NATIONAL PROGRAMME

ON

DRINKING WATER QUALITY

SURVEILLANCE

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Drinking Water Quality Surveillance Unit,
Division of Engineering Services,
Ministry of Health, Malaysia,
Kuala Lumpur.

October, 1983.

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PREFACE

This document is a workplan aimed at achieving the objectives set out in the National guidelines for Drinking Water Quality. As with the guidelines, this document was prepared by the unit of Drinking Water Quality Surveillance, Ministry of Health with the guidance of Dr. K.M. Yao and Dr. M. Nakamura of World Health Organisation, Western Pacific Regional Centre for the Promotion of Environment Planning and Applied Studies (WHO-PEPAS). We acknowledge their valuable contribution and advice with thanks.

We would like to take the opportunity here to acknowledge with thanks the representatives from PWD, DOC, and DOE for their valuable assistance in vetting through this document.

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Introduction

1.1. Background

1.1.1. The Public Works Department (PWD) is the central agency responsible for coordinating all water supply activities executed through State PWD's in Peninsular Malaysia, except for the State Water Boards (WB) of Penang and Malacca. These agencies provide treated water under pressure to the urban as well as the "less remote" rural communities.

1.1.2. As part of the Rural Environmental Sanitation Programme (RESP), the State Medical and Health Services Department (SMHSD) supplement the PWD and WB programme, by assisting the "more remote rural communities in obtaining sufficient quantities of untreated water.

1.1.3. In addition to the above mentioned agencies, some industries such as mining, oil palm and rubber estates provide drinking water to their resident employees.

1.1.4. The surveillance of drinking water quality is the responsibility of the Ministry of Health (MOH) and currently a regular monitoring programme is being carried out through the SMHSDs in conjunction with the operating agencies (PWD/WB).

1.1.5. The department of Chemistry provides Laboratory services in the testing of water samples.

1.1.6. In relation to sources for raw water, the Environmental Quality Act of 1974, constitutes a regulatory mechanism for prevention, abatement and control of water pollution at the source and is enforced through the Division of Environment (DOE) Ministry of Science, Technology and Environment.

1.1.7. The proposed national drinking water quality surveillance programme establishes a detailed work arrangement and activities in obtaining data on the quality of drinking water from the public water supply systems, processing and evaluating such data and transforming them into useful information for immediate action or long term planning, in the protection of the quality of our drinking water.

1.2. Need for a national drinking water quality surveillance programme

1.2.1. At present we have only drinking water quality monitoring programmes and not surveillance programmes. Monitoring is only one of the activities in a surveillance programme. Even then most of our existing monitoring programmes were established years back and require reviewing and updating because since then;

(a) tremendous amount of development has taken place in the discipline;

(b) most water supply systems have been largely extended due to increasing demands and

(c) there is also a need to standardise our criteria for monitoring programme design.

1.2.2. The trends of development in the country such as:

(i) progressive increase in urbanisation, industrialisation and agricultural activities;

(ii) general lack of centralised sewerage treatment facilities throughout the country and

(iii) droughts and floods are common.

result in heavy pollution and sullage and sewage contamination of our waterways.

1.2.3. Mostly surface water and shallow ground water are being exploited as source for our urban supplies; and untreated water from springs and wells are being supplied to the rural communities. If the drinking water supplied by such systems is not kept under proper surveillance, our consumers may be exposed to high risk.

1.2.4. That the present drinking water quality monitoring programme is inadequate in preventing or reducing health hazards via drinking water is clearly demonstrated by the following events:

(i) waterborne diseases such as typhoid, cholera and gastro-enteritis etc. are still prevalent in the country and

(ii) cases of high levels of heavy metals, nitrate, flouride, E. coli etc. has been reported to be present in our drinking water.

1.2.5. From the above considerations it is felt that there is an urgent need to establish immediately a national drinking water quality surveillance programme which, besides monitoring should include sanitary surveys, data processing and evaluation-institutional examination and a remedial action plan to ensure that the water available for human consumption is acceptable and safe.

1.3. Objectives of the Programme

The principal objective of this programme is to raise the standard of health of the people by ensuring the safety and acceptability of the drinking water provided to the consumer.

This objective can be achieved by reducing the incidence of water-borne communicable diseases or intoxication associated with poor public water supplies through effective surveillance.

This programme ensures that Public Health and Waterworks personnel will be alerted in time about deterioration in drinking water quality and be able to take preventive or remedial measures before any major outbreak of diseases or poisoning can occur.

1.4. Scope of the Programme

1.4.1. The National Drinking Water Quality Surveillance Programme shall cover all public water supply systems in the country.

1.4.2. Public Water Supply shall be as defined in the National Guidelines for Drinking Water Quality. They shall include:

(i) Urban public water supply

(ii) Rural public water supply

(iii) Privately owned public water supply.

