

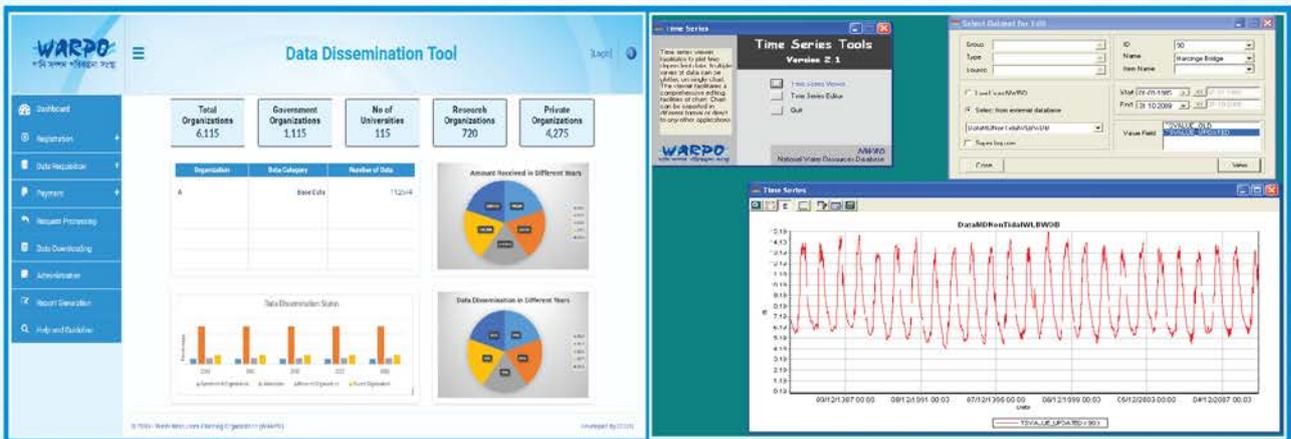


পানি সম্পদ পরিকল্পনা সংস্থা

Water Resources Planning Organization

## Inception Report

### Online Processing and Tracking of Water Resources Project Clearance and No Objection Certificates for Groundwater Abstraction



November 2019

Prepared by

**CEGIS**  
Center for Environmental and  
Geographic Information Services  
www.cegisbd.com

# **Inception Report**

**Online Processing and Tracking of Water Resources  
Project Clearance and No Objection Certificates  
for Groundwater Abstraction**

# Table of Contents

<b>List of Tables</b> .....	<b>iii</b>
<b>List of Figures</b> .....	<b>iii</b>
<b>Acronyms and Abbreviation</b> .....	<b>iv</b>
<b>Chapter 1 : Introduction</b> .....	<b>1</b>
1.1 Project Appreciation .....	1
1.1.1 Background.....	1
1.1.2 Objectives.....	1
1.1.3 Scope of Work .....	2
1.2 Deliverables .....	3
1.3 Resource Mobilization .....	4
1.4 Activities performed during inception stage .....	5
1.4.1 Contract Signing .....	5
1.4.2 Meetings.....	5
<b>Chapter 2 : Approach and Methodology</b> .....	<b>7</b>
2.1 Requirement Analysis/Needs Assessment.....	8
2.1.1 Literature Review.....	8
2.1.2 Review of Existing System .....	8
2.1.3 Identification of Requirements .....	8
2.2 Design and Development of Initial System Architecture .....	9
2.2.1 Presentation Layer .....	9
2.2.2 Web server .....	9
2.2.3 Application Server.....	10
2.2.4 Data Server .....	10
2.3 Coding Standard .....	10
2.4 Inception Workshop .....	11
2.5 Design and Development of Database .....	11
2.6 Design and Development of Web Portals and On-line System .....	11
2.6.1 Web Portal for Clearance Certificates.....	11
2.6.2 Web Portal for No Objection Certificates.....	14
2.6.3 On-line Data Dissemination Tool .....	17
2.7 Upgrade and Update Existing Desktop Applications .....	22
2.7.1 Data Quality Tool.....	22
2.7.2 Data Processing Tool .....	23

2.7.3	Statistical Analysis Tool .....	23
2.7.4	Metadata Editor .....	23
2.8	Update Guidelines, Policies and Protocols .....	25
2.8.1	Database Management Guideline .....	25
2.8.2	Data Collection Guideline .....	25
2.8.3	Data Sharing Protocol.....	25
2.9	Update Data Inventory Report .....	25
2.10	Security and Access Control .....	26
2.10.1	Application-level Security.....	26
2.10.2	Database-level Security .....	26
2.10.3	Operating System-level Security.....	27
2.11	Software Testing.....	27
2.11.1	Unit Testing .....	27
2.11.2	Integrated Testing .....	28
2.11.3	System Testing.....	29
2.11.4	User Acceptance Testing.....	29
2.12	Deployment of Database and Application .....	29
2.13	Backup and Recovery .....	29
<b>Chapter 3 : Capacity Building .....</b>		<b>31</b>
3.1	In-Class Training.....	31
3.1.1	On the Job Training.....	32
3.2	Workshop .....	32
3.3	Documentations.....	32
3.3.1	Design Report .....	32
3.3.2	Interim Report.....	33
3.3.3	Testing Report and Operational Plan.....	33
3.3.4	Draft Final Report .....	33
3.3.5	User Manual .....	33
3.3.6	Training Manual .....	33
3.3.7	Final Report .....	33
<b>Chapter 4 : Work Plan, Organization and Staffing .....</b>		<b>34</b>
4.1	General .....	34
4.2	Work Schedule .....	35
4.2.1	Team Composition and Task Assignment .....	37
4.2.2	Staffing Schedule.....	42
4.2.3	Project Implementation Arrangement .....	43
4.2.4	Project Organization.....	44

## List of Tables

Table 2.1: Status of Applications for Clearance Certificate .....	13
Table 2.2: Status of Applications for NOC.....	16
Table 3.1: Tentative Training Schedule for WARPO .....	31
Table 4.1: Team Composition and Task Assignment .....	37
Table 4.2: Staffing Schedule for the Project Period .....	42

## List of Figures

Figure 1.1: Contact Signing Ceremony of the Project .....	5
Figure 2.1: Flow Diagram of Methodology.....	7
Figure 2.2: System Architecture of Application Software .....	9
Figure 2.3: Home Page of Proposed Web Portal for Clearance Certificate.....	12
Figure 2.4: Flow Diagram of Clearance Certificate .....	14
Figure 2.5: Home Page of Proposed Web Portal for No Objection Certificate.....	15
Figure 2.6: Flow Diagram of No Objection Certificate .....	17
Figure 2.7: Desktop based Data Dissemination Tool .....	18
Figure 2.8: Home Page of Proposed On-line Data Dissemination Tool.....	19
Figure 2.9: Registration Form of Data Dissemination Tool .....	20
Figure 2.10: Flow Diagram of Data Dissemination .....	21
Figure 2.11: Data Quality Tool Developed for NWRD.....	22
Figure 2.12: Statistical Analysis Tool Developed for NWRD .....	23
Figure 2.13: Meta Data Editor Developed for NWRD .....	24
Figure 2.14: Software Testing.....	27
Figure 2.15: Unit Testing of Report Module.....	28
Figure 2.16: Integrated testing of Data Dissemination Tool .....	28
Figure 2.17: System testing of the Web Application.....	29
Figure 2.18: Incremental Backup .....	30
Figure 4.1: Tentative Work Schedule of the Project .....	36
Figure 4.2: Project Flow Chart .....	43
Figure 4.3: Project Organogram .....	44

## Acronyms and Abbreviation

CC	<i>Clearance Certificates</i>
CDSP	<i>Char Development and Settlement Project</i>
CEGIS	<i>Centre for Environmental and Geographic Information Services</i>
CERP	<i>Coastal Embankment Rehabilitation Project</i>
CSS	<i>Cascading Style Sheet</i>
DFD	<i>Data Flow Diagram</i>
DFR	<i>Draft Final Report</i>
HTML	<i>Hypertext Markup Language</i>
IWRM	<i>Integrated Water Resources Management</i>
MIS	<i>Management Information System</i>
NOC	<i>No objection certificate</i>
NWMP	<i>National Water Management Plan</i>
NWRD	<i>National Water Resources Database</i>
OTA	<i>Operational Acceptance Testing</i>
RFP	<i>Request For Proposal</i>
SQL	<i>Structured Query Language</i>
ToR	<i>Terms of Reference</i>
UAT	<i>User Acceptance Testing</i>
WARPO	<i>Water Resources Planning Organization</i>

# Chapter 1 : Introduction

## 1.1 Project Appreciation

### 1.1.1 Background

*Water Resources Planning Organization (WARPO) was established under the Water Resources Planning Act 1992 and mandated by the National Water Policy 1999 and the Bangladesh Water Act 2013 and its 2018 Rules which require it to act as not only as a strategic planning agency but also as a water resources management and regulatory agency. The recently gazette Bangladesh Water Rules 2018 place a wide range of new regulatory responsibilities on WARPO which will progressively implement by WARPO as it expands its staffing and establishes regional offices. To this end, it is essential to implement two of the highest priority measures in the 2018 Rules, those for water resources project clearance and force-mode groundwater abstraction, and also to ensure that the necessary information to apply these rules can be disseminated to those responsible for their implementation.*

*A particular feature of Sub-rule 47(6) under the Bangladesh Water Rules-2018 empowers WARPO to introduce digital processes where it deems appropriate. Thus, for new regulatory processes, this allows WARPO to leapfrog over paper-based systems to create an operating environment that is easier, quicker and cheaper to run and adds the immense benefits of greater transparency and accountability. This principle will demonstrate good governance by WARPO which benefits both public and private sectors and society at large through contributing to greater protection and more effective use of water resources.*

*The National Water Management Plan (NWMP, 2001), provides a framework to implement National Water Policy (1999) and Bangladesh Water Act 2013. This act significantly extends the mandate of WARPO into being a regulatory as well as planning organization, and requires a major expansion of its staffing and structure to achieve this. The new regulatory role is spelled out in the Bangladesh Water Rules 2018. Because implementation of all rules at all administrative levels will take a period of years, it is better to implement the Rules in parallel with increased resources in WARPO. Hence, Project Clearance and No Objection Certificates for force-mode deep tube wells and (partial) data dissemination have been selected as priority areas for action, and where operation will be supported by consultancy implants until WARPO has sufficient trained staff in place.*

### 1.1.2 Objectives

*The main objective of the project is to commence implementation of priority components of the Bangladesh Water Rules 2018, specifically for water sector project clearance and No objection certificate of groundwater abstraction under force mode. In support of these measures, the project will improve access to the information in the National Water Resources Database (NWRD) that is needed to support in decision making. This will contribute to the development of water resources in a more holistic and integrated way so as to help in finding the optimum compromise between the economic benefits across all sectors and conserving and protecting the water-related environment. The specific objectives of the consultancy service are listed below:*

- *Development of a web-based system for applying, processing and tracking Clearance Certificates as specified in Chapter 8 of the Bangladesh Water Rules, 2018.*
- *Development of a web-based system for applying, processing and tracking No Objection Certificates for Ground water under force-mode as specified in Chapter 10 of the Bangladesh water Rules 2018. For IT development purposes, there will be much synergy with clearance process, and as above, there will be listings of all applications and their status, and summary reporting thereof.*
- *Development of an on-line systems for dissemination of existing data of NWRD, ICRD and other sub-sets of NWRD for processing information to those who need information for the above measures and to other, previously approved users with established rights of, and procedures for, access to data. Within the established rules and restrictions, this will give easy access to water resources data (e.g. hydrological, environmental, social, economic, climate, fisheries etc.) that will facilitate implementation of integrated water resources management (IWRM) processes.*
- *Post und update a schedule of all regulatory measures under the Bangladesh Water Rules 2018 indicating the dates, by region and by sector, when they will come into effect so that all water users can be clear as to their obligations under the Bangladesh Water Act, 2013.*

### **1.1.3 Scope of Work**

*The overall scope of the project is to design and develop web based application for Clearance Certificates and No Objection Certificates as specified in Bangladesh Water Rules, 2018 and on-line Data Dissemination Tool. Operation and maintenance support for evaluating and issuing certificates is also required for the remainder of the project period. The detail scope of works as understood from the ToR are described below:*

- a) *System analysis, design, development and implementation of a web-based portal for the water sector Project Clearance Certification process described in Chapter 8 of the Bangladesh Water Rules 2018 with reference to implementing this for projects that exceed the financial threshold for determination by WARPO.*
- b) *System analysis, design, development and implementation of a web-based portal for issuing of No objection certificate (NOC) by WARPO for the abstraction of ground water by force-mode deep tube wells as specified in Rule 30(3) of Chapter 10 under the Bangladesh Water Rules 2018.*
- c) *System analysis, design, development and implementation of a web based Data Dissemination Tool to disseminate existing data of NWRD to line agencies, Government and private agencies, and registered researchers and students. The data will be limited to those themes that are included in the NWRD at the time of bid submission plus additional data items to the existing structure of these themes.*
- d) *Update Desktop computer with advance ArcGIS and Remote sensing Software (license software) needs for data analyzing, quality checking, processing and storing the requirements for (a), (b) and (c).*
- e) *Test application (a) with the DoE, prior to making the system fully operational.*

- f) Operate and maintain the on-line systems (a), (b) and (c) in compliance with the Conditions of the Bangladesh Water Rules 2018 for the remainder of the project.
- g) WARPO will provide the list of individuals and/or organization that will have access to the NWRD via password system.
- h) Establishing the protocols (signing MoU etc.) among different collaborative agencies for effective data storage, sharing and exchange through the NWRD web portal.
- i) Update the Data Management Guideline of the NWRD web portal which includes, maintenance and operation of NWRD web portal, data collection and processing, data Layer preparation, data quality checking, data storage and archiving, data categorization, Database development and management, principle of data sharing and dissemination, data Backup, data purging, maintaining standard in all aspects, roles and responsibilities of respective entities and other activities necessary for the best performance and efficiency of NWRD.
- j) Prepare/ update an online data inventory of data, database and remote sensing images of different organization. Moreover, data collection, processing, metadata, data sharing, status, data policy, backup system, software, and other data/database related activities.
- k) Upgrade existing offline tools of NWRD and ICRD (Data Quality Tool, Data availability Tool, Data Upload Tool etc.
- l) Development of online help and guidelines for the systems described in (a), (b) and (c) and establishment the linkages of the systems described in (a), (b) and (c) with the National Web Portal and WARPO website for easy accessibility of these systems to all stakeholders including district and upazilla offices.
- m) Development of online Mapping Tool and Reporting Tool in accordance with the requirement of (a) (b) and (c).
- n) Linkage with P-MIS (Project and Program MIS of NWRP/NWMP) with Clearing House Tools of WARPO.

