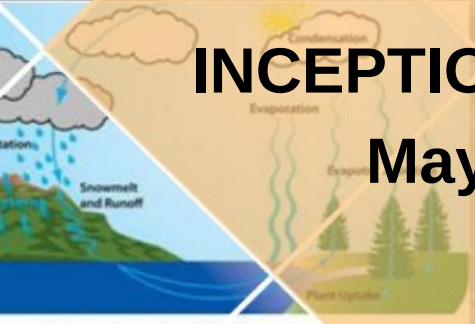
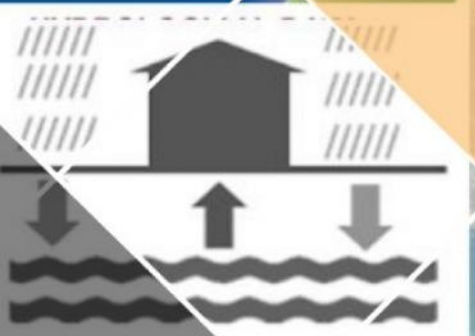
INCEPTION REPORT
May 2018





Technical Assistance and Management Consultancy (TAMC)

NHP
NATIONAL HYDROLOGY PROJECT

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Document Control

Version	Date	Comment	Prepared by
1	23/1/2018	TAMC Inception Report Version 1	TAMC Team, Wolfgang Krinner (TL), Sravan Kanukuntla (DTL)
2	8/2/2018	TAMC Inception Report Version 2, several corrections	TAMC Team, Wolfgang Krinner (TL), Sravan Kanukuntla (DTL)
3	18/5/2018	Revision of section 5.2 and minor corrections	TAMC Team, Wolfgang Krinner (TL), Sravan Kanukuntla (DTL)

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Acronyms and Abbreviations

AWP	Annual Work Plan
BE	Budget Estimate
BBMB	Bhakra Beas Management Board
BDS	Bidding Data Sheet
CGWB	Central Ground Water Board
CMC	Consultancy Monitoring Committee
CPCB	Central Pollution Control Board
CPMU	Central Project Management Unit
CWC	Central Water Commission
CWPRS	Central Water and Power Research Station
DVC	Damodar Valley Corporation
DWLR	Digital Water Level Recorder
ESA	Environmental and Social Assessment
ESMF	Environmental and Social Management Framework
eSWIS	Online Surface Water Information System
FEWS	Flood Early Warning System
FMR	Financial Management Reporting
GCC	General Conditions of Contract
GOI	Government of India
GW	Groundwater
HDUG	Hydrological Data User Group
HSO	Hydrological Studies Organisation of CWC
HP-I	Hydrology Project - Phase I
HP-II	Hydrology Project - Phase II
IA	Implementing Agencies
ICB	International Competitive Bidding
IMD	India Meteorological Department
ISO	Indian Standard Organization
ISRO	Indian Space Research Organization
ITB	Instructions to Bidders
IUFR	Interim Unaudited Financial Reports
KT	Knowledge Transfer
MOA	Memorandum of Agreement
M&E	Monitoring and Evaluation
MIS	Management information Systems
MOWR, RD&GR	Ministry of Water Resources, River Development & Ganga Rejuvenation
MPR	Monthly Progress Report
MWL	Maximum Water Level
NCB	National Competitive Bidding
NESAC	North-East Space Application Centre
NIH	National Institute of Hydrology
NHP	National Hydrology Project

NLSC	National Level Steering Committee
NPMU	National Project Management Unit
NRSC	National Remote Sensing Centre
NWIC	National Water Informatics Centre
PAD	Project Appraisal Document
PD	Project Director CPMU
PDO	Project Development Objectives
PIP	Project Implementation Plan
PM	Procurement Manual
PMTS	Project Monitoring and Tracking System
QPR	Quarterly Progress Report
RE	Revised Estimate
RTDAS	Real Time Data Acquisition System
SBD	Standard Bidding Document
SCADA	Supervisory Control And Data Acquisition
SCC	Special Conditions of Contract
SoI	Survey of India
SLPSC	State Level Project Steering Committee
SPMU	State Project Management Unit
SRS	System Requirement Studies
SW	Surface Water
UC	Utilisation Certificate
UT	Union Territory
WB	World Bank
WRD	Water Resources Department
WRIS	Water Resources Information Systems

EXECUTIVE SUMMARY

This Inception Report is submitted by the Consultant in accordance with the requirements of Contract Agreement. It provides an overview of the project status, a description of the activities carried out during the Inception Phase and presents the plans and requirements for project implementation.

The Consultant has started activities on 23 October 2017. Three months after project start a large part of the TAMC team has been mobilised, and 9 out of 10 core staff members, 15 out of 25 support staff, 1 member of the advisory team and the office support team have been deployed.

A project office has been established at the NPMU's premises in New-Delhi, the provided office space has been refurbished and the deployment of TAMC staff to the regional offices has started on 15 January.

The teams for different topic areas have formed and activities in all areas have started. During the first months all teams have been assessing the current situation and have been planning future activities. Internal management processes have been implemented and contacts with stakeholders are being established.

In the Negotiation Meeting it was agreed that the TAMC will further develop and improve the existing water information systems eSWIS and India-WRIS. In particular the TAMC's tasks include the development of new features under eSWIS including a module for groundwater and the development of a pre-processing tool for data obtained from real time data acquisition systems (RTDAS).

It is important to note that the task of further developing and improving the two information systems eSWIS and India-WRIS implies a profound restructuring and integration of both systems, in order to create the basis for future system growth and ensure ease of maintenance and the possibility to add new modules with a medium/long term perspective.

A significant increase of IT resources within the TAMC team compared to the team initially foreseen is required to carry out this task. A solution for mobilising additional resources allowing to perform all necessary IT development as per the Contract Agreement and at the same time avoiding an excessive reallocation of TAMC resources is presented in this report.

1 INTRODUCTION

Water resources management needs a solid information basis. Measured data is required to fully understand problems and develop solutions, including decisions on how best to allocate water between often competing uses. In a scenario of climate change, growing population and increasing water demand, water resource management is becoming increasingly important.

In the above context, the Government of India (GOI) wishes to expand the water resources monitoring system and institutional capacity for water resources management established in some states under the earlier phases of Hydrology Project, i.e. Hydrology Project Phase I (HP-I) and Hydrology Project Phase II (HP-II) to cover the entire country, including the States of the Indus, Ganga and Brahmaputra-Barak basins.

As a sequel to the earlier phases of the Hydrology Project, the currently on-going National Hydrology Project (NHP) will further improve and expand the water resources monitoring system, strengthen water resources operation and planning systems, and enhance institutional capacity for water resources management. The project will thus strengthen information and its access and will build up institutional capacity for evidence-based decision making in water resources planning and operational management at the basin scale across India using the latest technology and tools. NHP will cover both states that benefitted from HP-I and HP-II and states that were not included in the earlier project phases.

In the new states, support will be given to adopting the standards and procedures for monitoring and database management that were developed under the earlier projects. For HP-I and HP-II states, support will focus on upgrading and completing networks including for monitoring water use. In all the states, the focus will be on integrating data in a comprehensive national information system and using the information for improved water planning and management.

The National Project Management Unit (NPMU) has already been established and is functioning under the MoWR, RD&GR with the responsibility of overall project planning, management and coordination, fund allocation, financial and procurement management for NHP. The NPMU consists of multi-disciplinary team and currently supported by an internationally recruited Technical Assistance and Management Consultancy (TAMC) experts to provide close guidance and support to the sub-national agencies.

Eptisa Servicios de Ingenieria S.L. in Joint Venture with Ernst & Young LLP (Consultant) have been appointed by the NPMU (Client) for TAMC on 10th October 2017 to provide the consultancy services and to support the effective functioning of NPMU. Consultant has started functioning and providing expert services from the premises of NPMU from 23rd October 2017. As per the deliverables defined in the contract, Consultant has to submit the Inception Report at the end of 3 months. Hence the Inception Report is submitted by the Consultant to inform the Client and stakeholders on progress made during the preceding 3 months and overall planning for the coming months of the project. The draft inception report covers broadly the following:

- Project aim, objectives, methodology and its activities;

- Description of current situation upon the start of the project;
- Synergies with other on-going projects and with the target institutions;
- A description synopsis of the activities and work undertaken within specific areas during the inception phase; and
- A detailed Work Plan for the provision of each activity, area of expertise and list of deliverables and the management of the project.

1.1 Project Objectives

The main objectives of the NHP are to improve the extent, quality and accessibility of water resources information, and to strengthen the capacity of water resources management institutions in India.

The NHP aims to provide nation-wide surface and ground water data and information to users, including decision-makers for various needs:

- By investing in modernization of the real-time monitoring system;
- By establishing baseline & reference conditions of water quantity/quality and determining long-term trends;
- By using analytical tools and information services to improve handling routines in management of water resources, i.e. planning, forecasting, modelling & operating, and enabling measuring response to remedial measures and regulatory decisions; and
- By detecting emerging issues and threats of floods & droughts, as well as modernising institutions by investing into increasing people skills & knowledge and thus enhancing institutional capacities.
- By monitoring the state of the water resources in India and their change over time, which is integral to the development of effective and sustainable water resources management.

1.2 Project Financing

The complete project has a value of approximately INR 3640 Crore. The Loan Agreement between the Government of India and the International Bank for reconstruction and Development (World Bank) considers a total project value of US$ 350 million out of which 50% is financed through the World Bank, and the remaining 50% is financed nationally.

1.3 Institutional and Implementation Arrangements

The Ministry of Water Resources, River Development & Ganga Rejuvenation (MOWR, RD&GR) is the lead implementing agency for the Project. The implementation in each participating State/Union Territory (UT) will be the responsibility of the respective State/UT-level agencies (Groundwater and Irrigation/Water Resources Department). In addition, seven central agencies and two river basin agencies will also implement project activities pertaining to their specific mandates or basin areas. Overall, there will be 49 implementing agencies (IAs): the lead IA - MoWR, RD&GR, 7 Central Agencies; 2 River Basin Organizations; and 39 state/UT agencies dealing with surface and groundwater development and management. The list is given in Table 1 below.

Table 1: Implementing Agencies

Agencies	Organizations
Central Implementing Agencies	1. Ministry of Water Resources as the National Project Monitoring Unit (NPMU) and Implementing Agency 2. Central Water Commission (CWC) 3. Central Ground Water Board (CGWB) 4. National Institute of Hydrology (NIH) 5. Central Water and Power Research Station(CWPRS) 6. Bhakra Beas Management Board(BBMB) 7. Central Pollution Control Board (CPCB) 8. Survey of India (SoI) 9. National Remote Sensing Centre (NRSC) 10. Damodar Valley Corporation (DVC)
State Implementing Agencies	11. Andhra Pradesh (GW) 12. Andhra Pradesh (SW) 13. Assam 14. Bihar (GW) 15. Bihar (SW) 16. Chhattisgarh (GW) 17. Chhattisgarh (SW) 18. Goa 19. Gujarat (GW) 20. Gujarat (SW) 21. Haryana 22. Himachal Pradesh 23. Jharkhand 24. Karnataka (SW) 25. Kerala (GW) 26. Kerala (SW) 27. Madhya Pradesh 28. Maharashtra (GW)

	29. Maharashtra (SW) 30. Manipur 31. Meghalaya 32. Mizoram 33. Nagaland 34. Odisha (GW) 35. Odisha (SW) 36. Punjab 37. Rajasthan 38. Sikkim 39. Tamil Nadu 40. Telangana (GW) 41. Telangana (SW) 42. Tripura 43. Uttar Pradesh (GW) 44. Uttar Pradesh (SW) 45. Uttarakhand 46. West Bengal (GW) 47. West Bengal (SW) 48. Delhi 49. Puducherry

Out of 29 states/UTs participating in the Project, 19 states/UTs have a joint department for surface and groundwater and, thus, would have one IA each. In the remaining 10 states, the surface and groundwater departments operate under different secretariats, which reflect the compartmentalization of water sector institutions in India, including at the central level.

Consistent with the NHP's conceptualization as a national project covering the entire country, MoWR, RD&GR is introducing NHP as a Central Sector Scheme, where funds will be allocated to the IAs as a grant from the central government. This is distinct from HP-I and HP-II, which were multi-State loans, and demonstrates GOI's strong commitment to the objectives of the project. The Central Sector Scheme is a well-established funding modality in India, used for many ongoing national programs.

Implementation responsibilities are distributed across the central and sub-national IAs to maintain the balance and risk between centralized and state-based activities, and to minimize interdependence between the Centre and the States while ensuring the integration and standardization of systems. All central and sub-national IAs are required to have project management units (PMUs) with the multi-disciplinary team required to implement project activities. Each IA is accountable for technical, fiduciary, safeguards and monitoring and evaluation aspects, and shall have designated trained experts to perform these functions. The eligibility to participate in the Project as an IA required the establishment of a PMU and submission of detailed project implementation plans (PIPs). Figure 1 below provides a schematic illustration of the implementation arrangements.

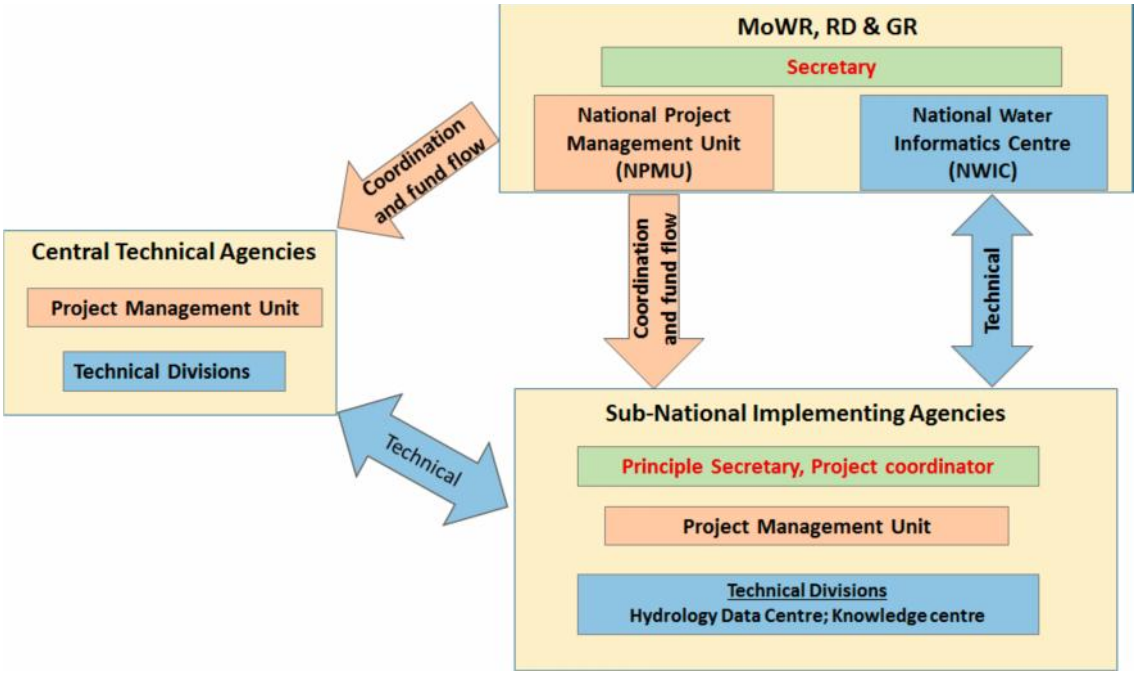


Figure 1: Project Implementation Arrangements

1.3.1 National level

Following the HP-II model, a National Project Management Unit (NPMU) has been established in MoWR, RD&GR. It is responsible for overall project planning, management and coordination; fund allocation; financial and procurement management; monitoring safeguards compliance; monitoring and evaluation (M&E) including the development and operation of a management information system (MIS) and regular progress reporting to the World Bank; and communications and outreach. The NPMU also provides technical support to sub-national agencies (e.g. developing standardized products) and ensures quality control. The NPMU consists of multi-disciplinary team and is supported by the TAMC with around 40-50 experts to provide close guidance and support to the sub-national agencies.

The NPMU is guided by the National Level Steering Committee (NLSC) as an overarching project governing body, with planning, advisory and strategic coordination roles. The technical agencies involved in project implementation at the central level are: CWC, CGWB, NIH, CWPRS, CPCB, SoI and NRSC. All central IAs have established Central Project Management Units (CPMU). Each CPMU will have a multi-disciplinary team (including fiduciary, safeguards and monitoring and evaluation experts) and will coordinate with the respective agency's internal divisions in order to implement activities assigned to it. These agencies are responsible for the development of national level river basin platforms, software, standards, protocols, and guidelines. They are also responsible for providing support to the sub-national agencies to introduce and apply these products at that level. Of the seven existing central IAs, two agencies (NRSC and SoI) are new to the NHP, although they have experience with World Bank

procedures. Some of the divisions at these central agencies will be upgraded to “centres of excellence” for learning and exchange, equipped with modernized infrastructure and facilities and attracting international expertise and / establishing collaborative arrangements with international organizations.

In addition, the National Water Informatics Centre (NWIC) is being set up as an independent organization with adequate administrative and financial powers under the overall control of Secretary, MoWR, RD & GR. Once this Centre will be operational, there will be improved transparency helping in the resolution of inter-state conflicts related to water management and distribution. The dissemination of data through the NWIC to the agencies will be possible in accordance with the necessary administrative permissions. Since the data will be centrally managed through the web, there will be less disputes and data accessibility will be easier. The Project will also result in the improvement of data storage, exchange, analysis and dissemination through the NWIC.

1.3.2 Sub-national level

The sub-national agencies participating in the NHP include State/UT IAs, river basin organizations and regional centres. State/UT IAs are water resources or irrigation departments and/or the groundwater departments. The nodal units in these departments/organizations are the hydrology data centres (already established in HP-II states) or equivalent divisions in new states. As the implementation of project activities concerns various departmental divisions, State Project Management Units (SPMUs) have been established. As stated above, most States have one IA and, hence, one SPMU. The 10 States with separate surface and groundwater departments have two SPMUs each. There are two implementing agencies at river basin level: Bhakra Beas Management Board (BBMB) and Damodar Valley Corporation (DVC). Similar to state agencies, they are responsible for the implementation of project activities and have established project management units (PMUs) for this purpose. The eight north eastern States have proposed to establish North East Centre for Water Resources Management so that they can operate and manage the systems introduced under the project in an integrated manner in line with a river basin approach. The establishment of this centre will be supported under the Project.

The Sub-national IAs receive funds from the MoWR, RD&GR and are fully accountable for managing finances, including requesting fund releases; procurement; physical and financial progress reporting, including updating the MIS; and safeguards compliance. The sub-national agencies are supported by the NPMU and the central IAs to implement their activities, as mentioned above. The IAs may also hire additional technical and management expertise to meet specific needs. Similar to arrangements at the national level (National Level Project Steering Committee – NLPSC), State Level Project Steering Committees (SLPSCs) are to be established to provide strategic and policy direction. Numerous training events have already been conducted to begin the process of capacity building in order to level the playing field

across sub-national IAs (in particular, those that did not participate in HP-I and II). In addition, well-performing agencies from HP-II will mentor new IAs. The States are also encouraged to nominate staff to be seconded to central agencies to ensure active participation in the development knowledge products and ownership. Some of the advanced sub-national centres will be given the opportunity to upgrade to become “Centres of excellence”.

2 SCOPE OF CONSULTANCY SERVICES

2.1 Objectives and Main Activities of the Consultancy

The primary objective of the TAMC is to support the National Project Monitoring Unit (NPMU) of the MOWR, RD & GR in the implementation of the Project. It shall provide support to all implementing agencies to assist with project planning, procurement, technical developments, training and capacity building. It shall also provide support for project reporting to the World Bank, and monitoring project progress.

The TAMC Consultant provides a team of experts including technical and non-technical staff, and all resources necessary for delivering the services for the NHP with regard to project management and project implementation. The TAMC provides support to all implementing agencies assisting with project planning, procurement, technical developments, training and capacity building along with overall coordination. Most of TAMC team is based at the NHP project office in Delhi. In addition 4 regional offices are set up at Gandhinagar, Hyderabad, Kolkata and Guwahati for being closer and providing support to all 49 Implementing Agencies (IAs).

The TAMC Consultancy provides support for the National Hydrology Project implementation to the National Project Monitoring Unit (NPMU) and all other Implementing Agencies (IAs) in the following areas:

- Technical advice and support for all activities envisaged under the NHP including identification and deployment of hydro-meteorological equipment, IT hardware and software, SCADA systems for irrigation, IWRM, hydrological modelling, Reservoir management, surface water and groundwater interaction & assessment, etc.;
- Program management support (including procurement support as well as financial management support);
- Advisory support for the implementation of the National Hydrology Project;
- Development of management and financial reporting systems for internal and external reporting;
- Development of software for web-based data entry for an MIS for monitoring and evaluation of project implementation & thereafter assisting IAs in understanding of MIS through real time support;

- Financial monitoring and reporting using MIS;
- Technical & Management support related to establishment of National Water Informatics Centre (NWIC) and its ISO certification;
- Awareness raising and capacity building;
- Reporting.

In addition to the above mentioned activities the TAMC will also further develop and improve the existing water information systems eSWIS and India-WRIS. In particular the TAMC's tasks include the development of new features under eSWIS including a groundwater module and the development of a pre-processing tool for data obtained from real time data acquisition systems (RTDAS).

Many activities such as the development of information system, the establishment of standard processes and procedures, the planning and design of supervision and monitoring procedures and other technical matters will be carried out in the first four years of the project. Some support activities to IAs may also continue as and when required through the TAMC regional/national offices. The consultancy support to the NPMU will continue for the contract 'period of 8 years (until October 2015) or until the completion of the Project, whichever is earlier, involving the preparations of a MIS report, a completion report as well as other deliverables such as final reports on the development of a future strategy/ road map for the programme. The Consultant will liaise closely with the other consultancies at central and state level which are in place or under process of procurement by various IAs.

The activities of the consultancy include the following technical and management aspects.

- Programme Management Support
- Procurement Support
- Technical Advice and Support
- MIS Support
- Monitoring and Evaluation of Project Implementation
- Financial Management
- Awareness raising, capacity building and training
- Improvement and further development of eSWIS and India WRIS

The various sub-activities required under these main areas together with the relevant timelines are detailed in Sections 4 and 5.

2.2 Project Components

Based on the experience under HP-I and HP-II, a four-pronged approach to achieve the project objectives has been adopted: (i) modernizing monitoring, including establishing comprehensive, automated, real-time monitoring and data management systems nation-wide for surface and groundwater, both quality and quantity; (ii) enhancing analytical tools for water resources assessment, hydrologic and flood inundation forecasting, water infrastructure operations, groundwater modelling, and river basin and investment planning; (iii) transforming knowledge access, using cloud computing, internet, mobile devices, social media and other communication tools to modernize access to and visualization of customized water information by all stakeholders; and (iv) modernizing institutions through investments in people and institutional capacity.

In line with the four-pronged strategy described above, the project is divided into four components: (A) Water resources monitoring systems; (B) Water resources information systems; (C) Water resources operations and planning systems; and (D) Institutional capacity enhancement. Essentially the data systems (A) will feed into the information systems (B) to improve planning and operations and to produce water information products (B and C), all of which will provide the basis for improved decision-making on investment planning, water resources allocation, flood and drought management, and irrigation capacity and efficiency. Technical capacity for systems, planning, operations and policy and decision-making will be built under Component D. The project components are summarised in the following Figure**Error! Reference source not found.**.

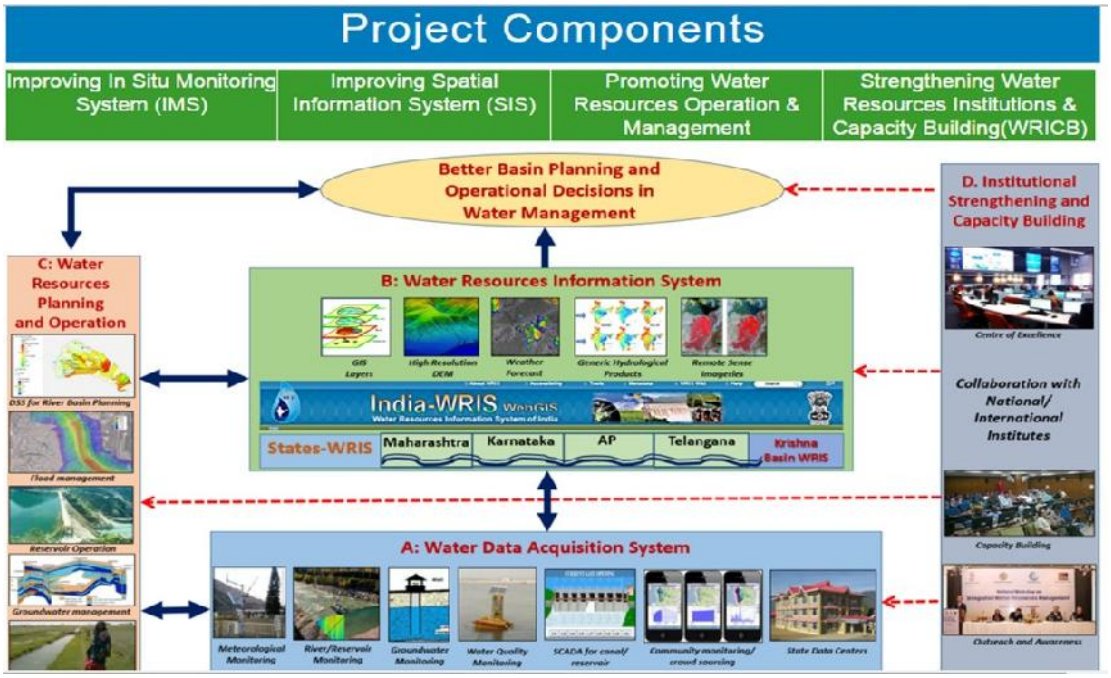


Figure 2: Project Components

The project components are detailed below.

A. Water Resources Monitoring Systems

This component will finance the establishment/modernization of new and existing hydromet monitoring systems including meteorology, stream flow, groundwater and water storage measurements and construction of Hydro informatics centres that capture both water resources and uses. This component will be implemented by all state/UTs with the support of core central agencies. The major activities include:

A1: Hydromet observation network

A2: Supervisory control and data acquisition systems for water infrastructure

A3: Establishment of hydro informatics centres

B. Water Resources Information Systems

Component B will support strengthening of National and sub-national water information centres with web-enabled water resources information systems through standardization of databases and products from various data sources/departments; and make comprehensive, timely and integrated water resources information available to decision makers for effective planning, decision taking and operations. The sources of data/information will include the real time data

acquisition networks and centres under Component A, remote sensing data, topographical maps and knowledge products developed under Component C.

The Project will develop or strengthen centres for web-based water resources information systems (WRIS) at central, regional, river basin and state/UT levels. The web-based India-WRIS (http://www.india-wris.nrsc.gov.in/wris.html) will be strengthened particularly through integration with state level data and will be operated by the National Water Informatics Centre (NWIC) at MoWR, RD&GR. The sub-national level WRIS will be introduced at state/UTs and river basin levels.

C. Water Resources Operation and Planning Systems

This component will support the development of interactive analytical tools and decision support platform that would integrate database, models and scenario manager for hydrological flood forecasting, integrated reservoir operations and water resources accounting for improved operation, planning and management of both surface and groundwater. The component will provide interactive systems to analyse the impacts of alternative management scenarios and generate knowledge product using real time data under component B. Component C has three sub-components:

C1: Development of analytical tools and decision support platform (river basin modelling; stream flow forecasting and reservoir operation systems; and irrigation design and operations)

C2: Purpose-driven support

C3: Piloting innovative water resource management solutions

D. Institutional Capacity Enhancement

Component D aims to build capacity for knowledge-based water resources management. It would support establishment of water resources knowledge centres, professional development, project management and operations. Component D has three sub-components:

D1: Water resources knowledge centres

D2: Professional development

D3: Project management and operational support

The TAMC will support the NPMU to fulfil activities under all the various components and sub-components of the NHP detailed above with the help of appropriate technical and non-technical staff inputs during the project period.

Project components and project activities are directly interconnected in the sense that in general activities cover all four components. The following table describes the relationship between components and activities.

Table 2: Relationship between Project Components and Project Activities

Components / Activities	A. Water Resources Monitoring Systems	B. Water Resources Information Syst.	C. Water Resources Op. & Planning Systems	D. Institutional Capacity Enhancement
Programme Management Support	X	X	X	X
Procurement Support	X	X	X	X
Technical Advice and Support	X	X	X	X
MIS Support	X	X	X	X
Monitoring and Evaluation of Project Implementation	X	X	X	X
Financial Management	X	X	X	X
Awareness raising, capacity building & training	X	X	X	X

2.3 Deliverables

As listed in Section 8 on page 56 of the Contract document, the project deliverables are as follows:

- Inception Report (end month 3) - The Inception Report will review in detail the current status of project implementation, defining a detailed work programme for the TAMC activities for the upcoming 9 months plus an outline work plan for the balance of the contracted period
- Brief quarterly reports on TAMC activities - Format for these reports will be agreed with the NPMU and will briefly summarise activities during the quarter and upcoming activities for the next quarter
- Annual progress report for TAMC activities - These reports will provide a summary of TAMC activities for the year, together with a detailed work plan for the upcoming 12 month's work. These will be submitted at the end of each financial year. The report is to be submitted 15 days before agreed date for annual review
- Needs-based Technical Reports - When appropriate, as judged by NPMU, the TAMC will prepare and submit a technical report on an aspect of the project for consideration of the NPMU and project stakeholders. These will be used to clarify technical issues, or to propose changes of emphasis in project implementation
- Mid-term report at the end of Years 3 and 6 - Detailing the achievements of the TAMC in relation to the task as agreed with the NPMU in the Inception Report, together with a work plan for the upcoming years
- Draft withdrawal plan at the end of Year 7 and final withdrawal plan in the 2nd Quarter of Year 8.
- Process Documentation Report for the whole project

- Final report - This report will be prepared 3 months before the end of the TAMC contract and will provide a detailed account of TAMC activities and an overview of project achievements. It will include a review of the services provided, the impact of the services on project performance and outcomes, and recommendations for future activities.

In addition to above, the deliverables to be provided by the Consultant as per Appendix 1 and Annexure IV pages 59 and 77 respectively of the Contract Agreement and their status at the time of Inception Report are given in below in Table 3 (Consultancy Commencement Date T: 23 Oct 2017).

Table 3: Status of Deliverables (until T+36)

Deliverables	Date due	Progress Status
Inception Report	23 Jan 2018 (T+3)	Submitted
Report on Data Requirements and Gap Analysis for major applications – IWRM, Flood Modelling, India-WRIS, Water quality and Purpose Driven Support Initiatives	23 Jan 2018 (T+3)	Review of Current Practices, Methodologies and Data Needs in Progress; most aspects are covered in Inception Report; separate report will be submitted by end Feb 2018
Quarterly Physical and Financial Report (up to 31 Dec 2017)	31 Jan 2018	in progress, report will be submitted by mid Feb 2018
Architecture Design of up-scaled and Revamped India-WRIS (Hardware and Software)	23 Apr 2018 (T+6)	Current database and application module review in Progress
Preparation of Project Document in respect of hardware & software and cost for establishment of Flood Modelling Centre and IWRM Modelling Centre	23 Jul 2018 (T+9)	In progress
Review and Finalisation of Hydro-meteorological networks of sites	23 Oct 2018 (T+12)	Initial design finalised, review in progress
Typical Standardised design for sites & civil layout drawings	23 Oct 2018 (T+12)	In progress
Preparation of technical specification & Finalisation of sites for SCADA for Reservoir and Canal	23 Oct 2018 (T+12)	In progress. Site visits undertaken for Okhla and Hathnikund barrages
Standardisation of anti-theft and anti-vandalism measures, for different categories of sites	23 Oct 2018 (T+12)	In progress
Plan and design training program for Master Trainers / TOT	23 Oct 2018 (T+12)	Training needs assessment in progress. Questionnaire sent to IAs, Workshop planned for spring 2018
Report on identification and coordination for collaboration/ partnership with National/ International Institutes for Training	23 Oct 2018 (T+12)	Training needs assessment in progress. Probable institutes list being prepared

Deliverables	Date due	Progress Status
Framing of Technical specification for data storage servers, other hardware and software (State)	23 Oct 2018 (T+12)	Requirement specification under discussion
Review of the existing Databases, System Design and Processes for e-SWIS. Linkages with India-WRIS. Development of User Friendly e-SWIS Dashboard	23 Apr 2018 (T+18)	Review meetings with stakeholders on database, user requirements and data analysis modules in progress
Preparation of report on the lessons learnt for use of automatic data acquisition systems	23 Oct 2019 (T+24)	To be prepared
Support for IWRM – furnish a detailed report based on international examples of RBOs and IWRM in Indian context	23 Oct 2019 (T+24) Onwards	To be prepared
Switching India-WRIS to latest platform – Design and development of new GUI and new database structure	23 Apr 2019 (T+30)	Review meetings with stakeholders on user requirements and data base design in progress
Develop a multi-lingual documentary film of the project for promoting awareness	23 Oct 2020 (T+36)	To be prepared
Support to NPMU in scrutiny and modification of Proposals of PDS	Continuous Process	In progress
Procurement Support	Continuous Process	TAMC Support in progress
MIS Support	Continuous Process	TAMC Support in progress
Financial Management	Continuous Process	TAMC Support in Progress
Project Management Support	Continuous Process	TAMC Support in progress

3 PROJECT ORGANISATION

To work for the National Hydrology Project of India, developing a water resources monitoring and information system for the entire national territory, is a privilege for any company and any water sector professional. At the same time, the National Hydrology Project is not only a fascinating but also a very challenging undertaking due to several reasons:

- Size of the territory
- Scale of the systems to be implemented
- Investment volume
- Involvement of a large number of institutions at several levels
- Wide range of different technical and non-technical to be dealt with

In accordance with the terms of the Contract the TAMC has put in place a multi-disciplinary team in order to successfully respond to the challenges of this extraordinary project. The nature and the scale of the NHP project demand a well thought-out project management approach is based on several key elements:

- Efficient project management
- Efficient project team organisation structure with clear reporting lines, and clear internal and external processes
- Multi-disciplinary team combining experts from a variety of fields, covering all relevant technical and non-technical areas of expertise
- Good working atmosphere and team spirit
- Excellent internal and external communication

The consultant is aware of the importance of managing the interfaces between the project and its different partners and stakeholders. In consequence, excellent communication one of the key factors for successful project implementation. The Consultant will follow an open, proactive, participatory approach that allows developing a constructive and partner-oriented working atmosphere between the parties involved, for the benefit of this outstanding project.

3.1 Team Structure and Mobilisation

As stated above the project requires to cover a wide range of different areas of expertise, including:

- Technical expertise (such as monitoring networks, information systems, water resources assessment and decision support tools, etc.), and
- Non-technical expertise (such as procurement, finances, programme management, etc.)

At the same time the TAMC has to deal with a large number of project partners (IAs), institutions and stakeholders. Thus the project team has been set-up in a way that allows to address the specific needs of each topic area (which go from procurement to instrumentation to financial management.

The solution to this challenge is to establish a project organisation that comprises teams for different topic areas (technical and non-technical). The following Figure 3 shows the TAMC team structure.

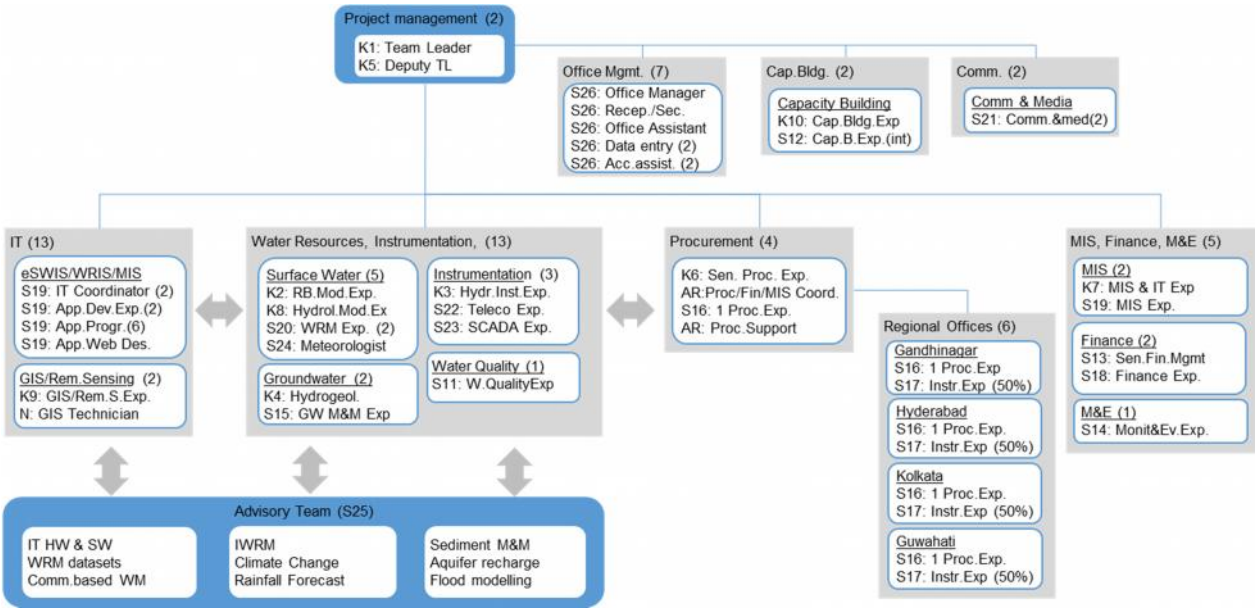


Figure 3: TAMC Project Team Structure

Most of team members along with the key experts have been mobilised and the dates on which they are mobilised are given below in Table 4.

Table 4: TAMC Project Team Mobilisation

No	Name	Position	Total-mon proposal	Planned joining date	Actual joining date
Core Staff - International					
K-1	Dr. Wolfgang Krinner	Team Leader	78		23-oct
K-2	Dr. Nesa Ilich	River Basin Modelling Expert	72		4-dic
K-3	Dr. Jayaraman Potty	Hydro-met Instrumentation Expert	36		8-jan
K-4	Peter Ravenscroft	Hydrogeologist and Ground Water Modelling Expert	36	19-feb (TBC)	
Core Staff - National					
K-5	Dr. Sravan Kumar Kanukuntla	Deputy Team Leader	72		20-nov
K-6	Desh Raj	Sr. Procurement Expert	72		06-dic
K-7	Rajendra Arun Patel	MIS & IT Expert	78		15-nov
K-8	Dr. Ashoke Basistha	Hydrologist and Hydrological Modelling Expert	72		28-dic
K-9	Dr. Ashok Kaushal	GIS & Remote Sensing Expert	48		6-nov
K-10	Madhu Sudan Doria	Capacity Building Expert	48		05-dic
Support staff					
S-11	Dr. Jubair Tariqul Alam Chowdhury	Hydrochemist and Water Quality Expert	36	TBD	
S-12	Philip Appleton	Capacity Building Expert (international)	24	19-feb (TBC)	
S-13	Devender Kumar Khurana	Sr. Finance Management Expert	78		06-dic
S-14	Anil Kumar Agarwal	Monitoring & Evaluation (M&E) Expert	78		06-dic
S-15	Dhiren Kumar Chavda	Ground Water Management and Modelling Expert	72	on hold	

No	Name	Position	Total-mon proposal	Planned joining date	Actual joining date
S-16.1	Vikas Patil	Procurement Expert-1 (Kol)	42		13-nov
S-16.2	Murali Reddy	Procurement Expert-2 (Hyd)	42		06-dic
S-16.3	Dipesh Desai	Procurement Expert-3 (Gan)	42		22-nov
S-16.4	Quazi Wasiuddin	Procurement Expert-4 (Guw)	42	07-mar	
S-16.5	Amit Sethi	Procurement Expert-5 (Del)	42		17-jan
S-17.1	Sunil Patil	Instrumentation Expert-1 (Hyd)	45	15-feb	
S-17.2	Pravin Pote	Instrumentation Expert-2 (Kol)	45	15-feb	
S-18	Mayank Shekar Singh	Finance Expert	78		21-nov
S-19.1	Amlan Sarkar	MIS Expert	30	on hold	
S-19.2	TBN	Application Development Expert	30	TBD	
S-19.2	TBN	Application Development Expert		TBD	
S-19.3	Mohit Sharma	Application Programmer	30		8-nov
S-19.3	Sergio Herrero	Application Programmer			25-nov
S19.3	Piyush Dubey	Application Programmer			8-jan
S19.3	Amit Kumar	Application Programmer			11-jan
S19.3	Amit Lakhera	Application Programmer		12-feb (TBC)	
S19.3	TBN	Application Programmer		TBD	
S19.3	TBN	Application Programmer		TBD	
S19.3	TBN	Application Programmer		TBD	
S19.3	TBN	Application Programmer		TBD	
S19.3	TBN	Application Programmer		TBD	
S19.3	TBN	Application Programmer		TBD	
S19.3	TBN	Application Programmer		TBD	
S-19.4	Garima Varshney	Database Designer	30		30-nov
S-19.4	Sneha Shirohi	Database Designer			10-jan
S-19.5	Santosh Gupta	Application Web Designer	30		21-nov
S-20.1	Shuvra Sangeeta	Water Resources Management Expert-1	36		01-feb
S-20.2	Jaya Sood	Water Resources Management Expert-2	36	15-feb	
S-21.1	Sayantan Ghosh	Communication and Media Expert-1	7,5	20-feb	
S-21.2	TBN	Communication and Media Expert-2	7,5	on hold	
S-22	Anil L. Shirgave	Telecommunication Expert	24	feb-18	
S-23	Rakesh Bhatt	SCADA Expert	24		13-nov
S-24	TBN	Meteorologist (international)	24	on hold	
	Azizul Quadir	Coordination Procurement/Finance/MIS	0		23-oct (not bill.)
	Ankit Sharma	Procurement Support	0		19-Dec (not bill.)
Advisory Team					
S-25.1	TBN	Integrated Water Resources Management Advisor	3	on hold	
S-25.2	TBN	Climate Change Advisor	4	on hold	
S-25.3	TBN	Short & Midterm Rainfall Forecast Advisor	4	on hold	
S-25.4	TBN	Sediment Modelling and Management Advisor	3	on hold	
S-25.5	TBN	Aquifer Recharge Management Advisor	3	on hold	
S-25.6	TBN	Flood Modelling Advisor	8	on hold	
S-25.7	TBN	Spatial & Non-sp.datasets for W.Res.Mgmnt Adv.	9	on hold	
S-25.8	Francisco Jimenez	IT Hardware & Software Advisor	6		21-nov
S-25.9	TBN	Community-based Water Management Advisor	6	on hold	
Technical and Office Support Team					
S-26.1	Ankita Bharti	Data Entry Operator	192		4-dec
S-26.1	TBN	Data Entry Operator		TBD	
S-26.2	Sobiaya Yaqoob	Receptionist/Project Secretary	96		04-dic
S-26.3	Vijay Sehgal	Office Manager	96		23-oct
S-26.4	Sumanta Prasad	Office Assistant	144		14-nov
S-26.4	TBN	Office Assistant		TBD	
S-26.5	Gaurav Kumar	Accounts Assistant	192		7-dec
S-26.5	TBN	Accounts Assistant		TBD	
		TOTAL	2353		
		TOTAL w/o Technical & Office Support	1633		

The key experts K1, K2, K3, K4, K5, K6, K7 and S13 will play an important role in coordinating departments and maintaining relations with experts from other organisations.

The key for developing a productive project organisation is good communication and coordination between different topic areas (departments/experts) and organisations. A good project team atmosphere (both internally and in the relation with other organisations is essential for good communication and cooperation. To achieve a positive team spirit, departments should be physically close and good office conditions have been ensured. The TAMC is holding regular team meetings with NPMU team and organise activities to enhance team building.

In its relationship with the Implementing Agencies and other project parties, the TAMC is reaching out and established direct communication at a very early project stage, considering that good working relationship with the project partners is essential for the project success.

3.2 Team Composition

The Client's and the stakeholders' interests and investments can only be protected by the Consultant when the Consultant has sound control over the Project. TAMC has provided a strong Team Leader and an experienced consulting team, which will additionally count on the backstopping support of senior staff and specialists.

Eptisa and Ernst and Young have assembled a skilled and experienced International and National Project Team, specialized in programme management, water information systems, data and information management, integrated water resources management, procurement, financial management, capacity development, and organisational and human resources development, with extensive experience in projects worldwide, as well as in the region. These skills guarantee sound management of the project and the achievement of top-quality outputs.

The Team Leader is responsible for the overall project management. He currently leads his colleagues and encourage performance at a high level of proficiency by empowering staff to be creative and productive, using their resources and ideas within their area of authority and expertise, but always in compliance with the terms of the contract.

The international experts have joined to develop certain tasks as required by the project. The experts will provide technical advice and support to the programme, and will contribute to capacity building within the Implementing Agencies and other partner organisations. Local experts will bring to the table local knowledge and expertise, making sure that measures and systems proposed align with the national framework.

Given the fact that not all experts' inputs can be attributed to deliverables (many experts provide input to specific technical issues) the Consultant has taken the approach to assign experts' inputs to deliverables and activities. Out of the large number of activities identified in the project work plan, the following set has been identified which covers the main project areas:

1. Programme management support
2. Procurement support
3. Technical support: Monitoring networks/Water information systems/Analysis and DSS tools
4. MIS support
5. National Water Informatics Centre (NWIC)
6. Monitoring and Evaluation of Project Implementation
7. Financial management
8. Awareness raising, capacity building and training
9. Technical and Office Support

Accordingly, the experts' inputs have been assigned to the mentioned deliverables and activities. A summary of the planned deployment of resources to perform the required activities and fulfil the deliverables is shown in Section 5.

Current status of activities with the team up to the inception stage is as follows.

- Project office established
- Refurbishment of office space finalised
- Regional offices have started operation on 15 Jan 2018
- 9 out of 10 core staff members, 14 out of 25 support staff, 1 member of advisory team and office support team deployed
- Teams for different topics have formed and activities in all areas have started
- Assessment of current situation and planning of activities ongoing
- Establishment of internal management processes in process
- Contacts with some stakeholders established

A work plan and a more detailed plan of time frames is carried out during the Inception Phase and detailed in Section 5.

3.3 Project Monitoring and Steering

Several Committees have been established for the monitoring and supervision of the National Hydrology Project (NHP) project and the Technical Assistance and Management Consultancy (TAMC) contract under the NHP.

National Level Steering Committee (NLSC)

A National Level Steering Committee has been established for monitoring the implementation of the National Hydrology Project. The Committee is organised under the chairmanship of the Secretary of the MoWR, RG & GR and comprises 20 members from Central and State level Implementing Agencies and Senior Officers from other departments which participate or have a stake in the National Hydrology Project.

The first meeting of the National Level Steering Committee (NLSC) was held on 23 November 2017 under the chairmanship of the Secretary of the MoWR, RG & GR Dr. Amarjit Singh.

Consultancy Monitoring Committee (CMC)

The Consultancy Monitoring Committee has been formed to monitor the activities and the progress of the Technical Assistance and Management Consultancy (TAMC) under the National Hydrology Project.

The first meeting of the Consultancy Monitoring Committee (CMC) was held on 10 January 2018 under the chairmanship of the Joint Secretary (A & GW) of the MoWR, RG & GR. During the meeting the progress of the TAMC since project start was presented and the future activities discussed. It is planned that during the initial phase of the Project the Consultancy Monitoring Committee will meet at monthly intervals.

4 DESCRIPTION OF PROJECT ACTIVITIES BY AREAS

4.1 Procurement Support

4.1.1 Scope of work

The procurement of water resources monitoring and information systems through the Implementing Agencies (IAs) including the surrounding processes (system definition, specification, design and implementation) is at the core of the NHP programme. Accordingly the TAMC puts major emphasis on the procurement support to be provided to the IAs. At the different project stages of the Project the IAs will require different levels of support for their

procurement activities. Table 5 below provides a list of activities to be performed by the TAMC as per the RFP requirement. Tasks corresponding to each activity are herewith reiterated to confirm consensus on the scope of work under the TAMC contract.

Table 5: Procurement Activities

No.	Activity as per RFP	Description of tasks corresponding to activity	Output(s)	Timeline
1.	Assessment of existing procurement systems and procurement implementation capacity of IAs	• Discussions with IA representatives to assess current procurement systems and implementation capacities • Analysis of existing procurement documents, guidelines and systems • Recommendations for improving procurement capacities	• Report on existing procurement systems/ capacities including recommendations for improvement	T + 12 months
2.	Development of standardised procurement documents, bid opening and bid evaluation procedures and guidelines	• Comparison of documents/ procedures applied by different IAs • Development of standardised procurement documents, procedures and guidelines in line with the World Bank procurement guidelines and NHP procurement manual	• Standard procurement documents/ procedures/ guidelines	Continuous
3.	Support for IAs in development of specific bidding documents (if needed)	• Support to IAs through distribution of procurement documents (guidelines, procedures, specifications, etc.) and model / sample bid documents • Support to IAs in development of specific bid documents as required	• Specific bidding documents (if needed)	On request
4.	Coordination of project standard technical specifications for key equipment	• Assessment/ comparison of technical specifications used in previous tender processes • Selection/ development of standard technical specifications	• Standard technical specifications for key equipment • Sharing of Best Practice TORs/ Specification amongst the IAs	T + 18 months

No.	Activity as per RFP	Description of tasks corresponding to activity	Output(s)	Timeline
5.	Review of bidding documents, bid evaluation reports for major procurement and recommendations for contract award	• Screening of bid documents, bid evaluation reports for major procurement and recommendations for contract award prior to submission to the World Bank for approval / clearance as required	• Bidding document/ evaluation reports reviews as required	Continuous
6.	Provide procurement support on request through audit of the quality	• Development of procedures for audits, tests, etc. • Planning and performance of quality audits, quality tests, field verifications, test measurements, etc. for small sample	• Procedures for quality inspections, audits, test measurements, etc. • Audits, test reports for identified sample	On request
7.	Coordination of preparation of annual work plans and procurement plans	• Technical support to IAs in the preparation of annual work plans and procurement plans • Coordination with IAs and adjustment of plans as required	• Annual work plans & procurement plans/ schedules	Continuous
8.	Advice on contract management as required by IA	• Support during implementation of procurement contracts (supervision, contract management, quality control, financial management, etc.), as required	• Contract management support as and when required	On request

4.1.2 Report on current activities

4.1.2.1 Team structure

In order to fulfil the objectives of the NHP programme, the TAMC is structured into different teams based on task assignments corresponding to functional requirements. Each team while working independently collaborates with other teams with a vision to achieve the overall objectives of the NHP programme. The Procurement team structure is shown in Figure 4.

The TAMC Procurement team comprises one Senior Procurement Expert and five (5) Procurement Experts. The Procurement team is being led by the Senior Procurement Expert. Four Procurement Experts have already been deployed and one remaining Procurement Expert is planned to be deployed by the first week of March 2018. Three Procurement Experts have already started to work from the regional offices as from 15 of January 2018. The entire

procurement team is expected to be fully mobilised and the four regional Procurement Experts to be deployed by the end of February.

The Procurement team will be supported by different technical experts including Instrumentation, Water Resources, Hydrogeology & Groundwater Modelling, SCADA, Telecommunication, MIS, IT and Finance, depending on the specific requirements. The SCADA Expert has already been deployed on the project and is assisting the IAs in the finalization of technical specifications of key procurement items like RTDAS, DWLR and SCADA.

In addition to the key and non-key staff under the TAMC contract, two additional staff members, namely a Procurement/Finance/MIS Coordinator and a Procurement Support person, have been mobilized in the project to ensure smooth coordination among teams and with the client, and to ensure quality outputs and deliverables. The chart below presents the structure of the procurement team.

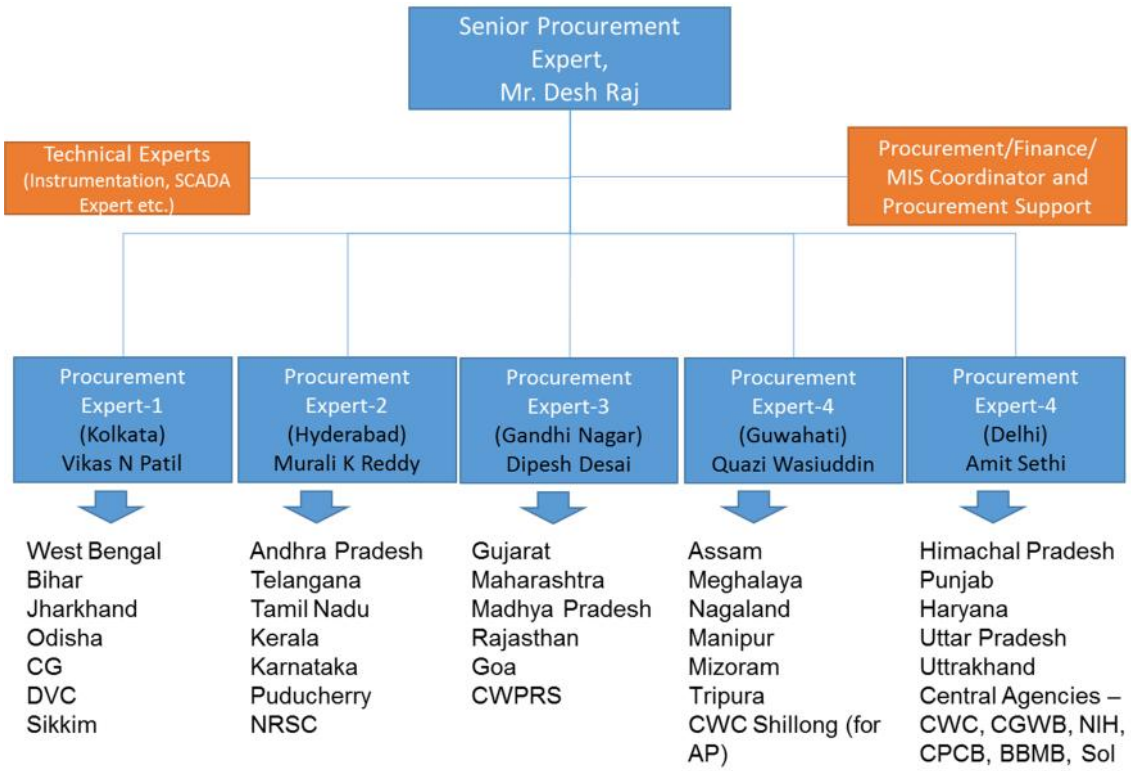


Figure 4: Procurement Team Structure

4.1.2.2 Activities developed during the inception phase

Many activities have been undertaken by the procurement team since the mobilization of the TAMC team on 23rd October 2017. A progress update against identified activities / tasks is presented in detail below.

4.1.2.2.1 Assessment of existing procurement systems and procurement implementation capacity of IAs

In the NHP, there are 49 implementation agencies – 39 state level agencies and 10 central agencies, each at different level in terms of procurement implementation capacity. Some IAs are better placed than others which is reflected from their fund utilization ratio for the last two financial years i.e. FY 2016-17 and FY 2017-18. Reasons that can be attributed to better fund utilization of these agencies could be proactive role by their concerned officers or staffs, familiarity of department with the World Bank procurement guidelines, involvement in HP-I and/ or HP-II projects.