1.4.3. The programme shall be implemented in the following phases

Phase	Plan	Time
I	Consolidate the existing urban drinking water quality surveillance programme.	by 86
II	Integrate the isolated rural water supply systems and the privately owned public water supply systems into the programme.	by 86/87
III	Gather data on the suitability of surface and ground sources for potable supply.	by 87
IV	Develop a data processing system for on-going water quality surveillance programme.	by 89
V	Review of the whole programme in terms of cost and effectiveness.	by 90

1.5. Levels of Surveillance

Table 1 and 2 recommends and describes the activities of the various levels of surveillance of drinking water quality (published by WHO monograph 63). From the tables, it is obvious that at present, Level II or the Basic Level of surveillance is the situation in this country. The National Drinking Water Quality Surveillance Programme described herein shall attempt to meet the performance Level IV and will proceed to the next higher surveillance Level V when situation permits.

Table 1 – Programme of Surveillance

Level of Surveillance	Description	Country Situation
I	Initial	No surveillance programme.
II	Basic	Have a nominal programme with severe limitations in scope and effectiveness.
III	Interim	Established programme in major cities only but not nation-wide.
IV	Intermediate	Have an established nation-wide programme but need to increase effectiveness.
V	Advanced	Good system to control water-borne epidemics.

Table 2 – Summary of Principal Activities for Varying Levels of Surveillance

Activity by the surveillance organisation	Level of Surveillance			
	I	II	III	IV
Laws, Regulations and Policies.	Basic	Basic	Intermediate	Complete
Enforcement	As needed for above	As needed for above	As needed for above	As need for above
Drinking Water Standards	–	Bacterial only	Bacterial + some chemical	W.H.O. or equivalent
Technical Assistance	None	Limited	Passive	Active
Training : Staff	None	On job	On job + short course	Previous + technical institute
Water Works Operators	None	Seminars	Seminars + short courses	Previous + technical institute

Table 2 (cont'd)

Activity by the surveillance organisation	Level of Surveillance			
	I	II	III	IV
Sanitary Surveys	Major cities	All cities	All urban, some rural	All urban, many rural
Approval of Sources	As above	As above	As above	As above
Sampling and Monitoring	As above	As above	Urban areas	Urban areas, special rural
Standard Methods of Analysis	Residual Cl_2	Bacterial residual Cl_2	Bacterial + some chemical	WHO or equivalent
Reporting Requirements	Per above 4	Per above 4	Per above 4	Per above 4
Remedial Action	As needed	As needed	As needed	As needed
Establishment of Laboratory(ies)	–	Existing health lab.	Central/ regional lab. if needed	+ fully equipped ref. lab.
Design Standards or Criteria.	–	Advisory	Informal approval	Formal approval
Control of Cross-Connections.	None	None	Advisory	Active Programme
Plumbing Code	None	None	Advisory	Codified
Laboratory Support Services	None	None	Media + reagents available	Evaluate lab. at large plants
Material and Additives Standards	None	None	Advisory	Approved listing
Regulation of Special Water Supplies:				
Institutional	Hospitals, major rail, air terminals	+ schools, army posts prisons	+ major housing projects	+ Other concentrated populations
Temporary	None	Large camps	Fairs, markets	As above

Table 2 (cont'd)

Activity by the surveillance organisation	Level of Surveillance			
	I	II	III	IV
Tanker	Major cities	All cities	Urban areas	All urban, some rural
Bottled Water	None	None	Large commercial bottlers	All commercial bottlers
Ice	None	None	Large commercial manufacturers	All commercial manufacturers

N.B. The activities for Level V are similar to those of Level IV with the exception of other additional activities such as those being practised in the advanced countries.

2. **Key Programme Elements** (Details are given in the Manual)

Surveillance of drinking water quality is the continuous and vigilant public health assessment and overview of drinking water supplies. Essentially this drinking water surveillance programme includes the following key elements of surveillance:

(i) Monitoring
(ii) Sanitary surveys
(iii) Data processing and evaluation
(iv) Remedial action
(v) Institutional examination

2.1 **Monitoring**

2.1.1. Monitoring is the laboratory or field examination of water samples taken from various points in the water supply system, representative of the condition of the water in that supply.

2.1.2. Monitoring programme shall be jointly formulated on a yearly basis and implemented for each district by the respective District Health Office (DHO) and the District Public Works Department (DPWD) in accordance with the requirements given in the National Guidelines on Drinking Water Quality (NGDWQ).

2.2. **Sanitary Surveys**

2.2.1. Sanitary survey is an on the site inspection and evaluation of all conditions, devices and practices in the water supply system that could present a health hazard to the consumer.

2.2.2. Sanitary survey programme shall be jointly formulated on a yearly basis for each district and implemented by the respective DHO and DPWD in accordance to the requirements given in the National Guidelines for Drinking Water Quality.

2.3. **Data Processing and Evaluation**

2.3.1. The purpose of data processing activity is to condense a great amount of data into information that can be utilised for decision making and in improving management and operational methods of a drinking water quality surveillance programme.

