NWSDB

National Water Supply & Drainage Board
Sri Lanka

P1 MANUAL
PROJECT PLANNING FEASIBILITY

March 2019

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PREFACE

Procedure Manuals and Design Manuals for NWSDB have been prepared about twenty-five years back under the USAID SRI LANKA PROJECT 383-0088. Due to the rapid changes in Procedures and Technology during the past 25 years, these manuals need to be updated to suit the present-day situation incorporating the present technology and changes in environmental and social aspects.

In 2009 NWS&DB had taken steps for updating the P1 Manual first in the series of Procedure Manuals by appointing an updating committee comprising NWS&DB members as well as outside members having expertise in the subject area. In the latter part of year 2009 it was published and from there onwards it has been used as a reference document for preparation of Prefeasibility and Feasibility Studies for water supply projects.

Following several years of use, comments for the Manual were obtained from the users and the comments addressing the practical viewpoints as well as the theoretical concepts which had not been included in the first revision have been incorporated into the Manual in order to make it more applicable.

Basically, the Manual describes the administrative aspects of project formulation and planning procedures and main contents to be included in the Prefeasibility and Feasibility study reports. The Review Committee is of opinion that the users of the Manual will be able to produce comprehensive Prefeasibility/Feasibility Study reports by following the P1 Manual and appeal to the users to follow the guidelines consciously and adopt to real life situations appropriately.

This Manual is specifically targeted for water supply projects and it can be principally applied for preparation of Prefeasibility/Feasibility Study reports for waste water projects also. Until an Addendum with sections specifically applicable to waste water projects is produced, this Manual can be used for waste water projects also.

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D9 - Plumbing Code
D10 -Pre Stressed Concrete Manual for Circular Tanks

P1 MANUAL UPDATING TEAM NWSDB TEAM - *Full Time*

Mr. D.S.D. Jayasiriwardene	-	DGM (P&D)
Mr. U.C. Pathiranage	-	AGM (P&D-Documentation)
Mrs. Rajika Balasooriya	-	Chief Engineer (P&D)
Mrs. Nisanka Mahamithawa	-	Senior Engineer (P&D)
Mrs. Thanuja Premaratne	-	Engineer (P&D)

NWSDB TEAM – *Part Time*

Mrs. Srima de Silva	-	AGM (Finance)
Mr. D.Seneviratne	-	Chief Sociologist (P&P)
Mr. K.M. Prematilaka	-	Manager (Groundwater Studies)
Mr. L.P.R.J. Wijesinghe	-	Senior Chemist

CONSULTANTS

Mr. Peter Ebsoe	-	Civil Engineer - NIRAS Consultant

Mr. Athula Priyantha	-	Local Consultant - Environmentalist
Ms. Yvani Deraniyagala	-	Local Consultant – Economist

PLANNING & DESIGN MANUAL REVIEW COMMITTEE (PDMRC)

This manual was reviewed and approved by PDMRC. Members of that committee at the time of commencement were as follows (Appointed on 16.01.2014).

Mr. D.S.D. Jayasiriwardena	- Addl.GM (S/E)	- Chairman
Mr. K. R. Dewasurendra	- Addl.GM (WSP)	- Member
Mr. D. U. Sumanasekera	- Addl.GM (CS)	- Member
Mr. R.S.C. George	- Addl.GM (P&P)	- Member
Mr. R.H. Ruvinis	- DGM (P&D)	- Member
Mr. S. G. Jayawardene	- DGM (Sewerage)	- Member
Ms. Srima De Silva	- DGM (F)	- Member
Mr. B. L. Gunerathne	- AGM (M&E-P&D)	- Member
Mr. U.C. Pathiranage	- AGM (Doc-P&D)	-Member
Ms. S. Jayasinghe	- Chief Engineer (P&D)	-Secretary

Members of the PDMRC appointed on 22.05.2017 are as follows.

Eng. J. R. Nadurana	- Addl. GM (Sewerage)	- Chairman
Eng. R. H. Ruvinis	- Addl.GM (WSP)	- Member
Eng. S. G. R. Rajkumar	- Addl.GM (N/C)	- Member
Eng. T. S. Wijethunga	- Addl.GM (P&P)	- Member
Eng. S. G. Jayawardene	- DGM (Sewerage)	- Member
Eng. K. J. V. A. Perera	- PD (GAMIWSP)	- Member
Eng. K. W. Premasiri	- DGM (P&D)	- Member
Mrs. A. P. Srima. De Silva	- DGM (Costing)	- Member
Eng. B. L. Gunerathne	- DGM (M&E-Services)	- Member
Eng. S. Sumanaweera	- DGM (Production)	- Member
Eng. U. C. Pathiranage	- AGM (Doc-P&D)	- Member
Eng. S. Jayasinghe	- C Eng.(P&D/ Design Manual)	- Secretary

Members of the PDMRC appointed on 30.11.2018 are as follows.

Eng. N.H.Kulanatha	- Addl. GM (S/E)	- Chairman
Eng. R. H. Ruvinis	- Addl.GM (WSP)	- Member
Eng. T. S. Wijethunga	- Addl.GM (P&P)	- Member
Eng. K. J. V. A. Perera	- Addl.GM (C/S)	- Member
Eng. U.Rathnapala	- DGM (P&D)	- Member
Mr. A. G. S. Kumara	- DGM (Costing)	- Member
Eng. D.N.De.S. Gunathilaka	- DGM (Sewerage)	- Member
Eng. T.M.W.Sunil Bandara	- DGM (M&E)	- Member
Eng. T.W.M.L.P.Wijesundara	- AGM (Doc-P&D)	- Member
Eng.R.R.N.P.Rathnayake	- Specialist (Water Treatment)	- Member
Eng. S. Jayasinghe	- AGM (JPU)	- Member

Eng. S. Kalubowila - CEng. (P&D/ Design Manual) - Secretary

ABBREVIATIONS

ADB	-	Asian Development Bank
AD	-	Agricultural Department.
Addl.GM (F)	-	Additional General Manager (Finance)
AG	-	Attorney General
AWPLR	-	Average Weight Prime Lending Rate
BOI	-	Board of investment
CANC	-	Cabinet Appointed Negotiating Committee
CAPC	-	Cabinet Appointed Procurement Committee
CBO	-	Community Based Organization
CDC	-	Capital Development Cost
CEA	-	Central Environmental Authority.
CLS	-	Chief of Laboratory Services [AGM (Laboratory Services)]
CMC	-	Colombo Municipal Council
CP	-	Corporate Planning
CRC	-	Capital Recovery Cost
CVM	-	Contingent Valuation Method
DB	-	Design & Built
DCC	-	District Co-ordination Committee
DCFROR	-	Discounted Cash Flow Rate of Return
DDHS	-	District Director of Health Services
DEM	-	Digital Elevation Module
DI	-	Ductile Iron
DLCC	-	Divisional Level Co-ordination Committee
DMA	-	District Metering Areas
DNCWS	-	Department of National Community Water Supply
DS	-	Divisional Secretariat
DTH	-	Down the Hole
EA	-	Environmental Assessment
ECD	-	Export Crop Department
ECS	-	Environmental Conservation Society
EIA	-	Environmental Impact Assessment
EIRR	-	Economic Internal Rate of Return
EM	-	Electro Magnetic
EPL	-	Environmental Protection License
ERD	-	External Resources Department
FBCA	-	Financial Benefit Cost Analysis
FD	-	Forest Department
FHO	-	Family Health Officers

FIRR	-	Financial Internal Rate of Return
FNPV	-	Financial Net Present Value
FOCC	-	Financial Opportunity Cost of Capital
GPR	-	Ground Penetrating Radar
GSS	-	Gami Seva Sevana
GIS	-	Geographic Information System
GM	-	General Manager
GN	-	Grama Niladhari
GND	-	Grama Niladhari Division
GOSL	-	Government of Sri Lanka
HO	-	Head Office
HSD	-	Health Service Department
IEE	-	Initial Environmental Examination
IP	-	Induced Polarization
IRR	-	Internal Rate of Return
ITI	-	Industrial Technology Institution
JICA	-	Japanese International Corporation Agency
LA	-	Loan Agreement
LG	-	Local Government
LPCD	-	Liters Per Capita Demand Per Day
LUPPD	-	Land Use Policy Planning Department
MC	-	Municipal Council
MOU	-	Memorandum of Understanding
MRI	-	Medical Research Institute
MSD	-	Management Services Department
NBD	-	National Budget Department
NCDs	-	Non-Communicable Diseases
NEA	-	National Environmental Act
NGO	-	Non-Governmental Organization
NPA	-	National Procurement Agency
NPD	-	National Planning Department
NPV	-	Net Present Value
NSRC	-	Neo Synthesis Conservation Society
NWSDB	-	National Water Supply and Drainage Board
OER	-	Official Exchange Rate
O&M	-	Operation & Maintenance
OIC	-	Officer In Charge
OP	-	Other Relevant Projects.
P&D	-	Planning and Designs
P&P	-	Policy and Planning
PAC	-	Project Appraisal Committee
PAV	-	Project Appraisal Visit
PC	-	Project Committee
PCPP	-	Perennial Crop Development Project.
PCU	-	Project Coordination Unit

PD	-	Project Director
PDDP	-	Participatory Dry zone Development Project.
PFS	-	Pre-Feasibility Study
PHI	-	Public Health Inspector
PHN	-	Public Health Nurse
PIU	-	Project Implementation Unit
PRC	-	Project Review Committee
PSC	-	Project Steering Committee
PV	-	Present Value
RDHS	-	Regional Director of Health Services
ROR	-	Rate of Return
RSC	-	Regional Support Centre
RWHT	-	Rain Water Harvesting Tank
SDG	-	Sustainable Development Goals
SEA	-	Strategic Environmental Assessment
SERF	-	Shadow Exchange Rate Factor
SCF	-	Standard Conversion Factor
SIA	-	Social Impact Assessment
SLR	-	Sri Lankan Rupees
SP	-	Self-Potential
SWRF	-	Shadow Wage Rate Factor
T&C	-	Tenders and Contracts
TCE	-	Total Cost Estimate
TDEM	-	Time Domain Electro Magnetic
TEC	-	Technical Evaluation Committee
UC	-	Urban Council
UDA	-	Urban Development Authority
UFW	-	Unaccounted for Water
USD	-	United States Dollars
VAT	-	Value Added Tax
VLF	-	Very Low Frequency
VSD	-	Variable Speed Drive
WACC	-	Weighted Average Cost of Capital
WD	-	Wildlife Department
WHO	-	World Health Organisation
WRB	-	Water Resources Board
WS	-	Water Supply
WSP	-	Water Supply Project

SECTION 1
INTRODUCTION

INTRODUCTION

A formalised procedure for water supply and waste water project identification, planning, feasibility, selection and project preparation is deemed necessary in order to realise the following objectives,

- To ensure that the limited resources of the sector are utilised on projects having the greatest social need.
- To ensure the availability of water sources of acceptable quality and also ensure their security and reliability.
- To ensure that the projects are technically feasible, properly and appropriately conceived and designed.
- To ensure that the projects respond to needs and the social aspects of the user community they serve, to the maximum extent possible.
- To ensure that the service area, designed population to be served and projected water demands are realistic and adequate up to the end of the design period.
- To ensure that projects are sustainable and financially viable according to established criteria and that adequate funds will be available for O&M.
- To ensure proper financial planning for the capital and initial O&M budgets.
- To ensure that the projects are economically viable.
- To ensure that the projects are environmentally acceptable and sufficient mitigation measures on environmental and social aspects are taken.
- To ensure optimize execution and efficient operation thorough work programming manpower scheduling and technology application.
- To ensure the project will produce potable water throughout the life of a quality acceptable to the relevant standards.

It is important that this procedure be adopted for all projects undertaken by NWSDB, regardless of:

- The promoting /requesting agency
- The type of project
- The size and cost of the project
- The source of funding (GOSL, NWSDB or Donor Funding)
- The construction/procurement method.

These guidelines describe the project identification and selection procedures and give detailed guidance for carrying out prefeasibility and feasibility studies and preparation of the respective reports.

Master Plans, Regional Plans and Sector Plans are not covered by this P1 Manual. Master Plans and Sector Plans are assumed to be completed prior to preparation of the reports indicated in this Manual.

SECTION 2

PROJECT FORMULATION AND APPROVALS

2. PROJECT FORMULATION AND APPROVALS

This chapter aims to provide a direction to those, in different sections of the NWSDB, who are involved in planning and designing of projects. The Guidelines generally address all types of projects implemented with local and foreign funding. This chapter covers both projects which are originated at the RSCs and projects which are handled by the P&D Division of HO. The Guidelines cover the roles played by different divisions and sections *(*RSC, P&D, P&P, etc.*)* at different stages of the project planning and formulation process for drinking water supply and as well as waste water projects.

Refer **Section-2-Annex-1 and Section-2-Annex-2** for flow chart/s of the project planning and formulation process for prefeasibility and feasibility studies, respectively.

STAGE - I - Prefeasibility Study
The need of the Project shall be identified, justified and initiated by the planning staff of the RSC or the P&D division of HO depending on the type and scale of the project.

Role of RSC
All projects except, inter RSC and inter provincial projects are to be carried out by the RSC planning staff. From the commencement of prefeasibility studies, the RSC will keep the P&D Section, HO apprised and share data and information as required.

Role of P&D division, HO
All inter provincial and inter RSC projects are to be carried out by P&D section, HO. However, the respective RSC- P&C/Sector Planning / Development/P&D sections should collaborate during the study. As and when requested the P&D section HO will provide direction and guidance to the RSCC.

The projects within a province shall be prioritized by the RSC using the approved prioritization criteria. Overall project prioritization among the provinces will be done by the P&P division.

The RSC or the P&D section HO shall prepare the design concepts for projects within the province and for inter provincial projects respectively. The P&D section of HO shall provide as necessary, assistance to the RSCs in interpretation of standards, design norms and use and application of design manuals.

The rates shall be based on the most recent NWSDB rate book. If rates are not available in the NWSDB rate book, market rates or rates based on recent procurements of NWSDB can be used.

The RSC or the P&D section HO shall forward the prefeasibility report to the PAC to obtain clearance to proceed to the feasibility stage. The RSC shall obtain concurrence of P&D section HO for the prefeasibility report, before forwarding to the PAC. RSC shall also conduct a Project Appraisal Visit (PAV) with the participation of all relevant sections of the RSC, before sending the report to P&D division HO for concurrence.

If the P&D section HO is preparing the prefeasibility report, a Project Appraisal Visit (PAV) shall be arranged in consultation with all involved RSCs. Guideline for the PAV including the

suggested participants is given in **Section-2-Annex-3**. The prefeasibility report shall be prepared in accordance with this Planning Manual (P1).

The PAC shall qualify a project as a "Major Project" in consideration of its magnitude, complexity, and the social / political sensitivity, at the time of assessing the prefeasibility report.

The PAC will review/evaluate the prefeasibility report on technical, financial and socio-economic considerations in compliance with the P1 Manual.

The PAC will assess the priority and grant approval to the RSC or P&D division of HO to proceed to the feasibility stage and authorize allocation of funds to commence the feasibility study. If the approval is not granted, further proceedings will be done as directed by the PAC. **PAC approval will not be required for Capital Works not exceeding 50 Million Rupees in value carried out by RSCC.**

Funds for feasibility studies of new projects have been allocated under capital Budget; Investigation, survey and feasibility studies. The P&D section HO will apportion the allocation for each year among P&D HO and RSCC depending on the needs and priorities. Alternatively, agreed funding sources could also be used. A Project Review Committee (PRC) will be appointed by the GM with the representations of all related divisions at the commencement of the feasibility study to handle all matters pertaining to major projects, inter RSC and inter provincial projects. The PRC shall continue to function from the feasibility, procurement, up to the implementation stage. The PRC concurrence shall be obtained for each stage.

STAGE - II - Feasibility Study

A comprehensive feasibility study shall be carried out based on the scope and concepts of the prefeasibility report.

The feasibility study shall be prepared strictly in accordance with the Planning Manual (P1). The RSC or the P&D division HO will carry out the conceptual designs including water source/intake assessment, treatment concepts including process designs and need for pilot plant studies, transmission and distribution layouts and initial network modelling.

The TCE shall be prepared based on the most recent NWSDB rate book. If rates are not available in the NWSDB rate book, market rates or rates based on recent procurements of NWSDB can be used.

TCE shall be prepared by the planning staff of the RSC for all projects except inter RSC, inter provincial and major projects. The RSCC shall coordinate and obtain necessary guidance and direction from the P&D section, HO as and when necessary.

TCE shall be prepared by the P&D section of HO for all inter RSC, inter provincial and major projects. The P&D HO shall coordinate and work together with the RSC- P&C / Sector Planning / Development/P&D sections during the study period.

The PRC shall be apprised at regular intervals when preparing the feasibility report.

Note:

The P&D section will provide specialist assistance on mechanical, electrical and electronic (including automation), structural, water treatment process, and waste treatment process to

the RSCS. Depending on the need, the services of outside Experts may be obtained. AGM (Sociology) will provide sociological inputs as required. Financial data shall be provided by Finance Section of HO. Regarding any water quality issues relevant technical inputs shall be obtained from AGM (Laboratory Services).

STAGE - III - PAC Approval

The RSC or the P&D section of HO shall forward the feasibility report along with the TCE and the PRC recommendation for the PAC approval. The concurrence of P&D section, HO shall be obtained for the feasibility report before forwarding to the PAC.

If the substance and the scope of the feasibility report is different to that of the prefeasibility study, a Project Appraisal Visit (PAV) shall be arranged by the PRC in consultation with all involved RSCs and the updated feasibility report shall be submitted to the PAC.

Prior to seeking the PAC approval for the project proposal, the consent / clearance shall be obtained from the respective Divisional Level Co-ordination Committee (DLCC) and District Co-ordination Committee (DCC) by the Provincial DGM or DGM (P&D). The consent / clearance shall be mainly for the raw water source, extraction quantity and the coverage area of the project. The relevant agreements/approvals with the Department of Irrigation/Mahaweli Authority and Farmer Organizations shall be forwarded with the request for clearance/consent. RSC/P&D shall ensure that the project is presented to the respective DLCC and DCC and a clearance letter shall be obtained from divisional secretary and district secretary respectively or relevant meeting minutes shall be attached.

The PAC approval shall be obtained for;

- The scope of the project.
- The Total Cost Estimate.
- The effect of the project on the cash flow of NWSDB shall be verified using available financial and tariff model (Finance section in consultation with P&P section)
- Implementation mechanism of the proposed project.
- Approval of TCE – TCE shall be approved according to the relevant Procurement Guideline by the designated approving authority; based on the value of TEC.

STAGE - IV - Board Approval

The RSC / P&D HO will submit the draft Board Paper based on the PAC approval, to P&P section in order to obtain approval of the board of directors for the project.

The Board approval shall be obtained for;

- The Feasibility Report.
- The Total Cost Estimate.

The P&P section shall follow up on the board decision and keep the P&D/RSC informed of the decision.

STAGE - V - NPD Clearance

Upon the approval of board of directors and DDC/DLCC approval, the NPD concept paper shall be prepared by DGM (P&D) or respective DGM (RSCC) / Addl. GM (Operation), whoever is responsible for preparing the project proposal. The concept paper and the feasibility report shall be sent to DG (NPD) with a covering letter seeking NPD clearance through the Secretary of the line ministry in charge of water supply under the GM's signature.

A copy of the letter shall be sent to P&P section to enable them to follow up the NPD clearance.

Clarifications (if any) sought by the NPD with regard to the project shall be answered by the P&P section in consultation with the P&D HO/RSC. The P&P section shall be responsible to secure NPD approval.

The NPD may concur the project and forward their recommendations to the ERD with a copy to the line Ministry and the NWSDB when foreign funding is envisaged. The P&P section shall ensure that the proposal is received to ERD.

If foreign funding is not envisaged, the NPD may forward the request to National Budget Department (NBD) to allocate local funds. This allocation shall be included and be reflected in the Annual Capital Budget prepared by the Corporate Planning Division.

STAGE - VI - Cabinet Approval

Upon the receipt of the NPD clearance; either local funds or foreign funds; the ministry shall forward the cabinet paper to obtain approval of the Cabinet of Ministers;

- For the Implementation of the project
- For the Total Cost Estimate

For such projects a draft cabinet memorandum (both a soft copy and a hard copy) should be prepared by the respective DGM (RSCS)/Addl. GM (Operation) or DGM (P&D) and should be sent to the P&P section. The P&P section will forward the same after incorporating their comments to the Secretary of the line ministry in charge of water supply under Chairman's signature to obtain the approval of Cabinet of Ministers.

STAGE - VII - Securing Funds-For Projects

After NPD clearance the proposal shall be submitted to ERD to seek foreign funds for the same. P&P section will follow up this activity.

The ERD may seek foreign funds for the implementation of the project from donors acceptable to the ERD/Ministry of Finance. The NWSDB P&P section through the line ministry shall provide all necessary assistance to the ERD and the donors by providing the necessary information and data.

The budget division of the ministry of finance shall allocate funds for locally funded projects.

SECTION 3

PRE-FEASIBILITY STUDIES

3. PRE-FEASIBILITY STUDIES

3.1 Objectives and Scope

Once a potential project or a number of potential projects (or sub projects where applicable) have been identified, it is necessary to carry out preliminary studies to evaluate the priority and need for the project or sub-projects, in view of overall national plans and limited financial resources. It is also necessary to establish whether or not the project(s) will be technically feasible and appropriate, socially and environmentally acceptable and financially and economically viable. Such studies are termed prefeasibility studies.

If the prefeasibility studies show that the potential project(s) is not technically feasible, then no further work is warranted and the report may be shelved until conditions change.

However, the prefeasibility studies show that the project meets (or some of the sub-projects meet) the selection criteria, then the planning process for each approved project should commence and shall be followed by detailed feasibility studies.

The prefeasibility studies shall be carried out with sufficient field work, to produce required report/s and they shall be brief and concise. It should present the findings of preliminary studies.

The scope shall include,

- Determination of service area
- Assessment of existing water supply situation
- Socio-economic study
- Water resources assessment
- Water quality assessment
- Water demand assessment
- Preliminary designs
- Environmental assessment
- Assessment of health and sanitation aspects
- Cost estimates for capital works
- O&M cost
- Projected revenue
- Financial and economic analysis

Alternative options to meet the project objectives should be considered.

