

8 2 4
Z W 8 4

Republic of Zimbabwe

MINISTRY OF WATER RESOURCES AND DEVELOPMENT

THE NATIONAL MASTER PLAN FOR
RURAL WATER SUPPLY AND SANITATION

Inception Report

LIBRARY
International Institute for
for Community Water Supply

NOVEMBER 1983
INTERCONSULT A/S

824-2W84-3577
-1

TABLE OF CONTENTS

		<u>PAGE</u>
1.0	INTRODUCTION	1
1.1	General	1
1.2	Scope of Work	2
2.0	WATER RESOURCES	5
2.1	General	5
2.2	Hydrology	5
2.2.1	Scope of Work	5
2.2.2	Presentation	6
2.2.3	Timing and Extent of Work	7
2.3	Hydrogeology	9
2.3.1	General	9
2.3.2	Activities Carried out to Date	9
2.3.3	Future Work Activities	11
2.3.4	Standardization of Hydrogeological Date Collection	14
2.4	Water Quality	15
3.0	WATER ENGINEERING	16
3.1	General	16
3.2	Rural Water Supply Project	17
3.2.1	General	17
3.2.2	Evaluation of Present Design	17
3.2.3	Rehabilitation	19
3.2.4	State of the Art Review	19
3.2.5	Standard Design of Different Water Supply Schemes	20
3.2.6	Design Manual	22
3.2.7	Water Demands	23
3.3	Water Conservation Project (WCP)	24
3.3.1	General	24
3.3.2	Evaluation of Present Design of Livestock Water Supplies	26
3.3.3	Proposed Standard Design of Livestock Water Supplies	26
3.3.4	Design Manual	27
3.3.5	Livestock Water Supply Programme	28
3.4	Rural Water Supply Programme	29

LIBRARY, I.B. ...
 CENTRE FOR ... WATER SUPPLY
 AND ...
 P.O. Box ...
 Tel: (070) 81450 ext 141/142
 RN: 0519677
 LO: 824 2W04
 vol. 1

KD 5196
 Centre
 for Community Water Supply

		<u>Page</u>
9.0	PLAN OF OPERATION	56
9.1	Work Plan	56
9.2	Timing	56
9.3	Consultants Staff	57
9.3.1	Expatriate Staff	57
9.3.2	Locally Employed Personnel	60
9.4	Remuneration and Payments	61
9.4.1	Payment Schedule	61
9.4.2	Budget Estimate	62
9.5	Reporting	63
9.5.1	Inception Report	63
9.5.2	Quarterly Progress Reports	64
9.5.3	Water Resources Report	64
9.5.4	Sanitation Report	64
9.5.5	Management Report	64
9.5.6	Human Resources Development Report	64
9.5.7	Design Manual	65
9.5.8	Operation and Maintenance Report	65
9.5.9	Draft Executive Report	65
9.5.10	Final Executive Report	65
10.0	PROPOSED EXTENSION OF THE STUDY	66
10.1	Electronic Data Processing (EDP) - Requirements within the Water and Sanitation Sectors	66
10.1.1	Introduction	66
10.1.2	Water Resources Data Bank	66
10.1.3	Terms of Reference for a Feasibility Study Regarding the EDP - Requirements within the Water and Sanitation Sectors	76
10.2	Draft Action Plan for the Decade	78
10.3	The Inclusion of Peri-Urban Areas in the Study	80
10.4	Proposed Extension of Terms of Reference to include Commercial Farming Areas	81
10.5	Testpumping of Shallow Wells	84
10.6	Seminars	86

		<u>Page</u>
4.0	SANITATION	31
4.1	Evaluation of Existing Water Supply and Sanitation Projects in Zimbabwe	31
4.2	Application of Technology	31
4.3	Sanitation Project Implementation Consideration	32
4.4	National Health Profile	34
4.5	Training Requirements	35
4.6	Health Education	36
4.7	Monitoring and Evaluation	37
5.0	SOCIO-ECONOMIC	39
5.1	Objectives	39
5.2	Summary of Socio-Economic Studies to be Undertaken	39
6.0	MANAGEMENT STUDY	47
6.1	Objectives	47
6.2	Scope of Work	47
7.0	HUMAN RESOURCES DEVELOPMENT	51
7.1	Objective	51
7.2	Scope of Work	51
8.0	FINANCE AND ECONOMIES	52
8.1	Financial Resources Availability	52
8.2	Financial Analysis	52
8.3	Economic Analysis	53
8.4	Development Programmes	53
8.5	A Water Pricing Policy	54

- Appendix 2.1 - Terms of Reference for local personnel involved in field Hydrogeological work.
- Appendix 2.2 - Water Quality Parameters to be analysed.
- Appendix 9.1 - Curriculum Vitae
E.Skjelfoss.
- Appendix 9.2 - Curriculum Vitae
F.Kvaerneng.

APPENDIX A: Included in separate folder.

- Figure 1 - Work Flow Diagram
- Figure 2.1 - 2.5 - Work Plan
- Figure 3. - Payment Schedule
- Figure 4.1 - 4.19 - Operation and Expense Schedules

1.0 INTRODUCTION

1.1 General

In a letter to the Norwegian Embassy from the Ministry of Economic Planning and Development (MEPD) dated 14th June 1982, the Norwegian Government was requested to provide financial and technical assistance to carry out a National Rural Water Master Plan (NWMP) for Zimbabwe.

The Norwegian Agency for International Development (NORAD), acting on behalf of the Norwegian Government, became the executing agent for the project. A shortlist of four Norwegian Consulting Engineers was prepared by NORAD and these firms were invited to submit proposals to undertake the NWMP.

The proposals were evaluated by the Ministry of Water Resources and Development (MWRD) together with NORAD and Interconsult A/S was selected to undertake the project.

Subsequent to negotiations between MWRD and Interconsult A/S in April 1983, during which representatives from NORAD took part, a contract was signed between the parties on 19th April 1983. This contract became effective after the formal Agreement between the Governments of Zimbabwe and Norway was signed on 7th July 1983.

Offices from which Interconsult A/S would operate within Zimbabwe were procured in Harare and members of the project team arrived during October and November 1983.

Co-ordination between the MWRD and Interconsult A/S is to be through a Project Co-ordinator advised and guided by a Steering Committee. The Consultant reports to the Project Co-ordinator and the Project Co-ordinator reports to the MWRD. The roles of the Steering Committee and Project Co-ordinator are detailed in the Agreement signed on 7th July in Section 3.

1.2 SCOPE OF WORK

The objective of this project is to formulate a National Master Plan for Rural Water Supply and Sanitation (NMWP), the aim of which is to provide guidance as to the availability, reliability and quality of the national water resources and sanitation facilities and the variations in demands throughout the rural areas. Special consideration will be given to communal lands and resettlement areas.

In the broadest sense, the planning objectives are to make the greatest possible contribution to rural development and regional welfare. However, in order to provide a definite direction to the programme, it is necessary to deal with some specific objectives rather than with one general goal. The sub-objectives of the plan are as follows:-

1. To provide an organized inventory of available resources within the sector.
2. To provide an organized inventory of existing water supply and sanitation facilities and ongoing schemes.
3. To assess water demands for domestic, village, gardening and livestock consumption.
4. To formulate standard schemes and strategies that will best serve the needs of the population in the rural areas, and which are in accordance with realistic social, technical and economical goals, yet preserving the flexibility required to integrate the diverse functions and approaches of the various institutions operating within the sector.
5. To formulate training proposals and organization of structures that will ensure the necessary manpower is available for implementation and future operation and maintenance.
6. To formulate a strategy for a National Rural Sanitation programme and proposals for public health education.

7. To formulate phased Development Programmes on a priority basis.

In Zimbabwe a great deal of research and work has already been undertaken in the rural water supply and sanitation field, this ranges from the pioneering technology development carried out by the Ministry of Health's Blair Research Laboratory to the successful implementation of various water and sanitation projects throughout the country. Furthermore, the Zimbabwe Government has formulated a number of policies and priorities that relate to rural development including water supply and sanitation.

The purpose of developing a National Master Plan for Water Supply and Sanitation (NMWP) is to propose sector activities within the framework of Government Policies and priorities for implementation on a national scale. Emphasis will be placed on building from the success of the smaller scale community based projects which have been introduced in some areas.

To enable the implementation of a national plan through the existing institutional structures two issues need to be addressed. Firstly, a number of organizations and Ministries have responsibilities in the sector and protocols for cooperation and clear guidelines on division of responsibilities need to be developed in order to minimize overlap and increase efficiency. Secondly, an increasing number of aid agencies and donors are pledging support or expressing interest in the sector, clear policies and planning are therefore required in order to best utilize this assistance.

The NMWP will make specific recommendations on inter-ministerial cooperation and planning and provide specific guidelines for the implementation of National Water Supply and Sanitation programmes.

In order to develop the master plan strategy and make recommendations a number of broad integrated studies and reviews will be undertaken. The main areas are as follows:-

- i) Water Resources
- ii) Water Engineering
- iii) Sanitation
- iv) Socio-economics/Socio-anthropology
- v) Management
- vi) Human Resources Development
- vii) Economy and Finance

A number of detailed reports will be prepared and summarized in a Summary Report which will include, but will not be limited to, recommendations with regard to:

- i) A National Rural Water Supply Programme
- ii) A National Rural Sanitation Programme
- iii) The Management of the Government institutions involved in water and sanitation development including the needs for Human Resources Development.

A description of the reports to be included in the Study is given in section 9,5.

The work to be done within the different sub-sectors is described below.

2.0 WATER RESOURCES

2.1 General

Water availability is the most basic ingredient in the NMWP for the purpose of planning for future water use. It is necessary to determine the location and type of each water source, and the quantity and quality of water with respect to time available from each source. Hence, a priority task is the review of relevant information related to the meteorological and hydrological network, stream flow records, rainfall distribution, evaporation, vegetative use, groundwater resources, water analyses, sediment transport, present pollution levels etc.

The Water Resources Study will be divided into two major sections: surface water, in the following also referred to as hydrology, and ground water, also referred to as hydrogeology.

2.2 Hydrology

2.2.1 Scope of Work

In the contract between MWRD and Interconsult A/S the scope of the surface water studies has been summarized as follows:

- i) Review existing discharge records, particularly with respect to low flows. Review available rainfall and evaporation data. Study previous reports on the hydrology of Zimbabwe.
- ii) Evaluate the quality of data, and select reliable stations for further analysis. These stations are to be visited in the field. It is likely that additional discharge gaugings will have to be taken at a few river gauge stations to confirm the rating curves at low stages.

- iii) Assess low flow frequencies in the various areas of Zimbabwe. Subject to the availability of data, show the flows as isohyets on an isohyet map. Construct typical dry weather recession curves for rivers in the various areas.
- iv) Estimate dry weather flows on basis of low flow frequencies and recession curves in the area. Take spot gaugings during dry weather to support the low flow calculations.
- v) Estimate possible reservoir requirements if the low flows are insufficient to meet the estimated consumption.

2.2.2 Presentation

The hydrology report will be divided into four sections:

- Introduction
- Meteorology (mainly rainfall)
- Evaporation
- Surface Runoff.

The hydrology report will include maps showing rainfall stations, evaporation stations and discharge stations. A map will also be prepared showing discharge stations with perennial flow. To the extent maps are already available they may be directly included in the report.

It would be desirable to work out a map showing low flow runoff in the areas with perennial rivers. Preparation of such a map, however, is dependent upon low flow frequency analysis from a large number of stations, and can only be made if the hydrological data is transferred from the computer punch cards upon which the data are currently stored by the MWRD to computer tape.

We have also been informed that a sufficient number of stations with undisturbed flows may not be available, as water is abstracted for irrigation from most rivers.

2.2.3 Timing and Extent of Work

The hydrological study will partly be based on existing information and partly on the analysis of new data. To what extent new analysis may be made is greatly dependent on the availability and accessibility of data.

The total amount of time to be spent on the hydrology report, according to the contract, is 7 man-months. There is a large amount of information to be collected and presented in the report. The time estimate has been made on the assumption that rainfall data as well as runoff data are available as computer print outs.

