Government of the People's Republic of Bangladesh
Ministry of Water Resources

Water Resources Planning Organization

Terms of Reference (ToR)
for

Assessment of water resources availability and lowest safe yield of aquifer in 10 districts of the North-Central Hydrological Regions of Bangladesh for effective implementation of Bangladesh Water Act, 2013

(বাংলাদেশ পানি আইন, ২০১৩ এর কার্যকর প্রয়োগে বাংলাদেশের উত্তর-কেন্দ্রীয় হাইড্রোলজিক্যাল অঞ্চলের ১০ টি জেলায় পানি সম্পদের প্রাপ্যতা এবং ভূ-গর্ভস্থ পানিধারক স্তরের নিরাপদ আহরণ সীমা নিরুপণ)

Component 2 of the Project:
"Hydrological investigation & modelling of the state of surface and groundwater resources"

WARPO
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1. Introduction:

Sustainable solutions to water problems require a paradigm shift from compartmental sub-sector-wise development to holistic water governance. Such a paradigm is encapsulated in the Integrated Water Resources Management (IWRM) concept. IWRM challenges conventional, fractional water development and management systems and emphasizes an integrated approach with coordinated decision making across sectors and scales. Furthermore, to face the growing challenges regarding water rights, protection of resources, water use, and water services management, Bangladesh has enacted a comprehensive legal framework called the Bangladesh Water Act, 2013, which received the President's assent on 2nd May 2013. This act outlines a coordinated and comprehensive regime for the development, management, extraction, allocation, use and conservation of water resources.

Therefore, it is necessary to put the Bangladesh Water Act, 2013 and the Bangladesh Water Rules, 2018 into practice in the entire Bangladesh and to understand local economic and social dynamics related to water management in line with IWRM concept. At a local scale, the problems of water scarcity in the critical and vulnerable areas in Bangladesh continue unchecked, existing irrigation and drinking water wells are being abandoned or operate at reduced capacity, the water table continues to fall unsustainably. Awareness of the problems, inside and outside the critical areas, has increased but initiatives to reverse the trends have been piecemeal, uncoordinated and inadequate in scale. Several projects took important steps to correct the problems, but much more is needed to coordinate, implement and facilitate water-saving and water-enhancing actions.

Water Resources Planning Organization (WARPO) is an apex organization under the Ministry of Water Resources (MoWR), dealing with nationwide water resources planning and is designated by the Bangladesh Water Act, 2013 as the nodal agency for coordinating IWRM. WARPO is mandated as the lead agency for implementation of the Act and its Rules and the regulation of water resources development. The National Water Policy (NWPo), 1999 also requires that WARPO will routinely update the water resources assessment of the country and monitor the state of water resources system so that the implementation, performance and the impacts of the National Water Management Plan (NWMP)/the National Water Resources Plan (NWRP) can adequately be addressed. Thus WARPO will implement the proposed project in compliance with the Bangladesh Water Act, 2013 and Bangladesh Water Rules, 2018 to protect the water sources and aquifers, and to develop sustainable water resources management in solving practical problems of water scarcity.

The problems of water resources in most of the districts of Bangladesh are enormous. This study has been undertaken in 10 districts in the North-central hydrological regions of Bangladesh where complex hydrogeological conditions and adverse water quality make water supply difficult. In spite of having large number of natural streams, ponds and decent groundwater storage, the scarcity of potable water is acute. Groundwater of acceptable quality is not available in most parts of these regions due to relatively shallow depths for easy

withdrawal by conventional hand pump tube wells. Salinity intrusion is also very common in the South-west hydrological region which has caused significant negative impacts on agricultural, fish and livestock production. The low saline pond water is used for many domestic purposes, but completely unsuitable for drinking. Other problems include arsenic in groundwater, drainage congestion, sedimentation in rivers, riverine and coastal flooding etc. The use of easily available waters as source of domestic water supply requires extensive costly treatment which is not a practical proposition for scattered rural population nor affordable in the context of rural economic condition in the study area.

Bangladesh, being an agricultural country, is highly dependent on groundwater irrigation given the fact that the existence of this resource was seen as abundant till recent years. As the surface water supply is decreasing day by day during the dry season, but the demand for irrigation is ever increasing, so the increasing trend in agricultural production is leaving the aquifer in vulnerable brink. Groundwater irrigation drastically increased in Bangladesh since the last three decades. But the source is limited and it is declining day by day due to intensive use of tube wells during dry season. In addition, rapid urbanization and industrialization in the recent years make the situation more critical. According to Bangladesh Water Act, 2013 and its Rules, it is important to identify the water scarce areas and sustainable water resources management. The paradigm shift from 'groundwater development' to 'groundwater management' in Bangladesh as laid out in Bangladesh Water Rules, 2018 through aquifer mapping in different hydro-geological settings require robust groundwater management plans at the appropriate scale to be devised and implemented. As one of the major sources of water for the country as well as an inevitable part of the hydrological system, groundwater resource needs to be seen as limited resource and therefore its management plan should associate the specification of sustainable abstraction limit.

The recent downward trend in groundwater levels in most of the districts of Bangladesh is evidently representing the alarm, coined with the rapid urbanization and industrialization which is persistently decreasing the potential recharge area as well as deteriorating quality of water. The groundwater aquifer is in complex nature, mainly addressed by deep, saline and arsenic. The scope for groundwater recharge has been reduced drastically due to unplanned paving in most of the areas. On the other hand demand is increasing day by day. As a result, groundwater table in these districts is successively falling by years with increasing withdrawal of water for domestic, municipal, industrial and irrigation. Therefore, it is very important to assess the quantity and quality of surface and groundwater resources and their use and demand in the study area. Assessment of surface and groundwater resources in these districts within the proposed project will help to address the efficient use of surface and groundwater resources as well as sustainable water resources planning and management for operationalizing the Bangladesh Water Act, 2013 in Bangladesh. To undertake this assessment, services will be required of qualified professional firms/organizations experienced in hydrological investigation and modelling of the state of surface water and ground water resources in the project area.

A detail analysis and modelling through a proven scientific tool will be required to enable the user to analyze and set the threshold limits for abstraction and usage considering future climate change and sustainability and for the enforcement to operationalize the Bangladesh Water Act, 2013 and its Rules. Numerous studies are conducted on groundwater depth fluctuation, recharge potentials and aquifer characteristics for the different regions on a broader scale revealing the vulnerability of the aquifer and groundwater resources. However, actual representation of the aquifer system and water budget based on hydrodynamic modelling is required to examine the present and future vulnerability scale. The Bangladesh Water Act, 2013 keeps the provision of determining the safe yield level of aquifer up to Mouza level, and declaration of Water Stress Area for a specific period, which seeks a clear understanding of the state of water resources of the designated area to have proper monitoring of the implementation of the Bangladesh Water Rules, 2018.

