Concept Note on National Project on Aquifer Management (NAQUIM)

1 Introduction

Aquifer mapping is a process wherein a combination of geologic, geophysical, hydrologic and chemical field and laboratory analyses are applied to characterize the quantity, quality and sustainability of ground water in aquifers. There has been a paradigm shift from "groundwater development" to "groundwater management". An accurate and comprehensive micro-level picture of groundwater in India through aquifer mapping in different hydrogeological settings will enable robust groundwater management plans at the appropriate scale to be devised and implemented for this common-pool resource. This will help achieving drinking water security, improved irrigation facility and sustainability in water resources development in large parts of rural India, and many parts of urban India as well. The aquifer mapping program is important for planning suitable adaptation strategies to meet climate change also. Thus the crux of NAQUIM is not merely mapping, but reaching the goal – that of ground water management through community participation.

2 Objective

The primary objective of the Aquifer Mapping Exercise can be summed up as **"Know your Aquifer, Manage your Aquifer"**. Demystification of Science and thereby involvement of stake holders is the essence of the entire project. The involvement and participation of the community will infuse a sense of ownership amongst the stakeholders. This is an activity where the Government and the Community work in tandem. Greater the harmony between the two, greater will be the chances of successful implementation and achievement of the goals of the Project. As per the Report of the Working Group on Sustainable Ground Water Management, "It is imperative to *design* an aquifer mapping programme with a clear-cut *groundwater management purpose*. This will ensure that aquifer mapping does not remain an academic exercise and that it will seamlessly flow into a participatory groundwater management programme. The aquifer mapping approach can help integrate ground water availability with ground water accessibility and quality aspects.

3 Outputs

The Outputs and of Aquifer mapping will be both scientific and social. Some of the Scientific Outputs include:

I. Disposition of Water Bearing Formations

- Surface outcrop
- Subsurface continuity in vertical and horizontal disposition
- Overlay of different litho units to form a group & aquifer system, E.g. – Alluvium – Gravel, sand, silt & clay in different percentage underlain by compact Sandstone,/shale, hard rock etc.

II. Water Bearing Capacity

- Variation with depth

- Changes in space & time
- Run off zone, recharge zone, discharge zone
- Abstraction status

III. Aquifer (Formation water) Quality

- In-situ (depositional)
- Anthropogenic
- Vertical zonation
- Blending/Migration of pollutants in aquifers with time

IV. Strategies for Sustainable Management

- Quantification of water within different layers (Aquifers- 1,2 3 etc)
- Quality in each aquifer (group)
- Demand-Supply analysis
- Estimation of prevailing Development Status
- Precise assessment of functional wells for agriculture, industries, drinking water purposes (modified well census as village wise by public participation to be translated into aquifer wise & then administrative unit)

V. Identification of Clusters of Aquifers (layers)

- Vertical-horizontal flow of recharged water from source – rainfall, canal, applied irrigation etc.
- Formation of Aquifer Management Unit (clustering of villages & depth defined
- Preparation of Aquifer Management Plans for sustainable ground water management. The AMPs need to be prepared in a simplified manner so that they are easily understood and implementable by the stakeholders and ensuring wider acceptability. Sustainability necessarily means the reliability, resilience and the vulnerability of the resource. Reliability is the ability of system to meet demands; resilience is the measure of the ability of the system to recover from failure and vulnerability is the measure of loss/damage incurred because of failure.

4 Outcomes & benefits

The Social Outputs and benefits are less tangible but their significance cannot be undermined.

- Involvement of community and stakeholders would enable the State Governments to manage their resources in an efficient and equitable manner, thereby contributing to improved overall development.
- Demystification of science will result in better understanding of aquifers at community level. The amalgamation of scientific inputs and traditional wisdom would ensure sustainable ground water resource management.
- Community participation and management would ensure sustainable cropping pattern, thereby contributing towards food security.

