

資料 6-3 : 第 1 回現地調査 (BWSSB)

Meeting Minutes – Digital Transformation Assessment with BWSSB

Date: 14:40-15:40 on July 23, 2025

Location: 9th floor at BWSSB Office , Bengaluru

Attendees:

- JICA Consulting Team: Ohno, Ogata, Ohara, and Mr. Rohit (India)
 - BWSSB: Mr. Sanath Kumar (Chief Engineer, Design section), Mr. Mahaeswarappa (Additional Chief Engineer (MS & IT), Mr. Chandrasekhar, Executive Engineer, Ms. Lakshmi, AEE, Ms. Kavita (IT department), Ms. Ashwini (TA)
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1. Meeting Objectives and Survey Outline

-Presented by: JICA Consulting Team

-The team requested interviews with **key departments** to understand:

- Current tools
- Operational procedures
- Documentation (IT systems, business processes, KPI monitoring)
- Staffing roles and responsibilities
- Digital vision and planning documents, if available

2. BWSSB's IT Structure and Key Personnel

- **IT Office:** Located on the **7th floor** of the BWSSB building (also hosts GIS data center)
 - Mr. Sanath gave a brief overview of the digital tasks performed by his department including management of data and IT infrastructure, quality control, management of SCADA systems for real time monitoring, NRW monitoring, supporting digital services and customer engagement, ensuring smooth functioning of billing and revenue systems including periodic meetings and audits.
 - Key personnel introduced:
 - **Mr. Maheswarappa** – Additional Chief Engineer (MS&IT) with computer engineering qualifications.
 - **Mr. Chandrasekhar** – Executive Engineer, Design; liaison for coordination
 - **Mr. Shilpa (Main IT staff under Mr. Maheswarappa) *not attended today**
 - **Ms. Lakshmi (AEE responsible for MIS)**
 - **Ms. Kavita** – Core IT staff
 - **Ms. Ashwini** – Technical Assistant/UFW Division Accountant
 - Mr. Sanath Kumar promised to offer support for meetings and coordinating site visit arrangements (e.g., SCADA, AI monitoring of borewell)
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3. Current Digital Initiatives at BWSSB

• **AI application:**

Mr. Sanath Kumar informed there are currently two initiatives involving AI applications in BWSSB, one is Kaveri on Wheels, which is a digital initiative to regulate city's water tanker

services, and one is a pilot AI study involving IoT for monitoring of borewells conducted in collaboration with Indian Institute of Science (IISc). Both are described below:

KAVERI ON WHEELS

- Kaveri on Wheels is a digital initiative launched by BWSSB to modernize and regulate the city's water tanker services.
- The program is designed to provide Bureau of Indian Standard-certified Cauvery water to residents who lack piped water access, particularly in eastern Bengaluru, through a transparent and technology-driven system.
- Launched recently for **booking water supply**
- Users can book tankers remotely

AI application: IoT collaboration with Indian Institute of Science

- Installed at 8 borewell sites to monitor:
 - **Water levels**, seasonal variation
 - **Energy use**, extraction rate
- Aims to shift dependency from **groundwater to Cauvery water**
- Includes **real-time data** and **optimization strategies**
- Research study with Industry with two professors
- **Future Plans:**
 - Digitize **Non-Revenue Water (NRW)** monitoring and UFW management using IoT/AI
 - Develop a centralized **real-time database** (including STPs and BBMP-acquired areas)

4. Challenges Faced by BWSSB

Explained by BWSSB Officials

- **Urban Growth Pressure:**
 - Bengaluru is one of the **fastest growing cities** in the world.
 - Population: Over **1.5 million**, with **70% being non-local residents**.
 - BWSSB's **service area has expanded** from 245 km² to **775 km²**.
- **Human Resource Constraints:**
 - Staff numbers have **reduced from 5,000 to 3,000** due to retirements and hiring freeze.
 - Heavy reliance on **outsourced employees**, especially for clerical and meter-related tasks.
 - Officials described the situation as "**very tough and challenging**", citing workload and insufficient personnel to manage expansion and increasing consumer base.
- **Operational Pressure:**
 - CE Sanath reported **working more than private sector hours**, and **sleeping only 3 hours daily** during peak summer due to water shortages.

- Increasing customer connections, rising expectations, and limited staff are stretching BWSSB's capacity.
 - **Digitalization Needs:**
 - Recognized the vast scope of digital transformation.
 - Stressed the need for **clarity** on what aspects of digitalization are being prioritized by JICA (e.g., customer service, infrastructure, AI use cases).
 - Currently, BWSSB does not have a specific Digital Strategy Document in place. However, digitalization and automation efforts have recently begun and are progressing step by step.
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5. Coordination and Communication Proposals

Suggestions by BWSSB & JICA Team

- **Questionnaire Approach:**
 - BWSSB requested that JICA first share a **survey questionnaire** with the key BWSSB personnel introduced in the meeting, outlining specific data needs.
 - This would help departments better understand the scope of the assessment and **prepare accurate responses**.
 - **WhatsApp Group Proposal:**
 - BWSSB proposed forming a **WhatsApp group** with key BWSSB staff and the JICA survey team for:
 - Quick queries
 - Day-to-day updates
 - Faster problem-solving
 - Key participants include IT engineers, UFW representatives, and JICA survey team counterparts.
 - **Scheduling Support:**
 - BWSSB requested a **tentative survey program** from JICA survey team, including:
 - Number of days in Bengaluru
 - Site visits
 - Interview targets
 - BWSSB will then coordinate accordingly and facilitate introductions, permissions, and visits.
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6. Final Remarks and Informal Dialogue

- **Closing Statements:**
 - BWSSB reaffirmed their commitment to **support the JICA study**.
 - Officials requested a **clear work sequence/schedule** by the evening so that relevant departments can start preparing.
 - BWSSB also acknowledged the need to balance their existing heavy workload

while supporting the digitalization effort.

FYI:

KAVERI ON WHEELS

<https://kaverionwheels.bwssb.gov.in/#/tankerownerregistration>

https://www.hindustantimes.com/cities/bengaluru-news/bengaluru-residents-can-now-book-gps-tracked-cauvery-water-tankers-via-phone-report-101742266208122.html?utm_source=chatgpt.com

Meeting Memo – Ms. Shilpa V., Executive Engineer

Date: 11:00-12:30 on July 25, 2025

Location: 7th floor at BWSSB Head Office, Kaveri Bhavan, Bengaluru

Attendees:

- JICA Consulting Team: Ohno, Ogata, Ohara, and Mr. Rohit (India)
- BWSSB: Ms. Shilpa V., Executive Engineer, IT section, (Responsible for Billing and GIS)

1. Meeting Overview and Objectives

- The meeting commenced with a briefing from the Japanese side, explaining their objective: to understand the current data management and application systems used by BWSSB, as part of a broader information-gathering mission.
 - They plan to analyze the data in Japan and conduct a follow-up visit later.
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2. Geographic Information System (GIS)

Presentation by BWSSB Representative:

- BWSSB has implemented a GIS system that maps all water and sanitation infrastructure, including waterlines, sanitary lines, manholes, and pumping stations.
- The GIS data is hosted by **Karnataka State Remote Sensing Application Center (KSRSAC)**, the nodal agency for multiple government organizations including BWSSB, BBMP, and others.

Key Features and Practices:

- **Desktop GIS Application** is used for daily operations like pipeline replacements and diameter changes.
 - These updates are transferred to the KSRSAC server **every fortnight**.
 - The **public** can access the KSRSAC GIS portal, though BWSSB cannot directly update the server.
 - BWSSB has **requested direct update rights**, especially for mapping **curved water lines**, which current tools do not support.
 - The KSRSAC currently supports only straight-line mapping; updates to include curves are pending.
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3. Billing and Collection System

System Overview:

- A billing and collection system called as “SAJALA” is utilized. It was developed and maintained by the **National Informatics Center (NIC)** since **2003**.
- Supports **~1.1 million connections**.
- The application manages:
 - Customer identification (via **RR numbers**)
 - Meter reading

- Bill generation
- Collection tracking

Operational Features:

- On-site NIC staff handle upgrades and maintenance.
- Customer details in the system include:
 - Name, address, contact number
 - Meter number, monthly consumption, billing amount, and payments
- Customers apply for connections online. No formal contracts exist; all transactions are tied to the RR number.
- Meter readers use **handheld devices** to capture data and generate bills onsite.
- SMS notifications are sent twice:
 1. When the bill is generated
 2. Two days before the due date

4. Tariff Structure and Online Payment

Tariff Details:

- Tariffs increase **quarterly by 6.25% (sanitary charges)**. It is approved up to a total 50% increase by the authority at present.
- The most recent tariff hike started **May 1**. The next tariff increase is scheduled in Aug.
- Example: A water charge of ₹39,782 includes sanitary charges.

Payment Systems:

- Payments accepted via:
 - Net banking
 - Credit cards
 - UPI (Unified Payments Interface)
- Payments processed through the **BWSSB website**.
- Online platform "SAJALA" shows **demand vs. collection data**, though MIS is **not publicly disclosed**.

5. Meter Reading and Collection Practices

Collection Strategy:

- Meter reading is done by the **15th of every month**.
- The remainder of the month is dedicated to arrears collection.
- **Disconnection** for non-payment is rare due to manual workload and risk of revenue loss.

Collection Efficiency:

- Despite short-term dips, **overall collection is nearly 100%**, with arrears often settled in later months.
- Collection ratio between Apr. – Jun. 2025 is approximately 96%.
- Example Data:
 - Some months even exceed demand (e.g., ₹123 cr demand, ₹130 cr collected)

6. Meter Management and Replacement Policy

Defective Meter Handling:

- If a meter is **suspected to be non-functional**, it is marked as "SMS (Suspected Meter Stopped)" in the system.
- Billing continues based on the **average consumption over the past six months**.
- If after **two months** the meter is still non-functional, it is declared "**Meter Stopped**" and replaced.

Replacement Conditions:

- **BWSSB bears the replacement cost** in the following cases:
 - Meter is older than **seven years**
 - Malfunction is **not the consumer's fault**
 - If **intentional damage** by the customer is identified, the **customer is charged** for the replacement.
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7. System Improvement Needs and Maintenance

Continuous Improvement:

- The billing and collection system is **constantly upgraded and maintained** by NIC.
- BWSSB seeks to shift the platform to a more **standalone architecture**.
- Integration of new initiatives (e.g., **Rainwater Harvesting, construction penalties**) is ongoing.
- Regular **vulnerability assessments** (e.g., VAPT) are conducted annually, and findings are addressed.

Data Growth and Archiving:

- The application handles a large and growing volume of data.
 - There's a need for **data archiving** to manage historic information, especially for **audit purposes**.
 - Due to limited IT staffing, **outsourcing** of the entire application management is being seriously considered.
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8. Staffing Constraints

Current Staffing Status:

- The IT department is critically understaffed, consisting of two working groups:
 - **1 Executive Engineer (EE), 2 Assistant Executive Engineers (AEEs) and 1 Assistant Engineer (AE) (short of 2 AEs) and**
 - **1 Executive Engineer (EE) - sharing charge as AEE for other group, 2 Assistant Executive Engineers (AEEs) and 1 Assistant Engineer (AE) (short of 2 AEs)**
- Limited managerial staff are responsible for:
- System management
 - Paperwork and tender processes

- Technical coordination (e.g., with National Informatics Centre (NIC))
 - The situation is described as “**very difficult**”, necessitating capacity building.
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9. Discussion on Automatic Meter Reading (AMR) and Digital Architecture

AMR Implementation:

- **No AMR (Automatic Meter Reading)** has been implemented yet.
- Some conventional meters are **inaccessible**, often due to:
 - Poor placement
 - Obstruction by soil
 - Abandoned properties

Future Vision:

- BWSSB is exploring the **future integration of AMR** and digital automation to improve efficiency.
 - Further coordination is needed with the department responsible for digital architecture.
 - Contact with key personnel (e.g., Lakshmi, currently on inspection) is needed to gather full system architecture details.
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10. Access to MIS and Public Data

Management Information System (MIS):

- Internal MIS reports are generated (e.g., monthly demand vs. collection, number of connections, etc.).
- These reports are **not available to the public**.
- BWSSB does participate in **government data-sharing initiatives**, providing limited common datasets through platforms like "Sajala".

Performance Indicators:

- Key indicators tracked include:
 - **Demand and Collection**
 - **Water Consumption**
 - **Number of Active Connections**
 - **Non-Revenue Water (NRW)** (data obtained from another division)

Data Requests:

- The Japanese team requested monthly MIS data from **April 2024 to March 2025**.
- BWSSB agreed to share this upon receiving the official request via email.

Additional Information on Customer

- 1.2 million connections. BWSSB doesn't have service agreements with the customers.
- Only online applications are utilised for new connections now.
- No Service contract with customer. There is only an application for each customer.

Meeting Memo –Mr. V.B. Maheswarappa _Additional Chief Engineer (MIS & IT)

Date: 12:40-14:15 on July 25, 2025

Location: 7th floor at BWSSB Head Office, Kaveri Bhavan, Bengaluru

Attendees:

- JICA Consulting Team: Ohno, Ogata, Ohara, and Mr. Rohit (India)
- BWSSB: Mr. V.B. Maheswarappa, Additional CE (MIS & IT)

1. Introduction of IoT and AI Applications

- Participants discussed the use of **IoT (Internet of Things)** technologies in their water management systems.
 - Reference was made to **AI integration** in platforms similar to Blinkit and Swiggy as a commerce company, particularly in pre-management and complete service management.
 - These platforms are viewed as models for implementing AI in operational and inspection tasks.
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2. Online Consumer Connection System

- The **SAKALA system** was mentioned as part of the Karnataka government's initiative to ensure services are delivered within a stipulated timeframe.
 - BWSSB offers two types of customer connections:
 - **Domestic connections:** Must be completed within **14 days** after receiving the application.
 - **Commercial/apartment connections:** Require on-site verification and calculation of charges based on area (e.g., ₹ per square meter). Must be completed within **42 days** of receiving the application.
 - New water and sewerage connections are managed through **online applications**, eliminating the need to visit the office.
 - Application, tariff collection, and tracking are available via the website and mobile.
 - OTP (One-Time Password) based verification and SMS notifications are used.
 - The **application platform** is called **Jaladhare**, integrated with **SAJALA**, which is the billing & collection system including customer database.
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3. Digitalization of Billing and Revenue Collection

- Billing is categorized by:
 - Domestic (80% of customers in Bangalore),
 - Non-domestic,
 - Industrial/commercial (10–15%).
- Revenue significantly increased post the commissioning of the fifth stage project, with

monthly collection reportedly reaching ₹190–200 crore.

- **On-site Billing** and **biometric-based payments** have been introduced:
 - Meter readers use handheld devices with **GPS and GPRS** function.
 - Bills are generated and handed to the customers on-site and transferred to the servers in real-time.
 - **Biometric authentication** (e.g., fingerprint) ensures secure payments and prevents manipulation.
 - Use of **barcodes** on bills for easier identification.
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4. Billing Technology and System Evolution

- Historical billing practices involved manual reading, ledger entries, and high delays (up to 15 days) in bill delivery.
 - Transitioned to **WebApp-based billing architecture**, allowing data to flow via cloud systems with full centralization.
 - Introduction of **ECS (Electronic Clearing System)** allows direct bank deductions for recurring bill payments for certain kinds of customers.
 - Integration with **Bangalore One-stop Centers** enables citizens to pay water, electricity, taxes, and other dues at a single service center.
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5. MIS and Data Reporting

- **SAJALA** generates approximately **160–200 MIS reports**, including monthly and annual summaries.
 - These are used for data-driven decisions and operational monitoring.
 - **COVID-19 period** saw the issuance of **average bills via SMS** due to lack of field access, demonstrating system flexibility.
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6. New Connection Workflow and Delegation

- After an online application submission and documents are uploaded:
 - The application is routed to the **field office** and then escalated from the **Assistant Engineer** to the Head office, based on delegated authority levels.
 - Applications are tracked using OTP (one time password) and mobile authentication.
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7. Grievance and Compliance Management

- **24/7 complaint management systems** and **call centers** are in operation.
 - There is also a **compliance system** in place for real-time resolution tracking.
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8. Vehicle and Water Quality Monitoring

- GPS devices are installed on:
 - **Water tankers**
 - **Sewer jetting vehicles**

- All vehicle movements and water quality parameters are tracked through integrated systems.
- SCADA systems are being implemented or upgraded to facilitate real-time data transfer to central dashboards.

9. SCADA System Deployment and Integration

- SCADA systems have been implemented in **newly constructed WTPs/STPs**, while **older plants lack SCADA**.
- Real-time operational data (e.g., from WTPs, STPs, billing systems, complaint centers) will be integrated into a **centralized display hub**.
 - TV dashboards in officers' rooms are planned for live data monitoring.
- **SCADA modernization project**:
 - Migration from older SCADA hardware; only historical data shall be retained.
 - Full integration is an **ongoing 7-year JICA-funded project**, not yet completed.
 - Integration will begin post-completion, as outlined in the contractor's scope.

10. WTP and STP Network and Structure

- BWSSB operates nearly **37–38 STPs**, including secondary and tertiary plants.
- One major WTP site (TK Halli) is **90 km outside Bangalore**, at approximately **1000 feet elevation**, which sources water from the **Cauvery River**.
 - Water is pumped **three times** to reach Bangalore's altitude.
- **Six stages of water supply projects** have been developed:
 - **Stages I–IV**: Historical projects, already functional.
 - **Stage V**: Partially operational (capacity: 770 MLD), covers 110 villages.
 - **Stage VI**: Currently under DPR (Detailed Project Report) preparation; to use a source directly from KRS reservoir on Kaveri River.

11. JICA-Funded Projects

- **Stage V** is fully JICA-funded, including earlier stages (I, II).
- Integration with SCADA and IT platforms is part of JICA's financing scope (CP-24).
- Estimated total cost for the integration project is approximately **INR 160 crore**.

12. NRW (Non-Revenue Water) Management

- Previous NRW processes were **manual**: staff collected meter and receipt data from consumers.
- In the **UFW SCADA project established under Stage-4 Phase-II** **1500 electromagnetic meters** are in use, sending real-time data to a dedicated server.
 - Consumption vs. intake is monitored to assess water losses.
 - Historical projects involved **ultrasonic meters**, but accuracy degraded over time.

- BWSSB has introduced a **meter replacement policy**:
 - Domestic meters: every **10 years**
 - Non-domestic meters: every **7–8 years**
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13. GIS System Implementation and Certification

- BWSSB has a robust **GIS platform** (KGIS) developed by KSRAC, , integrated with field operations.
 - GIS maps include pipelines (line features), boundaries (polygon features), tanks/meters (point features).
 - GIS is used for planning, certification, and validation of infrastructure.
 - GIS data must be **certified before contractor's payments in construction works**:
 - Field engineers submit completion data.
 - GIS specialists verify and issue a **certificate**.
 - Without this certificate, payments to contractors are not processed.
 - This process was institutionalized around **2014–2015** and has been widely adopted by other departments as a best practice.
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14. GIS Map Acquisition and Digitization

- Initially, **Survey of India** and **NRSA** (National Remote Sensing Agency) provided large-format physical maps.
 - Later, digital transition enabled use of **satellite imagery** and **Google Maps**.
 - Early mapping was done via **aerial photography** from helicopters; current base maps are available via Karnataka Remote Sensing Application Center (KSRSAC).
 - **Digitized maps** now form the basis of the integrated GIS-Billing-Water management system.
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15. GIS and Billing System Integration

- GIS is now linked with:
 - Development management systems
 - Billing systems
 - Complaint tracking
- System architecture shifted from **standalone desktop installations** to **cloud-based web applications** with dashboards.
- Every infrastructure intervention (e.g., pipe laying) is geo-tagged and certified in the GIS for validation and audit trails.

16. Cybersecurity and Data Protection

- BWSSB is actively planning **cybersecurity enhancements** due to increased reliance on cloud and IT platforms.
 - Billing data is stored at the Karnataka **State Data Center (KSDC)**, managed

- by the **Government of Karnataka**.
 - A secondary **data node** is maintained in **Noida**, with potential backups for GIS and financial records.
 - Cybersecurity initiatives are expected to be advanced further through collaboration with the **CE's office** and key IT advisors.
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17. Conventional Billing System vs. Modern Digital Billing

- In the past, billing was conducted via manual processes:
 - Meter readers recorded values in notebooks, which were manually transferred into ledgers.
 - Billing involved **multiple weeks** of processing and hand-delivered printed bills.
 - **Cash collection clerks** were deployed in the field, leading to issues like **data inaccuracy** and **revenue leakage**.
 - Current billing system is **digital, centralized, and cloud-based**:
 - Shifted to **web applications** backed by **central databases**.
 - On-site billing devices (handheld terminals) are used for **real-time data entry** and **automatic bill generation**.
 - Barcodes and **biometric authentication (fingerprint)** ensure integrity of the process.
 - Billing architecture is now **fully paperless**, reducing fraud and improving efficiency.
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18. Digital Payment Mechanisms

- BWSSB has implemented diverse **consumer payment options**:
 - **Biometric verification** is required at multiple stages to authorize payments.
 - National Automated Clearing House (NACH) is a centralised system launched by National Payments Corporation of India (NPCI) with an aim to consolidate multiple ECS systems running across the country and provides a framework for the harmonization of standards & practices and removing local barriers/inhibitors. Electronic Clearing System (ECS) under NACH enables automated bank deductions of bills for retired people.
 - Integration with **Bangalore One-stop Centers** provides citizens a **single-window solution** to pay:
 - Water bills
 - Electricity bills
 - Taxes
 - Passport services, etc.
- Payment tracking:
 - All transactions are **geo-tagged** using **GPS**.

