Har Ghar Jal
Jal Jeevan Mission

Building Partnership
Changing Lives

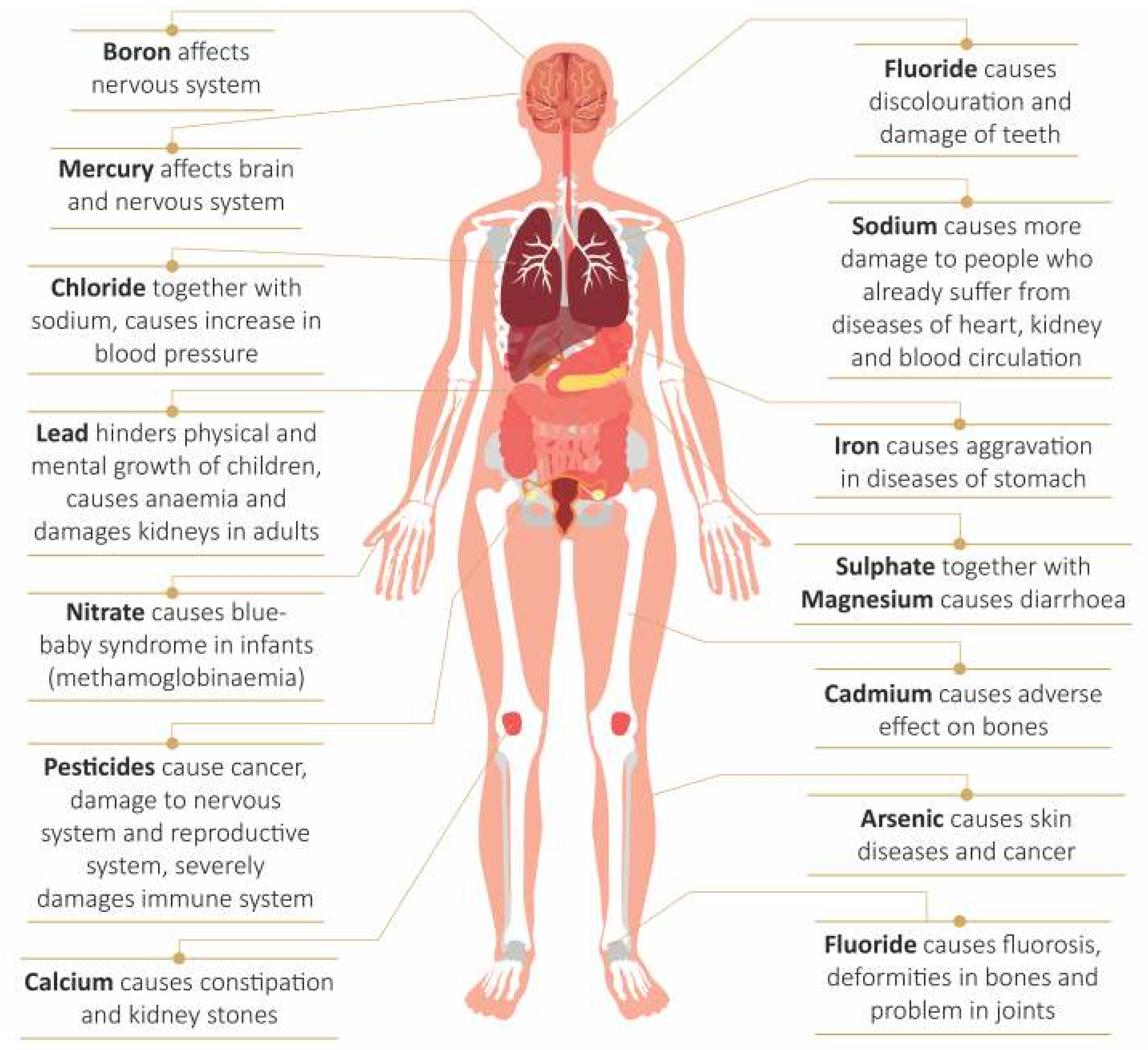
Drinking Water Quality Monitoring & Surveillance Framework

सत्यमेव जयते

Government of India
Ministry of Jal Shakti
Department of Drinking Water & Sanitation
National Jal Jeevan Mission

October, 2021

Impact of prolonged consumption of contaminated drinking water on human body



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प्रधान मंत्री

Prime Minister

MESSAGE

One of the five elements of nature, water is among the most essential pre-requisites for life. From households to fields and industry, water is one of the most crucial aspects of life and economy for societies and nations of the 21st century. Water security is one of the key concerns of the future.

Clean drinking water, improved sanitation and hygiene lead to better public health, especially of children and women, who are more vulnerable to water-borne diseases. We have been striving relentlessly to provide potable tap water supply to every home and to increase awareness on public health.

Our vision of building a New India and achieving Atmanirbharta can only be realised through peoples' participation at the grassroots level. It is the collective resolve of more than 130 crore people that India is today forging ahead on the path of growth and prosperity at an unimaginable pace.

In an effort to enhance peoples' participation, Jal Jeevan Mission (JJM) is being implemented in partnership with States. Drinking water is a basic need and it is envisioned that JJM will enable every household and public institution in our villages to have provision of assured tap water supply in adequate quantity and of prescribed quality on regular and long-term basis.

A critical element of this Mission is to ensure quality of water at all times. Water quality monitoring and surveillance, including regular testing of water quality and taking remedial action are among the key components of JJM. The Water Quality Monitoring Information System (WQMIS) has been put in public domain, as a one-stop information portal, with all water quality information, testing data, grievance redressal mechanism, etc. Leveraging innovative technology, a portable water testing device is being developed to make water testing easy.

Various initiatives have been taken to build public accountability and governance. At the village level, 5 women are trained, viz. ASHA worker, anganwadi worker, teacher, Pani Samiti/ Village Water & Sanitation Committee (VWSC) members, etc. on testing the quality of water, using Field Test Kits (FTKs) to empower our villages. A VWSC/ Pani Samiti with 50% women members has been constituted in every village.

In an effort to underline the importance of regular water quality testing, water quality monitoring & surveillance framework has been prepared with inputs from field and experts. This framework provides the strategy for all stakeholders to ensure potable tap water supply to every home and all schools, anganwadi centres, ashramshalas, health centres, community centres, wellness centres, GP buildings, etc. Such measures will go a long way in ensuring potability of tap water.

I am sure this framework will be very useful in strengthening water quality monitoring of tap water supply and empowering community in testing quality of water, maintaining surveillance, reducing risk of water-borne diseases. These steps will contribute towards improving public health.

Best wishes for all success of the endeavour.

(Narendra Modi)

New Delhi
आश्विन 09, शक संवत् 1943
1st October, 2021

गजेन्द्र सिंह शेखावत
Gajendra Singh Shekhawat

सत्यमेव जयते

जल शक्ति मंत्री
भारत सरकार
Minister for Jal Shakti
Government of India

Foreword

Jal Jeevan Mission accords highest priority to potability of the drinking water. Access to clean drinking water is one of the key determinants of public health, which can prevent many water-borne diseases. Over the years, the drinking water quality issues have emerged as a major challenge in the rural areas. With 85% of the rural water supply dependent on groundwater, geogenic contaminants like the Arsenic, Fluoride, Iron, heavy metals, etc., are posing serious health issues. Increased surface water pollution, primarily due to untreated sewage may also cause bacteriological contamination.

Addressing the water quality, has to become a shared responsibility with Government, private sector and community joining hands together. To create an enabling environment, the National Jal Jeevan Mission, Ministry of Jal Shakti, Government of India has come out with a comprehensive document in the form of a framework for drinking water quality monitoring and surveillance. This framework advocates creation of an independent drinking water quality monitoring and surveillance mechanism in all States/ UTs, that would take advantage of the new Water Quality Management Information System (WQMIS), designed in the line of CoVid-19 tracking system, that would analyse data, track the vulnerable areas and alert the concerned authorities to take remedial action. The existing financial assistance to States is retained under the new framework.

This hybrid document lays down the road-map for the new generation water quality monitoringby harnessing the private sector efficiency for public good by encouraging Public Private andPublic-Public partnership for infrastructure sharing. It also includes the protocol for operation ofexisting water quality labs at different levels in States. The National Jal Jeevan Mission has already asked States/ UTs to allow the testing of water samples of general public in the Government labs at a nominal rate. The framework would further strengthen this aspect.

I sincerely believe this document would be useful to States/ UTs to meet the mandate to deliver potable water of adequate quantity, prescribed quality on a regular and long-term basis to allrural homes. Moreover, it will help local communities to keep surveillance on drinking watersources and water supplied thus improving the overall public health of people especially children.

(Gajendra Singh Shekhawat)

जल शक्ति अभियान

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Shri Prahlad Singh Patel
Minister of State for Jal Shakti

2nd October,
New Delhi

Message

The Hon'ble Prime Minister has time and again emphasized the importance of water security for holistic development of the nation aided by the community participation. Providing safe water is a basic requirement to ensurebetter public health. Towards this, the National Jal Jeevan Mission has now brought out a framework document for water quality monitoring and surveillance which*inter alia* includes protocol for water testing laboratories, testing, sanitary survey, surveillance, remedial action, etc.

A number of new initiatives have been suggested like transparent water quality testing and monitoring mechanism, leveraging the strengths of public and private sectors for expanding the water quality testing lab infrastructure, surveillance by community at Gram Panchayat and community level and comprehensive Water Quality Monitoring Information System (WQMIS) that would seamlessly integrate all stakeholders and act as a nodal system for continuously tracking the quality of supplied tap water and the remedial action by the concerned authorities. The system would also acquire data from the IoT based monitoring of water quality taken up under the mission.

I am sure that with continued financial support to States/ UTs under Jal Jeevan Mission, this new Water Quality Monitoring & Surveillance framework would help in achieving the goal of to ensure to clean tap water supply to every rural household.

(Shri Prahlad Singh Patel)

पंकज कुमार
PANKAJ KUMAR
सचिव
Secretary

सत्यमेव जयते

आज़ादी का अमृत महोत्सव

भारत सरकार
जल शक्ति मंत्रालय
पेयजल एवं स्वच्छता विभाग
Government of India
Ministry of Jal Shakti
Department of Drinking Water & Sanitation

2nd October 2021

Message

Over a period of time, water quality has acquired centre stage in drinking water sector. Acknowledging the challenges and gaps in the delivery of clean water, the National Jal Jeevan Mission has now come out with a framework document for water quality monitoring and surveillance to ensure clean tap water to every rural household, schools, anganwadi centre, ashramshala, etc.

The reform processes required to be undertaken are segregating the water supply service delivery and water quality monitoring functions currently carried out by the Water Supply Departments; expansion of water quality infrastructure with increased private sector participation in setting up labs; opening of water quality labs to general public; and integrating the individual water quality samples tested both by Government and public in official monitoring and management information system to analyse and indicate the areas requiring attention on real time basis. The guidelines also have required protocol to meet modernization/ strengthening of labs, accreditation by NABL and day-to-day functioning of water quality labs set up at various levels by States/ UTs.

The framework would help States/ UTs to meet their water supply service delivery requirement. Funds under the Jal Jeevan Mission can be used for activities mentioned and it is earnestly believed that States/ UTs would take advantage of the reform process outlined, ensuring service delivery leading to enhanced public health.

(Pankaj Kumar)

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जय जय जय हे ।।
"रवीन्द्रनाथ टैगोर"
सुखदाम् वरदाम् मातरम् ।
वन्दे मातरम् ।
/HarGharJal

Har Ghar Jal
Jal Jeevan Mission

Bharat Lal
Additional Secretary & MD

National Jal Jeevan Mission
Government of India, Ministry of Jal Shakti
Department of Drinking Water and Sanitation

Preface

To improve the quality of life of people and enhance their ease of living, especially of women and children, Jal Jeevan Mission (JJM) was announced by Hon'ble Prime Minister on 15th August, 2019 to make provision of assured tap water supply in adequate quantity of prescribed quality with adequate pressure on a regular and long-term basis in all rural households (HHs) and public institutions, viz. schools, Anganwadi Centres (AWCs), ashramshalas (tribal residential hostels), health centres, wellness centres, Gram Panchayat buildings, etc. by 2024.

Assured water supply in homes reduces incidences of water-borne diseases and is thus, directly linked with improvement in public health and economic well-being of people. In the past few decades, several efforts were undertaken to improve public health indicators especially towards tackling water-borne or associated diseases. India has eliminated Guineaworm, became Polio-free, and is now making concerted efforts to reduce incidences of acute diarrhoea. Many States have also successfully contained Fluorosis as well by providing safe water to people. Focus has also been on JE/ AES affected areas and under JJM, States are working to prioritize provision of clean tap water supply to these areas. Since the announcement of JJM, tap water supply to HHs in JE/ AES affected areas has increased by 14 times, i.e. from 8 lakh (2.6%) to 1.16 Crore (37.83%). With focus on better health and well-being of children, a special campaign was launched on Gandhi Jayanti, i.e. 2nd October, 2020 to make provision of piped water supply in schools, AWCs and ashramshalas to ensure clean tap water supply for drinking, cooking mid-day meals, handwashing and for use in toilets. The relentless efforts resulted in ensuring provision of tap water supply in 7.93 lakh (76.93%) schools and 7.65 lakh (68.21%) AWCs so far.

Public Health professionals firmly believe that provision of clean tap water supply to every rural home and public institution will have multi-dimensional impact, viz. create a much more conducive environment for other public health programmes, improve health and nutritional status, reduce drudgery of women, improve mental health, etc. Most importantly, the perceptible improvement in public health of the nation vis-à-vis the reduction in water-borne diseases will be a boon to the nation's quest for higher economic growth.

To realize this vision, two important things are to be done regularly, i.e. water quality monitoring by suppliers and water quality surveillance by local community. The State PHED is to adopt a utility approach in implementing water supply schemes and work towards sensitizing, empowering and capacity building of GP/ VWSC members as well as local community. The holistic approach includes creating modern laboratory infrastructure duly accredited/ recognized by National Accreditation Board for Testing and Calibration Laboratories (NABL), initiating widespread public discourse on importance of water quality testing and its services, training and capacity building of various stakeholders, building capacity and capability of local community members to conduct regular water quality surveillance, sharing updated data on public domain through user-friendly technology, quick grievance redressal, etc. Basically, to create and develop a culture of regular water quality testing. The goal is to empower the water supply service providers, viz. PHED and its parastatal organizations, as well as the PRI institutions to function as public water utilities.

Embracing the aspirations of Digital India, under JJM, innovative technology is being adopted. Currently, the water quality surveillance by community is being carried using Field Test Kits (FTKs) that require usage of

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reagents and charts. This is going to change in future with the arrival of portable water quality testing devices that are already in making, in partnership with DPIIT and Startup India. The idea is to make water quality testing an easy and simple process by using automation of devices and reduce manual intervention in capturing data to the extent possible. Deep technologies are being explored to transform the devices/ equipment as we know to provide solutions to bigger problems, enable faster processing through data analytics, prompt remedial action, etc.

Ultimately, the effort is to improve public health by enabling people to test their water samples so that they can overcome apprehensions, if any, about quality of water and be able to consume the water directly from tap. The laboratories are to test samples from all drinking water sources/ sample delivery points at least once a year for chemical contamination and twice a year for bacteriological contamination, whereas the community is to be empowered to test their water sources/ sample delivery points at least once every month for bacteriological contamination, once a year for chemical contamination and upload the data on Water Quality Management Information System (WQMIS).

This document was earlier developed in the form of a drinking water quality protocol. However, keeping in view the vision of Jal Jeevan Mission and capturing the diverse requirements of States/ UTs, a Water Quality Monitoring & Surveillance (WQMS) Framework is prepared after several deliberations with various stakeholders, viz. States/ UTs, UNICEF, WHO and other sector experts.

I am thankful to the assistance extended by Dr. Balram Bhargava, DG, Indian Council for Medical Research (ICMR), Dr. Harpreet Singh and his team in developing, testing, and commissioning WQMIS. I compliment Shri N. Venkateshwaran, CEO, NABL and his team for expediting the accreditation/ recognition process of water testing laboratories. From the national mission, Shri Pradeep Singh, Director, DDWS and Shri Ambarish Karunanithi, water management specialist, WASH Institute developed the architecture of WQMIS, coordinated with ICMR for its execution, are training the State officers and looping back the feedback from States to make WQMIS a robust tool. Shri Manoj Kumar Sahoo, Director, DDWS led the framework development team and ensured that States/ UTs find ways to address their current WQMS challenges easily as well as plan a road map capturing the essence of JJM vision. Efforts of Shri Ajay Kumar, Director, DDWS for providing the initial draft of the framework and facilitating WQMS initiatives is acknowledged. Shri A. Muralidharan, Deputy Advisor, DDWS facilitated key information from various sector experts and condensing the vast information in a reader-friendly format. Ms. Spurthi Kolipaka, WASH Consultant, UNICEF has made significant policy perspective inputs and diligently worked on compiling, editing and designing the document. I am also thankful to all the support received from different chemists/ lab-in-charges, consultants from the PMUs supporting the national mission – KPMG and E&Y.

I am sure that this framework released by Hon'ble Prime Minister on 2nd October, 2021, will be of immense use to various stakeholders associated with the mission, especially the State PHED and its parastatal organizations to adopt the utility approach and build a culture of water quality testing, as well as empower communities to shoulder responsibilities of water quality surveillance. I am confident that this framework will help in ensuring potable tap water to every home as well as schools, AWCs, ashramshalas, etc. thus, improving public health and overall well-being of people of the country.

[Bharat Lal]

New Delhi
2nd October, 2021

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Annexes

Abbreviations

ADD	Acute Diarrhoeal Disease
AMC	Annual Maintenance Contract
APHA	American Public Health Association
ASTM	American Society for Testing and Materials
BCC	Behavioural Change Communication
BIS	Bureau of Indian Standards
CAMC	Comprehensive Annual Maintenance Contract
CGWB	Central Ground Water Board
CoE	Centre of Excellence
CWPP	Community Water Purification Plant
DDWS	Department of Drinking Water and Sanitation
DWQL	District Water Quality Laboratory
DWSM	District Water & Sanitation Mission
DPIIT	Department for Promotion of Industry and Internal Trade
FHTC	Functional Household Tap Connection
FTK	Field Test Kit
GeM	Government e-Marketplace
GP	Gram Panchayat
HR	Human Resource
ICMR	Indian Council of Medical Research
IEC	Information, Education and Communication
IMIS	Integrated Monitoring Information System
IoT	Internet of Things
ISO	International Organization for Standardisation
ISA	Implementation Support Agency

JE/ AES	Japanese Encephalitis/ Acute Encephalitis Syndrome (JE/ AES)
JJM	Jal Jeevan Mission
LPCD	Litres Per Capita per Day
KRC	Key Resource Centre
NABL	National Accreditation Board for testing and calibration Laboratories
NCDWSQ	National Centre for Drinking Water, Sanitation and Quality
NGO	Non-Governmental Organisation
NJJM	National Jal Jeevan Mission
NRDWP	National Rural Drinking Water Programme
NTU	Nephelometric Turbidity Units
O&M	Operation & Maintenance
P/ A	Presence/ Absence
PH	Public Health
PHE	Public Health Engineering
PPP	Public Private Partnership
PRI	Panchayati Raj Institutions
RWS	Rural Water Supply
SoP	Standard Operating Procedures
SO	Support Organisation
SLSSC	State-Level Scheme Sanctioning Committee
SWSM	State Water & Sanitation Mission
UDWQP	Uniform Drinking Water Quality Protocol
UT	Union Territory
VWSC	Village Water & Sanitation Committee
WQMS	Water Quality Monitoring & Surveillance
WQMIS	Water Quality Management Information System

Definitions

Drinking water sources	Groundwater (Dug/ open wells, borewell, tube-well, handpump, etc.)/ surface water (spring, check-dam, river, lake, pond, reservoir, canal, infiltration gallery etc.)/ safely stored rainwater.
Field Test Kit (FTK)	A portable multi-parameter kit used for examination of physico-chemical contamination as initial screening.
H2S vials	Hydrogen Sulphide (H2S) vials are used for ascertaining the presence/ absence (P/ A) of bacteria in water.
Laboratory gap assessment	Activity undertaken to assess the gaps in laboratories against the suggested laboratory requirements as per the WQMS framework document.
Laboratory improvement plan	Plan devised to improve the laboratory functioning as per the WQMS framework document with a prescribed timeline.
NABL accredited laboratories	Water quality testing laboratories accredited by National Accreditation Board for Testing and Calibration Laboratories (NABL).
Public health	Public health refers[1] to all organised measures (whether public or private) to prevent disease, promote health, and prolong life. A Public Health official is responsible for providing conditions in which people can live a healthy life.
Sanitary inspection	An on-site inspection of a water supply facility to identify actual and potential sources of biological contamination. The physical structure and operation of the system and external environmental factors (such as a toilet location) are evaluated. This information is used to decide appropriate remedial action to improve/ protect the drinking water source and supply system. Sanitary inspections are to be carried out for all new and existing sources of drinking/ domestic water supply.
Water quality	refers to physical, chemical, biological and radiological characteristics of water. The Bureau of Indian Standards (BIS) has specified safe drinking water quality standards (IS 10500:2012). These standards have two limits[2]— 'acceptable limits' and 'permissible limits in the absence of an alternate source'.
Water quality hotspots	The water sources where the concentration of chemical contaminants is found to be at the border line, i.e. a little lower than the permissible limit as prescribed in BIS: 10500.

[1] WHO definition
[2] Except pesticide residue and bacteriological quality

Water quality monitoring	Laboratory and field testing of water samples collected from water sources and tap connections by the agency responsible for rural water supply. Water quality monitoring is defined by the International Organization for Standardization (ISO) as: 'the programmed process of sampling, measurement and subsequent recording or signalling, or both, of various water characteristics, often with the aim of accessing conformity to specified objectives.'[3]
Water quality surveillance	A regular activity to be undertaken by Gram Panchayat and/ or its sub-committee, i.e. VWSC/ Pani Samiti/ User Group, etc. or schools/ anganwadi centres using Field Test Kits (FTKs) and similar assessments to identify and evaluate factors associated with drinking water which could pose a risk to health. Surveillance is regular, specific measurement and observation for the purpose of water quality management and operational activities.
Jal Sakhi/ Jal agua, etc.	Five women, viz. local health worker/ ASHA worker, GP/ VWSC/ Pani Samiti member, SHG member/ leader, AWC teacher/ helper, etc. trained in every village to test water quality using Field Test Kits (FTKs), undertake the surveillance activities and upload the data/ report on Water Quality Management Information System (WQMIS).
WQMIS	An online tool for water testing created, maintained and regularly monitored for investigating and tracking the quality of drinking water supplied. The data analytics used in WQMIS also aim to support the preventive measures to be taken for averting water-borne disease outbreaks.

[3] Water quality monitoring - A practical guide to the design and implementation of freshwater quality studies and monitoring programmes

1. Introduction

Jal Jeevan Mission, announced on 15th August, 2019 is under implementation in partnership with States to make provision of assured tap water supply in adequate quantity, of prescribed quality, with adequate pressure, on a regular and long-term basis in all rural households and public institutions, viz. schools, anganwadi centres, ashramshalas (tribal residential hostels), public/ community health centres, sub-centres, wellness centres, community centres, panchayat offices, etc. by 2024. Assured water supply in homes is directly linked with improved public health and economic well-being of people, as it reduces incidences of water-borne diseases and provides them time to invest in income-generation activities. It also improves the quality of life and enhances 'ease of living' by relieving people, especially women and children, from drudgery in fetching water from sources at a distance, especially in isolated, forested, and hilly areas, carrying heavy loads multiple times during a day; and by reducing the urban-rural gap.

Under Jal Jeevan Mission (JJM), the aim is to provide a Functional Household Tap Connection (FHTC) ensuring 'no one is left out'. The functionality of the tap is defined in terms of quantity, quality, pressure, and regularity of water supply. In 2019, out of about 18.93 Crore households in rural areas, only about 3.23 Crore (17%) had tap water connections. Thus, 83% of rural households are to be provided with tap water supply by 2024. In addition, the existing tap water connections are also to be made JJM compliant. This is the 'speed and scale' at which JJM is being implemented. However, JJM is not about 'mere infrastructure creation' but focus is on 'ensuring water service delivery in every household'. It is about achieving long-term drinking water security in villages in such a way as to avoid making emergency arrangements through deployment of tankers or trains, handpump installation, etc. in rural areas. It is a program that intends to 'make water everyone's business', by involving all stakeholders and turning it into a 'Jan Andolan' - a people's movement on water, by building local water utilities.

The year 2020 onwards has become challenging for our communities and systems testing the collective resilience. CoVid–19 pandemic has resulted in the loss of lives as well as livelihoods. Government of India and State Governments/ UT Administrations in unison have been taking several preventive measures to contain the spread of the virus. Frequent washing of hands with soap and social distancing were recognised among the most efficient and effective measures in controlling the spread of the virus. In this period, public health captured the imagination of people, and everyone realised the importance of preventive health care. It also made people realise that instead of fetching water from a public source, piped water supply into household is a better option in ensuring their safety, as it will reduce crowding around public water sources. People also realised that during a lockdown or when the whole family is in quarantine, fetching water from a public source poses a huge challenge. This realisation brought a sense of urgency to ensure potable tap water supply in adequate quantity in all households and public institutions. Most importantly, it has presented the importance of regular testing and the need for quality, affordable and accessible laboratory network.

Similarly, water testing has gained traction for its importance in monitoring the operation of water supply, verification of the safety of drinking water, investigation of disease outbreaks, validation process and preventive measures. Thus, Water Quality Monitoring & Surveillance (WQMS) is given topmost priority under JJM. Water quality testing tools are to be used for deciding safety of drinking water: at the source; within a piped distribution system; or at the delivery point.

Drinking water quality monitoring and water quality surveillance are distinct yet, closely related activities. Following the 'service delivery' approach, the drinking water quality is to be 'monitored' by the Public Health Engineering Department (PHED)/ Rural Water Supply (RWS) Department, i.e. supplier/ agency responsible to make provision of assured tap water supply, whereas the 'surveillance' of water quality at grass roots is the responsibility of the Gram Panchayats (GPs) and/ or its sub-committee, i.e. Village Water & Sanitation Committee (VWSC)/ Pani Samiti.

Regular testing of water supplied by PHEDs/ water utilities is a prerequisite of potable water supply to households and public institutions. However, educating communities about Water, Sanitation, and Hygiene (WASH) and the ill-effect of contaminated water on the human body, especially in infants, children, immune-compromised people and pregnant women is critical for public health. Thus, training and educating local village communities, including children in schools, to test water samples and surveillance of water sources as well as water at delivery points in homes and alerting people about possible contamination to prevent water-borne diseases are the most critical steps.

Thus, to ensure long-term assured service delivery, the most critical work through JJM is to bring awareness among all stakeholders, especially public health engineers, village communities, GPs/ VWSCs/ Pani Samitis, etc., in following the modern public utility approach so as to generate confidence in the public to consume water directly from tap. Building this confidence requires a transparent and responsive system with technological innovations such as sensor-based IoTs which provide automatic data on water supply quantity, quality and regularity. The data accessible to GPs/ VWSCs, local community and PHEDs alike is to be used to address any grievances, monitor the water supply and test water regularly. It is also necessary to have an assessment of drinking water quality for informed policy and programme. Surveillance activities in water quality management identify and evaluate factors that can pose a health risk and thereby enable preventive/ remedial action to ensure potability of water. Such an established system will lead the villages towards becoming WASH enlightened villages and significantly reduce the risk of water-borne diseases, if not eliminate them completely.

In many States/ UTs, drinking water supply agencies, i.e. PHE/ RWS department look after both supply of water and its surveillance. However, a separate cadre of employees (chemists) monitor the water quality and report to the engineers-in-charge of water supply. To build trust, the situation demands de-coupling of these two functions as well as functionaries and making water quality monitoring and surveillance an independent function with required autonomy, i.e., funds, functions and functionaries at every level, i.e., State/ UT/ district/ sub-division/ block. This is required for upholding the accountability of the Department/ Agency/ Nigam/ Board to supply safe water. The existing water quality testing laboratories are to be equipped with the State-of-the-art automated testing instruments that can test multiple parameters in such a way that involvement of manual operations during quality testing are minimal and the turn-around time for testing the samples is significantly brought down. This would also help to test more samples.

This framework prepared after several discussions with States/ UTs and other stakeholders, aims to facilitate in water quality testing, monitoring and surveillance activities effectively. With flexibility given to States/ UTs, this document aims to provide handholding technical support to PHE/ RWS Departments as follows:

i.) overall strategy to strengthen water quality monitoring and surveillance with a road map and collective vision of improving public health;

ii.) setting-up, up gradation and strengthening of drinking water quality testing laboratories at State/ UT, District and Sub-division/ block level including mobile water quality testing laboratories;

iii.) providing guidance to personnel at different managerial levels in water quality testing, monitoring, data interpretation and reporting;

iv.) involving Panchayati Raj Institutions (PRIs)/ community and empowering community on water quality monitoring and surveillance issues;

v.) generating awareness amongst community on importance of water quality testing and not to consume water for cooking and drinking purposes from the contaminated sources;

vi.) empowering communities to conduct sanitary surveys and indicative testing of drinking water at grassroots;

vii.) pre-defined roster of sources;

viii.) third-party verification;

ix.) corrective actions for contaminants by identifying safe source and identifying suitable treatment technologies; and

x.) guidance for NABL accreditation of drinking water testing laboratories as per IS/ ISO/ IEC:17025:2017.

2. Background & current status

The first case of Fluoride was found in Nalgonda in 1937. Rural drinking water supply programmes are being implemented in the country since 1954, starting with the National Water Supply Programme[4]. It was followed by many policy initiatives including focus on areas endemic with water-borne diseases. Focus on water quality including parasitic contamination, Fluoride, Iron and Salinity was highlighted for the first time in the Eighth Five Year Plan (1992-97). In 1997, Water Quality Monitoring and Surveillance (WQMS) system was first institutionalized.[5]

In 2002, Water Quality Monitoring & Surveillance (WQMS) was later mentioned as an activity under community communication campaign in Swajaldhara guidelines. In 2009, National Rural Drinking Water Quality Monitoring & Surveillance (NRDWQM&S) was specified as a key activity under support activity fund of 'National Rural Drinking Water Programme' (NRDWP) guidelines. The objective of NRDWQM&S was to enable communities to monitor and maintain surveillance on their drinking water sources and 5% of NRDWP fund on a 100% Central share basis was to be used for different support activities including WQMS.

In 2013, changes were introduced under WQMS component of National Rural Drinking Water Programme (NRDWP) to provide a greater thrust on water quality especially Japanese Encephalitis (JE)/ Acute Encephalitis Syndrome (AES)-affected areas, setting up/ upgradation of district/ sub-district water quality testing laboratories, supply of FTKs/ refills and training to grassroot workers, etc. for which 3% of fund was earmarked. The guideline also emphasised on NRHM provision of testing water quality (biological parameters) at Primary Health Centres (PHCs) and how such facilities, along with other laboratories in schools/ colleges may be used for the programme. Also, a uniform drinking water quality protocol was published in the same year. In 2017, the revised NRDWP guidelines increased WQMS fund use to upto 5% and introduced State share, viz. 90:10 for NE and Himalayan states and 60:40 for other states.

With the announcement of JJM in August, 2019 having a huge estimated outlay of Rs.3.60 lakh Crore, the WQMS component was subsumed from erstwhile NRDWP and the fund to be made available to States/ UTs is up to 2% of allocation, and the focus is now on improving overall public health by developing local water utilities. PHEDs are strengthened on water quality monitoring and communities are trained on water quality surveillance under the mission. Further, five women from every village, i.e. ASHA worker, Anganwadi worker, School teacher, GP member, social worker, etc. are being trained on water quality testing using Field Test Kits (FTKs), undertaking sanitary inspections, uploading data online, etc.

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[4] Chapter 2 of the operational guidelines for the implementation of JJM

[5] Pal, B. (2012). Five year plans and rural water supply in India: A critical analysis. *Developing Country Studies,* 2(3)

2.1 Situational analysis

The current number of laboratories situated at various levels is as under:

State/ UT laboratories	Regional laboratories	District laboratories	Sub-division laboratories	Block laboratories	Mobile laboratories	Total laboratories
31	22	644	923	333	58	2,011

Source: WQMIS

Under the Uniform Drinking Water Quality Protocol (UDWQP), targets for water quality monitoring were fixed for various levels of laboratories. For various reasons *inter alia* infrastructure, HR, fund, etc., the water samples tested were below the set targets. Standardization of different levels of laboratories certified through NABL accreditation was slow. These laboratories were testing the samples collected by Government agencies and there was a limited access to public to test their water samples. At the start of the Jal Jeevan Mission in August, 2019, only around 50 laboratories across country were NABL accredited.

At the village level, mandatory annual water quality testing using Field Test Kits (FTKs) by the community was sporadic due to non-availability of these kits/ reagents, lack of community ownership, awareness and training, etc.

In order to address these challenges, the mission has come out with a robust action plan and funding for water quality monitoring and surveillance, especially w.r.t improving infrastructure and functioning, developing local leadership through awareness and training, getting NABL accreditation of all laboratories, etc.

2.2 Water quality issues across country

Chemical and bacteriological contaminations have multiple health impacts. An excessive amount of Fluoride in drinking water exposes people to risks of crippling skeletal and/ or dental fluorosis. Long-term consumption of water contaminated with Arsenic leads to Arsenic poisoning or Arsenicosis, cancer of the skin, bladder, kidney, lung or diseases of the skin (colour changes and hard patches on palms and soles), blood vessels of legs and feet. A very high concentration of heavy metals in drinking water can lead to poisoning. Bacteriological (pathogens, bacteria, etc.) contamination of drinking water leads to diseases like cholera, dysentery, diarrhoea, typhoid, etc., which have an immediate impact on human body in terms of morbidity and sometimes lead to even mortality. Presence of Uranium has been observed in 18 States.

The IMIS maintained by Department of Drinking Water and Sanitation (DDWS) monitors drinking water sources having water quality issues mainly chemical contaminants such as Arsenic, Fluoride, Iron, Nitrate, Salinity and heavy metals as reported by states.

Arsenic	Fluoride	Salinity	Iron	Nitrate	Heavy Metals
10 States	20 States	17 States	28 States	17 States	3 States

Presence of water quality contamination hotspots across country as reported by States/ UTs

Source: JJM-IMIS

Nearly 19 States in India, *inter alia,* have drinking water source contaminated with Arsenic, Fluoride, Nitrate, Iron, Salinity or heavy metals etc. Additionally, the Union Ministry of Health & Family Welfare has identified 61 priority districts across five states that are affected by Japanese Encephalitis and Acute Encephalitis Syndrome (JE/ AES).

Apart from the chemical contamination, Japanese Encephalitis/ Acute Encephalitis Syndrome (JE/ AES) and Acute Diarrheal Diseases (ADD) affected districts are also to be strictly monitored. The Ministry of Health and Family Welfare has identified 60 districts which are the most affected with JE-AES attached at **Annex-I**. Keeping this in view, JJM accords priority to water quality-affected habitations as well as JE/ AES districts.

Further, groundwater meets 85%[6] of the rural drinking water requirement. According to an assessment by the Central Ground Water Board in 2018[7], 52% blocks in the country have *inter alia* at least one of the geogenic contaminants, viz. Arsenic, Chloride, Fluoride, Iron, Nitrate and Salinity.