5 Implementation Strategy

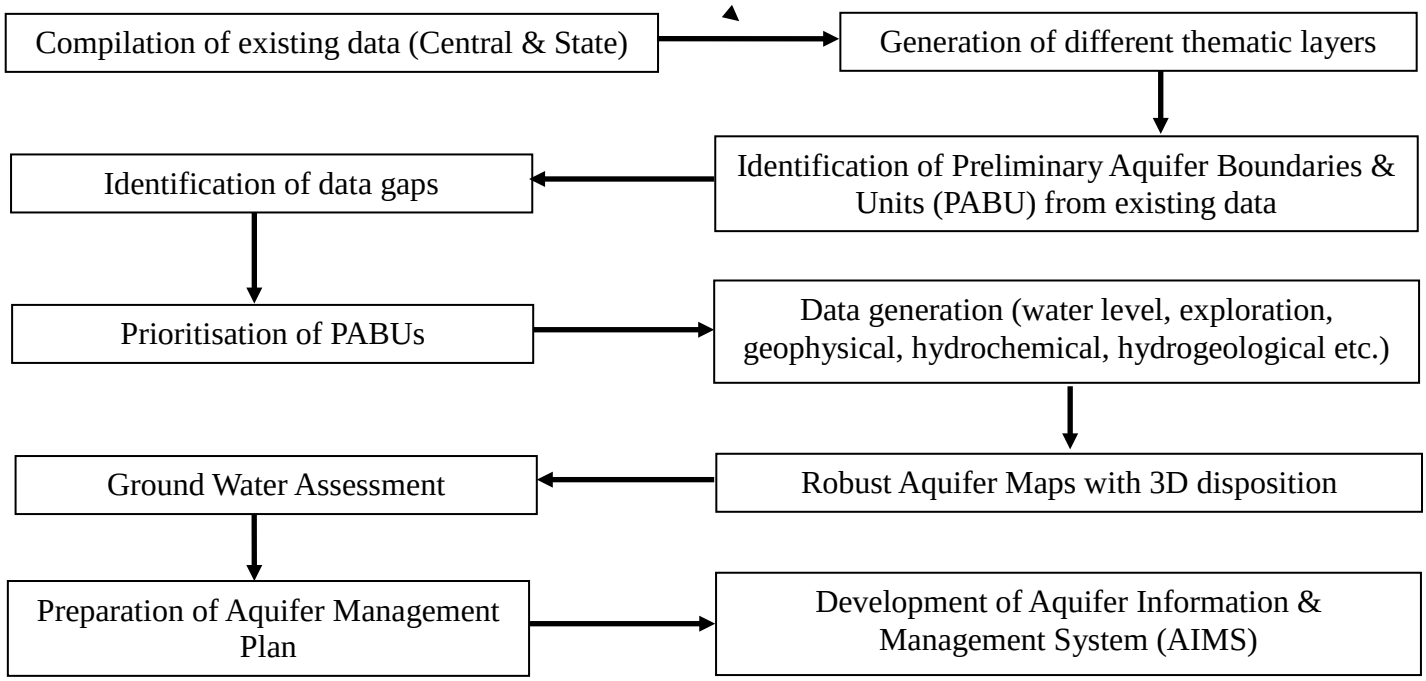
A national level programme of this nature has to be essentially decentralized, phased programme following a set of basic norms, criteria and training modules but with sufficient opportunities for addressing local needs and subsequent up-scaling.

The entire Aquifer Mapping exercise needs to be structured around three (3) pillars, viz.

(A) Technology |Support System
(B) Community Participation
(C) Institutional Arrangement

(A) Technology |Support System

The technical/scientific pillar is responsible for the entire aquifer mapping exercise. Following flow diagram is indicative of sequence of the major activities envisaged –



The detailed activities, responsible Agencies and timelines are given in Annexure-I.

(B) Community Participation

Since water is a State subject, execution of such a Project cannot be successful without taking the States on board. The involvement of State machinery including various departments, PRIs etc. is essential if the Aquifer Management Plans are to be implemented. The Nodal State Organisations need to be fully involved in preparation of Aquifer Maps. Further, the Aquifer Management Plans need to be developed by the State Government with assistance and support from Central Government.