- The billing device logs **lat-long coordinates** and syncs with the central server using **GPRS**.
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19. Handheld On-site Billing Devices

- Modern spot billing terminals include:
 - GPS for location tracking of meter readers.
 - Instant bill generation and **real-time syncing** with the server.
 - Barcode scanning for easy tracking.
 - Devices are **Bluetooth-enabled** and reduce reliance on legacy loading via USB.
 - Consumers receive bills **instantly**, and payment can be made online **within 24 hours**.
 - Device architecture supports **MIS report generation**, allowing field managers to track productivity.
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20. MIS and Analytics Reporting

- BWSSB's billing and service platforms produce over **160–200 standardized MIS reports**.
 - These include:
 - Demand vs. collection reports
 - Meter reading logs
 - Connection application status
 - Tariff-wise categorization
 - Zone/subdivision performance
 - All reports are accessible through **SAJALA**, the integrated billing system.
 - During **COVID-19**, BWSSB continued operations by:
 - Issuing **average bills** based on 6-month consumption history.
 - Delivering bills via **SMS** linked to the consumer's mobile number.
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21. Digital Tariff and Service Architecture

- New tariff structures were implemented in **May in 2025**.
 - The application system for new water connections is streamlined via the website:
 - Users input mobile number → receive OTP → upload documents → auto-routing to appropriate field engineer → approval → connection.
 - The process is managed through **delegation-based workflow**, involving multiple authorities including the **CE**.
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22. Complaint Management System (CMS)

- A **24/7 grievance redressal system** is in place.
- All complaints (water quality, leakage, billing issues, etc.) are logged and tracked via integrated platforms.
- Field responses and resolution timelines are monitored centrally.

23. Rainwater Harvesting and Occupancy Regulation

- **Rainwater Harvesting (RWH)** is **mandatory** for all new constructions.
- Occupancy Certificate is an official, legally required document issued by a local municipal or development authority, certifying that a building's construction is complete and compliant with approved plans, building codes, and safety regulations, making it fit and safe for human habitation. Occupancy Certificates (OCs) are also **legally required** to obtain utility connections.
 - Enforced via Supreme Court rulings.
 - Buildings lacking OCs are denied water/electricity supply.
- STPs (Sewage Treatment Plants) are now **mandatory for apartment complexes**.

24. Political and Administrative Coordination

- BWSSB's service area spans:
 - **16 divisions, 43 subdivisions, and 143 service stations.**
 - GIS is used to **superimpose BWSSB zones** over **BBMP wards** for efficient coordination.
- Word-wise and division-wise data helps in political reporting, infrastructure planning, and fund allocation.

25. GIS-Based Infrastructure Certification and Anti-Corruption Measures

- BWSSB has institutionalized a **GIS-based certification process** to validate completed infrastructure works:
 - After completion of physical work (e.g., pipeline laying), **field engineers** input all material and alignment data into the GIS system.
 - The work must then be **certified by a GIS specialist**, confirming accuracy of:
 - Material type
 - Pipeline length
 - Location coordinates
 - Alignment with sanctioned work orders
- Only after GIS certification is submitted, the **accounts department** processes contractor payments.
- This has become a **standardized safeguard** against corruption and overbilling.

26. Field Validation and Length Verification

- Example: If a contractor claims 3 km of pipe was laid, but actual verified GIS data shows only 2 km, payment is adjusted accordingly.
- Each work order and pipe-laying activity is verified against:
 - **Tender specifications**
 - **GIS maps**

- **Actual field conditions**
 - This process ensures **financial accountability** and **prevents fabrication of progress**.
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27. Standardization and Influence on Other Agencies

- The GIS certification framework was first implemented by BWSSB around **2014–2015** and was later presented in Delhi.
 - As a result, the **format and process were adopted by other departments** at state and national levels.
 - The initiative is considered a model for **data integrity and transparency** in infrastructure projects.
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28. GIS Software Platforms: ESRI and Bentley

- BWSSB primarily uses **ArcGIS** developed by **ESRI (Environmental Systems Research Institute)**.
 - ESRI software is globally recognized and used for:
 - Layered mapping
 - Infrastructure analysis
 - Spatial data certification
 - **Bentley Systems** is now also being explored or partially implemented as an alternative or complementary platform.
 - ArcGIS remains the **core GIS engine**, especially for certification and integration with billing and asset management.
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29. National and State-Level Recognition

- BWSSB received:
 - **National Award (2009)** for excellence in **revenue billing**, presented by the then **President of India (Ms. Pratibha Patil)**.
 - **State Award** for the same initiative.
 - Recognition was granted for achieving:
 - Full metering coverage
 - Transparent billing processes
 - Efficient customer service
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30. Data Accuracy and Centralized Control

- All data (billing, GIS, assets, SCADA, complaints) is controlled centrally:
 - A **single administrator** or team is responsible for compiling and presenting integrated data.
 - Presentation materials and dashboards are **internally prepared** for both internal management and external visitors.
- This centralized approach reduces inconsistency and ensures **single-source truth** across

departments.

31. Web GIS and Real-Time Dashboard

- BWSSB operates a **web-based GIS platform** (KGIS) developed by Karnataka Remote Sensing Application Center.
 - The platform includes:
 - Real-time dashboards
 - Layered asset views (pipelines, valves, tanks)
 - Zone, subdivision, and ward overlays
 - Map entry is conducted using authenticated credentials, and **data is locked after certification**.
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32. Historical Mapping Challenges and Evolution

- Early GIS work required:
 - Purchasing **paper maps** from **Survey of India**
 - Conducting **aerial photography** using helicopters (via NRSA – National Remote Sensing Agency)
 - Manual digitization of data into GIS platforms
 - Now, **Google Maps** and **satellite imagery** are used to base-map layers, improving:
 - Field accuracy
 - Visualization
 - Speed of updates
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33. Future Roadmap and Upgrades

- BWSSB is constantly upgrading its systems based on:
 - Emerging technology trends
 - Feedback from international partners and government mandates
 - Systematic reviews of data performance
 - Planned or ongoing enhancements include:
 - **Stage VI DPR finalisation and approval**
 - **Expanded SCADA integration**
 - **Cybersecurity hardening**
 - **Cloud-first architecture**
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34. International Collaboration and Knowledge Sharing

- The SCADA, GIS, billing, and IT integration models are frequently presented to:
 - International development agencies (e.g., JICA)
 - National peer utilities
 - Academic and policy delegations
- BWSSB considers itself an **IT-driven pioneer among Indian utilities**, with replicable

practices in:

- Asset validation
 - Digital billing
 - Infrastructure traceability
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35. Final Remarks and Visit Coordination

- Arrangements were confirmed for site visits to:
 - **WTP at TK Halli (Stages 1 to 5, ~90km from Bangalore)**
 - **SCADA-monitored STPs**
 - **BWSSB's Data Center or GIS Command Center at Shimsha Bhavan**
- Contact persons' (e.g., **Mr. Naresh**, Executive Engineer) and mobile numbers were shared for logistics.
- Delegation members were advised to start early due to travel distances and site coverage plans.

Meeting Memo –Mr. Chandrasekhar, Executive Engineer

Date: 15:15-16:00 on July 25, 2025

Location: 9th floor at BWSSB Head Office, Kaveri Bhavan, Bengaluru

Attendees:

- JICA Consulting Team: Ohno, Ogata, Ohara, and Mr. Rohit (India)
- BWSSB: Mr. Chandrasekhar (Executive Engineer), Design Section

1. IoT Implementation for Borewell Monitoring

1.1 Overview

- BWSSB manages approximately 16,000 public borewells in its jurisdiction. Currently, no consistent groundwater table data is available.
- To address this, BWSSB has initiated a tender to install IoT devices on these borewells.

1.2 Objectives of IoT Devices

- Monitor:
 - Groundwater levels
 - Discharge rates
 - Total water volume consumed
 - Power usage
 - Pump operating hours
- Automatically shut down pumps during:
 - Overload
 - Underload
 - Dry run
- Prevents pump motor burnouts and reduces maintenance burden.

1.3 Real-Time Monitoring System

- A dedicated web application developed for this project:
 - Covers all 198 BBMP wards.
 - Displays borewell locations equipped with IoT sensors.
 - Enables online monitoring and control (on/off switching).
 - Provides power analytics (voltage, current, total consumption).
 - Logs operational events with timestamps.
 - Sends failure alerts via Telegram.

1.4 Pilot Implementation

- Initial trial includes 3,000 borewells.
- Full data acquisition within 3 months is expected.
- Web application demo was shown; in-person or video demonstrations are also available.

2. Project Implementation Partners

- Two main contractors:
 - **Mr. Satish**

- **Mr. Veerabhadrapa (working with Krishi Hrudaya Pvt. Ltd., Bengaluru a company engaged in R&D)**
- Krishi Rudaya has an MOU with the Indian Institute of Science (IISc), Bangalore.
- The data collected is shared with IISc who are monitoring the study, including:
 - Monitoring of groundwater levels
 - Validating discharge rates and other parameters

2.1 Technical Collaboration

- Previously, the Karnataka Groundwater Directorate conducted random sampling (40–50 samples across Bengaluru).
 - With IoT deployment, BWSSB will obtain:
 - Exact water level depth
 - Borewell-specific water consumption
 - Energy usage metrics
-

3. Benefits of IoT Deployment

- **Preventive maintenance:** Real-time alerts and automatic shutdowns reduce the likelihood of pump failure.
- **Operational efficiency:** Eliminates the need for manual checks and reactive maintenance based on complaints.
- **Data-driven decision-making:** Enables year-round monitoring and regulatory control over groundwater extraction.
- **Support for sustainable management:** Sharing of extracted data with IISc to analyze and manage groundwater tables.

4. “Kaveri on Wheels” Project

4.1 Overview

- A digital water delivery initiative using **treated Cauvery River water**.
- BWSSB developed a **mobile app** (similar to Uber/Ola) enabling users to book tankers.
- Aimed at supplying water to areas **lacking piped water connections**.

4.2 App Features

- Consumers can select tanker’s volumes: **4,000L, 5,000L, 6,000L, or 12,000L**.
- Rates are **government-approved** and more affordable than private tankers.
- After booking and payment:
 - The app allocates one of BWSSB’s based on proximity to Ground Level Reservoirs (GLRs).
 - Drivers use **RFID cards** to initiate filling.
 - **IoT devices** monitor the flow during filling.
 - Customers can track delivery in real time and confirm receipt using **OTP authentication**.

4.3 Technology Use

- IoT devices are installed at all filling points.

- System ensures:
 - Accurate monitoring
 - Timely and transparent deliveries
 - Efficient tanker assignment and routing
-

5. Impact of “Kaveri on Wheels”

5.1 Market and Environmental Benefits

- Previously, **private tankers** charged ~₹1,000 per delivery and used groundwater.
- The new service:
 - **Lowered rates** to ₹400–500 per tanker
 - **Introduced competition**, forcing private operators to reduce prices
 - **Reduced dependency on groundwater**, promoting surface water use
 - Delivered **treated and quality-assured water**

5.2 Social and Policy Significance

- Created an equitable pricing model
 - Expanded water access in underserved neighborhoods
 - Improved public trust in government service delivery
-

6. Challenges in Digital Transformation

6.1 Operator Resistance

- Initial reluctance from field operators to share data (e.g., pump operation hours)
- Manual workflows hindered early adoption of IoT and SCADA
- Resistance is now **declining** as the system proves its value

6.2 Awareness and Acceptance

- **Cultural change** needed to shift from manual to digital operations
- Continuous **awareness building** is crucial

6.3 Capital and Technical Barriers

- High **capital investment** needed for SCADA systems in the **distribution network**
- Currently, SCADA is only available for **bulk flow meters on feeder lines >300 mm diameter**
- Smaller distribution pipes are **not yet integrated**

7. Future Digital Initiatives

7.1 Smart Meters for Individual Consumers

- A proposal has been submitted to:
 - Integrate individual consumers into the BWSSB digital network
 - Install **smart meters** with **automatic controllers**
 - Align water supply with **demand-based regulation**
- Current status:
 - Only **manual meters** are in use

- Discussions underway for pilot implementation

7.2 Prepaid Metering Possibilities

- Inspired by the **power sector**, BWSSB is considering **prepaid water meters**
 - Challenges:
 - **Technical feasibility** is confirmed
 - **Social acceptability** is a major hurdle
 - Consumers may resist prepayment for essential services
 - BWSSB sees potential if customer awareness improves
-

8. Current Digital Systems in Operation

8.1 Active Platforms and Tools

- **IoT** for borewell monitoring
- **Cauvery RMS** for resource management
- **Oracle ERP** for financial systems
- **SCADA** system for:
 - Main feeder pipelines
 - Cauvery Stage V project (recently commissioned)
- **SAJALA** (e-portal for online water connection applications)
- **Online billing** system
- **e-Office** system for administrative file movement

8.2 Functional Scope and Integration

- SCADA is currently limited to larger transmission lines
 - SCADA for **distribution networks** is not yet implemented
 - Integration among various platforms is **fragmented**
 - No **centralized dashboard** or unified digital architecture yet
-

9. IT Staffing and Organizational Capacity

9.1 Human Resource Challenges

- Severe shortage of **qualified IT personnel**
- No current **IT-specific staffing plan**
- IT responsibilities are managed by existing general staff

9.2 Anticipated Measures

- Following the expansion of the **Greater Bangalore** area:
 - BWSSB plans to **form a staffing assessment committee**
 - Aim: define future human resource needs for IT and digital operations
-

10. Digital Transformation Strategy

10.1 Current Status

- BWSSB lacks a **formal digital transformation master plan**
- Adoption of digital tools and apps has been **ad-hoc** and **department-specific**

10.2 Leadership and Vision

- The **BWSSB Chairman** supports digital adoption “wherever possible”
- There is growing awareness of the need for:
 - **Strategic planning**
 - **System integration**
 - Unified **digital governance framework**

10.3 Future Outlook

- A **comprehensive digital master plan** is recognized as a necessary next step
- Planned expansion of e-office to **technical sections**
- Goal: establish consistency and interoperability across systems

11. Asset Management Systems

11.1 Existing Limitations

- Participants inquired about BWSSB’s **asset inventory and planning system**.
- The current system (TIS) was acknowledged, but:
 - There is **no integrated asset management platform**.
 - Planning, inventory tracking, and lifecycle management remain **partially digitalized**.

11.2 Observations

- A more **comprehensive asset management environment** is needed to support:
 - Infrastructure planning
 - Predictive maintenance
 - Real-time performance tracking
-

12. NRW (Non-Revenue Water) and Contacts

12.1 NRW Management

- A reference was made to BWSSB’s **UFW-II division**, which monitors unaccounted-for water.
- The team was advised to connect with an officer stationed **in UFW-II division**, who is knowledgeable about NRW measurement.

12.2 Follow-up Coordination

- Suggestions were made to:
 - Share relevant WhatsApp contact details
 - Coordinate with the Chief Engineer’s office for further meetings
 - Connect with the technical section on the **third floor** for further details
-

13. Participant Q&A and Follow-up Items

13.1 Digital Transformation Strategy

- Participants requested clarification on whether a **master plan for digitalization** exists.
- BWSSB confirmed:
 - No formal strategy document exists yet

- Digital tools are adopted in a **piecemeal fashion**
- Leadership is supportive, and strategic planning will be pursued

13.2 Technical Proposal Requests

- BWSSB was asked to share:
 - Installation videos of IoT systems
 - Specifications and technical documentation
 - Work orders and terms of reference (ToR) for the borewell IoT implementation

13.3 Phase VI Cauvery Project

- Participants asked about:
 - The **scope and source** of water for **Stage VI** (Cauvery)
 - Digital tools used for **hydraulic modeling** and **system design**
 - BWSSB noted that a separate **project wing** is managing the planning, and details can be provided through a dedicated contact.
-

14. Closing Remarks

14.1 Summary Points

- The meeting highlighted:
 - Promising digital innovations (e.g., IoT borewell monitoring and Cauvery on Wheels)
 - Tangible impacts on service quality and cost reduction
 - Recognition of challenges in staffing, system integration, and strategic planning

14.2 Next Steps

- BWSSB agreed to:
 - Share relevant technical documentation and contact points
 - Consider forming a **digital transformation committee**
 - Explore ways to strengthen digital infrastructure through staffing, planning, and cross-platform integration

Meeting Minutes – Mr. K.N. Rajiv (Chief Engineer (Project Department))

Date: 16:05-16:30 on July 25, 2025

Location: 3th floor at BWSSB Head Office, Kaveri Bhavan, Bengaluru

Attendees:

- JICA Consulting Team: Ohno, Ogata, Ohara, and Mr. Rohit (India)
- BWSSB: Mr. K.N. Rajiv, Chief Engineer (Project)

1. Purpose of Visit

The JICA consulting team visited the BWSSB Design Section to gather detailed insights into digital tools and methodologies used in water resource planning studies, particularly in the context of the Detailed Project Report (DPR) for Stage 6.

- The team explained that their focus was not on project financing or approvals but on understanding digital and technical tools used in survey, planning, and design.
- The BWSSB official acknowledged the request and agreed to share relevant information while withholding the actual DPR document.

2. GPR Stage 6 – Project Scope and System Overview

Key Project Features:

- **Objective:** Transport 500 MLD (million liters per day) of water from the Kaveri River reservoir to Bengaluru.
- **Distance:** The source lies approximately 80 to 200 kilometers from the city (reservoir of KRS dam on Kaveri River).
- **Digital Systems in Place:**
 - **SCADA Systems:** Installed at intakes, GLRs (Ground Level Reservoirs), and integrated with central IT systems.
 - **Flow Meters:** Deployed throughout the network to measure intake, treatment, supply, and delivery at GLRs.
 - **Real-Time Monitoring:** The system supports complete flow tracking from the reservoir through to the end distribution points.
- **Source Water:** Directly drawn from a perennial KRS reservoir on Kaveri River.

3. Digital Tools Used for Survey and Hydraulic Planning

Survey and Design Tools:

- **Topographic Surveys:** Conducted using Total Stations across the entire route alignment.
- **Design Software:**
 - **AutoCAD:** Used for layout and structural drawings.
 - **Bentley WaterGEMS:** Used for hydraulic modeling.

- **Additional Technical Testing:**
 - **Water Hammer Tests:** Conducted particularly for gravity-fed pipeline sections.
 - The system consists of segments alternating between pumped and gravity flow lines.
 - **Energy Efficiency:**
 - Power consumption is reportedly 30% lower per MLD of water conveyed compared to earlier stages.
 - The project is financially structured to achieve full cost recovery within 10 years.
-

4. Smart Metering Initiative under Digitalization

Project Overview:

- **Scope:** Installation of **100,000 smart meters** for **bulk and non-domestic consumers**.
 - **Consumer Base:**
 - BWSSB has approximately **1.2 million connections**.
 - Of these, **30% are non-domestic consumers**, but they account for **70% of total revenue**.
 - **70% are domestic consumers**, contributing only **30% of revenue**.
 - **Technology:**
 - Smart meters will utilize **LoRa (Long Range Radio) technology** for automated, remote meter reading.
 - **Implementation Model:**
 - **Public-Private Partnership (PPP)** model.
 - A private agency will install and maintain the smart meters.
 - The agency will also collect readings for the next **10 years**, with payments linked to performance.
 - **Objectives:**
 - Eliminate human involvement in meter reading to **reduce manipulation** and **increase revenue accuracy**.
 - Improve billing precision and encourage timely payments.
 - Anticipated **revenue increase of around 5%** by avoiding tampered readings.
-

5. Domestic Consumers and Digital Metering

- The official clarified that while domestic consumers form the majority, investment in their smart metering would not yield a proportional return.
 - Therefore, priority is given to **commercial and high-priority consumers**.
 - **Strategic Focus:**
 - Improving efficiency and reliability of readings for revenue-critical consumers.
 - **No immediate plans** for smart metering domestic connections due to limited cost-benefit justification.
-

6. Current Meter Reading Practices and Future Transition

- **On-site Billing:**
 - BWSSB currently deploys meter inspectors for every ~3,000 connections.
 - Readings are entered via GPS-enabled devices.
 - Payments are processed **entirely online**, via:
 - **Kiosks**
 - **Electronic Clearing System (ECS) under NACH**
 - **No cash handling**
 - **Transition Plan:**
 - Existing meter readers will not be laid off.
 - Instead, they will be **reassigned to other departments** to avoid labor disputes and maintain workforce stability.
 - This approach avoids **social disruption** and **union resistance**, unlike in some other countries.
-

7. Management of Illegal Connections

- The BWSSB official acknowledged the issue of unauthorized water connections in some areas.
 - **Estimated Scope:**
 - Approximately **1–2%** of the network may consist of illegal connections.
 - **Enforcement Measures:**
 - Regular **detection drives** are conducted in collaboration with:
 - **Police**
 - **Meter readers**
 - Identified cases are penalized through:
 - **Fines**
 - **Potential imprisonment**
 - **Public Awareness:**
 - Campaigns through newspapers, loudspeakers (mics), and handbills are used to warn the public and promote regularization.
 - **Objective:**
 - Encourage offenders to come forward and legalize their connections to protect the financial integrity of BWSSB.
-

8. Closing Notes and Forward Steps

- BWSSB appreciated the dialogue and expressed readiness to share further non-confidential information in future engagements.

Meeting Minutes – NJS Engineers India Pvt. Ltd.

Date: 10:30-12:00 on July 28, 2025

Location: 9th floor at BWSSB Head Office, Bengaluru

Attendees:

- JICA Consulting Team: Ohno, Ogata, Ohara, and Mr. Rohit (India)
- NJS Engineers India Pvt. Ltd.: Mr. Pradipto Sarkar, Director, and Mr. Nizamuddin Ahmed, Sr. Vice President.

This memo summarizes the findings and ongoing work as discussed in the interview, highlighting the technical, operational, and managerial considerations shaping the CP-24 integration initiative for BWSSB and JICA. This memo condenses on-the-ground realities and expert recommendations and emphasizes the need for robust planning, accurate mapping, reliable power, and long-term maintenance investments to ensure future system sustainability and operational control.