Assessment and management of water resources could be done considering surface water and groundwater in isolation but this isolated approach would fail to address the integrated behavior of the land and water ecosystem, interaction between the surface and groundwater within the water ecosystem as well as water environment. To ensure the integrated management of resource base, a physically based distributed modelling system would be more realistic and appropriate over the traditional analytical approach. Mathematical model enables better understanding of the river-aquifer interaction, as well as, providing a tool that can be used to manage the water resources in the best possible way considering the relative contribution of the components on the water balance in the study area. The best option of future surface water and groundwater developments which will effectively utilize all available water resources with no or minimum negative environmental impacts is possible to find out through application of the surface water and groundwater interaction modelling technique. Therefore to ensure integrated management of water resources a physically based distributed modelling system would be more appropriate and realistic.

2. Project area

The Project will promote and facilitate the operationalizing of the Bangladesh Water Act, 2013. Most of the activities will be targeted at implementation of the Act, its Rules, IWRM interventions and assessment of state of water resources in the administrative limits of 10 districts in the North-central hydrological regions of Bangladesh (Fig. 2). An active water management area will be precisely aligned during the Inception period to coincide with Mouza boundaries. Table 2 shows the different districts within north-central hydrological regions.

TABLE 1:

PROJECT AREA (10 DISTRICTS) WITHIN NORTH-CENTRAL HYDROLOGICAL REGIONS

Sr. No.	Hydrological Region	No. of Districts	Name of Districts
2	North-Central	10	Jamalpur, Sherpur, Mymensingh, Tangail, Gazipur, Dhaka, Narayanganj, Narsingdi, Munshiganj, Manikganj
Total		**10**	

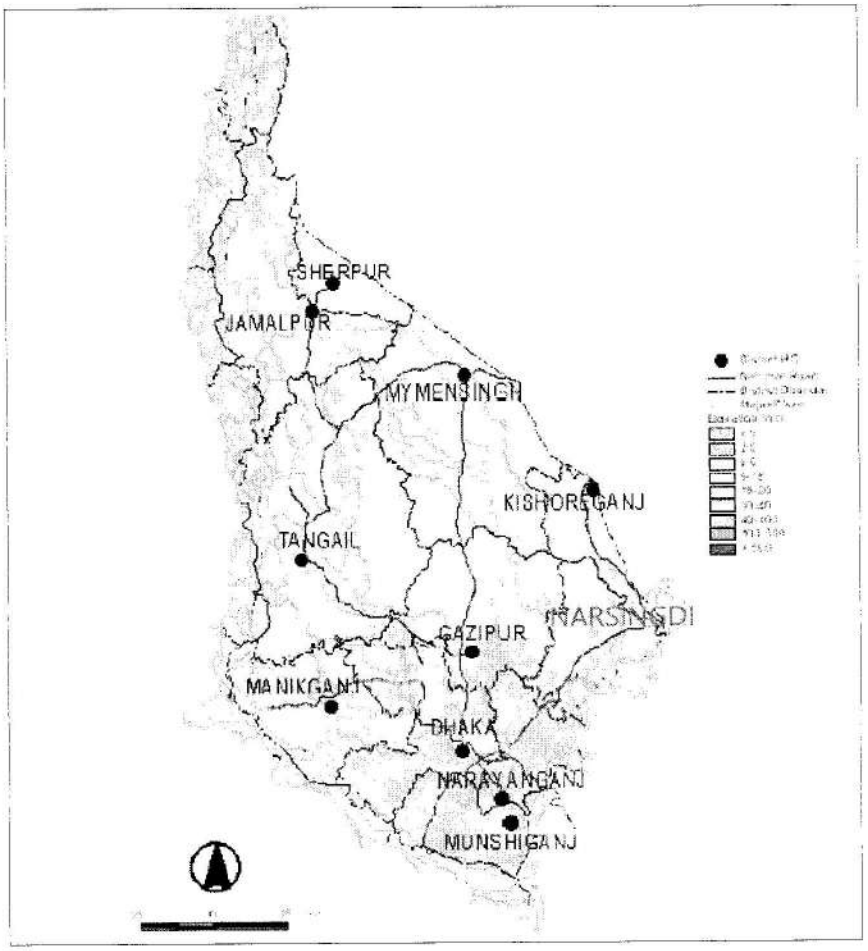

Fig. 1: The districts in the project area within north-central hydrological regions of Bangladesh.

3. Project Objectives

The main objective of this study is to develop numerical models to assess the state of surface and groundwater resources up to Mouza level for supporting operationalization of the Bangladesh Water Act, 2013 and Bangladesh Water Rules, 2018 in the study area.

The specific objectives of this study are -

(i) to investigate the present surface water and groundwater resources availability, use, quality and demand through field investigation and mathematical modelling,

(ii) to provide necessary comprehensive data, map and information required for operationalizing the Bangladesh Water Act, 2013 and Bangladesh Water Rules 2018, and

(iii) to create improved environment for sustainable water resources planning and management by enhancing water security and efficient water management considering Bangladesh Delta Plan 2100.

4. Scope of Works

The major scope of works of the National Consultants for this study will be (i) to assess the state of water resources through survey, field investigation, conceptual and numerical modelling; (ii) to investigate the aquifer system and groundwater recharge for preparing aquifer map; (iii) to determine the safe yield level of aquifer up to Mouza level in the study area; and (iv) to identify the Water Stress Area (WSA) considering present and future water uses.

Activities to perform:

- Collect hydrological, meteorological, hydro-geological, morphological, cross section of the major rivers and their tributaries/distributaries, Digital Elevation Model (DEM), groundwater level, water quality, aquifer properties and other necessary data from secondary sources as per required.
- Examine the present water use scenario, sectoral water demand, water quality and groundwater recharge mechanism in the study area based on the collected secondary data.
- Conduct field cross-section survey of major rivers and their tributaries/distributaries, install water level gauge and monitoring, discharge measurement and river bed material sampling and analysis.
- Preparation of Isohyetal maps depicting distribution of normal/annual/seasonal rainfall over the study area.
- Exploratory drilling and install necessary groundwater monitoring wells to fill up data gap, and put older wells back into service to study and monitor groundwater level, quality, aquifer system, aquifer behavior and subsurface lithology of the study area.
- Carry out reconnaissance survey, well inventory, field tests and laboratory tests of aquifer material samples to investigate sub-surface geological information, thickness of weathered zone, fracture density and spatial and temporal variations in groundwater quality.
- Perform pumping tests to investigate the hydraulic properties of the aquifer such as the specific storage, specific yield, porosity, transmissivity, hydraulic conductivity etc.