The assessment of existing procurement systems is still underway. However, some initial observations are captured in this report for better understanding. There is an overall lack of capacity at IAs regarding procurement. It has been observed that many IAs are not adhering to their approved procurement plan, which is key to efficient procurement and disbursement from the Bank. Submission of bid document to NPMU through MIS website is currently not linked to the approved procurement plan. Consequently, some of the bid documents were not aligned with the approved procurement plans of IAs. Since MIS system is under up-gradation at present, IAs have been requested to submit bid review checklist circulated with them by TAMC on 18th December 2017 along with each bid document being submitted for NPMU/ TAMC review.

Further, it has been observed during review of bid documents and meetings with IA officials that many IAs are deviating from the provisions of the model documents of the Bank. In the National Competitive Bidding (NCB) document, changes in the Instruction to Bidders (ITB) and the General Conditions of Contract (GCC) sections are not permissible by the Bank. However, many IAs had modified the ITB and GCC sections in their bid documents. It is suggested that whatever changes is required in the ITB section should be made in the Bidding Data Sheet (BDS) and ITB section should not be altered. Similarly, whatever changes is required in the GCC section should be made in the Special Conditions of Contract (SCC) and GCC section should not be altered.

In view of the requirement to build procurement implementation capacity at IAs, TAMC recommended that concerned staff(s) of each IA be provided 2 weeks training on procurement held in Hyderabad or Faridabad. Consequently, NPMU has sent a letter to all the IAs requesting them to consider the same. In addition, multiple ongoing trainings can be imparted by Procurement Experts from TAMC to both procurement and non-procurement staffs of IAs.

4.1.2.2.2 Development of standardised procurement documents, bid opening and bid evaluation procedures and guidelines

As mentioned earlier, IAs were making changes in the ITB and GCC sections of the bid documents submitted by them. In order bring uniformity in the bidding documents, TAMC team have provided NCB e-procurement single envelope document and two envelope document for

Goods that may be referred by IAs as sample bid documents. Sample documents for other procurement methods would also be developed in a similar manner.

4.1.2.2.3 Support for IAs in development of specific bidding documents

The TAMC team has been supporting the IAs in the development of specific bidding documents as requested by the NPMU on case to case basis. These documents are being developed after discussions with officials from IAs and incorporating comments and suggestions from NPMU. Meetings with officials from Madhya Pradesh, Maharashtra (SW), CGWB, SOI, Jharkhand, Gujarat (SW), and Rajasthan have been held so far. Eligibility criteria for Real Time Data Acquisition System (RTDAS) Goods bids have been standardized in discussion with NPMU and IAs.

4.1.2.2.4 Coordination of project standard technical specifications for key equipment

The technical expert of the TAMC has been assisting and coordinating with the NPMU in the finalization of the technical specifications and schedules for RTDAS, DWLR and SCADA bid documents. Major points under each key item are discussed below:

A. Real Time Data Acquisition System (RTDAS)

Bid documents from various IAs vis-a-vis Andhra Pradesh (SW), Madhya Pradesh, Himachal Pradesh, Jharkhand, Odisha (SW), Rajasthan, Gujarat (SW), Maharashtra (SW) have been analysed and based on the technical discussions with respective IAs following actions were taken to achieve the goal.

1. Study of technical aspects of the bid and understanding the current requirement of IAs
2. System architecture for RTDAS was drafted in consultation with IAs and NPMU in order to bring all the IAs on common platform and achieve the goal of data acquisition of all RTDAS system at ERS Delhi including further dissemination of data to respective IAs/ states at their state data centres
3. Based on latest technological trends available in market and considering the frame work agreement specifications, the technical specifications for various instruments were finalized in coordination with the NPMU officials
4. Incorporation of technical specifications of various instruments like UPS system, LED display, colour printers and other capital equipment which were not specified in bid documents submitted by IAs

5. Preparation of detailed price schedule and their related services along with grouping of instruments in RTDAS station in order to bring more clarity to bidders and stakeholders for better implementation of project
6. Preparation of detailed scope of inspection and tests to be performed on various instruments to ensure the availability of better quality instruments for the project
7. Finalization of the eligibility criteria in coordination with procurement team of the TAMC and NPMU in order to ensure the maximum participation of reputed bidders

B. Digital Water Level Recorder (DWLR)

Only one bid has been submitted to the TAMC for DWLR and following actions were taken by the TAMC.

1. Study of technical aspects of DWLR bid and understanding the current requirement of the IA
2. System architecture for DWLR system on GPRS technology has been prepared in order to bring the IAs on a common platform and achieve the goal of data acquisition of DWLR system in the eSWIS software at Delhi and at their respective state data centres by GPRS technology
3. Based on latest technological trends available in market and considering the frame work agreement specifications, the technical specifications for DWLR and Data logger instruments were finalized in coordination with NPMU
4. Incorporation of technical specifications of various instruments like UPS system, LED display, colour printers and other capital equipment which were not specified in the DWLR bid submitted by the IA
5. Preparation of detailed price schedule and related services in order to bring more clarity to bidders and stakeholders for better implementation of the project
6. Preparation of detailed scope of inspection and tests to be performed on various instruments to ensure the availability of better quality instruments for the project
7. Finalization of the eligibility criteria in coordination with procurement team of the TAMC and NPMU in order to ensure the maximum participation of reputed bidders

C. SCADA for Barrage Automation

Haryana and Uttar Pradesh (SW) have submitted bid documents for Barrage automation in their respective states. Following actions have been taken by the TAMC on the same.

1. After study of the bid documents, the TAMC had requested the IAs for site visits for better understanding of existing system. Accordingly, sites of Hathnikund and Okhla barrage was visited by the TAMC and NPMU jointly to understand the requirement of the end user

2. Draft schematic for Barrage automation system has been prepared by the TAMC in order to define major instrumentation requirement for the barrage automation

3. Based on the site visits and discussions with end user, draft specifications and control philosophy for SCADA system has been submitted for Okhla barrage automation to Uttar Pradesh (SW) for their review and further clarifications if any

4. Once the clarifications are received from the IA, the TAMC will assist in finalization of the BOQ and draft bid document for the same.

5. For Hathnikund barrage automation, draft specifications are under preparation.

4.1.2.2.5 Review of bidding documents, bid evaluation reports for major procurement and recommendations for contract award

As on 22nd January 2018, there are 40 documents (bid documents, evaluation report, TOR, technical specifications etc.) including 31 bid documents under different stages of review and development by TAMC. Out of 31 bid documents, there are 19 major bid documents - 14 RTDAS, 1 DWLR, 2 Piezometer, and 2 SCADA. The current status of all the documents is attached in Appendix 1.

The first Consultancy Monitoring Committee (CMC) meeting was held on 10th January 2018 to provide overview of the NHP and update on status of activities undertaken by the TAMC. In the meeting, status of major bid documents (RTDAS, DWLR, Piezometer and SCADA) planned by IAs in the last two years was presented to the committee members. Table 6 below captures the progress of major bid documents. A list of bids planned by IAs is attached in Appendix 1.

Table 6: Progress of Major Bid Documents

Major bid documents	RTDAS	DWLR / Piezometer	SCADA	Total
Total bids planned by IAs	35	14	7	**56**
IAs yet to initiate work on bid documents	15	8	4	**27**
Bid documents under preparation by IAs	6	3	1	**10**
Bid documents under review by TAMC	14	3	2	**19**
Finalized/ Planned to be finalization by end of January 2018	7	3	2	**12**

4.1.2.2.6 Provision of procurement support on request through quality audits

The TAMC will provide support through quality audits on request as instructed by the NPMU.

4.1.2.2.7 Coordination of preparation of annual work plans and procurement plans

It was observed that there are certain gaps in the existing MIS system that have been affecting the quick review of the submitted Annual Work Plans (AWPs) and Procurement Plans (PPs). Hence, a preliminary assessment of the existing MIS system has been carried out to understand the gaps and issues in the existing MIS system. Gaps in the existing MIS system in presented in Appendix 3. The MIS team is planning to address the above identified gaps during the up-grading of the existing MIS system.

Further the procurement team followed up with all IAs for the timely submission of physical and financial progress reports requested by NPMU from them in the month of November 2017. On 20th December 2017, the NPMU issued a letter to the Nodal Officers of all IAs regarding the preparation and submission of the AWP for the FY 2018-19. In the letter, NPMU mentioned the broad guidelines for balanced, continued and new activities planned to be undertaken by IAs. TAMC team followed up with all the IAs for submission of the same. As on 15th January 2018, 12 IAs – Andhra Pradesh (GW), Kerala (GW), Meghalaya, Mizoram, Odisha (GW), Punjab, Sikkim, Telangana (GW), Telangana (SW), West Bengal (SW), Puducherry and DVC – have submitted their respective AWPs for the FY 2018-19 on the MIS. Based on preliminary review of the submitted AWPs, distinction among balanced, continued and new activities is not coming out clearly, probably due to gap in the existing MIS. Hence, it is necessary to address the gaps in the MIS at the earliest possible. Action is being taken by the TAMC IT team in this regard. In parallel, a study of the STEP system of the World Bank is being undertaken for planning up-grading of the existing MIS.

4.1.2.2.8 Advice on contract management as required by IAs

The TAMC will provide support on request as instructed by the NPMU.

4.1.3 The way forward

4.1.3.1 Upcoming activities and development strategy/plan

The Procurement team has already been undertaking the tasks of reviewing bidding documents, bid evaluation reports, and development of specific bidding documents. In addition, as part of the scope of work under the TAMC contract, the procurement team is planning to undertake the following key tasks:

► **Assessment of existing procurement systems and implementation capacities**

Each procurement expert shall be responsible for assessment of procurement systems and implementation capacities of IAs falling under his/her purview or region. While the team is developing understanding of the procurement systems of many IAs through several meetings and discussions, a more focused approach is needed towards identifying prevailing issues and challenges. For this purpose, each Procurement expert shall conduct meetings/ interviews with nodal officers, project coordinator or concerned staff(s) in his/her region. A brief comparison of procurement documents, guidelines and systems with respect to the Bank guidelines will be undertaken to identify any areas of suggestions or improvements. In addition, procurement implementation capacity will be assessed in terms of qualification, experience and stability of dedicated manpower or staffs. To bring uniformity in capacity assessment of all the IAs, a common set of parameters or checklist will be developed. The World Bank approved Procurement Capacity Assessment Tools may be used to evaluate IAs. Further, it is recommended that state level PMUs be set up and operationalized soon to ensure smooth implementation of the projects under NHP. SPMU should have a dedicated office space and comprise of technical team and procurement expert who has sound knowledge about the PIP, AWP, PP and the World Bank procedures and guidelines. Procurement team shall also collaborate with the capacity building team to provide training to the concerned staffs of IAs on procurement procedures and basic sensitization of the entire staff of IAs on procurement procedures.

► **Handholding to IAs to expedite procurement activities**

Procurement is the backbone of expenditure management in the project. Since not many activities have been carried out over the last two years, expenditure management may become a challenging task for the NPMU. Hence, procurement team is planning to develop and implement a strategy to strongly push IAs to procure some critical items such as construction of data centre, construction of piezometer, supply & installation of DWLR, operational expenses, and shopping of off the shelve items.

► **Development of standardised documents and report formats**

The World Bank has developed standard bidding documents for certain procurement type and method. Besides, Government of India (GOI) Task Force in concurrence with the Bank has developed few model bidding documents. Ideally, IAs should use available standard bidding documents or model bidding documents for a particular procurement type and method. In case neither standard nor model bidding document is available, TAMC team would endeavour to standardize the document in collaboration with NPMU and the Bank and the same may be used by the IAs as sample document after approval from the Bank. Similarly, other documents like evaluation report, etc. may be developed. Besides, a procurement manual has been developed

by NPMU in consultation and concurrence with the Bank for the NHP. IAs should adhere to the procedures and guidelines outlined in the procurement manual.

- **Coordination of project standard technical specifications for key equipment**

Specifications of several equipment were finalized during HP-I and HP-II. TAMC team has already finalized specifications for RTDAS and DWLR in consultations with the client and some of the IAs. TAMC team comprising of instrumentation experts, SCADA expert, telecommunication expert and other technical experts will further review specifications for remaining key equipment and develop next versions of standard technical specifications for all the key equipment based on market intelligence, vendors' consultations, site requirements, project needs etc.

- **Provision of procurement support on request through quality audits**

Whenever requested by IAs through the NPMU, technical experts (Instrumentation experts, SCADA expert etc.) will support in conducting tests and audits of the installed instruments or items. A detailed procedure including sampling, types of tests, field verification, measurements, quality etc. shall be developed in consultation with NPMU and the Bank. The technical experts shall undertake quality audits for small sample on request from NPMU.

- **Coordination of preparation of annual work plans and procurement plans**

Based on preliminary review of the submitted AWPs for the FY 2018-19, distinction among balanced, continued and new activities is not coming out clearly, probably due to gap in the existing MIS. Hence, one of major upcoming activity is to address the gaps through up-gradation of the existing MIS. Procurement team will be coordinating with the MIS and IT team to streamline the system with respect to PIP, AWP and PP.

- **Advice on contract management as required by IAs**

As on date, not many bids have been floated or contracts have been signed. However, since many bid documents are being finalized by the TAMC team, it is expected that some of the IAs would require contract management guidance in terms of supervision, contract management, quality control, financial management, etc. Procurement team will coordinate with IAs, NPMU, the Bank and other TAMC teams to provide timely advice to the IAs whenever requested.

4.1.3.2 Team

In the Request for Proposal (RFP) for the selection of the TAMC, six experts (one Senior Procurement Expert and five Procurement Experts) were identified for undertaking procurement related activities. However, the need for two more experts – one Procurement Coordinator (Procurement/ MIS / IT/ Finance) and one Procurement Support person – has been identified after the team started working on the NHP, given the amount and complexity of the tasks and roles required. Since four procurement experts would be deployed at respective regional centres of the TAMC, efficient communication and quality control becomes critical for the success of the NHP. Further, the procurement team needs to collaborate with other teams like IT, MIS, Finance and the technical team (Instrumentation, SCADA, Water resources, etc.) throughout the duration of the TAMC contract. In this context, a person who could fill the role of Procurement Coordinator is much desired. The TAMC has provided a staff (non-billable to the client at present) for the identified role for the time being to ensure smooth execution of tasks. However, in long run, a permanent position (billable to the client) is requested to be created by the NPMU. The additional requirements for the procurement team are specified in Table 7 below.

Table 7: Additional Requirements of the Procurement Team

Additional position requested	Proposed duration (man-months)
Procurement Coordinator (Procurement/ MIS / IT/ Finance)	42
Procurement Support Person	72

4.1.3.3 Work programme

A work programme for the time until December 2018 is presented in Figure 5 below. A detailed work plan until 2021 is attached in Appendix 8.

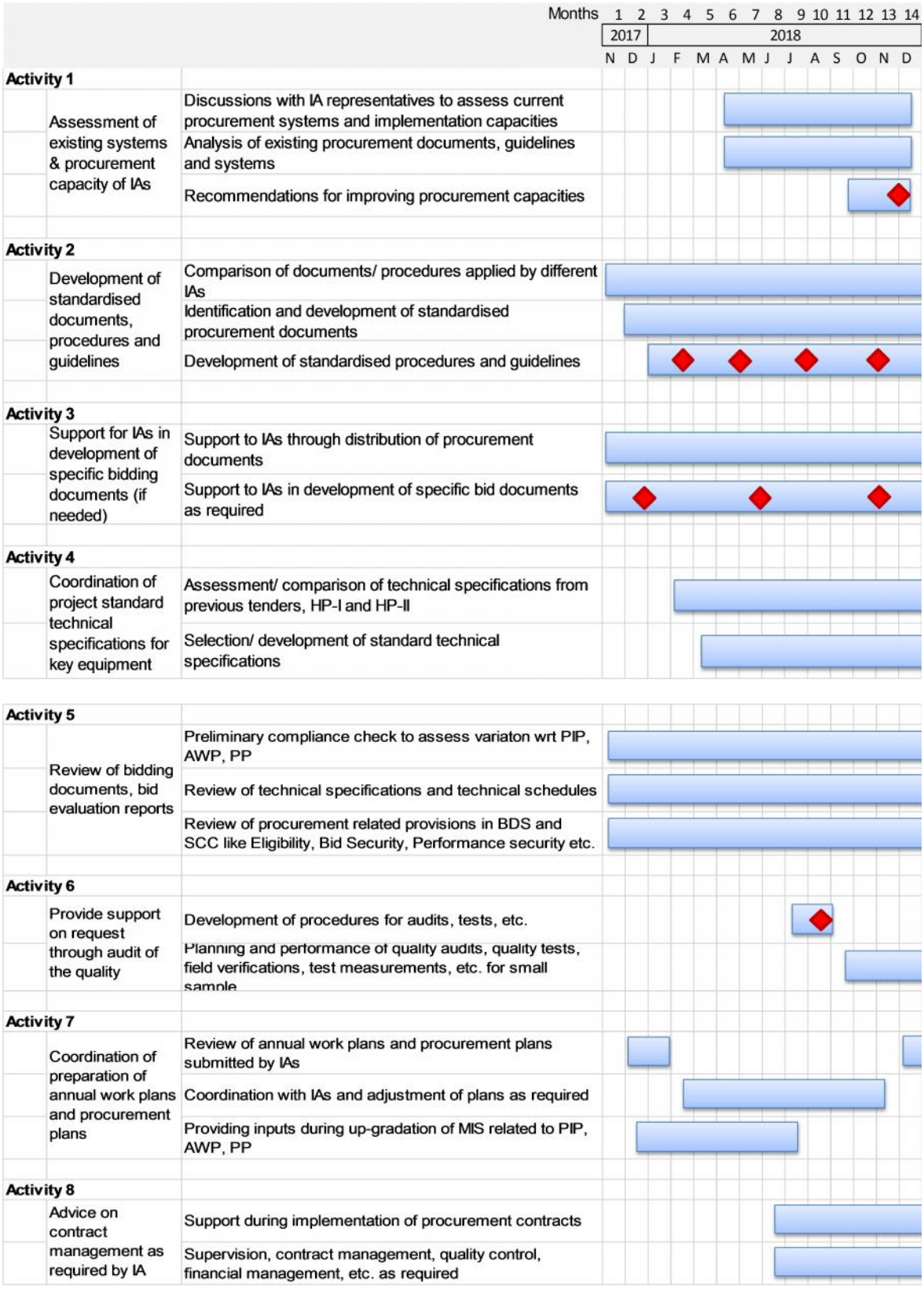


Figure 5: Procurement Work Programme until December 2018

4.2 Monitoring and Evaluation of Project Implementation

Monitoring refers to the continuous assessment of project implementation in relation to agreed schedules, use of inputs, infrastructure and services provided by the project beneficiaries, while, Evaluation is the periodic assessment of the relevance, performance efficiency and impact (both expected and unexpected) of the Project in relation to stated project objectives. The activities of Monitoring and Evaluation are important for effective, efficient and result oriented implementation of the project activities.

4.2.1 Scope of work

The scope of work of Monitoring and Evaluation of Project Implementation is as below:

- Design and implementation of project M&E system and integration with the project MIS;
- Evaluation of the Annual Work Plan, Procurement Plan and Budget;
- Preparation of Project Progress Reports and Mid-term Review Reports in relation to the project performance indicators.

4.2.2 Report on current activities

4.2.2.1 Existing team

The team structure for Monitoring and Evaluation of the project implementation is illustrated in Figure 6 below.

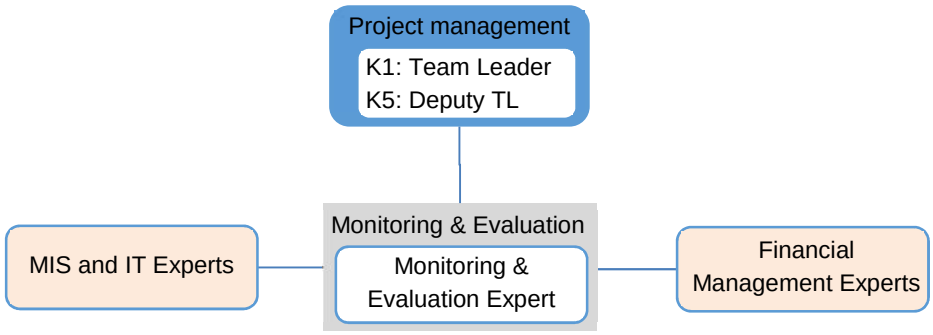


Figure 6: Monitoring and Evaluation Team Structure

The MIS and IT experts support the M&E expert for developing the module interfaced with MIS for monitoring and tracking the project activities. The Financial Management experts support the

M&E expert to review the financial progress of the project implementation activities vis-à-vis physical progress of the project.

4.2.2.2 Activities established during the Inception Phase

During the Inception Phase the existing Management Information System (MIS) has been analysed and gaps in the existing system relating to the Project Monitoring and Evaluation requirements have been identified.

Presently, the Project MIS comprises the following modules and sub-modules:

1. Overall Project Status
2. Readiness criteria
3. Project Progress
4. Status of review of PDS and Bid documents
5. PIP/Procurement
6. Training calendar and trainings conducted
7. Workshops calendar and workshops conducted
8. Project Documents
9. Project at a glance
10. Hydromet stations
11. Financial management

Under the module Project Progress, the following three sub-modules are included:

- Procurement Progress and disbursement
- Monitoring and Evaluation
- Performance of Implementing Agencies

These sub-modules comprise some indicators for monitoring the project activities. The analysis of these indicators and data processes has revealed the following gaps:

1. Absence of time based monitoring of implementation activities, i.e. achievement against a target at a proposed frequency;
2. No comparison between the level of target and achievements;
3. Not capturing project outputs;
4. No comparison of physical achievements vis-à-vis financial progress.

The TAMC Consultant for M&E has also looked at the India-WRIS and eSWIS portals developed during HP-I and HP-II to understand and capture the number of water resources monitoring stations providing the data/information on real-time basis, in order to establish the baseline values for surface water, groundwater and meteorological monitoring stations. During the study, it was observed that a number of State Implementing Agencies are not working on the eSWIS platform, and are thus not providing data of their own State stations in eSWIS. Only CWC and very few States are updating the data in eSWIS which however are also not on a real time basis. A thorough review is needed to establish the baseline values for all three types of monitoring stations. Therefore, baseline values of working water resources monitoring stations would be re-established after carrying out the baseline survey through a structured questionnaire and interacting with the Nodal Officers of the IAs. The same will be done for other PDO Indicators including those which refer to the performance level of IAs.

4.2.3 The way forward

4.2.3.1 Upcoming activities and development strategy/plan

Monitoring & Evaluation are important for the effective and efficient implementation of the project activities on a real time basis. The main objective of the M&E System of the NHP is to enable the project management:

- To ensure effective operation such that planned activities are being implemented as per schedule and are congruent with project objectives;
- To create learning environment and identify any likely short fall in expected performance;
- To evolve appropriate remedial actions;
- To motivate the Implementing Agencies to initiate the remedial actions;
- To monitor the implementation of remedial actions.
- Create baseline data on outcomes so that it assists in mid-term and final evaluation of the project impact.

These M&E tasks will arise at various levels of project management under NHP as described below:

Strategic Planning Level:

This refers to the top management, which manages the external environment of the project overarching project governing body, with planning, advisory, and strategic coordination roles. National Level Steering Committee will be responsible for this task.

Performance Planning Level:

This refers to the middle level management of the project which manages the overall project planning, management, coordination, fund allocation; financial and procurement management; monitoring safeguards compliance; M&E and technical support (with the support from Central Agencies i.e. CWC, CGWB, NIH, CWPRS, CPCB, SOI, and NRSC) for all the Implementing Agencies. National Project Management Unit (with M&E cell) will be responsible for this task.

Operational Planning Level:

At the operational planning level, State Level Project Steering Committee will provide strategic and policy directions to the State/UTs IAs. State Project Management Unit, River Basin Management Unit will be responsible to ensure the proper implementation of project activities, reporting physical and financial progress, updating MIS; and safeguards compliance.

The levels of project management mentioned above are different in the following aspects:

1. **Degree of complexity -** It is extremely high for the strategic planning level and relatively low at the operational planning level.
2. **Time span -** As one moves from operational planning level to strategic planning level, time span of decision-making is less. Top management reviews the project, once or twice in a year. State level management unit has to review the progress very frequently, often once in a month.
3. **Number of person involved -** The number of persons involved at operational planning level is much more as compared to strategic planning levels.
4. **Area of Operation -** It is a project as a whole in case of strategic planning level, as compared to specific state level project area only in case of state.
5. **Project Components –** Again activities and sub-activities under an implementing agency are much less than for project as a whole.

All the stakeholders involved at various levels, i.e. strategy, planning and operational, are responsible for ensuring implementation of the Project and delivery of the output/outcome as promised in the PDO timely and efficiently.

4.2.3.1.1 Designing Monitoring and Evaluation System

a) Results based Monitoring and Evaluation of NHP

The NHP will implement the result based Monitoring & Evaluation system to monitor the project progress and performance using the following methods and tools:

1. Monitoring implementation progress

This track shall monitor implementation progress (activities and inputs) against the PIP and the agreed annual work programs of the Implementing Agencies. The parameters to be tracked shall include:

a) Activities and inputs delivered;
b) Procurement progress;
c) Financial progress;
d) Institutional performance indicators.

2. Results monitoring

This track shall monitor results against the agreed Results Framework (Table 8), to measure overall results at the national level for the project as a whole and disaggregated at the level of each IA and state.

3. Institutional performance monitoring

This track shall monitor the performance of each Central and state Implementing Agencies, based on overall institutional performance against benchmarks as well as progress toward the agreed results and on implementation progress.

4. Interim and final evaluations

This track shall comprise three major assessments: project performance, results and emerging impacts. These will be presented as inputs to the two required Mid-term Reviews (year 3 and year 6) and to the Implementation Completion and Results Report due at the end of the project implementation period (year 8).

To capture the information/data at various levels, the Project Results Framework (Table 8) will be used for the development of the Project Monitoring and Tracking System (PMTS) and for tracking the project activities at the four levels mentioned above. This PMTS would be interfaced with MIS tool of NHP.

Table 8: Project Results Framework

Project Name: National Hydrology Project											
Project Development Objective: The PDO is to improve the extent, quality, and accessibility of water resources information and to strengthen the capacity of targeted water resources management institutions in India.											
These results are at: Project Level											
Project Development Objective Indicators											
S. No.	**Indicator Name**	**Base-line**	**Cumulative Target Values**								
			2017	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**End Target**
1	Water resources monitoring stations operated by implementing agencies providing validated data online (Number)	4,370	4,370	4,700	5,900	8,200	10,700	12,000	12,000	12,000	12,000
1.a	Surface water stations (Number)	909	909	1,000	1,300	2,000	2,200	2,300	2,500	2,500	2,500
1.b	Groundwater stations (Number)	2,310	2,310	2,500	3,200	4,400	5,900	6,600	7,000	7,000	7,000
1.c	Meteorology stations (Number)	1,140	1,140	1,200	1,400	1,800	2,200	2,500	2,500	2,500	2,500
2	Information products produced under the project made available to the relevant stakeholders (Number)	5	5	5	7	10	20	30	40	45	50
3	Water resources institutions achieving benchmark performance levels (Number)	10	10	10	12	14	17	20	22	24	25
3.a	Institutions upgraded to next performance level (Number - Supplemental)	0	0	0	2	5	8	10	15	20	25

Intermediate Results Indicators											
No.	**Indicator Name**	**Base-line**	**Cumulative Target Values**								
			2017	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**End Target**
1	WRIS users satisfied with the services (Percentage)	0	10	10	20	30	35	40	45	50	50
2	Water data centres functioning satisfactorily (Number)	10	10	10	12	15	18	22	26	28	30
3	Page views to access the information at WRIS (Number, thousands)	400	410	420	440	470	500	520	650	780	900
4	Water availability report for river sub-basins published regularly (Number)	3	3	5	8	12	16	20	25	30	30
5	Streamflow forecasting stations with improved lead time (Number)	200	200	200	220	250	300	310	325	325	325
6	Targeted professionals trained (Number)	0	50	100	300	600	900	1,200	1,500	1,800	2,000

b) Development of Project Monitoring and Tracking System (PMTS)

The components of the Project Monitoring and Tracking System (PMTS) shall be as follows:

i) Well-designed templates for monitoring of inputs use, outputs and environment and social impact monitoring. These templates would be designed for all four components and would be discussed with NPMU officials. The suggestions of NPMU officials would be incorporated. This frequency of monitoring of variables shall be as follows:
   a) Input use monitoring on quarterly basis;
   b) Output variable on six monthly basis;
ii) Each Implementing Agency will have a user ID and password to login into the system to interact with the system.
iii) Communication with the Implementing Agencies on any shortfalls, identified remedial actions through Dynamic web-based module would provide the exchange of views;
iv) Collection of baseline data both by Implementing Agencies and through online web-based software developed (eSWIS and WRIS etc.);
v) Information/Data collected during the field visits.

The functionalities of PMTS are follows:

i) To store data on server side (MIS) for all the Implementing Agency;
ii) Online monitoring of Inputs/Outputs and tracking accordingly;
iii) Feedback to IAs on any likely suggestions or unstructured data that would be stored in database on server side will be processed accordingly;
iv) To provide space for the feedbacks or any suggestions by IAs;
v) To facilitate easy and efficient retrieval of data as and when required for study by the senior officials;
vi) To generate and print out the various reports for decision-making levels. The online reports will be generated for the concerned senior officers for monitoring & evaluation of performance;
vii) Data security is maintained to relatively high level by implementing it at Database level, so as to ensure that only authorized personnel can make any changes, add or delete the information. Other users can have access to information on read only basis.

The information/data collected from the PMTS would be disaggregated at various levels:

1. Central Implementing agency level;
2. State Implementing agency level;
3. Project level;
4. Component level as and when required.

The information/data would be used to monitor implementation progress, overall project performance, results at various levels and by decision makers, supervisors, and other stakeholders to ensure timely and quality implementation and to allow corrections and troubleshooting.

Reporting arrangements:

The NPMU will submit a report to the World Bank containing (a) up-to-date physical and financial expenditure data compared to annual and end project targets; (b) updated indicators of project performance compared to annual and end of project targets; (c) successes and problems encountered during the reporting period with suggested remedial actions and social and environmental impacts of the project.

IAs will submit to NPMU: (i) technical, financial and procurement reports summarizing observations: (ii) six monthly reports summarizing projects M&E of preceding six months, cross-cutting issues and recommendations and updated project indicators.

Capacity Building and Training Requirement to Ensure Effective Implementation of PMTS:

MIS for the project as a whole will be much larger than the M&E component. PMTS of M&E component will be one of the modules of the entire project MIS. Capacity building in PMTS will be undertaken so that all the IAs can create data base at their level and use online facilities to provide M&E data. A training programme at the beginning of the implementation of online system and frequent interaction with IA will be carried out to solve any problem in the use of the online system.

c) Roles and Responsibilities of National Project Monitoring Unit

Project Monitoring and Evaluation (M&E) will be carried out at two separate levels. First, National Project Monitoring Unit (with the support of M&E cell at NPMU) will regularly monitor and report on the project's physical and financial inputs and outputs, at the implementing agency level. Secondly, an independent entity (TAMC) will be charged to carry out comprehensive outcome focused impact evaluations of NHP at three stages - baseline, mid-term reviews (3 and 6 year) and project completion.

The institutional structure of the M&E process will follow the overall organizational and governance structure of NHP. The primary responsibility for M&E will be with NPMU, led by the Director, NHP and assisted by technical team members, finance and procurement officers. The M&E system will identify problem areas at IA level, help management to administer project processes, aid project design and implementation, help make mid- course corrections, and help the project to achieve its overall project development objective.

d) Roles and Responsibilities of CPMU, SPMU and RBMU

As per the guidelines, each IAs will have to establish a Project Management Unit (SPMU, CPMU or RBMU) with responsibility for overall coordination and implementation of the project activities. PMU will be headed by a Chief Engineer and will have procurement and technical experts from government staff (hydrology data centre or equivalent), as well as IT staff on contract basis. Each SPMU will be staffed with a multidisciplinary team, including finance, procurement, safeguards. M&E focal points would also be appointed in each central, state and river basins who will support the project management units for carrying out monitoring and evaluation activities.

4.2.3.1.2 Baseline Survey for NHP

a) Objective and Use of Baseline Survey

Monitoring involves repeated assessment of a situation over time. Having an initial basis for comparison helps the project managers to assess what has changed over a period of time. So we need information about the initial starting point or situation before any intervention has taken place. This information is called baseline information. This is the line of base conditions against which comparisons are made later on. The baseline is the first critical measurement of performance indicators and is used as a starting point by which the future performance of the project is monitored. Baseline data should be collected at least for each identified outcome indicators.

b) Baseline Survey Procedures

As the success of the project will be, in part, measured by comparing the target values or achieved values, generation of baseline data becomes crucial. Often it has been observed that baseline studies suffer either from too much information or a lack of use of all these information or with data gap such that it is not adequate for assessment of progress or impact. Therefore, before deciding on the data to be collected, the following questions need to be debated both at implementing agency level as well as at the national level of the NHP Project:

1. What data is to be collected?
2. What are the sources of relevant data?
3. What are the data collection methods?
4. Who will collect the data?
5. How often these data will be collected?

A comprehensive questionnaire that has been prepared by the TAMC is given in Appendix 2. This questionnaire will form the basis for the generation of the baseline data.

4.2.3.1.3 Mid Term and Final Evaluation

The mid-term evaluation would be carried out for the project activities/measures during 3rd and 6th year after project commencement. The formats for data collection for mid-term evaluation and final impact evaluation would be devised at appropriate time and would be discussed with NPMU officers. Data/information would also be generated from India-WRIS, eSWIS and MIS etc. The impact of the project activities completed would be assessed both in physical and financial terms from the benefits accrued to the beneficiaries against the targets/objectives of the project. The data collected would be analysed comparing with the baseline line data for both mid-term evaluation and final impact evaluation.

The following table shows the major upcoming activities for M&E under the NHP.

Table 9: Activities for M&E under the NHP

Sl. No.	Description of activity	Schedule
1	**Inception Phase: Planning and Strategy**	
1a	Analysis of existing M&E system	Feb-18
1b	Interaction with Implementing agencies	Feb-18
1c	Analysis of existing MIS	Feb-18
1d	Scope Clarification	Feb-18
2	**Phase 1: Development of templates / formats for**	
2a	Baseline values	Feb-18
2b	Ranking of Implementing Agency	Feb-18
2c	Project Monitoring & Tracking System (PMTS) format for IA	Mar-18
3	**Phase 2: Fixing Baseline values & ranking**	
3a	Sharing of baseline and ranking templates with IA	Mar-18
3b	Follow up with IA to fill up the templates / formats	Apr-18
3c	Data collection, collation and analysis	May-18
3d	Report preparation for baseline values	May-18
3e	Report preparation for ranking of IA	continuous
4	**Phase 3: Design & Development of PMTS module**	
4a	Development of User Required Document for PMTS	Jun-18
4b	Development of PMTS module	Sep-18
4c	Pilot testing and implementation	Oct-18
4d	Modification / rectification in PMTS module if required	Nov-18
4e	Uploading of PMTS module in MIS	Nov-18
5	**Phase 4: Capacity Building & filling up data**	
5a	Capacity Building of IA for PMTS	continuous
5b	Filling up the data in PMTS module online	continuous
6	**Phase 5: Report generation**	

6a	Information / data collection, collation, processing & analysis	continuous
7	**Report generation at**	
7a	Component level	continuous
7b	Implementing Agency level	continuous
7c	Project level	continuous
7d	Ranking of Implementing Agency	continuous

4.2.3.1.4 Performance Indicators

The performance indicators for benchmarking the performance of the Implementing Agencies are given below. Proper weightage would be given to the indicators to calculate the performance level and upgradation during the project period. The consideration of indicators and its weightage would update over the project period based on the relevance.

Basic Information

1. Prepared Procurement Plan;
2. Prepared AWP (2018-19);
3. Bid documents ready;
4. Formation of State Level Steering Committee (SLSC);
5. No. of meetings held (SLSC).

Component A

1. Availability of Hydrological division with real time data collection facilities, modelling and trainings facilities;
2. Data back-up facilities;
3. Deployment of staffing;
4. Status of procurement of Hydro-met equipment and SCADA;
5. Establishment/renovation/furnishing of Hydro-informatics centres;
6. Status of digitization, processing and validation of historical data.

Component B

1. Status of database management facility;
2. Data sharing policy;
3. Data Sharing with stakeholders;
4. National WRIS / Sub-national WRIS page view;
5. Ease of Access to data;
6. Status of hydro-met monitoring stations for the following sectors:
   a) Surface water stations;
   b) Groundwater stations;
   c) Meteorological stations.

Component C

1. Development of Analytical tools and DSS
    a) River Basin Assessment system;
    b) Irrigation benchmarking of various projects;
    c) Operative Flood Forecasting System;
    d) Exchange of Information/data between stakeholders, state and central agencies;
    e) Number of departments/organizations with whom regular information is shared;
    f) Number of reports provided on web-portal;
    g) Knowledge/information product developed;
    h) Hydro-met/HIS manual developed.

Component D

1. Status of Hydrologic Modelling centre/knowledge centres;
2. Status of modelling team;
3. Trainings:
    a) Trainings conducted;
    b) Targeted professionals trained;
    c) Training courses developed;
4. Partnership developed with professional development institutes.

Financial Management

1. Component-wise collection and expenditure on quarterly basis

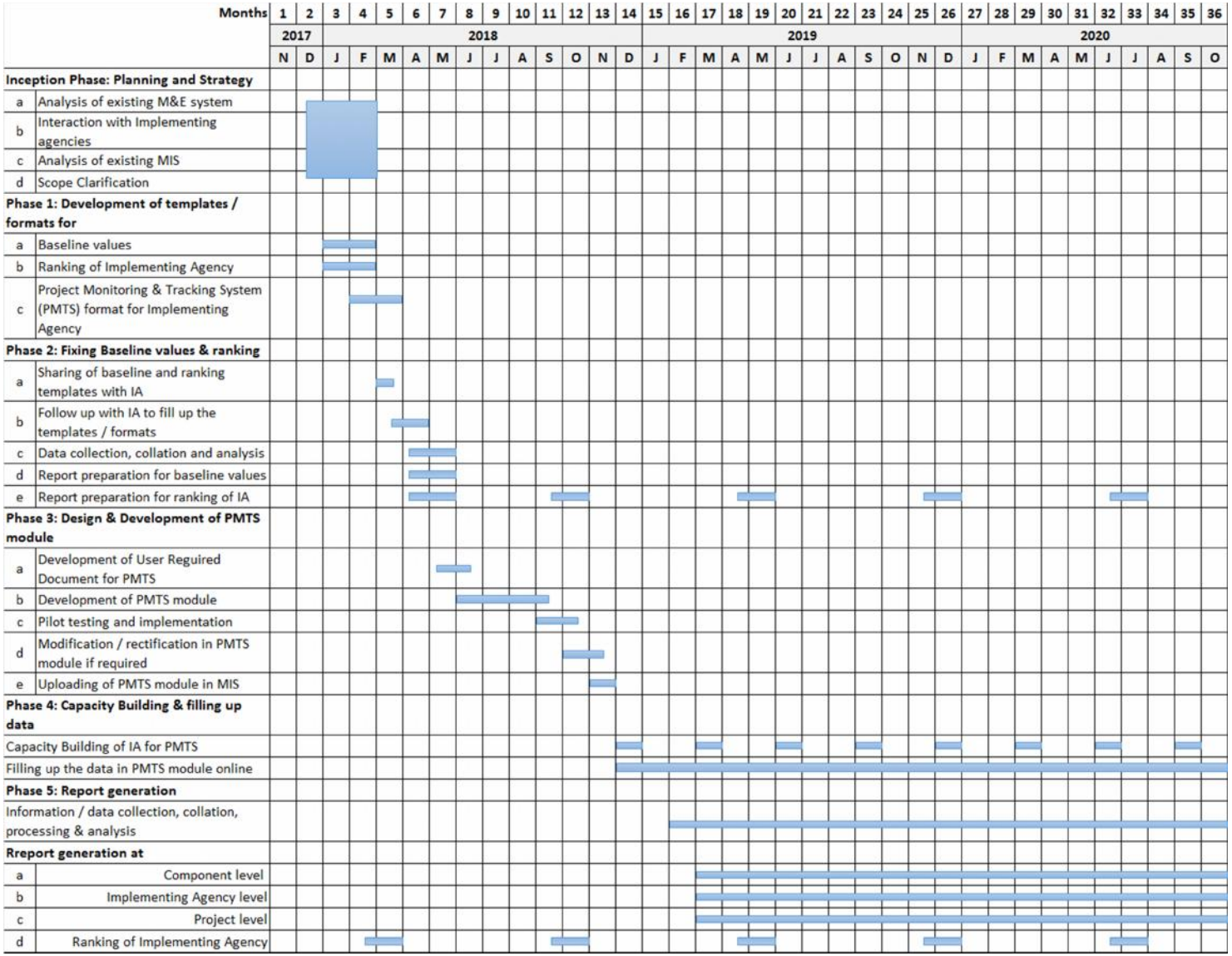
4.2.3.2 Team

As per scope of work, regular field visits to the Implementing Agencies are required for capacity building and verification and project progress. At present only one person is foreseen to perform all activities in the area of M&E.

4.2.3.3 Work programme

The detailed work programme for the upcoming 3 years is given in Figure 7 below.

Figure 7: Work Programme for Monitoring and Evaluation Activities



4.3 Financial Management

Financial management refers to the efficient and effective management of money funds in such a manner as to accomplish the objectives of the Project. Further, this activity of management is concerned with the planning, procuring and controlling of the financial resources as shown in Figure 8.

The primary role of financial management in National Hydrology Project (NHP) is to monitor the financial as well as the physical performance of the entire project.

The Financial Management Reporting and Compliance to the National Hydrology Project is a part of overall Technical Assistance and Management Consultancy (TAMC) agreement. As per the scope of work, TAMC as a whole shall provide technical and management consultancy to National Project Management Unit (NPMU) and Implementing Agencies (IA) in predefined areas.

Figure 8: Financial Management Activities

4.3.1 Scope of work

The scope of work of financial management covers the following areas:

1. Implementation of Financial Management Reporting System for internal and external reporting;
2. Financial management support to Implementation Agencies;
3. Financial monitoring and reporting, using effective IT tools;

4. Advisory role for IAs wherever necessary to fulfil the above scope of work efficiently and effectively.

4.3.2 Structure & Activities since inception

4.3.2.1 Financial management Team Organisation Chart

The TAMC financial management team comprises two persons. The team organisation structure is shown in Figure 9.

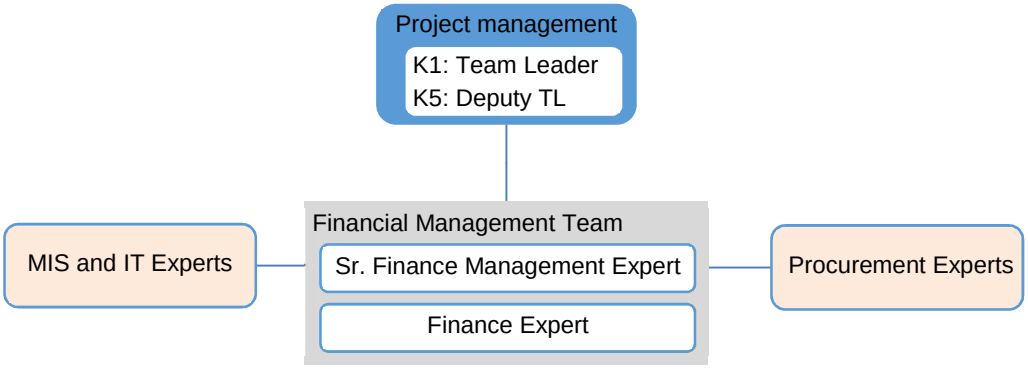


Figure 9: Financial Management Team Organisation Chart

4.3.2.2 Activities undertaken during the Inception Phase

During the Inception Phase the following activities have been undertaken.

Study of important finance related documents

Various documents relevant to the project have been studied during this period, such as:

a) Loan agreement with the World Bank;
b) Project Appraisal Document (PAD);
c) Memorandum of Agreement (MoA) with IA;
d) Financial Management Guidelines, procedures, policies etc.

Meeting with the World Bank team

The team has met with the officials of World Bank to gain acquaintance of their specific expectation, understanding the monitoring guidelines and deliverable from finance vertical for efficient and effective monitoring of the project, the discussion were held on the following points:

a) Criterion with respect to eligible and non-eligible expenditures to claim reimbursement;
b) Submission of claim on the basis of Utilisation Certificate (UC)/ Interim Un-audited Financial Report (IUFR) as per the loan agreement;
c) Planning of visits to IAs to understand its functionality and provide necessary support in relation to the financial management;
d) Timely completion of statutory audit and submission of the unqualified reports to prevent rejection/refund of reimbursement claims.

Discussion with MIS, IT and M&E teams

Under this heading the following activities have been carried out:

a) Analysis of existing MIS system in operation;
b) Suggested improvements in the gaps identified and recommendation to incorporate the followings:
    - Maker & checker concept to be incorporated,
    - Delegation of authority to be specified,
    - Well-organized and efficient Data Base Management System (DBMS), wherein the data can be retrieved by using in-depth (drilling-down) approach to extract the data from the source/base level.
    - The MIS shall be able to populate .pdf format documents for quick reference (e.g. audit report, UCs, etc.)
    - Summarising information with respect to monitoring of submission/ non-submission of data by all IA.
c) Assisted in developing the draft financial format for funds released by MoWR and respective expenditure incurred by IAs.

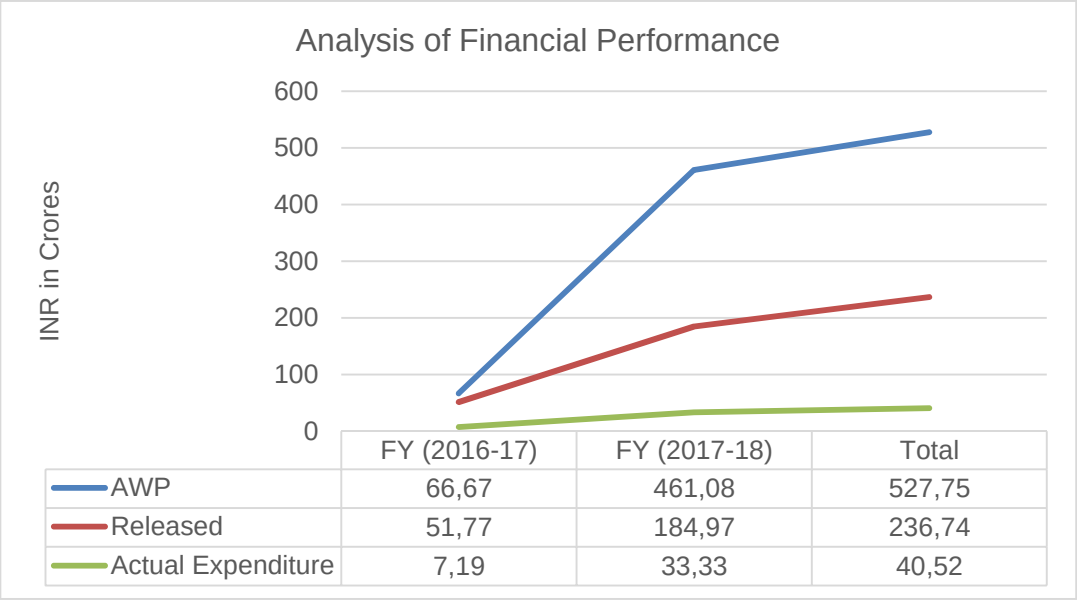
Follow-up with the Implementing Agencies

The following activities are to be mentioned concerning the follow-up with the Implementing Agencies:

a) Follow-up with IAs to update the data related to expenditure through emails, phone calls, etc.
b) Expenditure incurred on monthly basis to be bifurcated into component and activity wise.
c) Signed copy of IUFR & UC shall be submitted to NPMU on half yearly basis for onward claim submission to the World Bank.

Analysis of Financial Performance

An analysis of the Annual Work Plans (AWP) vs. Released vs. Actual Expenditure incurred by IAs has been performed. The results obtained are shown in Figure 10.



	FY (2016-17)	FY (2017-18)	Total
AWP	66,67	461,08	527,75
Released	51,77	184,97	236,74
Actual Expenditure	7,19	33,33	40,52

Source: MIS portal and information received from NPMU & IA

Actual Expenditure for FY (2017-18): considered for the period April to Dec. 2017

Released for FY 2017/18: for Central Agencies revised estimate considered

Figure 10: Analysis of Financial Performance

Analysis of Physical Performance

The current AWP are not including all quantitative details. In the Quantity column (termed as QID) is mentioned as 'Lump sum' against which quantity appearing is '0' (zero). In the absence of quantity of individual line item, physical performance could not be monitored. It has been recommended and agreed by the NPMU that with effect from FY (2018-19) all line items shall be quantified even if QID is mentioned as 'Lump-sum'.

Analysis of Budget Estimates (BE) vs. Revised Estimates (RE) vs. Actuals

The TAMC has analysed the actual expenditure incurred by the Central IA i.e. CWC, CWPRS, CGWB & NPMU till end of 3rd Qtr. (2017-18) and projected expenses incurred in 4th Qtr. as compared to budgeted and revised allocation of expenses. This exercise shall be required to be done every year to minimize the surrender of budget Allocations and to improve the performance activity of the Project.

4.3.3 The way forward

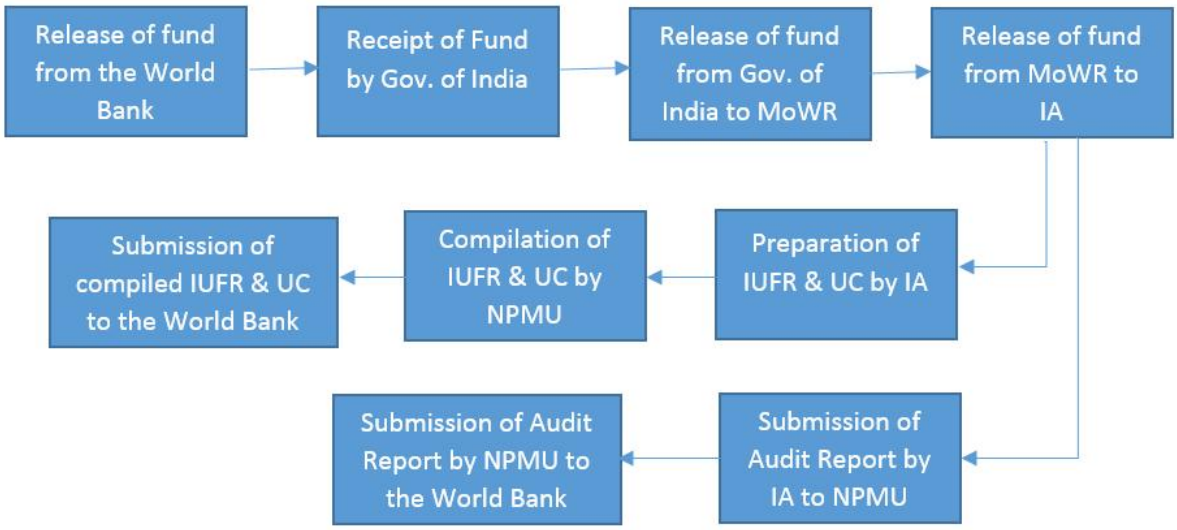
4.3.3.1 Upcoming activities and development strategy/plan

Compilation of Release of F**und** v**s. Expenditure**

Presently, expenditure data is being obtained from the IA via email and phone, as some of the IAs are not updating in the MIS portal and also existing MIS is being updated. System is being developed in MIS where a signal shall be flashed to the Administer/NPMU in case of non-submission of timely data in MIS by any IA followed by a SMS/email alert requesting to update MIS without further delay. Henceforth, all required data shall be available in MIS without a time gap.

Compilation of IUFR

As per the requirement, IUFR received from IA needs to be compiled every 6 months. To enable timely and uniform availability of IUFR with UC, system for the same is in development phase. The IT mechanism in the system shall assist in the generation of IUFR directly from the MIS portal. This can be downloaded, signed and sent by IA to NPMU along with Utilisation Certificate (UC). A preliminary report of IUFR generated in MIS can be compiled in advance to prepare the reimbursement claim which will be lodged with the World Bank after receipt of signed IUFR with UC.



Suggestive modification in existing IUFR

The existing format as provided in Memorandum of Agreement (MoA) is given in Table 10. It is a compiled IUFR to be submitted by NPMU to the World Bank.

Table 10: Existing IUFR Format

Format of Interim Unaudited Financial Report (IUFR) to be submitted by MOWR, RD&GR to World Bank

Table 1: **Summary report of IUFR with Component wise status of expenditures**

Project Name: National Hydrology Project

Period for which IUFR is submitted:

Amount in Rupees Million

PARTICULARS	Current Period	For the Year	CTD
Uses of funds			
Component A			
Component B			
Component C			
Component D			
Total use of funds			
Eligible expenditure			
Disbursement Percentage			
Eligible amount of claims			

PARTICULARS	Current Period	For the Year	CTD
Opening Balances of Advances to IA			
Add: Advances given during the period			
Less: Advance adjusted during the period			
Closing Balance of Advances			

The IUFR format submitted by IA to NPMU is predefined in MoA between MoWR and IA. It further needs to be strengthened by suggested modification mentioned below:

- Table 11 is the addition of Opening Balance column,
- Table 12 funds adjusted during the period (Expenditure incurred component wise and Advances) shall be captured.

Table 11**:** Addition of new column- Opening Balance

PARTICULARS	Opening Balance	Current Period	For the Year	CTD
Uses of funds				
Component A				
Component B				
Component C				
Component D				
Total use of funds				
Eligible expenditure				
Disbursement percentage				
Eligible amount of claims				

Table 12**:** Funds adjusted during the period

PARTICULARS	Current Period	For the Year	CTD
Opening Balances of Funds received from MoWR			
Add: Funds received during the period			
Less: Funds adjusted during the period (a+b) (a) Expenditure incurred component wise (b) Advances given during the period			
Closing Balance of Funds			
Balance as per Bank Statements*			

Note: In case of difference in closing balance of funds, a reconciliation statement is to be attached.

MIS to make fully operational for reporting

The formats for financial update and monitoring of project have been discussed with the MIS and IT team. After the development of the MIS, the necessary reports shall be

generated and modifications, if any, shall be discussed with the IT/MIS team. The existing MIS is being updated by the IT team and the TAMC team is providing suitable assistance where in appropriate information can be extracted from the MIS by the user in regards to the financial information, physical status of the Project as well as other parameters along with analysis at project, IA and component levels.

Analysis of Projected vs. Actual Expenditure

System shall be developed to analyse the Projected (Budgeted/Annual Work Plan) vs. Actual expenditure with the help of the MIS tools. Timely analysis shall be done to identify the variations with suitable reasons/justification and further recommendation shall be submitted to take appropriate action.

Visit to the office of IA

Implementing agencies shall be visiting on random and rotational basis. The visit shall provide necessary support in maintenance of book of accounts and strengthening of Internal Checks. Checklist/guidance notes have been provided for testing of implemented internal controls and necessary suggestions shall be provided after the identification of viable gaps.