2.3.2. All data collected through district monitoring and sanitary survey programmes or any other means shall be summarised by the District Health Office and sent to the SMHSD who shall compile all such district reports and send to the Unit of Drinking Water Quality Surveillance (UDWQS), Engineering Services Division, Ministry of Health for further processing and evaluation.

2.4. **Remedial Action**

2.4.1. Remedial action is a series of activities to be carried out to correct sanitary deficiency upon detection. Considerable judgement is required on the part of the evaluator in interpreting the relative effect of the identified deficiency on the safety of the supply and the type of corrective measures necessary. Generally such remedial action activities may include:

(i) resampling, sanitary survey or engineering system investigation to find out the probable cause;

(ii) institute corrective measures such as repairs, increased chlorine dosage, use of alternative source etc. or

(iii) notification and advice to the consumer or stop the supply.

2.4.2. The DHO and DPWD shall be jointly responsible for remedial actions. Upon detection of such sanitary deficiency through monitoring, sanitary surveys or any other means, the Medical Officer of Health shall liaise with the engineer/technician of the DPWD concerned to investigate the probable cause and to attempt to correct such faults until the original water quality is restored. (See Sec. 4.6 NGDWQ).

2.5. **Institutional Examination**

2.5.1. Institutional examination of water supply is a study on those elements of operation and management of the various relevant agencies such as poor engineering design or maintenance, ineffective supervision, insufficient training of staff, poor interagency coordination etc. which may result in health hazards to the consumer.

2.5.2. The UDWQS, Ministry of Health shall periodically carry out surveys/meetings to observe and identify problems faced by the ground staff who are actually implementing the programme, and attempt to find solutions to such problems.

3. **Organisational Arrangement**

This programme involves several agencies for its implementation (see Sec. 3.1.). The Unit of Drinking Water Quality Surveillance, Division of Engineering Services, Ministry of Health shall be the lead agency in coordinating such activities pertaining to drinking water quality so as to ensure that all drinking water from public water supplies in this country is free from health hazards.

3.1. **Participating Agencies and Roles**

The following is a list of the various agencies involved in the national drinking water quality surveillance programme. The administrative set-up is a three tier system (federal, state and district level) for the Ministry of Health and Public Works Department and a two tier system (federal and regional level) for the Department of Chemistry and Department of Environment.

3.1.1. **Ministry of Health (MOH)**

i)	at Federal level	:	Unit of Drinking Water Quality Surveillance (UDWOS)
ii)	at State level	:	State Medical & Health Services Department (SMHSD) (health division)
iii)	at District level	:	District Health Office (DHO) (general health unit)

3.1.2. **Public Works Department**: (PWD)

(i)	at Federal level	:	Federal PWD Water Supply Branch
(ii)	at State level	:	State PWD Water Supply Department
(iii)	at District level	:	District PWD

3.1.3. **Private Operator**: (P.O.): (Water Purveyor)

3.1.4. **Department of Chemistry**: (DOC)

(i)	at Federal level	:	Federal DOC
(ii) (iii)	at State level at District level	:	Regional DOC

3.1.5. **Department of Environment**: (DOE)

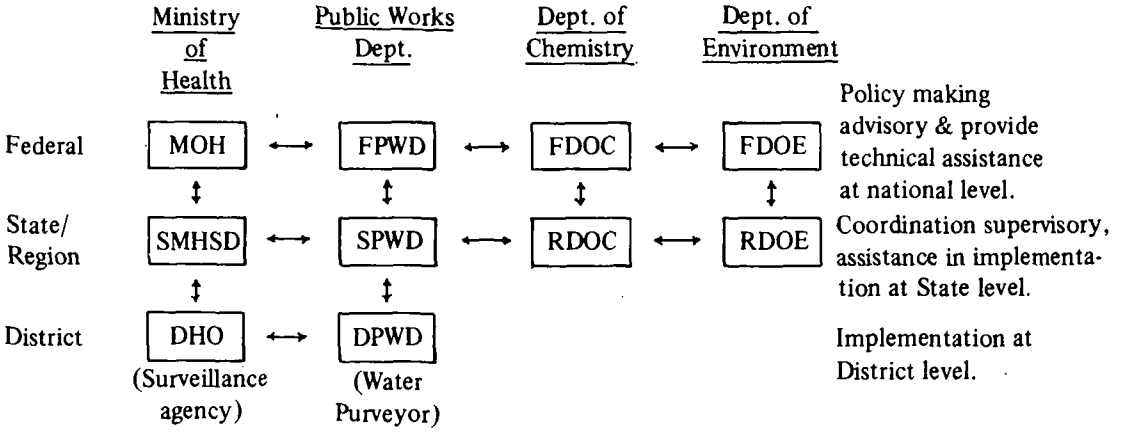
(i)	at Federal level	:	Federal DOE
(ii) (iii)	at State level at District level	:	Regional DOE

3.2. **Institutional Relationship**

Since a number of government agencies are involved in carrying out the drinking water quality surveillance programme, therefore continuous cooperation and liaison between these agencies is essential. However, each agency must adhere to its specific function and responsibility (see Sec. 3.3) such that overlapping is avoided and the overall programme can be implemented in the most efficient manner. A suggested inter and intra-agency organisation chart is shown in Figure 1. It is recommended that there should be efficient intra agency control (vertically) and appropriate inter agency interaction (horizontally) at the respective levels in order to ensure smooth implementation of the programme.