- Carry out Geophysical Resistivity Survey (GPRS) through Vertical Electric Sounding (VES) study to fill up necessary data gap and to develop a Conceptual model to formulate the composition and nature of the aquifer system in the study area.
- Determine the lateral and vertical extent, thickness and continuity of the aquifers and characterize the properties of aquifer sediments in the study area.
- Identify and delineate recharge and discharge areas of the aquifer by integrating data on rainfall, surface water, groundwater, land use and soil types.
- Assess the concentration of various chemical constituents in groundwater in aquifer through hydro-chemical analysis.
- Prepare the aquifer maps with GIS datasets depicting aquifer geometry, aquifer properties, geophysical parameters and water quality parameters.
- Update rainfall-runoff model, existing hydrodynamic model for river flow assessment and any other model, if necessary, for the study area.
- Develop a groundwater model to assess groundwater resources availability following the Conceptual model, and evaluate the trend of the groundwater movement by mapping of groundwater depth contour (maximum depth to phreatic surface, minimum depth to phreatic surface, fluctuation etc.) in the study area.
- Coupling of surface water and groundwater model to develop surface water-groundwater interaction model to get a complete natural hydrological scenario for assessment, analysis and prediction of groundwater and surface water resources of the study area.
- Assess the present surface water and groundwater availability, water quality and recharge mechanism using the developed model, and examine the impact of climate change on future water availability in the study area.
- Determine and fix the WL trend, safe yield level of aquifer up to Mouza level of the study area based on water resources availability, use, demand and recharge potential.
- Identify the Water Stress Area (WSA) considering present and future water uses, water quality in the study area, including technical constraints on water access; and provide suitable solution for sustainable water management in the Water Stress Areas.
- Identify, prioritize and design of suitable artificial recharge structures, their storage capacity and efficiency in feasible hydrogeological and environmental sites.
- Identify the potential water bodies needed for conservation as a source of potable water, as aquatic habitat, and for recharging underground aquifers.
- Develop and disseminate appropriate strategies for conjunctive use of rainwater, surface water and groundwater to improve efficiency of resource utilization and minimum groundwater abstraction.
- Develop and Establish Modern Research Laboratory for Water Measuring Water Quality Parametres.

- Any Other Activities assigned by DG, PD, PSC, PIC, Mid-Term Evaluation Committee for the fulfillment of the Project that is not addressed in Project Document. Moreover, the scope of works will also incorporate into the activities of log frame discussed as following:

৪.১ লগ ফ্রেম:

	সংক্ষিপ্ত বর্ণনা (NS)	বস্তুনিষ্ঠ যাচাই নির্দেশক (OVI)	যাচাইয়ের মাধ্যম (MOV)	গুরুত্বপূর্ণ অনুমান (IA)
লক্ষ্য	লক্ষ্য: বাংলাদেশ পানি আইন, ২০১৩ ও পানি বিধিমালা, ২০১৮ বাস্তবায়নের লক্ষ্যে প্রকল্প এলাকায় টেকসই সমন্বিত ভূ-পরিস্থ ও ভু-গর্ভস্থ পানি সম্পদের ব্যবস্থাপনা ও পরিকল্পনা প্রণয়ন করা।	• স্থিতিশীল অথবা উত্থাপিত পানি স্তর • সবার জন্য নিরাপদ পানি প্রাপ্যতা, গুণগত মান নিয়ে অনগ্রসর জনগণদের সন্তুষ্টিমূলক মত প্রকাশ • খাতভিত্তিক পানি সম্পদের ব্যবহার, গুণগত মান এবং চাহিদা, কাঙ্খিত রিচার্জ পটেনশিয়াল • নতুন প্রকল্পসমূহ পরিকল্পনা করার জন্য মন্ত্রণালয় কর্তৃক পানি বিধিমালা, ২০১৮ এবং সমন্বিত পানি সম্পদ ব্যবস্থাপনা (IWRM) বিবেচনা করা	• বিডব্লিউডিবি হাইড্রোগ্রাফ • জরিপ • হাইড্রোলজিকাল মানচিত্র • ওয়ারপো প্রতিবেদন • বিভিন্ন সংস্থার (বিএডিসি, এলজিইডি, বিডব্লিউডিবি) প্রতিবেদন • প্রকল্প ভিত্তিরেখা এবং পর্যবেক্ষণ • পানি আইন ২০১৩ বাস্তবায়ন ও পরিবীক্ষণে সহায়ক বিভিন্ন সংশ্লেষিত ও বিশ্লেষিত তথ্য-উপাত্তের সংখ্যা।	• হাইড্রোগ্রাফের সর্বোচ্চ ও সর্বনিম্ন তথ্য সংবলিত পাঁচ বছরের চলমান গড় • স্থানীয় পর্যায়ে অংশগ্রহণমূলক প্রক্রিয়ায় জনগনের সার্বিক সহযোগিতা
ফলাফল (Outcome)	ফলাফল ১: সমন্বিত পানি সম্পদ ব্যবস্থাপনা বাস্তবায়নে জনগনের প্রত্যক্ষ অংশগ্রহণের মাধ্যমে দীর্ঘমেয়াদী ও টেকসই পানি সম্পদ ব্যবস্থাপনা নিশ্চিতকরণ।	• স্থানীয় পর্যায়ে PRA পদ্ধতির মাধ্যমে FGD সভার সংখ্যা • বিদ্যমান পানি সম্পদের খাত ভিত্তিক ব্যবহার, গুণগত মান, চাহিদা ও উৎস চিহ্নিতকরণ • অনগ্রসর নাগরিকদের PRA কার্যক্রমের সাথে সম্পৃক্ত হওয়ার হার • উপজেলা পর্যায়ে PRA প্রতিবেদন অনুমোদিত	• যাচাইকৃত PRA প্রতিবেদন • উপজেলা পরিষদ বৈঠকের কার্যবিবরণী • ওয়ারপো প্রতিবেদন • প্রকল্প ভিত্তিরেখা এবং পর্যবেক্ষণ	
	ফলাফল ২: বিজ্ঞানভিত্তিক অনুসন্ধানের মাধ্যমে ভূ-গর্ভস্থ পানি সম্পদের নিরাপদ আহরণ নিশ্চিতপূর্বক পানি সম্পদ পরিকল্পনা ও ব্যবস্থাপনা সুদৃঢ়করণ।	• গ্রহণযোগ্য ভূ-গর্ভস্থ পানির উত্তোলন ও অ্যাকুয়াফারের WL ট্রেন্ড, সর্বনিম্ন নিরাপদ সীমা নিরূপন • ভূ-গর্ভস্থ ও ভূ-পরিস্থ পানি সম্পদের পরিমাণ ও রিচার্জ পটেনশিয়াল নির্ধারণ • পানি সম্পদের প্রাপ্যতা ও চাহিদা, গুণগত মান যথাযথভাবে বিবেচনা করে পানি সংকটাপন্ন এলাকা নির্ধারণ • পানি সংকটাপন্ন এলাকা নির্ধারণ বিষয়ে স্টেকহোল্ডারদের সাথে কর্মশালার সংখ্যা	• ওয়ারপো প্রতিবেদন • জরিপ/সার্ভে • মডেলের আউটপুট • হাইড্রোলজিক্যাল মানচিত্র • মধ্যমেয়াদী মূল্যায়ন প্রতিবেদন • বিশেষজ্ঞ সভার কার্যবিবরণী • স্টেকহোল্ডারদের সাথে কর্মশালার কার্যবিবরণী • এনডব্লিউআরডি নিরীক্ষণ প্রতিবেদন	