Surface water use is also on the rise and presently meets about 15% of the Indian rural drinking water requirement. However, surface water sources are more prone to pollution due to extensive use of chemical fertilizers, pesticides and unabated discharge of untreated/ partially treated sewage/ industrial wastewater in the catchment.

2.3 Challenges faced in water quality monitoring

Department of Drinking Water & Sanitation held five region-wise stakeholder consultation workshops in September, 2019 to discuss the modalities involved in implementation of JJM and firm up the same. The workshops were organized to finalize operational guidelines by gathering inputs from different stakeholders in States/ UTs on the overall scenario of drinking water supply, discuss innovative practices and challenges.

Due to the intermittent water supply adopted in the country, a loss of pressure in the water distribution system leads to a fall in hydraulic integrity[8]. Because of this, contaminants can enter the water supply distribution network. At the time of water supply, the positive pressure in the network prevents contaminants from getting into the network.

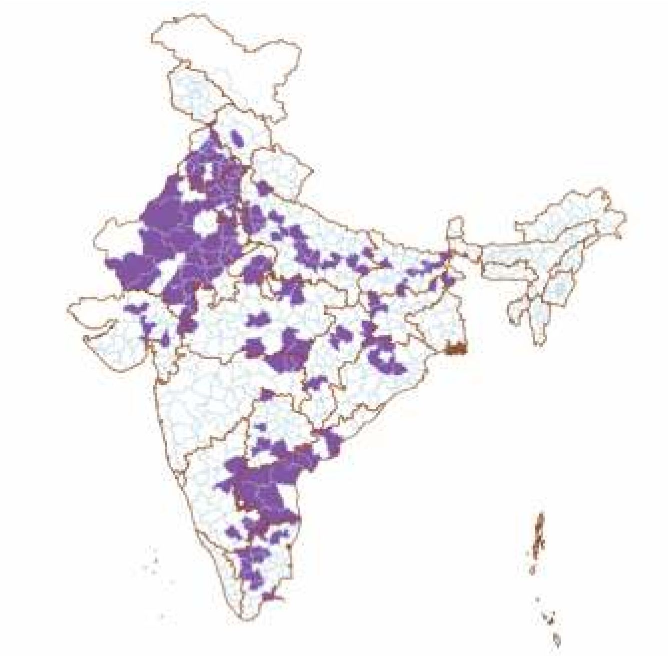
But, if the scheme is not operational 24x7, illegal pumps used to draw water from the network enable contamination of water in the pipes through leaky joints or points of seepage. Moreover, most of the time, water supply distribution lines pass through or near the existing sewerage systems making water supply more vulnerable.

Thus, there is a felt need to have community participation, ownership and contribution in all decisions pertaining to water supply systems. Community-led partnership with States/ UTs will therefore be the strategy for achieving the objectives of JJM.

Communities can make the best use of this opportunity and ensure that every rural household has FHTC delivering water in adequate quantity (minimum 55 lpcd) of prescribed quality (BIS:10500) and on regular basis as may be decided by the Gram Panchayat and/ or its sub-committee, i.e., VWSC/ Pani Samiti/ User Group, etc. State Government/ UT Administration and its respective departments are to play a true role of facilitator. This approach will bring long-term sustainability in the sector.

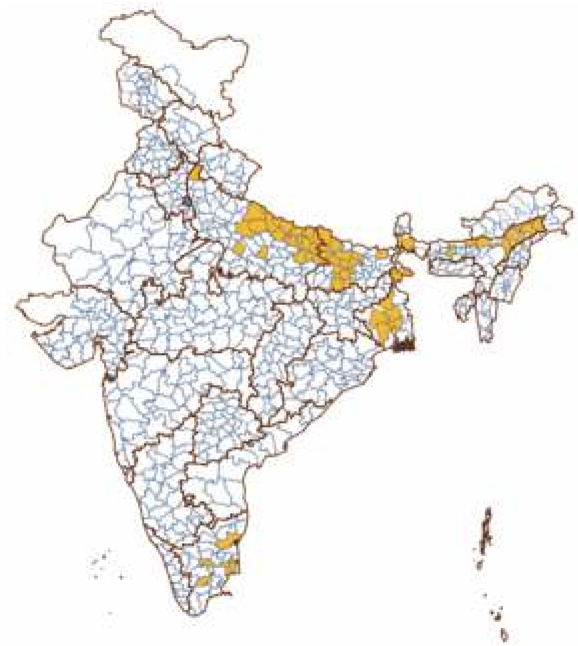
[6] National Compilation of Dynamic Groundwater Resources of India, 2017, by Central Ground Water Board, DoWR, RD & GR
[7] Groundwater quality in shallow aquifers in India, 2018
[8] The hydraulic integrity of a water distribution system represents the capacity to provide reliable quantities of water at acceptable pressures

Maps indicating quality-affected areas



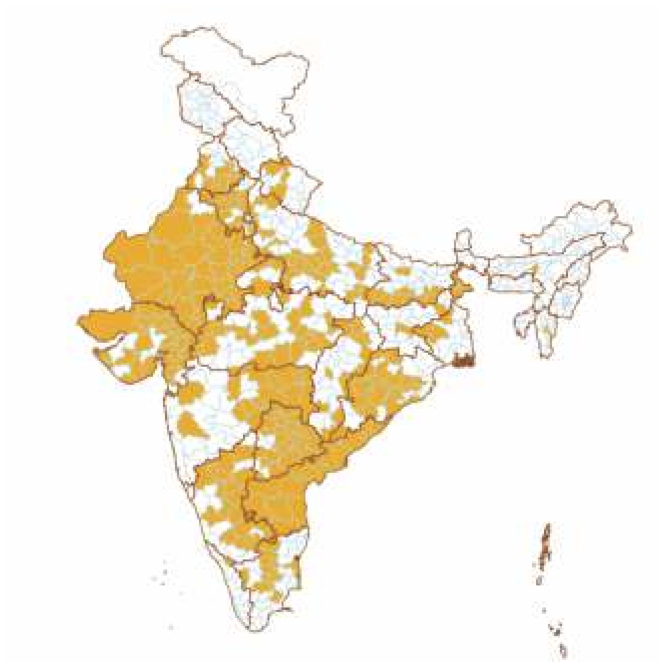
Map indicating high Uranium in shallow aquifers

Source: CGWB



Map indicating districts affected with JE/AES

Source: JJM-IMIS



District-wise Fluoride-affected areas

Source: JJM-IMIS

District-wise Arsenic-affected areas

Source: JJM-IMIS

(Note: A district is highlighted even if there is a single small hotspot in the entire district. The highlight does not necessarily indicate that the entire district is contaminated.)

Challenges faced in WQMS

1. Lack of confidence in people to drink water directly from tap/ opting for domestic treatment plants
2. Laboratories not open to public or costly charges
3. No regular water quality testing of drinking water sources
4. Unhygienic environment around public water supply delivery point
5. Community unaware of quality norms
6. Lack of community ownership on water quality testing
7. Non-availability of water quality data in public domain for analysis
8. Limited grievance redressal measures
9. Lack of innovative technology to monitor quality of water supplied
10. Laboratories unable to achieve sampling target
11. No standardization of laboratories
12. Lack of training to the HR involved in WQMS
13. Institutional and functional gaps in laboratories
14. Limited awareness on the linkages of WASH services and public health

3. Public health and water quality standards, monitoring & surveillance

3.1. Public health

Public health refers[9] to all organised measures (whether public or private) to prevent disease, promote health, and prolong life. A Public Health official is responsible for providing conditions in which people can live a healthy life. Consumption of contaminated water is one of the largest public health issues as it exposes individuals to health risks[10]. Hence, drinking water, contaminated with either geo-genic or anthropogenic or both, has a bigger influence in determining the health of individuals and communities. Recognizing the risks, water quality-affected habitations are accorded priority in the implementation of Jal Jeevan Mission. Similarly water quality monitoring & surveillance activities are prioritized.

3.2. Water quality standards

Water quality refers to physical, chemical, biological and radiological characteristics of water. The Bureau of Indian Standards (BIS) has specified safe drinking water quality standards (IS 10500:2012). These standards have two limits[11]—'acceptable limits' and 'permissible limits in the absence of an alternate source'. If any parameter exceeds the permissible limit such as chemical or radiological parameter, there should be investigation and where appropriate, implement remedial measures or restrict the continued use of the water supply for drinking purposes until water quality is considered acceptable. In such cases, it is critical to provide an alternative drinking-water supply. It is pertinent that drinking water source(s) be tested, as prescribed, to ensure that the supplied water meets the prescribed standards. Remedial action must be taken if the parameters tested are outside the prescribed limits.

For all piped water supply schemes, new or old, design requirements of water treatment plants/ community water treatment plants should take care of supplying drinking water with quality parameters within the prescribed limits. For more details, BIS Standard quoted above may be referred to.

There are 64 water quality characteristics/ pesticides/ organisms for which standards have been prescribed by BIS. A comparison of the standards for these parameters vis-à-vis WHO standards is given in **Annex-II**. A table showing basic water quality parameters along with required standards is as follows.

The operational guidelines for the implementation of Jal Jeevan Mission had 13 basic water quality parameters. The framework proposes 3 additional parameters, of which Colour and Odour are very basic physical characteristics of drinking water. Chlorination is done to eliminate the pathogenic contamination in drinking water and the procedure to add Chlorine is detailed in Central Public Health & Environmental Engineering Organisation (CPHEEO) manual. Thus, free residual Chlorine in drinking water is a direct indicator to ascertain that adequate chlorination has been done and that the water is pathogen free.

[9] WHO definition
[10] See the inside of cover page for pictorial representation
[11] Except pesticide residue and bacteriological quality

Basic water quality parameters

S. No	Characteristic	Unit	Requirement (Acceptable limit)	Permissible limit in the absence of alternate source
1.	pH	-	6.5- 8.5	No Relaxation
2.	TDS	Milligram/ litre	500	2000
3.	Turbidity	NTU	1	5
4.	Chloride (As Cl)	Milligram/ litre	250	1000
5.	Total Alkalinity as Calcium Carbonate	Milligram/ litre	200	600
6.	Total Hardness (as CaCO3)	Milligram/ litre	200	600
7.	Sulphate (as SO4)	Milligram/ litre	200	400
8.	Iron (as Fe) *	Milligram/ litre	1.0	No Relaxation
9.	Total Arsenic (as As)*	Milligram/ litre	0.01	No Relaxation
10.	Fluoride (as F) *	Milligram/ litre	1.0	1.5
11.	Nitrate (as NO3)	Milligram/ litre	45	No Relaxation
12.	Total coliform bacteria	Shall not be detectable in any 100 ml of sample		
13.	E.coli/ Thermotolerant coliform bacteria	Shall not be detectable in any 100 ml of sample		
14.	Free residual Chlorine	Milligram/ litre	0.2	1
15.	Colour	Hazen units	5	15
16.	Odour		Agreeable	Agreeable

*region specific contaminations

3.2.1 Important water quality parameters and their public health impact

3.2.1.1 Heavy metals

Under the IS 10500 standards, heavy metals are mentioned under the toxic substances table. Heavy metals are defined as metallic elements that have a relatively high density compared to water. Since most heavy metals are widely applied in industries, exposure and contamination of the workers and residents near such facilities is likely to occur. The harmful effects of heavy metals in humans depends on their dosage, rate of emission and period of exposure. Hazardous metals of concern for India in terms of their environmental load and health effects are Lead, Mercury, Chromium, Cadmium, Copper, and Aluminium, that are released into the water through anthropogenic activities such as mining, manufacturing, electroplating, electronics, and fertilizer production.

Heavy metals in water could lead to several neurological diseases in humans including Alzheimers, Parkinsons and multiple sclerosis. The adverse health effects that are associated with mercury and mercuric compounds in humans includes possible carcinogens; damage of the brain, lungs and kidneys; damage of developing fetuses; high blood pressure or heart rate; vomiting and diarrhea; skin rashes and eye irritation.

3.2.1.2 Pesticides

Under the IS 10500 standards, 18 pesticide residues limits and testing methods are mentioned. The pesticides belong to a category of chemicals used worldwide as herbicides, insecticides, fungicides, rodenticides, molluscicides, nematicides, and plant growth regulators in order to control weeds, pests and diseases in crops as well as for health care of humans and animals.

The consumption of chemical pesticides has been on a rise in India. Between 2015-16 and 2019-20, there has been a growth of 8.78% in the overall consumption of pesticides in the country, from 56,720 metric tonnes (MT) to 61,702 MT. Maharashtra and Uttar Pradesh are the major consumers of chemical pesticides in the country over the last five years.

Pesticide exposure has been proven to result in immunosuppression, hormone disruption, reduce intelligence, reproductive distortion and cancer. Impacts of pesticide exposure to humans can be categorized into acute health problems and chronic health problems. Chronic health problems encompass neurological effects such as onset Parkinson's disease, reduce the attention span, memory disturbances, reproductive problems, disrupt infant development, birth defect and cancer.

Acute health effects depend on the pesticide toxicity and the most common effects are reduced vision, headaches, salivation, diarrhoea, nausea, vomiting, wheezing, coma and even death. Moderate pesticide poisoning leads to mimic intrinsic asthma, bronchitis and gastroenteritis.

3.2.1.3 Pharmaceutical drugs in drinking water

The Pharmaceutical drugs get into the drinking water supply through several routes: some people flush unneeded medication down toilets; other medicine gets into the water supply after people take medication, absorb some, and pass the rest out in urine or feces. Some pharmaceuticals remain even after wastewater treatments and cleansing by water treatment plants. This is an emerging area of concern, however, research carried out so far across many countries and by WHO have not indicated any significant human health impact. It is necessary to have regular water quality monitoring of water supplied for drinking near the clusters of pharmaceutical industries/ parks so that other contaminants in combination with pharmaceuticals do not pose health risk.

3.2.1.4 Radioactive elements

The presence of radioactive elements in water is a serious area of concern in India. Bureau of Indian Standards (BIS) has not specified as yet a norm for uranium level in drinking water. The WHO have set drinking water standards for Uranium concentration in drinking water at 30 µg/L. Atomic Energy Regulatory Board, India has prescribed the maximum limit of U in drinking water at 60 µg/L (ppb). The Central Ground Water Board in its recent report[12] on the basis of above analysis of samples collected, it has been found that 151 Districts in 18 States are partly affected by high concentration (>30ppb) of Uranium in ground water. Preliminary studies on the health effects of drinking uranium-tainted water among animals and humans have revealed that it causes Nephritis (kidney damage). The kidney is the most sensitive organ for damage by uranium. Notably, this is said to be caused by the chemical effect of uranium, rather than a radiological, even though uranium is radioactive. Uranium can decay into other radioactive substances, such as radium, which can cause cancer with extensive exposures over a long enough period of time. Nonetheless, we need more comprehensive systematic studies to establish the chronic health effects of uranium exposure.

[12] CGWB Report on *Uranium occurrence in shallow aquifers of India,* June 2020.

3.2.1.5 Bacteriological requirements

Drinking water due to contamination from various sources, will have with disease-causing bacteria, viruses, or parasites (collectively called pathogens). WHO has listed the commonly occurring water borne pathogens as Bacteria, Viruses, Protozoa[13] and Helminths[14]. Under the IS 10500 standards, bacteriological requirement for drinking water is indicated by absence of coliform organisms. It also describes about the biological requirements of drinking water *inter alia* microscopic organisms. The presence of coliform bacteria, specifically *E. coli* (a type of coliform bacteria), in drinking water suggests the water may contain pathogens that can cause diarrhea, vomiting, cramps, nausea, headaches, fever, fatigue, and even death sometimes. Infants, children, elderly people, and people with weakened immune systems are more likely to be affected by pathogens in drinking water. Some of the pathogens that are known to be transmitted through contaminated drinking-water lead to severe and sometimes life-threatening disease. Examples include typhoid, cholera, infectious hepatitis (caused by hepatitis A virus [HAV] or HEV) and disease caused by Shigella spp. and E. coli O157. Others are typically associated with less severe outcomes, such as self-limiting diarrhoeal disease (e.g., Norovirus, Cryptosporidium).

3.3 Water quality monitoring & surveillance (WQMS)

Water quality monitoring is a fundamental tool in the management of safe drinking water supply. Water quality monitoring is defined by the International Organization for Standardization (ISO) as: 'the programmed process of sampling, measurement and subsequent recording or signalling, or both, of various water characteristics, often with the aim of accessing conformity to specified objectives.'[15] The focus is on testing procedures, using advanced instruments to strengthen water testing, accountability, maintaining the standard of laboratories by getting NABL accreditation and/ or recognition.

To pre-empt the issues arising out of poor water quality, Water Quality Management Information System (WQMIS), a database of water testing is created, maintained and regularly monitored for investigating and tracking the quality of water supplied and preventive measures taken for averting disease outbreaks. The PHE/ RWS Department/ agency responsible for the implementation of Jal Jeevan Mission in the States/ UTs are to test water quality at source at least twice a year, i.e., before and after the monsoon for bacteriological parameters and at least once in a year for chemical parameters.

Surveillance is regular, specific measurement and observation for the purpose of water quality management and operational activities. It involves active participation of Gram Panchayat and/ or its sub-committee (VWSC/ Pani Samiti/ User Group) and the local community in regularly testing water quality using Field Test Kits (FTKs) or water quality testing devices, which are under development. Five persons, preferably women, like local health workers, ASHA workers, GP/ VWSC/ Pani Samiti members, etc. have to be identified and trained in every village to undertake the surveillance activities. These well-trained persons have to be responsible for water quality testing and concurrently uploading the data/ report on Water Quality Management Information System (WQMIS). In this way, the GPs and/ or its sub-committees are expected to perform the responsibility of a 'public utility' at the village level. Even though FTK gives an indicative result, it helps in ascertaining whether the water supplier is fulfilling the mandated obligations or not. The multi-parameter FTK is used for examination of physico-chemical contamination as initial screening. The P/A water test kit is used to indicate presence or absence of coliforms in water samples. A separate Arsenic FTK is to be provided in areas with Arsenic contamination.

[13] Protozoa are single celled organisms
[14] Helminth is a general term meaning worm
[15] Water quality monitoring - A practical guide to the design and implementation of freshwater quality studies and monitoring programmes

As a part of the surveillance activity, a sanitary inspection[16] is also to be undertaken. It is an on-site inspection of a water supply facility to identify actual and potential sources of biological contamination. The physical structure and operation of the system and external environmental factors (such as a toilet location) are evaluated. This information may be used to decide appropriate remedial action to improve or protect the drinking water source and supply system. Sanitary inspections are to be carried out for all new and existing sources of drinking/ domestic water supply. The water quality monitoring & surveillance include:

I.) setting up/ strengthening State/ UT, district/ sub-divisional level or block level laboratories, including ones under PPP mode;

ii.) upgrading existing water quality testing laboratories, which *inter alia* includes procurement of equipment, instruments, chemicals/ reagents, glassware, consumables, etc.

iii.) hiring outsourced human resources (excluding regular staff);

iv.) hiring vehicles for transportation of water samples collected from the field to the laboratory;

v.) conducting water quality tests for all drinking water sources in all the villages and in sample households as prescribed;

vi.) expenses incurred for NABL accreditation/ recognition process, i.e. consultant fee, audit cost, application fee, annual fees, etc.

vii.) presumptive testing of water quality at Gram Panchayats/ anganwadi centres/ schools using Field Test Kits (FTKs) and to refer the positively tested samples to a nearby water testing laboratory for confirmation;

viii.) engaging communities in surveillance activities such as mandatory sanitary inspections;

ix.) capacity building and training of various stake-holders especially five women from every village;

x.) IEC activities on importance of consuming safe drinking water, including awareness generation amongst various communities;

xi.) corrective actions by State/ UT PHED/ RWS Department in case of a contamination, if required; alerting Health Department for mitigation and/ or corrective actions especially in Arsenic/ Fluoride, Uranium contaminants and bacteriological contaminations;

xii.) cross-verification of water quality data and integration with other laboratories of State/ UT/ Central government agencies;

xiii.) sharing the results of water quality testing with the community by way of SMS/ post cards and with all the stakeholders in water quality testing and management viz. Sarpanch, up-Sarpanch, GP members/ VWSC/ Pani samiti members, etc. The positive results to be uploaded on WQMIS which alerts officials wherever intervention from PHE/ RWS or Health Department is required, etc.

[16] Refer Jal Jeevan Mission Guidelines Chapter 10, page 60 for description

4. Strategy for Water Quality Monitoring & Surveillance (WQMS)

4.1 Vision

To facilitate provision of clean tap water supply to every rural home and public institution, ensuring testing & monitoring of drinking water supply & sources by the supplier; and regular water quality surveillance by community, to have confidence in consuming water directly from tap.

4.2 Mission

National Jal Jeevan Mission *inter alia* assists, empowers and facilitate States/ UTs in undertaking following functions:

i.) regular water quality testing of all drinking water sources/ sample households as per prescribed protocol;

ii.) capture and analyze test results; in case of deviations from the prescribed values, undertake remedial measures;

iii.) financial assistance for water quality testing, surveillance and up-gradation/ modernization of the laboratories *inter alia* their NABL accreditation and/ or recognition;

iv.) regular updating of data on Water Quality Management Information System (WQMIS);

v.) training and capacity building of all stakeholders so that they can perform their assigned WQMS duties effectively and efficiently; and

vi.) enabling Gram Panchayats/ VWSCs especially five women in every village to undertake water quality testing using FTKs or testing devices, sanitary inspection and upload data on WQMIS.

4.3 Strategy

JJM is implemented as a decentralized, demand-driven and community-managed programme with Gram Panchayat and/ or its sub-committee, i.e. Village Water & Sanitation Committee (VWSC)/ Pani Samiti playing a key role in planning, implementation, management, operation and maintenance of water supply within the villages. Moreover, Panchayats have a constitutional mandate to manage drinking water. Thus, the focus is to empower GPs/ VWSCs to function as public water utilities.

To achieve the vision of water quality monitoring & surveillance, following strategy may be adopted:

i.) State/ UT to transform the current rural water supply sector into a public utility functioning, *inter alia*, where there are sufficient laboratories which are all NABL accredited/ recognized and where community leads water quality surveillance and has access to alert authorities for immediate action;

ii.) Baseline assessment

A campaign-mode exercise needs to be undertaken to update data on WQMIS so as to build a robust strategy for both planning and implementation. The following assessment is required:

a.) re-verification and firming up of no. of drinking water sources (scheme ID and source ID);

b.) map service area of each laboratory to ensure no village[17] is left out;

c.) assess and classify water quality of all drinking water sources in the State/ UT;

d.) build up an inventory of FTKs[18], H_2S vials, etc. along with the expiry dates of reagents;

e.) based on the WQMS framework, conduct a laboratory gap assessment and improvement plan[19] to identify gaps in infrastructure, human resource (HR), inventory management, data sharing, etc. across all laboratories.

[17] Census coded village as adopted under Jal Jeevan Mission
[18] Previously, many GPs have been distributed with FTK and P/ A water test kit. Currently, the availability and usage of these kits is unknown
[19] Gap assessment and improvement plans are elaborated in Chapter-7

iii.) Institutional mechanism

a.) a robust institutional arrangement is required connecting the cadre of chemists, engineers and the existing four-tier framework under JJM, viz. VWSC, DWSM, SWSM, NJJM;

b.) States/ UTs to decouple the functions of water service delivery and water quality testing to develop trust, transparency and accountability. A drinking water quality Commissionerate is to be constituted to decouple the functions. The States/ UTs may designate the Chief Chemist to oversee the functioning of laboratories, water quality testing, monitoring and surveillance at all levels;

c.) plan for adequate human resource to operate the water quality testing laboratories, facilitate water quality surveillance activities, etc. as prescribed in the framework;

d.) regular training, capacity building, exposure visits, etc. to be planned to keep building the capabilities of laboratory personnel at all levels.

iv.) Water quality testing laboratories

a.) water quality testing laboratories are the backbone of monitoring and surveillance activities. Provision of safe drinking water necessitates a strong, well-spread and well-equipped laboratory network within a State/ UT to facilitate routine quality assessment efficiently. States/ UTs are to plan for setting up of a water quality testing laboratory at all levels, as a priority;

b.) at present, the network of water quality testing laboratories has a hierarchy based on their function at State/ UT, regional, district, sub-divisional/ block level. A certain number of mobile laboratories are also in operation in hilly and far-flung areas as per the necessity of States/ UTs. 2,011 drinking water quality testing laboratories are set up at various levels by the States/ UTs. Services of these laboratories are to be opened for the common public to get their water samples tested at affordable rates;

c.) parameters to be tested for assuring the potability of water depends on the type of contamination at the source, which may be either geogenic or anthropogenic or both. The State Governments/ UT Administrations are to adopt minimum testing facilities for laboratories at each level to be able to test the basic water quality parameters;

d.) 100% testing of all drinking water sources to be undertaken and mandatory[20] reports to be generated for wide dissemination;

e.) to maintain standards, all laboratories are to be accredited/ recognized by NABL with a timeline for the entire process;

f.) State/ UT laboratories are to test at least 5% of the total drinking water samples from all district level laboratories. In bigger States, regional laboratories at par with State laboratory may be set up to meet the additional requirement;

g.) State/ UT level laboratories have to undertake testing of drinking water samples, at least once a year, from specific areas in districts like industrial clusters/ heavy pesticide use/ pharma clusters/ areas with known radioactive materials like Uranium. Drinking water sources in these areas have to be constantly monitored and remedial measures undertaken based on the results;

h.) district laboratories are to test about 250 water sources/ samples per month (i.e., 3,000 in a year as per the target of IMIS roster available). The district laboratory will also act as a referral to the State/ UT labora-

[20] Atleast once a year for chemical contamination and twice a year for bacteriological contamination, viz. pre and post monsoon

tory. In case of large districts, academic institutions/ private laboratories may also be involved in PPP mode for testing water samples;

i.) it is recommended that there be at least one block-level laboratory in each block for testing all basic water quality parameters. In case of large blocks, depending on the sample load, more than one laboratory can be added to the network by tying up with existing institutions in the block as mentioned in para (ix.). In such a case, proper one-to-one mapping of the laboratories with villages has to be done so that public know where to access water testing services. Detailed sampling and the logistic plan covering all villages needs to be prepared. It is to be ensured that 'no village is left out' from ensuring water quality tests of sources/ delivery points. Further, the sub-divisional laboratory may cover multiple small blocks instead of setting up separate laboratories in each such block;

j.) If the laboratory already has sophisticated equipment for testing a certain number of water quality parameters, it is to be fully utilised to test as many basic water quality testing parameters as possible using that equipment. For example: If a laboratory has an ICP-MS (Inductively Coupled Plasma Mass Spectrometry)/ Spectro-photometer, it can test all the parameters and not be restricted to only a few parameters. However, in the case of the latter (Spectro-photometer), reagents have to be procured for testing multiple parameters. For testing equipments, while procuring reagents, it should be ensured that reagents are compatible with them so that equipments can be used optimally;

k.) with advancements in instrumentation that incorporate digital technologies to test water quality, different levels of laboratories have to procure equipments that can perform water quality testing for multiple parameters. These equipments would not only reduce the turnaround time for delivery of test results, but also significantly increase the number of tests that can done by the laboratory as well as bring down the human intervention in testing;

l.) it is important that human resources for handling these equipments are well qualified, their capacities built at regular intervals so that they get updated as the equipments get modernised and the data generated through the test results can be analysed for policy interventions.

v) Water quality surveillance

a.) surveillance is to be done by the local community every month. For this, the GPs/ VWSCs are to be trained and empowered to function as water utility, so that they are able to seamlessly undertake all necessary water quality related assessments in a time-bound manner, and ensure safe water supply to all;

b.) trainings and re-orientation at all levels for various stakeholders may be required to drive the utility approach;

c.) at village-level, all drinking water source(s) including private sources are to be tested for water quality using Field Test Kits (FTKs) along with sanitary inspection as well as two sample delivery points (taps) in each habitation which are at the tail-end;

d.) five women from every village, viz. ASHA worker, anganwadi teacher, SHG leader, etc. or any other active women member, to be trained on using FTKs and uploading the data on JJM portal;

e.) identify a designation title, viz. Jal Sakhi/ Jal Sahiya/ Jal agua/ Jal Varuni, etc. for the women trained on water quality;

f.) the two activities of water quality testing using FTKs of all drinking water source(s)/

sample delivery points and sanitary inspection of water supply system/ source(s) are to be undertaken at least once every month;

g.) customized water quality testing kits may be provided to GPs/ VWSCs based on historical and baseline water quality data. Additionally, instruments like Chlorimeter may be mandated;

h.) distribution of the kits to be linked to training of stakeholders;

i.) an annual procurement plan to be drawn based on the requirements of various levels of laboratories and included as part of annual action for WQMS earmarked funds;

j.) to empower GP/ VWSC to function as water utilities, they may be trained and facilitated to organize monthly community meetings on a dedicated day, i.e. 'Jal Suraksha Diwas', to discuss water quality testing, emerging challenges and way forward to address them, monitor the work carried by members assigned water quality surveillance, etc. In many States, a dedicated day every month, viz. 1st Thursday, last Friday, etc. are already assigned as health/ nutrition days. Similarly, a date/ day may be identified and designated as the water quality day enabling local communities to gather, discuss and resolve their issues related to water quality;

k.) similarly, such days could be observed at block level/ district level on a quarterly basis to visibilize the WQMS activities as well as to highlight any key issues.

vi.) Standard Operating Procedure (SOP) for water-borne disease outbreak

a.) outbreak of water-borne diseases are sporadically reported from many States. This is particularly observed during monsoon season or otherwise, when there is a chance of wastewater mixing with drinking water;

b.) climate change is predicted to increase the severity of weather-related events such as floods and droughts. India too, will be greatly affected by these changes. For example, heavy rains and resultant floods can create conducive environments for numerous water-borne diseases such as diarrhoea, cholera, dysentery, typhoid and other bacterial and viral diseases. Evidence shows that rising temperatures and warmer climates can trigger an increased frequency of water-borne diseases such as cholera, giardiasis, salmonellosis, and cryptosporidiosis. Droughts can also trigger water-borne diseases due to increasing water shortages compromising sanitation and hygiene. Since this is a public health issue affecting a large number of persons placing a burden on health institutions, it is essential to have coordinated protocol among multiple agencies involved to address it;

c.) the SWSM is to ensure a Standard Operating Procedure (SOP) to control the disease outbreak. This inter alia includes coordinating with water supply agency, pollution control board, health authorities and water quality testing laboratories;

d.) on report of such an outbreak, immediate action is to be taken to test the water samples in water quality testing laboratories (preferably accredited/ recognized ones by NABL) and water supply agency is to arrange to shut-off the contaminated water supply and provide alternative safe water. Arrangements are to be made to test all nearby source(s) of drinking water to pre-empt outbreak in that area. IEC activity is to be undertaken in the affected area informing the public about the precautions to be taken;

e.) in far off/ tribal/ forested areas, regular water quality surveillance of sources of drinking water are to be undertaken involving mobile laboratories, if available or by involving nearby trained VWSC/ Pani Samiti members, and results are to be analyzed for any deviations from normal values. The agencies are to ascertain the reason for the outbreak, and take stringent follow-up action, as per pollution control norms, if contamination is caused due to negligence.

vii.) Water quality hotspots

a.) there may be water sources with a borderline chemical contamination, i.e. a little lower than the prescribed limit as per BIS:10500. To ensure that the water supply through FHTC is of prescribed quality, villages using such water sources have to be periodically monitored and may be enlisted as 'hotspot sources[21]'. The list of such 'hotspot sources' is to be updated by the PHE/ RWS Department and such villages/ habitations need to be prioritised and monitored for regular water quality testing. Corrective measures need to be taken immediately, as and when required;

b.) before suggesting any such hotspot water source for piped water supply system, it is to be discussed with Gram Panchayat/ VWSC, etc. and approved through *Gram Sabha*;

c.) under NWQSM, some habitations have been marked as 'quality improved'. All sources in such habitations are to be recognized as hotspots and need to be monitored closely.

viii.) Awareness, training and capacity building

a.) JJM is a decentralized, demand-based, community-managed programme. PHE/ RWS department to play the role of a facilitator. Hence, plans to be made to build community/ public leadership to ensure long-term sustainability of the entire water supply system. Community/ public to be made aware of safe and unsafe water sources, harms of drinking contaminated water and importance of tap water;

b.) to sensitize public on water quality issues, maps indicating block-wise ground water quality to be put up on display in GP buildings, block and district offices;

c.) in areas with Fluoride and Arsenic contamination, it has been observed that lack of nutrition and health further compounds the problem. Convergence with departments handling nutrition and health in rural areas to be undertaken and efforts to be made to raise awareness on contamination-wise 'dos and donts'. IEC material in vernacular language to be prepared and widely disseminated;

d.) JJM calls for a massive shift in the implementation approach and hence trainings may be organized at all levels to emphasize on the importance of water quality from a public health perspective. The National Centre for Drinking Water, Sanitation and Quality (NCDWSQ), Kolkata set up as an apex body on PHE works with Key Resource Centres (KRCs), Centres of Excellence (CoEs), Professor Chairs on a hub and spoke model. The NCDWSQ and its associated centres thus may be utilized to train the personnel involved in WQMS regularly.

ix.) Digital governance

a.) to strengthen community-based water quality surveillance, pilot projects using sensor-based IoT systems for measuring and monitoring water quality to be demonstrated, and later be planned for scaling it up;

[21] As per Central Water Commission, the 'hotspot' is defined as having values of parameters beyond permissible levels, which is different from the definition as per JJM

b.) a dedicated Water Quality Management Information System (WQMIS) developed by NJJM in partnership with ICMR has been made available in the public domain to establish transparency and credibility, and prioritizing water quality. Trainings may be held for all human resource especially engaged in water quality on using WQMIS, and their role in it;

c.) State/ UT are to engage third-party verification agencies to check the functioning of water quality monitoring and water quality surveillance services;

d.) following the utility approach, State/ UT to develop a robust grievance redressal system with user-friendly technology where the water user is approached promptly, issue addressed at the earliest and user informed on action taken.

x.) Building partnerships

a.) States/ UTs may also tie up with chemistry laboratories of schools, colleges, universities, technical institutions, accredited private water quality testing laboratories to strengthen their water quality testing facilities, and all water laboratories be brought under the water quality testing network on a nominal payment basis. These additional facilities will follow the same protocols for testing as followed by State/ UT water quality laboratories. This will also help engagement of students in water testing activities and bringing awareness among them;

b.) internship opportunities may be provided to the students from similar fields for laboratory work and explore community engagement/ field work with students from social sciences;

c.) sector partners, KRCs, Implementation Support Agencies (ISAs), etc. may be engaged in undertaking WQMS activities, viz. Baseline/ gap assessment, training of various stakeholders, handholding community in water quality surveillance, strengthening water quality laboratories, etc.;

d.) States/ UTs may also encourage and promote entrepreneurship and enterprises in water quality testing at the local level. The local enterprises can provide water quality monitoring services to a cluster of villages or block(s) and make water quality testing easy to access for general public and these additional facilities will follow the same protocols for testing as followed in State/ UT water quality laboratories;

e.) States may explore partnerships with State Rural Livelihood Mission (SRLM) to benefit from the established network of Self Help Groups (SHGs). The SHGs may also be trained to function as water utilities, viz. taking ownership of water quality surveillance in one or more villages, etc. enabling their entrepreneurial spirit.