Project Overview

- Project Name: Design Engineering Construction, Commissioning of Centralized SCADA Centre for Monitoring & Control of Water Treatment Plants and Distribution System, Sewerage SCADA for monitoring of all Sewerage Facilities of BWSSB with Comprehensive Operation and Maintenance for 7 years (DBO Package No. BWSSP/JICA/CP-24)
- The project aims to integrate water supply, distribution and sewerage SCADA systems of BWSSB (Bangalore Water Supply and Sewerage Board) into a single centralized monitoring centre and analytical dashboard.
- The scope of the project includes and integration of all WTPs, PS, STPs, distribution network (including existing UfW SCADA), with installation of flow and pressure recording meters at location of all Ground Level Reservoirs (GLRs) – approx. 100 nos. and at 100 strategic locations in the distribution network for eg. where water quality and other issues are observed.
- Monitoring of water quality and pressure shall be carried out from a centralised location for data-driven decision-making for supply and network management.
- It will be a first of its kind centre in the region where both water supply and sewerage are getting integrated. Most of the latest technology as envisaged in 2019-20 during planning stage is being incorporated into the system.
- Upon commissioning it would be one of the largest JICA would have funded under monitoring systems.

Implementation Details

- System Integrators: Chavare Engineering Pvt. Ltd. (SI for Mitsubishi, handling a majority of the plants), Anderson Hauser A&H (supply of flow meters).
- Other vendors for hardware include: Siemens, Schneider, Allen Bradley. Japanese systems dominate, with 80% market share in installations. Pumping stations are supplied by Mitsubishi electric, STP projects: CP-25 with Mitsubishi, CP-26 will Schneider and CP-27 with Siemens.

- In CP-24 project there is a provisional sum kept for hardware gateway requirements etc. if identified for integration.
- Current Status:
 - Implementation is ongoing, with flow meters and integration work expected to complete by year-end, but may be extended by up to 3 months due to third-party dependencies.
 - Central Monitoring: Monitoring centre at Shimsha bhavan already operational (95% complete). Real-time data is coming in; some minor civil works remain.
 - WTPs being connected through both Fiber Optic Cables (FOCs) and GPRS, while STPs being connected only through GPRS (as only influent and effluent parameters are to be measured). Laying of FOCs mostly completely except for 5 km stretch from TK Halli to Vajrahalli pending.
 - The Phase-IV Stage-5 WTP (770 MLD) and Pumping Station at TK Halli is already integrated, and integration is in progress for Stage-4 Phase-II WTP (550 MLD). While Stage-4 Phase-II Plant is easier as it was planned for JICA integration, for earlier WTPs, integration requires certain hardware installations by respective contractors, and works are currently in progress for third party integration. Cabling and hardware mapping are mostly complete; software mapping is also completed. Issues faced involve compatibility across legacy (older) projects and third-party contractors. Currently WTP (770 MLD) and Pumping Station at TK Halli are connected through wireless, till cabling is completed.
 - Approximately 60% of GLR locations have been integrated and commissioned and the remaining are in process.
 - 70% of STPs already integrated and inlet outlet parameters being monitored. 33 STPs real-time WQ monitoring established, 15 in process.
 - UFW SCADA was established under Stage-4 Phase-II, with flow meters established at strategic locations in DMAs covering 40 percent of the entire area. Under CP-24 survey is currently in progress at locations of different flow meters to determine the exact locations, integration requirements and compatibility issues.

Monitoring System:

- Executive Engineer and Assistant Executive Engineer of BWSSB, and other stakeholders are posted at SCADA Centre at Shimsha Bhavan itself for immediate decision-making.
- Local and central O&M divisions actively maintain the network. Alerts/notifications are planned to be sent to relevant personnel depending upon area of concern and criticality of the issue.
- Currently UfW SCADA utilised by UfW section for DMA (District Metered Area) level monitoring for NRW (Non-Revenue Water) calculation to some extent. Survey in progress to integrate this system into the central system.
- Pumping stations: Some GLRs (Ground Level Reservoirs) and transmission lines (e.g., Hara Halli, TK Halli) have their own pumping stations, while direct pumping to distribution network has been reduced over time.
- All data under the scope of this project shall be recorded by the system and fed into SCADA including water quality data, demand and supply, flow, pressure, losses etc.

Control:

- The current scope of the CP-24 project focuses on monitoring and data analytics, and not on control. It focuses on the mandate of BWSSB for equitable distribution of water in the entire area.
- As operators mostly differ at each plant, centralized end-to-end control is not currently envisioned due to operational complexity.
- In the distribution system there is manual operation of valves, and no automated distribution control yet exists due to incompatibility of legacy hardware and power supply issues.
- **Two pilot projects currently under discussion in smaller DMAs for monitoring, control and scheduled operations of valves in the distribution system. Based on the experience of these pilot projects, future expansion will be planned and slowly the works are envisioned to be scaled up to include other DMAs.**
- Flow meters can operate on batteries, but actuated valves and other field devices require dependable power. Power supply and theft are major concerns at distributed and exposed points.
- The location of valves and meters is often problematic. Many were originally installed at street corners, but upgrades place them at the center of the street—sometimes requiring pipeline rerouting for actuator valve installations.
- Sometimes actual field locations may not match digital maps. Pipeline depth has also increased, causing further complications.
- Installation is difficult in many cases as per available mapping records,
Network Architecture, Communication & Control.

Parameter Monitoring & Laboratory Management

- Under CP-24, flow meters are being established to monitor 4 parameters for both inlet and outlet lines at GLRs.
- Major WWTPs monitor up to 15 parameters, while laboratory analysis is managed through Laboratory Information Management Systems (LIMS) for all treatment plants.

Challenges & Considerations

- **Integration:** Significant effort spent integrating older systems and aligning multiple stakeholders from various divisions and contractors.
- **Automation Limitations:** Automated valves and controls are absent due to legacy infrastructure (thousands of manual valves).
- **System Compatibility:** Not all valves/equipment are compatible with automated control; evolving technology leads to rapid obsolescence.
- **Distribution:** City's large area (800 sq. km) presents scaling challenges for centralized control; intermittent supply complicates automation. There are thousands of valves; a small DMA of 5 sq. km has over 25 valves, and many might not be compatible to be controlled, as these were established at different stages over a period.
- **Power supply** remains the biggest challenge for establishing remotely

operated/automated control —especially at distributed, theft-prone field sites.

- The location and depth of infrastructure often differ from digital maps, making device installation, upgrades, and repairs difficult.
- Operation and maintenance (O&M): Adequate funds and continuous maintenance are essential for sustainability.
- Maintenance and Monitoring: There is currently no routine active leak detection; efforts are sporadic or project specific. Incentives and capacity building for leak detection are recommended.

Future Roadmap

- Immediate Goals: Complete integration by year-end (or shortly after extension), with all flow meters and crucial WQ instruments installed and centralized.
- Commissioning: CP-24 is positioned to become a major JICA-driven achievement for integrated water infrastructure monitoring in Bangalore.
- Long-Term: Anticipate rapid technology changes and potential future upgrades; linkage with management dashboards is planned upon full operationalization.
- Vision: Move towards unified, data-driven analytics for both water and sewage at city scale, with real-time quality and pressure data.
- Analysis and AI: Advanced, AI-driven analysis for loss detection and non-revenue water (NRW) is being considered for future integration once the project works at the IT and OT end are completed.
- Making use of other latest technologies such as ‘digital twins’ may also be considered for implementation in the future. One of the challenges for technology is the rapid pace of development, something cutting edge at current stage may not remain so in a couple of years’ time.
- Need recognised to move towards monitoring of entire distribution system and also control (remote/automated), which still remains one of the most significant challenges.
- Continuous monitoring for leaks and more advanced analytics is also recognized as one of the future needs.
- Mandates & Regulatory: Regulatory focus is on water quality, equitable distribution of water, NRW assessment, and demand/pressure management, rather than drought prediction.

Recommendations

- Secure dedicated funds for maintenance in addition to initial installation of the latest systems.
- Investigate theft-resistant, alternative power solutions (e.g., solar/battery) for remote-field equipment.
- Prioritize updating records and conducting field surveys before embarking on extensive automation upgrades.
- Strengthen O&M teams with ongoing training, leak detection tools, and advanced analytics skills.

- Enforce greater coordination among multiple stakeholders (contractors, plant/division operators, contractors) to address legacy integration and operational bottlenecks.

Meeting Minutes –Ms. Laxmi, Executive Engineer, IT Section

Date: 11:50-13:15 on July 28, 2025

Location: 7th floor at BWSSB Head Office, Kaveri Bhavan, Bengaluru

Attendees:

- JICA Consulting Team: Ohno, Ogata, Ohara, and Mr. Rohit (India)
- BWSSB: Ms. Laxmi, Executive Engineer, IT Section

1. Introduction

- Ms. Laxmi explained about BWSSB MIS initiatives and water supply improvement programs, emphasizing support to underserved and non-pipeline areas.
- JICA survey team explained the scope of JICA DX project, and mentioned future plans to conduct similar interviews and development needs assessments in Cambodia.
- Ms. Laxmi highlighted establishment of latest initiatives such as 'Sanchari Kaveri', or 'Kaveri on Wheels' aimed at providing water via tankers to areas lacking piped water access.

2. Overview of “Kaveri on Wheels” (Launched May 9, 2023)

- Purpose: Deliver water to 110 villages where piped supply has not started or is insufficient Also caters on-demand basis to orders from apartment complexes etc.
- Setup: 110 access/filling points established out of which 80 are Ground Level Reservoirs (GLRs). These access points are called Cauvery Connect Centers (CCCs).
- Target Users: Areas with no pipelines or intermittent water supply.
- Consumer Access:
 - Mobile application developed for water requests and tracking.
 - Approximately 6290 consumers registered as on the date of the meeting.
 - More than 8869 orders were fulfilled over 2.5 months.

3. Operational Model

- **Tanker Fleet:**
 - 271 tanker owners registered; 281 tankers offered.
 - 185 tankers approved (54 government, 131 private).
 - Tanker sizes: 4,000, 5,000, 6,000, and 12,000 liters (12,000 liters most popular).
 - Formal one-year contracts with private tanker operators create employment and reduce "tanker mafia" dominance.
- **RFID & GPS:**
 - Drivers use Radio Frequency Identification (RFID) cards for authentication.
 - Vehicles are GPS-tracked from order assignment to delivery completion.
- **Service Area:**
 - Users are bound to GLRs within 5 km radius; 3 GLR options per user depending on water/tanker availability.

4. Technology & Order Management

- Order assignment is automated (not AI-based), based on tanker proximity and availability.
- GLRs have sanctioned daily capacity (e.g., 80,000 liters).
- Orders follow statuses: Confirmed, Assigned, Pending, Rejected.
- Completion involves OTP verification by drivers.
- All payments are processed online.
- Bulk booking system available for apartments and institutions requiring recurring deliveries.

5. System Architecture & Platforms

- Developed through a tender with Info Share, supported by BWSSB IT Department.
- Platforms:
 - **Frontend:** .NET
 - **Mobile Apps:** Flutter
 - **Database:** MySQL
 - IoT integration via APIs
- Data Management:
 - Databases cover consumers, vendors, drivers, IoT devices, GLRs, tankers, and orders.

6. Integration with Other Systems

- **SAJALA:** Separate billing system for consumers connected to the piped network. Manages meter-based spot billing via handheld devices.
- **Kaveri on Wheels** operates independently of Sajjala and serves both registered and unregistered consumers.
- Multiple user roles supported with distinct logins:
 - Drivers, vendors, AEEs (Assistant Executive Engineers), and IT administrators.
- **System Admin** manages GLR activations, RFID issuance, and database-level controls.

7. Monitoring and Control Mechanisms

- Each GLR is equipped with IoT-enabled flow meters and cameras.
- Automated dispensing is triggered upon valid order confirmation, with auto shut-off based on volume and tank levels.
- Inactive GLRs are tracked and flagged for technical issues.
- Admins monitor tank capacities and daily consumption to balance tanker and piped distribution.

8. Financial Performance

- Between May 9 and the meeting date (~2.5 months), the system generated approximately ₹1.8 million in revenue.
- Bulk orders (e.g., apartments) pay in advance by cheque addressed to the AEE chairman.
- Financial application details to be provided by Mr. Prakash (Finance Department).

9. GIS-Based Asset Management System

- GIS covers:
 - Water lines, sewer lines, manholes, valves
 - Pumping stations, STPs (Sewage Treatment Plants), WTPs (Water Treatment Plants), GLRs
- Attributes tracked:
 - Year of construction, depth, length, material
- Tools:
 - ArcGIS used for mapping.
 - Integration with KGIS (Karnataka GIS) and KSRAC (Karnataka State Remote Sensing Application Centre).
- **Phase 1:** Base map correction, attribute alignment, and data streamlining.
- **Phase 2** (planned): Automatic certificate generation, improved data entry, and possible drone mapping.
- 80–90% asset data currently updated in the GIS.

10. Lifecycle & Maintenance Planning

- While lifecycle automation is not yet implemented, staff use GIS queries to identify old pipelines for replacement planning.
- Preventive maintenance is manually managed using construction year and inspection updates.

11. Additional Digital Applications

- **Biometric Attendance System:** Biometric authentication app for all employees, for staff time management.
- **Vehicle Tracking System:** Private cloud services website maintenance by IT department vehicle tracking system for all 218 BWSSB vehicles including water tankers and machinery.
- **Parisara Jalasnehi app** for purchasing STP treated water usually ordered for construction purposes.
- **No-Objection Certificate (NOC) Application System:**
 - Required for:
 - Residential buildings ≥ 20 flats
 - Commercial properties $\geq 2,000$ sq. m
 - Educational institutions $> 5,000$ students
 - Builders must seek approval from BBMP, BWSSB, Pollution Control Board, and others.

12. Sakala Integration and Compliance

- Sakala: Karnataka state e-governance initiative for time-bound public service delivery.
- Integrated with:
 - Complaint Management System
 - SAJALA (billing)

- NOC application process
- Example timelines:
 - Water/sanitary complaints: 3 days
 - Residential water connection: 15 days
 - Florida-type developments: 48 hours
- Monthly Sakala review meetings are held.
- Public dashboard available on Sakala portal; government uses it to track performance and delays.

13. IoT and Borewell Monitoring

- Total borewells in the system: around 16,000
- IoT-based monitoring is being implemented:
 - Pilot testing of **AI-based borewell monitoring** is underway.
 - Includes tracking water levels, pump performance, and potential anomalies.
- **Key Contact:** Mr. Chandrashekhar (in charge of borewell monitoring and data collection)
 - He will provide the Terms of Reference (ToR) and further technical details.
 - Noted that some borewell data was already shared; remaining will be provided later.

14. Consumer and Complaint Data Management

- **Consumer data** is treated as a core asset:
 - Includes GPS-tagged locations, order history, and payment records.
 - Collected via app usage and spot billing devices.
- **Complaint Management System:**
 - Integrated into Sakala for timely resolution.
 - Daily reports generated and monitored.
 - Includes auto-logging of complaints related to water supply and sewerage.

15. Infrastructure and Hosting

- All digital applications (e.g., SAJALA, Kaveri on Wheels, NOC, biometric, vehicle tracking, Jalasnehi etc.) are hosted on a **private cloud** maintained in-house.
- Applications and website are managed centrally by the BWSSB IT department.

16. Financial Systems and Documentation

- **Finance Department** (Mr. Prakash, Accounts Section) manages:
 - Contractor payments
 - Billing systems
 - KPI reports
- JICA Survey team agreed to sit with the finance team to finalize which documents will be shared.
- **Requested items** include:
 - Vision documents

- Master plan
 - MIS reports
 - Financial system specifications
- KPI data such as collection ratio, metering ratio, and staff per 1,000 connections are available.

17. System Documentation and Information Sharing

- Visitors requested:
 - System design documents
 - Specification sheets
 - Application screenshots
 - Architecture diagrams showing integration across systems
- MSIC agreed to share major app documents including:
 - Kaveri on Wheels
 - SAJALA billing
 - Complaint management
 - NOC application system
 - Parisara Jalasnehi
- Clarified that smaller sub-applications will not be documented unless essential.

18. Future Upgrades and Development Plans

- GIS Phase 2 will aim to:
 - Enable **automated certificate issuance**
 - Improve accuracy of spatial data
 - Possibly adopt **drone-based mapping** for better resolution
- Current challenges:
 - Data entry inconsistencies
 - Lack of topology completeness
- BWSSB has requested enhanced features from KSRAC for smoother GIS input.

19. Concluding Notes and Next Steps

- Parties agreed to consolidate all shared data and documents into a common digital repository.
- Meeting attendees will reconvene with the finance department for pending financial documentation.
- Field validation and follow-up will be done jointly with local officers (e.g., AEEs).
- Acknowledgment of the strong performance by BWSSB in digital service delivery and integration under Sakala.

Meeting Memo –Mr. Prakash (Accounts Section)

Date: 13:15-14:45 on July 28, 2025

Location: 1st floor at BWSSB Head Office, Kaveri Bhavan, Bengaluru

Attendees:

- JICA Consulting Team: Ohno, Ogata, Ohara, and Mr. Rohit (India)
- BWSSB: Mr. Prakash, Accounts Section

1. Overview of Current Systems and Digital Transformation Plans

- BWSSB is undergoing major digital reforms to replace manual systems with integrated digital platforms.
- Key software systems under development or implementation:
 - Work Management System (WMS)
 - Human Resource Management System (HRMS)
 - E-Filing System for administrative correspondence
- These systems are being developed by the **Center for e-Governance**, a Karnataka state government institution.

2. Work Management Software (WMS) Implementation

- Purpose: Integrate the entire workflow from estimate preparation to contractor payment.
- Timeline:
 - Full implementation targeted for **September 1, 2025**.
 - Current completion rate: ~25%.
- Features
 - Customization for BWSSB's organizational structure, delegation powers, approval hierarchies, and common scheduled rates.
 - Real-time tracking of estimates, approvals, payments.
 - Integrated accounting—automatically posts to Oracle ledger systems.
 - Automatic updates to GIS (K-GIS) upon final payments.
 - Used successfully in other departments such as Rural Water Supply and Urban Water Supply Boards.
- Expected Benefits:
 - 90% reduction in manual work.
 - Eliminates duplication, enhances accountability, enables data security through state data centers.

3. Financial System Integration

- BWSSB currently uses **Oracle Financial Software** limited to ledger accounting.
- New WMS will integrate with Oracle to automatically prepare P&L accounts and balance sheets in real-time.
- Deadline for full integration: **September 2024** (per directive from the Chairman).
- Auditing and financial transparency:

- Plans to appoint SEBI-registered Chartered Accountants for quarterly audits.
- Quarterly reporting necessary for issuing **green bonds**.

4. Green Bonds and Revenue Generation Strategy

- BWSSB plans to raise **₹200 crore** through green bonds by end of the fiscal year.
- Supported by:
 - Audited quarterly accounts.
 - Approved biogas plant model.
 - Transaction advisory under Karnataka Public Procurement (KPP) model.
- Green bond funding will support non-revenue-generating infrastructure like sanitation systems.

5. Human Resource Management System (HRMS)

- Completion status: ~90%; expected to be operational by **September 2024**.
- Will manage ~1,700 employees including payroll, hierarchy, data entry, and tracking.
- Payroll to commence via HRMS in **August 2024**.
- HRMS and WMS are being implemented concurrently to streamline operations.

6. E-Filing System

- E-filing for internal correspondence is operational at the BWSSB head office.
- Planned extension to all Bangalore branch offices pending dedicated lease line infrastructure.
- Reduces paperwork and improves administrative traceability.

7. Government Reforms and Digital Strategy Alignment

- The digital transformation aligns with administrative reforms from:
 - Government of India
 - Government of Karnataka
 - World Bank requirements (mandatory for future project implementation).
- Expected impact:
 - Significant operational efficiency.
 - Real-time data access and transparency for internal stakeholders and the public.
 - Long-term cost reduction and data-driven management.

8. Revenue Systems and Analytical Dashboards

8.1 Billing and Collection Platforms

BWSSB operates three distinct systems for revenue management:

- **Jaladhare:** Handles capital receipts from new connections (one-time payments for infrastructure development).
- **SAJALA:** Collects monthly water supply charges from consumers.
- **Third Platform (under development):** Will handle other receipts, such as:
 - Government grants
 - Deposits
 - Right to Information (RTI) fees
 - Public contributions

8.2 Analytical Dashboard

- The Work Management System will include a **real-time analytical dashboard**, displaying:
 - Revenue
 - Expenditures
 - Pending payments
 - Comparison of actual vs. planned billing
 - Dashboards will integrate data from HRMS and all revenue platforms.
 - Designed to enhance transparency for management and external stakeholders (e.g., AG, banks, contractors).
-

9. Asset Management and GIS Integration

9.1 Asset Overview

- Total asset value estimated at **₹1 lakh crore** (₹1 trillion), spanning **800 sq. km** across Bengaluru.

Assets include water treatment plants (WTPs), pumping stations, pipelines, reservoirs, water tanks, valves, STPs, sewer lines etc..

9.2 GIS Integration with Work Management

- The WMS will feature its own **independent GIS component**, linked to the state's KGIS system.
- **Functionality:**
 - Track physical work progress geographically.
 - Automatically update GIS records after final bill payments or issue of work completion certificate.
 - Record measurements (pipeline length, number of manholes, valves) using GPS-linked mobile applications.
 - Defect Liability Period (DLP) tracking: One-year post-completion during which repairs are the contractor's responsibility.
- Prevents duplication of works and automates asset updates in the central GIS (KGIS).

9.3 Strategic GIS Use Cases

- BWSSB uses GIS data to:
 - Monitor capital and O&M works
 - Track DLPs and warranty periods
 - Identify areas with missing infrastructure or pipeline replacement needs
 - Currently, BWSSB staff makes manual updates on GIS maps for any works carried out through Arc-GIS, which are then updated in the KGIS by KSRAC. These manual GIS updates will be eliminated once full WMS-GIS integration is complete. The GIS records will automatically be updated in central KGIS after final payment or issue of work completion certificate.
-

10. Debt Structure and Financial Status

10.1 Current Debt Obligations

- **Government of Karnataka:** Approx. ₹16,000 crore (not actively collected due to political tariff limits).
- **LIC Loan (1993):** ₹20 crore loan, ₹2 crore pending, ends in 2029.
- **KUIDFC (Karnataka Urban Infrastructure Development Finance Corporation):** Provides subsidized loans covering up to 50% of project costs.