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		• এনডব্লিউআরডি তে হাইড্রোলজিকাল তথ্যের মান এবং পরিমান		
আউটপুট	আউটপুট ১.১: জনগনের প্রত্যক্ষ অংশগ্রহণের মাধ্যমে প্রকল্প এলাকায় বিদ্যমান পানি সম্পদের ব্যবহার, গুণগত মান, চাহিদা, উৎস চিহ্নিত করে পানি সম্পদ ব্যবস্থাপনার সঠিক অবস্থা সংক্রান্ত অংশগ্রহণমূলক গ্রামীণ মূল্যায়ন (PRA) প্রতিবেদন।	• স্থানীয় পর্যায়ে FGD সভার সংখ্যা • ইউনিয়ন ও উপজেলা পর্যায়ে PRA সভার সংখ্যা • অনগ্রসর নাগরিকদের PRA কার্যক্রমের সাথে সম্পৃক্ত হওয়ার হার • আইডব্লিউআরএম প্রক্রিয়ার সাথে নাগরিক এবং অনগ্রসর জনগণের সন্তুষ্টি	• ইউনিয়ন পর্যায়ে সভার কার্যবিবরণী • উপজেলা পরিষদ বৈঠকের কার্যবিবরণী • ওয়ারপো প্রতিবেদন • সভার কার্যবিবরণী	
	আউটপুট ১.২: বিভিন্ন খাত অনুযায়ী (যেমন- সেচ, মৎস্য, শিল্প, গৃহস্থালী প্রভৃতি) প্রকল্প এলাকায় ভূ-গর্ভস্থ ও ভূ-পরিস্থ পানি সম্পদের প্রাপ্যতা, ব্যবহার, গুণগত মান ও চাহিদা সংক্রান্ত উপাত্তভান্ডার ও প্রস্তুতকৃত ম্যাপ।	• খাতভিত্তিক পানি সম্পদের ব্যবহার, চাহিদা, গুণগত মান ও রিচার্জ পটেনশিয়াল প্রণয়ন • সনাক্তকৃত পর্যবেক্ষণ টিউবওয়েল এর বর্তমান সার্বিক অবস্থা • বর্তমান ভূমি ব্যবহারের তালিকা এবং কৃষি পদ্ধতি প্রণয়ন	• জিআইএস মানচিত্র • টাইম সিরিজ ডাটাবেস • যাচাইকৃত PRA প্রতিবেদন • বিশেষজ্ঞ সভার কার্যবিবরণী • ওয়ারপো প্রতিবেদন	
	আউটপুট ২.১: ভূ-পরিস্থ এবং ভূ-গর্ভস্থ পানির প্রাপ্যতা নিরুপন এবং প্রকল্প এলাকার প্রযুক্তিনির্ভর অ্যাকুয়াফারের WL ট্রেন্ড, ব্যপ্তি ও প্রকৃতি পর্যবেক্ষণ করে মৌজা ভিত্তিক পানি সম্পদের সার্বিক অবস্থা সম্পর্কিত ব্যাপক তথ্য ও প্রস্তুতকৃত ম্যাপ।	• স্থাপনকৃত প্রোডাকশন টিউবওয়েল এবং পর্যবেক্ষণ টিউবওয়েল এর সংখ্যা • পাম্পিং টেস্ট এবং ল্যাবরেটরী টেস্টের সংখ্যা • রেইনফল-রানঅফ মডেল, হাইড্রোডাইন্যামিক মডেল হালনাগাদ • ভু-পরিস্থ এবং ভূ-গর্ভস্থ পানির একত্রীকরণ মডেল প্রণয়ন • এনডব্লিউআরডিতে সংগৃহীত হাইড্রোলজিকাল তথ্যের মান এবং পরিমাণ	• জরিপ/সার্ভে • মডেলের আউটপুট • হাইড্রোলজিক্যাল মানচিত্র • অ্যাকুয়াফার ম্যাপ • মধ্যমেয়াদি মূল্যায়ন প্রতিবেদন • ওয়ারপো প্রতিবেদন • এনডব্লিউআরডি নিরীক্ষণ প্রতিবেদন	
	আউটপুট ২.২: গ্রহণযোগ্য ভূ-গর্ভস্থ পানির উত্তোলন ও অ্যাকুয়াফারের WL ট্রেন্ড, নিরাপদ পানি উত্তোলন স্তর সনাক্তকরণ এবং রিচার্জ পটেনশিয়াল নির্ধারণ করে প্রস্তুতকৃত চার্ট ও ম্যাপ।	• খাত ভিত্তিক পানি সম্পদের ব্যবহার, গুণগত মান নির্ধারণ • অ্যাকুয়াফারের WL ট্রেন্ড, নিরাপদ পানির স্তর সনাক্তকরণ ও নির্ধারণ • ভূ-গর্ভস্থ পানি সম্পদ এবং রিচার্জ পটেনশিয়াল নির্ধারণ	• প্রকল্প সমাপ্তির প্রতিবেদন • জরিপ/সার্ভে • চার্ট ও ম্যাপ • বিশেষজ্ঞ সভার কার্যবিবরণী • নির্বাচিত বিশেষজ্ঞদের সাক্ষাৎকার • স্টেকহোল্ডারদের সাথে কর্মশালার কার্যবিবরণী	মধ্যমেয়াদি মূল্যায়নে লক্ষ্যমাত্রা পর্যালোচনা এবং নির্দিষ্ট করা।