As India has a large rural and semi-literate population, demystification of the Science of Hydrogeology will be very crucial to enable them to understand the dynamics of ground water availability and its sustainable utilization. The various Stakeholders need to develop a sense of ownership, for only then will such a socially relevant project can be successful. Therefore, the community needs to be made aware of the objectives and benefits of aquifer mapping exercise and

their active participation through local people will be fundamental in implementation of the project.

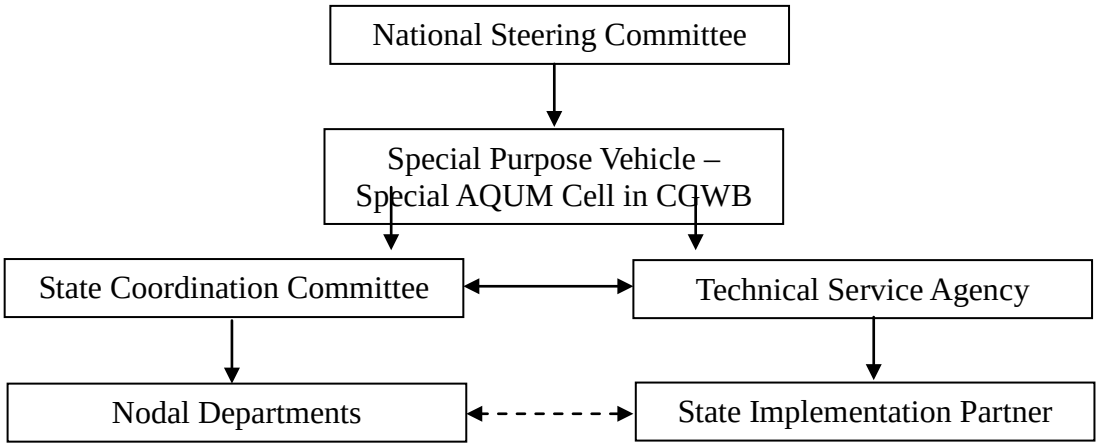
Some of the local educated people may be identified and imparted basic training on ground water, relevance of aquifer mapping, participatory management, etc. These trained persons, called para-hydrogeologists will be responsible for basic data collection like water level monitoring, well inventory, awareness raising etc. They can also be entrusted with activities like water budgeting, assessment of crop water requirements etc. The Aquifer mapping programme is expected to build capacity in the entire country by giving CGWB and State round water personnel hands-on experience in various techniques like aerial surveys, ground water modelling, participatory management etc.

(C) Institutional Arrangement

The programme therefore needs to have a three tier institutional arrangement with a large base and a small apex. The major operational partners proposed are:

- National Inter-departmental Steering Committee (NISC)
- Special Purpose Vehicle (SPV) / Special AQUM Cell in CGWB for implementation of NAQUIM.
- Technical Service Agency (TSA)
- State Coordination Committees (SCCs)
- State Implementing Partners (SIPs) and para-hydrogeologists
- Nodal Departments

The organogram for the National Project on Aquifer Management (NAQUIM) is as given below:



National Inter-departmental Steering Committee

A National Inter-departmental Steering Committee (NISC) is proposed to be constituted with the overall objective to provide guidance in the implementation of the Project at national level under the chairmanship of the Secretary, MoWR with representatives from related ministries like Science & Technology, Earth Sciences, Panchayati Raj, Environment & Forests, Agriculture, Rural Development, Drinking Water & Sanitation, etc. The Principal Secretaries of some of the States shall

be members of the NSC. The NSC shall also have representatives from MoWR like Mission Director, National Water Mission, Joint Secretary (Admn.), MoWR etc.

The proposed NISC shall be responsible for working out a clear National perspective for NAQUIM in consonance with latest technologies world-wide with the objective to tackle the upcoming challenges like over-exploitation of ground water, deteriorating ground water quality, water salinity, inter & intra-sectoral conflicts etc. NISC shall also finalise the protocols for participatory management of ground water.