Final recommendation for carrying out a feasibility study should be made demonstrating the project's viability, sustainability and how the project fits into any national plan. The need for more data collection and detailed investigations should be ascertained. Social aspects such as community interest and possible participation should also be considered.

The follow up activities such as investigations, surveys, water quantity and quality measurements, land acquisition requirements etc. should be identified and stated.

3.2 Study Approach and Methodology

The study should be carried out by a team under the coordination of the P&C / Sector Planning / Development / P&D sections of RSC and will comprise of Engineers (Civil, Mechanical, Electrical, Electronics and Process), Sociologists, Chemists, Geologists and Accountants. It is the responsibility of the Planning and Design / Planning and Coordination Engineer to enlist support from the other sections and professionals as required.

Assistance/Guidance from the Planning and Design section in HO may be obtained as necessary.

Prefeasibility study implementation shall be carried out following the steps discussed below.

Desk study
Prior to a site visit, it would be appropriate to carry out a preliminary desk study.

The following data and information should be collected.

- Any previous reports or estimates
- Drawings and design details, O&M manuals of the existing works
- Available maps (1:50,000 / 1:10,000, etc.), including GIS maps or recent Satellite images of the concerned area and water sources
- Land use planning maps from LUPPD District/Divisional offices
- Population data
- Population density maps
- Hydrological maps and geological maps
- Socio-economic data
- Water quantity and quality data
- Data on existing wells, and other water sources
- Data on boreholes constructed by NWSDB and Water Resources Board

Data could be obtained from;

- DS office – Resource Profile
- The main and RSC libraries and record rooms of NWSDB for files and previous reports
- Library for population data and reports
- Raw water quality data from the NWSDB data base (from development section) or from O&M of the selected source is already used by existing WSS
- Bacteriological / Chemical test data from central laboratory, relevant RSC or regional office.
- In case of augmentation/rehabilitation of an existing system or if the proposed water source is presently used by a NWSDB scheme; the large database of chemical and Bacteriological test results of relevant Region, RSC and Central Laboratory.
- The Investigation section and the Groundwater section data bank.
- The web site of Census and Statistics Department for population details, growth rate, potable water usage by the community, sanitation details etc.
- The climatic data and pan evaporation data from the Department of Meteorological and the Department of Irrigation.
- Water resource study reports (Department of Irrigation, Mahaweli Authority of Sri Lanka etc.)
- Data of existing RWS systems from RWS section HO/district RWS Units and DNCWS databases.

Design Horizon
Generally the design period shall be 30 years after commencement. Certain components however may have varied design periods. Operation period (for financial and economic analysis) shall be 40 years after commencement of the operation.

Identification of the project service area and service population:
Due consideration shall be given to the demographic, land use pattern, socio-economic, water resources, environmental aspects and development trends in the area. The development data regarding industrial, commercial and tourism sectors shall be obtained from relevant authorities.

Water Resources
An assessment of the groundwater and surface water resources of the area should be made. Groundwater data could be obtained from NWSDB's Groundwater section and from Water Resources Board through GW section. For small systems, groundwater may be the preferred source.

Larger water supplies would generally utilise surface water resources. However, groundwater potential should be verified. Data on surface water sources could be obtained from the Department of Irrigation and the Mahaweli Authority of Sri Lanka as applicable. Implications of water sharing also should be taken into account and agreement for abstraction reached. MOUs or agreements should be signed for where necessary.

Service area/Area maps
Based on the population, population densities, development trends, land use planning maps etc., the approximate service area should be determined. GIS area maps of suitable scale indicating the latest road network, land use plan and data on existing water supplies (if applicable) should be prepared.

Site survey
Once the preliminary desk study is completed, a site survey/s shall be undertaken by the team members and it is important that this should be coordinated through the AGM (RSC) and the Chief Engineer (RSC-P&C/ Sector Planning/ Development).

The survey should include:

- Interviews with the Local Officials and NWSDB personnel.
- Inspections of existing and potential water sources and probable intake sites.
- Inspection of existing water supply systems components/units.
- Brief surveys to cover the areas on economic, social, environmental and sanitation.
- Visit and survey to probable headworks and storage sites.
- Visit along the probably raw water, treated water and main distribution line routes.
- Identification of development trends and data verification.
- Water borne diseases and CKDu data (where relevant) from DDHS/ PHI.

Data from DS/GND offices and from other sources shall be collected. If the data is not available in these offices, primary data shall be collected by means of field surveys and questionnaires.

Project planning
On completion of the site survey, project planning work and preliminary designs should be undertaken.

Planning criteria as detailed in **Section 4 (page – 13)** shall be used.
Project planning should cover,

- Determination of service area
- Demographic and socio-economic studies
- Service population
- Water demand
- Review of existing water supplies
- Water source assessment/selection

Preliminary designs should cover,

- Study of alternative options
- Project concept including location of water intake, treatment, storage and distribution arrangement.
- Water quality analysis/water treatment concept
- Preliminary hydraulic analysis and pipe sizing
- Ancillary buildings
- Operational vehicles and equipment
- Water source conservation requirements
- Social safeguards (preliminary)
- Environmental safeguards (preliminary)
- Rural water supply needs
- Capital cost estimates
- Operational cost estimates
- Implementation schedule

On completion of the preliminary designs, preliminary financial and economic analysis should be undertaken based on the guidelines given in **Chapter 9A and 9B in Section 5.**

After completion of the above, the following activities should be carried out;

- Writing of the prefeasibility report
- Holding a PAV at RSC level – Comprising CE (P & D)/ O & M Manager/ DE/ Regional Chemist/ OIC/ Sociologist/ AGM (RSC)/ Chaired by DGM (RSC) or AGM (RSC)
- Preparation of project summary sheet
- Preparation of project summary report if applicable
- Compliance with the Checklist/s
- Preparation of letter of transmittal by P&D HO/RSC to Addl. GM (P&P) for sending the report to PAC.
- Preparation of letter to Addl. GM (F) by Addl. GM (P&P) for his comments prior to PAC meeting.

3.3 Contents and Report Organisation

Annex (i) shows a typical title page and table of contents for a prefeasibility report.
The following notes briefly describe the contents of each section of the report.
The cover of the report as well as its title page that follows, should clearly indicate;

- The name of line ministry and authority to whom the report is prepared (NWSDB)
- The title of prefeasibility report
- The name of project
- The name of the section who prepared the report
- The date of completion of the report

The table of contents shall be set out to give the reader a good understanding of the report material and report organisation.

It should comprise of,

- The chapter headings
- The section headings, and sub-headings, if any
- Separate lists of tables and figures
- A list of appendices
- A list of abbreviations, organisations and acronyms

Project summary sheet shall be essentially included in the prefeasibility/feasibility report. The format of the project summary sheet is given in **Annex -iii.**

The main body of the prefeasibility report shall comprise of the following chapters.

Chapter 1	-	Introduction
Chapter 2	-	Existing Water Supply Facilities
Chapter 3	-	Health and Sanitation Aspects
Chapter 4	-	Social Aspects
Chapter 5	-	Environmental Aspects
Chapter 6	-	Water Resources
Chapter 7	-	Planning Criteria
Chapter 8	-	Proposed Project
Chapter 9A	-	Financial Analysis
Chapter 9B	-	Economic Analysis
Chapter 10	-	Conclusions and Recommendations

The contents of the above are discussed in detail in **Section – 5 (page – 19)** of this manual.

3.4 Check List and Letter of Transmittal

After preparing the prefeasibility report, the responsible Chief Engineer/Engineer shall check the report against the checklist for prefeasibility reports-for Chief Engineer/Engineer given in **Annex-(v).**

The AGM who certifies the prefeasibility report shall check the report against the certification of prefeasibilty studies by AGM in **Annex-(vii)** and it shall be included in the report.

The prefeasibility report shall be submitted with a formal letter of transmittal prepared by the officer / agency responsible for its preparation, to the authority which is responsible for authorising the study (NWSDB). For reports prepared by the RSCs or the P&D Section at Head office, this could be in the form of an internal memo. The format of the letter of transmittal is in **Annex-(ix).**

3.5 Letter To Addl. GM (F)

The P&P section shall forward the prefeasibility study report to Addl. GM (F) by letter two weeks before the PAC meeting. Addl.GM (F) will be required to comment on the effect of the project on the cash flow of NWSDB at the PAC meeting. The format of the letter to Addl. GM (F) is in **Annex-(xi).**

SECTION 4
PLANNING CRITERIA

4 PLANNING CRITERIA

4.1 Design Horizon

Design period shall be 30 years after commissioning. Operation period (for financial and economic analysis) shall be 40 years after commencement of the operation.

4.2 Service Area and Service Population

Assessment of service area and population where by the scale of the project is determined is a decisive step in water supply planning and all related social, economic and environmental factors will have to be considered. Hence collecting accurate details on status of the existing water supplies (if any) reasonable assumptions on land development patterns and trends, expected population migration scenarios, seasonal migration, development programmes in the area and other infrastructure in the vicinity, educational, housing, commercial, social and cultural aspects shall be made during planning stage. Site visits shall be done for verification of data.

Due consideration shall be given to the following factors in selection of the project area.

- Demography and GND administrative boundaries of the area
- Population density of area
- Capacity of source(s)
- Development trends in the area
- Percentage of Samurdhi beneficiaries and percentage of poor people within the area (Source:http://www.statistics.gov.lk/poverty/SpatialDistributionofPoverty2012 13.pdf)
- Existing safe water coverage in the area by water sources based on data from NWSDB/DSD (Resource Profile)/Census on Population and Housing – 2012.
- Quality and quantity of water in the above water sources during dry/ wet spells
- Percentage of population having electricity
- Affordability
- Political priorities
- Social needs
- Environmental aspects
- Areas with high incidence and prevalence to chronic diseases (E.g. : CKDu)
- Areas of high water borne diseases prevalence
- Road development trends.
- Trends of in migration and high-rise condominiums

Note: *Care should be taken to ensure people living close to selected source(s) and along the route of water conveyance are considered and that the marginalised groups are not left out. When it is not possible or viable to provide water from the proposed system to these communities, alternative options shall be considered.*

Data sources for maps

- Base maps from mapping section of NWSDB (**Refer Section-4-Chapter-4-Annex-1**)
- Department of Survey
- UDA – Planning and GIS divisions
- Google maps
- LUPPD for land use maps
- UDA approved development plans

A GIS based map of suitable scale indicating the GND boundaries of the project area, population density, the land use plan map, water bodies, the road network, the key buildings etc. shall be prepared and this should be the base for the prefeasibility.

For sustainability of the project, determination of service area and population coverage of the project shall be done conscientiously. For example, a GND with a population density less than 300 persons/km^2 will not be feasible for pipe borne water supply since it affects the viability of the overall project. Areas with lower population densities should be supplied using rural water supply principles. However in a particular selected area there could be isolated GND's with population densities less than 300 persons/Km^2. In such situations those isolated GNDs shall be considered as appropriate for the main water supply. The population densities could be computed using data from department Census and Statistics. In inhabitable areas, especially where there are mountains, marshes, wetlands, and forest and wildlife reservations; a factor may be used to adjust the population densities.
A sample GIS map for project prioritisation is in **Section-4-Chapter-4-Annex-2.**

Required data for the GIS map

- Population data
- Land use data
- 1:10,000 Topographical maps
- Existing water supply coverage maps; NWSDB and CBO managed RWS schemes
- Water sources
- Areas of high water borne diseases prevalence
- Road network
- Ground water point sources (wells) location maps
- Existing industries, commercial buildings etc.

Details of existing CBO managed schemes situated within the service area should be collected, analysed and a decision should be taken in accordance with the guidelines numbers 1, 2 and 3 issued by the Secretary of the Ministry of City Planning and Water Supply on his letters No 3/5/7 dated 26th October 2018 or any subsequent guideline.

Further if there are serious issues with ground water quality which has adverse health impacts, such GNDs will have to be considered for pipe borne water supply disregarding population densities.

The percentage of population considered will also be related to the population density of the particular area. As a general guideline, following coverage percentages against the population density bands are suggested.

Section -04- Table 01: **Population and recommended coverage**

Population Density (Population/Km^2)	Recommended Coverage (%)
<300	30
300-500	40
501-750	50
751-1000	60
1001-1250	70
1251-1500	80
1501-2000	90
>2000	100

Note: *The respective coverage percentages could be reviewed based on research carried out in existing service areas for both drinking water supply and waste water management projects.*

It is recommended not to implement an urban water supply project, if the population density in less than 300 per Km^2; unless there are valid reasons to justify it.

Affordability or willingness to pay is also generally considered. However, in view of the unreliability of the data, and the need to achieve the targets set by SDGs, these criteria will not be seriously considered. However, it is necessary to identify the percentage of Samurdhi beneficiaries and percentage of poor people within the area in order to provide them assistance to obtain the initial service connection at an affordable cost or in instalments.

Population due to seasonal migration should be assessed using a reasonable value (<20 lpcd) considering the migrating population due to cultural /seasonal events.

For detailed calculation of population forecast refer **Section-4-Chapter-4-Annex-3** and **Section-4-Chapter-4-Annex-4** for the sample calculation. For this calculation composite growth rate considering all the factors contributing to population increase shall be prepared with suitable assumptions.

Data sources

- GND wise population data from Department of Census and Statistics (Web site www.statistics gov.lk) and DS Planning Officer, Grama Niladhari
- National Physical Planning Department for Sacred Areas and Regional Plans for certain areas (Web site www.nppd.gov.lk)
- Urban Development Authority for UDA declared areas; UDA Planning Section (Web site www.uda.lk)
- Google maps
- Resource profile of DS
- LUPPD maps

Population growth rate depends on several factors, namely,

- Population growth due to people living in the area. Use DSD growth rates
- Migration due to improved facilities, land availability and land use patterns
- Future developments such as industries, commercial activities, housing projects, etc.

The existing and expected population densities in GNDs at the design horizon shall be marked on maps or tabulated according to the defined density bands. The percentage of water supply coverage in the respective GNDs should be assessed based on the specified criteria. Final forecasted population density within the identified area shall be verified with land available in the DSDs, using the GIS maps.

4.3 Water Demand Assessment

a. Domestic Water Demand

Domestic water demand is assessed based on the projected population from households, per capita demand (LPCD) and the percentage of population that could be covered during the design period.

Assessment of domestic population shall be based on following;

i. Population served by the existing schemes.

From the number of served connections and using household size obtained from DSD /Social data, served population can be assessed.

Data sources

- RSCS/Manager/OIC
- NWSDB Commercial data base (scheme level, OIC level, meter reader packs; trends etc.)
- CBO

ii. Present un-served population in the proposed area

Following data sources shall be used for estimating present un-served population in the project area.

Data sources

- LUPPD Officer (Land Use Planning Policy Department)
- Local Authorities
- UDA (Web site www.uda.lk)
- DS Divisions

iii. Population Forecast depending on availability of bare lands.

Initial assessment to be obtained from the LUPPD Officer.

- From available maps and information from the Local Authorities, the bare lands available for residential purposes to be identified. Assessment to be based on area specific plot sizes for households. Refer **Section-4-Chapter-4-Annex-5** for regulations on land sub division and amalgamation.

Future population due to bare land usage shall be forecast by assuming a fairly accurate value initially and it may vary to 100% gradually by considering the potential migrants when water supply is provided.

Due to the limitation of lands in urban areas and surroundings, the present trend is for vertical development; specially housing units and condominiums. Allowances should be made for such developments in consultation with UDA, Local Authorities, relevant Ministries etc.

iv. Population due to seasonal migration.

Use a reasonable value or a percentage considering the migrating population due to cultural /seasonal events. Seasonal migrating population can be obtained from District and Divisional Secretary Offices.

The **per capita demand** will be influenced by,

- The level of affluence of the community
- Availability of alternative sources such as wells, rainwater
- Level of water tariff and affordability
- Awareness of water conservation

The commercial database of NWSDB provides water usage data for existing water supply schemes in different geological areas and for different customer categories. These data can be obtained to meet your needs from the commercial database, even up to road level. These data can be directly used when considering augmentation or improvements to existing schemes. However, the data shall be adjusted to the existing scheme's limitations in supply hours, pressure and quality of water.

Based on details collected from the existing water supply schemes on the consumption of water, following values are suggested for per capita consumption. Different values may be used based on specific consumption information from the areas concerned.

Section -04- Table 02: Per capita demand according to the population density

Projected Population Density (Persons/ hectare)	Category	Per Capita Consumption (litre per capita per day)	Percentage to the waste water planning
	High Developed Area	180 - 200	80%
> 100	Urban	140 - 160	80%
20 to 100	Semi-urban	120 - 140	80%
0 to < 20	Rural	100 - 120	80%
	Water scarce areas	60	80%

Note: *The respective per capita consumptions could be reviewed based on research carried out in existing service areas.*

Evaluate different scenarios based on different levels of per capita consumption.

b. Non-Domestic Water Demand

Non-domestic water demand is assessed based on the commercial, institutional and industrial establishments in the area.

Future developments in these sectors will enhance the non-domestic demands.

Data sources

- If the proposed area is an urban area declared by UDA, development plans are available with the UDA. Annex-UDA website provides a list of towns with development plan and there relevant details.
- (See:http://www.uda.gov.lk/attachments/regulations/gazetted_dp_declared_urban_areas.pdf)
- For other areas including plans of sacred areas are available in the Department of National Physical Planning.
- Development plans available with Divisional Secretaries, BOI etc.
- Ministry of Industries, Regional Director (Regional Industrial Centre)
- Ministry of Mega Polis and Western Development LUPPD Land Use Maps

Non-domestic water demand should be computed as follows:

- In existing service areas, use actual consumption data.
- Data from similar neighboring areas may be used.
- For new/extended areas, if details of the establishments are available, the consumption norms given in D2 Manual – Urban Water Supply and Sanitation could be used.
- Special demands for establishments such as hospitals, schools, government & commercial Institutes, large industries etc. should be considered separately.
- Alternatively, for new/extended areas, a percentage of the domestic demand, 10-12% for rural and semi-urban areas and 15% for urban areas could be used. If the non-domestic demand is calculated with the assumptions, the calculation is done by equalizing the domestic demand to 85% of the total demand.

c. Non-Revenue water (NRW)

Non-Revenue Water (NRW) considered for water demand computations are the physical losses in transmission, storage and distribution systems. If actual NRW percentage is high in an existing system, an improvement plan shall be provided in the report.

NRW could be estimated on the following basis.

- For existing service areas, the current level of NRW should be used. If there are identified special programs to reduce NRW, such information should be taken into account. If the NRW level in the existing system is high, appropriate proposals should be included in the proposed project to reduce same to an acceptable limit.
- For new/extended areas a NRW ratio of 15% is recommended.

d. District Metering Area (DMA) Concept

Refer P11- NRW Leak Detection Manual for details of DMAs and incorporate the DMA concept into the project distribution system.

e. Fire Demand

Fire demand will have to be provided for in urban water supplies in industrial and commercial areas. The requirements will have to be determined in consultation with the Fire Brigade of the Municipality / Local Authority.

f. Existing CBO managed schemes

Consider inclusion/exclusion of CBO managed schemes for the present project. When existing CBO managed schemes are situated within the identified water served area a decision should be taken as outlined in the Guideline issued by the Secretary to the Ministry on 26th October 2018 or subsequent guidelines.

Water demand scenarios based on varied service coverage percentage (%) and per capita consumptions may be evaluated especially for large water supply projects.

The projected average day water demands from present up to design year, generally for 30 years should be summarised in tabular and graphical format in a clear manner, stating all assumptions. Where alternatives for service areas with different source options are considered, projections should be made for each alternative. The formats shown in **Section-4-Chapter-4-Annex-6** may be used for demand calculation and **Section-4-Chapter-4-Annex-7** gives a sample calculation for a demand forecast.

g. Water System Planning (WSP) Concept

Refer relevant WSP guidelines/ manuals and perform the risk assessment including hazard identification and initial risk assessment.

SECTION 5

PRE-FEASIBILITY MAIN REPORT

5. PREFEASIBILITY STUDY MAIN REPORT

CHAPTER 1 – INTRODUCTION

This chapter shall discuss the need for the study, its background, objectives and the methodology adopted.

1.1. Authorization

Include how, why and with whom request the study was initiated.

1.2. Objectives and scope

Discuss the need for the project and study objectives in the context of national or local plans if any. Any terms of reference or letters of instruction defining the scope of work should be included or alternatively, a statement describing the scope of the study.

1.3. General description of project area

This should include the physical and cultural setting of the project and the future beneficiaries. Include brief outlines of geography and project location, population, and social, economic and environmental aspects.

Include, with complete source references, reviews of any previous reports, investigations or estimates which are relevant to the present study. Avoid irrelevant information.

1.4. Implementation of the prefeasibility study

How, when and with whom request the study was carried out, shall be included. Briefly describe the extent of office, field and laboratory studies and identify the engineer responsible and the names of the study team.

1.5. Limitations of the prefeasibility study

Possible Limitations

- Missing social data for economic and other analysis, not collected through a survey
- Lack of data for water reliability
- Inadequate water quality data covering dry/wet cycles
- Lack of or gaps in health data
- No public/ community consultations

Briefly describe the assumptions made and applicable limitations when carrying out the prefeasibility study, e.g. when collecting existing data, in population forecasting, investigations etc.

CHAPTER 2 - EXISTING WATER SUPPLY FACILITIES

In this chapter all the existing facilities such as NWSDB existing schemes / LA / CBO and other systems shall be described with suitable plans and sketches showing locations and layout of facilities. Scheme details including capacities, water quality data, and water quality analyses may be presented in Appendices.

Details of other sources such dug wells, tube wells, streams, hand pumps, rain water systems, tanks, canals, etc. shall be also described.

2.1. NWSDB Water Supply Schemes

2.1.1. Facilities of Existing NWSDB Water Supply Schemes

If there is any NWSDB water supply scheme, describe the following, on the basis of inspections and interviews with the scheme OIC or relevant officers;

- **History of the scheme -** When was it built, by whom, original design population and production if known, and detail of subsequent additions/ extensions

- **Scheme details and conditions –** Number of connections, present demand pattern using billing data, coverage area (including map(s)), intake and unit processes for water treatment, treatment plant capacity and losses, pumps, chemical dosing equipment, chlorinators, power supply, transmission, storage and distribution, etc. Technical details of water treatment plants and pumping stations shall be recorded using the formats given in **Section-5-Chapter-2-Annex-1** and **Section-5-Chapter-2-Annex-2** respectively.