	সংক্ষিপ্ত বর্ণনা (NS)	বস্তুনিষ্ঠ যাচাই নির্দেশক (OVI)	যাচাইয়ের মাধ্যম (MOV)	গুরুত্বপূর্ণ অনুমান (IA)
		• এনডব্লিউআরডিতে সংগৃহীত হাইড্রোলজিকাল তথ্যের মান এবং পরিমাণ	• এনডব্লিউআরডি নিরীক্ষণ প্রতিবেদন	
	আউটপুট ২.৩: পানি সম্পদের বর্তমান ও ভবিষ্যত প্রাপ্যতা, ব্যবহার, গুণগত মান, চাহিদা ও পুনর্ভরণের সার্বিক অবস্থা বিবেচনা করে পানি সংকটাপন্ন এলাকা নির্ধারণ। অধিকন্তু, যে কোন এলাকার ভূ-গর্ভস্থ ও ভূ-পরিস্থ পানির গুনগত মান নির্ণয়ের মাধ্যমে সুবিধাভোগিদের সেবা সহজীকরণ।	• খাত ভিত্তিক পানি সম্পদের ব্যবহার, গুণগত মান নির্ধারণ • যথাযথভাবে পানি সংকটাপন্ন এলাকা সনাক্তকরণ ও নির্ধারণ • সংরক্ষনের জন্য সম্ভাব্য জলাশয় সনাক্তকরণ • পানি সংকটাপন্ন এলাকা নির্ধারণ বিষয়ে স্টেকহোল্ডারদের সাথে কর্মশালার সংখ্যা	• প্রকল্প সমাপ্তির প্রতিবেদন • চার্ট ও ম্যাপ • বিশেষজ্ঞ সভার কার্যবিবরণী • নির্বাচিত বিশেষজ্ঞদের সাক্ষাৎকার • স্টেকহোল্ডারদের সাথে কর্মশালার কার্যবিবরণী	মধ্যমেয়াদি মূল্যায়নে লক্ষ্যমাত্রা পর্যালোচনা এবং নির্দিষ্ট করা।
ইনপুট	ইনপুট: • সরেজমিনে মাঠ পরিদর্শন • তথ্য-উপাত্ত সংগ্রহ • কর্মশালার মতামত • বিশেষজ্ঞদের পরামর্শ • অর্থ	প্রকল্পের জন্য বরাদ্দকৃত টাকার পরিমান ৪৫১২.০০ লক্ষ টাকা • স্থানীয় পর্যায়ে (মৌজা, ইউনিয়ন, উপজেলা) PRA সভা • ২ টি কেন্দ্রীয় স্তরে এবং ১০ টি জেলায় স্টেকহোল্ডারদের সাথে ১০ টি মতবিনিময় কর্মশালা/আলোচনা সভা	• প্রকল্পের ডিপিপি • সমন্বয় সভার কার্যবিবরণী • মধ্যমেয়াদি মূল্যায়ন প্রতিবেদন	• এডিপি তহবিল • টেকসই তহবিল

5. Expected Output

The outputs of the study are as follows:

- Base map of the study area using updated information showing observation/ monitoring wells, alignments of rivers and canals, wetlands, road network, administrative headquarters etc;
- Different hydrological and hydrogeological maps using GIS/RS and modelling techniques;
- Aquifer maps with GIS datasets showing aquifer geometry, aquifer properties, geophysical and water quality parameters.
- Maps of groundwater quality regime showing distribution of important chemical constituents in groundwater;
- Updated rainfall-runoff model, hydrodynamic model for river flow assessment for the study area;
- A coupled surface water-groundwater interaction model for assessment of groundwater and surface water resources in the study area;

- Sectoral water resources demand projection in the study area (agriculture, domestic and industrial uses, navigation, fisheries, environment);
- Union-wise and Mouza-wise groundwater resources and recharge potential presented by charts and maps;
- Charts showing Union-wise and Mouza-wise allowable abstraction and safe yield level of aquifer in the study area;
- Maps showing Water Stress Area (WSA) under shortage of water resources considering present and future water uses,
- Working design of suitable artificial recharge structures, their types, storage capacity, efficiency and cost estimates, and
- Maps showing potential water bodies needed for conservation as a source of potable water and aquatic habitat in the study area.

6. Data Collection and Methodology:

The approach of collecting required data on hydrological, meteorological, hydro-geological, morphological, cross section of the major rivers and their tributaries/distributaries, Digital Elevation Model (DEM), groundwater level, water quality, aquifer properties, lithological data, existing DTWs/STWs and monitoring wells, required field survey and investigation, pumping tests, laboratory tests are to be submitted by the Consultant before commencement of the study. The methodology to execute the mathematical modelling works and the Critical Path Method (CPM) analysis are also to be submitted by the Consultant before commencement of the study.

7. Work Plan and Manning Schedule

The Work Plan and the manning schedules of the study for Modelling Personnel are to be submitted by the Consultant before commencement of the study.

8. Duration of the Contract

The Consultant will be procured for a period of 03 years (Thirty Six months) from the date of commencement according to the Contract.

9. Major Deliverables

- Detail assessment of the state of surface and groundwater resources up to Mouza level for each of the 10 districts in the study area.
- Detail assessment of aquifer formation, aquifer characteristics, groundwater movement and safe yield up to Mouza level in the study area.
- Detail assessment of Water Stress Area (WSA) under shortage of water resources considering present and future water uses in the study area.

10. Professional inputs

Formation of an effective team of professionals is prerequisite for the successful completion of any assignment. This is particularly important in a project like the proposed study with the stipulated objectives. A very careful thought has, therefore, been given in forming the team composition with a number of national professionals. Thus, the team members have been selected considering their academic qualification, professional expertise and practical experience of conducting similar studies as well as the requirements described in Terms of References (ToR) and the individual tasks proposed under each position of the project. The assignment of the Consultants will require substantial experience in their respective fields.

The National Consultants will be engaged under a single contract acting as one team of experts. It is estimated that for carrying out the above-mentioned study including relevant data collection, a total of **434 man-months** of consulting services of National Consultants will be required for the project. The estimated staff requirements for the study have been given below in the following table:

Sl. No.	Description of the Position	Number of Consultants	Input (man-month)
1	Senior Water Management Expert/Team Leader (01 nos.)	1	18
2	Soil and Groundwater Management Specialist (01 nos.)	1	10
3	GIS/RS Expert (02 nos.)	2	20
4	Hydrodynamic Modeller (02 nos.)	2	20
5	Groundwater Modeller (02 nos.)	2	24
6	Hydrologist (01 nos.)	1	10
7	Surface Water Specialist (01 nos.)	1	10
8	Hydrogeologist (01 nos.)	1	20
9	Survey Specialist (01 nos.)	1	20
10	Hydrochemist (01 nos.)	1	12
11	Data Analyst (02 nos.)	2	20
12	Research assistant (10 no- 1 no per district)-Non Key Expert	10	240
13	Lab attendent (2)-Non key Expert	2	48
	Total	**27**	**434**

11. Qualification and Responsibilities of the Modelling Consultants

The educational qualification, required experiences and the tasks and responsibilities of each of the Modelling Consultants for this study have been described in details below:

Qualification, Experience and Responsibilities of Personnel for
Hydrological investigation and modelling of the state of surface and groundwater resources