Special Purpose Vehicle/Special AQUM Cell in CGWB

A Special Purpose Vehicle (SPV) comprising a Special AQUM Cell is proposed to be constituted at for implementation of the Project on national level. The SPV/QUM Cell will comprise officers from CGWB on redeployment basis. *The SPV/ AQUM Cell will, thus, be an extended arm of CGWB with substantive powers to take decisions*. The Structure of AQUM Cell is proposed as given below:

S. No.	Post	Rank	No. of Post	Pay Scale
1	National Coordinator	Joint Secretary	1	37400-67000 GP 10000
2	State Coordinator	Director	18	37400-67000 GP 8700
3	Director at HQ	Director	2	37400-67000 GP 8700 15600-39100 GP 7600
4	Admn Officer/ Finance Officer	Under Secretary	2	15600-39100 GP 6600
5	Project Engineer / Project Scientists	Deputy Secretary to Assistant Director	42 *	15600-39100 GP 7600 to 15600-39100 GP 5400
6	Project Associates	Section Officer	36	9300-34800 GP 4800

*6 Project Scientist required at the Secretariat Head Quarters in the cell.

In addition, following support staff would be required;

PS – 1 No. (at HQ)

PS/PA – 20 Nos. (2 at HQ and 18 at Regional Offices)

Steno - 2 Nos. (at HQ)

Asstt/UDC/LDC - 20 Nos. (2 at HQ and 18 at Regional Offices)

SRF/JRF - 40 Nos. (4 at HQ and 36 at Regional Offices)

DEOs - 40 Nos. (4 at HQ and 36 at Regional Offices)

The SPV/AQUM Cell will be responsible for coordination with the State Coordination Committees (SCCs) and Technical Service Agency (TSA). The SPV/AQUM Cell will assist the States in the preparation of Aquifer Maps, preparation of Aquifer Management Plans and in the participatory management of ground water. The SPV/AQUM Cell shall identify and prioritize the Preliminary Aquifer Boundary and Units (PABUs) for which the Action Plan for data generation will be devised. The SPV/AQUM Cell and the States shall then finalise the Aquifer Maps with 3D disposition. This SPV/AQUM Cell will also identify the Aquifer Management Units (AMUs) in consultation with

SCCs where participatory ground water management programmes will be undertaken. The SPV shall identify partners/ consultants/ organizations/ institutions etc. to assist in project implementation and enter into agreements/ MoUs with the same.

Technical Service Agency

A Technical Service Agency (TSA) is proposed to be constituted at Central level and will be identified by MoWR. The TSA is proposed to comprise a consortium of National level NGOs with adequate experience in the field of ground water, capacity building and participatory management related activities.

The TSA shall be responsible for identification of State specific NGOs, called State Implementation Partners (SIPs), which will be involved in the implementation of the Project. The TSA shall also be responsible for imparting Training of Trainers (TOTs) of the SIPs, standardisation of training modules, oversee the activities of SIPs in organsing participatory aquifer management programmes at Aquifer level, thereby monitoring the capacity building programme on behalf of MoWR.

State Coordination Committees

A State Coordination Committee (SCC) is proposed to be constituted in each State/Union Territory with the overall objective of implementation of the Project at State level. The SCC is proposed to be chaired by the Principal Secretary in-charge of ground water of the State Government with representatives from related departments like Ground Water, Irrigation, Drinking Water, Agriculture, Forests, etc. The SCC will also comprise representative from SPV, TSA, SIPs and Collectors/ Members of Zila Panchayat on rotation basis. Concerned Regional Director, CGWB shall be the Member Secretary of SCC.

The SCC shall be responsible for Implementation of the Project in the State. State level NGOs called State Implementation Partners (SIPs) who would participate in the Project will be identified by the TSA and approved by SCC. SCC shall also be responsible for implementation of the Project through Line departments of the State and will associate with SPV and chalk out a Working Plan for the Preparation of Aquifer Maps, preparation of Aquifer Management Plans implementation of participatory ground water management through SIPs.