With respect to the runoff data this assumption has proved to be only partly correct. The data are stored on cards, and the runoff can only be printed out station by station. It is not possible, for example, to obtain a print out of stations such that an analysis involving several stations can be undertaken.

The only print outs available from the computer are tables of daily and monthly flows, station by station.

As the Hydrological Department is in the process of transferring the data from cards to tape, for use on the new Perkin-Elmer computer, no purpose will be served in working out further programmes for the old card-reading computer. Such programmes would in any case be of limited use as the data are stored on cards.

We have been informed that MWRD has made a request to Sweden to provide an expert to speed up the data transfer and to work out new programmes. It is not known at present whether this request will be met.

If the Swedish data expert does not arrive within a few weeks we recommend that a similar expert be provided by Interconsult. This expert should be made available at the earliest possible date, and independently of the more comprehensive computer project proposed elsewhere in the inception report.

However, the Swedish data expert is not expected to arrive in Zimbabwe until early 1984. After the expert has arrived it may take from 3 - 6 months to complete the data transfer and to work out the necessary programmes. Accordingly, the data are unlikely to be available before mid 1984.

The data will therefore be available after the date when our hydrologist is due to have his work completed according to his time schedule.

On the basis of the above we would like to suggest the following:-

Recommendations:

1. Due to uncertainty about the date when the runoff data will be available on tape (at the earliest mid 1984) we will at present plan our work as if these data will not be available for our report. The presentation of hydrological data will therefore be somewhat limited, and to a great extent be based on previous publications.
2. The hydrology report would be very much improved if we could make use of data from tape. We therefore recommend that the services of our hydrologist be extended if the data will become available within a reasonable time and before the NMWP is completed.

3. Whether or not the data may be used in the hydrology report, it is important that an effort be made to speed up the transfer of data to tape for future planning purposes. Interconsult is prepared to provide a data expert on short notice for this purpose, on the assumption that additional funds are made available by NORAD.

2.3 Hydrogeology

2.3.1 General

This section of the inception report deals with the hydrogeological studies. The activities undertaken so far are discussed, the original work plan is assessed and the detailed activity and timing schedule for the programme is given on the flow chart in Fig. 1.

A recommendation concerning the incorporation within the Contract of additional activities considered essential for the correct development of the water resources of Zimbabwe is made. These include the short term testing of shallow wells, and the preparation of a computer based data storage and retrieval system. The necessity of including these activities was realised at the completion of the existing data gathering phase.

2.3.2 Activities Carried out to Date

The hydrogeological activities commenced in July 1983. At this time all existing information concerning the geology was obtained from the Geological Survey Department in Harare. These geological data, which included 93 published reports, memoirs and maps, covers approximately two thirds of Zimbabwe.

The geological data available are largely directed towards mineral exploration with the emphasis on stratigraphy and lithology, structural data are limited. However, the published maps represent a significant and important base for the geological and hydrogeological evaluation presently being undertaken.

The geological information has been interpreted to provide control to the Earth Resources Terrain Satellite (ERTS) interpretation, discussed below, and to prepare a regional geological assessment of the country. A draft geological report and regional geological sequence are currently in preparation. These are being continuously reviewed as the ERTS interpretation progresses and will be updated as the field work advances.

The 1:500 000 scale topographic maps covering the entire country have been purchased. These maps are currently being processed, amended and updated. The new names gazetted on 15.10.82 are being incorporated into these maps which will form the topographic base for the final hydrogeological maps.

The photographic transparencies of the 1:250 000 scale topographic maps for the entire country have also been obtained. These transparencies are being used as the base for the ERTS Landsat image interpretation. Working field sheets will be printed from these transparencies.

Thirty two ERTS Landsat images at 1:250 000 scale have been obtained to cover the whole of Zimbabwe. These images have been selected from various satellite runs such that the best quality images have been obtained. The images have been computer enhanced by Spectral Africa Ltd to provide maximum geological detail. The quality of the images is excellent and geological detail is clearly seen. Each image covers an area of approximately 35000 to 40000 Km², depending upon the latitude.

The ERTS images were received at the end of August 1983. The photogeological interpretation and associated desk

study of the available geological data commenced at the beginning of September and is expected to be completed by the end of January 1984.

The aim of the ERTS image study is to re-interpret the geology of Zimbabwe in hydrogeological terms. The emphasis of the interpretation is to identify significant structural features and areas of weathering and unconsolidated cover, features which influence secondary permeability and are therefore of paramount importance to the groundwater potential. Where necessary the geology is being simplified into similar lithological units.

To date the interpretation has covered the northern areas of the country along the borders with Zambia and Mocambique

Standard schedules for the recording of data collected during the field survey are presently being prepared. These schedules are designed to record data in a consistent manner and will include geological and hydrogeological information concerning existing facilities, type and operational status, population, estimated water consumption, existing water quality, and groundwater pollution threat.

Standard schedules for the routine recording of test pumping data are also being prepared.

2.3.3 Future Work Activities

These will comprise both office and field work as detailed in the work flow diagram of Fig. 1.

1) Field Activities

The field activities are scheduled to commence in February 1984 as the desk study phase is nearing completion and the choice of the localities for borehole testing can be determined. The field activities will include a representative borehole and well census, the short term testing of key boreholes using the consultants equipment operated by locally recruited personnel, the collection of water quality data and the running of a calibration geo-electrical survey.

The calibration geo-electrical survey will provide guidelines for the optimization of future borehole siting by enabling a geo-electrical succession for each major hydrogeological unit to be prepared. In addition, the geological data will assist in the delineation of areas where shallow wells could be located as an alternative to boreholes, and areas where the hydrogeological conditions are only suited to shallow wells.

A recommendation to include the testing of 50 - 60 shallow wells in the programme of hydrogeological field activities is made in Section 10.5 . The aquisition of this pumping data will assist in the preparation of shallow well design parameters for each of the various lithological units in Zimbabwe.

Of concern during the execution of the field survey is the security situation in Matabeleland. It is proposed that the field work in this region be carried out by a locally recruited technician/field assistant working under our direct supervision. In order to ensure that the correct standards are adhered to, the Terms of Reference to which the technician must work are given as Appendix 2.1.

During the continuance of the hydrogeological studies, liason will be maintained with ongoing groundwater projects, including the EEC funded Masvingo drilling project, the Italian Government funded Kariba Valley drilling programme, the NORAD/DDF rural drilling programme, the O.D.A. Primary Water Supply Unit and the various shallow well digging projects including the Ministry of Health Self Help project and those run by Lutheran World Federation and UNICEF.

It is anticipated that the field activities will require 12 man-month.

ii) Office Work

The office work will cover the desk study, to include the collation and interpretation of available borehole and shallow well records, data held by other consultants, mining houses etc., the interpretation of all the hydraulic, hydrochemical and geo-electrical data collected during the field activities, part of which will be undertaken using computer techniques, the integration of all the information gathered during the field and office work phases, the compilation of the final hydrogeological map and accompanying legend at a scale of 1:500 000, and the preparation of the final report.

Recommendations pertaining to the standardization of future drilling equipment, including specifications, will be included in the final report. This is considered important in view of the diverse types of drilling machines presently being acquired and operated by the various Government agencies.

Priority rural development programmes will be identified and described, particularly in relation to the suitability of the construction of shallow wells or boreholes in each area. Draft standard Terms of Reference for the development of rural groundwater supply projects will be prepared and included in the final report. These terms of reference will include optimization of borehole and shallow well siting procedures, optimum borehole and shallow well design, and optimization of hydrogeological and hydraulic data collection.

It is anticipated that the preparation of the hydrogeological map and final report will be completed by mid December 1984.

2.3.4 Standardization of Hydrogeological Data Collection

Reference is made to chapter 10.1 EDP-Requirements within the Water and Sanitation Sector.

Due to uncertainty about the approval of the proposed extension of the Study, we would like to stress the following:

The terms of reference for the NMWP makes specific mention of the need for the establishment of routine procedures, and we consider the collection of hydrogeological data to be of primary importance to the formulation of any future development plan.

The development of a computer based hydrogeological data bank and storage retrieval system is essential in view of the large amount of information that will be obtained both during the implementation of the NMWP and other groundwater investigation and development programmes.

If this study is implemented the standardized procedures will be available within 2 months, and the data retrieval system by the end of the NMWP-period.

2.4 Water Quality

Both surface runoff and groundwater require bacteriological, physical and chemical analyses for classification and appropriate use according to an agreed standard for drinking water. Physical and chemical analyses will be carried out at the Government Analyst Laboratory in Harare. Bacteriological tests will be carried out by the Consultant using field-kits.

This study will included collection of water samples from rivers, lakes and representative key boreholes and shallow wells. The water quality parameters. to be analysed are described in Appendix 2.2. Approximately 500 samples will be collected.

Groundwater quality data will be incorporated into the final hydrogeological map.

Based on these analyses the Consultant will prepare guide lines for source selection and the selection of water treatment methods.

Provisional drinking water quality standards will be proposed. The Consultant will also make suggestions with regard to the improvements in the control of water quality by proposing an adequate water quality surveillance system in association with Ministry of Health.

3.0 WATER ENGINEERING

3.1 General

The Water Engineering part of the Master Plan is divided into:

- i) Rural Water Supply-Project
 - ii) Water Conservation Project,
- which together with the socio-economic study will form a National Rural Water Supply Programme.

Water supply and demands are directly related to the living patterns of the urban and rural population, and the development potentials of the Provinces and Districts.

Growth in population and economic development usually results in increased water demand per capita, indicating the rise in the standard of living. In modern planning, consideration of the improvement of living standards as reflected in forecasts on water use, is essential. The main requirements for a proper rural water supply programme are a full understanding of local conditions and practices, promotion and provision of appropriate facilities and technology, combined with an education and training programme that can bring about changes in order for the community to gain full benefit from the improved facilities.

To achieve this, the proposed water engineering group consists of a multi-disciplinary team to provide a balanced and integrated approach.

The team will consist of:-

- Senior Water Engineer
- Water Engineer
- Social Anthropologist
- Economist
- Agricultural Engineer
- Soils Classifications Engineer

3.2 Rural Water Supply Project

3.2.1 General

The Rural Water Supply Project is described under the following headings:-

- a) Evaluation of present designs
- b) Rehabilitation
- c) State of the Art Review
- d) Standard design of different Water Supply Schemes
- e) Design Mannuals
- f) Water Demands

3.2.2 Evaluation of Present Design

The Consultant will collect all available planning and design data from the existing schemes selected in co-operation with the MWRD and the MOH. The schemes selected should include different designs and locations, and will include up to:-

- 25 Piped schemes (5 in each MWRD Province)
- 60 Boreholes
- 140 Shallow wells

The evaluation will include:-

- i) Basic design assumptions.
Data on water demand, water quality and population projections will be compiled - if available.
- ii) Drawings.
Tender drawings and "as built" drawings will be looked into and checked if they agree with the existing facilities.

iii) Water Source/Treatment.

The piped schemes will be tested for quantity and quality and compared with the design assumptions. The efficiency of treatment facilities will be evaluated.

iv) Distribution.

Available data regarding the following technical aspects will be collected:-

- Intake structures.
- Working pressure and rate of flow in the reticulation systems.
- Storage capacities.
- Leakage and pipe conditions.
- Pumping units.

v) Construction Procedures and Costs.

Existing construction procedures including payment procedures, material procurement, supervision procedures and contract specification will be tabulated. Where community self help schemes are investigated the various cost inputs including direct Government subsidy, contract labour and local labour will be assessed.

A financial analysis will be carried out including an estimation of the replacement cost of each component, accumulated depreciation based on economic life, and the current net asset value.

vi) Operation and Maintenance.

Reporting and recording routines, as well as present maintenance routines will be investigated. A general

evaluation of the adequacy of existing equipment, tools and spares as well as organization and budgeting will be prepared.

The data will be compiled and evaluated in order to arrive at recommendations for future designs.