Name of the Post	Educational qualification	Experience	Responsibilities
1	2	3	4
Senior Water Management Expert/Team Leader	He/she must have a Bachelor's degree, preferably with a Master's/PhD degree, in Civil Engineering/Water Resources Engineering/Water Resources Management/Hydrology/ Geology from a well reputed university.	He/she must be a nationally reputed figure in water sector in Bangladesh and must have minimum 20 years of working experience in water resources planning and management having background in mathematical modelling in water resources sector. He/she must have minimum 10 years of practical working experience in leading similar projects on water resources management and groundwater modelling and assessment and leading multi-disciplinary and multi-national teams in similar water resources management projects.	▪ Overall responsibility for hydrological investigation and modelling task of the project. ▪ Full responsibility for all aspects of planning, liaison and reporting for the modelling team. ▪ Supervise all aspects of project implementation and work in close cooperation with Project Director. ▪ Study and review of previous water resources development projects in the study area. ▪ Examine present water availability and use scenario and water demand in the study area. ▪ Identify data gaps, bottlenecks and suggest primary data collection, if required. ▪ Develop approach and methodology for data processing, analysis and modelling. ▪ Orient the conceptual model and strategic work plan to carry out the modelling activities. ▪ Coordinate and supervise the modelling and investigation tasks of other experts in the team. ▪ Identify Water Stress Area (WSA) considering present and future water uses. ▪ Develop appropriate strategies for conjunctive use of rainwater, surface water and groundwater. ▪ Prepare the final modelling report on state of water resources in the study area. ▪ Maintain close contact with the Project Director and the Project Coordinator for regular reporting of project activities.

Name of the Post	Educational qualification	Experience	Responsibilities
1	2	3	4
Soil and Groundwater Management Specialist	He/she must have a Bachelor's degree, preferably with a Master's/PhD degree, in Civil Engineering/Water Resources Engineering/Water Resources Management/Geolology/ Hydrology/Soil Science from a well reputed university.	He/she must be a nationally reputed figure in water sector in Bangladesh and having minimum 18 years of working experience in water resources planning and management having background in mathematical modelling in water resources sector. He/she must have minimum 10 years of practical working experience in similar projects on water resources management and groundwater modelling and assessment.	▪ Provide overall technical advice and support for planning, design and implementation of hydrological investigation and modelling tasks. ▪ Study and review of previous groundwater resources development projects in the study area. ▪ Review and examine information related to groundwater availability and current and future sectoral demands. ▪ Identify gaps that need to be addressed to complete the groundwater assessment. ▪ Develop approach and methodology for groundwater data processing, analysis and modelling. ▪ Formulate and guide field survey in conducting aquifer test or pumping test. ▪ Coordinate and supervise the data collection and tasks of other specialists in the modelling team. ▪ Identify groundwater recharge mechanisms, abstraction and demand for major aquifer systems. ▪ Determine and fix the lowest groundwater safe yield level for respective aquifer systems. ▪ Identify and map groundwater vulnerable areas in accordance with Bangladesh Water Act, 2013. ▪ Assist the Team Leader in preparing the details groundwater assessment report. ▪ Any activity assigned by the Project Director for the interest of the project. ▪ Maintain close contact with the Project Director and the Project Coordinator for briefing the output.

Name of the Post	Educational qualification	Experience	Responsibilities
1	2	3	4
GIS/RS Specialist	He/she must have a Bachelor's degree, preferably with a Master's/PhD degree, in Geography/Civil Engineering/ Water Resources Engineering/ Computer Science/Urban and Regional Planning/Geology/ Environmental Science from a well reputed university.	He/she must have minimum 15 years of working experience in GIS application, Satellite image processing, analyzing and designing projects using ESRI software (ArcGIS, ArcInfo Desktop, ArcSDE, ArcView) and other software (ERDAS Imagine). He/she must have minimum 10 years of practical experience in similar GIS related activities in producing GIS coverage, contour maps, Digital Elevation Model (DEM); building and maintaining GIS databases.	▪ Acquire data/maps/reports from different primary and secondary sources. ▪ Design, create and maintain geospatial database and develop maps and aerial photography. ▪ Analyze and interpret results using standard GIS and RS tools and techniques. ▪ Produce GIS based geological and hydro-geological maps of the study area. ▪ Establish surface water and groundwater resources inventory which is compatible to GIS. ▪ Develop a GIS system based on the latest available aerial imagery base map to depict details of the boreholes and behavior of the groundwater. ▪ Map potential groundwater recharge areas and aquifer spatial coverage in different parts of the study area. ▪ Prepare GIS based maps of water stress areas, water zoning, aquifer formation maps. ▪ Oversee data flow, management and distribution activities to support GIS. ▪ Provide training to WARPO professionals on GIS and RS. ▪ Any activity assigned by the Project Director for the interest of the project. ▪ Maintain close contact with the Project Director and the Project Coordinator for briefing his/her output.

Name of the Post	Educational qualification	Experience	Responsibilities
1	2	3	4
Hydrodynamic Modeller	He/she must have a Bachelor's degree, preferably with a Master's degree, in Civil Engineering/Water Resources Engineering/Geology/Hydro-informatics/Hydrodynamic Modelling/Hydrology from a well reputed university.	He/she must have minimum 15 years of working experience in surface water modelling, 2D and 3D hydrodynamic modelling, numerical model coding and post-processing. He/she must have practical working experience in similar projects with organizing large geo-physical datasets, data assimilation techniques, pre-processing input datasets and post-processing model outputs, with excellent programming ability, including proficiency in Fortran, Matlab or Python, and NetCDF.	▪ Update the existing HD model for river flow assessment, the rainfall-runoff (NAM) model and any other model, if necessary, for the study area. ▪ Process and analyze the primary and secondary hydrological data for model set up. ▪ Develop and calibrate Water Balance model and specify boundary conditions. ▪ Assess the hydrographic conditions and hydrodynamics of rivers, lakes and reservoirs in the study area. ▪ Examine the impact of climate change on future surface water availability in the study area. ▪ Determine and fix the lowest safe yield level of aquifer in the study area. ▪ Develop approach and methodology for decision making on regulation on different usages of surface water. ▪ Provide training on hydrodynamic modelling. ▪ Any activity assigned by the Project Director for the interest of the project. ▪ Maintain close contact with the Project Director and the Project Coordinator for briefing his/her output.

Name of the Post	Educational qualification	Experience	Responsibilities
1	2	3	4
Groundwater Modeller	He/she must have a Bachelor's degree, preferably with a Master's degree, in Civil Engineering/Water Resources Engineering/Geology/Hydro-informatics/Groundwater Modelling from a well reputed university.	He/she must have minimum 15 years of working experience in developing groundwater flow models, integrated surface and groundwater models, numerical model coding and post-processing. He/she must have practical working experience in similar projects with organizing large geo-physical datasets, data assimilation techniques, pre-processing input datasets and post-processing model outputs, with excellent programming ability, including proficiency in Fortran, Matlab or Python, and NetCDF.	▪ Develop the Conceptual model to formulate the composition and nature of the aquifer system. ▪ Assist in collection, processing and analysis of all types of groundwater and aquifer related data. ▪ Formulate and guide field survey in conducting aquifer test or pumping test. ▪ Process and analyze the primary and secondary hydrological data for model set up. ▪ Develop and calibrate groundwater model from information relating to geological structure and aquifer properties. ▪ Simulate groundwater flow in aquifers including groundwater abstractions and interactions with river and other surface water bodies. ▪ Simulate groundwater levels and river flows for various scenarios such as changes in pumping rates, climate change scenarios. ▪ Carry out analysis of the groundwater recharge using groundwater models. ▪ Any activity assigned by the Project Director for the interest of the project. ▪ Maintain close contact with the Project Director and the Project Coordinator for briefing his/her output.