10.2 Revenue and Tariff

- Monthly revenue: Approx. **₹185 crore** (after 30% tariff hike in April 2025).
 - Last revision was in 2014.
 - The tariff is designed for **cost recovery only**, covering:
 - Power charges
 - Establishment and administrative expenses
 - Debt servicing (LIC and KUIDFC)
 - Despite cash flow breakeven, financial statements may show losses due to:
 - Non-cash items (e.g., depreciation, provisions)
 - Government loan liabilities
-

11. Operations & Maintenance (O&M) Costs

11.1 Annual O&M Budget: ₹650 crore

- **Committed Expenditure: ₹80 crore**
 - Mainly for fuel (water tankers, pumping stations)
 - **Tendered O&M: ₹175–200 crore**
 - Covers WTPs, STPs, and major pumping stations
 - **Emergency O&M: ₹350–370 crore**
 - Emergency repairs (leaks, manhole damage, burst pipes)
 - These expenses represent **<1% of BWSSB's total asset value**.
-

12. ERP (Enterprise Resource Planning) and System Unification

12.1 ERP Strategy

- The WMS, HRMS, and financial modules together shall constitute a functional **ERP system**.
- All systems are being developed by the **Center for e-Governance**, Karnataka, ensuring:
 - State data center storage
 - Tender-free development process
 - Long-term sustainability and integration

12.2 Bank Partnership Model

- BWSSB is negotiating with two banks to:
 - Cover ₹35 lakh in technology development costs over 5 years.
 - Provide welfare benefits (e.g., medical care, term insurance, concessional loans) for employees and outsourced staff.

- Support technology implementation in exchange for banking visibility and social responsibility impact.

13. SCADA and Technical System Integration

- BWSSB is deploying **SCADA (Supervisory Control and Data Acquisition)** to monitor:
 - Water treatment and pumping operations
 - Pipeline pressure and supply status
 - Quality control metrics
 - SCADA complements the Work Management System by providing real-time technical data.
 - GIS and SCADA will be integrated to:
 - Link physical infrastructure to operational data
 - Support proactive maintenance and emergency response
-

14. Defect Liability Period (DLP) Tracking via GIS

14.1 Work-Based GIS Registration

- For every capital project:
 - Geographic data (start/end points, pipeline length, valves, manholes) are logged during execution.
 - Measurements are used to validate work before **final bill payment**.

14.2 Defect Liability Period (DLP) related Automation

- Upon final payment, the system records the **Completion Date**.
- Automatically triggers a **1-year DLP**:
 - No repair payments are allowed during DLP coverage.
 - Prevents repair payments from being made to contractors/vendors during defect liability/ warranty period, during which they are liable for any defects/repairs.

14.3 GIS Integration

- Once DLP ends, the asset is formally transferred into the **O&M (Operations & Maintenance)** database.
 - GIS tags updated assets and restricts overlapping work during DLP.
 - Manual GIS updates (previously done using ArcGIS and KSRSAC coordination) will be eliminated via automation from the WMS.
-

15. Asset Updating and Replacement Logic

- The system distinguishes between:
 - **Capital Works** (e.g., laying a new 400mm pipeline replacing an old 300mm one)
 - **O&M Replacements** (e.g., fixing damaged manholes or sections within DLP)
- Only capital additions modify the GIS asset value or extent.
- O&M works are logged but **do not increase asset count/value**.

15.1 Workflow Example:

1. New work initiated: GIS marks planned location.
 2. Work measured and recorded during execution.
 3. Completion triggers DLP and GIS update.
 4. After DLP, assets shift to O&M database.
 5. Any post-DLP repair/replacement (e.g., manhole) is treated as new capital work if extending beyond the original scope.
-

16. IT Governance and Data Security

- BWSSB leverages Karnataka State Data Center (SDC) to store:
 - All WMS, HRMS, and GIS data securely.
 - Key advantages:
 - Government-run infrastructure with continuous cybersecurity updates
 - Reduced vendor dependence and cost
 - Trusted hosting for sensitive financial and engineering data
 - Access permissions are tiered:
 - Separate logins for internal officers, contractors (limited to their works), external reviewers (e.g., Auditor General, banks)
-

17. ERP Convergence and Future Vision

- BWSSB is effectively developing a **modular ERP**:
 - Finance (Oracle + WMS)
 - HR (HRMS)
 - Assets (WMS + GIS)
 - Revenue (Jaladari, Sajala, Other Receipts platform)
 - Operations (SCADA, field monitoring)
 - ERP implementation is structured around mature government-owned systems rather than new vendor platforms.
 - Integrated dashboards offer real-time visibility across all modules, supporting performance reviews and financial audits.
-

18. Transparency and Public Accessibility

- Post-implementation, BWSSB plans to:
 - Offer GIS-based project visibility to the public
 - Provide dashboard views for funding agencies and regulators
 - Enable contractors to monitor their work status and DLP via login access
 - Transparency and accountability are key drivers, aligned with administrative reforms and green bond compliance.
-

19. Institutional Alignment and Readiness

- All modules (HRMS, WMS, Revenue Systems, GIS, SCADA) are being aligned under a common governance and implementation timeline:
 - **August 2024:** HRMS live with payroll integration
 - **September 2024:** Work Management System go-live
 - **Year-end 2024:** Green bond issuance and audited accounts
- BWSSB leadership emphasized that the maturity of government-developed platforms, combined with internal readiness, makes this a "once-in-a-generation" transformation for the organization.

Meeting Minutes – Bulk Flow Meter Monitoring and UFW Project Review

Date: 16:30-17:00 on July 28, 2025

Location: 2nd floor at BWSSB Office, Survarna Bhavana, Malleshwaram, Bengaluru

Attendees:

- JICA Consulting Team: Ohno, Ogata, Ohara, and Mr. Rohit (India)
- BWSSB: Ms. Nalini, Executive Engineer, UFW-II Department

1. Introduction

- The JICA Survey Team initiated the meeting to explain their objective of gathering information on existing digital transformation (DX) systems within BWSSB, with a specific focus on bulk flow meter monitoring and associated technologies.
- They inquired about the data collection processes, software platforms, and integration with broader water management efforts.

2. Current Monitoring System for Bulk Flow Meters

- BWSSB representative explained that approximately **1500 bulk flow meters** are being monitored.
- Data from these meters is transmitted to a central server and is actively used by both **maintenance personnel and subdivision-level staff** to observe **inflow and outflow trends**.
- This information supports operational decisions and helps maintain balanced distribution across different subdivisions.

3. Technology and Access

- The system is described as “good” but lacks a specialized monitoring application. The team currently uses platforms like **Skype** for communication and coordination.
- The representative confirmed that there is **no dedicated application** for monitoring, though meter data is visible through an internal **web-based portal**, accessible to maintenance personnel.

4. Responsibilities for Leak Detection

- The monitoring division does not directly handle leak detection.
- Instead, **leak monitoring and repair are handled by individual subdivision teams**, while the central division manages data collection, meter installation, and UFW (Unaccounted for Water) project implementation.

5. Historical Context – JICA Phase 2 Projects

- Three major UFW projects were executed under JICA Phase 2:
 - **D2A**
 - **D2B**
 - **D1A**
- Each project included **flow meter installations, asset replacements, and formation of DMAs (District Metered Areas)**.

- Projects were broadly executed over **3 years** and followed by **5 years of O&M (Operations and Maintenance)** support.
- These initiatives aimed to **reduce water loss** and modernize infrastructure in critical zones.

6. Project Constraints and Outcomes

- While the goal was to reduce water loss to below 60%, full coverage across all areas was not achieved due to various constraints.
- Nevertheless, **completed zones showed improvement**, and by the project's end in 2022, the NRW in those areas is reported to have reduced to **22–23%**.

7. CP24 Project Integration

- The JICA survey team asked about the **integration of distribution SCADA systems** with the **central control system at Shimsha Bhavan**, as part of the **JICA CP24 project**.
- Concerns included:
 - Compatibility between **systems installed during different project phases**
 - Role of BWSSB departments in addressing these integration issues
- The representative clarified:
 - **CP24 aims to integrate all data streams (bulk meters, SCADA, etc.) into a unified platform.**
 - Data from the **2013–2022 JICA UFW projects** and **bulk flow meters installed by BWSSP** are currently stored on a local server.
 - This legacy data will eventually be **migrated and visualized on the CP24 platform** for consolidated monitoring.
- Additional points:
 - Earlier, the **MIS team** managed the data, but it is now under the UFW monitoring team's control.
 - Integration work is ongoing, and **system compatibility issues** are being addressed by both internal departments and external consultants.

8. DMA Area Coverage and Historical Mapping

- The representative showed a **map of the Bangalore Metropolitan area**, describing it as:
 - An older network covering approximately **225–245 km²**
 - Historically known for contamination and aging infrastructure
- Under the JICA project:
 - **209 DMAs were formed** across identified pockets (e.g., $83 + 83 + 52 = 209$ DMAs).
 - Later **expanded areas** (CMC extensions) were not included in the DMA formation and lack such monitoring.
- The SCADA system installed during JICA phase 2 was specifically designed to **serve the established DMAs**, and not the newer expansion zones.

9. NRW Assessment Methodology

- The UFW division assesses **Non-Revenue Water (NRW)** through:
 - **Inflow and outflow measurements** for **43 subdivisions**, using bulk meter readings
 - **Billing cycle data**, which spans from the **20th of one month to the 21st of the next**
- With this method, they are able to:
 - **Quantify UFW/NRW** per subdivision
 - Identify leakage patterns or anomalies in water usage
- The representative emphasized:
 - **Subdivision offices have access to SCADA data**
 - **Each subdivision is responsible for leak detection, repair, contamination management, and asset replacement**

10. Coordination Between UFW Office and Subdivisions

- The team asked about coordination between the **UFW division and subdivision offices**.
- The representative explained:
 - The UFW team is responsible for **DMA creation and system setup**
 - Once systems are operational, the **subdivision teams take over daily operations and maintenance**
 - SCADA data is accessible to both central and subdivision teams for independent and collaborative monitoring

11. Follow-up Presentation and Closing Discussion

- Due to **urgent internal deadlines**, the representative could not provide a full walkthrough during this meeting.
- She invited the PX team to return the following day at **2 PM**, after their scheduled visit to the **Chief Engineer**, for a **comprehensive presentation** on:
 - UFW project history
 - Performance achievements
 - Current maintenance structure
 - Integration roadmap with CP24
- Before concluding, the representative briefly demonstrated their internal **monitoring webpage**, showing:
 - Real-time data from bulk flow meters
 - Subdivision-level connection statistics
 - Flow volume and NRW/UFW calculations for each service area

12. Web Portal Demonstration

- Before concluding the session, the representative gave a **brief overview of the BWSSB's internal monitoring webpage** used for bulk flow meter data visualization.
- Key features demonstrated:

- Displays **real-time inflow and outflow volumes** per subdivision
- Includes **total number of connections per subdivision**
- Helps calculate **UFW (Unaccounted for Water) / NRW (Non-Revenue Water)** for each area
- Data is synchronized with the **billing cycle**, which operates from the **20th of one month to the 21st of the next** (e.g., April 20 to May 21).
- This system enables teams to:
 - Detect missing meters or malfunctioning equipment
 - Monitor consumption trends
 - Plan for corrective measures such as **asset replacement or repairs**

13. Operational Follow-Up and Staff Responsibilities

- The representative clarified that:
 - **Leak repair, contamination response, and meter replacement** are part of the **daily maintenance work** assigned to subdivision O&M teams.
 - These responsibilities are embedded into regular operations and **do not require special instruction** from the central UFW office unless large-scale interventions are needed.
- Subdivision offices are expected to:
 - Monitor SCADA data themselves
 - Identify abnormal trends or leakage levels
 - Conduct field inspections and initiate appropriate repairs
- The UFW division only intervenes when:
 - **Setting up or handing over new DMA systems**
 - Monitoring overall system health or data integration progress
 - Collaborating with subdivisions on major updates or compatibility issues with CP24

Meeting Minutes – Centralised SCADA Centre, BWSSB

Date: 11:00-13:00 on July 29, 2025

Location: Centralised SCADA Centre, BWSSB Office, Shimsha Bhavan, Bengaluru

Attendees:

- JICA Consulting Team: Ohno, Ogata, Ohara, and Mr. Rohit (India)
- BWSSB: Mr. Srinivas, Executive Engineer; Chavare Engineering Pvt. Ltd. (System Integrator): Mr. Sachin Jawale, GM Automation), NJS Engineers India Pvt. Ltd. (PMC): Mr. Salauddin

1. Welcome and Introduction to CP 24 SCADA Project

- **Speaker:** Executive Engineer, BWSSB
 - Welcomed visitors from JICA survey team.
 - Introduced the CP 24 package as part of the Kaveri Water Package.
 - Explained that the package covers **both water and sewerage SCADA systems** across all BWSSB installations.
 - The objective of the meeting was to provide an overview of the integrated SCADA system and its future functionality.

2. Project Overview and Current Status

- Earlier System Integration: MIS-2 SCADA Centre was established in 2014 and dedicated to Stage IV Ph-II plants. There was minimal integration with other existing facilities of BWSSB and only a few parameters were being monitored. MIS-2 SCADA centre was nearing the end of life for most of the IT hardware and not sized for future upgradations and integration.
- Current JICA funded CP-24 project includes the establishment of Centralised SCADA control room and integration of water and sewerage SCADA systems including water treatment plants at TK Halli (Stages I to V), pumping stations (Stages I to V) at TK Halli, Harohalli and Tatguni, Ground Level Reservoirs (100 locations), existing UfW SCADA (established under Stage-IV Phase-2), strategic locations in the distribution network for establishment of flow meters, pressure transmitters and water quality analysers (100 locations) and STPs. WTPs and Pumping stations are being connected through both Fiber Optic Cables and wireless, while STPs, GLRs and distribution system shall be connected only through GPRS.
- Monitoring Centre at Shimsha bhavan already operational (95% complete). Real-time data is coming in; some minor civil works remain. Cabling and hardware mapping are mostly complete, except for approx. 5 km between TK Halli and Vajrahalli.
- The Phase-IV Stage-5 WTP (770 MLD) and Pumping Station at TK Halli is already integrated, and integration is in progress for Stage-4 Phase-II WTP (550 MLD).

- Approximately 60% of GLR locations have been commissioned for integration and the remaining are in process.
- 70% of STPs are already integrated and inlet outlet parameters being monitored. 33 STPs real-time WQ monitoring established, 15 in process.
- Survey works are currently in progress at the locations of flowmeters under UfW SCADA to determine the exact locations, integration requirements and compatibility issues. Establishment of flowmeters etc. at strategic locations in the distribution system is also in progress.

3. System Architecture and Components

- **Architecture Details:**
 - Server bank includes **6–7 servers**: root server, scanner servers, and front-end server.
 - Operator session and engineering session each have dual-monitor workstations.
 - A large **video wall** displays system-wide monitoring.
- **Alarm System:**
 - SMS and email alerts triggered when pre-defined parameters exceed limits.
 - Escalation hierarchy: Divisional Engineer → Executive Engineer → Senior Management.
- **Data Sources:**
 - Data collected from:
 - **WTPs and pumping stations** via **Fiber Optic Cable (FOC) and GPRS networks**
 - **GLRs (~100 units)** with flow meters, level transmitters, and water quality analysers to measure pH turbidity, TDS and residual chlorine via **GPRS using MQTT protocol** (under commissioning for integration)
 - Key strategic locations in distribution network (100 nos.) to measure water quality, flow and pressure via **GPRS using MQTT protocol** (yet to be integrated)
 - Flow meters at strategic locations under UfW SCADA already established under Stage-4 Phase-II via **GPRS using MQTT protocol** (survey currently in progress)
 - STPs to measure inlet and outlet parameters (under commissioning for integration) via **GPRS using MQTT protocol**
 - Devices buffer data locally during outages and retransmit when connection resumes.

4. Data Security and Network Redundancy

- **Cybersecurity Measures:**
 - Protected by **hardware and software firewalls**, regularly updated.
 - Uses **encrypted MQTT protocol** for data transmission.
 - Data is stored **locally** (not on cloud) for government data security compliance.
 - Data stored in local server in encrypted format, only authorised persons can access
 - Antivirus software updated on a regular basis
 - Data shall be shared to relevant personnel in the form of reports
- **IoT SIM Technology:**
 - SIM cards are **device-locked** (work only with registered devices, bound by MAC/IP).
 - Prevent unauthorized use even if physically removed.
- **Network Redundancy:**
 - Dual SIMs from **different service providers** enable automatic failover.
 - Ensures **high system uptime** and prevents data loss.

5. Parameters Monitored – Water and Sewerage

- **Water Systems:**
 - Inlet/outlet flows, GLR levels, chlorine, turbidity, pH, etc.
- **Sewerage Systems:**
 - Monitors **BOD, COD, nitrogen levels**, and **electricity consumption** at STPs.
 - Energy use is tracked against performance and tender SLAs.
 - Efficiency of treatment is judged by comparing inlet and outlet parameter levels.

6. DMA Implementation for Distribution Monitoring

- **District Metering Area (DMA) Pilot:**
 - Two pilot projects are under discussion (tentatively covering 5 km distribution pipeline, 50-60 DMAs for each GLR, scope yet to be finalised) for testing:
 - Integration from **GLRs to distribution networks**
 - Using **battery-operated flow meters** for strategic monitoring.
 - Control and automated scheduling for operation of valves from remote location
 - Goal is to detect UFW (Unaccounted-for Water), assess flow balance, and analyze leakage or anomalies.
 -
- **Pilot Implementation Timeline:**
 - Estimated duration: **3–4 months**.
 - Full city-wide rollout decision to follow based on pilot results.

7. Data Analysis and Future Applications

- **Long-Term Data Collection Objective:**
 - After collecting **8–10 months of data**, analysis will begin.

- Analysis will identify:
 - **Water demand trends**
 - **Leakage and UFW rates**
 - **Infrastructure performance and needed upgrades**
 - Seasonal, time-based, and spatial patterns.
- **Demand-Supply Analysis:**
 - System will support future demand projection by analyzing:
 - Area-based consumption
 - Seasonal variation
 - Time-of-day patterns
 - Expansion needs due to population growth or new colonies
- **Use in Infrastructure Planning:**
 - Insights from analysis will guide:
 - WTP/GLR capacity augmentation
 - Distribution pipeline upgrades
 - Energy consumption optimization
- **Division of Responsibility:**
 - **SCADA team** collects and maintains data.
 - **Division of BWSSB responsible for planning and analytics** will use the data for demand forecasting.

8. Future Control Capabilities

- **Current Status:**
 - The system is focused on **monitoring only** at this stage.
- **Future Vision:**
 - **Remote control functionality** may be added:
 - Examples: Shut off water supply from GLR to a specific area during irregular supply events.
 - Control could be executed from the central SCADA room or locally.
- **Pilot Plan:**
 - Two DMA pilot projects may include **remote control capabilities**.
 - Pilot will evaluate feasibility before broader implementation.

9. Mobile Application Development

- **Purpose:**
 - Mobile application under development for field-level visibility.
 - Will allow authorized personnel to:
 - View inflow/outflow data at GLRs
 - Monitor pumping station data
 - Track real-time alerts
- **Access Control:**
 - Only **authorized users** can view reports and analytics.

- Uses secure login with location-specific access restrictions.

10. Reporting Features and Issue Escalation

- **Automated Reports:**
 - Reports are generated and distributed to **designated officers** (e.g., AEEs, EEs).
 - Reports cover:
 - Data anomalies
 - Device disconnections
 - Parameter threshold breaches
- **Alarm and Issue Escalation:**
 - Alarms generated for device failures or communication errors.
 - Operators follow up with field teams for on-site troubleshooting.
 - Real-time dashboards display site status (e.g., offline devices).

11. Integration with Existing Systems and UFW Data

- **Legacy Devices:**
 - UFW monitoring devices already installed under prior projects are being integrated. Survey currently in progress to determine the hardware requirements for integration.
 - Same MQTT protocol shall be utilised to bring their data into the centralized SCADA system.
- **Data Storage:**
 - All SCADA data is stored **on-premise** (not cloud-based) due to government data security protocols.
 - Local cloud-like infrastructure is maintained within the data center.

12. Cybersecurity Measures

- **Protocols & Infrastructure:**
 - Uses **MQTT and HTTPS** with encryption.
 - Encrypted data collection, transmission, and storage.
 - Only **pre-approved IP/MAC devices** can communicate with the system.
- **Firewall & Antivirus:**
 - Hardware and software firewalls regularly updated.
 - Antivirus software also installed on all servers.
- **Access Management:**
 - Strict authorization levels defined.
 - No external data sharing; only selected report formats sent to authorized members.
- **SIM Security:**
 - IoT SIMs can't be misused in regular mobile phones.
 - They are locked to specific devices and communicate only with BWSSB's central servers.

13. Data Transmission Frequency

- **Standard Devices:**
 - Transmit data every **15 minutes**.
- **Battery-Operated Devices:**
 - Longer intervals to conserve battery.
 - Buffer and batch-upload data when reconnected.

Meeting Minutes – Central SCADA Room, Shimsha Bhavan, BWSSB

Date: 13:00-14:00 on July 29, 2025

Location: Centralised SCADA Centre, BWSSB Office, Shimsha Bhavan, Bengaluru

Attendees:

- JICA Consulting Team: Ohno, Ogata, Ohara, and Mr. Rohit (India)
- Chavare Engineering Pvt. Ltd. (System Integrator): Mr. Sachin Jawale, GM Automation), NJS Engineers India Pvt. Ltd. (PMC): Mr. Salauddin

1. Overview of the Water Management System

- The meeting began with an overview of the ongoing implementation of a SCADA-based water management system.
- The system is designed to monitor the water supply network from source to distribution points including pumping stations, GLRs (Ground Level Reservoirs), and WDBs (Water Distribution Boards).
- The system is currently under commissioning. Some parts are already live, while others are still in development.
- The SCADA system displays both real-time and historical data, updated every 15 minutes for online devices.
- Offline devices are flagged in the system to ensure visibility for operators.