5. Institutional mechanism

The overall responsibility of WQMS activities is with Rural Water Supply (RWS)/ Public Health Engineering Departments (PHED)/ Water Board/ Nigams and other institutions at various levels, viz. village, district, and State/ UT levels. They play a key role in planning, implementation and monitoring of WQMS activities.

This chapter provides an institutional framework considering all key stakeholders of water quality monitoring & surveillance and specifically aimed to empower the role of Chemists in the States/ UTs along with requirement of Human Resources (HR) at different levels.

5.1 Institutional roles and responsibilities

5.1.1 National level

The National Jal Jeevan Mission (NJJM), Department of Drinking Water and Sanitation (DDWS), Ministry of Jal Shakti, has the following mandate:

i.) provide policy guidance, financial assistance and technical support to States/ UTs;

ii.) issue necessary guidelines/ advisories from time to time;

iii.) facilitate the planning of WQMS activities and handholding of State/ UT officials, including chemists for NABL accreditation of laboratories;

iv.) create and maintain a separate Water Quality Management Information System (WQMIS) for implementing and monitoring JJM activities in States/ UTs;

v.) ensure regular updating of WQMS activities data on IMIS/ WQMIS, and take corrective actions when required;

vi.) organise national consultations, workshops, seminars, etc. and facilitate capacity building of State/ UT officials, including chemists, and other human resources through cross-learning and sharing of best practices, success stories, etc.;

vii.) promote innovation, research, advanced mobile apps to verify proper collection of samples and geo-tagging of the same including technological development activities;

viii.) third-party verification/ evaluation/ assessment of laboratories and data entered by States/ UTs on WQMIS, etc.

5.1.2 State/ UT level

5.1.2.1 State Water & Sanitation Mission (SWSM)

Functions of SWSM:

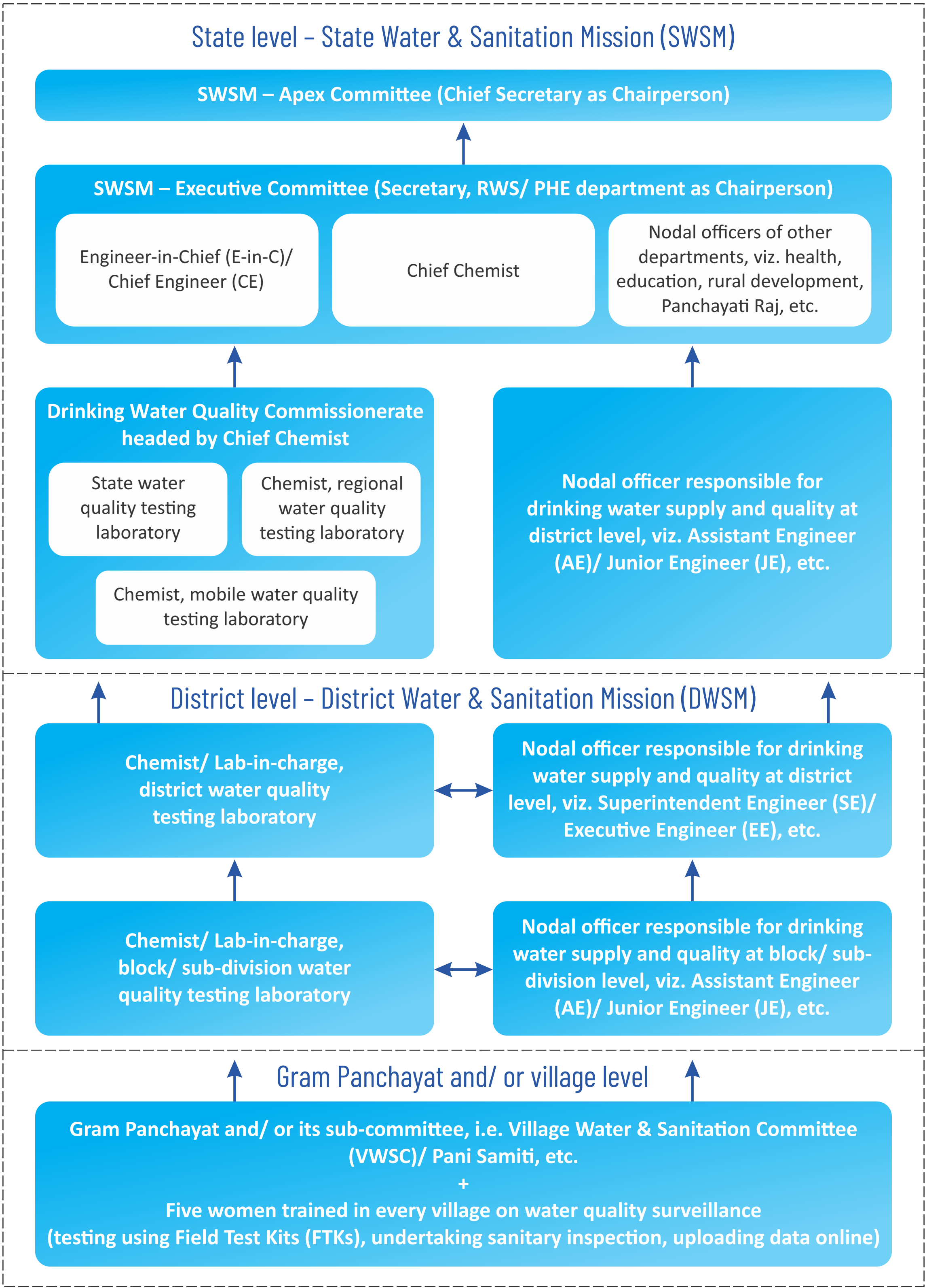
I.) responsible for overall water quality monitoring and surveillance activities and coordination at the State/ UT level;

ii.) nominate Chief Chemist of drinking water quality commisionerate as the member of executive committee of SWSM;

iii.) monitor population exposure to unsafe drinking water, the extent of exposure by risk level, and the severity of that risk's contribution to disease burden;

iv.) include an agenda item on drinking water quality in every Apex Committee meeting of SWSM chaired by the Chief Secretary;

Institutional framework



v.) firm up State/ UT policy on engaging dedicated human resource for ensuring water quality testing as well as surveillance using Field Test Kits including any honorarium;

vi.) recognise well-performing districts, Gram Panchayats and/ or its sub-committee, i.e., VWSC/ Pani Samiti/ User Group, etc., ISAs from time-to-time and develop a policy to reward them;

vii.) designate a title for the five trained women in every village, viz. Jal Sakhi/ Jal Sahiya/ Jal Agua, etc. as per the local culture;

viii.) guide/ facilitate laboratories at all levels through policy and financial assistance, etc.

5.1.2.2 Drinking Water Quality Commissionerate

A Drinking Water Quality Commissionerate (DWQC) is recommended for separation between water supply delivery and water quality testing services.

Many people do not drink water directly from tap due to lack of trust. Significant trust deficit on quality of water supplied exists among the general public, who often avail a point-of-use treatment device. Currently, in States/ UTs, the drinking water supply agency looks after both supply of water and its quality. However, a separate cadre of employees, viz. Chemists, dedicatedly work in this agency to monitor the water quality, but report to the engineers who are responsible for water supply. Keeping this in view, to develop trust, transparency and accountability with regard to water quality, the States/ UTs are to give autonomy to those operating water quality testing laboratories and designate the Chief Chemist to oversee the functioning of laboratories, water quality testing, monitoring and surveillance at all levels.

The current situation demands de-coupling of the two functions of water supply and water quality monitoring, as well as functionaries and make water quality monitoring and surveillance an independent function with required autonomy, i.e. funds, functions and functionaries at every level, i.e. State/ UT/ regional/ district/ Sub-division/ block. To achieve this, it is important to create a separate Drinking Water Quality Commissionerate (DWQC) with the Chief Chemist (Water Quality) of the State/ UT designated as the nodal officer. She/ he/ they would directly report to the Secretary or Pr. Secretary of the Department responsible for the rural water supply on all matters relating to water quality with information copy to the counterpart engineers as well. She/ he/ they are to monitor/ guide the effective implementation of WQMS activities in the State/ UT.

Given the priority and funding support (2% WQMS fund) to WQMS activities, the Commissionerate is to also be financially empowered to meet the requirements of carrying out the WQMS mandate, viz. strengthening laboratories, undertaking community engagement activities, etc. Further, the Commissionerate is to also be vested with the financial powers at par with the Head of the RWS/ PHE department. Similarly, the Chief Chemist is to be provided with necessary authority for communicating with concerned line departments and are provided vehicle facilities for periodic inspection of laboratories, as per State/ UT norms and any other requirements.

The DWQC is to issue monthly reports on the drinking water quality status, water quality monitoring & surveillance. The report is to be placed before the Apex Committee for its consideration and deliberations. The aim of DWQC is to ensure that all the laboratories in the State/ UT are providing the recommended services and meeting all standards for laboratory quality and safety as well as build capacities of communities to undertake regular water quality surveillance. The States/ UTs are to complete this transition by 2nd October, 2022 positively. The functions of DWQC are to:

i.) assist the SWSM/ RWS/ PHE Department in carrying out the functions of the mission;

ii.) prepare State/ UT and district annual action plans on WQMS activities following a participatory bottom-up approach;

iii.) plan and guide strengthening of water quality testing laboratories by setting-up or upgrading State/ UT/ district/ sub-division/ block/ mobile laboratories and monitoring their performance by undertaking their assessment and suggesting improvement plans;

iv.) considering the area-wise contaminations/ challenges within the State/ UT, firm up a list of parameters to be tested at different levels along with the necessary equipment to test the same. All basic water quality parameters are to be tested at all levels. A suggestive list of parameters to be tested at each level is mentioned at **Annex-III**;

v.) develop human resource policy *inter alia* including institutional memory, remuneration, capacity building, etc. and ensure that adequate human resources are available in all laboratories and that one Lab-in-charge/ Lab technician is not assigned more than one laboratory;

vi.) plan, guide and monitor NABL accreditation and/or recognition of all laboratories set up in the State/ UT;

vii.) develop and implement capacity building plan/ Information Education and Communication (IEC) material/ Behavioural Change Communication (BCC) strategy for all stakeholders involved in WQMS activities and generate awareness on various aspects of water quality and its importance, water-borne diseases and health effects of contaminated water, safe handling and storage of water, etc.;

viii.) prepare documents/ manuals on water quality testing and monitoring, SoPs for treatment of laboratory wastewater and safe disposal of laboratory wastewater;

ix.) prepare SoPs for proper sampling, i.e. collection, preservation, transportation, analysis, reporting and data interpretation of the test results;

x.) establish a mechanism for proficiency test (cross-verification of test results) carried out by different laboratories in the State/ UT;

xi.) undertake R&D/ innovative interventions addressing water quality issues in the State/ UT;

xii.) network and coordinate with Department of Atomic Energy (DAE) approved laboratories/ NABL accredited laboratories for monitoring radioactive and virological parameters;

xiii.) draw up the Standard Operating Procedures (SOP) to control water-borne disease outbreak, if any, duly empowering DWSMs to coordinating with water supply agency, pollution control board, health authorities and water quality testing laboratories;

xiv.) conduct training on WQMS activities for all stakeholders through workshops, seminars, etc. and generate awareness on various aspects of water quality and its importance, waterborne diseases and their health effects, safe handling and storage of water, etc.;

xv.) organise training, workshops, seminars for various stakeholders on WQMS activities;

xvi.) develop communication material on WQMS activities especially for communities; Update and generate State/ UT-level maps on different types/ intensity of contamination to be placed in State/ UT laboratories/ offices of RWS/ PHED;

xvii.) explore partnerships in implementing WQMS activities;

xviii.) carry regular review meetings with the Chemists of different levels of laboratories to ensure work as per action plan;

xix.) capture best practices, success stories and share for dissemination;

xx.) set up robust grievance redressal system and monitor and ensure that water quality grievances are addressed on priority, etc.

To shoulder this responsibility at DWQC, Technical Support Unit (TSU) with specialization in public health, water quality monitoring & surveillance, management, community mobilization, capacity development, etc. needs to be deployed. The States/ UTs may also leverage the TSU's capabilities for synergizing IEC and capacity building activities with existing Project Management Units (PMUs).

5.1.2.3 State/ UT level water quality testing laboratory

There is to be a state-of-the-art State/ UT level drinking water quality testing laboratory in every State/ UT with the capacity to analyse all physical, chemical and microbiological parameters as mentioned in BIS IS 10500: 2012 and its subsequent amendments. It is to be headed by a senior-level experienced Chief Chemist/ Chief Microbiologist. Once the decoupling is done in the State/ UT, as elaborated in para 5.1.1, the Chief Chemist is to report to the Secretary, RWS/ PHED.

In case of large States/ UTs, depending on requirement, regional laboratories at par with State-level laboratory may need to be set up so that State/ UT laboratory is not overloaded. The lab-in-charges of the regional laboratories are to report to the Chief Chemist at State/ UT laboratory. States/ UTs may also upgrade an existing district laboratory to a regional laboratory which would perform both the functions, as indicated earlier.

A regional laboratory will have the same facilities as a State/ UT laboratory, and are to be located in such a way that all districts in that specific region can easily access its services. The human resources in these laboratories are to be at par with State/ UT laboratories, but the person in-charge is to report to the Chief Chemist of the State/ UT laboratory.

Functions of State/ UT level water quality testing laboratory are to:

i.) work as a referral institute to analyse specific or newly/ emerging water quality problems;

ii.) identify emerging contaminants as well as instruments/ equipment required for their testing;

iii.) test at least 5% of the total drinking water samples across all district level laboratories, with random and uniform geographical spread, including positively tested samples referred by district/ sub-division/ block/ mobile laboratory;

iv.) monitor & ensure timely data updation on WQMIS;

v.) monitor the performance of the district, sub-divisional/ block/ mobile laboratories and ensure Quality Assurance & Quality Control (QA & QC) in these laboratories and suggest plans for their improvement and strengthening;

vi.) ensure proper AMC/ CAMC/ calibration of all instruments/ equipment using Certified Reference Material (CRM) as per 'IS/ ISO/ IEC17025:2017';

vii.) data analysis of State/ UT laboratory samples, including the positively tested samples from district, sub-divisional/ block/ mobile laboratories and follow-up corrective action to ensure potability of drinking water;

viii.) coordinate with similar laboratories of other departments in the State/ UT/ Central Government agencies; recommend corrective actions to Engineer-in-Chief/ Chief Engineer of the department;

ix.) determine the risk of pollution from various sources and delineate the areas prone to water contamination (hotspots) on the State/ UT map, recommend corrective actions;

x.) ensure timely procurement of chemicals/ glassware/ consumables as per procedural formalities or State Government/ UT Administration rules. Render periodic guidance to the chemist at district/ block level laboratories;

xi.) support SWSM in procurement/ refilling FTKs/ bacteriological vials on time;

xii.) support SWSM/ concerned authority in procurement of laboratory instruments/ equipment, etc.

5.1.3 District level

5.1.3.1 District Water & Sanitation Mission (DWSM)

The District Water and Sanitation Mission (DWSM) is responsible for overall water quality monitoring and surveillance activities at the district level. While the Executive Engineer, RWS/ PHWD is the Member-Secretary of DWSM and responsible for supply of water to households, the Chemist-in-charge of the district laboratory is responsible for the performance of laboratories in the jurisdiction.

Functions of DWSM:

i.) responsible for overall water quality monitoring and surveillance activities and coordination at the district level;

ii.) monitor population's exposure to unsafe drinking water, the extent of exposure by risk level, and the severity of that risk's contribution to disease burden;

iii.) raise issues of importance on drinking water quality to SWSM;

iv.) implement the SOP for water-borne disease outbreak, as required, in coordination with water supply agency, pollution control board, health authorities and water quality testing laboratories;

v.) recognise well-performing sub-divisions/ blocks/ GPs/ VWSCs, and ISAs from time-to-time and reward them;

vi.) guide/ facilitate laboratories under its jurisdiction, etc.

5.1.3.2 District level water quality testing laboratory

The district laboratories are to assist the DWSM in carrying out the functions of the mission. The Chemist in-charge of the district laboratory is responsible for WQMS activities in the district and is to report to the State/ UT Chief Chemist on all matters regarding water quality testing laboratories and their functioning, with an information copy marked to the executive engineer or engineer in-charge of water supply at district level.

The district-level laboratories perform the following functions:

i.) monitor and implement WQMS activities in the district and take corrective action;

ii.) raise awareness and develop capacity among all stakeholders on various aspects of water quality and its importance, waterborne diseases and health effects of contaminated water, safe handling and storage of water, etc.;

iii.) encourage and promote local entrepreneurship and enterprises for water quality testing;

iv.) analyse water quality data generated at various laboratories in the district and take corrective action, if required;

v.) monitor and update WQMS activities data on IMIS and WQMIS regularly;

vi.) plan, guide and monitor NABL accreditation of all laboratories set up in the district;

vii.) monitor the working of laboratories set up in the district and ensure the prescribed number of samples are tested and the results shared with district nodal officer/ concerned officer;

viii.) cross-verify water quality data and integrate it with data from other laboratories of the State/ UT/ Government agencies;

ix.) explore the possibility of engaging laboratories in colleges/ universities/ polytechnic institutes/ private pathological laboratories for water quality testing on nominal payment basis mutually agreed between DWSM and concerned institutions;

x.) procure Field Test Kits (FTKs)/ refills/ bacteriological vials from the suppliers empanelled with the State/ UT and distribute them at block/ GP level for water testing;

xi.) take measures for strengthening and monitoring community-based water quality surveillance and sanitation activities prepared by SWSM;

xii.) put up district map of water quality-affected areas (hot spots), indicating the type and intensity of contamination, at the district collectorate and monitor the water quality regularly;

xiii.) monitor water quality grievances and ensure they are addressed on priority;

xiv.) test water quality parameters of local importance. The major functions of these laboratories include: drinking water quality testing of all sources as per protocol, their monitoring & surveillance;

xv.) closely monitor hotspots, undertake field visits to hotspots/ quality-affected areas;

xvi.) prepare water quality maps indicating the type and intensity of contamination in the area of their jurisdiction; recommend corrective action to PHED/ RWS Department and alert the community;

xvii.) laboratory gap assessment and implementation of laboratory improvement plans;

xviii.) technical support to DWSM in purchase of consumables and non-consumable items to ensure proper working of laboratories;

xix.) coordinate and share data with State/ UT laboratory and other relevant stakeholders in the State/ UT and district, e.g., health department;

xx.) strengthen PRIs, GP and/ or its sub-committee, i.e., VWSC/ Pani Samiti/ User Groups and involve community in water quality monitoring and surveillance activities including sanitary inspections;

xxi.) implement quality assurance and quality control procedures;

xxii.) communicate test results to the Executive Engineer, Zila Parishad, Assistant Executive Engineer and to Gram Panchayats and/ or sub-committee, i.e., VWSC/ Pani Samiti/ User Groups for corrective actions at district and sub-divisional level; ensure display of water quality test results at GP level;

xxiii.) regular quality testing of water supply in schools, aganwadi centres, GP offices and other village institutions using Field Test Kits (FTKs)/ bacteriological vials and communicating results to the authority concerned;

xxiv.) monitor utilisation of Field Test Kits (FTKs)/ refills/ bacteriological vials in GPs, schools, anganwadi centres and other public institutions;

xxv.) district laboratories are responsible for testing 250 water sources/ samples per month (3,000 in a year as per the target of roster available on Department/ National Mission IMIS) covering all sources randomly spread geographically, including the positively tested samples referred by the sub-division/ block laboratory/ mobile laboratory for basic water quality parameters. The district laboratory will also refer the positively tested samples to the State/ UT laboratory immediately. The other parameters may be tested as per local contamination at the district level;

xxvi.) regular monitoring and site visit of water quality hotspots, etc.

5.1.4 Sub-divisional/ block level

The drinking water quality testing laboratories at sub-divisional/ block levels are the core agencies to test water quality parameters of local importance. Sub-division/ block level laboratory Chemist is responsible for WQMS activities at the respective sub-division/ block level. The sub-division/ block level laboratory Chemist in charge is to report to the Chemist in charge of the district laboratory for water quality, with a information copy marked to the engineer in-charge for rural water supply.

The functions of the sub-division/ block level laboratories include:

i.) drinking water quality testing of all sources in their jurisdiction and their monitoring and surveillance;

ii.) sub-divisional/ block level laboratories will test 100% water sources under its jurisdiction; once for chemical parameters and twice for bacteriological parameters (pre and post monsoon) in a year, covering all sources of a block at least for basic water quality parameters. The positively tested samples will be referred to the district laboratory immediately. The other parameters may be tested as per local contamination. In case, block level laboratories are not available, services of laboratories of nearby educational institutions or universities may be explored and availed;

iii.) training and awareness generation activities about water quality in rural areas and grassroot level water quality workers;

iv.) involving PRIs, GP and/ or its sub-committee, i.e., VWSC/ Pani Samiti/ User Groups and the community in water quality monitoring and surveillance activities including sanitary inspections;

v.) regular monitoring of water quality parameters of local importance, reporting the test results to the district level laboratory and sharing the results with the community;

vi.) communicating the test results to sub-divisional Engineer/ Assistant Engineer, Junior Engineer and GPs and/ or sub-committee i.e., VWSC, Pani Samiti, etc;

vii.) ensuring regular drinking water quality tests using Field Test Kits (FTKs)/ bacteriological vials in all schools, anganwadi centres, other village institutions and communicating the test results to concerned authority including DWSM and other stakeholders in the district, e.g., the district health department;

viii.) monitoring utilisation of Field Test Kits (FTKs)/ refills/ bacteriological vials in GPs, schools, anganwadi centres, other public institutions and sharing the results with concerned authority;

ix.) implementing quality assurance and quality control procedures, etc.

5.1.5 Mobile drinking water quality testing laboratory

The mobile water quality testing laboratories may be set up to test specified parameters in inaccessible areas. They play a major role following a cyclone, flood, earthquake, etc., as they can reach the affected areas at short notice. The drinking water quality commissionerate will identify the requirement of mobile laboratories and monitor their activities.

The functions of mobile laboratory are:

i.) water quality monitoring and surveillance in remote areas/ hot spots/ disaster prone areas;

ii.) cross-verification of results with other laboratories;

iii.) water quality testing and management during disasters and natural calamities;

iv.) awareness generation amongst the PRIs and community;

v.) any specially assigned task.

A brief write-up on Haryana's mobile laboratory is mentioned in **Annex-IV**, etc.

5.1.6 Gram Panchayat and/ or its sub-committee, i.e. VWSC/ Pani Samiti

The Gram Panchayat and/ or its sub-committee, i.e. VWSC/ Pani Samiti are to shoulder key responsibility of planning, implementation, management, operation & maintenance of in-village water supply systems including regular water quality testing, grievance redressal, etc. The GPs/ VWSCs are to function as local water utilities.

Functions of GP/ VWSC in WQMS are:

I.) water quality surveillance activities as per the protocol established;

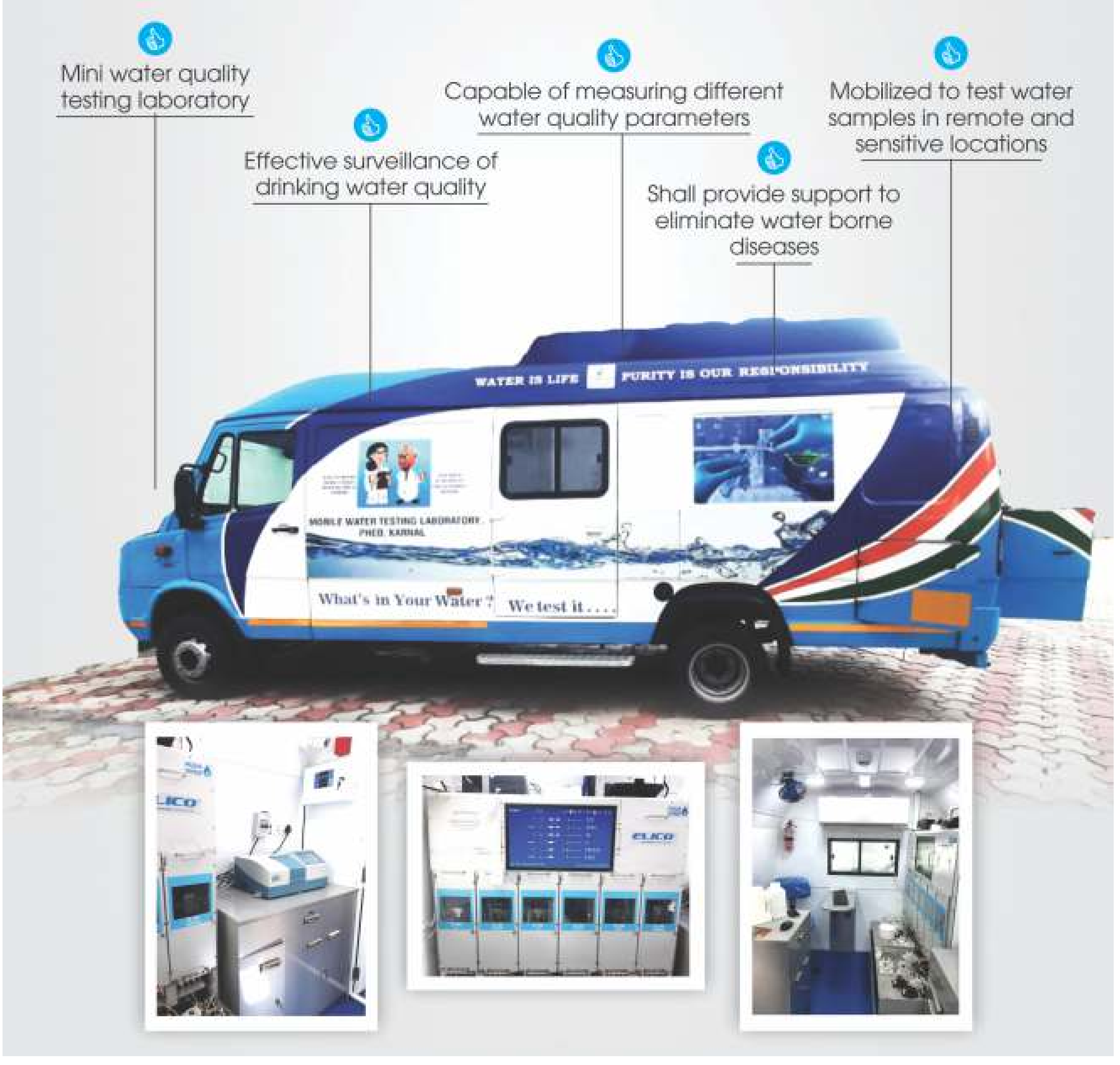
ii.) presumptive testing of water quality using FTKs/ bacteriological vials and regularly reporting test results to RWS/ PHE Department at sub-division/ block level laboratory as the case may be;

iii.) identifying, appointing and training five women from the local community to conduct water quality tests using FTKs/ bacteriological vials and reporting the results;

iv.) sanitary inspection, once every month, and submitting the report to RWS/ PHE Department;

v.) ascertaining drinking water quality at the household level through regular testing of samples;

vi.) testing all drinking water sources, including private sources, using FTKs/ bacteriological vials;



Features of mobile water quality testing van, Haryana vii.) testing all drinking water sources/ supply in all schools, anganwadi centres and other public institutions, and submitting the test reports to RWS/ PHE Department. Block/ sub-divisional level chemist to nominate a member from VWSC for uploading all water quality data on the WQMIS portal;

viii.) supporting awareness generation in schools, anganwadi centres, health centres, GPs/ PRIs on various aspects of water quality and its importance, waterborne diseases and their health effects, safe handling and storage of water, etc.;

ix.) working with ISAs in supporting communities in the use of FTKs/ bacteriological vials and sanitary inspections;

x.) promoting tap water connections through wall writings like 'Tap water is free from contamination';

xi.) conducting awareness campaign among children;

xii.) raising awareness on greywater status, especially treatment and reuse, etc.

5.1.7 Implementation Support Agencies (ISAs)

NGOs/ VOs/ women SHGs/ CBOs/ Trusts/ Foundations, etc. that are referred as Implementation Support Agencies (ISAs) are playing a critical role as partners in mobilizing and engaging the communities to plan, design, implement, manage, operate & maintain in-village water supply systems. Around 13,000 ISAs have been engaged by different States/ UTs to handhold GPs/ VWSCs.

In addition to their functions as prescribed in the operational guidelines for implementation of JJM, they may additionally be engaged to carry out the following functions in regards to WQMS:

I.) assist in baseline assessment, training and capacity building of local communities;

Village-level meetings to discuss water supply ii.) facilitate GPs/ VWSCs in conducting timely water quality tests, undertaking sanitary inspections and uploading the data;

iii.) identify and facilitate training of five women in every village who can shoulder the responsibility of water quality surveillance;

iv.) build awareness on various aspects of water quality monitoring and surveillance, water quality contamination, safety of tap water supply, etc.;

v.) document success stories/ case studies;

vi.) facilitate special campaigns on water quality testing, etc.;

vii.) conduct exposure visits for grassroots representatives to learn from one another by showcasing best practices of WQMS including adopting digital tools, etc.

5.1.8 Sector Partners

Sector partners are organizations like UN agencies, international developmental agencies, foundations/ trusts/ NGOs/ CBOs/ corporates with CSR funds, etc., proactively working in the water sector with wide outreach and impact. 184 sector partners have been engaged for their support in designing campaigns, capacity building, innovative technology, management, monitoring, evaluation, etc.

In addition to their functions as prescribed in the operational guidelines for implementation of JJM, they may additionally be engaged to carry out the following functions in regards to WQMS:

I.) facilitate in exploring partnerships for effective implementation of WQMS, set up pilot demonstrations, etc;

ii.) support in producing relevant policy documents, SoPs, etc.

iii.) support in bringing innovative technology, best practices/ case studies from across the globe in strengthening WQMS;

iv.) carry evaluation studies and assist policy making;

v.) develop material relevant to water quality and design creative outreach campaigns;

vi.) facilitate organization of conferences, workshops, etc. at regular intervals on water quality, etc.

5.1.9 Key Resource Centres (KRCs)[22]

Partnership for knowledge-building have been envisaged with Government/ Non-Government institution including universities/ deemed universities/ administrative/ management/ engineering institutions/ training institutions, etc. of repute that would function as Key Resource Centres (KRCs). These institutions would be engaged for capacity building, reorientation of different stakeholders, dissemination of knowledge and information, development of high-quality print and audio-visual content, documentation of best practices, etc. to transform the eco-system of drinking water supply sector.

The guidelines for capacity building by Key Resource Centres (KRCs) specify its functions in detail. Some of the KRC functions w.r.t WQMS are as under:

I.) design course/ study material, develop and deliver end-to-end high-quality capacity building programs;

ii.) conduct training and capacity building of national and State/ UT stakeholders;

iii.) provide knowledge support to the stakeholders on the latest innovations, tools and best practices that promote effective and efficient delivery of services and monitoring;

[22] Guidelines for capacity building by KRCs (available on www.jjm.gov.in)

iv.) organize small and large events like workshops, seminars, symposiums, round table discussions, conferences, meetings, expert talks on issues relating to safe drinking water;

v.) conduct research and assessments on various issues of drinking water; etc.

5.1.10 National Centre for Drinking Water, Sanitation and Quality (NCDWSQ)

To bring higher knowledge and provide learning opportunities to public health engineers, the 'National Centre for Drinking Water, Sanitation and Quality (NCDWSQ)' has been established at Kolkata as an apex institution for Public Health Engineering (PHE). The institute is envisioned to serve as a premier institute and bridge the wide prevailing knowledge and capacity gap in the field of PHE. The institute will follow a 'hub and spoke model' and partner with the Key Resource Centres (KRCs), Centres of Excellence (CoE) and Professor Chairs being set up by DDWS across the country and work in the areas of training and capacity building, education and academic programmes, research and innovation, and outreach and consulting, etc. Further, the institute is also in process of setting-up state-of-the-art water quality testing laboratory.

The institute initiated interactions with State/ UT PHEDs/ water & sanitation Departments through frequent capacity building, classroom trainings, reorientation programmes and is encouraging them to innovate to meet existing and emerging challenges.

5.2 Requirement of Human Resource (HR)

Staff needs for an effective water quality assessment laboratory varies a great deal. To estimate needs in terms of human resources, the following factors may be taken into account:

I.) total work load;

ii.) schedule of on-site analysis, camp analysis and laboratory analysis;

iii.) geomorphology/ terrain of the area;

iv.) demographic conditions;

v.) size and complexity of the supply system;

vi.) distance of sampling points and water supply systems.

Suggestive guideline for staff required for various levels of laboratories

S.No.	Laboratory type	HR position	No. of HR required
1.	State/ UT level/ Regional level	Chief Chemist/ Cheif Water Analyst	01
		Senior Chemist/ Senior Water Analyst/ Senior Microbiologist	01
		Chemist/ Water Analyst	02
		Microbiologist/ bacteriologist	01
		Laboratory Assistant	03
		Data Entry Operator	02
		Lab Attendant	02
		Field Assistant (task/ need based)	02

S.No.	Laboratory type	HR position	No. of HR required
2.	District level	Chemist/ Water Analyst	01
		Microbiologist/ Bacteriologist	01
		Laboratory Assistant	02
		Data Entry Operator	01
		Lab Attendant	01
		Field Assistant (task/ need based)	02
3.	Sub-divisional/ Block level	Junior Chemist	01
		Junior Microbiologist	01
		Laboratory Assistant	01
		Data Entry Operator	01
		Lab Attendant	01
		Field Assistant (task/ need based)	01
4.	Mobile	Junior Chemist/ Microbiologist	01
		Field Assistant (task/ need based)	01
		Driver	01

(Note: Staffing requirements mentioned here are indicative of the WQMIS requirements)

An incumbent with Chemistry/ Microbiology qualification may be allotted chemical or microbiological analytical work, at any level of the laboratory, as per workload/ human resources available in the laboratory. Different States/ UTs have a different designation for water quality professionals such as Water Analyst/ Chemist/ Assistant Chemist/ Junior/ Sr. Scientific Assistants/ Scientific Officer/ Research Officer, etc. These designations/ titles are suggestive and may be decided by the respective State Government/ UT Administration.

These positions can be filled with regular/ contractual personnel or can even be outsourced following due procedure as per extant rules of the State Government/ UT Administration. However, all States/ UTs must ensure at least one regular post of Water Analyst/ Chemist for the drinking water quality testing laboratory in each district.

Keeping in view the pattern of different State Governments/ UT Administrations, the educational qualification and experience required for various positions in the water laboratories is suggested as under.

