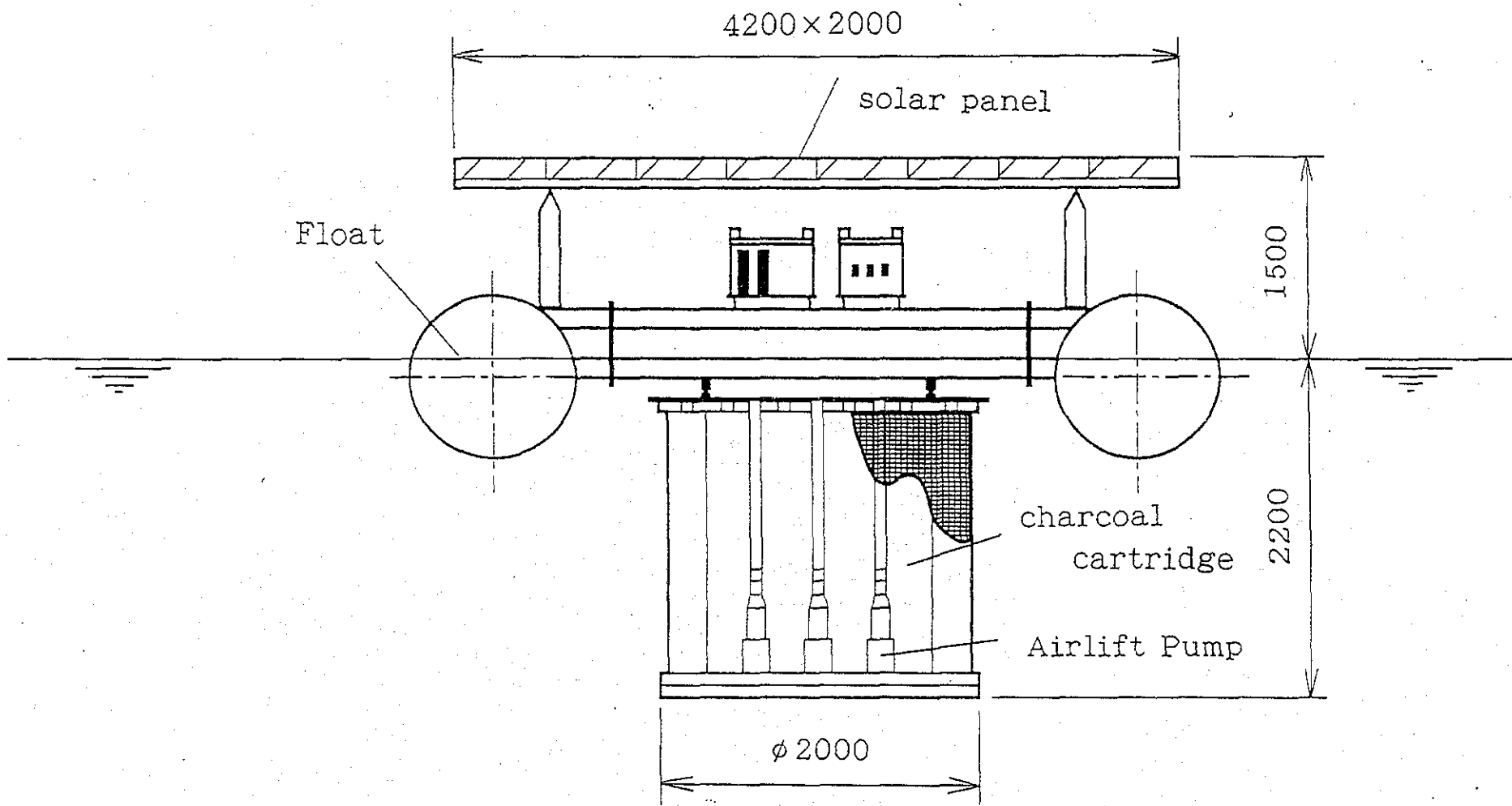
Type	Prefab Type Small Size Sewage Plant
Quantities of Plant	3 Plants
Treatment Capacity	240 M <sup>3</sup> / Day / Plant
Treatment Method	Contact Aeration Treatment Process
Filter Media	Special Filter Bed
Installation	Place on the Concreted Surface

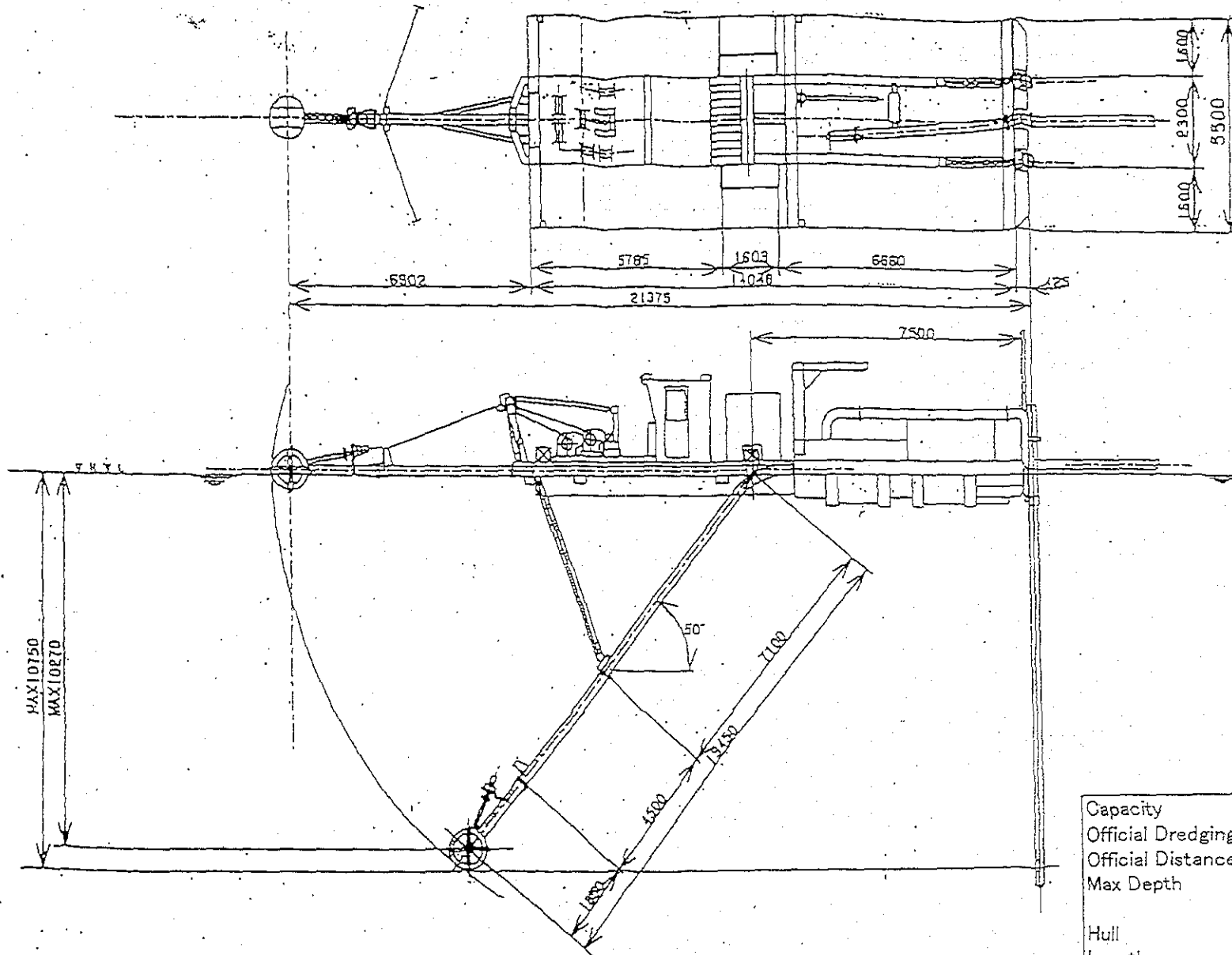
## Specifications

Type	Floating-type Lake-water Purification system
Quantities of Unit	25 Units
Purification Capacity	500 M <sup>3</sup> / Day / Unit
Energy	Solar System
Power	0.6 kW / Unit (for Airlift Pump)
Purification Materials	Charcoal
Installation	4 Anchors / Unit
Maintenance	Maintenance Free (Automatic Backwash)