Providing support/ training to IA

The TAMC will provide the necessary support/ training to the IAs as per requirement with regards to the maintenance of financial records. In addition to this, training programme/ guidance notes/ knowledge update shall be shared and discussed with all the stake holders, wherever necessary.

Training and support in PFMS

The primary objective of PFMS is to facilitate sound Public Financial Management System (PFMS) for Government of India (GoI) by establishing an efficient fund flow system as well as a payment cum accounting network. PFMS provides various stakeholders with a real time, reliable and meaningful management information system and an effective decision support system, as part of the Digital India initiative of GoI. After effective training and implementation of PFMS at all IA uniformly, the reporting format of funds, expenses including reconciliation of data of PFMS with IUFR shall be recommended in consultation with IT/Database team.

Establishment of Effective Internal Control Mechanisms at IAs

During the visit to the office of IA, TAMC shall review the existing Internal Control by verifying the transactions, relevant documents and records. Internal control is an inbuilt process to assure achievement of a project's objectives with operational effectiveness and efficiency, reliable financial reporting, and compliance with laws, regulations and policies. Any gap identified during the review shall be understood and a roadmap shall be developed. Checklist and guidance note shall be prepared based upon transactions at IA and gaps will be identified and documented by the team. After analysis and consultation with stakeholders, necessary rectifications, modification and recommendation shall be documented and provided to mitigate the risk and improve the efficiency.

Sample Checklist for detailed Questionnaire		
Sl. No.	**Particulars**	**Remarks**
	Assessment of present system	
	Cash & Bank	
1	Authority - Operational	
2	Approval	
3	Reconciliation	
	Receipt and recording of Funds	
4	Accounting system and verification of receipts	
5	Reconciliation between fund released by MoWR and actual receipt	
	Disbursement / Utilisation of Funds	
6	Verification of accounting entries	
7	Matching of expenditure with AWP	
8	Procurement guideline and approvals	
	Reporting	
9	Monthly reporting/ update of expenditure in MIS	
10	Half yearly preparation of IUFR	
11	Verification and reconciliation of Reports with Books of Accounts	
Vouching and documentation will be an integral part of the checklist.		

Internal Audit system

In view of the volume of transactions/ project cost and multi-location controls, a mechanism of regular Internal Audit needs to be placed. This is also in line with the MoA between MoWR and IA. An Internal Audit of transactions in detail before Statutory Audit will not only check the expenses but also will be a support to management and auditors to conduct audit timely and smoothly.

Coordination with IA for settlement of adverse audit paras

TAMC shall coordinate with the IA and the Auditors for settlement of adverse audit paras. For pending paras of previous audit reports, the information needs to be furnished by the department followed by the verification of the records for the settlement of adverse audit paras.

Mechanism for resolution of prior year audit findings shall be developed and action plan for going forward shall be made. Nature of auditor's adverse comment to be discussed with finance authority/ Nodal officer and action is to be taken:

- If rectification is feasible, discussion shall be made with IA and required action to be taken to drop the audit para;
- If rectification is not feasible, identify the reason and recommend appropriate action at IA level in consultation with the MoWR.

4.3.3.2 Team

As per the scope of work, regular visit to the office of IA shall be required. Presently two team members are available under the finance vertical.

4.3.3.3 Work programme

During the coming 9 months it is planned to develop the following activities:

1. Monthly monitoring and support to NPMU in compilation of expenditures received from IAs,
2. Analysis of expenditure and comparison of variance with AWP on monthly/ quarterly basis as may be required,
3. Support to NPMU in compilation of UC & IUFR for the period ending 31st March, 2018
4. Support to NPMU to lodge reimbursement claim with the World Bank on the basis of UC & IUFR received,
5. Support to IT/database team in development of existing Finance Module of MIS
6. Provide necessary training and support in PFMS
7. Visit to IA on selective region/ zone basis to review existing Internal Control System, documentation of questionnaire, identifying gaps and actions to plug the gaps and required support at IA level,
8. Coordination with IA with respect to compliance of Audits and submission of the audit reports,

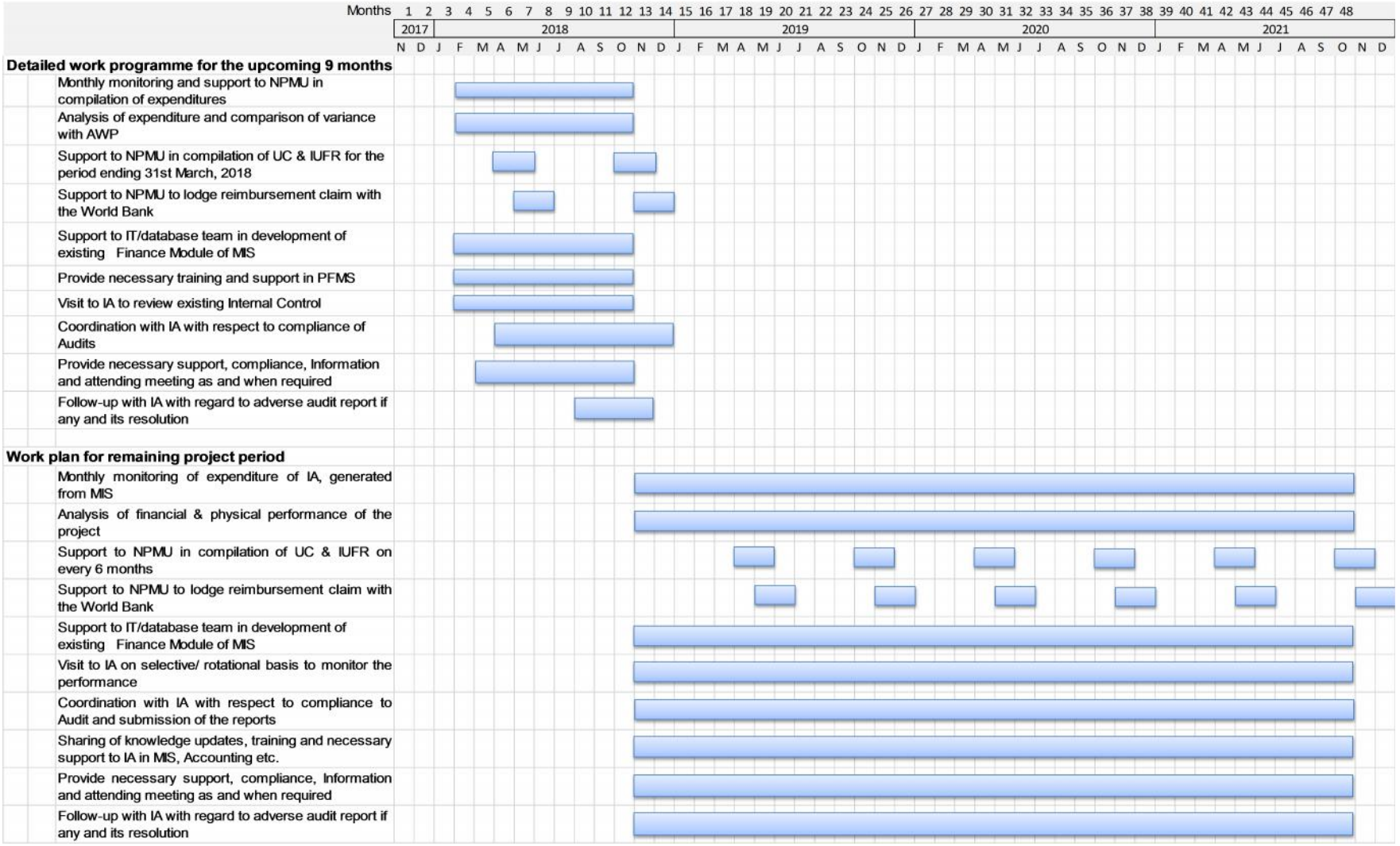
9. Provide necessary support, compliance, information and attending meeting as and when required by MOWR/ NPMU/ World Bank.
10. Follow-up with IA with regard to adverse audit report if any and its resolution to minimise the ineligible expenditure as per the World Bank guidelines.

During the remaining project period it is plan to develop the following tasks:

1. Monthly monitoring of expenditure of IAs, generated from MIS
2. Analysis of financial & physical performance of the Project
3. Support to NPMU in compilation of UC & IUFR on every 6 months
4. Support to NPMU to lodge reimbursement claim with the World Bank.
5. Support to IT/database team in development of existing Finance Module of MIS
6. Visit to IA on selective/ rotational basis to monitor the performance.
7. Coordination with IA with respect to compliance to Audit and submission of the reports
8. Sharing of knowledge updates, training and necessary support to IA in MIS, Accounting etc., wherever required.
9. Provide necessary support, compliance, Information and attending meeting as and when required by MOWR/ NPMU/ World Bank,
10. Follow-up with IA with regard to adverse report if any and its resolution to minimise the ineligible expenditure as per the World Bank guidelines.

The anticipated Work Plan for the finance team is presented in Figure 11.

Figure 11: Work plan for finance team:



4.4 Management Information System (MIS)

4.4.1 Scope of work

The purpose of the Management Information System is to work as a regular management tool to help project management units at all levels (national and state level) to track implementation progress, implementing agency performance and results, thus enabling them to monitor the physical and financial progress of the Project.

The MIS Application has initially been developed in the period 2015-2016 to cover and capture data for few reporting purposes as stand-alone modules. At this stage it needs to be further scaled-up by the TAMC in order to enhance existing and add new functionalities.

The National Project Management Unit will be the owner of the Management Information System for monitoring physical and financial progress. The broader scope of work mentioned as below

- Designing/Architecting the application based on M&E indicators and define source of information
- Restructuring of project at two Mid-term reviews
- Annual maintenance, over all implementation, backups and all other security parameters at the levels.

The MIS system will facilitate project status monitoring of the below indicated activity modules:

1. **Project Module** - This module will facilitate capturing and monitoring project status and progress of this world-bank funded project. The will be broken into below submodules
    a. Project Readiness Criteria
    b. Project implementation plan(PIP) from individual agencies and consolidated at NPMU
    c. Annual Work Plan(AWP) for entire duration of project rom individual agencies and consolidated at NPMU
2. **Procurement Module** - This Module will facilitate creation and submission of Procurement Plan (PP) by implementing agencies against AWP. This will also capture schedule for procurement and facilitate in Planning, Implementation, Monitoring and Post Review.
3. **Monitoring and Evaluation Module (M&E)** - This module will facilitate capturing project Key Performance Indicators and their weightage for evaluating the project progress. Once base data of project readiness is captured, the module will facilitate capturing the project progress against the indicators. Ranking of implementing agencies will be done through the system.

4. **Finance Module** - The purpose this module is to plan budget, record fund allocations, record expenditure and track the funds made available for each of the activity items in MIS. This module will also facilitate record keeping of findings of internal and external auditors.

   Based on the Procurement Plan approved by the WB and Annual Work Plan, Budget estimates are prepared by all the accounting centres for the overall NHP Project down to each granular activity for the next Financial Year. The Budget once approved by NPMU and MoWR RD&GR triggers release of funds to be allocated for implementing various activities through PFMS. Based on the available funds, expenditures are made by various accounting centres relevant data is captured in the system. As the financial year progress, 2nd allocations for the remaining months of the current financial year based on utilization of 1st tranche.

   While processes relating to financial management are going on, Internal and External audits may take place periodically. The Auditors periodically may audit the finance accounts (Budget and Expenditure) and document their observations. These observations are required to be recorded in the MIS system for further analysis by the project stakeholders.

5. **Reports and Dashboards** - Every module has it's on set of dashboard showing the graphical presentation of component progress along with the key activity based alerts for the module owner and the consolidated login has the overall status of projects with module wise graphs & key no achievement, besides this the predefine formats of MPR, QPR, Annual, MTR, MoRD Report and facility to generate On demand deport based on parameter selection.

6. **Training and Feedback** - The existing module has a hierarchy system, the user will be able to enter data on a day-to-day basis regarding organize Training Program, Attach training Material, Download list of Participants, while the next three levels of users will be able to view compiled reports (output indicators) based on the data entered.

   Enhancing the existing training module capture feedback of trainee, Assessment, Analysis of training program is included with build-in reports for the training conducted along with the participant attended the training.

7. **Grievance Module** - Any grievance faced during implementation of the project can be addressed through the Grievance Redressal portal. In order to deal with the complaints received from all the stake holders (e.g. contractors/ suppliers) effectively, a complaint handling mechanism would be available in the MIS, and immediate action would be initiated on receipt of complaints to redress the grievances.

   a. There will be online registration of Complaint.

   b. Complaints are also under supervision of Nodal officer / PD.

8. **Document and Content Management System** – The existing module has the facility to maintain library of various section like Training, HP1 and 2 related documents, Various

Manuals & Guidelines prepared during the project, Presentations, reference model document for Procurement etc. The module has the facility to place the demand of seeking approval, submission of proposal and facility to make more paperless and faster communication between the NPMU and IAs. The improvement area here in procurement related document which should be linked with existing PIP, PP and Plan to track the actual implementation related to procurement and also for IUFR link with Finance module.

9. **Knowledge Management Module -** During the life-span of the project, provision of Knowledge Management platform will help participation of agencies and communities across the Implementing Agency (IAs) involved with the Project at various levels to share best practices, ideas, other publications etc. It is envisaged that the sharing of knowledge in various forms will happen through multiple collaboration tools such as document repository, blogs, wikis, login based discussion forums to understand the current requirements and achievements of the project and 'ask an expert'.

The key features of the proposed MIS are as follows:

- To manage both proactive and on-demand responses to requests for information,
- To manage a document management and dissemination system which ensure that quality standards.
- To coordinate the workflow of all documents that comes within the SharePoint and the online document Management system.
- Implementing agency will have their own web chapter (Agency Dashboard), to track all the activities mentioned above. Every implementing agency will ensure their physical and financial progress using MIS system. Dedicated webpage for agencies with provision to publish own events and success stories etc.; maintenance of contact directory by individual agencies
- A robust document management system, to create a data repository for all the documents including should be maintained.
- Login based discussion forum on the web portal to understand the current requirements and achievements of the project.
- GIS or Google based platform for existing hydro met stations and to design proposed hydro met stations should be taken further.
- Develop a dynamic calendar which will reflect the capacity building parameters (upcoming Trainings, workshops, meetings) as well as a track or reminder for the annual work plan activities.

- Baseline indicators will be developed into the system to track future procurement & financial activities.
- User Authentication and Role management module to ensure user credentials, roles and access to the system. This module will be designed based on MIS stakeholders (NPMU, and SPMU & CPMU). The main user of the application at project management unit as administrator will be Agency and agency will have rights further to divide the roles based on technical sections.
- Based on data flow mechanism complete procurement policy, procurement roadmap to be introduced within the system.
- Procurement, finance and audit systems will be developed and integrated with the existing modules.
- Physical tracking modules developed during initial phases will be fully integrated into finance/procurement modules (This phase).
- The MIS system will be finally hosted over national informatics centre, so TAMC has to ensure the security scrutiny, data backup policy and all other critical parameter before migration over the NIC server.
- Responsive design to be able to use from Mobile
- Interface with e-SWIS, e-GEMS, etc. to in view of capturing and displaying information required for monitoring and evaluation
- Readiness module having adjustable marking scheme for each agency, with marks based on uploading of documents and information; dynamic update of marks and comparison**;**
- Detailed module for Project Implementation plan, having a hierarchical module to plan costs by individual agencies at up to fourth level of detail
- Modules for project description, description of project components, FAQ, web links, implementation support and arrangement
- Venders module for list of registered vendors and interface for registration of new vendor
- Modules for interface based uploading of advertisement / notifications and automatic publishing of notices on website based on database
- Reports and dashboards
- Procurement page with hierarchical classification of procurement documents, procurement trainings, standard and example bid documents, procurement procedures and manuals

- Web based calendar for trainings, missions, workshops, meetings etc. along with agenda, presentations and participation lists
- Mobile responsive for uploading information and alerts

4.4.1.1 Gap Analysis - Gap assessment of existing MIS with respect to PIP, AWP and PP

A preliminary assessment of the existing MIS system has been carried out to understand the gaps and issues in the existing MIS system. Table 13 below mentions some of the gaps in the existing MIS system and proposes solutions to address the same. Overall list of enhancement and development of new functionalities are attached as Appendix 2.

Table 13: MIS Gap Analysis

No.	MIS Reference	Gaps in the Existing System	Suggested Potential Solution	Proposed MIS
1	PIP section	PIP provides a list of activities, both procurement and operation related, to be undertaken by an IA over a period of 8 years. Each activity may either be taken wholly or be split into many sub-activities while preparing AWP and PP. If it is split into sub-activities, estimated cost will change when translating from PIP to AWP to PP. Further, review type (post/prior) depends on the estimated cost as per PP activity and not as per PIP or AWP activity. Since existing PIP format includes a column on Bank review, it might create unnecessary confusion.	"Bank review" column may be removed from the PIP – Cost section and may only be kept in the PIP – Procurement Plan section.	With reference to Procurement the threshold limits are define and based on the cost the system Method (ICB/NCB/ Shopping) and type of procurement the system automatically define the procurement method.
2	PIP section	A column for Procurement type (Goods / Works / Non Consulting Services / Consulting Services) is not included in the PIP – Cost section at present. Including this column in the PIP – Cost section would bring better clarity when clubbing activities from AWP into PP.	A column for Procurement type (Goods / Works / Non Consulting Services / Consulting Services) may be included	While preparing PP the method is selected for monitoring the stage procurement

No.	MIS Reference	Gaps in the Existing System	Suggested Potential Solution	Proposed MIS
3	PIP section	PIP – Cost section provides total quantity and total amount for each of the activities. At present, there is no mechanism to ensure that activities / sub-activities planned in AWPs thus far are falling within the bracket of estimated quantity and amount as per PIP.	Columns mentioning balance quantity and amount under each activity of PIP may be included. Values in these columns should get automatically computed based on quantity and amount considered in AWPs of various years.	Proposed to cross check with the expenditure and the total provision, the balance should be always displayed while creating the AWP and doing the expenditure.
4	AWP section	When adding an activity from PIP to an AWP, automatic carry forwarding options is not available at present. Due to this, IAs are currently unable to import balance activities from 2016-17 and 2017-18 AWPs. They would be required to put the details of previous activities again in the system while creating AWP 2018-19.	Options for automatic / simplified importing of balance activities from previous AWPs may be developed.	Any activity created for every year should be treated as new whether that will be on-going or newly created or balance of last AWP is needed for next AWP.
5	AWP section	In the existing MIS system, quantity and amount are not mandatory fields when adding a new activity in an AWP. Further, input fields for quantity and amount can take both numerical as well as words.	Quantity and amount fields may be made mandatory and should only take numerical values.	Here additional window provided to select the possible items or no should be in box where mention as '1' quantity.
6	Procurement Plan section	Procurement plan is currently not linked with AWP in the system. Any correction in mismatch between AWP and PP is being done manually and through review of checklist submitted by the IA. To ease the process, it is recommended that PP be integrated with the AWP in manner so as to enable IAs to import single activity or multiple activities directly from AWP and form a procurement package. If this is done, then there wouldn't be any requirement of checklist to be submitted by the IA and chances of any mismatch will automatically reduce.	PP section may be linked and integrated with AWP section	Cross check proposed to link the PIP and AWP provision.
7	Procurement Plan section	At present, it is difficult to know the quarterly procurement plan of IAs. Due to this, monitoring of physical and financial progress is not happening effectively.	A mandatory field for "Quarter" may be added. IAs may be required to select the quarter in which they are planning to float the bid document.	In proposed procurement module all Plan, Schedule and actual implementation was proposed.

No.	MIS Reference	Gaps in the Existing System	Suggested Potential Solution	Proposed MIS
8	Expenditure section	Input field for capturing expenditure is taking data in both numerical and words form. Further, system of alert is not available if the actual expenditure exceeds the budgeted amount or amount mentioned in the contract agreement.	Input field may be upgraded to capture only numerical data. Further, an alert system may be built in to notify the IA about any exceed from the budgeted/agreed amount. If required, the system should be able to generate automatic approval mechanism in such scenarios.	Cross check with Budget, Allocation proposed to check the expenditure pattern.
9	"Add Bid Document" section	Any bid document being submitted by the IA to NPMU for review or recommendations should ideally have linkage with or reference to the approved PP. At present, IAs are uploading bid documents without any linkage or reference to the PP. NPMU has requested IAs to submit bid review checklist along with corresponding bid document to check whether the bid document is complying with the PIP, AWP and PP. Significant efforts are being made to review the compliance checklist.	"Add Bid Document" section may be properly linked to the approved PP of respective IAs during up-gradation of the existing MIS system.	All Procurement document proposed to link with PP activity for tracking the stages of procurement.

4.4.2 Report on current activities

4.4.2.1 Existing team

The TAMC has established an integrated IT team for the development of the tasks required under the scope of works. Along with the development of the MIS significant additional IT development is required for the eSWIS and WRIS systems. In relation to the team initially foreseen, the TAMC team needs to be adjusted substantially to perform the required IT development.

It is proposed that the TAMC IT team shall be integrated, working simultaneously on a time-sharing basis on MIS, e-SWIS and WRIS, depending on the requirements for development of each component during different project phases.

At present the following team is involved in the MIS requirement gathering and development activities (Figure 12).

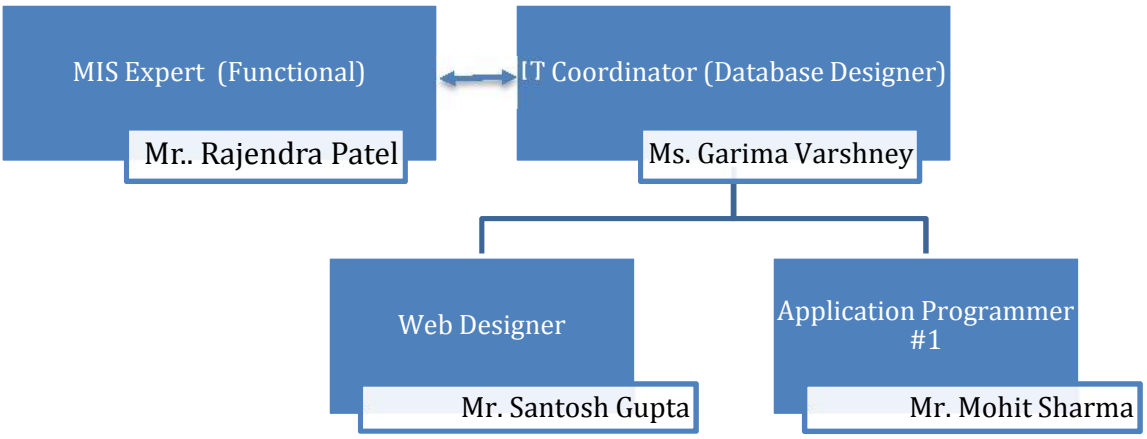


Figure 12: Current MIS Team

4.4.2.2 Activities Developed during the Inception Phase

The following activities have been developed during the Inception Phase:

1. **KT from the company which has developed the previous MIS (Net Soft)**: Knowledge transfer from the previous vendor development team to the TAMC MIS IT Team.
2. **New Domain**: Previously website running on government domain (inidwrm.org). The website has been shifted to the government domain (nhp.mowr.gov.in)
3. **Relocation of Existing Code**: Move the website code from Godaddy server to NIC Server
4. **Security Audit**: Complete the security audit of the current code and move to NIC Server.
5. **Enhancement of existing Website GUI**: Code cleaning and enhance look n feel through CSS.
6. **New Website Design**: Create new website design and replace the existing website.
7. **Maintenance of existing Website**: Resolve operational issues and improve the existing page code and validation.
8. **Set-up Infrastructure**: Install and configure the development and staging environment for MIS development.
9. **Gap Analysis**: Study of existing MIS application and analysis of Gaps against “to-be” system.

The current activities taken up are in line with user's expectations of running three parallel work streams

1. Maintenance of the current MIS application
2. User Requirement gathering and preparation of URS document
3. Development and enhancement of features/modules

For the development and enhancements of MIS application, User requirement gathering is under progress. While a team working parallel with users for gathering the user's requirement, another team is working on

- Design review of existing application
- UI-UX changes to adhere mobile responsive application requirement
- Prioritise and Development of functions to cater to immediate requirements

Figure 13 below indicates achievement and work in current activities

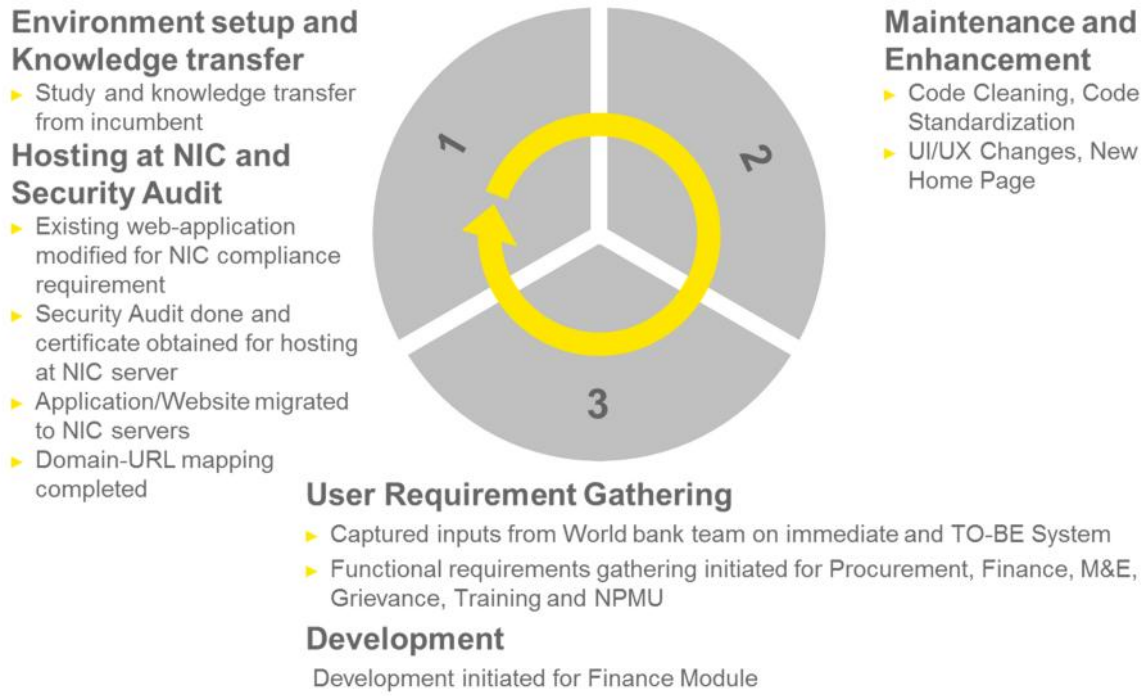


Figure 13: MIS Status of Current Activities

4.4.3 The way forward

4.4.3.1 Upcoming activities and development strategy/plan

Approach for MIS application development shall be agile development methodology customised to incorporate user's immediate needs. User specifications shall be documented and signed off. In parallel, with close interaction of users of NPMU and implementing agency, the application will be further maintained and enhanced based on priorities. Figure 14 below depicts the approach of development-

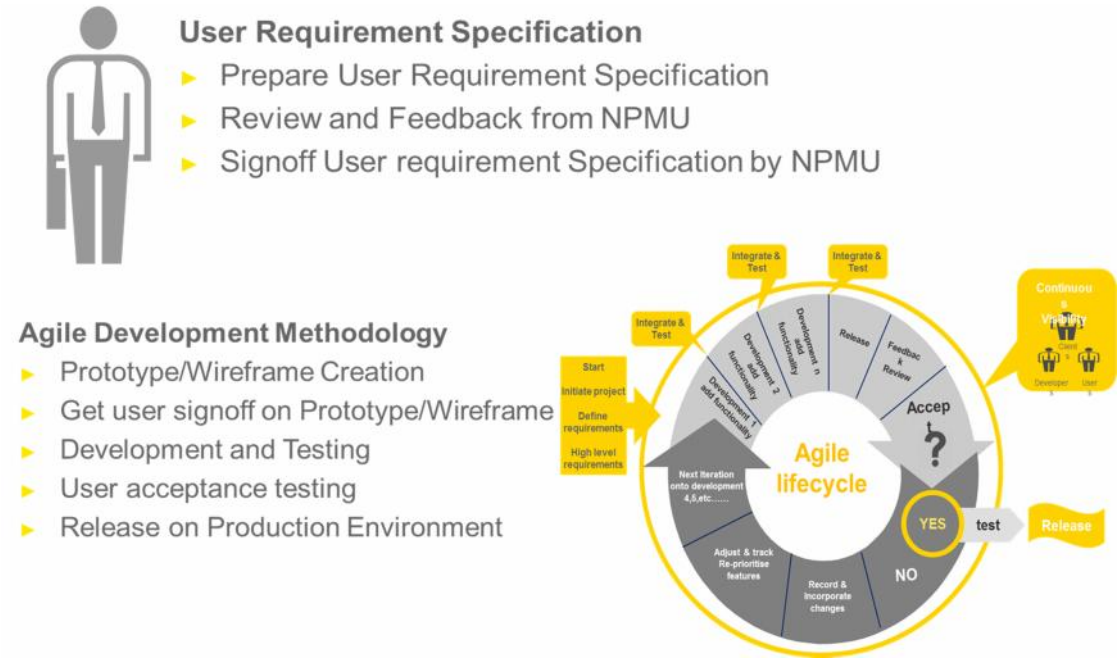


Figure 14: MIS Application Development Methodology

4.4.3.2 Key Functional Requirement

Figure 15 below depicts provides a layered view of the key functional requirements of MIS application. The financial system is central module of MIS application which form basis of capturing project implementation plan and subsequent validations.

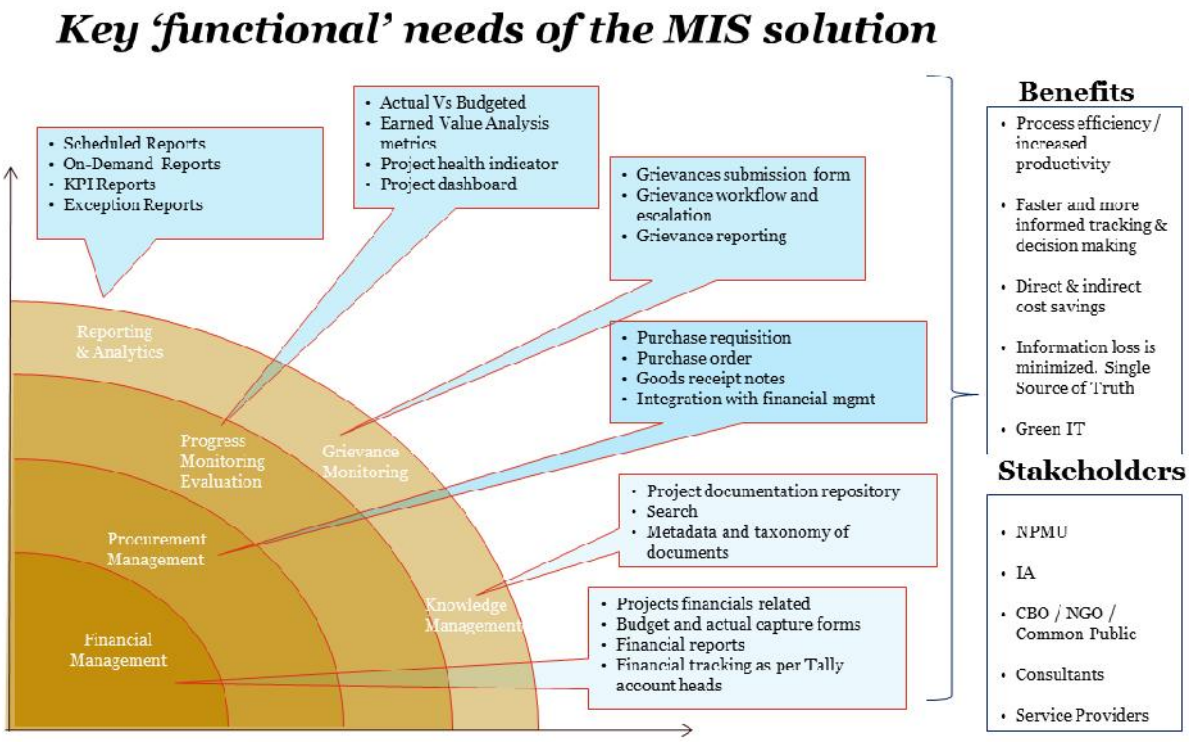


Figure 15: Key Functional Requirement of MIS Application

4.4.3.3 Proposed Functional Overview

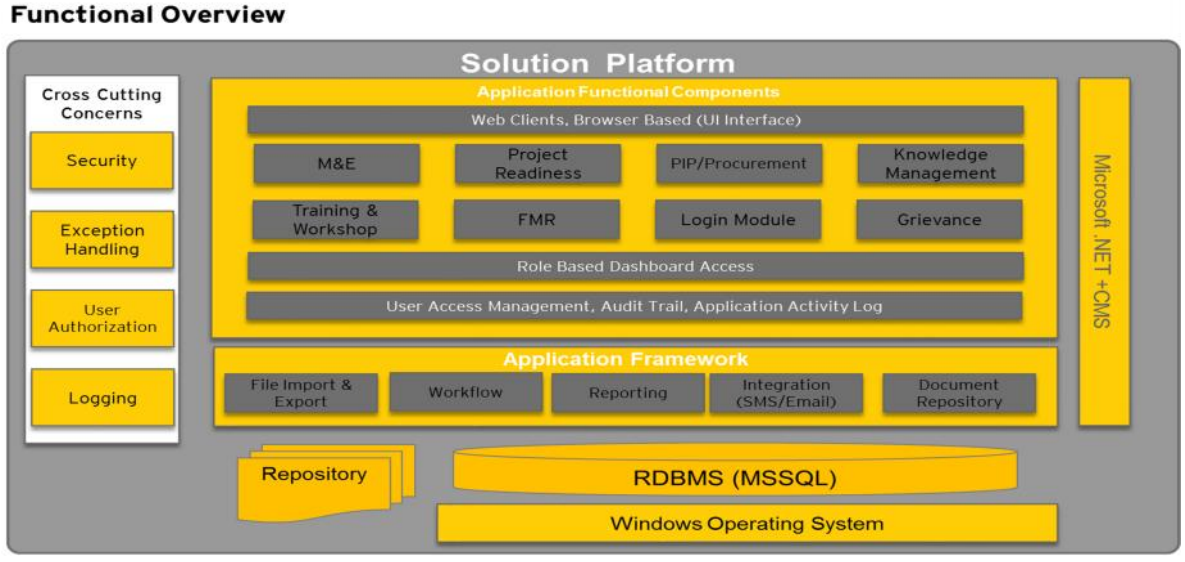


Figure 16: MIS-Functional Architecture

4.4.3.4 Proposed Solution Architecture

The proposed MIS for NHP is to be built on multi-tier enterprise components and enterprise business analytics systems. The solution would support web browser for online access, fine grained access control for user authentication and authorization, the user interface for access integration to backend application systems, service oriented infrastructure as underneath platform, reporting solution for decision support system, dashboards to different users and integration framework with other system of NHP. The proposed system is to be secured, scalable, and interoperable to meet the requirements of NHP. The NHP MIS application shall be accessible over Internet.

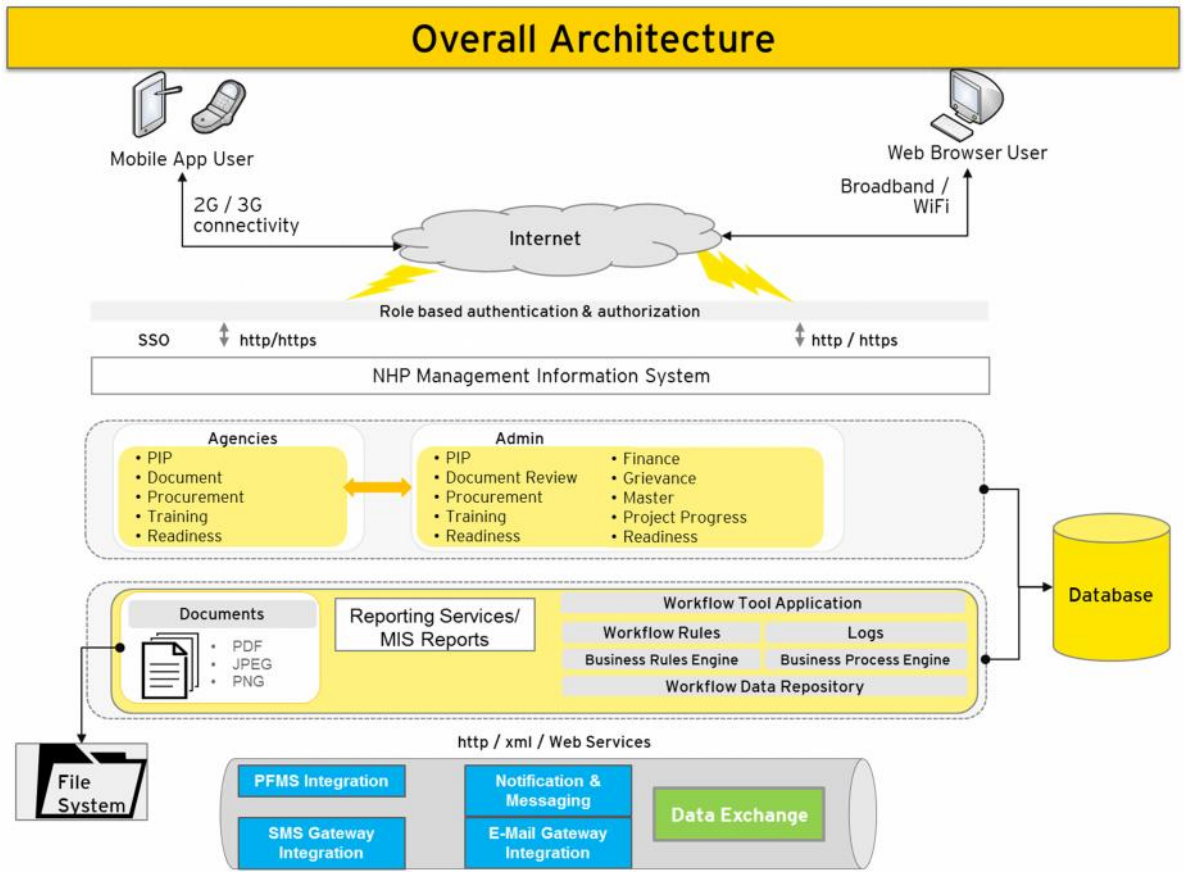


Figure 17: MIS Solution Architecture

4.4.3.5 Deployment Architecture:

The application is/planned to be hosted on NIC servers. The physical security of servers is being administered by NIC. NIC also conducts random audit of application and database security feature, and intimate for any discrepancies identified. System administration, Backups and availability and security are being managed by NIC. Figure 18 below depicts the indicative deployment architecture.

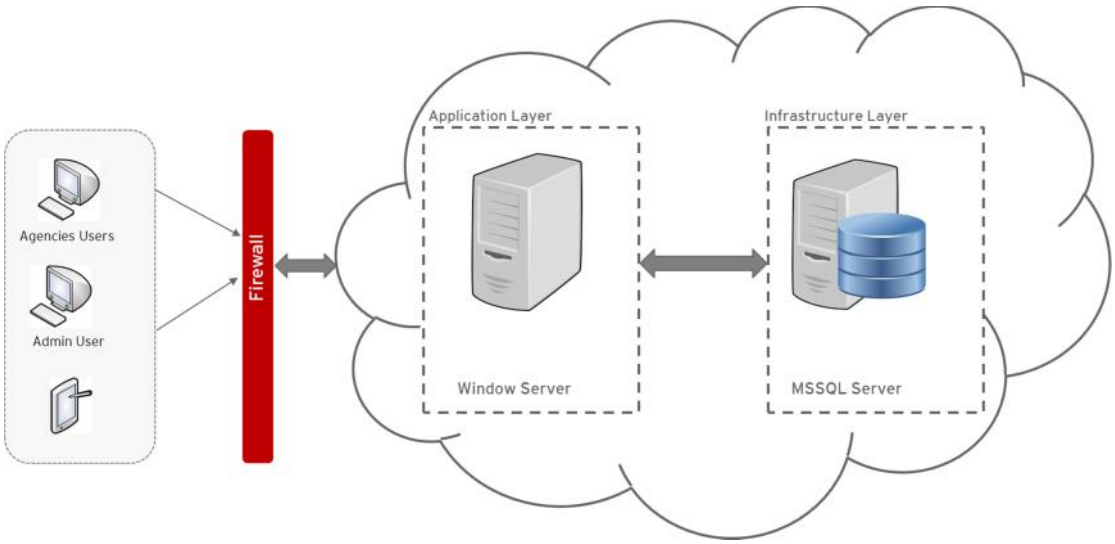


Figure 18: MIS Application Deployment Architecture

4.4.3.6 Team

Proposed team for MIS development is as below, assuming that during the period of MIS development, two programmers shall be deployed. As IT team is integrated team for MIS, e-SWIS & WRIS, remaining team members shall contribute in other applications within the scope as per project phase's requirement

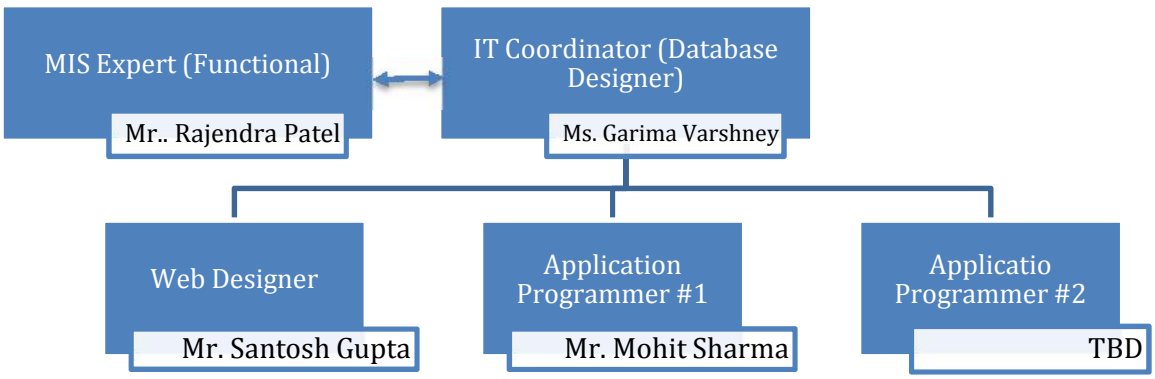


Figure 19: MIS Proposed team for Development

4.4.3.7 Work programme

The following points have been considered while creating the work plan for the MIS development:

1. The TAMC is providing support for Operations and maintenance of MIS applications, in parallel with the MIS application development activities

2. User's priorities for overall IT delivery requirements for MIS, e-SWIS, WRIS, etc.

3. Team adjustments for overall IT scope.

The detailed work programme for the project period for development and maintenance of MIS application is proposed as below,

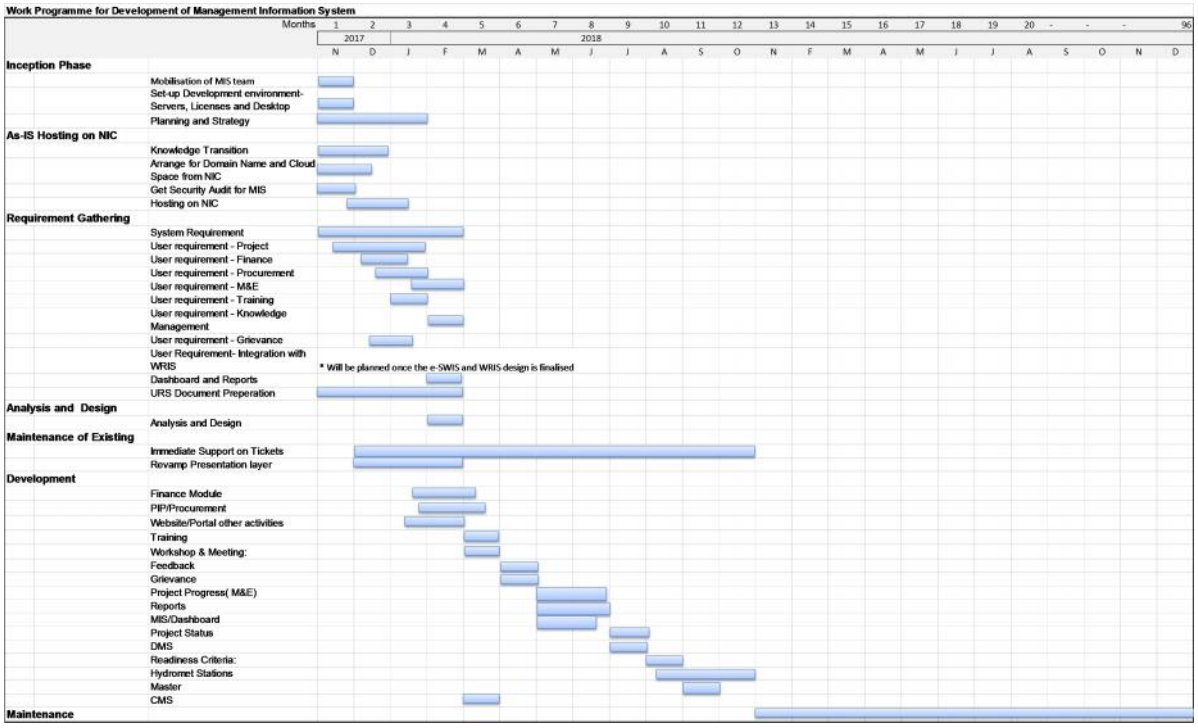


Figure 20: MIS Application Development Plan

Note: There is a slight deviation in terms of timeline from the RFP due to the considerations mentioned above.

4.5 Water Information Systems Development – eSWIS/WRIS

4.5.1 Scope of work

In the Negotiation Meeting of 8th August 2017 it was agreed that the TAMC will further develop and improve the existing water information systems eSWIS and India-WRIS. In particular the TAMC's tasks include the development of new modules under eSWIS including a module for groundwater and development of a pre-processing tool for data obtained from real time data acquisition systems (RTDAS), in accordance with the list of requirements given in Appendix I of Annexure IV of the Minutes of the Negotiation Meeting.

The TAMC shall also improve the existing India-WRIS, including the development of a new graphical user interface (GUI) and a new database structure as per Appendix II of Annexure IV of the Minutes of the Negotiation Meeting.

Table 14: eSWIS-WRIS Deliverables agreed in the Negotiation Meeting

Deliverables	Timeline (months)
Review and improvement for automatic data acquisition system. Review of eSWIS, eGEMS & eWQIS. Development of new modules under eSWIS and user friendly dashboard as per Appendix I.	T + 18
Switching India-WRIS to latest platform a. Development of new GUI of India-WRIS, dash board using Java Script and HTML, or any other latest technology including advance tools such as morphometric parameter b. Design and development of new database structure for WRP database of WRIS c. Multi-layer and multiple attribute query Further details as per Appendix II.	T + 30

It is important to note that the task of further developing and improving the two information systems eSWIS and India-WRIS not just includes the development of new features but implies a profound restructuring and integration of both systems. This is required for several reasons:

- Need to create the basis for system growth
- Ease of maintenance and addition of new modules with a medium/long term perspective (need for clear technology stack, avoiding duplications of data entry and data storage, etc.)
- Significant increase expected in data volume, number of users (unknown capabilities and technical devices) and use intensity
- Development of a distributed system necessary for assuming a greater work load, both in terms of number of users and required resources
- Need for integration with third party systems, in particular State-WRIS

It is equally important to note that the TAMC team is not in charge of the operation of the existing systems eSWIS, WRIS and GEMS.

4.5.2 Report on current activities

4.5.2.1 Existing team

The development of eSWIS and India-WRIS was not initially foreseen in the Request for Proposal. During the Negotiation Meeting it was agreed that the TAMC should assume this task but no adjustment of the proposed team was made at this stage. The TAMC started activities with an IT team similar to the one in the proposal (see Figure 21). However, a significant adjustment of the IT team is required in order to be able to address the needs for the development of eSWIS and WRIS. A proposal for this adjustment is presented in 4.5.3.4.

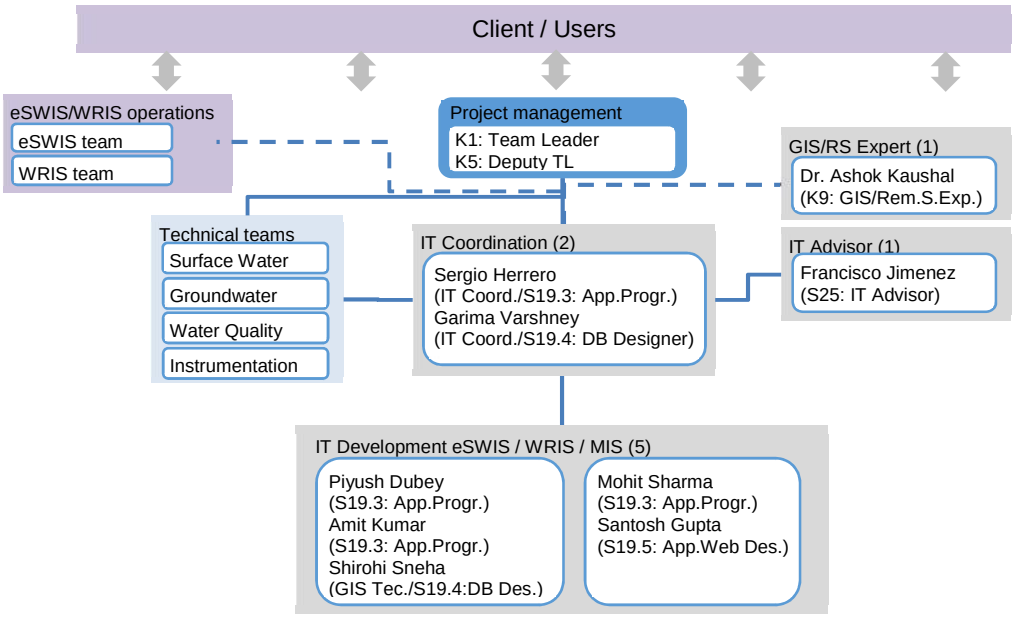


Figure 21: Current IT team

4.5.2.2 Activities developed during the inception phase

During the Inception Phase the IT team has developed the following activities:

- Initial analysis of existing systems, including both in terms of IT infrastructure and user requirements
- Load tests and performance testing of existing system (eSWIS)
- Proof of concept of used technologies for developing a distributed system based on the existing technologies (in particular PostgreSQL, Spring Framework)
- Proof of concept of user interface based on Primefaces (planned technology for GUI to be implemented)

- Identification of existing problems in terms of system performance, expected future growth of data volume and number of users, and preparedness for future development and integration
- Identification of user requirements and start of development of user requirements specification (URS)
- Definition of to-be system (functional architecture and integration architecture)
- Initial definition of technology stack
- Definition of development methodology
- Activity planning (including planning for eSWIS-WRIS-RTDAS integration), considering different development phases
- Identification of priorities for future development (see phases presented below)
- Definition of required hardware architecture for development and testing environment

The reports on the performance testing performed, the Proof of Concept (PoC) of PostgreSQL for high availability architecture and the required hardware architecture for the development and testing environment are presented as Appendices to this report.

4.5.3 The way forward

The following fundamental considerations concerning the approach for the future development of eSWIS and WRIS have been established:

- Use existing components wherever possible to reduce overall timeframes for the completion of the project without compromising the overall objective
- Enhance existing components with incremental approach towards to-be system
- All enhancements/new developments should be done in accordance with system development plan
- Use open source wherever possible, use/maintain proprietary components where necessary/appropriate

In order to understand the proposed development path, the following sections aim to explain the initial circumstances of the systems seen from the IT side, as well as the identified difficulties and needs, and justify the solution proposed.

The following systems have been considered: eSWIS, WRIS, GEMS (specifically for groundwater module to be developed under eSWIS)

4.5.3.1 Analysis of current IT systems

Current eSWIS technology stack and architecture

The existing eSWIS consists of four main modules: Data Entry module, Secondary Validation module, Flood Forecast module and Data Dissemination module.

The eSWIS Data Entry and Data Validation modules are currently implemented using a 4-layer web application model:

- Data Layer (PostgreSQL and PostGIS)
- Data Access Layer (Hibernate ORM. Data services exposed through Spring MVC Dependency Injection)
- Domain Layer (Spring MVC, part of the domain logic is exposed through web services)
- Front End Layer (GWT)

The eSWIS data dissemination module is implemented through Open-CMS with some custom modules to access data from the other two modules through web services.

Reports and statistics generation are handled manually in the domain layer on demand. Documents are generated through a mix of JasperReports and POI. Logging is handled through Tomcat's log4j. Graph generation is handled by jFreeCharts at server side.

Identified non-functional eSWIS issues

The following problems and non-functionalities of the existing eSWIS system have been identified:

- Application overloads during labour intensive processes (importing, report generation), slowing down or hanging up.
- Limited client internet access hinders proper user experience
- Front End overloads client's browser due to being heavy-weight (GWT)
- Some of the components are out of date or partially deprecated as part of the natural lifecycle of software components (GWT)
- Horizontal scalability requires replication of the whole application

Identified limits to integrating eSWIS

Several limitations regarding the integration of eSWIS have been identified:

- Part of the domain logic is not currently available through the integration platform (Spring MVC) due to being located on the Front End Layer, and may require some refactoring to successfully expose all the logic as services.
- GWT doesn't integrate easily with other Front End frameworks.
- Proposed to-be system is considering SOA scalability to improve integration capabilities. Spring MVC does not support it fully.
- Part of the functionality is replicated in the other applications.

Current WRIS Technology Stack and Architecture

WRIS consists of a single composite application, split on 4 main components:

- Data layer (Oracle)
- Data access / Back End layer (ArcSDE, ArcGIS Server)
- Front End layer (Flex, ArcGIS API for Flex).
- Web Service layer (several technologies, including PHP, Java and .NET) – used for communications with third party servers.

Identified non-functional WRIS issues

The following problems and non-functionalities of the existing India-WRIS system have been identified:

- Low performance due to high client-side demand (Flash/Flex)
- Lack of appropriate functionality to update the data in the system.
- One of the technological components in use (Flex) is currently deprecated and unsupported by the vendor.
- Non-standardized web service formats and development

Identified limits to integrating WRIS

In terms of system integration the main limitations of India-WRIS are:

- Flex offers integration through RESTful and SOAP web services, but due to its deprecation requires a full rebuild.

- Domain logic is tightly coupled with data access and front end modules, complicating the transition to a different technology.
- Pre-existing services for data transfer could be reused, but at this point it is unknown if the data format from third parties will remain the same. Additionally, the non-standardized format of the web services presents a maintenance risk.
- Part of the functionality is replicated in the other applications.

Current GEMS Technology Stack and Architecture

The existing ground water information systems GEMS is based on the following technologies:

- GEMS is currently fully developed as a client-server application developed in VC++. Most of the logic is written in the client side, with the server side of the application mostly only handling data storage.
- Internally, GEMS contains several integrations with MapInfo to handle geographical information.
- Data storage is handled by Oracle; each CGWB office has its own independent database.
- Reporting and statistical analyses are handled through Crystal Reports and SPSS libraries.
- Several custom made graphs have been implemented starting from zero.