The community level socio-economic aspects of the evaluation are described in detail in Section 5.

3.2.3 Rehabilitation

The Consultant shall, based on the study of Evaluation of Present Design (3.2.2) prepare a rehabilitation schedule for existing water supply facilities, with the following objectives:

- To assess the operational efficiency of completed schemes.
- To provide feed back to planners and designers on the validity of the original planning assumptions.
- To provide feedback to the Government on the suitability of current means of water development.
- To indicate areas where complementary and/or supplementary inputs could improve the rural water supply investments.

The Consultant will propose a system for monitoring and evaluation to review, monitor and evaluate schemes during and after construction.

3.2.4 State of the Art Review

A number of multilateral and bilateral Agencies have done and continue to do research and development within the water supply sector - especially in the field of appropriate technology. A State of the Art Review will be undertaken with special emphasis on technology applicable to Zimbabwe.

Agencies/institutions of special interest are:-

- Blair Research Laboratory, Harare
 - The World Bank Technology Advisory Group (TAG)
 - Ross Institute, London School of Hygiene and Tropical Diseases
 - WHO/International Reference Centre
 - UNICEF
 - USAID
 - Intermediate Technology Group, London
 - Norwegian Institute for Water Research (NIVA)
- etc.

3.2.5 Standard Design of Different Water Supply Schemes

Based upon data from the present design procedure analysis, and the "State of the Art Review" the Consultant will prepare recommendations on standard water schemes for different types and capacities. The standard designs will be based on different water sources and quality and will take into account:-

- (i) Area and Population Density to be Served.

Different geographic areas will be tabulated, listing a wide range of population within that area. The study will take into consideration the existing rural structure, the ongoing planning for resettlement and development of urban and rural growth points.

- (ii) Intake Structures.

Possible solutions for different areas will be evaluated. This will include surface water intakes and groundwater development such as:-

- River intakes
- Dams
- Shallow wells
- Boreholes
- Springs, and
- Rainwater collection.

(iii) Treatment

Depending on the size of the scheme and the quality of the raw water, different solutions will be proposed. This study will range from more sophisticated facilities in the greater Rural Growth Points to small scale, low cost solutions in the rural areas, small villages etc.

(iv) Pumping Devices

Depending upon the water quantity, depth of ground water table, variations in water level, rivers and dams, static head, different pumping devices will be reviewed. These will include hand operated pumps, diesel or electric powered pumps, and wind or solar driven units.

(v) Distribution

Different stand pipes and wash places will be reviewed and recommended. Pipe types and classes will be tabulated.

(vi) Storage

Recommendations on storage volume and location within the distribution area will be made. Elevated tanks or ground reservoir will be discussed.

(vii) Operation and maintenance.

For the different standard schemes the necessary routine maintenance will be specified, including the need for tools and equipment, minimum stock of spare parts, distribution and storage of fuel and chemicals.

The discussions will not only deal with the technical solutions. Emphasis will also be laid on the construction costs, the socio-economic aspects regarding usage, consumption, operation and maintenance, health and environmental impact.

3.2.6 Design Manual

The solutions and recommendations from the Standard Design discussions as well as Management Study will be presented in a separate Draft Design Manual. The Manual will include:-

(i) Design Procedures.

Techno - administrative procedures for departmental and consultancy design, agreements etc.

(ii) Organization.

Summary and conclusions from the Management Study.

(iii) Design Criteria.

Information on design periods, demand figures, water quality requirements, data for treatment and distribution systems, storage etc.

(iv) Standardization.

This will include the specification for standards and type drawings, conditions of tender documents and contract, units, symbols etc.

As an Appendix to the Design Manual the Consultant will include a chapter outlining the relevant planning procedures from master plans - feasibility studies - preliminary design to final design. Further, the Consultant will describe which type of activities are normally covered under the various planning/design steps described above.

3.2.7 Water Demands

Present Domestic Demands

Domestic water use depends on population characteristics (density and classification) as well as on the prevailing standards of living. Variations in ethnic and cultural composition are expected to have some, but not substantial, influence on domestic water use. A detailed and realistic estimate will be required to evaluate the Country's domestic water requirements in various districts. We will take the following steps to establish criteria for planning, based on a sample survey:

- i) Compilation of information on:-
 - Service Centre and Rural Growth Point population (area, density);
 - Rural population (density and settlement patterns)
 - Service Centre and Rural Growth Point domestic water supplies; treatment plant capacities, condition of plant and provision for expansion and system efficiency, also quantities of untreated water supply used, if any;

- Investigation on quantity, quality, usage and adequacy of present supplies.

ii) Determination of actual per capita use and consumption for Service Centres, Rural Growth Points, and rural areas allowing for variations due to specific needs.

iii) Determination of present theoretical per capita use and consumption.

The survey will include 25 existing rural water supply schemes (5 in each MWRD province), as referred to in sections 3.2.2 above.

Projected Domestic Demands

Present population status, density, trends of growth and development and classification will be based on statistical information, latest census results, and resettlement analysis. The Consultant will in their estimates incorporate the relevant planning that may affect population trends as well as the natural growth rates in order to determine basic water demands for urban and rural domestic uses.

In this task we will summarize the total projected demands for the project-horizons of 1983 and 1993 as well as the future demands up to 2003, regardless of possible envisioned conflicts or competitions of various demands for the same water sources.

3.3 Water Conservation Project (WCP)

3.3.1 General

In certain areas the conservation of water is of utmost importance and is the only possibility to supply water for human and livestock consumption.

Water conservation without soil protection is meaningless if the dams are not to become silted up.

The dams should not be constructed before a soil protection programme has been carried out, and the Consultant will make proposals for an integrated soil protection and water conservation programme based on the people's interest and eagerness for self-help projects.

The most crucial issue in the provisions of livestock watering is whether or not the people will accept the necessary control of livestock population. Without this control the provision of new water supplies will merely aggravate problems without producing any long-term benefits. Consequently any integrated development plan involving water must include:-

- (i) control of grazing
- (ii) water development to allow a better use of grazing

This means that it is essential to widen the perspective and include a broader view of ecology. Hence the environmental/ecological impact of the proposed components of the livestock water supply plans will be assessed and if the adverse effects can be foreseen, projects will be examined and remedial measures will be recommended and costed.

Any existing plans to halt land degradation will be critically assessed and recommendations for required soil and water conservation measures, grazing control and farming practices will be made for risk zones. Recommended conservation projects will be ranked in order of priority.

The Water Conservation Project will be divided into the following give sub-items:-

- a) Evaluation of Present Design of Livestock Water Supplies.
- b) Proposed Standard Design of Livestock Water Supplies.
- c) Design Manual
- d) Livestock Demand
- e) Livestock Water Supply Programme.

3.3.2 Evaluation of Present Design of Livestock Water Supplies

The Consultant will collect all available planning and design data from a selection of existing schemes, as described in Section 3.2.2.

3.3.3 Proposed Standard Design of Livestock Water Supplies

Based upon data from the present design procedure and the "State of the Art Review" the Consultant will come up with recommendations on standard designs to supply water for human and livestock consumption based on different water resources, type design capacity and ecological zones and will discuss:-

a) Storage.

Recommendations on storage volume and location within the distribution area will be made. Elevated tanks or ground reservoir will be discussed.

b) Distribution.

Different pumping devices, stand pipes, cattle troughs, wash places and dip tanks will be reviewed and recommended.

c) Treatment.

Low cost solutions for treatment of water for human consumption as well as separating the water for livestock consumption will be proposed. The risk of water related diseases like shistosomiasis will be discussed.

3.3.4 Design Manual

The solutions and recommendations from the Standard Design discussions as well as the Management Study will be presented in a Water Engineering Draft Design Manual. The Manual will include design procedures and criteria, organization, standardization and implementation guidelines as discussed in Section 3.2.6

The Water Engineering Design Manual will include the solutions and recommendations with regard to the Livestock Water Supplies.

Future Livestock Demands

Livestock projections will partly depend on forecasts for food need (land carrying capacity) and export demands. The communal lands include areas possessing a substantial potential for the development of livestock on a larger scale, which may become an important factor in the future economy of the Country.

Possible water use conflicts and problems may arise from the development of water sources for livestock. Such conflicts may be obvious where the water supply is limited and demands from more than one sector of development are competing.

Such conflicts may become minimized with a balanced planning where the demands for the future livestock population of the regions is fully provided for, and taken into consideration as an important part of the total water supply demands for the area.

However, in assuming the future water demands for livestock which again will form the basis for improved water supplies, it is necessary to investigate the carrying capacity of the land in areas to be included in the NMWP. Therefore, a review of relevant information on climatological, soil and vegetation data will be included in the study.

Agricultural statistics concerning livestock composition and numbers, as well as variations over a period of years, will be collected from sources in the Ministry of Agriculture as well as from Provincial Agricultural Head-quarters.

It is of special importance to work in close co-operation with Government agencies on matters concerning soil erosion, flooding, and general problems of land degradation. Methods of soil and water conservation will be studied. The study will include recommendation on soil and water conservation measures in the upper parts of river catchments, where simple construction works would have important effects. The same will apply to water harvesting methods in the driest areas.

3.3.5 Livestock Water Supply Programme

This part of the study will include the following:-

- a) Selection of areas where combined schemes for both human and livestock consumption will be appropriate.

The schemes required in each district will be listed and classified based on:-

- The Water Source
- The projected Water Demand
- The recommended Technical options
- The Soil Protection Requirements
- Ecology

- b) Projected cost estimates for each District.
- c) Recommendations for a programme of implementation for each district.

Based on selection criteria, proposed by the Consultant and approved by the Client, a number of schemes will be given priority for implementation.

3.4 Rural Water Supply Programme

Based on agreed standards for different types of schemes, the Consultant will on district level work out a National Rural Water Supply Programme. This programme will include the following:-

- a) List the type of water schemes required in each district in order to reach the goals of the National Rural Water Master Plan as outlined in T.O.R., the Contract, Appendix A. For each district, the number of schemes will be classified based on:
- The Water Source
 - The projected water demands
 - The recommended technical option
- b) Overall projected cost estimates for each District.

4.0 SANITATION

4.1 Evaluation of Existing Water Supply and Sanitation Projects in Zimbabwe

A number of agencies and authorities are implementing water sector projects in various areas of the country. These projects have varying mixes of water supply and sanitation integrated with other components such as health education, nutrition, primary health care etc.

Noteable projects are:

- 1) Lutheran World Federation: Shallow Wells and Sanitation Project, Mataberland.
- 2) UNICEF: Shallow Wells Project, Mataberland.
- 3) St Teresa's Mission, Chilmanzi
- 4) St Pauls Mission, Musami
- 5) Bandolfi Mission, Masvingo
- 6) Bindura Primary Health Care Project
- 7) Mtshete, Filabusi, Gwanda, Sanitation Projects - Provincial MOH
- 8) Mondoro, Serima, Zvimoto, Sanitation Projects - Ministry of Health
- 9) Biketa Integrated Rural Development Project
- 10) Triangle Environmental Health Project.

Some of these projects are remarkably successful in terms of coverage, community participation and implementation strategy.

It is proposed to evaluate these projects in detail as a basis from which to develop sound national implementation strategies, whilst taking into account the difficulties and logistical problems of larger scale programmes.

4.2 Application of Technology

The sanitation technology used in these domestic projects is almost without exception the Blair Latrine or, as it is sometimes known, the Zimbabwe Improved Pit Latrine (ZIMVIP) developed by the Ministry of Health's Blair Research Laboratory.

The ZIMVIP is inexpensive, hygienic, easy to construct and has been readily accepted by the users. The robustness and acceptability of the VIP latrine is also confirmed by its use in the neighbouring countries of Tanzania, Botswana and Malawi, and it is likely that the ZIMVIP will continue to be the technology of choice. However, whilst the ZIMVIPS were being constructed in various areas of Zimbabwe it has been noted that minor detailed modifications have been made to the standard Blair unit, and a number of issues have emerged; should a door be added? Is the circular or square spiral preferable? The project evaluation will include determining local design preferences (if any) and the NMWP will make recommendations for minimum construction standards that will maintain ventilated improved pit latrine principles.