Data source
- OIC's records
- As built drawings
- O&M manuals

- Condition of the structures in the existing scheme.
- **Water production** – Design capacity of existing scheme and operating capacity, reasons if not operating at full capacity.
- **Discuss the categories of water use -** Indicate the availability of Rural Water Supply Schemes with bulk supply, water sharing by other stake holders, etc.
- Existing water source location, capacity, reliability, quality. Discuss possible sources of pollution, source constraints and possibility of abstracting more water – safe yield and quality records including Heavy Metals, Fluoride, Iron, Manganese, Algae, Salinity, Hardness and Pesticides. Salinity intrusion to be checked where relevant.
- If more water is to be abstracted, approval from the relevant authority should be obtained prior to finalisation of feasibility studies.
- Size and lengths of transmission/distribution mains
- Pipe line conditions- age, material, location and frequency of pipe bursts etc.
- Estimation of losses – NRW values, causes and number of leaks/pipe bursts/damages. Losses through illegal connections, metering errors etc.

Data source (Maps of coverage area)
- OIC, NWSDB
- District Engineer, NWSDB
- Manager (O&M), NWSDB
- Maps updated using GPS

- Supply hours during wet and dry seasons (See **Section-5-Chapter-2-Annex-3**).
- O&M staff – numbers and categories, whether there is a need for 24 hours shift duty and any other relevant details.
- Responsibilities of O&M for production and distribution, billing and collection, NRW reduction, preventive maintenance.
- O&M expenditure and revenue including corresponding amounts per cubic meter of water produced. This should also include the overhead component (in proportionate to cubic meter produced in the region).
- Details of operational performance.
- If the new connections are not provided, state the reasons for same. Also analyse the number of consumers in the waiting lists maintained by O&M.
- Water quality issues – water quality reports to be included (at least for one year). Indicate whether quality can be improved with simple or conventional treatment. Details of failed Physical, Chemical and Bacteriological reports should be presented in a table (See **Section-5-Chapter-2-Annex-4** and **Section-5-Chapter-2-Annex-5** for sample tables) based on the results obtained for the last 3 years.
- Public complaints on water quality (taste, odour and appearance) should be presented, if available.

2.1.2. Constraints in the existing NWSDB system

Describe the difficulties faced by the people in obtaining their daily water requirements and use of other means of water supply to supplement their requirements. Indicate whether the water supply is continues or otherwise. Describe the details of water supply duration per day in the format given in **Section-5-Chapter-2-Annex-3**.

Discuss the possibility of continuing with the present water source/s and their limitations.

2.1.3. Rehabilitation/Upgrading/Augmentation Needs of Existing NWSDB System

Discuss the need and possibilities of rehabilitation, upgrading or augmentation.
CBO managed RWS schemes and other piped water supply systems

2.2.1 Facilities of the Water Supply Schemes

If there are any other pipe borne water supply scheme, describe the following, on the basis of inspections and interviews with the relevant officers and stakeholders.

History of the scheme - When was it built, by whom, original design population and production if known, and subsequent additions/ extensions.

- **Scheme details and conditions –** Number of schemes in the area, population served by different means of water supply services, number of connections, present demand pattern using billing data, coverage area (including map/s), intake and unit processes for water treatment, treatment plant capacity and losses, pumps, chemical dosing equipment, chlorinators, power supply, transmission, storage and distribution, etc. Technical details of water treatment plants and pumping stations shall be recorded using the formats given in **Section-5-Chapter-2-Annex-1** and **Section-5-Chapter-2-Annex-2** respectively.

Data source
- Officer In Charge's records of relevant authority
- As built drawings
- O&M manuals
- The M&E/MIS System installed in the DNCWS and copied in NWSDB RSC HO.

- Condition of the structures in the existing scheme.
- **Water production –** Design capacity of existing scheme and operating capacity, reasons if not operating at full capacity.
- **Discuss the categories of water use -** Indicate the availability of Rural Water Supply.
- Schemes, water sharing by other stake holders, etc.
- Existing water source location, capacity, reliability, quality. Discuss possible sources of pollution, source constraints and possibility of abstracting more water – safe yield and quality records including heavy metals, fluoride, iron, manganese, algae, salinity,
- hardness and pesticides. Salinity intrusion to be checked where relevant.
- If more water is to be abstracted, approval from the relevant authority should be obtained prior to finalisation of feasibility studies.
- Size and lengths of transmission/distribution mains.
- Pipe line conditions- age, material, location and frequency of pipe bursts etc.
- Estimation of losses - causes and number of leaks/pipe bursts/damages. Losses through illegal connections, metering errors etc.

Data source (Maps of coverage area)

- Municipal Council
- Pradesiya Sabha
- Authorized Government / Private Sector
- DS office/NWSDB RWS Unit/DNCWS/CBO/Maps from an available source updated using GPS

- Supply hours.
- Details of operational performance.
- If the new connections are not provided state the reasons.
- Water quality issues – water quality reports to be included (at least for one year). Indicate whether quality can be improved with simple or conventional treatment.
- Public complaints on water quality (taste, odour and appearance).

2.2.2. Constraints in the existing system

Describe the difficulties faced by the people in obtaining their daily water requirements and use of other means of water supply to supplement their requirements. Indicate whether water supply is having 24 hours of the day.
Discuss the possibility of continuing with the present water source/s and their limitations and details on proposed expansion projects under relevant authority.
Discuss the different uses or water rights of the sources.

Describe the availability of water sources for other than drinking (washing, bathing, cleaning) and their reliability.

2.2.3. Rehabilitation/Upgrading/Augmentation Needs

Discuss the need and possibilities of rehabilitation, upgrading or augmentation.

2.3. Other Drinking Water Facilities

If there are drinking water sources within the selected water served area such as hand pumps tube wells, dug wells, springs, canals, streams, rainwater harvesting tanks etc., those details should be presented.

Details of existing water source locations, capacity, reliability, quality. Discuss possible sources of pollution, source constraints and possibility of abstracting water during both dry and wet seasons and quality records including Heavy Metals, Fluoride, Iron, Manganese, Algae, Salinity, Hardness and Pesticides. Salinity intrusion to be checked where relevant.

Public complaints on water quality (taste, odour and appearance)

2.4. Existing drinking water supply coverage within the proposed water served area

Based on the data obtained and the details presented in this section, it is now necessary to present the existing water supply coverage details within the area identified for the new project. These data should cover both the situation in the wet season as well as the dry season. The data should be presented based on the DSDs and the format given in **Section-5-Chapter-2-Annex-6** could be used for that purpose.

Data source

- NSWDB RSC Sector Planning section
- Resource Profile of DSD office
- NWSDB District RWS Unit/DNCWS District office
- Census of Population and Housing- 2012
  A10 : Households in occupid housing units in Districts and Divisional Secretary's Divisio ns by principal source of drinking water, 2012

CHAPTER 3 – HEALTH AND SANITATION

This chapter should provide a brief account of the health and sanitation aspects of the area. The required inputs should be provided by the technical and sociological staff.

3.1 Health and Hygiene Aspects

Describe briefly about:

- Local health services, their capability and priorities.

- The prevalence of water related and water borne diseases (Diarrhea/Dysentery/ Hepatitis A and Typhoid) for the last Five (05) years within the proposed water served area.
- Specific health issues related to NCDs/Chronic diseases such as CKDu, Fluorosis.
- Nitrate/Nitrite/Hardness issues.

Data related to prevalence of diseases (Rate per 100,000 population), any seasonal trends in diseases, can be obtained from the RDHS office/Regional Epidemiologist/DDHS/ PHI.
Note any local programmes to improve health condition of the area by GOSL and NGOs (E.g. Malaria, Filariasis, prevention / vaccination programmes). Also include any suggestions for health improvements to the community. Indicate any other health indicators related to the area.

3.1.1. Prevalence of diseases

Quantify all the health indicators such as water borne diseases, CKDu etc. on prevalence of 100,000 population. Any other diseases trends shall be quantified if it is required and data is available. In case of CKDu it is important to identify report of new cases for the last 3 year (incidents) for 100,000 population. The format is given in **Section-5-Chapter-3-Annex-1** should be used to present the data.

3.1.2. Costs for treatment to the diseases

It is also necessary to obtain details regarding the available relevant health institutions closest to the proposed project area and the distances travelled in order to calculate the time and travel cost required to obtain treatment for water borne diseases as well as CKDu etc. The cost of special treatments and medicine necessary for NCDs /chronic diseases such as CKDu should be also ascertained. These cost details are required for the calculation of Economic Benefits. The **Section-5-Chapter-3-Annex-2** should be used to provide these data.

The costs involved in treating CKDu patients are very high and includes transport by a vehicle to the Kidney Dialysis Units which are available only in a Base Hospital and the cost of staying for one to nights as well as very high costs for Drugs. These costs should be identified during the visits to site.

3.1.2. Costs for loss of income from sicknesses due to diseases

The population in the project area will lose productive days due to sickness from water related/water borne illnesses. The total number of days lost will provide the basis to calculate the loss of income from these sicknesses. The weightage average time spent for one visit to the closest health institution in **Section-5-Chapter-3-Annex-2** should be used to provide these data.

3.2 Sanitation Aspects

If there is a sanitation component in the project, the sanitation aspects should be addressed in more details, including an estimate of numbers, types and condition of latrines in use. Indicate any problems of surface drainage, pollution, solid waste disposals to the selected water source, high groundwater table, and flooding in the project area, swamps, etc.
Hygiene habits of the community including estate community and other vulnerable communities whether open defecation is practiced, should be indicated. Health related data shall be obtained from the Department of Health officially.

If there is no sanitation component, a brief description of the sanitation facilities in the community should be made. Highlight any potential problems such as pollution of water

sources, poor surface drainage which may occur or be aggravated by implementation of a water scheme without a corresponding improvement in sanitation.

- Percentage coverage of sanitation in the area shall be compared with the national average based on data from DDHS/PHI and DSD resource profile. If sanitation coverage is lagging far behind, a proposal for sanitation improvement should be included into the project.
- Requests and need of Septage treatment facilities shall be reported; specially if pollution of water sources by human excreta is an issue.

Also mention briefly about:

- Local customs and practices with respect to sanitation,
- Cultural or religious factors influencing choice of water source or excreta disposal system.

Baseline data on health and sanitation shall be included in social survey.

Data sources

- Regional Epidemiologist/ Regional Director of Health Service
- DDHS/PHI/MOH
- O&M Office of NWSDB
- Department of Census and Statistics (Web site: www.statistics.gov.lk)
- Resource Profile at DS (Sampath Pethikada)

CHAPTER 4 - SOCIAL ASPECTS

Social assessment is a process for taking account of the key relevant social issues through a participatory strategy, for involving a wide range of stakeholders, to ensure that development activities are responsive, affordable and sustainable. The sociologist attached to RSC/Region should take the lead role in data collection, field surveys, data analysis and reporting.

A guideline on social assessment to be used by sociologists in RSCC for planning of new water supply and sanitation projects and Socio-Economic survey is included in **Section-5-Chapter-4-Annex-1.**

However, there are several information sources such as resource profile (Sampath Pethikada) of DSS. These available information shall be obtained, analysed and data gaps identified, prior to planning field surveys in order to reduce duplication.

Sample questionnaire for social survey based on the above guideline is given in **Section-5-Chapter-4-Annex-2** in English, Sinhala and Tamil medium.
Following information shall be provided in the report. This should be based on secondary data as much as possible.

4.1. Information on the location of the project area

*Refer **Chapter 1**- Introduction*

4.2. Demography

*Refer **Chapter 8** – Proposed Project*

4.3. Socio- Economic Status

- Employment Patterns;
  (Data source: Resources profile in DS Office)
- Income distribution;
  (Data source: Resources profile in DS Office)
  Based on Samurdhi recipient percentage and percentage below poverty line (poverty head count). These data can be obtained from DSS and respective web sites. (Source: http://www.statistics.gov.lk/poverty/ SpatialDistributionOfPoverty2012_13.pdf)
- Availability of electricity may also be an indicator.
- In addition, focused interviews with village level officers, occupants and visual
- inspection of household appliances could be conducted.

4.4. Existing water-use practices and social issues

Potential water sources and conflicting issues with different agencies and affected communities in obtaining water resources shall be described. (E.g. land issues, water rights, sharing of water, issues during dry seasons, protecting catchments).

Describe how people use water for their daily requirements (there may be other means of water supply, even if there is an existing scheme available) in term of social behaviour. Format for the existing water usage during wet and dry spells is in **Section-5-Chapter-2-Annex-6.**

Describe the existing sources of water, their locations, the distance travelled by users to fetch water, yield and quality (provide analyses). Emphasis shall be for the different types of sources used, distance travelled and time taken for fetching water for difference purposes such

as drinking and cooking, washing and bathing, washing clothes, sanitary purposes etc. during dry and wet seasons. Note whether the sources (e.g. streams or shallow wells) are getting depleted during dry season and what alternative sources are used in such situations. The different water sources used for different purposes during dry and wet seasons shall be presented using the format given in **Section-5-Chapter-4-Annex-3.**

Time taken to fetch water specifically for drinking and cooking purposes is an important parameter to calculate the economic benefits from a potential water supply project. The format for submitting the data is given in **Section-5-Chapter-4-Annex-4.**

In addition, the format for presenting time taken to fetch water for washing and bathing, washing clothes, sanitary purposes etc. is given in **Section-5-Chapter-4-Annex-5.**

Similar data could be obtained for distance and time used to collect water or for washing and bathing purposes; during wet and dry seasons.

Discuss the different uses or water rights of the sources and alternative water sources.
Discuss the possibility of continuing with the present water sources and their limitations.

4.5. Public/Stakeholder Consultation

Discussions can be held to resolve difficult issues related to land and water rights of families and communities and agencies. Useful information on existing water and sanitation situation in the proposed area can be obtained at the same time.
Stakeholders and concerned officers, the residents, Grama Niladhari, DS, RDHS officers, PHI, Community leaders, officers of department of Agrarian development, officers of Department of Irrigation, Samurdhi Niladhari, Pradeshiya Sabha or UC/MC officials, leaders of Farm Organizations shall be consulted.

Data sources

- DS
- RDHS/DDHS/PHI
- Grama Niladari
- Discussion with occupants
- Local Authorities
- Samurdhi Niladaris
- Farmer Organizations
- Department of Irrigation
- Department of Agrarian Development
- Existing CBOs
- NWSDB RWS Units/DNCWS District Units

Refer **Section-5-Chapter-4-Annex-6** for "Public Consultation and Hearing Process in Water Supply Sector".

During the public consultation process available data from different sources shall be validated and data gaps shall be filled.

4.6. Baseline Data

Baseline data on public health aspects related to drinking water should be established based on the Socio Economic Survey / Questionnaire in **Section-5-Chapter-4-Annex-2** and the

report provided by the Sociologist. Baseline data shall be documented in order to facilitate post-project benefit monitoring.

Following baseline indicators shall be described in the report,

i. Prevalence of water borne diseases.
ii. Prevalence and Incidence of CKDu.
iii. Distance and time for fetching water during dry/wet seasons.
iv. Population served by different water sources (safe water coverage) during dry/wet seasons.
v. NRW percentage in case of existing scheme.
vi. Failure of number of physical, chemical and bacteriological samples in case of improvement of existing scheme.
vii. Hours of supply during dry/wet seasons in case of existing scheme.

4.7. Identification of lands and acquisition

When the lands are selected to the project, priority shall be given to the crown lands. Government or semi government lands can be leased. Alternatively, private lands can be acquired. The details of selected land shall be recorded in the format given in the **Section-5-Chapter-4-Annex-7.**

4.8. Resettlement

Resettlement plan, if applicable, shall be prepared and included into the report as shown in Table in **Section-5-Chapter-4-Annex-8.**

4.9. Social Safeguard Management Plan

In the Social Safeguard Management plan mitigation measures or management strategy shall be indicated for the social impacts which are identified through public consultation or any other information sources. Compliance monitoring shall be carried out during the construction or after completion.

Budget for the social safeguard management plan should be prepared and indicated in the cost estimate. Social safeguard screening format prepared according to the social safeguard management plan shall be included into the report.

Data sources

- PS
- DSD
- UDA
- CEA
- Survey Department
- NWSDB Library
- LUPPD District/ Divisional Officer
- Atlas
- Preview previous study reports available in the Ministry of Irrigation and Water Management.
- National Physical Planning Department
- Department of Irrigation
- Provincial Irrigation
- Department of Agrarian Development
- IWMI Mahaweli
- Authority of Sri Lanka

The necessary format for Social and Environmental Screening Procedure format is given in **Section-5-Chapter-4-Annex-9.**

CHAPTER 5 - ENVIRONMENTAL ASPECTS

Following information shall be included in the prefeasibility study report. All aspects shall be covered in brief and detail studies may not be necessary at this stage.

Land use maps of the selected areas, could be used to collect relevant data and information at this stage. LUPPD has developed the land use maps and these digital maps can be obtained either from NWSDB Mapping section or from LUPPD officer of the District Secretariat.

5.1. Legal requirements for environmental impact assessment

If a SEA has been conducted by CEA the available data shall be extracted and included.
State whether an EIA/IEE is required to be carried out depending on sensitivity of the water sources selected.

Legal requirements for conducting Environmental Impact Assessment (EIA) are given in **Section-5-Chapter-5-Annex-1.** (For more details refer http://www.cea.lk/).

An EPL shall be essentially obtained and it is required for discharging treatment plant wastes. Details with respect to EPL is in **Section-5-Chapter-5-Annex-2.** (For more details refer http://www.cea.lk/).

5.2. Existing environmental situation of the project area

Write briefly about the Physical, Biological and Social Environment. This information can be extracted from the Environmental Atlas published by CEA.

A land use map of the catchment area and project area shall be presented.

Relevant shape files received from LUPPD are available in the Mapping Section. Refer **Section-5-Chapter-5-Annex-3** for a sample land use plan map.

5.3 Possible environmental impacts which could arise from proposed water supply project

Write briefly about the possible environmental impacts, which could occur during different phases of the project including operations. (E.g. need for enhanced drainage facilities, disturbances from night work, hazards from chlorine gas leakage, treatment plant effluent / sludge disposal, third party damages, effects of dewatering, excessive noise, damages to the property, deforestation and dust.)

Treatment plant waste shall be treated as per the EPL requirements of the receiving body before discharging them.

5.4. Possible environmental issues which could affect the success and sustainability of the proposed water supply project

Mention the possible environmental issues, which could affect the success and sustainability of the project;

- Within the catchment area
- Upstream of the water source (part of the upper catchment area)

- Siltation
- Flooding
- Salinity intrusion
- Water source pollution (EPLs issued for the upstream industries to be studied)
- Conflict between stakeholders

EPL issued for the upstream industries shall be studied in order to assess the pollution load and to decide the unit treatment process.

Environmental impacts and Environmental issues of the project identified in **Section 5.2** and **Section 5.3** shall be included in the scoping of EIA/IEE of the project.

5.5. Possible mitigation measures

Mention the proposed mitigation (Including catchment protection/reforestation, source protection, providing livelihood and resettlement) measures for the identified possible environmental impacts by using available data and based on local authority/CEA regulations. Water Safety Plan should be initiated to include the possible mitigation measures. This should cover both the impacts due to the project as well as impacts that affect the project.
Refer **Section-5-Chapter-5-Annex-4, Section-5-Chapter-5-Annex-5** for details.

5.6. Environmental management plan

Environmental management plan shall be prepared.

Environmental management plan shall be included in the Pre-feasibility / Feasibility report as an Annex

For details refer **Section-5-Chapter-5-Annex-6.**

5.7. Cost estimation for mitigation of environmental impacts

Cost estimation for the above mitigation measures including public awareness/resettlement programmes shall be prepared and included as an item in the TCE.

Refer **Section-5-Chapter-5-Annex-7** for details.

CHAPTER 6 - WATER RESOURCES

An assessment of the groundwater and surface water resources of the area should be made. Groundwater data could be obtained from NWSDB's Groundwater Section and from Water Resources Board. The RSC Geologist should be entrusted with the task of assessing the ground water potential and submitting the required details and data.

Larger water supplies would generally utilize surface water resources. Data on surface water sources could be obtained from the Department of Irrigation and Mahaweli Authority as applicable. Implications of water sharing also should be taken into account and agreement for abstraction should be reached.

A study should be carried out on the water source alternatives including the source that is currently used, if any, such as rivers, streams, lakes, tanks, irrigation canals, springs, deep and shallow groundwater and also nearby water schemes with excess capacity.

Surface Water Sources

Alternative water sources should be identified using the following:

- 1:50,000, 1:10,000 available maps ,digital data and GIS shape files(which indicates water sources);

Data sources

- NWSDB Mapping Section
- Survey Department
- UDA – GIS Section
- Department of Irrigation /Provincial Department of Irrigation / Department of Agrarian Development (DAD)/IWMI/ Mahaweli Authority

- Interviews with personnel from Water Resources Institutions, Local Leaders and
- Residents, Scheme OIC, Area Engineer/District Engineer/RWS Engineer, Manager(O&M).
- Field inspections with approximate gauging of water source if necessary. (Refer **D2 manual** for further details – RSC has the responsibility for Gauging)

For each alternative, assess:

- Adequacy of water source yield.
- Annual extraction for raw water shall be expressed as an average annual runoff of the relevant river basin/stream based on the closest gauging station.
- In case of reservoir or tank, this percentage shall be calculated based on the relevant river basin calculation and not on reservoir capacity.
- Average annual runoff shall be obtained from the closest gauging stating from the raw water extraction point (Refer **D-2 Manual** for details). Any trans-basin inflows and outflows should be considered.
- Water quality variations (provide analyses). Analysis should include pH, Colour, Turbidity, Heavy Metals, Fluoride, Iron, Manganese, Algae, Salinity, Hardness, Pesticides, etc. Special consideration shall be given for potential taste and odour issues. These measurements should cover at least one (01) year to include both wet and dry seasons. Refer **D3 Manual** for sampling requirements.
- Treatment process required; (Refer **Chapter 4 of D3 Manual**)
- Other users having water rights to source, if any, such as irrigation, mini-hydro or industrial users, both upstream and downstream.