Identified limits to integrating GEMS

Regarding the integration of GEMS the following limitations have been identified:

- Impossibility of integrating with web applications due to desktop architecture
- Sharing data with other applications requires extensive effort (done manually in most cases through import and export tools)
- Synchronizing data among users requires a high effort and manual intervention as data storage is not unified.
- System needs to be redesigned into a web application. Business logic needs to be extracted and rewritten using a non-proprietary language and platform when possible.
- Part of the functionality is replicated in the other applications

Scalability Concerns

For all three systems there are concerns regarding the future scalability:

- Due to the scope of the project, the network traffic and number of accesses would increase several times compared to the current state.
- None of the existing systems is fit for real time data acquisition and analysis due to volume of data.

Third Party concerns that might influence design

A number of concerns exist regarding third party systems:

- States must develop their own state-side WRIS to address their own needs under TAMC guidance. These applications should be able to integrate with the main India-WRIS application.
- Some states have already started to develop their own state-side WRIS. This might conflict with the direction decided for the central WRIS, as those should in theory be based on central WRIS' directives
- New data providers and consumers may require new, unforeseen modules

Reasoning behind presented implementation

Front End

There are many reasons to rework the existing front end layers considering the problems listed above. Still, this approach requires substantial work, so further input from the client in regards to the viability of this objective is required.

- WRIS Front end is tightly coupled to the ArcGIS technology layer – if this layer is not replaced, the front end can only be migrated to ESRI's JavaScript API. Otherwise, other front end technologies can be considered. As the current implementation of WRIS is working fine and one of the fundamental considerations is code reusability, re-implementing WRIS or keeping it as is and only changing the bare minimum (Flex Front End to JavaScript ESRI API and Oracle DB engine to PostgreSQL) has to be considered carefully.
- Due to all three existing applications leaning heavily towards MVP or MVVM, it is recommended to use a front end framework that can implement those patterns for ease of transition.

- Due to latency concerns, a client-side strong front end framework based on asynchronous calls would be preferable due to low number of communications (if done right)
- Most end-client computers being generally low spec, however, points to server-side frameworks as a better option to avoid overload on the client
- Ideally, lightweight client-side frameworks like VUI.js would work best, but those provide low library support and low expertise availability, requiring much more work and specialized personnel to implement
- PrimeFaces meets these requirements and thus is the proposed technology of choice for the new modules and eSWIS. WRIS Front End will be redesigned to ESRI's JavaScript API.

Back End

- Both eSWIS and WRIS have already been designed under specific architectures that are not easily transferable to SOA and micro-services architecture, making the change a huge endeavour. Instead, a progressive approach towards hybrid Service Oriented Architecture will be implemented to handle integration and inter-process communication.
- A fully Service Oriented Architecture based on an ESB is not recommended due to the amount of complexity it would add to the development and the potential operational overhead added by the ESB.
- A pure micro-services architecture is not recommended either, as it introduces a lot of complexity and requires a full rebuild of all the existing applications in scope.
- WRIS exposes its services as ESRI Map Services. These can be integrated into the SOA application or, if WRIS backend is rebuilt, will have to be exposed through the Open Source technology of choice.
- eSWIS is designed as a pool of Dependency-Injectable services in Java, an open source language. Exposing them as web services should be generally rather simple and will be done on a need basis.
- Individual components from GEMS can be either encapsulated as-is, or rewritten as a mix of Java services and proprietary libraries and integrated, depending on preference. GEMS is not suitable for a web application, but holds a lot of water-business specific components that are not trivial to replicate with pure open source technologies.
- To simplify the maintenance of the modules and allow for continuous delivery, the usage of Spring Integration over barebones Spring Framework is suggested, as it allows easier integration of non-spring modules and distribution of services across servers. Spring integration also simplifies the generation of SOAP and REST based web services.
- WRIS Back End will remain as a collection of ESRI/ArcGIS map services, as it is functional and scalable.

Data Layer

- Currently all three systems support the main features required by a water resources database, including a varying degree of GIS support, time series support and non-spatial data.
- WRIS is more focused on the GIS support part, eSWIS is more focused on the non-spatial data, and GEMS has a mix of both.
- GEMS is not suitable for a web application database.
- WRIS GIS support requires the whole technology stack to be tightly coupled to ESRI infrastructure, which allows for a SOA based on ESRI services but locks the database schemas and frontend into ESRI's technologies.
- Neither offer support for the amount of data generated by the Automated Data Acquisition Systems, and thus a database and back end to support them would need to be built from scratch – depending on size of data.
- The conclusion is to keep eSWIS and WRIS in their native environment (PostgreSQL plus PostGIS & Oracle plus ArcGIS, and later PostgreSQL plus PostGIS and ArcGIS respectively for eSWIS and WRIS) and integrate GEMS into eSWIS and WRIS

4.5.3.2 To-Be System Architecture

4.5.3.2.1 Data flow Update Process

One of the primary goals of TAMC is the unification of the data flow across water resources information systems. This covers two main features: automated data transit between the components and removal of data duplication and unnecessary redundancy when possible.

Current State

Currently, the two main subsystems act as independent modules that do not interact with each other:

eSWIS

- Relies on manual data input, importing information from legacy applications (SWDES) and manual bulk imports from telemetry.
- Stores the data categorizing it logically in 5 differentiated partitions: GIS based data, Observed Data, Published Data, Validated Data and Modelled Data.

WRIS

- Obtains non-spatial data from manual data input and includes automatic processes to directly acquire unprocessed data from MDB dumps generated by the telemetry systems. This data is not processed nor validated in WRIS.
- Stores this data in two main logical blocks: a non-spatial tablespace to hold Hydro-meteorological data and a SDE based tablespace to hold all the rest of the data (including Spatial and non-Spatial data)

The current data flow is depicted in the following figure.

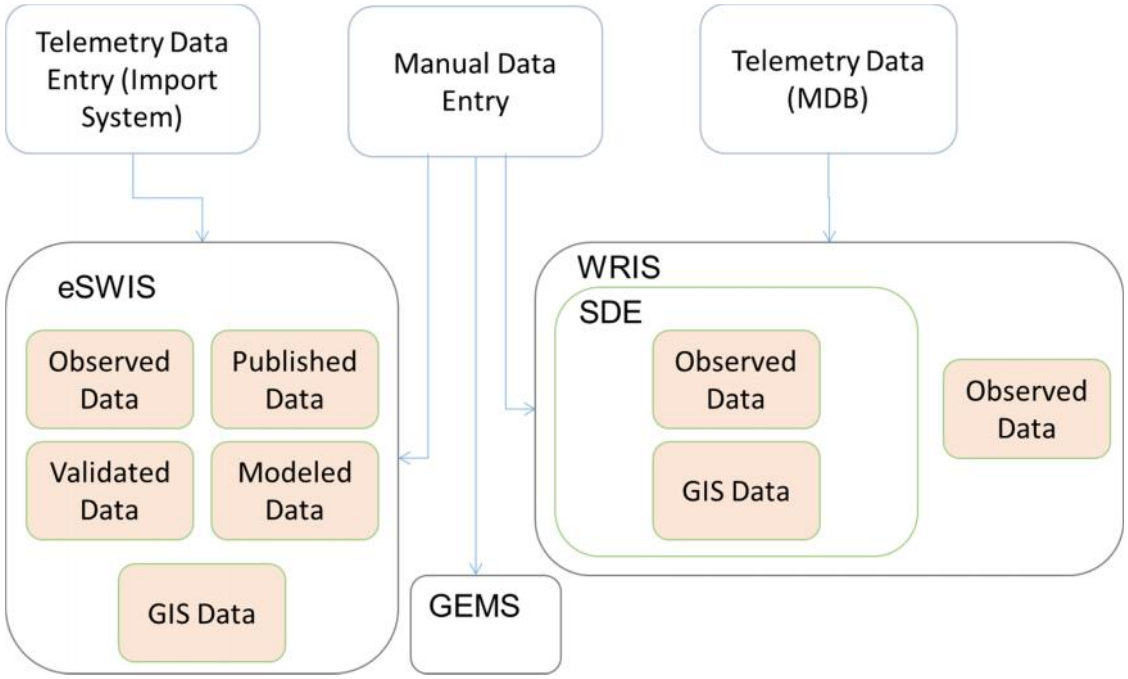


Figure 22: Current data flow

Proposed Phase 1 state

The first phase intends to minimize data duplicity between systems, ensure correct evaluation of automatically acquired data, and minimize the amount of duplicated data input required by keeping all systems automatically synchronized.

For this purpose, a number of connections and elements are introduced to the whole system:

- A Pre-Processing component is introduced to handle the storage and automated processing of RTDA from Telemetry and Ground Water. This component is designed using SQL/NoSQL technologies to handle quickly large volumes of data coming from telemetry in real time.

- A web-service based connection between the existing eSWIS component and the Pre-Processing component, by which the processed data is loaded in eSWIS as Observed Data for evaluation by experts.
- The non-SDE-based data component in WRIS is removed from the system, as it is fully duplicated in eSWIS. Instead, WRIS will request this information directly from eSWIS through web-services. To ensure proper interactivity and validity, this data will be acquired from the Published Data dataset in eSWIS.
- A secondary web-service based integration will copy the remaining, SDE-based data from eSWIS into WRIS, under the assumption that only published data will be available through WRIS. Externalizing the SDE-based data will be done in a later phase, if required.
- Non-hydrological related data, such as water demands, would remain as manual data entry through WRIS. Further subsystems to upload data either from bulk updates or third parties might be developed on a by need basis.

All web service based communications should comply with widely accepted open standards, such as WaterML 2.0 or similar.

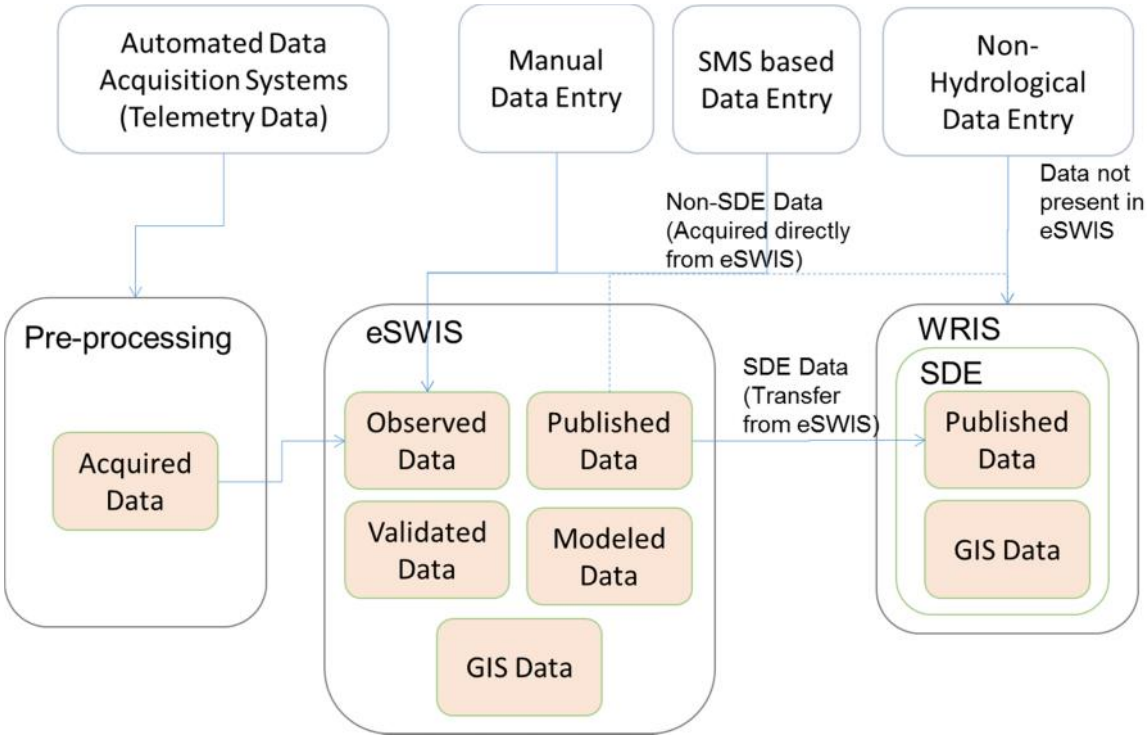


Figure 23: Proposed data flow (Phase 1)

4.5.3.3 Functional Redesign

To meet the standards required by the TAMC project, a number of components have to be developed from zero or redesigned to meet non-existing functionality, malfunctions, and non-functional limits on the existing systems.

The required work includes:

- A redesign of eSWIS physical architecture to guarantee high availability and load balancing.
- Reworking the graphic user interface for both eSWIS and WRIS to meet user experience criteria and remove COTS components when possible.
- Redefining the existing software architecture to meet SOA standards.
- Implementing the pre-processing subsystem to gather and evaluate real time data acquisition.
- Implementing the Ground Water module and the extension to the Water Quality module.

Phase 1

The following changes will be implemented in order to accomplish Phase 1 goals:

1. Pre-processing: A fully new component will be designed to store, decrypt and do initial processing of RTDAS data. The tentative technology stack is based on Java. Pre-Processing Data will be made available through web services.
2. Architecture integration (See data flow process update above): A new web service based component will be included in eSWIS to expose data to WRIS and to pre-processing. Spring Integration or similar integration framework will be used to provide this support with minimum effort.
3. Removal of non-SD tablespace from WRIS
4. Design and implementation of Ground Water Module and Water Quality Module
5. High availability and load balancing of eSWIS:
    a. eSWIS Database server will be configured in master/stand-by configuration with pgPool-II and streaming replication.
    b. eSWIS application server will be replicated and configured for load balancing through a web server with Apache
    c. New eSWIS web services server component will be replicated and configured for load balancing through the above web server
    d. eSWIS web server itself will be configured for high availability through enterprise switch and virtual IP
6. eSWIS graphic interface will be redesigned (tentative GUI Framework: PrimeFaces) to address concerns of usability and performance / throughput. As part of the development, the data import/export interface and procedure and the graph library will be reworked to meet new needs.

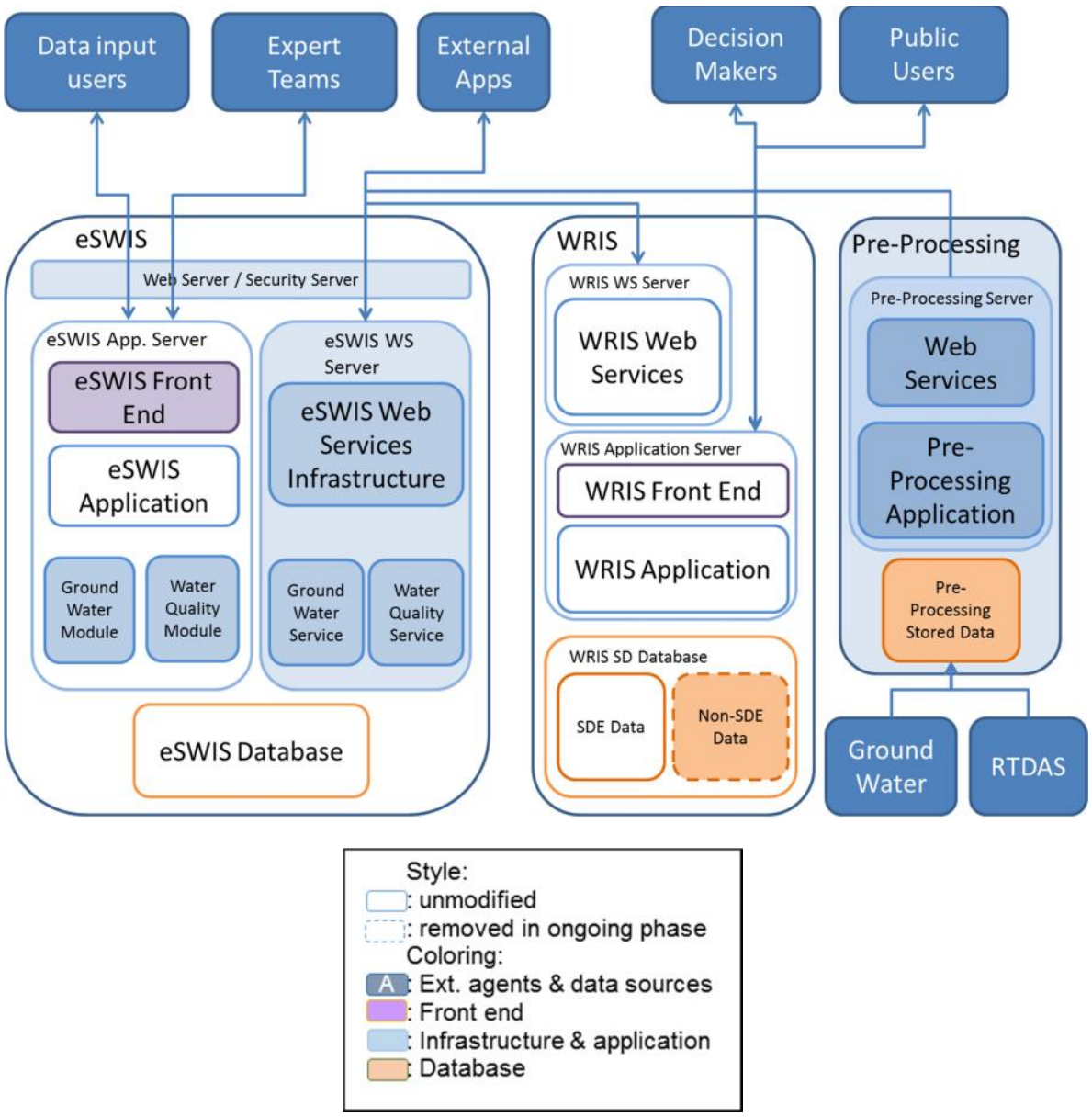


Figure 24: Phase 1 Functional Design

Phase 2

The second phase focuses on redesigning and expanding the WRIS system to meet contract requirements. To this end, WRIS user interface will be migrated from obsolete Flex technology to ESRI JavaScript technology, WRIS database will be replaced from Oracle to PostgreSQL and new modules will be implemented as per requirements.

Due to the size of the initial migration to JavaScript, the process will be started during the phase 1 with the objective to finish by the end of phase 2.

The remaining tasks, including the design of new modules and the switch of database engine will be undertaken fully during phase 2.

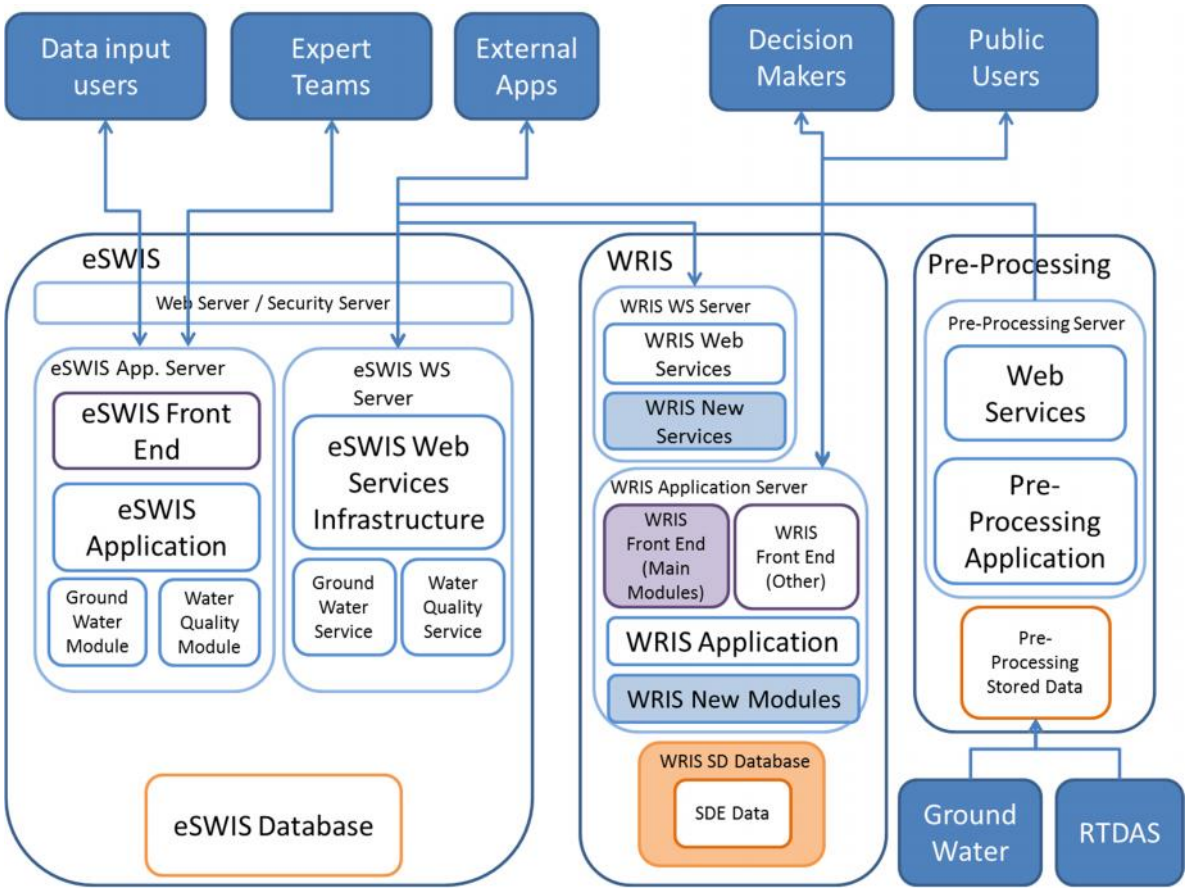


Figure *25*: Phase 2 Functional Design

Operation phase

At completion of phases 1 and 2, the requirements for further development of eSWIS/WRIS will have to be assessed. There may be a need to rework existing components of eSWIS into standalone services and integrate them in the overall SOA framework.

Also, the migration of some WRIS modules to a JavaScript based front end may continue.

Furthermore, new components may be developed in parallel under the SOA framework to meet future requirements.

It is essential that at the completion of the development phase (end of phase 2), adequate institutional arrangements are in place for ensuring operation, maintenance and further development of the system. This means that at the beginning of 2020 the National Water Informatics Centre (NWIC) needs to be in place and fully operational.

The following aspects are particularly important in this regard:

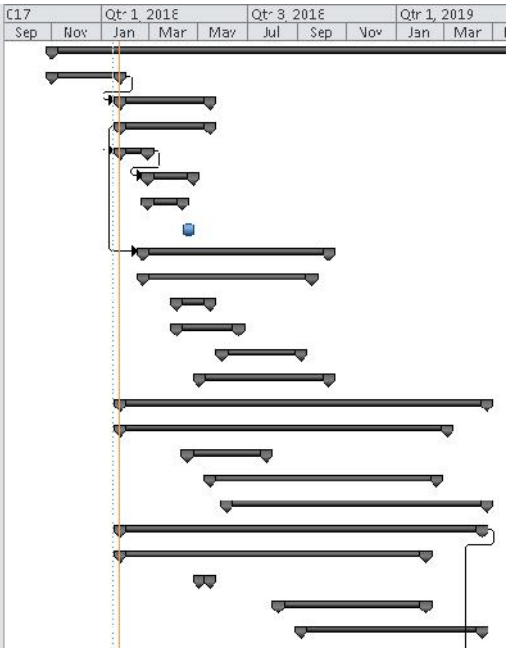
- Resources for operation and maintenance:
  Sufficient financial and personal resources for operation and maintenance are required to guarantee the sustainability of the system.
- Technical capabilities:
  The organisation in charge of system operation and maintenance requires in-house technical expertise. It should not be dependent only on external service providers.
- Staff continuity:
  Staff familiar with the technical aspects of the system needs to be retained at the completion of the development phase. In case of change of staff, sufficient overlap is required for ensuring knowledge transfer. Long term staff arrangements are recommended to avoid inefficiency and loss of knowledge through excessive staff rotation.
- Need for further system development and improvement:
  Like any information system, eSWIS/WRIS will require further development and improvement after completion of the development phase. New functional and technological needs will arise and a team has to be in place to carry out the required developments thus ensuring that the system is regularly updated and is in accordance with latest technologies.
- Close connection with stakeholders:
  The organisation in charge of system operation and maintenance (NWIC) should have a direct working relationship with the main system users (data providers and data users), in order to ensure that system operators and developers are always aware of the functional requirements and eventual operational problems.

4.5.3.4 Work programme and team

As explained above, a 2-phase approach is proposed to subsequently improve the existing water information systems and arrive at the desired final solution. The consultant plans to develop the required activities in accordance with the following work programme.

Phase 1

	Name	Duration	Start	Finish
1	WISTAMC	247 wks	01/11/17	26/07/22
2	Planning&Stategy	12 wks	01/11/17	23/01/18
4	Framework Requirements	16 wks	24/01/18	15/05/18
5	Business Requirements	16 wks	24/01/18	15/05/18
9	System Requirements	5 wks	24/01/18	27/02/18
15	System Architecture	8 wks	28/02/18	24/04/18
16	Software Architecture	6 wks	20/02/10	10/04/10
19	Hardware Arch tecture	2 wks	11/04/13	24/04/18
20	Telemetry Data Adquisition	33 wks	21/02/18	09/10/18
21	Software	30 wks	21/02/18	18/09/18
37	Hardware	6 wks	04/04/18	15/05/18
41	Database	11 wks	04/04/18	19/06/18
48	Deployment	14 wks	30/05/18	04/09/18
52	Testing	23 wks	02/05/18	09/10/18
59	eSWIS Improvement	65 wks	24/01/18	23/04/19
60	Software	58 wks	24/01/18	05/03/19
85	Database	14 wks	18/04/18	24/07/18
89	Deployment	40 wks	16/05/18	19/02/19
93	Testing	46 wks	06/06/18	23/04/19
100	WRIS Integration	64 wks	24/01/18	16/04/19
101	Software	54 wks	24/01/18	05/02/19
116	Hardware	2 wks	02/05/18	15/05/18
119	Deployment	26 wks	08/08/18	05/02/19
125	Testing	32 wks	05/09/18	16/04/19



Phase 2

	Name	Duration	Start	Finish
130	WRIS Improvement	58 wks	17/04/19	21/04/20
131	Software	47 wks	17/04/19	10/03/20
146	Database	14 wks	22/05/19	27/08/19
150	Deployment	31 wks	10/07/19	11/02/20
154	Testing	40 wks	17/07/19	21/04/20
161	User Acceptance Testing and Production Deployment	94 wks	10/10/10	20/07/20
166	Capacity Building	88 wks	05/12/18	11/08/20
169	Maintenance	104 wks	29/07/20	26/07/22

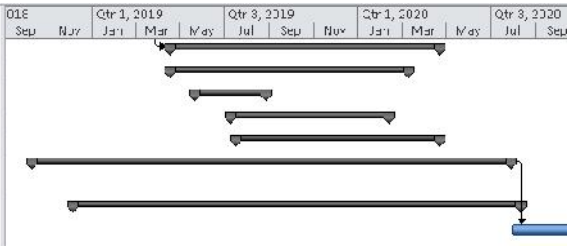


Figure 26: Work programme for eSWIS, WRIS and Telemetry Data Acquisition development

The complete work programme including all activities is presented in Appendix 6 of this report.

For the implementation of this work programme a total team of one IT consultant, one software architect, 18 developers and one tester for a period of 24-30 months has been considered. The total required resources are estimated at 463 man-months.

Table 15: Estimated resource requirements for eSWIS-WRIS development

Activity \ Profile	IT Consultant (1)	Software Architect (1)	Developer general (6)	Developer eSWIS (4)	Developer WRIS (8)	Tester	Total
1. Framework Requirements	2						2
2. System Architecture	2	2					4
3. Telemetry Data Acquisition	4	5	30			6	45
4. eSWIS Improvement	10	9	26	52		6	103
5. WRIS Integration	5	3			94	4	106
6. WRIS Improvement	6	9	58	40	82	10	205
Total	29	28	114	92	176	26	465

Considering also the staff requirements for the development of additional modules for the project MIS system and the IT Hardware and Software Advisor, the total staff requirements for the IT development (including eSWIS, WRIS, Telemetry Data Acquisition and the MIS system) are estimated as follows:

Table 16: Estimated staff requirements for eSWIS, WRIS and MIS development

Profile	Number of staff			Man-months		
	eSWIS-WRIS	MIS	Total	eSWIS-WRIS	MIS	Total
IT Advisor	1	--	1	30	--	30
IT Consultant	1	1	2	29	30	59
Software Architect	1	--	1	28		28
MIS Expert	--	1	1	--	30	30
Developers (Application Programmer, DB Designer, Application Web Designer)	18	3	21	382	90	472
Tester	1	--	1	26	--	26
Total	22	5	27	495	150	645

These IT staff requirements (required for a period of 24-30 months) are significantly larger than the numbers originally foreseen in the RFP.

Table 17: IT staff requirements according to the RFP

Profile	Number of staff	Man-months
IT Advisor	--	--
MIS Expert	1	30
Application Development Expert	1	30
Application Programmer	1	30
Database Designer	1	30
Application Web Designer	1	30
Total	4	150

The IT team thus needs to be increased significantly for doing the required IT development in the stipulated time frame.

As regards organisational structure, the following team is proposed for the development of the future water information system (positions in red still to be filled).

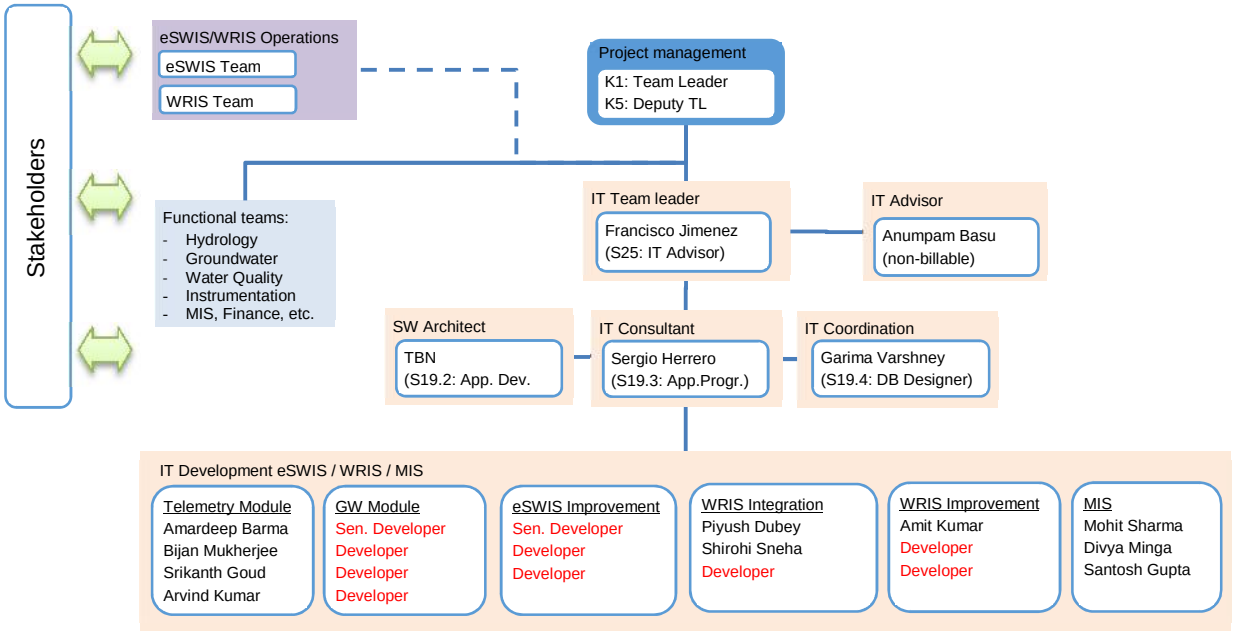


Figure 27: Proposed IT team for eSWIS, WRIS and MIS development (Phases 1 and 2)

4.6 Technical Advice and Support

4.6.1 Flood forecasting

The consultants have familiarized themselves with the existing flood operation system in India and they are actively contributing to the process of streamlining the tender documentation for the Flood Early Warning System (FEWS) that was released in December of 2017. The summary of findings and current recommendations is listed below.

The Government of India (GoI) currently uses a simple flood warning system which relies on the use of regression between water levels at an upstream and a downstream station on the same river, while also taking into account the average time travel between the two stations. This system has so far been reasonably accurate with the correlations between the forecasted and realized water levels of over 0.8. Although simplistic in nature, this approach is limited to instances where the base reference station and the flood forecasting station are in close proximity, thus limiting the forecasts to short lead time periods.

To enable longer lead time forecasts, and to also link forecasts further into the future by using weather forecasts provided by India Meteorological Department (IMD), the GoI has initiated efforts to set up and run hydrodynamic models as a basis for the current and future flood forecasting system. The existing approach uses the previous 7 days of rainfall combined with the weather forecast for 3 days of future rainfall forecasts that are obtained from IMD. Several issues have been identified that require attention in an effort to improve the existing flood forecasting system used by CWC:

- The current hydrologic/hydrodynamic models used as part of the flood forecasting procedure have not been calibrated using historic rainfall and runoff data. This reduces their accuracy and reliability for forecasting future events.
- The reliability of weather forecasts with respect to their historical realization has not been assessed. This should be assessed and improved if possible.
- The current modelling process is not connected to the real time eSWIS database to include data from automatic rainfall gauges and hydrometric stations. It is essential to establish this connection such that the existing basin conditions can be used to match the updated information in the basin with the initial conditions for each subsequent model run.
- The size and nature of Ganga River and its tributaries is a challenge to model using 1D hydrodynamic modelling environment due to numerous braids. The need for 2D modelling has been established. However, it is also recognized that the use of 2D modelling may not be suitable for Early Flood Warning Systems due to a significant computational effort that may require between 12 and 24 hours for a single system solution. A flexible mesh and combined 1D-2D modelling may help reduce the execution times, as well as the use of multi-processor workstations; however there is no guarantee that these measures can bring down the execution times within a reasonable

level to warrant the use of a 2D model in real time forecasting. It is therefore imperative to create flood maps for various return flow periods and develop a statistical relationship between the upstream inflows and basin rainfall, on the one hand, and the resulting flooded areas on the other. Also, there is a need to address the breach of flood protection dykes and assess how the existing gates on the dukes should be operated to reduce the likelihood of future dyke failures.

- The importance of being able to gain real time access to rainfall and especially flow conditions in Nepal for the purpose of flood forecasting has been established. Flood studies on the Ganga's northern tributaries should investigate the best way to secure and incorporate this information into the future FEWS.

Following the initial evaluation and discussions with the client, CWC, the World Bank officials and other stakeholders, it was decided to restructure the upcoming Terms of Reference to reflect the above mentioned needs for future developments and improvements. The General requirements to be met from this project are broadly divided in three phases as follows:

Task I - Verification of the Currently Used Rainfall Data

The existing modelling practice relies on the use of areal precipitation estimates obtained via remote sensing data received from TRMM and GPM satellite platforms. This practice needs to be tested against the existing network of rainfall gauges on the ground, so as to determine the reliability and accuracy of the input obtained via remote sensing. Literature surveys show that the rainfall estimation through satellites often does not reveal the actual peak quantity particularly during heavy rainfall events. The ToR will include a selection of up to 100 rainfall gauges which are to be included in this analysis, along with the concurrent historic period for which both the sets of data (satellite and ground-based in-situ observations) are available and establish the reliability of the rainfall estimates that are currently used in the existing flood forecasting.

Task II – Hydrologic Analyses of Historic Flows

The goal of this assignment is to validate and process historic data for selected hydrometric series so as to create design flood hydrographs for return flow periods of 2, 5, 10, 25, 50, 100, 200 and 500 years for selected flow recording stations on the Ganga river and its tributaries for the following stations. The initial ToR requested that the flood plain maps for various return flow periods be developed and stored in the database. It did not include the work on processing hydrologic data required to eventually achieve that goal. This step will include naturalization of flows, which will also provide input data for IWRM and other future studies, frequency analyses, design hydrographs and hydrodynamic modelling

Task III – Development of Early Flood Warning System

The Government of India (GoI) wants to introduce a modern early flood warning system that relies on database and modelling tools that can be accessed and updated in real time. Due to the complexity of Ganga river basin, the current state of the art of hardware and software may render this goal infeasible, and the ultimate solution may rely on a statistical relationship that

can be developed for a range of 2D solutions between inputs (upstream inflows and precipitation) and the downstream flooded areas. The purpose of the proposed FEWS is to save lives by providing early flood warnings in a timely manner using web sites that are accessible by mobile phone applications. To achieve this, several issues must be addressed:

The successful bidder should develop a dashboard utility to ease communication with the database and the selected modelling tool in each direction (i.e. in reading from the database and saving relevant results in it). To dynamically alter the input data points that change in real time on a daily basis. This utility would re-write those sections of the input data files for the selected modelling tool that change on a daily basis. Hence, the goal is to simulate the process of fetching the real time data from the e-SWIS database that would eventually be available. The client's consultants will assist in providing the utility to download the flows and precipitation series from the existing database for the desired period and time step length.

Investigate solution times for 2D models and options for their reduction using flexible mesh and/or work stations with parallel processing capabilities. Provide a summary technical report on the ways to improve model run times for 2D simulation runs of the project area of interest (Ganga river and its tributaries from Varanasi to Farakka) and make conclusions regarding its applicability for real time modelling.

Team members of the TAMC and the CWC jointly visited the North-East Space Application Centre (NESAC), part of the Indian Space Research Organization (ISRO), in their Shillong office between January 3rd and 5th to discuss the development of the flood forecasting model for the Brahmaputra basin. The model which is currently being developed by NESAC by NESAC includes a two-pronged approach to calibrate the rainfall-runoff model, on the one hand, and to improve the weather forecasts. NESAC has created its own weather forecasting model that runs on an in-house supercomputer independently from the weather forecasting conducted by IMD.

This makes it possible to use both NESAC or IMD's forecasts, or their combination if possible. This meeting resulted in an agreement for future collaboration between CWC and NESAC on the development and use of the flood forecasting model for the Brahmaputra basin. The NESAC staff will present the results of their modelling to CWC for their review and approval. The TAMC team will continue to be involved in this process.

4.6.2 Integrated Water Resources Management (IWRM)

Technical assistance on IWRM could not be provided as part of the tendering process which has preceded the mobilization of the consultants and initiation of the project. However, a request to comment on the evaluation criteria was posed, and the consulting team came up with a set of recommendations and guidelines that could be used on future tenders. Those were forwarded to the client. Among else, they include:

General Objectives. In the context of water scarcity the main objective of a River Basin Management Plan is to quantify available resources, estimate water demand, establish water balances and make a proposal for the allocation of water quantities to users.

Assessment of Water Demands. The proponent should be able to demonstrate how water demands will be estimated, both the current and those projected for future time periods 10 or 20 years from now. This is a critical topic given that there is very little information on the actual water use.

Proponents should propose the establishment of water use priorities based on the existing government policies (legal framework), or if those do not exist, the proponent should propose a methodology to establish them.

Deficit sharing policies should also be proposed and tested using the proponent's modelling tools. Stakeholders' negotiations usually involve mutual investigations of multiple modelling scenarios to gain insight how their future needs affect others.

Water Supply. Several issues should be addressed:

Assessment of input data development and criteria for selection of the appropriate river basin model, including establishment of the criteria for model selection.

Assessment of need for additional river infrastructure. The proponent should evaluate future deficits in supply in view of the available resources, climate change impacts, and growing water demands.

infrastructure development options (assessment of the most suitable storage site and the optimum live storage for each site to minimize future deficits).

Interaction between Ground Water and Surface Water. Large amount of water is pumped from aquifers every year for irrigation supply. This may impact the ground water tables in the long term, and in turn reduce river flows in the dry season which originate from aquifer drainage. Proponents should propose a way to assess long term impacts of increased use of ground water for irrigation as part of the overall basin assessment for 10 or 20 years ahead. This should involve coupled surface and ground water management modelling.

Water Quality. Current trends in water quality constituents should be identified and measures to address possible issues now and the future should be addressed in the tender documentation.

Institutional Development. The consultation and coordination of stakeholders is essential for the success of IWRM. A good IWRM proposal should also address the current level of institutional capacity and identify requirements for capacity building to enable realization of the proposed IWRM plan.

Water Accounting normally forms part of river basin studies that match the available water supply with the existing or future demands. Early water accounting models required that the

users build in specific allocation rules at times when there was not enough water in the system to satisfy the needs of every stakeholder. Recent versions of water accounting models include various deficit sharing options that are either rule based or derived by mathematical optimization. They are the basis for developing modelling scenarios that investigate various reservoir operating policies and drought management plans. The adopted river basin plan is usually the result of stakeholders' negotiations that involved joint inspection of a range of river basin modelling scenarios. Water accounting studies require the development of naturalized flow records over historic period with available flow and water levels data, which are matched with the current level of infrastructure development (dams and canals), and the current or future levels of water use estimates. Seasonal operating rules for reservoirs are first derived by using historic data. They are then applied in real time if and when the seasonal forecasts become available.

The tender document for Extended Hydrologic Prediction has be reviewed. There is a lot of overlap in this tender with the pervious FEWS tender, which should be removed. The EHP project should focus on the management of droughts, and it should address the development and implementation of the reservoir operating rules for this purpose. A revision of the EHP tender documentation will continue as soon as the next draft of FEWS document is re-submitted to the client for additional evaluation.

Integrated Water Resources Management should include all aspects of FEWS, EHP, application of suggested reservoir operating rules and water demand management that had previously been inspected and adopted as part of a River Basin Plan.

4.6.3 Purpose Driven Support (PDS)

Under the National Hydrology Project, it is planned to further improve and expand the water resources monitoring system, strengthen water resources operation and planning systems, and enhance institutional capacity for water resources management. For this purpose, it is envisaged to provide support to the selected purpose driven support initiatives proposed by the implementing agencies with partnership from academic institutions/ research organisations of repute. It is anticipated to build up institutional capacity for evidence-based decision making in water resources planning and operational management at the basin scale across India using the latest technology and tools.

The TAMC is expected to support the programme by providing advice on PDS design (on request), participating in technical review of the studies, and providing technical input, suggestions and guidance to the PDS lead investigators on request and at the periodic progress review events. Under this activity, about 30 proposals were received from different state government departments. They would be reviewed by the TAMC before the final decisions about their selection are made by the CWC. A list of the proposals received by the TAMC at the stage of the inception is shown in Appendix 7.

4.7 Awareness Raising, Capacity Building and Training

4.7.1 Scope of work

The scope of work under awareness raising, capacity building and training includes:

- Developing project promotional material including posters, handouts etc. regarding the project as well as development materials for promoting water resources planning, benefits of hydrological information system, management of water resources using river basin approach and principles and IWRM for wider circulation.
- Conducting awareness campaigns including workshops, consultative meetings with HDUGs, celebration of World Water Day, etc.
- Developing an appropriate record of project implementation (including filmed interviews) for a documentary film of the project for promoting awareness
- Providing support and technical materials to assist efforts by IAs to improve communications with stakeholders concerning the project objectives and its outcomes

The TAMC is envisaged to provide advice and support to improve delivery of the programme. Along with the institute/institutes entrusted with the responsibility for management of majority of the capacity-building programme, the TAMC is expected to:

- Work with the institute/institutes to support development of a coordinated training needs assessment every two year during the project implementation phase
- Support the institute/institutes to prepare annual training calendar with the IAs to meet training needs, including providing information about training opportunities internationally
- Develop a system for reporting and assessing training programmes, and monitor training through annual reporting in the MIS
- Support the IAs wishing to develop links with local research institutes and advise on collaborative arrangements, on request
- Coordinate with all International Training & Study-tour and support NPMU and IAs in getting adequate administrative and technical clearance

The terms of reference covers this aspect under the Component D: Institutional Capacity Enhancement. It envisages to build capacity for knowledge-based water resources management, through providing support for establishing water resources knowledge centres, professional development, project management and operations. The water resources knowledge centres are expected to support the establishment or strengthening of ‘centres of excellence’ in order to develop expertise and a pool of experts and to ensure that the knowledge, tools and innovations developed under the project are implemented for the purpose of improved water resources management. Among other identified tasks, developing

partnerships with national and international institutes, establishing communities of practice, providing internships and arranging visiting expert programs, launching training and workshops for knowledge exchange and professional networking, and facilitating hackathons to develop innovative water applications are also part of the project. It is also planned to have outreach and awareness program to showcase NHP to a broad audience, both the specific target audiences such as local communities in irrigated or flood prone areas, and the public at large.

4.7.2 Report on current activities

The current activities of the team on capacity building have been discussed under the following sub-sections.

4.7.2.1 Existing team

The current TAMC comprises a team of highly qualified experts with a large national and international experience in the water sector and other related fields. Centred on the expert on capacity building, the capacity building activity will enrich from the experience of experts from all the different fields, drawing on their experiences in the water sector. The chart of the team primarily envisaged to provide support for the capacity building activities is furnished underneath. It is envisaged to draw help from the recognised partner institute for training and also other national/international organisations of repute following the specific training needs as they develop.

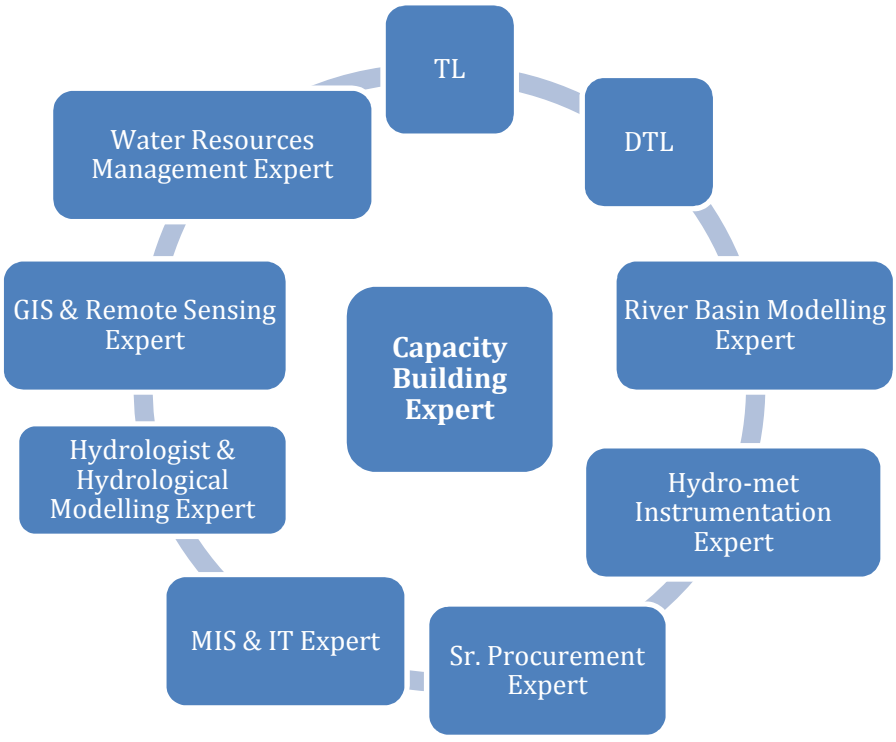


Figure 28: Team members participating in capacity building

4.7.2.2 Activities developed during the inception phase

During the inception phase it has been attempted to prepare a roadmap of capacity building for the year ahead. It was proposed to develop plans for future years accommodating the needs/shortcomings faced during the first year of implementation, as received through feedbacks of the training programmes.

Gap analysis

It could be understood that the training programmes in the earlier projects (HP – I and HP – II) were evolved with the core strength of the available faculty for providing the training in consideration. Relying on the strength and capacity of the scientists in the National Institute of Hydrology and the Central Water Commission, these were a big success, being able to disseminate the requisite information and impart the essential skills to the staff of the implementing agencies associated with the project. However, the lateral spread of these projects was much smaller compared to that of the National Hydrology Project, which is aimed to cover the entire country. So, the implementing agencies in the newly participating states need more focussed assistance.

Current status of project implementation

Keeping the above points in view, an introductory meeting with the Training Coordinator of the National Institute of Hydrology, Roorkee, the training associates over the last two projects, was conducted on 2nd January, 2018 to discuss about the lessons learnt and the possibilities of improvement. As a follow up, questionnaire about the training needs has been prepared and sent to all the implementing agencies on 9th January 2018. Moving away from the current approaches of training in water resources focussing on Surface Water Hydrology, Ground water hydrology, Environmental Hydrology, Hydrological Investigation, Advance Topics in Hydrology, it is proposed to have programmes centred on the real world problems faced in specific geographical regions, and interdisciplinary knowledge and expertise required to address it. Suggested training programme structure may be mandated to include features like:

a) Training kit including essentials required for successful implementation in ground (e.g. software, templates, forms, reference material etc.)
b) Lecture component with lecture notes
c) Tutorials/ Hands on sessions
d) Mini project
e) Study visit
f) Short quiz-type exam
g) Training report including feedback of the trainees

4.7.3 The way forward

Moving far ahead of the phase of data collection, validation and analysis, the current project aims to imbibe the stakeholders with the concept of integrated water resources management.

The domain of water resources in the country are under the control of the State Irrigation, Minor Irrigation, Public Health Departments (dealing with municipal water supply) and Water Resources Departments, Electricity Boards (regulating the dams generating hydropower), Ground Water Boards and couple of other institutions of these type who were mandated to work in a small specific silo of the entire gamut of the water resources sector. The fact that surface and ground water are interrelated, the fact that increase of population and rapid trend of urbanisation has already pushed the per capita water resources availability though the boundaries of inadequacy, calls for collective water resources management in an integrated way that envisages optimisation both at the supply and the demand side is the need of the hour. The climate change is adding to the difficulties, making the distribution of rainfall even more erratic, helping to increase the scarcity of water even further. The activities under the National Hydrology Project are aimed to address these gaps in the best way possible under such a national initiative.

4.7.3.1 Upcoming activities and development strategy/plan

Based on discussion with stakeholders, it is being conceived to introduce separate training programmes to cater to the needs and availability of officials/staff with different levels of seniority. A draft training schedule will be formulated once the feedback is received. A national level workshop is being planned involving all the implementing agencies at Tiruvananthapuram on 8th-9th March 2018, for the assessment of the training needs and finalisation of the training schedule. Obtaining information about different national and international institutes of repute in specific disciplines related to the project matters is being carried out with a viewpoint to have training/higher education/exposure visit/collaboration plans. Once such example is the Carlton University, Canada. Other institutes are:

- Cranfield University, UK
- UNESCO-IHE, Delft, The Netherlands
- Delft University of Technology, Delft, The Netherlands
- Deltares, Delft, The Netherlands,
- DHI, Denmark
- USACE, Washington DC, USA
- USGS, Virginia, USA
- University of Nebraska, USA
- Colorado State University, Colorado, USA
- The University of Utah, USA
- International Centre of Excellence in Water Resources Management (ICE Warm) Adelaide, Australia
- The Australian Academy of Technology and Engineering, Melbourne, Australia
- Asian Institute of Technology, Bangkok

- International Water Management Institute, Colombo, Sri Lanka

In a similar vein, the national institutes specialised in the water resources may be

- IIT Roorkee
- IIT Madras
- Interdisciplinary Centre for Water Research (ICWaR), IISc Bangalore
- ICAR Indian Institute of Soil and Water Conservation, Dehradun
- CWPRS (Central Water and Power Research Station)
- Irrigation Training Management Institute, Kota

The National Water Academy at Pune, well known for conducting training courses for the officers of the Central Water Commission, has been identified as the training coordinator along with NIH, Roorkee for the National Hydrology Project. It is envisaged to bring in an intensification of focus towards the successful implementation of project. With their active collaboration, the first training programme on Benchmarking Irrigation Projects has already been planned for 12th to 16th March, 2018. Separate training programmes are envisaged for data entry operators (longer duration, up to a week or more), orientation workshops/visits for senior level decision makers (two days at national level and two weeks to two months at international level) and intermediate level training courses/workshops for the mid-career professionals. The firming up of the training calendar for the year will be done after the national level workshop. The training programme also envisages to develop and operationalize training packages which are amenable to be organized with standard/ fairly uniform instructional strategy on decentralized basis, using “Training of Trainer (ToT)” approach proposed in the National Training Policy -2012. Selection of trainers would have to be carried out after finalisation of the criteria.

Every year, it is planned to have regional workshops to have feedback on the trainings arranged in the previous year, so that the gaps in existing structure may be addressed through modification as per requirement. Delhi, Gandhinagar, Hyderabad, Kolkata and Guwahati are envisaged as the tentative centres for these regional level workshops, which may be modified as required. The proposed classification showing the organisation of the Implementing Agencies under each of the centres is shown in the schematic diagram below:

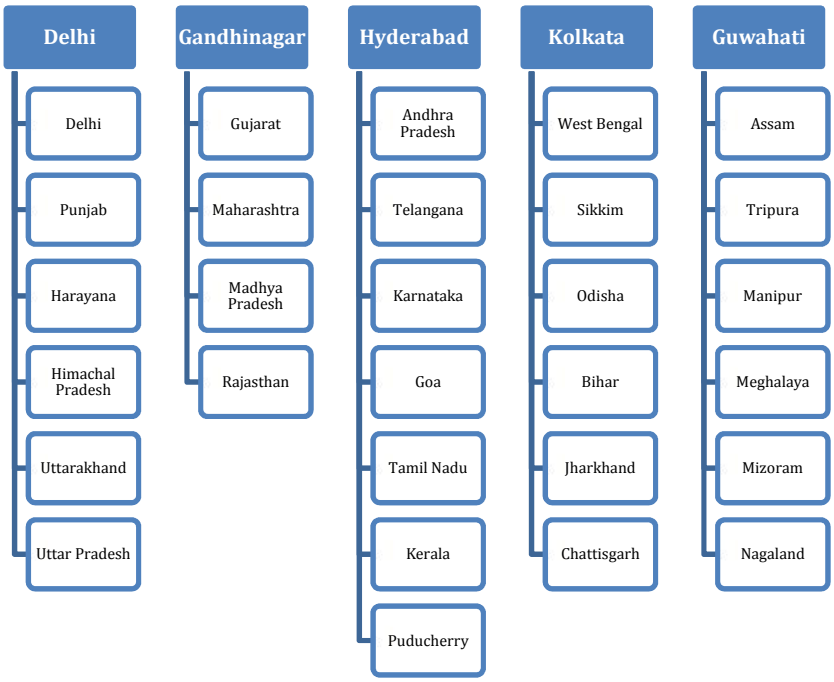


Figure 29: Proposed regional grouping of Implementing Agencies

Specific challenges

It has been recognised worldwide that the challenges of water resources management cannot be efficiently handled with the regulatory approach only. The exclusion of stakeholders from the domain of decision has been at least partially responsible for the sub-optimal performances of the water sector. The engineers dealing with the different compartments of the water sector in the Central and State Governments seldom found it convenient and important to take it to the stakeholders. As a result, the management was basically on the supply side, based on principles of engineering. Recognising the shortcomings of this approach, the national hydrology project plans to have outreach and awareness program that are aimed to address local communities in irrigated or flood prone areas, and the public at large. Under this category, it may be planned to organise poster making/essay writing/debate competitions for the school/college students. The events may be organised from district to state and national level. This activity, even though posing difficulties and consuming resources in the inception, will not only be able to provide visibility to the project, but also spread the problems and currently perceived perspectives to the young mind – in whose hands rests the sustainability of water resources in the future. It may be hoped that some innovative outcomes may crop up, to tackle the problems like flood related deaths in Bihar that has been plaguing us for ages. For each phase (district, state and national) a time period of three months may be considered, which will be updated through the experience gained during the first implementation.