## 1.2 Deliverables

The deliverables of this project are as follows:

- A. Comprehensive on-line processing and reporting tool for water sector project Clearance Certificates (CC).
- B. Comprehensive on-line processing and reporting tool for No Objection Certificates (NOC) for Ground Water Abstraction under force-mode deep tube wells.
- C. Online 'Data Export/Dissemination Tool' for data dissemination from NWRD, ICRD and other subsets of NWRD to a specified group of users.
- D. Upgrade and update of all existing Desktop application tools of NWRD and ICRD with advance features
  - i. Data Quality Tools for validation and verification of collected data

- ii. *Data Processing Tools for converting collected data from various organizations and agencies to National Water Resources Database (NWRD) format.*
- iii. *Statistical Analysis tools for generating reports and graphs.*
- iv. *Metadata editor for creating, editing, updating and deleting of NWRD Meta data. Add features, so that WARPO professionals can create, update and delete new data layer, sub-layer and can import data directly to data layer and/or data sub-layer.*

#### **E. Guidelines Policies**

- i. *Updated NWRD 'Database Management Guideline' including the roles and responsibilities of all collaborating agencies for central database maintenance, operation, data collection, processing, quality, standardization, data policies, backup, standardization and all other activities necessary for proper management and efficiency of the database.*
- ii. *Guidelines for overall water resources data collection plans containing review sect oral data collection responsibilities, up-gradation of data collection etc.*
- iii. *Updated Data quality Methodologies to maintain the quality of data in all steps including Data collection, processing, storing and dissemination.*
- iv. *Updated Guideline of Data Quality Check, Assessment and Improvements and Policies for Data import, data export.*

### **1.3 Resource Mobilization**

*A multi-disciplinary team of CEGIS has been mobilized from September 26, 2019 to conduct "Online Processing and Tracking of Water Resources Project Clearance and No Objection Certificates for Groundwater Abstraction". The team includes the following professionals:*

- 1 *Malik Fida A Khan, Team Leader (Water Resources Engineer)*
- 2 *Abul Kashem Md. Hasan , Deputy Team Leader (Data base specialist)*
- 3 *Md. Shafiqul Islam, Data Analyst*
- 4 *Md. Mostafizur Rahman, GIS Expert*
- 5 *Mohammad Shahidul Islam , Remote Sensing Expert*
- 6 *Badal Mohammad Faruque , System Analyst*
- 7 *Md Anisur Rahman , Computer Programmer*
- 8 *Md. Abdul Hadi , Computer Programmer*
- 9 *Tanvir Ahmed, Hydrologist*
- 10 *Ahmed Zulfiqar Rahaman, Hydrogeologist*

## 1.4 Activities performed during inception stage

### 1.4.1 Contract Signing

The contract was signed between WARPO and CEGIS on September 26, 2019. Fahmida Akhtar, Principal Scientific Officer (Senior System Analyst), Water Resources Planning Organization (WARPO) and Malik Fida A Khan, Executive Director, CEGIS signed the contract on behalf of WARPO and CEGIS respectively (Picture 1.1).



Figure 1.1: Contact Signing Ceremony of the Project

### 1.4.2 Meetings

The project has started through an excellent participatory kick-off meeting attended by a number of senior officials both from the WARPO and CEGIS. The meeting was held on September 30, 2019 at WARPO chaired by Fahmida Akhtar, Principal Scientific Officer (Senior System Analyst), WARPO. Md. Ekram Ullah, Principal Scientific Officer (Agriculture); Md. Masud Alam, Principal Scientific Officer (Monitoring and Evaluation); AKM Khusrul Amin, Senior Scientific Officer (Fisheries); Md. Hasan Shahariar, Senior Scientific Officer (Environment); Md. Jahid Hossain, Senior Scientific Officer (Ground Water); Krishna Chandra Bhadra, (Senior Scientific Officer) (Programmer); Md. Tariqul Islam, Scientific Officer (Agriculture); Abul Kashem Md. Hasan, Director, Database, ICT and System Management Division, CEGIS Md Anisur Rahman (Senior Programmer), CEGIS Tanvir Ahmed (Hydrologist), CEGIS were presented in the meeting.

In the meeting, the process and procedure of issuing clearance certificate for water resources development projects was discussed in the light of Bangladesh Water Rules 2018. Twelve application forms for clearance certificate for different water resources related projects as described in Bangladesh Water Rules 2018 were discussed in the meeting. It was also suggested to prepare the user guidelines for submitting these forms. Guidelines for

*different committee and WARPO for evaluating these forms will also be prepared. Application forms of web application for clearance certificate will be prepared as per Bangladesh Water Rules 2018.*

*Another meeting was held on October 28, 2019 at WARPO. In the meeting, officials were discussed about the desktop tools such as TS tools, Data processing tools. This tools will need to be functional as per requirement of WARPO. In the meeting they also discussed about the online Data Dissemination Tools and the payment procedure of the application process.*

## Chapter 2 : Approach and Methodology

In order to prepare an efficient approach and methodology to carry out the activities of the proposed project successfully, a thorough investigation has been done on the RFP/ToR and an initial examination has been carried out on the existing information available with the WARPO. In the software development lifecycle Agile/Iterative models will be followed. Based on the investigations a comprehensive approach and methodology has been developed and presented in Figure 2.1. A description of the different steps of the methodology is given in the subsequent sections.

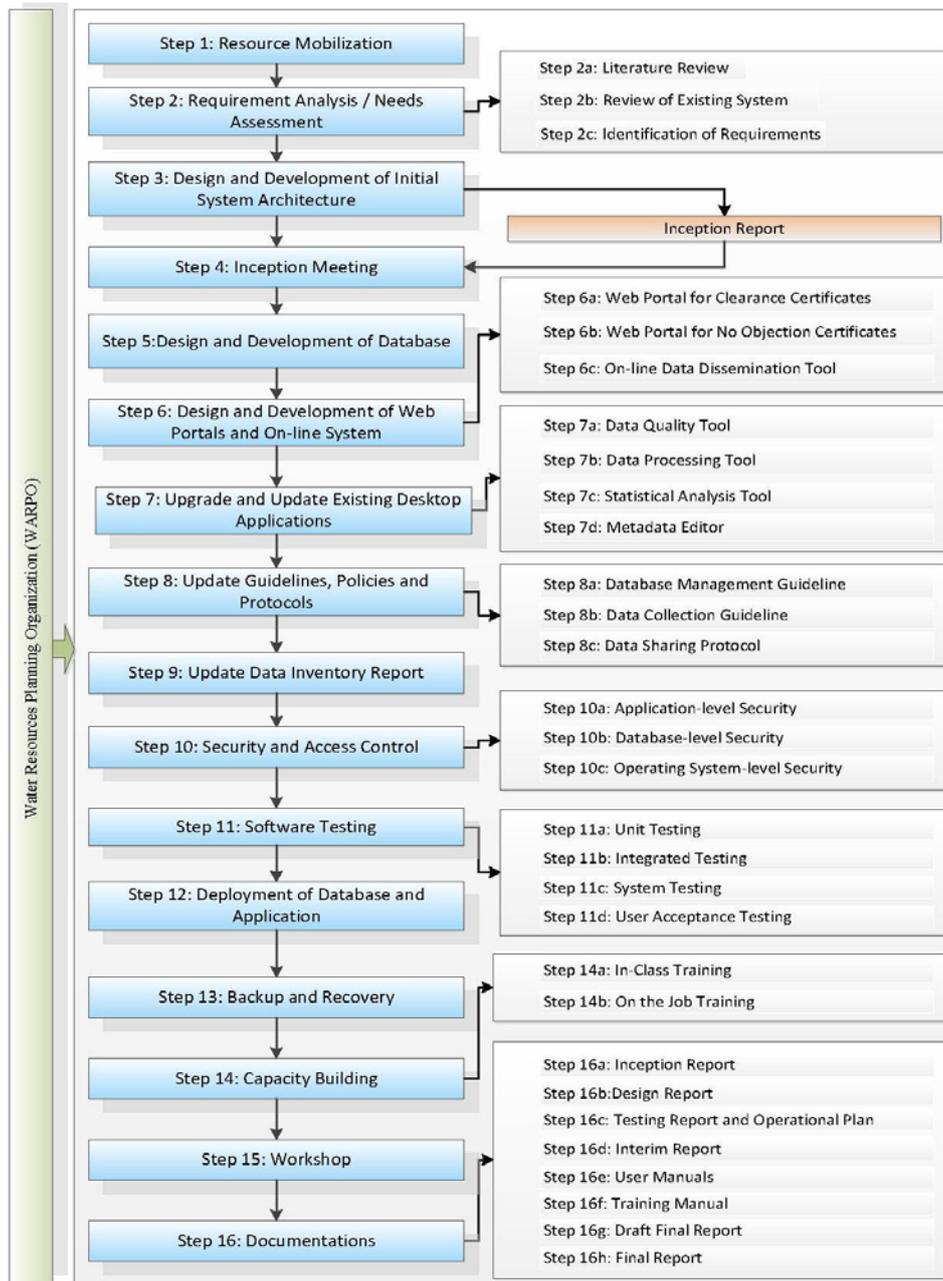


Figure 2.1: Flow Diagram of Methodology

## **2.1 Requirement Analysis/Needs Assessment**

*An initial discussion meeting has been organized with relevant officials of WARPO to understand the details of requirements of the project such as design of the web portals and on-line system, design diagram of database, data and information need, expected outputs/outcomes of the project, features and functionalities of the web portals and on-line systems and running environment of the proposed system etc. The needs assessment task is being accomplished by performing the following sub-activities.*

### **2.1.1 Literature Review**

*Collection and review of relevant reports, documents and information will be a continuous process throughout the project period. Extensive literature review will be made at this stage to accumulate the necessary information to finalize the approach and methodology and also for clear understanding. Existing documents such as Bangladesh Water Act 2013, Bangladesh Water Rules 2018, National Water Management Plan, National Water Policy 1999, Data Dissemination Policy of WARPO, Time Series Data Quality Control Guideline, Spatial Data Quality Guideline, Final Report on Maintenance, Updating and Dissemination of National Water Resources Database, Data Inventory Report of NWRD and ICRD and other reports prepared under previous phases of development and update of NWRD and ICRD is being reviewed to understand project's objectives, activities and implementation mechanism.*

### **2.1.2 Review of Existing System**

*The consultant team is examining the existing web applications and databases of NWRD and ICRD, web portal of PMIS, desktop based Data Dissemination Tool, Data Quality Tool, Data Analysis Tool, Metadata Editor, NWRD Data Availability Tool, available data and corresponding attribute information. The technical documents and user manual of the existing systems and database structures, Databases Design and Construction Details including Metadata and other documents on existing system is also being reviewed to get a clear idea of the different components and framework of the system. Beyond this existing computerized system, Consultant team will investigate the relevant physical/manual system to assess the potential improvement area for computerization that fit within the scope of work.*

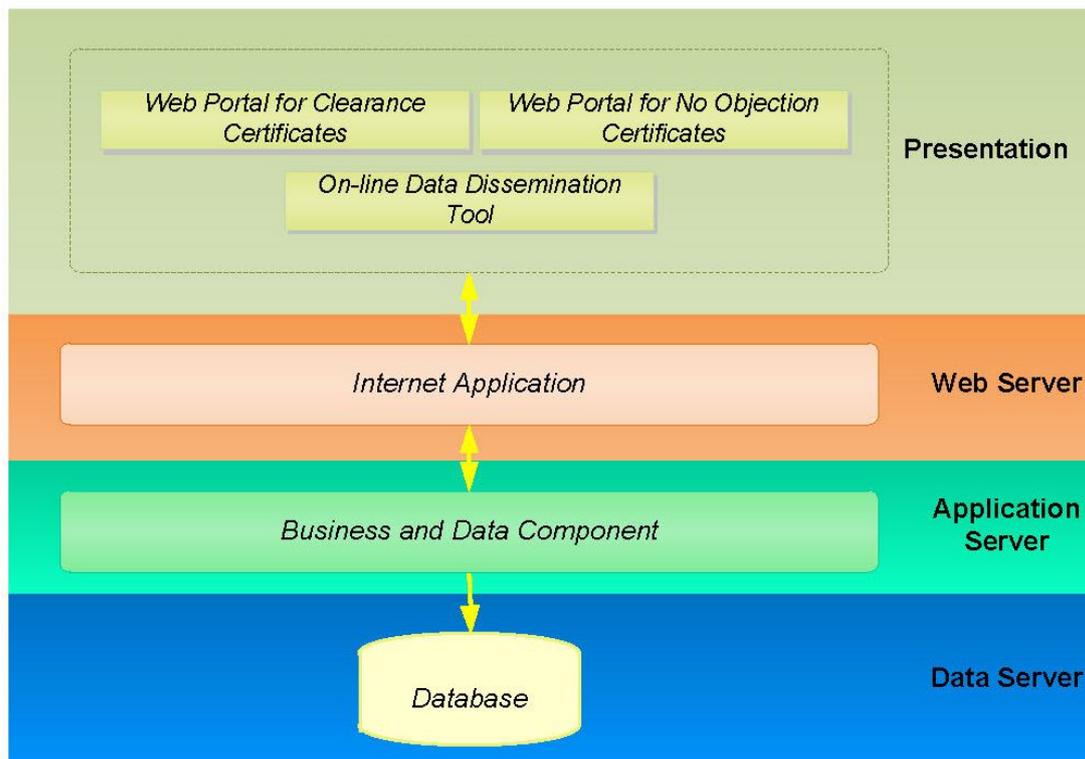
### **2.1.3 Identification of Requirements**

*The features and functionalities of the existing systems (Data Dissemination Tool, Data Quality Tool, Data Analysis Tool, Metadata Editor, and NWRD Data Availability Tool) identified in the previous sub-activities section is being analyzed and will be shared with WARPO officials. Required number of meetings with WARPO officials will be arranged to determine the requirements of the proposed systems (web portal for water sector project Clearance Certificates and No Objection Certificates for Ground Water Abstraction, On-line Data Dissemination Tool) at its required level of details. These meetings will also identify the design and development platform of the database, framework of intended web portal. Consultant team will then analyze the findings and finalize the features and functionalities of existing as well as new systems. Then it will be consulted with the relevant WARPO officials for their review and suggestions. The consultant team will establish and document the business requirements of the system. A requirement will be traceable back-ward to requirements and the stakeholders that motivated it.*

## 2.2 Design and Development of Initial System Architecture

Depending on the requirement as identified in the RFP/ToR and the functionalities determined in the needs assessment, a logical model or framework (Figure 2.2) of the new system will be developed. The system will be designed and developed using the standard four-tier architecture of software development. It will consist of the following layers:

- Presentation (user-interface)
- Web server
- Application server
- Data server



**Figure 2.2: System Architecture of Application Software**

### 2.2.1 Presentation Layer

The presentation layer is a user-interface that a user uses to interact with the application. It will be developed using ASP .Net core, Javascript, HTML5, CSS3, jQuery and Ajax. Model-View-Controller (MVC) approach will be used in this development. A Standard and dynamic reporting engine will be used to develop different customized reports. The design and look of interfaces will be made simple and user-friendly in consultation with the officials of WARPO.

### 2.2.2 Web server

The main component for a web-enabled application is the web server. It is a program that manages and delivers web pages and allows users to communicate with the server for data service through the Internet or the intranet. The web server will be configured using Internet Information Services 7 or higher.

### 2.2.3 Application Server

The application layer will consist of business and data components. The business component is used to impose different business rules and logic. The data component is responsible for retrieving data from the server. The application layer will be developed using ASP .Net core.

### 2.2.4 Data Server

The data server contains data, views, triggers and stored-procedure. It executes SQL statements, views, triggers and stored-procedure for data manipulation. A relational database Oracle 11g 64 bit will be used for storing data as WARPO already has license version of this database.