ANNEX-5D

# Floating-Type Lake-water Purification System





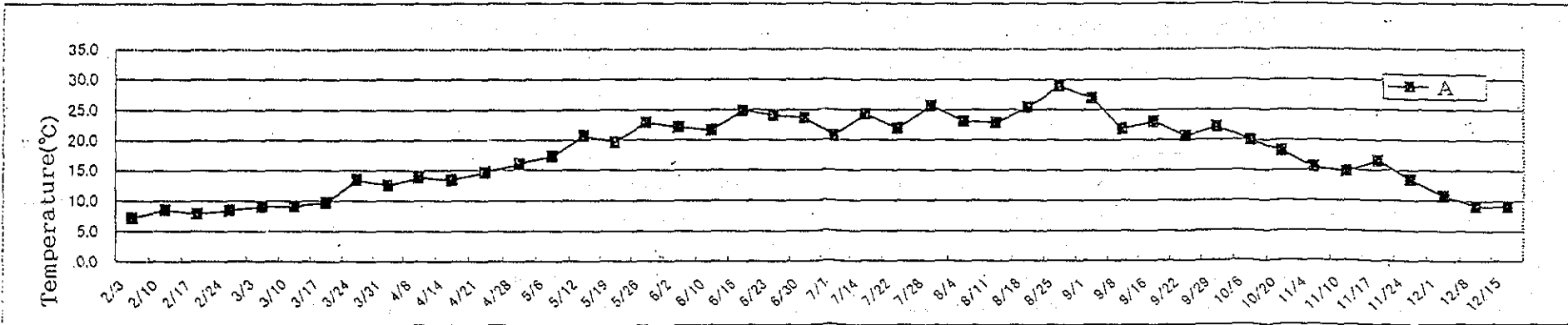
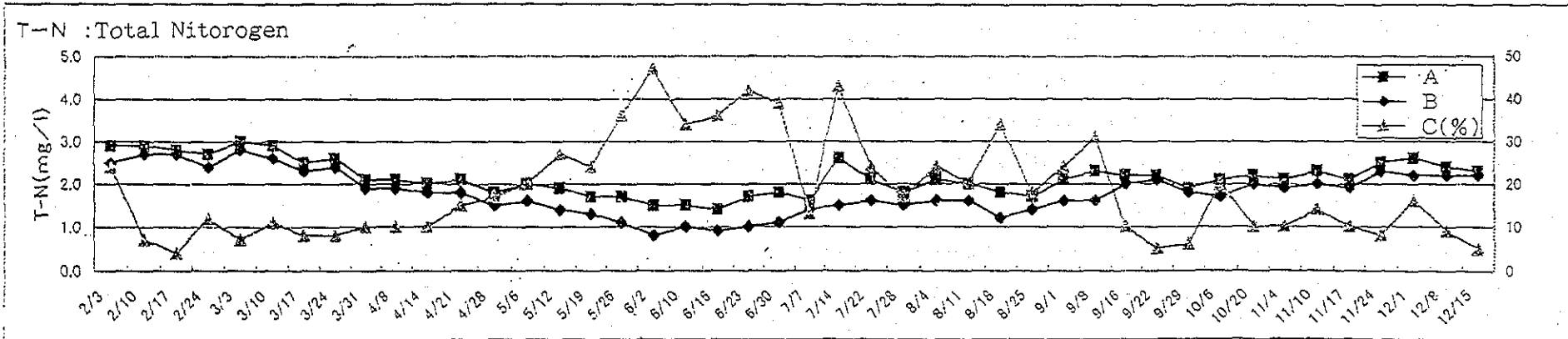
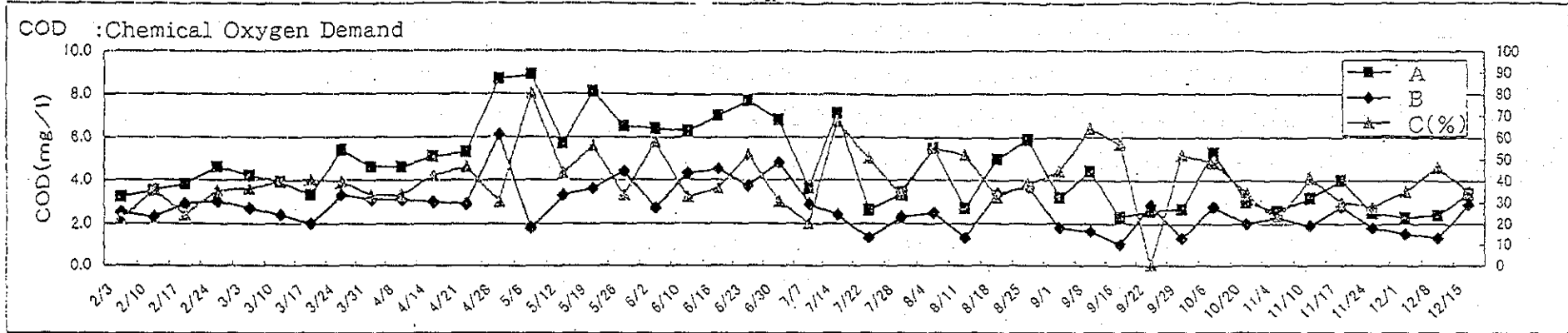
PUMP DREDGER (200PS)

Capacity	
Official Dredging	: 36ton/h
Official Distance	: 800m
Max Depth	: 10m
Hull	
Length	: 14m
Breadth	: 5.5m
Depth	: 1.2m
Main Engine	: 510PS
Main Sand Pump	: 200PS

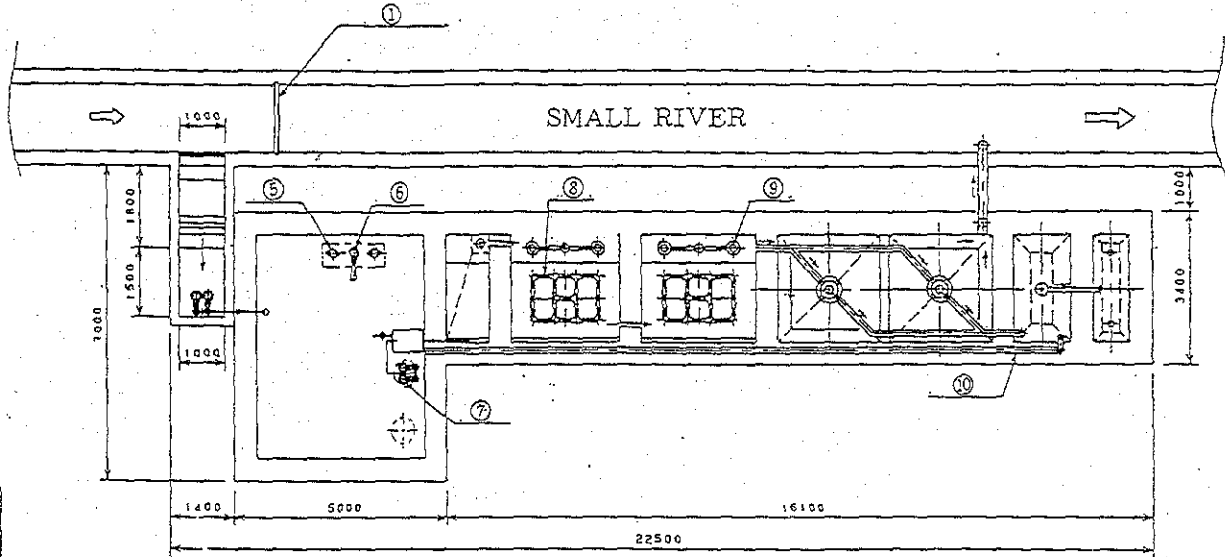
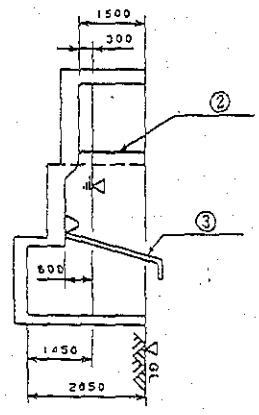
# Float-Type Lake-Water Purification System