4.7.3.2 Work programme

The tentative work programme is portrayed graphically below.

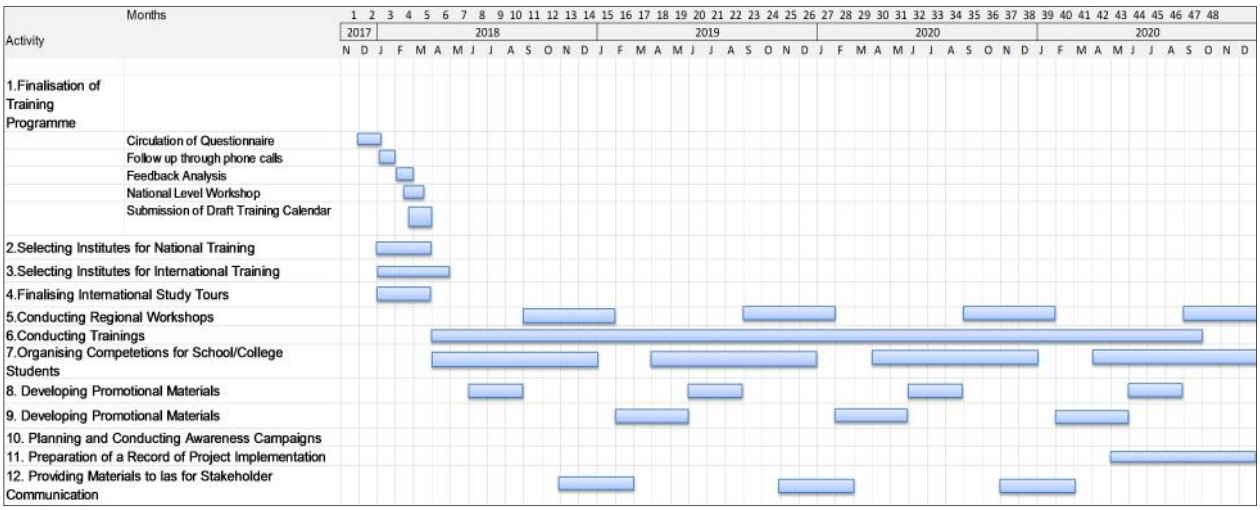


Figure 30: Capacity building work programme

5 TAMC WORK PLAN AND WORK PROGRAMME

5.1 Work Plan and Work Programme

The RFP determines that the Inception Report shall include a *detailed Work Programme for the TAMC activities for the upcoming 9 months and an outline Work Plan for the balance of the contract period*. The Work Programme is to *outline the plan for the implementation of the main activities/tasks of the assignment, their content and duration, phasing, interrelations, milestones (including interim approvals by the Client) and tentative delivery dates of the reports*.

The TAMC assignment covers a broad range of different activities, going from technical support and advice to programme management support, IT development and capacity enhancement. To fulfil the project requirements an important set of tasks needs to be accomplished, with their corresponding outputs and deliverables.

To present activities, outputs and deliverables, a Work Programme has been defined which presents these activities in a chronological context. It also shows interrelations, delivery dates of documents and other milestones such as Client´s approvals where applicable. Activities and the corresponding deliverables have been grouped by topic areas.

A bar chart showing the detailed Work Programme for the next 9 months and the outline Work Plan for the following period representing the Consultant's understanding of the activities and tasks required for the successful implementation of the project at the inception phase are included as Appendix 8 to this document.

The TAMC Work Plans for the different topic areas are also described in detail in the respective sections of chapter 4. The overall TAMC Work Plan is a compilation of the above partial work plans for each of the support areas.

This Work Programme will be the basis for developing activities and producing deliverables in the different topic areas. Each team is responsible for the activities and deliverables to be produced within its area. The Work Programme will be monitored and regularly updated throughout the Project period.

A proposed Deployment Schedule of international and national experts is presented in Appendix 9.

5.2 Staff requirements for implementation of Work Programme

To fulfil this Work Programme, the below described staff requirements have been identified. In order to mobilise the required resources a twofold approach is proposed:

1. Partial reallocation of resources from other areas of the TAMC team where optimisation is possible without affecting the overall objectives and deliverables of the Project
2. Deployment of certain non-billable resources by the Consultant in order to manage the overall efforts required for the IT development work with the possible re-appropriations as indicated above

With this approach a substantial reinforcement of the IT team is possible in line with the development requirements without affecting the overall performance of the TAMC team. The staff which according to the estimate presented in section 4.5.3.4 is required for the eSWIS, WRIS and MIS development (645 man-months) is thus obtained in the following way.

Table 18: Staff for eSWIS, WRIS and MIS development

Description	Total months proposal	Total months update
MIS team	150	144
IT Advisor	6	30
Additional IT staff (re-appropriation-billable)		236
Total IT staff (billable)		410
Additional non-billable resources		235
Total	156	645

The following Table 19 shows a comparison of the staff profiles and durations considered in the proposal and the proposed staffing as identified during the Inception Phase.

Table 19: Staff as per proposal and proposed revised staffing

No	Name	Position	Home-mon proposal	Total-mon proposal	Home-mon update	Total-mon update	Planned joining date	Actual joining date
Core Staff - International								
K-1	Dr. Wolfgang Krinner	Team Leader	2	78	2	78		23-oct-17
K-2	Dr. Nesa Ilich	River Basin Modelling Expert	10	72	10	72		4-dic-17
K-3	Dr. Jayaraman Potty	Hydro-met Instrumentation Expert	2	36	2	36		8-ene-18
K-4	Peter Ravenscroft	Hydrogeologist and Ground Water Modelling Expert	2	36	2	36		6-mar-18
Core Staff - National								
K-5	Dr. Sravan Kumar Kanukuntla	Deputy Team Leader		72		72		20-nov-17
K-6	Desh Raj	Sr. Procurement Expert		72		72		6-dic-17
K-7	Rajendra Patel	MIS & IT Expert		78		36		15-nov-17
K-8	Dr. Ashoke Basistha	Hydrologist and Hydrological Modelling Expert		72		72		28-dic-17
K-9	Dr. Ashok Kaushal	GIS & Remote Sensing Expert		48		20		6-nov-17
K-10	Madju Sudan Doria	Capacity Building Expert		48		48		5-dic-17
Support staff								
S-11	TBN	Hydrochemist and Water Quality Expert		36		36	TBD	
S-12	Philip Appleton	Capacity Building Expert (international)		24		12	TBD	
S-13	Dinesh Kumar Gandhi	Sr. Finance Management Expert		78		30		3-may-18
S-14	Anil Kumar Agarwal	Monitoring & Evaluation (M&E) Expert		78		56		6-dic-17
S-15	Dhiren Kumar Chavda	Ground Water Management and Modelling Expert		72		58	may-18	
S-16.1	TBN	Procurement Expert-1 (Kol)		42		42	TBD	
S-16.2	Murali Reddy	Procurement Expert-2 (Hyd)		42		42		6-dic-17
S-16.3	Dipesh Desai	Procurement Expert-3 (Gan)		42		42		22-nov-17
S-16.4	TBN	Procurement Expert-4 (Guw)		42		42	TBD	
S-16.5	Amit Sethi	Procurement Expert-5 (Del)		42		42		17-ene-18
S-17.1	Sunil Patil	Instrumentation Expert-1 (Hyd)		45		45		19-feb-18
S-17.2	Pravin Pote	Instrumentation Expert-2 (Kol)		45		45		10-may-18
S-18	Mayank Shekar Singh	Finance Expert		78		78		21-nov-17
S-19.1	Amlan Sarkar	MIS Expert		30		30		15-abr-18
S-19.2	TBN	Application Development Expert		30		24	TBD	
S-19.3	Mohit Sharma	Application Programmer		30		30		8-nov-17
S-19.3	Sergio Herrero	Application Programmer				30		25-nov-17
S-19.3	Piyush Dubey	Application Programmer				30		8-ene-18
S-19.3	Amit Kumar	Application Programmer				30		11-ene-18
S-19.3	Divya Monga	Application Programmer				26		25-abr-18
S-19.3	TBN	Application Programmer				24	TBD	
S-19.3	TBN	Application Programmer				24	TBD	
S-19.3	TBN	Application Programmer				24	TBD	
S-19.4	TBN	Application Programmer				24	TBD	
S-19.4	Garima Varshney	Database Designer		30		30		30-nov-18
S-19.4	Sneha Shirohi	Database Designer				24		10-ene-18
S-19.5	Santosh Gupta	Application Web Designer		30		30		21-nov-17
S-20.1	Shuvra Sangeeta	Water Resources Management Expert-1		36		36		1-feb-18
S-20.2	Jaya Sood	Water Resources Management Expert-2		36		36		19-feb-18
S-21.1	Sayantan Ghosh	Communication and Media Expert-1		7,5		7,5	1-jun-18	
S-21.2	TBN	Communication and Media Expert-2		7,5		7,5	on hold	
S-22	Anil L. Shirgave	Telecommunication Expert		24		24	on hold	
S-23	Rakesh Bhatt	SCADA Expert		24		36		13-nov-17
S-24	TBN	Meteorologist (international)		24		24	on hold	
Advisory Team								
S-25.1	TBN	Integrated Water Resources Management Advisor		3		3	on hold	
S-25.2	TBN	Climate Change Advisor		4		3	on hold	
S-25.3	TBN	Short & Midterm Rainfall Forecast Advisor		4		3	on hold	
S-25.4	TBN	Sediment Modelling and Management Advisor		3		3	on hold	
S-25.5	TBN	Aquifer Recharge Management Advisor		3		3	on hold	
S-25.6	TBN	Flood Modelling Advisor		8		3	on hold	
S-25.7	TBN	Spatial & Non-sp.datasets for W.Res.Mgmnt Adv.		9		3	on hold	
S-25.8	Francisco Jimenez	IT Hardware & Software Advisor	3	6	15	30		21-nov-17
S-25.9	TBN	Community-based Water Management Advisor		6		3	on hold	
Technical and Office Support Team								
S-26.1	Ankita Bharti	Data Entry Operator		192		96		4-dic-17
S-26.1	Manoj Prajapati	Data Entry Operator				96		5-mar-18
S-26.2	Varsha Sharma	Receptionist/Project Secretary		96		96		7-may-18
S-26.3	Sumanta Prasad	Office Manager		96		96		23-oct-17
S-26.4	Ampu Kumar Harsh	Office Assistant		144		96		14-nov-17
S-26.4	Vijay Chand	Office Assistant				48		24-abr-18
S-26.5	TBN	Accounts Assistant		192		96	TBD	
S-26.5	TBN	Accounts Assistant				96	TBD	
		TOTAL		2353		2437		
		TOTAL w/o Technical & Office Support		1633		1717		

In addition hereto the Consultant is deploying additional non-billable staff in order to support the project team. The following table gives an overview of the already mobilised and planned non-billable staff for IT and other areas.

Table 20: Non-billable staff

No	Name	Position	Home-mon proposal	Total-mon proposal	Home-mon update	Total-mon update	Planned joining date	Actual joining date
Support staff								
non-bill	Amardeep Barma	Application Programmer						1-may-18
non-bill	Bijan Mukharjee	Application Programmer						2-may-18
non-bill	Srikanth Gaud	Application Programmer						9-may-18
non-bill	Arvind Kumar	Application Programmer						9-may-18
non-bill	Rajan Kumar	Application Programmer					4-jun-18	
non-bill	TBN	Application Programmer					TBD	
non-bill	TBN	Application Programmer					TBD	
non-bill	TBN	Application Programmer					TBD	
non-bill	Azizul Quadir	Coordination Procurement/Finance/MIS						23-oct-17
non-bill	Ankit Sharma	Procurement Support						19-dic-17
Advisory Team								
non-bill	Anupam Basu	IT Advisor						1-mar-18

It is to be noted that the proposed staffing covers the estimated IT staff requirements and although the total number of man-months increases the total project cost remains within the limits defined by the TAMC contract agreement.

5.3 Points needing attention

During the Inception Phase a number of areas have been identified which in the Consultant's view require particular attention during the project implementation.

1. Staff requirements for IT development

Significant additional resources are required in order to perform all necessary IT development as per the Contract Agreement. This issue has been analysed and described in detail in the previous sections. The TAMC underlines the need for a partial reallocation of staff and for mobilising additional resources in order to deliver the project.

2. Capacity building

Capacity building and institutional development are the basis for successful water management. The NHP programme includes a large training and capacity building component. However, this not necessarily guarantees the desired outcome in terms of institutional development. A clear and effective plan is required to ensure that capacities of all IAs are improved.

3. Communication with Implementing Agencies

Continuous and effective communication with the Implementing Agencies is essential. Due to its recent inception, the TAMC team has not yet fully developed all required communication channels with the IAs. It is planned to improve this aspect in the coming months. Hereby the

Deputy Team Leader will act as the TAMC's "nodal officer", organising communication with IAs and coordinating communication channels for different topics (procurement, M&E, finance, IT, etc.), with the objective to further implicate IAs in the NHP programme and enhance ownership.

4. Project ownership on behalf of Implementing Agencies/States

During the initial months the TAMC team has observed that not all IAs are equally aware of the NHP programme. More efforts need to be made to ensure project ownership on behalf of all Implementing Agencies/States.

5. Continuity of monitoring networks after maintenance period

The NHP programme will suppose a massive investment in hydro-meteorological monitoring networks and information systems in the country over the coming years. At this moment not all IAs are sufficiently experienced in the operation and maintenance of these networks. During the vendors' warranty and maintenance period the possibilities of systems failing is comparatively reduced. However, after that period a risk exists that no adequate arrangements for maintenance and repair are in place when systems become defective. During the Project period adequate arrangements have to be found to mitigate this risk.

6. Continuity of eSWIS-WRIS after IT development

Equally adequate arrangements have to be put in place to ensure that the new India Water Information System (until now eSWIS and WRIS) can rely on appropriate arrangements for operation, maintenance and subsequent development.

According to the project description included in the RFP, during the project duration NWIC has to be established and developed. The development of a robust and effective organisation is considered essential for the success of the future Water Information System which in turn will be the centrepiece of water management in India. As described in section 4.5.3.3 several aspects are critical in this context:

- Ensuring sufficient resources for system operation and maintenance
- Requirement for in-house technical capabilities on behalf of the organisation in charge of system operation and maintenance
- Staff continuity, retention of knowledge and knowledge transfer
- Need for further system development and improvement after completion of the development phase
- Close connection direct working relationship with stakeholders and main system users

APPENDICES

1. Procurement
2. M&E Baseline Survey Questionnaire
3. MIS Gap Analysis
4. eSWIS Performance Testing
5. Hardware Architecture for Development and Testing Environment
6. Water Information System (eSWIS-WRIS-Data Acquisition) Work Programme
7. List of Proposals submitted for Purpose Driven Studies (PDS)
8. TAMC Work Programme and Work Plan
9. TAMC Team Deployment Schedule

Appendix 1: Procurement

Appendix 1: Procurement

Appendix 1a: Status of documents as on 22nd January 2018

S. No.	Name as per Bidding Document	Implementation Agency (IA)	Type of document	Item	Status of technical review	Status of procurement review	Target date for finalization (Indicative)	Status of documents
1	NCB for Supply Installation, testing commissioning and Maintenance of Digital Water Level recorders with telemetry system in Piezometer for Ground Water Survey in Madhya Pradesh & integrate it with data center located at Bhopal Madhya Pradesh.	Madhya Pradesh	Bid document	DWLR	Completed	Completed	28-12-2017	Meeting with IA conducted on 14th and 15th December 2017 to discuss the bid documents. Bid documents finalized by TAMC and approved by NPMU. NPMU send the bid documents to the IA on 28th December 2018 for any changes/ modifications and further submission to NPMU for approval. Further to submission to IA, some changes were suggested by the Bank which was incorporated and revised bid document was shared with the NPMU on 17th January 2018.

S. No.	Name as per Bidding Document	Implementation Agency (IA)	Type of document	Item	Status of technical review	Status of procurement review	Target date for finalization (Indicative)	Status of documents
2	NCB for Supply Installation, testing commissioning and Maintenance of Real Time Data Acquisition System (RTDAS) for selected Dams, Reservoirs and Rivers/ Streams of Sindh and Betwa Sub-basins of Ganga Basin and integrate with Data Center located at Bhopal, Madhya Pradesh.	Madhya Pradesh	Bid document	RTDAS	Completed	Completed	05-01-2018	Meeting with IA conducted on 14th and 15th December 2017 to discuss the bid documents. Bid documents finalized by TAMC and approved by NPMU. NPMU send the bid documents to the IA on 5th January 2018 for any changes/ modifications and further submission to NPMU for approval. Further to submission to IA, some changes were suggested by the Bank which was incorporated and revised bid document was shared with the NPMU on 17th January 2018.

S. No.	Name as per Bidding Document	Implementation Agency (IA)	Type of document	Item	Status of technical review	Status of procurement review	Target date for finalization (Indicative)	Status of documents
3	NCB for Supply Installation, testing commissioning and Maintenance of RTDAS for Godavari River basin in Marathwada Region	Maharashtra (SW)	Bid document	RTDAS	In Progress	In Progress	12-02-2018	Meeting with IA conducted on 19th December 2017 to discuss the bid document. Technical specification were discussed. IA was requested to make suggested changes and redraft bid documents in line with the model bid documents of the Bank shared with them. MP RTDAS bid document (Single Envelope) and Jharkhand RTDAS bid document (Two Envelope) were shared with IA for reference purpose. NPMU to be requested to ask IA to submit revised bid to NPMU by 22nd January 2018 along with bid review checklist and sanctioned estimates for further review and finalization of bid documents.

S. No.	Name as per Bidding Document	Implementation Agency (IA)	Type of document	Item	Status of technical review	Status of procurement review	Target date for finalization (Indicative)	Status of documents
4	SUPPLY, INSTALLATION, TESTING, COMMISSIONING AND MAINTENANCE OF REAL TIME DATA ACQUISITION SYSTEM (RTDAS) OF IRRIGATION AND WATER RESOURCES DEPARTMENT HARYANA UNDER NATIONAL HYDROLOGY PROJECT(NHP)	Haryana	Bid document	RTDAS	In Progress	Completed	25-01-2018	Bid document finalized in line with the sample document of the Bank and MP DWLR / RTDAS bid documents. NPMU requested to ask IA for submission of Instrument and location wise grouping of items and preparation of the detailed "schedule of Requirement for Goods & related services" before 15th January 2018 as per the format in the sample MP RTDAS bid document shared with them. NPMU sent a mail to the IA on 9th January requesting the same.
5	Haryana SCADA Hathini Barrage	Haryana	Bid document	SCADA	In Progress	Yet to initiate	09-02-2018	Site visit conducted on 15th December 2017. Technical specification is under finalization.

S. No.	Name as per Bidding Document	Implementation Agency (IA)	Type of document	Item	Status of technical review	Status of procurement review	Target date for finalization (Indicative)	Status of documents
6	UP SCADA Okhla Barrage	Uttar Pradesh (SW)	Bid document	SCADA	In Progress	Yet to initiate	19-01-2018	Site visit conducted on 13th December 2017. First draft of technical specification send to NPMU on 8th January 2018. NPMU forwarded the specifications to IA for their review and comments. BOQ and bid document under preparation.
7	Supply, Installation, Testing, Commissioning and Maintenance of Real Time Data Acquisition System (RTDAS) for selected Automatic Weather Stations Automatic Rain Gauges, Automatic Water Level Recorders (Radar type above 30m) sites in Himachal Pradesh and integrate with Data Center (VSAT) located at Mandi Himachal Pradesh under National	Himachal Pradesh	Bid document	RTDAS	Completed	Completed	22-01-2018	Bid document finalized in line with the sample document of the Bank and MP DWLR / RTDAS bid documents. NPMU requested to ask IA for submission of Instrument and location wise grouping of items and preparation of the detailed "schedule of Requirement for Goods & related services" before 15th January 2018 as per the format in the sample MP RTDAS bid document shared with them. NPMU sent a mail to the IA on 9th January requesting

S. No.	Name as per Bidding Document	Implementation Agency (IA)	Type of document	Item	Status of technical review	Status of procurement review	Target date for finalization (Indicative)	Status of documents
	Hydrology Project.							the same. IA clarified on call that grouping of items is not applicable for Himachal Pradesh. Bid document finalized and shared with NPMU on 17th January 2018.
8	SUPPLY, INSTALLATION, TESTING, COMMISSIONING, TRAINING AND MAINTENANCE OF REAL TIME DATA ACQUISITION SYSTEM (RTDAS) OF S.W ODISHA UNDER NATIONAL HYDROLOGY PROJECT (NHP). STATE-ODISHA	Odisha (SW)	Bid document	RTDAS	In Progress	In Progress	30-01-2018	Bid document to be finalized in line with the sample document of the Bank and finalized MP DWLR / RTDAS bid documents. NPMU requested to ask IA for submission of Instrument and location wise grouping of items and preparation of the detailed "schedule of Requirement for Goods & related services" before 15th January 2018 as per the format in the sample MP RTDAS bid document shared with them. NPMU sent a mail to the IA on 9th January requesting the same.

S. No.	Name as per Bidding Document	Implementation Agency (IA)	Type of document	Item	Status of technical review	Status of procurement review	Target date for finalization (Indicative)	Status of documents
9	Construction of State Data Centre at Kohima under National Hydrology Project	Nagaland	Bid document	Others	NA	Completed	29-11-2017	Bid documents along with comments sent through mail to IA on 29-11-2017 a suggested by NPMU.
10	NCB for Construction of Piezometer Monitoring Wells (Hard copy received)	CGWB	Bid document	Piezometer	NA	In Progress	31-01-2018	Comments were send to NPMU on 23rd December 2017. Meeting with IA was held on 29th December 2017 to discuss the bid document. IA required to submit justification for deviation from model document with respect to the eligibility criteria and standard forms and make necessary changes as suggested.

S. No.	Name as per Bidding Document	Implementation Agency (IA)	Type of document	Item	Status of technical review	Status of procurement review	Target date for finalization (Indicative)	Status of documents
11	ICB for procurement of 1. Absolute Gravity Meter (Field Version) (01 No.) 2. Relative Gravity Meter (02 Nos.) for NGDC, SOI	SOI	Bid document	Others	In Progress	In Progress	TBD	As directed by Rakesh Kashyap sir, modified document as per e-procurement two envelope method (document was in physical form submission method) and return to IA with discussion with Rakesh Kashyap sir. NPMU suggested IA to make separate bid for Absolute gravity meter and Relative Gravity meter in December 2018. IA submitted separate bids in pdf format to NPMU for review on 17th January 2018. NPMU requested IA to submit both the bids in word format along with bid review checklists.

S. No.	Name as per Bidding Document	Implementation Agency (IA)	Type of document	Item	Status of technical review	Status of procurement review	Target date for finalization (Indicative)	Status of documents
12	NCB for Hiring agency for providing services of Skilled Persons (i.e. MIS Assistant, Stenographer, Accounts Officer, ArcGIS Assistant; Surveyors, Retired Staffs of Survey of India for QA/QC) for Project office, National Hydrology Project, Survey of India	SOI	Bid document	Others		In Progress	TBD	Consulting (QCBS) document was used by the IA. NPMU returned the document to IA as it needs to be prepared in NCS format.
13	Shopping for Goods- Total station with Accessories (4 Nos.)	Andhra Pradesh (SW)	Bid document	Others		Completed	TBD	Bid documents sent to NPMU on 5th December 2017 for further action. Revised bid document (prepared E-5 Document under shopping) shared by IA given to TAMC for further review on 10th January. Comments shared with NPMU on 10th January 2018 for further necessary action.

S. No.	Name as per Bidding Document	Implementation Agency (IA)	Type of document	Item	Status of technical review	Status of procurement review	Target date for finalization (Indicative)	Status of documents
14	SUPPLY, INSTALLATION, TESTING, COMMISSIONING AND MAINTENANCE OF REAL TIME DATA ACQUISITION SYSTEM (RTDAS) OF WRD JHARKHAND UNDER NATIONAL HYDROLOGY PROJECT (NHP)	Jharkhand	Bid document	RTDAS	Completed	Completed	05-01-2018	Meeting with IA conducted on 2nd to 5th January 2018 to discuss and finalize the bid documents. Bid documents finalized by TAMC and submitted to NPMU for review and further action. NPMU sent the bid document to IA. IA is requested to submit the revised bid document after making changes as suggested by TAMC regarding grouping of items. Technical specifications under finalization and revised document is expected to be shared by 19th January 2018. Finalized bid document share with NPMU on 22nd January 2018 for further action.
15	Construction of 200 mm x 165 mm dia. 40 Nos. piezometers in hard rock up to125 m deep in urban areas and 50m deep in	Jharkhand	Bid document	Piezometer	Completed	Completed	05-01-2018	Meeting with IA conducted on 2nd to 5th January 2018 to discuss and finalize the bid documents. Bid documents finalized by

S. No.	Name as per Bidding Document	Implementation Agency (IA)	Type of document	Item	Status of technical review	Status of procurement review	Target date for finalization (Indicative)	Status of documents
	rural areas including installation of signboards in different districts of Jharkhand							TAMC in the Shopping format as suggested by IA and NPMU. NPMU sent the bid documents to the IA for any changes/modifications and further submission to NPMU for approval.
16	Supply, Installation, Testing, Commissioning and Maintenance of Real Time Data Acquisition System for River Basins and Major Reservoirs in West Bengal	West Bengal (SW)	Bid document	RTDAS	Yet to initiate	Yet to initiate	19-01-2018	Bid documents to be finalized in line with sample MP RTDAS bids. Meeting with IA may be planned in January 2018.
17	SUPPLY, INSTALLATION, TESTING, COMMISSIONING AND MAINTENANCE OF REAL TIME DATA ACQUISITION SYSTEM (RTDAS) OF NORTH EASTERN STATE OF INDIA UNDER NATIONAL HYDROLOGY	CWC	Bid document	RTDAS	In Progress	In Progress	TBD	Wold Bank is developing model document for ICB 2 envelope.

S. No.	Name as per Bidding Document	Implementation Agency (IA)	Type of document	Item	Status of technical review	Status of procurement review	Target date for finalization (Indicative)	Status of documents
	PROJECT (NHP)							
18	Supply & Installation of Flood Early Warning System Including Development of Hydrodynamic Models for Real Time Flood Forecasting coupled with Weather Forecast and Inundation Modelling in Indian River Basins	CWC	Bid document	Others	In Progress	In Progress	23-02-2018	Wold Bank is developing model document for ICB 2 envelope. Technical specifications being finalized by CWC meanwhile. Meeting conducted with CWC (2 round of meetings) and with client to agree in-principle restructuring of the TOR document. EHP (Early Hydrological Prediction) tender document has been evaluated and discussed during our meeting with the Stakeholders and the WB officials on December 20th, 2017, along with the EFWS tender. The EHP tender document contains significant overlaps with the EFWS tender document. Hence, it was suggested to separate the short term forecasting capability and include it in

S. No.	Name as per Bidding Document	Implementation Agency (IA)	Type of document	Item	Status of technical review	Status of procurement review	Target date for finalization (Indicative)	Status of documents
								ESWS, while the seasonal forecasts will remain part of the future EHP tender. Also, reservoir operation was taken completely out of ESWS and it will be only included in the EHP.
19	Supply, Fixing and Placing of Office Furniture at State Data Centre, Water Resources Bhawan, Sector 68, S.A.S. Nagar (Mohali)	Punjab	Bid document	Others		Completed	01-01-2018	Minutes of pre-bid meeting reviewed and submitted to NPMU. Comments on bid documents shared with NPMU and proposed amendments prepared for IA reference.
20	Supply & Installation of AWS Stations P3 (GSM) / GPRS / INSAT Including AMC for 5 years.	Gujarat (SW)	Bid document	RTDAS	In Progress	In Progress	25-01-2018	Meeting with IA conducted on 20th, 21st and 22nd December 2017 to discuss the bid document drafted by IA. IA requested to make necessary changes in the document and submit revised bid document to NPMU for further review and discussions if any. NPMU to be requested to ask IA to submit revised bid to NPMU by 22nd

S. No.	Name as per Bidding Document	Implementation Agency (IA)	Type of document	Item	Status of technical review	Status of procurement review	Target date for finalization (Indicative)	Status of documents
								January 2018 along with bid review checklist and sanctioned estimates for further review and finalization of bid documents.
21	The Supply, Installation, Testing, Commissioning, Operation and Maintenance of Real Time Data Acquisition System (RTDAS) for selected, Reservoirs and Rivers/ Streams for Surface Water sector in Vindhyachal region and integrate with Data Center located at Lucknow.	Uttar Pradesh (SW)	Bid document	RTDAS			16-02-2018	Bid document submitted by IA included many items which should not be part of RTDAS bid. Hence, NPMU returned the bid document to IA for revision.
22	The Supply, Installation, Testing, Commissioning Operation and Maintenance of Real Time Data Acquisition System (RTDAS) for selected Dams for Surface Water sector in Bundelkhand	Uttar Pradesh (SW)	Bid document	RTDAS			16-02-2018	Bid document submitted by IA included many items which should not be part of RTDAS bid. Hence, NPMU returned the bid document to IA for revision.

S. No.	Name as per Bidding Document	Implementation Agency (IA)	Type of document	Item	Status of technical review	Status of procurement review	Target date for finalization (Indicative)	Status of documents
	Region and integrate with Data Center located at Lucknow, Uttar Pradesh							
23	MAINTENANCE OF REAL TIME WATER QUALITY MONITORING STATIONS (RTWQMS)	CPCB	Bid document	Others			30-01-2018	The Bid Document for Operation and Maintenance of Real Time Water Quality Monitoring Stations (RTWQMS) submitted by Central Pollution Control Board has been prepared on ICB Goods procurement document. The value of the O & M assignment is approx. 2.50 crores and therefore, it is a NCB. Since it is an O&M procurement, use of Standard NCS document is advised and attached for convenience. The IA may accordingly be advised.
24	The Supply, Installation, Testing, Training, Commissioning, Operation and Maintenance of Real	Kerala (SW)	Bid document	RTDAS			05-02-2018	Bid documents to be finalized in line with sample MP RTDAS bids. Meeting with IA may be planned in January 2018.

S. No.	Name as per Bidding Document	Implementation Agency (IA)	Type of document	Item	Status of technical review	Status of procurement review	Target date for finalization (Indicative)	Status of documents
	Time Data Acquisition System for Kerala State							
25	SUPPLY, INSTALLATION, TESTING, COMMISSIONING AND MAINTENANCE OF REAL TIME DATA ACQUISITION SYSTEM (RTDAS) OF WRD, RAJASTHAN UNDER NATIONAL HYDROLOGY PROJECT (NHP)	Rajasthan	Bid document	RTDAS	Completed	Completed	31-01-2018	Bid documents finalized in line with sample MP RTDAS bids and sent to NPMU on 11th January 2018 for further necessary action. TAMC is incorporating minor changes in the bid document in line with changes made in the MP RTDAS bid document. Finalized bid document share with NPMU on 22nd January 2018 for further action.
26	Design, Development, Hosting, Implementation and Training/ Operational Support for Android Based Mobile App for Status of Water Level in Uttar Pradesh & Ground Water Awareness with Web based Application for	Uttar Pradesh (SW)	TOR	Others	In Progress	NA	31-01-2018	

S. No.	Name as per Bidding Document	Implementation Agency (IA)	Type of document	Item	Status of technical review	Status of procurement review	Target date for finalization (Indicative)	Status of documents
	Ground Water Data Collection & Management System							
27	PDS Studies		PDS					
28	EHP (Early Hydrological Prediction)	CWC	TOR	Others	In Progress	Yet to initiate	23-02-2018	EHP (Early Hydrological Prediction) tender document has been evaluated and discussed during our meeting with the Stakeholders and the WB officials on 20th December, 2017, along with the EFWS tender. The EHP tender document contains significant overlaps with the EFWS tender document. Hence, it was suggested to separate the short term forecasting capability and include it in ESWS, while the seasonal forecasts will remain part of the future EHP tender. Also, reservoir operation was taken completely out of ESWS and it will be only included in the EHP.
29	State WRIS		TOR					

S. No.	Name as per Bidding Document	Implementation Agency (IA)	Type of document	Item	Status of technical review	Status of procurement review	Target date for finalization (Indicative)	Status of documents
30	Procurement of Water Quality Lab equipment - Proposed List of Equipment with Technical Specifications	Andhra Pradesh (SW)	Technical Specs	Others			TBD	
31	Shopping for Goods - Equipment E-5 document (4 nos.)	Meghalaya	Bid document	Others	In Progress	In Progress	TBD	First set of comments shared with NPMU on 26th December 2017. NPMU was requested to share the comments with the IA. Technical specifications used in the document were very old and hence NPMU was requested to ask IA to revised technical specifications. IA to submit the bid documents with revised specifications for NPMU recommendation.
32	TOR for hiring Consultant for setting up of Testing, Calibration and Certification Facility (TCCF) at CWPRS	CWPRS	TOR	Others	Yet to initiate	Completed	TBD	Document reviewed from procurement aspect on 10th January 2018. Technical review to be initiated after Water Quality Expert is on board. NPMU has send

S. No.	Name as per Bidding Document	Implementation Agency (IA)	Type of document	Item	Status of technical review	Status of procurement review	Target date for finalization (Indicative)	Status of documents
								back the document to the IA with their comments on 12th January 2018.
33	National Competitive Bidding for Non-Consulting Services for Conducting River Cross Section and Embankment Asset Survey of River Chandan	Bihar (SW)	Bid document	Others	Yet to initiate	In Progress	16-01-2018	NPMU has send back the document to the IA with their comments on 12th January 2018.
34	Issues requiring advice from WB/ NPMU - A. RT-DAS Tillari Project; B. Operation & Maintenance of laboratory; C. Hydro meteorological instruments installed under HP II; D. Appointment of Ground Water Specialist	Goa	Others	Others	Completed	NA	15-01-2018	Meeting with officials held at NPMU on 12th January 2018. Key points discussed are as below: A. RT-DAS Tillari Project i) Preparation of discharge calibration curve should be the responsibility of bidder. ii) Up looking ADCP at two locations (at main canal regulators) considering the minimum depth of 50cm of Canal for almost more than six months in year. iii) ADCP shall be considered for separate procurement & not to be

S. No.	Name as per Bidding Document	Implementation Agency (IA)	Type of document	Item	Status of technical review	Status of procurement review	Target date for finalization (Indicative)	Status of documents
								integrated with RTDAS bid iv) TAMC & NPMU have discussed the system architecture for RTDAS which covers all the points specified for IT hardware at state data centre. C. Hydro meteorological instruments installed under HP II IA was suggested to evaluate the proposal for installation of new equipment viz a viz repair and AMC for existing equipment.
35	NCS for Scanning Reports, Documents, Maps and Entering Time Series and Other Data	Bihar (SW)	Bid document	Others			31-01-2018	

S. No.	Name as per Bidding Document	Implementation Agency (IA)	Type of document	Item	Status of technical review	Status of procurement review	Target date for finalization (Indicative)	Status of documents
36	Supply, Installation, Testing, Commissioning and Maintenance of Real Time Data Acquisition System (RTDAS) for selected Barrages, Reservoirs and Rivers/ Streams for Surface Water sector in Andhra Pradesh and integrate with Data Center located at Vijayawada / Amaravathi, Andhra Pradesh	Andhra Pradesh (SW)	Bid document	RTDAS	Completed	In Progress	11-01-2018	Andhra Pradesh RTDAS bid document was already approved by the Bank. TAMC reviewed the bid document in line with sample MP RTDAS bid document and comments were provided to NPMU on 11th January for further necessary action. Further comments on the bid was sought by IA on 15th January 2018.
37	Provision of services for Acquisition, Processing and Delivery of DEM (0.5m) and Digital Orthophoto data	SOI	Bid document	Others	Yet to initiate	Yet to initiate	24-01-2018	We may suggest the Implementing agency to re-draft the bid document using the standard bid format as per World Bank Procurement Guidelines dated January 2011 (Revised July 2014).

S. No.	Name as per Bidding Document	Implementation Agency (IA)	Type of document	Item	Status of technical review	Status of procurement review	Target date for finalization (Indicative)	Status of documents
38	Bid Document of generation of updated geodatabase	SOI	Bid document	Others	In Progress	In Progress	02-02-2018	The Request for Bids submitted by Survey of India is based on SBD Non Consultancy Services (After July 1, 2016) whereas we have to the SBD in all sections applicable before July 1, 2016. NPMU was suggested requested to request IA to follow all SBDs applicable before July 1, 2016. Meeting with officials from IA held on 15th and 16th January 2018 at NPMU. Salient points discussed included: 1. The BDS draft on the SBD for NCS has been prepared. 2. They have been advised to prepare list of deliverables corresponding to payment conditions mentioned in the SCC. 3. Advised to prepare Activity Schedule/ Price Schedule with respect to

S. No.	Name as per Bidding Document	Implementation Agency (IA)	Type of document	Item	Status of technical review	Status of procurement review	Target date for finalization (Indicative)	Status of documents
								reimbursable and remunerations for personals proposed. 4. Adjudicator has to be a neutral person. 5. Provide variation SCC clause 6.4 Payments TAMC have shared the SBD for NCS and requested to send revised bid document at the earliest.
39	Evaluation report of Construction of State Data Center at DVC Maithon	DVC	Evaluation Report	Others	NA	Completed	16-01-2018	Comments on technical bid evaluation report submitted to NPMU on 6th December 2017. NPMU submitted Financial Bid Evaluation Report to TAMC on 1st January 2018. Comments on Financial Bid Evaluation Report shared with NPMU on 2nd January 2018. Supporting documents shared with NPMU/TAMC on 15th January 2018 and cleared on 16th January 2018.

S. No.	Name as per Bidding Document	Implementation Agency (IA)	Type of document	Item	Status of technical review	Status of procurement review	Target date for finalization (Indicative)	Status of documents
40	TSGWD-NHP-Procurement of Goods/Works – Certain clarifications on bidding process	Andhra Pradesh (GW)	Clarification	Others	NA	In Progress		Issues were discussed with NPMU and NPMU sent mail to the World Bank for seeking clarifications. Response awaited from the Bank.

Completed

Cleared from TAMC end

Pending at TAMC end

Appendix 1b: List of major bids (RTDAS, DWLR, Piezometer, SCADA) planned by IAs

S. No.	Package Name	Implementation Agency	Component	Amount
1.	Drilling of Piezometers for study of saline ingression (coast length of 974 Km)	AP (GW)	Piezometer	71.25
2.	Real Time data acquisition System	AP (SW)	RTDAS	922
3.	Procurement and Installation of RTDAS	Assam	RTDAS	223.66
4.	Procurement of Real Time Hydro meteorological Sensors	BBMB	RTDAS	70
5.	RTDAS for Gandak ,Mahananda, Sone, Punpun, Kiul Harohar basin, eighteen reservoir/dams and civil works	Bihar (SW)	RTDAS	599
6.	MEDIUM PIEZOMETERS + PROTECTION WORK	CG (GW)	Piezometer	165
7.	RTDAS for Surface Water	CG (SW)	RTDAS	129
8.	RTDAS for surface water	CWC	RTDAS	160
9.	Real Time Data Acquisition system (RTDAS) For DVC	DVC	RTDAS	717
10.	RTDAS for Tillari canal	Goa	RTDAS	75
11.	Procurement of DWLR with Telemetry	Gujarat (GW)	DWLR	605
12.	Supply & Installation of AWS Stations P3 (GSM) / GPRS / INSAT Including AMC for 5 years.	Gujarat (SW)	RTDAS	1020
13.	Water Level Recorder Radar 50mtr (P9 (GSM) / GPRS / INSAT) with AMC for 5 years.	Gujarat (SW)	RTDAS	1206
14.	Purchase of AWLR and Rain Gauges, ADCP with Vehicle Mounted Crane	Haryana	RTDAS	311
15.	Set of Data Center Equipment consisting of SCADA Master Station, receiver & ancillary equipment, GSM/VSAT receiver and ancillary equipment, computer system used with VSAT Master Station to collect data, computer system for the GSM data collection, quality control computer, including design, manufacture, testing, delivery at Panchkula along with the software solution, web based tools, associated interface wiring, termination, commissioning site acceptance testing, supply of mandatory spares, etc.	Haryana	SCADA	100
16.	supply, installation & commissioning Automatic weather station & Automatic Rain Gauges	Himachal Pradesh	RTDAS	169
17.	Supply, installation and commissioning of Snow Pillows	Himachal Pradesh	RTDAS	32

S. No.	Package Name	Implementation Agency	Component	Amount
18.	Supply of AWLR Radar Type above 30 mtrs.	Himachal Pradesh	RTDAS	36
19.	Piezometers with DWLRS	Himachal Pradesh	Piezometer	140
20.	"Digital Rain Gauge (DRG) , AWLR, Flow Rate etc. with GSM/VSAT" with civil works	Jharkhand	RTDAS	289
21.	Construction of piezometers	Jharkhand	Piezometer	80
22.	Data Acquisition system(RTDAS) for surface water	Karnataka	RTDAS	570
23.	AWS & TRG Installation Housing (new)	Karnataka	RTDAS	29
24.	NHP- The Supply, Installation, Testing, Training, Commissioning, Operation and Maintenance of Hydrological Information System for Kerala State	Kerala (SW)	RTDAS	597
25.	RTDAS for Madhya Pradesh	Madhya Pradesh	RTDAS	3873
26.	Groundwater Measurement Equipment DWLR with Telemetry	Madhya Pradesh	DWLR	615
27.	Canal SCADA for Major Reservoirs-Samrat Ashok Sagar and Harsi Canal System	Madhya Pradesh	SCADA	550
28.	Procurement of DWLR Telemetry for existing GW Monitoring Wells	Maharashtra (GW)	DWLR	209
29.	Supply, Installation, Testing, Commissioning And Maintenance Of RTDAS with Establishment Of Data Centre For The Tapi River Basin	Maharashtra (SW)	RTDAS	80
30.	Supply, Installation, Testing, Commissioning And Maintenance Of RTDAS With Establishment Of Data Centre For The Godavari River Basin In Marathwada Region	Maharashtra (SW)	RTDAS	80
31.	Supply, Installation, Testing, Commissioning And Maintenance Of RTDAS With Establishment Of Data Centre (Goods) For The Lower Godavari River Basin In Vidarbh Region	Maharashtra (SW)	RTDAS	100
32.	SCADA system for reservoir operation of Hatnur Barrage in Tapi basin	Maharashtra (SW)	SCADA	10
33.	Supply, Installation, Testing, Commissioning And Maintenance Of RTDAS for part of Krishna river basin	Maharashtra (SW)	RTDAS	50
34.	Supply, Installation, Testing, Commissioning And Maintenance Of RTDAS with integration at existing Data Center, Pune for Westward flowing rivers in Konkan basin	Maharashtra (SW)	RTDAS	35
35.	Setting up of new Hydro-met Station Networks. (RTDAS)	Meghalaya	RTDAS	266
36.	Hydro-met system (RTDAS)	Mizoram	RTDAS	683
37.	RTDAS	Nagaland	RTDAS	395

S. No.	Package Name	Implementation Agency	Component	Amount
38.	Construction of Medium & Deep Piezometer [A1.2.02 & A1.2.03]	Odisha (GW)	Piezometer	146
39.	Supply, Installation, Testing, Commissioning, Training and Maintenance of Hydrological Information System for Odisha State	Odisha (SW)	RTDAS	575
40.	Shallow wells/ Piezometers and Deep Piezometers	Puducherry	Piezometer	8
41.	DWLR with Telemetry	Puducherry	DWLR	13.5
42.	Procurement and installation of DWLR with Telemetry for GW	Punjab	DWLR	880
43.	RTDAS For Punjab	Punjab	RTDAS	370
44.	Installation of RTDAS for Ground Water	Rajasthan	DWLR	498
45.	Hydrological Instruments (Sensors & Telemetry Systems) including DAS software	Telangana (SW)	RTDAS	574
46.	Hydro-met Network for Tripura along with Civil Work	Tripura	RTDAS	46
47.	DWLR with telemetry for ground water monitoring	Tripura	DWLR	7
48.	Real Time Data Acquisition System (RTDAS) incl. civil work for Surface Water	Uttar Pradesh (SW)	RTDAS	930
49.	Canal SCADA System	Uttar Pradesh (SW)	SCADA	300
50.	Installation of Block wise Key Piezometers	Uttar Pradesh (GW)	Piezometer	254
51.	Procurement of Hydro-Met Instruments (AWS, ARS, AWLR, VS, DWLR, & ADCP)	West Bengal (GW)	RTDAS	331
52.	Civil Works for Hydro-Met Instruments (AWS,ARS, AWLR, VS & DWLR)	West Bengal (GW)	RTDAS	98
53.	Supply, Installation, Testing, Commissioning and Maintenance of Real Time Data Acquisition System (RTDAS) for River Basins and Major Reservoirs in West Bengal	West Bengal (SW)	RTDAS	1744
54.	Supply, installation, testing, commissioning, training and maintenance of Automatic Operation of Durgapur Barrage along with collection, storage and dissemination of data	West Bengal (SW)	SCADA	300
55.	Construction of Control Room for SCADA of Durgapur Barrage	West Bengal (SW)	SCADA	60
56.	Construction of Control Room for SCADA of Tilpara Barrage	West Bengal (SW)	SCADA	60

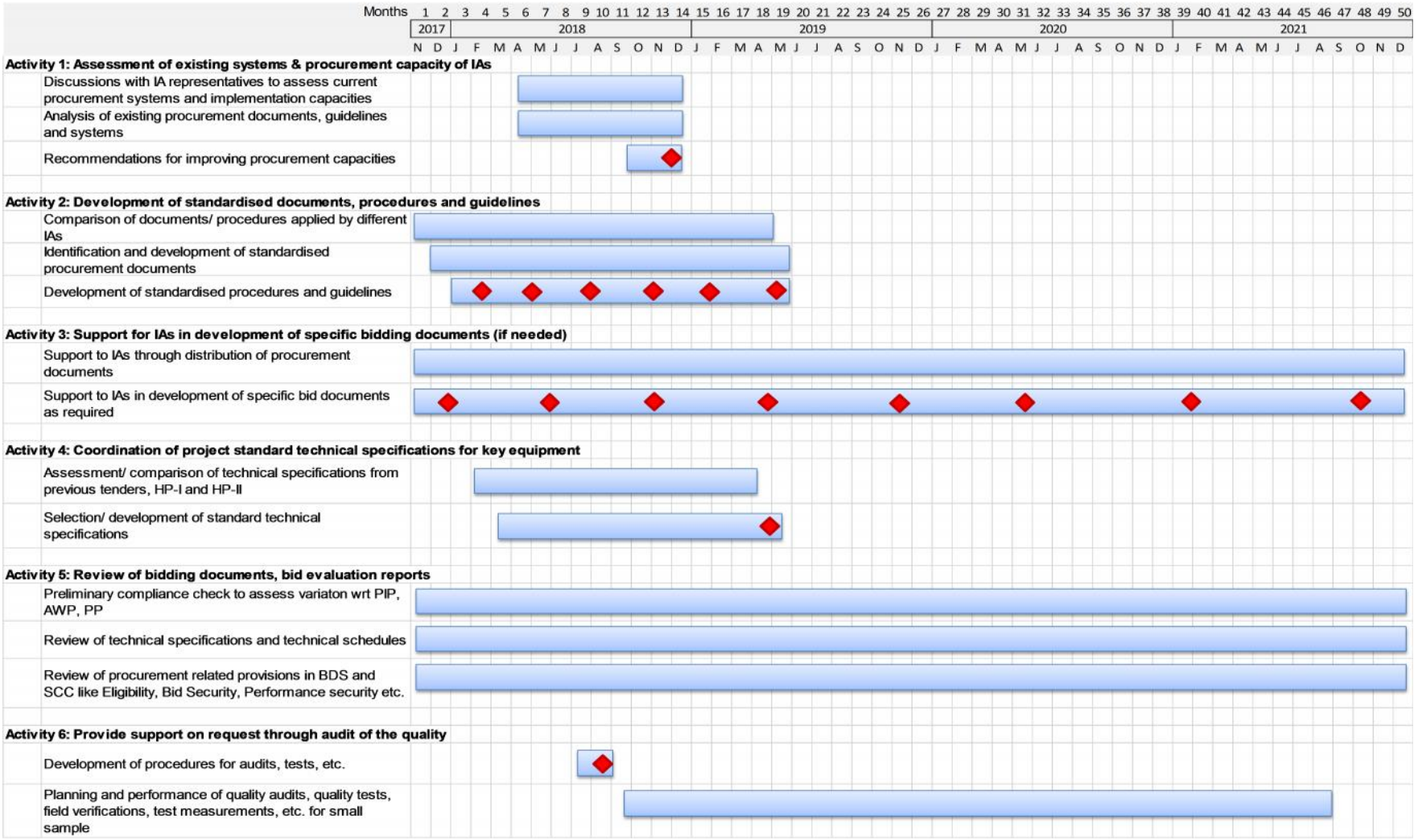
Appendix 1c: Gaps in the existing MIS and potential solution

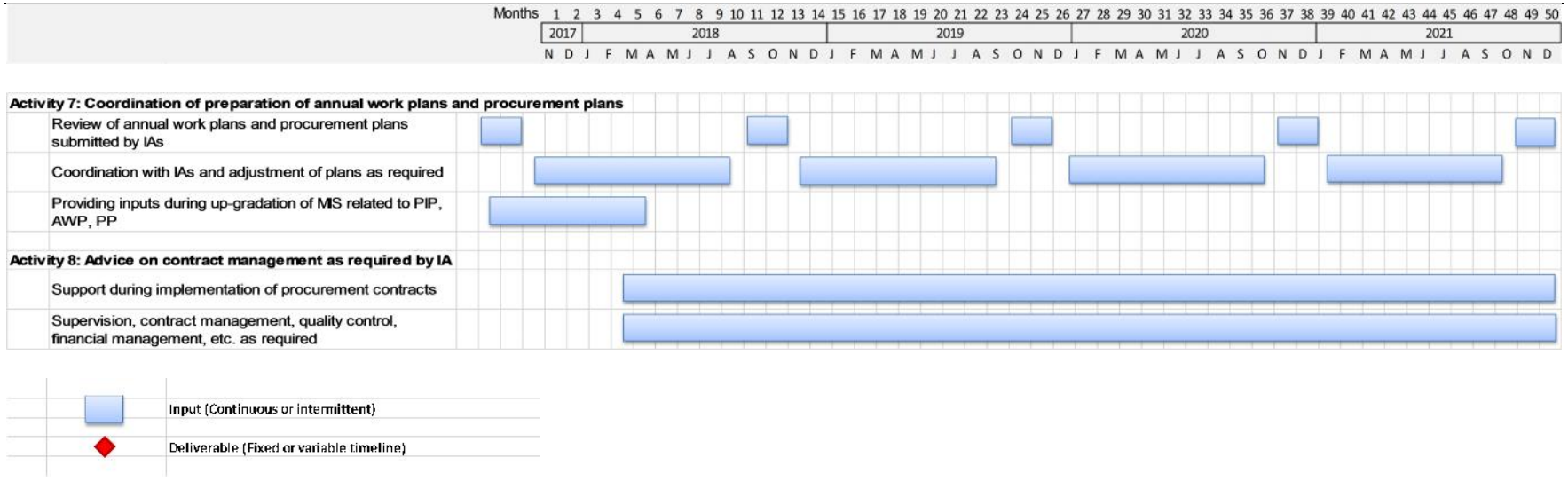
S. No.	MIS Reference	Assessment of gaps	Potential solution
1.	PIP section	PIP provides a list of activities, both procurement and operation related, to be undertaken by an IA over a period of 8 years. Each activity may either be taken wholly or be split into many sub-activities while preparing AWP and PP. If it is split into sub-activities, estimated cost will change when translating from PIP to AWP to PP. Further, review type (post/prior) depends on the estimated cost as per PP activity and not as per PIP or AWP activity. Since existing PIP format includes a column on Bank review, it might create unnecessary confusion.	"Bank review" column may be removed from the PIP – Cost section and may only be kept in the PIP – Procurement Plan section.
2.	PIP section	A column for Procurement type (Goods / Works / Non Consulting Services / Consulting Services) is not included in the PIP – Cost section at present. Including this column in the PIP – Cost section would bring better clarity when clubbing activities from AWP into PP.	A column for Procurement type (Goods / Works / Non Consulting Services / Consulting Services) may be included
3.	PIP section	PIP – Cost section provides total quantity and total amount for each of the activities. At present, there is no mechanism to ensure that activities / sub-activities planned in AWPs thus far is falling within the bracket of estimated quantity and amount as per PIP.	Columns mentioning balance quantity and amount under each activity of PIP may be included. Values in these columns should get automatically computed based on quantity and amount considered in AWPs of various years.
4.	AWP section	When adding an activity from PIP to an AWP, automatic carry forwarding options is not available at present. Due to this, IAs are currently unable to import balance activities from 2016-17 and 2017-18 AWPs. They would be required to put the details of previous activities again in the system while creating AWP 2018-19.	Options for automatic / simplified importing of balance activities from previous AWPs may be developed.
5.	AWP section	In activity type, there are two options – New activity and Ongoing activity. There is no provision to select balance	Third option for Balance activity may be created. Accordingly, input requirements for the three

S. No.	MIS Reference	Assessment of gaps	Potential solution
		activities at present. There can be third option for balance activities. New activity would be the one that was not considered in any of the previous AWPs whereas Ongoing activity would the one that was initiated in earlier years but not much progress has happened so far. Balance activity could be the one which was part of earlier AWPs but was not initiated in its planned year.	options may be modified. For example, IAs should not be required to input the details again for either Ongoing or Balance activities. System may be developed in such a way that IAs are able to easily extract information from previous AWPs.
6.	AWP section	In the existing MIS system, quantity and amount are not mandatory field when adding a new activity in an AWP. Further, input fields for quantity and amount can take both numerical as well as words.	Quantity and amount fields may be made mandatory and should only take numerical values.
7.	AWP section	Quantity and amount fields are not linked with the allocated values in PIP at present. It is difficult to ensure that cumulative values fall within the limit assigned in PIP.	Quantity and amount fields may be linked to ensure that they are within prescribed limits. In case of lump sum value for quantity field, input field may be modified accordingly.
8.	AWP section	In the approved fund planning, limits for allocation has been set for all the IAs. There is no automatic check on the extent to which activities can be selected in AWP for a particular year. It is being done manually at present.	AWP section may be strengthened so as to automatically put a check when activities (total quantity and total value) exceeds the prescribed limits for an IA.
9.	Procurement Plan section	Procurement plan is currently not linked with AWP in the system. Any correction in mismatch between AWP and PP is being done manually and through review of checklist submitted by the IA. To ease the process, it is recommended that PP be integrated with the AWP in manner so as to enable IAs to import single activity or multiple activities directly from AWP and form a procurement package. If this is done, then there wouldn't be any requirement of checklist to be submitted by the IA and chances of any mismatch will automatically reduce.	PP section may be linked and integrated with AWP section
10.	Procurement Plan section	There is also a need to improve the flow of the inputs/ data fields. After "Package Name" field, "Package Amount" field	Suggested improvement in the input / data flow may be considered.