## 2.3 Coding Standard

ASP.Net core (MVC) programming language will be used to develop the system in order to meet the documented requirements of the system. Code Indentation will be used for better readability. A maximum line length for comments and code will be established to avoid horizontal scrolling of editor window. Spaces will be used after each comma, operators, values and arguments. Large or complex sections of code will be broken into smaller comprehensible modules/ functions. Source code will be arranged and separated between different files. The standard naming convention will be used for each section. Elusive names that are open to subjective interpretation will be avoided. Class names will not be included in the name of class properties. For naming routines, the verb-noun method will be used. Computation qualifiers (Avg, Sum, Min, Max, Index) will be appended to the end of a variable name where appropriate. Customary opposite pairs (such as min/max, begin/end, and open/close) in variable names will be used. Mixed-case formatting will be used to simplify reading. Boolean variable names will contain Is which implies Yes/No or True/False values such as filesFound. Using terms such as Flag when naming status variables will be avoided which differ from Boolean variables in that they may have more than two possible values. For example, Instead of document Flag, a more descriptive name such as document Format Type will be used. Meaningful name will be used even for a short-lived variable that may appear in only a few lines of code. Single-letter variable names, such as i or j will be used for short-loop indexes only. A list of standard prefixes will be developed for the project to help developers consistently name variables. For variable names, notation that indicates the scope of the variable will be included. Constants will be all uppercase with underscores between words. Built-in functions and third-party library functions with our own wrapper functions will be wrapped. Error message and recover or fail will be reported gracefully and useful error messages will be provided. When modifying code, the up to date will always be kept with the comments around it. At the beginning of every routine, standard, boilerplate comments, indicating the routine's purpose, assumptions, and limitations will be provided as it is very much helpful to understand. Adding comments at the end of a line of code will be avoided. To conserve resources, the development team will be selective in the choice of data type to ensure the size of a variable is not excessively large. The scope of variables will be kept as small as possible to avoid confusion and to ensure maintainability. When writing classes, the use of public variables will be avoided. Instead, procedures to provide a layer of encapsulation and also to allow an opportunity to validate value changes will be used. Data connections will not be opened using a specific user's credentials. Connections that will be

opened using such credentials will not be pooled and reused, thus losing the benefits of connection pooling.

## **2.4 Inception Workshop**

At the end of the needs assessment, a draft inception report has been prepared mentioning the details of the approach, methodology, work plan, technology transfer, System Requirement Specification and reporting. This report will be submitted to Project Management Unit of WARPO in 20 copies at the end of 2 months from signing of contract. An inception workshop will be arranged on the Draft Inception Report within one week from submission of the Report discussing with the Project Director. All officials concerned of WARPO and other stakeholders will be invited in the meeting. The approach and methodology of the project implementation will be presented and finalized through this meeting. The comments of the participants will be incorporated in the final version of the inception report and will be submitted to WARPO for approval. Henceforth, the approved inception report will be the final guiding document to carry out the project activities.

## **2.5 Design and Development of Database**

Database will be designed and developed based on NWRD and the initial system architecture of the overall system. Actually, new tables required for two web portals and on-line system will be included into NWRD database. In order to develop these tables, the requirements identified in the ToR as well as in the needs assessment will be converted into Data Flow Diagram (DFD). Depending on the DFD a logical model will be developed to produce an ER diagram. This ER diagram will be presented to relevant officials of the WARPO for approval. Depending on the approved logical model (ER Diagram), the physical tables will be designed. To avoid data redundancy and inconsistency, the tables will be normalized. Master-child relationship will be implemented between tables to maintain data relationships and the referential integrity. The referential integrity will ensure that, no data could be entered in the child tables without entering corresponding data in the master table. Each table will maintain a primary key, which will uniquely identify each record in the table to reduce the chances of data duplication.

## **2.6 Design and Development of Web Portals and On-line System**

Based on the requirements identified in the ToR as well as in the needs assessment and the initial system architecture, two web portals and one on-line system will be developed.

### **2.6.1 Web Portal for Clearance Certificates**

According to Bangladesh Water Rules 2018, a number of water resources development related projects needs to get Clearance Certificate from respective Committee based on the estimated cost. Projects for which estimated cost is less than 10 lac, will need Clearance Certificate from Integrated Water Management Committee of Union. If estimated cost of the projects is in between 10 Lac and 20 Lac, then these will need Clearance Certificate from Integrated Water Management Committee of Upazilla. Clearance Certificate from Integrated Water Management Committee of District will be needed if project cost is more than 20 lac but less than 50 lac. Clearance Certificate form WARPO will be required if project cost exceed 50 lac. Again if a project covers more than one union, then Clearance will be needed from Integrated Water Management Committee of Upazilla. If a project includes multiple Upazilla, then Clearance from Integrated Water Management Committee of District will be

required. If a project includes multiple districts, then Clearance from WARPO will be required. A web based interactive system will be developed for applying, processing and tracking these water sector Project Clearance Certificates. The portal will allow users to make and register applications, track progress and get certificates. It will allow WARPO to process and evaluate application with respect to predefined criteria and provide certificate. The guidelines of Clearing House will be developed as per requirements following Bangladesh Water Rules as well as acts, rules, policy, plan and strategy of WARPO. Based on this guideline, the portal will be developed. This portal will have a linkage with P-MIS (Project and Program MIS of NWRP/NWMP). In the home of this portal, a schedule of all regulatory measures under the Bangladesh Water Rules 2018 will be updated indicating the dates, by region and by sector, when they will come into effect. It will help all water users to be clear as to their obligations under the Bangladesh Water Act, 2013.

As per Bangladesh Water Rules, there are 12 forms for the Clearance certificate process for different projects such as Flood Control Management, Excavation and re-excavation of khal projects and river bank protection projects etc. The user guidelines and evaluation guidelines for these forms are preparing. Based on these guidelines web application will be developed. A tentative home page of portal is shown in Figure 2.3.

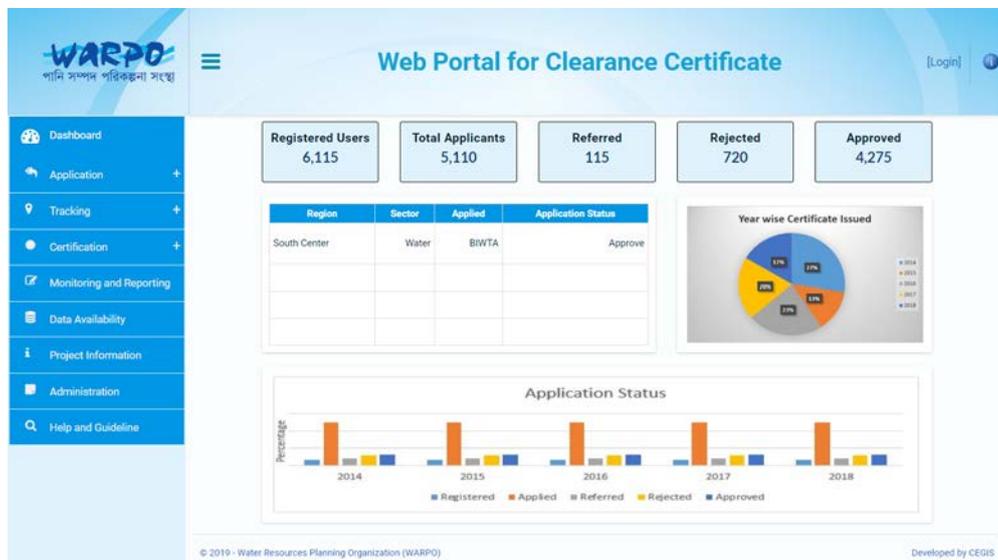


Figure 2.3: Home Page of Proposed Web Portal for Clearance Certificate

The portal will have following 9 modules:

- 1) Dashboard:** It will give an overview and summary information of the web portal. The dashboard of this portal could display the overall status of application for Clearance Certificate, sector wise application status, year wise application submitted, and year wise certificate issued.
- 2) Application Module:** This module will have help user to apply for Clearance Certificate for a particular project by providing required information. The module will have been developed based on Application Form 3.1 to 3.11 as described in Bangladesh Water Rules 2018. Each of these forms is related to a particular type of water sector projects. After login to the module, the registered user will fill up the respective form, upload supporting documents and submit it to the central database.

- 3) Tracking Module:** *This module will have been used by Integrated Water Management Committee of Union, Integrated Water Management Committee of Upazila, Integrated Water Management Committee of District and WARPO. It will help to track, review and analyze the applications based on the information provided by the applicant. If information provided by applicant is not sufficient, then the module can send a request to applicant for additional information. The module will also allow user to incorporate information obtained through field visit. The system will evaluate each application based on some criteria defined according to Rule 22(1) of Chapter 8 of Bangladesh Water Rules 2018. It will prepare a list of eligible applicants for Clearance Certificates and make their status enable to get the certificates from the system. A notification through email will also be sent automatically to the applicants informing their status.*
- 4) Certification Module:** *This module will allow qualified applicants to get Clearance Certificates from the portal as pdf file or printed copy.*
- 5) Monitoring and Reporting Module:** *This module will have two interface. One interface will be used by the applicants to see the status of their applications. The status may be registered, referred, rejected or approved. Other interface will be used by Integrated Water Management Committee of Union, Integrated Water Management Committee of Upazila, Integrated Water Management Committee of District and WARPO and to view the status of all applications. In both case, information can be displayed as table shown in Table 2.1.*

**Table 2.1: Status of Applications for Clearance Certificate**

SN	Region	Sector	Project Type	Project Name	Applicant	Applicant Status
1	South Central	Water	Dredging	Dredging at River A	BIWTA	Approved
2						
3						
4						
5						

*The module will also allow WARPO to view the summarized information of different activities of different committees such as total number of applications, total number of rejected or approved projects. The module will provide facilities to search or query information based on region, sector, type, applicant name or applicant status and generate customized reports such as list of approved applications, list of rejected application for a particular project type, number of approved, rejected or referred applications for different type of projects. The reports will be shown in chart or table format. Generated reports may be printed or exported in PDF, Excel or other desired format.*

- 6) Data Availability Module:** *This module will quantify the volume of surface water and groundwater availability and monitor water usage of project locations. Surface water level, discharge, water bodies, groundwater level other water sources will be used by this module. This information will be analyzed and total usage of water will be calculated.*
- 7) Project Information Module:** *This module will be open for all users. Using this module, user can see list of projects, their status and action-dates and act where appropriate. This module will also provide facilities to generate summary report on the progress of clearance activities by region, sector and agency wise.*

- 8) **Administration Module:** This module will be used by Administrator to do some administrative works. It will allow Administrator to add new data layers, assign right to users.
- 9) **Help and Guideline Module:** This module will have an interactive interface to assist and guide the users to use different module of the portal. A detail user manual in PDF format will also be available here.

The flow diagram of the clearance certificate is shown in Figure 2.4.

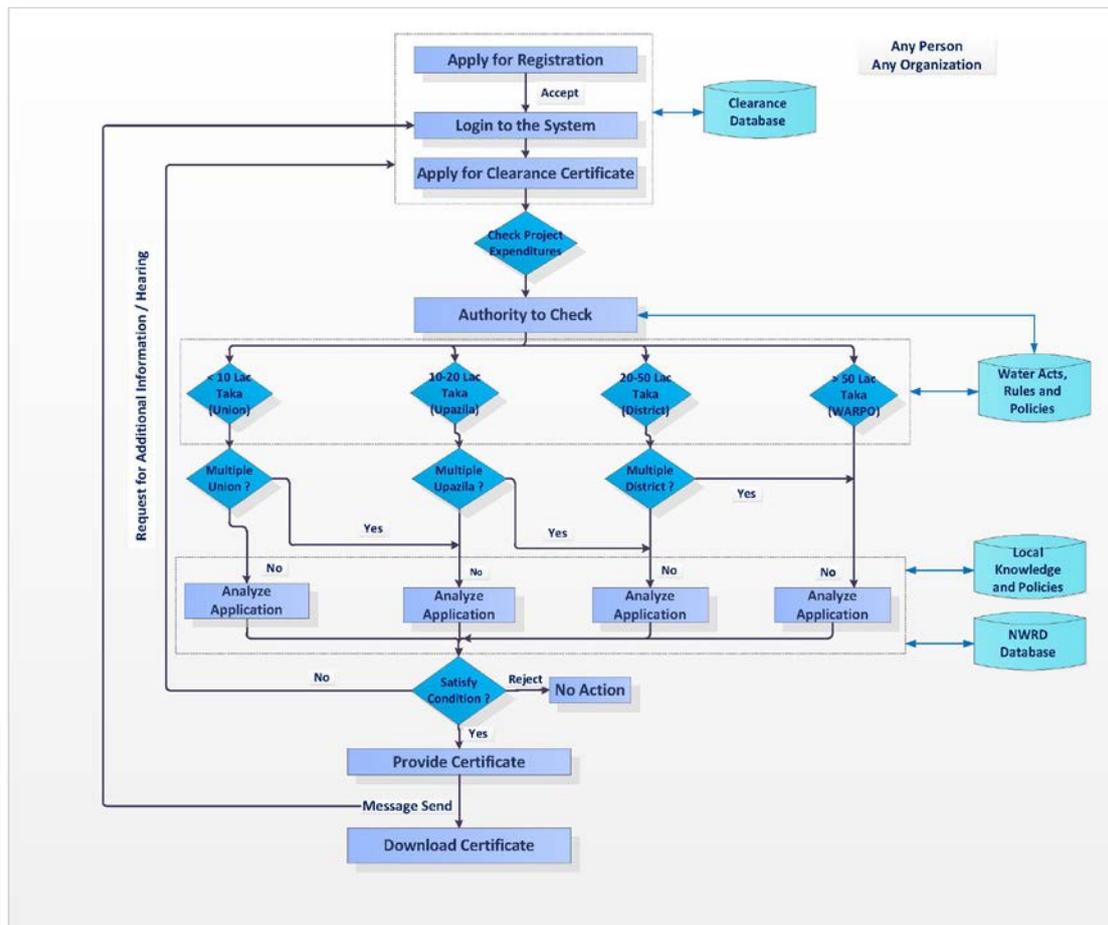
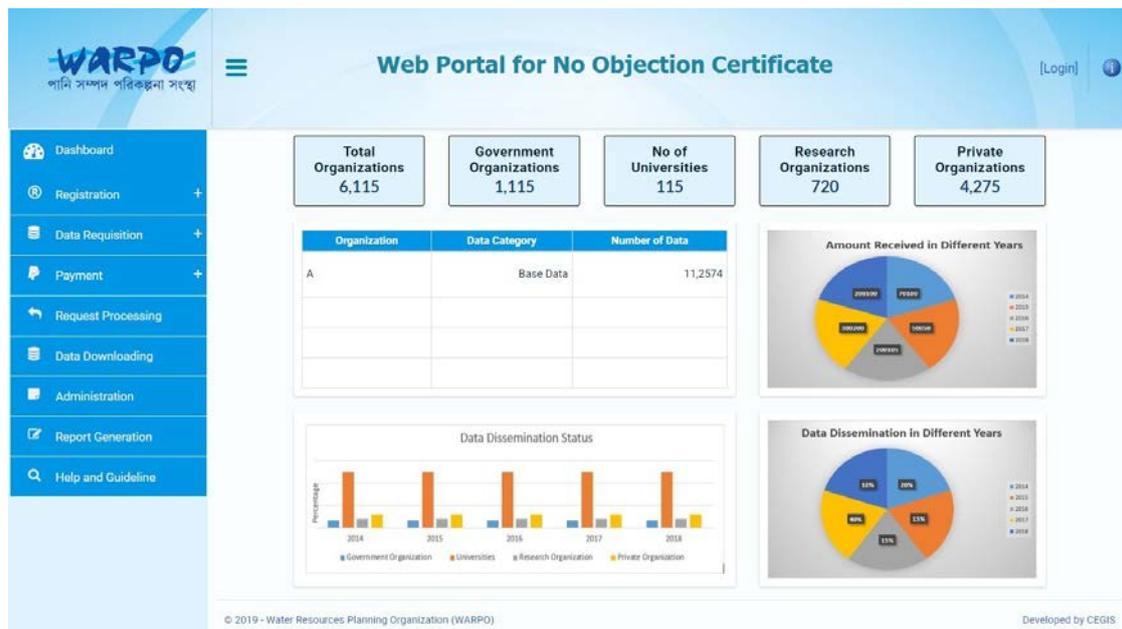


Figure 2.4: Flow Diagram of Clearance Certificate

### 2.6.2 Web Portal for No Objection Certificates

According to Bangladesh Water Rules 2018, all water resources development related projects involved in abstraction of ground water by force-mode deep tube wells need to get No Objection Certificate (NOC) from WARPO. A web based interactive system will be developed for applying, processing and tracking these No Objection Certificates as described in Rule 30(3) of Chapter 10 of Bangladesh Water Rules 2018. The portal will allow users to make and register applications, track progress and get NOC. It will allow WARPO to process and evaluate application with respect to predefined criteria and provide NOC. The guidelines of NOC will be developed as per requirements following Bangladesh Water Rules as well as acts, rules, policy, plan and strategy of WARPO. Based on this guideline, the portal will be developed. In the home of this portal, a schedule of all regulatory measures under the Bangladesh Water Rules 2018 will be updated indicating the dates, by region and

by sector, when they will come into effect. It will help all water users to be clear as to their obligations under the Bangladesh Water Act, 2013. A tentative home page of portal is shown in Figure 2.5.