- Water rights for extraction from the respective water sources shall be obtained; either through a valid document from the legally accepted custodian or through a MOU with existing water users.
- Any potential sources of upstream pollution; include a land use map of the water catchment.
- *E.g.: usage of agrochemicals / upstream erosion/ solid waste discharge/ discharge of industrial wastes/solid waste dumps/discharge of hospital waste, etc.*
- Community acceptability of source.
  (Discuss with village leaders, priests, Grama Niladhari, Samurdhi Niladhari, etc.)
- Elevation and location of source, distance to project area and whether pumping is required.
- Source protection measures including water safety plan, source improvement programs.
  (Refer and **Section-5-Chapter-5-Annex-4** of Environmental Chapter)
- Requirement of environmental flow should be considered.

Data sources

- Information from Environmental Officers in DS Offices.
- Grama Niladhari.
- Pradeshiya Sabha.
- Village Leaders.
- Residents.
- Department of Irrigation /Provincial Department of Irrigation / Department of Agrarian Development (DAD)/IWMI/ Mahaweli Authority
- LUPD Officer

6.2. Groundwater sources

The groundwater is a hidden and renewable resource which can be used with little or no treatment.

The groundwater potential of the area is governed by the hydro geological and structural geological conditions of the respective area. Therefore, a comprehensive hydro geological investigation is needed to understand the behaviour of groundwater system and its sustainability. Refer **Section-5-Chapter-6-Annex-1** for details of investigation methods, test drilling methods, yield testing etc.

The service of the RSC geologist should be obtained in this case.

Following are to be considered,

- Water quality of the groundwater source to be carefully scrutinized and likely treatment process should be determined.
- In areas where special health issues e.g. CKDu are prevalent, special systems may have to be considered.
- Desk study to delineate groundwater potential areas using existing data and maps (structural and geological) and remote sensing methods, when required.

Section -05- Table 01 : Data Source

Map	*Scale*	*Data source*
Topographic	*1:63,000* *1:50,000* *1:10,000*	*Survey Department*
Structural Geology	*1:50,000*	*Geological Survey and Mines Bureau*
Geology Map	*1:100,000*	*Geological Survey and Mines Bureau*
Existing Borehole data		*GWIS (Groundwater Information System) (NWSDB)/Water Resource Board.*
Areal Photos	*Different Scale*	*Survey Department*
Satellite Imagery	*Different Resolution*	
Hydro-Meteorological data		*Department of Meteorological*
Land Use	*1:50,000* *1:10,000*	*Urban Development Authority*

- Acquisition of subsurface characteristics using indirect methods. At least, two geophysical methods are necessary, e.g. resistivity (Wenner, Schlumberger, IP, SP), EM, VLF, TDEM etc.
- Estimate groundwater recharge by using available data.
- Pollution sources with respect to recharge area and risks to aquifer to be evaluated.

Each alternative source shall be evaluated based on the above and the best source shall be selected. In some cases, two or more potential alternative/supplementary sources may be considered for further evaluation.

Assessment of Ground Water is essential and test drilling shall be carried out, if decided as a potential source.

In addition, potential locations should be also identified for re-charge of ground water and the identified re-charge zones should be protected by including into the WSP.

If there is a potential to extract very deep ground water, further studies for investigation shall be initiated including test drilling. Measures should be included for ground water recharge and well head protection.

6.3. Sea / Brackish water source

If the other options are not feasible, seawater / brackish water shall be considered as an option. From D3 Manual sea water intake selection criteria shall be rephrased and included.

6.4.Consultations for Consent

Prior to finalization of the water source, public and stakeholder consultations shall be done to obtain the consent for the water source.

CHAPTER 7 - PLANNING CRITERIA

Guidelines for the 'Planning Criteria' to be used are given in **Section 4**.

In this chapter a summary of the planning criteria used in the study should be stated.

They should cover,

- Design Horizon
- Assessment of population growth rates
- Seasonal migration
- Assessment of future developments
- Per capita water demands
- Assumptions for non-domestic water demands
- Assumptions for NRW and details of proposed DMAs and numbers of connections in each DMAs.
- Basis for fire demand
- Position regarding CBO managed schemes

Assumptions for planning criteria based shall be provided.

CHAPTER 8 - PROPOSED PROJECT

The project proposal should establish the approximate served population and water demand, water sources available and how these may be developed, rehabilitation/ augmentation work required on the existing scheme if any, the scope of new works and the preliminary costs for constructing and operating the scheme. Detailed surveys, field investigations etc., are not necessary at this stage.

The proposal shall be based on the guidelines specified in **Section 4**: Planning Criteria.

8.1 Population and water demand

The following shall be included.

- A map(s) indicating the GND boundaries, population densities, existing and proposed service areas.
- Computational table for projected water demand. The assumptions should be clearly stated.
- Listing and the position regarding CBO managed rural water supply schemes.

Format and Basic sample calculation for population forecast are given in **Section-4-Chapter-4-Annex-3** and **Section-4-Chapter-4-Annex-4** respectively**.** A basic format and basic sample calculation for demand forecast calculation are **in Section-4-Chapter-4-Annex-6** and **Section-4-Chapter-4-Annex-7** respectively.

- Computational table for projected DS Division wise service population shall be given in a table format and it is in **Section-5-Chapter-8-Annex-1**.

8.2. Water source

Describe all water source alternatives including the source(s) that is currently used, if any, such as rivers, streams, lakes, tanks, irrigation canals, springs, deep and shallow groundwater, and nearby water schemes with excess capacity.

The alternative water sources should be evaluated based on the guidelines given in **Section 6**.

The availability of groundwater and its potential as a source should be reported. A comparison of the alternatives should be made and the basis for selection of the source(s) should be stated.

8.3. Comparison of alternative proposals

For comparison of alternative proposals, the alternatives on the following may be considered.

- Water sources
- Storage locations
- Transmission arrangements
- Distribution arrangements

As a first step the alternatives may be assessed based on their merits, demerits and preliminary costing based on conceptual designs. Environmental and social impacts should also be considered. Details of such assessments shall be presented in the report.

If it is not possible to select the best option at this stage, it may be necessary to proceed with the detailed evaluation after carrying out preliminary designs for the respective alternatives.

8.4. Preliminary Designs

Preliminary designs shall be carried out for the main components of the water supply scheme including,

- Location and conceptual design of Intake.
- Intake/pumping station capacities and configuration.
- Hydraulic designs and sizing of raw water transmission pipelines.
- Location and conceptual design of treatment facilities.
- Location and capacities of ground and elevated storage facilities.
- Hydraulic designs and sizing of treated water transmission pipelines.
- Preliminary hydraulic designs and pipe sizing of water distribution system.

A schematic diagram of the proposed water supply system shall be prepared.
Explanatory notes and tables may be included as necessary.

Ancillary items such as offices, staff quarters, vehicles, power supply arrangements, laboratory facilities, catchment protection, rural water supply and sanitation provision, training needs etc. shall be identified.

8.5. Sizing of the Components

- For determination of Treatment plant capacity, the total water requirement calculated above can be used as the base with relevant loss coefficients (generally 5% water losses are accounted in treatment plants. Special consideration shall be given for Membrane filtration systems)
- Clear water tank in the treatment plant shall be sized for minimum of 2 hours supply.
- The total capacity of the distribution reservoirs in the system shall be within half (1/2) to one third (1/3) of the total capacity of the scheme.
- For sizing of transmission pipe system, the total demand of the areas to be served from a particular transmission line shall be accounted in consideration with the maximum daily peaking factors.(Refer **D2 Manual** for details)
- For sizing of distribution pipe systems, one option is the linear density along roads to be assessed (Refer data sources below) and hourly peak factor shall be considered. (Refer **D2 Manual** for details). However, a more accurate method is to use GIS based maps with different layers such as population density, housing and structures, land use plan to identify the different types of dwellings and then verify through a site survey, if necessary.
- GIS base map of Distribution / Transmission system should be included and shall be used to calculate distribution demand.
- Elevations can be obtained from digital data from Survey Department and DEM shall be formed. Availability of a DEM for the area concerned shall be verified with the Mapping Section.

Data sources

- Maps from Department of Survey (Web site www.surveydept.lk) etc.
- Available GIS maps from UDA (Web site www.uda.lk)
- Available maps from Mapping Section of NWSDB
- LUPPD Officer

8.6. Identification and selection of lands

Identification and selection of lands necessary for acquisition or purchasing for the different components of the water supply scheme shall commence during the pre-feasibility stage.

The procedures to be followed and purchasing or acquisition shall be completed prior to finalisation of feasibility stage.

A status report on lands shall be presented.

8.7. Public Consultations

The outcome of public and stakeholder consultations concerning the water source should be presented including minutes of DLCC and DCC.

8.8. Proposed facilities

This section should describe the facilities to be rehabilitated / upgraded / new works, for each alternative recommended including,

- Type and location of intake
- Size, materials and route of transmission pipelines
- Capacity, type and location of treatment plant if any
- Proposed technologies and facilities for treatment plant upgrading if applicable
- Capacity and type of pumps and location of pumping stations
- Use of VSDs for energy optimization and efficient operation of the scheme
- Capacity and location of storage facilities.(When selecting the locations for storage facilities the cost incurred for access routes shall be economized and consider the alternative materials such as Steel, Ferrocement etc. for constructing storage facilities. Explore the possibility of using pumping systems with VSD instead of elevated storages)
- Approximate lengths and sizes of distribution pipelines
- Type of chemical dosing arrangements
- Communication and data transfer facilities
- Offices, staff quarters and vehicles
- Training requirements
- Power supply and alternative power (solar power)
- Energy saving and green technology
- Treatment plant waste collection, treatment and disposal (settled sludge and backwash recovery, waste from lime/alum tanks)
- Laboratory facilities

- Proper and safe disposal of laboratory waste

8.9.Total Cost Estimate (TCE)

Section-5-Chapter-8-Annex-2 shows a typical format for the Total Cost Estimate (TCE). Costing is based on the rates included in the NWSDB Rate Book. Refer notes given below;

- Unit Rate: The value directly taken from the Rate Book
- The basic amount for each item shall be calculated on above 'Unit Rate'.
- The 'basic amount' shall be apportioned as local and foreign according to the identified cost factors based on their degree of influence. (For cost factors refer **Section-5-Chapter-8-Annex-3).**
- The apportioned amounts as foreign and local shall be considered respectively for price escalation using appropriate foreign and local inflation factors for each year of implementation. Refer NWS&DB Rate Book for the specified price escalation percentages relevant to the year.
- In addition, allow in the cost estimate for all facilities necessary for O&M as mentioned in checklist in **Section-5-Chapter-8-Annex-4.**
- Include the cost for preparation of feasibility report in the total cost estimates.
- Include cost for catchment protection, RWS and sanitation improvements, training, staff quarters, vehicles, offices, tools etc.

8.10. Alternative proposal evaluation

If there are several alternative technical proposals with respect to the water source, storage locations transmission rules and distribution systems, they shall be evaluated based on the overall capital and operational costs. The least cost option shall be selected based on NPV. Applicable environmental and social aspects also should be considered.

8.11. Operation and maintenance costs

Tentative monthly operation and maintenance costs should be developed, based on accepted norms and staff levels, which should be discussed with Manager (O&M) beforehand, and described in the report.

Consider requirements / costs for;

- O&M staff – numbers and categories (Average salary issued by Add/GM (F))
- shift work (depending on pumping hours),
- Overall supervision by Treatment Plant (Process) Engineer /OIC / staff,
- Power costs,
- Chemical costs,
- Maintenance of head works, transmission and distribution works,
- Providing connections including installation of meters, meter reading and billing,
- Administration and overhead of regional office (Rs.../m^3) – the total office overhead/ total production capacity.

The expected unit cost per cubic metre of treated water produced shall be computed.

8.12. Sanitation (If there is a sanitation component in project)

Describe the facilities to be constructed, including the proposed numbers and types of latrines, and include a tentative cost estimate. Note any potential problems with soil type, drainage and water table which may affect the latrine type or construction method.

Even though sanitation component is not in the project, if there is a necessity to construct septage treatment, latrines and sanitation facilities to protect water source, they shall be included in the report with the tentative cost estimate.

Percentage coverage of sanitation in the area shall be compared with the national average. If there is a considerable gap in coverage, need of improving the sanitation facilities shall be emphasized in the report.

8.13. Implementation schedule

Include a chart similar to **Section-5-Chapter-8-Annex-5** showing, in outline, the tentative implementation schedule. Indicate who would be responsible for detailed design and construction supervision. This may be reviewed at a later stage.

The critical areas that could affect smooth implementation shall be identified.

8.14. Water safety plan

Water Safety Plan for the project shall be described. Brief introduction on the water Safety plan is given in **Section-5-Chapter-8-Annex-6.**

CHAPTER 9A - FINANCIAL ANALYSIS

9A.1 Financial benefit - cost analysis

A financial benefit - cost analysis (FBCA) is done to assess the financial viability of the proposed project.

The financial benefit - cost analysis is done for the project and not for the entire economy or the entire water utility. The FBCA focuses on the additional financial benefits and costs to the water utility resulting from the project. In contrast, the economic benefit-cost analysis evaluates the project from the viewpoint of the entire economy.

The financial benefit-cost analysis includes the following Eight steps.

i) Determining annual project revenues.
ii) Determining project costs and operation and maintenance cost (as given in **Chapter 6**).
iii) Determining loan repayment schedule.
iv) Calculating annual project net financial benefits.
v) Determining the appropriate discount rate.
vi) Calculating discounted cash flows.
vii) Calculating the financial Net Present Value (NPV).
viii) Calculating the Financial Internal Rate of Return (FIRR).

Project revenues, costs and net benefits need to be determined on a "with-project" and "without-project" basis. They are estimated in current prices for a selected year (e.g., current prices for year 2021), using the official exchange rate for imported items. The revenues of the project comprise of entirely user charges, that is, not taking into account government subsidies.

Project revenues need to be determined for different groups of users[1] as each may have different consumption patterns, may be charged at a different tariff and may respond differently to tariff increases. These price-quantity relationships are part of the demand forecast.

When calculating project revenues, we need to project the following:

i) Water supplied at present without the project (if this is a new project, this value will be zero).
ii) Water supplied with the new proposed project (*Refer **Chapter 6**)*
iii) The average tariff (Refer NWSDB tariff model)
iv) Connection cost - CDC and CRC shall not be included in the financial analysis – (Refer **NWSDB Rate Book**)
v) Number of connections without the project *(Refer **Chapter 2**)*
vi) Number of new connections with the new proposed project *(Refer **Chapter 8**)*

[1] Categories can be obtained from the NWSDB tariff structure

The following assumptions[2] shall be made when calculating the project revenues:

- Average consumption per connection shall be obtained from the commercial data base pertaining to the relevant Managers.
- Tariff - rate of increase can be obtained from the NWSDB Tariff model given in **Section-5-Chapter-9-Annex-1.**
- Increasing trend of connections shall be assessed.
  Note: in the working example we use a rate of increase of 10% per annum. In case of augmentation/ rehabilitation, consumption rates for domestic and other categories shall be obtained from commercial data base of relevant Manager areas. In case of new projects, consumption rates for domestic and non-domestic shall be calculated based on the percentage assumed during water demand calculation.

The project water supply and revenues are determined as the difference between the "with-project" and the "without project" situations.

Data for calculating project revenues could be extracted from **Chapter 8.1.**

Once the least-cost alternative among technically feasible alternatives is selected, the preliminary project cost estimates can be worked out in greater detail by the engineer. Costs of the following need to be calculated. Data for calculating total project costs could be extracted from **Chapter 8**.

i) Investment Costs

(a) Capital Costs;

- Civil works
- Supply of pipes
- Laying of pipes
- Supply and installation of pumps and motors
- Supply and installation of chemical dosing equipment and chlorinators
- Supply and installation of generators
- Environmental/social mitigation costs
- Land acquisition
- Road reinstatement
- Power supply
- Purchase of vehicles
- Staff quarters
- Training/Health Education
- Inspection and testing of materials
- Improvement of water resources and catchment protection measures
- Any other costs associated with the capital works
- Costs for Safety precautions to workers as well as third parties.

Some elements that need to be added when calculating costs;

[2] percentages under these assumptions can be changed accordingly

- **Exchange Rate :** This needs to be determined to convert local currency to the foreign currency used and vice versa .Use the parity rate given in GM's letter in the Rate Book

- **Duties and Taxes:** Cost due to taxes and duties (Custom Duties[3]) can be calculated based on the appropriate percentages for taxes[4] and custom duties declared by the GOSL including VAT, NBT etc. Use the Rate Book.

- **Physical Contingency:** An allowance should be added to reflect the expected increase in the base cost estimates due to possible changes in quantities and method of implementation. For example, a physical contingency of 10% should be left for civil works and 5% of the cost of equipment and supplies.

- **Price Contingency:** An allowance should be added to reflect expected cost increases due to changes in unit prices. This is calculated as a percentage of the base cost including physical contingencies calculated above. Prices changes could result from changes in local and international inflation rates, changes in local currency exchange rates etc. When computing price contingencies, it is important to separate foreign and local currency components of the investment and apply appropriate local and foreign inflation rates.

(b) Water quality monitoring and testing of water sources from the prefeasibility stage to commissioning of the project.
Water quality testing programme
Procurement of equipment for water analysis and labs

ii) Operation and maintenance cost

(See **Chapter 8** for more information on O&M expenditure)

Estimates of O&M costs are usually prepared by the engineer and forwarded to the Financial Analyst / Economist. Several methods exist by which O&M costs are estimated. Rate of increase in O&M costs need to be determined based on inflation rates etc.

- Estimate O&M costs as a percentage of (cumulative) investment costs.
- Analyse the past performance of the utility and relate the total O&M costs to the volume of water produced and/or distributed.
- Calculate specific cost items to specific outputs and total them in a second step. For example, costs of electricity and chemicals could be calculated on the basis of a specific requirement per Cubic Meter (m^3) of water produced and the labour requirements could be calculated on the basis of the number of employees per connection. (This is the more accurate method)

Percentage Overhead Costs shall be obtained from the NWSDB Rate Book.

iii) Re-Investments during the project cycle

[3] Data available from Department of Customs
[4] Data available from Department of Inland Revenue

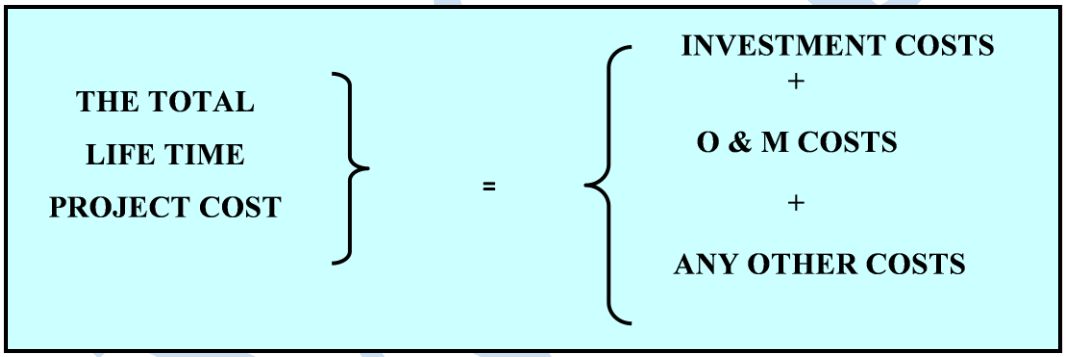
The predicted life of machinery and equipment used are to be included. Predict the cost of the items for the particular year using the NWSDB rates with the escalation factors.

iv) Other Costs

Any cost which do not come under investment cost and O&M cost shall be included under this section.

The costs should be attributed to the project on a with-project and without- project basis. Only the additional costs due to the project should be taken into account. The project costs should be calculated on an annual basis and should be equal to the with-project costs less the without-project costs. It should also be noted that in many cases the system would deteriorate further in the without-project scenario.

When calculating the investment, foreign and local currency components are distinguished to establish the foreign exchange implications of the project and counterpart financing requirements.



Capital repayment: Divide the total loan component by the repayment period leaving aside the grace period.

(E.g. SLR 10mn to be paid over 20 years = 500,000 a year)

Interest Repayment - The annual interest rate would need to be multiplied by the total remaining capital. As such, the total interest payment would decrease as the remaining capital decreases over the years.

Interest During construction - Interest to be calculated for implementation cost identified in the cost estimate during construction at the interest rate defied by the Government of Sri Lanka. (E.g. 6%)

The analysis should be done up to the loan repayment period. Previous loan repayment of same project (although it has several phases) should not be considered.

Project Net Benefit = Project Revenues - Project Costs

Note: *The net benefit stream is sometimes called the (net) cash flow.*

In the Financial Analysis, the following scenarios shall be considered.

Scenario – 1; Project assuming 100% cost recovery

i) Project in isolation with AWPLR (Average Weighted Prime Lending Rate) discounting rate (market discount rate for countries such as Sri Lanka, India[5])

IRR calculated for this scenario shall be more than AWPLR + 2.5% for positive NPV, for the project to be viable for commercial financing.

- Total loan to be repaid with interest rate of AWPLR + 2.5%,
- Grace period 3 years and loan repayment period to be 12 years,
- O&M Cost shall be increased (assume a rate of 5% p.a.),
- Revenue to be increased according to Tariff policy (assume a rate of 5% p.a.),
- Financial analysis to be carried out for 40 years.
- Interest payment to be paid as based on assumed contract cost from first year.

If the IRR is greater than AWPLR + 2.5% the project is viable and no need to analyse the next scenarios.

Scenario – 2; Project financing under the Government on lending concession

ii) If the project is not viable for commercial financing as described in scenario i above, the discounting rate shall be calculated based on weighted average cost (**Section-5-Chapter-9-Annex-2**) (grant loan mix) of capital (WACC). If the IRR calculated for this scenario is more than the WACC, then the project is financially viable for development financing.

- A component of the loan, depending on the urban and rural categories to be repaid with applicable interest rate,
- Grace period 3 years after commissioning and loan repayment period to be 12 years,
- O&M Cost shall be increased (assume a rate of 5% p.a.),
- Revenue to be increased according to Tariff policy (assume a rate of 5% p.a.),
- Financial analysis to be carried out for 40 years.