A further important aspect of the implementation strategy would be to ensure that building materials or manufactured components for latrines are available and affordable in the project area and that these materials/components are compatible with the recipients level of building skills. The NMWP will also review building materials and components available and make recommendations as to necessary inputs in the project area.

The attitudinal and behavioural study will consider other aspects of domestic hygiene such as personal and domestic washing and their relationship to technology. The NMWP will also formulate recommendations for appropriate bathing and washing facilities.

4.3 Sanitation Project Implementation Consideration

A State of The Art Review

In recent years interest and research in the field of low cost sanitation has increased tremendously, probably in response to two factors.

- i) An increasing awareness that appropriate or low cost sanitation is the most feasible solution for providing hygienic excreta disposal facilities in the developing world, especially in rural areas.
- and ii) Promotion by the International Drinking Water Supply and Sanitation Decade.

This has resulted in the development of a number of appropriate technologies including the Blair Latrine (discussed above). Another aspect of low cost sanitation that has been somewhat neglected and is in many respects more important than technology development is the organization or 'packaging' of projects. This is especially important where capital resources are limited and the recipient is expected to contribute in cash or labour to the construction of his latrine or water supply and then later assume maintenance responsibilities.

For these 'self help' projects to be successful large inputs of promotional, motivational and educational activities are required. These 'communication support' activities together with financial arrangements, logistical planning, providing materials and or components for construction make up the 'package'.

The NMWP will review current thinking and trends in appropriate technology and project organization both in Zimbabwe and more generally.

Neighbouring Countries with Projects of Interest are:

Tanzania

- i) Ministry of Health/UNICEF funded Wangingombe Water Supply and Sanitation project.
- ii) Ministry of Lands and Urban Development/World Bank funded Dar es Salaam Sewerage and Sanitation project.
- iii) Ministry of Lands/KFW funded Buguruni Squatter Area Upgrading project.
- iv) Ministry of Water Energy and Minerals, Rukwa and Kigoma Regional Water and Sanitation Master Plans Mbeya, Ruvuma and Iringa Regional Water and Sanitation Master Plan (NORAD and DANIDA funded respectively).

Botswana

- i) Ministry of Local Government and Lands Sanitation projects related to site and service housing in Gaborone, Francistown and Selebi Phikwe.
- ii) Rural Sanitation project (USAID funded).
- iii) Squatter Upgrading project Old Naledi Gaborone.

Mozambique

- i) Urban and Rural Sanitation Projects.

Other Countries with Sanitation projects of note are:

India and the Indian sub continent where large numbers of pour flush latrines have been constructed in urban and rural areas. The project 'package' includes subsidised loans from state governments, training of local private builders who become extension workers and promoters.

Vietnam, China and South East Asia where safe excreta disposal is related to agricultural extension work. Double vault composting latrines are promoted and used as temporary storage for human excreta until it is rendered safe, thereby hygienically preserving the valuable fertilizer resource.

4.4 National Health Profile

In order to plan for maximum health impact of environmental interventions it is necessary to know the National Health Profile, and in particular the major water and excreta-related diseases in the population. Principal routes of disease transmission can then be identified and optimum environmental and behavioural changes specified which are likely to achieve the greatest improvement in the Nations Public Health. The National Health Profile will moreover provide a basis for identifying priority regions and foci for National Water Management.

A comprehensive and up-to-date national health profile is not currently available. A National Health Information System is presently being developed to reflect the MOH's concern for preventive and primary health care, but detailed information is not likely to be available for inclusion into the NMWP. A considerable amount of data already exists in the MOH, from hospital records, provincial reports, the valuable research undertaken by the Blair Research Laboratory and from occasional research carried out by departments at the University Medical School. The WHO have recently collated a file of information on the National Health Profile in Zimbabwe.

In order to develop a National Health Profile for the NMWP it is proposed to undertake a review of all the sources mentioned above, including field trips to all hospitals whose records are judged to be better than average.

Special attention will be given to the principal water and excreta-related diseases and much detailed information will be collated on the epidemiological characteristics of these diseases.

4.5 Training Requirements

In developing the Master plan strategy a number of training requirements are almost certain to emerge, these may range through:-

- i) Refreshing village health workers and health assistants in technical, motivation and communications skills
- ii) Training local builders in improved latrine construction
- iii) Training new categories of extension workers or extension assistants
- iv) Training individuals or recipients
- v) Training project support personnel both at community and local government levels in various skills from financial management to physical maintenance etc.

The NMWP will identify these training requirements, and make detailed recommendations as to training programmes.

4.6 Health Education

Health Education in the context of the NMWP and the water sector may be considered in a number of aspects:

- i) A motivational process in which people are encouraged and shown how to build latrines and become involved in water supplies:
- ii) Specific behavioural modification interventions in which unhygienic practices are identified and changed, this includes proper usage of the new latrines:
- iii) The conventional health education/information process in which diseases and their vectors of transmission are discussed.

Until fairly recently it was considered by some authorities that discussion of excreta and water related diseases was sufficient to motivate people into constructing latrines. However, recent experience indicates that people build latrines for a number of complex reasons, often unrelated to health, such as privacy, status, convenience etc.

After preliminary research into social feasibility, attitudinal and behavioural patterns the education process in a sanitation project may move through a number of phases during project implementation:-

- Project awareness and information.
- Motivation, participation, management.
- Technical, implementation.
- Usage and behaviour modification.
- Reinforcement by conventional health education.
- Maintenance.

In Zimbabwe the main thrust of health education is through the Village Health Workers who deliver a number of 'messages' directly to the villages and communities. The Village Health Worker is also a motivational force in the community, encouraging latrine and well construction, the health assistants providing technical support.

The NMWP will review the educational inputs required for a National Sanitation Programme and will make recommendations as to appropriate methods and techniques within the existing health education framework, this will consist of developing guidelines for educational inputs at each stage of project implementation.

Other educational needs are discussed in Training Requirements.

4.7 Monitoring and Evaluation

In the implementation of projects it is essential to establish systematic monitoring and evaluation procedures both in the short and long term.

Monitoring may be considered as the regular recording of activities and comparing progress with some pre-established programme so as to quickly bring to the attention of the monitor any problems that may hinder the implementation progress.

Evaluation of ongoing projects is an extension of monitoring in which the problems identified are analysed and corrective action recommended, typical recommendations may require for example that:-

- a) slow or non functioning activities be accelerated
- or b) functioning facilities need improvement
- or c) the utilisation of facilities need improvement
- or d) supplementary or complementary activities need re-emphasising or initiating.

Evaluation also may be seen as a longer term device for improving future projects in the light of experience. This experience may lead to modification of future programmes and dissemination of information to other agencies in the same sector.

A further aspect of evaluation is the longer term study of impact i.e.

- a) to establish if the project has improved the health and economic status of the target group
- b) to establish the relative impact of investment in water as opposed to sanitation or health education and the effects of combinations of the above
- c) to establish economic returns for water sector investment as compared with other sectors.

The NMWP will recommend specific guidelines for monitoring and evaluating procedures and general guidelines for use in impact studies. However, it should be noted that the measuring of health improvement after water or sanitation interventions is difficult and often inconclusive. Also the present state of the art in epidemiological forecasting makes it extremely difficult if not impossible to predict incremental health status improvement that may be expected from incremental improvements in water supply and sanitation. (2)

- (1) Maximum Evaluation Procedures for Water Supply and Sanitation WHO publication ETS/83.1 CDD/OPR/83.3 Feb 83.
- (2) 'Water and Human Health' F.E.McJunkin USAID July 1983.

5.0 SOCIO-ECONOMIC

5.1 Objectives

The objective of collecting social, economic, cultural and behavioural data in the Master Plan is to inform national planners of social parameters in project and programme design in the sector. This information will contribute towards decisions in selecting optimum technologies and design standards; educational needs and strategies; community participation procedures in project implementation; local level institutional structures and procedures (including maintenance and cost recovery); methods of project implementation more generally and will feed back to financial decisions in national planning.

5.2 Summary of Socio-Economic Studies to be Undertaken

A comprehensive understanding of human behaviour requires knowledge at several levels. Different methodologies are best suited to gathering different sorts of information.

A mix of data gathering techniques (quantitative/qualitative, participatory/'objective' questionnaire/in-depth interviews/observation) will be utilized. The following studies will be undertaken:

1. Review of existing data.
2. National rural socio-economic survey of water and sanitation practices and facilities.
3. In-depth attitudinal and observational studies of water and sanitation usage in a few selected locations.
4. Study of the structure and functioning of local-level organizations in selected areas.
5. Community planning workshops in a few selected areas, in which local residents will themselves propose solutions to their own water and sanitation provision.

Review of Existing Data

In order to utilize the period of data collection most effectively and to minimize repeating what is already known, an extensive review of existing knowledge will first be undertaken. It is apparent that a reasonable amount of data already exists or is presently being gathered, but it is not always readily accessible.

The team will become familiar with available data in MWRD, MOH, MOA, MOLGTP, MOLRRD and other ministries, with relevant studies carried out by multilateral, bilateral and NGO organizations, and with studies carried out by University researchers. In particular the following studies will be reviewed: the MWRD water and sanitation baseline survey, provincial reports on sector activity in the MWRD and the MOH; the National Household Survey and other data from the CSO; Census Data; and miscellaneous baseline studies carried out in rural areas by various agencies including the UNEP-funded Sabi River Valley Study and the University 'Sibungwe' study.

National Rural Socio-Economic Study

Certain socio-economic information is required on a national scale to facilitate the development of the NMWP. To collect this data a national survey will be undertaken by questionnaire. Subjects to be covered in the questionnaire include:

- household data
- community data
- type and status of water and sanitation facilities
- details of access and usage
- willingness and ability to contribute cash and/or labour for water and sanitation

- preferences in technology options ..
- presence of tools, soap and other items
- inspection of existing facilities
- water use in small scale agricultural and livestock purposes.

Discussions are presently being held with the Central Statistical Office (CSO) to collaborate in data collection. It is envisaged that CSO can be contracted to undertake the raw data collection for the NMWP; alternatively the study will be conducted by a separate team of enumerators on a smaller scale.

The CSO are developing a national sample frame representing every administrative division in the country and covering the range of land apportionment regions. It presently covers communal areas only. The CSO has a full-time cadre of enumerators and enumerator team leaders spread throughout the country. Enumerators have received training in administering questionnaires and a system quality control has been established. Collaborative data collection with the CSO should provide national data by the most effective means in the time available, as well as supplement CSO's data bank and support the existing enumerator network.

It is envisaged that the questionnaire will be drafted and cleared with the full range of interested parties by the end of December 1983. Pilot history, training of enumerators and final development of the questionnaire will be completed by the end of January 1984. Data collection (approx. 3600 households in Communal Areas) will be undertaken in February 1984, and analyses by computer will follow. The extension of this survey to cover other land apportionment regions, commercial farming areas and small-scale farming areas would require additional time and money.

Attitudinal and Observational Studies

The national socio-economic survey outlined above will collect a wide variety of data within the limitations of what can be collected by enumerators on a questionnaire. The study will largely collect factual information and public information about perceptions and what people say they do. Attitudinal data and behavioural data on what people actually do needs to be collected by other means.

Attitudinal and observational studies will be carried out in approximately 4 sites to complement the data from the national socio-economic survey. The sites will be selected to represent basic socio-geographic regions in the country and will include existing projects and sites at which there has been no water or sanitation intervention. A tentative list of sites would be:

- A location in a communal area in Masvingo Province
- A farm worker community in Mashonaland
- A location in a resettlement area in Matabeleland
- A location in a community in the Zambesi Valley.

Field workers will undertake 6 discrete attitudinal and behavioural studies in these localities. These are:

1. Water Usage and Contact Activities

To determine exact quantities of water used, precise water usage practices and all water contact behaviours, fieldworkers will undertake studies of water contact, collection and storage in both the dry and wet seasons. Data will be collected by observation in the household, by observation at source, and by self-recording.