2. System Architecture and Data Collection

- Data from field instruments is collected via Remote Terminal Units (RTUs), which transmit data using the MQTT protocol.
- The communication chain includes Ethernet switches and firewalls before data reaches the central servers.
- Each RTU serves as an intermediary between the device and the MQTT broker.
- A data validation team compares the incoming digital data with manual field readings to ensure accuracy.
- The infrastructure also includes PLCs (Programmable Logic Controllers), particularly for logging maintenance-related data.

3. Monitoring Interface and Visualization Features

- The SCADA system includes a graphical user interface with map-based visualization.
- Operational parameters such as water level, flow rate, valve position, pump status, and power consumption are visualized.
- Color coding is used:
 - Green: Operational
 - Red: Error/Issue
- Flow direction is also graphically indicated, and level switches are installed in reservoirs.
- Operators can zoom into specific locations and select various parameters (e.g.,

clear water level, total consumption).

- The interface shows data for today, yesterday, and monthly aggregates.

4. Maintenance Tracking and Operational History

- The system logs when a pump or equipment is taken offline for maintenance and when it is returned to operation.
- This information is displayed in the central system and tagged by location.
- Operational hours for each pump are tracked, and future maintenance planning is based on accumulated usage.
- Logged data includes:
 - Start and stop time
 - Total hours of operation
 - Downtime due to maintenance
- These features aim to support preventive maintenance and operational planning.

5. Data Analysis and Pump Efficiency

- Parameters such as pump power consumption and water flow rate are stored and analyzed to evaluate efficiency.
- Temperature readings (e.g., winding temperature) are monitored locally.
- The intention is to establish a relationship between power usage and volume of water pumped.
- Analysis of such data will support energy efficiency improvements in the future.

(To be continued in Part 2 with sections on Alarm System, Reporting, Future Enhancements, and Visitor Remarks.)

6. Alarm System and Notifications

- The SCADA system includes a live alarm display with definitions for various abnormal conditions (e.g., abnormal water levels, pump failures).
- Alarm logic is based on defined parameter ranges. Once field instruments are fully commissioned, alarms will automatically populate.
- Alarms are visible both at the centralized SCADA control center and at the local site HMIs (Human Machine Interfaces).
- Historical alarm data is also stored and can be reviewed by operators.
- Examples of alarm conditions:
 - Reservoir water level falling below a defined threshold
 - Pump failure or excessive power consumption
- Operators will be notified through:
 - Central monitoring screens
 - Mobile application (planned)
 - SMS or email notifications (under development)
- Currently, communication regarding alarms is handled manually (via phone), but the system is being enhanced to include automatic notifications to operators.

7. Reporting and Data Export

- The system allows for report generation on:
 - Inlet and outlet flow quantities
 - Consumption patterns
 - Pump operation hours
- Data reports can be exported in Excel or PDF formats.
- Daily, monthly, and historical data can be viewed and downloaded.
- A template for report formats is being finalized in consultation with BWSSB.
- Data is already being logged and stored in the system; the next step is configuring automated report templates.

8. Future Enhancements: Mobile App and Remote Communication

- A mobile application is being developed to:
 - Notify field operators of alarms or issues in real-time
 - Allow them to view operational status remotely
- The system aims to establish two-way communication between the central command and field personnel.
- Alerts for issues (e.g., pump failures) will be sent simultaneously to:
 - The central SCADA team
 - Local operator interface
 - Mobile phones of responsible field staff
- The current communication method is via phone calls and WhatsApp messages.
- In future, alerts and daily reports will be automatically routed through the mobile app, allowing more efficient response times.

9. Pilot Implementation and Field Operations

- The system is currently in the pilot stage, covering specific GLRs and WDBs.
- Local operators still perform manual valve operations in the morning and evening based on predefined schedules (e.g., 7:00 AM and 5:00 PM).
- Local HMIs are already installed for on-site monitoring, but centralized control is not yet in place.
- The team plans to eventually enable centralized monitoring and control, supported by mobile app integration.
- Two pilot projects of 3-4 months duration each for monitoring and control in distribution system are currently under discussion in BWSSB to be taken up in less populated areas (tentatively covering 5 km distribution pipeline, 50-60 DMAs for each GLR, scope yet to be finalised). These pilot projects will include control and remote scheduling for operation of valves.
- Based on the experience from these pilot projects, future expansion of centralized monitoring and control for the distribution system shall be planned.

10. Visitor Interaction and Study Tour

- Toward the end of the meeting, international visitors (likely part of a JICA-related utility study tour) asked clarifying questions about remote monitoring and communication protocols.
- The presenters explained that while real-time alerts and data logging are under development, most actions are still coordinated manually.
- Visitors noted that they would be traveling next to Cambodia to study another utility.
- The host team mentioned that more live data would be available in about three months, and the system would be more fully functional upon their return visit.

11. Technical System Components and Architecture

a. Communication & Protocols

- **MQTT Protocol:**
 - Lightweight messaging protocol used for real-time data transfer.
 - Enables communication between RTUs (Remote Terminal Units) and the central server.
- **RTUs:**
 - Collect and transmit data from field-level instruments (e.g., flow meters, level sensors).
 - Communicate with MQTT brokers.
- **PLCs (Programmable Logic Controllers):**
 - Installed locally to control and monitor equipment operation.
 - Log operational and maintenance data.
- **Firewalls and Ethernet Switches:**
 - Secure and manage data flow between field instruments and central servers.

b. Data Validation

- Manual validation of system data against field readings is ongoing.
- Field teams confirm instrument outputs and SCADA readings during the commissioning phase.

c. Visualization and Interface

- Central monitoring displays:
 - Color-coded operational status (green = normal, red = issue).
 - Reservoir levels, pump statuses, valve positions, and directional flow.
- Map-based interface:
 - Allows zooming into specific geographical areas.
 - Data points are geotagged for clarity (e.g., pumping stations, reservoirs).
- Historical data visualization:
 - Daily, weekly, and monthly comparisons available.
 - Parameters such as power consumption vs. discharge volume used for efficiency

assessment.

d. Data Security

- Firewall protection (both software and hardware), protection from malware, antivirus software updated on a regular basis.
- Port number and IP addresses defined for mobile devices from which data would come in, 2 SIM cards from different service providers issued for each device, one for backup to prevent data loss, every 15 minutes the data is transferred to the central location.
- MQTT is an encrypted protocol, data is also stored in the local historian server in encrypted format, only authorised personnel shall have access.

11. Data Analysis

- After the system is in place, it is planned that BWSSB shall conduct water supply and demand analysis on 8-10 months' collected data (covering seasonal variations), aimed at ensuring equitable distribution of water. Predictive analysis etc. is also envisaged to be carried out by the relevant divisions. For AI & ML related applications, the system integrator informed that they have software packages available, which may be opted in by BWSSB at a later stage, if so required.

12. Operational Insights and Challenges

- **Pump Efficiency Monitoring:**
 - System aims to correlate energy use with water output.
 - Helps in identifying inefficient pumps or abnormal operating conditions.
- **Maintenance Scheduling:**
 - Tracking of operational hours allows timely preventive maintenance.
 - System logs:
 - Downtime events
 - Fault locations
 - Duration of maintenance
- **Challenges Noted:**
 - Accessibility to remote areas during field commissioning.
 - Coordination among multiple legacy systems with varying software/hardware compatibility (especially in older installations from the 1970s–1980s).
 - Integration with existing local SCADA setups requires case-by-case hardware assessment.

13. Future Integration and Plans

- **Mobile App Deployment:**

- To provide alerts and reports to field personnel in real-time.
- Will support communication between SCADA center and on-site operators.
- **Report Automation:**
 - System will soon enable automated daily/monthly reporting using standardized formats.
 - Reports to be configured by BWSSB, with delivery to both management and operator levels.
- **Full System Rollout:**
 - WDB and GLR sites prioritized first.
 - Progressive coverage expansion planned over the next quarter.
 - Continuous synchronization between central and local systems planned for seamless data sharing.

14. Closing Remarks and Follow-up Actions

- Visitors appreciated the system walkthrough and confirmed they were proceeding to Cambodia next for further study.
- Host engineers noted that in three months, additional live data would be available and full reporting functionalities would be active.
- Both sides expressed interest in further exchanges on operational practices and digital utility management.

Meeting Minutes – Mr. Purushothama BG, Additional Chief Engineer, UFW-II Department

Date: 15:45-16:30 on July 29, 2025

Location: 2nd floor at BWSSB Office, Survarna Bhavana, Malleshwaram, Bengaluru

Attendees:

JICA Consulting Team: Ohno, Ogata, Ohara, and Mr. Rohit (India)

BWSSB: Mr. Purushothama BG, Additional Chief Engineer, UFW-II Department

1. Introduction and Objectives

- The JICA survey team introduced the purpose of the meeting: a digitalization survey to understand BWSSB's current and future use of digital tools in operations.
 - Key digital aspects to be covered include GIS, SCADA, pipeline digitization, bulk flow meters, metering, and asset management across the water supply system.
-

2. Current Digital Infrastructure at BWSSB

- BWSSB has a **Geographical Information System (GIS)** managed by the MIS department at Kaveri Bhavan.
 - GIS maps the entire water and sewerage network, valves, and related infrastructure.
 - The consultants had previously visited the GIS center and reviewed components.
 - A **SCADA (Supervisory Control and Data Acquisition)** system is operational to monitor bulk flow meters, aiding in UFW (Unaccounted for Water) tracking.
-

3. NRW/UFW Reduction Projects

a. Pilot Project (2002)

- Focused on pressure zoning and leak repair, not asset replacement.
- Approximately 60,000–70,000 leakages were repaired.
- The pilot was successful and paved the way for larger projects.

b. JICA-Funded Projects: D1A, D2A, D2B

- Covered ~3,894 km of pipelines in Bangalore core area (225 sq. km).
 - Replaced 635 km (17%) of pipelines.
 - UFW reduced from 49.33% to 22.72%.
 - Total investment: ₹635 crores, recovered within 3.5 years.
-

4. Ongoing Projects:

Tahal

- 100% asset replacement in project areas, in earlier projects pipe diameters upto 100 mm were replaced, in this project upto 700 mm are replaced.
- Creation of **26 DMAs (District Metered Areas)**; 22 DMAs resulted in UFW below 10%, with some as low as 6%.
- Funded by the Government of Karnataka; target completion: December (delayed due to

COVID-19).

- Performance-based contract with financial deductions if UFW remains above 10%.

Other Government Initiatives

- Another government-funded ₹200 crore project is under process involving 100 percent replacement of assets, and setup of bulk flow meters to cater to selected DMAs/Sub-DMAs including in the newly added areas (outside core metropolitan area)
-

5. Metering and SCADA Integration

- BWSSB maintains ~900,000 meters, with ongoing installations in 110 outskirt villages.
 - City divided into 16 divisions and 43 subdivisions.
 - SCADA monitors inflow/outflow to determine UFW per subdivision and DMA.
-

6. Recent Expansion and Temporary Increase in UFW

- UFW figures recently increased due to addition of “fifth phase” areas with ongoing connection and testing activities.
 - Leakages and incomplete service in new areas are contributing to the higher figures.
-

7. Completed Project Details and Achievements

- **D1A completed on:** 31 May 2023
 - **D2A completed on:** 31 Dec 2022
 - **D2B completed on:** 30 Sep 2019
 - Total network area: 3,894 km; replaced 635 km (17%).
 - Project area: 132.5 sq. km.
 - UFW reduction: 49.33% to 22.7%.
-

8. Incentives and Funding

- BWSSB received ₹20 crores in incentives from the central government for successful project outcomes.
 - BWSSB representative expressed gratitude for JICA’s cooperation and funding support in earlier projects.
-

9. Operational Utilization of SCADA and UFW Systems

- After completion, UFW systems are handed to maintenance divisions.
 - Web-based SCADA dashboards help divisions monitor inflows/outflows.
 - Plan to scale monitoring to service station and individual meter level for granular control.
-

10. Organizational Structure for Water Supply Monitoring

- BWSSB divided into four zones: North, East, West, and South.
- Each zone managed by Chief Engineers (CEs) and Additional Chief Engineers (ACEs).
- Regular performance and UFW review meetings are held.

- Ongoing CP-24 project aims to integrate SCADA for STPs, GLRs, and water quality.

11. Digital Transformation Challenges

The BWSSB representative highlighted multiple implementation challenges:

- **Power Supply:** Reliable, uninterrupted, and high-quality power is essential for full digital control. Many SCADA components and flow meters require 24/7 power, and battery-operated units are viable only for small-scale use.
- **Aging Infrastructure:** Many pipelines are over 60–70 years old and are difficult to locate or upgrade, especially in developed areas with ground congestion.
- **Human Factors:**
 - Field operations rely heavily on manual valve operators (e.g., “valvemen”) for water distribution.
 - Full automation could reduce jobs, leading to resistance among workers.
 - The official noted a historical parallel: initial resistance during computerization was eventually replaced by widespread adoption.
- **Technology Lifecycle:**
 - Rapid technological changes (e.g., from 2G to 5G and beyond) create cost and obsolescence issues.
 - Updating meters, servers, and integration systems frequently would be financially and operationally difficult.

Quote: “100% digitization is a challenging task. Realistically, we can target 50–75%. A step-by-step approach is needed.”

12. Smart Metering (AMR/AMI) Status and Limitations

- BWSSB has implemented **Automatic Meter Reading (AMR)** for only a few hundred connections—negligible compared to the total (~900,000).
- **Pilot Observations:**
 - Goa’s smart meter project faced **10–20% data transmission failure** due to poor network connectivity.
 - Even bulk meters in Bangalore occasionally fail to transmit due to lack of signal in remote areas.
- **Cost Factors:**
 - Smart meters cost approx. ₹6,000 per connection.
 - Additional costs include communication network (LoRa/IoT), billing system integration, and potential consumer resistance to recurring upgrades.
- **Technology Obsolescence:**
 - AMR technology has rapidly evolved; earlier retrofitted models on mechanical meters have been replaced by embedded digital ones.
 - Future upgrades (e.g., with AI or new data protocols) could render existing meters outdated.

- **Conclusion:**
 - Manual reading remains cheaper and more stable under current conditions.
-

13. Pipeline Replacement Strategy

- Focus on replacing **old pipelines (60–70 years old)** in the **core area (225 sq km)**.
 - Materials replaced include:
 - **Cast Iron (CI)**
 - **PVC**
 - **Cement pipes**
 - New materials used:
 - **Ductile Iron (DI)**
 - **Mild Steel (MS)**
 - Replacement is done in **phased micro-projects** (e.g., 10–15 km at a time), depending on feasibility and funding.
 - New projects are easier; older areas are congested with traffic and buried assets, complicating upgrades.
-

14. Leak Detection and Intermittent Supply Challenges

- Leak detection using Japanese equipment was piloted, but not scalable in Bangalore due to:
 - **Ground complexity:** numerous underground utilities.
 - **Turbulence and background noise** interfering with acoustic detection.
- Intermittent supply (non-pressurized, ~3 hours on alternate days) makes leak detection harder and increases risk of leaks compared to 24/7 pressurized systems.

Quote: “In Japan, pipelines are replaced every 30 years. Here, we still use 70-year-old pipes.”

15. Asset Management in Ground Level Reservoirs (GLRs)

- Workflow meters installed at GLRs to monitor outflows.
 - Remodeling and realignment of old pipelines within GLRs underway to improve efficiency.
 - Aim: Replace legacy infrastructure to improve distribution and minimize losses.
-

16. Financial Strategy and External Support

- BWSSB seeks consolidated projects where possible, with interest in future JICA support.
 - Replacement project sizes and costs vary by area density and road width:
 - Dense, narrow localities require more pipeline length and effort.
 - Broad, low-density areas require fewer pipelines.
-

17. Consumer Interface and Service Line Responsibility

- **Main pipelines:** maintained by BWSSB.

- **Household service connections:** under consumer responsibility.
 - Consumers are notified in case of visible leakages on their side.
 - BWSSB can replace all components during full-scope projects; afterward, future replacements of service connections must be handled by the consumer.
-

18. Outlook on Digitalization and Consumer Participation

- Consumer participation and acceptance of new systems (e.g., smart meters) is uncertain.
- Need for public education and involvement emphasized.
- Final message: The balance between **automation** and **human operation, cost and efficiency**, must be carefully managed.

資料 6-4 : 第 2 回現地調査 (BWSSB)

Meeting Minutes – Digital Transformation Assessment with BWSSB

Date: 10:45-11:25 on Oct 27, 2025

Location: 7th floor at BWSSB Office , Bengaluru

Attendees:

- JICA Survey Team: Ohno, Ogata, Ohara, and Mr. Rohit (India)
- BWSSB: Ms. Lakshmi Yadav K (Executive Engineer, IT Section)

1. Financial and Performance Updates

- It was reported that the **water tariff** had been **revised from 140 crores to 190 crores**.
 - Participants agreed that **KPI data for the past three years** should be obtained for reference.
 - The team had previously requested the **annual report** containing KPI sector data but received incomplete information. It was decided That **Ms. Laxmi shall be responsible for collecting the information from the respective officers and share the with JICA survey team**.
-

2. Comprehensive IT Strategy

- One of the recommendations of the JICA survey team included the development of a **comprehensive IT strategy for BWSSB** which should include financial reports, key performance data, and measurable indicators.
 - **EBITDA margins** as calculated through BWSSB financial statements were discussed, with a noted figure of **-7.3%**. The JICA survey team explained the methodology used to calculate the figure.
 - It was decided that standard definitions for financial indicators will be established to ensure uniformity across reports.
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3. IT Maturity and Cybersecurity

- The organization is assessing its **IT maturity**, referring to **Level 1 and Level 2 (Ripple levels)** classifications.
 - Ongoing **system upgrades and digital initiatives** were recognized, though they lack full coordination.
 - Emphasis was placed on **enhancing cybersecurity policies** and **training all employees** on cyber safety.
 - Relevant **IT and cybersecurity circulars** have been issued and are available on the organization's website.
-

4. IT Governance and AI Implementation

- Participants discussed the need for a **centralized “single-window” system** to manage all IT and AI projects.
 - It was noted that several departments currently conduct IT initiatives **without consulting the central IT team**, leading to inefficiencies.
 - The team highlighted increasing **cyberattack incidents** and agreed on the importance of **standardized IT policies** and **central oversight**.
 - Implementation of **AI-based monitoring systems** was identified as a future area of focus.
-

5. Review of Potential Solutions

- A document prepared by the JICA survey team, listing considerations for **11 potential architectural and IT solutions** was reviewed and discussed.
- Each solution has been assigned scores based on **three main aspects** (such as impact, feasibility, and contribution).
- It was agreed that these proposed solutions would serve as the **basis for further evaluation and prioritization** in upcoming discussions.

Meeting Minutes – Digital Transformation Assessment with BWSSB

Date: 11:30-12:05 on Oct 27, 2025

Location: 7th floor at BWSSB Office , Bengaluru

Attendees:

- JICA Consulting Team: Ohno, Ogata, Ohara, and Mr. Rohit (India)
- BWSSB: Mr. V.B. Maheswarappa, Additional CE (MIS & IT), Ms. Lakshmi Yadav K (Executive Engineer, IT Section)

1. Purpose of the Meeting

1.1 The meeting aimed to confirm the current status of information sharing for KPI assessment and to clarify what data is still required.

1.2 Participants discussed how to obtain accurate and up-to-date KPI data, including water production, NRW (Non-Revenue Water), metering, financial indicators, and staffing efficiency.

1.3 The organization's digital transformation maturity and identified areas for improvement were also discussed.

2. Request for Annual Reports and KPI Data

2.1 It was confirmed that **financial statements** had been received from Mr. Prakasha in the finance department.

2.2 However, the **complete annual reports** containing detailed KPI data were still pending.

2.3 The assessment team requires at least **three years of data** on water production, NRW, metering rates, service coverage, and financial performance.

2.4 It was agreed that Ms. Lakshmi would follow-up with relevant personnel for validation and for obtaining the requisite KPI information.

2.5 Participants agreed that data from unofficial sources such as websites or academic reports shall be updated once the relevant official data is shared by BWSSB. The timeline for sharing the remaining data was also discussed, and it was agreed that it should be shared allowing enough time for the JICA survey team to validate and include in their draft report.

3. Clarification on “World Bank Details”

3.1 There was some confusion regarding a request for “World Bank details.”

3.2 It was clarified that the intent was not to request data specifically from the World Bank but rather to collect **information on funding agencies** in general.

3.3 The participants agreed that the **primary focus should remain on KPI data**, while funding-related information is a **secondary priority**.

3.4 Financial statements already provide adequate information on liabilities and financial resources.

4. Discussion on Metering Rate and Performance Metrics

4.1 The utility reported a **metering rate of approximately 95%**, which was recognized as a high achievement in the Indian context.

4.2 Participants confirmed that in India, a 100% metering rate is very rare, while countries like Bangladesh have already adopted JICA's standard of full metering.

4.3 It was explained that out of around **1.14 million total connections**, about **48,000** are **unmetered**, mostly **sanitary connections** managed independently by customers.

4.4 Some figures such as the **water coverage rate (71%)** were considered outdated and may not reflect the current situation. It was decided that BWSSB shall provide the updated data.

4.5 The **collection ratio** (around 60–70%) and **NRW data** were also found to be based on old information, since BWSSB had not yet provided the updated data. It was agreed that JICA survey team would update it once BWSSB shares the requested information.

5. Staffing Levels and Efficiency Metrics

5.1 The group discussed the international indicator of **staff per 1,000 connections**, where fewer staff generally indicates higher efficiency.