## Operating Data(1)

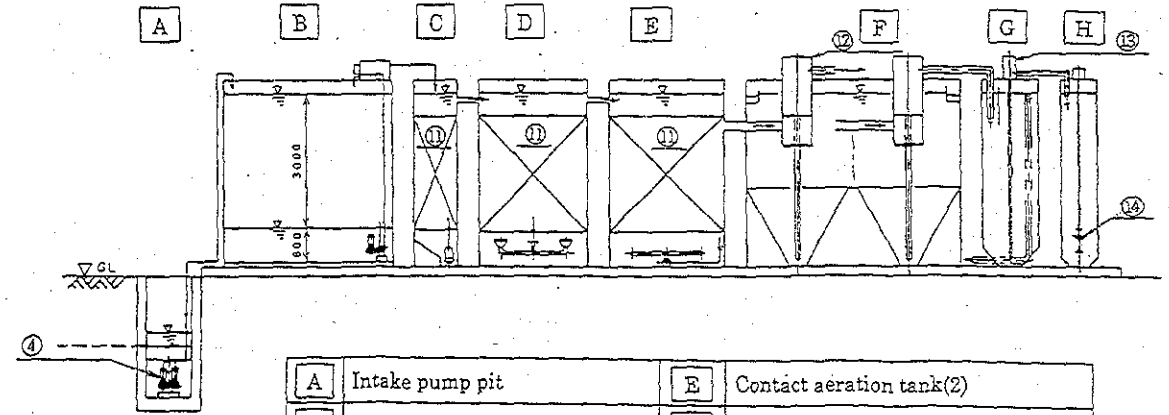
A: Before Purification  
 B: After Purification  
 C: Ratio of Purification



# Prefab Type Small Size Sewage Plant



①	Weir
②	Coarse screen
③	Fine screen
④	Submerged pump
⑤	Submerged blower
⑥	Submerged mixer
⑦	Rawwater pump
⑧	Backwashing system
⑨	Diffuser
⑩	Overflow pipe
⑪	Contact filter
⑫	Sludge airlift-pump
⑬	Thickening sludge airlift-pump
⑭	Mixer

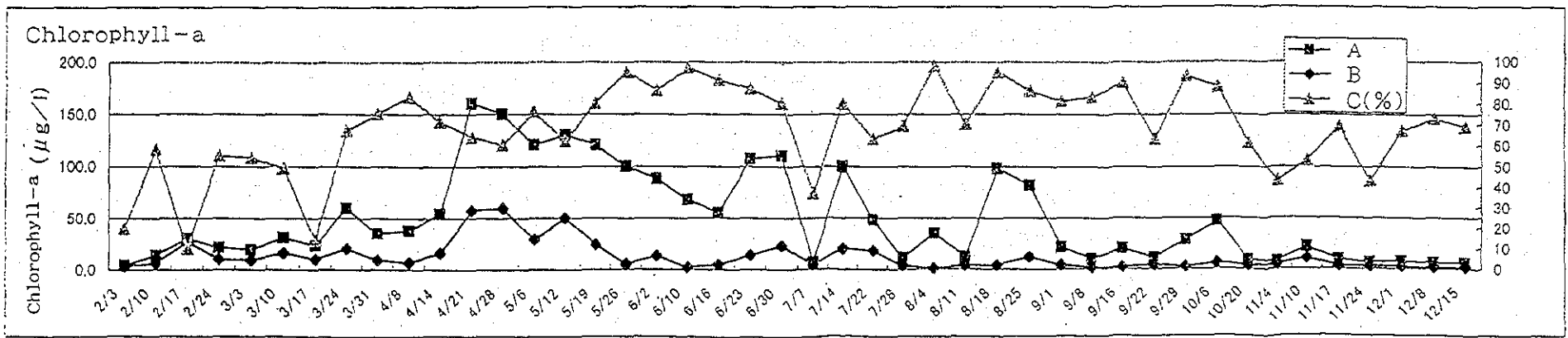
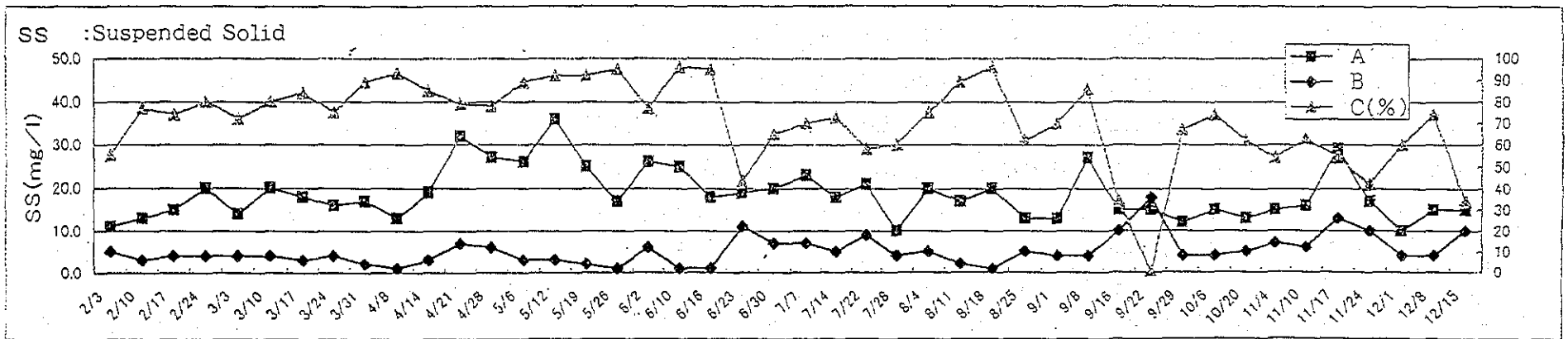
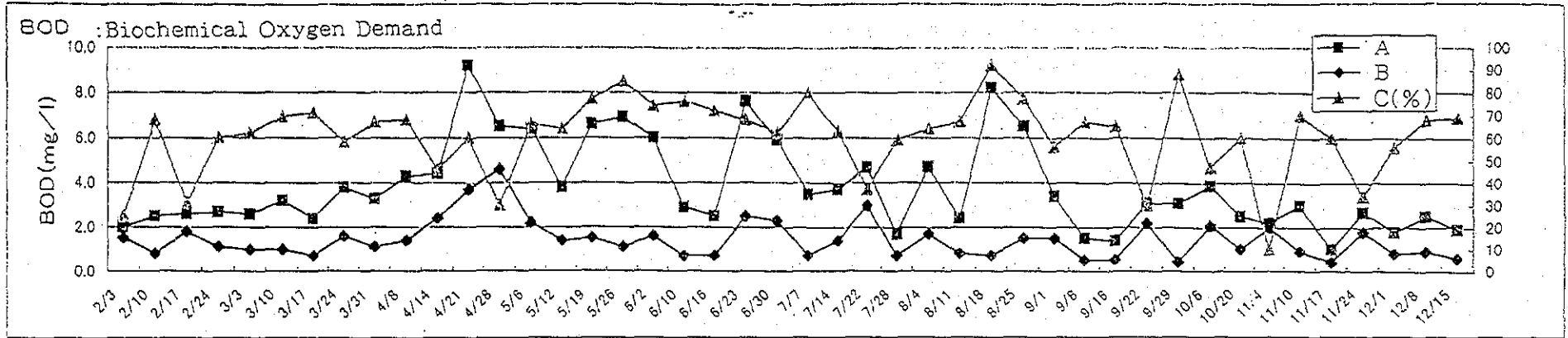


A	Intake pump pit	E	Contact aeration tank(2)
B	Flow equalization tank	F	Settling tank
C	Grit separation tank	G	Sludge thickening & storage tank
D	Contact aeration tank(1)	H	Sludge storage tank



A: Before Purification  
 B: After Purification  
 C: Ratio of Purification

### Operating Data(2)



187. Decisions of Meeting: (1) Unless otherwise provided for in this Act, any decisions of the meeting of the District Council and the District Development Committee shall be made on the basis of a majority of the Members present at the meeting.

(2) In the event of a tie of votes at a meeting of the District Council and the District Development Committee, the person presiding over the meeting shall exercise the casting vote.

(3) Ex-officio Members shall not be entitled to take part in the voting.

#### Chapter - 4

#### Functions, Duties and Powers of the District Development Committee

188. Functions, Duties and Powers of District Council: (1) The functions and duties of the District Council shall be as follows :-

- (a) To pass the budgets, plans and programme submitted by the District Development Committee.
- (b) To adopt the resolution relating to taxes, charges, fees, tariff, loans or borrowings and internal resources submitted by the District Development Committee.
- (c) To evaluate the programmes relating to the District plan operated by the District Development Committee and give necessary directions.
- (d) To hold discussions on the audit reports of the District Development Committee and give necessary directions to the District Development Committee for settlement of irregular amounts.