S. No.	MIS Reference	Assessment of gaps	Potential solution
		should appear and values should be automatically calculated based on the summation of cost of different activities taken and clubbed from AWP. In "Procurement Type" field, different options are currently being provided – Goods / Works / Non Consulting Services / Consulting Services. Since activities are already categorized in AWP, respective field in the Procurement section may be populated from AWP. In case there are more than one activities belonging to different category, category of activity with higher cost may be taken. Further, "Bank review" and "Procurement method" fields may be automatically populated depending on the threshold values prescribed by the Bank.	
11.	Procurement Plan section	At present, it is difficult to know the quarterly procurement plan of IAs. Due to this, monitoring of physical and financial progress is not happening effectively.	A mandatory field for "Quarter" may be added. IAs may be required to select the quarter in which they are planning to float the bid document.
12.	"Add Bid Document" section	Any bid document being submitted by the IA to NPMU for review or recommendations should ideally have linkage with or reference to the approved PP. At present, IAs are uploading bid documents without any linkage or reference to the PP. NPMU has requested IAs to submit bid review checklist along with corresponding bid document to check whether the bid document is complying with the PIP, AWP and PP. Significant efforts are being made to review the compliance checklist.	"Add Bid Document" section may be properly linked to the approved PP of respective IAs during up-gradation of the existing MIS system.

Appendix 1d: Detailed work plan till 2021 (Procurement)




Months 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
2017 2018 2019 2020 2021
N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
Activity 7: Coordination of preparation of annual work plans and procurement plans
Review of annual work plans and procurement plans submitted by IAs
Coordination with IAs and adjustment of plans as required
Providing inputs during up-gradation of MIS related to PIP, AWP, PP
Activity 8: Advice on contract management as required by IA
Support during implementation of procurement contracts
Supervision, contract management, quality control, financial management, etc. as required
Input (Continuous or intermittent)
Deliverable (Fixed or variable timeline)

Appendix 2: M&E Baseline Survey Questionnaire

National Hydrology Project

Monitoring and Evaluation Questionnaire

SECTION -1: GENERAL INFORMATION

Table 1: Implementing Agency's Background:

Sl. No.	Particulars	
1	Name of Implementing Agency	
1a	Central Agency	
1b	State Agency	
2	If state agency:	
2a	Surface water agency	
2b	Ground water agency	
2c	SW & GW combined agency	
3	Name of Nodal Officer	
4	Contact No.	
5	Email ID	

Table 2: Basin/Sub-basin details in the State:

Sl. No.	Name of Basin	Name of Sub-basin	Sub-basin nomenclature as per IndiaWRIS	Area (sqkm)
1				
2				
….				

Table 3: Project's Basic Information:

Sl. No.	Particulars	Unit	Response
1	Prepared AWP (2018-19)	Y/N	
2	State Level Steering Committee formed	Y/N	
3	No. of SLSC meetings held	Nos.	

SECTION - 2: HYDRO-MET STATIONS

Project Development Objective (PDO) Indicators - 1: Water Resources Monitoring Stations

Table 4: Do you have Hydro-met stations for data collection

If yes, number of hydromet stations:

Sl. No.	Monitoring stations	Numbers			
		Manual	Automatic	RTDAS	Total
1	Surface water stations				
2	Groundwater stations				
3	Meteorological stations				

Table 5: Surface water stations - working status and providing data

Sl. No.	Type of station	Gauge level	Gauge level + Discharge	Gauge level + Discharge + Sediment	Gauge level + Discharge + Water Quality	Gauge level + Discharge + Sediment + Water Quality	Total
1	**Manual**						
1a	Working						
1b	Temporary not working						
1c	Not working						
2	**Automatic**						
2a	Working						
2b	Temporary not working						
2c	Not working						
3	**RTDAS**						
3a	Working						
3b	Temporary not working						
3c	Not working						

Table 6: Groundwater stations - working status and providing data

Sl. No.	Type of station	Groundwater level	GW level + Temperature	GW level + Temperature + TDS	GW level + quality	Total
1	**Manual**					
1a	Working					
1b	Temporary not working					
1c	Not working					
2	**Automatic**					
2a	Working					
2b	Temporary not working					
2c	Not working					
3	**RTDAS**					
3a	Working					
3b	Temporary not working					
3c	Not working					

Table 7: Meteorological stations - working status and providing data

Sl. No.	Type of station	Automatic Raingauge	Automatic water stations	Automatic Raingauge + Automatic water stations	Total
1	**Manual**				
1a	Working				
1b	Temporary not working				
1c	Not working				
2	**Automatic**				
2a	Working				
2b	Temporary not working				
2c	Not working				
3	**RTDAS**				
3a	Working				
3b	Temporary not working				
3c	Not working				

SECTION - 3: KNOWLEDGE/INFORMATION PRODUCTS

Project Development Objective (PDO) Indicator - 2: Information products developed

Table 8: Knowledge/information products developed:

Sl. No.	Name of products/manuals	Products/manuals is shared with (name of agency)	Product accessible through			
			On request	Online*	Mobile	Other mode, specify
1	Topographic surveys					
2	Digitized maps					
3	Earth observation data products					
4	Ensemble forecast products					
5	Web-based analytical tools					
6	Forecasting materials					
7	water accounting reports					
8	HIS manuals					
9	Any other product, specify					
…						
…						
…						
…						

* provide website link

SECTION - 4: IMPLEMENTING AGENCY PERFORMANCE

Project Development Objective (PDO) Indicator - 3: Performance of water resources institutions

Institutional setup (25%)

PDO - 3 (a)

Do you have staff who are carrying out technical studies/analyses related to water resources (Y/N)

Table 9: No. of staff undertaking technical work

Sl. No.	Staff	Numbers
1	Chief Engineer	
2	Superintending Engineer	
3	Executive Engineer	
4	Asstt. Executive Engineer	
5	Asstt. Engineer	
6	Others	
	Total	

Training arrangements (25%)

PDO - 3 (b)

Do you have training arrangement for the staff? (Y/N)

Table 10: Number of staff who have received training during last 12 months in which subjects:

Sl. No.	Subject	No. of staff
1		
2		
3		
…		
…		
…		

Service provision (50%)

PDO - 3 (c)

Is your organisation providing services to other organisation? (Y/N)

Table 11: If yes, which services and name of organisation:

Sl. No.	Type of services*	Name of Organization
1		
2		
3		
4		
5		
6		

* Type of services may be "providing reports on flood forecasting, river basin assessment, collaboration & information exchange etc." developed under the project.

INTERMEDIATE RESULTS INDICATORS

SECTION - 5: WATER DATA CENTRE

Intermediate Results Indicator 1 through eWRIS/WRIS

Table 12: Intermediate Results Indicator 2

Sl. No.	Indicators	Units	Remarks
1	Data centre in place	yes/no	
2	% of stored data digitized	%	
3	Infrastructure for database management in place*	yes/no	
4	Data back-up policy in place	yes/no	
5	Data sharing policy in place	yes/no	
6	Data accessibility	OR/online/ mobile/others	

*data monitoring, processing and dissemination

Intermediate Results Indicator 3 through eWRIS/WRIS

Intermediate Results Indicator 4

Table 13: Number of reports provided on web-portal (monthly/seasonal):

Sl. No.	Description	Number
1	Storages	
2	Inflow forecast	
3	Projected demands	
4	Flood forecasting	
5	SW monthly report	
6	GW monthly report	
7	Water avilability	
8	Disaster	
9	Others (specify)	

Intermediate Results Indicator 5

Number of stations/reservoirs where flood forecast is improved with increase in lead time at least by one day (nos.)

Intermediate Results Indicator 6

Table 14: Number of targeted professional trained:

Sl. No.	Name of training course	Number of professionals trained	No. of days training provided
1			
2			
3			
4			
5			

Appendix 3: MIS Gap Analysis

MIS GAP Analysis Report

Module Name	Submodule	Features	User	Existing/New	MDOE	Comments
Finance						
	Admin Module					
		Budget Allocation	NPMU	Existing	M	Budget Allocation, Component wise and based on AWP by NPMU admin. Need to be redeveloped as the validations and checks need to be incorporated while entering the budget, Maker Checker IA Wise
		Annual Budget Estimate Entry	Implementing Agency	New	M	validation of 60% expenditure, Freezing, Revalidation Facility
		Annual Budget Estimate Approval	NPMU	New	M	
		Revised Estimate Entry	Implementing Agency	New	M	6 monthly, validation of 60% expenditure, Freezing, Revalidation Facility
		Revised Estimate Approval	NPMU	New		6 Monthly
		Final Grant	NPMU	New	M	Entry of Tranches released (As and when)
		ADD/Update Interest/Other receipt	Implementing Agencies	Existing	M	Screen modification for other recipt
		Interchange of budget (admin right)	NPMU	Existing	M	Log needs to be maintained. Presently it is a open screen. Any changes need internal validation and checks.
	Agency Module	Demand for Budget	Implementing Agencies	New	M	Every 6 month Demand for budget, validation of expenses if 60% utilised against previous allocation
		Approval of Budget (Revalidation/Freeze/Approval)	NPMU	New	M	
		Expenditure Entry	Implementing Agencies	New	M	Based on allocation, validations and checks need to be incorporated while entering the budget
		Revised Expenditure	Implementing Agencies	New	M	Based on allocation, validations and checks need to be incorporated while entering the and revised budget
		Final Budget demand	Implementing Agencies	New	M	validations and checks need to be incorporated while entering final demand
		Audit Monitoring	Implementing Agencies	New	M	Tracking of audit query and action to be taken by the agencies. Audit shold be done by third party or Audit Agency
	MIS/Dashbaord	Dashboard- Physical and financial progress- Decision Support System	NPMU/Implementing Agency	New	M	Based on role and authority matrix, information will be displayed, drill down report, % progress
		Dashboard- Physical and financial progress- Decision Support System	NPMU	New	M	Overall
		Reports - Monthly Progress report	NPMU/Implementing Agency	New	M	Overall and Component wise MPR, Based on role and authority matrix, information will be displayed
		IUFR (Quarterly/Monthly/Yearly)	NPMU/Implementing Agency wise	Existing	M	Report generation in three formats, Need to be formatted in Worldback format, updation required to capture validations level
		IUFR Submission	Implementing Agency	New	M	Upload faclity of IUFR Submission

Module Name	Submodule	Features	User	Existing/New	MDOE	Comments
		IUFR Status report	NPMU	New	M	NPMU needs overall status of submitted /non-submitted IUFR
		IUFR Consolidated	NPMU	New	M	
		IUFR - ReOpen after Submission	NPMU/Implementing Agency	New	M	Facility to revise Submitted IUFR
		Financial Progress (Monthly/Quartely/Yearly)	NPMU/Implementing Agency	NEW	M	Report generation , need to be parameterised, date from - date to
		Reports- SOC	NPMU/Implementing Agency	NEW	M	Report generation , need to be parameterised, date from - date to
	Alerts & Notifications	SMS/Email	Auto	NEW	M	Mail, SMS alert on demand submission, on approvals
		Scheduler for Notifications	Auto	NEW	M	Mail, SMS reminders based on Schedulers based on SLAs. Language need to be finalised with MPMU
	Integration	Integration with PFMS		E	E	Roadmap
PIP/Procurement						
	Admin/Agency					
		Add/Update Activity	NPMU/Implementing Agency	Exisiting	M	Modification on UX and Validation Checks
		Add/Update ItemCode	NPMU/Implementing Agency	Exisiting	M	Modification on UX and Validation Checks
		Add/Update Equipements	NPMU/Implementing Agency	Exisiting	M	Modification on UX and Validation Checks
		Add/Update Cost	NPMU/Implementing Agency	Exisiting	M	Modification on UX and Validation Checks
		Add/Update River Basin	NPMU/Implementing Agency	Exisiting	M	Modification on UX and Validation Checks
		Add/Update Annual Work Plan	NPMU/Implementing Agency	Exisiting	M	Provision to introduce STEP Reference number, Quarterly capturing
		Add/Update Procurement Plan	NPMU/Implementing Agency	Exisiting	M	Provision to introduce STEP Reference number
		Add/Update Expenditure	NPMU/Implementing Agency	Exisiting	M	Modification on UX and Validation Checks
		Equipement Calculator	NPMU/Implementing Agency	Exisiting	M	Modification on UX and Validation Checks
		Item Shuffling	NPMU/Implementing Agency	Exisiting	M	Component Shuffling, Existing shuffling faclity is for component shuffling.
		AWP Allocation Summary	NPMU/Implementing Agency	Exisiting	M	Modification on UX and Validation Checks
		AWP Planned Summary	NPMU/Implementing Agency	Exisiting	M	Modification on UX and Validation Checks
		Declaration	NPMU/Implementing Agency	Exisiting	M	IUFR Declaration
		Edit/Delete/ReOpen Package	NPMU/Implementing Agency	Exisiting	M	Procurement Package
		Steps 1- Select Procurement Category Step 2-On basis of Category Select Procurement Method Step 3- Based on selected method Road map will be generate i.e EOI Date, Pre-bid query etc.	NPMU/Implementing Agency	New	M	Validation against PIP, AWP, STEP number, capture Planned

Module Name	Submodule	Features	User	Existing/New	MDOE	Comments
		Progress Tracking of Pacakge/ Activity - Target, Document prepared, Approved, NIT Issue, Award of Contract - Update at each stage	NPMU/Implementing Agency	NEW	M	Physical and financal tracking of the each acitivity, Actual VS Planned
		Master Child- Procurement Category, Procurement Method, Procurement Stages	NPMU	New	M	Add Delete facility for mapping of procurement stages based on Procurement method and type
	MIS/Dashboard	Reports	NPMU/Implementing Agency		M	
		Procurement Summary	NPMU/Implementing Agency	NEW	M	Parameterize Report
		Procurement Scheduling	NPMU/Implementing Agency	NEW	M	Parameterize Report
		Procurement Implementation	NPMU/Implementing Agency	NEW	M	Parameterize Report
		Dashboard for Procurement	NPMU/Implementing Agency	NEW	M	TBD
	Integration				M	
		Integrate with MIS Finance Module	NPMU/Implementing Agency	NEW	M	Check if Budget is avialable at Componenet/Sub component level
	Alerts & Notifications	SMS/Email	Auto	NEW	M	Mail, SMS alert on submission, on approvals
		Scheduler for Notifications	Auto	NEW	M	Mail, SMS reminders based on Schedulers based on SLAs. Language need to be finalised with MPMU
Project Status		User Dashboard	NPMU/Implementing Agency	Existing	M	Dashboard to be modified based on new inputs
		Visitor Dashboard	all	New	M	
		Admin Dashboard	NPMU	New	M	
Project Progress(M&E)		Procurement Document (Progress)	NPMU/Implementing Agency	Existing	M	Dashboard to be modified based on KPIs and weightage , hardcoding of weightage to be removed
		M&E (Physical Progress) - Project Readiness	NPMU/Implementing Agency	Existing	M	Dashboard to be modified based on KPIs and weightage , hardcoding of weightage to be removed
		Performance (Overall Performance)	NPMU/Implementing Agency	Existing	M	Dashboard to be modified based on KPIs and weightage , hardcoding of weightage to be removed
Readiness Criteria:		PIP Cost Tab	NPMU/Implementing Agency	Existing	M	Need to up updated for new fields
		PIP	NPMU/Implementing Agency	Existing	M	
		Procurement Plan	NPMU/Implementing Agency	Existing	M	
		Work Plan	NPMU/Implementing Agency	Existing	M	
		Ministry Review	NPMU/Implementing Agency	Existing	M	
		Dashboard	NPMU/Implementing Agency	Existing	M	Need to up updated for new fields

Module Name	Submodule	Features	User	Existing/New	MDOE	Comments
Training						
	Admin/Agency	Training Calendar	NPMU/Implementing Agency	Existing	M	
		Add New Training	NPMU/Implementing Agency	Existing	M	
		Attach Traning Material	NPMU/Implementing Agency	Existing	M	
		Download List of Participante	NPMU/Implementing Agency	Existing	M	
		Participants Attendance	NPMU/Implementing Agency	Existing	M	If participant de-register from training
		Participants Verification	NPMU/Implementing Agency	Existing	M	If participant de-register from training
					M	
	Agency Staff	Registration of Participants	NPMU/Implementing Agency	Existing	M	Few fields need to be added
		Participant Edit Profile	NPMU/Implementing Agency	NEW	M	Log needs to be maintained.
		De-register from training	NPMU/Implementing Agency	NEW	M	
		Training Summary	NPMU/Implementing Agency	NEW	M	Link with Feedback Module and maintain the log
		Facility of on-spot registration	NPMU/Implementing Agency	Existing	M	New fields
	MIS/Dashboard	Dashboard for Training	NPMU/Implementing Agency	NEW	M	to be decided
		Reports	NPMU/Implementing Agency	NEW	M	3-4 Standard reports
	Alerts & Notifications	SMS/Email	Auto	NEW	M	Mail, SMS alert on submission, on approvals
		Scheduler for Notifications	Auto	NEW	M	Mail, SMS reminders based on Schedulers based on SLAs. Language need to be finalised with MPMU
Workshop & Meeting:						
	Admin/Agency	Workshop Calendar	NPMU/Implementing Agency	Existing	M	IA onetime upload and update
		Add New Workshop	NPMU/Implementing Agency	Existing	M	
		Attach Workshop Material	NPMU/Implementing Agency	Existing	M	
		Download List of Participante	NPMU/Implementing Agency	Existing	M	
		Participants Attendance	NPMU/Implementing Agency	Existing	M	If participant de-register from workshop
		Participants Verification	NPMU/Implementing Agency	Existing	M	If participant de-register from workshop
	User	Registration of Participants	NPMU/Implementing Agency	Existing	M	
		Participant Edit Profile	NPMU/Implementing Agency	NEW	M	Log needs to be maintained.
		De-register from Workshop	NPMU/Implementing Agency	NEW	M	
		Workshop Summary	NPMU/Implementing Agency	NEW	M	Link with Feedback Module and maintain the log
	MIS/Dashboard	Dashboard for Workshop		NEW	M	TBD
		Reports		NEW	M	3-4 Standard reports
	Alerts & Notifications	SMS/Email	Auto	NEW	M	Mail, SMS alert on submission, on approvals
		Scheduler for Notifications	Auto	NEW	M	Mail, SMS reminders based on Schedulers based on SLAs. Language need to be finalised with MPMU
DMS						

Module Name	Submodule	Features	User	Existing/New	MDOE	Comments
	Admin Module	ADD New Document	NPMU/Implementing Agencies	Existing	D	
		Update Document	NPMU/Implementing Agencies	Existing	D	
		Review Document	NPMU/Implementing Agencies	Existing	D	
		Approved Document	NPMU/Implementing Agencies	Existing	D	
		Reject Document	NPMU/Implementing Agencies	Existing	D	
		Document Category Master	NPMU/Implementing Agencies	Existing	D	Need to provide GUI for Master entry
		Document Transfer b/w Agencies	NPMU/Implementing Agencies	NEW	D	Sharing document between agencies, Log needs to be maintained.
	Agency Module	Add New Document	Implementing Agencies	Existing	D	
		Update Document	Implementing Agencies	Existing	D	
		Document Transfer b/w Agencies	Implementing Agencies	NEW	D	Sharing document between agencies,Log needs to be maintained.
	Alerts & Notifications	SMS/Email	Auto	NEW	D	Mail, SMS alert on submission, on approvals
		Scheduler for Notifications	Auto	NEW	D	Mail, SMS reminders based on Schedulers based on SLAs. Language need to be finalised with MPMU
					D	
	MIS/Dashboard	Reports/Queries		NEW	D	Queries faclity, Parameterised
		Dashboard		NEW	D	Dashboard for Document overall status
Feedback						
	Admin/Agencies Module	Question Master	NPMU/Implementing Agencies	NEW	M	Dynamic question has been create by Admin/Agencies
		Answer Category Master	NPMU/Implementing Agencies	NEW	M	Category of Answer i.e. checkbox,textbox,radio button etc.
		Associate with Traning	NPMU/Implementing Agencies	NEW	M	Mapping with training/workshop module
		Activate/De-activate	NPMU/Implementing Agencies	NEW	M	Activate/De-Activate the feedback without deactivating the training/workshop
	User Module	Feedback Form	Participant	NEW	M	Generate dynamically
		Rating the traning with graphical presentation	Participant	NEW	M	Part of feedback form
		Overall rating	Participant	NEW	M	Part of feedback form
		Populate feedback page according to training	Auto	NEW	M	After completition of training/workshop feedback form will be populated
	MIS/Dashboard	Dashboard:-	Based on Role	NEW	M	
		Admin	Based on Role	NEW	M	See overall Progress
		Agencies	Based on Role	NEW	M	Agency wise Progress
		Participant	Based on Role	NEW	M	Participant wise progress
			Based on Role		M	
		Reports:-	Based on Role	NEW	M	3-4 reports

Module Name	Submodule	Features	User	Existing/New	MDOE	Comments
		Analysis	Based on Role	NEW	M	
		Plan vs achivement	Based on Role	NEW	M	
	Alerts & Notifications	SMS/Email	Auto	NEW	M	Mail, SMS alert on submission, on approvals
		Scheduler for Notifications	Auto	NEW	M	Mail, SMS reminders based on Schedulers based on SLAs. Language need to be finalised with MPMU
Grievance						
	User Module	Generate Grievance (without Login)	Website User	Existing	M	
		Reminder	Website User	Existing	M	Integration with SMS & Email Notification
		View Status	Website User	Existing	M	Integration with SMS & Email Notification
		Response	Website User	Existing	M	Integration with SMS & Email Notification
		Escalation	Website User	NEW	M	Escalate to the Admin in case use not satisfy
	Agency Module				M	
		Response/Closed	Implementing Agencies	Existing	M	
		Forward to Admin	Implementing Agencies	NEW	M	In case the gruevance not resolve at his/her level
		Escalation	Implementing Agencies	NEW	M	Escalate to Aadmin in case SLA not meet
	Admin Module				M	
		Response/Closed	NPMU	NEW	M	
		Forward to Appelate Authority	NPMU	NEW	M	Escalate to Aadmin in case SLA not meet
	Appellate Authority				M	
		Response/Closed	Appellate authority	NEW	M	Finally response and close the grievance
	Alerts & Notifications	SMS/Email	Auto	NEW	M	Mail, SMS alert on submission, on approvals
		Scheduler for Notifications	Auto	NEW	M	Mail, SMS reminders based on Schedulers based on SLAs. Language need to be finalised with MPMU
	MIS/Dashboard	Reports		NEW	M	
		Dashboard Admin		NEW	M	
		Dashboard Agency		NEW	M	
		Appellate Authority		NEW	M	
CMS	**CMS ADMIN**	Content Management	Admin	NEW	D	This is required for publising, updating various documents and guidelines
		Menu Management	Admin	NEW	D	
		Publish Management	Admin	NEW	D	
		Multilingual	Admin	NEW	D	
		Article Management	Admin	NEW	D	

Module Name	Submodule	Features	User	Existing/New	MDOE	Comments
		Creating and Managing Informational Pages	Admin	NEW	D	
		Template Management	Admin	NEW	D	
		FAQ Management	Admin	NEW	D	
Reports					M	
		Implementing Agency	ALL Users based on Role	EXISTING	M	
		Staffs	ALL Users based on Role	EXISTING	M	
		PDS Documents	ALL Users based on Role	EXISTING	M	
		BID Documents	ALL Users based on Role	EXISTING	M	
		Training Feedback	ALL Users based on Role	EXISTING	M	
		E Procurement Assessment	ALL Users based on Role	EXISTING	M	
		Release vs. Expenditure	ALL Users based on Role	EXISTING	M	
		Agency Summary Profile	ALL Users based on Role	EXISTING	M	
		Performance Manual	ALL Users based on Role	EXISTING	M	
		Procurement Document	ALL Users based on Role	EXISTING	M	
Hydromet Stations						
		Exisiting Hydromet Stations	Publically	New	M	We will publish data static/ dynamic from e-Swis/WARIS
		Proposed Hydromet Stations	Publically	New	M	We will publish data static/ dynamic from e-Swis/WARIS
		Ground Water	Publically	New	M	We will publish data static/ dynamic from e-Swis/WARIS
		Water level	Publically	New	M	We will publish data static/ dynamic from e-Swis/WARIS
		Precipitations	Publically	New	M	We will publish data static/ dynamic from e-Swis/WARIS
		Weather Stations	Publically	New	M	We will publish data static/ dynamic from e-Swis/WARIS
Master	**Project Plan**	ADD	NPMU	Existing	M	This facility is to capture all the overall project physical and financial target as per PAD document
		EDIT	NPMU	Existing	M	
		DELETE	NPMU	Existing	M	
	Component Master	ADD	NPMU	Existing	M	
		EDIT	NPMU	Existing	M	
		DELETE	NPMU	Existing	M	
	Sub-Component Master	ADD	NPMU	Existing	M	
		EDIT	NPMU	Existing	M	
		DELETE	NPMU	Existing	M	
	Vendor Master	ADD	NPMU/Implementing Agency	Existing	M	New module to be created for Standard Configuration/ Features, and faclititate vendor selection based in standard/protocols/features

Module Name	Submodule	Features	User	Existing/New	MDOE	Comments
		EDIT	NPMU/Implementing Agency	Existing	M	
		DELETE	NPMU/Implementing Agency	Existing	M	
	Equipment Master	ADD	NPMU/Implementing Agency	Existing	M	
		EDIT	NPMU/Implementing Agency	Existing	M	
		DELETE	NPMU/Implementing Agency	Existing	M	
	WEB Event	ADD	NPMU/Implementing Agency	Existing	M	GUI changes, Scrolling
		EDIT	NPMU/Implementing Agency	Existing	M	
		DELETE	NPMU/Implementing Agency	Existing	M	
	Gallery	ADD	NPMU/Implementing Agency	Existing	M	facility to upload multiple image
		EDIT	NPMU/Implementing Agency	Existing	M	facility to upload multiple image
		DELETE	NPMU/Implementing Agency	Existing	M	
	SPMU Staff	ADD	NPMU/Implementing Agency	Existing	M	
		EDIT	NPMU/Implementing Agency	Existing	M	
		DELETE	NPMU/Implementing Agency	Existing	M	
	ADD User	ADD	NPMU	Existing	M	
		EDIT	NPMU	Existing	M	
		DELETE	NPMU	Existing	M	
		BLOCK	NPMU	Existing	M	
	SLA	Add	NPMU	New	M	Service level for reminders, time stamping capturing
		Edit	NPMU	New	M	
		Delete	NPMU	New	M	
		Activate/Deactivate	NPMU	New	M	
Website/Portal other activities			Publically			
		New Home Page	Publically	NEW	M	
		Responsive Design	Publically	NEW	M	
		Prntable and Exportable	Publically	New		Infotmation, Queries and printing of all information/forms/queries
		Re-Open IUFR Declaration	Publically	NEW	M	
		New Pages for HP1	Publically	NEW	M	
		New Pages for HP2	Publically	NEW	M	
		SMS Integration	Publically	NEW	M	
		MIS Dashboard for Visitor	Publically	NEW	M	
		Code Cleaning	Publically	Existing	M	
		Standardization of Code	Publically	Existing	M	
		Cosmetic Changes	Publically	Existing	M	

Definations:

M Must required 'This feature should be built into the final system unless the cost is too high.'

Module Name	Submodule	Features	User	Existing/New	MDOE	Comments

D Desirable requirement. 'This feature should be built into the final system unless the cost is too high.'
O Optional requirement. 'This feature can be built into any system we have.'
E Possible future enhancement. 'This feature may be used in the final system, however we just want the feature in and of itself.'

Appendix 4: eSWIS Performance Testing

Analysis of the performance of eSWIS during high load activity

During recent months, the activities of Report Generation and Bulk Import Upload have been identified to strongly impact the throughput and performance of eSWIS. The following report represents a condensed version of the results generated by the tests carried out to assess the cause of this impact.

1. Starting Conditions

Environment:

The following equipment was used to perform the tests:

Hardware:

- Single Intel E7-2820 Processor – 2.0 GHz / 8 cores / 16 threads
- 64 GB DDR3 RAM
- 2 x 1 TB 7.2 RPM NL SAS HDD – Raid 0/1

Software:

- Tomcat v 7.0.42
- Java v 1.7.0_51
- Apache v 2.4.6
- PostgreSQL 9.1.13

Tomcat is configured to request the OS for up to 42 GB RAM

Testing procedure:

The tests were performed by logging the CPU and memory activity of the system during operation time. The system was pushed to its working limits by starting simultaneously the following tasks:

- 3 Report generations (Central Flood Control Room Daily Bulletins, all reports included)
- 4 Imports (MERO_11.01.2017.MDB.zip, 152.764 MB, 1347.168 MB uncompressed)

eSWIS handles all these tasks concurrently in individual threads.

The results of this test will be designated Test Case A.

Because the import process is much longer than the report generation, a second test with the same input was carried out, but the reports were started roughly 8 hours after the import process started. The results from this test will be designated Test Case B

During the test, a test user performed some routine operations to test the performance under heavy load and logged his experiences.

The time during file upload was not tested, although operation proceeded smoothly during that period.

2. Test Results

2.1 Test Case A

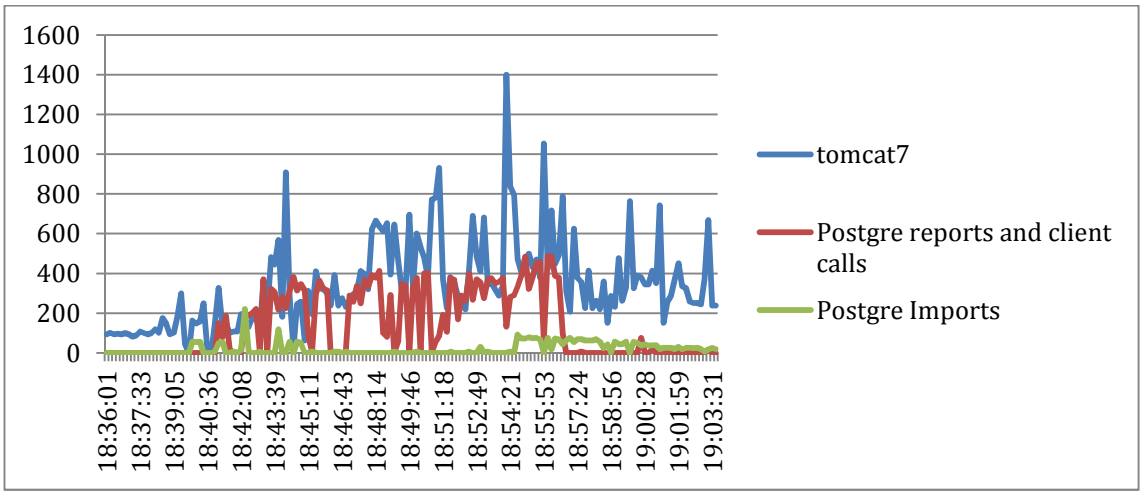


Figure 1: CPU usage during simultaneous operation (early)

This graph represents the CPU consumption during simultaneous operation of the system early on, until the reports are finished (roughly 30 minutes). The application server and database server is in a state of recent restart, and thus it is working in a clean environment.

As observed, most of the cycles are consumed by the application server, while roughly 1 core is used per generated report at its fullest on the database side.

The application server performance is more complex to examine, because its process is quite irregular. It shows several points where the resource usage increases sharply, which is also common during normal operation

The database import generation has a lot of processing overhead, and thus takes time to start consuming cores in database tasks. This is further examined at a later point.

During this time period, the normal operation of the application did not experience lowered performance for the test users.

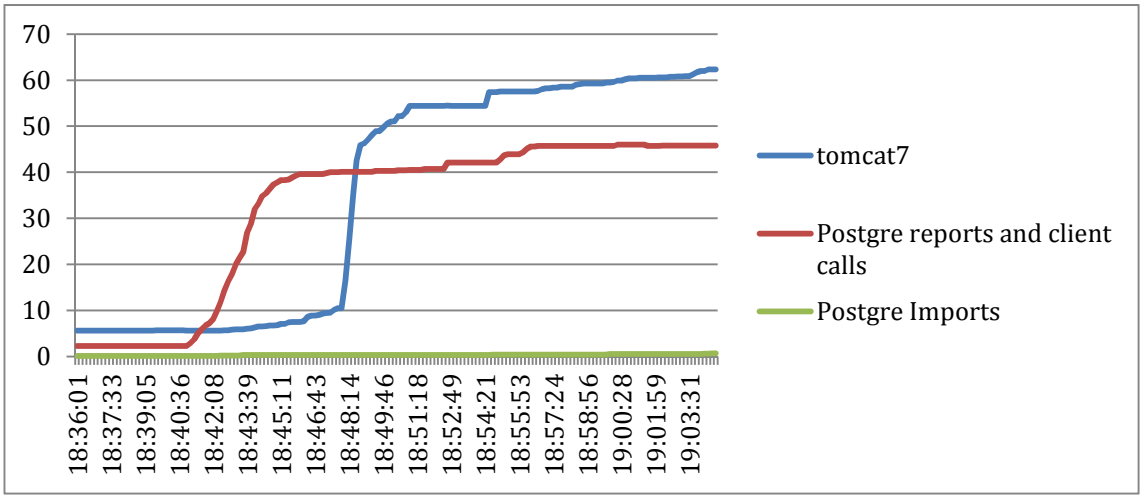


Figure 2: Memory usage during simultaneous operation

This graph represents the memory usage during the same time period than in the previous one.

For reference, the tool used is giving the aggregate of percentage of memory usage per thread. Several threads can access the same memory page, and thus the results can be higher than 100%, as a single page can be accessed by more than one thread. Regardless, this is indicative of the amount of resources required by individual subsystems, especially in contrast with the consumption of individual tasks.

In this case, the PostgreSQL threads for reports quickly increase their resource consumption quickly up to the maximum allowed by the system, and the application server quickly grows to its maximum. This in turn forces the slow starting import processes to remain inactive until later on.

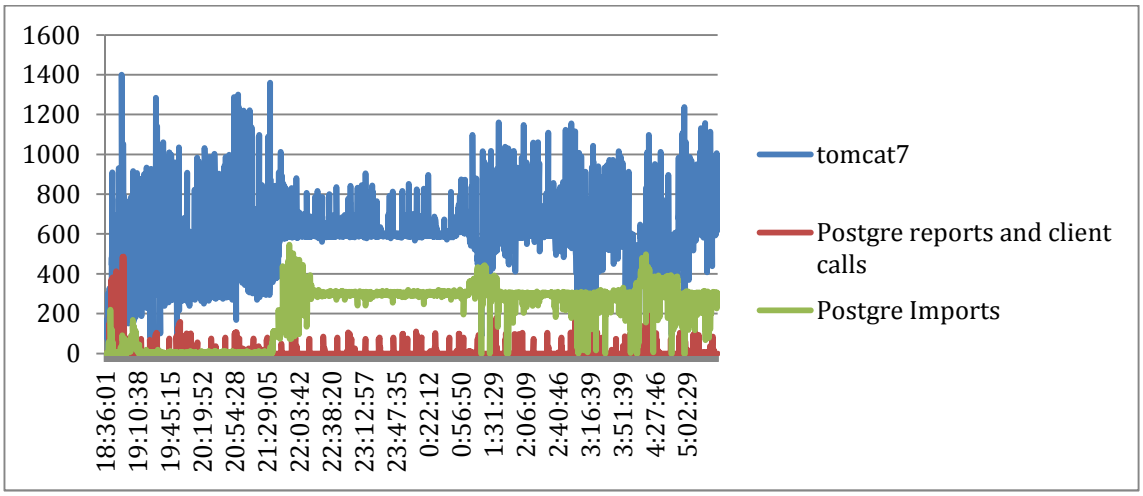


Figure 3: CPU usage evolution (long term)

This graph displays the CPU usage over the import process, which takes several hours to complete. The report generation ends quite early on, and thus does not affect the bulk of the import process, although it leaves some live processes in wait for further connections.

The import process goes over several stages, and strains both the database service and the application service, which can be observed by the stabilization of the CPU usage of the application server. In worst case, it takes up to 2 cores per thread in the application server space and up to 1 core per thread for database queries (which according to the WAL logs is mostly writes).

During peak operation, the test users did experience poor performance.

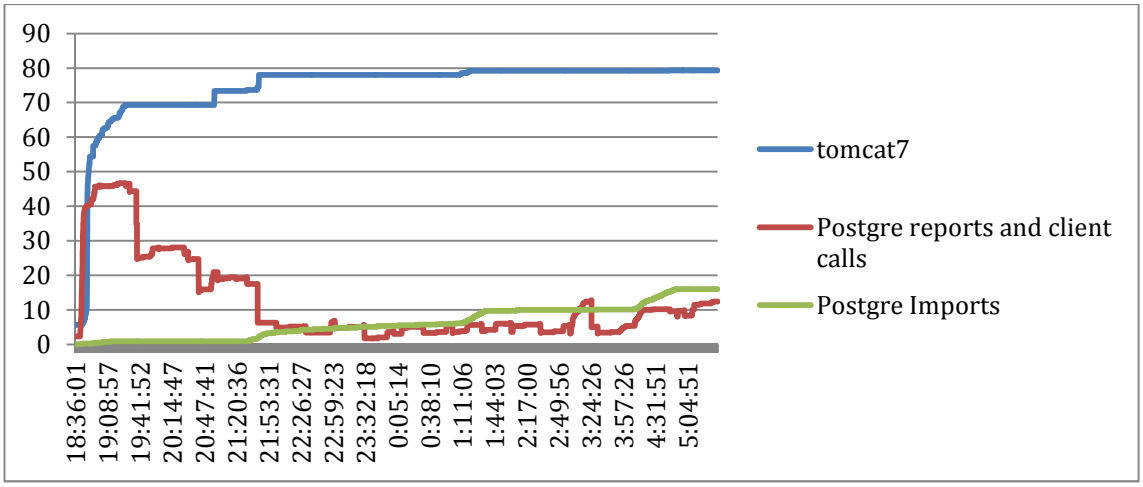


Figure 4: Memory usage evolution (long term)

This graph displays the memory usage of the system the import process. Overall, the system maintains its resource usage for the application server as expected, but shows relatively low memory requirement on import tasks, in contrast to CPU requirements.

2.2 Test Case B

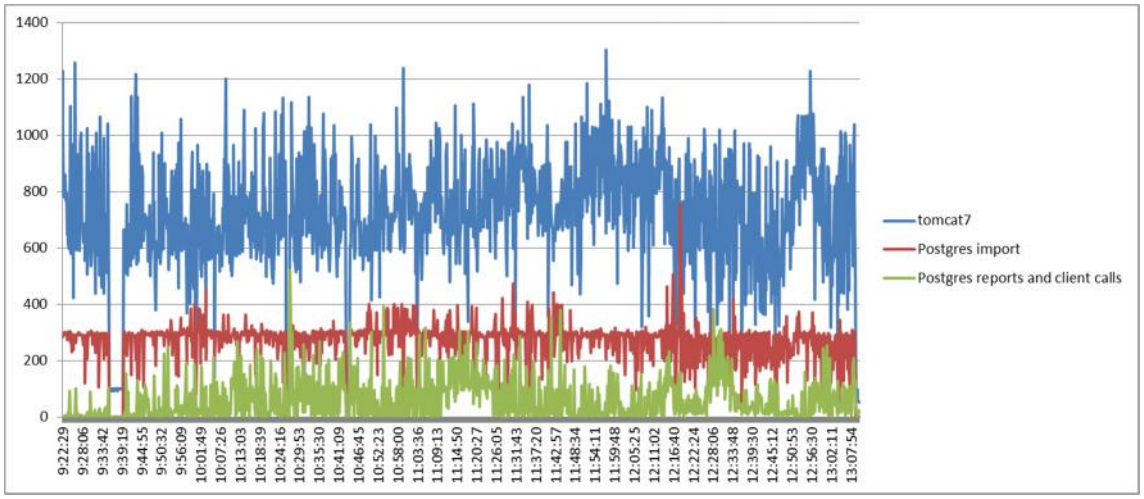


Figure 5: CPU usage during simultaneous operation (late start)

This graph shows the CPU usage during simultaneous operation of report generation and import processing, once the late (heavy) phase of import processing has begun until the reports are finally generated. The report generation took several hours to finish, in stark contrast with the previous case.

During this period, the CPU usage remains more or less stable due to resource scarcity. Similarly, and in contrast with the previous case, report generation seems to consume much less CPU for the same reason, while import processing stays stable.

The test users reported severe performance impact during this phase in all their tasks.

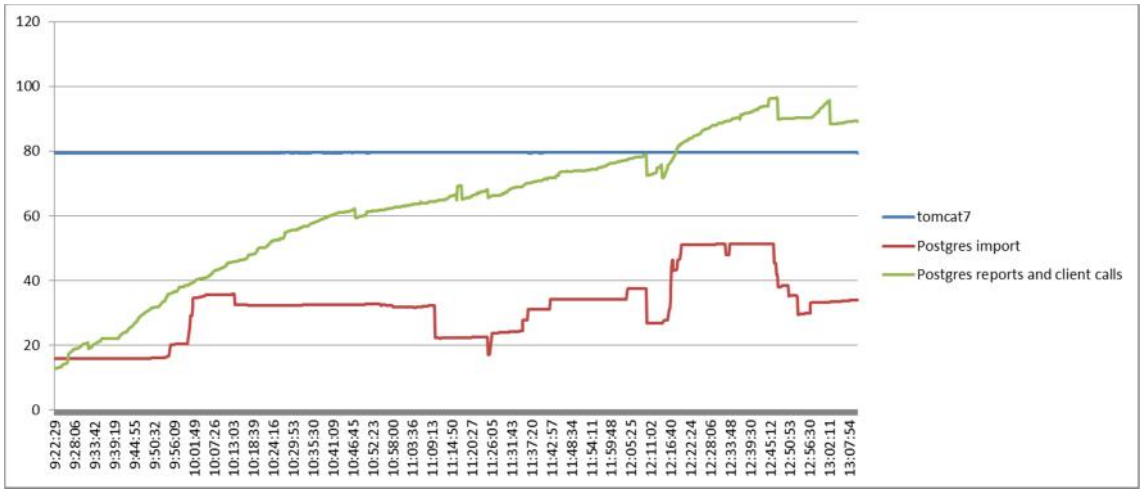


Figure 6: Memory usage during simultaneous operation (late start)

In this case the usage of memory in the system shoots up for reports as in previous cases, but in a much more progressive manner. This is an effect of the reduced capability of the system to cope with CPU demand as seen above. Memory usage for tomcat remains stable, although it does free some memory for the other processes later on, and imports remain in a more or less congruent state.

Appendix 5: Hardware Architecture for Development and Testing Environment

Hardware Architecture for Development and Testing Environment

The following infrastructure is considered to be required in order to develop the software needed by the Project.

The figures considered below are based on the assumption of working on a physical, on-site server for the development environment and testing server and a cloud based server for the staging and production servers.

1. Development and Testing Environment

The development environment will be in charge of:

- Automated testing
- Automated build generation ("Nightly builds")
- On demand build generation
- Automated deployment
- System monitoring
- Code Repository
- Issue Tracking and Project Management
- Developer testing

The environment requires the following virtual machines for it to be functional:

Hardware Product	Quantity	Type	Remarks
Nagios Server	1	Virtual Machine	2 core and 4 GBs RAM
Web Server	1	Virtual Machine	2 cores and 4 GBs RAM
ArcGIS Server	1	Virtual Machine	4 cores and 16 GBs RAM
Application Server	4	Virtual Machine	2 cores and 8 GBs RAM
Development Tools	1	Virtual Machine	4 cores and 16 GB RAM
Issue Tracking and Project Management	1	Virtual Machine	4 cores and 16 GBs RAM
SQL Database Server	1	Virtual Machine	4 cores and 16 GBs RAM
NoSQL database Server	1	Virtual Machine	4 cores and 16 GBs RAM

These should be served on a physical machine with at least 8 TB of storage to archive and keep track of application and code version tracking

The full system would require:

- 32 cores
- 128 GB of RAM
- 8 TB of HDD in either Raid 0/1 or Raid 5

Additionally, a secondary external physical server is required to hold WRIS database due to the Oracle licensing schema. Recommended configuration for development environment would be:

- Single Server with 4 cores and 16 GB RAM, 1 TB hard drive

Additionally, the following software would be required:

Software Product	Quantity	Type	Remarks
VMWare	1	Virtualization License	License for 36 cores
Red Hat Linux	1	OS License	RHL Enterprise edition 7
Ubunutu	9	OS	Ubuntu Server 16.04
ArcGIS Server	1	License	EDN with ArcGIS for Desktop Enterprise 10.5
Windows Server	2	License	Windows Server 2016
Oracle	1	License	Oracle 11g r2

2. Staging Environment

The staging environment will be in charge of:

- User Acceptance Testing and Load Testing
- Staging production deployments

For this purpose, and given that the hardware needs of the system will grow based on further development, the preference is for a cloud based environment with a starting size of:

- 208 cores
- 832 GB of ram
- 8 TB of hard drive

Divided in 14 Virtual Machines and 2 Physical Machines.

Software Product	Quantity	Provided by	Type	Remarks
Web Server	1	NIC	Virtual Machine	4 cores and 16 GBs RAM, 160+ GBs HDD
Web Server	2	NIC	Virtual Machine	4 cores and 16 GBs RAM, 100 GBs+ HDD
Application Server	4	NIC	Virtual Machine	16 cores and 64 GBs RAM, 260 GBs+ HDD
Application Server	2	NIC	Virtual Machine	16 cores and 64 GBs RAM, 160+ GBs HDD
NoSQL database server	2	NIC	Virtual Machine	16 cores and 64 GBs RAM, 1TBs+ HDD
Nagios Server	1	NIC	Virtual Machine	4 core and 16 GBs RAM, 110+ GBs HDD
SQL Database Server	1	NIC	Virtual Machine	16 cores and 64 GBs RAM, 460+ GBs HDD
NoSQL database Server	1	NIC	Virtual Machine	16 cores and 64 GBs RAM, 860+ GBs HDD
SQL Database Server	2	NIC	Physical Machine	16 cores and 64 GBs RAM, 560 GBs+ HDD

Additionally, the following software would be required:

Software Product	Quantity	Type	Remarks
Red Hat Linux	2	OS License	RHL Enterprise edition 7
Ubuntu Linux	10	OS	Ubuntu Server 16.04
ArcGIS Server	2	License	ArcGIS for Server Enterprise 10.5
ArcGIS Desktop	2	License	ArcGIS for Desktop Enterprise 10.5
Windows Server	4	License	Windows Server 2016
Oracle	2	License	Oracle 11g r2

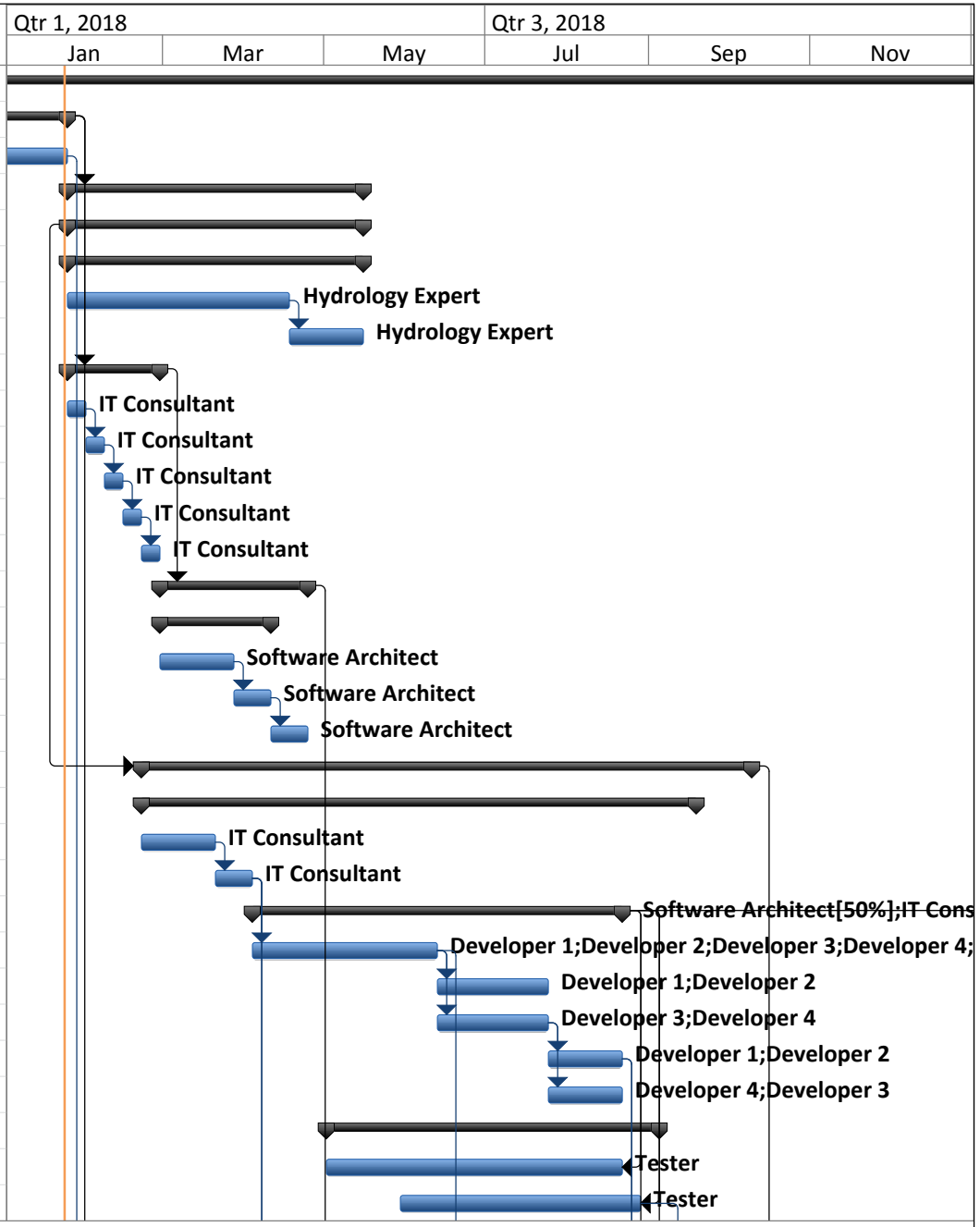
VMWare vSphere 6.5 license for virtualization (assumed to be present).

Other considerations:

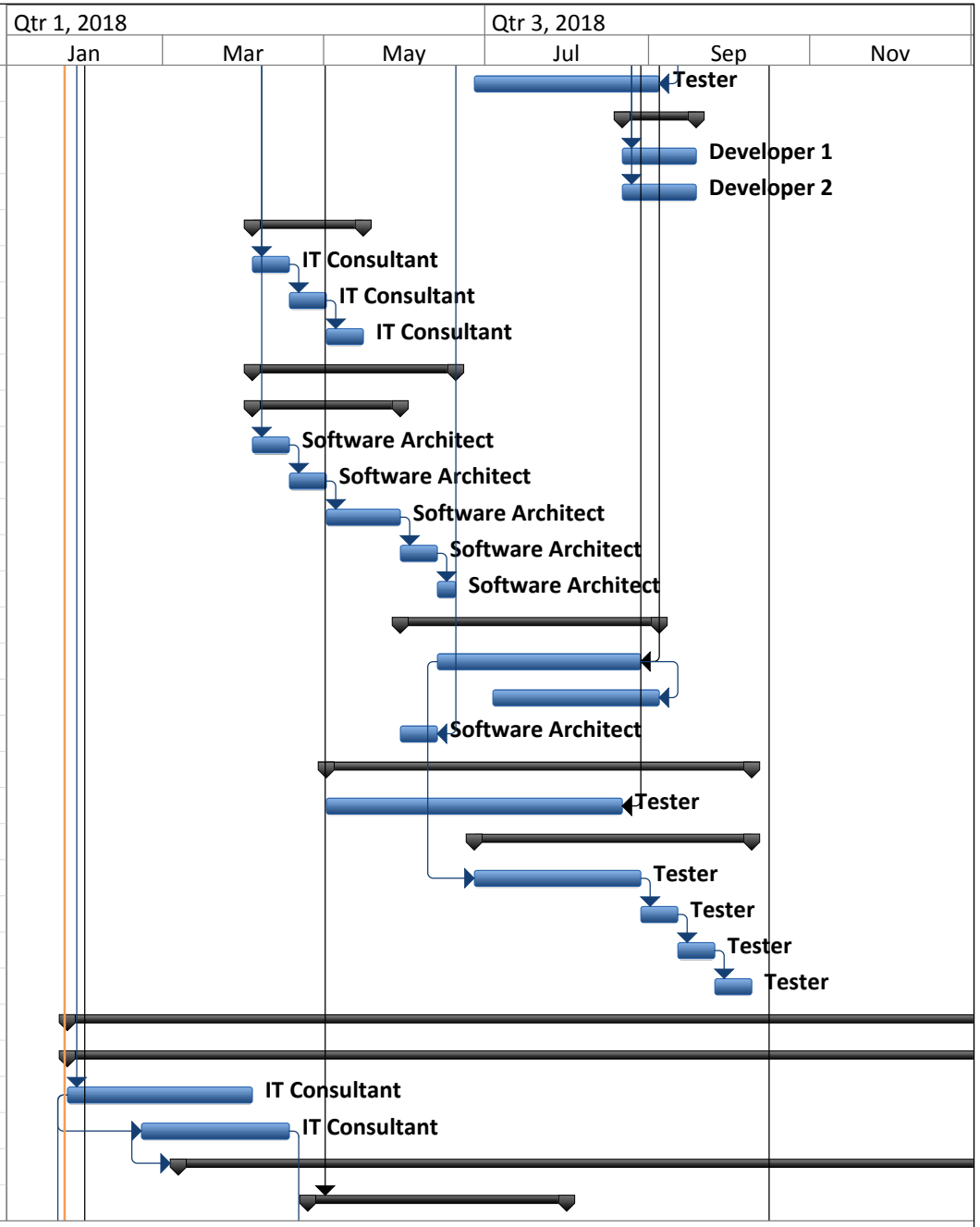
- Dedicated connection/VPN between the servers and NHP – 2 Mb symmetric minimum, 5 Mb symmetric recommended.