Qualification and experience required for laboratory staff

S.No.	Designation	Educational qualification	Experience
1.	Chief Chemist/ Chief Water Analyst	Post-graduation in Sciences with Chemistry/ Environmental Sciences/ Microbiology/ Biotechnology/ Biological Sciences as one of the subjects	Minimum 15 years experience in laboratory water quality analysis and monitoring
2.	Sr. Chemist/ Sr. Water Analyst	Graduation in Sciences with Chemistry/ Environmental Sciences as one of the subjects	Minimum 10 years experience in laboratory water quality analysis and monitoring
3.	Sr. Microbiologist	Graduation in Sciences with Microbiology/ Biotechnology/ Biological Sciences as one of the subjects	Minimum 10 years experience in laboratory water quality analysis and monitoring
4.	Microbiologist	Graduation in Sciences with Microbiology/ Biotechnology/ Biological Sciences as one of the subjects	Minimum 5 years experience in laboratory water quality analysis and monitoring
5.	Jr. Chemist / Jr. Water Analyst	Graduation in Sciences with Chemistry/ Environmental Sciences as one of the subjects	Candidate with higher qualification in the cited subjects shall be preferred
6.	Jr. Microbiologist	Graduation in Sciences with Microbiology/ Biotechnology/ Biological Sciences as one of the subjects	Candidate with higher qualification in the cited subjects shall be preferred
7.	Lab Assistant	10+2 in Science Group	Candidates with one year experience in water quality laboratory may be preferred
8.	Data Entry Operator (DEO)	10+2 with skills in computer fundamentals	Graduate with 1-year computer course may be preferred
9.	Field Assistant	10^{th} pass	Candidates with 1- year experience in water quality laboratory may be preferred
10.	Lab Attendant	8^{th} pass	Minimum one-year experience in water testing laboratory and 10^{th} pass may be preferred

The remuneration to the laboratory human resources may be fixed according to the States/ UTs standard schedule of Rates (SoR). Alternatively, the remuneration may be fixed at par with the best in the sector to attract the most competent personnel. The human resource, qualification and experience required, and remuneration to be paid should be approved by the State Water and Sanitation Mission (SWSM). The aim is to get the best possible and competent personnel for working in the laboratories. While fixing the remuneration, minimum wage and prevailing market rate should be kept in mind.

States/ UTs may hire an agency to provide human resource support for water testing laboratories. All costs of outsourced staff for laboratories, including mobility allowances as well as engagement of outsourced agencies, are allowed under WQMS fund. The financial terms and conditions of the outsourcing agency should have the approval of the SLSSC, duly following the procedural formalities as per Government rules. Salaries of the regular staff should be met from the State Government/ UT Administration funds. The overall responsibility of smooth functioning of drinking water quality testing laboratories at all levels lies with the Secretary, PHE/ RWS Department as Chairperson of the Executive Committee of SWSM. The roles and responsibilities of laboratory personnel are as under.

Roles & responsibilities of laboratory personnel

S.No.	Role/ designation	Responsibilities
1.	Chief Chemist/ Chief Water Analyst	i.) overall in-charge of all the drinking water quality testing laboratories set up in the State/ UT; ii.) upkeep of the central repository of water quality analysis manual, and other related documentation for smooth functioning of laboratories; iii.) prepare Standard Operating Procedures (SOPs) for proper sampling techniques, i.e. collection, preservation, transportation, analysis, reporting and data interpretation of test results; iv.) prepare Annual Action Plan for an effective WQM&S, both for basic and newly emerging parameters; v.) ensure proper AMC/ CAMC of instruments/ equipments following approval from competent authority duly adopting procedural formalities as per State Government/ UT Administration rules; vi.) ensure timely procurement of chemicals/ glassware/ consumables after approval from competent authority and adopting procedural formalities as per State Government/ UT Administration rules; vii.) ensure proper calibration of all instruments/ equipments using Certified Reference Material (CRM) as per 'IS/ISO/IEC 17025:2017'; viii.) plan corrective actions in consultation with Engineer-in-Chief/ Chief Engineer of the department; ix.) ensure compilation of water treatment technologies and corrective actions; x.) ensure cross verification of test results, quality control and safety in laboratories at all levels;

S.No.	Role/ designation	Responsibilities
		xi.) supervise and guide reporting staff on sampling, water quality analysis, data analysis, identification of standard corrective actions based on water quality analysis data; xii.) ensure correctness of data uploaded on JJM IMIS; xiii.) any other task in the interest of ensuring safe drinking water supply; xiv.) plan, guide & support for NABL Accreditation of laboratories in the State/ UT at least for parameters of basic water quality importance and other parameters as per local conditions, etc.
2.	Sr. Chemist/ Sr. Water Analyst/ Sr. Microbiologist	i.) render proper assistance to the Chief Chemist in proper upkeep of the laboratory as stated above; ii.) provide guidance to the Chemists and microbiologists at district and sub-divisional/ block level laboratories; iii.) handling of advanced water testing instrumentation in the State/ UT level laboratory; iv.) ensure testing of targeted samples of State/ UT laboratory; v.) analyze sanitary surveillance data after selective field checks; vi.) any other task in the interest of proper water quality management in the State/ UT, etc.
3.	Chemist/ Water Analyst/ Microbiologist	i.) render proper assistance to the concerned reporting officer for achieving the targets set for water quality testing; ii.) implementation of proper sampling techniques, i.e. collection, preservation, transportation and analysis of physico-chemical and microbiological parameters; iii.) updation of water quality data on IMIS regularly; iv.) fumigate periodically to maintain the sanctity of the microbiological laboratory; v.) any other task in the interest of proper water quality management in the State/ UT, etc.
4.	Jr. Chemist/ Jr. Microbiologist	i.) render proper assistance to the concerned reporting officer for achieving the targets set for water quality testing; ii.) implementation of proper sampling techniques as collection, preservation, transportation and analysis of physico-chemical and microbiological parameters; iii.) ensure proper upkeep of the lab; iv.) any other task in the interest of proper water quality management in the State/ UT, etc.

S.No.	Role/ designation	Responsibilities
5.	Laboratory Assistant	i.) prepare reagent solutions and assist Chemist and Microbiologist in carrying out analysis; ii.) any other task assigned by the Chemist/ Microbiologist, etc.
6.	Data Entry Operator	i.) timely entry of water quality data into the IMIS formats; ii.) he/ She is to keep record of all of the samples collected and analyzed in laboratory on computer; iii.) any other task assigned by the Chemist/ Microbiologist, etc.
7.	Field Assistant	i.) collection, preservation, transportation, proper labeling and storing of samples in the laboratory; ii.) any other task assigned by the Chemist/ Microbiologist, etc.
8.	Lab Attendant	i.) cleaning of glasswares and help in maintaining the laboratory in clean condition; ii.) any other task assigned by the Chemist/ Microbiologist, etc.

Apart from the mentioned ones, some specific roles for Chief Chemist that need to be discharged as technical head of the water quality are:

i.) participating in programmes of Doordarshan/ All India Radio (AIR) about various aspects of water quality in the State/ UT;

ii.) generating public awareness on water quality through educational institutions, i.e. schools and colleges, etc.;

iii.) coordinating with other stakeholders and Departments; advocating for good sanitation of spring sheds, watersheds, catchment areas of lakes and ponds that serve as drinking water sources, etc.

6. Strengthening water quality testing

Strengthening water quality testing laboratories involves their up-gradation by providing appropriate infrastructure, including laboratory accommodation and environment, instruments, equipment, etc. Provision of safe drinking water necessitates a well located and equipped laboratory network within the State/ UT for water quality assessment. The network of such water quality testing laboratories may have a structure based on a State/ UT laboratory, district laboratories, sub-divisional/ block/ a certain number of Mobile laboratories as per the necessity of State/ UTs PHE/ RWS Departments.

6.1 Public-private partnerships and other possibilities

Achieving the JJM objective of providing safe water implies testing, monitoring, analysing and communicating with the stakeholders for taking the follow-up action. As there is a disproportionate relationship between the number of water sources and water quality laboratories available for testing, there is a necessity for a large number of laboratories to meet the water quality testing requirement. However, setting up new laboratories using Government resources would imply investments, delays and sustainability issues in the long run. In this scenario, the PPP route involving private laboratories from different institutions will be desirable. It will not only save cost and time but will also give access to their infrastructure, human resources and services at short notice. This can help get results fast.

JJM, therefore, encourages building partnership with all stakeholders. Towards this, the States/ UTs can explore Public-Private Partnership wherein the PHE/ RWS Department may collaborate with NABL/ ISO/ other suitably accredited water quality testing private laboratories. JJM can leverage such laboratories as Support Organisations (SO) and utilise their strengths following all SOPs as per government procedure. Additionally, the Public-Public Partnership may also be explored with the water quality testing laboratories of other/ similar State/ UT/ Central Government agencies, i.e., Central Pollution Control Board/ Central Water Commission/ Central Ground Water Board, State Pollution Control Boards/ laboratories under Public Health Centres/ Community Health Centres that can extend these services, etc.

Further, States/ UTs may also designate any NABL/ ISO/ other suitably accredited Public or Private water quality testing laboratory as Support Organisation for water quality testing, following all formalities prescribed in Government procedures. Under JJM, States/ UTs can encourage and promote entrepreneurship and enterprises for water quality testing at local level. These could be responsible for a cluster of villages or block(s) and ease the access to water quality testing for public.

The footprint of water quality testing can further be increased by engaging laboratories at colleges, universities, higher secondary schools, polytechnic institutes, private NABL accredited/ BIS approved water quality testing laboratories, etc., on mutually agreed payment basis. The laboratories in these institutions can be used for testing water samples and also can be made accessible to all the stakeholders, for which an agreed sum can be paid on sample basis. Several States/ UTs have already used PPP model to operate the water quality testing laboratories. Few examples are captured at **Annex-IV**.

6.2 Specification for laboratory and other infrastructural requirements

I.) **Physical facility**: The design of the laboratory at the State/ UT, district and sub-divisional level shall depend upon the volume of analytical work required to be done at each level. In deciding the requirement of space, due attention should be given to the space needed for permanently installed equipment and optimal performance of analytical work by the laboratory personnel. While constructing the new laboratory, or modifying the existing one, provision for future expansion must be made. The State/ UT/ district level laboratories should preferably be in Government owned buildings.

ii.) **Location of the laboratory**: The location and contact details of all laboratories must be prominently displayed using sign boards, posters, wall paintings etc. near bus stations, railway stations, Gram Panchayat offices, schools and other important public places. The location of all laboratories must be given wide publicity so that the common man is aware where to go to seek water quality analysis. The location of laboratories should be at State/ UT, district, sub-division/block HQ level. The location of all laboratories should be geo-tagged, and details available on State/ UT department and DDWS websites. The laboratories should be located such that they get adequate natural lighting and ventilation. A standard design of laboratories may be prepared.

iii.) **Renovation/ upgradation of existing laboratories and establishment of new laboratories:** States/ UTs can utilize WQMS funds for strengthening water quality testing Laboratories by setting-up/ up-grading State/ UT/ district/ sub-division/ block/ mobile laboratories. Payments of rental charges of various levels of laboratories are allowed under WQMS. For the State/ UT level laboratories, construction of the building is also permitted, provided adequate land is made available by the State Government/ UT Administration.

iv.) **Floor space:** Floor space for the laboratory is mentioned in **Annex-V.** Use of smooth tiles on floors should be avoided, and anti-skid measures should be taken.

v.) **Walls of the laboratory**: The walls should be finished smoothly in a light colour and should have sufficient thickness and provision for built-in cabinets. A standard Dos and Don'ts chart is to be made prominently visible. Standard practices as per the Bio-Safety Level (BSL) and Chemical Safety Level (CSL) for specific parameters are to be followed.

vi.) **Lighting:** All workrooms, including passages in the laboratory, should be well lighted. There should be enough windows provided in the laboratory area (except the microbiological lab) with transparent window glasses. Translucent roofs are now available to facilitate adequate illumination during the daytime. This may be thought of while planning the roof of the laboratory. Adequate provision of artificial lighting should be provided to supplement natural light. Additional plug points should be provided for extra lighting if needed. (online voltage stabilizer may be considered).

vii.) **Fuel gas supply:** Provision for supply of fuel gas and gas burners on the workbenches shall be provided wherever required.

viii.) **Balance room:** The digital balance shall be placed on a separate table in a cubicle or enclosure in the laboratory.

ix.) **Media preparation and sterilization room:** For microbiological/ bacteriological analysis, additional facilities for media preparation, centrifuging, sterilization by autoclaving etc., are mandatory and a separate enclosure for accommodating these facilities needs to be provided.

x.) **First Aid Box:** All laboratories must ensure that they have adequately equipped first aid box with proper medicines/ bandages/ eyewash. The first aid box should be placed such that it is easily accessible to all staff members. The laboratory should also have a First Aid Chart. First Aid material should be reviewed for its shelf life every three months, and expired material should be disposed of in a proper manner.

xi.) **Library:** Each State/ UT Laboratory shall have a computerized library facility having all Standard Operating Procedures (SOPs) and books/ journals/ periodicals related to drinking water quality, water-related diseases and water quality monitoring and surveillance. An adequate number of IEC material on consumption of safe drinking water, personal and environmental hygiene may be kept for distribution to rural people who visit the laboratories.

xii.) **Computers and Printers:** Each laboratory shall have required number of computers, printers and other consumables.

xiii.) **Work tables and benches:** Suitable laboratory furniture is to be procured by State/ UT, district or sub-division/ block level laboratories as per local requirement and may be such that they can easily be maintained and cleaned. Preferably, it may be vibration free/ shock-resistant. Adequate provision may be made for storing chemicals and reagents as per guidelines/ standards.

xiv.) **Instruments**: The list of instruments required is provided in **Annex-VI**. (These are only suggestive in nature and addition/ deletions with advancement in technology may be made as deemed appropriate by the State Government/ UT Administration). With advancements in instrumentation that incorporate digital technologies to test water quality, different levels of laboratories have to procure equipments that can perform water quality testing for multiple parameters. These equipments would not only reduce the turn-around time for delivery of test results, but also significantly increase the number of tests that can done by the laboratory as well as bring down the human intervention in testing. A list of such equipments is given at **Annex-VII**.

xv.) **Calibration of equipments/ instruments:** The equipments/ instruments used for testing have to be regularly calibrated as per their requirement. An annual schedule needs to drawn up for calibration showing the frequency of calibration, intermediate checks to carried out along with remarks. Suggested format is given in **Annex-VIII**.

xvi.) **Maintenance:** The States/ UTs may develop an appropriate Annual Maintenance Contract (AMC)/ Comprehensive Annual Maintenance Contract (CAMC) policy for maintenance, calibration, repairs of instruments/ equipment available in the laboratories. However, it is preferable that for instruments/ equipment of value less than Rs.10 lakh, Annual Maintenance Contract (AMC) may be adopted and for sophisticated instruments/ equipments of value more than Rs.10 Lakh, Comprehensive Annual Maintenance Contract (CAMC) be adopted. The AMC /CAMC may be one of the terms & conditions of bid document while procuring instruments and equipments of the laboratory. The States/ UTs may also frame policy for procurement of reagents, chemicals, glassware's and other related consumables required for the drinking water quality testing. Government e-Marketplace (GeM) platform may be used widely for procurement purposes.

xvii.) **Glassware:** The suggestive list of glassware required is provided at **Annex-IX**. The quality of glasswares may be Borosilicate Class B in general and Class A for NABL accredited laboratories. Subsequent procurement could be based on actual needs.

xviii.) **Chemicals for State/ UT, district and sub-divisional/ block laboratories:** The suggestive list of chemicals for State/ UT, District and Sub-divisional/ block level laboratories is provided at **Annex-X**. Any additional chemicals if required may also be procured. This may vary with the routine parameters that are intended for testing. Subsequent procurement could be based on actual needs. Laboratories are to have at least 3 months back up of chemicals. Also States/ UTs are to ensure that only Analytical Reagent (AR)/ Guaranteed Reagent (GR) grade chemicals are used for water quality testing. It is also suggested that each laboratory may keep sufficient stock of disinfectants like bleaching powder, Potassium permanganate and un-hydrated lime with adequate precautions so that these can be used by the trained laboratory professionals for disinfection purpose. Chemicals used for Field Test Kit shall invariably include date of manufacture, batch number and expiry date. State/ UT is also requested to refer 'Standard methods for the examination of water and waste water', 23rd edition, published by APHA (American Public Health Association).

6.3 Water quality analysis requirements

6.3.1 Methodology for sampling

There are many important factors for accurate analysis of a sample. These include:

i.) proper collection of the samples;

ii.) transportation;

iii.) storage and procedures for microbial and chemical analysis; and

iv.) data analysis and interpretation.

The general precautions in the Bureau of Indian Standards, i.e., IS-3025/1622 and/ or 'Standard methods for the examination of water & wastewater'- latest edition [published jointly by American Public Health Association (APHA), and American Society for Testing and Materials (ASTM)] may be referred to for detailed information on sampling and testing procedures. The sampling containers recommended in Indian Standards need to be used for collection. The recommended ones are glass or poly-ethylene plastic containers. Nowadays, air tight glass vials are also available in the market and that can also be used for obtaining/ transfer of samples.

The Department of Drinking Water and Sanitation, Ministry of Jal Shakti, Government of India has introduced the concept of a pre-planned roster of sources to be sampled for water quality testing every month. The roster is to be generated based on the data of drinking water sources uploaded by the States/ UTs on JJM IMIS. The objective is to ensure temporal and spatial random sampling and testing of all sources evenly spread geographically. The sources/ sampling points are to be selected on JJM IMIS based on the monthly target of the district drinking water quality testing laboratories, i.e., 250 number of sources/ delivery points per month, out of which 75% sources/ delivery points to be generated from the roster while the remaining 25% to be selected by the States/ UTs based on local environmental conditions.

6.3.2 General guidelines/ precautions for collecting/ handling of drinking water samples

The general guidelines and precautions for drinking water sampling are as follow:

I.) all sources/ delivery points selected for sampling and analysis to be linked to scheme ID in the JJM IMIS;

ii.) collect a sample that conforms to the requirement of the sampling programmes and handle it carefully so that it does not deteriorate or get contaminated during its collection, preservation and transportation to the laboratory;

iii.) before filling up the container, rinse it two or three times with the water being collected for physical and chemical examination; do not rinse for microbiological examination;

iv.) while collecting a sample from the distribution system, flush lines adequately, taking into consideration the diameter and length of the pipe to be flushed and the velocity of flow;

v.) collect samples from tube-wells only after sufficient pumping (purging) to ensure that the sample represents the groundwater source;

vi.) when samples are to be collected from a river or stream, analytical results may vary with depth, flow, distance from the banks. In surface water bodies, water samples may preferably be collected at 0.2 times the depth of the water body from the surface water level;

vii.) once the sample is collected, login into WQMIS and choose the laboratory where the sample needs to test as per the roaster and generate the automated reference number which will be used as the label. Labelling is an important part of the sampling programme;

viii.) the State/ UT may undertake a one-time survey for recording GPS coordinates of drinking water sources through a suitable agency;

ix.) all samples collected in specified sampling containers/ bottles are to be transported in proper 'ice box' within 24 hours to the chosen water quality testing laboratory.

6.3.3 Collection of water samples

6.3.3.1 Departmental samples

For collecting and bringing water samples to the laboratory, the laboratory staff may either be provided with a departmental vehicle or a suitable hired vehicle. The task-based Field Assistant may be given suitable remuneration per sample collected from the source. The methods for sampling water should adhere to the Product Manual for Drinking Water according to IS 10500:2012 (released in October 2020). The sampling containers recommended are either glass or polyethylene plastic containers. Nowadays, airtight glass vials are also available in the market, and they can also be used for obtaining/ transferring samples.

6.3.3.2 Water samples from public

At present, the water quality tests are carried out by the PHE/ RWS Department at delivery points or drinking water sources or pre/ post-treated water from the water treatment plant but not at the point of use or consumption. Also, so far, consumers had few options for getting their water tested through laboratories or FTKs. Many households, lacking trust in the quality of water supplied, install a point-of-use treatment unit, incurring additional expenditure. Even after installing such household water treatment plants, people cannot ascertain whether the treated water from such plants is potable.

While NJJM is in the process of providing safe water to all rural households, focus on assuring the safe water supply is required from the public health perspective, which will go a long way in preventing water-borne diseases and promote a healthy environment. To improve the ease of living and to empower individuals, there should be an easy and quick means for the general public to test the water quality at affordable price. To achieve this, it is necessary to make all water quality laboratories operated/ engaged by the Public Health Engineering/ Rural Water Supply Department accessible to rural households and all other concerned stakeholders for testing the supplied water. The test results of the samples must be communicated in a seamless way to all stakeholders for follow-up action/ analysis for building trust in the public water supply. By making the quality of piped water known to the public, there will be increased accountability of the supplier for providing safe drinking water. The public can create an account in WQMIS portal and can choose a laboratory to test the water sample for the desired parameters.

6.3.3.3 Centralized supply chain

i.) The States/UTs should put in place a robust supply chain, preferably with an online inventory management system. They should plan requisition/ procurement information of chemicals, instruments, glassware etc. to ensure uninterrupted supply chain management;

ii.) The State Governments/ UT Administration can also use the Government e-marketplace Portal (GEM) for procurement of instruments, glassware, etc.

iii.) The centralised State-level agency should procure all reagents. Reagents and consumables should meet the technical specifications including the technology, sensitivity and specificity criteria, etc.;

iv.) The vendors or authorised channel partner(s) of the vendors should deliver the reagents and consumables directly to the districts. But the billing should be done by the primary vendors, and the payments should be made to their accounts only. All payments should be made online through PFMS only;

v.) Central district stores must have the requisite infrastructure for receiving the supply from the vendors; and

vi.) The States/ UTs must ensure that water quality testing is not interrupted because of non-availability of consumables.

6.3.4 Quantity of sample to be collected

Samples for chemical and microbiological analysis are to be collected separately as the two tests follow different methods of sampling and preservation[23]. The interval between collection and analysis of a sample must be the shortest possible. However, the holding time of the samples and their preservation varies from parameter to parameter. The non-conservative parameters which change rapidly with time and cannot be stabilized (e.g: pH, conductivity, turbidity, residual chlorine, temperature, etc.) are to be measured immediately in the field after sampling.

Sampling may be done by the field assistants. If they are not available, staff working in district/ sub-divisional/ block laboratory should identify VWSC member/ students and train them in the sampling procedures for different types of parameters (chemical and microbiological). After training, they may be allocated cluster of GPs for collecting the samples in a planned manner. Laboratory staff should also ensure that the sample collectors are provided with polyethene bottles/ amber-coloured glass bottles and sterilized borosilicate glass bottles (BOD bottles), icebox and necessary chemicals for preservation of the samples. The sample collector should take the signature of water supply operator/ GP member or any household member to verify their presence during the sample collection. Alternatively, the rural water supply departments may use advance technological intervention like geo-fencing/ geo-tagging of sources to be sampled.

Quantity of sample to be collected

S. No.	Analysis type	Quantity
1.	Physical and Chemical Analysis	1,000 ml (non-acidified)
2.	Microbiological Analysis	250 ml in pre-sterilized glass bottles
3.	Metals Analysis	1,000 ml (acidified)

[23] As per Indian Standards IS 3025: 1987 (Part I)

6.3.5 Analytical quality assurance and quality control

In the context of analytical work, the terms quality assurance and quality control are often treated as synonymous. In fact, they are different concepts. Analytical quality control is the generation of data for the purpose of assessing and monitoring how good an analytical method is and how well it is operating. This is normally described in terms of within-day and day to day precision.

By contrast, analytical quality assurance comprises following all technical recommendations to ensure the laboratory is producing valid results. Quality assurance thus encompasses analytical quality control but also includes many other aspects such as proving that the individuals who carried out the analysis were competent to do so, and ensuring that the laboratory has established and documented analytical methods, equipment calibration, procedures, management lines of responsibility, a system for data retrieval, sample handling procedures and so on. A checklist for effective analytical quality assurance/ sample inspection report is given in figure 2 above. Each item on the checklist is scored with either 'Yes' or 'No'. If the answer is 'No' for any of the checklist items, necessary improvements are required.

Analytical quality assurance and quality control/ model inspection reporting format

Do laboratory personnel have
- clearly defined responsibilities?
- qualifications?
- experience?
- training?

Is space
- adequate for the types and number of analyses being undertaken?

Is equipment
- adequate?
- regularly serviced and maintained?
- calibrated and used only by authorized personnel?

Are materials
- bought from a reliable supplier, who carries out quality control?

Are there proper facilities
- for the receipt and storage of samples and systems for coding and identifying them?

Is data
- archived?
- retrievable?

Are methods
- validated?
- documented?
- monitored?

Is safety assured by
- adequate working and waste disposal procedures?
- training of staff?
- proper maintenance of equipment?
- proper supervision of staff?

6.3.6 Water quality testing using Field Test Kit (FTK) at Gram Panchayat/ village level

The Field Test Kits (FTKs) used for examining physio-chemical contamination in water not only serve the purpose of the initial screening of contamination but are also effective in generating community awareness about drinking water quality.

The kits are used at the grassroot level, i.e., Gram Panchayats/ Village Water & Sanitation Committees, for indicative test results. Water quality testing laboratories may also use the same for primary investigation. The kit is used in conjunction with tablet/ reagents and colour charts to test different parameters. The kits are portable, easy to carry, easy to use and do not require any kind of energy or power. Kits are available for testing the parameters listed below:

i.) Turbidity by visual comparison method

ii.) pH by pH strips colour comparison method

iii.) Total Hardness by Titrimetric method

iv.) Total Alkalinity by Titrimetric method

v.) Chloride by Titrimetric method

vi.) Ammonia by visual comparison method (Optional)

vii.) Phosphate by visual comparison method (Optional)

viii.) Residual Chlorine by visual colour comparison method

ix.) Iron by visual colour comparison method

x.) Nitrate by visual colour comparison method

xi.) Arsenic (by separate Arsenic kit)

xii.) Fluoride by visual colour comparison method

xiii.) Bacteriological vials (Presence/ Absence) water test kit (H_2S vial test)

A separate Arsenic field test kit is also available in the market, which can be used in the States/ UTs where Arsenic is detected in drinking water sources. Gram Panchayats and/ or their sub-committee, i.e., VWSC/ Pani Samiti/ User Group, etc., must ensure to test 100% drinking water sources, including private sources, and water supply at schools, anganwadi centres under their jurisdiction using FTK at least once in a month. The monthly test results are uploaded on the WQMIS portal.

6.3.7 Sanitary inspection

A sanitary inspection is an on-site inspection of a water supply facility to identify actual and potential sources of microbiological contamination for evaluation of the functionality and operation of the system and external environmental factors (such as toilet location). Sanitary inspections of water supply facility should be carried out from time to time by community as well as by the concerned laboratory officials. The sanitary inspection forms are given in Annex-XI. These forms consist of a set of questions which have 'yes' or 'no' answers. The questions are structured so that the 'yes' answers indicate that there is the risk of contamination, and 'no' answers indicate that the particular risk is absent. Each 'yes' answer scores one point and each 'no' answer scores zero points. At the end of the inspection, the points are added up, and the higher the total of identified risks, the greater the risk of contamination.

Risk assessment and sanitary inspections have to be carried out monthly, and the results of sanitary inspections and the recommended remedial actions must be reported. All the sanitary inspections done by the community can then be sent to the block/ sub-divisional/ district/ State/ UT level laboratory, which should also undertake a minimum of two sanitary inspections in a year along with microbial water quality monitoring to check the reliability of the information. In Japanese Encephalitis/ Acute Encephalitis Syndrome (JE/ AES) and Acute Diarrheal

Diseases (ADD) affected districts, the sanitary inspection must be undertaken twice in a year, especially during the monsoon and post-monsoon seasons. Strict surveillance and remedial action by the water supply agency is also mandatory during this period.

6.4 IEC and training activities

States/ UTs are to engage appropriate agencies to carry out IEC activities for creating awareness about water quality among the public. The States/ UTs to get the Information, Education and Communication (IEC) plan prepared (materials for TV, radio, newspaper advertisements, banners, handouts etc.) for enabling the public to get their water quality tested in the laboratories. Community members to be trained on risk assessment of water supply, sanitary inspection, proper handling and safe storage of water, etc. Key behaviours may be targeting using customized social behavioural change campaigns. Also, States/ UTs are to prominently display standardized signages informing public about water quality parameters, list of water tests and water laboratory services to raise their awareness of water issues. In order to assure public about the quality of water supply, States/ UTs may consider digital displays indicating the quality parameters of raw water and supplied water.

Water quality training and recommended IEC activities:

i.) display contact details of the nearest water quality testing laboratory in prominent locations in every village/ block/ district;

ii.) water quality training of RWS/PHE department stakeholders, Gram Panchayat and/ or its sub-committee, i.e., VWSC/ Pani Samiti/ User Group, etc., ISAs, PRIs, village level technicians, etc.;

iii.) awareness generation on water quality issues, water-borne diseases and their health impacts;

iv.) developing water safety planning;

v.) behavioural change communication on 'strictly avoiding water from quality-affected source' and guiding them for remedial measures;

vi.) inter-personal communication (door to door contact) on the importance of safe drinking water in nutrition;

vii.) audio-visual publicity of ill effects of consuming contaminated water; the importance of sanitary inspection; the process of getting private water quality sources tested, etc.;

viii.) wall writings promoting tap water such as — 'Tap water is free from contamination', etc.;

ix.) promote consumption of tap water supply through slogans, group meetings, street play, etc.;

x.) sensitize public on water quality issues; display water maps in GP, block, district and State/ UT offices indicating groundwater quality at GP, block, district and State/ UT level;

xi.) in areas of Fluoride and Arsenic contamination, it is observed that lack of nutrition aggravates health impacts from the consumption of the contaminated water. Integrated approach with departments handling nutrition and health in rural areas to be explored and efforts to be made to raise awareness on contamination-wise Dos and Don'ts. IEC material in vernacular language to be prepared and disseminated.

Trainings for women at GP level

For women to efficiently carry out water quality testing and monitoring using FTK, they need training in the following:

i.) use of FTKs for water quality testing of chemical parameters;

ii.) use of FTKs for testing bacteriological contamination of drinking water;

iii.) hands-on training in uploading of FTK test results on WQMIS portal;

iv.) field level training in carrying out monitoring and surveillance activities;

v.) health effects of contaminated water and immediate home remedies for addressing them;

vi.) leadership, team work, community mobilizing, etc.

Further, to create a robust ecosystem of water quality, all key stakeholders, viz. GP members, block officials, district level officers, etc. are also to be trained and sensitized on WQMS. Active youth may also be identified and sensitized on the same. It is important to raise awareness and sensitize all stakeholders on water quality, especially making them realize that water quality issue is a health issue and thus needs to be addressed on priority.

Sector Partners, Key Resource Centres (KRCs), Implementation Support Agencies (ISAs), etc to be engaged for training and IEC activities. Further, the National Centre for Drinking Water, Sanitation and Quality (NCDWSQ) may also be approached for classroom trainings for different stakeholders, new and innovative technology, etc.

6.5 Recording and reporting of data

All drinking water quality testing laboratories in the State/ UT are to maintain proper records of all details related to stock of chemical/ consumables, instruments/ equipments, sampling, analysis etc. The instrument/ equipments are to be properly labelled. The following is the suggested process of recording and reporting of data:

Village level trainings on water quality testing using FTKs i.) the laboratories are to keep records of submitted samples and completed analysis in a manner that provides easy data retrieval ability. All laboratory data sheets are to be dated and signed by the concerned Chemist and the Head of the laboratory or his/ her designee. All data entries are to be done preferably at the respective laboratory level into the standardised formats of JJM-WQMIS;

ii.) the water analysis report for all drinking water sources to mention the acceptable and permissible limits of IS 10500:2012 for all basic water quality parameters along with actual observation of each physical/ chemical/ microbiological constituent;

iii.) through WQMIS, test reports are made accessible to the concerned official, i.e. Junior Engineer (JE), Assistant Engineer (AE), Assistant Executive Engineer (AEE)/ Sub-Divisional Engineer (SDE), Executive Engineer (EE), Superintending Engineer (SE), Director (WWSO)/ Chief Engineer/Engineer-in-Chief and to the concerned Gram Panchayat (GP) and/ or its sub-committee, i.e. VWSC/ Pani Samiti/ User Group, etc for taking up corrective action. The test results may also be displayed on GP notice board or at other suitable public place;

iv.) automated alerts are sent to Member Secretary, DWSM and would be enabled for VWSC chairperson, in case of samples that are found to have contamination beyond permissible limits;

v.) State/ UT laboratory to also consider undertaking regular technical evaluation/ checks/ audits of District/ sub-divisional/ block/ mobile laboratories. Example: quality of analysis, repeatability statistics, etc., to maintain a quality assurance oversight in the data as confidence in the quality of the data is key to the effectiveness and reputation of the water quality monitoring and surveillance systems;

vi.) State/ UT PHE/ RWS Departments to fix accountability to ensure correct entry of water quality data on JJM-WQMIS;

vii.) State/ UT may establish an inter-district cross verification system for checking the quality of laboratory functioning. DDWS, MoJS, GoI may also undertake random checks/ audits of laboratories/ cross-verification of test results/ 3rd party verification through National Centre for Drinking Water, Sanitation and Quality (NCDWSQ) or any other authorized agency/ KRC throughout the country, whenever felt necessary;

viii.) the State/ UT PHE/ RWS Department to have a grievance redressal system for facilitating the community to express their concerns on quality of water;

ix.) a citizen corner already exists in the website of the Ministry. Any complaint on drinking water quality in rural areas of the country can be posted for taking up corrective action by clicking the icon 'Public Grievances';

x.) State/ UT may take appropriate action to remove the data of duplicate sources;

xi.) sanitary inspection formats would also be made available on JJM-WQMIS;

xii.) at the village level, the VWSC is to maintain records on FTK testing, sanitary inspection details, stock keeping of the FTK/ reagents, grievances related to water quality, etc.

With the adoption of Water Quality Management Information System (WQMIS), States/ UTs are to use this portal for reporting all water quality test results. Further details on WQMIS are elaborated in the dedicated Chapter 9. The data uploaded in WQMIS, be it for samples obtained from individuals, FTK tests, or those collected by State/ UT level officials, will be integrated and uploaded in the system. All the samples collected by State/ UT officials have to be mandatorily geo-tagged for uploading in the system.

6.6 Safety measures to be followed in the laboratory

6.6.1 Safety measures while handling hazardous chemicals

I.) All containers must be clearly labelled and read before opening. If dispensing into another container, put label along with warning;

ii.) minimal stocks not exceeding 500 ml of corrosive or flammable solvents only may be kept in the workroom. The remaining be stored in in a safe place;

iii.) glacial acetic acid must be regarded as a flammable solvent;

iv.) ether and low boiling point flammable liquids must not be kept in the fridge;

v.) large containers of corrosive or flammable liquids should never be put on high shelves or where they can be knocked down or fall. Also, never put together/close by liquids that react violently;

vi.) never carry/ hold bottles by neck alone. Open bottles with care;

vii.) when diluting concentrated sulphuric acid or other strong acids, it should be added to water in a heat resistant vessel. Gloves and safety glasses should be used at such times;

viii.) paint circles on shelves for keeping bottles in the right places;

ix.) all hazardous chemicals should be kept in safe custody;

x.) States/ UTs, If they so desire, adopt good laboratory practices of using a dispenser for handling concentrated acid as a safety measure.

6.6.2 Safety measures for neutralizing spills of hazardous chemicals

i.) If the amount/ volume of spillage is small, dilute with water or detergent;

ii.) if the amount is large, protective aprons, rubber gloves and boots must be worn, and treatment carried out according to the wall chart showing how to manage chemical spillage;

iii.) hydrochloric acid and sulphuric acid can be neutralised with anhydrous sodium carbonate; shovel the neutralised solution into a plastic bucket, dilute with water and run to waste;

iv.) ammonia solution, ethanol, methanol and formalin are best treated by diluting with water, collecting and running to waste;

v.) windows must be opened;

vi.) Phenols must be diluted with tap water in 1:20 ratio before draining.