- (e) To approve the District level subject-wise programmes to be operated in the District.
- (f) To approve the bye-laws of the District Development Committee.
- (g) To evaluate the administrative functions of the District Development Committee and give necessary directions to the District Development Committee.
- (h) To grant approval, as required, on the remuneration, number of positions, allowances and other facilities of the employees proposed by the District Development Committee.
- (i) To decide on the sale and disposal, transfer of, or letting on hire, the property of the District Development Committee.
- (j) To delegate some of the powers conferred on it to the District Development Committee.

(2) The District Development Committee shall not be entitled to carry out the following functions unless a resolution is passed by a majority of the total number of Members of the District Council:-

- (a) To sell, and dispose of, or transfer the property of the District Development Committee.
- (b) To raise loans.
- (c) To impose taxes, fees, charges, duties.
- (d) Any other matter as prescribed.

(3) The District Council shall exercise power conferred on it under this Act and Rules and by laws made under this Act.

(4) The District Council shall form accounts committee under the chairmanship of a Member of the District Council, comprising in maximum of five members including him; and the functions, duties and powers of such a committee shall be as prescribed.

(5) The District Council may form different committees in a manner that the other Members of the District Council, except those who are the members of the accounts committee referred to in sub-section (4), are included in subject-wise committees as prescribed to render necessary advice and suggestions to the District Council.

(6) The other functions, duties and powers of the District Council shall be as prescribed.

189. Functions, Duties and Powers of the District Development Committee: (1) In addition to implement and cause to be implemented, the decisions and directions of the District Council, the functions and duties of the District Development Committee shall be as follows :-

(a) Relating to Agriculture:

- (1) To make District level policy on agriculture and livestock development, and formulate and operate programmes in consonance therewith, and inspect and monitor, and cause to be inspected and monitored, the programmes operated.
- (2) To arrange for, and cause to be arranged for, the seeds, fertilizers and other agricultural inputs required in the District.

- (3) To provide, and cause to be provided, the services relating to agriculture extension in the district development area.
- (4) To promote, and cause to be promoted, the agricultural Haat markets and fairs.
- (5) To manage and cause to be managed, the markets for agricultural products.

(b) Relating to Rural Drinking Water and Habitation Development:

- (1) To formulate and implement, and cause to be implemented, such drinking water plans as are to benefit the people in more than one village development area in rural areas of the district development area.
- (2) To formulate plans on habitation and market development in rural areas of the district development area, and implement and cause to be implemented them.

(c) Relating to Hydropower:

To formulate, implement, operate, distribute and maintain and repair projects on mini and micro hydropower and other energy, and cause to be done the same.

(d) Relating to Works and Transport:

- (1) To prepare a master plan of district-level roads in the district development area and get it approved by the District Council.
- (2) To build, operate, monitor, evaluate and maintain and repair the approved District level roads, and cause to be done the same.
- (3) To formulate, build and maintain and repair the plans of suspension bridges required in the district development area and cause to be done the same.
- (4) To make necessary arrangements on the means of transport to be operated within the district development area.
- (5) To give licence to "D" class contractors and cancel and renew it pursuant to the prevailing law.
- (6) To develop and promote the water-ways and ropeways.

(e) Relating to Land Reforms and Land Management:

To protect and promote the Ailani (unregistered) land and governmental barren land situated within the district development area.

(f) Relating to Development of Women and Helpless People:

- (1) To prepare and implement a plan required for the upliftment of the women in the district development area.
- (2) To carry out acts on the protection of the orphans, helpless women, the aged, disabled and incapacitated persons as per the national policy, and to carry out or cause to be carried out acts on the wiping out of social ill-practices and the protection of the girls and women.

(g) Relating to Forest and Environment:

- (1) To prepare plans on forests, vegetation, biological diversity and soil conservation, and implement and cause to be implemented the same.
- (2) To protect and promote, and cause to be protected and promoted, the environment.

(h) Relating to Education and Sports:

- (1) To set priority for establishing schools in the district development area and make recommendation therefor.

- (2) To make recommendation, setting out rationale and reasons, for the approval and dissolution of the schools in the district development area.
- (3) To supervise and monitor the schools in the district development area and assist in their operation and management.
- (4) To formulate policies and programmes on the District level adult education as well as informal education.
- (5) To set programmes relating to sports and physical development, and implement and cause to be implemented them.
- (6) To form a District level sports development committee.

(i) Relating to Wages for Labour:

- (1) To determine rate of wages for labour and rate of workmanship at the district level.
- (2) To set and operate programmes on abolition of child labour and rescue of the children,

(j) Relating to Irrigation and Soil-erosion and River Control:

- (1) To formulate, implement, operate and maintain and repair programmes on



irrigation, ditch, embankment, and small ditch providing facility to more than one village development area in the district development area, and cause to be done the same.

- (2) To formulate plans on prevention of soil- erosion, river cutting etc. in the areas affected from such acts, and implement and cause to be implemented the same.

(k) Relating to Information and Communications :

- (1) To give approval to set up cinema halls in the district development area except the Municipality area.
- (2) To open district level libraries, reading rooms and information centers in other rural areas except the Municipality area in the district development area.

(l) Relating to Language and Culture:

- (1) To keep records of culturally and religiously important places located within the district development area and to preserve and promote them by having them repaired and maintained.
- (2) To promote, and cause to be promoted, various

languages, religions and cultures,

- (3) To preserve, promote and use, and cause to be preserved, promoted and used, the archaeological objects, languages, religion, art and culture within the district development area.

(m) Relating to Cottage Industry:

- (4) To maintain records of the cottage industries to be establish within the district development area.
- (5) To identify and develop an industrial zone in the district.

(n) Relating to Health Service:

- (1) To operate and manage, and cause to be operated and managed, the district level health posts, hospitals, Ayurvedic dispensaries, health centres, health offices etc.
- (2) To formulate and implement the programmes such as family planning, mother child welfare, extensive vaccination, nutrition and population education and public health.
- (3) To give approval to open sub-health posts in the village development areas

under the district development area and inspect and monitor them.

(4) To make arrangements for the supply of such medicines and materials and equipment relating to treatment as required for the district development area, and inspect and monitor the quality standards thereof.

(5) To prohibit or remove the public use of the things injurious to the public health in the district development area.

(6) To prohibit the sale, distribution and consumption of such consumable goods as may cause adverse impacts on the public health.

(o) Relating to Tourism :

To protect, promote, expand and utilize the natural, cultural, historical and touristic heritages in the district development area, and cause to be done so.

(p) Miscellaneous:

(1) To maintain data of the district development area.

(2) To carry out necessary acts in respect of controlling natural calamities.

- (3) To protect the movable and immovable properties remained under the ownership and control of the District Development Committee.
- (4) To draft the bye-laws of the District Development Committee and submit it to the District Council.
- (5) To carry out such other functions as prescribed under the prevailing law.

(2) The District Development Committee may give grants for the approved programme to any organization, association or body, being subject to the approved budget.

(3) The District Development Committee may, subject to this Act, carry out the development and construction works by entering into agreement as prescribed with any individual, governmental or non-governmental organization or person. Information on the agreement so entered into shall have to be given to His Majesty's Government.

Provided that without prior approval of His Majesty's Government no such agreement shall be entered with any international non-governmental organization or foreigner.

(4) If it is received information that any project or programme of national level operated in the district development area has not been operated effectively or any kind of irregularity has been done there, the District Development Committee may give necessary suggestions in that regard or make recommendation to the concerned body for action.

(5) In addition to those as mentioned in this Act, other functions, duties and powers of the District Development Committee shall be as prescribed.

20. Power to Form Sub-committee : (1) The District Development Committee may, as per necessity, form a sub-committee to render assistance in its functions.

(2) The sub-committee to be formed pursuant to sub-section (1) may consist of the representative of the consumers' group, the representative of non-governmental organizations, women, backward class, intellectuals, social worker and experts.