5.2 BWSSB suggested that this interpretation is not directly applicable to India. In the Indian context, **higher staffing levels** are partly due to **social and employment considerations**.

5.3 While automation may reduce staffing in developed countries, maintaining employment remains important in India.

5.4 The utility currently employs about **2,000 engineers** for **1.1 million consumers**, and it was noted that field-level staffing is still insufficient.

It was agreed that the final survey report will include a note explaining that the staffing indicator should be interpreted in the Indian context, where social and employment factors are significant.

6. Digital Transformation (DX) Maturity Assessment

6.1 The team reviewed the organization's digital transformation progress across six key parameters

6.2 The organization currently has **firewalls installed**.

BWSSB informed that **cyber security training** is being conducted in BWSSB, and the

organization has begun internal awareness campaigns. A Security Operation Centre (SOC) will also be established regarding the same.

6.4 Based on the six parameters, the team discussed the organization's DX maturity as **level as assessed** on a five-level scale.

6.5 It was agreed that the goal is to advance to the next level by formalizing a **comprehensive digital strategy** and strengthening cybersecurity and SOP implementation.

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7. Key Risks and Considerations

7.1 Some KPI figures currently used are outdated or inconsistent. Updated information is required from BWSSB.

7.2 Staffing indicators should not be used without socio-economic interpretation.

8. Decisions and Agreed Actions

- 1.
2. Departments concerned will submit the **latest figures** for KPIs including water production, NRW, metering, service coverage, and collection ratio.
3. Staffing efficiency will be **contextualized for India** in the report, reflecting social and employment objectives.
4. The assessment team will **update KPI scorecards** and **replace temporary data** with official figures when received. BWSSB shall share the data giving enough time to validate and update in the draft report.

Main Points of Discussions – Digital Transformation Assessment with BWSSB

Date: October 27, 2025

Time: 12:20 – 13:10

Venue: BWSSB IT Department

Attendees:

Mr. Sanath Kumar V, Chief Engineer, QA, IT & B, BWSSB

Mr. Maheswarappa V B, Additional Chief Engineer (MIS & IT)

Ms. Lakshmi Yadav K Executive Engineer, BWSSB

Mr. Atsuo Ohno, Team Leader, JICA Survey Team

Mr. Ogata Koichi, JICA Survey Team

Mr. Ohara Yu, JICA Survey Team

Mr. Rohit Mishra (India), TEC

Main points expressed and discussed are shown below:

1. The Mr. Sanath Kumar V, Chief Engineer, QA, IT & B, BWSSB started the meeting appreciating JICA's collaboration with BWSSB for DX enhancement.
2. Mr. Atsuo Ohno, Team Leader, JICA Survey Team mentioned the findings and the results of consideration of main challenges of BWSSB, level of digital maturity, digital architecture and future potential solutions for BWSSB. In addition, he explained that these digital solutions were selected from the perspective that they can contribute to supporting the growth of BWSSB in the line with JICA cluster approach. Therefore, they are expected to play a role not only enhancing the digitalization, but also in facilitating the growth of BWSSB.
3. Chief Engineer highlighted various important points essential for development of the utility. He emphasized the importance of building a sustainable IT and maintenance structure in the future. He discussed the concept of establishing a Central Control Room. This facility could integrate multiple monitoring systems—such as SCADA, billing, and other operational dashboards—into a unified platform. A central dashboard capable of generating alarms and alerts would enable more efficient management of utility functions.
4. Chief Engineer emphasized that IT interventions should be brought under a single umbrella. Currently, individual projects are being implemented separately by various departments, leading to dispersed information. A centralized monitoring and maintenance system under a central umbrella such as the IT Cell was suggested to ensure smoother integration and sustainability after project handover.
5. Chief Engineer highlighted ongoing major initiatives of BWSSB, including: IoT-based monitoring and control of borewells at several locations, implementation of digital payment

systems for new connections, development of a centralized SCADA system under the CP-24 project, and others.

6. The need to expand IT manpower with increased digitization was also discussed. It was suggested that management may consider filling this gap either through recruitment or outsourcing, depending on feasibility.

7. Chief Engineer suggested that chlorination plants should be included under centralized monitoring and control systems, and the use of gaseous chlorine should be eradicated and be replaced with latest technologies.

8. Chief Engineer further highlighted the importance of automation in GIS operations, through centralized portal and should be systematized to improve accuracy and efficiency.

9. The JICA survey team stressed the significance of implementing robust demand forecasting measures to support future planning and system optimization.

10. The JICA survey team highlighted the importance of cyber security with increased digital initiatives. BWSSB informed that training for cyber security was already underway in BWSSB, and a Cyber security Security Operation Centre (SOC) will be established regarding the same.

Meeting Minutes – Digital Transformation Assessment with BWSSB

Date: 13:20-15:05 on Oct 27, 2025

Location: 7th floor at BWSSB Office , Bengaluru

Attendees:

- JICA Consulting Team: Ohno, Ogata, Ohara, and Mr. Rohit (India)
- BWSSB: Ms. Lakshmi Yadav K (Executive Engineer, IT Section)

1) Customer Awareness & Internal Training

- Existing **circulars and website guidance** cover password hygiene, antivirus use, internet usage, and related security practices (issued since 2023).
 - **Training sessions have not yet been delivered** due to staff being on survey duty; **two sessions are planned** when availability improves.
 - Technical documents and SOP-style guidance exist and can be circulated more broadly.
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2) Cybersecurity Program

- Plan to establish a **Project Monitoring Unit (PMU)** to oversee high-priority security issues.
 - Agreement in principle to implement a **Security Operations Center (SOC)** to **monitor network traffic regularly** and improve incident visibility/response.
 - SOC and SOP terminology were clarified (SOC = Security Operations Center; SOP = Standard Operating Procedure).
 - Participants suggested **including SOC details in the minutes** and aligning terminology in future documents.
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3) IT Staffing & Organizational Policy

- **Core concern:** Over-reliance on **outsourced IT personnel** has diluted accountability and continuity.
 - Current in-house capacity: **~5 Computer Science professionals** supporting the organization, which is **insufficient** for the stated DX ambitions.
 - **Position:** Recruit **permanent IT employees** (policy change required) rather than expanding outsourcing.
 - Rationale: **Responsibility, security, and institutional knowledge** are stronger with permanent staff; outsourcing works as a **temporary** measure only.
 - Additional operational need: **Assistant Engineers (AE) and Junior Engineers (JE)** to support field operations critical to digital transformation.
-

4) Data & Digital Transformation (Customer and Enterprise Data)

- Working model to **categorize utility data into four groups**, with emphasis on **customer data and collection processes**.
 - Some customer-facing information is accessible, and certain datasets are **shared with government entities**.
 - Present systems are largely **web-based**; current operations are **not** using IoT sensors for processing.
 - **Digital Architecture (As-Is)**: It was noted that **sensor data is not currently connected with customer/service data**, and this disconnection should be addressed in future architecture revisions.
-

5) Smart Metering & IoT Roadmap

- **Current**: No active sensor/IoT processing; existing solutions are web-based.
 - **Planned: Advanced Metering Infrastructure (AMI)** for **high-consumption customers** (future project; AMI will enable richer telemetry and integration).
 - Clarified terms: AMI (Advanced Metering Infrastructure) and AMR Automatic” Meter Reading were discussed in relation to future connectivity pathways.
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6) AI-Based Leak Detection (Pilot)

- Ongoing **AI-driven leak detection pilot** (no satellite imagery; **in-ground sensors**).
 - **Deployment**: Sensors inserted **every ~200 meters** along **~1 km stretches** in **vulnerable areas** (noted in **northern and southwestern zones**).
 - Objective: Detect signatures of leaks/decomposition and **validate pilot efficacy** before scale-up.
 - Next step contingent on **pilot results** and technical team’s report.
-

7) Asset & Maintenance Management

- The team proposed an **integrated Asset Management and Maintenance Management System**.
 - This approach goes **beyond asset tracking** to include **preventive maintenance planning** and comprehensive management of equipment such as pipelines, pumps, and valves.
 - The proposal draws on **examples of** Asset Management Systems (EAM(Enterprise Asset Management)/ CMMS(Computerized Maintenance Management System)), illustrating a combined asset/maintenance approach and investment strategy.
-

8) Documentation, KPIs, and Funding Readiness

- For external funding/loans, **annual financials alone are insufficient**; **KPI-rich operational reports and dashboards** are needed (e.g., service level benchmarks, NRW, coverage, metering, production).
 - **Grants may be difficult** given the organization's relative maturity; **loans** or programmatic funding are more plausible.
 - Agreement to **share soft/hard copies** of available documents; circulate internally and **consolidate feedback** across departments before finalizing.
-

9) Change Management & Adoption

- The **Chief Engineer** has a clear **digital transformation (DX) strategy** and forward-looking ideas, but these **advance faster than the organization's current readiness**.
 - Ms. Laxmi observed that sometimes there are **gaps in understanding between management and general employees**, which hinder smooth implementation.
 - It was emphasized that developing a **shared DX strategy** and **communicating it effectively across management and staff levels** is essential to ensure alignment and sustainable digital transformation progress.
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10) Website/Policy Notes

- **IT policy is published on the official website**, and should be kept consistent with future updates on cybersecurity and digital initiatives.

Meeting Minutes – Digital Transformation Assessment with BWSSB

Date: 15:10-16:00 on Oct 27, 2025

Location: 1st floor at BWSSB Office , Bengaluru

Attendees:

- JICA Consulting Team: Ohno, Ogata, Ohara, and Mr. Rohit (India)
- BWSSB: Mr. Prakasha, Accounts Section

1) Executive Summary

- BWSSB is implementing an ERP-driven suite centered on **HRMS** and **Work Management System (WMS)**, with additional **Asset**, **Receipt**, and **Audit** modules.
- **HRMS V1** is ready for release and targeted to generate the **current month's salaries** (to be paid in the **first week of December**).
- **WMS V1** (streamlined, with minimized paper flow but full approvals and accounting) will start after management sign-off and security audit/UAT; **WMS V2** will deliver end-to-end automation.
- The solution will integrate with **Central SCADA** (financial/context data) and **GIS** (asset registration), run on **Karnataka State Data Center (KSDC)**, and leverage **KSWAN** for connectivity.
- Target is to run the legacy and new systems in parallel now and move fully to the ERP by the **next financial year (April)**.
- Estimated total program cost is **~INR 10 crore**; management expects efficiency gains to recover costs within a **quarter**.

2) Scope & Architecture (ERP)

- ERP comprises three principal modules:
 - **Asset module** (capitalization and asset lifecycle).
 - **Receipt module** (all income flows).
 - **Audit module** (revenue and expenditure audits; reconciliations in near real time).
 - HRMS (Human Resources Management System)
- **WMS** is positioned as a core ERP component spanning estimate → execution → bill → payment → capitalization.
- All receipts and all expenditures (HR, work payments, GA, power charges, debt service) will be accounted for within the ERP.

3) HRMS — Status & Approach

- **Data migration:** 1,400 staff records completed out of ~1,700; ~300+ pending (delay driven by B/C-group deputations).

- **Resourcing:** 25 staff trained and deployed to field offices to complete service-register based entries.
- **V1 scope:** end-to-end **salary computation** (earnings, deductions) validated for **55 employees** across scenarios; aim is to **generate current month salaries in HRMS** and disburse in the **first week of December**.
- **V2 scope:** intake of **legacy data** (e.g., loan details) that do not affect salary computations and employee postings to be integrated.
- **UAT:** invited for HRMS following completion of data entry and security checks.

4) WMS — Overview & Phased Implementation

- **V1:** streamlined process with minimized paper, full approvals and accounting from **estimate to bill payment**; initial parallel run with legacy process, then cutover by the **next financial year**.
- **V2: full automation**—including system-generated bills from contractor-entered measurements, automatic price-escalation calculations (index-based), validations (GST registration, performance guarantees), quantity controls, and end-to-end digital approvals.
- **Volumes:** expected to cover **25,000+ emergency works** and all contract types.
- **Contractor portal:** user IDs mapped to **PAN**; contractors can view bill/payment status and download work details.
- **Organizational resilience:** WMS can adapt to BWSSB restructuring under **Greater Bangalore Authority** (new regions/divisions, reassignments).

5) Collaboration, Infrastructure & Readiness

- **Centre for eGovernance (eGov), Govt. Of Karnataka:** strong support (large team, extended hours); **FRS completed**; earlier server issues resolved.
- **Security:** **security audit** planned this month, followed by **UAT** with selected offices.
- **E-filing:** live in Administrative Section; statewide rollout requires **KSWAN** dedicated line; all data hosted in **KSDC**.

6) Integrations

- **SCADA (CP-24 / Central SCADA)**
 - **Data flow:** WMS → SCADA (financial/context only). Users viewing an asset in SCADA can see when/under which package it was constructed, contractor, costs, last bill status, commissioning, etc.
 - **Scope boundary:** SCADA remains for **real-time O&M monitoring** (GLRs, STPs, pumping stations, distribution); WMS supplies **financial history** and project context.

- **GIS**
 - Completed works in WMS are entered into **GIS** as assets; avoids duplication for O&M works.
 - Asset capitalization and linkage to ERP **Asset module** on work completion.

7) Dashboards & Transparency

- **Analytical dashboards:**
 - **Operations view:** day-wise pending items, workflow status, exceptions.
 - **Project view:** portfolio → program → package drill-down (e.g., JICA/World Bank programs), showing est. vs. actual expenditures, approvals, bills, reductions, EMDs, supporting documents, and approval trails.
- **Stakeholder access** (role-based): public (limited), auditors, banks/lenders, contractors, UDD/Central Govt. departments; quarterly Chartered Accountant audits planned.
- **Payments:** plan to **batch all payments at 3:00 PM** daily to reduce delays and increase predictability.
- **Knowledge sharing:** Process module for external aid projects to be integrated with WMS. All information and correspondence to be stored as legacy data.

8) Costs & Funding Notes

- **WMS module:** < **INR 1 crore** (to be finalized).
- **HRMS module:** ~**INR 4.50 crore (incl. GST)** with two years' maintenance.
- **ERP program:** references to ~**INR 5 crore** (ex-HR) and overall ~**INR 10 crore**.
- **ROI:** expectation to **recover within one quarter** via efficiency savings (reduced paper, faster processing, consolidated procurement, etc.).
- **GST position:** BWSSB currently treated as a **government authority**; pursuing **local authority** classification to enable **GST exemptions** (e.g., service contracts with **>75 persons manpower**), thereby lowering project costs.

9) Organization & Change Management

- Anticipated **restructuring:** new regions/divisions; Chief Engineer as head of multiple maintenance divisions; request to defer structural changes' operational impact until the **next FY**.
- ERP/WMS designed to **absorb organizational changes** (creation/closing/holding of entities within software).

10) Milestones & Targeted Dates

- **HRMS V1:** release now; **current month salary** to be generated in HRMS; **payout in first week of December**.
- **WMS V1:** demonstration scheduled; post-management approval → backend data load → **security audit** (this month) → **UAT** (selected offices) → go-live initiation; parallel

run this FY

- **WMS V2:** post-V1 stabilization; full automation (bills, escalations, validations, AI-assisted checks). Planned to release from next financial year.
- **E-filing expansion:** dependent on **KSWAN** provisioning.

11) Risks & Dependencies

- **Data readiness:** completion of remaining ~300 staff entries for HRMS.
- **Connectivity:** **KSWAN** dedicated lines required for enterprise-wide e-filing and stable access to KSDC.
- **Organizational changes:** live restructuring may affect roles/approvals; mitigated by ERP flexibility.
- **Compliance:** timely completion of **security audit** before UAT and broader rollout.
- **Contractor onboarding:** database setup and phased access (some features deferred to V2).

12) Action Items

1. **HRMS data completion** — Trained 25 staff to finalize ~300 pending records; confirm readiness for payroll run.
2. **Security audit** — Schedule and complete this month; address findings promptly.
3. **WMS V1 UAT** — Prepare UAT datasets (current-month estimates/bills), nominate pilot divisions, capture feedback.
4. **KSWAN provisioning** — Follow up on dedicated lines for e-filing expansion and stable KSDC access.
5. **Contractor access plan** — Finalize PAN-linked IDs, onboarding steps, and help materials (V1 scope; V2 enhancements).
6. **Dashboard baselines** — Configure project and operations analytics; define KPIs and exception thresholds.
7. **GST & classification** — Continue engagement with State/Centre on **local authority** status and exemptions.
8. **Change management** — Align ERP role/approval matrices with planned organizational structure; stage updates to avoid mid-FY disruption.

Meeting Minutes – Digital Transformation Assessment with BWSSB

Date: 11:30-12:30 on Oct 27, 2025

Location: 2nd floor at BWSSB Office in Malleshwaram, Bengaluru

Attendees:

- JICA Consulting Team: Ohno, Ogata, Ohara, and Mr. Rohit (India)
- BWSSB: Ms. Nalini (Executive Engineer, UFW-II Division) and Monitoring Team Members

1) Monitoring Dashboard

- Tracks **flow (and pressure) data** across multiple **DMAs** from **~2,000 flowmeters** installed under packages **D1A (central), D2A (west), D2B (south)**.
- **Status colors:**
 - **Green** = data received;
 - **Red** = data not yet received (expected later).
- **Data path:** device → raw (non-readable) format → conversion software → SCADA storage (per-meter folders).
- **Access:** Desktop and **mobile**; **Telegram** integration under way for push access.

4) Coverage & DMA Counts (as stated by team)

- **D1A: 43 DMAs** (114 flowmeters).
- **D2A: ~80 DMAs**. (183 flowmeters)
- **D2B: ~80 DMAs (~250 flowmeters cited)**.
- Flowmeters installed in other initiatives, after D1A, D2A and D2B. These are power-operated meters with battery backup.
- Overall, approx 2000 flow meters are installed in the BWSSB municipal area. Concerned field officers can access their readings through their phones identifying the flowmeters in their area through their respective IDs, and act accordingly.
- Note: Monitoring is **operational** (inlet/outlet, flow, pressure). **Revenue/billing** systems are **separate** and not integrated here.
- **NRW is calculated using billing data from another department and flow-meter data from the SCADA system. Because the billing data is not integrated with SCADA, the team must obtain it from the designated department; otherwise, NRW cannot be calculated. At present, the head of the NRW department calculates NRW manually, and no automated calculation has been implemented so far.**

5) Meter Types & Data Frequencies

- **Battery-operated meters (~40% in the total area):**

- Log every **15 min stored**; **transmit once per day (24h lag)** to conserve battery.
 - Battery life typically **4–7 years**; real-time transmission would shorten life to months.
- **Power-operated meters (~60% in the total area):**
 - **Real-time** updates, commonly **every 10 min**; some configurations moving toward **~2–3 min** pushes.
- Team mentioned **~60% of DMAs** have real-time flow via powered meters (phrasing varied; treat as indicative).

6) Use of Data in Operations

- **Monthly review meetings** with area officers/end-users per DMA to compare usage, losses, and control measures.
 - **Daily/hourly monitoring** by field staff via phone; operators **open/close valves** to balance supply against **saturation limits**, redistribute flows, and manage shifts across areas.
 - Real-time readings facilitate **faster in-field reactions**.
-

7) Maintenance & Replacement Practices

- **Triggers:** red status, non-communication, or **anomalous readings**.
- **Process:**
 - Dispatch team → check power feed/cables → verify with **portable clamp-on meters** → if mismatch, inspect coil resistance/condition.
 - Fault causes include **power issues**, **coil damage** (e.g., surge), and **mechanical damage** during excavation.
- **Replacements in a year: ~60 flowmeters** can be replaced per year. **There is no preventive maintenance and some failure happens and staff will respond to it.**
- **Funding:**
 - **Repairs/replacements:** BWSSB board & revenue budgets.
 - **New projects:** external agencies (e.g., **World Bank**) as cited.

8) Water Quality & New Devices

- Legacy flowmeters: **no water quality** sensing.
- Newer meters feature **conductivity sensors**, enabling **water quality** capture (pressure/flow remain standard).
- **CP-24** noted to include **water quality monitoring**, addressing this gap.

9) SCADA Integration & Data Hosting

- Existing systems **write to SCADA-side folders** per meter; operators can view the same data centrally.

- **Uncertainty** remains over **CP-24** integration mechanics:
 - Whether CP-24 will **pull from the existing server** or **directly from field devices**.
 - **Format compatibility** (multiple device protocols in use) and **server capacity** for “n” formats.
 - Organizational split across **two divisions** contributes to ambiguity.
- Team aims to **keep current system operating** to avoid **data loss** during transitions.

10) Organizational Scope & Boundary Notes

- Historical mention of **9 divisions** on one screen; current total stated as **22 divisions**.
- DMA concept strongly applied under D1A/D2A/D2B; other areas may be monitored **by boundary** rather than full DMA rehabilitation.

Meeting Minutes – Digital Transformation Assessment with BWSSB

Date: 13:00-13:20 on Oct 27, 2025

Location: 7th floor at BWSSB Office, Bengaluru

Attendees:

- JICA Consulting Team: Ohno, Ogata, Ohara, and Mr. Rohit (India)
- BWSSB: Ms. Lakshmi Yadav K (Executive Engineer, IT Section)

1. Purpose of the Meeting

The meeting focused on evaluating potential solutions for improving the water management system, with a particular emphasis on the **Non-Revenue Water (NRW)** management component. Participants reviewed **the evaluation/scoring system** previously introduced and discussed the **evaluation criteria, scoring methodology, and prioritization** of proposed design solutions.

2. Review of Evaluation System and Request for Input

Ms. Lakshmi was requested to offer **personal opinions** regarding the **preliminary solutions** that had been proposed, asking which of them appeared **most effective or suitable** for implementation in the next two to three months.

It was emphasized that improvements should be incorporated and that the evaluation process should **consider the views of all members**, rather than relying on a single opinion.

3. Discussion on Evaluation Criteria

Questions were raised about **how these criteria were determined**, what **documentation supported** the evaluation, and whether **budgetary aspects**—both investment and operational costs—were included.