If the IRR is more than WACC, it is considered the project is viable and analysis shall not be done further.

Scenario – 3; Project funded under the Government on lending concession, including economic analysis.

iii) If IRR becomes less than WACC an economic analysis need to be carried out to arrive at a feasible solution. However, at the prefeasibility stage it is difficult to carry out an economic analysis. Therefore it shall be recommended in the prefeasibility report to carry out a socio economic survey in the pre-feasibility stage in order to find out the details for economic analysis.

[5] Data available from Central Bank of Sri Lanka

If the (FIRR + EIRR) is more than WACC, it is considered the project is viable and analysis should not be continued

Scenario – 4; Project assuming only covering the O & M cost

iv) Further the financial analysis shall be carried out only taking into account the operation and maintenance cost. If the project is viable with operation and maintenance cost, the project shall be recommended for grant funding.

- The discount rate shall be taken as 5%
- O&M Cost shall be increased (assume a rate of 5% p.a.)
- Revenue to be increased according to Tariff policy (assume a rate of 5% p.a.)
- Financial analysis to be carried out for 40 years

Example of calculating WACC

If project is not commercially viable, then discounting rate shall be calculated based on Weighted Average Cost Of Capital (WACC). This is typically used as the benchmark to assess the financial viability of the projects for Development Financing. In this case the repayment of the loan has to be with 8% and 6% interest respectively for urban and rural areas if not specifically mentioned otherwise.

50% Capital Cost Recovery for Urban Areas and 25% Capital Cost Recovery For Rural Areas should be applied based on the on lending terms by the Treasury to the NWSDB.

The discount rate to be used in financial benefit-cost analysis is the Weighted Average Cost of Capital (WACC). This WACC represents the cost incurred by the entity in raising the capital necessary to implement the project. Since most projects use several sources to raise capital and each of these sources may seek a different return, the WACC represents a weighted average of the different returns paid to these sources.

Section -5- Table 02 : WACC for a project in an Urban Area

	Weight (%) (W)	**Interest Rate (%) (R)**	**WACC = (W/100) x (R/100)**
Grant	50	0	0
Loan	50	6	0.03
Total	100		0.03
WACC			3.0%

Section -5- Table 03: WACC for a project in a Rural Area

	Weight (%) (W)	**Interest Rate (%) (R)**	**WACC = (W/100) x (R/100)**
Grant	75	0	0
Loan	25	6	0.009
Total	100		0.009
WACC			0.9%

For a project in an area where a mix of both Urban and Rural areas exist, the component of the loan repayment and the WACC shall be calculated based on the percentage of population in Rural and Urban categories in the area.

Example - WACC

% of Population in rural category	-	40%
% of Population in urban category	-	60%
Rate for an urban area alone	-	3%
Rate for a rural area alone	-	0.9%
Therefore, WACC for the mix of Areas	-	$\frac{(3\% * 60) + (0.9\% * 40)}{100}$
	=	**2.16%**

Example – Calculating component of loan repayment

% of loan repayment for an urban area alone	-	50%
% of loan repayment for a rural area alone	-	25%
% of Population in rural category	-	40%
% of Population in urban category	-	60%
Therefore, % of for the mix of Areas	-	$\frac{(50\% * 60\%) + (25\% * 40\%)}{100}$
	=	**40.0%**

The financial net present value (FNPV) shows the present value of the net benefit stream, or the projects' worth today. The discount rate to be used here is the WACC. The NPV is a way to decide whether or not to invest in a project by looking at the projected cash inflows and outflows.

To calculate NPV we need to

- Determine the time scale we are looking at
- Calculate the discounted cash flows (as described above)
- Determine required rate of return (if applicable)

i) Each cash inflow/outflow is discounted back to its present value (PV).
ii) Each of these discounted cash flows is then added together.
iii) The initial cost (C_o) is subtracted

Hence the NPV formula would read as;

$$NPV = \sum_{t=1}^{T} \frac{C_t}{(1+r)^t} - C_0$$

t - The time of the cash flow

r - The discount rate (the rate of return that could be earned on an investment in the financial markets with similar risk.)

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DATEVALUE =NPV(B3,C9:G9)

	A	B	C	D	E	F	G	H
1								
2	Tax rate	40%						
3	Cost of Capital	12%						
4								
5		"Now"	Year 1	Year 2	Year 3	Year 4	Year 5	
6	Revenues		$500	$500	$500	$500	$500	
7	- Costs		$300	$300	$300	$300	$300	
8	- Tax		$80	$80	$80	$80	$80	
9	= Cash Flow		$120	$120	$120	$120	$120	
10								
11	NPV	=NPV(B3,C9:G9)						
12								
13								

Section -5- Figure 01: Excel Worksheet for NPV Calculation

(Refer **Section-5-Chapter-9-Annex-3** for details of NPV)

A positive FNPV indicates a profitable project, i.e. the project generates sufficient funds to cover its cost, including loan repayments and interest payments. If the FNPV, discounted at the WACC of 4.4%, turns out to be positive, the project is earning an interest of at least the required 4.4%.

A negative FNPV points to a project that does not generate sufficient returns to recover its costs, to repay its loan and to pay interest. Note that, as a general principle of discounting cash flows for the purpose of IRR calculations, loan repayments and interest payments are not considered part of the economic cost.

Sometimes it will be difficult to establish financial viability of the project. In such cases it would be necessary to ensure that at least O&M expenditure can be met. In such a case it is necessary to take out the total capital cost of the project and verify if the total income generated from the project is sufficient to cover the O&M costs.

The profitability of a project to the entity is indicated by the project's financial internal rate of return (FIRR). The FIRR is also the discount rate at which the present value of the net benefit stream in financial terms becomes zero.
The Internal rate of return (IRR) is the rate of return produced by each dollar for the amount of time that dollar is in the investment. The IRR is used by firms to decide whether they should make investments. It is also called discounted cash flow rate of return (DCFROR) or rate of return (ROR). It is an indicator of the efficiency or quality of an investment, as opposed to net present value (NPV), which indicates value or magnitude.

The project is a good investment proposition if its IRR is greater than the rate of return that could be earned by alternate investments of equal risk (investing in other projects, buying bonds, even putting the money in a bank account). Thus, the IRR should be compared to any alternate costs of capital. (Refer **Section-5-Chapter-9-Annex-4** for details).

Thus, in the case of cash flows at whole numbers of years, to find the internal rate of return, find the value(s) of *r* that satisfies the following equation:

$$NPV = \sum_{t=0}^{N} \frac{C_t}{(1+r)^t} = 0$$

Note that instead of converting to the present we can also convert to any other fixed time; the value obtained is zero if and only if the NPV is zero. (Refer **Section-5-Chapter-9-Annex-5** for details)

CHAPTER 9B - ECONOMIC ANALYSIS

When a project is not financially viable considering only its financial terms, an economic analysis shall be carried out considering the indirect benefits and costs due to the project. The economic analysis of a Water Supply Project (Urban or Rural) has to follow a sequence of interrelated steps.

- Identify Project Purposed.
- Identify Economic Costs and Benefits.

(Refer **Section-5-Chapter-9-Annex-6** and **Section-5-Chapter-9-Annex-7** for more details)

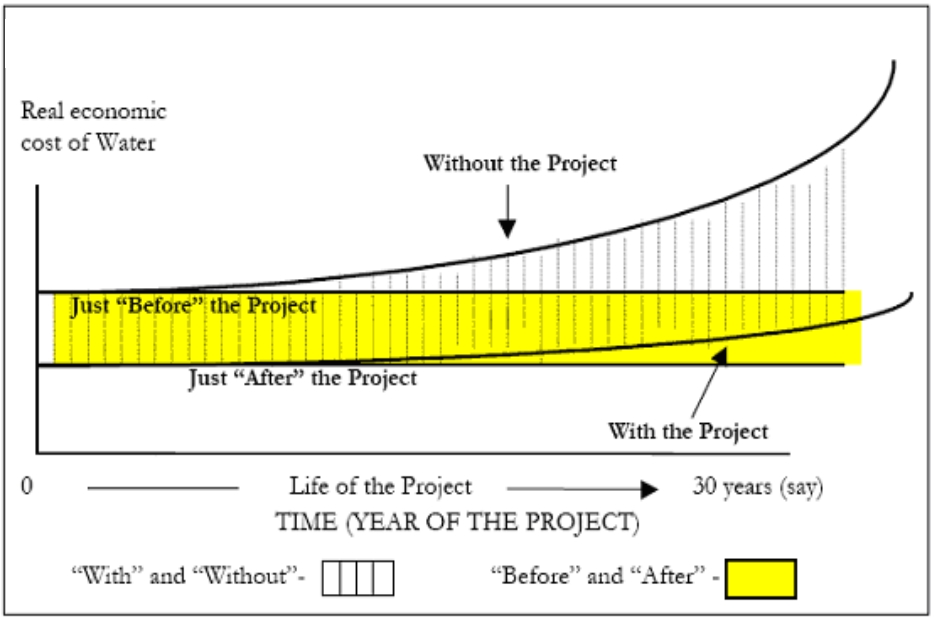
The initial step in testing the economic viability of a project is to identify, quantify and value the economic costs and benefits. The following two important principles are to be followed.

i) Comparison between 'with-project' and 'without-project' situations; and,
ii) Distinction between 'non-incremental' and 'incremental' inputs (costs) and outputs (benefits).

(Refer **Section-5-Chapter-9-Annex-6**)

The comparison between "with" and "without" the project is often different from the comparison between "before" and "after" the project. The without project situation is that which would prevail if the project is not undertaken. For example, population in the project area will grow leading to an increase in the use of water; and water sources will become increasingly scarce and remote, contributing to a higher cost of water to the consumers. The situation, therefore, will not remain static at the level just "before" the project.

The project inputs and outputs should be identified, quantified and valued by comparing the 'without-project' situation with that of the 'with-project' to cover the relevant project benefits and costs. Figure below shows the differences of the real economic cost of water in the 'with' and 'without' project and the 'before' and 'after' project situations. A similar diagram could also be used to show the differences in the benefits between the various project situations.



Section -5- Figure 02: "With" "Without" Project vs. "Before" and "After" Project

(I) Costs

In estimating the Economic Costs, some items of the financial costs are to be excluded while some items not considered in the Financial Costs are to be included. This is to reflect costs from the viewpoint of the Economy as a whole rather than from the viewpoint of the Individual Entity.

They are summarized below:

a) **Taxes, Duties, and Subsidies**

There would be instances where for example, the government is correcting environmental costs through a tax or a pollution charge.

For example, the volume of water withdrawn from existing agricultural use which is supplied to a newly established industrial plant is to be considered as agricultural water. Its economic cost is based on the demand price of agricultural water and as such, the transfer element (Tax or Subsidy) is a part of the demand price.

b) **External Effects**

These refer to such effects of a water supply project on the activities of individuals/ entities outside the project that affect their costs and benefits but which are not directly reflected in the financial cash flow of the project. For example, environmental effects of a WSP, such as river water pollution due to discharge of untreated wastewater effluent, affect activities like fishing and washing downstream.

(II) Benefits

Health Benefits

Water supply projects have been justified on the basis of expected public and private health benefits, which are likely to occur with the project due to the overall improvement in the quality of drinking water. Such benefits are likely to occur provided, the adverse health impacts of an increased volume of wastewater can be eliminated or minimized.

Accordingly, health benefits due to the provision of safe water have the following two dimensions.

Avoided private/public health expenditures

To calculate this, the data obtained from socio-economic surveys can be used. The total amount of expenditure spent on water related/water borne illnesses have to be added up and an average taken to be multiplied by the whole population in the project area.

$$\frac{Ex}{Ps} \times P$$

Where:

Ex = Total expenditure on water related illness

Ps = Sampled population

P = Population in project area

ii) Economic value of days of sickness saved

To calculate this, the data obtained from the Socio-Economic surveys can be used. Add up the total number of days the population in the project area have been sick from water related/water borne illnesses. Then multiply the total number of days by the average daily income.

$$Sd \times Y \times P$$

Where:
Sd = Total number of sick days per person for the year
Y = Average daily income
P = Total population

b) Time Cost Saving Benefit

In the without-project situation, time spent in collecting water from the nearest source of water supply (e.g., wells, tank, river, stand posts on the road) may be high, especially during the dry season. An important benefit from a piped water supply is that it brings the source of water very near to the households. Time saved in with- and without-project situations can be estimated.

$$\frac{T}{24} \times 365 \times Y \times \frac{P}{Ps}$$

Where:
T = Hours spent collecting water per day
365 = Days of the year
24 = Hours in a day
Y = Daily income
Ps = Sampled population
P = Population in project area

c) Increases in land values

Refer **Section-5-Chapter-9-Annex-7** for more details

Before any detailed analysis is done, it is necessary for the project team to get acquainted with the area where the project has been identified. This is to acquire knowledge about the physical features; present situation regarding existing facilities and their use; constraints (if any) against the optimal use of existing facilities; the communities and users especially their socio-economic conditions; etc.

In view of the complex set of data to be collected, need for rigorous analysis and the low reliability/accuracy of data, this factor is not recommended to be included to the Economic Analysis.

To collect this information, the following surveys must be undertaken in the area:

i) **Reconnaissance survey** – to collect basic information of the area and to have discussions with the beneficiaries and key persons involved in the design, implementation and management of the project.
ii) **Socio-economic survey** – to get detailed information about the household size, earnings, activities, present expenditure for water supply facilities, along with health statistics related to water-related diseases, etc.
iii) **Contingent Valuation Method** - This is based on questions put to households on how much they are willing to pay (WTP) for the use of different levels of water quantities.
iv) **Survey of existing water supply facilities -** Knowledge of the present water supply sources; treatment (if any) and distribution in addition to the quantity and quality of water; Non-Revenue Water (NRW); and any constraints and bottlenecks which are coming in the way of the optimum use of the existing facility.

Using the information taken from the survey results and other secondary data sources, effective demand for water can then be estimated. Two important considerations are:

i) Effective demand is a function of the price charged. This is ideally based on the economic cost of water supply provision to ensure optimal use of the facility, and neither over-consumption nor under-consumption especially by the poor should occur. The former leads to wastage contributing to operational deficits and the latter results in loss of welfare to the community.
ii) Reliable water demand projections, though difficult, are key in the analysis of alternatives for determining the best size and timing of investments.

Approaches to demand estimation for urban and rural areas are usually different. In the urban areas, the existing users are normally charged for the water supply; in the rural areas, there may not be any formal water supply and the rural households often do not have to pay for water use. An attempt can be made in urban areas to arrive at some figure of price elasticity and probably income elasticity of demand. This is more difficult in the case of water supply in rural areas with a preponderance of poor households.
(Refer **Section-5-Chapter-9-Annex-8** for more details)

Once the costs and benefits, including external effects, have been identified and quantified they should be valued. Decisions by the producers and users of project output are based on financial prices. To appraise the consequences of their decisions on the national economy, benefits and costs are to be valued at economic prices. Therefore, the (financial) market prices are to be adjusted to account for the effects of following government interventions and market structures.

i) Transfer payments - taxes, duties and subsidies incorporated in market prices of goods and services;
ii) Official price of foreign exchange where government controls foreign exchange markets;
iii) Wage rates of labour where minimum wage legislation affects wage rates;
iv) Commercial cost of capital where government controls the capital market.

Hence, as market rates in those cases are poor indicators of the economic worth of resources concerned, they need to be converted into their shadow prices for economic analyses.

Principle of Shadow Pricing (Economic Pricing)

a) Opportunity Cost

Opportunity cost is the benefit foregone from not using a good or a resource in its next best alternative use. To value the benefits (outputs) and costs, the opportunity cost measured in economic prices is the appropriate value to be used when calculating the:

Opportunity Cost of Labour;
Opportunity Cost of Land;
Opportunity Cost of Water; etc.

b) Weighting

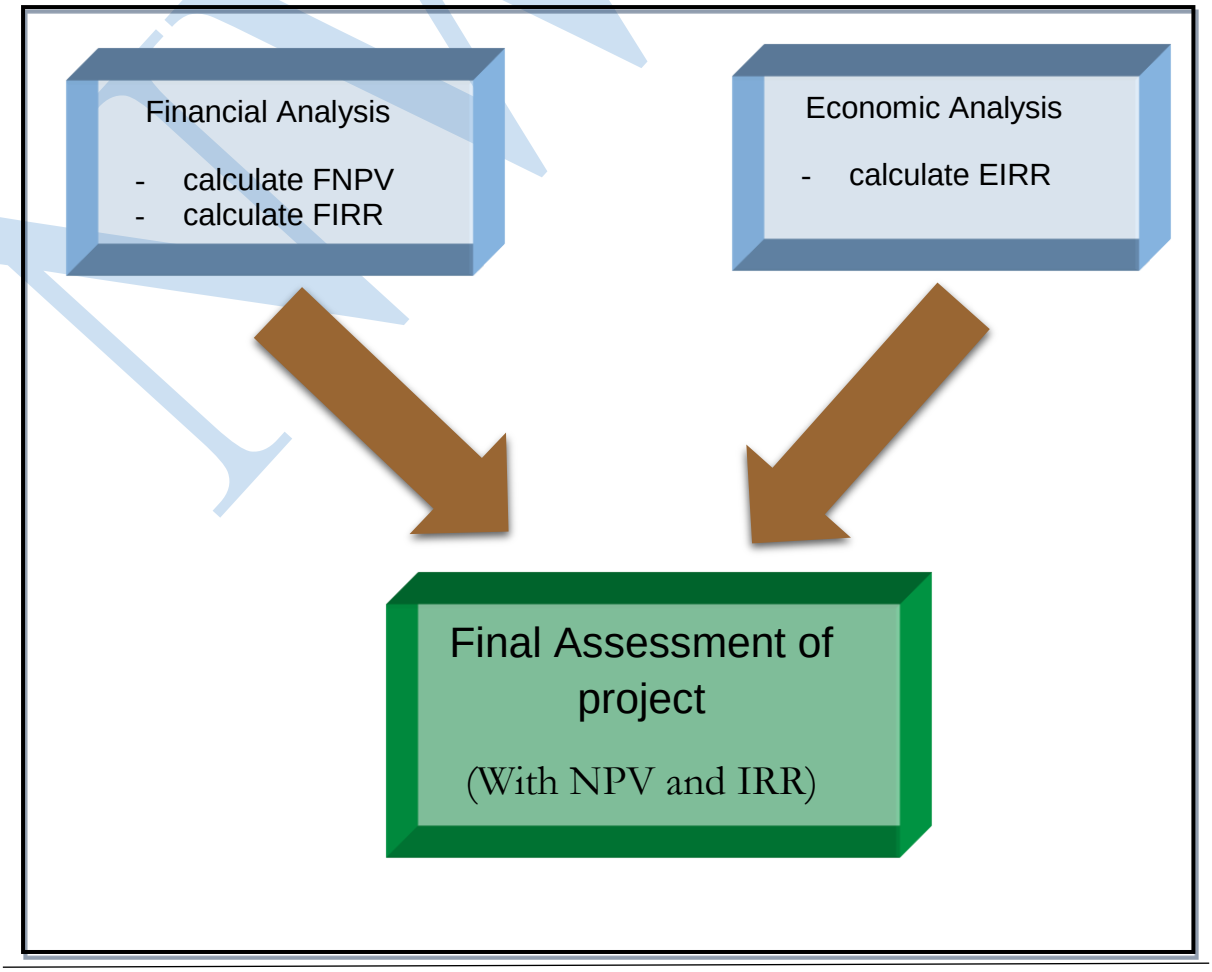
The actual values obtained for the economic analysis need to be weighted up or down depending on their importance to the project. For example, although a family may not have to spend Rs. 1000 on medical care, this Rs. 1000 may need to be weighted down by 60%. Therefore, the actual rupee benefit contribution to the project would be Rs. 600.

Section -5- Table 04: Example of weightings

Benefits	Contribution (Rs.)	Weightage	Weighted Benefit (Rs.)
Savings from decreased health expenditure	200	0.25	50
Savings from less days lost due to illness	400	0.25	100
Extra income from decrease in time spent collecting water	600	0.50	300
TOTAL	**1200**	**1.00**	**450**

Note: *Total of all weights should be equal to 1*

9.3 Combining Financial and Economic Analysis



Section -5- Figure 03: Combining Financial and Economic Analysis

In our working example we have considered the first two scenarios as follows:

1. Financial analysis given at market interest rate of AWPLR (**Section-5-Chapter-9-Annex-9*a***).
2. Financial analysis considering that 50% of the finance is given from the government at an interest rate of 5% i.e. WACC 5%. (**Section-5-Chapter-9-Annex-9b**).

The following assumptions have been made in the example

- Tariff to be increased by 25% for every three years
- Connection fees to be increased by 25% for every three years
- O&M cost to be increased by 10% per annum

CHAPTER 10 – CONCLUSIONS AND RECOMMENDATIONS

Develop firm conclusions regarding the technical and financial feasibility of the project, and comment on the social need, community interest/participation and health and environmental aspects. Categories the priority of the project accordingly. List recommended actions and requirements for further detailed studies at feasibility stage, if the project proceeds.

The formal project evaluation procedure is set out in **Section 2**. A copy of the report will be submitted to the Project Appraisal Committee (PAC). If the report is for a large project, and is more than a few pages long, PAC will require a separate Summary Report in the format given in **Annex (IV).** If complete, this will answer the important questions that PAC will want to know.

Following the evaluation, AGM (P&D)/AGM (RSC) will be requested to prepare a letter / statement of intent for execution with the Local Authority if required, prior to commencement of work on the pre- feasibility study.

Based on the outcome of the prefeasibility study, the following aspects should be highlighted in the recommendation;

- Need for Sanitation if the coverage gaps are high in the project area
- Need for a Septage facility depending on the degree of pollution to the water sources
- Water source protection and improvements for surface water and infiltration proposals for ground water
- Implementation of the identified Environmental Management Plan
- Improvements to identified existing RWS systems.

SECTION 6

FEASIBILITY STUDY AND REPORTING

6. FEASIBILITY STUDY AND REPORTING

6.1. Objectives and Scope

Feasibility studies should be carried out only for those schemes which have been shown to be suitable for implementation at the prefeasibility stage and have been so recommended by the PAC.

Feasibility and Designs shall be carried out parallel for the schemes approved by the PAC irrespective of availability of funding.