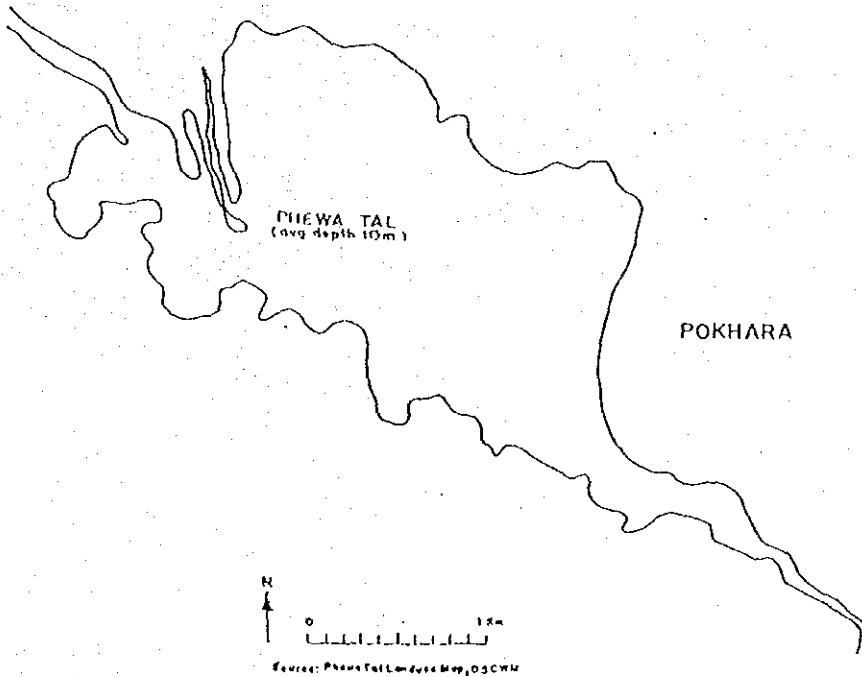
(3) The functions, duties, powers and procedures of the sub-committee to be formed pursuant to sub-section (1) shall be as prescribed by the District Development Committee.

21. Functions, Duties and Powers of President : The functions, duties and powers of the President shall be as follows :-

- (a) To direct the Secretary to convene the meeting of the District Development Committee.
- (b) To submit, or cause to be submitted, reports and proposals at the meeting of the District Council and the District Development Committee.
- (c) To make necessary arrangement to prepare budgets and programmes of the District Development Committee.
- (d) To get progress report prepared by having the decisions of the District Council and the District Development Committee implemented.
- (e) To allocate the subject-wise function to the Vice-President and Member, and monitor and coordinate the district level subject-

HIS MAJESTY'S GOVERNMENT OF NEPAL  
MINISTRY OF FOREST AND SOIL CONSERVATION  
DEPARTMENT OF SOIL CONSERVATION

WATER QUALITY MONITORING  
OF  
PHEWA LAKE



By:

SOIL AND WATER LABORATORY SECTION

KATHMANDU

JUNE, 1996

## PREFACE

The analytical study of water quality from the different parts of the country has been continued within the regular programme by the Soil and Water Laboratory of the Department of Soil Conservation.

The water quality monitoring of Phewa Lake has been started from the fiscal year 2052/053 (1995/96) by Soil and Water Laboratory. With the kind suggestion of the Director General Mr. Mohan Prasad Wagley the water sampling spot points on the lake has been identified according to the 'Stratified Random Sampling Method'. Mr. Kiran Dongol from Research Section has carried out the calculation and statistical procedures for the location of sampling points and Mr. Dhurba Nepal-District Soil Conservation Office, Kaski has provided the survey maps and other necessary informations at the time of water samples collection from Phewa lake. Collection of water samples from the lake and some selected physical and chemical parameters of the samples have been determined quantitatively in Laboratory of the Department by Mr. Upendra Sapkota, Ms. Padmira Dangol and Mr. Amulya Tuladhar. Ms Vijaya from the Cartographic Section has carried out the drafting of the maps. All the computer work and manuscript compilation have carried out by the Computer Section of the Department.

Field supports (e.g. motor vehicle, provision of technical assistant) was provided by District Soil Conservation Office, Kaski at the time of water sampling is acknowledged herewith.

Soil and Water Laboratory,  
Department of Soil Conservation,  
Babarmahal, Kathmandu.

## CONTENTS

	Page
1. INTRODUCTION	1
2. OBJECTIVES	1
3. SAMPLING	2
i) POINTS	2
ii) FREQUENCIES	7
iii) METHODS	7
4. TRANSPORT OF SAMPLES	8
5. RESULTS AND DISCUSSIONS	8
6. SUMMARY AND CONCLUSION	14
7. REFERENCES	14

## LIST OF TABLES

TABLE I	DESCRIPTION OF SAMPLES COLLECTION SPOT POINTS, PHEWA LAKE.	4
TABLE II	ANALYTICAL RESULTS OF WATER SAMPLES OF PHEWA LAKE COLLECTED AT FIRST TIME: 2 <sup>ND</sup> WEEK OF JANUARY 1996.	12
TABLE III	ANALYTICAL RESULTS OF WATER SAMPLES OF PHEWA LAKE COLLECTED AT SECOND TIME: 3 <sup>RD</sup> WEEK OF APRIL 1996.	13

## LIST OF FIGURES

1. SAMPLES COLLECTION SPOT POINTS LOCATION MAP OF PHEWA LAKE.	6
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## 1. INTRODUCTION

The analysis of water is the major subject in the modern environmental chemistry. Lakes are one of the most important resources of water for the mountainous country like Nepal. Phewa lake is situated in one kilometer south west of Pokhara city, Kaski district at an elevation of about 793 m (IWMP). The area of the lake is 6.7 sq. km. (about 443 hectares) and it holds approximately  $53 \times 10^6$  cubic meter of water. At present, this lake is mostly used for hydropower generation (1000 KW capacity), irrigation (320 hectares) and recreations -- boating and swimming. This lake and Machhapuchchhre (the Himalayas) have made Pokhara an attractive tourists site. Harpan Khola the main tributary of Phewa lake is a perennial stream and from north western direction it is entering in the lake. The lake is surrounded by hills on two sides--north and south, village Pame is situated on the north -- western side and on the eastern side by Pokhara city itself. Pollution load in Phewa lake is mainly from non-point sources. There are hotels, restaurants and residential buildings that discharges their wastes directly into the lake. On the northern side of the lake there are the agriculture fields. At the time of monsoon the rain water run from the hillside towards its bottom where there are agriculture fields and the manures and pesticides spread by the farmers on their agriculture field run in the lake. Another most important and severing problem of Phewa lake is the siltation in the lake from its tributaries and from its surrounding.

In city like Pokhara, where lake water is used for recreational purposes such as swimming and boating water pollution on the lake impedes these activities. Also tourism, which is the major source of the country's income cannot flourish around polluted streams and lakes. Fishing and fish-farming have been declining in this lake over the years. Fishermen, whose livelihood depend on the unpolluted streams and lakes, will be unable to sustain themselves and will have to look for other alternatives. The same kind of problems arouse for the boatmen for their livelihood.

## 2. OBJECTIVES

The prime objective of the water quality monitoring is to characterise the water quality of Phewa lake over a long time frame. The water quality monitoring is mainly based on quantitative determination of selected physical and chemical parametric values that present in the water where various interventions have been implemented (discharges from hotels and restaurants, fish farming, outlet of Seti channel in the lake and the tributaries running in the lake.)

The annual rate of quantitative increment of physical and chemical parametric values in the water of Phewa lake with respect to the accepted values of fresh-water lakes is related with the discharges in the lake from its surroundings. From the quantitative increments of the values of selected parameters, we can obtain the following informations:

- to identify the concentration of pollution at different spot points and relate with the sources of pollutions
- rate of pollution in the lake
- to aware the surrounding dwellers and the users,
- the base-line support, guide-line and back-stopping for the concern authorities who renew or award license to the hotels, restaurants and other, so that, the authorities should ensure that the commercial complex surrounding the lake have adequate facilities (mainly septic-tanks and soak-pits) to process the organic wastes they generate.

### 3. SAMPLING

#### 3.1 Sampling Points

Since the concentration of pollution level distribution at Phewa lake is heterogeneous in nature, the "Stratified Random Sampling" technique is adopted. For this the whole lake area is divided into six (6) different segments, with reference to the fixed bench marks (B.M.) around the shore of the lake. Most of the sampling points are located near the B.M. and at the middle of the delineated area. The surface strata is differentiated by joining hypothetical lines of B.M. 15 to Temple and straight to boat hiring point near Baidam, Temple to B.M. 18, B.M. 4 to B.M. 18 B.M. 13 to B.M. 4 and B.M. 101 to B.M. 18 and also the segmented areas are defined as area A., B., C., D., E., and F.

According to "Stratified Random Sampling Method" and adopting the "Proportional Allocation Method" under which the size of samples (i.e. no. of samples) from different segmented area are kept proportional to the size of the segmented area (i.e. surface area which is in advance calculated by dot-grid method), the total size of the samples comes out to be 400 at maximum probability of 50%. While considering sampling fraction of 10% out of 400 samples 40 samples have to be taken from the whole area of the lake.