**Figure 2.5: Home Page of Proposed Web Portal for No Objection Certificate**

The portal will have following 9 modules:

- 1) **Dashboard:** It will give an overview and summary information of the web portal. The dashboard of this portal could display the overall status of application for No Objection Certificate, sector wise application status, year wise application submitted, and year wise certificate issued.
- 2) **Application Module:** This module will help user to apply for NOC for a particular project by providing required information. The module will be developed based on Application Form 7 as described in Bangladesh Water Rules 2018. After login to the module, the registered user will fill up the form, upload supporting documents and submit it to the central database.
- 3) **Tracking Module:** This module will be used by WARPO officials. It will help to track, review and analyze the applications based on the information provided by the applicant. If information provided by applicant is not sufficient, then the module can send a request to applicant for additional information within 15 days after getting application. The module will also allow WARPO user to incorporate information obtained through field visit. The system will evaluate each application based on some criteria defined according to Rule 31(4) and 31(5) of Chapter 10 of Bangladesh Water Rules 2018 and generate a list of eligible applicants for NOC and make their status enable to get the NOC form the system. A notification through email will also be sent automatically to the applicants to inform the status of the application.
- 4) **Certification Module:** This module will allow qualified applicants to get NOC from the portal as pdf file or printed copy. The module will also have option to appeal for reconsideration when an agency gets notification for temporary suspension.

- 5) Monitoring and Reporting Module:** *This module will have two interface. One interface will be used by the applicants to see the status of their applications. The status may be registered, referred, rejected, suspended or approved. Other interface will be used by WARPO to view the status of all applications. In both case, information can be displayed as table shown in Table 2.2.*

**Table 2.2: Status of Applications for NOC**

SN	Region	Sector	Project Name	Applicant	Applicant Status
1	South Central	Water	Deep Tube Installation for Drinking Water	BADC	Approved
2					
3					
4					
5					

*The module will provide facilities to search or query information based on region, sector, type, applicant name or applicant status and generate customized reports such as list of approved applications, list of rejected application for a particular project type, number of approved, rejected or referred applications for different type of projects. Generated reports may be printed or exported in PDF, Excel or other desired format.*

*After providing NOC to applicants (agencies), WARPO will regularly monitor them to ensure that they are maintaining the conditions required for NOC. If any agency fails to maintain the conditions, then using this module, WARPO can suspend the NOC of that agency temporarily. A notification through email will be automatically sent to the agency mentioning the reasons of suspension and asking to come for a hearing. If the explanation of the agency in the hearing satisfy WARPO technical committee, then suspension will be withdraw. Otherwise, NOC of the agency will be suspended permanently.*

- 6) Data Availability Module:** *This module will quantify the volume of groundwater availability and monitor water usage of project locations. Groundwater level, borehole locations of BWDB, Aquifer Properties will be used by this module. This information will be analyzed and total usage of water will be calculated.*
- 7) Project Information Module:** *This module will be open for all users. Using this module, user can see list of projects involved in abstraction of ground water by force-mode deep tube wells, their status and action-dates and act where appropriate. This module will also provide facilities to generate summary report on the progress of NOC activities by region, sector and agency wise.*
- 8) Administration Module:** *This module will be used by Administrator to do some administrative works. It will allow Administrator to add new data layers, assign right to users.*
- 9) Help and Guideline Module:** *This module will have an interactive interface to assist and guide the users to use different module of the portal. A detail user manual in PDF format will also be available here.*

The flow diagram of No Objection certificate is shown in Figure 2.6.

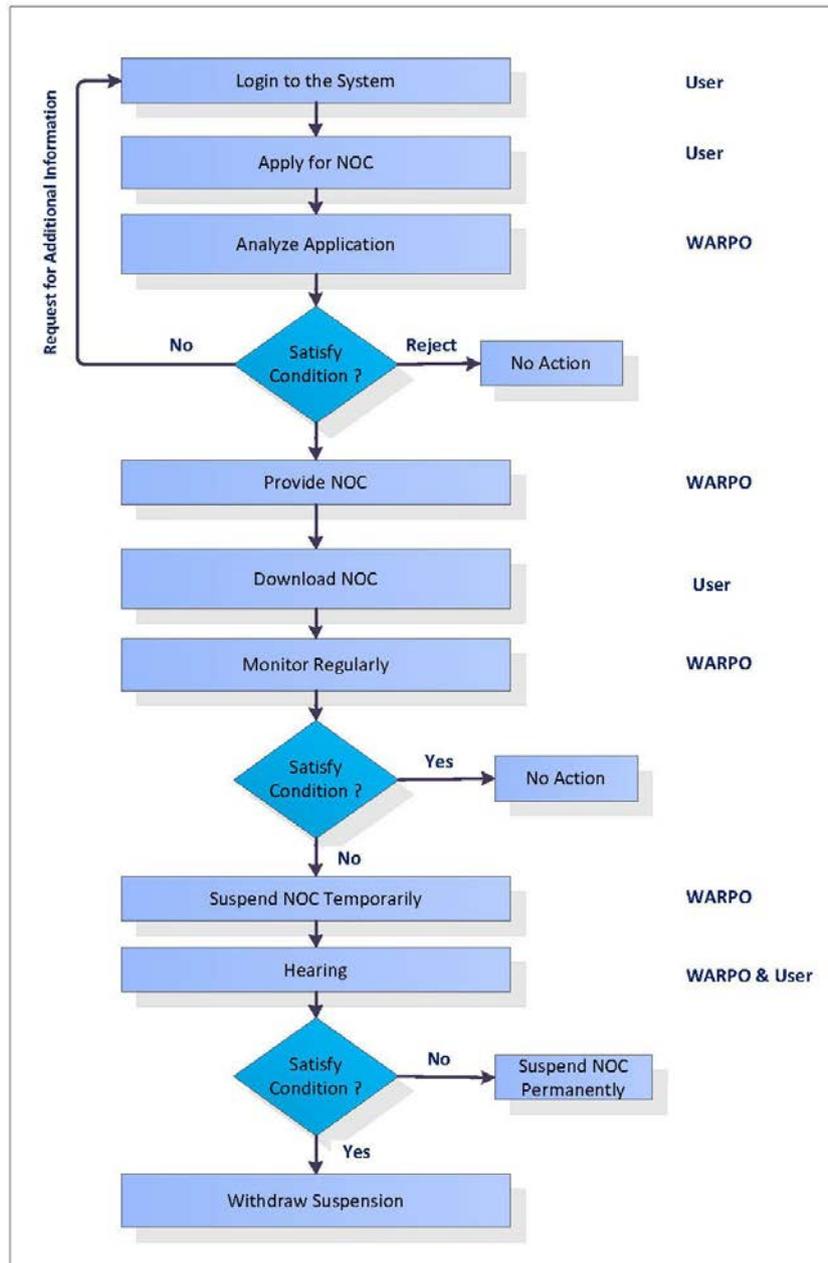
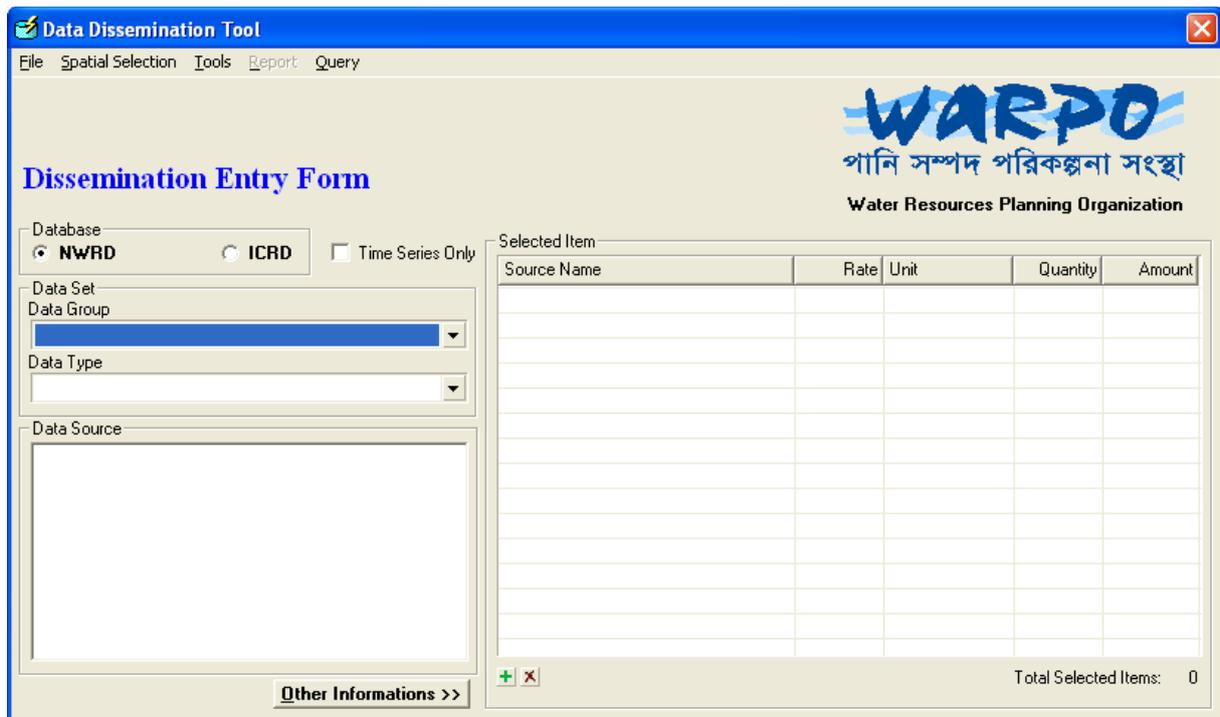


Figure 2.6: Flow Diagram of No Objection Certificate

### 2.6.3 On-line Data Dissemination Tool

WARPO has developed a desktop based Data Dissemination Tool (Figure 2.7) with the assistance of CEGIS and has been using it to dissemination data from NWRD and ICRD for a long time. It is a very interactive tool. The major functions of this tool are to display and prepare the data availability, data estimation cost, invoice, data receiving form for client, and finally data export for CD writing. This tool is very flexible to select time series data on user requirement. User can select time series data for particular stations and for particular years or hydrological years. It can retrieve data and price from the server. During exporting data for dissemination a readme text file is created which contains the details explanation of each data layers for user.



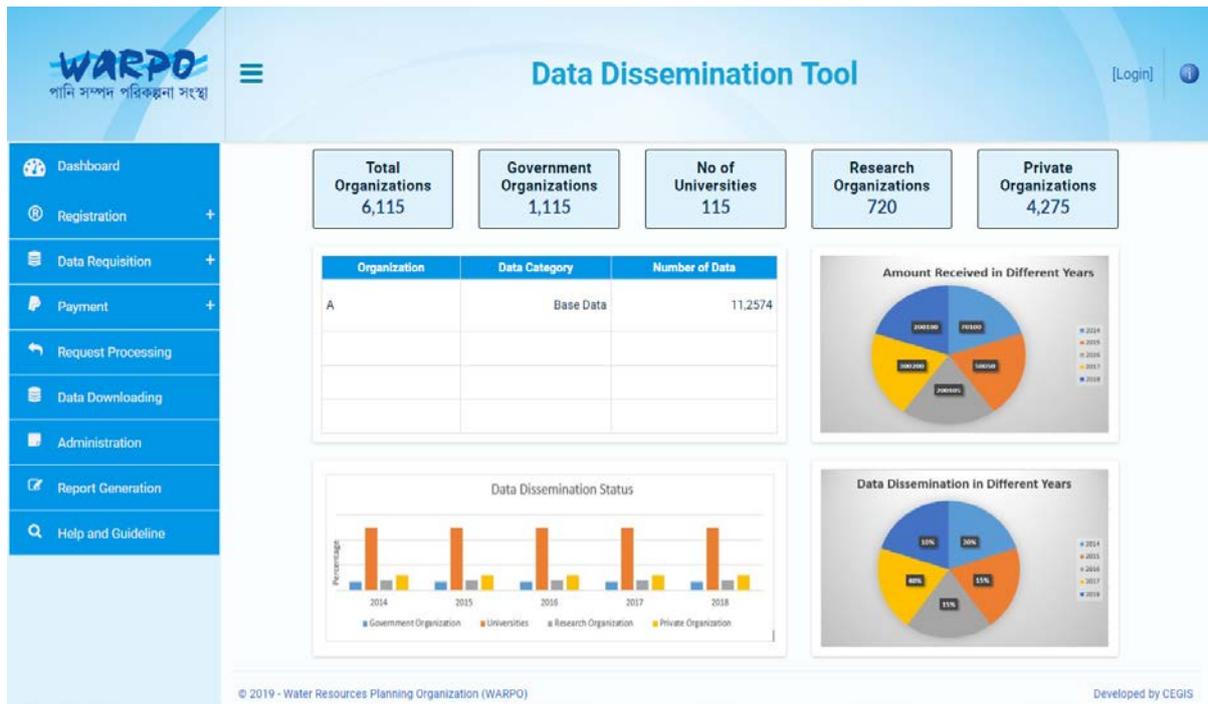
**Figure 2.7: Desktop based Data Dissemination Tool**

This tool also provide facilities to

- Update data price.
- Update exchange rate.
- Update wet and dry period definition.
- Search data layers.
- Save selected information for later use.

Existing Data Dissemination Tool is desktop based. It needs to install in a client machine (PC). Outside users cannot access to this tool. When a user requests for data, WARPO needs to select the desired layers and prepare estimation for the users. If a web based tool is developed, then all these tasks (data selection, prepare estimation etc.) Related to data dissemination can be done by users through internet. After getting request for data, WARPO can either accept or reject the request using this tool. If the request is accepted, then after getting payment, WARPO can send a temporary user ID and password to the user for downloading data.

On-line Data Dissemination Tool will be developed to disseminate existing data from NWRD, ICRD, and other sub-sets of NWRD such as Char Development and Settlement Project (CDSP), Coastal Embankment Rehabilitation Project (CERP) and others to line agencies, Government and private agencies, and registered researchers and students. These data will be required for issuing Project Clearance Certificate or No Objection Certificate, implementing Integrated Water Resources Management (IWRM) process or water sector related study/research. The system will disseminate data following the Data Dissemination Policy of WARPO. A tentative home page of portal is shown in Figure 2.8.



**Figure 2.8: Home Page of Proposed On-line Data Dissemination Tool**

This on-line system will have following 8 modules:

- 1) **Dashboard:** It will give an overview and summary information of the on-line system. The dashboard could display the overall status of data dissemination, organization wise data dissemination status, year wise data dissemination, and year wise amount received from data dissemination.
- 2) **Registration Module:** This module will allow users (agencies, researchers and students) to get registration into the system. Users want to be registered, need to fill up a simple request form (Figure 2.9) providing some basic information such as name, designation, organization, email address and purpose of registration and submit it. Administrator will review and analyze the submitted information and if agree to accept the request then an automated generated User ID and Password will be sent to the email address of the user.