Figure 1

Inter & intra-agency organisation chart
(Drinking Water Quality Surveillance Programme)



3.3. Functions and Responsibilities

The following Table 3 lists the various functions and responsibilities of the participating agencies in the National Drinking Water Quality Surveillance Programme. It was proposed on the principle of complementation and not competition. It is aimed at promoting improved performance and discourages complacency. Proper utilisation of available resources by each agency will enable a more efficient public service to be provided.

Table 3 – Functions and Responsibilities of the various agencies

Agency	Function	Responsibility
(Surveillance) MOH – UDWQS SMHSD DHO	Surveillance of drinking water quality	to ensure that all drinking water quality in the country is free from health hazards, to find out what is wrong and assists in putting matters right.
(Water Purveyor) FPWD SPWD DPWD	Supplying of potable water	to provide water of sufficient quantity and quality to the population.
(Laboratory) FDOC RDOC	Testing of water	to provide laboratory services for analysis of water samples.
(Environment protection) FDOE RDOE	Controlling of pollution at source	to protect the raw water sources from being unduly polluted.

The detailed activities assigned to the different agencies are described in Sec. 3.4.

3.4. Activities

The following are a list of the major activities to be carried out by the respective participating agency in the programme.

3.4.1 **Ministry of Health.**

3.4.1.1. Unit of Drinking Water Quality Surveillance:

(i) administers and coordinates the National Drinking Water Quality Surveillance Programme. This includes providing consultancy and technical assistance to the States in formulating and implementing their monitoring programmes and sanitary survey programmes;

(ii) recommends and reviews guidelines, standards, manuals etc. for programme implementation;

(iii) processes, analyses and evaluates all data pertaining to drinking water quality and to make them available for decision makers;

(iv) identifies technical and methodological gaps, training needs and other problems

associated with the implementation of the programme and provides or recommends solution;

(v) promotes health education and self inspection (especially for process quality control and analytical quality control);

(vi) promotes and coordinates research activities;

(vii) "approves" new sources for potable supply and water treatment methods;

3.4.1.2. **State Medical and Health Services Departments**

(i) administers and coordinates the drinking water quality surveillance activities;

(ii) supervises and assists the district in the formation and implementation of the district drinking water quality surveillance programmes and sanitary survey programmes;

(iii) compiles all data pertaining to drinking water quality from the districts and forwards them to the UDWQS, Ministry of Health for processing;

(iv) controls privately owned public water supply systems by a permit or registration system;

(v) coordinates in investigation and research activities;

3.4.1.3. **District Health Office**

(i) formulates and implements the district water quality monitoring programmes and sanitary survey programmes together with the District Public Works Department;

(ii) samples water and makes sanitary survey as scheduled in the programmes and prepares monthly summary reports of such activities to the SMHSD for further processing;

(iii) liaises with the DPWD to investigate water quality problems and where appropriate assists in remedial actions & reports the incidence to the SMHSD;

(iv) inspects regularly on privately owned public water supply systems and report to the SMHSD about findings;

(v) assists in carrying out investigation such as public complaints or research activities.

3.4.2. **Public Works Department**

3.4.2.1. **Federal Headquarters of Public Works Department, K.L.**

(i) Collects and collates hydrological statistical data on water supplies for Peninsular Malaysia.

(ii) Carries out research and provides standards on water supply equipment, water treatment, design of water installation and facilities.

(iii) Examines and analyses the results of laboratory tests on water samples.

(iv) Identifies and appraises new projects.

(v) Plans, designs and supervises the construction of Felda and Johor Tenggara Water Supply Schemes.

(vi) Provides technical advice (including designing of water supply schemes) to States and other Government authorities.

(vii) Implements programme for exploration and development of groundwater resources.

(viii) Conducts research on water treatment processes.

3.4.2.2. **State JKR/Water Department/Water Board of Authority**

(i) Examines and analyses the results of laboratory tests on water samples for quality control purposes.

(ii) Identifies and appraises new projects.

(iii) Implements new projects.

(vi) Is responsible for the management of the water supply systems in the State.

(v) Tests candidates for and awards plumbing licences.

3.4.2.3. **District JKR Office/District Water Office/Regional Water Office**

(i) Takes water samples for testing, examines and analyses the results for quality control purposes.

(ii) Supervises the construction of new projects.

(iii) Operates and maintains the public water supply systems.

(iv) Provides tanker supplies for areas facing water shortage.

(v) Inspects and approves the water supply plumbing systems of buildings.