Name of the Post	Educational qualification	Experience	Responsibilities
1	2	3	4
Hydrologist	He/she must have a Bachelor's degree, preferably with a Master's degree, in Civil Engineering/Water Resources Engineering/Water Resources Management/Hydrology from a well reputed university.	He/she must have minimum 12 years of working experience in water resources management and hydrological analysis in water resources sector. He/she must have practical working experience in similar projects on water management, surface water modelling, aquatic resource management and flood risk management with excellent programming ability.	▪ Study and review of previous water resources development projects in the study area. ▪ Review of surface water flows, static water resources availability, water use and demand in the study area. ▪ Process and analyze the hydrological data for water resources planning and flood management. ▪ Assess the relationship between rainfall, runoff, streamflow, evapotranspiration and soil water content. ▪ Undertake hydrological assessment to develop flood and drought management strategy. ▪ Examine the impact of climate change on future surface water availability in the study area. ▪ Develop rating curve for dry period. ▪ Estimate water yields, taking into account the utilization of surface water. ▪ Identify the potential water bodies for conservation as a source of potable water and aquatic habitat. ▪ Provide training to WARPO professionals on hydrological modelling. ▪ Any activity assigned by the Project Director for the interest of the project. ▪ Maintain close contact with the Project Director and the Project Coordinator for briefing his/her output.

Name of the Post	Educational qualification	Experience	Responsibilities
1	2	3	4
Surface Water Specialist	He/she must have a Bachelor's degree, preferably with a Master's degree, in Civil Engineering/Water Resources Engineering/Geology/Hydro-informatics/Hydrodynamic Modelling/Hydrology from a well reputed university.	He/she must have minimum 12 years of working experience in surface water modelling, hydrodynamic modelling, flood risk management and river flow assessment. He/she must have practical working experience in similar projects on water resources management, aquatic resource management, surface water modelling, with excellent programming ability, including proficiency in Fortran, Matlab or Python, and NetCDF.	▪ Study and review of previous surface water resources development projects in the study area. ▪ Update the existing HD model for river flow assessment, the rainfall-runoff (NAM) model for the study area. ▪ Process and analyze the primary and secondary hydrological data for model set up. ▪ Assist in developing and calibrating Water Balance model and specify boundary conditions. ▪ Undertake hydrological assessment to develop flood and drought management strategy. ▪ Examine the impact of climate change on future surface water availability in the study area. ▪ Estimate water yields, taking into account the utilization of surface water. ▪ Identify the potential water bodies for conservation as a source of potable water and aquatic habitat. ▪ Any activity assigned by the Project Director for the interest of the project. ▪ Maintain close contact with the Project Director and the Project Coordinator for briefing his/her output.

Name of the Post	Educational qualification	Experience	Responsibilities
1	2	3	4
Hydro-geologist	He/she must have a Bachelor's degree, preferably with a Master's degree, in Geology/ Soil Science/Hydrogeology/ Environmental Science from a well reputed university.	He/she must have minimum 10 years of working experience in groundwater occurrence and movement, aquifer formation, groundwater hydraulics and groundwater recharge mechanism. He/she must have practical working experience in similar projects with hydro-geological investigation, groundwater sampling tests, pumping tests, design and commission of boreholes.	▪ Formulate specification of hydro-geological field investigation and survey. ▪ Assist in the collection, processing and analysis of all types of groundwater related data. ▪ Understand and interpret maps, geological data, historical evidence and models to build up the groundwater regime of the study area. ▪ Supervise installing necessary groundwater monitoring wells and borehole logs and put older wells back into service. ▪ Drill exploratory boreholes in order to obtain missing data. ▪ Perform groundwater sampling at field sites using specialized instrumentation and equipment. ▪ Carry out hydro-geological investigation on site such as hydraulic aquifer tests or pumping tests and evaluate their results ▪ Bring the samples to the laboratory for testing. ▪ Monitor aquifer system, aquifer behavior and subsurface lithology of the study area. ▪ Determine the lateral and vertical extent, thickness and continuity of the aquifer in the study area. ▪ Any activity assigned by the Project Director for the interest of the project. ▪ Maintain close contact with the Project Director and the Project Coordinator for briefing his/her output.

Name of the Post	Educational qualification	Experience	Responsibilities
1	2	3	4
Survey Specialist	He/she must have a Bachelor's degree, preferably with a Master's degree, in Civil Engineering/Water Resources Engineering from a well reputed university.	He/she must have minimum 10 years of working experience in river cross-section survey, sampling and field data collection. He/she must have practical working experience in similar field data collection, discharge measurement, water level gauge installation, river bed material sampling and measurement.	▪ Formulate realistic field data collection plan and schedule. ▪ Participate survey work to be conducted for field data collection. ▪ Lead and supervise the field data collection team with necessary safety measures. ▪ Conduct extensive cross-section survey of river course, distributaries, tributaries and other water channel on requirement. ▪ Water level gauge installation, reading arrangement, discharge and river bed material sampling and measurment. ▪ Inform the status and progress of the data collection activities regularly to the PMU. ▪ Assist the Team leader and the Deputy Team Leader in preparation of the detail survey report. ▪ Any activity assigned by the Project Director for the interest of the project. ▪ Maintain close contact with the Project Director and the Project Coordinator for briefing his/her output.

Name of the Post	Educational qualification	Experience	Responsibilities
1	2	3	4
Hydro-chemist	He/she must have a Bachelor's degree, preferably with a Master's degree, in Chemistry/ Geology/Environmental Science/Hydrogeology/Geology & Mining from a well reputed university.	He/she must have minimum 10 years of working experience in groundwater management and groundwater quality analysis. He/she must have practical working experience in similar hydro-chemical investigation, groundwater sampling tests, laboratory tests of hydro-chemical parameters.	▪ Assist in collection, processing and analysis of all types of groundwater quality data. ▪ Collect and analyse water samples for physical and chemical parameters and interpret their results in relation to sectoral water uses. ▪ Perform groundwater sampling at field sites using specialized instrumentation and equipment. ▪ Carry out hydro-chemical investigation at field level and bring samples to the laboratory for testing. ▪ Responsible for quality analysis for groundwater at field level. ▪ Supervise the laboratory analysis of hydro-chemical parameters. ▪ Any activity assigned by the Project Director for the interest of the project. ▪ Maintain close contact with the Project Director and the Project Coordinator for briefing his/her output.