**Figure 2.9: Registration Form of Data Dissemination Tool**

- 3) **Data Requisition Module:** *This module will help registered user to select data layers from NWRD, ICRD, CDSP or CERP and prepare data requisition. A list of data layers from the databases will be available here. An advance search engine will assist user to search data layers based on different search criteria. During selecting a data layer, user can select export format. Before selecting data, user will be able to view metadata, data in table or map format and bundle information. Metadata is the background information that includes content, quality, availability, history, condition and other appropriate characteristic of the datasets. Bundle information describe the column of the table or attribute information. Both metadata and bundle information insure that potential data user can make an informed decision about whether data are appropriate for the intended use. The system will also incorporate some graphical and mapping tools which will enhance the understanding of water resources and the interactions between different component of the hydrological cycle and water-dependent ecosystems. It will also allow user to identify any water feature contained in the databases (NWRD, ICRD, CDSP and CERP) in an area of interest. Based on data requisition, the system will allow to submit an invoice.*
- 4) **Payment Module:** *This module will have been enable for a user, when the invoice made by that user is accepted. After making payment (off-line) in a respective bank account, information of the payment (transaction number and others) can be submitted and scanned copy of the payment related documents can be uploaded using this module. Simultaneously, a notification message will be sent to Administrator and users. The Online payment will be digital that user can put their payment id and bank name in the application process to proceed the application for data.*
- 5) **Request Processing Module:** *Administrator will process data requests using this module. He/she will check the data requests and corresponding invoice. If requested data can be provided, then the Administrator will enable the payment module for that request and send a message through email asking to make payment. On the other*

hand, if it is not possible for WARPO to provide all the requested data, then Administrator will make required changes in data requisition. Based on these changes, the corresponding invoice will be automatically updated. Administrator then send a message to make payment if the user agree with the changes. For a particular data requisition, if payment is already made, then data will be made available for downloading. A notification will also be sent to the user.

- 6) **Data Downloading Module:** This module will allow user to download requested data. User will get a link for downloading. Clicking on this link will download the data into the local computer. During downloading, a readme text file will be created which will contain the details explanation of each data layers. A log file will also be maintained to keep track of each download activities.
- 7) **Administration Module:** This module will be used by Administrator to do some administrative works. It will allow Administrator to add new data layers, update data price and exchange rate and create users.
- 8) **Report Generation Module:** This module will assist user (data requester) to generate reports on list of data layers, price of layers and total cost for each data requisition. Administrator will generator different customized report such as list of organizations purchased data, total amount received from different organization for a particular year, list of data layers requested most etc.
- 9) **Help and Guideline Module:** This module will have an interactive interface to assist and guide the users to use different module of the tool. A detail user manual in PDF format will also be available here.

The flow diagram of the clearance certificate is shown in Figure 2.10.

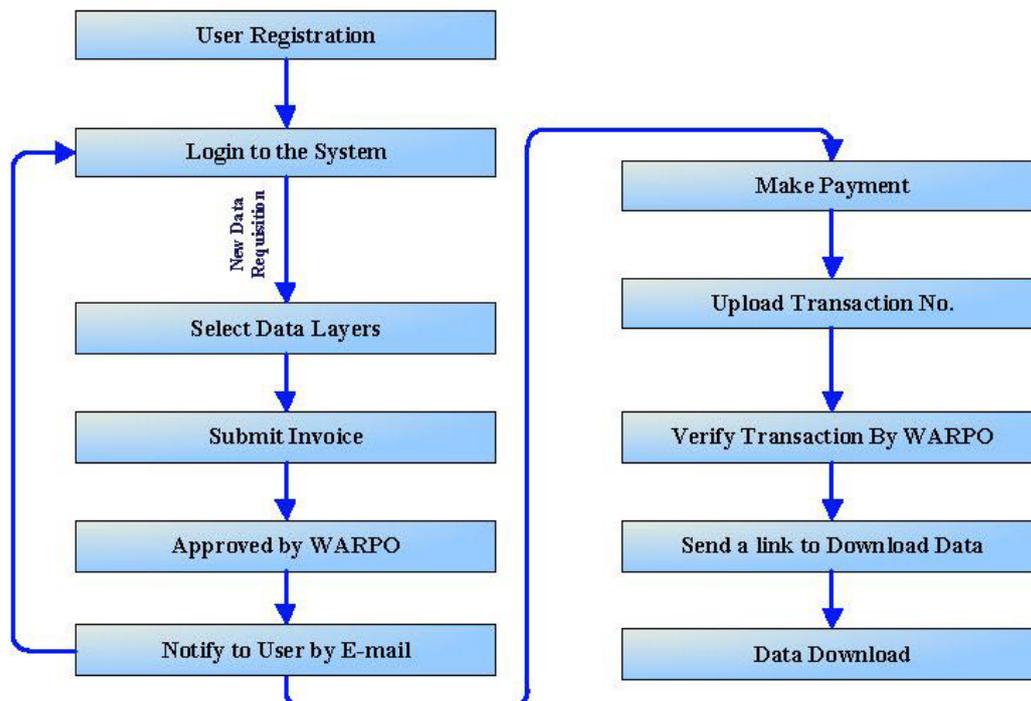


Figure 2.10: Flow Diagram of Data Dissemination

## 2.7 Upgrade and Update Existing Desktop Applications

A number of desktop application has been developed under previous phases of NWRD to assist the activities related to database (NWRD, ICRD, CDSP and CERP) updating. These application will be upgraded and updated with recent tools and technologies.

### 2.7.1 Data Quality Tool

Hydro-meteorological data are an important component for the planning process as the country’s land and water resource systems need continuous planning and management. Quality assurance for hydro-meteorological data are important particularly for WARPO, because WARPO is maintaining different national (NWRD) and regional level (ICRD) databases which contain a large number of temporal (hydro- meteorological) data. A tool for Data Quality Control and Assessment shown in Figure 2.11 has been developed to check and improve the quality of temporal data. It helps to check overshoot and undershoot and ensure quality of temporal data following the quality control guideline of NWRD. This tool facilitates for comparison & visual plotting of data to check the quality using different analytical method. This tool will need to be functional as per requirement of WARPO.

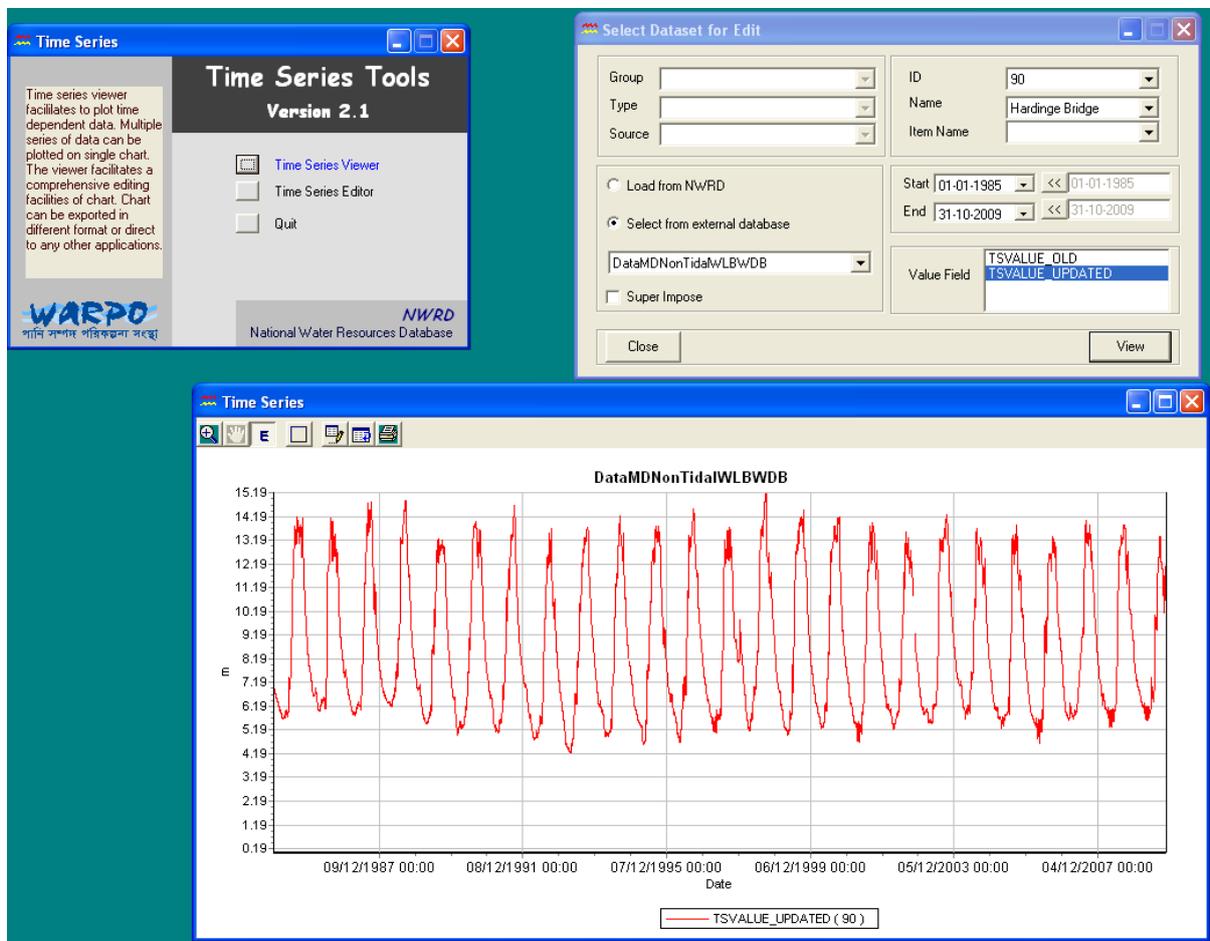


Figure 2.11: Data Quality Tool Developed for NWRD

### 2.7.2 Data Processing Tool

Temporal and attribute data that has been collected from different Data Providing Agencies are in different format. An online Data Processing Tool has been developed to convert collected data into a format compatible to NWRD and ICRD, databases. This tool will be updated to make it more generic.

### 2.7.3 Statistical Analysis Tool

A desktop base Statistical Analysis Tool was developed to analyze time dependent data. This tool has been upgraded to web base (Figure 2.12) in the previous phase. The main function of this tool is to support the user to analyze Time Series data using simple statistical calculation, display calculated data either in chart or tabular format and export calculated data to user format. This tool can also help user to retrieve time series data in hydrological year wise and separately either in dry or wet period wise. The simple statistical analysis is available to calculate the sum, max, min, average, count and standard deviation of different time series data. Different type of Frequency Analysis, Dependable Analysis is also incorporated in this tool. The calculated results can be viewed and exported. This tool will be functional as per requirement of WARPO.

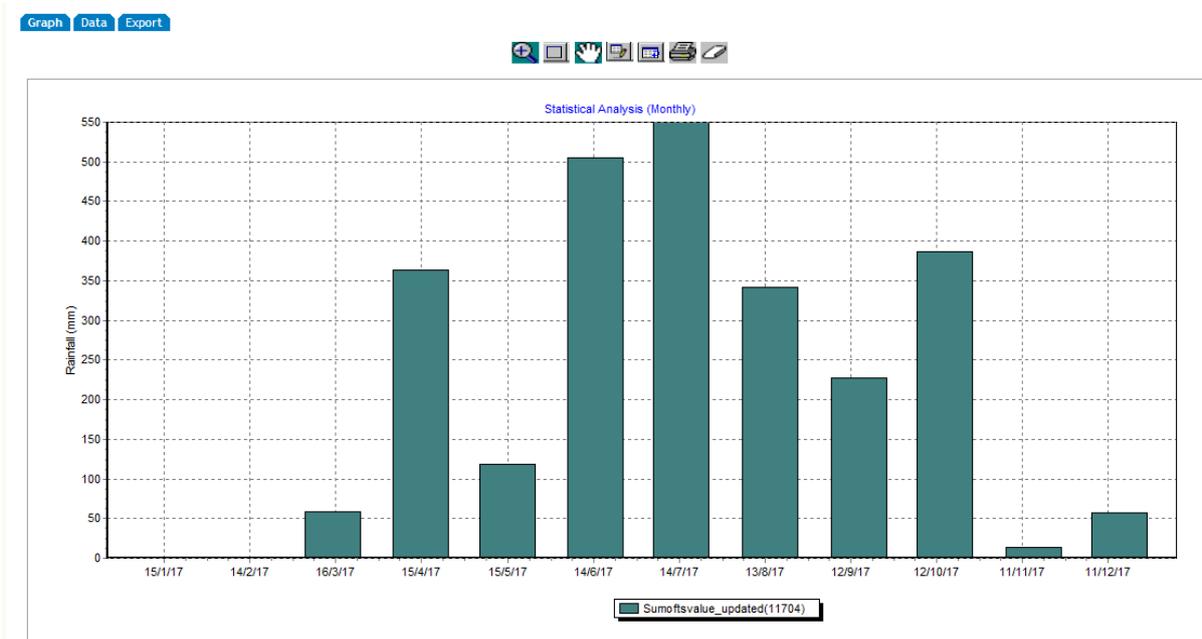


Figure 2.12: Statistical Analysis Tool Developed for NWRD

### 2.7.4 Metadata Editor

Metadata is "data about data". It is the background information of the data. Each data layer of NWRD contains metadata. A tool has been developed to add, edit or delete metadata for a particular data layer easily and efficiently. This tool (Figure 2.13) also helps to update Data Definition Tables (defines group and type of a layer) and bundle information (description of tables/attribute tables). This tool will be updated so that data layers can be directly imported from NWRD database. The Metadata Editor system functionally updated as per requirement of WARPO. It will be updated for other databases (ICRD, CDSP and CERP) also.