6.6.3 Safety measures for operating the equipment

I.) Only trained staff should operate the equipment;

ii.) operating instructions should be available for each instrument;

iii.) check the autoclave water level before loading;

iv.) in the case of fire, electrical equipment should immediately be switched off and disconnected;

v.) take care to avoid live wires;

vi.) when not in use, switch off and withdraw the plug from the socket;

vii.) avoid the use of multi-adaptors. If must, use the ones fitted with fuses;

viii.) phone numbers of persons/ organisations to be contacted during an emergency/ accident must be displayed prominently in the lab.

6.6.4 Using fire extinguishers

i.) Water extinguishers are suitable for fires involving ordinary combustible materials, e.g., wood, paper, textile, upholstery. Never use water for electrical wires or liquids on fire;

ii.) dry powder extinguishers or sand are suitable for liquids on fire, electrical fires and burning metals.

6.6.5 First Aid

i.) First aid chart should be prominently mounted on the laboratory wall;

ii.) first aid box must always be equipped and should be accessible to laboratory staff. An emergency eyewash bottle with a bottle of sterilized water should be readily available;

iii.) a universal poison antidote is useful. Activated aluminium oxide or a tin of evaporated milk should be readily available. A tin opener and some waterproof dressing material should also be readily available;

iv.) all employees in the laboratory must know the location of the first aid box.

6.6.6 Additional safety/ hygiene requirements

i.) Safety instructions and precautions to be followed in the laboratory must be prominently displayed inside the laboratory;

ii.) BIS specifications IS 10500:2012, Drinking Water Specification IS 3025, Method of Sampling & Test (Physical & Chemical) IS 1622, Methods of Sampling & Microbiological examination of water and APHA Manual should be made available in every laboratory. JJM support fund may be used for the procurement of these specifications;

iii.) the date of preparation of a reagent solution and the date of its expiry must be clearly written and labelled on its bottle;

iv.) under no circumstances the sanctity of a laboratory should be violated. Unauthorized persons should not enter the laboratory. Eating should not be allowed in a laboratory space meant for analysis;

v.) a clean and well-maintained toilet MUST be attached/ available in the laboratory premises with handwashing facility and soap;

vi.) all laboratories should have adequate water supply facilities with required pressure for safe operation;

vii.) facilities such as foot-operated eye shower, safety/ water shower, washbasins, foot-operated dust bins must be available;

viii.) a laboratory must have an AC fitted if it performs a significant number of tests. Or air conditioner/ heater/ humidifier may be provided to maintain specified temperature and relative humidity;

ix.) personal hygiene is a must for all staff of the laboratory, especially microbiologists. All laboratory staff should wear aprons/ caps/ gloves during the preparation of the solution and testing (requirement is parameter specific) and the same must be washed at regular intervals;

x.) drinking water samples should only be tested after proper calibration of the instruments.

6.7 Waste management

Wastewater from water quality testing laboratories is generally composed of organic and inorganic matter and a wide range of chemicals and heavy metals. It is also one of the most difficult wastewaters to treat. If a chemical waste cannot be transported safely without treatment, it needs to be treated at its present site. If the chemical waste originates in a laboratory, it should be treated there.

In some cases, on-site treatment is performed under special permits issued by the regulatory agency. A good safety programme requires constant care in the disposal of laboratory waste. Corrosive materials should never be poured down in a sink or drain. These substances can corrode the drainpipe and/ or trap. Corrosive acids should be poured down in corrosion-resistant sinks and sewers using large quantities of water to dilute and flush the acid. Hazardous chemicals/ substances must be disposed of by methods that comply with local environmental regulations. Check/ confirm the local requirements before disposal. Laboratories should maintain a comprehensive list of wastewater discharges, details of sources and locations of the discharges, analytical or other data characterizing the nature and volume of the discharge.

After careful consideration, management can determine the acceptable limits of drain disposal of non-hazardous substances. USEPA, 2000 provides the following general guidelines:

i.) Use drain disposal only if the drain system flows to a wastewater treatment plant and not into a septic tank system or a stormwater sewer system that potentially flows directly into surface water;

ii.) Make sure that the substances being disposed of are compatible with each other and with the piping system;

iii.) Discharge only those compounds that are soluble in water (such as aqueous solutions), are readily biodegradable, are low in toxicity and contain no metals that can make the sludge toxic.

Laboratory wastewater neutralization before discharge is significant. Therefore, the discharge of weak corrosive solutions ($5.5<pH<12.0$) to the laboratory sinks in small quantities (less than one litre per hour) is permissible. Corrosive solutions with pH ranges ($2.0<pH<5.5$) and ($12.0<pH<12.5$) must be neutralized before sink/drain disposal. Corrosive solutions with pH ranges ($pH<2.0$) and ($pH>12.5$) at the conclusion of the laboratory process must be managed as hazardous waste. The coagulation-flocculation (CF) process is a versatile method used either alone or combined with biological treatment for removing suspended solids, organic matter as well as colour in wastewater. Likewise, coagulation followed by flocculation process is an effective way of removing high concentration of organic pollutants. Ozonation is a chemical process in which ozone is used to transform harmful chemicals into less harmful compounds. However, chlorination may also be adopted if the ozonation facility is not available. It has been used for disinfection, oxidation of inorganic and organic compounds, removal of odour, colour and particle. In this technology, the treatment is carried out in a batch process. First, pH is adjusted. It is followed by ferric sulphate dose, stirring time is 2 minutes at 500 rpm, and after settling of flocs, ozonation/ chlorination is carried out of clarified water for 1. Similarly, the microbial waste has to be autoclaved before discharge following the SoP referred to in clause 5.1.1.(vii).

At the village level, the waste generated from the FTKs, viz. broken/ unusable test tubes, etc. to be disposed off as per the solid liquid waste management guidelines. The reagents used for testing and the resulting solution may be diluted before being disposed off in any drain. The expired reagents, if any, are to be handed back to the designated laboratory.

6.8 Turnaround time

Timely availability of test results is the key for expeditious and comprehensive management of contaminated water sources. States/ UTs should measure and monitor turnaround time of test reports. For an accurate analysis of the turnaround time for laboratory services, the starting point should be the time of sample collection at the water quality laboratories where the tests are prescribed. The endpoint should be the printing of reports at the laboratories or receipt of electronic report at the laboratories (if printing facility is not available at the laboratories). It is recommended that the turnaround time for testing the chemical parameters should not exceed more than 24 hours, whereas for testing the biological parameters, the turnaround time should not exceed beyond 48 hours.

It is recommended that the State/ UT governments keep a close watch on the turnaround time for each kind of test at different levels of laboratories. The State/ UT governments should also do a root cause analysis for the delays and take necessary actions to plug the gaps.

The online application will also be used to monitor the turnaround time, which tracks the sample status almost instantaneously. For overcoming delays in the turnaround time, the State/ UT governments should ensure that the laboratories continually work on improving operational efficiency and monitor turnaround time at every level.

6.9 Tariff for testing water samples

JJM intends to create an inclusive and equitable water quality testing system where stakeholders can test their water samples at an affordable cost. An indicative list of cost for different water tests is as follows.

6.10 Rating of laboratories

The mission would undertake rating of the laboratories and award the best performing laboratories. The rating criteria is given in **Annex-XII.**

Suggestive Tariff for testing water quality parameters

(Amount in Rupees)

<table>
<tr><th>S. No.</th><th>Parameters</th><th>Individual Rates Recommended</th><th>Package Rates Recommended</th></tr>
<tr><td>1.</td><td>Odour</td><td>1</td><td rowspan="8">50</td></tr>
<tr><td>2.</td><td>Color</td><td>1</td></tr>
<tr><td>3.</td><td>pH</td><td>1</td></tr>
<tr><td>4.</td><td>Total dissolved solids</td><td>1</td></tr>
<tr><td>5.</td><td>Turbidity</td><td>5</td></tr>
<tr><td>6.</td><td>Total alkalinity</td><td>20</td></tr>
<tr><td>7.</td><td>Total hardness</td><td>20</td></tr>
<tr><td>8.</td><td>Residual Chlorine</td><td>1</td></tr>
<tr><td>9.</td><td>Chloride</td><td>50</td><td>50</td></tr>
<tr><td>10.</td><td>Sulphate</td><td>50</td><td>50</td></tr>
<tr><td>11.</td><td>Iron</td><td>50</td><td>50</td></tr>
<tr><td>12.</td><td>Total Arsenic</td><td>100</td><td>100</td></tr>
<tr><td>13.</td><td>Fluoride</td><td>50</td><td>50</td></tr>
<tr><td>14.</td><td>Nitrate</td><td>50</td><td>50</td></tr>
<tr><td>15.</td><td>Total coliform bacteria</td><td>100</td><td>100</td></tr>
<tr><td>16.</td><td>E. coli or thermotolerant coliform bacteria</td><td>100</td><td>100</td></tr>
</table>

7. Laboratory gap assessment and improvement plan

The laboratory gap assessment and improvement plan[24] is an important tool that helps analyze the water quality testing laboratories at various levels on different aspects. The laboratories are to be assessed for following aspects:

1. Human resources and training
2. Physical infrastructure including laboratory accommodation and environment.
3. Process infrastructure including instruments, equipments and their calibration status and AMC; chemicals and glasswares; standards and relevant aspects.
4. Documentation including availability of procedures; raw data maintenance; documents and records.

7.1 Assessment - Human resources and training

7.1.1 Status of availability of laboratory staff at different levels

7.1.1.1 Availability of staff at different levels along with their qualification and experience

HR position	No. of HR required	Name of staff	Qualification	Experience	Status (regular/ contractual)
I. State/ UT level/ regional level					
Chief Chemist/ Chief Water Analyst	01				
Senior Chemist/ Senior Water Analyst/ Senior Microbiologist	01				
Chemist/ Water Analyst	02				
Microbiologist/ bacteriologist	01				
Laboratory Assistant	03				
Data Entry Operator	02				
Lab Attendant	02				
Field Assistant (task/ need based)	02				

[24] These plans were made by the Shriram Institute for Industrial Research for the State of Chhattisgarh, supported by UNICEF. These plans are just for reference and State/ UT may formulate its own format based on the requirement for baseline assessment.

HR position	No. of HR required	Name of staff	Qualifica-tion	Experience	Status (regular/ contractual)
II. District level Note: each sub-division/ block to have a separate sheet					
Chemist/ Water Analyst	01				
Microbiologist/ Bacteriologist	01				
Laboratory Assistant	02				
Data Entry Operator	01				
Lab Attendant	01				
Field Assistant (task/ need based)	02				
III. Sub-divisional/ block level Note: each sub-division/ block to have a separate sheet					
Junior Chemist	01				
Junior Microbiologist	01				
Laboratory Assistant	01				
Data Entry Operator	01				
Lab Attendant	01				
Field Assistant (task/ need based)	01				
IV. Mobile laboratories Note: each sub-division/ block to have a separate sheet					
Junior Chemist/ Microbiologist	01				
Field Assistant (task/ need based)	01				
Driver	01				

The assessment to also cover laboratory-wise comments/ remarks on the availability, qualification and experience of the staff.

7.1.1.2 Laboratory-wise matrix of the availability of qualified and experienced HR

Many States/ UTs are currently employing staff from different backgrounds in the laboratories. The States/ UTs are to conduct a detailed assessment and fill all the roles as per the educational qualification requirement mentioned in the framework. The analysis matrix of available HR is used to indicate if the staff member is hired on a Regular (R)/ Temporary (T) role. The example shows use of existing Hand Pump Technicians (HPT) hired by PHED as Field Assistants (FAs). The analysis matrix is to be done for all levels of laboratories. The highlighted area in the table points the requirement for immediate intervention and hiring of staff.

Analysis of available HR for district level laboratories

S. No.	District name	Chemist	Microbiologist	LA	DEO	LAT	FA
1.	District – 1	1-R	X	2-T	X	X	HPT
2.	District – 2	1-R	X	X	X	X	HPT
3.	District – 3	1-R	X	2-R	X	1-R	HPT
4.		X	X	1-T	X	X	HPT
5.		X	X	1-R	X	X	HPT
6.		1-T	X	1-T	X	X	HPT

Table is shown as an example. Actual data to be reflected here based on field assessment.

7.1.2 Assessment: Training of staff

The States/ UTs are to conduct a detailed assessment of the current capacities of the laboratory staff at all levels. This format helps capture their previous training and form a base for future training needs assessment. The highlighted area in the table points to the requirement of intervention and need for immediate capacity building of the staff.

Status of training at district water quality laboratories

S. No.	District name	Chemist	Microbiologist	LA	FA
1.	District – 1	No Training	NA	No Training	
2.	District – 2	Yes (One training)	NA	NA	
3.		Yes (Six Trainings)	NA	Yes (both LA obtained Two Trainings each)	
4.		NA	NA	No Training	

Table is shown as an example. Actual data to be reflected here based on field assessment.

7.2 Assessment - Physical infra-structure (accommodation and laboratory environment)

Based on the layout provided in the WQMS framework as well as field requirement or as prescribed by the State/ UT.

7.2.1 Design of State/ district/ sub-division level laboratory prepared by State

The State/ UT's respective layout of State/ UT/ district/ sub-division water quality laboratory is to be referred. A reference is at Annex-V. The assessment of current laboratory design/ space is to be undertaken in reference to the prescribed layout. The following table will help assess the gaps in laboratory space and design at different levels, thus highlighting the requirement for immediate intervention.

Laboratory design at different levels

Area plan as per PHED layout	Actual area		Suggestions
	sq.m	sq.ft	
Main Lab			to be divided into • sample keeping area • wet chemical (titration/ preparation) • digestion with fuming hood
Bacteriological Lab			to be divided into • laminar flow region • placement of incubators/ equipment
Chemist Room			seating for • chemist • a/chemist & lab. assistant
A/ Chemist Room			to be used as • instrument room • documentation centre
Chemical Store			to be used as store for • chemicals • glasswares • tested samples for disposal
Total			-

As per WQMS framework, the suggestive space requirement for DWQL is as follows:

S. No.	Space	Suggested Area
1.	Space for Analysis (in m^2)	60 m^2 (including 20 m^2 for microbiological testing)
2.	Space for storage	25 m^2
3.	Space for office and library	15 m^2
	Total Space Requirement	**100 m^2 (1076 ft^2)**

Based on the above requirement, the laboratory space requirement may be analyzed for different laboratories as under:

Assessment of laboratory space requirement at different levels

S. No.	District name	Space for analysis		Space for storage		Space for office and library		Total space for laboratory	
		Actual Space	Shortfall	Actual Space	Shortfall	Actual Space	Shortfall	Actual Space	Shortfall

Example shown for district level laboratories. Same exercise is to be conducted for all levels.

7.2.2 Laboratory environment

The Laboratory environment and safety plays vital role towards effective operation of laboratory. There are many components of laboratory environment such as maintenance of optimum temperature and humidity in addition to ensure proper air exchanges and venting of fumes being generated during the process of digestion, distillation, or any other reaction. Laboratory shall have adequate supply of water to carry out various processes. The essential physical requirements for laboratory environment and safety are adequate ventilation, availability of fuming hoods and exhaust fans, adequate water supply, availability of fire extinguishers etc. in addition to many other requirements.

The status of these essential requirements, as observed during the assessment of is illustrated below:

Essential requirements of laboratory

S. No.	District	Ventilation	Fuming hood	Water supply	Exhaust fan	Fire extinguisher
1.		Adequate	Available	Adequate	Not Available	Available
2.		Inadequate	Not Available	Inadequate	Not Available	Not Available
3.		Adequate	Not Available	Adequate	Not Available	Available
4.		Inadequate	Not Available	Inadequate	Not Available	Not Available

Table is shown as an example. Actual data to be reflected here based on field assessment.

7.3 Assessment - Equipment and instrumentation

Water testing laboratory to be well equipped with instruments required for analysis of essential tests. In addition, it is also desirable that laboratory be equipped with advanced instruments with respect to State/ UT specific contaminants/ newly emerging contaminants.

7.3.1 Status of equipment/ instruments in district water quality laboratories

The status of equipment/ instruments availability is illustrated in following tables.

Status of the availability of equipment/ instruments

District name	pH meter	EC meter	Nephalometer	UV-Vis Spectrophotometer	D/ Balance	Oven
	√	√	√	√	√	√
	√(NF)	√	√	X	√	X
	√	√	√	√(NF)	√	√
	√(NI)	√(NI)	X	√(NI)	√(NI)	√(NI)
	√(NI)	√(NI)	√	X	√(NI)	√(NI)
NI: Not Installed/ Not in Use; NF: Not Functioning/ Breakdown						

The table is shown as an example. This exercise is to be undertaken for laboratories at all levels.

Status of the availability of equipment/ instruments

District name	Ion Meter	Volumetric Analysis	Double Distillation	Arsenic Testing	Bacteriological Incubators	Autoclave	UV Laminar Flow
	√	√	√	X	√	√	√
	X	√	Single	X	X	X	X
	√	√	Single	X	√	√	√
	X	X	Single (NI)	X	√(NI)	√(NI)	√(NI)
	√(NI)	X	Single (NI)	X	√(NI)	√(NI)	√(NI)
NI: Not Installed/ Not in Use; NF: Not Functioning/ Breakdown							

The table is shown as an example. This exercise is to be undertaken for laboratories at all levels.

Status of the availability of equipment/ instruments

DWQL	MF Assembly	PC-Colony Counter	Refrigerator	Advanced Instruments	
				AAS for Heavy Metals/ Uranium Testing	GC-MS/ HPLC/ GC for Pesticides residue testing
	√	√	√	X	X
	X	Microscope	√	X	X
	√(NI)	√(NI)	X	X	X
NI: Not Installed/ Not in Use; NF: Not Functioning/ Breakdown					

Tables are shown as an example. Actual data to be reflected here based on field assessment. This exercise is to be undertaken for laboratories at all levels.

7.3.2 Annual Maintenance Contract (AMC) mechanism for laboratories

The Annual Maintenance Contract (AMC) is one of the safeguard to ensure trouble-free operation of instruments/ equipment as preventive and corrective maintenance of instruments/ equipment is ensured through this mechanism.

Weightage assigned for AMC of equipment/ instruments

Equipment/ Instrument	AMC (Y/N)	Remarks
pH meter		
Conductivity meter		
Turbidimeter		
Hot air oven		
UV Laminar Air Flow		
UV-Visible Spectrophotometer		
Bacteriological Incubators		
Autoclave		
Refrigerator		
Digital Balance		
Atomic Absorption Spectrophotmeter		
GC-MS/ HPLC/ GC		

7.4 Laboratory-wise areas of concern

Note: Table is filled as an example. Actual data to be reflected here based on field assessment for all levels of laboratories.

Area of concern	Attention required	Laboratory
Shortage of Human Resources	In many districts, there is an acute shortage of laboratory staff. This is the area of immediate concern because other resources are becoming redundant due to non-availability of staff. DWQLs are not having Qualified, Experienced and Trained Microbiologist.	All Districts
Inadequacy of laboratory accommodation	Laboratory accommodation is not only inadequate but planning for placement of items is also unorganized in many districts. Due to this, the significant equipment in most of the laboratories are either not installed or not in use.	All Districts except ...
Improper laboratory environment	Laboratory environment comprising of maintaining ventilation, fumes control etc. is inadequate in most of the laboratories. There is no separation of acid usage/ digestion areas from the areas where instruments are kept. Even microbiological facilities are also placed in the same room at most of the places. Few laboratories are not even connected to water supplies.	All Districts except ...
Under-utilization of equipment/ instruments	Most of the laboratories are equipped with most of the essential equipment/ instruments including those required for microbiological testing. However, it has been noticed that the equipment is either not installed or are not in use in most of the laboratories due to one reason or other. Hence, costly resources of the laboratory are becoming redundant due to continuous under-utilization.	District names
Poor maintenance of instruments	Maintenance of equipment/ instruments in laboratory is not up-to-the mark. Even laboratories are not maintaining equipment history cards and logbooks. There is no system of preventive and corrective maintenance of instruments and there is no back-up support in this regard.	...
Improper Documentation	Almost all the laboratories are very poor in maintaining records, raw data books, calculation sheets, standardization records etc.	
Poor housekeeping	Mostly laboratories are operational in a very unsystematic manner. There is no system of keeping the samples and finally disposing these in an organized way.	
Data Quality	Data Quality including uncertainty analysis is a very significant aspect of decision-making process and hence this area needs considerable attention.	
No Proper Method	Most of the laboratories are neither having Standard Methods of Testing or Specifications of the Bureau of Indian Standard, nor the Standard Operating Procedures.	

Area of concern	Attention required	Laboratory
Use of Field Test Kits in laboratory	Most of laboratories are using FTKs in laboratory and not using the accurate laboratory testing methods. The accuracy and reliability of FTK is not being ascertained.	
Standardization and Calibration	Laboratories are not standardizing the standard normal solution for the purpose of titrations. Equipment/ instruments even the pH meter/ EC meters/ Balance are not being calibrated before use.	

7.5 Laboratory improvement plan

Keeping in view of the gap assessment, considerable attention is required to optimize the operation of laboratories in to strengthen the water safety planning.

Note: Actual data based on analysis of the laboratory assessment is to be reflected here. Improvement plans to be made for each laboratory post the gap assessment.

Improvement plan of water quality laboratory: __<name of laboratory>

HR and training

- i.) Requirement of qualified, experienced and trained staff
- ii.) training needs (external/ internal) of staff

Physical infrastructure

- i.) Requirement of physical space for analysis, storage, office and library
- ii.) Requirement for laboratory environment and safety
- iii.) Requirement for regular housekeeping & decongestion

Process infrastructure

- i.) Requirement for instruments, equipments and their calibration
- ii.) Requirement of chemicals and glassware
- iii.) AMC of all equipment/ instruments

Data & documentation

- i.) Record of laboratory-wise areas of concern
- ii.) develop work instruction manuals
- iii.) maintain calibration records & reviews

Immediate Interventions required in areas of <highlight areas>

8. NABL accreditation

Out of 2,011 laboratories in the States/ UTs, only about 50 of them were NABL accredited at the time of announcement of JJM. However, since the announcement of Jal Jeevan Mission, all laboratories are mandated to be accredited/ recognized by NABL and so far, 330 laboratories are NABL accredited/ recognized. The infrastructure and processes of water testing laboratories should comply with NABL standards and protocols.

The laboratory accreditation program in India was initially set-up by Department of Science & Technology, Government of India in 1982 with its name as 'National Coordination of Testing & Calibration Facilities (NCTCF)' for providing accreditation services to testing & calibration laboratories. Subsequently in 1993, NCTCF was renamed as 'National Accreditation Board for Testing and Calibration Laboratories (NABL)'.

Presently, NABL is a constituent Board of Quality Council of India (QCI), an Autonomous Body under the Department for Promotion of Industry and Internal Trade (DPIIT), Ministry of Commerce and Industry, Government of India. NABL is well recognized nationally and internationally. NABL accreditation is accepted by almost all Government departments/ regulators. Internationally, NABL is a full signatory of International Laboratory Accreditation Co-operation (ILAC) MRA.

NABL is a Mutual Recognition Arrangement (MRA) signatory to ILAC as well as Asia Pacific Accreditation Co-operation (APAC) for the accreditation of Testing and Calibration Laboratories (ISO/IEC 17025), Medical Testing Laboratories (ISO 15189), Proficiency Testing Providers (PTP) (ISO/IEC 17043) and Reference Material Producers (RMP). Such MRA reduces technical barriers to trade and facilitates acceptance of test/ calibration results between countries which MRA partners represent.

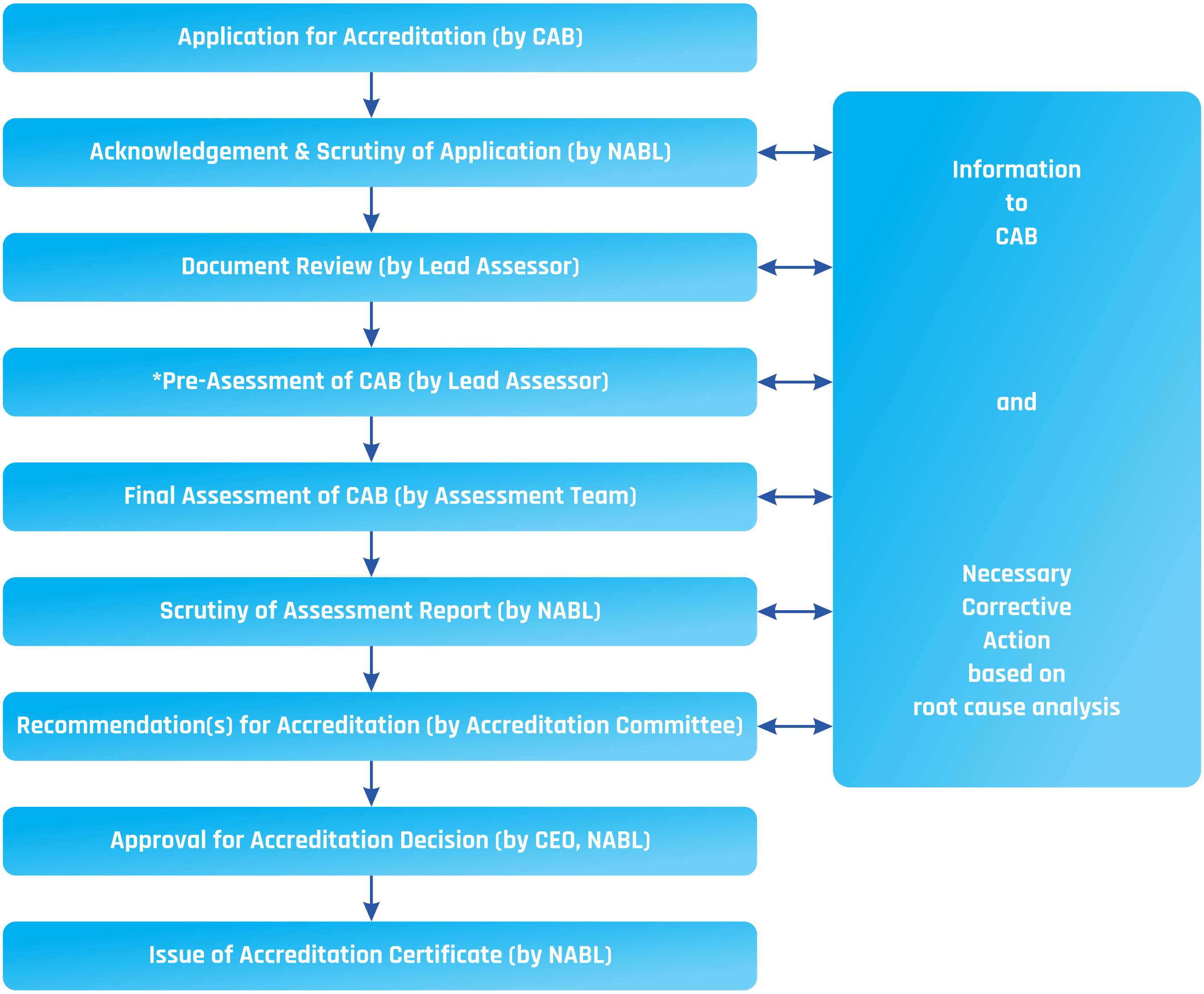
Accreditation process

Laboratories are required to apply through NABL Web Portal in prescribed application form along with prescribed application fee. The applicant laboratory (testing and calibration) should describe the management system in accordance with ISO/IEC 17025: 2017. It may be noted that laboratories at State/ UT/ district level apply for NABL accreditation and at block/ sub-division level for NABL recognition.

The acknowledgement with unique ID of the laboratory will be sent to laboratory and scrutiny of application for its completeness in all aspects will be done. NABL may ask for additional information/ clarification(s) at this stage, if found necessary.

The preliminary document review of the application and management system document/ quality manual submitted by the laboratory is carried out by NABL whereas the detailed review is carried out by Lead Assessor. The lead assessor informs the inadequacies in the document review, if any. The laboratory addresses the deficiencies in the application and makes changes in the management system document accordingly within seven days.

A pre-assessment (one day) of the laboratory is conducted by lead assessor appointed by NABL. Since Pre-assessment is optional, laboratory is required to express its willingness to undergo preassessment in writing within two days of completion of document review. The laboratory must ensure their preparedness by carrying out an internal audit and a management review before pre-assessment.



*** Optional for laboratories (Testing Calibration/ Medical Testing)**

The lead assessor submits a pre-assessment report to NABL and shares a copy of the non-conformities with the laboratory. The laboratory takes corrective actions on the non-conformities raised and submits a report to NABL within fifteen days. After the laboratory has taken satisfactory corrective actions based on root cause analysis, NABL proposes constitution of an assessment team. The date(s) for assessment are decided in agreement with the laboratory. The assessment team includes the lead assessor, the technical assessor(s)/ expert(s) in order to cover the scope for which the accreditation has been sought. The assessment is generally carried out for two days.

The assessment team verifies laboratory's documented management system and checks its compliance with the requirements of ISO/IEC 17025:2017 and other NABL policies. The documented Management system, SOPs, work instructions, test methods etc. are assessed for their suitability, implementation and effectiveness. The laboratory's technical competence to perform specific tasks is also evaluated.

The assessment report contains the test witness report, recommended scope of accreditation and remarks on the laboratory's compliance to ISO/IEC 17025: 2017 and relevant NABL policies. The non-conformities, if identified, are reported in the assessment report. It also provides a recommendation towards grant of accreditation or otherwise. The report prepared by the assessment team is sent to NABL. However, a copy of summary of assessment report and copies of non-conformities, are provided to the laboratory at the end of the assessment visit.

The assessment report is examined by NABL and follow up action, as required, is initiated. Laboratory has to take necessary corrective action on non - conformities/ concerns based on root cause analysis and submit a report along with evidence to NABL within 30 days. NABL monitors the progress of closure of non -conformities. After the submission of corrective action(s) by the laboratory, the assessment report along with corrective actions is reviewed by the Accreditation Committee. In case the Accreditation Committee finds deficiencies in the assessment report, NABL obtains clarification from the Lead Assessor/ Technical Assessor/ laboratory. In case everything is in order, the Accreditation Committee makes appropriate recommendations regarding accreditation of the laboratory to the CEO, NABL. Based on review of assessment report, accreditation committee may also make other recommendations (denial of accreditation, verification assessment etc.) to CEO, NABL.

CEO, NABL is the approving authority for all accreditation related decision making. When accreditation is granted to the laboratory, NABL issues an accreditation certificate which has a unique number, QR code, date of validity along with the scope of accreditation.

NABL has developed a Jal Prayogashaala Accreditation Portal (JPAP) for Government water testing laboratories under the Ministry of Jal Shakti, Government of India. This portal provides accreditation to government water testing laboratories as per ISO/ IEC 17025: 2017. On one hand, it will provide ease of access to members of public in applying online for testing routine water quality parameters such as pH, taste, colour, odour, turbidity, Calcium, Magnesium, total hardness, total alkalinity, Coliform, E.coli etc., on the other hand, the laboratories can opt for accreditation for more typical parameters as relevant for a region.

The aim is to help the laboratories, even at district and sub-district level in the country, to establish their competence at par with any laboratory at the national level. Government laboratories while applying for accreditation through this portal will have access to standard formats of test methods, certified reference materials, instruments etc. as relevant to each parameter. The accreditation will ensure seamless improvement in the resources and competence of the laboratories. Over time, it will help laboratories acquire greater efficiency and efficacy in analysing test results. It will also ensure drinking water supplied in every household in India is safe for consumption. The process will give laboratories a boost, and the public will have convenient access to accredited laboratories throughout the country. For the laboratories at sub-division/ block level, NABL has facility to accord recognition (not accreditation) to them after carrying out assessment through proficiency testing. This opportunity can be availed by the State Governments/ UT Administrations to get these laboratories recognised. It is pertinent to mention that there are 93 block level and 1,149 sub-division laboratories in the country.

The list of parameters for which NABL accreditation/ recognition is to be obtained is given below for various levels of laboratories:

List of water quality parameters for NABL accreditation

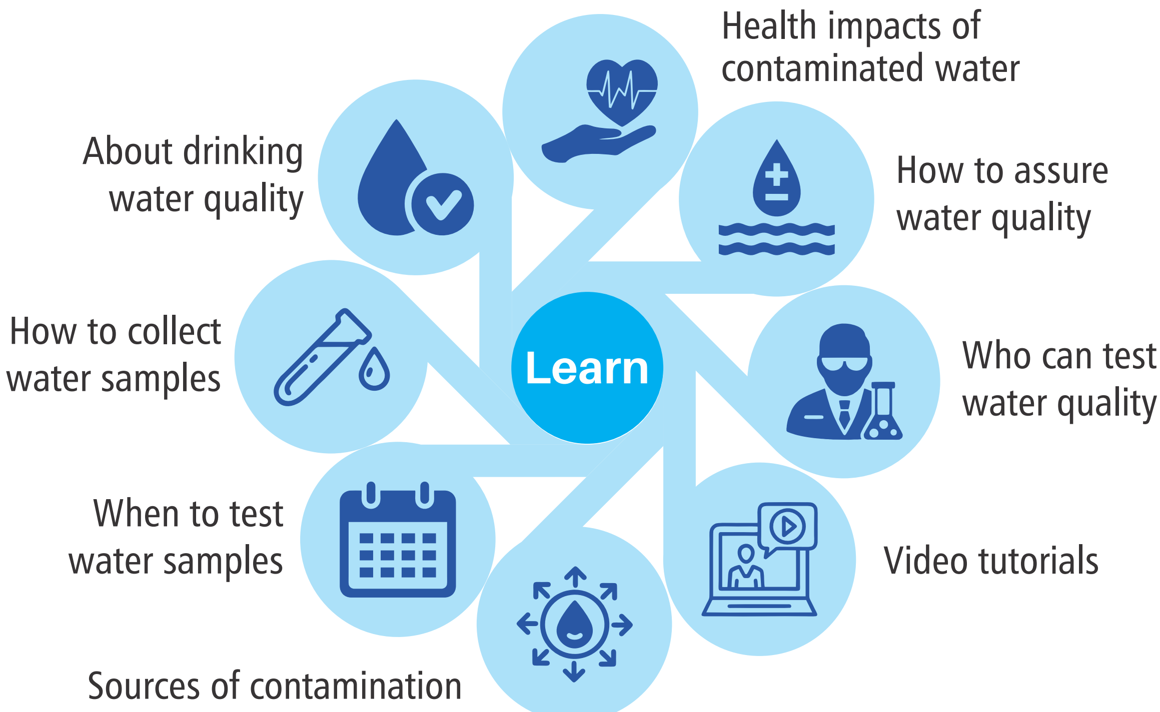
S. No.	Parameters	State/ UT	District	Block/ sub-division
1.	Color	All parameters from S. No 1 – 17 and gradually other parameters as per BIS: 10500 to be applied for NABL accreditation	All parameters to be applied for NABL accreditation	On the basis of proficiency testing, all parameters to be recognized by NABL
2.	Odour			
3.	Taste			
4.	PH value			
5.	Total dissolve solids			
6.	Turbidity			
7.	Chloride			
8.	Total Alkalinity			
9.	Total Hardness			
10.	Sulphate			Area specific
11.	Iron			Area specific
12.	Total Arsenic			Area specific
13.	Fluoride			Area specific
14.	Nitrate			Area specific
15.	Residual Chlorine			Not applicable
16.	Total Coliform bacteria			
17.	E. Coli or thermo tolerant coliform bacteria			
18.	Gradually for other parameters (Heavy Metals etc.) as per BIS;10500		Area specific	

9. Water Quality Management Information System (WQMIS)

The Indian Council of Medical Research (ICMR) has developed a robust online portal on CoVid-19 test monitoring information system with a clear data flow protocol. Using the system, CoVid-19 testing laboratories transfer the test results to the tested person, State/ UT and national databases and concerned local official for surveillance and record. Similarly, NJJM, in partnership with ICMR, has developed an online portal on Water Quality Information Management System (WQMIS).