Name of the Post	Educational qualification	Experience	Responsibilities
1	2	3	4
Data Analyst	He/she must have a Bachelor's degree, preferably with a Masters' degree, in Computer Science/Electrical & Electronics Engineering/Civil Engineering/ Water Resources Engineering/ Statistics/Applied Statistics from a well reputed university.	He/she must have minimum 10 years of working experience in Information Technology, database management, data processing and analysis and statistical analysis of data. He/she must have practical experience in similar projects with data analysis of water level, rainfall, discharge etc., building and maintaining databases with excellent proficiency in statistical software (R, SPSS) and programming (XML, Javascript)	▪ Acquire data/maps/reports from different primary and secondary sources. ▪ Analyze all types of primary and secondary data under guidance from the Team Leader and the Deputy Team Leader. ▪ Analyze and interpret results using standard statistical tools and techniques. ▪ Design, create and maintain relational databases and data systems. ▪ Assist the Team Leader to preparation of reports by providing data and information. ▪ Any activity assigned by the Project Director for the interest of the project. ▪ Maintain close contact with the Project Director and the Project Coordinator for briefing his/her output.

Name of the Post	Educational qualification	Experience	Responsibilities
1	2	3	4
Research Assistant	He/she must have a Bachelor's degree in any discipline. Preference will given in Computer background, Research, lab and Data analyst activities.	He/she should have at least 05 years professional experience including Research activities, Lab work, field supervision, co-ordination and data survey.	• Conduct Reseach and data analysis. • Conduct Lab research. • Coordinate among the field supervisors, enumerators, team leader and other responsible member of the team; • Monitor, supervise of the field level staffs and resolve the problems if raised at the field level; • Ensure the quality of data; • Provide field data to the team leader and other members from the field; • Assist team leader; and • Any other responsibility assigned by the PD

Name of the Post	Educational qualification	Experience	Responsibilities
1	2	3	4
Lab attendent	He/she must have a Bachelor's degree in any discipline.	He/she should have at least 2 years professional experience preferably in data collection and Lab field	• Conduct Lab Reseach and data analysist. • Collecting sample from field. • Conduct field survey (quantitative and qualitative); • Cross check the collected data sheets for ensuring quality of data; • Conduct interviews with individuals to collect data. • Verify data for accuracy and completeness. • Others as necessary • Job assigned by PD

12. Survey, Investigation, Data Collection, Field & Laboratory Tests

The Consultants have to carry out the following activities for survey, investigation and data collection through installation of monitoring and production wells and by performing field and laboratory tests:

A. Survey, Investigation & Data Collection

Sl. No.	Description of Items	Unit	Quantity
1	Data collection from secondary sources (available hydrological, meteorological, hydrogeological etc.)	Item	-
2	Cross-section survey of major rivers, distributaries/tributaries, canals etc.	nos.	2500
3	River WL (non-tidal) gauge installation and monitoring (10 stations, 12 months)	station-month	120
4	River Discharge (non-tidal) measurement (10 location, 2 measurement per month, 6 months)	nos.	120
5	Tidal River WL gauge/Pressure sensors installation	nos.	10
6	Tidal River WL gauge/Pressure sensors reading and monitoring (10 stations, 12 months)	station-month	120
7	Tidal River discharge measurement by ADCP (10 location, 1 measurement per month, 6 months)	nos.	60
8	River Bed material sampling and analysis	nos.	100
9	Monitoring of GW level data (372 Well, 2 ys)	nos.	8928
10	Union wise Aquifer Mapping (744 Union @ 6 no)	nos.	4464
11	Collection of satellite images	Item	-
12	Geo-referencing of satellite images	Item	-
13	Processing of satellite images	Item	-
14	Geophysiscal resistivity survey through Vertical Electrical Sounding (VES)	nos.	71

B. Installation of Monitoring & Production Well			
Sl. No.	**Description of Items**	**Unit**	**Quantity**
1	Exploratory drilling with installation of monitoring well (upto 200m) with fencing	nos.	168
2	Exploratory drilling with installation of monitoring well (upto 300m) with fencing	nos.	42
3	Installation of monitoring well at main aquifer	nos.	162
4	BM/RL Connection monitoring well with fencing	nos.	372
6	Installation of production well for pumping Test where required well is unavailable	nos.	10
7	Installation of seepage & percolation measurement pipe	nos	71
8	Measurement of seepage & percolation	nos	71
9	Training and Capacity building with exposure visit	nos	3

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B. Installation of Monitoring & Production Well			
Sl. No.	**Description of Items**	**Unit**	**Quantity**
10	Transport, fieldtrip, supervision & monitoring, stationary, phtocopy, printing and reporting	item	-

C. Field & Laboratory Test			
Sl. No.	**Description of Items**	**Unit**	**Quantity**
1	Pumping Test using existing DTW/STW or newly constructed productions	nos.	50
2	Groundwater and surface water sampling	nos.	500

- Installation of total 372 Monitoring wells at different depth where 168 Monitoring wells at 200-meter depth; 42 Monitoring wells at 300-meter depth; 162 Monitoring wells at main aquifer depth of all 50 mm diameter with at least D class pipe and 10 production wells with 250 x 150 mm diameter with at least E class pipe with proper fencing of all wells in 10 districts of the North-Central Hydrological Regions of Bangladesh.
- Boring by using 150 mm dia cutter and 50 mm dia heavy type G.I pipe (with appropriate wall thickness and outside diameter; weight at least 3.517 kg/m, capable to withstand at least 50 kg/cm2 pressure) and other equipments capable of drilling up to a depth of 200 meter, 300 meter and main aquifer by water jet system through all sorts of soil strata providing protection of caving by supplying necessary casing pipe. Collection of soil samples at every 3 meter interval and at every change of soil strata and preserving them in a controlled environment for analysis and laboratory test. Finally, withdrawal of boring and casing pipes etc. complete and accepted by the Engineer-in-charge.
- Pumping test with existing deep tube wells and newly constructed deep tube wells at main aquifer.
- All the components of A,B,C of article 12 must be done accordingly.
- Union wise Aquifer Mapping (744 Union @ 6 no) have must to be prepared and submitted to WARPO.
- GW level data (372 Well) have to be collected and submitted to WARPO.
- Training and Capacity building with exposure visit have to be completed.
- Lision and coordination must be maintain with PRA and Automation Team.
- Any Other Activities assigned by DG, PD, PSC, PIC, Mid-Term Evaluation Committee for the fulfillment of the Project that is not addressed in Project Document and ToR. Moreover, the scope of works will also incorporate into the activities of log frame discussed above.

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Zaheen-Ibn-Abedin
Assistant Project Director-3
Water Act Implementation in 10 Districts
Project, WARPO.

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