State Implementation Partners

State Implementation Partners (SIPs) are proposed to be constituted for each State (2 in Nos.) / Union Territory (1 in No.). The SIPs will be identified by the TSA and the SCC will approve them. SIPs are proposed to comprise State level NGOs with adequate experience in the field of ground water, capacity building and participatory management related activities.

The SIPs shall identify potential rural youths (para-hdrogeologists) in consultation with the PRIs, conduct the actual class room and field trainings using external consultants or resource persons of

TSA and draw supports from other state resource agencies. The SIPs shall provide hand holding support to the trainees (para-hydrogeologists) as their mentor for periodic data collection and sensitization of stakeholders. The SIPs shall submit the data periodically to SCC for onward transmission to SPV. The costs of training the para-hydrogeologists will be borne by the SPV.

Nodal Departments of the State Government

The SCC shall identify the Nodal Department, preferably the Ground Water Department of the State/Union Territory, for implementation of the project. The Nodal Department shall also identify Nodal Officers at district(s) level.

The Nodal Department / Nodal officers shall be responsible for Aquifer Mapping exercise and other allied activities in association with the Regional Offices of CGWB, SIPs and under overall supervision of SCC.

Annexure-I

Time-Lines for various activities under NAQUIM

Task	Activity	Responsible agencies	Year wise coverage				
			1	2	3	4	5
1A. Review & Compilation of Existing data, Reports etc. ▪ Geology ▪ Landforms (Physiography) ▪ Sub surface Geology ▪ Well Census – Aquifer wise o Dug well, shallow tube well/ filter points tapping watertable aquifer o Bore well tapping weathered zones & fractured zones down to 200m (300m in select areas) o Tube wells (300m in general, 600m in select areas)							
1.1	CGWB	CGWB					
1.2	States	CGWB					
1.3	Other Organisations (NIH, NGRI, NEERI, DWSS, CMPDI, etc.)	CGWB					
1 B. Procurement of data							
1.4	SoI toposheets on 1:50,000	CGWB, Digitization to be outsourced					
1.5	SoI toposheets on 1:10,000, including contours at 1m intervals or less; well details including lat-long & RLs, all water bodies, bench marking, gravity surveys, aerial photographs, DEMs etc.	CGWB, to be outsourced to SoI					

1.6	GSI Maps on 1:50,000 scale	CGWB, Digitization to be outsourced					
1.7	Rainfall data (IMD)	CGWB					
1.8	NRSC data (Geo-referenced) or the data from DWSS on 1:50,000 scale	CGWB					
1.9	NBSS Soil Maps	CGWB, Digitization to be outsourced					
1.10	Any other map/data	CGWB, Digitization to be outsourced					
2 Preparation of Thematic layers on 1:50,000 scale GIS layers (Soil, land use, hydrological features, administrative units, rainfall distribution, water quality ranges- As, Fe, F, TDS, pesticides etc) required for characterization of groundwater resources, stress on resources and identification of management issues. • Base map depicting observed data points (Central/State/NGO/Institutions data) o Water Level & Water Quality Monitoring wells o Sub surface geology o Electrical logs of select bore holes –Functional or abandoned, drilled by Government / Private agencies o VES data by CGWB/Outsourcing Depth to Bed rock maps from CGWB & State agencies from Hydrogeological surveys & exploration.							
2.1	Compile all available information on	CGWB					

	1:250,000 scale maps already available with CGWB to bring uniformity						
2.2	Transfer all 1:250,000 thematic layers on the 1:50,000 scale toposheets	CGWB					
3. Identification & Evaluation of Preliminary Aquifer Boundaries & Units (PABUs) Involves GIS applications for demarcation of aquifer boundaries and division into smaller units, using various software for defining preliminary 3-D disposition of aquifer systems and thereby defining a conceptual model of the aquifer units.							
3.1	Define Preliminary Aquifer Boundary & Units	CGWB					
3.2	Preliminary 3-D disposition of aquifers using different software	CGWB					
3.3	Development of Conceptual Hydrogeological Model	CGWB, SGWD					
4. Identification of Data Gaps in PABUs Once the smaller Aquifer Units have been defined on the 1:50,000 scale, the units will be defined on the data availability and data gaps in respect of various essential parameters need to be identified.							
4.1	Exploration	CGWB, SGWD					
4.2	Hydrogeology	CGWB, SGWD					
4.3	Geophysics	CGWB, SGWD					