3.4.3.**Department of Chemistry**

3.4.3.1. **Federal Department of Chemistry**

(i) Administers and coordinates laboratory activities in the National Drinking Water Quality Surveillance Programme.

(ii) Compiles and evaluates all laboratory data.

(iii) Provides analytical and advisory services in the National Drinking Water Quality Surveillance Programme.

(iv) Provides laboratory services for the examination of chemicals etc. used in the water treatment processes.

(v) Evaluates and issues reports of laboratory examination of water samples.

(vi) Recommends and reviews guidelines, standard methods and manuals in the programme.

(vii) Provides training and technical advice to in-plant laboratories.

(viii) Evaluates and approves the use of field test kits.

(ix) Implements Analytical Quality Control.

(x) Provides laboratory research and investigation.

(xi) Provides sample containers with the appropriate treatment.

(xii) Provides field investigation when necessary.

3.4.3.2. **Regional Department of Chemistry**

(i) Administers and coordinates laboratory activities in the National Drinking Water Quality Surveillance Programme (state).

(ii) Compiles all data and forwards them to the Headquarters Laboratory.

(iii) Provides analytical and advisory services in the National Drinking Water Quality Surveillance Programme (state).

(iv) Provides laboratory services for the examination of chemicals etc. used in the water treatment processes.

(v) Evaluates and issues reports of the laboratory examination of water samples.

(vi) Provides training & technical advice to in-plant laboratories.

(vii) Implements Analytical Quality Control.

(viii) Provides laboratory research and investigation.

(ix) Provides sample containers with the appropriate treatment.

(x) Provides field investigation when necessary.

3.4.4.**Department of Environment**

Functions carried out at;

3.4.4.1. **Head Quarters**

(i) To plan and coordinate annual water quality monitoring programme.

(ii) To process, evaluate and interpret as well as publish water quality monitoring data and information.

(iii) To recommend and supervise methodology or system to be adopted pertaining to water quality monitoring.

(iv) To prepare annual reports on the status of national raw water quality.

(v) To liaise with international bodies pertaining to water quality management for the exchange of information and sharing of experiences.

(vi) To develop and recommend national raw water quality criteria and standards.

3.4.4.2. **Regional Office**

(i) To implement regional water quality monitoring programmes.

(ii) To compile monitoring data, evaluate and report Programme Performance.

(iii) To carry out investigation arising from complaints.

(iv) To help check on compliance of various Regulations under the Environmental Quality Act, 1974.

(v) To carry out baseline studies and pollution source inventory within the selected basins.

(vi) To alert enforcement units and other related agencies upon detection of pollution.

4. Work Plan

This section details the major activities to be carried out under the programme, the agency or agencies responsible and the phases for implementation.

4.1. Formulation of Guidelines and Manuals

4.1.1. The UDWQS, Ministry of Health shall be responsible for drafting the following documents:

(i) The National Guidelines on Drinking Water Quality (see Sec. 4.1.2).

(ii) The Manual on Drinking Water Quality Surveillance (see Sec. 4.1.3).

These two documents shall be vetted and adopted by the National Committee on Drinking Water Quality (see Sec. 4.1.4) before they are applied in the proposed National Drinking Water Quality Surveillance Programme.

4.1.2. The National Guidelines on Drinking Water Quality shall include:

(i) raw water quality criteria
(ii) drinking water quality standards
(iii) standard sampling procedures and equipment
(iv) standard laboratory and field testing methods
(v) monitoring and sanitary survey requirements &
(vi) a system of reporting and remedial action procedures.

4.1.3. The Manual on Drinking Water Quality Surveillance shall detail the procedures and methodology involved in fulfilling the requirements stipulated in the National Guidelines on Drinking Water Quality.

4.1.4. The "National Committee on Drinking Water Quality" shall serve as an advisory committee to the Federal Government, (Minister of Health) on matters pertaining to Drinking Water Quality.

The Committee shall comprise of representatives from the following organisations

(i) Ministry of Health
(ii) Federal Public Works Department

(iii) Federal Department of Chemistry

(iv) Federal Department of Environment

4.2. **Establishment of district monitoring programmes and sanitary survey programmes and remedial action plan.**

4.2.1. Upon adoption of the National Guidelines on Drinking Water Quality and the Manual on Drinking Water Quality Surveillance, the UDWQS, Ministry of Health shall assist the State Medical and Health Services Departments, the District Health Office and together with the District Public Works Department in establishing the district monitoring, and sanitary survey programmes and the remedial action plan in accordance with the requirements prescribed in the National Guidelines on Drinking Water Quality.

4.2.2. The district monitoring programmes, sanitary survey programmes and remedial action plan shall be reviewed and adopted by the "State Drinking Water Quality Coordination Committee" concerned (as defined in sec. 4.2.3).

4.2.3. The State Drinking Water Quality Coordination Committee shall serve as an advisory committee to the State Government on matters pertaining to drinking water quality in the State. The above shall be a sub-committee of the State Action Council and shall comprise of permanent representatives from the following:

(i) State Medical and Health Services Department (Secretariate)

(ii) State Public Works Department

(iii) Regional Department of Chemistry

(iv) Regional Department of Environment

(v) State Executive Councillor responsible for health matter.