Appendix 6 a: Water Information System (eSWIS-WRIS-Data Acquisition) Work Programme (2018)

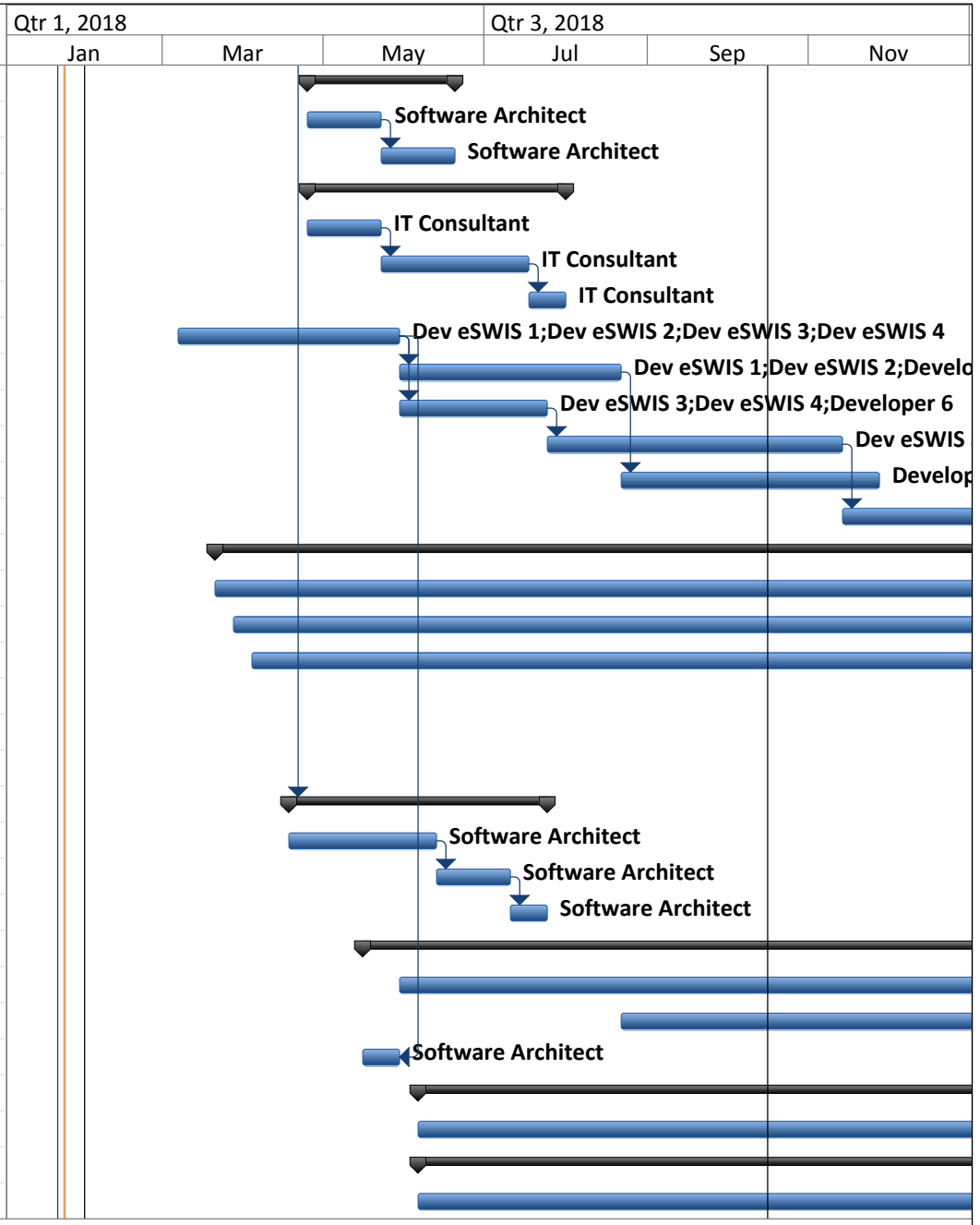
ID	Name	Duration	Start	Finish
1	**WISTAMC**	**247 wks**	**01/11/17**	**26/07/22**
2	**Planning&Strategy**	**12 wks**	**01/11/17**	**23/01/18**
3	Inception Report	12 wks	01/11/17	23/01/18
4	**Framework Requirements**	**16 wks**	**24/01/18**	**15/05/18**
5	**Business Requirements**	**16 wks**	**24/01/18**	**15/05/18**
6	**User Requirements Specification**	**16 wks**	**24/01/18**	**15/05/18**
7	Functional Requirements	12 wks	24/01/18	17/04/18
8	Data Requirements	4 wks	18/04/18	15/05/18
9	**System Requirements**	**5 wks**	**24/01/18**	**27/02/18**
10	Security requirements	1 wk	24/01/18	30/01/18
11	Environment requirements	1 wk	31/01/18	06/02/18
12	Hardware Requirements	1 wk	07/02/18	13/02/18
13	Network Requirements	1 wk	14/02/18	20/02/18
14	Response time	1 wk	21/02/18	27/02/18
15	**System Architecture**	**8 wks**	**28/02/18**	**24/04/18**
16	**Software Architecture**	**6 wks**	**28/02/18**	**10/04/18**
17	Logial Architecture	4 wks	28/02/18	27/03/18
18	Physical Architecture	2 wks	28/03/18	10/04/18
19	Hardware Architecture	2 wks	11/04/18	24/04/18
20	**Telemetry Data Adquisition**	**33 wks**	**21/02/18**	**09/10/18**
21	**Software**	**30 wks**	**21/02/18**	**18/09/18**
22	Software Requirements Specifications	4 wks	21/02/18	20/03/18
23	Low Level Design	2 wks	21/03/18	03/04/18
24	**Development**	**20 wks**	**04/04/18**	**21/08/18**
25	Telemetry Data Gathering	10 wks	04/04/18	12/06/18
26	Data Validation	6 wks	13/06/18	24/07/18
27	Data Processing	6 wks	13/06/18	24/07/18
28	Data Export to Main DDBB	4 wks	25/07/18	21/08/18
29	Data Backup Proccess	4 wks	25/07/18	21/08/18
30	**Unit Testing**	**18 wks**	**02/05/18**	**04/09/18**
31	Unit Test Implementation	16 wks	02/05/18	21/08/18
32	Unit Testing	13 wks	30/05/18	28/08/18



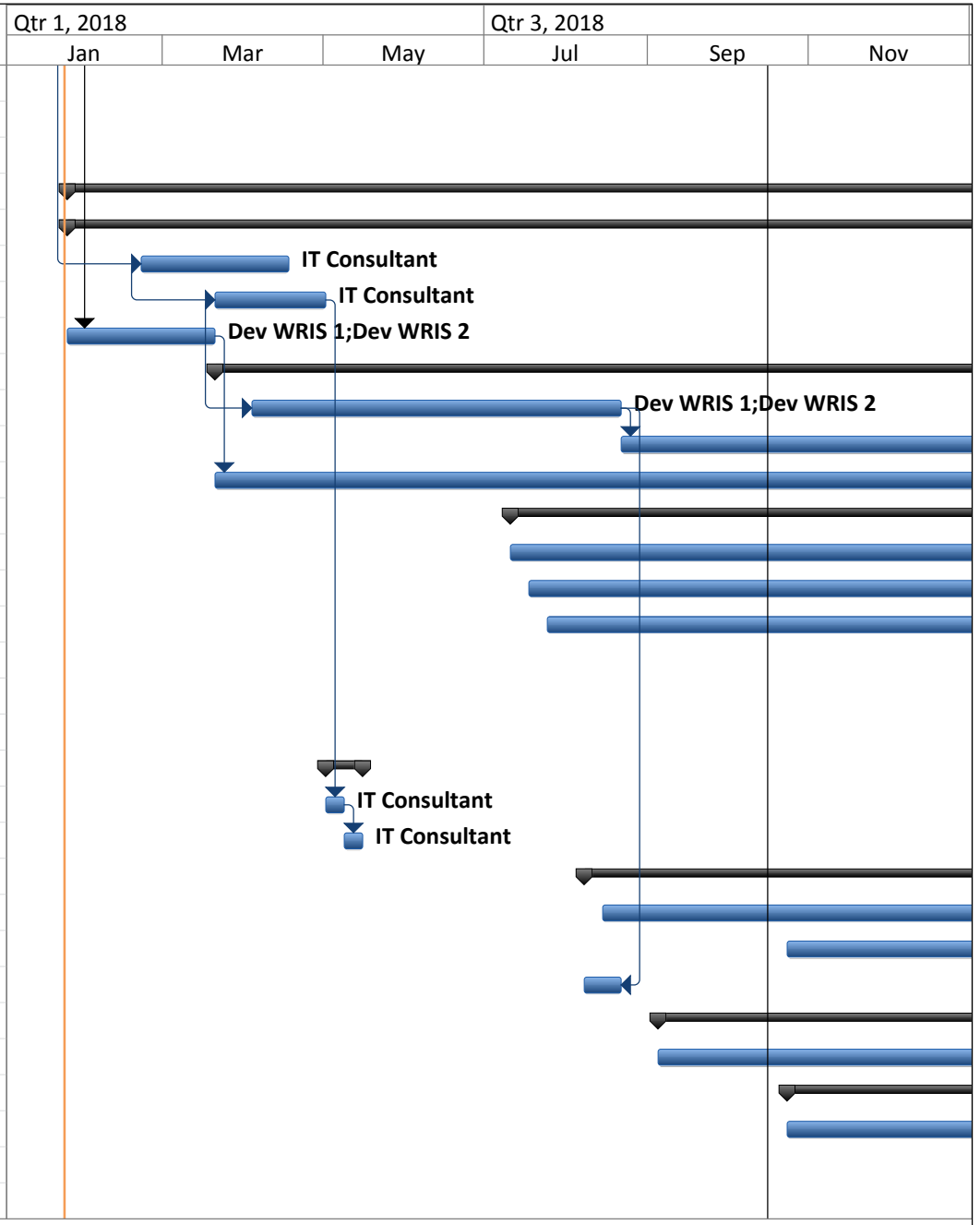
ID	Name	Duration	Start	Finish
33	Unit Testing Result	10 wks	27/06/18	04/09/18
34	**User support documentation**	**4 wks**	**22/08/18**	**18/09/18**
35	User Guide	4 wks	22/08/18	18/09/18
36	System Administration Guide	4 wks	22/08/18	18/09/18
37	**Hardware**	**6 wks**	**04/04/18**	**15/05/18**
38	Hardware Requirements Specification	2 wks	04/04/18	17/04/18
39	Hardware system definition	2 wks	18/04/18	01/05/18
40	Hardware unit/component testing	2 wks	02/05/18	15/05/18
41	**Database**	**11 wks**	**04/04/18**	**19/06/18**
42	**DataModel Design**	**8 wks**	**04/04/18**	**29/05/18**
43	Conceptual	2 wks	04/04/18	17/04/18
44	Logical	2 wks	18/04/18	01/05/18
45	Physical	4 wks	02/05/18	29/05/18
46	Database Implementation	2 wks	30/05/18	12/06/18
47	Database testing	1 wk	13/06/18	19/06/18
48	**Deployment**	**14 wks**	**30/05/18**	**04/09/18**
49	Test Enviroment Deployment	11 wks	13/06/18	28/08/18
50	Deployment Guide	9 wks	04/07/18	04/09/18
51	Deployment Plan	2 wks	30/05/18	12/06/18
52	**Testing**	**23 wks**	**02/05/18**	**09/10/18**
53	Test Plan	16 wks	02/05/18	21/08/18
54	**Testing & verification**	**15 wks**	**27/06/18**	**09/10/18**
55	Component Testing	9 wks	27/06/18	28/08/18
56	Integration testing	2 wks	29/08/18	11/09/18
57	System Performance Testing	2 wks	12/09/18	25/09/18
58	Testing Result Report	2 wks	26/09/18	09/10/18
59	**eSWIS Improvement**	**65 wks**	**24/01/18**	**23/04/19**
60	**Software**	**58 wks**	**24/01/18**	**05/03/19**
61	Software Requirements Specifications	10 wks	24/01/18	03/04/18
62	Low Level Design	8 wks	21/02/18	17/04/18
63	**Development**	**48 wks**	**07/03/18**	**05/02/19**
64	**Software Architecture Improveme**	**14 wks**	**25/04/18**	**31/07/18**



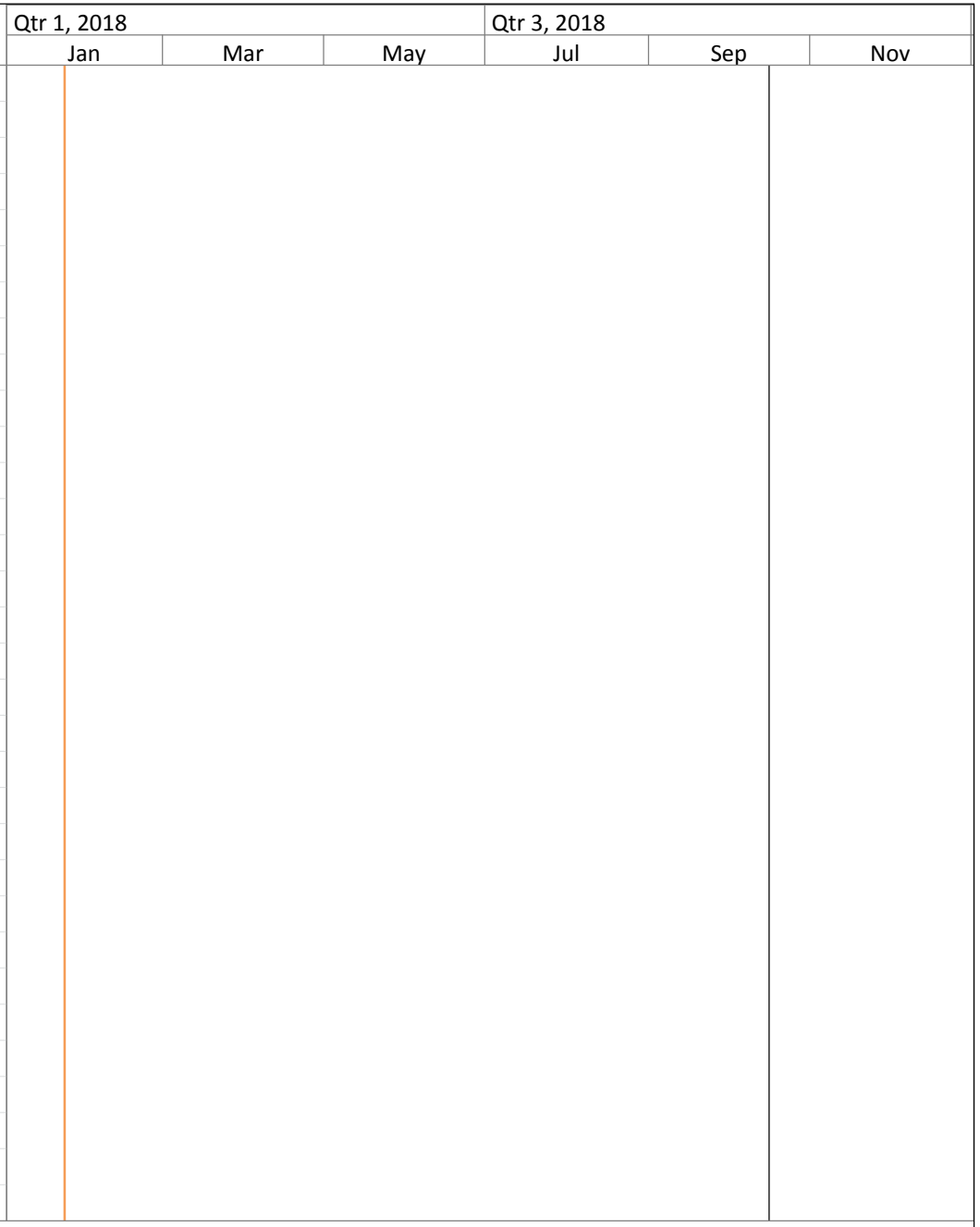
ID	Name	Duration	Start	Finish
65	**SOA Architecture**	**8 wks**	**25/04/18**	**19/06/18**
66	SOA Architecture Design	4 wks	25/04/18	22/05/18
67	Infraestructure for SOA Archit	4 wks	23/05/18	19/06/18
68	**High Availability Architecture**	**14 wks**	**25/04/18**	**31/07/18**
69	Design	4 wks	25/04/18	22/05/18
70	Implementation	8 wks	23/05/18	17/07/18
71	Testing	2 wks	18/07/18	31/07/18
72	Groundwater Module	12 wks	07/03/18	29/05/18
73	Water Quality Module	12 wks	30/05/18	21/08/18
74	Data Import/Export Improvement	8 wks	30/05/18	24/07/18
75	GUI Improvement	16 wks	25/07/18	13/11/18
76	New Functionality 1	14 wks	22/08/18	27/11/18
77	New Functionality 2	12 wks	14/11/18	05/02/19
78	**Unit Testing**	**48 wks**	**21/03/18**	**19/02/19**
79	Unit Test Implementation	46 wks	21/03/18	05/02/19
80	Unit Testing	46 wks	28/03/18	12/02/19
81	Unit Testing Result	46 wks	04/04/18	19/02/19
82	**User support documentation**	**4 wks**	**06/02/19**	**05/03/19**
83	User Guide	4 wks	06/02/19	05/03/19
84	System Administration Guide	2 wks	06/02/19	19/02/19
85	**Database**	**14 wks**	**18/04/18**	**24/07/18**
86	DataModel Improvement	8 wks	18/04/18	12/06/18
87	Database Improvement Implementati	4 wks	13/06/18	10/07/18
88	Database testing	2 wks	11/07/18	24/07/18
89	**Deployment**	**40 wks**	**16/05/18**	**19/02/19**
90	Test Enviroment Deployment	37 wks	30/05/18	12/02/19
91	Deployment Guide	26 wks	22/08/18	19/02/19
92	Deployment Plan	2 wks	16/05/18	29/05/18
93	**Testing**	**46 wks**	**06/06/18**	**23/04/19**
94	Test Plan	35 wks	06/06/18	05/02/19
95	**Testing & verification**	**46 wks**	**06/06/18**	**23/04/19**
96	Component Testing	37 wks	06/06/18	19/02/19



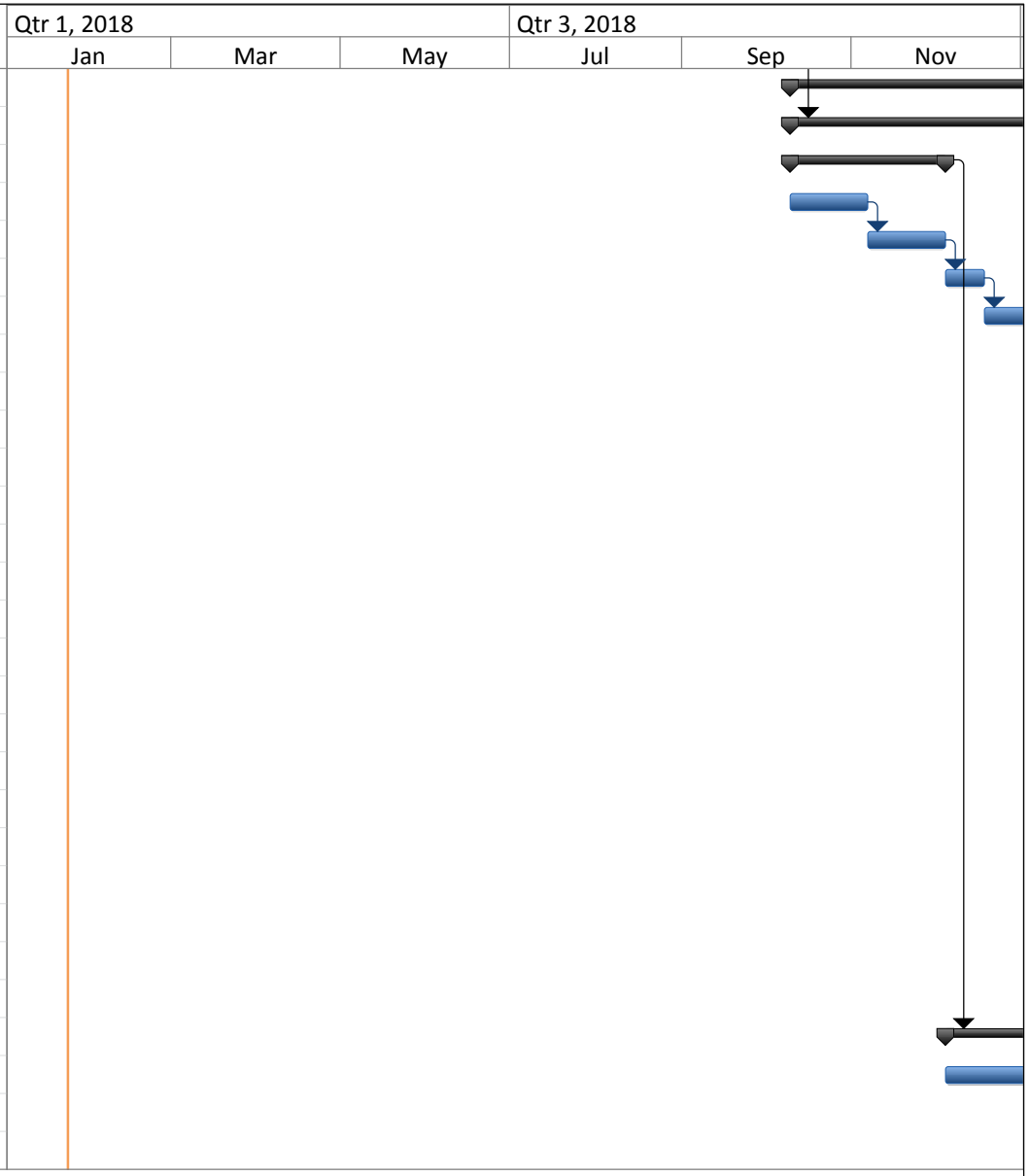
ID	Name	Duration	Start	Finish
97	Integration testing	4 wks	20/02/19	19/03/19
98	System Performance Testing	4 wks	20/03/19	16/04/19
99	Testing Result Report	1 wk	17/04/19	23/04/19
100	**WRIS Integration**	**64 wks**	**24/01/18**	**16/04/19**
101	**Software**	**54 wks**	**24/01/18**	**05/02/19**
102	Software Requirements Specifications	8 wks	21/02/18	17/04/18
103	Low Level Design	6 wks	21/03/18	01/05/18
104	Presentation Layer Replace A&D	8 wks	24/01/18	20/03/18
105	**Development**	**44 wks**	**21/03/18**	**22/01/19**
106	eSWIS Web Services Integration	20 wks	04/04/18	21/08/18
107	SDE Database Import Process	20 wks	22/08/18	08/01/19
108	Replace Presentation Layer Phase 1	44 wks	21/03/18	22/01/19
109	**Unit Testing**	**30 wks**	**11/07/18**	**05/02/19**
110	Unit Test Implementation	28 wks	11/07/18	22/01/19
111	Unit Testing	28 wks	18/07/18	29/01/19
112	Unit Testing Result	28 wks	25/07/18	05/02/19
113	**User support documentation**	**3 wks**	**09/01/19**	**29/01/19**
114	User Guide	1 wk	09/01/19	15/01/19
115	System Administration Guide	2 wks	16/01/19	29/01/19
116	**Hardware**	**2 wks**	**02/05/18**	**15/05/18**
117	Hardware Requirements Specification	1 wk	02/05/18	08/05/18
118	Hardware system definition	1 wk	09/05/18	15/05/18
119	**Deployment**	**26 wks**	**08/08/18**	**05/02/19**
120	Test Enviroment Deployment	24 wks	15/08/18	29/01/19
121	Deployment Guide	15 wks	24/10/18	05/02/19
122	Deployment Plan	2 wks	08/08/18	21/08/18
123	**Testing**	**32 wks**	**05/09/18**	**16/04/19**
124	Test Plan	20 wks	05/09/18	22/01/19
125	**Testing & verification**	**25 wks**	**24/10/18**	**16/04/19**
126	Component Testing	15 wks	24/10/18	05/02/19
127	Integration testing	4 wks	06/02/19	05/03/19
128	System Performance Testing	4 wks	06/03/19	02/04/19



ID	Name	Duration	Start	Finish
129	Testing Result Report	2 wks	03/04/19	16/04/19
130	**WRIS Improvement**	**53 wks**	**17/04/19**	**21/04/20**
131	**Software**	**47 wks**	**17/04/19**	**10/03/20**
132	Software Requirements Specifications	8 wks	17/04/19	11/06/19
133	Low Level Design	2 wks	08/05/19	21/05/19
134	**Development**	**41 wks**	**17/04/19**	**28/01/20**
135	Replace Oracle to Postgresql for SD	4 wks	22/05/19	18/06/19
136	New Functionality 1	18 wks	22/05/19	24/09/19
137	New Functionality 2	18 wks	25/09/19	28/01/20
138	Replace Presentation Layer Phase 2	40 wks	17/04/19	21/01/20
139	**Unit Testing**	**36 wks**	**05/06/19**	**11/02/20**
140	Unit Test Implementation	34 wks	05/06/19	28/01/20
141	Unit Testing	34 wks	12/06/19	04/02/20
142	Unit Testing Result	34 wks	19/06/19	11/02/20
143	**User support documentation**	**6 wks**	**29/01/20**	**10/03/20**
144	User Guide	4 wks	29/01/20	25/02/20
145	System Administration Guide	2 wks	26/02/20	10/03/20
146	**Database**	**14 wks**	**22/05/19**	**27/08/19**
147	DataModel Improvement	8 wks	22/05/19	16/07/19
148	Database Improvement Implementati	4 wks	17/07/19	13/08/19
149	Database testing	2 wks	14/08/19	27/08/19
150	**Deployment**	**31 wks**	**10/07/19**	**11/02/20**
151	Test Enviroment Deployment	30 wks	10/07/19	04/02/20
152	Deployment Guide	30 wks	17/07/19	11/02/20
153	Deployment Plan	2 wks	11/09/19	24/09/19
154	**Testing**	**40 wks**	**17/07/19**	**21/04/20**
155	Test Plan	24 wks	14/08/19	28/01/20
156	**Testing & verification**	**40 wks**	**17/07/19**	**21/04/20**
157	Component Testing	30 wks	17/07/19	11/02/20
158	Integration testing	4 wks	12/02/20	10/03/20
159	System Performance Testing	4 wks	11/03/20	07/04/20
160	Testing Result Report	2 wks	08/04/20	21/04/20

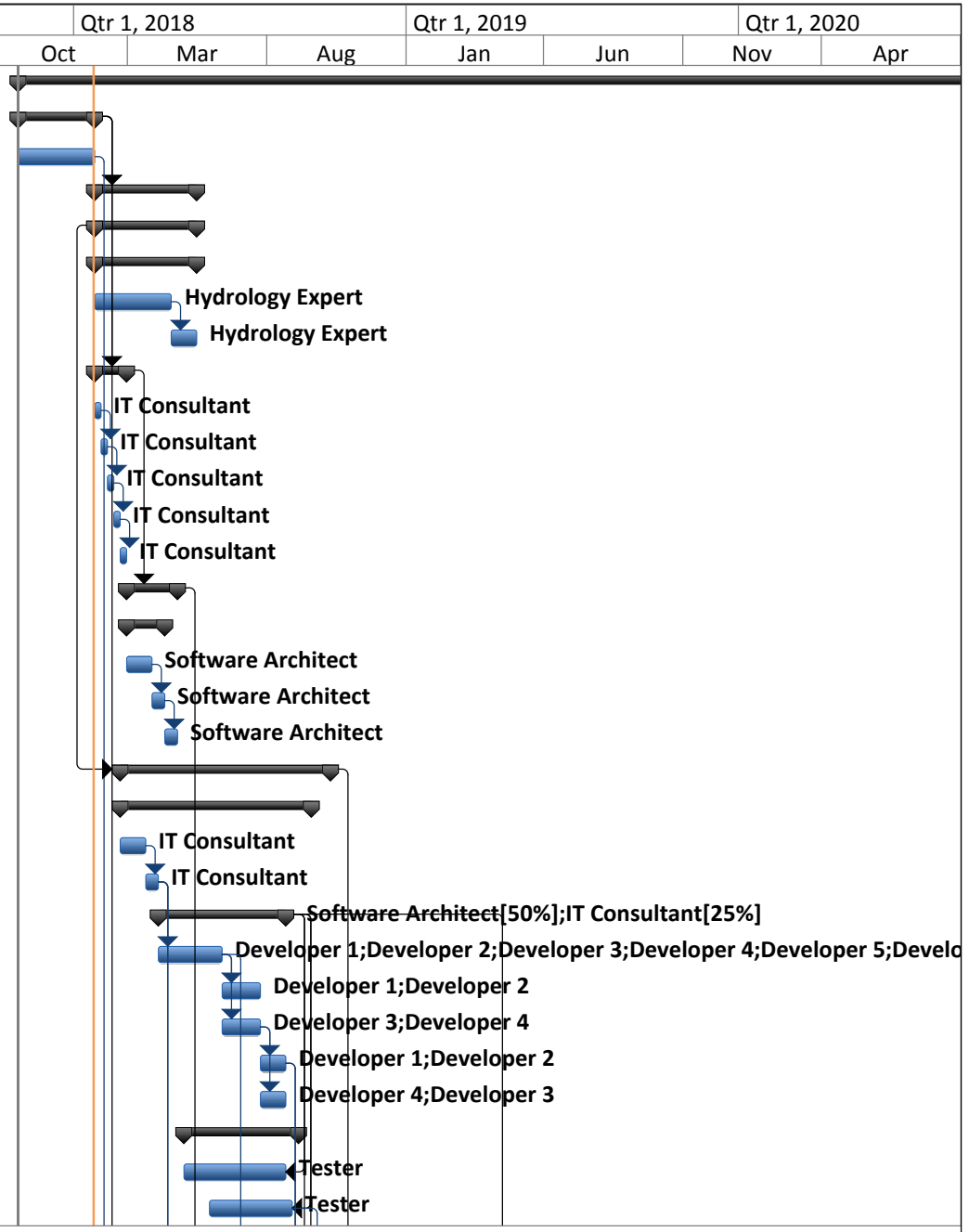


ID	Name	Duration	Start	Finish
161	**User Acceptance Testing and Production D**	**94 wks**	**10/10/18**	**28/07/20**
162	**Telemetry Data Adquisition**	**14 wks**	**10/10/18**	**15/01/19**
163	**User Acceptance Testing**	**8 wks**	**10/10/18**	**04/12/18**
164	User Testing	4 wks	10/10/18	06/11/18
165	Observations Fixing	4 wks	07/11/18	04/12/18
166	Production Enviroment Deployment	2 wks	05/12/18	18/12/18
167	Test Production Environment	4 wks	19/12/18	15/01/19
168	**eSWIS Improvement**	**14 wks**	**24/04/19**	**30/07/19**
169	**User Acceptance Testing**	**8 wks**	**24/04/19**	**18/06/19**
170	User Testing	4 wks	24/04/19	21/05/19
171	Observations Fixing	4 wks	22/05/19	18/06/19
172	Production Enviroment Deployment	2 wks	19/06/19	02/07/19
173	Test Production Environment	4 wks	03/07/19	30/07/19
174	**WRIS Integration**	**14 wks**	**17/04/19**	**23/07/19**
175	**User Acceptance Testing**	**8 wks**	**17/04/19**	**11/06/19**
176	User Testing	4 wks	17/04/19	14/05/19
177	Observations Fixing	4 wks	15/05/19	11/06/19
178	Production Enviroment Deployment	2 wks	12/06/19	25/06/19
179	Test Production Environment	4 wks	26/06/19	23/07/19
180	**WRIS Improvement**	**14 wks**	**22/04/20**	**28/07/20**
181	**User Acceptance Testing**	**8 wks**	**22/04/20**	**16/06/20**
182	User Testing	4 wks	22/04/20	19/05/20
183	Observations Fixing	4 wks	20/05/20	16/06/20
184	Production Enviroment Deployment	2 wks	17/06/20	30/06/20
185	Test Production Environment	4 wks	01/07/20	28/07/20
186	**Capacity Building**	**88 wks**	**05/12/18**	**11/08/20**
187	Phase 1	32 wks	05/12/18	16/07/19
188	Phase 2	32 wks	01/01/20	11/08/20
189	Maintenance	104 wks	29/07/20	26/07/22

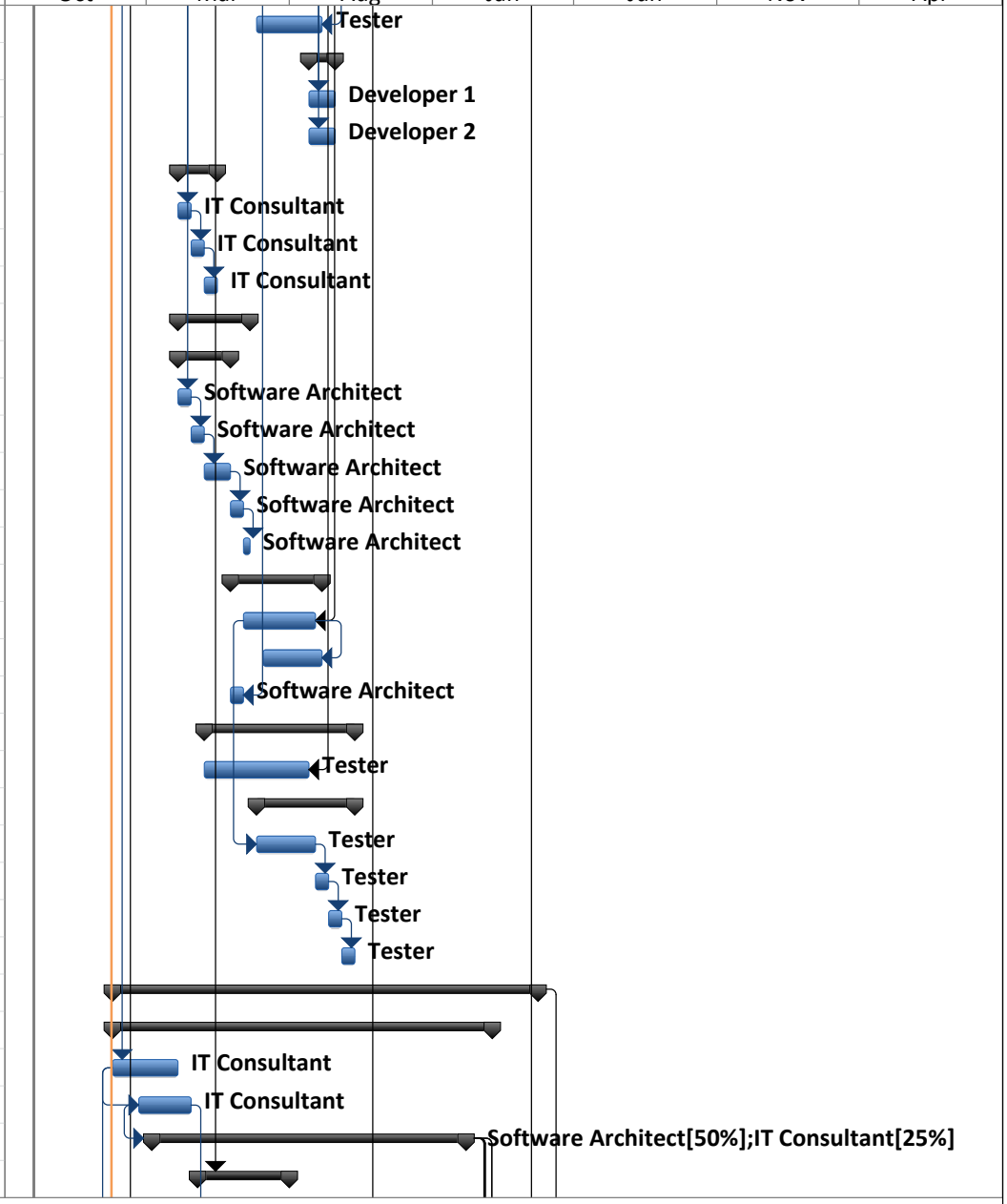


Appendix 6 b: Water Information System (eSWIS-WRIS-Data Acquisition) Work Programme (2018-2020)

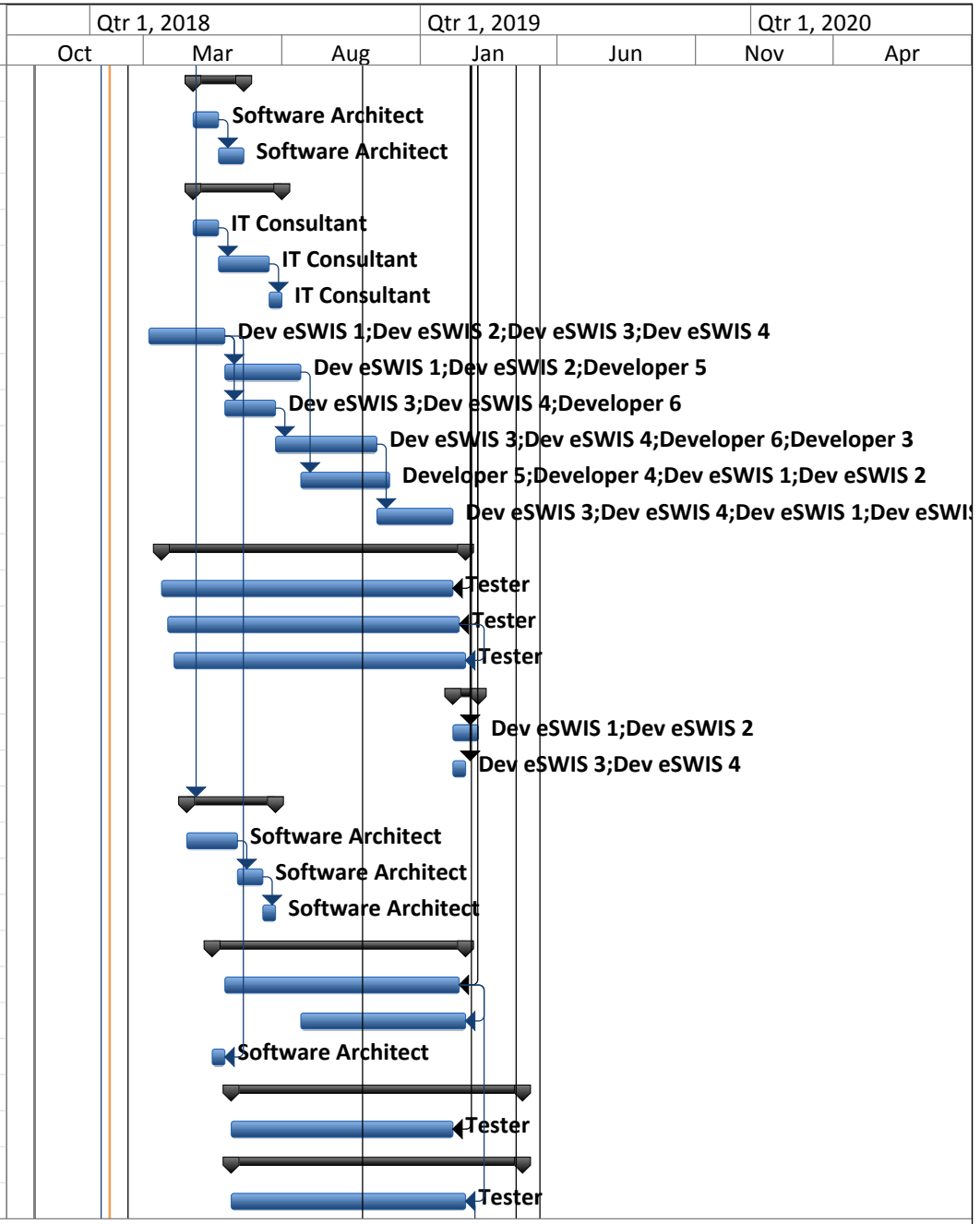
ID	Name	Duration	Start	Finish
1	**WISTAMC**	**247 wks**	**01/11/17**	**26/07/22**
2	**Planning&Strategy**	**12 wks**	**01/11/17**	**23/01/18**
3	Inception Report	12 wks	01/11/17	23/01/18
4	**Framework Requirements**	**16 wks**	**24/01/18**	**15/05/18**
5	**Business Requirements**	**16 wks**	**24/01/18**	**15/05/18**
6	**User Requirements Specification**	**16 wks**	**24/01/18**	**15/05/18**
7	Functional Requirements	12 wks	24/01/18	17/04/18
8	Data Requirements	4 wks	18/04/18	15/05/18
9	**System Requirements**	**5 wks**	**24/01/18**	**27/02/18**
10	Security requirements	1 wk	24/01/18	30/01/18
11	Environment requirements	1 wk	31/01/18	06/02/18
12	Hardware Requirements	1 wk	07/02/18	13/02/18
13	Network Requirements	1 wk	14/02/18	20/02/18
14	Response time	1 wk	21/02/18	27/02/18
15	**System Architecture**	**8 wks**	**28/02/18**	**24/04/18**
16	**Software Architecture**	**6 wks**	**28/02/18**	**10/04/18**
17	Logial Architecture	4 wks	28/02/18	27/03/18
18	Physical Architecture	2 wks	28/03/18	10/04/18
19	Hardware Architecture	2 wks	11/04/18	24/04/18
20	**Telemetry Data Adquisition**	**33 wks**	**21/02/18**	**09/10/18**
21	**Software**	**30 wks**	**21/02/18**	**18/09/18**
22	Software Requirements Specifications	4 wks	21/02/18	20/03/18
23	Low Level Design	2 wks	21/03/18	03/04/18
24	**Development**	**20 wks**	**04/04/18**	**21/08/18**
25	Telemetry Data Gathering	10 wks	04/04/18	12/06/18
26	Data Validation	6 wks	13/06/18	24/07/18
27	Data Processing	6 wks	13/06/18	24/07/18
28	Data Export to Main DDBB	4 wks	25/07/18	21/08/18
29	Data Backup Proccess	4 wks	25/07/18	21/08/18
30	**Unit Testing**	**18 wks**	**02/05/18**	**04/09/18**
31	Unit Test Implementation	16 wks	02/05/18	21/08/18
32	Unit Testing	13 wks	30/05/18	28/08/18



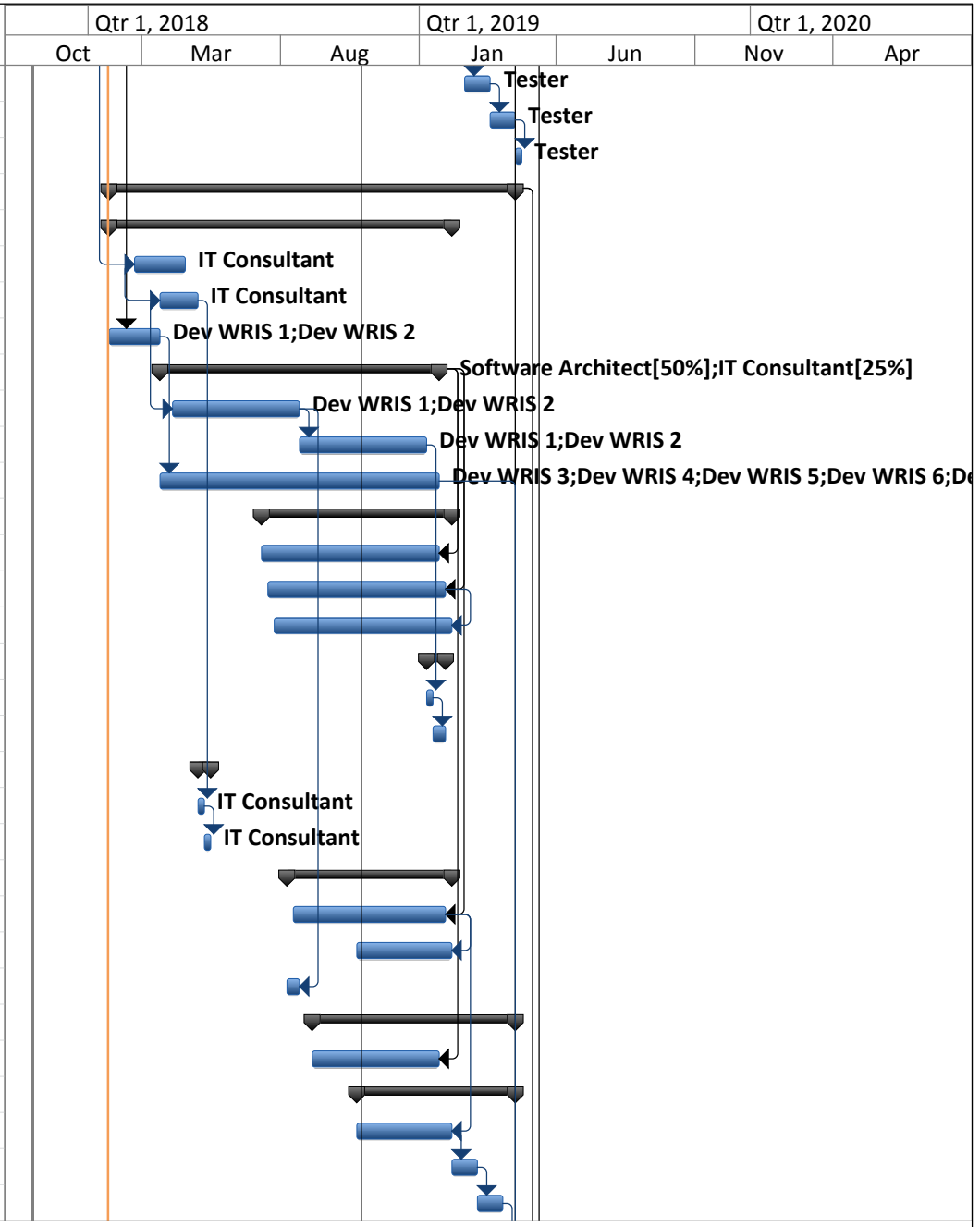
ID	Name	Duration	Start	Finish
33	Unit Testing Result	10 wks	27/06/18	04/09/18
34	**User support documentation**	**4 wks**	**22/08/18**	**18/09/18**
35	User Guide	4 wks	22/08/18	18/09/18
36	System Administration Guide	4 wks	22/08/18	18/09/18
37	**Hardware**	**6 wks**	**04/04/18**	**15/05/18**
38	Hardware Requirements Specification	2 wks	04/04/18	17/04/18
39	Hardware system definition	2 wks	18/04/18	01/05/18
40	Hardware unit/component testing	2 wks	02/05/18	15/05/18
41	**Database**	**11 wks**	**04/04/18**	**19/06/18**
42	**DataModel Design**	**8 wks**	**04/04/18**	**29/05/18**
43	Conceptual	2 wks	04/04/18	17/04/18
44	Logical	2 wks	18/04/18	01/05/18
45	Physical	4 wks	02/05/18	29/05/18
46	Database Implementation	2 wks	30/05/18	12/06/18
47	Database testing	1 wk	13/06/18	19/06/18
48	**Deployment**	**14 wks**	**30/05/18**	**04/09/18**
49	Test Enviroment Deployment	11 wks	13/06/18	28/08/18
50	Deployment Guide	9 wks	04/07/18	04/09/18
51	Deployment Plan	2 wks	30/05/18	12/06/18
52	**Testing**	**23 wks**	**02/05/18**	**09/10/18**
53	Test Plan	16 wks	02/05/18	21/08/18
54	**Testing & verification**	**15 wks**	**27/06/18**	**09/10/18**
55	Component Testing	9 wks	27/06/18	28/08/18
56	Integration testing	2 wks	29/08/18	11/09/18
57	System Performance Testing	2 wks	12/09/18	25/09/18
58	Testing Result Report	2 wks	26/09/18	09/10/18
59	**eSWIS Improvement**	**65 wks**	**24/01/18**	**23/04/19**
60	**Software**	**58 wks**	**24/01/18**	**05/03/19**
61	Software Requirements Specifications	10 wks	24/01/18	03/04/18
62	Low Level Design	8 wks	21/02/18	17/04/18
63	**Development**	**48 wks**	**07/03/18**	**05/02/19**
64	**Software Architecture Improveme**	**14 wks**	**25/04/18**	**31/07/18**



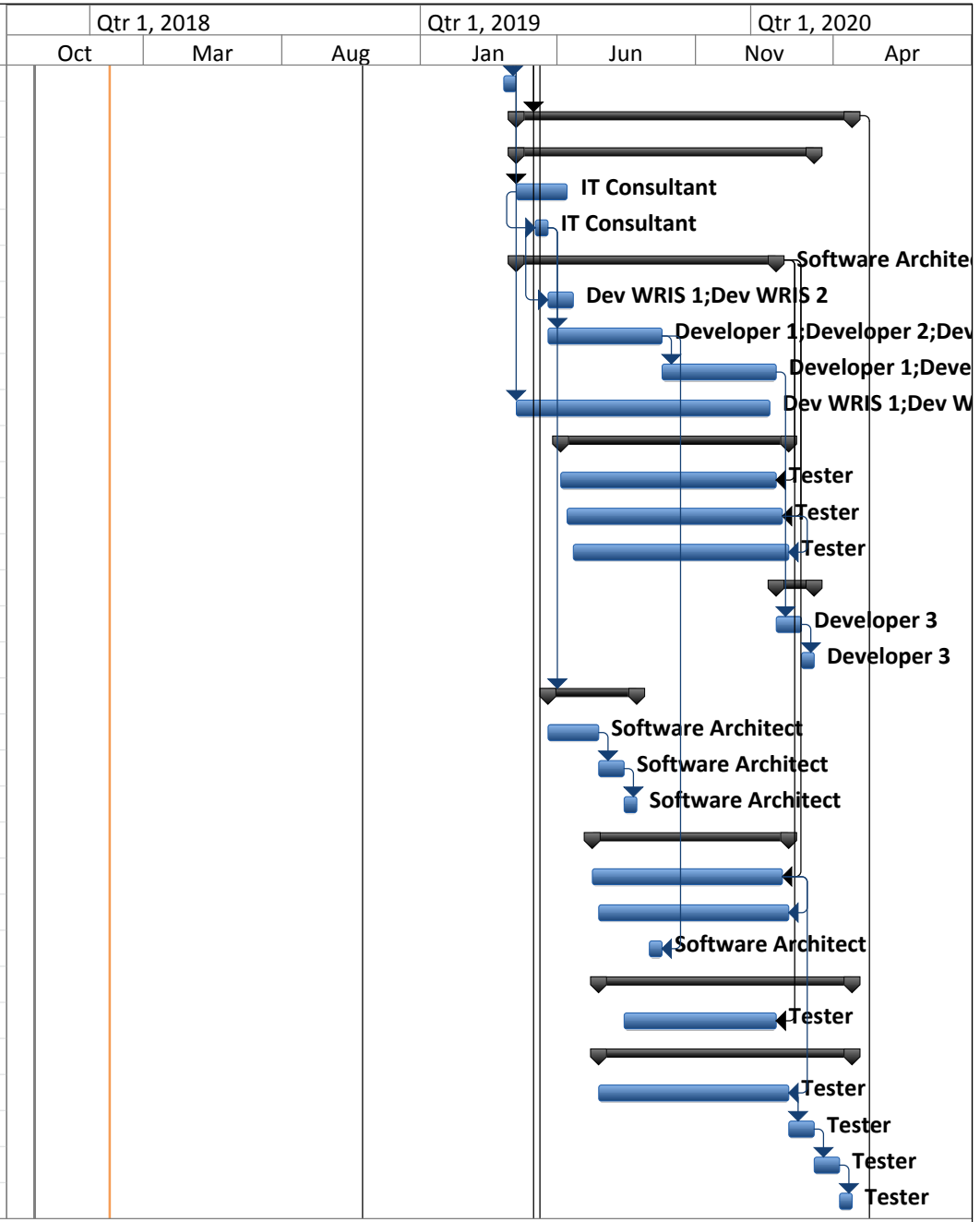
ID	Name	Duration	Start	Finish
65	**SOA Architecture**	**8 wks**	**25/04/18**	**19/06/18**
66	SOA Architecture Design	4 wks	25/04/18	22/05/18
67	Infraestructure for SOA Archit	4 wks	23/05/18	19/06/18
68	**High Availability Architecture**	**14 wks**	**25/04/18**	**31/07/18**
69	Design	4 wks	25/04/18	22/05/18
70	Implementation	8 wks	23/05/18	17/07/18
71	Testing	2 wks	18/07/18	31/07/18
72	Groundwater Module	12 wks	07/03/18	29/05/18
73	Water Quality Module	12 wks	30/05/18	21/08/18
74	Data Import/Export Improvement	8 wks	30/05/18	24/07/18
75	GUI Improvement	16 wks	25/07/18	13/11/18
76	New Functionality 1	14 wks	22/08/18	27/11/18
77	New Functionality 2	12 wks	14/11/18	05/02/19
78	**Unit Testing**	**48 wks**	**21/03/18**	**19/02/19**
79	Unit Test Implementation	46 wks	21/03/18	05/02/19
80	Unit Testing	46 wks	28/03/18	12/02/19
81	Unit Testing Result	46 wks	04/04/18	19/02/19
82	**User support documentation**	**4 wks**	**06/02/19**	**05/03/19**
83	User Guide	4 wks	06/02/19	05/03/19
84	System Administration Guide	2 wks	06/02/19	19/02/19
85	**Database**	**14 wks**	**18/04/18**	**24/07/18**
86	DataModel Improvement	8 wks	18/04/18	12/06/18
87	Database Improvement Implementati	4 wks	13/06/18	10/07/18
88	Database testing	2 wks	11/07/18	24/07/18
89	**Deployment**	**40 wks**	**16/05/18**	**19/02/19**
90	Test Enviroment Deployment	37 wks	30/05/18	12/02/19
91	Deployment Guide	26 wks	22/08/18	19/02/19
92	Deployment Plan	2 wks	16/05/18	29/05/18
93	**Testing**	**46 wks**	**06/06/18**	**23/04/19**
94	Test Plan	35 wks	06/06/18	05/02/19
95	**Testing & verification**	**46 wks**	**06/06/18**	**23/04/19**
96	Component Testing	37 wks	06/06/18	19/02/19