4.4	Water level Monitoring	CGWB, SGWD					
4.5	Water Quality	CGWB, SGWD					
4.6	Hydrology/Hydrometeorology	CGWB, SGWD					
5 Prioritisation of PABUs (on the basis of data gaps/ availability) On the basis of data availability and data gaps, the PABUs will be prioritised for data collection. The units will be classified into various categories on the basis of extent and type of data gaps.							
5.1	Prioritisation of PABUs	CGWB & SGWD					
6. Action Plan for data generation, analysis and interpretation – Investigative Work Plan On the basis of prioritisation made above, an action plan for bridging the data gap will be drawn. By the end of 2nd year, the results of heliborne survey would also start coming and can help in devising the most suitable methodology for data generation. The role of international consultants having similar experience would also be very critical for this phase.							
6.1	Preparation of Action Plan indicating type, extent & methodology for data collection	CGWB, SGWD & Consultants					
6.2	Exploration	CGWB, SGWD, Out Sourcing	Based on 1:250000 scale		Based on 1:50000 scale		
6.3	Hydrogeology	-do-	Based on 1:250000 scale		Based on 1:50000 scale		
6.4	Geophysics	-do-	Based on 1:250000		Based on 1:50000 scale		

			scale				
6.5	Water level Monitoring	-do-	Based on 1:250000 scale		Based on 1:50000 scale		
6.6	Water Quality	-do-	Based on 1:250000 scale		Based on 1:50000 scale		
6.7	Hydrology/Hydrometeorology	-do-	Based on 1:250000 scale		Based on 1:50000 scale		
7. Preparation of Aquifer Maps • 2D – Plan View with thickness as Isopach,, quality contours, specific yield/Yield Potential zonations • 3D – block view of aquifer disposition and geometry. • Scale 1:50,000 paper copy & soft copy which can be used to over lay on 1:10,000 to be prepared by SoI.							
7.1	Refinement of thematic layers on 1:50,000 & 1:10,000 scale	CGWB, SGWD, Out Sourcing					
7.2	Integration of various thematic layers and models on GIS platform	CGWB, SGWD, Out Sourcing					
7.3	Preparation of Aquifer Maps, i.e. 3-D Disposition of aquifers	SGWD, CGWB					
8. Ground Water Assessment Making an assessment and preparation of various maps indicating Points suitable for recharge, Area suitable for protected water supply, Hydrochemical zonation for development & Management strategies, etc.							
8.1	Ground water modelling	CGWB, SGWD,					

		Consultants					
8.2	Ground water resource assessment	CGWB, SGWD, Consultants					
8.3	Preparation of Vulnerability map for aquifer Unit	CGWB, SGWD, Consultants					
8.4	Identification of Feasible areas for GW development and Recharge	CGWB, SGWD, Consultants					
9. Preparation of Aquifer Management Plans Preparing Aquifer management plans which can be implemented through community participation. This might also entail development of DSS with GW modeling for prediction of different stress conditions of particular aquifer or group of aquifers							
9.1	Identification of Aquifer Management Units (AMUs)	SGWD, CGWB					
9.2	Preparation of Aquifer Management Plans	SGWD, CGWB, PRIs, NGOs					
9.3	Define the scope of participatory ground water management.	SGWD, CGWB, PRIs, NGOs					
10. Development of Aquifer Information & Management System (AIMS) An Aquifer Information & Management will be developed which will be for public domain as well as for domain experts where information, maps, data can be easily accessed.							
10.1	Development of AIMS	Outsourcing					