4.3. **Implementation**

4.3.1. Upon adoption of the said programmes by the State Drinking Water Quality Coordination Committee, they shall be implemented accordingly by the respective agencies.

4.3.2. The drinking water quality monitoring programme and sanitary survey programme shall be implemented on the following public water supply systems according to the time frame stipulated.

4.3.2.1. **Urban Public Water Supply (implemented by 1986)**

It shall include all public water supply systems operated by PWD/WB in the urban areas.

4.3.2.2. **Rural Public Water Supply**

(i) It shall include all public water supply systems operated by PWD/WB (implemented by 1986).

(ii) It shall include all public water supply systems operated by MOH (implemented by 1987).

4.3.2.3. **Privately owned Public Water Supply System**

It shall include all public water supply systems operated by private operators (implemented by 1987).

4.4. Programme Evaluation and Report

4.4.1. Evaluation

The programme shall be evaluated annually by UDWQS, Ministry of Health based on the following indicators:

(i) **Programme Efficiency:**

(a) percentage of water samples successfully collected, tested and the result processed and evaluated;

(b) percentage of water sample test results successfully detected, violation due to either breakdown or overloading of the water supply system as a result of excessive pollution;

(c) percentage of sanitary surveys carried out;

(d) percentage of sanitary surveys carried out that result in detection of fault.

(ii) **Programme Effectiveness:**

(a) percentage of violation test reports being effectively transformed into action resulting in the prevention of potential health hazards;

(b) percentage of sanitary surveys resulting in corrective measures being taken to avoid potential health hazards;

(c) percentage improvement in general health statistics;

(d) percentage reduction in public complaints about water quality.

4.4.2. Report

An annual report on the programme in terms of progress, performance effectiveness, problems encountered and recommendations made etc. shall be prepared by the UDWQS, Ministry of Health and a copy sent to the Heads of all participating agencies.

5. Information Flow System

5.1. General data flow in the NDWQSP

The major consideration in the drinking water quality surveillance programme concerns the flow of data from the monitoring stations to the ultimate user. The various processes involved

in the flow of information in this programme are shown in fig. (2) which include collection stations, the analytical system, the data handling and dissemination system and the data user.

5.2 **Collection Station**

Collection station activities are divided into three categories as follows:

(i) collection of water samples at monitoring station to be used for laboratory analysis;

(ii) in-situ testing of water samples and

(iii) observations

5.3 **The Analytical System**

The analytical system includes the in-situ, as well as laboratory testing of water sample and is one of the critical elements in the data system. Lack of accuracy and precision at this stage will propagate errors throughout the entire surveillance programme. The Department of Chemistry, and personnel concerned have to use standard methods of analysis, quality assurance and uniform data reporting (etc. as required in the National Guidelines on Drinking Water Quality) to ensure the compatability of data and also subsequent use of the data within the system.