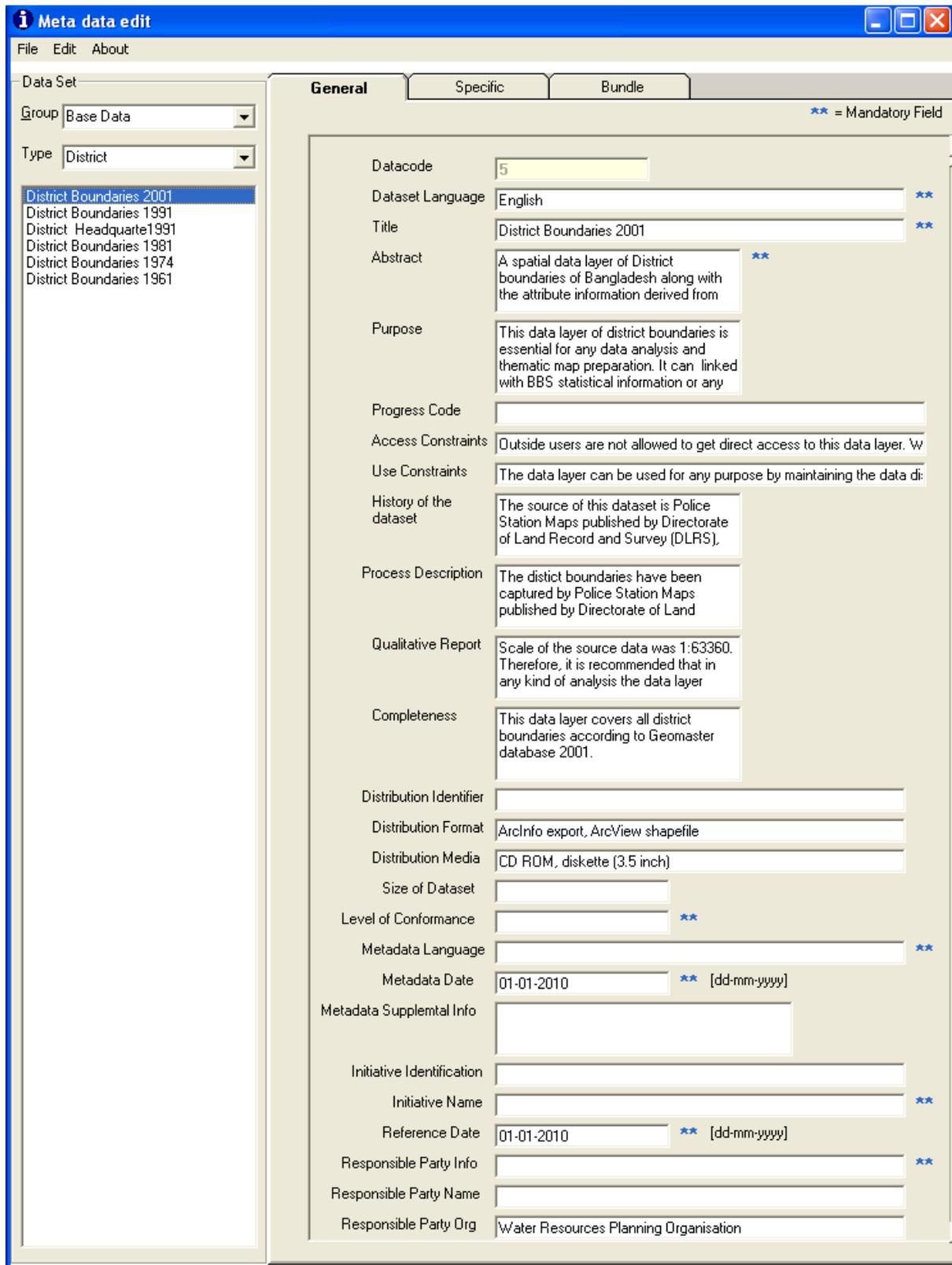


Figure 2.13: Meta Data Editor Developed for NWRD

## **2.8 Update Guidelines, Policies and Protocols**

*A number of guidelines and policies has been developed to manage data, plan data collection, check data quality and disseminate data. These guidelines and policies will be updated as per requirement of WARPO. Some new guidelines will also be developed.*

### **2.8.1 Database Management Guideline**

*A Database Management Guideline has been prepared describing database, metadatabase, data definition tables, data type (temporal, attribute and spatial), hierarchical structure of spatial data, views and stored procedures of NWRD. This guideline helps to manage and update the database. This guideline will be updated to include maintenance and operation of NWRD web portal, data collection and processing, data Layer preparation, data quality checking, data storage and archiving, data categorization, database development and management, principle of data sharing and dissemination, data Backup, data purging, maintaining standard in all aspects, roles and responsibilities of respective entities and other activities necessary for the best performance and efficiency of NWRD. XML Schemas 1.0 or above will be used to manage and overall Enterprise Schema. Metadata Object Facility (MOF) will be used to define, manipulate and integrate metadata and data in a platform independent manner. Data Archiving will be performed in such a way that it can support integrity checking through hashing, audit logging and regulatory compliance.*

### **2.8.2 Data Collection Guideline**

*A data collection guideline will be developed which will contain plan for water resources data collection, review of sectoral data collection responsibilities and upgrade method of data collection. This guideline will help to update data quality methodologies to maintain the quality of data in all steps including data collection, processing, quality checking, storing and dissemination.*

### **2.8.3 Data Sharing Protocol**

*A framework of communication infrastructure needs be introduced to connect NWRD with other national level databases outside WARPO like BWDB, BBS, DoF, BARC, SoB, BBS etc. and to share data and information among these agencies. In order to develop this framework, several workshops and dialogues have been held at WARPO with these line agencies in previous phase of NWRD. A guideline named “Co-operative Inter-agency Networking towards Improved Database Management” has been developed and disseminated among the prime data providing agencies. In this guideline, WARPO has proposed to form an inter-agency network committee and offered to develop a framework for communication infrastructure. In this connection MoUs needs to be signed among different collaborative agencies such as BADC, BMD, UDD, DPHE, DoE, SPARRSO, BMDA, BIWTA, DWASA, DBHWD, DAE, SRDI and BBS. It is to be noted here that, MoUs with some agencies has already been signed such as DBHWD. MoUs with remaining agencies will be signed under this project.*

## **2.9 Update Data Inventory Report**

*A comprehensive data inventory report comprising data availability in 24 organizations was prepared during the development of NWRD under WARPO with assistance of EGIS-II project. It's a live document and need to keep update in regular basis. The inventory report*

has been further updated in the previous phase of NWRD based on the open discussion held at the launching meeting of the project and in consultation with the planners at WARPO and other potential users. The report contains the name and number of the database available in different organizations and their needs necessary for the future plan to create, update and redundancy of data sets. This report will be further updated under this project.

## **2.10 Security and Access Control**

Security and access control is a major issue in designing and developing web-based application. The proposed systems will support application based, database level and operating system based authentication for control. Following are the steps of the control measures for possible exposed threats.

### **2.10.1 Application-level Security**

For a web-based application, application level security is a major concern. This can be implemented, by introducing a firewall between the web server and the network. For intranet, application-level security will be implemented by assigning a unique ID and password to each user. Using this ID and password, the user will access the application. This security feature for which user will access the web based systems, will be specified at database-level.

### **2.10.2 Database-level Security**

To implement database-level security and to protect data from unauthorized access and the database will not be accessible directly from external network (non-government network). Strict security policies will be established for archived data to prevent unauthorised access and data loss. RDBMS will be used with security controls to ensure aggregation (value of disclosed data) and inference (confidentiality). Four user groups can be created and different levels of access rights can be assigned to each group. Each user will be assigned to a particular user group.

The four levels of security access that could be implemented for this project are as follows:

- 1) Level 1:** This level will be assigned to registered users (agencies, researchers and students) of web based systems. Each of the following system will have its own registered users.
  - a. Web Portal for Clearance Certificates: submit application, print certificate.
  - b. Web Portal for No Objection Certificates: submit application, print certificate.
  - c. On-line Data Dissemination Tool: make data requisition, download data.
- 2) Level 2:** This level will be assigned to Administrator. Each of the following system will have its own administrator.
  - a. Web Portal for Clearance Certificates: create user, assign rights.
  - b. Web Portal for No Objection Certificates: create user, assign rights.
  - c. On-line Data Dissemination Tool: create user, assign rights, process data requests, and generate customized reports.
- 3) Level 3:** This will be assign to a Group of WARPO officials for web portals of Clearance Certificates and No Objection Certificates. Using this role, he/she can

track, review and analyze application, monitor application status, generate customized reports.

- 4) **Level 4:** It will be assigned to high officials of WARPO to see different customized reports.

The security levels will be finalized after discussing with WARPO officials.

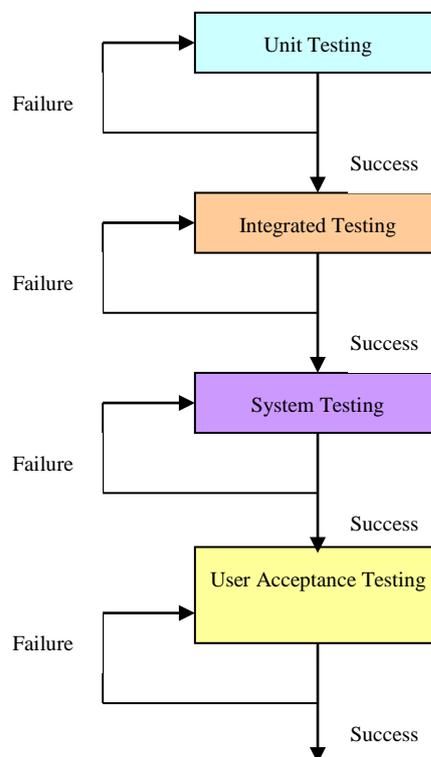
### 2.10.3 Operating System-level Security

Operating system-level security means the limitation of physical access to a machine and would require an additional login in order to gain access.

The operating system will restrict unauthorized users from logging on or opening the computer and database itself, securing database to deleting or adding any data from unauthorized users. Operating system-level security will be implemented by assigning a user ID and password to each user. Each user will be then assigned to a particular user group.

## 2.11 Software Testing

After developing the software, different levels testing need to be performed to ensure software quality. In this project the following tests will be performed in sequence as shown in Figure 2.14.



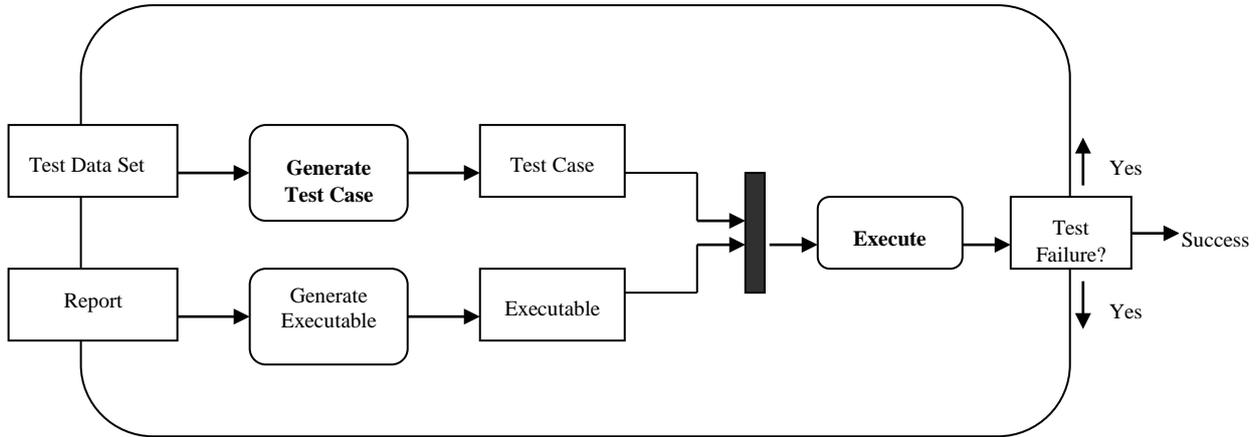
**Figure 2.14: Software Testing**

### 2.11.1 Unit Testing

It is a procedure used to validate that a particular module of source code is working properly. The procedure is to write test cases for all functions and methods so that whenever a change causes a regression, it can be quickly identified and fixed. This type of testing is

mostly done by the developers. In this project every module of the system will be tested separately by using separate test data sets. Unit test for the Report module is shown in Figure 2.15.

**Test Data Set:** Spatial and attribute data.

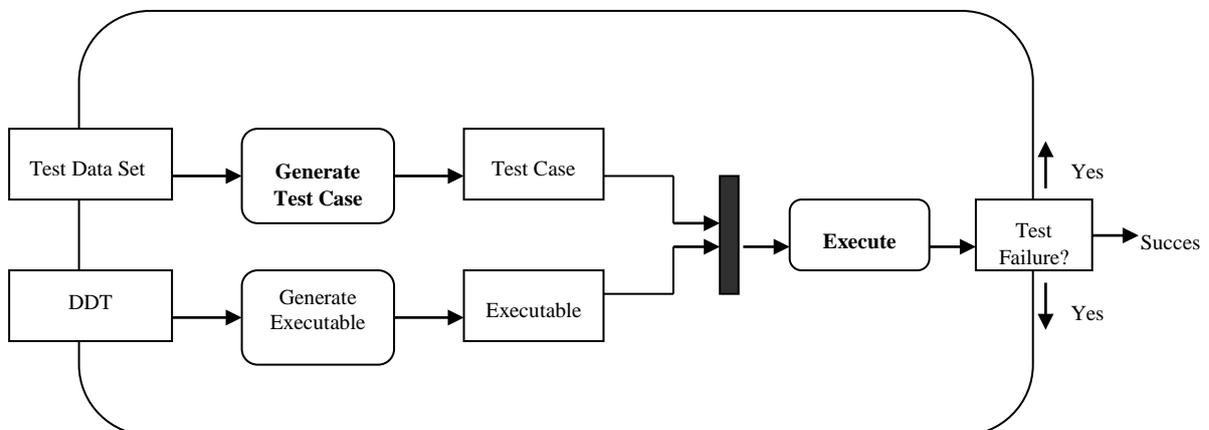


**Figure 2.15: Unit Testing of Report Module**

Separate test data set will be selected and separate unit test will be performed for each module of the System.

**2.11.2 Integrated Testing**

It is the phase of software testing in which individual software modules are combined and tested as a group. After performing unit test, all modules will be combined to develop the overall system. The integrated system will be tested to validate that multiple parts of the system interact according to the system design. The same test data sets used in unit test for different modules will be applied to the integrated system. If the system responses according to the system design, the test will be successful. Otherwise, the system will be modified and tested again. The integrated testing of the Data Dissemination Tool (DDT) is shown in Figure 2.16.



**Figure 2.16: Integrated testing of Data Dissemination Tool**

### 2.11.3 System Testing

System testing is conducted on a complete, integrated system to evaluate the system's compliance with its specified requirements. System testing falls within the scope of Black Box testing, and as such, should require no knowledge of the inner design of the code or logic. Before performing this testing, network, data server, web server and web applications will be installed and configured. The same test data sets used in unit test will be applied to the overall system. If any problem is encountered during testing, developers will investigate the problem and try to find out the actual reason of the problem. Problems may arise from network, data server or web server. After identifying the problem, it will be fixed and system test will be performed again. Developers will perform this test. Figure 2.17 shows the system testing of the Application Systems of WARPO.

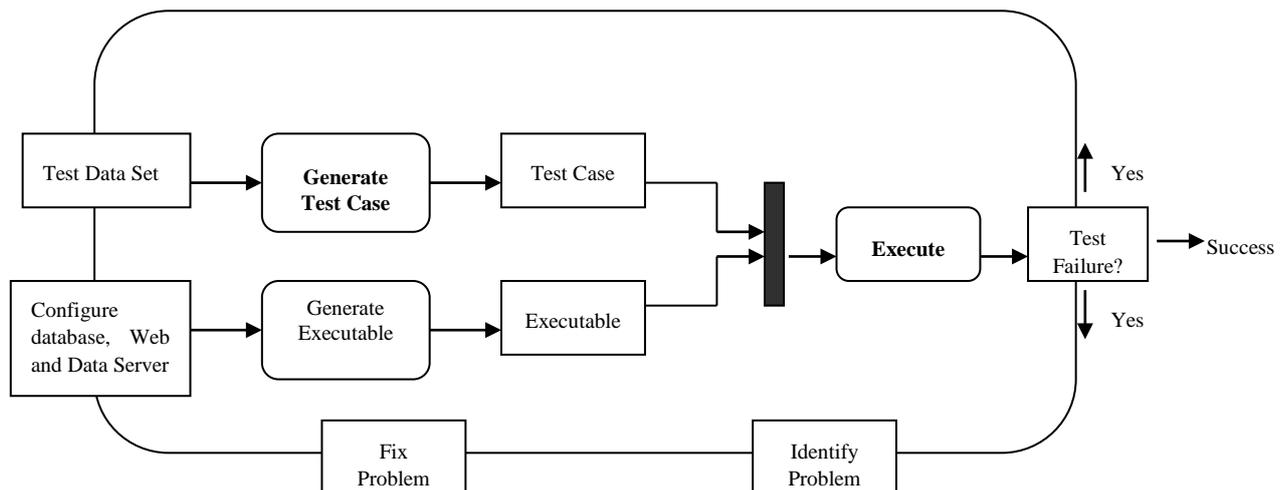


Figure 2.17: System testing of the Web Application

### 2.11.4 User Acceptance Testing

User Acceptance Testing (UAT) is a process for obtaining confirmation by the owner or client of the system under test, through trial or review, that the modification or addition meets mutually agreed-upon requirements. In software development, UAT is one of the final stages of a project and will often occur before a client or customer accepts a new system. After developing the overall system and performing the system test, the responsible official of WARPO will be invited to test the system.