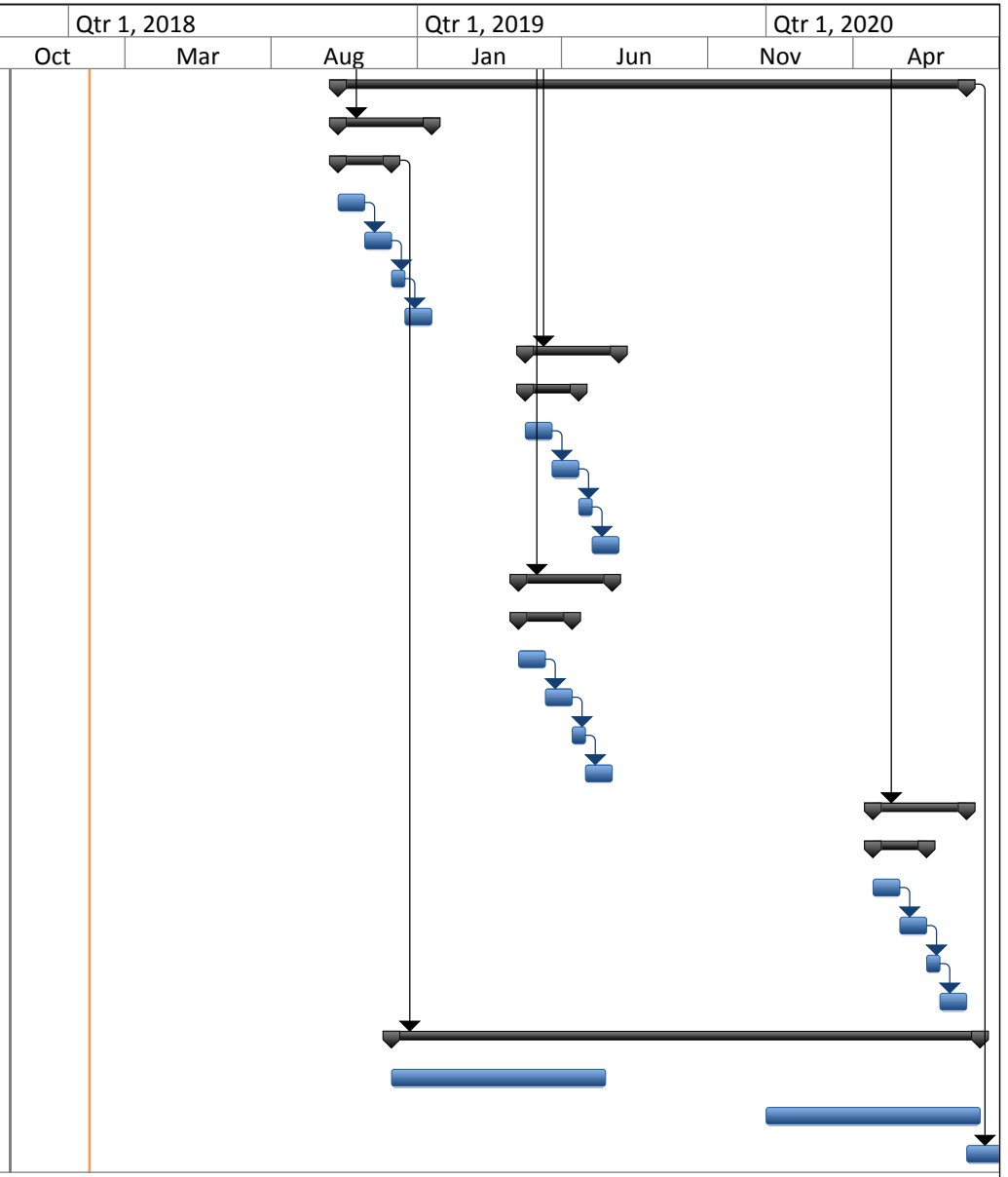
ID	Name	Duration	Start	Finish
97	Integration testing	4 wks	20/02/19	19/03/19
98	System Performance Testing	4 wks	20/03/19	16/04/19
99	Testing Result Report	1 wk	17/04/19	23/04/19
100	**WRIS Integration**	**64 wks**	**24/01/18**	**16/04/19**
101	**Software**	**54 wks**	**24/01/18**	**05/02/19**
102	Software Requirements Specifications	8 wks	21/02/18	17/04/18
103	Low Level Design	6 wks	21/03/18	01/05/18
104	Presentation Layer Replace A&D	8 wks	24/01/18	20/03/18
105	**Development**	**44 wks**	**21/03/18**	**22/01/19**
106	eSWIS Web Services Integration	20 wks	04/04/18	21/08/18
107	SDE Database Import Process	20 wks	22/08/18	08/01/19
108	Replace Presentation Layer Phase 1	44 wks	21/03/18	22/01/19
109	**Unit Testing**	**30 wks**	**11/07/18**	**05/02/19**
110	Unit Test Implementation	28 wks	11/07/18	22/01/19
111	Unit Testing	28 wks	18/07/18	29/01/19
112	Unit Testing Result	28 wks	25/07/18	05/02/19
113	**User support documentation**	**3 wks**	**09/01/19**	**29/01/19**
114	User Guide	1 wk	09/01/19	15/01/19
115	System Administration Guide	2 wks	16/01/19	29/01/19
116	**Hardware**	**2 wks**	**02/05/18**	**15/05/18**
117	Hardware Requirements Specification	1 wk	02/05/18	08/05/18
118	Hardware system definition	1 wk	09/05/18	15/05/18
119	**Deployment**	**26 wks**	**08/08/18**	**05/02/19**
120	Test Enviroment Deployment	24 wks	15/08/18	29/01/19
121	Deployment Guide	15 wks	24/10/18	05/02/19
122	Deployment Plan	2 wks	08/08/18	21/08/18
123	**Testing**	**32 wks**	**05/09/18**	**16/04/19**
124	Test Plan	20 wks	05/09/18	22/01/19
125	**Testing & verification**	**25 wks**	**24/10/18**	**16/04/19**
126	Component Testing	15 wks	24/10/18	05/02/19
127	Integration testing	4 wks	06/02/19	05/03/19
128	System Performance Testing	4 wks	06/03/19	02/04/19



ID	Name	Duration	Start	Finish
129	Testing Result Report	2 wks	03/04/19	16/04/19
130	**WRIS Improvement**	**53 wks**	**17/04/19**	**21/04/20**
131	**Software**	**47 wks**	**17/04/19**	**10/03/20**
132	Software Requirements Specifications	8 wks	17/04/19	11/06/19
133	Low Level Design	2 wks	08/05/19	21/05/19
134	**Development**	**41 wks**	**17/04/19**	**28/01/20**
135	Replace Oracle to Postgresql for SD	4 wks	22/05/19	18/06/19
136	New Functionality 1	18 wks	22/05/19	24/09/19
137	New Functionality 2	18 wks	25/09/19	28/01/20
138	Replace Presentation Layer Phase 2	40 wks	17/04/19	21/01/20
139	**Unit Testing**	**36 wks**	**05/06/19**	**11/02/20**
140	Unit Test Implementation	34 wks	05/06/19	28/01/20
141	Unit Testing	34 wks	12/06/19	04/02/20
142	Unit Testing Result	34 wks	19/06/19	11/02/20
143	**User support documentation**	**6 wks**	**29/01/20**	**10/03/20**
144	User Guide	4 wks	29/01/20	25/02/20
145	System Administration Guide	2 wks	26/02/20	10/03/20
146	**Database**	**14 wks**	**22/05/19**	**27/08/19**
147	DataModel Improvement	8 wks	22/05/19	16/07/19
148	Database Improvement Implementati	4 wks	17/07/19	13/08/19
149	Database testing	2 wks	14/08/19	27/08/19
150	**Deployment**	**31 wks**	**10/07/19**	**11/02/20**
151	Test Enviroment Deployment	30 wks	10/07/19	04/02/20
152	Deployment Guide	30 wks	17/07/19	11/02/20
153	Deployment Plan	2 wks	11/09/19	24/09/19
154	**Testing**	**40 wks**	**17/07/19**	**21/04/20**
155	Test Plan	24 wks	14/08/19	28/01/20
156	**Testing & verification**	**40 wks**	**17/07/19**	**21/04/20**
157	Component Testing	30 wks	17/07/19	11/02/20
158	Integration testing	4 wks	12/02/20	10/03/20
159	System Performance Testing	4 wks	11/03/20	07/04/20
160	Testing Result Report	2 wks	08/04/20	21/04/20



ID	Name	Duration	Start	Finish
161	**User Acceptance Testing and Production D**	**94 wks**	**10/10/18**	**28/07/20**
162	**Telemetry Data Adquisition**	**14 wks**	**10/10/18**	**15/01/19**
163	**User Acceptance Testing**	**8 wks**	**10/10/18**	**04/12/18**
164	User Testing	4 wks	10/10/18	06/11/18
165	Observations Fixing	4 wks	07/11/18	04/12/18
166	Production Enviroment Deployment	2 wks	05/12/18	18/12/18
167	Test Production Environment	4 wks	19/12/18	15/01/19
168	**eSWIS Improvement**	**14 wks**	**24/04/19**	**30/07/19**
169	**User Acceptance Testing**	**8 wks**	**24/04/19**	**18/06/19**
170	User Testing	4 wks	24/04/19	21/05/19
171	Observations Fixing	4 wks	22/05/19	18/06/19
172	Production Enviroment Deployment	2 wks	19/06/19	02/07/19
173	Test Production Environment	4 wks	03/07/19	30/07/19
174	**WRIS Integration**	**14 wks**	**17/04/19**	**23/07/19**
175	**User Acceptance Testing**	**8 wks**	**17/04/19**	**11/06/19**
176	User Testing	4 wks	17/04/19	14/05/19
177	Observations Fixing	4 wks	15/05/19	11/06/19
178	Production Enviroment Deployment	2 wks	12/06/19	25/06/19
179	Test Production Environment	4 wks	26/06/19	23/07/19
180	**WRIS Improvement**	**14 wks**	**22/04/20**	**28/07/20**
181	**User Acceptance Testing**	**8 wks**	**22/04/20**	**16/06/20**
182	User Testing	4 wks	22/04/20	19/05/20
183	Observations Fixing	4 wks	20/05/20	16/06/20
184	Production Enviroment Deployment	2 wks	17/06/20	30/06/20
185	Test Production Environment	4 wks	01/07/20	28/07/20
186	**Capacity Building**	**88 wks**	**05/12/18**	**11/08/20**
187	Phase 1	32 wks	05/12/18	16/07/19
188	Phase 2	32 wks	01/01/20	11/08/20
189	Maintenance	104 wks	29/07/20	26/07/22



Appendix 7: List of Proposals submitted for Purpose Driven Studies (PDS)

Appendix - List of Proposals submitted for Purpose Driven Studies (PDS)

No.	Project Title	Major Institution	Project Duration	Name	Amount (Lakhs)	Area of Research	Remarks
1	Chemical & Isotopic Characterization of Deep Aquifers of Middle Ganga Basin	NIH, Roorkee	3.5 Years	Dr. Sudhir Kumar	55.4	Ground Water (Identification of ground water aquifers and its quality and sustainability)	To be reviewed
2	Hydro-geochemical Evolution and Arsenic Occurrence in Aquifer of Central Ganges Basin	NIH, Roorkee	3.0 Years	Mr. Sumant Kumar	70.0	Ground Water (Determination of the spatio-temporal variation of arsenic (As) in the ground water in Bhojpur district, Bihar)	To be reviewed
3	Web GIS Based Spring Inventory for Vulnerability Assessment and Hydro-Geological Investigation of Selected Springs for Sustaining Local Water Demand in Ravi Catchment of Himachal Pradesh	NIH, Roorkee	4.0 Years	Mr. SS Rawat	69.0	Interdisciplinary/ hydrology/ groundwater/Water Quality/IT (Development of an inventory of Physical and hydrochemical characteristics of spring water resources in Himachal Pradesh.	To be reviewed
4	Hydrochemical & mineralogical evaluation of the Arsenic affected, Shallow (<50 m) Holocene aquifers of West Bengal& its effect on food chain, West Bengal India.	State Water Investigation Directorate (SWID), GoWB	4.0 Years	Mr. Rhitwik Chatterjee	50.0	Ground water/Water Quality (Quantification of Arsenic in WB aquifers).	To be reviewed
5	Studies on Occurrence, Distribution and Sustainability of Natural Springs for Rural Water Supply in parts of Western Ghats, India	NIH, Belagavi	3.0 Years	Dr. B.K. Purandara	54.54	Surface Water Hydrology (Rural Water distribution system)	To be reviewed
6	Investigating water stress using hydrometeorological and remote sensing data	NIH, Roorkee	3.0 Years	Mr. D.S. Rathore	Not mentioned	Surface Water Hydrology (Development of drought Indices using met, hydro and satellite information)	To be reviewed
7	Sedimentation study of Hirakud Reservoir using Optic and Microwave Remote Sensing Technology	NIH, Kakinada	3.0 Years	Dr. V.S. Jeyakanthan	51.19	Surface Water Hydrology (Development of a method to estimate the reservoir capacity using Remote sensing method)	To be reviewed

No.	Project Title	Major Institution	Project Duration	Name	Amount (Lakhs)	Area of Research	Remarks
8	Measurment of discharge of the flowing stream using image processing techniques in Muvattupuzha basin	Irrigation department, Kerala State	2.0 Years	Mr. Benoy Tomy George	40.0	Surface Water Hydrology (Development of a flow measurement system for rivers using acoustic method in collaboration with CWPRS)	To be reviewed
9	Groundwater Quality Assessment with special reference to Sulphate contamination in Bemetara District of Chhattisgarh State and ameliorative measures	NIH, Roorkee	3.0 Years	Mr. MK Sharma	28.966	Ground Water/Water Quality (Studies on sulphate contamination in Bemetara district of Chhattisgarh and recommendation of possible solution)	To be reviewed
10	Evaluation of Impacts of Rabi Irrigation in Ganga River Sub Basin of Madhya Pradesh	NIH, Bhopal	3.0 Years	Mr. Ravi Galkate	41.512	Surface Water Hydrology (Surface water distribution system)	To be reviewed
11	Groundwater Quality Assessment of Southwest Punjab Emphasizing Carcinogenic Contaminants and their Possible Remedial Measures	NIH, Roorkee	3.0 Years	Dr. Rajesh Singh	65.602	Ground Water/Water Quality (Analyzing water quality of selected areas in Punjab with an emphasis on carcinogenic chemicals, identifying their sources, and suggesting appropriate remedial measures)	To be reviewed
12	Modelling of Tawa Reservoir Catchment and Development of Tawa Reservoir Operation Policy under Climate Change.	NIH, Roorkee	3.0 Years	Mr. Shashi Poonam Indwar	26.96	Surface Water Hydrology (Reservoir operation and management under the purview of climate change)	To be reviewed
13	Assessment of impacts of groundwater salinity on regional groundwater resources, current and future situation in Mewat, Haryana – possible remedy and resilience building measures	NIH Roorkee	3.0 Years	Dr. Gopal Krishnan	65.0	Ground Water (Ground water salinity estimation in Haryana)	To be reviewed
14	Development of a comprehensive plan for conservation and sustainable management of Bhimtal and Naukuchiatal lakes, Uttarakhand	Irrigation Department, Uttarakhand	3.0 Years	Mr. Amarnath Singh Bisht	78.06	Surface Water Hydrology (Hydrological investigations on the Bhimtal and Naukuchiatal lakes to develop a rejuvenation and	To be reviewed

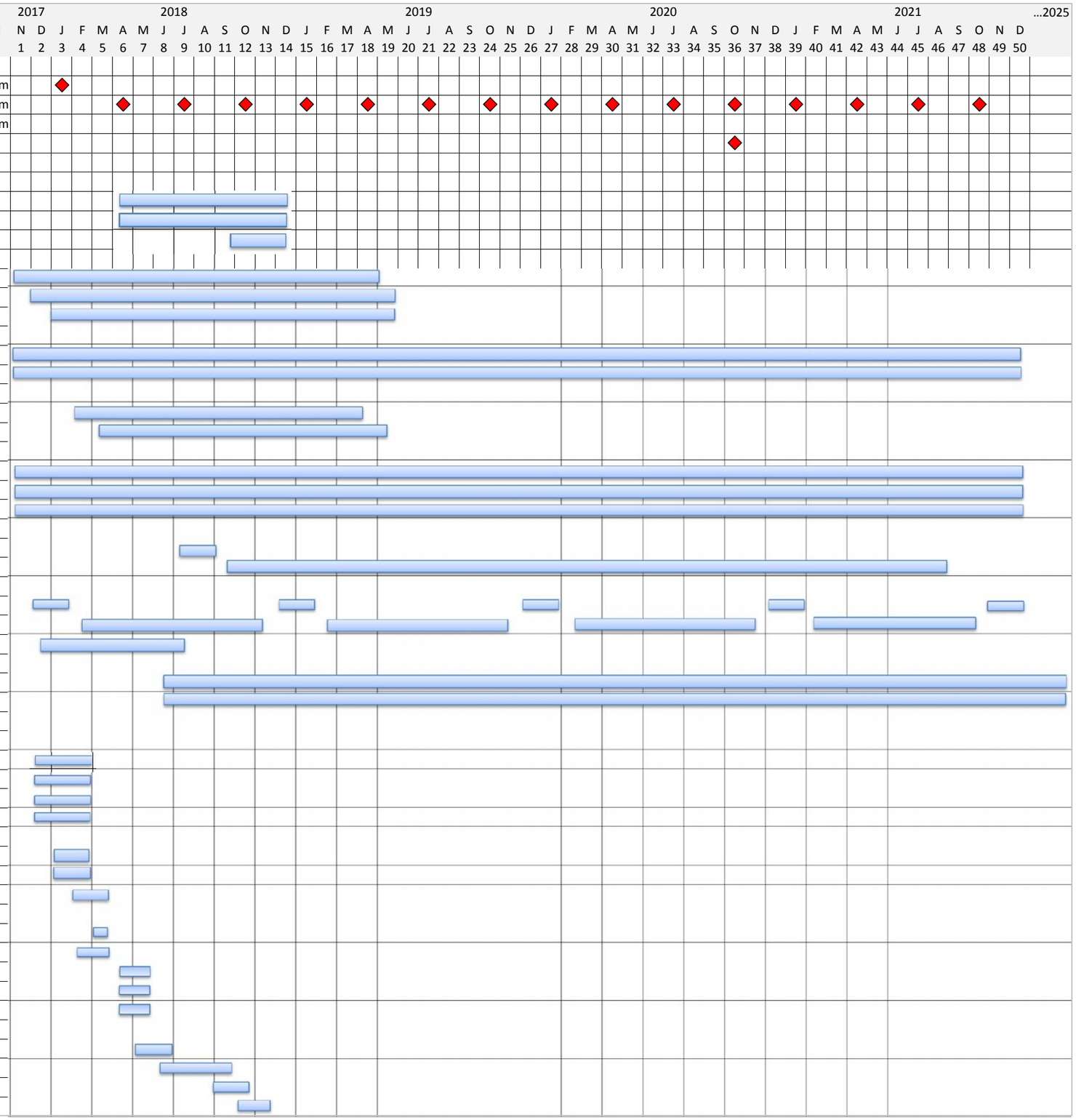
No.	Project Title	Major Institution	Project Duration	Name	Amount (Lakhs)	Area of Research	Remarks
						conservation plan)	
15	AssessmentSAAssessment of Surface Water Quality status and evolving mitigation measures to improve the water quality in Thrissur Corporation	Irrigation Design and Research Board (IDRB), Irrigation Dept., Kerala	2.0 Years	Superintending Engineer	50.0	Surface Water Hydrology (Assessment of Water quality and measures for quality improvement over Trichur Municapal Corporation, Kerala)	To be reviewed
16	Integrated Study on Groundwater Dynamics in the Coastal Aquifers of West Bengal for Sustainable Groundwater Management	NIH Roorkee	3.5 Years	Dr. Someshwar Rao	51.5	Ground Water Hydrology (Sea water intrusion over the coastal zone in WB will be assessed)	To be reviewed
17	Ganges aquifer management in the context of monsoon runoff conservation for sustainable river ecosystem services – A pilot study	NIH Roorkee	4.0 Years	Dr. Surjeet Singh	57.70674	Ground Water/Surface Water (River-aquifer interaction study)	To be reviewed
18	Impact Assessment of the Upcoming Irrigation Projects and Climate Change on the Droughts and Desertification Scenario for Chambal Basin in Western Madhya Pradesh	NIH Roorkee &	4.0 Years	Dr. T. Thomas	88.8	Surface Water Hydrology/ Climate Change (Analysis of droughts, the desertification and also study the impacts of the water resources projects on the prevailing climate change scenario)	To be reviewed
19	Water efficient Irrigation by using SCADA system for Medium Irrigation Project (MIP) Shahnehar.	IPH Department, Hydrology C&M Division Shimla-4.	3.0 Years	Vijay Kashyap	75.0	Surface Water Hydrology (Irrigation)	To be reviewed
20	Groundwater salinity source identification in Godavari Delta, A.P	NIH Kakinada	3.0 Years	Dr. Satyaji Rao	61.096	Ground water Hydrology (Identification of sources of salinity in Godavari Delta)	To be reviewed
21	Assessing effect of coastal process and catchment behavior near river mouth of	Gujarat Engineering	4 Years	P.B. Choudhary	86.00	Surface water Hydrology (Study changes in catchment area and	Under review

No.	Project Title	Major Institution	Project Duration	Name	Amount (Lakhs)	Area of Research	Remarks
	Ambika and Auranga rivers (Tapi river basin in South Gujarat)	Research Institute (GERI)				course of River Ambica and Auranga and its consequent effect on river morphology and sediment transport behavior)	
22	Effective flood protection works in vulnerable tail reaches of rivers Tapi, Damanganga & Mahi of Gujarat state	Gujarat Engineering Research Institute (GERI)	4 Years	P.B. Choudhary	77.60	Surface water Hydrology (Suggesting type of protection work at different reaches of river under study and evaluating the performance of suggested protection work on physical models)	Under review
23	Assessing efficacy of Piano Key Weirs on low height existing weirs to increase the spillway discharge capacity	Gujarat Engineering Research Institute (GERI)	4 Years	P.B. Choudhary	25.00	Surface water Hydrology (Study effect of changes to Piano Key Weir crest on discharge capacity)	Under review
24	Studies on Saline ingression in selected river basins of Kerala and the impact/extent of sea water intrusion in coastal Aquifers of Kerala state	Irrigation Department, Govt of Kerala	3 years	Preetha Sugathan	62.5	Surface Water/Water Quality (Understanding the process of the salinity intrusion in the tidal reach)	Under review
25	Mapping of groundwater quality in the Industrial belt of Ernakulum District	Ground Water Department, Kerala	3 Years	Soya. Y. Das	48.72	Ground Water/Water Quality (Studying groundwater quality in and around the industrial area)	Under review
26	Study of River Network, Water Quantity and Quality for Assessment of Environmental Flow requirement for Sustenance of the Sundarban's Ecosystem	River Research Institute, Irrigation & Waterways Directorate, Govt. of West Bengal	3 Years	Dr. Bibhas Chandra Barman	85.034	Surface Water Hydrology (Assessing the environmental flows for Indian Sundarbans)	Under review
27	Study of surface and subsurface water interaction using remote sensing, geohydrological and geophysical	Central Water & Power Research	3 Years	Dr. C. Krishnaiah	28.8	Ground Water/Surface Water Hydrology (Mapping the subsurface flow regime and evaluating its spatial	Under review

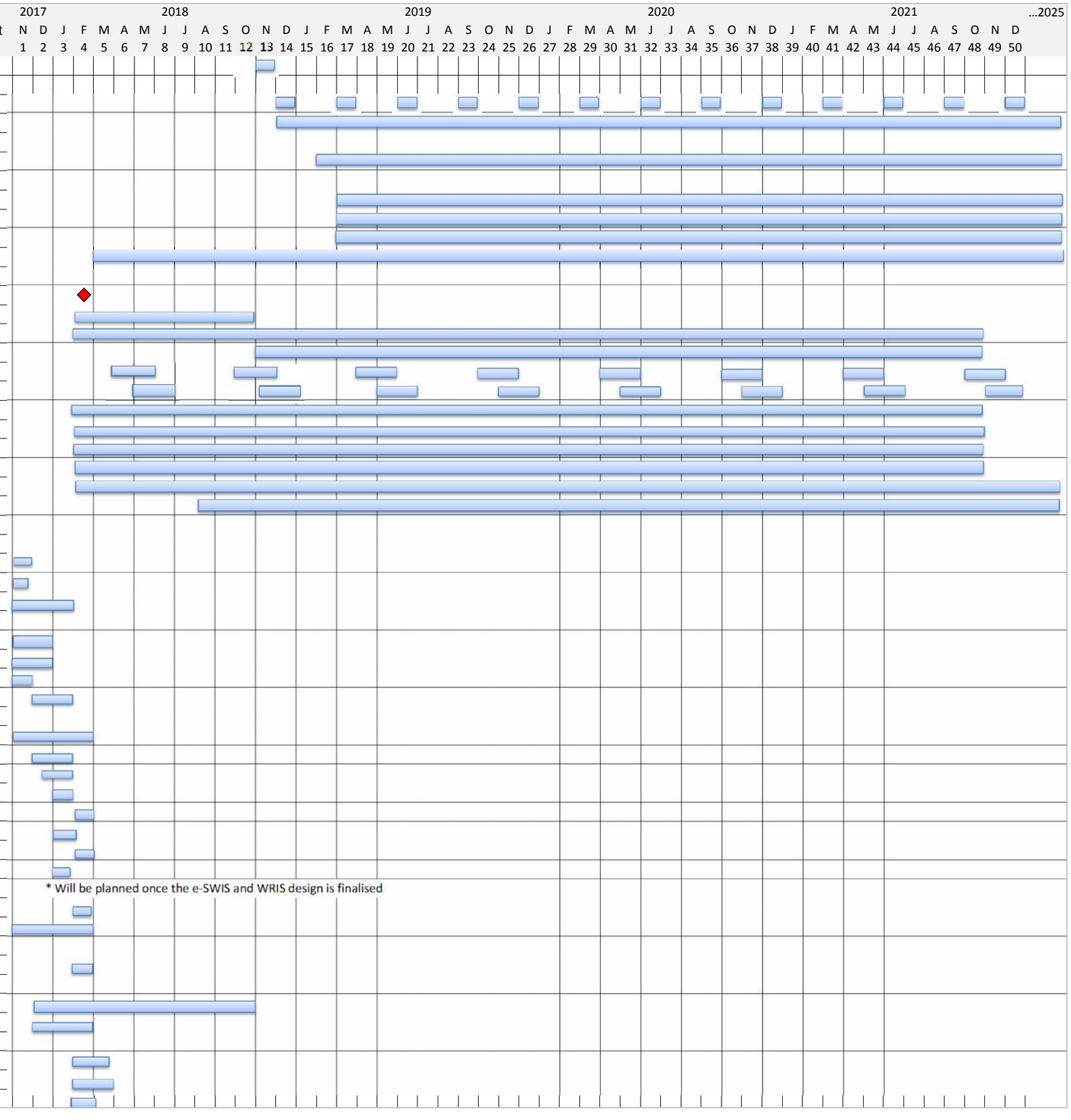
No.	Project Title	Major Institution	Project Duration	Name	Amount (Lakhs)	Area of Research	Remarks
	techniques and its modelling	Station, Pune				interaction with surface water, locating artificial recharge sites)	
28	River Rejuvenation of Mutha River reach flowing through Pune city and suburbs, Maharashtra	Central Water and Power Research Station	3 years	Dr. Shanti Vaidya	70.0	Surface Water/ Water Quality (Study of water quality of Mutha and Mula-Mutha river reach from down- stream of Khadakwasla Dam to Daund)	Under review
29	Impact of Urbanization on Groundwater Quality and Management in Greater Hyderabad Municipal Corporation (GHMC), Hyderabad	Telangana Sate Ground Water Department	3 years	K. Laxma	123.32	Ground Water/Water Quality/IT (Developing online groundwater data retrieval and monitoring system for GHMC area following comprehensive understanding of the groundwater quality issues of Hyderabad city)	Under review
30	To study surface – ground water interaction to develop a comprehensive hydrogeological frame work to manage groundwater resource in an over exploited groundwater assessment unit	Telangana Sate Ground Water Department	3 years	K. Laxma	87.32	Ground Water Hydrology (Understanding the dynamic response of a fractured rock aquifer system to natural and anthropogenic stress in the over-exploited Lingala Ghanpur micro basin, Jangoan District)	Under review

Appendix 8: TAMC Work Programme and Work Plan

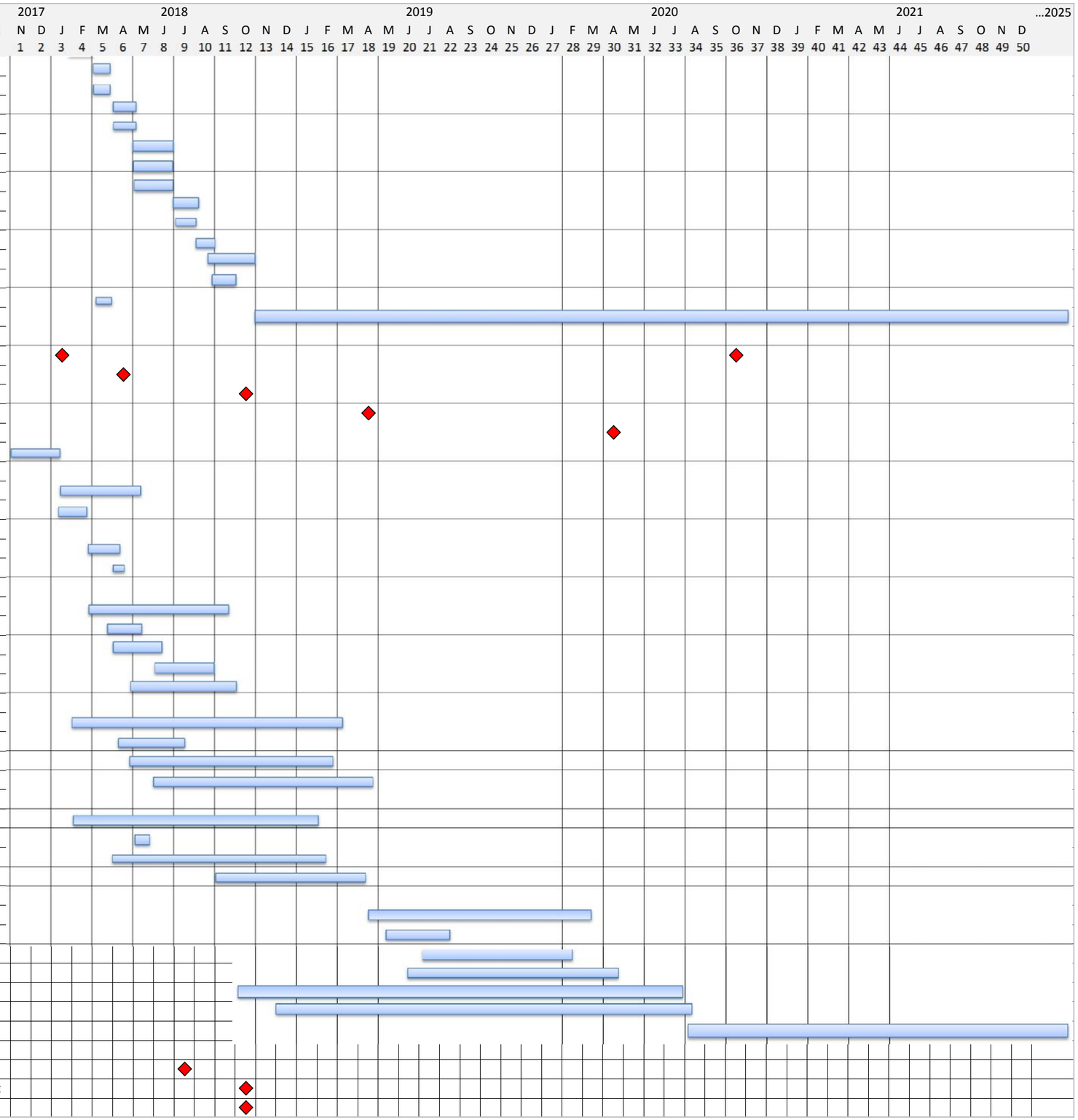
Activity/Deliverable	Lead	Support
General Deliverables		
Inception Report	TL/DTL	TAMC team
Quarterly Reports/Annual Progress reports	TL/DTL	TAMC team
Mid-term Report	TL/DTL	TAMC team
Multilingual Documentary Film of the Project	Comm	
Procurement Support		
Assessment of existing systems & procurement capacity of IAs		
Assessment of IA current procurement systems and implementation capacities		
Analysis of existing procurement documents, guidelines and systems		
Recommendations for improving procurement capacities		
Development of standardised documents, procedures and guidelines		
Comparison of documents/ procedures applied by different IAs		
Identification and development of standardised procurement documents		
Development of standardised procedures and guidelines		
Support for IAs in development of specific bidding documents		
Support to IAs through distribution of procurement documents		
Support to IAs in development of specific bid documents as required		
Coordination of project standard tech. spec. for key equipment		
Assessment/comparison of technical specs from previous tenders (HP-I & HP-II)		
Selection/ development of standard technical specifications	Proc	
Review of bidding documents, bid evaluation reports		
Preliminary compliance check to assess variaton wrt PIP, AWP, PP		
Review of technical specifications and technical schedules		
Review procurement rel. provisions in BDS & SCC (eligibility, bid security, etc.)		
Provide support on request through audit of the quality		
Development of procedures for audits, tests, etc.		
Quality audits, quality tests, field verifications, test measurements		
Coordination of prep. of annual work plans & procurement plans		
Review of annual work plans and procurement plans submitted by Ias		
Coordination with IAs and adjustment of plans as required		
Providing inputs during up-gradation of MIS related to PIP, AWP, PP		
Advice on contract management as required by IA		
Support during implementation of procurement contracts		
Supervision, contract management, quality control, financial management, etc.		
Monitoring and Evaluation		
Inception Phase: Planning and Strategy		
Analysis of existing M&E system		
Interaction with IAs		
Analysis of existing MIS		
Scope Clarification		
Phase 1: Development of Templates / Formats		
Baseline values		
Ranking of Implementing Agency		
Project Monitoring & Tracking System (PMTS) format for Implementing Agency		
Phase 2: Fixing Baseline Values & Ranking		
Sharing of baseline and ranking templates with IA		
Follow up with IA to fill up the templates / formats		
Data collection, collation and analysis		
Report preparation for baseline values		
Report preparation for ranking of IA	M&E	
Phase 3: Design & Development of PMTS		
Development of User Requirements Document for PMTS		
Development of PMTS module		
Pilot testing and implementation		
Modification / rectification of PMTS module if required		



Activity/Deliverable	Lead	Support
Uploading of PMTS module in MIS		
Phase 4: Capacity Building & Filling Data		
Capacity Building of IA for PMTS		
Filling up the data in PMTS module online		
Phase 5: Data Collection, Analysis & Report Generation		
Information/data collection, collation, processing & analysis		
Report generation		
Component level		
Implementing Agency level		
Project level		
Ranking of Implementing Agency		
Financial Management		
Quarterly Physical and Financial Report		
Analysis of expenditure and comparison of variance with AWP		
Monthly monitoring of expenditure of IA, generated from MIS		
Analysis of financial & physical performance of the project		
Support to NPMU in compilation of UC & IUFR on every 6 months		
Support to NPMU to lodge reimbursement claim with the World Bank	Fin	
Support to IT/database team in development of existing Finance Module of MIS		
Visit to IA on selective/ rotational basis to monitor the performance		
Coordination with IA for compliance to Audit and submission of the reports		
Sharing of knowledge updates, training and support to IA in MIS, Accounting etc.		
Support, compliance, Information and attending meeting as required		
Follow-up with IA with regard to adverse audit report if any and its resolution		
Management Information System		
Inception Phase		
Mobilisation of MIS team		
Set-up Development environment: Servers, Licenses, Desktop		
Planning and Strategy		
As-is Hosting on NIC		
Knowledge Transition		
Arrange for Domain Name and Cloud Space from NIC		
Get Security Audit for MIS		
Hosting on NIC		
Requirement Gathering		
System Requirement		
User requirement - Project		
User requirement - Finance		
User requirement - Procurement		
User requirement - M&E		
User requirement - Training		
User requirement - Knowledge Management		
User requirement - Grievance		
User Requirement- Integration with WRIS		
Dashboard and Reports		
URS Document Preperation		
Analysis and Design	IT/MIS	
Analysis and Design		
Maintenance of Existing		
Immediate Support on Tickets		
Revamp Presentation layer		
Development		
Finance Module		
PIP/Procurement		
Website/Portal other activities		

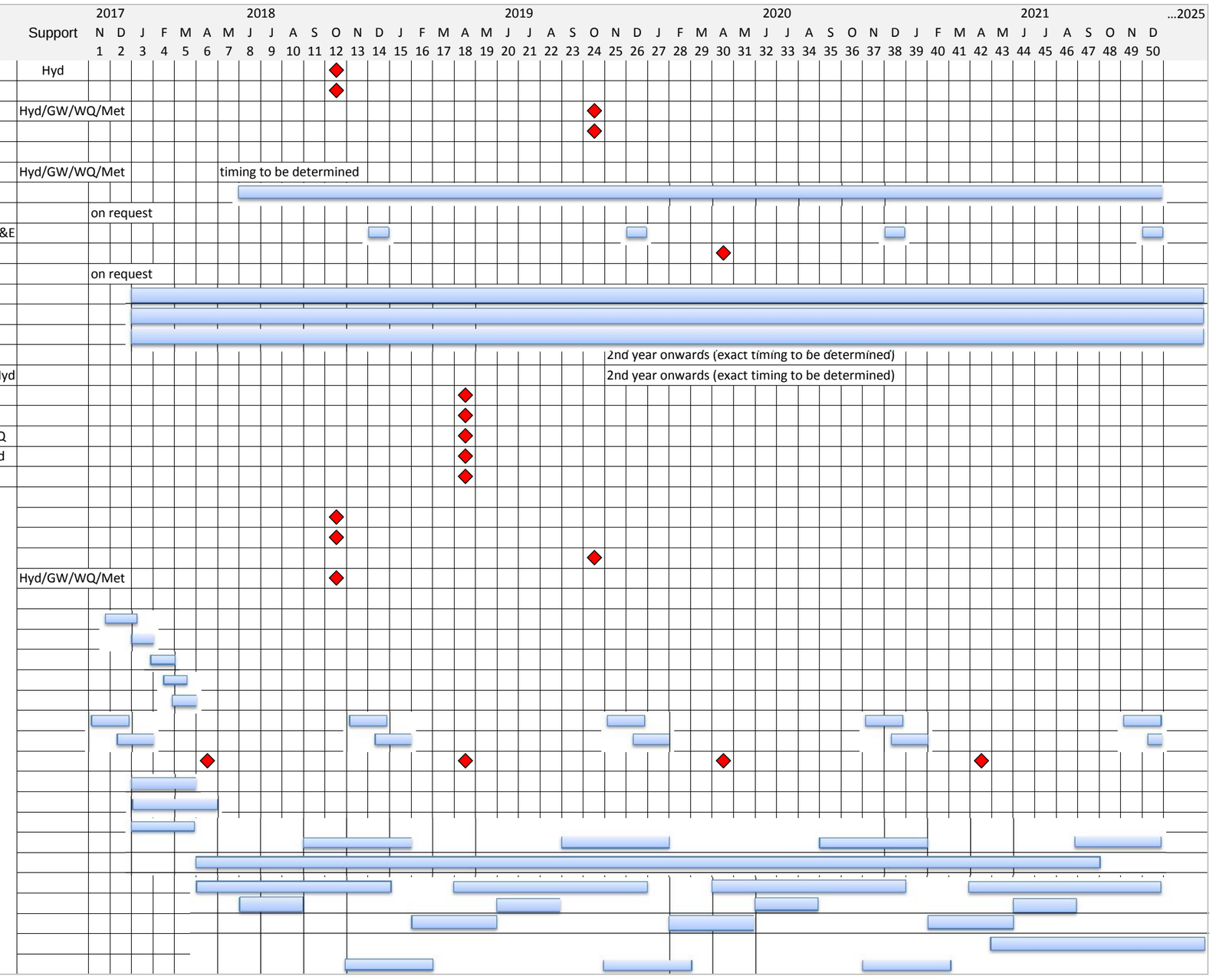


Activity/Deliverable	Lead	Support
Training		
Workshop & Meeting:		
Feedback		
Grievance		
Project Progress(M&E)		
Reports		
MIS/Dashboard		
Project Status		
DMS		
Readiness Criteria:		
Hydromet Stations		
Master		
CMS		
Maintenance		
Water Information Systems Development (eSWIS-WRIS)		
Report on Data Requirements and Gap Analysis for major applications		
Architecture Design of up-scaled and revamped India-WRIS		
Technical Specification (HW and SW) for State Data Centres		
Development of improved eSWIS		
Switching India-WRIS to Latest Platform		
Planning and Strategy - Analysis of Existing Systems and Scope Clarification		
Framework Requirements		
Business Requirements		
System Requirements		
System Architecture		
Software Architecture		
Hardware Architecture		
Automatic Data Adquisition System		
Software		
Hardware		
Database		
Deployment		
Testing	IT	
eSWIS Improvement		
Software		
Database		
Deployment		
Testing		
WRIS Integration		
Software		
Hardware		
Deployment		
Testing		
WRIS Improvement		
Software		
Database		
Deployment		
Testing		
User Acceptance Testing and Production Deployment		
Capacity Building		
Maintenance		
Technical Advice and Support		
Project Document (HW/SW architecture, Cost) Flood & IWRM Modelling Centres	Hyd	
Review and finalisation of Hydromet Networks of sites	Hyd	GW/Met
Typical Standardised design for sites & civil layout drawings	TBD	



TAMC WORK PROGRAMME AND WORK PLAN

Activity/Deliverable	Lead	Support
Preparation of tech. specs, finalisation of sites for SCADA for res. & canals	Instru	Hyd
Standardisation anti theft/vandalism measures	Instru	
Report on lessons learnt for use of automatic data acquisition systems	Instru	Hyd/GW/WQ/Met
Report on IWRM/RBOs (international examples)	Hyd	
Framework & architecture for 5 Centres of Excellence/Modelling Centres/WALMIs	Hyd	
Review of manuals prepared in HP-I, HP-II and NHP	Instru	Hyd/GW/WQ/Met
Inspection, monitoring, quality checks, testing of comm.syst.& telemetry equip.	Instru	
Conceptual design of State/National hydro-informatiucs centres	IT	
Technical audit of hydro-meteorological site performance	Instru/M&E	
Development of protocols for irrigation management using hydro-met data	Hyd	
Technical support to IAs in solving specific water management issues	Hyd	
Support to NPMU in procuring consultants for IWRM, FF, DSS, GW modelling, etc.	Hyd	
Report for NPMU on ongoing studies and recommendations	Hyd	
Support to NPMU in scrutiny and modification of Proposals of PDS	Hyd	
Review, performance evaluation & gap analysis of 1D modelling for 3 days FF	Hyd	
Report on institutional, admin., regulatory, policy, collaborative & legal aspects	TL/DTL/Hyd	
Framework document for water accounting with pilot study (say Narmada)	Hyd	
Framework document for Integrated Reservoir Operation (say Narmada)	Hyd	
Framework document for ground water and water quality modelling	GW/WQ	
Strategy for use of remote sensing technologies and climate change adaptation	GIS/Hyd	
Extended Hydrologic Predictions for a river basin (say Narmada)	Hyd	
Capacity Building		
Plan & design Training Programme for Master Trainers/ToT		
Report Identification of National/International Training Institutes		
Design of Training module for SWA level workers		
Design of first stage trouble shooting module / FAQ / trouble shooting manual		Hyd/GW/WQ/Met
Preparation of Annual Training Calendar 2018/19		
Circulation of Questionnaire		
Follow up through phone calls		
Feedback Analysis		
National Level Workshop		
Submission of Draft Training Calendar		
Training Needs Assessment	CapB	
Preparation of Annual Training Calendar		
Report of progress review of IAs capacity building program & impact assessment		
Selection of Institutes for National Training		
Selection of Institutes for International Training		
Finalising International Study Tours		
Conducting Regional Workshops		
Conducting Trainings		
Organising Competitions for School/College Students		
Developing Promotional Materials		
Planning and Conducting Awareness Campaigns		
Preparation of a Record of Project Implementation		
Providing Materials to IAs for Stakeholder Communication		



Appendix 9: TAMC Team Deployment Schedule

TAMC Team Deployment Schedule

No	Name	Position	Oct		Nov				Dec				Jan 2018					Feb				Mar				Apr				
Core Staff - International			23-10	30-10	6-11	13-11	20-11	27-11	4-12	11-12	18-12	25-12	1-1	8-1	15-1	22-1	29-1	5-2	12-2	19-2	26-2	5-3	12-3	19-3	26-3	2-4	9-4	16-4	23-4	30-4
K-1	Dr. Wolfgang Krinner	Team Leader	1	1	1	1	1	1	1	1			0,8	1	1	1	1	1	1	1	1	1	1	1	0,2	1	1	1	1	1
K-2	Dr. Nesa Ilich	River Basin Modelling Expert							1	1	1	1	1	1	1	1	1w home office				1	1	1	1	1	1	1	1	1	1
K-3	Dr. Jayaraman Potty	Hydro-met Instrumentation Expert												0,8	1						1	1								
K-4	Peter Ravenscroft	Hydrogeologist & Groundwater Modelling Expert																		1	1	1	1					1	1	1
Core Staff - National																														
K-5	Dr. Sravan Kumar Kanukuntla	Deputy Team Leader					1	1	1		1	1	1	1	0,8	1	1	0,4	1	1	1	1	1	1	1	1	1	1	1	1
K-6	Desh Raj	Sr. Procurement Expert							0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6		0,8		1		1	1	1		1	1	1		1
K-7	Rajendra Arun Patel	MIS & IT Expert				0,6	1	1	1	1	1	1	0,6	0,6	0,6		0,8	1	1		1	1	1	1	1	1	1	1	1	1
K-8	Dr. Ashoke Basistha	Hydrologist and Hydrological Modelling Expert										0,4	1	1	1		1	1	1	1	1	1	1	1		1	1	1	1	1
K-9	Dr. Ashok Kaushal	GIS & Remote Sensing Expert			1		1		1	1		1	1		1		1	1		1		1		1		1		1		1
K-10	Madhu Sudan Doria	Capacity Building Expert							0,8	1	1	1	1	1	1	1	1		1											
Support staff																														
S-11	Dr. Jubair Tariqul Alam Chowdhury	Hydrochemist and Water Quality Expert																												
S-12	Philip Appleton	Capacity Building Expert (international)																												
S-13	Devender Kumar Khurana	Sr. Finance Management Expert							0,6	1	1	1	0,4	1	0,8	1	1	0,6	1	1	1	1	1	1	1	1	1	1	1	1
S-14	Anil Kumar Agarwal	Monitoring & Evaluation (M&E) Expert							0,6	0,6	1	1	1	0,8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S-15	Dhiren Kumar Chavda	Ground Water Management and Modelling Expert																												
S-16.1	Vikas Patil	Procurement Expert-1 (Kol)				1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1
S-16.2	Murali Reddy	Procurement Expert-2 (Hyd)							0,6	0,8	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1
S-16.3	Dipesh Desai	Procurement Expert-3 (Gan)					0,6	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1
S-16.4	Quazi Wasiuddin	Procurement Expert-4 (Guw)																				0,6	1	1	1		1	1	1	1
S-16.5	Amit Sethi	Procurement Expert-5 (Del)													0,6	0,6	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S-17.1	Sunil Patil	Instrumentation Expert-1 (Hyd)																	0,4	1	1	1	1	1	1	1	1	1	1	1
S-17.2	Pravin Pote	Instrumentation Expert-2 (Kol)																	0,4	1	1	1	1	1	1	1	1	1	1	1
S-18	Mayank Shekar Singh	Finance Expert					0,8	1	1	1	1		0,8	1	1	1	1	0,8	1	0,8	0,6	1	1	1	1	1	1	1	1	1
S-19.1	Amlan Sarkar	MIS Expert																												
S-19.2	TBN	Application Development Expert																												
S-19.2	TBN	Application Development Expert																												
S-19.3	Mohit Sharma	Application Programmer			0,6	1	1	1	1	1	1	1	0,8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S-19.3	Sergio Herrero	Application Programmer						1	1	1	1				0,8	1	1	1	1	1	1	1	1	1			1	1	1	1
S19.3	Piyush Dubey	Application Programmer												1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1
S19.3	Amit Kumar	Application Programmer												0,2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S19.3	Amit Lakhera	Application Programmer																	1	1	1	1	1	1	1	1	1	1	1	1
S19.3	TBN	Application Programmer																												
S19.3	TBN	Application Programmer																												
S19.3	TBN	Application Programmer																												
S19.3	TBN	Application Programmer																												
S19.3	TBN	Application Programmer																												
S19.3	TBN	Application Programmer																												
S19.3	TBN	Application Programmer																												
S-19.4	Garima Varshney	Database Designer						0,4	1	1	1		0,8	0,8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S-19.4	Sneha Shirohi	Database Designer												0,6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S-19.5	Santosh Gupta	Application Web Designer					0,8	1	1	0,6	1	0,8	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1
S-20.1	Shuvra Sangeeta	Water Resources Management Expert-1															0,2	1	1	1	1	1	1	1	1	1	1	1	1	1
S-20.2	Jaya Sood	Water Resources Management Expert-2																		1	1	1	1	1	1	1	1	1	1	
S-21.1	Sayantan Ghosh	Communication and Media Expert-1																												
S-21.2	TBN	Communication and Media Expert-2																												
S-22	Anil L. Shirgave	Telecommunication Expert																												
S-23	Rakesh Bhatt	SCADA Expert				1	1	1	1	1	1	0,8	0,8	1	0,6	1	1	1	0,4	1	1	1		1	1	1	1	1	1	1
S-24	TBN	Meteorologist (international)																												
	Azizul Quadir	Coordination Procurement/Finance/MIS					0,4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Ankit Sharma	Procurement Support									1	0,6	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1
Advisory Team																														
S-25.1	TBN	Integrated Water Resources Management Advisor																												
S-25.2	TBN	Climate Change Advisor																												
S-25.3	TBN	Short & Midterm Rainfall Forecast Advisor																												
S-25.4	TBN	Sediment Modelling and Management Advisor																												
S-25.5	TBN	Aquifer Recharge Management Advisor																												
S-25.6	TBN	Flood Modelling Advisor																												
S-25.7	TBN	Spatial & Non-sp.datasets for W.Res.Mgmnt Adv.																												
S-25.8	Francisco Jimenez	IT Hardware & Software Advisor					0,8	1	1	1					0,6	1	1				1	1	1	1				1	1	1
S-25.9	TBN	Community-based Water Management Advisor																												
Technical and Office Support Team																														
S-26.1	Ankita Bharti	Data Entry Operator							1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1
S-26.1	TBN	Data Entry Operator																												
S-26.2	Sobiaya Yaqoob	Receptionist/Project Secretary							1	1	0,8	1	1	1	0,8	1	0,8	1	1	1	1	1	1	1	1	1	1	1	1	1
S-26.3	Vijay Sehgal	Office Manager	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0,6	1	1	1	1	1	1	1	1	1	1	1	1
S-26.4	Sumanta Prasad	Office Assistant				0,8	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S-26.4	TBN	Office Assistant																												
S-26.5	Gaurav Kumar	Accounts Assistant							0,4	1	1	1	0,8	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1
S-26.5	TBN	Accounts Assistant																												

TAMC Team Deployment Schedule

No	Name	Position	May		Jun			Jul				Aug				Sep					
Core Staff - International			7-5	14-5	21-5	28-5	4-6	11-6	18-6	25-6	2-7	9-7	16-7	23-7	30-7	6-8	13-8	20-8	27-8	3-9	10-9	17-9	24-9
K-1	Dr. Wolfgang Krinner	Team Leader	0,8	0,8	1	1	1	1	1	1	1	1	1	1				1	1	1	1	1	1
K-2	Dr. Nesa Ilich	River Basin Modelling Expert	1	1	1	1	1	1	1	1	1	1	1	1					1	1	1	1	1
K-3	Dr. Jayaraman Potty	Hydro-met Instrumentation Expert																					
K-4	Peter Ravenscroft	Hydrogeologist & Groundwater Modelling Expert	1					1	1	1	1					1	1	1	1				
Core Staff - National																							
K-5	Dr. Sravan Kumar Kanukuntla	Deputy Team Leader	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
K-6	Desh Raj	Sr. Procurement Expert	1		1	1	1		1	1	1		1	1	1		1	1	1		1	1	1
K-7	Rajendra Arun Patel	MIS & IT Expert	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
K-8	Dr. Ashoke Basistha	Hydrologist and Hydrological Modelling Expert	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
K-9	Dr. Ashok Kaushal	GIS & Remote Sensing Expert		1		1		1		1		1		1		1		1		1		1	
K-10	Madhu Sudan Doria	Capacity Building Expert																					
Support staff																							
S-11	Dr. Jubair Tariqul Alam Chowdhury	Hydrochemist and Water Quality Expert																					
S-12	Philip Appleton	Capacity Building Expert (international)																					
S-13	Devender Kumar Khurana	Sr. Finance Management Expert	1		1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1
S-14	Anil Kumar Agarwal	Monitoring & Evaluation (M&E) Expert	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1
S-15	Dhiren Kumar Chavda	Ground Water Management and Modelling Expert																					
S-16.1	Vikas Patil	Procurement Expert-1 (Kol)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S-16.2	Murali Reddy	Procurement Expert-2 (Hyd)	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1		1	1
S-16.3	Dipesh Desai	Procurement Expert-3 (Gan)	1		1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1
S-16.4	Quazi Wasiuddin	Procurement Expert-4 (Guw)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S-16.5	Amit Sethi	Procurement Expert-5 (Del)	1		1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1
S-17.1	Sunil Patil	Instrumentation Expert-1 (Hyd)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S-17.2	Pravin Pote	Instrumentation Expert-2 (Kol)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S-18	Mayank Shekar Singh	Finance Expert	0,6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S-19.1	Amlan Sarkar	MIS Expert																					
S-19.2	TBN	Application Development Expert																					
S-19.2	TBN	Application Development Expert																					
S-19.3	Mohit Sharma	Application Programmer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1
S-19.3	Sergio Herrero	Application Programmer	1	1	1	1	1	1	1	1	1	1	1	1					1	1	1	1	1
S19.3	Piyush Dubey	Application Programmer	1		1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1
S19.3	Amit Kumar	Application Programmer	1		1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1
S19.3	Amit Lakhera	Application Programmer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S19.3	TBN	Application Programmer																					
S19.3	TBN	Application Programmer																					
S19.3	TBN	Application Programmer																					
S19.3	TBN	Application Programmer																					
S19.3	TBN	Application Programmer																					
S19.3	TBN	Application Programmer																					
S19.3	TBN	Application Programmer																					
S-19.4	Garima Varshney	Database Designer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S-19.4	Sneha Shirohi	Database Designer	1		1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1
S-19.5	Santosh Gupta	Application Web Designer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S-20.1	Shuvra Sangeeta	Water Resources Management Expert-1	1		1	1	1	1	1	1	1	1		1	1	1	1		1	1	1	1	1
S-20.2	Jaya Sood	Water Resources Management Expert-2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1
S-21.1	Sayantan Ghosh	Communication and Media Expert-1																					
S-21.2	TBN	Communication and Media Expert-2																					
S-22	Anil L. Shirgave	Telecommunication Expert																					
S-23	Rakesh Bhatt	SCADA Expert	1		1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1
S-24	TBN	Meteorologist (international)																					
	Azizul Quadir	Coordination Procurement/Finance/MIS	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1		1
	Ankit Sharma	Procurement Support	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Advisory Team																							
S-25.1	TBN	Integrated Water Resources Management Advisor																					
S-25.2	TBN	Climate Change Advisor																					
S-25.3	TBN	Short & Midterm Rainfall Forecast Advisor																					
S-25.4	TBN	Sediment Modelling and Management Advisor																					
S-25.5	TBN	Aquifer Recharge Management Advisor																					
S-25.6	TBN	Flood Modelling Advisor																					
S-25.7	TBN	Spatial & Non-sp.datasets for W.Res.Mgmnt Adv.																					
S-25.8	Francisco Jimenez	IT Hardware & Software Advisor	1				1	1	1	1				1	1					1	1	1	1
S-25.9	TBN	Community-based Water Management Advisor																					
Technical and Office Support Team																							
S-26.1	Ankita Bharti	Data Entry Operator	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1
S-26.1	TBN	Data Entry Operator																					
S-26.2	Sobiaya Yaqoob	Receptionist/Project Secretary	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1
S-26.3	Vijay Sehgal	Office Manager		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S-26.4	Sumanta Prasad	Office Assistant	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1		1	1
S-26.4	TBN	Office Assistant																					
S-26.5	Gaurav Kumar	Accounts Assistant	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S-26.5	TBN	Accounts Assistant																					