By adopting the Proportional Allocation Method, the no. of samples to be taken from different segmented area are as follow:

<u>S.No.</u>	<u>Segmented area</u>	<u>Size (number) of Samples</u>
1.	A	5*
2.	B	9*
3.	C	8
4.	D	4
5.	E	9
6.	F	5

Total No: 40

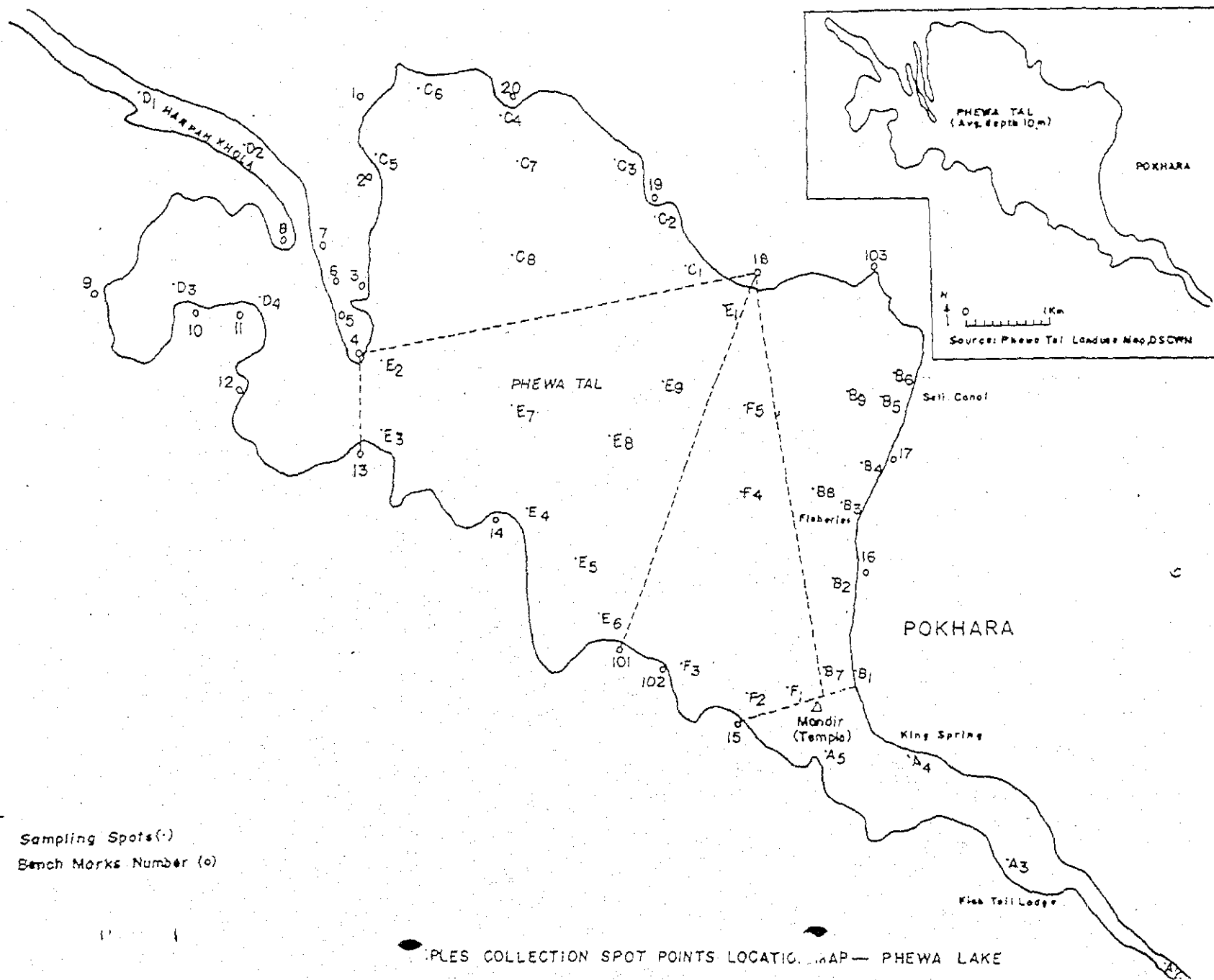
Note: \* Since the pollution concentration is high at segment 'A' and 'B' the "Double Weightage" is given.

Table I

S.No.	SAMPLE IDENTIFICATION CODE	DESCRIPTION OF SAMPLES COLLECTION SPOT POINT'S, PHEWA LAKE
1	A <sub>1</sub>	Samples collected from near Dam Site
2	A <sub>2</sub>	Samples collected from near Hotels/Houses
3	A <sub>3</sub>	Samples collected from near Fishtail Lodge
4	A <sub>4</sub>	Samples collected from near King's spring
5	A <sub>5</sub>	Samples collected from back side of Temple Barahi
6	B <sub>1</sub>	Samples collected from near Baidam
7	B <sub>2</sub>	Samples collected from close to Bench mark No 16
8	B <sub>3</sub>	Samples collected from near Fisheries.
9	B <sub>4</sub>	Samples collected from close to Bench mark No 17
10	B <sub>5</sub>	Samples collected from near out-let of Seti Cannel (Southern Side)
11	B <sub>6</sub>	Sample collected from near out-let of Seti Cannel (Northern Side)
12	B <sub>7</sub>	Samples collected from northern side of Barahi Temple
13	B <sub>8</sub>	Samples collected from the crossing point between Bench mark No 4 to fisheries and Bench mark No 103 to Temple.
14	B <sub>9</sub>	Samples collected from the crossing point between Bench mark No 4 to Seti Cannel and Bench mark No 103 to Temple
15	C <sub>1</sub>	Samples collected from near Bench mark No 18
16	C <sub>2</sub>	Samples collected from near Sedi (Pipal Tree)
17	C <sub>3</sub>	Samples collected from near Bench mark No 19
18	C <sub>4</sub>	Samples collected from very close to Bench mark No 20
19	C <sub>5</sub>	Samples collected from near Bench mark No 2
20	C <sub>6</sub>	Samples collected from near Khapaudi Village/house (single)
21	C <sub>7</sub>	Samples collected from the crossing point between Bench mark No 2 to Bench mark No 19 and Bench mark No 20 to bench mark No 14
22	C <sub>8</sub>	Samples collected from to crossing point between Bench Mark No 3 to Bench mark No 18 and Bench mark No 20 to bench mark No 14
23	D <sub>1</sub>	Samples collected from upper side of Harpan Khola Bridge
24	D <sub>2</sub>	Samples collected from lower side of Harpan Khola Bridge
25	D <sub>3</sub>	Samples collected from very close Bench mark No 10
26	D <sub>4</sub>	Samples collected from very close Bench mark No 11
27	E <sub>1</sub>	Samples collected from very close to Bench mark No 18

28	E <sub>2</sub>	Samples collected from very close to Bench mark No 4
29	E <sub>3</sub>	Samples collected from very close to Bench mark No 13
30	E <sub>4</sub>	Samples collected from very close to Bench mark No 14
31	E <sub>5</sub>	Samples collected from between Bench mark No 14 and Bench mark No 101
32	E <sub>6</sub>	Samples collected from very close to Bench mark No 101
33	E <sub>7</sub>	Samples collected from the crossing point between Bench mark No 4 to fisheries and Bench Mark No 20 to Bench mark No 14
34	E <sub>8</sub>	Samples collected from the crossing point between Bench mark No 4 to Fisheries and Bench mark No 18 to Bench mark No 14
35	F <sub>9</sub>	Samples collected from the crossing point between Bench mark No 4 to Seti Cannel and Bench mark No 18 to Bench mark No 14
36	F <sub>1</sub>	Sample collected from north western side of very close to the Temple
37	F <sub>2</sub>	Samples collected from very close to Bench mark No 15
38	F <sub>3</sub>	Samples collected from very close to Bench mark No 102
39	F <sub>4</sub>	Samples collected from the crossing point between Bench mark No 4 to fisheries and Bench mark No 18 to Bench mark No 15
40	F <sub>5</sub>	Samples collected from the crossing point between Bench mark No 4 to Seti Cannel and Bench mark No 19 to the Bench mark No 15

Description of Samples Collection Spot points, Phewa Lake.