2. Sanitation Usage

The acceptability of latrines in rural communities will be assessed by observational studies of sanitation usage both at schools and in individual household.

3. Personal and Environmental Hygiene

Key indicators in personal and environmental hygiene will be established during pilot studies. These are likely to include:

- details of defecation behaviour
- post defecation ablutions
- hygiene before food preparation and consumption
- eating habits
- child care practices
- disposal of household wastes etc
- children using latrines.

Community fieldworkers will undertake regular household observations of these indicators by stationing themselves within a certain number of households every month and recording actual practices. This data will be used to generate hypotheses regarding the principal behavioural risk factors in disease transmission.

4. Concepts of Health, Hygiene and Disease Transmission

Social anthropological fieldwork within the field sites will provide the basis for analysis of basic concepts in disease transmission in the major cultural groups in the country.

5. Water Storage

Behavioural studies on water storage practices will be backed up by bacteriological studies of the pollution of stored water.

6. Handwashing

Regular and effective handwashing with soap has been shown in numerous studies to be highly important in the control of many water and excreta-related disease. More information on customary handwashing is needed in order to develop educational and technological strategies to improve handwashing. Behavioural studies of handwashing in household observation will be supplemented by bacteriological studies of the effect of customary handwashing.

The later 2 studies mentioned above require microbiological back-up to complement the field data collection. As the NMWP budget stands there is presently no provision to undertake these studies. Hard data on these aspects of personal hygiene is most important in order to sharpen the focus of educational activities in the sector, and it is proposed that a supplementary grant be made to provide for these studies.

Local-Level Organisation

The managerial issues to be addressed in the sector range from the macro/institutional to micro/local level. The former are dealt with in Section 6. Managerial issues at the local-level are no less important. The Government of Zimbabwe's concern for popular participation in rural development does not negate, but rather enhances, the need for sound administrative structures and procedures at the local level. Questions which need to be addressed in formulating local-level administrative guidelines include:

- What is the most appropriate institutional structure to undertake local-level management of water and sanitation implementation, project implementation, operation and maintenance?
- Do the local-level organizations have the capacity to manage water and Sanitation Projects?
- What are the training needs of these local-level structures?
- What are the optimum procedures which might be adopted in undertaking certain critical functions e.g. cost recovery and maintenance.

To make recommendations on these and other related issues the NMWP will review existing local-level organisations in different sectors and study existing water and sanitation project management in pilot projects. Data for this study will be gathered both in the course of the field visits to the principal existing water and sanitation projects (see section 4.2.1), and by developing in depth case histories of local-level organization in the sites selected for the attitudinal and behavioural studies.

Community Planning Workshops

One of the objectives of the social studies to be undertaken in the NMWP is to develop a more precise understanding of the user's viewpoint and pass this information to national planners. There is no more direct way of doing this than by involving users themselves in the planning process. This involvement in planning and implementing a local project is a successful community based project. A measure of popular involvement is also appropriate in developing plans at the national level, though the extent of community involvement at this stage should be limited so as not to raise expectations at too early a stage.

Once the major social studies are completed, it is proposed to undertake approximately 4 one-day community-based planning workshops in different regions of the country at which local people will have the opportunity to consider and discuss the problems of water and sanitation provision in their own communities, and at which key ideas and conclusions resulting from the other social studies can be checked in specific localities. The workshops will be attended by community members from the locality of the workshop. Participants will be asked to identify their problems in the sector and themselves to propose solutions given certain constraints.

Clearly these isolated workshops will not be a substitute for community involvement in project implementation, nor are they in themselves a sound basis for master planning. Their purpose is as a forum for discussion with users of study findings and to document users own opinions about problems and priorities in water and sanitation provision.

6.0 MANAGEMENT STUDY

6.1 Objectives

The principal objective of the Management Study is to identify, define and schedule opportunities for improving the performance of the Government Water and Sanitation Agencies, and to provide for their systematic implementation, within the Governmental Organizations and Procedures.

6.2 Scope of Work

Description and evaluation of the respective roles played by the different Ministries, Government bodies, and Aid Organizations in the field of rural water supply and sanitation. In pursuance of the above we will undertake the following:

i) Organization

Identify opportunities for improving performance through internal re-organization, the introduction of new functions and the better utilization of systems.

The consideration of the re-organization of responsibilities will also take into account:

1. A basis for the geographic definition of regional units for the conduct of decentralized functions.
2. Recommendations for the specific transfer of responsibilities between Governmental Agencies.
3. The need for lower level staff to have authority not presently delegated to them.

ii) Finance

Review of financial controls, to include their effectiveness, with particular reference to use of vehicles, fuel usage, and personnel procedures.

Proposals will be made in areas including accounts, procurement and supply management, revenue collection, maintenance systems, planning and programming, and public information.

iii) Management Systems

Analysis of management systems will be made, including those relating to planning, programming, costing and budgeting.

Existing planning, programming and budgeting systems will be studied with a view to improving the ability to forecast capital and recurrent requirements and revenues. The possible establishment of a high level comprehensive planning, programming and budgeting unit will be considered. A valuation will be carried out of the direct labour construction programme, with a view to improving methods of supervision and construction management. Procurement and supply management will be evaluated with a view to ensuring adequate control systems and also identifying opportunities for annual purchases.

iv) Information Systems

Information requirements for operations and maintenance will be evaluated, including the development of a performance reporting system. Cost accounting methods will be sought.

v) Revenue

Ways and means of improving revenue collection performance within existing organizational arrangements will be sought.

vi) Coordination and Utilization of Donor Aid and Assistance

Numerous agencies and donors are presently active or have expressed interest in supporting the water and sanitation sector (and other closely related sectors such as health) in Zimbabwe. These include; Norwegian, Swedish, British,

Korean, Italian, Japanese, Belgian, Saudi, Yugoslavian, Bulgarian, West German, Dutch, Cuban, Finnish, Canadian, Australian, Rumanian and Kuwaiti bilateral aid programmes; UNICEF, WHO, World Bank, EEC and ADB Multilateral Agencies and also a number of NGO's such as Lutheran World Federation, War on Want, Oxfam, Save the Children Fund etc.

Some of this assistance seems to overlap and be duplicated whilst other areas of the sector are under supported. For optimum utilisation of this assistance the planning and coordination functions for the sectors require strengthening.

The NMWP will make recommendations on the planning, coordination of external assistance and identify and give priority to areas where assistance is most needed.

vii) Institutional and Community Studies

A number of Government Ministries and organizations are involved to some extent in the water and sanitation sector, these include:

Ministry of Water Resources and Development

Ministry of Health

Ministry of Local Government and Town Planning

Ministry of Lands Resettlement and Rural Development

Ministry of Community Development and Womens Affairs

Ministry of Agriculture

Ministry of Construction

Ministry of Housing

Ministry of Finance Economic Planning and Development

The roles and interrelationships of these institutions within the sector will be reviewed and the NMWP will make detailed recommendations as to ways in which activities can be coordinated and rationalised. However, we believe the Government itself is reviewing the roles and activities of various ministries and we must await the findings of this review before proceeding with the study.

Similarly, a number of ministries and organizations work at community level. Several of these institutions have extension workers, including for example:

Agricultural extension workers - Ministry of Agriculture
Village Health Workers and Health Assistants - Ministry
of Health

Community Development Promoters - Ministry of Community
Development and Womens Affairs.

The roles of the community extension workers and their relationship with local government at provincial and district level and with the communities themselves will be reviewed prior to developing recommendations for implementation proposals and community involvement strategies. An essential aspect of this will be an examination of community level project management and maintenance structures and procedures. We understand that the existing local government structures are also being reviewed by Central Government, and our recommendations must take into account any changes that may be proposed.

7.0 HUMAN RESOURCES DEVELOPMENT

7.1 Objective

The aim will be to assist Government in assessing the manpower development needs within the Rural Water Supply and Sanitation Sectors.

7.2 Scope of Work

The study will identify the professional and specialized staff required for the planning and development, implementation, operations, maintenance and administration.

The study will include:

- a) A review of existing employment categories by job classification.
An analysis will be made of each classification to be included in the recommended organization, and a job description/personnel specification.
Emphasis will be given to identification of educational experience and aptitude factors needed to perform each classification.
- b) Preparation of a detailed manpower inventory showing minimum and actual entry qualifications against employment categories.
- c) Assessment of the competitiveness of salaries, career development opportunities, and recruitment procedures.
- d) Preparation of manpower forecasts needed to meet development targets.
- e) Assessment of existing training, and also availability of higher education, vocational and technical training.
- f) Recommendations on appropriate training, including curricular, on a modular basis.
- g) Estimated cost of training recommendations.
- h) A thorough analysis of the personnel system and procedures to identify opportunities for improved working relationships.

8.0 FINANCE AND ECONOMICS

8.1 Financial Resources Availability

The Consultant will examine the probable availability of finance for the rural water supply and sanitation sectors. This will be done by examining; (i) the proportion of GNP and Government finance which would, on the evidence of recent trends, be available for water supply and sanitation development and operation, and (ii) the extent to which local finance may be boosted by foreign aid. The probable availability of finance, together with more optimistic and pessimistic projections will form the framework within which alternative development plans will be formulated.

8.2 Financial Analysis

Estimates of development and operation and maintenance costs of typical water supply and sanitation schemes will be made. This will be followed by an examination of the financial requirements for both development and operation and maintenance of alternative overall programmes, including the cost build up over time. The estimates will show all major cost components.

Future revenues based on demand forecasts and the recommended pricing policy will be estimated. A financial analysis will then be undertaken for both typical projects and alternative overall programmes in which the annual cost and revenue projections will be compared using standard discounted cash flow techniques. This will demonstrate the financial viability of both typical schemes and the alternative overall programmes, and the probable cash flow of the executing/operating agency.

The financial analysis will be undertaken in both constant 1984-values and in estimated monetary values throughout the programme period. Since the Consultants cannot forecast inflation with any accuracy they will undertake a sensitivity analysis with a range of alternative rates of inflation to determine the implications of inflation for the financial performance of the programme.

8.3 Economic Analysis

An economic analysis will be undertaken with the objective of demonstrating the value of the water projects/programme to the nation. Consequently the probable benefits of rural supplies and sanitation in different areas of Zimbabwe will be investigated. Where appropriate the difference in benefits likely to arise from alternative designs at schemes where high and low cost alternatives based on different levels of service, water quality etc exist, will be assessed.

Unfortunately most of the probable social, health and economic benefits will not be amenable to quantification and consequently they will only be described. This means that the quantitative economic analysis will largely be limited to a cost effectiveness exercise. In such an analysis the financial costs will be corrected for market distortions to reflect real values, for example when unskilled labour, foreign exchange and taxes/duties are involved, using standard shadow pricing techniques. A specific example where a cost effectiveness analysis will be utilized is the question of labour intensive versus capital intensive construction. Labour intensive methods for activities such as small dam construction will increase employment and may be economically less costly even though resulting in a higher financial cost.

The descriptive economic analysis will include an examination of;

- (i) the contribution of typical projects and the overall programme to meeting various national socio-economic objectives, (ii) complementarity with other development projects.

8.4 Development Programmes

The NMWP will present short, medium and long term programmes for the sector based on the analysis of alternative programmes and on the probable availability of financial and other resources. They are as follows;

- (a) A 3-year Programme which will specify priorities, and the time scheduling of necessary additional investigations, design work, and the implementation of the higher ranking schemes which are within the financial ceiling of the Programme. The proportion of the probable resource availability which will be required for operation and maintenance will be calculated.

- (b) A 10-year Development Programme which will outline the size, scope and direction of the rural water supply and sanitation activities.
- (c) A 20-year Perspective Plan which will discuss the main aspects of long term development in the broadest terms.

8.5 A Water Pricing Policy

The major objective of this study will be to examine the present pricing policy and to recommend an appropriate tariff structure for the rural water supplies during the planning period. All issues which have any bearing on pricing policy will be examined.