The feasibility report is the final step of the planning process, prior to acceptance of implementation. During the feasibility study, the investigations for all possible water sources should be completed so that their yields and water quality parameters are firmly established.

Designs of sufficient detail should be carried out to ensure accurate cost estimates, as is required to decide between alternatives and to justify the selected option. It should address the entirety of technical, institutional, social, health and sanitation, environmental, financial and economic considerations related to the project. It should include recommendations for operation and maintenance, setting out the necessary staffing requirements. Revenue projections should be included, based on existing tariffs indicating the additional sums required (if any) to cover total costs (O&M, capital repayment, interest and overheads). Cost of water per unit should be clearly stated.

The report will be transmitted to the NWSDB management through the Project Appraisal Committee which has the responsibility of determine project viability and approve for implementation. Thereafter necessary funding for implementation could be sought.

The report should be factual, carefully documented and clearly presented so that a non-technical reader unfamiliar with the project may follow it without difficulty. Assumptions used, and the reliability of data (with data source) should be commented upon. The report should be thorough and comprehensive but, at the same time, concise, and not filled out with unimportant or unnecessary details. In technical terms the approach to facilities planning should emphasise low maintenance requirements and minimum operating costs.

The aspects of community interest or awareness, involvement and participation, health education, local customs and practices, social and economic factors will normally be contributed by Sociologists who should work hand-in-hand with Planning Staff in carrying out the studies.

Study requirements and content will vary to some extent, depending on project size and type, and the requirements of the funding agency. However, the objectives mentioned above must be met.

6.2 Approach and Methodology

As for prefeasibility studies, the work will be carried out by a team under the coordination of the P&D HO /Planning and Design section in RSC level and will comprise Engineers, Sociologists, Chemists, Accountants, Economists, Geologists and Environmentalists. It is the responsibility of the Planning and Design section Engineer to enlist support from the other sections and professionals as required.

The feasibility studies would involve detailed data collection, investigations and surveys. In addition to technical aspects, social, economic, health, environmental, sanitation and financial aspects should be covered. The data collection and investigations carried out during prefeasibility stage shall be revalidated.

This work should be carried out with the knowledge and assistance of P&D-HO, AGM (RSC), Chief Engineer (P&D-RSC) and the relevant Manager (O&M).

Engineering/technical staff will carry out the following,

- Evaluation of existing scheme (if any) or existing water source.
- Confirmation of the water source in liaison with Geologists.
- Revalidating the water requirements.
- Evaluation of the alternatives for headworks, transmission and distribution identified during prefeasibility stage.
- Selection of the best option for the water supply scheme.
- Rehabilitation or augmentation requirements of existing works.
- Carrying out surveying, investigations of the transmission and distribution systems.
- Carrying out transmission and distribution system modelling.
- Survey of culvert and bridge crossings.
- Finalising locations for storage facilities.
- Soil investigations in identified locations.
- Identification of environmental issues.
- Study and ascertain the social acceptance levels in liaison with Sociologists.
- Water quality data trend analysis in liaison with Chemists.
- Finalization of unit treatment processes and prepare treatment plant layouts.
- Requirements for catchment protection in consultation with Chemists, Sociologists, Geologists.
- Operation and maintenance aspects and costs.
- Rural water supply requirements in the area.
- Sanitation and surface drainage (as required).

Chemists will carry out the following.

Analysis of raw water quality and recommend pollution mitigation as necessary.

Geologists will carry out the following.

- Hydrogeological studies.
- Investigation and analysis of ground water sources.
- Ground water recharging needs and well head protection measures.

Sociologists will carry out work on the community aspects.

- Generating community interest and harnessing participation.
- Social, environmental and economic data collection.
- Community willingness / ability to pay.
- Sanitation and health data collection.
- Evaluation of service areas.
- Promoting health education.
- Promoting environmental protection and source improvements.
- Evaluating level of community participation in respect of source improvement, environmental protection, sharing of water, construction and O&M of scheme as applicable.

Finance and Commercial Section staff will undertake/assist planning staff as necessary in carrying out the financial, revenue, and economic aspects.

- Past financial performance of existing schemes.
- Operation and Maintenance costs.
- Expected revenues.
- Financial and Economic projections and project viability.
- Source of funding.

Details of the approach to each of the above aspects are given in the following sections.

The time taken for execution of a feasibility study and preparation of report will vary depending on the project size and type, but may be expected to average about 180 man days of work.

6.3 Contents of Feasibility Report

Annex (ii*)* shows a typical title page and table of contents for the feasibility report which is basically similar to that for the prefeasibility report for the first four chapters. However, the feasibility report should go into the subjects in more depth. The chapters on economic, financial and institutional aspects shall be much more comprehensive and detailed. Project summary sheet shall be essentially in the feasibility report and the format is given in **Annex (iii).**

The contents and report organisation shall be as follows:

Title Page

Table of Contents Summary

Main Report

Chapter 1 - Introduction

Chapter 2	-	Existing Water Supply Facilities
Chapter 3	-	Health and Sanitation
Chapter 4	-	Social Aspects
Chapter 5	-	Environmental Aspects
Chapter 6	-	Water Resources
Chapter 7	-	Planning Criteria
Chapter 8	-	Proposed Project
Chapter 9	-	Economic and Financial Analysis
Chapter 10	-	Conclusions and Recommendations

Subject content of the eight chapters of the main body of a feasibility report is discussed in detail in **Section –7** of this manual.

6.4 Check List and Letter of Transmittal

Having prepared the feasibility report as per the guidence given above, the person who prepared the report shall check the report in accordance with the check list of feasibility report in **Annex-(vii).**

The person who certify the feasibility report shall check the report in accordance with the the Checklist of feasibility report in **Annex-(ix).**

This is the formal presentation of the report by the officer and the agency responsible for its preparation, to the officer and the agency responsible, for authorising the study (NWSDB). For reports prepared by the Regional Support Centres or the Planning and Designs section at head office, this could be in the form of an Internal Memo. The format of the letter is in **Annex-(xi).**

6.5 Letter to Addl. GM (F)

The P&P Section shall forward the feasibility study report to Addl. GM (F) to comment on the effect of the project on the cash flow of NWSDB. This letter shall be transmitted to the Addl. GM (F), Two weeks prior to the PAC meeting so that any comments could be made at the PAC meeting. The format of the letter to Addl. GM (F) is in **Annex-(xii).**

SECTION 7

FEASIBILITY STUDY

MAIN REPORT

7. FEASIBILITY STUDY MAIN REPORT

The feasibility main report shall comprise of Eight Chapters. These are discussed in detail in the following sections.

CHAPTER 1 - INTRODUCTION

The following sub-sections of the introduction shall be similar but have to be more detailed than in the Pre-Feasibility Study Report (PFS).

1.1 Authorization
1.2 Objectives and Scope
1.3 General description of project area
1.4 Implementation of the feasibility study
1.5 Acknowledgement

Acknowledge assistance given by individuals of other organisations and local authorities who have participated in or contributed to the study.

CHAPTER 2 – EXISTING WATER SUPPLY FACILITIES

This section should give full details of existing facilities with detailed data and drawings. Provide adequate maps and sketches showing location and layout of facilities. Scheme details, data and water quality analyses may be in Appendices.

A check list for data collection at an existing scheme is presented in Annexures; ***Section-5-Chapter-2-Annex-1, Section-5-Chapter-2-Annex-2, Section-6-Chapter-2-Annex-1, Section-6-Chapter-2-Annex-2, Section-6-Chapter-2-Annex-3, Section-6-Chapter-2-Annex-4, Section-6-Chapter-2-Annex-5 & Section-6-Chapter-2-Annex-6.*** The list should be worked through, item by item during field inspections accompanied by the OIC.

2.1 Facilities of Existing Water Supply Schemes

If there is any existing scheme, describe the following, from the basis of brief inspections and interviews with the scheme OIC or relevant personnel.

History of the scheme – When built, by whom, original design population and production if known, and subsequent additions/extensions information in the PFS report to be revalidated.

Data sources (Maps of coverage area)

- OIC, NWSDB
- District Engineer, NWSDB
- Manager (O&M), NWSDB

Scheme details and conditions – Number of schemes in the area, population served by different means of water supply services, coverage area including maps, intake and treatment, treatment plant capacity and losses, pumps, chemical dosing equipment, chlorinators, power supply and storage, etc. Include a schematic diagram of each scheme as appropriate. Information in the PFS to be revalidated. Additional details/drawings may be provided.

Water production – Design capacity of existing scheme and operating capacity, reasons if not operating at full capacity. Information in the PFS to be revalidated.

Discuss the categories of water use - Mention availability of Rural Water Supply Schemes, water sharing by other stakeholders, etc. Information in the PFS to be revalidated.

Existing water source - Source location, capacity, reliability, quality, possible ways of water pollution and possibility of abstracting more water - yield and quality records to be included. Salinity intrusion and the trend to be checked if relevant. Information in the PFS to be revalidated.

Alternative water sources – Source locations (with maps), quality and reliability of sources, possible ways of water pollution

- **Lengths of transmission/distribution mains.** Same as in PFS Information in the PFS to be revalidated.

Data source

- Existing records of O&M Staff

- **Number of connections** –Road wise details of connections, waiting list for connections can be included if available. Assuming families per household in the relevant DSs covered, the served population can be assessed.

Pipe line condition - Age, Material, frequency of pipe bursts etc.

Data sources

- DDHS / PHI of area
- O&M office of NWSDB

Note; *It may not be possible to open up a pipeline just to see the condition inside. In some cases, old pipes recently removed from the system could be inspected or photographs from repairs carried out recently could be used. Alternatively pipeline pressure tests can be useful to show up pipeline blockage or partially closed valves.*

- Estimation of losses - Causes and number of losses (pipe bursts - mention pipe materials, break down details, illegal connections, metering errors etc.) Give details for past three years in graphical format. Maps indicating leaks and bursts in pipeline available in O&M to be used as the basic data.

Data source

- Records from the office of OIC

- Supply hours,
- O&M staff – numbers and categories,
- Responsibility of O&M for supply and distribution, billing and collection, NRW reduction, preventive maintenance,
- O&M Costs and revenue - this should also briefly include overhead component (in proportionate to cubic meter produced in the region) and details of operational performance.
- Water quality issues – water quality reports to be included. Note: With the assistance of Regional Chemist, obtain samples of raw water and treated water for chemical analysis, obtain samples from past records and comment on the treatment process; use the correct sampling procedures (Refer **Section-6-Chapter-2-Annex-7**). Obtain samples or records of past analyses, if available from the distribution system, for bacteriological and chlorine residual testing. Obtain records of routine testing analyses at scheme.
- Public water related/based disease

Data sources

- OIC of the scheme
- Commercial Section of Regional Office

2.2 Present Water Use Practices

Describe how people use water for their day to day work. (There may be other means of water supply even if there is an existing scheme available).

Describe the existing sources of water, their location (also include the distance travelled by users to fetch water), yield and quality (provide analysis) if an existing water supply scheme is not available. Quantitative details to be given including number of dug wells, tube wells, rain water tanks, etc. and number of families using each source as a percentage of population. Note whether the sources (e.g. streams or shallow wells) are getting depleted during dry season and what alternative sources are used in such situation.

Also discuss the water rights of the sources and alternative water sources.

2.3 Problems and Rehabilitation/Upgrading Augmentation Needs

Discuss the problems in existing schemes and highlight rehabilitation/ upgrading/ augmentation needs.

CHAPTER 3 – HEALTH AND SANITATION ASPECTS

The health status of the population of an area is directly related to the quality of water supply and use of hygienic latrines. A useful index is the pattern of morbidity of water and sanitation related diseases such as Diarrhoeal, Dysentery, Typhoid, Hepatitis, Worm Infestations, etc. prevalent in the area under study. It is therefore, important to obtain information and data on following for a period of at least 3 years.

3.1 Health Aspects

Discuss the following.

- The type, quality and accessibility of water for drinking and domestic purposes.
- Occurrence of water and sanitation related diseases (Dental disease due to fluoride problem, Diarrhoea, Dysentery, Typhoid, Hepatitis, Worm Infections, dental fluorosis etc.); and the numbers of patients seeking treatment.
- The seasonal trends of water borne diseases due to changes in weather and climate shall be discussed. Special health issues such as CKDu, Fluorosis, Nitrate/Nitrite contamination etc.
- Where patients get treatment from - a Local Clinic/Dispensary, Rural/District Hospital, private western medical practitioners or indigenous medical practitioners etc.
- Even though the GOSL has provided free health care, patients may seek their own choice of treatment depending on their affordability and beliefs. The number of deaths from water and sanitation related diseases.
- The health services provided and infrastructure - Pay particular attention to find out whether PHNs, PHIs and DDHSs are available in the project area, and details of any preventive programmes for water borne/ water related diseases;
- Health indicators related to the project area or district.
- Health improvement programmes if any, stating whether there are any health education programmes.

3.2 Sanitation Aspects

If there is a sanitation component to the project, this topic should be dealt with in more detail. Discuss the following in detail.

- Local customs and practices with respect to sanitation. Open defecation may be surrounded by certain cultural factors and beliefs in some villages. This type of local customs can cause water pollution and other related impacts.
- Hygiene habits of the community.
- The type and availability of latrines – whether cistern flushes, pour flush, pit latrine etc. Comment on the general state of maintenance of latrines and conformity to requirements such as distance to wells etc.
- Pay particular attention to open pit latrines as they provide breeding sites for flies and mosquitoes and are unacceptable.
- Houses without latrines. The reason/s for not having a latrine.

- The number of pre-school attending children in the community, their water supply and sanitation facilities and practices, possibilities of water contamination since pre-school age children are more susceptible to water and sanitation related diseases
- The number of school children in the community and their water supply and sanitation facilities.
- The general cleanliness and quality of the environment in the project area and household premises. Comment on disposal of household refuse and potential environmental pollution.
- Garbage , toxic waste and septage disposal facilities of local authorities, disposal points of garbage, whether there are any possibilities for polluting the water sources, other sources of pollution such as industries, slaughter houses, markets, service stations , agro-industry, etc.
- Adequacy of existing wastewater treatment facilities of hospitals, industries, service stations, etc. and status of existing surface drainage systems.
- Existence of high water table or flooding in the area.
- Existence of marshy / swampy areas.
- Seasonal migrations in the area during the particular period of the year and its impact on sanitation.

Even if there is no sanitation component, this section should be included, describing in brief the sanitation facilities in the community. Highlight any potential problems such as pollution of sources or poor surface drainage which may occur or be aggravated by implementation of a water scheme without a corresponding improvement in sanitation.

3.3 Health and Sanitation Data for Economic Analysis

Water Supply Schemes have been justified on the basis of expected public health benefits, which are likely to occur with the project due to the overall improvement in the quality of drinking water. There could also be negative impacts due to increased volume of wastewater. Accordingly, health benefits due to the provision of safe water have two dimensions.

The following should be considered for economic analysis.

i) Reduced health expenditures for government and individuals – Assess the amount spent for the last 03 years on medical care for water related illnesses.
ii) Economic value of days of sickness saved – Assess the number of days the individual has been sick in the last 03 years due to water borne diseases. This can be multiplied by the average daily wage to obtain a cost for the year.
iii) The cost Incurred by the Individuals for Treatment and Travelling to Medical Centres / Hospitals – Assess the cost involved based on the data for the last 03 years and calculate the costs accordingly.

Data sources

- The PHI and the Family Health Worker should have information and data on morbidity from water and sanitation related diseases.
- The local MOH / DDHS would have records of patients from hospitals who are suffering from modifiable diseases, such as dysentery, typhoid, hepatitis etc. This, however, does not give a correct picture as many patients seek treatment from indigenous or private medical practitioners.
- Statistical unit of Health Department, the Ministry of Health publishes annually "The Health Bulletin" providing information on morbidity, mortality, health infrastructure and services. The data is by Regional Director of Health Services (RDHS) of the area
- The Annual Reports and Health Reports of the RDHS would also provide information on public health and sanitation components
- It should be emphasized that sufficient up-to-date information and data on water supply, sanitation, morbidity and mortality patterns may not be available. Therefore, it would be useful to undertake a special socio-economic & health survey of the project area. This is discussed in detail in Annexure; **Section-5-Chapter-4-Annex -1**.
- Regional Epidemiologist at the Provincial Directorate for Health Services

CHAPTER 4 - SOCIAL ASPECTS

Social Assessment is a process for taking account of the key relevant social issues through a participatory strategy, for involving a wide range of stakeholders, to ensure that development operations are responsive, affordable and sustainable.

Following information in details shall be provided in the report. Questionnaire given in **Section-5-Chapter-5-Annex-2** shall be used to collect details.

4.1 Administrative Boundaries

Mention the administrative boundaries of the proposed project area. Refer **Chapter 1**.

4.2 Demography

- Population size, growth rate, mobility
- Average household size and characteristics

4.3 Socio-Economic Status

- Average Family size
- Status of Establishments
- Level of education or Literacy
- Income distribution and Expenditure patterns

Data source

- Resource Profile in DS Office

- Willingness to pay and affordability

4.4 Social Issues regarding Existing Water-Use Practices

Potential water sources and conflicting issues in obtaining water resources from different agencies and affected communities (e.g. land issues, water rights, sharing of water, protecting catchments as common property).

4.5 Social Assessment

4.5.1 Procedure for Social Assessment

There are several methods for social assessment as given below. A mix of any or all these methods can be used to assess socio-economic and cultural factors.

- Social surveys
- Stakeholder consultations
- Focus group discussions
- Interviews of key informants
- Participatory Rapid Appraisal (PRA) Techniques

Some tools that may be adopted for collecting information / primary data for social assessment are the following.

- Observation
- Questionnaires
- Interviews
- Home visits
- Community meetings and consultations
- (Divisional Coordinating Committee (DCC) meeting will be a good place)
- Small group discussions

Refer details in **Section-5-Chapter-4-Annex-1**

4.5.2 Public/Stakeholder Consultation

The concepts of Public Consultation and Hearing Process are applicable to water supply schemes in main cities, small towns and villages to determine the needs/demand of pipe water supply and sanitation schemes, willingness to pay for the services including capital contribution, identification of potential water sources, protection of watershed area and water quality, agreement for formation of the Community based Organizations devoted for planning ,operation and maintenance of the water supply facility provided except in case of main town water supply schemes.

During the public consultation process available data from different sources shall be validated and data gaps shall be filled.

4.6 Data for Valuation of Social Cost/Benefit

4.6.1 What is Baseline Survey

The purpose of a baseline survey is to provide an information base against which to monitor and assess a project/s' progress and effectiveness during implementation and after the project is completed. Sometimes the data needed for a baseline, against which to measure the degree and quality of change during project's implementation, will already exist. In such cases the only task is to collate the data and ensure that it can be updated in the longer term. So it is important to find out what information is already available. But more commonly, there will not be any existing data, or it will be incomplete or of poor quality, or it will need to be supplemented or broken out into categories that are relevant for the project being implemented.

When planning a baseline survey, it is needed to determine both what change needs to be assessed and what sort of comparison(s) will need to be made as part of that assessment of change.

4.6.2 Primary Data

The details of baseline survey and methodology are discussed in this chapter. A baseline study measures the situation at the beginning of the project. This can then be compared to the situation after the end of intervention, to establish what change has occurred. Further, the data on details of family size, income of the beneficiaries, necessity of water, water consumption patterns, time spent in collecting water, the amounts beneficiaries are willing to pay for water per month and hygiene habits and disease statistics are obtained for this baseline survey.

4.6.3 Economic Data

In the 'without-project' situation, time spent in collecting water from the nearest source of water supply (e.g., wells, tank, river, stand posts on the road) may be high, especially during the dry season. An important benefit from a piped water supply and provision of public taps is that it brings the source of water very close to the households. Time saved considering 'with-project' and 'without-project' situations can be estimated. It is somewhat difficult to value time in monetary terms. Different approaches have been used by different agencies and authorities in this regard.

4.7 Resettlement

Population transfer or resettlement is the movement of a large group of people from one region to another, often a form of forced migration imposed by state policy or international authority.

In Sri Lanka, in the government development programmes resettlement is commonly exercised. Resettlement cannot be avoided in some major water supply projects. The resettlement programmes shall be planned to satisfy the community of resettled people and ensure that they contribute positively and effectively to the society and economy. Within the resettlement process the people shall be ensured secured and honourable living by providing suitable shelter, sanitation, livelihood and other assistance effectively to improve their standard of living.

If we identify the resettlement process and social issues regarding water supply the resettlement effects can be minimized and project will be affordable and sustainable. Therefore, resettlement shall be planned very consciously and cautiously considering all the aspects within it. A guideline for planning the resettlement activities is in **Section-5-Chapter-4-Annex-8.** The resettlement budget prepared at this stage can be used for preparation of cost estimate in Clause 8.6 herein.

4.8 Social Screening Reports

Many bi-lateral and multi-lateral donors and other funding agencies now require Social Screening Reports or similar screenings to be included in the Feasibility Reports and a sample of one such Report is given in **Section-6-Chapter-4-Annex-1.**

4.9 Social Impact Assessment (SIA)

A social impact assessment should be carried out to find out, how various groups of people are affected by the project. SIA will be conducted to ensure that benefits of the project are maximized, prevent negative social impact and avoid controversies, link goodwill between project proponents and the public.

Please refer **Chapter 4 – Social Aspects**, for methods of collection of data.

Details are given in **Section-5-Chapter-4-Annex -1**.

4.10 Social Safeguard Management Plan

In the Social Safeguard Management Plan mitigation measures or management strategy shall be indicated for the social impacts which are identified through public consultation or any other information sources. Compliance monitoring shall be carried out during the construction or after completion.

Budget for the social safeguard management plan should be prepared and indicated in the cost estimate. Social safeguard screening format prepared according to the social safeguard management plan shall be included into the report.

CHAPTER 5 - ENVIRONMENTAL ASPECTS

Environmental impacts due to implementation of a new water supply scheme or an augmentation of an existing water supply scheme shall be discussed in this chapter.

Land use map of selected areas, available data and the National Atlas published by CEA could be used to collect relevant data and information.

Following information should be included in the feasibility study report.

5.1 Legal requirement for environmental impact assessment

State whether an EIA is required to be carried out.