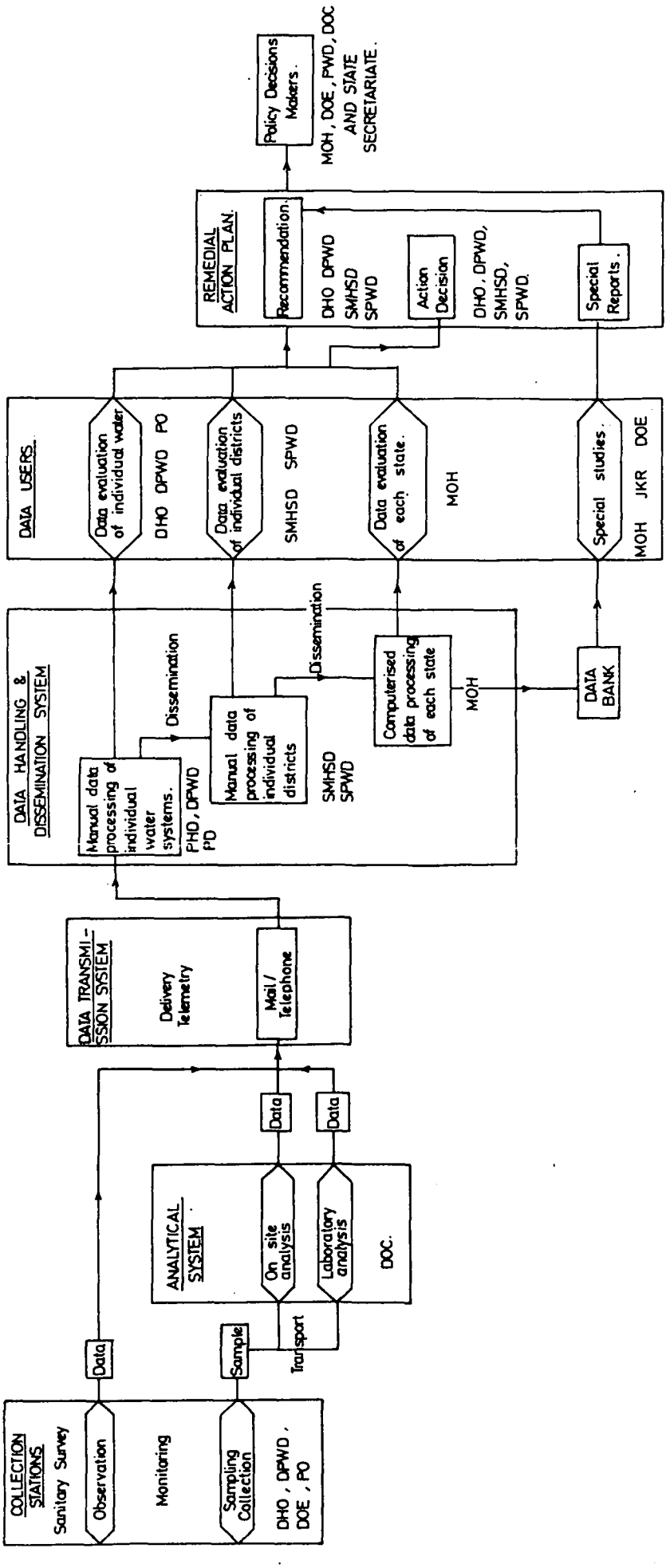
5.4 **The data transmission system**

This surveillance programme involves only two modes of data transmission i.e. by telephone or by delivery (mail/by hand). The data to be transmitted by these modes are classified as follows:

	Type of Information	Modes of Transmission
i)	Laboratory reports :	
	(a) Non violation reports	Mail
	(b) Violation (exceeding recommended and mandatory level, excluding those health investigation level).	Mail
	(c) Violation (exceeding health investigation level).	Telephone
ii)	In-situ test reports ($R.Cl_2$)	Telephone/by hand
iii)	Observation (during sampling/sanitary survey)	Telephone/by hand

The above classification established is based on the priorities of the data needed to accomplish the objective i.e. to prevent health hazards in drinking water within a certain time frame.

FIG.2 : GENERAL DATA FLOW IN NDWQSP



5.5 Data handling and dissemination

Data in the form of laboratory reports, field observations obtained through the collection station, analytical system or sanitary surveys are received by the appropriate personnal of the districts (DHO, DPWD, FDOE, etc.) who shall manually process and disseminate such data to the users for transforming such information into action or for management and operation improvements (ref. to fig. 2).

5.6 Data Users

The main users of these data generated by the programme are DHO & DPWD to initiate their remedial action plan. The SMHSD and SPWD utilises the district data for state policy making. The UDWQS, Ministry of Health processes the state data and utilises and evaluates them for long term decision making (ref. to fig. 2).

6. Surveillance detection and response mechanism (details are given in the manual)

Basically this drinking water quality surveillance programme employs three detection and response mechanisms for uncovering deterioration of the drinking water quality and for the restoration.

The three detection and response mechanisms are as follows:

(i) laboratory detection and response mechanism
(ii) in-situ test detection and response mechanism
(iii) sanitary survey detection and response mechanism

6.1. Laboratory detection and response mechanism

This mechanism utilises the laboratory data obtained through monitoring to alert the health and waterworks authorities of any deficiencies or potential deficiencies in the public water supply system. Thus, prompt corrective action can be effected before the situation deteriorates and adversely impairs the health of the consumer.

6.2. In-situ test detection and response mechanism

This involves regular on-the-site testing of residual chlorine, the levels of which will serve to indicate the possibilities of bacteriological contamination.

At present this on-the-site testing is being carried out routinely during sampling of water for the public water supply system as scheduled in the District Monitoring Programme and its auxiliary programme.

Such a mechanism would make it possible for corrective action to be taken in the quickest possible time.

6.3. Sanitary survey detection and response mechanism

Sanitary survey is a systematic and regular inspection of the source, treatment plant and the distribution system. The findings of such a survey will serve to detect any existing or potential problems, which if not rectified early may result in further deterioration of the drinking water quality.

7. Man-power and training requirements

7.1. Manpower requirements

The major categories of staff of the various departments involved in the current monitoring programmes are listed in the following Table 4:

Department	Category of Staff
Unit of Drinking Water Quality Surveillance, Ministry of Health.	Biochemist Microbiologist Public Health Engineer
State Medical and Health Services Department.	Deputy Director of Health and Medical Services State Public Health Engineer Chief Health Inspector Senior Health Inspector (sanitation).
District Health Office	Medical Officer of Health Health Inspector
Public Works Department at Federal, State and District level.	Engineer Technical Assistant Technician
Department of Chemistry, Federal and Regional level	Chemist Biologist Laboratory technician
Department of Environment	Environmental Officer Assistant Environmental Officer

Table (4) Categories of Staff of the various departments involved in the current Drinking Water Quality Monitoring Programme

The personnel listed in Table (4) shall be implementing the proposed national drinking water quality surveillance programme. Although there may be some slight addition in responsibilities for these personnel concerned, it is envisaged that no additional staff will be needed during the initial stage of implementation (Stage I) at the Federal, State or District level. However, in the later stages (Stage II, III, IV and V) such a need may arise for all the departments concerned especially for the Unit of Drinking Water Quality Surveillance, Ministry of Health.