The study will for practical reasons be divided into the following sub-surveys:

1. Cost/revenue survey.
2. Technical survey.
3. Willingness/ability to pay survey.

The sub-surveys 1 and 2 will to a great extent be based on the information made available through the Water Engineering and Management parts of the NMWP. The sub-survey 3 will be incorporated in the Socio-Economic studies as described above.

The Consultant will deal with the following issues:

- Outline the current national water pricing policy and revenue collection systems as it operates in different provinces.
- Examine the current revenues from, and financial position of, the rural water supplies resulting from the present pricing policy. Where there are significant differences, identify the reasons.

- Outline the theory behind pricing policy for water supplies i.e. the wish
 - (i) to allocate resources efficiently
 - (ii) not to exclude the poor from receiving the services
 - (iii) to achieve financial viability.

- Examine the conflicts between these goals.
Discuss the rationale for various cost recovery policies.

- Based on the findings critically examine the current policy.

- The ability to pay for water will be assessed, taking into account income levels, cost of living etc.

- The willingness to pay will be examined taking into account factors such as reliability, revenue collection systems, alternative natural water resources, distribution methods, etc.

- Examine the similarity/contrasts in the willingness to pay for water in different parts of the country and identify the reasons for major differences.

- Recommend the appropriate objectives for water pricing policy for the next ten years.

- Based on the investigations into average and marginal costs, consumers willingness to pay and revenue projections, recommend objectives, i.e. the appropriate national rural pricing policy for the next ten years. This shall include:
 - i) Recommendation on the appropriate rural water supply pricing, i.e. price structure and price level.
 - ii) Examination on whether water quality, technology, and consumer participation in the development of a supply should affect rural water supply rates.

9.0 PLAN OF OPERATION

9.1 Work Plan

The plan of operation for the execution of the National Master Plan has been slightly revised according to the Contract and according to the availability of the Staff engaged by the Consultant for the study. Due to the fact that the 'coming into force' of the Contract was somewhat delayed compared to the anticipated plan of mobilization, the majority of the Staff had been temporarily engaged in other duties. The revised and detailed plan of operation, schematically shown on the Work Flow Diagram, Figure 1, takes into consideration the actual availability of the engaged staff. The Work Flow Diagram outlines schematically all the phases of the study as specified in the Work Plan, Figure 2/1 - Figure 2/5. Each operation is planned in detail and is given a particular Operation Code No. in the Work Plan. The Staff Members engaged in each work Operation are also specified on the Work Plan, including the time and kilometerage budgeted for that particular operation and Staff member. The Work Flow Diagram is carefully designed in such a way that data obtained from one or several particular work operations, needed for other phases of the study, shall become available at the time needed. It must be stressed that with the short time available for this major study, it is essential that the work operations are being executed and completed according to schedule.

9.2 Timing

The revised Work Plan is changed slightly as compared to the Contract. Although there are some changes with respect to man-power input, the major changes are rather connected to the phasing of the different Work Operations. This is again connected to the availability of the engaged Expatriate Staff.

According to the Contract the duration of the study is planned to last 15 months from 1st October 1983, which means submission to the Client of the Draft Executive Report by 31st December 1984. A summary of the major dates will be as follows (see the Work Flow Diagram Fig. 1):

Operation

Commencement of Mobilization	15th Jul 1983
Permanent Staffing of Local Office	1st Oct 1983
Submission of Inception Report	15th Nov 1983
1st Progress Report	15th Feb 1984
2nd Progress Report	15th May 1984
3rd Progress Report	15th Aug 1984
4th Progress Report	15th Nov 1984
Submission of Draft Executive Report	31st Dec 1984
Submission of Final Executive Report	31st Mar 1985

The Consultant has experienced some major obstructions during the mobilization of equipment to Harare, by considerable delays in clearing of the said equipment through Customs. Although clearly stated in the Contract that the Client shall assist in timely granting of the Consultant, and/or any of his personnel and their dependents of the issue of import licences, etc., and in spite of the Clients efforts to do so, rather slow communication between other Ministries involved has been the major obstruction to a smooth mobilization of the necessary equipment and thus the desired progress of work. An effort will be made by the Consultant to catch up on some of the time lost during the said operation, however, this issue may cause some delays in the Study.

9.3 Consultants Staff

9.3.1 Expatriate Staff

Some small changes in the list of Expatriate Staff as outlined in the Contract have been required. The major changes are as follows:-

- M.Jorstad, Social Anthropologist, has, due to withdrawal from the project been replaced by P.Cross, Social Anthropologist.
- R.Finsrud, Sanitary Engineer, has due to illness been replaced by E.Skjelfoss, Sanitary Engineer.

The above changes have previously been drawn to the attention of the Client and NORAD and approved of.

The Consultant would like to propose a further minor change to the Expatriate Staff. Mr O.K.Paulsen, assigned to the project as Senior Water Engineer and Assistant Project Manager, has been engaged as Resident Manager of the Consultants Branch Office in Zambia for the last 2½ years. Due to the withdrawal from appointment as new Resident Manager in Zambia by Mr Paulsens successor, Mr Paulsen will have to divide his time between the Company's obligations in Zambia and Zimbabwe for some time. Four man-months less input by Mr Paulsen to the NMWP is proposed, substituted by an additional input of 3 man-months by Mr E.Skjelfoss who's experience is very relevant to the Work-operations he has been assigned to. Mr Skjelfoss C.V. is included as Appendix 9/1. Mr Skjelfoss is the approved Sanitary Engineer on the project. His previous assignment was, however, only for 3 months.

Mr Skjelfoss is a Division Director of Ostlandskonsult and in charge of planning and design of water supplies and sanitation projects. The Company's involvement in the Western Province of Zambia is under his supervision.

Except for the above mentioned changes, the Expatriate Staff will be engaged in the study as outlined in Contract and according to the revised Work Plan. However, the work input by expatriate personnel has been reduced by a total of 5 man-months as compared to the Contract. The reason for this is the delay of the commencement of the study and the availability of the Expatriate Staff.

We strongly recommend that the 5 man-months saved are spent on EDP-Services in the Consultants office in Harare.

According to the Contract, 2 man-months was allocated for the computer work, which was scheduled to be undertaken in Norway. An amount of NOK60.000 was allocated to cover this operation. This work is related to the socio-economic study and the water engineering study. If the Consultants computer facilities already available in Harare are used, the output from the socio-economic study will be much quicker and more reliable. In addition it will be feasible to undertake a more comprehensive analysis.

With regard to water engineering, the need for our own computer specialist is more evident than before. During the Contract negotiations we were informed that the latest census was available. However, it appears that the breakdown of the census is still not complete and we will therefore have to do part of the census calculation ourselves.

Furthermore, the data collected through the Water Supply inventory will also be computerized instead of being manually tabulated.

Of these reasons we would strongly recommend Mr F.Kvaerneng, Water Engineer and Computer Specialist, as part of the Consultants team for this assignment.

Mr F.Kvaerneng's experience with EDP in connection with inventory of water supplies as well as rehabilitation will become an asset to the project due to a more intensive use of computer techniques than previously anticipated by the Consultant. The proposed 5 man-months input by Mr F.Kvaerneng is duly registered in the Work Plan and accounted for in the Budget.

His C.V. is enclosed as Appendix 9/2.

9.3.2 Locally Employed Personnel

As requested by the Client during the Contract negotiation and as mentioned in Clause 2.7.2 of the Contract, the Consultant has made an effort to increase the input of locally employed personnel. According to the revised Work Plan, the number of man-months for locally engaged qualified staff will be increased from 26 as specified in the Contract to a total of 41. The majority of the local staff may be hired through Rural Development Services, a local Consulting Engineering firm who may provide assistance to Interconsult A/S in this respect. As Zimbabwe presently has a shortage of qualified staff, the required staff as specified in the Work Plan is not readily available. However, as of now it appears that Rural Development Services is able to supply personnel with the required qualifications.

The increase in local manpower input is mainly tied to the following operation:

Operation No	Operation	Increase in man-months over Contract
3.2.6	Test Pumping Supervision and Well Census	2.0
3.2.8	Execution of Test Pumping	4.5
4.6	Inventory of Existing Water Supplies	3.0
4.15	Water Engineering Study	4.0
4.18	Water Tariff Study	1.5
	Total sum	15.0

This increase is mainly due to the security situation in part of the country and the advice not to use expatriate personnel for long periods in certain areas. The local personnel knowing the area will have to have military or police escort, which may result in a substantial delay to our operations.

9.4 Remuneration and Payments

9.4.1 Payment Schedule

Based on the rates and adjustments agreed to in the Contract, a Payment Schedule has been worked out and is presented in Appendix A to this report as Fig. 3. The Payment Schedule presents the estimated cash flow on a monthly basis, from the beginning to end of the study. The costs are broken down in the following major groups of expenses:

1. Fees
2. Overseas Travel Expenses
3. Overseas Allowances
4. Local Travelling
5. Rent of Equipment
6. Other Expenses

From the estimated sum of 1 - 6 for each particular month a deduction of 20% is made for repayment of the Advance Payment of NOK2.000.000. Full repayment of this sum is estimated to have been completed after the month of June 1984.

The Payment Schedule is based on a detailed breakdown of the estimated costs for each work operation and the man-power input of each staff member. The breakdown of the monthly estimated and actual expenses is entered into the Operation and Expense Schedules. A separate schedule is prepared for each month of the Project.

The Payment Schedule is the summary of the estimated expenses shown on the Operation and Expense Schedule and included in this Inception Report. The actual expenses will be entered onto the schedules as the study proceeds. This will enable both the Client and the Consultant to keep a close financial control as to the progress of the Project.

Any changes in the work plan or the man-power input can be seen immediately by comparing the estimated input and the actual input on the monthly Operation and Expense Schedule Appendix A, Fig. 4/1 - Fig. 4/19.

9.4.2 Budget Estimate

The Payment Schedule indicates a sum total of remunerations and expenses of NOK15.155.400 which although well below the Contract sum of NOK15.200.000, is however, above the Contract estimate of NOK13.817.000 excluding 10% contingencies. The major causes of the estimated increase of remunerations and expenses are mainly due to the following:-

1. Fees A larger input of locally employed experts and personnel. As to the latter, an increase of manpower input by the test pumping teams and the field survey connected to the Sanitation Study is noted. For the sanitation surveys, students from the University will be engaged, for who's services the standard University rates for wages and field allowances will be paid. A larger price increase for the fees of the expatriate personnel than anticipated in the Contract has also been encountered.
2. Overseas Travel Expenses This is estimated to be the same as in the Contract.
3. Allowances These have increased compared to those estimated in the Contract, mainly due to the increase of field activities by locally engaged personnel.
4. Local Travelling This has increased slightly due to the reasons given in 1 and 3 above.

5. Rent of Equipment This is increased slightly due to a longer test pumping period of 7½ months under operation No. 3.2.8, 'execution of test pumping'.
6. Other Expenses These are increased due to a higher estimate of printing and photocopying. In particular, copying of drawings has proved more expensive than previously anticipated.

The conclusion drawn from the Consultants' cost estimate is that provided the Master Plan Study is executed within the frame of the Work Plan, presented, and that the small alterations proposed in the Inception Report are approved of, the Study will be completed within the Contract sum of NOK15.200.000. The contingencies of NOK1.383.000 in the Contract are therefore reduced to NOK44.600.

9.5 Reporting

According to the Contract and the revised Work Plan, the following reports and dates of submittal are foreseen by the Consultant.

9.5.1 Inception Report

This report will be submitted around mid November 1983.

According to the Contract the anticipated time of submittal was 1st November 1983. Due to a burglary from the Consultants office of a new typewriter and delays through Customs for clearing of software and parts for the Consultants Word Processor, a delay of 2 to 3 weeks for the Inception Report is unavoidable.