Legal requirements for conducting Environmental Impact Assessment (EIA) are given in **Section-5-Chapter-5-Annex -1.**
Details of EPL are in **Section-5-Chapter-5-Annex-2.**

5.2 Existing environmental situation of the project area

Describe about the physical, biological and social environment in detail. Relevant data can be extracted from the National Atlas and field survey.

A land-use map of catchment areas and project area shall be presented.
Refer **Section-5-Chapter-5-Annex -3** for details.

5.3 Possible environmental impacts which could arise from the proposed water supply project

Possible environmental impacts which could arise due to the proposed project should be stated.
Refer Section-5-Chapter-5-Annex -1 for details.

5.4 Possible environmental issues which could affect the success and sustainability of the proposed water supply project

Mention the possible environmental issues, which could affect the success and sustainability of the project. The guideline in **Section-5-Chapter-4-Annex -9** could be used for data collection;

- From the catchment area and
- From upstream of the water source (Part of upper catchment area)

5.5 Possible Mitigation Measures

Mention the possible mitigation measures for the identified possible environmental impacts.

- Impacts by the project
- Impacts that affect the project

- Implementation plan for the mitigation measures

Refer **Section-5-Chapter-5-Annex -4.**

5.6 Source protection and catchment conservation programme

For Major Projects include briefly a programme for source protection and catchment conservation.

A typical format of such a programme is given in **Section-5-Chapter-5-Annex -5.**

5.7 Environmental Management Plan

Environmental Management Plan, which consist of implementation of mitigation plan; monitoring of mitigation measures; institutional arrangement for implementation and monitoring of mitigation measures; and the time frame, should be prepared and included in the report.

Details are given in **Section-5-Chapter-5-Annex -6.**

5.8 Cost Estimation for Mitigation of Environmental Impacts

A cost estimate shall be prepared for the above mitigation measures.

Refer **Section-5-Chapter-5-Annex -7** for details.

5.9 Environmental Screening Reports

Many bi-lateral and multi-lateral donors and other funding agencies now require Environmental Screening Reports or similar screenings to be included in the Feasibility Reports and a sample of one such Report is given in **Section-5-Chapter-4-Annex -9**.

A sample Ecological Impact Assessment report is given in **Section-6-Chapter-5-Annex -1** for further reading and to use if necessary.

CHAPTER 6 – WATER RESOURCES

Detailed investigations should be carried out for all potential water sources identified in the prefeasibility study.

The source(s) required to cater for the projected water demand should be evaluated in terms of quantity, quality, environmental feasibility and social acceptability. The advantages and disadvantages of the different sources should be tabulated.

For each source,

- Carryout surveys and investigations up to level required to establish technical feasibility, sustainability and a realistic cost estimate for abstraction/intake.

6.1. Surface water sources

For each source, to assess the safe yield,

Data source

- Department of Irrigation
- Mahaweli Authority of Sri Lanka
- Department of Agrarian Development
- Provincial Department of Irrigation

- Carryout flow measurements and gauging to measure minimum flows, dry weather flows, flood flows; collect hydrological data (rainfall, stream flows, runoff coefficients) to carryout simple hydrological analyses to assess safe yield of source in average and drought years. (Refer D2 Manual for details)
- Keep a record of minimum and maximum levels of water sources (streams, lakes, rivers, etc.) to assess the safe yield of water source.
- For reservoirs, tanks and lakes collect details and show level vs. capacity curves.
- For reservoirs, tanks and lakes collect details of Inflow, outflow and evaporation and carryout water balance.
- Consider other users of water source and assess the quantity of usage. (Used for cultivation, downstream uses etc.)
- If there is a need for carry out hydraulic modelling of the source, the details should be collected or the services of an organization / agency should be obtained.

6.2. Ground Water Sources

Regarding ground water sources, a report shall be obtained from a geologist. Desk study report of the pre-feasibility study can be used as a guide.

Groundwater is a hidden and renewable resource which can be used as it is direct or after limited treatment.

The groundwater potential of the area is governed by the hydro-geological and structural geological conditions of the respective area. Therefore, a comprehensive hydro geological investigation is needed to understand the behaviour of groundwater system and its sustainability.

Further to the results obtained from the prefeasibility study the following steps should be followed to assess the groundwater potential.

i) Geophysical Methods

The sub-surface characteristics at the probable potential area will be acquired using indirect methods (geophysical methods). The geophysical methods such as thickness of geological formations, depth to water level, location of subsurface faults and thicknesses, nature of geological materials, and depth to bed rock provide very useful information.

Each and every geophysical method has advantages, disadvantages, and constrains. Therefore at least two of following methods should be used.

- Resistivity Survey
- Electromagnetic method
- Self-potential Method (SPM).

Data source

- Department of Irrigation
- Mahaweli Authority of Sri Lanka
- Department of Agrarian Development
- Provincial Department of Irrigation

- Seismic refraction and reflection
- Magnetic method

(Refer Section-5-Chapter-6-Annexx-1)

ii) **Auguring and Jetting**

This method is widely used during groundwater investigations to grasp an idea of the subsurface conditions in alluvium and quaternary deposits when necessary.

iii) Geophysical Logging

Geophysical logging is also an indirect method and is used to collect the subsurface details of drilled boreholes. All geophysical logs are obtained by lowering a probe down the borehole and recording continuous measurements with depth.

The widely used methods are listed below for information.

- Caliper logging
- Electrical Resistivity logging.
- Spontaneous potential logging
- Temperature logs

(**Refer Section-5-Chapter-6-Annexx-1, Section 2**)

iv) Detailed Hydrogeological Analysis and Conceptual Model

Based on details collected from the above, hydrological analysis and conceptual model will be done for better understanding of the groundwater system and to ascertain the following.

- Define recharge and discharge areas
- Define water bearing formations (thickness and extent)
- Define type of well or intake, and well design
- Define screens, gravel pack, slot size, etc.
- Define inter relationship between aquifers
- Define drilling method, number of wells, predicted drilling depth, diameter and well spacing
- Establish hydrogeological parameters such as transmissivity, storage coefficient, and specific yield
- Establish hydrogeological factors relating to the groundwater quality

v) Test Drilling

Based on the results obtained from the above studies, potential locations for groundwater abstractions shall be identified.

Test drilling shall be done to assess the geological formations, flushing yield and quality of the groundwater.

(Refer Section-5-Chapter-6-Annexx-1, Section 3)

vi) Yield Testing

Pumping tests are mainly conducted to calculate well and aquifer parameters and to determine the optimum yield of a well. There are two types of tests used to calculate aquifer and well parameters.

They are;

- Step- drawdown test
- Constant- rate test.

During the yield test, water samples shall be collected and tested to obtain the groundwater quality.
(Refer Section-5-Chapter-6-Annexx-1, Section 4)

The effect on surrounding deep / shallow wells shall be monitored during the tests.

vii) Groundwater geochemistry

Groundwater geochemistry map should be prepared to understand the aquifer environment, possible changes due to the groundwater pumping, and groundwater flow pattern.
Groundwater geochemistry has a potential use for tracing the origin and the history of groundwater. Water compositions through reactions with the environment and groundwater quality may yield information about the environment through which the water circulated.

The analysis of major ions (Sodium, Potassium, Calcium, Magnesium, Carbonate, Bi-Carbonate, Fluoride and Chloride) and redox potential are important to determine recharge zones and geochemical modelling of groundwater.
(Refer Section-5-Chapter-6-Annexx-1, Section 6)

viii) Groundwater budget and groundwater recharge

Knowledge of the amount of natural recharge to an aquifer is mandatory in groundwater development programme. Therefore, the natural annual groundwater recharge should be assessed by using appropriate methods.
(Refer Section-5-Chapter-6-Annexx-1, Section 5)

ix) Groundwater conservation and sustainability of the aquifer

Following factors shall be assessed in respect of groundwater protection and sustainability of the aquifer and the aquifer system.

- Pollution sources with respect to recharge area and potential risks to aquifer
- Groundwater flow pattern and system
- Identification and demarcation of areas for well head and aquifer protection
- Artificial recharging capacity
- Future groundwater development

Parameters to be considered;

- Sampling methods
- Water safety plans
- Water quality monitoring
- Water quality surveillance programme
- Water quality sanitary survey

(Refer **Section-6-Chapter-2-Annexx-7** for details).

- On the basis of quantity and quality of water source, select one or more (if available) possible alternatives for further study and analysis.
- Discard water sources having problems in quality and quantity.

CHAPTER 7 - PLANNING CRITERIA

Guidelines for the 'Planning Criteria' to be used are given in **Section 4**.
In this chapter a summary of the planning criteria used in the study should be stated.

They should cover,

- Design Horizon
- Assessment of population growth rates
- Seasonal migration
- Assessment of future developments
- Per capita water demands
- Assumptions for non-domestic water demands
- Assumptions for NRW and details of proposed DMA's and number of connections in each DMA
- Basis for fire demand
- Position regarding CBO managed schemes

Data sources

- RSCS
- OIC
- CBO

Data sources

- Maps from Department of Survey (Web site www.surveydept.lk) etc
- Available GIS maps from UDA (Web site www.uda.lk)
- Available maps from Mapping Section of NWSDB

CHAPTER 8 - PROPOSED PROJECT

Data sources for Maps

- Mapping Section of NWSDB (Refer Section-4-Chapter-4-Annex-1)
- Survey Department
- Planning and GIS Section of UDA
- Google Maps
- LUPPD for land use maps

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The proposal shall be based on the guidelines specified in **Section 4: Planning Criteria**.

8.1 Population and water demand

The following shall be included.

- A map(s) indicating the GND boundaries, population densities, existing and proposed service areas.

Data sources

- If the proposed area is an urban area declared by UDA, development plans are available with the UDA. Section-4-Chapter-4-Annex-5 shows a list of urban areas declared by UDA.
- For other areas including plans of sacred areas are available in the Department of National Physical Planning.
- Development plans available with Divisional Secretaries, BOI etc.

- Computational table for projected service population.
- Computational table for projected water demand. The assumptions should be clearly stated.
- Listing and the position regarding CBO managed rural water supply schemes.

Data sources

- NWSDB Mapping Section
- Department of Survey
- UDA – GIS Section
- Department of Irrigation /Provincial Department of Irrigation/ Department of Agrarian Service/IMMI/Mahaweli Authority

For detailed calculation of population forecast refer **Section-4-Chapter-4-Annex-2** and **Section-4-Chapter-4-Annex-3** as a guideline. For this calculation composite growth rate considering all the factors contributing to population increase as described in "Assessment of Growth Rates" in the Chapter Planning Criteria shall be prepared with suitable assumptions.

A basic sample calculation is given **in Section-6-Chaptre-8-Annex-1**. A basic format for demand calculation and basic sample calculation for demand calculation are in **Section-4-Chapter-4-Annex-6** and **Section-4-Chapter-4-Annex-7** respectively.

8.2 Water source

The information and evaluation under the prefeasibility study should be revalidated and more details on flow measurements, water quality etc. may be added.

Describe all water source alternatives including the source(s) that is currently used, if any, such as rivers, streams, lakes, tanks, irrigation canals, springs, deep and shallow groundwater, and nearby water schemes with excess capacity.

The alternative water sources should be evaluated based on the guidelines given in **Section 5.** The availability of groundwater and its potential as a source should be reported. Such a report should be presented even if groundwater is not recommended as a source.

A comparison of the alternatives should be made and the basis for selection of the source(s) should be stated.

8.3 Comparison of alternative proposals

The alternative proposals identified during the prefeasibility stage with the revalidated data and information should be compared. The alternative proposals may consist of alternatives on the following.

- Water sources
- Storage locations
- Transmission arrangements
- Distribution arrangements

The alternatives may be assessed based on their merits, demerits and preliminary costing. Environmental and social impacts should also be considered. If it is not possible to select the best option at this stage, it may be necessary to proceed with the detailed evaluation after carrying out preliminary designs for the respective alternatives.

8.4 Preliminary Designs

It is expected that additional investigations and surveys related to the intake, treatment plant, transmissions, distribution system, would have been carried out after prefeasibility stage.

Hence the preliminary designs carried out during feasibility stage will have to be more detailed. Preliminary designs shall be carried out for the main components of the water supply scheme including,

- Intake/pumping station capacities, design layout, pump duties, ancillary equipment.
- Raw water transmission pipe trace, hydraulic designs and sizing.

Data sources

- District land use officer
- Local Authorities
- UDA (Web site www.uda.lk)
- DS Divisions

- Location, conceptual design and processes of treatment facilities.
- Location and capacities of ground and elevated storage facilities.
- Treated water transmission pipe traces, hydraulic designs and sizing.
- Distribution system pipe layout, preliminary hydraulic network analysis and pipe sizing.

8.5 Design Aspects

Intake and Treatment Plant:

- Carry out a survey of the upstream areas to check on any pollution sources that may affect water quality. Verify possibility of pollution mitigation.
- Based on the water quality analyses that have been carried out (Chemical and Bacteriological, Heavy Metals, Pesticides, Manganese, Algae etc.), select the treatment method.

- Carryout basic hydraulic designs to size the treatment plant components.
- Arrange treatment plant components on the site map of suitable scale.
- Design the connecting channels or pipelines. Carry out basic hydraulic calculations to determine pipe diameters or channel cross sectional areas.

Decide on the instrumentation and the level of automation in the treatment plant.

- In instances of complex water quality, a pilot plant study may have to be carried out.
- In some situations, it may be feasible to incorporate Mini Hydro Power Plant which could supplement the power requirement of the treatment plant/pump house and/or supply excess power to the national grid.

Data source

- Refer Chapter 2

Basic design criteria to be adopted to size the treatment plant components, pipe diameters, pump capacity, pumping head, etc.

- For each possible alternative source, develop a schematic diagram showing components (Intake, treatment plant, storage reservoirs, pump houses, distribution system etc.) and locate them on a map.

(Select a suitable scale, maps are available in Department of Survey /UDA-GIS Division)

- Show integration of projects with existing water supply scheme, if any.
- Describe facilities of each water supply alternative. Show hydraulic profiles, pipe routes, sizes, materials etc.

(Refer **Section-6-Chapter-8-Annex-2** and **D2 Manual** for basic design criteria)

Transmission system:

- Possible pipeline routes should be identified.
- Gravity transmissions should be designed for the carrying capacity of the pipeline during the design period. For large systems duplicating the pipeline within the design period may be considered.
- Pumped transmissions should be designed for optimum pipe diameter considering transmission / pump capacity and the corresponding capital and life cycle electricity costs.

- The pipe material and class/pressure rating shall be compatible with the working pressure of the pipeline including surge pressures. The pipe material / type of joints could differ according to the terrain, soil condition, above ground construction etc.
- Surge pressures should be computed using an appropriate method/software. Where necessary suitable surge suppression equipment should be provided.
- Soil testing on pipeline route will have to be carried out if preliminary inspections indicate encountering weak soils or rock excavation.

(Refer **Section-6-Chapter-8-Annex-2** and **D2 Manual** for basic design criteria)

Pumping facilities:

Decide on the pumping configuration, pumping hours, capacity and number of pumps, standby pumps etc.
For transmission systems that are subject to varying pressures or flow rates the possibility of incorporating of VSD should be checked.

A Variable Speed Drive (VSD) is a type of motor controller that drives an electric motor by varying the frequency and voltage supplied to the electric motor.

VSDs may be used for,
Raw water transmission,

a) When there is a substantial fluctuation in the source water level.
b) To regulate the flow rate to the treatment plant.

Treated water transmission,

a) Mainly for flow rate regulation.

Procedure for designing VSD for level fluctuation

- Determine the pump head range corresponding to the design flow rate.
- Select an appropriate pump with characteristics to match the higher head duty at approximately 90% of maximum speed.
- Check the speed of the pump for the lower head duty. Preferably it should be equal or higher than 60% of maximum speed.
- Procedure for designing VSD for flow rate regulation
- Determine the pump head range corresponding to the higher flow rate.
- Select an appropriate pump with characteristics to match the higher flow rate at approximately 90% of maximum speed.
- Check the speed of the pump for the lower flow rate. Preferably it should be equal or higher than 60% of maximum speed.
- For distribution systems also there could be VSD pumping applications. In larger systems it may not be always feasible to satisfactorily maintain the supply from elevated storage. The land availability and cost of elevated storage may be restrictive.

Under such situations, direct pumping from ground storage to distribution may be considered using multiple pumps or VSDs. Elevated storage tanks could function as balancing storage.

Multiple pumps are more suited for lower capacity systems. The number of pumps in operation would vary depending on peak, average or lower consumption times.

VSD pumping systems are suited for larger capacity systems. Here the pump speeds would be varied to suit the flow (consumption) variation.

Procedure for designing VSDs for direct pumping to distribution

- Assess the diurnal consumption variation of the system. Consider existing/proposed elevated storage tanks.
- Carry out time simulated hydraulic analysis using a suitable software. Identify the critical points in the distribution in terms of pressure. Fix the hydraulic grade at these points. With the time simulated analysis it will be possible to establish head-capacity variation of the system.
- Pick about five duty points including the peak and low flows. Select an appropriate pump with characteristics to match the higher flow rate at approximately 90% of maximum speed.
- Check the speed of the pump for the lower flow rate. Preferably it should be equal or higher than 60% of maximum speed. Pump efficiency at the lower flow rate should be checked.
- At times it may not be possible to realise the lower flow rate with the same pump. In which case a separate lower capacity pump may have to be used for lower flow rates.
- Specifications for the pump, VSD and frequency control instrumentation should be drawn up on the above basis. M&E section should be consulted for preparation of detailed specifications.
- Decide on the level of automation. (Fully automated or partially automated with manual override, remote sensing etc.)
- Describe availability of power, land requirement and availability of access roads etc.

Renewable energy sources such as solar, wind power should be considered where applicable especially for small scale facilities. Systems should be designed for minimum/optimum power consumption.
(Refer **Section-6-Chapter-8-Annex-2** and **D2 Manual** for basic design criteria)

Distribution system
Layout of distribution pipe network may vary depending on the water storage locations. If there are alternative storage locations the corresponding alternative distribution systems will have to be designed.

The following procedure should be followed.

- Locate storage reservoirs/tanks in the distribution system. Determine storage capacities.
- Develop the distribution pipe network. Assign/distribute the water demands to the respective nodes. Elevation of pipe route/nodes shall be obtained using a high accuracy GPS or levelling instrument. Cross reference may be done with the available maps.
- Carry out hydraulic analysis. Ensure optimisation of the design in compliance with the minimum pressure requirement. If there are elevated areas outside the road/pipe network or possibility of extension of the network, higher residual pressures may be required in the corresponding nodes as applicable. Tabulate the pipeline diameter, pipe materials and lengths.

- Time simulation hydraulic analysis will have to be carried out if direct pumping systems or VSDs are to be provided. (Refer **Section-6-Chapter-8-Annex-2** and **D2 Manual** for basic design criteria)
- Verify the water travel in the distribution system using the model analysis and reduce the stagnant time and dead ends by improving the system.

Rehabilitation / augmentation of existing schemes

The details and data of the existing scheme as indicated in **Chapter 2** shall be obtained and analysed. A detailed study of the following in terms of capacity, working condition, reliability, efficiency and remaining useful life should be made.

- Intake structure, pumping equipment, ancillary equipment
- Raw water transmission system
- Water treatment facility structures, pumps, equipment, pipework
- Treated water transmission system
- Storage reservoirs
- Distribution system

The same procedure as stipulated for new systems should be followed in order to ascertain the augmentation / rehabilitation capacities and requirements.

The physical works may include,

- Rehabilitation / modification of the intake structure
- Rehabilitation / replacement of raw water pumps and ancillary equipment
- Rehabilitation / laying of additional raw water transmission pipeline
- Rehabilitation / augmentation of treatment plant components
- Extension / additional treated water storage
- Rehabilitation / replacement of treated water pumps and ancillary equipment
- Rehabilitation / laying of additional treated water transmission pipelines
- Rehabilitation / laying of additional distribution pipelines

Additional considerations,

- Elevations given in the available drawings may be used.
- Check the pipe line routes for way leaves, encroachments.
- Check additional land requirements for treatment facilities, pumping stations, storage tanks, and disinfection facilities.
- If treated water storage is inadequate and providing additional storage is not feasible due to non-availability of lands etc., consider direct pumping systems with multiple pumps or VSDs converting existing storage tanks to balancing tanks.

Maps and Schedules,

- Show preferably in a GIS map or on a 1: 50,000 map (or other suitably scaled map) site locations of intake, raw water transmission, treatment plant, storage reservoirs, treated water transmission, pumping stations and distribution zones.
- The hydraulic profile of the entire system shall be provided.
- Show on a map the locations of rural water supply schemes within the project area.

- Provide a schedule of all lands to be acquired and the status of acquisition.

8.6 Total Cost Estimate

Section-5-Chapter-8-Annex-2 shows a typical Total Cost Estimate based on estimated costs from the NWSDB Rate Book. Some explanations are given below;

- Unit Rate: The value directly taken from the Rate Book,
- The Basic Amount for each item shall be calculated based on the 'Unit Rates'.
- The 'Basic Amount' of each item shall be proportioned as the fraction influenced by local costs and the fraction influenced by foreign costs. Cost factors shall be assigned accordingly. These factors shall be used for computation of price escalations. (For cost factors refer **Section-5-Chapter-8-Annex-3**).
- The Cost factors proportioned to foreign and local costs are included in the NWS&DB Rate Book.
- In addition, allow in the cost estimate for all O&M facilities as mentioned in **Section-5-Chapter-8-Annex-4.**
- Include the cost for preparation of feasibility report in the total cost estimates.

In preparation of the TEC, in addition to the major project components, due attention should be given to the following in order that an all-inclusive comprehensive TEC is prepared.

- Awareness of depth of Water Table in pipeline routes and work sites
- Soil investigation for structures and transmission mains
- Rock profiles in Intake, Treatment plant location and along pipe line routes
- Landscaping requirements
- Detailed survey at culverts and bridge crossings
- Environmental issues
- Resettlement
- Catchment Protection and Water Safety Plan
- Road types and road reinstatement requirements including the existing utilities in the roads and space available for new pipe laying work
- Rural water supply requirements

O&M costs:

The O&M arrangement should be stated and a complete assessment of the O&M costs should be made considering the following.

- Staff and labour requirements (for intake, treatment plant, distribution, pump houses)
- Chemicals requirement,
- Electricity requirement,
- Maintenance programme,
- Spare parts,
- Vehicles,
- Quarters,
- Water Safety Plan,
- Water source and catchment protection / improvement of water source.