The requirements for manpower at such stages shall be evaluated then and shall take into account the level of surveillance and the surveillance activities involved at that time.

7.2. Training Requirements

Like other programmes, the national drinking water quality surveillance programme requires proper training of personnel as one of the pre-requisites for its successful implementation. Such training shall be aimed at ensuring that the personnel concerned attains a minimum level of proficiency required to carry out the assigned functions. It is recognised that most of the existing staff already have the basic qualification and field experience, hence only short, in-service training courses will be sufficient in keeping them abreast of the current developments and practices in the discipline.

Training is required in areas such as:

(i) Sanitary survey and monitoring programme, planning and execution.

(ii) Proper sampling and sample handling.

(iii) Laboratory and field testing techniques.

(iv) Back siphonage and cross-connection control.

(v) Water quality and treatment (especially disinfection) &

(vi) Waterborne diseases, chemical toxicity etc.

It is proposed that the training should be carried out in the following manner:

(i) by training engineers, technical assistants from the State Public Works Departments and public health engineers, health inspectors from the State Medical and Health Services Department, at a central training course;

(ii) at the end of such courses, the participants shall return to their respective States to organise and conduct jointly (i.e. State Public Works Department and State Medical & Health Services Department) similar courses at State level to train their district colleagues. The Unit of Drinking Water Quality Surveillance, Ministry of Health shall assist in conducting such training courses.

8. Estimation of Cost

This section describes the relative increase in cost likely to be incurred in implementing the proposed national drinking water quality surveillance programme as compared with the existing drinking water quality monitoring programmes. The comparison is made in terms of manpower, sampling and testing as well as equipments required. These are described in the succeeding paragraphs. raphs.

8.1. Manpower

The manpower requirement for the proposed surveillance programme was based on the manpower of the on going monitoring programme. Therefore no extra cost is foreseen here, at least for the initial stages of the proposed programme (i.e. stage 1 – see Sec. 1.4.3).

8.2. Sampling and Testing

In addition to monitoring, the proposed surveillance programme includes activities such as sanitary surveys, data processing and evaluation, remedial action and institutional examination. Besides monitoring, the other activities mentioned above should not incur much additional cost to the agencies concerned. The annual operational budget of the respective agencies should be able to absorb the costs and hence discussion here is not necessary.

As for monitoring, the proposed surveillance programme requires the establishment of District Drinking Water Quality Monitoring Programme in accordance with the requirements stipulated in the National Guidelines on Drinking Water Quality. Considerable changes made in terms of the number of parameters to be tested for a particular water sample, and the frequencies of such parameters to be evaluated may result in additional cost.

The cost of monitoring mainly arises from sampling and testing. If we assume that the cost for sampling and testing are the same in the proposed new monitoring programme as the current monitoring programme, then we have only to consider the difference in the number of samples involved in the two programmes. In view of the increase number of sampling points, additional sampling stations will have to be set up. This additional cost will be borne by the water purveyor.

8.3. Equipment and Material

Mainly laboratory equipment required in the analytical system are considered in the costing of the proposed programme. These are summarised in Table (5).

Table (5) Equipment and reagents required by the various agencies

Agency	Equipment	Situation
District Health Office	pH meter or test kit	existing
	Chlorine test kit	existing
	Millipore Kit	optional
Public Works Department (Water treatment plant laboratory)	Turbidimeter	existing/to be purchased
	pH meter or test kit	existing
	Chlorine test kit	existing
	Colour comparater	existing
Department of Chemistry	Atomic Absorption Spectro photometer (for heavy metals)	existing/to be purchased.
	Gas chromatography systems for pesticides.	existing/to be purchased.
	Proportional counters	(available at PUSPATI)

Annex 1

Bacteriological Samples.

If we take the eg. of 100,000 population then from fig 1 of National Guidelines the no. of bacteriological samples/month is 100. Assuming sampling is done weekly then number of samples/week is 25. The average number of bacteriological samples taken for the current monitoring programme for a population of 100,000 is 10.

Increase in number of bacteriological samples $= \frac{10}{25} \times 100$

$= 40\%$

Chemical Samples

In the new monitoring programme, monthly chemical samples are taken at 3 points namely

i) Raw water intake
ii) Treatment plant outlet
iii) Service reservoir
and yearly samples taken at all other points

In the present monitoring programme chemical samples are taken monthly at all points in the system.

Decrease in number of chemical samples $= \frac{3}{10} \times 100$

$= 33\%$