9.5.2 Quarterly Progress Reports

To be submitted on or before the following dates:

1st Progress Report:	15th February 1984
2nd Progress Report:	15th May 1984
3rd Progress Report:	15th August 1984
4th Progress Report:	15th November 1984

9.5.3 Water Resources Report

This report will follow the completion of the Hydrological Study, the Hydrogeological Study and the Water Quality exercises, all of which are programmed to be completed by 15th November 1983. Reporting will follow and the report will be submitted by 15th December 1983.

9.5.4 Sanitation Report

This study will be divided into three major studies:

- A. The Attitudinal Survey
- B. The Health Profile Study
- C. The Socio-Economic Study

The results and data reporting from A. will become an input to the Rural Water Supply Programme. The Sanitation Report will follow the completion of the studies under B. and C. Submittal of this report will be within 1st October 1984.

9.5.5 Management Report

This report will follow the completion of the Management Study which is scheduled for the end of March 1984. The Data from this Study will however be utilized as an input to the Sanitation Study, and the report may only be ready for submittal on or before 1st October 1984.

9.5.6 Human Resources Development Report

Data for this report will be obtained among others from the Management Study. This report will follow the completion of the Human Resources Development Study by the end of July 1984. The report is anticipated ready for submittal on or before 1st October 1984.

9.5.7 Design Manual

Is scheduled to be completed by 1st August 1984. However, some additional input to the Design Manual may be included in connection with the Rural Water Supply Programme. For this reason, the Design Manual may not be ready for submittal until approximately 1st November 1984.

9.5.8 Operation and Maintenance Report

This report will be completed by the end of June 1984. However, input and feedback to/from the Rural Water Supply Programme may become an asset to this Report. Therefore the Consultant anticipates a submittal date on or before 1st October 1984.

9.5.9 Draft Executive Report

This report will include a summary of the aforesaid reports as well as the main content of the Rural Water Supply Programme as the major issue. The report is scheduled to be completed during the months of November and December 1984. The submittal date has been set as 31st December 1984.

9.5.10 Final Executive Report

The Final Executive Report is the revised and corrected version of the Draft Executive Report, when all the remarks and corrections required by the Client have been executed. This report has been scheduled to be completed during the period 15th February to 31st March 1985, subject to the time required by the Client for comments and approval of the Draft Executive Report.

The submittal date for the Final Executive Report is scheduled for 31st March 1985.

10.0 PROPOSED EXTENSION OF THE STUDY

10.1 Electronic Data Processing (EDP) - Requirements within the Water and Sanitation Sectors

10.1.1 Introduction

Reference is made to the Contract, appendix B, clause 7.1, where it is stated that computer services for the NMWP are to be further discussed.

After having become more familiar with the computer services in Zimbabwe, the Consultant would like to propose that possible consulting services in the field of data processing should not be limited to the NMWP only. Zimbabwe is fairly well equipped with hardware that could be utilized to establish a data bank, and to carry out extensive analysis in the water sector. The requirements would be that reliable basic data are collected, put on computer tape and the necessary programmes worked out.

As a first step it is recommended that a feasibility study be carried out to determine the EDP - requirements within the water and sanitation sectors.

The Consultant is prepared to undertake this feasibility study for EDP - Requirements within a short period of time as the decision on our recommendation in this respect may influence the agreed reporting system.

In the following we have described the creation of a WATER AND SANITATION RESOURCES DATA BANK and the Terms of Reference for a Feasibility Study.

10.1.2 Water Resources Data Bank

General

One of the main objectives for this proposed extension of the National Master Water Plan Project is the creation of a Water Resources Data Bank.

The rationale for the creation of such a Data Bank is based on the realization that the ambitious goals of the Government within the Water Development Sector will require a solid foundation of relevant data for correct planning to best achieve the set targets.

The Water Resources Data Bank will ultimately contain readily accessible computerized information on Hydrology, Hydrogeology, Water Quality, Water Apportionment and Existing Water Supply and Sanitation Projects.

A number of computer programmes will be prepared to enable data from several of the above mentioned general areas of information to be interlinked and processed, thus combining the data into meaningful forms for planning purposes.

The first and also the most energy and time consuming task in the establishment of a data bank is the gathering of reliable raw data from various sources, the subsequent checking of the data and the filling in of missing information from other sources. Sometimes gaps of data may require synthesizing to arrive at reliable sets of records that can be consolidated into a useful format.

The gathering, checking and consolidation of data dealing with water permits is believed to be fairly straightforward, as this information is methodically recorded and filed.

As far as hydrological information is concerned the actual gathering of data will be relatively easy as the data are already on cards.

With respect to existing hydrogeological data much of this is of limited reliability. A substantial proportion of the available data is therefore not of sufficient quality to form the basis for the hydrogeological aspects of the water resources data bank.

Existing water quality data is also problematic to gather and incorporate in the data bank due to the lack of an organized recording and filing system.

The setting up of a task force to extract and evaluate the existing data in terms of reliability, source and position, and to organize the data selected is warranted.

HYDROLOGY

Rainfall, Organization of data

The collection and processing of rainfall data is carried out by the Department of Meteorological Services, Ministry of Transport. Data from all rainfall stations (approx. 2500) has been put on magnetic tape.

However, up to 1979 only monthly values are available. From the year 1979 - 1980 daily values have been punched. The rainfall-year begins on the 1st July and ends 30th June.

Of the approximately 2500 stations approximately 1100 are still operational. More than 30 years of records are available for about 800 stations.

It would be desirable to have all rainfall data available on tape on a daily basis. This task is basically a question of punching, and we believe this will be carried out by the Meteorological Services without expatriate assistance.

Rainfall output

Programmes for listing of the rainfall station network, programmes for print outs of monthly summaries and a few additional programmes are available.

To obtain full benefit of the rainfall data in the rainfall-runoff studies the following programmes would be desirable.

- a) Point Rainfall:
- b) Annual and monthly means and Standard deviation from mean.
- c) Frequency distributions giving 50, 75, 80, 90 and 95% probability of exceedance.
- d) Reliability of rainfall during wet seasons given as amount of rainfall to be expected with a certainty of 2, 5, 10,....90, 95, 98% probability of exceedance during a period of 10, 20, 30, 60 or 90 consecutive days.
- e) Bumbel or other distribution of maximum point rainfalls for 1, 2, 3, 4, 5, 6 or 7 consecutive days. (This can be done only on records with no missing data).
- f) Soil Moisture Balance, Marginal Areas.
- g) A model which simulates the available soil moisture on a daily basis for a given soil type and a given crop with described varying water demand during the growing season.
- h) The model should produce frequency distributions of crop yield for the rainy season, given for instance as:-
100% crop yield 60% of the years, 50% crop yield 75% of the years.
- i) Area Rainfall:
- j) Combining rainfall from individual stations to area rainfall over any area with digitized borders.

Runoff, General

The most basic information required in water resources planning is information on stream flow.

Most gauge height records collected by the Hydrological Department have been converted to discharges and punched on cards. Until the data are transferred to tape it will not be possible to carry out comprehensive analysis for a large number of stations. The Hydrological Department is in the process of transferring the data to tape.

For the analysis needed for the NMWP it is of greatest importance that the data transfer is speeded up.

We have had separate discussions with the Hydrological Department on this matter. At present it has not been confirmed whether our services will be required for this purpose, or if the Hydrological Department will obtain assistance from other sources.

The total number of discharge stations on the rivers is in the order of 650, of which approximately 360 are automatic recorder stations. The coverage of stations, therefore, seems to be adequate in most areas.

It is not known to what extent the data are continuous and complete. To fill in gaps it would be convenient to obtain a rainfall-runoff model.

Rainfall Runoff Model

A model used for daily discharge synthesis consists of two major components. One component is the storm runoff, i.e. rainfall excess, and the other the base flow.

The primary input to the model is daily point rainfall. The rainfall is then converted into storm runoff through a process in which antecedent precipitation, climatic region, soil type, land use and vegetative cover are taken into consideration.

The storm runoff is adjusted for base flow through recession curve analysis, and where spring flow is of importance further adjustments are made.

The primary result from the model is daily "point runoff". The point runoff is then combined into daily sub-basin wide runoff. Next step combines sub-basin flow into stream flow from any wanted larger catchment area or as runoff from any area with digitized borders.

Runoff-Output

Below follows a description of some suggested programs/outputs based on daily runoff input.

- Annual and monthly means and standard deviations from mean.
- Frequency distributions giving 50, 75, 80, 90, 95 and 98% probability of exceedance.

- Storage yield indices; storage required to guarantee a given sustained flow with a given acceptable probability of failure.

- Flow duration data.
- Low flows for 1, 5, 10 and 30 day periods.
- Flood flows for various return periods.
- Programmes for plotting of graphs showing the results from the above analysis.

Water Apportionment

The consultant believes that the gathering, coding and checking of data can most conveniently be based on river cards, filed by catchments.

Apart from the amount of water abstracted, information of the permit holder etc., it is extremely important that the map references for each abstraction are coded accurately. Accurate details of the map references will enable print outs of the permits in any digitized area to be obtained. As the map references have not been written on the cards, these have to be obtained from the 1:50,000 scale maps where all permits are marked.

HYDROGEOLOGY

Recently some major groundwater exploration and development projects have been implemented. Similar projects may be implemented in the near future.

It would be advantageous if hydrogeological information gathered during the current programmes and any new investigations could be incorporated into the NMWP. To accomplish this all the information gathered on the various projects needs to be collected in a standardized manner such that the data collection is similar quality.

The Terms of Reference for the NMWP makes specific mention of the need for the establishment of routine procedures, and we consider the collection of hydrogeological data to be of primary importance to the formulation of any future development plan.

From the information we have gathered so far, and from discussion with both Government and Consulting personnel, it is clear that the quality of the existing hydrogeological data is poor. Although there are considerable data available as computer print outs it would appear that these are of a qualitative nature only and are not amenable to form the basis of a revised computer based storage system for the following reasons:

- The data are obtained from drillers records of poor accuracy, with limited field control.
- The grid references are inaccurate.
- The yield data given are based on short tests of unknown nature. They cannot be used for quantitative appraisal of water resources (only qualitative).
- No distinction is made between a dry hole and a successful hole with an unreported yield.

In order to avoid loss of information on current and future projects we therefore recommend that standardized procedures and schedules for the reliable recording of drilling and hydrogeological data be prepared without delay.

To prepare such procedures and schedules a study of the optimum format and essential information to be collected is required.

Such data will include information as relevant relating to the borehole and/or well (position, construction details, drilling technique used) geology intersected, hydrogeological data (depth of weathering, significant fractures) hydraulic

data (tested yield, including type of test carried out and raw test data), and groundwater quality (physical and chemical constituents).

It is obviously important that the implementation of the routine collection and recording of these data and standardized format be made a requirement of all drilling contractors and consultants by the Ministry of Water Resources and Development.

All information collected must be filed in a suitable manual retrieval system. This system will form the basis for the development of the computer based storage and retrieval system.

The development of a computer based hydrogeological data bank and storage retrieval system is essential in view of the large amount of information that will be obtained both during the implementation of the NMWP and other groundwater investigation or development programmes. Once reliable data are available in the water resources data bank the preparation of suitable programmes will allow these data to be manipulated in an advantageous manner to assist in the further development of locally available groundwater resources.

Such programmes will enable ready retrieval of for example, average drilling depths in any particular area or geology, average borehole/well yield in any particular area or geology, positions of existing boreholes/wells in any area, the most suitable borehole/shallow well construction in an area of interest, groundwater quality in any particular area or geology, and delineation of areas of good or poor quality groundwater. Other outputs obtainable from the computer programmes should include diagrammatic borehole logs, and suitable hydrochemical plotting (Schoeller, Piper etc)

Water Quality

The NMWP will include the collection of water samples from rivers, lakes and boreholes. According to the Contract more than 500 samples comprising several water quality parameters will be required. It is important to include this Water Quality Data into the Water Resources Databank, particularly as the existing information on groundwater is scanty.

Inventory of existing Water Supply and Sanitation Facilities

According to the Contract, Appendix B, clause 1, an organized inventory of existing Water Supplies and Sanitation facilities should be provided. For this purpose, the Consultant has planned to use his own EDP-facilities.