It was noted that **benchmarking** had been used to define the criteria and It was confirmed that the **JICA reference material** served as the **basis for assessment**. Each solution was evaluated using a **1–3 point scoring scale** per criterion, with a **maximum total of 9 points**.

Even if some individual scores were adjusted, it was expected that the **top four solutions** would remain consistent:

- Formulation of a comprehensive DX Master Plan
- Development of an Asset Management System
- NRW Countermeasures using AI Technologies (Satellite Imagery Leak Detection and Pipeline Deterioration Diagnosis)

These four were viewed as both **practical and high-impact**, aligning with previous recommendations.

4. Evaluation Process and Documentation

Ms. Lakshmmi requested a **snapshot of the evaluation slides** to better understand the **scoring process**. It was confirmed that the **JICA reference material** served as the **basis for assessment**, with scoring examples showing:

- **3 points** = major improvement or strong impact
- **2 points** = moderate improvement
- **1 point** = minimal improvement

This broad framework was considered useful for **identifying potential solutions**.

Ms. Lakshmi and BWSSB agreed to review the slides collectively and share any alternative ideas or missing solutions with the evaluation team for further consideration.

5. NRW Calculation and Integration into SCADA

The discussion then shifted to **NRW calculation methods**, which are currently **performed manually**.

Mr. Ohno explained that some **volume data** had been implemented, but **billing water information** remained inconsistent, making accurate calculation difficult.

They discussed plans to integrate **automatic NRW ratio calculations** in the **next version of the SCADA system**, using both **billing water volume** and **input water volume**.

It was noted that before automation could be achieved, **100% metering** of all **input and output points** must be completed.

The team estimated that full metering might be achieved **soon**, pending resolution of minor technical issues.

6. Smart Meter Implementation

The team discussed the introduction of **smart meters**, noting that **AMI (Advanced Metering Infrastructure)** meters are **expensive** and therefore being **prioritized for high-consumption users** such as:

- Apartment complexes
- Commercial and industrial users

These users contribute **approximately 70% of total revenue** but represent only **30% of total connections**.

To optimize costs, **LoRa-based automatic meter reading (AMR)** technology was being considered for these bulk users.

This is amongst some of the new initiatives of BWSSB as informed by CE (Projects) during first survey visit.

7. Report Preparation Schedule

The meeting concluded with a discussion on the **report timeline**:

- **Draft Report submission:** mid-December to JICA
- **Completion of evaluations and finalization of details:** by the end of November.

Participants agreed to coordinate to ensure all assessments and solution recommendations are completed on schedule.

The JICA survey team requested BWSSB to provide any comments or suggestions on the proposed materials and solutions by the end of November.

8. Closing

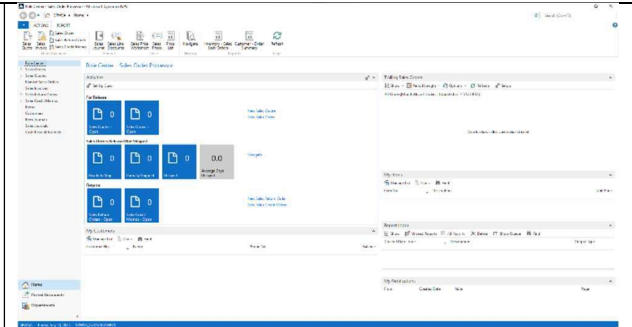
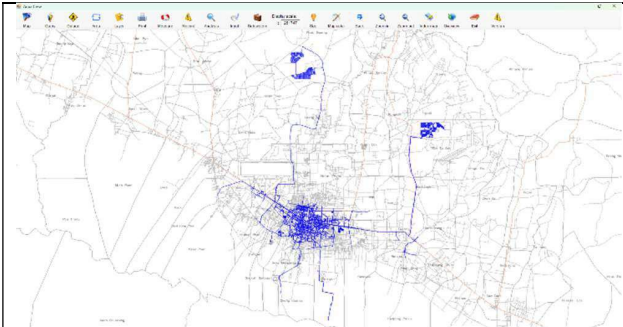
The session ended with mutual appreciation for the cooperation and data sharing among members.

It was agreed that the team would continue refining the evaluation results and circulate supporting materials (evaluation slides, criteria documentation) for further validation.

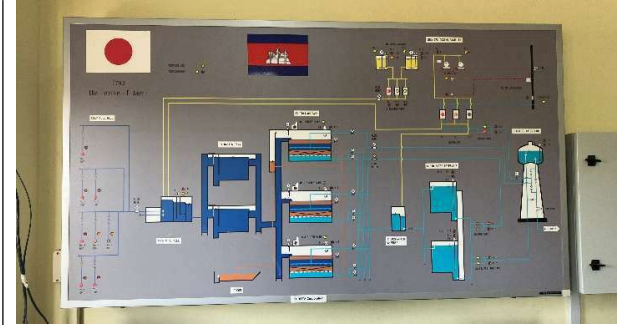
資料- 7 : 写真集

資料 7 写真集

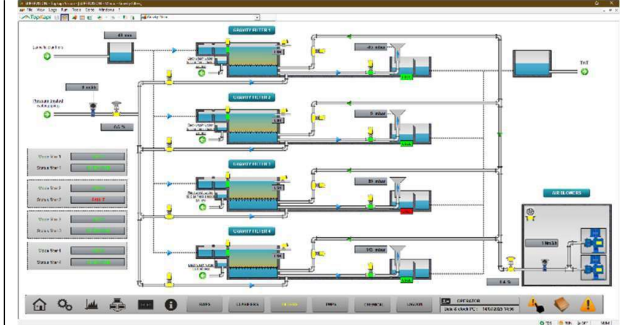
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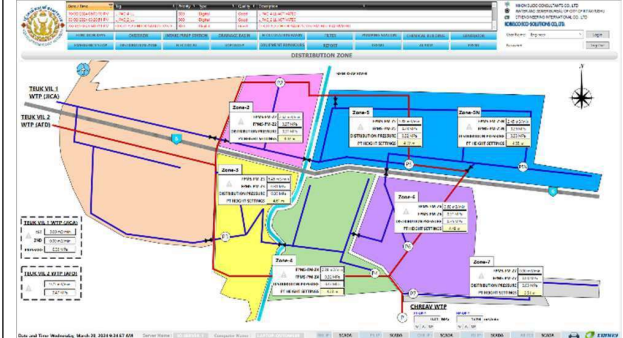
Aqua Crew



SUMS



SCADA WPT1



SCADA WTP2



SCADA WTP3



Leak Detection equipment

Site Visit (Distribtuion pipeline)

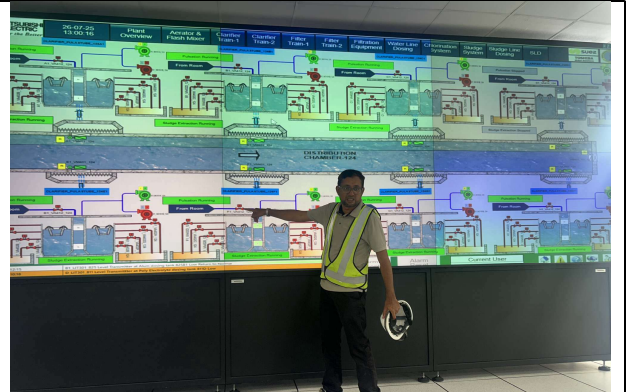


Meeting with MISTI

BWSSB



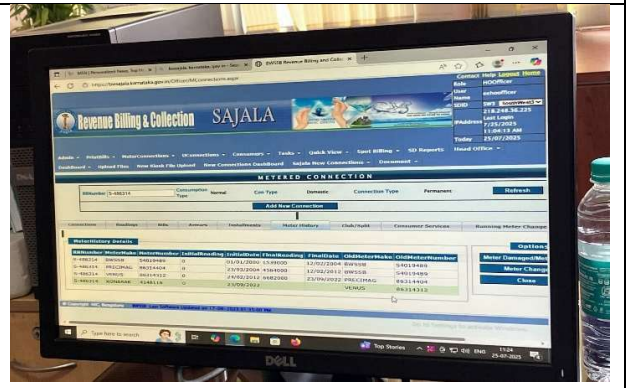
Site Visit at WTPs



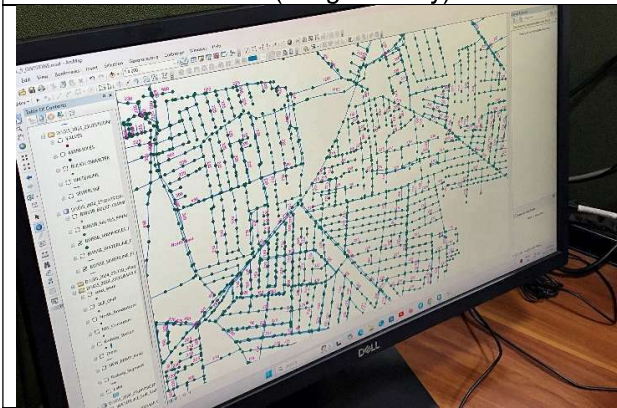
SCADA Room at WTP



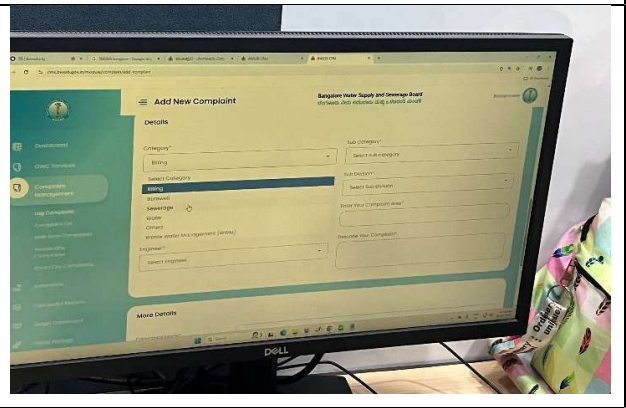
Central SCADA Centre (Bengaluru City)



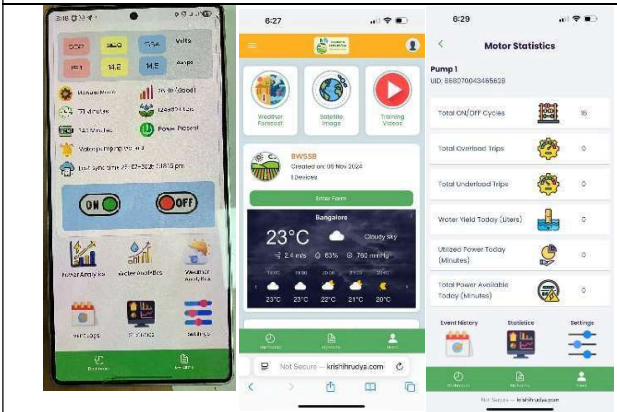
SAJALA



ArcGIS



Complaint Management System



AI Borewell Monitoring



Meeting with IT Dep.

資料- 8 : 「クラスター事業戦略進捗モニタリングシート」

国名：インド 水道事業体名：ベンガルール上下水道局 (Bangalore Water Supply and Sewerage Board (BWSSB))
国名：インド 水道事業体名：ベンガルール上下水道局 (Bangalore Water Supply and Sewerage Board (BWSSB))

No.	評価項目	モニタリング指標	データ	単位	データ 取得年	備考	出典	モニタリ ングに 必須	位置付け／記入上の留意点／計算式	
水道サービス指標										
1	事業規模	給水人口 (顧客数)	12,900,000	人	2024	接続数：11.18万件 質問票回答（2025年8月）	https://bwssb.karnataka.gov.in/info-1/About+BWSSB/en	●	・水道事業の規模感を把握するための指標 ・一般に水道事業体が把握しているのは、水道利用人口ではなく、料金徴収の単位である給水栓数（接続数）であるため、給水栓数（接続数）を記載してもよい。	
2		給水普及率	71	%	2017		ISEC(2020): Benchmarking of Bangalore Water Supply and Sewerage Board (BWSSB)	●	・水道事業体が対象エリアの水需要を満たしているのかを把握するための指標 ・計算式：給水人口/給水対象エリアの人口 ・普及率の定義（分子、分母にどのような数字を用いているのか）や計算方法は要確認。	
3		浄水生産能力	1,450,000	m ³ /日	2024	フェーズ3協力準備調査の報告書（2017年）による浄水能力（公称）：計1,310,000m ³ /日	https://bwssb.karnataka.gov.in/info-1/About+BWSSB/en	●	・水道事業の規模感を把握するための指標。	
4	サービス水準	給水時間	4-5	時間/日	2020		ISEC(2020): Benchmarking of Bangalore Water Supply and Sewerage Board (BWSSB)	●	・水道事業体の運転維持管理能力を確認し、水道サービス水準・顧客満足度を把握するための指標。 ・連続給水ではなく時間給水の場合、1日（または1週間）あたりの給水時間を記載。一般に、時間給水を採用する理由としては、①配水可能な水量の絶対的に不足している。②漏水が多く24時間給水では漏水量が増加する、等が挙げられる。 ・給水区域中でばらつきがある場合、●～●時間/日など幅を持たせた記載も可。	
5		給水水質		—				●	・水道事業体の運転維持管理能力を確認し、水道サービス水準・顧客満足度を把握するための指標。 ・浄水場出口の水質が問題ないか（浄水場での水質基準順守率）、給水栓での残留塩素濃度を確認する（給水栓での水質基準順守率、残留塩素検出率）。数字の把握が難しい場合は定性的な評価で代替。 ・定性的な評価として、使用者から苦情が発生していないか等も確認する。	
6		給水圧		—					・水道事業体の運転維持管理能力を確認し、水道サービス水準・顧客満足度を把握するための指標。 ・高台や管網の末端など、水圧が最も低くなる箇所をモニタリング地点として選定し、適正な水圧があるかどうかを確認する。定量的な把握が難しいことも多く、その場合は定性的な評価で代替（給水栓における水圧について住民から苦情が発生していないか等）。	
7		顧客満足度		—					・顧客満足度を確保するための指標 ・使用者が水道サービスに対して満足しているか、何に関して不満を抱えているかを確認する（定性的な評価）。 ・水道サービスの改善が期待できる案件においては、顧客満足度調査をプロジェクトのスクープに含めることも検討する（全体的な満足度に加えて、水量（給水時間）・水質・水圧・水道事業体の顧客対応・水道料金等、項目ごとの満足度を調査）。	
財務データ(経営・財務指標#14-25を1964年制定の Bangalore Water Supply and Sewerage Board (BWSSB)の財務データに準拠)										
a	BS	流動資産	ベンガルール市域	INR	2022-23	BWSSB, Annual Accounts for the Year 2022-23			流動資産に該当する全勘定項目を加算 [Current Assets]+[Sundry Debtors]+[Deposits]+[Internal Divisional Transfers Debits]+[Cash and Bank]	
b		現預金	18,995,159,808.70	INR					[Cash and Bank]	
c		固定資産	257,098,743,736.01	INR					固定資産に該当する全勘定項目を加算 [Fixed Assets]+[Investments]+[Works in Progress]+[Works in Progress – Deposit Works]	
d		資産合計	319,786,664,842.15	INR	BWSSB				流動資産＋固定資産＋[Net Deficit as per previous B/S]+[Deficit for the year]	
e		一年前の資産合計	255,979,675,235	INR	BWSSB				同上	
f		固定負債	85,438,586,209.91	INR					固定負債に該当する全勘定項目を加算 [Loans]+[Provisions]	
g		有利子固定負債	83,225,182,004.00	INR					[Loans]	
h		自己資本	141,629,608,092.99	INR					[Grants and Contributions]+[Reserve Funds]	
i	PL	売上高	14,909,291,630.00	INR					[Water Revenue incl. Meter Hire]	
j		営業利益	-875,619,221.34	INR					[Surplus / Deficit]	
k		経常利益	-4,011,229,723.34	INR				n		
l		減価償却費	2,963,520,365.84	INR						
m		金融収益	不明	INR						
n		利払い	3,135,610,502.00	INR					[Interest Payment on Loans]	
o		補助金 (長期前受金戻入)	95,222,878,085.68	INR					[Grants and Contributions] ※B/Sより	
p		純利益	-4,011,229,723.34	INR					[Net Surplus / Deficit]	
q	CF	EBITDA	2,087,901,145	INR						
r		営業CF	不明	INR						
s		投資CF	不明	INR						
t		為替	1.68	換算レート						
経営・財務指標										
8	経営状況	会計制度	BS表とPL表を用いて年次会計報告書を作成している。CF表は作成していない。	—	2025	現地調査ヒアリング		●	・企業会計の適用有無を確認するための項目。 ・成長する水道事業体の前提条件として、企業会計を適用し、財務三表を用いて経営状況を把握・管理できている必要あり。	
9		水道料金水準	2025年4月に料金改訂。 一般家庭の場合（15mm）： 20m3当たり 約345ルピー（3.93USD） 30m3当たり 約670ルピー（7.62USD） ●使用量に応じた従量制料金。 ●上水：下水＝4：1の比率で料金を設定。 ●別途、井戸使用者は衛生手数料を加算。	—	2025	現地調査ヒアリング		●	・水道料金水準が適切に設定されているか確認するための指標。・給水時間、給水圧、給水水質等の改善後に料金値上げを行った場合、料金徴収率に影響がないか等を確認し、クラスター事業戦略のシナリオを検証する。 ・データの計算方法としては、①営業収益（料金収入）を有収水量で割る方法（日本では「供給単価」と呼称）と、②水道料金表から標準家庭において1か月水道を利用した場合の料金を算出して、単位水量あたりの料金を求める方法がある。世銀 IBNETでは②を採用し、水使用量の少ない貧困層を念頭に1か月に0m3を使用する場合の水道料金をデータベース化しているが、より標準的な使用量として1か月に20m3を使った場合で計算しているケースもある。 ・用途を問わず、水道事業体全体としての水道料金水準を把握するためには①がよく、住民の支払い能力や支払い意志額と比較する場合には②が用いられる。 ・1世帯当たりの収入がわかる場合、水道料金負担と比較する（目安は3～5%程度）。	
10		料金徴収率	98	%	2024	現地調査ヒアリング回答（2025年11月実施）		●	・水道事業体の料金回収能力を確認するための指標。 ・ある期間に発行した水道料金の請求書の総額に対する、実際に徴収した水道料金の総額の比率。 ・給水時間、給水圧、給水水質等の改善や従量制への移行によって向上するか確認し、クラスター事業戦略のシナリオを検証する。料金徴収率が低い場合、料金支払いの有無で顧客間に不公平感が生じるため、料金改定に対する支持が得られにくくなる。	
11		無収水率	37%以上	%	2018	Blueprint for the future (Vision 2050)		●	・水道事業の運営能力を把握するための指標。水道システム（送配水管網）への投入水量から、料金請求対象水量（有収水量）を差し引いて求められる無収水量を、水道システム投入水量で割って算出。 ・途上国では正確に計算されている事例は多くなく、精度の低い推定値であるその場合は「〇〇%と推定されている」等と記述する。	
12		漏水率	不明	%					・無収水のうち、どの程度が物理的損失であるかを把握し、水道事業体の運転維持管理能力を確認するための指標。 ・途上国では正確に計算されている事例は多くなく、精度の低い推定値であるその場合は「〇〇%と推定されている」等と記述する。	
13		メーター設置率	94.83	%	2017	ISEC(2020): Benchmarking of Bangalore Water Supply and Sewerage Board (BWSSB)			・従量料金制を導入しているか、導入できる環境にあるかを確保するための指標。 ・ある期間に発行した水道料金の請求書の総額に対する、実際に徴収した水道料金の総額の比率。 ・給水時間、給水圧、給水水質等の改善や従量制への移行によって向上するか確認し、クラスター事業戦略のシナリオを検証する。料金徴収率が低い場合、料金支払いの有無で顧客間に不公平感が生じるため、料金改定に対する支持が得られにくくなる。	
14		事業規模	売上高	14,909	百万INR	2022	BWSSB, Annual Accounts for the Year 2022-23		●	・水道事業体の規模感を把握するための指標。過去のトレンド（水道料金収入の成長、縮小、安定、不安定など）も確認する。 ・水道事業は資本集約的な産業であり、水道料金のみでコストリカバリーするためには一定以上の規模が必要と考えられる。費用を含めて水道料金でコストリカバリーが可能な規模の目安としては、日本の水道事業体の実績を踏まえると、給水人口10万人以上、送配水管1kmあたりの給水人口150人以上と考えられる。
				25,048	百万円	2022	BWSSB, Annual Accounts for the Year 2022-23			
15			純利益	-4,011	百万INR	2022	BWSSB, Annual Accounts for the Year 2022-23		●	・水道事業体の財務状況（特殊要因も含めて）/特定の総合的な収益力/規模感を把握するための指標。 ・純利益率に関する指標（自己資本当期純利益率：ROE、総資産当期純利益率：ROAなど）は収益性を把握するデータとして良く利用される。 ・水道事業は資本集約的な産業であり、水道料金のみでコストリカバリーするためには一定以上の規模が必要と考えられる。
				-6,739	百万円	2022	BWSSB, Annual Accounts for the Year 2022-23			
16		EBITDA	2,088	百万INR	2022	BWSSB, Annual Accounts for the Year 2022-23		※	・水道事業体がどの程度のキャッシュフローを創出する能力（規模）があるかを把握するための指標。 ・計算式：営業利益（Operating Profit）÷各種償却費（Depreciation）もしくは Depreciation and amortisation charges） ・水道事業のように設備投資が多く償却費負担の大きい場合の収益力を分析する際に用いられる。	
			3,508	百万円	2022	BWSSB, Annual Accounts for the Year 2022-23				
17	収益性	EBITDAマージン	14.00	%	2022	BWSSB, Annual Accounts for the Year 2022-23		※	・活用可能なキャッシュフロー・創出能力を把握するための指標。水道事業のように設備投資が多く償却費負担の大きい場合の収益力を分析する際に用いられる。 ・計算式：EBITDA/売上高（SalesまたはIncome） ・指標の目安：30%以上が目標。世銀のUtility of the FutureではWorld Classの上下水道事業体の閾値を30%と設定。	
18		総資産営業利益率（ROA）	-0.30	%	2022	BWSSB, Annual Accounts for the Year 2022-23		※	・総資産に対する収益性を把握するための指標。数値が高いほど、投資した資産が効率的に収益に貢献していると判断できる。クラスター事業戦略において、資産規模を増やして収益性を高めるアプローチを掲げており、係る成果を確認する。 ・計算式：営業利益（Operating Profit）/ 総資産（Total Assets） ・指標の目安：5%以上が目標。	
19		売上高経常利益率（長期前受金戻入を除く）	-26.9	%		BWSSB, Annual Accounts for the Year 2022-23		※	・営業活動（水道事業）と財務活動に関する経営効率（突発的な損益を含まない、通常の経営活動の効率）を把握するための指標。クラスター事業戦略では、規模を上げるだけでなく経営効率の改善を目指しており、係る成果を確認する。 ・計算式：（経常利益（Ordinary Profit）-補助金（長期前受金戻入）（Government and other grants等））/売上高（Income） ・指標の目安：15%以上が目標。	
20	安全性	自己資本比率	44.3	%		BWSSB, Annual Accounts for the Year 2022-23	BWSSB, Annual Accounts for the Year 2022-23	※	・資金調達面（BSの右側）での安全性を把握するための指標。数値が高いほど経営が安定している。 ・計算式：自己資本（Total Equity, Capital）/総資産（Total Assets） ・指標の目安：40%以上が目標（収益性の高い事業体の場合は30%以上）	
21		固定長期適合率	113.2	%		BWSSB, Annual Accounts for the Year 2022-23	BWSSB, Annual Accounts for the Year 2022-23	※	・資本構成上の安全性（固定資産を固定負債と自己資本で賄っているか）を確認する指標。長期借入金及び自己資本の範囲内の投資になっていない場合、資金繰りが圧迫される。水道事業は固定資産の割合が大きいため要注意。 ・計算式：固定資産（Non-current Assets）/（固定負債（Non-current Liabilities）+自己資本（Total Equity）） ・指標の目安：100%を上回る場合は要注意（固定資産の一部を流動負債で賄っている状態）	
22		インタレストカバレッジレシオ	#VALUE!	倍				※	・フロー面から見た安全性を把握するための指標。債務返済能力（利息を支払うだけの利益を獲得しているか）を確認。 ・計算式：（営業利益（Operating income）+金融収益（受取利息（Interest income）+配当金（Dividend income））/支払利息（Interest expense） ・指標の目安：1.0倍を下回る場合は要注意（金融費用が事業利益を上回っている状態）	
23		EBITDA有利子負債倍率	30.8	倍		BWSSB, Annual Accounts for the Year 2022-23	BWSSB, Annual Accounts for the Year 2022-23	※	・資金繰りの面からの安全性を把握するための指標。EBITDAはキャッシュ創出能力を意味するため、有利子負債の返済に要する平均年数を示すと解釈される。 ・計算式：（有利子負債（Liability with interest）-現預金（Cash and deposits））/ EBITDA ・指標の目安：5倍以下が目標（成長ステージに依る）	
24		キャッシュフロー	フリーキャッシュフロー	#VALUE!	百万INR				※	・水道事業体の成長ステージを把握するための指標。マイナスの場合は黎明期～成長期、プラスの場合は成熟期にあり、FCFが高水準から低下している場合、成熟期を過ぎて衰退期にあると考えられる。 ・計算式：営業キャッシュフロー（Cash flows from operating activities）-投資キャッシュフロー（Cash flows from investing activities）
25	営業キャッシュフロー・マージン		#VALUE!	%				※	・売上高に対して、営業活動を通じた現金収入の割合を確認することで、経営状況を判断するための指標。営業利益（PLの数値）が高くとも、本指標の数値が低い場合、債務支払いが滞る（マイナスの場合は黒字倒産する）可能性がある。 ・計算式：営業CF/売上高×100 [%] ・指標の目安：15%以上が目安（要精査）	
分析欄・備考欄				—	—	—				