The WQMIS is designed to capture water quality test results by individuals, Governmental agencies and FTK tests conducted by the village community. All these test results are integrated into the system and shared with the relevant authorities and stakeholders. The results are accessible online for data and trend analysis. It is useful as advance alerts for timely remedial action.

Jal Jeevan Mission - Water Quality Management Information System (WQMIS)



The benefits of WQMIS are as follows:

i.) access to nationwide data on quality of drinking water sources/ supply for each administrative unit. This can help in ensuring safe supply of drinking water for all;

ii.) initiate remedial action, if quality parameters of the samples tested are beyond prescribed values;

iii.) easy management of inventories, human resources and financial transaction of the laboratories;

iv.) online NABL accreditation;

v.) access of all stakeholders to the nearest laboratories through online mode.

The features of this portal are as follows:

i.) all the laboratories in the States/ UTs will be registered and mapped in the portal;

ii.) every State/ UT shall have a 'Super Admin' who will register all the laboratories (State/ District/ Block/ Sub-divisional/ Mobile level laboratories) and also nominates the in-charge for each laboratory registered;

iii.) one of the five women trained to perform the FTK test in every village is registered in the online portal by the block/ sub-divisional laboratory in-charge to upload the FTK test results;

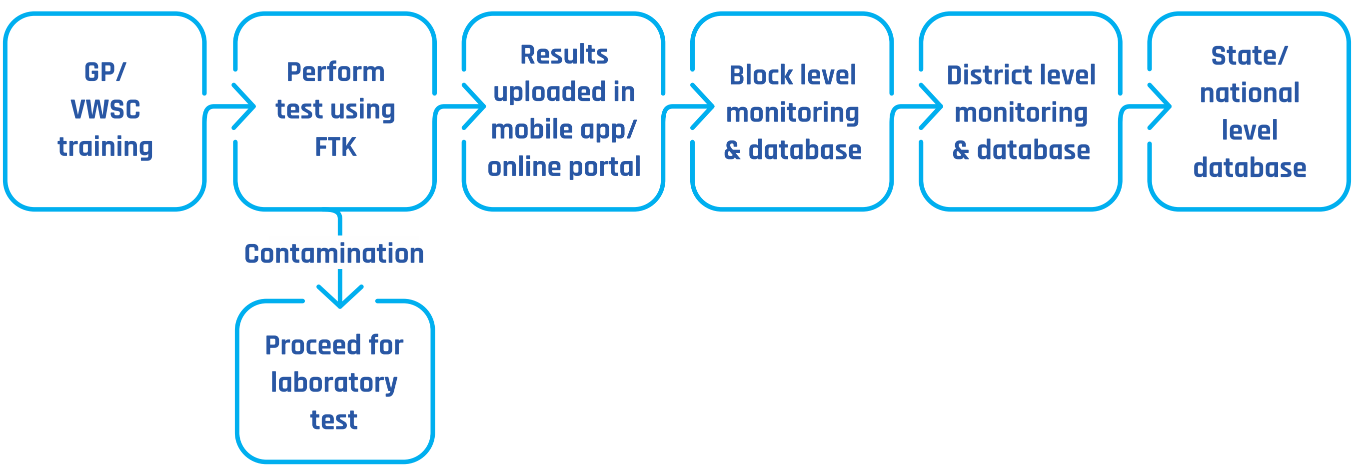
iv.) access to water sample test results and other details;

v.) access to laboratory inventory, human resources, and fees collected by each laboratory;

vi.) auto alerts to concerned State/ UT PHED official to initiate remedial action, in case water sample is tested positive for contamination;

vii.) auto alerts to district health officer for initiating public health risk assessment in case of repeated/ severe contamination of test samples, etc.

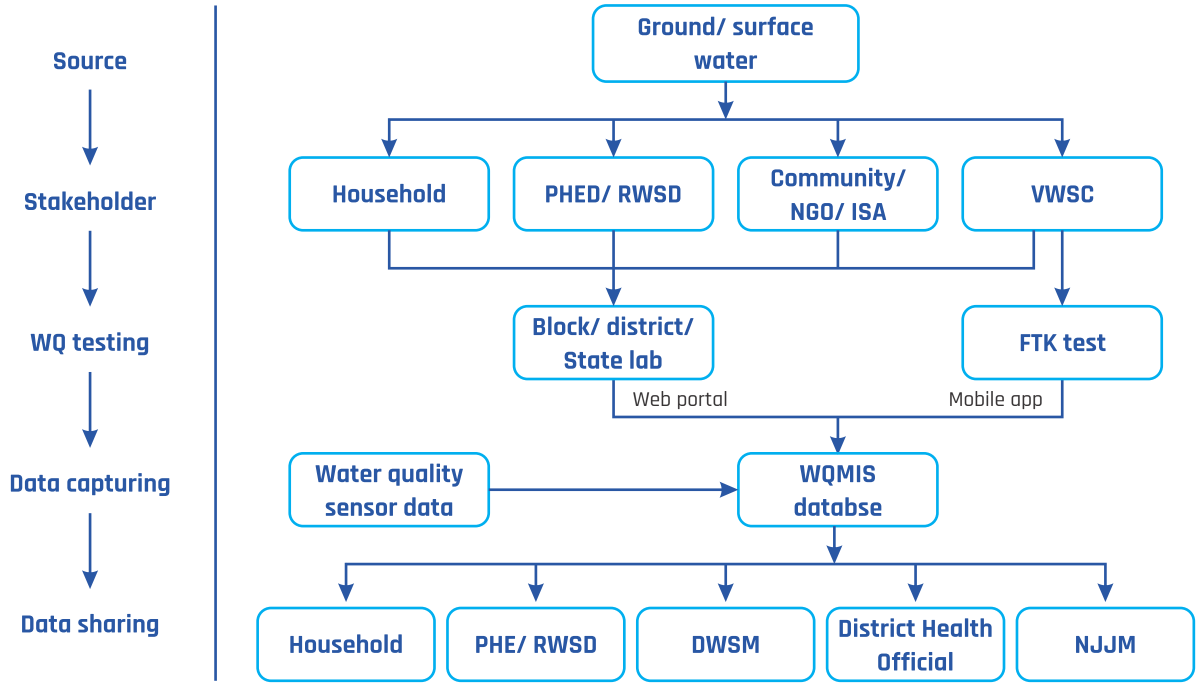
Workflow for FTK test



9.1 Data sharing and remedial action

Once WQMIS is integrated, it will generate a large volume of data on the quality of different drinking water sources. The FTK test data, water quality sensor data from the smart water supply system (if available) and water sample test results collected from different laboratories can be collated to derive a comprehensive picture of the quality of water sources. Also, if quality data of a particular sample shows significant contamination, an alert will be sent to the concerned district health official for immediate medical attention to the affected population as well as to the concerned Executive Engineer of the PHE department for identifying the source of contamination and timely remedial measures.

Data Sharing framework



The data sharing can help in taking the following actions:

I.) **Information action:** The laboratory in charge analyses the test results to map the source(s) of contamination. Information about the identified source(s) of contamination is then sent to all the stakeholders — consumers, PHED/ RWSD, DWSM, district health officer, and NJJM.

ii.) **Executive action:** Executive Engineer of a PHE or Rural Water Supply department is the person in charge of remedial action. The respective VWSC should undertake water quality surveillance activity of such contaminated water sources. If significant biological or chemical contamination is identified, the district health official should undertake a detailed environmental and epidemiological analysis and classify the risk accordingly for the initial remedial actions.

iii.) **Risk management:** To manage the risk emanating from water quality, classify the health risk with the assistance of the health department and take suitable remedial action or an alternate safe drinking water source. In case the contamination is caused by an individual or by an industrial body, etc., necessary administrative measures need to be taken as per applicable law to stop the contamination immediately. If community lifestyle habits cause contamination (leading to the spread of JE-AES), appropriate IEC activities must be taken up to raise their awareness.

9.2 Monitoring through WQMIS

9.2.1 National Jal Jeevan Mission

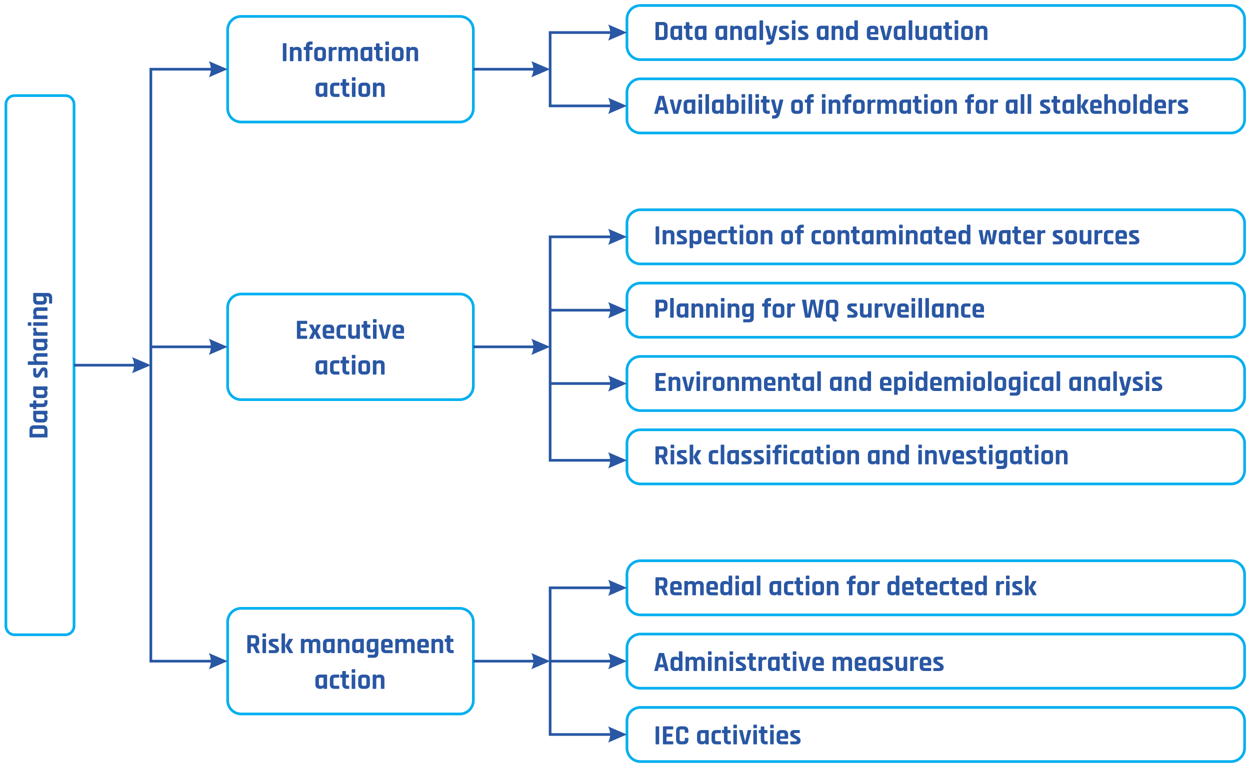
Under WQMIS, a centralised dashboard is created at the national level to monitor the workings of all the laboratories and to visualise data of their test results.

9.2.2 State/ UT level

The WQMIS dashboard for the Super Admin at a State/ UT level has the following features:

i.) list of water samples received and test done at all the laboratories;

Risk management framework



ii.) the status of the remedial action taken to provide safe drinking water;

iii.) a real-time map showing the status of potability of each water source in the State/ UT;

iv.) generation of daily, weekly, and monthly MIS data analytics and reports (in the form of statistical reports, charts and data summary visuals) for better monitoring and supervision;

v.) the operational status of every laboratory (working/ non-working/ condition of equipment/ quantity of reagents/ human resources);

vi.) status of NABL accreditation of the laboratories.

9.2.3 District level

The WQMIS dashboard for district Lab-in-charge has data for all the block and sub-divisional level laboratories. The WQMIS district-level dashboard has the following features:

i.) list of water samples received and tests done in each district/ block/sub-divisional laboratory as well as FTK/ H_2S test conducted at village level;

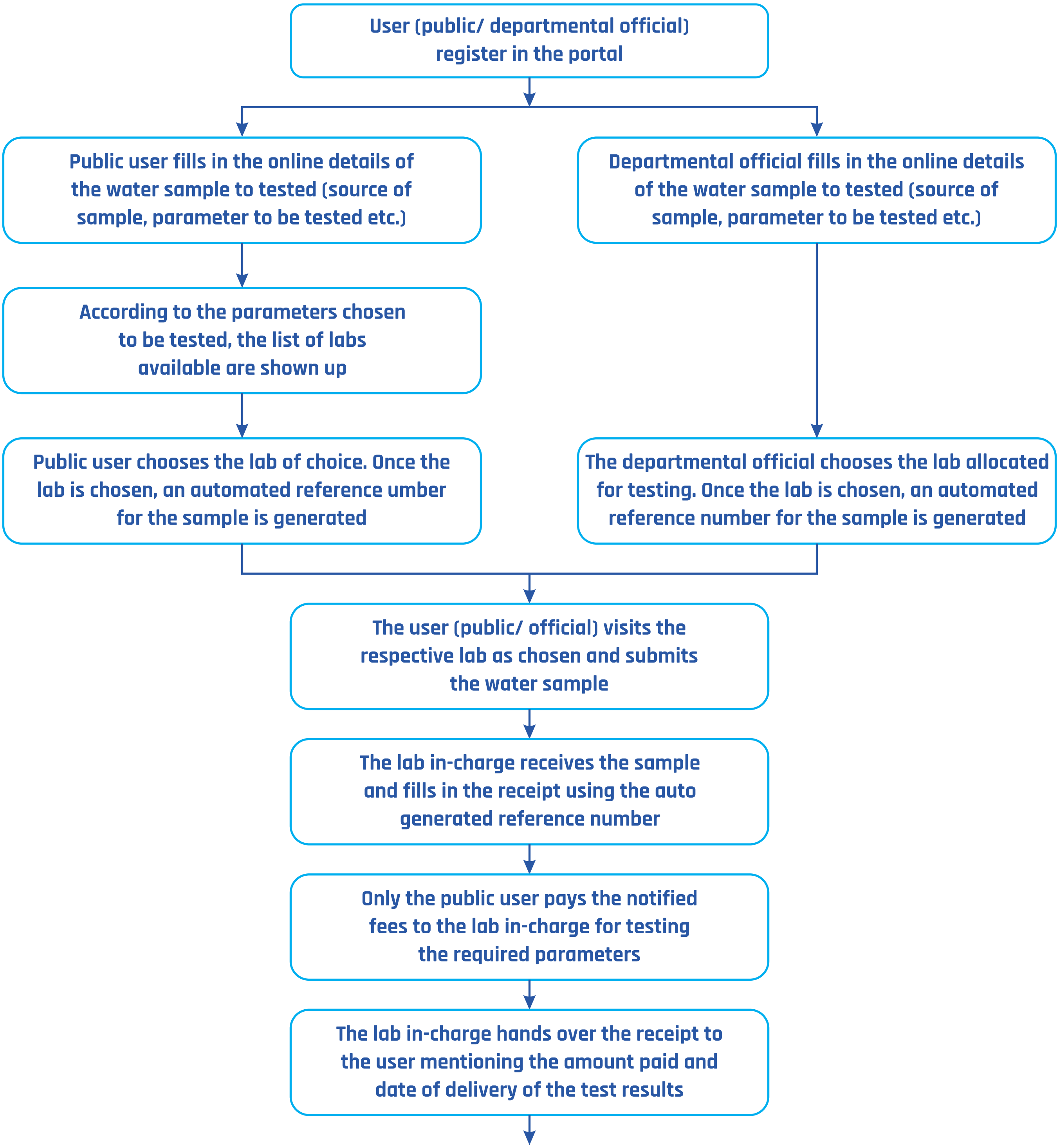
ii.) the status of the remedial actions taken to provide safe drinking water within a district jurisdiction;

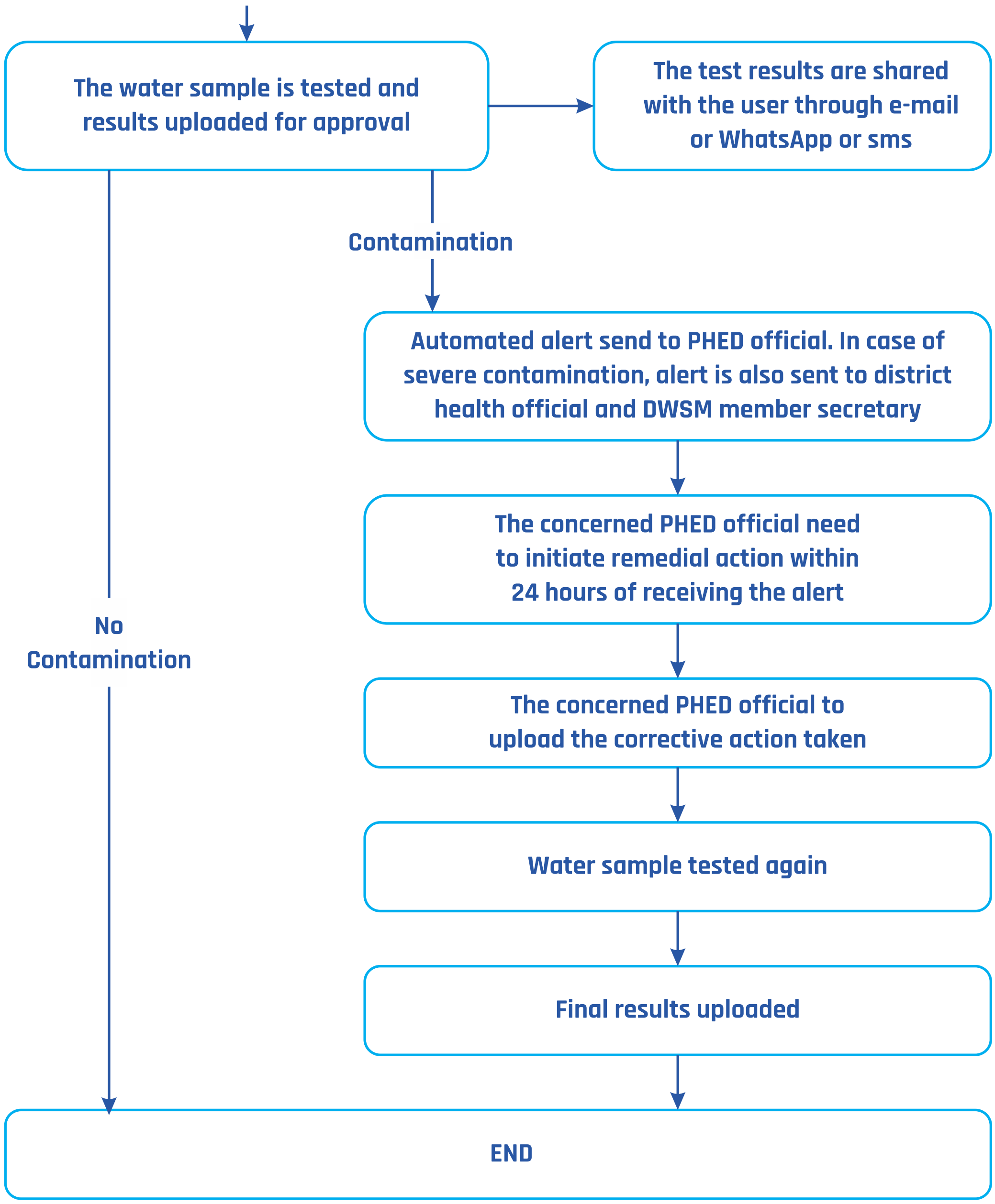
iii.) a real-time map showing the status of potability of each water source in the district;

iv.) the operational status of all block and sub-divisional laboratories (working/ non-working/ condition of equipment/ quantity of reagents/ human resources);

v.) status of NABL accreditation of laboratories under the district jurisdiction.

Workflow for laboratory testing




The water sample is tested and results uploaded for approval
The test results are shared with the user through e-mail or WhatsApp or sms
Contamination
Automated alert send to PHED official. In case of severe contamination, alert is also sent to district health official and DWSM member secretary
The concerned PHED official need to initiate remedial action within 24 hours of receiving the alert
The concerned PHED official to upload the corrective action taken
Water sample tested again
Final results uploaded
No Contamination
END

9.2.4 Block/ sub-divisional level

The WQMIS dashboard for the block/ sub-divisional level laboratories has the following features:

i.) list of water sample received and test done at each block/sub-divisional laboratory as well as FTK test conducted at village level;

ii.) the status of the remedial action taken to provide safe drinking water within the block jurisdiction;

iii.) a real-time map showing the status of potability of each water source in the block;

iv.) the operational status of all block/ sub-divisional laboratories (working/ non-working/ condition of equipment/ quantity of reagents/ human resources);

v.) status of FTK at each village within the block;

vi.) status of NABL accreditation of all the laboratories under the block jurisdiction.

9.2.5 Village level

The WQMIS dashboard for a VWSC or Pani Samiti has the following features:

i.) status of FTK testing in the village;

ii.) quality aspects of the drinking water sources;

iii.) number of samples tested from the village (both departmental and Public).

10. Financial planning and funding

Up to 2% of the total annual JJM allocation to the States/ UTs is meant for activities related to water quality monitoring and surveillance. The guidelines of the mission (Para 10.2 i.) to v.)), details the activities that can be funded for water quality monitoring and surveillance (WQMS). The same are reproduced below:

i.) up to 2% of the allocation to States/ UTs can be utilized for carrying out WQMS activities;

ii.) all the above activities shall have a funding pattern of 90:10 for NE and Himalayan States and 60:40 for remaining States. The fund sharing pattern for UTs shall be 100:0 between Centre and UT Administration in UTs without legislature and 90:10 for UTS with legislature;

iii.) the fund may be utilized for activities like setting up of new laboratory (building cost permitted only for State/ UT level laboratory), new district/ sub-divisional laboratories (building cost to be borne by the State Government/ UT Administration, rental charges could be booked under this fund), laboratories under PPP mode, upgrading of existing water quality testing laboratories which inter-alia include procurement of equipments, instruments, chemicals/ reagents , glassware, consumables, hiring of outsourced human resources (regular staff to be paid salaries by the State Government/ UT Administration), hiring of vehicles for transportation of water samples collected from the field to the laboratory and expenses incurred for NABL accreditation process (consultant fee, audit cost, application fee and annual fee).

iv.) these funds can also be used for procurement of FTKs, refills and bacterial detection kits;

v.) salary of regular staff and any services, expenditure incurred in excess of the 2% allocation will be met from fund of the State Government/ UT Administration. SWSM may also decide to pay honorarium to a dedicated person at GP level for ensuring water quality tests through FTKs/ bacteriological vials in prescribed time and submit data to higher authorities.

It has now been decided to allow the funding of additional activities as given below in addition to the above activities.

I.) building cost for setting up a new laboratory at regional, district, sub-divisional/ block levels. Land cost in all cases is to be borne by the State/ UT. Booking of rental charges can continue to be charged till such time new laboratories are set up. This would require a substantial increase in fund and thus require a revision of current threshold funding level (up to 2%) based on actual costs of setting up of laboratories with modern equipment on field;

ii.) in case of laboratories set up under PPP or public-public partnerships, funding on per sample basis, both for collection and testing, to be mutually decided between the State/ UT and the service provider;

iii.) in case of laboratories at colleges, universities, higher secondary schools, polytechnic institutes, private NABL accredited/ BIS approved water quality testing laboratories, etc. funding on per sample basis, both for collection and testing, to be mutually decided between the State/ UT and the institution. Further, cost of NABL accreditation of these laboratories can also be funded. It may be noted that funding for colleges, universities, higher secondary schools, polytechnic institutes would be allowed for all types of institutions (Govt./ Govt. aided/ private/ deemed etc.).

Fund sharing pattern between the Centre and States/ UTs are the same as under JJM except that in the case of States with 50:50 fund sharing under JJM, for WQMS it will be 60:40 between Centre and respective States.

It may be noted that the States/ UTs may notionally allocate the 2% of total allocation towards WQMS activities and may release the same in advance so that the WQMS activities as per the approved Annual Action Plan (AAP) are carried out. In future, WQMS fund will be disbursed separately and the Annual Action Plan will have a separate review on WQMS.

11. Road ahead for assured water quality

Jal Jeevan Mission is being implemented since 2019, in partnership with States, to make provision of tap water supply in every rural home and public institution by 2024. The focus is on functionality of tap water connection, viz. water supply in adequate quantity of prescribed quality with sufficient pressure on regular and long-term basis. The programme is not aimed at mere infrastructure creation or making provision of tap water connections, but to ensure long-term 'assured service delivery' with modern public grievance redressal systems for which departments handling rural water supply & sanitation or parastatal organizations in States/ UTs as well as village level institutions have to work as 'public utilities'.

The effort is to reduce the urban–rural gaps in terms of water supply service delivery. It is envisaged that improved services will enable people to realize their full potential in life and livelihood. To achieve this goal, focus is on speedy implementation and improved 'service delivery' especially in un-serviced/ unreached areas and to avoid adverse ramifications due to disruption in service.

For execution of work at this scale and with speed, robust strategies and action plans at State/ UT level are already developed, viz. Village Action Plans (VAPs), District Action Plans (DAPs), State Action Plans (SAPs) and based on the same Annual Action Plans (AAPs) of each State/ UT are being approved every year. The WQMS component in these plans captures details related to its activities. The progress against the plans is also being regularly reviewed at various levels for speedy and timely implementation. These plans developed through capturing data and its analysis are in line with the vision of JJM, and are to be implemented in its true letter and spirit.

For ensuring quality of water supply and to maintain overall surveillance of water supply at local level, five women from every village are being trained on using Field Test Kits (FTKs) to test water for its quality, undertake regular sanitary inspection and upload data on WQMIS portal. The effort is to establish systems so that people feel confident about quality of tap water and consumer water directly from the tap. Rigorous and regular water quality testing at the local level as well as strengthening water quality monitoring through water quality testing laboratories are ways to create confidence about the quality of tap water supply.

All water quality testing laboratories across the country are to be standardized, modernized/ upgraded and are to be mandatorily NABL accredited/ recognized. The laboratories have been opened to public so that people can get their water samples tested at a nominal cost, receive digital report and have remedial action taken, if water found to have any contaminants beyond the permissible limit. There is a need to raise awareness on regular water quality testing at the laboratories and that the nearest laboratory can be located very easily through Water Quality Management Information System (WQMIS) or its app. With advancements in instrumentation that incorporate digital technologies to test water quality, different levels of laboratories have to procure equipments that can perform water quality testing for multiple parameters. These equipments would not only reduce the turn around time for delivery of test results, but also significantly increase the number of tests that can done by the laboratory as well as bring down the human intervention in testing. It is important that human resources for handling these equipments are well qualified, their capacities built at regular intervals so that they get updated as the equipments get modernised and the data generated through the test results can be analysed for policy interventions.

Groundwater is the primary source of drinking water in most of the rural India. However, due to the depleting groundwater level, surface water use is also on the rise. For both groundwater and surface water-based rural drinking water supply schemes, it is vital to monitor the bacteriological and chemical parameters to ascertain the safety of water quality. The local community is to undertake monthly water quality testing and sanitary inspections to ascertain the quality.

Sometimes, water may also get contaminated at the end-user due to poor hygiene or improper storage. Thus, focus to also be on raising awareness on water storage, water safety, etc. and empower people with information related to public health.

In many areas, especially in water-stressed blocks/ districts, due to over-utilization/ over-drawl of water for agricultural purposes, the drinking water sources run a risk of getting depleted resulting into non-functionality of the water supply systems, necessitating water supply by making emergency arrangements. In such cases, the huge public investment on water supply systems may also become unfruitful if water sources are not protected, which means people are to made aware and sensitized at the local level on importance of using available water judiciously as well as enhance their capacities to make them fully able to manage, operate and maintain in-village water supply systems. It also requires village communities to start water budgeting to understand and improve water-use efficiency by changing water usage patterns, shifting to less water consuming crops and/ or switching to micro irrigation e.g. drip and sprinkler system, etc. Reduction in agricultural use will enhance water security for drinking and domestic purposes.

The road ahead is thus to build capacities of local communities to be able to achieve service level benchmarking for rural drinking water supply at GP/ village level and monitor it regularly. The benchmarks have been provided in the 'Manual for utilization of 15th Finance Commission tied grants to RLBs/ PRIs'. The goal is to develop 'WASH enlightened villages'/ 'WASH Prabuddh Gaon', wherein the local communities are equipped to provide long-term assured water supply and sanitation services to all ensuring 'no one is left out'.

In line with the motto of JJM, i.e. 'building partnerships, changing lives', 184 sector partners, 104 Key Resource Centres (KRCs), over 13,000 Implementation Support Agencies (ISAs) , etc. have been engaged at different levels to raise awareness and build capacities of various stakeholders on water quality monitoring & surveillance.

Presently, rural households with piped water supply do not have any means to test the potability of their water supply. In the healthcare sector, there are devices to check health parameters like blood sugar, blood pressure, oxygen level, pregnancy, etc. However, a portable device to test water quality is not commonly available. There is a need for a portable water testing device so that people can check at least the basic water quality parameters of the drinking water supply they use. For developing such a kit, JJM in partnership with DPIIT launched an innovation challenge to develop portable water quality testing devices for use at domestic as well as by GPs/ VWSCS, Pani Samitis. Such innovative tools are to be made available to all villages in partnership with States.

The Water Quality Management Information System (WQMIS) is enabling digital governance with online service delivery monitoring. Sensor-based IoT devices are to be installed in every village for automatic data capturing to measure and monitor the water supply, and fully equip local community to manage, operate and maintain these digital tools. Additionally, such a system can provide real-time information on the consumption and demand patterns of the user groups over time, which is valuable for demand management at the aggregate level. Such a system will also help minimise non-revenue water use, ensure proper management and effective operation and maintenance of water supply systems in the villages. IoT based remote monitoring would benefit all stakeholders (government, utility, and citizens) across multiple dimensions like economic, social, environmental and health and safety. Similarly, responsive systems to be developed for taking remedial action/ public grievance redressal, so that service is not disrupted at any point of time.

Further, it is important to study the water quality patterns, document and analyze the same for effective policy intervention. The sources have to be tracked for developing a water quality trail and understand its linkage with reasons for quality deterioration. Such evaluation studies to also be taken up regularly in association with educational/ other interested institutions.

The National Jal Jeevan Mission is working with States/ UTs for assured service delivery to village communities which will help in realizing vision of JJM, i.e. developing 'water enlightened villages'/ *'Jal Prabudh Gaon'* so that paucity of safe drinking water does not become a limiting factor in the socio-economic development and our quest for high economic growth.