8.7 Sanitation (if there is a sanitation component in project)

Describe the facilities to be constructed, including the proposed numbers and types of latrines, and include a tentative cost estimate. Note any potential problems with soil type or drainage which may affect the latrine type or construction method.

Even if a sanitation component is not there in the project, if there is a necessity to construct septage treatment, latrines and sanitation facilities to protect the water source, such items shall be included in the report with the tentative cost estimate.

8.8 Water Safety Plans

Water Safety Plan for the Project shall be described. Brief introduction on the Water Safety Plan is given in **Section-5-Chapter 8–Annex-6.**

8.9 Implementation Schedule

Include a chart similar to **Section-5-Chapter-8-Annex-5** showing in outline, the tentative implementation schedule. Indicate who would be responsible for detailed design and construction.

CHAPTER 9A - FINANCIAL ANALYSIS

9.1 Financial Benefit-Cost Analysis

The above section is as described in **Section 7** for prefeasibility studies, except for the following:

The analysis should be done up to the loan repayment period. Previous loan repayments in respect of the same project (even though it has several phases) shall not be considered.

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Project Net Benefit = Project Revenues - Project Costs

Note: The net benefit stream is sometimes called the (net) cash flow.

In the Financial Analysis, the following scenarios shall be considered.

Scenario – 1; Project assuming 100% cost recovery

i) Project in isolation with AWPLR (Average Weighted Prime Lending Rate) discounting rate (market discount rate for countries such as Sri Lanka, India[7])

IRR calculated for this scenario shall be more than AWPLR + 2.5% for positive NPV, for the project to be viable for commercial financing.

- Total loan to be repaid with interest rate of AWPLR + 2.5%,
- Grace period 3years and loan repayment period to be 12 years,
- O&M Cost shall be increased (assume a rate of 5% p.a.),
- Revenue to be increased according to Tariff policy (assume a rate of 5% p.a.),
- Financial analysis to be carried out for 40 years.

Interest payment to be paid as based on assumed contract cost from first year.

If the IRR is greater than AWPLR + 2.5% the project is viable and no need to analyse the next scenarios.

Scenario – 2; Project financing under the Government on lending concession

ii) If the project is not viable for commercial financing as described in (i) above, the discounting rate shall be calculated based on weighted average cost (**Section-5-Chapter-9-Annex-2**) (grant loan mix) of capital (WACC). If the IRR calculated for this scenario is more than the WACC, then the project is financially viable for development financing.

- A component of the loan, depending on the urban and rural categories to be repaid with applicable interest rate,
- Grace period 3 years after commissioning and loan repayment period to be 12 years,
- O&M Cost shall be increased (assume a rate of 5% p.a.),
- Revenue to be increased according to Tariff policy (assume a rate of 5% p.a.),
- Financial analysis to be carried out for 40 years.

If the IRR is more than WACC, it is considered the project is viable and analysis shall not be done further.

Scenario – 3 : **Project funded under the Government on lending concession, including Economic analysis.**

iii) If IRR becomes less than WACC an economic analysis need to be carried out to arrive at a feasible solution. However, at the prefeasibility stage it is difficult to carry out an economic analysis. Therefore it shall be recommended in the prefeasibility report to carry out a socio economic survey in the pre-feasibility stage in order to find out the details for economic analysis.

If the (FIRR + EIRR) is more than WACC, it is considered the project is viable and analysis should not be continued?

Scenario – 4 : Project assuming only covering the O & M cost

Further the Financial Analysis shall be carried out only taking into account the operation and maintenance cost. If the project is viable with operation and maintenance cost, the project shall be recommended for grant funding.

- The discount rate shall be taken as 5% ,
- O&M Cost shall be increased (assume a rate of 5% p.a.),

[7]Data available from Central Bank of Sri Lanka

- Revenue to be increased according to Tariff policy (assume a rate of 5% p.a.),
- Financial analysis to be carried out for 40 years.

CHAPTER 9B - ECONOMIC ANALYSIS

When a project is not financially viable considering only its financial terms, an economic analysis shall be carried out considering the indirect benefits and costs due to the project. The economic analysis of a Water Supply Project (urban or rural) has to follow a sequence of interrelated steps.

- Identify Project Purposed
- Identify Economic Costs & Benefits

(Refer **Section-5-Chapter-9-Annex-7** and **Section-5-Chapter-9-Annex-8** for more details)

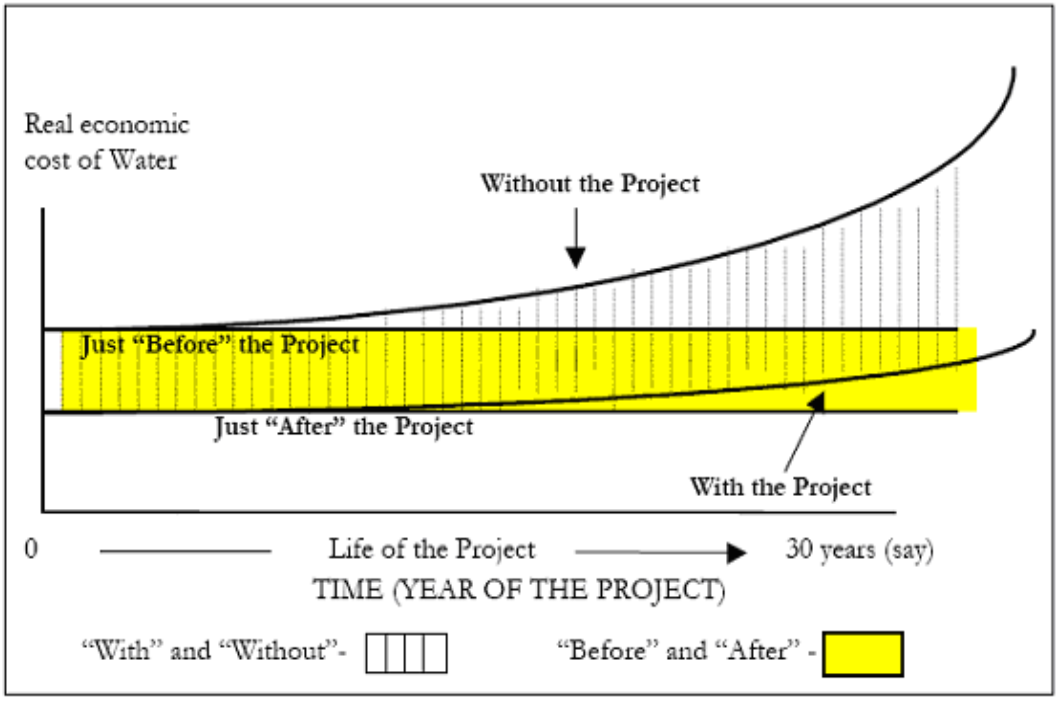
The initial step in testing the economic viability of a project is to identify, quantify and value the economic costs and benefits. The following two important principles are to be followed.

i) Comparison between 'with-project' and 'without-project' situations; and,
ii) Distinction between 'non-incremental' and 'incremental' inputs (costs) and outputs (benefits).

(Refer **Section-5-Chapter-9-Annex-7**)

The comparison between "with" and "without" the project is often different from the comparison between "before" and "after" the project. The without project situation is that which would prevail if the project is not undertaken. For example, population in the project area will grow leading to an increase in the use of water; and water sources will become increasingly scarce and remote, contributing to a higher cost of water to the consumers. The situation, therefore, will not remain static at the level just "before" the project.

The project inputs and outputs should be identified, quantified and valued by comparing the 'without-project' situation with that of the 'with-project' to cover the relevant project benefits and costs. Figure below shows the differences of the real economic cost of water in the 'with' and 'without' project and the 'before' and 'after' project situations. A similar diagram could also be used to show the differences in the benefits between the various project situations.



Section -7- Figure - 01: "With" and "Without" Project vs. "Before" and "After" Project

(I) Costs

In estimating the economic costs, some items of the financial costs are to be excluded while some items not considered in the financial costs are to be included. This is to reflect costs from the viewpoint of the economy as a whole rather than from the viewpoint of the individual entity.

They are summarized below:

a). Taxes, Duties, and Subsidies

There would be instances where for example, the government is correcting environmental costs through a tax or a pollution charge.

For example, the volume of water withdrawn from existing agricultural use which is supplied to a newly established industrial plant is to be considered as agricultural water. Its economic cost is based on the demand price of agricultural water and as such, the transfer element (tax or subsidy) is a part of the demand price.

b) External Effects

These refer to such effects of a Water Supply Project on the activities of individuals/entities outside the project that affect their costs and benefits but which are not directly reflected in the financial cash flow of the project. For example, environmental effects of a WSP, such as river water pollution due to discharge of untreated wastewater effluent, affect activities like fishing and washing downstream.

(II) Benefits

a). Health Benefits

Water Supply Projects have been justified on the basis of expected public and private health benefits, which are likely to occur with the project due to the overall improvement in the quality of drinking water. Such benefits are likely to occur provided, the adverse health impacts of an increased volume of wastewater can be eliminated or minimized.

Accordingly, health benefits due to the provision of safe water have the following two dimensions.

b). Avoided private/public health expenditures

To calculate this, the data obtained from socio-economic surveys can be used. The total amount of expenditure spent on water related/water borne illnesses have to be added up and an average taken to be multiplied by the whole population in the project area.

$$\frac{Ex}{Ps} \times P$$

where:

Ex = Total expenditure on water related illness
Ps = Sampled population
P = Population in project area

c). Economic value of days of sickness saved

To calculate this, the data obtained from the socio-economic surveys can be used. Add up the total number of days the population in the project area have been sick from water related/water borne illnesses. Then multiply the total number of days by the average daily income

$$Sd \times Y \times P$$

Where:

Sd = Total number of sick days per person for the year
Y = Average daily income
P = Total population

d). Time Cost Saving Benefit

In the without-project situation, time spent in collecting water from the nearest source of water supply (e.g., wells, tank, river, stand posts on the road) may be high, especially during the dry season. An important benefit from a piped water supply and provision of public taps is that it brings the source of water very near to the households. Time saved in with- and without-project situations can be estimated.

Where:

$$\frac{T \times 365}{24} \times Y \times \frac{P}{Ps}$$

T = Hours spent collecting water per day
365 = Days of the year
24 = Hours in a day
Y = Daily income
Ps = Sampled population
P = Population in project area

e). Increases in land values

Refer **Section-5-Chapter-9-Annex-7** for more details

Before any detailed analysis is done, it is necessary for the project team to get acquainted with the area where the project has been identified. This is to acquire knowledge about the physical features; present situation regarding existing facilities and their use; constraints (if any) against the optimal use of existing facilities; the communities and users especially their socio-economic conditions; etc.

In view of the complex set of data to be collected, need for rigorous analysis and the low reliability/accuracy of data, this factor is not recommended to be included to the Economic Analysis.

To collect this information, the following surveys must be undertaken in the area:

(i) **Reconnaissance survey** – to collect basic information of the area and to have discussions with the beneficiaries and key persons involved in the design, implementation and management of the project.

(ii) **Socio-economic survey** – to get detailed information about the household size, earnings, activities, present expenditure for water supply facilities, along with health statistics related to water-related diseases, etc.

(iii) **Contingent Valuation Method** - This is based on questions put to households on how much they are willing to pay (WTP) for the use of different levels of water quantities.

(iv) **Survey of existing water supply facilities** - Knowledge of the present water supply sources; treatment (if any) and distribution in addition to the quantity and quality of water; unaccounted-for-water (UFW); and any constraints and bottlenecks which are coming in the way of the optimum use of the existing facility.

Using the information taken from the survey results and other secondary data sources, effective demand for water can then be estimated. Two important considerations are:

(i) Effective demand is a function of the price charged. This is ideally based on the economic cost of water supply provision to ensure optimal use of the facility, and neither over-consumption nor under-consumption especially by the poor should occur.

The former leads to wastage contributing to operational deficits and the latter results in loss of welfare to the community.

(ii) Reliable water demand projections, though difficult, are key in the analysis of alternatives for determining the best size and timing of investments.

Approaches to demand estimation for urban and rural areas are usually different. In the urban areas, the existing users are normally charged for the water supply; in the rural areas, there may not be any formal water supply and the rural households often do not have to pay for water use. An attempt can be made in urban areas to arrive at some figure of price elasticity and probably income elasticity of demand. This is more difficult in the case of water supply in rural areas with a preponderance of poor households.
(Refer **Section-5-Chapter-9-Annex-8** for more details)

Once the costs and benefits, including external effects, have been identified and quantified they should be valued. Decisions by the producers and users of project output are based on financial prices. To appraise the consequences of their decisions on the national economy, benefits and costs are to be valued at economic prices. Therefore, the (financial) market prices are to be adjusted to account for the effects of following government interventions and market structures.

(i) Transfer payments - taxes, duties and subsidies incorporated in market prices of goods and services;

(ii) Official price of foreign exchange where government controls foreign exchange markets;

(iii) Wage rates of labour where minimum wage legislation affects wage rates;

(iv) Commercial cost of capital where government controls the capital market.

Hence, as market rates in those cases are poor indicators of the economic worth of resources concerned, they need to be converted into their shadow prices for economic analyses.

Principle of Shadow Pricing (Economic Pricing)

a) Opportunity Cost

Opportunity cost is the benefit foregone from not using a good or a resource in its next best alternative use. To value the benefits (outputs) and costs, the opportunity cost measured in economic prices is the appropriate value to be used when calculating the:

Opportunity Cost of Labour.
Opportunity Cost of Land.
Opportunity Cost of Water. etc.

b) Weighting

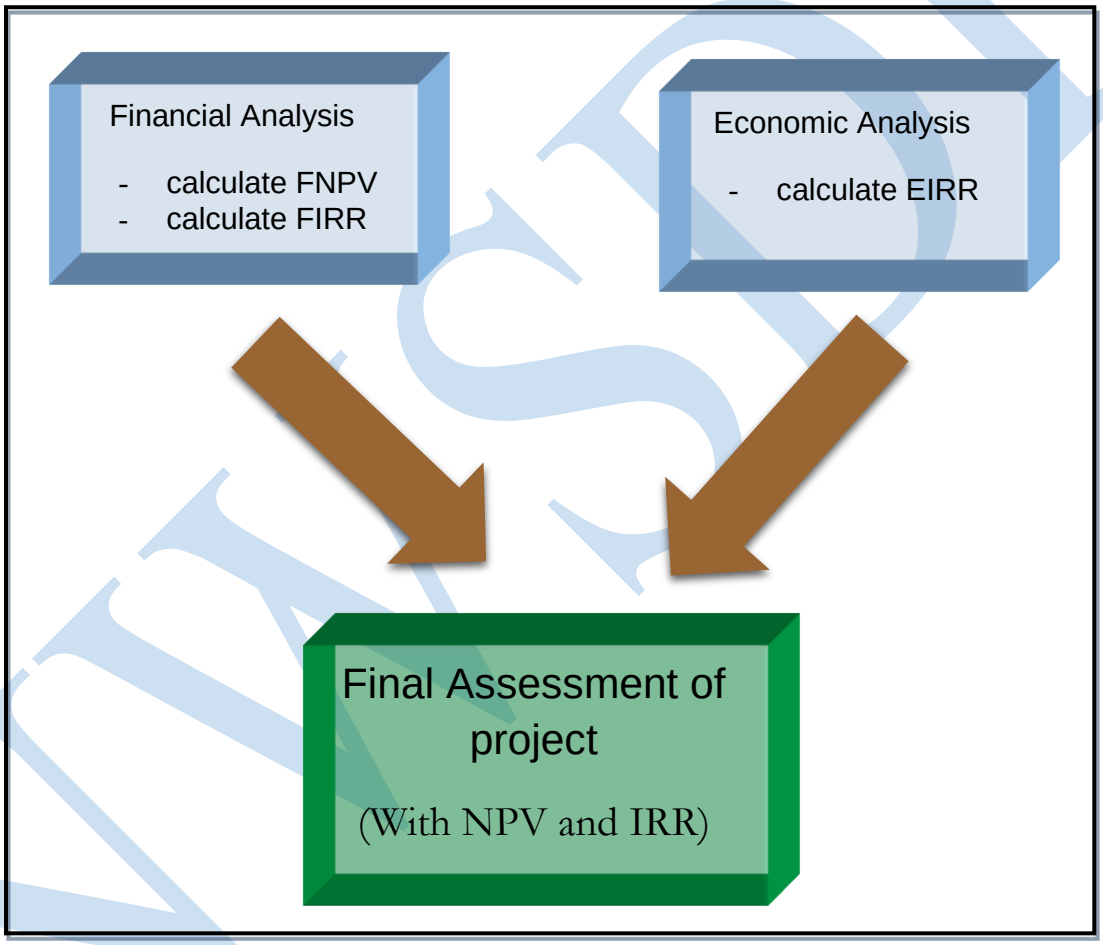
The actual values obtained for the economic analysis need to be weighted up or down depending on their importance to the project. For example, although a family may not have to spend Rs. 1000 on medical care, this Rs. 1000 may need to be weighted down by 60%. Therefore, the actual rupee benefit contribution to the project would be Rs. 600.

Section -7- Table 01: *Example of weightings*

Savings from decreased health expenditure	200	0.25	50
Savings from less days lost due to illness	400	0.25	100
Extra income from decrease in time spent collecting water	600	0.50	300
TOTAL	1200	1.00	450

Note: *Total of all weights should be equal to 1*

9.1 Combining Financial and Economic Analysis



Section -7- Figure - 01: Combining Financial and Economic Analysis

In our working example we have considered the two scenarios as follows:

1. Financial analysis given at market interest rate of AWPLR (**Section-5-Chapter -9-Annex-9a**).
2. Financial analysis considering that 50% of the finance is given from the government at an interest rate of 5% i.e. WACC 5%. (**Section-5-Chapter-9-Annex-9b**)

The following assumptions have been made in the example.

- Tariff to be increased by 25% for every three years;
- Connection fees to be increased by 25% for every three years;
- O&M cost to be increased by 10% per annum.

CHAPTER 10 – CONCLUSIONS AND RECOMMENDATIONS

10.1 Project Objective

Briefly describe the objective of the project. Provide background information regarding the project area and setting.

10.2 Project Justification

Briefly describe the justification of the project. The current status of water supply and need to provide / augment pipe borne water supplies in the area.

10.3 Conclusion

Comment briefly on the following.

- Selected project and main reasons for its selection (water source, yield, quality, land availability, pipeline routes etc.)
- The technical and financial feasibility
- Economic benefits
- Environmental, social and political aspects – both positive and negative; and mitigation measures.
- Funding requirements; possible source of capital funding; capital and O&M cost recovery.
- Proposed implementation schedule; resource requirement; and project management.
- Management of scheme and operational responsibilities.
- Other important issues if any; risks; uncertainties; sensitivities; and any other important factors affecting or likely to affect the project.

10.4 Recommendations

- Mention the recommended project, major actions and responsibilities for step by step progress towards the project implementation i.e. who does, what, when etc.
- Mention the additional or continued surveys, data collection, etc. necessary to carry out detailed designs satisfactorily and also achieve sustainable and efficient operation. (E.g. source yield, water quality, source production water supply etc.),
- Who will be responsible for maintaining and carrying out activities?
- Funding arrangements.

List all reports, data, manuals, texts, etc. referred to in the preparation of the study and report.

SECTION 8

TECHNIQUES OF REPORT WRITING

SECTION 8: TECHNIQUES OF REPORT WRITING

The problems listed below seem to occur fairly regularly in feasibility reports prepared by the NWSDB or by others. These areas and linked issues shall be reviewed to ensure that they do not occur in future reports.

- No statement of why the report is prepared or for whom; no authorisation or terms of reference.
- Incomplete table of contents, no list of figures, tables or appendices.
- No summary of important aspects or summary report.
- Inadequate background information or historical information of project area or scheme.
- No acceptable map of project area or location of scheme.
- Lack of scales or direction indicators (e.g. North) on drawings or maps; use of non-standard scales; (Access to a reducing/enlarging photocopy machine is useful for bringing maps to standard metric scales.
- Use of a mix of imperial and metric units and non- standard abbreviations (see revised Design Manual).
- Evidence of lack of report drawing standards; drawings often lack clarity and are of poor quality.
- Report presentation and/or poor typing quality; tables lack clarity; lack of checking causing errors.
- Start of Chapters not on new pages.
- Tables of important back-up data and drawings/figures are useful and should be illustrated in the main body of report adjacent to relevant text. However, often these are too numerous which tends to interrupt the smooth flow of the report text. In such cases, include at the ends of chapters or in an Appendix. Secondary back-up data (e.g. tables/ figures of temperature, rainfall, stream flow, maps of gauging stations, etc.) should also be in the Appendices.
- Details or calculations shown in main body of report- these should be attached as an Appendix to the report or in design files.
- No comments on reliability of sources of data presented; lack of references.
- Concentration on irrelevant or unimportant details at the expense of more important but may be less tangible aspects. (i. e. highly detailed population projections against very sketchy estimates of yield of water source).

SECTION 9

EVIDENCE OF INADEQUATE FIELD INVESTIGATIONS

9. EVIDENCE OF INADEQUATE FIELD INVESTIGATIONS

- Evidence of lack of community level involvement; no assessment of community interest or future participation.

- Inclusion of national population statistics – which are usually irrelevant for a small scheme. It would be more appropriate to use field data.
- Some confusion over population growth assessments.
- Disregarded for population density and actual dispersion of population
- Over-emphasis on detailed water consumption data in a rural area particularly non-domestic consumption.
- Inadequate assessment of house connection requirements; unrealistic allowances for leakage/unaccounted-for water.
- Insufficient consideration of relationship between yield of source and water demands.
- Inappropriate/inadequate approach to hydrological / hydro geological aspects of sources and source yields, lack of hydrological data or use of mapping, or data on existing groundwater source / wells; lack of flow gauging and low flow analysis.
- Insufficient water quality analyses, specially covering both wet and dry seasons.
- No proper rationale for per capita consumptions.
- Lack of information on available alternative water sources for other than drinking purposes.
- Inappropriate consideration of peaking factors or treatment losses in sizing of facilities.
- No proper basis for cost estimates.
- No clear conclusions and recommendations for actions; authors seem reluctant to make firm statements or express reasoned judgments.

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