**LEGEND**

- A<sub>1</sub>, A<sub>2</sub>, A<sub>3</sub> Sampling Spots (•)
- 1, 2, 3, 4 Bench Marks Number (o)

SAMPLES COLLECTION SPOT POINTS LOCATIC. MAP — PHEWA LAKE

tape necessary information such as date, time and spot location points in short-form has been marked by a marker-pen (generally by black, blue or green ink).

#### 4. TRANSPORT OF THE SAMPLES

All the samples from the different spot points of Phewa lake are collected according to the processes described above and are kept in the boat. The collected samples have been transported in the motor vehicle standing on the bank of the lake from the boat by hand and brought in the office house by the motor vehicle. The samples are placed in series on the dark and cool place of the ground-floor room of the office house (temperature of the room approx. 16°C to 18°C max: on January and 22°C to 24°C max. on April) taking care that all the sample containing bottles are kept on the floor are not on one upon another. The first batch collection were brought by the office motor vehical from Pokhara to the laboratory of the Department in Kathmandu and the second batch collection were brought by air-plane and from airport to the laboratory of the Department in Kathmandu by motor vehical.

#### 5. RESULTS AND DISCUSSIONS

The water samples collected at both time (2nd week of January 1996 and 3rd week of April 1996) from the different spot points of Phewa lake were analysed for the parameters: pH, electrical conductivity (mS), alkalinity (mg/lit CaCO<sub>3</sub>), total hardness (mg/lit CaCO<sub>3</sub>), phosphate (mg/lit phosphorous), Chloride (mg/lit chlorine), total solid (mg/lit dissolved and undisclosed solid) and nitrate (mg/lit nitrate N). All the fourty samples collected at first time and the fourty samples collected at second time were analysed in the soil and water laboratory of the Department of Soil Conservation. Most of the samples have high value of pH in the first batch collection of the samples and low value of pH in the second batch collection of samples. Similarly the value of electrical conductivity is slightly high in the first batch collected samples than in the second batch collected samples. For the alkalinity test, the second collection have high value than in the first collection. Similarly the phosphate valued also have high of the second batch collected samples than of the first batch collected samples. Most of the chloride valued is high in the samples of second batch collection than in the samples of first batch collection and few values are equal too. Almost all the values of dissolved and undissolved total solid have high values in the first batch collection than in the second batch collection.

## pH

The quantity pH is defined as the logarithm (to the base 10) of the reciprocal of hydrogen ion concentration. A neutral solution is one in which  $\text{pH}=7$  and acid solution one in which  $\text{pH} < 7$  and an alkaline solution one in which  $\text{pH} > 7$ . In the water samples of Phewa lake the pH values are in between 8.00 and 7.30 in the first batch collection and 8.47 and 7.31 in the second batch collection. It seems that the water samples collected from different spot points are very slightly alkaline in character.

## Electrical Conductivity

Electrical conductivity is the dimension figure for dissolved salts. It depends upon the temperature of water. Contamination of high quantity of dissolved salts indicates the high value of electrical conductivity at that temperature. While collecting the second batch of samples of water from different spot points of Phewa lake electrical conductivity of the sampled water of Phewa lake were recorded immediately by the conductivity meter when the samples were collected in the sample collection polythene bottles and at the same time the temperatures of the sampled water was recorded. The electrical conductivity values of the sampled water of different spot points of Phewa lake are between 0.15 mS to 0.05 mS in the first batch of collection and 0.09 mS to 0.04 mS in the samples of second batch of collection which concludes that the electrical conductivity values of Phewa lake are rather low.

## Alkalinity

The alkalinity value of the sampled water indicates whether the source from where the water samples have been taken have the contamination of human and animal waste, and the surrounding of the source have other different activities such as household washing and loundries etc. by which the alkaline substances are generated which contaminate the main source. The alkalinity values of the sampled water from different spot points of Phewa lake are 0.47 mg./lit  $\text{CaCO}_3$  to 0.13 mg/lit  $\text{CaCO}_3$  in the first batch collected samples and 1.76 mg/lit  $\text{CaCO}_3$  to 0.42 mg/lit  $\text{CaCO}_3$  in the scnd batch collected samples.



### Total hardness

Water shows different amount of hardness. But hardness is also an indicator of pollution effected by urine, sewage and dissolved manure. The amount of hardness of lake water increase through the intake of these pollutants. The total hardness of sampled water of Phewa lake from the different spot points have the highest value of 92.84 mg/lit  $\text{CaCO}_3$  to the lowest value of 27.42 mg/lit  $\text{CaCO}_3$  in the first batch collected samples and 104.84 mg/lit  $\text{CaCO}_3$  to 19.41 mg/lit  $\text{CaCO}_3$  in the second batch collected samples.

### Phosphate

Phosphate is the nutrient for the production of bio-mass in water, therefore the phosphate ions which are not taken up by the plants are thus immobilised in the soil. In natural water the amount of phosphate is 0.1 mg/lit. If there is a higher value it infers faecal pollution. Therefore phosphate is a reliable indicator for faecal pollution due to sewage, manure, fertilizer and washing powder contamination. In the water samples of Phewa lake the highest value of phosphate is 0.08 mg/lit P and the lowest value as 'trace' in the first batch collection and the highest value of 0.31 mg/lit P and the lowest value as 'trace' in the second batch collection.

### Chloride

The high concentration of chloride in lake water is an indicator of faecal pollution. Polluted water contents 30 to 100 mg/lit Cl and heavily polluted water contents 300 mg/lit Cl. In the sampled water of Phewa lake chloride contents are 4.85 mg/lit Cl as the highest value to 0.69 mg/lit Cl as the lowest value in the first batch collection and 11.10 mg/lit Cl to 0.69 mg/lit Cl in the second batch collection of the sampled water from the different spot points of the lake.

### Total Solid

It is one of the indicator of the pollution that faecal how much total solid have been holding by the sampled water per liter. The sampled water is well shaken in the sample collected bottle and known volume of water is evaporated in a previously weighed evaporating basine on the water bath. The difference of the two weights of the evaporating basing (empty and after complete evaporation of the known volume of sampled water) gives the total value of the dissolved and undissolved solids that content in the known volume of the sampled water. The

highest value of total solid found in the first batch collected water sample from Phewa lake is 840 mg/lit and the lowest value is 60mg/lit and in the second batch collection the values of total solids are as the highest value is 720mg/lit and the lowest value is 20mg/lit.

### **Nitrate**

Organic and inorganic nitrogen compounds are coming in the lake water from different sources like precipitation, scours of agricultural fields, sewage, tributaries. In lake water like Phewa ammonia is found as an intermediate of the decomposition of nitrogenated organic compounds from human and animal excrement and through fertilizer scour. Nitrite is produced from ammonia by nitrification and nitrate is produced from nitrite by the same nitrification process. In lake water nitrate supports the growth of plants and aquatic animals which are stressing the water due to their excrements. In the water samples collected from Phewa lake the highest nitrate value is found as 20.40 mg/lit  $\text{NO}_3$  and the lowest value is as 'trace' quantity in the second batch collection from the different spot points of Phewa lake.