Books and reference materials for WQMS

The following materials/ books can be used for reference by laboratory personnel for adhering to standards and procedures.

i.) Operational Guidelines for the implementation of Jal Jeevan Mission

ii.) Margdarshika for Gram Panchayat and Paani Samiti

iii.) Manual for utilization of 15th Finance Commission tied grant to RLBs for water and sanitation for the period 2021-22 to 2025-26

iv.) Guidelines for Capacity Building by Key Resource Centres (KRC)

v.) IS 10500 – 2012 – Drinking Water Specification

vi.) IS 3025 (Part I) – 1987 – Methods of Sampling and Test (Physical and Chemical) for Water and Waste Water

vii.) Water Quality Reports of Central Ground Water Board (http://cgwb.gov.in/wqreports.html)

viii.) Guidelines for Drinking-water quality – World Health Organisation (https://www.who.int/teams/envIronment-climate-change-and-health/water-sanitation-and-health/water-safety-and-quality/drinking-water-quality-guidelines)

ix.) American Water Works Association – Manuals and practices (https://www.awwa.org/Resources-Tools/Resource-Topics/Water-Quality)

x.) Drinking Water Quality and Public Health – Edited by Patrick Levallois and Cristina Villanueva Belmonte (Eds.) – International Journal of Environmental Research and Public Health

xi.) Water Quality & Treatment: A Handbook on Drinking Water (Water Resources and Environmental Engineering Series) - American Water Works Association (Author), James K. Edzwald

xii.) 'Integrated fluorosis mitigation: guidance manual. Nagpur, India', National Environmental Engineering Research Institute (NEERI); 2007

xiii.) Mitigation and Remedy of Ground Water Arsenic Menace in India; A Vision Document, National Institute of Hydrology, MoWR

xiv.) Manuals for public user, State Super Administrator, FTK user, Lab-in-charge, Lab Technician, etc. are available on JJM-WQMIS

Annex-I

List of 60 most seriously affected districts with Japanese Encephalitis and Advanced Encephalitis Syndrome (JE/ AES)

S. No.	State	State S. No.	District	S. No.	State	State S. No.	District
1.	Assam	1.	Barpeta	31.	Uttar Pradesh	1.	Azamgarh
2.	Assam	2.	Dhemaji	32.	Uttar Pradesh	2.	Bahraich
3.	Assam	3.	Diburgarh	33.	Uttar Pradesh	3.	Ballia
4.	Assam	4.	Golaghat	34.	Uttar Pradesh	4.	Balrampur
5.	Assam	5.	Jorhat	35.	Uttar Pradesh	5.	Basti
6.	Assam	6.	Lakhimpur	36.	Uttar Pradesh	6.	Deoria
7.	Assam	7.	Sibsagar	37.	Uttar Pradesh	7.	Gonda
8.	Assam	8.	Sonitpur	38.	Uttar Pradesh	8.	Gorakhpur
9.	Assam	9.	Tinsukia	39.	Uttar Pradesh	9.	Hardoi
10.	Assam	10.	Udalguri	40.	Uttar Pradesh	10.	Kanpur Dehat
11.	Bihar	1.	Araria	41.	Uttar Pradesh	11.	Kushinagar
12.	Bihar	2.	Darbhanga	42.	Uttar Pradesh	12.	Lakhimpur Khari
13.	Bihar	3.	Gaya	43.	Uttar Pradesh	13.	Maharajganj
14.	Bihar	4.	Gopalganj	44.	Uttar Pradesh	14.	MauRae
15.	Bihar	5.	Jehanabad	45.	Uttar Pradesh	15.	Bareli
16.	Bihar	6.	Muzzaffarpur	46.	Uttar Pradesh	16.	Saharanpur
17.	Bihar	7.	Nalanda	47.	Uttar Pradesh	17.	Sant Kabir Nagar
18.	Bihar	8.	Nawada	48.	Uttar Pradesh	18.	Shravasad
19.	Bihar	9.	Paschim Champaran	49.	Uttar Pradesh	19.	Siddharch Nagar
20.	Bihar	10.	Patna	50.	Uttar Pradesh	20.	Sitapur
21.	Bihar	11.	Purba Champaran	51.	West Bengal	1.	Bankura
22.	Bihar	12.	Samasdpur	52.	West Bengal	2.	Bardhaman
23.	Bihar	13.	Saran	53.	West Bengal	3.	Birbhum
24.	Bihar	14.	Siwan	54.	West Bengal	4.	Dakshin Dinajpur
25.	Bihar	15.	Vaishali	55.	West Bengal	5.	Darjeeling
26.	Tamil Nadu	1.	Karur	56.	West Bengal	6.	Hooghly
27.	Tamil Nadu	2.	Madurai	57.	West Bengal	7.	Howrah
28.	Tamil Nadu	3.	Thanjavur	58.	West Bengal	8.	Jalpaiguri
29.	Tamil Nadu	4.	Tiruvarur	59.	West Bengal	9.	Malda
30.	Tamil Nadu	5.	Villupuram	60.	West Bengal	10.	Midnapur West

Annex-II

Drinking water quality standards - Comparison of BIS 10500:2012 and WHO standards

S. No.	Parameters	Unit	IS 10500:2012B		WHO Limit	Remark	Reference
			Acceptable limit	Permissible limit			
1.	Colour	Hazen Units	5	15	WHO does not set formal guideline values for substances on the basis of consumer acceptability.		Sec 2.5, Page 28
2.	Odour		Agreeable	-			
3.	Taste		Agreeable	-			
4.	Turbidity	NTU	1	5	<5		
5.	pH		6.5 to 8.5	No relaxation	Guideline values have not been established	Values found are below those of health concern	Table 8.7
6.	TDS/ Electrical Conductivity	mg/ l	500	2000	-do-	Values found are below those of health concern	Table 8.7
7.	Total Alkalinity (as calcium carbonate)	mg/ l	200	600			
8.	Chloride (as Cl)	mg/ l	250	1000	-do-	Values found are below those of health concern	Table 8.7
9.	Fluoride (as F)	mg/ l	1	1.5	1.5		
10.	Ammonia (as total ammonia-N)	mg/ l	0.5	No relaxation	Guideline values have not been established	Values found are below those of health concern	Table 8.12
11.	Nitrate (as NO3)	mg/ l	45	No relaxation	50		Table 8.13
12.	Sulphate (as SO4)	mg/ l	200	400	Guideline values have not been established	Values found are below those of health concern	Table 8.7
13.	Boron* (as B)	mg/ l	0.5	1	2.4		Table 8.8

S. No.	Parameters	Unit	IS 10500:2012B		WHO Limit	Remark	Reference
			Acceptable limit	Permissible limit			
14.	Calcium (as Ca)	mg/ l	75	200			
15.	Magnesium (as Mg)	mg/ l	30	100			
16.	Total Hardness (as CaCO3)	mg/ l	200	600	Guideline values not established	Values found are below those of health concern	Table 8.7
17.	Sulphide (as H2S)	mg/ l	0.05	No relaxation	Guideline values not established	Values found are below those of health concern	Table 8.7
18.	Chloramines (as NH2Cl)	mg/ l	4	No relaxation			
19.	Iron (as Fe)	mg/ l	1	No relaxation	Guideline values have not been established	Values found are below those of health concern.	Table 8.7
20.	Manganese (as Mn)	mg/ l	0.1	0.3	Guideline values have not been established		
21.	Copper (as Cu)	mg/ l	0.05	1.5			
22.	Total Chromium (as Cr)	mg/ l	0.05	No relaxation	0.05		Table 8.8
23.	Cadmium (as Cd)	mg/ l	0.003	No relaxation	0.003		Table 8.10
24.	Lead (as Pb)	mg/ l	0.01	No relaxation	0.01		Page 383
25.	Nickel (as Ni)	mg/ l	0.02	No relaxation	0.07		Page 397
26.	Total Arsenic (as As)	mg/ l	0.01	No relaxation	0.01		Table 8.8
27.	Mercury (as Hg)	mg/ l	0.001	No relaxation	0.006		Table 8.10

S. No.	Parameters	Unit	IS 10500:2012B		WHO Limit	Remark	Reference
			Acceptable limit	Permissible limit			
28.	Barium (as Ba)	mg/ l	0.7	No relaxation	For Atrazine and its chlorostriazine metabolites: 0.1 mg/L, For Hydroxyatrazine: 0.2 mg/L		Table 8.8
29.	Zinc (as Zn)	mg/ l	5	15	Guideline values have not been established	Values found are below those of health concern.	Table 8.15
30.	Aluminum* (as Al)	mg/ l	0.03	0.2	Guideline values have not been established		Page 311
31.	Selenium (as Se)	mg/ l	0.01	No relaxation	0.04		Table 8.8
32.	Silver (as Ag)	mg/ l	0.1	No relaxation			
33.	Molybednum (asMo)	mg/ l	0.07	No relaxation	Guideline values have not been established	Values found are below those of health concern.	Table 8.7
34.	Total coliform bacteria	Shall not be detectable in any 100 ml sample			Must not be detectable in any 100 ml sample		
35.	E.coli/ Thermotolerant coliform bacteria	Shall not be detectable in any 100 ml sample			Must not be detectable in any 100 ml sample		
36.	Radioactive elements						
	Alpha emitters	Bq/ l	0.1	No relaxation	0.5		Page 208
	Beta emitters	Bq/ l	1	No relaxation	1		Page 208
37.	Cyanide (as CN)	mg/ l	0.05	No relaxation	Guideline values have not been established	Values found are below those of health concern.	Table 8.9

S. No.	Parameters	Unit	IS 10500:2012B		WHO Limit	Remark	Reference
			Acceptable limit	Permissible limit			
38.	Poly Aromatic Hydrocarbons (as PAH)	mg/ l	0.0001	No relaxation	0.0007		
39.	Free Residual Chlorine	mg/ l	0.2	1	0.5		Page 107
40.	Polychlorinated Biphenyls	mg/ l	0.0005	No relaxation			
41.	Anionic Detergents (as MBAS*)	mg/ l	0.2	1			
42.	Mineral oil	mg/ l	0.5	No relaxation			
43.	Phenolic Compound (as C6H5OH)	mg/ l	0.001	0.002	0.5		
44.	Trihalomethanes a.Bromoform	mg/ l	0.1	No relaxation			
	b.Dibromomethane	mg/ l	0.1	No relaxation			
	c.Bromodichloromethane	mg/ l	0.06	No relaxation			
	d.Chloroform	mg/ l	0.2	No relaxation			
45.	Alachlor	µg/ l	20	No relaxation	0.02		Table 8.13
46.	Atrazine	µg/ l	2	No relaxation	for Atrazine and its chloro-s-triazine metabolites: 0.1 mg/L, For Hydroxyatrazine: 0.2 mg/L		Page 319

S. No.	Parameters	Unit	IS 10500:2012B		WHO Limit	Remark	Reference
			Acceptable limit	Permissible limit			
47.	Aldrin/ Deildrin	µg/ l	0.03	No relaxation	0.000 03		
48.	Alpha HCH	µg/ l	0.01	No relaxation	Chemicals from agricultural activities excluded from guideline value derivation		Table 8.11
49.	Beta HCH	µg/ l	0.04	No relaxation			
50.	Butachlor	µg/ l	125	No relaxation			
51.	Chloropyr-iphos	µg/ l	30	No relaxation	30		Table 8.13
52.	Delta HCH	µg/ l	0.04	No relaxation			
53.	2,4-Dichlorophen oxyacetic acid	µg/ l	30	No relaxation	30		Page 407
54.	Dichlorodiphe nyltri-chloroethane (DDT)	µg/ l	1	No relaxation	1		Table 8.18
55.	Endosulfan (alpha,betaan d sulphate)	µg/ l	0.4	No relaxation	Not mentioned	Values found are below those of health concern.	
56.	Ethion	µg/ l	3	No relaxation			
57.	Gamma–HCH (Lindane)	µg/ l	2	No relaxation	2		Table 8.13
58.	Isoproturon	µg/ l	9	No relaxation	9		Table 8.13
59.	Malathion	µg/ l	190	No relaxation	Not mentioned	Values found are below those of health concern.	Table A3.2
60.	Methyl parathion	µg/ l	0.3	No relaxation			Table A3.2

S. No.	Parameters	Unit	IS 10500:2012B		WHO Limit	Remark	Reference
			Acceptable limit	Permissible limit			
61.	Monocro-tophos	µg/ l	1	No relaxation	Excluded	Has been withdrawn from use in many countries and is unlikely to occur in drinking water	
62.	Phorate	µg/ l	2	No relaxation	Excluded		Table A3.1
63.	Uranium (*Atomic Energy Regulation Norms / ** USEPA)	mg/ l	0.06*/ 0.03**	0.06*/ 0.03**	0.03	Only chemical aspects of uranium addressed	Table 8.8

Annex-III

List of Parameters to be monitored at each level of laboratories

Parameters	State / UTLab	District lab	Sub-divisional/ Block Lab
Physical Parameters			
Temperature	Yes	Yes	Yes
Colour	Yes	Yes	Yes
Odour	Yes	Yes	Yes
Taste	Yes	Yes	Yes
Turbidity	Yes	Yes	Yes
pH	Yes	Yes	Yes
Chemical Parameters			
TDS/Elect. Conductivity	Yes	Yes	Yes
Total Alkalinity	Yes	Yes	Yes
Chloride	Yes	Yes	Yes
Fluoride	Yes	Yes	Area Specific*
Ammonia	Yes	Yes	No
Nitrate	Yes	Yes	Yes
Nitrite*	Yes	No	No
Sulphate	Yes	Yes	Yes
Silica	Yes	No	No
Potassium	Yes	Area Specific*	No
Boron*	Yes	No	No
Calcium (as Ca)	Yes	No	No
Magnesium (as Mg)	Yes	No	No
Total Hardness	Yes	Yes	Yes
Sulphide	Yes	No	No
Chloramines (as Cl2)	Yes	No	No

Parameters	State / UTLab	District lab	Sub-divisional/ Block Lab
Heavy Metals			
Iron	Yes	Yes	Area Specific*
Manganese	Yes	Area Specific*	Yes
Copper	Yes	Area Specific*	No
Total Chromium (as Cr)	Yes	Area Specific*	No
Cadmium	Yes	No	No
Lead	Yes	Area Specific*	No
Nickel	Yes	Area Specific*	No
Total Arsenic(asAs)	Yes	Yes	Area Specific*
Mercury	Yes	Area Specific*	No
Barium	Yes	Area Specific*	No
Zinc	Yes	Area Specific*	No
Aluminium*	Yes	Area Specific*	No
Selenium	Yes	Area Specific*	No
Silver	Yes	Area Specific*	No
Molybdenum (as Mo)	Yes	No	No
Biological Contaminations			
Total coliform bacteria	Yes	Yes	Yes
E.coli/ Thermotolerant coliform bacteria	Yes	Yes	Yes
Virus: V.cholera, S.typhi, S.dysentrae, Staphiloccocus, F.streptococci, G.lamblia	***	No	No
Specific Parameters			
Total Pesticide Residue	Yes	No	No
Radio-active elements	**	No	No
Cyanide	Yes	No	No
Poly Aromatic Hydrocarbons (PAH)	Yes	No	No
Free Residual Chlorine	Yes	Yes	Yes

Parameters	State / UTLab	District lab	Sub-divisional/ Block Lab
Poly chlorinated Biphenyls	Yes	No	No
N-Nitro-sodi-methylamine (NDMA)	Yes	No	No
Anionic Detergents (as MBAS)	Yes	No	No
Oils & Grease	Yes	Yes	No
Dissolved Oxygen (DO)	Yes	Yes	No
Biochemical Oxygen			
Demand (BOD)	Yes	Yes	No
Chemical Oxygen Demand (COD)	Yes	Yes	No
Mineral oil	Yes	No	No
Phenolic Compound (asC6H5OH)	Yes	No	No
Trihalomethanes a. Bromoform b. Dibromomethane c. Bromodichloromethane d. Chloroform	Yes	No	No
Individual Pesticide			
Alachlor	Yes	No	No
Atrazine	Yes	No	No
Aldrin/Dieldrin	Yes	No	No
Alpha HCH	Yes	No	No
Beta HCH	Yes	No	No
Butachlor	Yes	No	No
Chloropyriphos	Yes	No	No
Delta HCH	Yes	No	No
2,4-Dichlorophenoxyacetic acid	Yes	No	No
Dichlorodiphenytri- chloroethane (DDT)	Yes	No	No
Endosulfan (alpha, beta and sulphate)	Yes	No	No
Ethion	Yes	No	No

Parameters	State / UTLab	District lab	Sub-divisional/ Block Lab
Gamma–HCH (Lindane)	Yes	No	No
Isoproturon	Yes	No	No
Malathion	Yes	No	No
Methyl parathion	Yes	No	No
Monocrotophos	Yes	No	No
Phorate	Yes	No	No
Uranium	Yes	No	No
Total Organic Carbon (TOC)	Yes	No	No
Total number of parameters to be monitored	73	23 + 12 Area Specific*	16 + 03 Area Specific*

i.) *Area Specific parameter is to be tested on past history of occurrence/district water quality profile prepared by central and/or state agency / Water quality reports prepared by reputed institutions viz academic / research / NGOs etc., Scientific journals indexed under Science Citation Index (SCI).

ii.) **To be converged with Atomic Minerals Directorate /BARC/ PRL/ BRIT and other DAE approved laboratories. Alternatively, BARC/ BRIT can provide technical supporting providing a Uranium testing facility by upgrading existing laboratories.

iii.) ***Viral parameters may be got analysed at any NABL accredited lab/at any institute of repute.

iv.) The suggestion of "No" above is only general in nature. Depending upon the occurrence of different parameters locally, the same may be monitored regularly. The above list of parameters is suggestive in nature. State/ UT may therefore, analyse such parameters which are of local importance.

v.) #State/ UT laboratories may monitor Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD)and Chemical Oxygen Demand(COD) in surface water if eutrophication is observed/ reported. These parameters may also be of importance at the down-stream of industrial areas/ discharge of treated/ partially treated/untreated sewage from urban local bodies.

Annex-IV

Best practices and case studies

I. The refurbished water quality testing laboratories of Punjab

The Drinking Water and Sanitation Department has upgraded 31 different levels laboratories in the State (1 State lab, 6 regional Laboratories and 24 District/ Block level). In order to have ease of identification of water quality testing laboratories by public, uniform colour pattern of painting the outer and inner walls of these laboratories have been done. Modular furniture with overhead storage for optimising space utilisation; installation of sink made of PPR[25] material which does not get corroded with chemicals; running electrical race along the working tables of laboratories for power connections that avoids short-circuiting due to chemical spillage; and three-way swan neck type tap for ease of laboratory use are some of the highlights of these upgradation works. In order to enhance the safety of laboratory personnel, pressure pump is installed at roof top for EYE washer, in case of emergency requirement to clean the eyes due to coming in contact with chemicals. The estimated cost of these works was Rs. 13.17 lakh.

II. The state-of-the-art mobile water quality testing laboratory of Haryana

The Public Health Engineering Department, Haryana has procured a state-of-the-art mobile water quality laboratory that can operate throughout the State and capable of testing 10 parameters *inter alia* microbiological test using analyzers/ sensors/ probes/ instruments based on colorimetric, electro-Chemistry, etc. The laboratory would enable meeting multiple objectives like providing easy access for water testing and reach at last mile of remote rural location; onsite deployment of mobile laboratory in case of spread of water-borne diseases, quick access to water quality test reports due to onsite result printing facility and cross check the test results from regular laboratories, when required. The parameters that can be measured are pH, Alkalinity, TDS, Hardness, Residual Chlorine, Zinc, Nitrite, Fluoride, Turbidity and Micro-biological test of water samples. This mobile water testing laboratory van has been uniquely designed and fully loaded with latest technologies and features:

i.) GPS enabled for location tracking and analyzed sample data can be transmitted to a centralized Departmental server via GPRS/3G connectivity with Power backup;

ii.) on-site recording and reporting of results through a smart phone, capable of recording GPS coordinates, taking photos of the water source and recording results, including sanitary survey (if needed), and the ability to send results direct to a web based secure central server;

iii.) fully automated sensor-based analysis (injection of the sample, addition of the reagents and recording of the results) and simultaneously on each sensor controlled by centrally commanded software;

iv.) semi-automated analysis by spectrophotometer (data automatically transferred to pre-programed centrally commanded software);

v.) LED display unit for instant display the results after analysis; and

vi.) onsite report printing of sample in appropriate format.

III. Public-Private Partnership in Water Quality Monitoring in West Bengal

In West Bengal, out of two hundred and seventeen (217) rural drinking water quality testing laboratories, seventy-nine (79) are jointly managed by NGOs. UNICEF supported the State Public Health Engineering

[25] Poly Propylene Random Co-polymer

Department (PHED) in identifying potential NGO partners who can collaborate with the Department in setting up water quality monitoring laboratories. A Memorandum of Understanding is signed between PHED and the concerned NGO, which entails details on infrastructure to be provided and maintained by both PHED and NGO, utilisation of O&M funds and other related activities.

These laboratories are housed in the buildings owned by the respective NGOs. Basic infrastructure, including the laboratory furniture and refrigerator, is provided by the NGO. Laboratory staff are engaged by the NGO, but trained and remunerated by PHED. The laboratory instruments and equipment, chemicals, reagents etc. are procured and supplied on need basis by the respective PHED Water Supply Divisions.

Samples collected from spot sources (hand pumps, tube-wells, wells, springs, etc.) as well as piped water supply schemes are tested for location-specific chemical parameters. All laboratories do not test all types of contaminants. District and sub-divisional level laboratories have been set-up and categorised based on location-specific contaminants. Laboratories categorised based on seven location-specific chemical contaminants are as mentioned in the figure.

Water quality laboratories in West Bengal

S. No.	Laboratory Type	Managed by	
		PHED	NGOs
1.	Arsenic	32	24
2.	Fluoride	26	18
3.	Salinity	15	10
4.	Arsenic & Fluoride	11	0
5.	Arsenic & Salinity	8	10
6.	Arsenic, Fluoride & Salinity	3	0
7.	General	43	17
	Total	138	79
	Grand total	217	

Annex-V

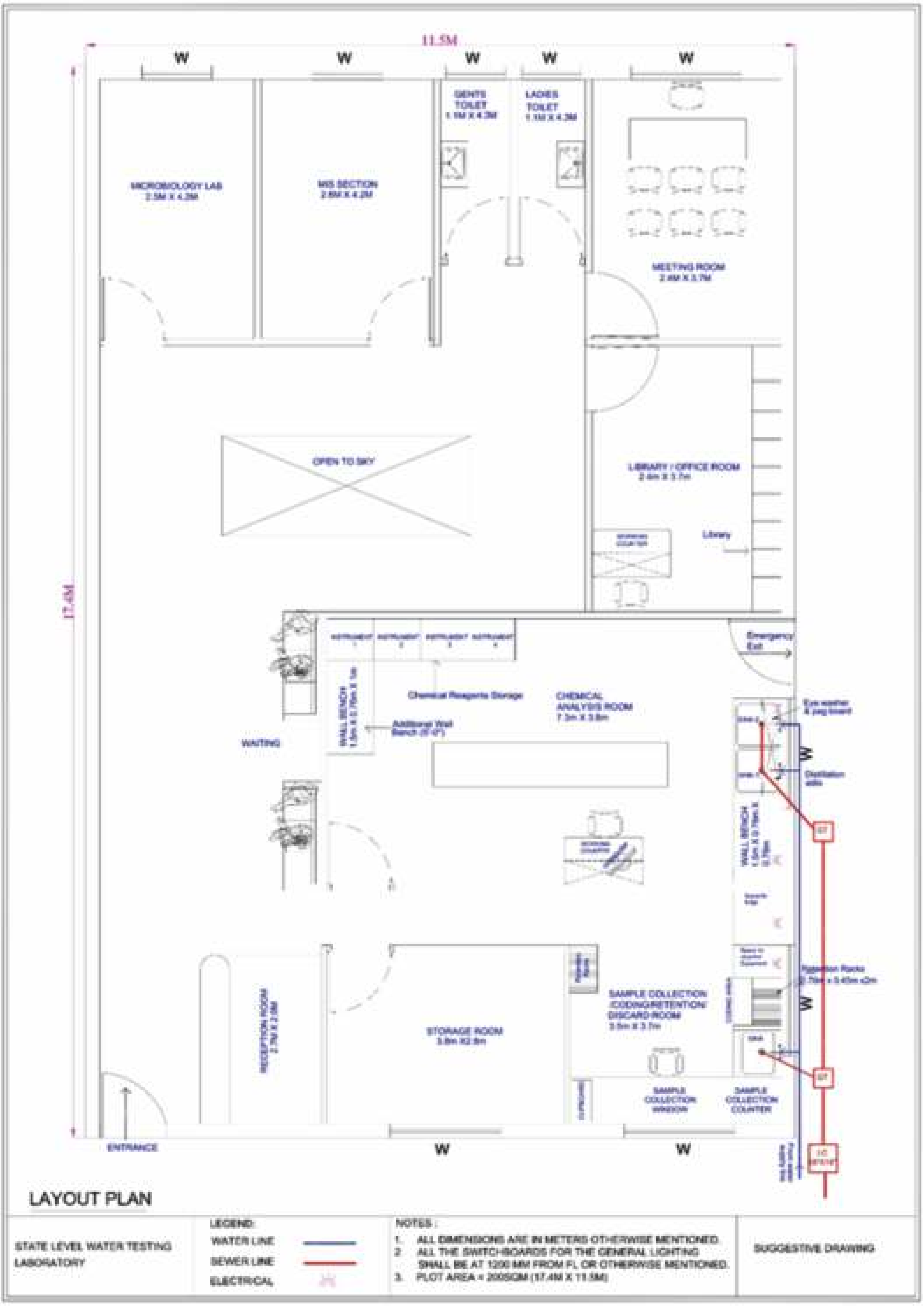
Suggestive laboratory infrastructure

S. No.	Infrastructure	State/ UT laboratory	District laboratory	Sub-division/ block laboratory
1.	Space for Analysis (in m^2)	80 (including 20 for microbiological)	60 (including 20 for microbiological)	50 (including 10 for microbiological)
	Space for Storage (in m^2)	45	25	20
	Space for office & library	45	15	10
	Total space req. (in m^2)	200*	100	80
2.	No. of Computers	02 (include 1 system for library)	01	01
3.	Internet	Yes	Yes	Yes
4.	No. of UPS	02	01	01
5.	Inverters (back up time=3 hrs)	02	02	01
6.	Printer	02	01	01
7.	Telephone facility	Yes	Yes	Yes
8.	Fax	Yes	Yes	Yes
9.	AC	Yes	Yes	Yes
10.	Provision for fume hood	Yes	Yes	Yes
11.	Provision for gas connection	Yes	Yes	Yes (Only LPG)

All laboratories shall invariably adopt roof-top rainwater harvesting structure and include waste-water/ spent water treatment before being disposed-off and also adopt proper SLWM (Solid and Liquid Waste Management) procedures for safe disposal of laboratory waste as per MOEF&CC/ State Government/ UT Administration norms, etc.

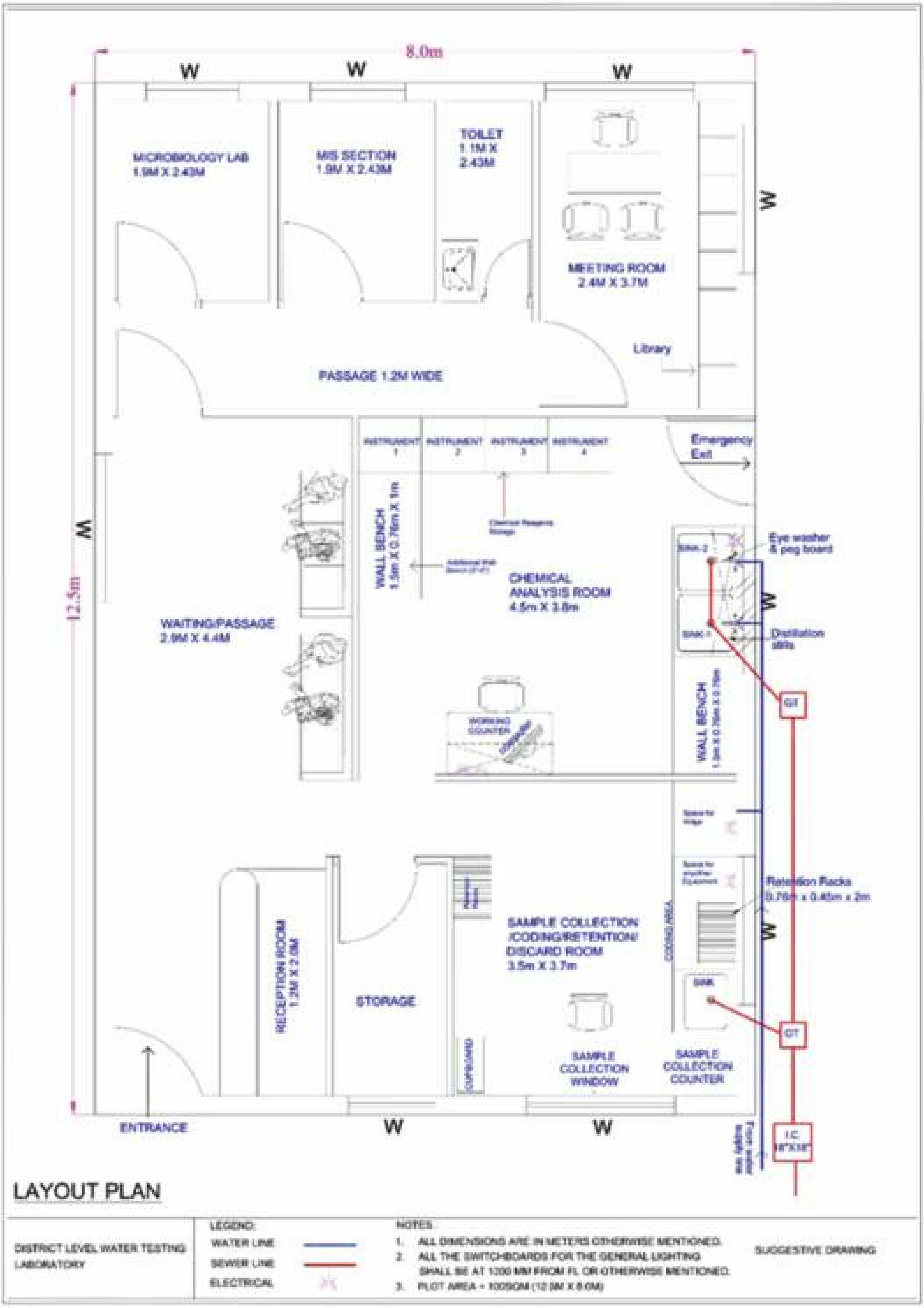
Annex-VA

Suggestive State/ UT-level laboratory layout



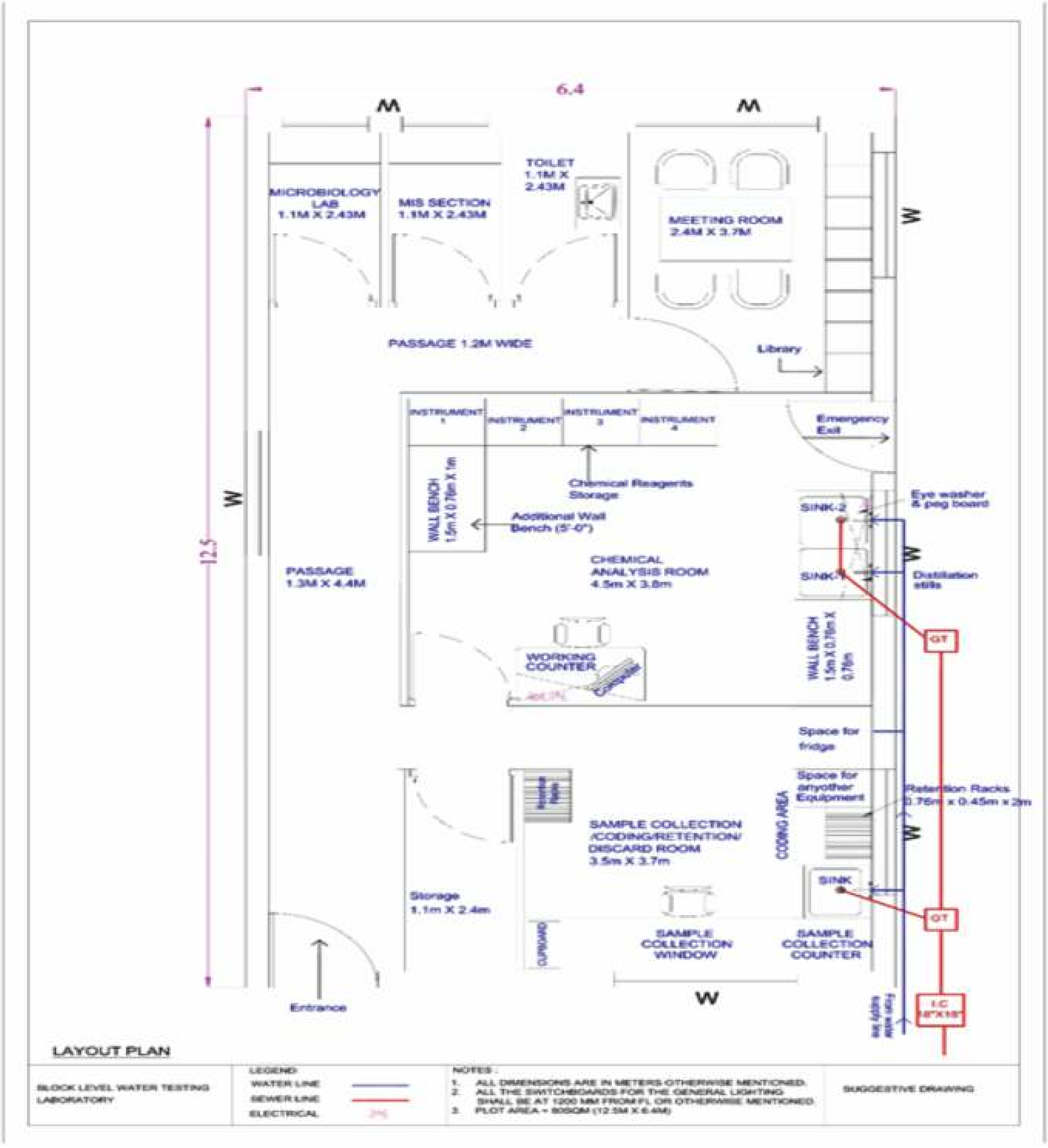
Annex-VB

Suggestive district-level laboratory layout



Annex-VC

Suggestive block-level laboratory layout



Annex-VI

Suggestive list of instruments requirement in laboratories

S. No.	Item	Specification	State/ UT	District	Sub-division
1.	pH meter (both laboratory based and portable type)	Digital display (0-14 range)	Yes	Yes	Yes
2.	TDS/ Conductivity meter (both laboratory based and potable type)	Direct reading digital display	Yes	Yes	Yes
3.	Nephelometer (Turbidimeter)	Digital reading: 0-100 NTU	Yes	Yes	Yes
4.	Digital balance	Single pan Cap.200 gr Tarring device Accuracy- 0.0001gm	Yes	Yes	Yes
5.	UV- Visible spectrophotometer	Should cover wavelength of important	Yes	Yes	No
6.	Refrigerator	295 Liters cap	Yes (2 no's)	Yes	Yes
7.	Water still	Stainless steel (Cap. 5 liters/h)	Yes	Yes	Yes
8.	Voltage stabilizer/ Inverters	Standard make	3 Nos	2 Nos	2 Nos
9.	Hot Plate	Big size	2 Nos	1 No	1 No
10.	Heating mantle	Cap 1 liter	Yes	Yes	Yes
11.	Water bath	Big size	Yes	Yes	Yes
12.	Hot air oven	Standard make- Big Size	4 Nos	2 Nos	2 Nos
13.	Bacteriological incubator	Temp control device (Range 1 to 50 degree centigrade) Medium Size	2 Nos	2 Nos	2 Nos
14.	Autoclave	Medium size steel cabinet	2 Nos	1 Nos	1 No
15.	Magnetic stirrer	With speed control and Teflon paddle	2 Nos.	1 No	1 No
16.	Microscope	Binocular	Yes	Yes	No
17.	Vacuum pump	1 hp Cap	Yes	Yes	Yes

S. No.	Item	Specification	State/ UT	District	Sub-division
18.	Atomic Absorption Spectrophotometer (AAS) with electrode lamp	-	Yes	No/ Yes#	No
19.	Inductively coupled plasma- optical emission spectrometry (ICP-OES)/ mass spectrometry (MS)	-	Yes	No	No
20.	UV laminar Air flow chamber for bacteriological analysis	-	Yes	Yes	Yes
21.	Plate count and colony counter	Standard make	Yes	Yes	Yes
22.	Arsenic Testing Instrumentation (portable)	-	Yes	Yes	Yes+
23.	Hydride generator with all accessories	-	Yes	Yes**	Yes+
24.	DO meter	Digital	Yes	Yes	Yes
25.	Cool box with icepacks		Yes	Yes	Yes
26.	Specific Ion meter along with electrodes (for Fluoride)	Digital	Yes	Yes	Yes
27.	Fume coup board		Yes	Yes	Yes
28.	GC-MS / HPLC/ LC-MS	Digital	Yes	No	No
29.	Auto burette and auto pipette		Yes	Yes	Yes
30.	Uranium analyser	Digital	Yes	No/ Yes*	No
31.	Thermometers	Digital	Yes	Yes	Yes
32.	Single Stage distillation apparatus	-	Yes	Yes	Yes
33.	Double distillation Apparatus/ Ultrapure Water Purification System to provide type I/type II water for sophisticated instruments	-	Yes	Yes	Yes
34.	Argon, Nitrogen, Hydrogen Helium & Oxygen Gas Cylinders (To be used with AAS/ Advanced Spectrophotometer)/ICP-MS/ OES	-	Yes	Yes	No

S. No.	Item	Specification	State/ UT	District	Sub-division
35.	Kjeldal distillation apparatus	-	Yes	Yes	No
36.	Pressure Pump	-	Yes	Yes	No
37.	Membrane filtration	-	Yes	Yes	Yes
38.	PCR machine	-	Yes	No	No
39.	Deep freezer (-20 deg C)	-	Yes	No	No
40.	Micropipette	-	Yes	No	No
41.	Centrifuge	-	Yes	Yes	No
42.	Redflux Apparatus/ COD digester	_	Yes	Yes+	No
43.	Ion Chromatograph	-	Yes	No	No

Note: The equipment listing is based on the incremental approach for choosing the parameters to be tested at each level of laboratories. However, the laboratory should have the necessary equipment's if it tests parameters specific to the areas.

#Wherever heavy metals contamination/Uranium is found to be high

** Wherever Arsenic contamination is found to be high

***Where pesticides/ Uranium is detected

+Wherever applicable

****Trained and experienced Human Resource (HR) with M.Sc. qualification required for operation of the same

Annex-VII

List of equipments that can be used for testing multiple water quality parameters

S. No.	Name of the equipment	Parameters that can be tested	Reference to IS 10500: 2012
1.	Multi-parameter Colorimeter/ Photometer.	Ranges from 8 to 11 among the parameters mentioned below: i.) pH ii.) TDS iii.) Turbidity	**Table 1 Organoleptic and Physical Parameters.** Out of 6 parameters, three can be tested. They are pH, TDS and turbidity.
	-do-	iv.) Chloride v.) Total Alkalinity vi.) Total Hardness vii.) Sulphate viii.) Iron ix.) Fluoride x.) Nitrate	**Table 2 General Parameters Concerning** Substances Undesirable in Excessive Amounts. Out of 24 parameters, 7 can be tested.
		xi.) Arsenic	**Table 3 Parameters Concerning Toxic Substances.** Out of 12 parameters, 1 can be tested.
In addition to the above, there are different combinations of equipments available in the market either testing individual or above group of parameters.			
2.	Atomic Absorption Spectroscopy	i.) Aluminium ii.) Barium iii.) Copper iv.) Iron v.) Magnesium vi.) Manganese vii.) Selenium viii.) Silver ix.) Zinc	**Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts.** Out of 24 parameters, 11 can be tested.
	-do-	x.) Cadmium xi.) Lead xii.) Mercury xiii.) Nickel xiv.) Total Arsenic (as As) xv.) Total Chromium (as Cr)	**Table 3 Parameters Concerning Toxic Substances.** Out of 12 parameters, 6 can be tested.