### 2.12 Deployment of Database and Application

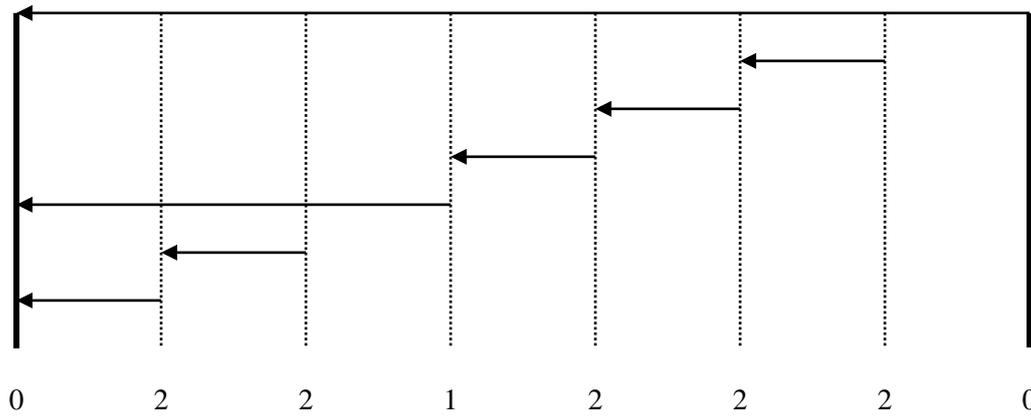
The database will be installed, created and configured at the server of WARPO. All checked and tested information will be transferred from the test database to the production (central) database. The web applications will be installed and configured into the central web server.

### 2.13 Backup and Recovery

As data can be lost or database can be corrupted due to hardware failure or software crash, the system will provide facilities to take regular backup of the database. In order to reduce backup space and time a multilevel incremental backup procedure will be used.

An incremental level  $x$  backup will copy all changed blocks since previous incremental level  $y$  backup where  $x \geq y$ ,  $y \geq 0$  and  $x \neq 0$ .

An example of multilevel incremental backup strategy is shown in Figure 2.18.



**Figure 2.18: Incremental Backup**

:

## Chapter 3 : Capacity Building

Transfer of knowledge and technology is an important issue required for smooth operation and management of the project. The objective of technology transfer could be achieved through selecting suitable training programs and involving implementing officials. Both in-class training and on-the-job training will be provided to the officials of WARPO. However, a training needs assessment will be made through discussion with WARPO officials.

### 3.1 In-Class Training

Eight in-class training programs will be arranged. First 5 programs will be organized for WARPO officials and remaining 3 will be organized for officials of WARPO and other stakeholders.

1. Training on GIS and RS: basic and advance training on GIS and RS
2. Training on Programming: programming concept, programming language (ASP .Net)
3. Training on Database: create new table, insert and update data, create views and stored procedure
4. Training on Data Quality Checking: quality checking of spatial data based on quality checking guidelines, quality checking tool
5. Training on Web Portal and Database administration.
6. Training on On-line Dissemination Tool
7. Training on Web Portal for Clearance Certificates
8. Training on Web Portal for No Objection Certificates

The training schedule, contents of the training program and number of participants will be finalized after discussing with WARPO officials. It is to be noted here that Consultant will provide technical support and assistance to organize the training programs. However, a tentative training schedule for WARPO is given in Table 3.1. Some of the trainings programs has already been started.

**Table 3.1: Tentative Training Schedule for WARPO**

Subject of Training	User Group	Number of Officials	Duration of Training
Training on GIS and RS	User group	10	7 days (8-hours session)
Training on Programming	Administrative group	5	5 days (8-hours session)
Training on Database	Administrative group	5	2 days (8-hours session)
Training on Data Quality Checking	User group	10	5 days (8-hours session)
Training on Web Portal and Database administration	Administrative group	5	3 days (8-hours session)
Training on On-line Dissemination	User group	30	2 days

Subject of Training	User Group	Number of Officials	Duration of Training
<i>Tool</i>			<i>(8-hours session)</i>
<i>Training on Web Portal for Clearance Certificates</i>	<i>User group</i>	<i>30</i>	<i>2 days (8-hours session)</i>
<i>Training on Web Portal for No Objection Certificates</i>	<i>User group</i>	<i>30</i>	<i>2 days (8-hours session)</i>

### **3.1.1 On the Job Training**

*A team of client part will work with the project team. On the job training will be provided to the client team during the development of database and application, installing and configuring the database and web server, trouble shooting and fixing different problems, taking backup and tuning of database within the project period.*

### **3.2 Workshop**

*Consultant will have provided to technical support and assistance to WARPO to organize three (03) workshops. The first workshop will have been a launching workshop, organized after submission of the Inception Report. The workshops will be open to the Government Officials, NGO's and professionals working in water resources sector. The main target of the workshop is to share the approach and methodology to be followed in the project.*

*The second workshop will be organized after submission of the Interim Report. The main target of the workshop is to share the progress and activities of the running project. The Final Workshop will be organized after submission of Draft Final Report (DFR). The objective of the workshop would be to disseminate the findings and incorporate valuable suggestions from different experts on water resources planning and management. In between there will be seminars to disseminate the study outcome to have responses and feedbacks.*

### **3.3 Documentations**

*In addition of Inception report, following four types of documents will be prepared and delivered to the WARPO during the different time periods of the project.*

- 1. Design Report*
- 2. Testing Report and Operational Plan*
- 3. Interim Report*
- 4. User Manual*
- 5. Training Manual*
- 6. Draft Final Report*
- 7. Final Report*

#### **3.3.1 Design Report**

*At the end of the 3 (three) months of the commencement of the services, the consultant shall prepare and submit 20 copies of the Design Report. This report will include database design, procurement requirements and the installation and testing plan.*

### **3.3.2 Interim Report**

*At the end of the 4 (four) months of the commencement of the services, the consultant shall prepare and submit 20 copies of Interim Report. The report will contain progress of the project activities.*

### **3.3.3 Testing Report and Operational Plan**

*At the end of the 5 (five) months of the commencement of the services, the consultant shall prepare and submit 20 copies of Testing Report and Operational Plan.*

### **3.3.4 Draft Final Report**

*At the end of the 7 (seven) months of the commencement of the services, the consultant shall prepare and submit 30 copies of Draft Final Report. WARPO and other relevant organizations will give comments on the draft within 15 days after receiving the draft final report. The report will be finalized incorporating comments from WARPO and other organizations and will be submitted to WARPO within 15 days after receiving comments. The final of the Draft Final Report need to be approved by Director General of WARPO.*

### **3.3.5 User Manual**

*Detail user manuals for 1) Web Portal for Clearance Certificates, 2) Web Portal for No Objection Certificate and 3) On-line Data Dissemination Tool will be prepared furnishing the following items:*

- *Purpose and scope of the project*
- *Definitions, acronyms, and abbreviations*
- *List of references*
- *Detail description of user interface*
- *Navigation details of web-based applications*
- *List of probable error messages and error handling procedure*
- *Detailed description of backup and recovery procedure*

*The report will be submitted in 5 (five) copies at the end of 9 (nine) months of the commencement of the services.*

### **3.3.6 Training Manual**

*High quality training manuals will be prepared and supplied to WARPO wherever required. Furthermore, presentation slides and other audiovisual methods implied in the training will be made available to the users. The report will be submitted in 5 (five) copies at the end of 9 (nine) months of the commencement of the services.*

### **3.3.7 Final Report**

*At the end of the 9 (nine) months of the commencement of the services, the consultant shall prepare and submit 30 copies of Final Report along with all digital copy, and other documents relevant to the project to the Project Director after incorporating necessary observations/comments from different organizations.*

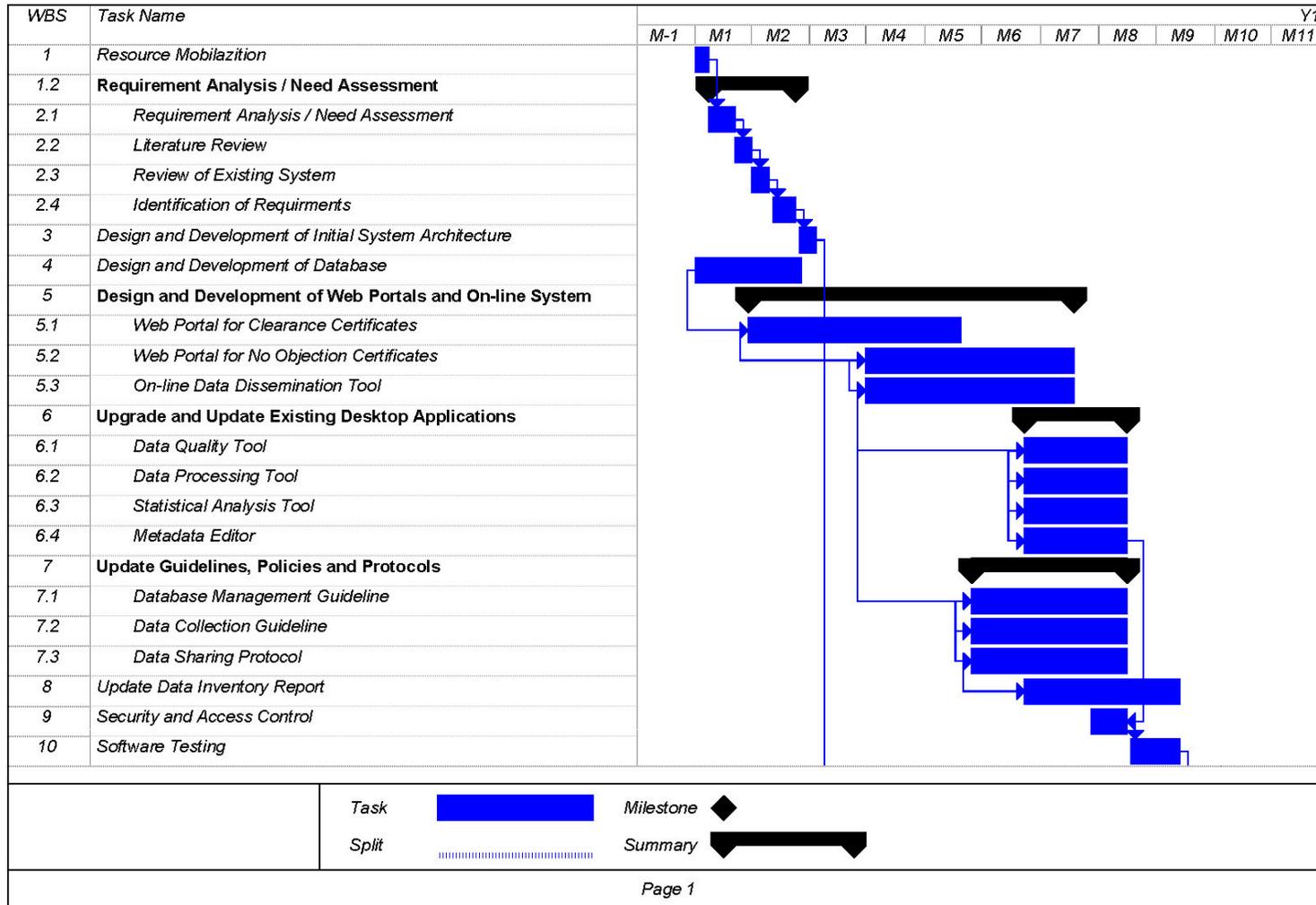
## Chapter 4 : Work Plan, Organization and Staffing

### 4.1 General

*The Work Plan set out for this project is proposed to be an innovative and interactive approach for guiding the development of database and web enabled application tools. Timely and efficient implementation of activities through proficient management of key experts and resources to drive sustainable development is the first and foremost intent of this project. In this regard, a well-prepared implementation plan has been developed for this project considering the workload, technical considerations and availability of resources.*

## 4.2 Work Schedule

Tentative work schedule of the project is given Figure 4.1.



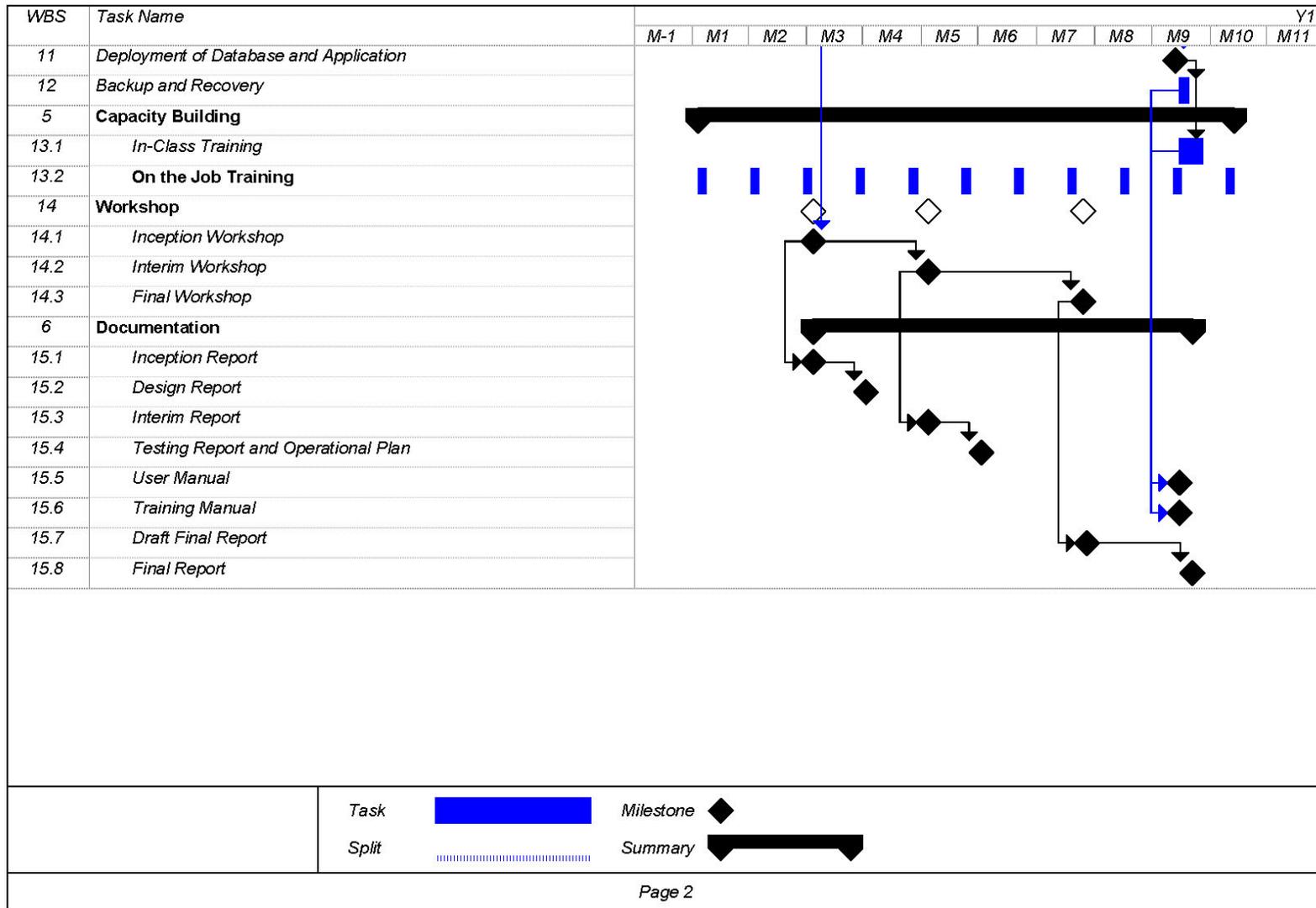


Figure 4.1: Tentative Work Schedule of the Project

**4.2.1 Team Composition and Task Assignment**

Team composition and task assignment of the professional staffs are given in Table 4.1:

**Table 4.1: Team Composition and Task Assignment**

Name of Staff	Firm/ Organization	Area of Expertise	Position Assigned	Task Assigned
Malik Fida A Khan	CEGIS	Management of multi-disciplinary team, numerical modelling, water resources management	Team Leader (Water Resources Engineer)	<p>His tasks and responsibilities shall include but not be limited to the followings:</p> <ul style="list-style-type: none"> <li>• Overall responsibility or guide and co-ordinate to achieve the outputs of the project;</li> <li>• Full responsibility for all aspects of planning, liaison and reporting;</li> <li>• Development of online help and guidelines for the web-based systems;</li> <li>• Update the groundwater models data and assess ground water recharge and potential data from local to planning areas for the Database Server;</li> <li>• Identify the possible groundwater resources data, water quality data, suitable methods of abstraction and environmental impacts under future climate change scenarios for the project;</li> <li>• Assess present and future use of groundwater for domestic, agricultural and industrial purpose in view of climate change;</li> <li>• Evaluate impacts of groundwater withdrawal on aquifer river interaction, impacts on drinking water supply, salt intrusion and determine appropriate mitigation measures;</li> <li>• Any activity assigned by the Project Director for the interest of the project;</li> <li>• Maintain close contact with the Project Director and the Project Coordinator for briefing his/her output;</li> <li>• Participate in the Workshop and attend meetings as and when required;</li> </ul>

Name of Staff	Firm/ Organization	Area of Expertise	Position Assigned	Task Assigned
				<ul style="list-style-type: none"> <li>• To assist project director for successful completion of the project;</li> <li>• Time to time inform the progress of the project to DG, WARPO.</li> </ul>
Abul Kashem Md. Hasan	CEGIS	MIS, Database Management, Web GIS, System and Programming	Deputy Team Leader (Data base specialist)	<p>His tasks and responsibilities shall include but not be limited to the followings:</p> <ul style="list-style-type: none"> <li>• Preparation of Database architecture for web- based systems of Project Clearance, NOC and NWRD database system, system analysis, design and development of web-based systems of Project Clearance, NOC and NWRD, Support IT experts coordination with GIS experts;</li> <li>• Perform database system design, database models (logical and physical) and design database in both Spatial and Spatial datasets; Management of training to the WARPO and provide support to colleagues in carrying out the development work;</li> <li>• Monitoring database administration Backup, restore and maintain close contact with the Project Director and the Project Coordinator for briefing his/her output.</li> </ul>
Md. Shafiqul Islam	CEGIS	Water resources planning, Data Analysis, Database Management	Data Analyst	<p>His tasks and responsibilities shall include but not be limited to the followings:</p> <ul style="list-style-type: none"> <li>• Responsible for supporting Database Experts in designing and development of Data Quality for Database;</li> <li>• Provide on Dara Quality;</li> <li>• Provide support to senior consultants and carrying out the development work;</li> <li>• Provide training on data quality checking on spatial and tabular data; Participate in the Workshop; Attend meetings as and when required; Perform database administration, Backup and restore.</li> <li>• Any activity assigned by the Project Director for the interest of the project;</li> </ul>

Name of Staff	Firm/ Organization	Area of Expertise	Position Assigned	Task Assigned
Md. Mostafizur Rahman	CEGIS	Web GIS, Database and Remote Sensing	GIS Expert	<ul style="list-style-type: none"> <li>• Maintain close contact with the Project Director and the Project Coordinator for briefing his/her output.</li> </ul> <p><i>His tasks and responsibilities shall include but not be limited to the followings:</i></p> <ul style="list-style-type: none"> <li>• Prepare plan for GIS application in consultation with other specialists of the consultant team;</li> <li>• Development and production of GIS products and where appropriate devise management and marketing strategies to make the GIS unit self-sustaining;</li> <li>• Provide training on GIS and RS for different stages to the WARPO officials;</li> <li>• Plan and design the analysis of different layers of spatial data and presentation of the results for better interpretations;</li> <li>• Deliver all collected/analyzed GIS data to NWRD and coordination his/her colleagues;</li> <li>• Implement and manage GIS projects and delivery of work products and any other assignment requested by Team Leader.</li> <li>• Any activity assigned by the Project Director for the interest of the project</li> <li>• Maintain close contact with the Project Director and the Project Coordinator for briefing his/her output.</li> </ul>
Mohammad Shahidul Islam	CEGIS	GIS, Database and Remote Sensing	Remote Sensing Expert	<ul style="list-style-type: none"> <li>• His tasks and responsibilities shall include but not be limited to the followings:</li> <li>• Support problem solving and advise on innovative techniques relevant to water resources assessment and monitoring as well as outputs for the NWRD database and related project;</li> <li>• Design, create and maintain geospatial database and develops maps and aerial photography.</li> <li>• Acquired data/maps/reports from different primary and secondary sources</li> </ul>

Name of Staff	Firm/ Organization	Area of Expertise	Position Assigned	Task Assigned
				<ul style="list-style-type: none"> <li>• Analyze and interpret result using standard Remote Sensing tools and technique</li> <li>• Provide training on RS for different stages the WARPO officials;</li> <li>• Plan and design the analysis of different layers of spatial data and presentation of the results for better interpretations;</li> <li>• Implement and manage RS projects and delivery of work products and any other assignment requested by Team Leader;</li> <li>• Any activity assigned by the Project Director for the interest of the project;</li> <li>• Maintain close contact with the Project Director and the Project Coordinator for briefing his/her output.</li> </ul>
<p><i>Badal Mohammad Faruque</i></p>	<p>CEGIS</p>	<p><i>Networking System, System Analysis &amp; development</i></p>	<p><i>System Analyst</i></p>	<p><i>His tasks and responsibilities shall include but not be limited to the followings:</i></p> <ul style="list-style-type: none"> <li>• <i>Identify Networking system for database system;</i></li> <li>• <i>Prepare Database Networking architecture, system analysis, design and development. Support IT/ Database experts coordination with GIS experts; Perform database system design, database models (logical and physical) and design Networking within different Tools with server in both Spatial and Spatial datasets;</i></li> <li>• <i>Provide training on Computer Networking system to the WARPO officials;</i></li> <li>• <i>Provide support to team leader and colleagues in carrying out the development work;</i></li> <li>• <i>Support General maintenance of the software application;</i></li> <li>• <i>Participate in the Workshop and attend meetings as and when required;</i></li> <li>• <i>Perform database administration, Backup and restore;</i></li> <li>• <i>Any activity assigned by the Project Director for the interest of</i></li> </ul>

Name of Staff	Firm/ Organization	Area of Expertise	Position Assigned	Task Assigned
				<p>the project;</p> <ul style="list-style-type: none"> <li>• Maintain close contract with the Project Director the Project Coordinator for briefing</li> </ul>
Md Anisur Rahman	CEGIS	Web site Development, database management, Programming	Computer Programmer	<p>His tasks and responsibilities shall include but not be limited to the followings:</p> <ul style="list-style-type: none"> <li>• Develop web based Data Dissemination Tool, Debug and fix software related problems;</li> <li>• Provide support to team leader and colleagues in carrying out the development work;</li> <li>• Provide training to the WARPO official on use of data dissemination tool;</li> <li>• Prepare user manual, technical document and training manuals;</li> <li>• Any activity assigned by the Project Director for the interest of the project;</li> <li>• Maintain close contact with the Project Director and the Project Coordinator for briefing his/her output.</li> </ul>
Md. Abdul Hadi				
Tanvir Ahmed	CEGIS	Hydrology, Water Resources, GIS and Remote Sensing	Hydrologist	<p>His tasks and responsibilities shall include but not be limited to the followings:</p> <ul style="list-style-type: none"> <li>• Collection of reports/maps/data from secondary sources, participate in data collection program;</li> <li>• Analysis of all types of data under guidance of senior professionals in the project team;</li> <li>• Assist team members as and when required.</li> <li>• Any activity assigned by the Project Director for the interest of the project;</li> <li>• Maintain close contact with the Project Director and the Project Coordinator for briefing his/her output.</li> </ul>
Ahmmmed Zulfiqar Rahaman	CEGIS	Hydrogeology, Water Resources, GIS and Remote	Hydrogeologist	<p>His tasks and responsibilities shall include but not be limited to the followings:</p> <ul style="list-style-type: none"> <li>• Collection of reports/maps/data from secondary sources,</li> </ul>

Name of Staff	Firm/ Organization	Area of Expertise	Position Assigned	Task Assigned
		Sensing		<p>participate in data collection program;</p> <ul style="list-style-type: none"> <li>• Analysis of all types of data under guidance of senior professionals in the project team;</li> <li>• Assist team members as and when required.</li> <li>• Any activity assigned by the Project Director for the interest of the project;</li> <li>• Maintain close contact with the Project Director and the Project Coordinator for briefing his/her output.</li> </ul>

#### 4.2.2 Staffing Schedule

Table 4.2: Staffing Schedule for the Project Period

No	Name of Staff	Position	Staff-month input by month					Total staff-month input			
			4	8	12	16	18	Home	Field	Total	
1	Malik Fida A Khan	Team Leader (Water Resources Engineer)	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■		9		9	
2	Abul Kashem Md. Hasan	Deputy Team Leader (Data base specialist)	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■		9		9	
3	Md. Shafiqul Islam	Data Analyst	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■		9		9	
4	Md. Mostafizur Rahman	GIS Expert	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■		6		6	
5	Mohammad Shahidul Islam	Remote Sensing Expert	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■		6		6	
6	Badal Mohammad Faruque	System Analyst	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■		6		6	
7	Md Anisur Rahman	Computer Programmer	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■		4.5		9	
8	Md. Abdul Hadi	Computer Programmer	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■		4.5		9	
9	Tanvir Ahmed	Hydrologist	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■		9		9	
10	Ahmmmed Zulfiqar Rahaman	Hydrogeologist	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■		9		9	
			Total						72		72

■ ■ ■ ■ ■ Discontinuous input      ■■■■■ Continuous input

### 4.2.3 Project Implementation Arrangement

The Consultant shall have been work under the direct supervision of the Project Director, WARPO and fully responsible to Director General, WARPO. The different Sections of WARPO shall assist the project team as required. For field survey and field data collection work, the consultants shall work with the WARPO professionals. WARPO professional will suggest and will go field for data collection with the consultant but total responsibility of data collection will be upon the consultant.

The Project Director will have ensure that the objectives of the study as detailed in the ToR are achieved within the agreed time schedule and that the recommendations of the project are acceptable to GoB. He will in the context of the ToR direct the planning process and work programming, supervise the execution of the study and monitor progress according to the said objectives. The Consultant will be required to reschedule activities on the requests of the Project Director if this becomes necessary.

The activity of the project will have been carried out in close consultation with and full cooperation of the WARPO officials. Meetings to monitor progress of the project activities will have been held at least once a month or more often when deemed necessary. The Consultant team will carry out the services as detailed in the Scope of Work and Job Description of Professional in the best interest of the Client. The WARPO will correspond with the consultant for any kind of official, administrative, financial, technical or other related work. Project Flow Chart is given in Figure 4.2.

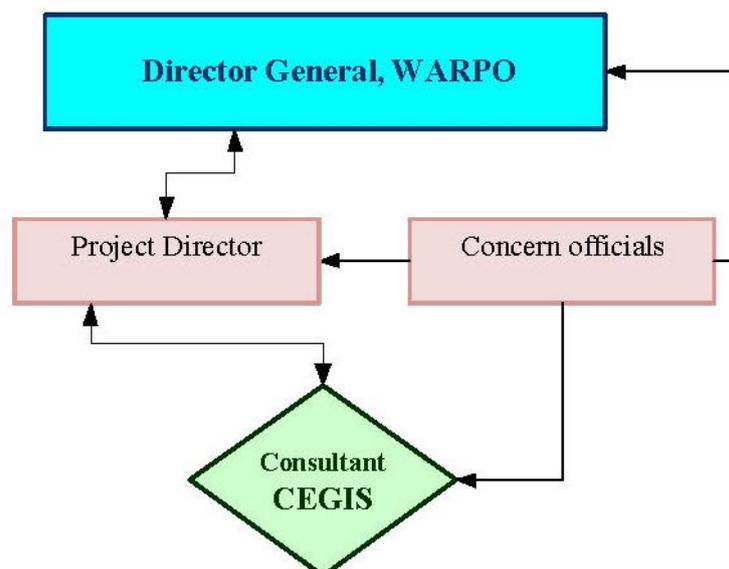


Figure 4.2: Project Flow Chart

#### 4.2.4 Project Organization

The project will be organized as per the RFP/ToR of the project. For smooth execution of the project activities, the consultant will work with a group of WARPO officials at the WARPO premises. The consultants are well experienced in multidimensional activities. They will provide their best services and maintain close liaison with the WARPO officials regarding different issues.

The consultants shall carry out the services as detailed out in "Scope of Works" and "Expected Output" with the "Requisite Qualifications, Experiences and Responsibilities of the Consultants" in the best interest of the Government with reasonable care, skill and diligence with sound engineering, administrative and financial practices and shall be responsible to the executing agency (WARPO) for discharge of responsibilities. The Team Leader will be responsible to the Director General, WARPO for proper and timely execution of all the activities of study mentioned-in the ToR of the project.

The Team Leader will monitor the overall project activities. He will hold regular internal meetings with his staff members and review the planning process, work program and monitor progress according to the set objectives of the ToR. He will inform the Project Director and Director General of WARPO from time to time on the progress and apprise them of the project status. The detailed layout of the project organization is given in Figure 4.3.

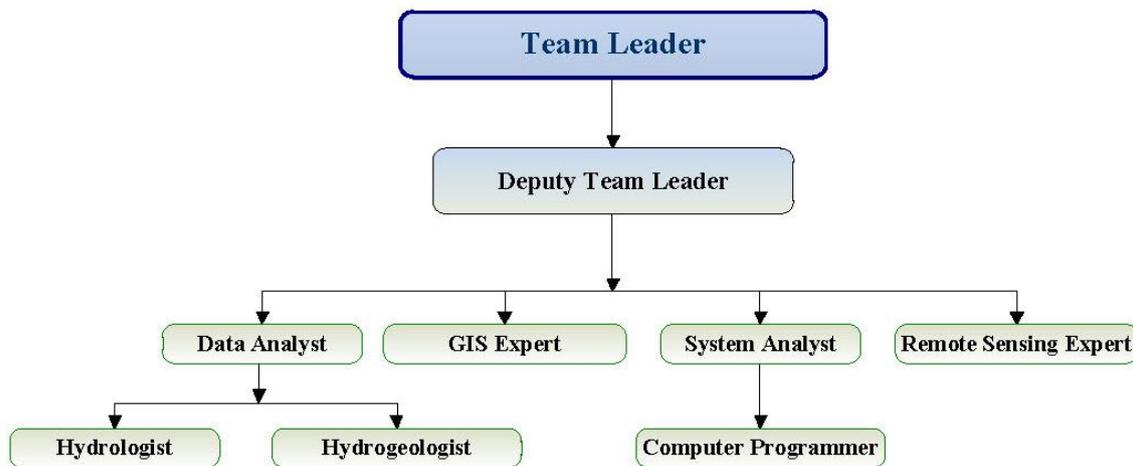


Figure 4.3: Project Organogram