Table

Samples	pH	Electrical conductivity (mS)	Alkalinity mg/lit CaCO <sub>3</sub>	Total Hardness mg/lit CaCO <sub>3</sub>	Phosphate mg/lit P	Chloride mg/lit Cl	Total solids mg/lit
1. A <sub>1</sub>	7.91	0.07	0.34	60.18	0.01	0.69	272
2. A <sub>2</sub>	7.52	0.10	0.39	40.17	0.01	4.16	260
3. A <sub>3</sub>	7.87	0.09	0.29	15.14	0.01	2.08	270
4. A <sub>4</sub>	7.47	0.11	0.34	28.37	0.08	1.38	76
5. A <sub>5</sub>	7.60	0.08	0.31	58.41	Trace	4.85	36
6. B <sub>1</sub>	7.73	0.09	0.31	72.15	0.02	2.77	58
7. B <sub>2</sub>	7.66	0.08	0.31	47.10	Trace	1.38	220
8. B <sub>3</sub>	7.63	0.09	0.18	62.18	0.01	2.08	94
9. B <sub>4</sub>	7.52	0.09	0.42	76.19	0.04	3.47	64
10. B <sub>5</sub>	7.80	0.08	0.29	68.29	Trace	3.47	60
11. B <sub>6</sub>	7.60	0.15	0.42	53.57	0.01	2.08	840
12. B <sub>7</sub>	7.60	0.09	0.34	68.13	0.03	2.77	240
13. B <sub>8</sub>	7.64	0.09	0.31	67.68	0.02	2.08	150
14. B <sub>9</sub>	7.73	0.08	0.29	60.38	0.03	2.08	280
15. C <sub>1</sub>	7.56	0.09	0.23	58.13	0.01	2.08	220
16. C <sub>2</sub>	7.30	0.09	0.31	50.51	0.01	3.47	340
17. C <sub>3</sub>	8.00	0.08	0.29	46.98	0.01	2.08	100
18. C <sub>4</sub>	7.60	0.08	0.31	48.21	Trace	2.77	100
19. C <sub>5</sub>	7.52	0.08	0.21	60.40	0.01	1.38	150
20. C <sub>6</sub>	7.61	0.08	0.21	54.48	0.02	1.38	320
21. C <sub>7</sub>	7.58	0.08	0.23	51.24	0.01	2.77	350
22. C <sub>8</sub>	7.80	0.08	0.31	46.19	0.01	2.77	60
23. D <sub>1</sub>	7.79	0.05	0.13	40.18	0.02	2.08	2.60
24. D <sub>2</sub>	7.53	0.05	0.18	40.18	Trace	2.08	320
25. D <sub>3</sub>	7.52	0.07	0.21	53.21	0.01	2.77	210
26. D <sub>4</sub>	7.55	0.07	0.26	76.58	0.01	3.47	220
27. E <sub>1</sub>	7.63	0.08	0.29	49.18	0.01	2.08	480
28. E <sub>2</sub>	7.80	0.07	0.21	45.38	0.01	1.38	330
29. E <sub>3</sub>	7.61	0.08	0.29	42.21	0.03	0.69	290
30. E <sub>4</sub>	7.61	0.08	0.29	50.18	0.01	2.77	290
31. E <sub>5</sub>	7.63	0.08	0.34	47.81	0.01	2.08	240
32. E <sub>6</sub>	7.54	0.08	0.47	27.42	0.01	1.38	360
33. E <sub>7</sub>	7.61	0.08	0.29	92.84	0.01	1.38	100
34. E <sub>8</sub>	7.61	0.08	0.29	50.60	Trace	3.47	60
35. E <sub>9</sub>	7.53	0.08	0.39	57.16	0.03	3.47	800
36. F <sub>1</sub>	7.51	0.10	0.31	37.13	Trace	3.47	660
37. F <sub>2</sub>	7.54	0.08	0.31	56.08	0.01	1.02	240
38. F <sub>3</sub>	7.64	0.07	0.31	48.40	0.01	2.08	320
39. F <sub>4</sub>	7.69	0.08	0.39	38.72	0.02	2.77	100
40. F <sub>5</sub>	7.58	0.08	0.39	56.23	0.01	2.08	530

Analytical results of water samples of Phewa lake collected first time (first batch collection) : 2<sup>nd</sup> week of January, 1996.

Table III

Samples	pH	Electrical Conductivity (mS)	Temp (°C)	Alkalinity mg/lit CaCO <sub>3</sub>	Total Hardness mg/lit CaCO <sub>3</sub>	Phosphate mg/lit P	Chloride mg/lit Cl	Total Solids mg/lit	Nitrate mg/lit NO <sub>3</sub>
1. A <sub>1</sub>	7.35	0.08	24.7	0.58	58.24	0.12	4.16	200	4.17
2. A <sub>2</sub>	7.33	0.08	25.4	1.76	38.83	0.19	1.38	180	5.57
3. A <sub>3</sub>	7.53	0.07	24.5	0.42	54.36	0.28	3.24	180	6.71
4. A <sub>4</sub>	7.58	0.06	24.9	0.42	27.18	0.31	4.16	40	4.65
5. A <sub>5</sub>	7.46	0.06	25.0	1.00	54.36	0.24	2.08	20	4.36
6. B <sub>1</sub>	7.45	0.08	28.0	0.50	69.81	0.27	4.85	20	1.08
7. B <sub>2</sub>	7.50	0.07	27.9	0.44	42.71	0.15	0.69	140	5.71
8. B <sub>3</sub>	7.48	0.08	27.8	0.42	58.24	0.31	2.77	60	6.21
9. B <sub>4</sub>	7.31	0.07	24.6	0.47	66.01	0.10	4.16	20	8.43
10. B <sub>5</sub>	7.88	0.08	26.2	0.48	62.13	0.22	4.85	20	6.42
11. B <sub>6</sub>	7.94	0.09	26.0	0.68	46.59	Trace	4.85	520	4.25
12. B <sub>7</sub>	7.47	0.07	27.9	0.71	69.89	0.10	4.85	160	6.21
13. B <sub>8</sub>	8.05	0.08	26.9	0.50	62.13	0.01	4.16	80	3.11
14. B <sub>9</sub>	8.25	0.08	26.9	0.47	54.36	0.23	3.47	160	2.29
15. C <sub>1</sub>	7.42	0.07	25.3	0.66	54.36	0.11	2.08	100	1.34
16. C <sub>2</sub>	7.39	0.06	24.7	0.52	46.59	0.07	3.47	220	4.65
17. C <sub>3</sub>	7.36	0.06	26.2	0.52	46.59	0.16	4.16	40	3.19
18. C <sub>4</sub>	7.31	0.07	25.8	0.50	46.59	0.06	0.38	40	4.33
19. C <sub>5</sub>	7.42	0.07	27.5	0.50	46.59	0.13	0.69	80	Trace
20. C <sub>6</sub>	7.71	0.08	28.7	0.58	58.24	0.18	7.63	260	0.18
21. C <sub>7</sub>	7.52	0.07	27.8	0.60	50.48	Trace	6.24	200	Trace
22. C <sub>8</sub>	7.93	0.08	27.6	0.60	46.59	0.01	6.24	20	20.40
23. D <sub>1</sub>	7.44	0.04	27.3	0.52	34.94	0.07	6.94	200	Trace
24. D <sub>2</sub>	7.37	0.05	26.4	0.60	38.83	0.17	11.10	260	Trace
25. D <sub>3</sub>	7.54	0.07	27.0	0.58	54.36	0.13	9.02	140	Trace
26. D <sub>4</sub>	7.51	0.07	26.0	0.73	81.54	0.17	5.55	160	Trace
27. E <sub>1</sub>	7.42	0.07	25.2	0.89	46.59	0.19	4.16	400	Trace
28. E <sub>2</sub>	7.69	0.06	29.7	0.87	46.59	0.21	4.16	260	Trace
29. E <sub>3</sub>	7.44	0.07	25.3	0.76	46.59	0.16	5.55	240	Trace
30. E <sub>4</sub>	7.53	0.07	26.8	0.47	54.36	0.11	4.16	240	2.51
31. E <sub>5</sub>	8.47	0.07	25.9	0.63	50.48	Trace	2.08	140	Trace
32. E <sub>6</sub>	7.39	0.07	26.3	0.68	19.41	Trace	5.55	200	0.23
33. E <sub>7</sub>	7.87	0.07	26.5	0.71	104.84	0.05	2.77	20	Trace
34. E <sub>8</sub>	7.65	0.08	27.5	0.71	50.48	Trace	6.94	20	Trace
35. E <sub>9</sub>	7.71	0.06	27.2	0.66	58.24	Trace	8.32	720	Trace
36. F <sub>1</sub>	7.91	0.08	28.0	0.81	27.16	Trace	4.16	540	0.23
37. F <sub>2</sub>	7.78	0.07	24.9	0.68	66.01	Trace	2.08	120	0.31
38. F <sub>3</sub>	7.45	0.07	26.2	0.44	50.48	Trace	4.16	280	Trace
39. F <sub>4</sub>	7.47	0.08	27.0	0.73	42.71	Trace	5.55	40	Trace
40. F <sub>5</sub>	7.40	0.07	26.9	0.68	66.01	Trace	6.94	400	0.01

Analytical results of water samples of Phewa lake collected at second time (second batch collection) : 3<sup>rd</sup> week of April, 1996.

## 5. SUMMARY AND CONCLUSION

The above discussions and results concludes that complexity of issues are facing by Phewa lake and also the surrounding areas. The present environmental problem can become severely worse as Pokhara city grows. The concerned authority who renews and awards license to hotels, restaurants and other institutions in the surrounding of Phewa lake, it should ensure that the erected buildings and business complexes must have adequate facilities (mainly septic-tanks and soak-pits) to process the organic wastes they generate. The water quality monitoring of Phewa lake should be continued by the Soil and Water Laboratory of the Department of Soil Conservation for at least five years regularly with strictly following the frequency periods to achieve the sufficient data of degraded quality of water of Phewa lake to fulfil the objectives.

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