S. No.	Name of the equipment	Parameters that can be tested	Reference to IS 10500: 2012
3.	Gas Chromatography-Mass Spectrometry.	i.) Alachlor ii.) Atrazine iii.) Aldrin/ Dieldrin iv.) Alpha HCH v.) Beta HCH vi.) Butachlor vii.) Chlorpyriphos viii.) Delta HCH ix.) DDT (o,p and p,p-Isomers of DDT, DDE and DDD) x.) Endosulfan (alpha, beta and sulphate) xi.) Gamma-HCH (Lindane) xii.) Malathion xiii.) Methyl Parathion. xiv.) Phorate	**Table 5 Pesticide Residues Limits and Test Method** Out of 18 parameters, 14 can be tested.
4.	Gas Chromatography-Head Space.	Trihalomethanes (THMs) a. Bromoform b. Dibromochloromethane c. Bromodichloromethane d. Chloroform	**Table 3 Parameters Concerning Toxic Substances.** Out of 12 parameters, 1 can be tested.
5.	Inductive Coupled Plasma-Optical Emission Spectroscopy.	i.) Boron ii.) Copper iii.) Iron iv.) Magnesium v.) Manganese vi.) Silver vii.) Zinc	**Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts.** Out of 24 parameters, 7 can be tested.
	-do-	viii.) Cadmium ix.) Lead x.) Molybdenum xi.) Nickel xii.) Total Chromium (as Cr)	**Table 3 Parameters Concerning Toxic Substances.** Out of 12 parameters, 5 can be tested.
6.	Inductive Coupled Plasma – Mass Spectrometry.	Uranium	Nil. Limits set by WHO and Atomic Energy Regulatory Board (AERB) of India.
7.	Liquid Chromatography-Mass Spectrometry	i.) 2,4-Dichlorophenoxyacetic acid ii.) Ethion iii.) Isoproturon iv.) Monochrotophos.	**Table 5 Pesticide Residues Limits and Test Method** Out of 18 parameters, 4 can be tested.

Annex-VIII

Calibration of instruments

S. No.	Type of Equipment/ Instrument/ Calibration Item	Recommended Frequency of Calibration	Intermediate Checks	Remarks
1.	Weighing Balance	Every year or on repair;	a) Each weighing do Zero check b) One month - one point check using a calibrated weight close to working capacity c) Six months-Repeatability checks at the upper and lower ends of the scale using a calibrated weight	Reference weights to be used should be standard class F2 or better with established permissible errors.
2.	Weights	Weight has to be calibrated externally by an accredited laboratory, at least once in two years.	-	-
3.	Temperature Controlled Enclosures/ Thermostatically Controlled Equipment as Ovens, Incubators, Aging, Vacuum; Environmental conditioning chambers.	Preferably from an accredited calibration laboratory once in a year	Six monthly temperature check around working range	Maintain parameters to an accuracy of within a range as stipulated in methods.
4.	Temperature Controlled Enclosures; Autoclave, Temp. Controlled water bath, furnaces.	To be carried out based on usage	-	-
5.	Thermometers (Liquid in glass)	Calibration from accredited laboratory.	Once a year Check at ice point or at points of use.	Ice point. If outside five times the uncertainty of the calibration, complete recalibration is required.
6.	Timing Devices : Stop watches, clock	Every Year	-	-

S. No.	Type of Equipment/ Instrument/ Calibration Item	Recommended Frequency of Calibration	Intermediate Checks	Remarks
7.	Hygrometer	Calibration by an accredited calibration laboratory. Once in a year	-	-
8.	Volumetric labware (Burette, Pipette and Volumetric flask)	Internal calibration on receipt.	-	It should be verified that the tolerance is in desired acceptable limit (Class A & Class B glasswares)
9.	UV-Visible Spectrophotometer/ Colorimeter	Quarterly- Photometric Absorbance and wavelength accuracy for the working range.	-	Using CRM
10.	Atomic Absorption Spectrophotometer	Performance check by CRM as per manufacturer's instruction	When used, Standard solution of specific element	Generally the performance check is done against the initial value checked at the time of installation.
11.	Conductivity Meter	Once a year, Full range calibration with CRM	For every set of sample tested, Reference standard, One point calibration. Adjust cell constant if necessary. When used, with Standard solution.	-
12.	Gas Chromatograph, GC-MS/HPLC/LC-MS	Quarterly, System performance including: Resolution, Sensitivity, repeatability, retention time and noise level	When used, Standard solution / mixture	-
13.	pH Meter	Once a year, Full range calibration with CRM	To be checked with working standard before use.	-
14.	Micropipettes	Once a year internal calibration	-	-

Note 1: The staff should be trained to handle the laboratory ware appropriately, to avoid abuse (avoid overheating and use of corrosive solutions and ensure appropriate cleaning) of the volumetric laboratory wares, so as to ensure the validity of calibration through its life.

Note 2: The calibration history for each instrument must be recorded.

Annex-IX

A suggestive list of glassware required

S. No.	Item	State/ UT lab	District lab	Sub-division lab
1.	Conical flask	24	16	12
	Cap. 100 ml	50	30	20
	250 ml	24	16	12
	500 ml	10	06	03
	1000 ml	10	06	03
2.	Beakers	24	16	12
	Cap. 100 ml	24	16	12
	250 ml	24	16	12
	500 ml	12	08	04
	1 lt.	06	04	02
	2 lt	06	04	02
3.	Pipette	12	08	04
	Cap. 5 ml	20	12	08
	10 ml	12	08	04
	20 ml	12	08	04
	25 ml	06	04	02
	50 ml	04	02	02
	100 ml	04	02	02
4.	Pipette (Graduated)	06	04	02
	Cap. 1 ml	10	06	04
	5 ml	12	08	04
	10 ml	06	04	02
	20 ml	06	04	02

S. No.	Item	State/ UT lab	District lab	Sub-division lab
5.	Burette (ordinary)	12	08	04
	25 ml	12	08	04
	50 ml	02	01	01
	100 ml			
6.	Burette (Automatic) Cap. 50 ml	3	Not Req.	Not Req.
7.	Desiccators	6	4	3
8.	Reagent Bottles	25	20	15
	100 ml	50	35	30
	250 ml	36	24	18
	Cap. 500 ml	24	10	06
	1 lit	10	06	03
	2 lit	10	06	03

Annex-X

Standard methods and chemical required

Refer Product Manual for Drinking Water according to IS 10500: 2012

Suggestive list of Chemicals Required at different levels of laboratories*.

S. No.	Name of Chemical	State/ UT Lab	District Lab	Block/ sub - divisional Lab
1.	Acetic acid, glacial	(15x500ml)	(10x500ml)	(6x500ml)
2.	Alizarin Red S	(2x500g)	(1x500g)	(1x500g)
3.	Ascorbic acid	(5x100g)	(3x100g)	(2x100g)
4.	Absolute alcohol	(10x500ml)	(7x500ml)	(5x500ml)
5.	Aluminium Potassium Sulphate	(5x500g)	(3x500g)	(2x500g)
6.	Ammonium Acetate	(10x500g)	(7x500g)	(5x500g)
7.	Ammonium Chloride	(10x500g)	(7x500g)	(5x500g)
8.	Ammonium Hydroxide	(15x500g)	(10x500g)	(7x500g)
9.	Ammonium Purpurate/ Muroxide	(7x100g)	(5x100g)	(3x100g)
10.	Arsenic Trioxide	(5x500g)	(4x500g)	(2x500g)
11.	Barium Chloride	(15x500g)	(12x500g)	(10x500g)
12.	Bromocresol green indicator	(5x100g)	(3x100g)	(2x100g)
13.	Boric Acid	(4x500g)	(3x500g)	(2x500g)
14.	Calcium Chloride(fused)	(7x500g)	(5x500g)	(5x500g)
15.	Calcium Chloride	(4x500g)	(3x500g)	(2x500g)
16.	Ethylene Diamine Tetra-acitic Acid (EDTA)	(7x500g)	(7x500g)	(7x500g)
17.	Erichrome BlackT	(5x10g)	(5x10g)	(5x10g)
18.	Eriochromecyanine:R	(5x10g)	(3x10g)	----
19.	Ferrous Ammonium Sulphate	(5x500g)	(3x500g)	(2x500g)
20.	Hydrochloric Acid	(7x2.5L)	(5x2.5 L)	(3x2.5 L)
21.	Hydroxyl amine Hydrochloride	(5x500g)	(3x100g)	(2x500g)
22.	Hydrogen Peroxide	(5x500ml)	(3x500ml)	(2x500ml)

S. No.	Name of Chemical	State/ UT Lab	District Lab	Block/ sub - divisional Lab
23.	Electrolytic Iron	(3x100g)	(2x100g)	(1x100g)
24.	Lead Acetate	(3x500g)	(2x500g)	(1x500g)
25.	Methyl Orange Indicator/ Methyl Red indicator	(7x100g)	(5x100g)	(5x100g)
26.	Phenolphthalein Indicator/ P&R Indicator	(7x100g)	(5x100g)	(5x100g)
27.	Potassium Hydroxide	(10x500g)	(7x500g)	(5x500g)
28.	1-10, Phenanthroline, Monohydrate	(10x10g)	(7x10g)	(7x10g)
29.	Potassium permanganate	(5x100g)	(3x100g)	(2x100g)
30.	Potassium Iodide	(5x500g)	(3x500g)	(2x500g)
31.	Potassium Chromate	(5x500g)	(3x500g)	(2x500g)
32.	Potassium Hydrogen Phthalate	(3x500g)	(2x500g)	(1x500g)
33.	Stannous Chloride	(5x100g)	(3x100g)	(2x100g)
34.	Silver diethyl-di thio-carbamate	(5x100g)	(3x100g)	-----
35.	Sodium Hydroxide	(10x500g)	(7x500g)	(5x500g)
36.	Silver Nitrate	(10x250g)	(7x250g)	(5x250g)
37.	Sodium Acetate	(5x500g)	(3x500g)	(2x500g)
38.	Sodium Thiosulphate	(10x500g)	(7x500g)	(5x500g)
39.	Starch (Soluble)	(10x500g)	(7x500g)	(5x500g)
40.	Sodium Fluoride (Anhydrous)	(5x500g)	(3x500g)	(2x500g)
41.	Sodium Arsenate	(4x100g)	(3x100g)	(2x100g)
42.	SPADNS	(3x100g)	(2x100g)	(2x100g)
43.	Zirconyl Oxy chloride, Octo hydrate	(5x100g)	(3x100g)	(2x100g)
44.	Sodium Sulphate (anhydrous)	(5x500g)	(3x500g)	(2x500g)
45.	Sulphuric acid	(7x2.5L)	(5x2.5 L)	(3x2.5 L)
46.	Sulphuric acid (Fuming) Oleum (if specifically required)	(5x250g)	(3x250g)	(2x250g)
47.	Sodium Chloride	(5x500g)	(3x500g)	(2x500g)
48.	Potassium Dichromate	(5x500g)	(3x500g)	(2x500g)

S. No.	Name of Chemical	State/ UT Lab	District Lab	Block/ sub - divisional Lab
49.	Calcium Carbonate (anhydrous)	(7x500g)	(5x500g)	(4x500g)
50.	Phenol, white	(5x500g)	(3x500g)	(2x500g)
51.	Potassium Nitrate	(5x500g)	(3x500g)	(2x500g)
52.	Sodium Sulphate,	(5x500g)	(3x500g)	(2x500g)
53.	pH Indicator paper, Range 2-14 with comparatr	(5rolls)	(3rolls)	(2rolls)
54.	Methylated spirit	(10x500ml)	(7x500ml)	(5x500ml)
55.	MacConkey broth, dehydrated (Hi-media)	(10x500ml)	(7x500ml)	(5x500ml)
56.	Total Ionic Strength Adjustment Buffer (TISAB)	(15x500ml)	(10x500ml)	(7x500ml)
57.	Oxalic acid	(5x100g)	(3x100g)	(2x100g)
58.	Silver sulphate	(5x100g)	(3x100g)	(2x100g)
59.	Sodium arsenite	(4x100g)	(3x100g)	(2x100g)
60.	Potassium dihydrogen phosphate	(5x100g)	(3x100g)	(2x100g)
61.	Ammonium molybdate	(7x100g)	(5x100g)	(3x100g)
62.	Nitric acid	(7x2.5L)	(5x2.5 L)	(3x2.5 L)
63.	Ammonium metavanadate	(7x100g)	(5x100g)	(3x100g)
64.	Anhydrous potassium nitrate	(5x100g)	(3x100g)	(2x100g)
65.	Sulphanilamide	(5x100g)	(3x100g)	(2x100g)
66.	Sodium nitrite	(5x100g)	(3x100g)	(2x100g)
67.	Sodium oxalate	(5x100g)	(3x100g)	(2x100g)
68.	Sodium metasilicate nano hydrate	(5x100g)	(3x100g)	(2x100g)
69.	Sodium bicarbonate	(5x100g)	(3x100g)	(2x100g)
70.	Sodium borate decahydrate	(5x100g)	(3x100g)	(2x100g)
71.	Sodium Tetraborate	(5x100g)	(3x100g)	(2x100g)
72.	Glycerol	(7x100ml)	(3x100ml)	(2x100ml)
73.	Potassium chloride	(5x100g)	(3x100g)	(2x100g)
74.	Carmine reagent	(5x100gm)	(3x100gm)	------

S. No.	Name of Chemical	State/ UT Lab	District Lab	Block/ sub - divisional Lab
75.	Ammonium solution	(10x100ml)	(7x100ml)	(5x100ml)
76.	Mercury Sulfate	(5x100g)	(3x100g)	(2x100g)
77.	Silver Nitrate	(10x250g)	(7x250g)	(5x250g)
78.	Sodium bisulphate	(5x100g)	(3x100g)	(2x100g)
79.	Sodium Acetate	(10x500g)	(7x500g)	(4x500g)
80.	Zinc metal	(5x100g)	(3x100g)	-----
81.	Potassium ferricyanide	(5x100g)	(3x100g)	(2x100g)
82.	Zincon (2-carboxy-2-hydroxy-5-sulfoformazylbenzene)	(5x100g)	(3x100g)	----
83.	Methanol	(5x500ml)	(2x500ml)	(2x500ml)
84.	Phosphoric acid	(5x100ml)	(3x100ml)	(2x100ml)
85.	Anhydrous potassium bi-iodate	(5x100g)	(3x100g)	(2x100g)
86.	Chloroform	(7x500ml)	(3x500ml)	(2x500ml)
87.	Ethyl ether	(5x500ml)	(5x500ml)	(3x100ml)
88.	Anhydrous potassium bromide	(5x100g)	(3x100g)	-----
89.	Potassium ferricyanide	(5x100g)	(3x100g)	(2x100g)
90.	Alkylbenzene Sulfonate (LAS) solution	(10x100ml)	(4x100ml)	----
91.	Methylene Blue	(5x10g)	(3x10g)	(2x10g)
92.	Sodium phosphate, mono basic monohydrate	(5x100g)	(3x100g)	(2x100g)
93.	N-hexane	(5x100ml)	(3x100ml)	(2x100ml)
94.	Petroleum ether	(5x100ml)	(3x100ml)	(2x100ml)
95.	M-Endo Agar	(3x500gm)	(2x500gm)	(1x500gm)
96.	M-FC Agar	(3x500gm)	(2x500gm)	(1x500gm
97.	EMB Agar	(3x500gm)	(2x500gm)	(1x500gm)
98.	MacConkey Agar	(3x500gm)	(2x500gm)	(1x500gm)
99.	TCBS Agar	(4x500gm)	(3x500gm)	(2x500gm)
100.	XLD Agar	(3x500gm)	(2x500gm)	(1x500gm)

S. No.	Name of Chemical	State/ UT Lab	District Lab	Block/ sub - divisional Lab
101.	Bismuth Sulphite Agar	(3x500gm)	(2x500gm)	(1x500gm)
102.	Salmonella Shigella Agar	(3x500gm)	(2x500gm)	(1x500gm)
103.	KF Streptococcus Agar	(3x500gm)	(2x500gm)	(1x500gm)
104.	Mannitol Salt Agar	(5x500gm)	(3x500gm)	(3x500gm)
105.	Lactose Lauryl Tryptose broth	(3x500gm)	(2x500gm)	(1x500gm)
106.	Ethyl Alcohol	(10x500ml)	(7x500ml)	(4x500ml)
107.	Rosolic Acid	(5x100ml)	(3x100ml)	(2x100ml)
108.	Bromocresol purple	(5x100ml)	(3x100ml)	(2x100ml)
109.	TT Csolution	(5x100ml)	(3x100ml)	(2x100ml)
110.	Brilliant Green Bile Growth	(5x100ml)	(3x100ml)	(2x100ml)
111.	E.C. Broth	(5x100ml)	(3x100ml)	(2x100ml)
112.	Luaryl Sulphate Broth	(5x100ml)	(3x100ml)	(2x100ml)
113.	Phosphoricacid5%H3PO4	(10x500ml)	(5x500ml)	----
114.	Anhydrous KBrO3	(3x500gm)	(2x500ml)	----
115.	Sodium arsenite (NaAsO2)	(4x500gm)	(2x500gm)	(2x500gm)
116.	Urea	(10x500gm)	(5x500gm)	-----
117.	Antimony metal	(5x1gm)	(3x1gm)	(2x1gm)
118.	Choromo tropic acid	(5x100 gm)	(3x100 gm)	(2x100 gm)
119.	Devarda'salloy	(10x10gm)	(5x10gm)	(3x10gm)
120.	Borate buffer	(10x500ml)	(5x500ml)	(2x500ml)
121.	Anhydrous sodium sulphate	(10x500gm)	(5x500gm)	(3x500gm)
122.	CCl4	(6x500ml)	(2x500ml)	-----
123.	Dithiozonesolution	(3x500ml)	(5x500ml)	----
124.	NH4CNS	(10x500gm)	(4x500gm)	-----
125.	AgNO3 Anhydrous	(5x100gm)	(5x100gm)	(5x100gm)
126.	K2HPO4	(5x500gm)	(5x500gm)	(1x500gm)

S. No.	Name of Chemical	State/ UT Lab	District Lab	Block/ sub - divisional Lab
127.	KH2PO4	(5x500gm)	(5x500gm)	(1x500gm)
128.	Potassium ferricyanide	(5x500gm)	(5x500gm)	(1x500gm)
129.	Azomethane	(5x500gm)	------	----
130.	Silverdiethyl-dithiocarbamate	(3x500gm)	(3x500gm)	(3x500gm)
131.	Ammonium or potassium sulphate	(4x250gm)	(3x250gm)	----
132.	2-3 Diamino naphtheline (DAN) Solution	(4x100 ml)	(2x100 ml)	-----
133.	Hydroxyl amine sulphate	(5x500gm)	(5x500gm)	(2x500gm)
134.	Sodium Nitroprusside	(5x500gm)	--	--
135.	Trisodiumcitrate	(5x500gm)	--	--
136.	Phosphate Buffer	(3x500ml)	---	--
137.	Ferro in indicator	(3x250ml)	--	--

* For testing equipment's, while procuring reagents, it should be ensured that they are compatible with them so that equipment's can be used optimally.

Annex-XIA

Sanitary inspection form for piped water supply

I. Type of facility: Piped water supply

1. General information: Zone: .... Area: ....
2. Code number linked to scheme ID: ....
3. Date of visit: ....
4. Water samples taken? .... Sample Nos. .... *E.coli*/ 100 ml..........

II. Specific diagnostic information for assessment

(Please indicate at which sample sites the risk was identified) Risk sample no

1. Do any stand posts[26] leak? Y/ N ....
2. Does surface water collect around any standpost? Y/ N ....
3. Is the area uphill of any standpost eroded? Y/ N ....
4. Are pipes exposed close to any standpost? Y/ N ....
5. Is human excreta on the ground within 10m of any standpost? Y/ N ....
6. Is there a sewer within 30m of any standpost? Y/ N............
7. Has there been a discontinuity in the last 10 days at any standpost? Y/ N ....
8. Are there signs of leaks in the main pipes? Y/ N............
9. Do the community report any pipe breaks in the last week? Y/ N ....
10. Is the main pipe exposed anywhere in the vicinity? Y/ N ....

Total score of risks ..../10

Risk score: 9-10 = Very high; 6-8 = High; 3-5 = Medium; 0-3 = Low

III. Results and recommendations:

The following important points of risk were noted: (list nos. 1-10)

Signature of surveyor:

Comments:

[26] In case the village is having 100% tap connections, 5% of the tap connected households can be surveyed along with standposts, if present.

Annex-XIB

Sanitary inspection form for piped water with service reservoir

I. Type of facility: piped water with service reservoir

1. General information: Zone: .... Area: ....
2. Code number linked to scheme ID: ....
3. Date of visit: ....
4. Water samples taken? .... Sample Nos. .... *E.coli*/ 100 ml..........

II. Specific diagnostic information for assessment

(Please indicate at which sample sites the risk was identified) Risk Sample No

1. Do any standpipes leak at sample sites? Y/ N ....
2. Does water collect around any sample site? Y/ N ....
3. Is area uphill eroded at any sample site? Y/ N ....
4. Are pipes exposed close to any sample site? Y/ N ....
5. Is human excreta on ground within 10m of standpipe? Y/ N ....
6. Sewer or latrine within 30m of sample site? Y/ N ....
7. Has there been discontinuity within last 10 days at sample site? Y/ N ....
8. Are there signs of leaks in sampling area? Y/ N ....
9. Do users report pipe breaks in last week? Y/ N ....
10. Is the supply main exposed in sampling area? Y/ N............
11. Is the service reservoir cracked or leaking? Y/ N ....
12. Are the air vents or inspection cover insanitary? Y/ N ....

Total score of risks ..../12

Risk score: 10-12 = Very high; 8-10 = High; 5-7 = Medium; 2-4 = Low;

0-1 = Very Low

III. Results and recommendations:

The following important points of risk were noted: (list nos. 1-12)

Signature of surveyor:

Comments:

Annex-XIC

Sanitary inspection form for hydrants and tanker trucks

I. Type of facility: Hydrants and tanker trucks

1. General information: Zone: .... Area: ....
2. Code number linked to scheme ID: ....
3. Date of visit: ....
4. Is water samples taken? .... Sample Nos. .... *E.coli*/ 100ml ....

II. Specific diagnostic information for assessment risk

1. Is the discharge pipe dirty? Y/ N ....
2. Is the discharge water dirty/ smelly/ coloured? Y/ N ....
3. Is the delivery nozzle dirty or in poor condition? Y/ N ....
4. Are there any leaks close to the riser pipe of the hydrant? Y/ N ....
5. Is the base of the riser pipe for the hydrant sealed with a concrete apron? Y/ N ....
6. Is the tanker ever used for transporting other liquids? Y/ N ....
7. Is the inside of the tanker dirty? Y/ N ....
8. Does the tanker fill through an inspection cover on the tanker? Y/ N ....
9. Is there direct contact of hands of supplier with discharge water? Y/ N ....
10. Does the tanker leak? Y/ N ....

Total score of risks ..../10

Risk score: >8/10 = Very high; 6-8/10 = High; 4-7/10 = Intermediate; 0-3/10 = Low

III. Results and recommendations:

The following important points of risk were noted: (list nos. 1-10)
And the authority advised on remedial action

Signature of surveyor:
Comments:

Annex-XID

Sanitary inspection form for gravity-fed piped water

I. Type of facility: Gravity-fed piped water

1. General information: .... System name: ....
2. Code number linked to scheme ID: ....
3. Date of visit: ....
4. Water samples taken? .... Sample Nos. ....

II. Specific diagnostic information for assessment

(please indicate at which sample sites the risk was identified) Risk Sample No

1.	Does the pipe leak between the source and storage tank?	Y/ N ....
2.	Is the storage tank cracked, damaged or leak?	Y/ N ....
3.	Are the vents and covers on the tank damaged or open?	Y/ N ....
4.	Do any Standposts leak?	Y/ N ....
5.	Does surface water collect around any Standpost?	Y/ N ....
6.	Is the area uphill of any Standpost eroded?	Y/ N ....
7.	Are pipes exposed close to any Standpost?	Y/ N ....
8.	Is human excreta on the ground within 10m of any Standpost?	Y/ N ....
9.	Has there been discontinuity in the last 10 days at any Standpost?	Y/ N ....
10.	Are there signs of leaks in the main supply pipe in the system?	Y/ N ....
11.	Do the community report any pipe breaks in the last week?	Y/ N ....
12.	Is the main supply pipe exposed anywhere in the system?	Y/ N ....

Total score of risks ..../12

Risk score: 10-12 = Very high; 8-10 = High; 5-7 = Medium; 2-4 = Low; 0-1 = Very Low

III. Results and recommendations:

The following important points of risk were noted: (list nos. 1-12)

Signature of surveyor:

Comments:

Annex-XIE

Sanitary inspection form for deep borehole with mechanized pumping

I. Type of facility: Deep borehole with mechanized pumping

1. General information: .... System name: ....
2. Code number linked to scheme ID: ....
3. Date of visit: ....
4. Water sample taken? .... Sample No. .... E.coli/ 100ml..........

II. Specific diagnostic information for assessment risk

1. Is there a latrine or sewer within 30m of pumphouse? Y/ N ....
2. Is the nearest latrine unsewered? Y/ N ....
3. Is there any source of other pollution within 30m? Y/ N ....
4. Is there an uncapped well within 100m? Y/ N ....
5. Is the drainage around pumphouse faulty? Y/ N ....
6. Is the fencing damaged allowing animal entry? Y/ N ....
7. Is the floor of the pumphouse permeable to water? Y/ N ....
8. Does water forms pools in the pumphouse? Y/ N ....
9. Is the well seal insanitary? Y/ N ....

Total score of risks ..../9

Risk score: 7-9 = High; 3-6 = Medium; 0-2 = Low

III. Results and recommendations:

The following important points of risk were noted:

Signature of surveyor:

Comments:

Annex-XIF

Sanitary inspection form for borehole with hand pump

I. Type of facility: Borehole with hand pump

1. General information: .... System name: ....
2. Code number linked to scheme ID: ....
3. Date of visit: ....
4. Water sample taken? .... Sample No. .... E.coli/ 100ml..........

II. Specific diagnostic information for assessment risk

1. Is there a latrine within 10m of the borehole? Y/ N ....
2. Is there a latrine uphill of the borehole? Y/ N ....
3. Are there any other sources of pollution within 10m of borehole? Y/ N ....
   (e.g. animal breeding, cultivation, roads, industry etc)
4. Is the drainage faulty allowing ponding within 2 m of the borehole? Y/ N ....
5. Is the drainage channel cracked, broken or need cleaning? Y/ N ....
6. Is the soakage pit missing or ponding ? Y/ N ....
7. Is the apron less than 1m in radius? Y/ N ....
8. Does spilt water collect in the apron area? Y/ N ....
9. Is the apron cracked or damaged? Y/ N ....
10. Is the handpump loose at the point of attachment to apron? Y/ N ....

Total score of risks ..../ 10

Risk score: 9-10 = Very high; 6-8 = High; 3-5 = Medium; 0-3 = Low

III. Results and recommendations:

The following important points of risk were noted:

Signature of surveyor:

Comments:

Annex-XIG

Sanitary inspection form for protected spring

I. Type of facility: Protected spring

1. General information: .... System name: ....
2. Code number linked to scheme ID: ....
3. Date of visit: ....
4. Water sample taken? .... Sample No. .... E.coli/ 100ml..........

II. Specific Diagnostic Information for Assessment Risk

1. Is the spring unprotected? Y/ N ....
2. Is the masonry protecting the spring faulty?. Y/ N ....
3. Is the backfill area behind the retaining wall eroded? Y/ N ....
4. Does spilt water flood the collection area? Y/ N ....
5. Is the fence absent or faulty? Y/ N ....
6. Can animals have access within 10m of the spring? Y/ N ....
7. Is there a latrine uphill and/or within 30m of the spring? Y/ N ....
8. Does surface water collect uphill of the spring? Y/ N ....
9. Is the diversion ditch above the spring absent or non-functional? Y/ N ....
10. Are there any other sources of pollution uphill of the spring? (e.g. solid waste) Y/ N ....

Total score of risks ..../10

Risk score: 9-10 = Very high; 6-8 = High; 3-5 = Medium; 0-3 = Low

III. Results and recommendations:

The following important points of risk were noted:

Signature of surveyor:

Comments:

Annex-XIH

Sanitary inspection form for rainwater collection and storage

I. Type of facility: Rainwater collection and storage

1. General information: .... System name: ....
2. Code number linked to scheme ID: ....
3. Date of visit: ....
4. Water sample taken? .... Sample No. .... E.coli/ 100ml..........

II. Specific Diagnostic Information for Assessment Risk

1. Is rainwater collected in an open container? Y/ N ....
2. Are there visible signs of contamination on the roof catchment? (e.g. plants, excreta, dust) Y/ N ....
3. Is guttering that collects water dirty or blocked? Y/ N ....
4. Are the top or walls of the tank cracked or damaged? Y/ N ....
5. Is water collected directly from the tank (no tap on the tank)? Y/ N ....
6. Is there a bucket in use and left where it can become contaminated? Y/ N ....
7. Is the tap leaking or damaged? Y/ N ....
8. Is the concrete floor under the tap defective or dirty? Y/ N ....
9. Is there any source of pollution around the tank or water collection area? Y/ N ....
10. Is the tank clean inside? Y/ N ....

Total score of risks ..../10

Risk score: 9-10 = Very high; 6-8 = High; 3-5 = Medium; 0-3 = Low

III. Results and recommendations:

The following important points of risk were noted: (list nos. 1-10)

Signature of surveyor:

Comments:

Annex-XI(I)

Sanitary inspection form for piped water supply with service reservoir and mechanised pumping

I. Type of facility: Piped water supply with service reservoir and mechanised pumping

1. General information: .... System name: ....
2. Code number linked to scheme ID: ....
3. Date of visit: ....

4. Water sample taken? .... Sample No. .... E.coli/ 100ml..........

II. Specific diagnostic information for assessment risk

1. Does the pipe leak between the source and storage tank? Y/ N ....
2. Does surface water collect around any Standpost? Y/ N ....
3. Can animals have access within 10m of the reservoir Y/ N ....
4. Does open defecation is prevalent or cattle-dung is observed within 50 m of the reservoir? Y/ N ....
5. Is there a sewer within 30m of any tap stand or reservoir? Y/ N ....
6. Are the pipes corroded? Y/ N ....
7. Are there signs of leaks in the mains pipes? Y/ N ....
8. Are the reservoirs used for human and cattle bathing? Y/ N ....
9. Are the buried pipes ever checked for leakage? Y/ N ....
10. Are storage tanks are cleaned at specified intervals? Y/ N ....

Total score of risks .... /10

Risk score: 9-10 = Very high; 6-8 = High; 3-5 = Medium; 0-3 = Low

III. Results and recommendations:

The following important points of risk were noted: (list nos. 1-10)

Signature of surveyor:

Comments:

Annex-XIJ

Sanitary inspection form for the source of dugwell (ringwell)

I. Type of facility: Dugwell (Ringwell)

1. General information: .... System name: ....
2. Code number linked to scheme ID: ....
3. Date of visit: ....
4. Water sample taken? .... Sample No. .... E.coli/ 100ml..........

II. Specific Diagnostic Information for Assesment Risk

1. Is there a latrine or sewer within 30m of the dugwell? Y/ N ....
2. Is the wall of the well lined properly and the well covered adequately? Y/ N ....
3. Is open defecation prevalent or cattle-dung found within 50 m of the ringwell? Y/ N ....
4. Does the well is used for bathing and washing of clothes? Y/ N ....
5. Is there any water drainage facility available around platform of the well and does the drainage facility leads to water stagnation within 30 m of the wall? Y/ N ....
6. Does the well have fixed stainless steel/aluminium buckets with chain pulley for drawing water? Y/ N ....
7. Is the well deep? Y/ N ....
8. Does the water of the well appears visibly clean? Y/ N ....
9. Is there any other source of pollution within 10 m of the well? (e.g. animal breeding, cultivation, roads, industry etc) Y/ N ....
10. Was the well chlorinated during last 7 days Y/ N ....

Total score of risks ....../10

Risk score: 9-10 = Very high; 6-8 = High; 3-5 = Medium; 0-3 = Low

III. Results and recommendations:

The following important points of risk were noted: (list nos. 1-10)

Signature of surveyor:

Comments:

Note: The above-mentioned questionnaire of the sanitary surveys is suggestive. States/UTs may develop their questionnaire as per local needs. All the sanitary survey formats should have the Surveyor's signature and Pradhan/Sarpanch/ Chairman VWSC of the concerned Gram Panchayat.

Annex-XII

Criteria for rating of laboratories

S. No.	Checklist	Yes	No
1.	Whether the laboratory is properly spaced?		
2.	Whether the laboratory has dedicated lab in-charge?		
3.	Whether the laboratory has sufficient Human Resource (HR)?		
4.	Whether the laboratory has Generator/ UPS for uninterrupted power backup?		
5.	Whether the laboratory has adopted sufficient safety measures?		
6.	Whether the equipment in the laboratory is properly calibrated?		
7.	Whether the laboratory staff have been trained on ISO 17025:2017?		
8.	Whether the records are properly maintained?		
9.	Whether Backup facility of the laboratory test report is available?		
10.	Whether necessary statutory clearance for setting the laboratory obtained?		
11.	Whether the data have been properly uploaded in IMIS?		
12.	Whether the data have been properly uploaded in WQMIS?		
13.	Whether the equipment's/ instruments have AMC?		
14.	Whether proper Waste Management is in place?		
15.	Whether the stock register of chemicals/ reagents is maintained?		
16.	Whether the material safety data sheet is maintained?		
17.	Whether relevant IS standards / Manuals is kept?		
18.	Whether safety signages /SOPs display arrangementsis done?		
19.	Availability of safety items like: lab coat, gloves, mask, safety goggles, shoes		
20.	Whether first aid box and list of first aid items duly approved and maintained?		
21.	Whether quality manual is prepared and kept?		
22.	Internet facility in laboratories		
23.	Washroom to be identified separately for male and female		
24.	Whether the laboratory is NABL accredited?		
25.	Whether the laboratory performs sample testing in compliance with drinking water quality framework document.		

22-25 : 5 star • 18-21 : 4 Star • 12-17 : 3 Star • 6-11 : 2 star • 1-5 : 1 star

Note:

Note:

Development of portable water quality testing devices

Jal suddhi mapak

Biomimicry technologies pvt. ltd.

E-jal 'portable multiparameter water quality analyzer'

ELICO pvt. ltd.

Digital field test kit reader - a smartphone attachable pocket device

EyeNetAqua solutions pvt. ltd.

Padma - real time inorganic and E. coli contamination detection using smart device

ELICO pvt. ltd.

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