However, it is a requirement to transfer all these charts to a Water Resources Data Bank.

Water apportionment - Output

Apart from the programmes required to establish the data files a selection of programmes should be written to make it possible to extract and print permit information according to certain defined selection criteria or combination of criteria such as:

- Drainage area or any other digitized area
- Purpose of extraction
- Flow abstractions within a given range
- Date of granting of permit
- Date of expiry of permit

Other Applications

Within the broad Terms of Reference of the NMWP a data storage and retrieval system has a number of additional applications that are useful to the MWRD and other bodies such as the MOH and Decade National Action Committee, for example:

- a) General library and information catalogue, especially when combined with micro film storage. This may also be interfaced with the International Water Decade information system.
- b) Development of an intersectoral/interministerial data and information base, for example with MOH and CSO.
- c) Recording of details and progress of interministerial programmes within the sector.

10.1.3 Terms of Reference for a Feasibility Study Regarding the EDP-Requirements within the Water and Sanitation Sectors

1. Status of electronic data processing (EDP) in Zimbabwe.

Obtain reliable information about existing EDP activities with emphasis on governmental affairs. Specifically survey the following:

- Established EDP - Services and their obligations e.g. the Ministry of Health, Village Health Worker reporting system. CSO.
 - Experience, know-how, human resources, hardware and software within these services. The extent of support and following-up offered by the suppliers.
 - The situation with respect to any plans or direction for the National, Governmental and/or Departmental EDP-Development and usage.
 - Additional relevant information.
2. Analyse the need for EDP as related to the NMWP.

It is necessary to conduct a thorough analysis of how EDP can efficiently contribute to the realization of the

intentions set out in the Terms of Reference for the NMWP. Such an analysis shall be carried out in close cooperation with the relevant authorities and interested-parties. The final goal should be the creation of a Data Bank.

3. Evaluation of Relevant Hard and Software.

Relating to item 2 above, determine the design parameters for the EDP-system. Evaluate the existing Governmental EDP-systems and identify necessary supplements in order to fulfill the design parameters.

4. Analysis of the Hard and Software markets in Zimbabwe.

Presupposing that new acquisitions are required, detailed information about the following shall be obtained:

- Is adequate hardware offered by companies well established in Zimbabwe.
- If not, what can be done to induce other companies?
- How well suited is software offered by the hardware suppliers? If not satisfactory, are there other sources national or international, of relevant software (the relevance to be judged on basis of applicability, safety and ease-of-use).

5. System and Program-Development.

If the design parameters cannot be met by systems which are already in house or easily available, system and programme development will be required.

6. Training.

Training may be necessary in these two areas:

- EDP in general
- Special introduction to purchased systems and equipment.

The extent of such training should be evaluated and discussed with the authorities in Zimbabwe. Suppliers of hard and software may be useful in this context.

7. A review of the data, information collection and recording systems and procedures.

This will be carried out in order to ensure that reliable data is presented for processing.

10.2

Draft Action Plan for the Decade

In concurrence with the aims and procedural guidelines suggested by the United Nations, the Government of Zimbabwe established a Water Decade National Action Committee (NAC) towards the end of 1982. A technical support committee and three standing sub-committees dealing with:-

- a) Baseline Data Collection
- b) Health Education
- c) Community Participation

were set up at the same time.

At its inception the functions of the NAC were seen to be:

- "(i) Arrange for review of the current sector situation and national resources available for the sector;
- (ii) set tentative goals and targets for the Decade for this sector;
- (iii) identify potentials and quantum of additional resources that can be generated from the communities;

- (iv) formulate policy with regard to population groups to be served and decide on tentative levels of service;
- (v) identify constraints and means of
 - (a) overcoming them, or
 - (b) minimizing their impact;
- (vi) = enunciate concrete policy guidance for
 - (a) programme development,
 - (b) criteria for identifying priority projects, and
 - (c) project formulation;
- (vii) designate departments or ministries for preparing national programmes on the basis of policy guidance given;
- (viii) identify projects or components thereof for which external resources (technical and financial) may be required;
- (ix) designate an officer who will liaise with the UNDP Resident Representative on behalf of the NAC;
- (x) arrange for a plan of action to be prepared for the various activities decided upon with target dates and approve the plan of action; and
- (xi) monitor progress and take corrective action as necessary. "

The NAC is clearly an important instrument for establishing policy and interministerial cooperation, especially in view of the multi-ministerial composition of its membership. However, the NAC does not have any executive powers and UNDP (in Zimbabwe) are limited in their support of NAC by their own staffing constraints.

The NAC's operating budget is drawn from the limited funds of individual ministerial budgets and its administration falls upon the shoulders of Government officers already fully employed by their own duties.

The NMWP will recommend ways and means of strengthening the role of NAC. It is therefore recommended that the Terms of Reference for the NMWP be expanded to enable the master planning team to work in close cooperation with NAC and that one of the first objectives be to draft a 'Decade Action Plan'.

Furthermore we would recommend the following actions be taken;-

- a) The appointment of a full time 'secretariat' person. This would ease administration especially when NAC assumes the role of identifying projects and external resources.
- b) Specific administration and operating funds should be sought and a budget established.
- c) UNDP should be encouraged to assume a more active role by senior Government officials especially in bilateral donar coordination.

Technical and financial assistance as in a) and b) may well be available from bilateral donars active in the sector.

10.3

The inclusion of Peri-urban areas in the Study

The Terms of Reference for the NMWP are presently restricted to rural areas. However, we have been made aware of the potential future problems in planning for and providing water supply and sanitation facilities in peri-urban areas in the light of projected urban migration levels.

The population of Zimbabwe is growing rapidly (3,5% per year) and it has been conservatively estimated that the urban population growth rate may exceed 7% per year. This means, for example that the population of Harare will almost double in this decade. Most of the additional urban population will live in unplanned peri-urban areas.

The migration of the rural poor to larger urban centres inevitably results in the growth of these informal un-planned housing areas that often lack basic services and amenities including water supply and sanitation.

To address the problem and in order to integrate National planning in the sector it is recommended that either the terms of reference for this study be expanded or a separate study be commissioned to consider planning of water supplies and sanitation in peri-urban areas.

10.4 Proposed Extension of Terms of Reference to include Commercial Farming Areas

Zimbabwe has inherited a diverse system of land apportionment. The population of 7,5 million is roughly divided as follows:

	<u>% Land</u>	<u>% Population</u>
Urban Areas	1	21
Communal Areas	42	56
Small-scale Purchase Areas	3	2
Commercial Farming Areas	31	21
Forestry , Parks and Wild Life	16	-
National Land	7	-
	<u>100</u>	<u>100</u>

The present Terms of Reference (TOR) for the NMWP covering rural areas make special mention of communal areas and resettlement areas. These two land apportionment areas were identified by the Government of Zimbabwe as priority areas for development after independence and the initial TOR reflect these priorities.

The percentages are rough approximations adapted from the 1969 Census. This categorization takes no account of Resettlement areas which are largely derived from Commercial Farming Areas.

The Commercial farming lands cover an extensive rural area not mentioned in TOR for the NMWP. This land apportionment region covers roughly a third of the land area of Zimbabwe and contains approximately 1,7 million people, predominantly farm labourers and their families. Prior to independence this land area was exclusively restricted to european farmers and the highest proportion of land grades I and II occur within this region. The commercial farms range in size from the large ranches in Matabeleland to smaller field-crop and mixed farms in Mashonaland.

The farm worker population and their dependants for the most part live in compact mud and thatch housing clusters or 'compounds' on individual farms. A consequence of the war was that the compounds were densified and few compounds have subsequently become more dispersed. The conditions for farm labourers are among the worst in Zimbabwe; incomes are at the minimum wage of \$52 per month, though short term contract workers who are an increasing section of the farm worker population may receive less than this, workers have no wide-spread organization representing their interests; a high proportion are immigrants from neighbouring countries; and environmental conditions are generally poor.

There is little available information on the environmental status of farm worker compounds, but a study of the health status of farm workers in central Mashonaland a year after independence found that 67% of households had no sanitation whatsoever, 18% used river water as their primary water source and 74% used communal water points.

A follow up study at the beginning of 1983 after a primary health care programme focussing on environmental health, reduced the number of households without sanitation to 31% (but a control study of non-project farms still showed that 83% of households had no facilities), and the number of project households still using river water as their primary source to 2%.

The inadequacy of water, sanitation and other facilities are reflected in the health status of farm workers. Sixty five percent of children under 5 in the 1981 study were found to have chronic malnutrition, and 40% of the same children were found to have wasting, or acute malnutrition, 58% of children under 5 were found to have had diarrhoea in the last four weeks on non-project farms in the 1983 study. Many of the principle health problems on farms such as malaria, diarrhoeal diseases and schistosomiasis are related to inadequate environmental facilities on farms.

It is proposed that the TOP be extended to include commercial farming areas.

The reasons for this proposal are as follows:-

- Commercial farms account for about a fifth of the population on a third of the land area.
- Commercial farms contain the poorest and least priveleged sectors of Zimbabwe society.
- Farm labourers and their families appear to have a very low level of water and sanitation provision.
- Indications are that farm labourers and their families have the highest incidence and prevalence of water and excreta-related diseases.
- The Government is restructuring the historical divisions of land and population. In the long term administrative relations to the commercial farming area are likely to be similar to those in communal areas. A national plan developed without reference to this extensive and important section of the population will therefore be severely weakened.

However, the extension of the Study to commercial farming areas will greatly enlarge the workload and the time frame of the NMWP.

- The extension would need to cover just under a third of the country's land area, and a fifth of its population.
- Data on existing water and sanitation provision on commercial farms has not been recorded and would have to be entirely gathered from field work. Information on population, social factors, health structures and other categories of the data necessary for the NMWP would also have to be gathered in field surveys.
- At present the Government of Zimbabwe access to the farms is legally restricted. Access should be obtained with the support of the Commercial Farmers Union and the consent of individual farmers, but this will entail further delays in data collection.

10.5 Testpumping of Shallow Wells

During the data collection phase and the early stages of the desk study it has become apparent that a certain emphasis is being placed by the MWRD and MOH on the use of shallow wells as an alternative to boreholes for rural water supplies.

At present no provision is made in the hydrogeological programme for the field pump testing of selected wells to gather information to enable optimum design parameters to be formulated. It is proposed therefore that the Terms of Reference be extended to include the short term controlled testing of approximately 50 - 60 shallow wells such that the near surface horizons of various water bearing lithologies are sampled. The tests will be run for 3 - 6 hours.

Water samples will be collected at the beginning and end of the test to check the groundwater quality and to monitor any changes in quality under pumping.

Since the results of the testing of shallow wells are particularly susceptible to seasonal changes in water level, it is advisable that the testing be carried out towards the end of the dry season. It is therefore recommended that this testing should overlap with the latter part of the borehole testing programme and be undertaken from July to end September 1984.

It is estimated that approximately 3 man-months of field work will be required for this testing followed by 1,5 man-months for data interpretation.

The field testing will be run under controlled conditions according to standard specifications prepared by the principle hydrogeologist. It is proposed that the testing be the responsibility of a locally recruited field assistant/ technician working under these specifications.

The equipment required to undertake the testing is given below.

- a small electrical submersible pump with capacity 0,3 to 0,5 l/sec from a depth not exceeding \pm 15m.
- a lightweight portable generator with suitable power output.
- ancillary equipment (water level meter, resistivity meter, pH meter).
- 4 wheeled drive vehicle for the field survey. It is estimated that approximately 20 000 km will be required.

10.6 Seminars

It is proposed that members of the study team should organize and present regular seminars on various aspects of water resource planning and policy formulation. Such seminars would be aimed at meeting two main objectives. Firstly they would contain a multi-disciplinary training element wherein participants would be informed on a number of questions central to water supply development. In particular it is intended that participants should gain an insight into issues which are outside their own professional backgrounds, for example engineers would be exposed to the views of economists and sociologists.

The second objective would be to enable the Consultants to receive feedback from a wide audience on policy issues which are central to the National Master Plan.