(留意点)
1. 水道事業体の発展段階に関わらず、全ての水道事業体で「最低限必要な指標」のデータは収集することを目指す。
2. ※の指標は、発展段階の高い水道事業体（水道事業体成長支援型、スケールアップ支援型）については最低限必要な指標とし、データの収集を目指す。

上水道案件 セクター／水道事業体 基本情報チェックシート

国名：インド 水道事業体名：ベンガルール上下水道局（Bangalore Water Supply and Sewerage Board（BWSSB））

	指標・情報	重要度	数値・情報	単位	出典
セクター概要					
1	国家人口	★★	146,000	万人	国連人口基金、2025年 (World Population Dashboard)
	一人当たりGDP	★★	2,697	USD／人	WB, GDP per capita (current USD), 2024年
2	年間降水量	☆	900 (ベンガルール市)	mm／年	Climate Risk Country Profile: Cambodia, 2021 (WB & ADB)
	気候帯	☆	熱帯サバナ (ベンガルール市)		Climate Risk Country Profile: Cambodia, 2021 (WB & ADB)
3	国全体の水道普及率	★★	59	%	JPM、2024年 (Piped water supplyの普及率)
4	水道セクターのガバナンス	★★	カルナータカ州政府（Government of Karnataka）管轄で、ベンガルール市の一部局（上下水道局）で水道事業を実施。		
5	主要な開発方針、開発課題	★★	州全体の水分野計画としては、地方給水プログラムとしてJal Jeevan Mission（JJM）があり、カルナタカ州政府と中央政府がプログラムを実施している。一方、ベンガルール都市圏）の主要開発計画としては、主要なものとしてカーヴェリ（Cauvery）給水拡張：Cauvery Water Supply Scheme 第5期（Stage V）が実施中である。 開発課題としては、ベンガルール市の将来的な急激な人口増加と水需要の逼迫、水源の多様化と統合的水資源アプローチによる効率的な水利用、地下水資源の低下などが挙げられる。		
水道事業体の概要					
1	水道事業体の形態、監督・規制体制	★★	1964年制定の Bangalore Water Supply and Sewerage Act, 1964 に基づき設立された水道・下水道の公的事業体。ベンガルール市の一部局（上下水道局）であり、カルナータカ州政府（Government of Karnataka）管轄。		BWSSB
2	当該水道事業体の計画給水区域	☆	ベンガルール市域		0
3	水源	★★	コーヴェリ川、地下水		ISEC(2020): Benchmarking of Bangalore Water Supply and Sewerage Board (BWSSB)
4	水源開発余力	☆	—		
5	一日平均給水量	★★	約 2,225 MLD	万m ³ ／日	BWSSB
6	一人一日平均給水量	★★	平均 100～125 LPCD	リットル／人／日	BWSSB
7	財務規模、収支	★★	総収入(Total revenue): 14,909 総費用(Total expenditure before tax): 22,870 営業費用(Total operational cost): 19,734 営業費用比率(Operating cost coverage): -5.87 ※営業費用比率=(Water sales + Service fees) / (Total operational expenses - depreciation)	百万INR	BWSSB Annual Account (2019-2022)
8	1,000接続当たりの職員数	☆	3.2	人／1,000栓	質問票回答（2025年8月、11月実施）
9	施設の状況、施設の運転・維持管理状況	★★	バンガロール市内のすべてのGLR、配水網の主要地点で流量・水圧・水質監視を行うための、SCADAによる配水管路網管理ソリューションが導入された。一方で、SCADAシステムはモニタリングを主目的としており、制御機能までは想定していない。マニュアルによる配水管理（バルブ開閉作業）に大きく依存している。 管路給水区域外への給水は給水車による給水を実施している（Cauvery on wheels）。また深井戸のモニタリングシステムの改善を実施している。地上配水池（GLR）や配水管網などのいくつかの施設は整備後、50年以上経っており、更新・修繕が必要。無収水は約35％程度と比較的高く、老朽化した配管網が多いことや漏水探査などの活動は行われておらず、プロジェクトによる配水管更新に依存しており、今後の取り組みが大きな課題として残る。		現地調査ヒアリング（2025年8月、11月）
10	水道事業体の業務目標と課題	★★	① 修繕・更新計画の実施 － CRS水道システムの修繕・更新・処理技術のアップグレード: 250 MLD (by 2025), 750 MLD (by2035), 1250 MLD (by2050) ② SCADA整備計画の実施 － すべての上下水道施設について中央SCADAシステムの拡張・統合 (by 2025) ③ 配水管網修繕・更新計画の実施 － オンライン流量モニタリング機器の設置、データ収集・分析 (by 2025) ④ 無収水削減計画の実施 35% (2020), 30% (2025), 25% (2035), 25% (2050) ⑤ メータ更新計画の実施 － 故障メータの更新 (by 2035)		現地調査ヒアリング（2025年8月、11月）

No.		評価項目	モニタリング指標	データ	単位	データ取得年	備考	出典	モニタリングに必須	位置付け／記入上の留意点／計算式
水道サービス指標										
1	事業規模	給水人口（顧客数）		179,186	人	2024		質問票回答（2025年7月実施）	●	・水道事業の規模感を把握するための指標。 ・一般に水道事業体が把握しているのは、水道利用人口ではなく、料金徴収の単位である給水栓数（接続数）であるため、給水栓数（接続数）を記載してもよい。
2		給水普及率		46.69	%	2024	給水人口／給水区域内人口×100	質問票回答（2025年7月実施）	●	・水道事業体が対象エリアの水需要を満たせているのかを把握するための指標。 ・計算式：給水人口／給水対象エリアの人口 ・普及率の定義（分子、分母にどのような数字を用いているのか）や計算方法は要確認。
3		浄水生産能力		90,000	m ³ ／日	2024		質問票回答（2025年7月実施）	●	・水道事業の規模感を把握するための指標。
4	サービス水準	給水時間		24	時間／日	2024		質問票回答（2025年7月実施）	●	・水道事業体の運転維持管理能力を確認し、水道サービス水準・顧客満足度を把握するための指標。 ・連続給水ではなく時間給水の場合、1日（または1週間）あたりの給水時間を記載。一般に、時間給水を採用する理由としては、①配水可能な水量の絶対的に不足している、②漏水が多く24時間給水では漏水量が増加する、等が挙げられる。 ・給水区域中でばらつきがある場合、●～●時間／日など幅を持たせた記載も可。
5		給水水質		水質基準の順守率：100%	—	2024		質問票回答（2025年7月実施）	●	・水道事業体の運転維持管理能力を確認し、水道サービス水準・顧客満足度を把握するための指標。 ・浄水場出口の水質が問題ないか（浄水場での水質基準順守率）、給水栓での残留塩素濃度を確認する（給水栓での水質基準順守率、残留塩素検出率）。数字の把握が難しい場合は定性的な評価で代替。 ・定性的な評価として、使用者から苦情が発生していないか等も確認する。
6		給水圧		0.20MPa	—	2024	最新のビジネスプラン2022～2026では、市内の平均給水圧を約0.25MPa、末端給水圧を約0.15MPaと規定。	質問票回答（2025年7月実施）		・水道事業体の運転維持管理能力を確認し、水道サービス水準・顧客満足度を把握するための指標。 ・高台や管網の末端など、水圧が最も低くなる箇所をモニタリング地点として選定し、適正な水圧があるかどうかを確認する。定量的な把握が難しいことも多く、その場合は定性的な評価で代替（給水栓における水圧について住民から苦情が発生していないか等）。
7		顧客満足度		N/A	—					・顧客満足度を確保するための指標。 ・使用者が水道サービスに対して満足しているか、何に関して不満を抱えているかを確認する（定性的な評価）。 ・水道サービスの改善が期待できる案件においては、顧客満足度調査をプロジェクトのスコープに含めることも検討する（全体的な満足度に加えて、水量（給水時間）・水質・水圧・水道事業体の顧客対応・水道料金等、項目ごとの満足度を調査）。
財務データ（経営・財務指標#14-25を自動計算）					単位	データ年	出典	財務項目	特記事項	
a	BS	流動資産		3,511,040,000	現地通貨	2024	SRWSA Audited Financial Statements and Independent Auditor's Report, 31 Dec. 2024		以降、単位は現地通貨（KHR）	
b		現預金		9,016,933,000	現地通貨				Current assets（流動資産）のうち、Cash and cash equivalent（現金）のみ計上	
c		固定資産		598,331,024,000	現地通貨					
d		資産合計		633,441,429,000	現地通貨					
e		一年前の資産合計		588,207,368,000	現地通貨					
f		固定負債		448,472,956,000	現地通貨					
g	PL	有利子固定負債		446,378,414,000	現地通貨				Non-current liabilities（固定負債）のうち、Borrowing（借入金）のみ計上	
h		自己資本		184,222,457	現地通貨				Total equityを計上	
i		売上高		21,410,098	現地通貨				Revenue のうち、Water salesのみ計上	
j		営業利益		2,401,418,000	現地通貨				Profit from operationを計上	
k		経常利益	－	1,750,656,000	現地通貨				Profit before income taxを計上	
l		減価償却費		6,413,716,000	現地通貨					
m		金融収益		381,666,000	現地通貨					
n		利払い		4,533,740,000	現地通貨					
o		補助金（長期前受金戻入）	－	－	現地通貨					
p		純利益	－	1,964,757,000	現地通貨					
q	CF	EBITDA		8,815,134,000	現地通貨					
r		営業CF		683,287,000	現地通貨					
s		投資CF	－	48,443,414,000	現地通貨					
t		為替		0.0367	現地通貨／円換算レート				2025年9月2日現在	
経営・財務指標										
8	経営状況	会計制度	企業会計を適用し、財務諸表（BS、PL、CF）を毎年度作成している。	—	2024			質問票回答（2025年7月実施）	●	・企業会計の適用有無を確認するための項目。 ・成長する水道事業体の前提条件として、企業会計を適用し、財務三表を用いて経営状況を把握・管理できている必要あり。
9		水道料金水準	使用水量6m3当たり 0.25 USD	—	2024			質問票回答（2025年7月実施）	●	・水道料金水準が適切に設定されているか確認するための指標。・給水時間、給水圧、給水水質等の改善後に料金値上げを行った場合、料金徴収率に影響がないか等を確認し、クラスター事業戦略のシナリオを検証する。 ・データの計算方法としては、①営業収益（料金収入）を有収水量で割る方法（日本では「供給単価」と呼称）と、②水道料金表から標準家庭において1か月水道を利用した場合の料金を算出して、単位水量あたりの料金を求める方法がある。世銀IBNETでは②を採用し、水使用量の少ない貧困層を念頭に1か月に6m3を使用する場合の水道料金をデータベース化しているが、より標準的な使用量として1か月に20m3を使った場合で計算しているケースもある。 ・用途を問わず、水道事業体全体としての水道料金水準を把握するためには①がよく、住民の支払い能力や支払い意志額と比較する場合には②が用いられる。 ・1世帯当たりの収入がわかる場合、水道料金負担と比較する（目安は3～5%程度）。
10		料金徴収率	99.89	%	2024			質問票回答（2025年7月実施）	●	・水道事業体の料金回収能力を確認するための指標。 ・ある期間に発行した水道料金の請求書の総額に対する、実際に徴収した水道料金の総額の比率。 ・給水時間、給水圧、給水水質等の改善や従量制への移行によって向上するか確認し、クラスター事業戦略のシナリオを検証する。料金徴収率が低い場合、料金支払いの有無で顧客間に不公平感が生じるため、料金改定に対する支持が得られにくくなる。
11		無収水率	5.83	%	2024			質問票回答（2025年7月実施）	●	・水道事業の運営能力を把握するための指標。水道システム（送配水管網）への投入水量から、料金請求対象水量（有収水量）を差し引いて求められる無収水量を、水道システム投入水量で割って算出。 ・途上国では正確に計算されている事例は多くなく、精度の低い推定値であるその場合は「〇〇%と推定されている」等と記述する。
12		漏水率	771	回／年	2024	年間の漏水発生回数を集計 ※管路延長＝881 km（2025年6月時点）	質問票回答（2025年7月実施）		・無収水のうち、どの程度が物理的損失であるかを把握し、水道事業体の運転維持管理能力を確認するための指標。 ・途上国では正確に計算されている事例は多くなく、精度の低い推定値であるその場合は「〇〇%と推定されている」等と記述する。	
13		メーター設置率	100	%	2024		質問票回答（2025年7月実施）		・従量料金制を導入しているか、導入できる環境にあるかを確認するための指標。 ・客観的には無収水率と無収水量を、それに起因して配水の不公平（浄水場や配水池に近い顧客は溜沢に水を使える一方、管路の末端まで配水されない）が生じる。顧客メーターを設置し従量制に移行することで、配水（水道サービス）の改善に繋がりが、支払い意志が向上すると考えられる。	
14	事業規模	売上高		21	百万現地通貨	2024	SRWSA Audited Financial Statements and Independent Auditor's Report, 31 Dec. 2024		●	・水道事業体の規模を把握するための指標。過去のトレンド（水道料金収入の成長、縮小、安定、不安定など）も確認する。 ・水道事業は資本集約的な産業であり、水道料金のみでコストリカバリーするためには一定以上の規模が必要となる。施設費用を含めて水道料金でコストリカバリーが可能な規模の目安としては、日本の水道事業体の実績を描まると、給水人口10万人以上、導送配水管1kmあたりの給水人口150人以上と考えられる。
				1	百万円	2024			●	・水道事業体が（特殊要因も含めて）得た総合的な収益力（規模）を把握するための指標。 ・純利益率に関する指標（自己資本当期純利益率：ROE、総資産当期純利益率：ROAなど）は収益性を把握するデータとして良く利用される。 ・水道事業は資本集約的な産業であり、水道料金のみでコストリカバリーするためには一定以上の規模が必要と考えられる。
15		純利益		－1,965	百万現地通貨	2024			●	・水道事業体が（特殊要因も含めて）得た総合的な収益力（規模）を把握するための指標。 ・純利益率に関する指標（自己資本当期純利益率：ROE、総資産当期純利益率：ROAなど）は収益性を把握するデータとして良く利用される。 ・水道事業は資本集約的な産業であり、水道料金のみでコストリカバリーするためには一定以上の規模が必要と考えられる。
				－72	百万円	2024				
16	収益性	EBITDA		8,815	百万現地通貨	2024			※	・水道事業体がどの程度のキャッシュフローを創出する能力（規模）があるかを把握するための指標。 ・計算式：営業利益（Operating Profit）÷各種償却費（Depreciationもしくは Depreciation and amortisation charges） ・水道事業のように設備投資が多く償却費負担の大きい場合の収益力を分析する際に用いられる。
				324	百万円	2024				
17		EBITDAマージン		44.46	%	2024			※	・活用可能なキャッシュフロー創出能力を把握するための指標。水道事業のように設備投資が多く償却費負担の大きい場合の収益力を分析する際に用いられる。 ・計算式：EBITDA／売上高（SalesまたはIncome） ・指標の目安：30%以上が目標。世銀のUtility of the FutureではWorld Classの上下水道事業体の間値を30%と設定。
18	安全性	総資産営業利益率（ROA）		0.39	%	2024			※	・総資産に対する収益性を把握するための指標。数値が高いほど、投資した資産が効率的に収益に貢献していると判断できる。クラスター事業戦略において、資産規模を増やして収益性を高めるアプローチを掲げており、係る成果を確認する。 ・計算式：営業利益（Operating Profit）／総資産（Total Assets） ・指標の目安：5%以上が目標。
19		売上高経常利益率（長期前受金戻入を除く）		－8176.78	%	2024			※	・営業活動（水道事業）と財務活動に関する経営効率（突発的な増益を含まない、通常の経営活動の効率）を把握するための指標。クラスター事業戦略では、規模を上げるだけでなく経営効率の改善を目指しており、係る成果を確認する。 ・計算式：（経常利益（Ordinary Profit）－補助金（長期前受金戻入）（Government and other grants等））／売上高（Income） ・指標の目安：15%以上が目標。
20		自己資本比率		44.46	%	2024			※	・資金調達面（BSの右側）での安全性を把握するための指標。数値が高いほど経営が安定している。 ・計算式：自己資本（Total Equity, Capital）／総資産（Total Assets） ・指標の目安：40%以上が目標（収益性の高い事業体の場合は30%以上）
21	安全性	固定長期適合率		94.57	%	2024			※	・資本構成上の安全性（固定資産を固定負債と自己資本で賄えているか）を確認する指標。長期借入金及び自己資本の範囲内の投資になっていない場合、資金繰りが圧迫される。水道事業は固定資産の割合が大きいため要注意。 ・計算式：固定資産（Non-current Assets）／（固定負債（Non-current Liabilities）＋自己資本（Total Equity）） ・指標の目安：100%を上回る場合は要注意（固定資産の一部を流動負債で賄っている状態）
22		インタレストカバレッジレシオ		0.61	倍	2024			※	・フロー面から見た安全性を把握するための指標。債務返済能力（利息を支払うだけの利益を獲得しているか）を確認。 ・計算式：（営業利益（Operating income）＋金融収益（受取利息（Interest income）＋配当金（Dividend income））／支払利息（Interest expense） ・指標の目安：1.0倍を下回る場合は要注意（金融費用が事業利益を上回っている状態）
23		EBITDA有利子負債倍率		49.61	倍	2024			※	・資金繰りの面からの安全性を把握するための指標。EBITDAはキャッシュ創出能力を意味するため、有利子負債の返済に要する平均年数を示すと解釈される。 ・計算式：（有利子負債（Liability with interest）－現預金（Cash and deposits））／EBITDA ・指標の目安：5倍以下が目標（成長ステージに依る）
24	キャッシュフロー	フリーキャッシュフロー		－47,760	百万現地通貨	2024			※	・水道事業体の成長ステージを把握するための指標。マイナスの場合は黎明期～成長期、プラスの場合は成熟期にあり、FCFが高水準から低下している場合、成熟期を過ぎて衰退期にあると考えられる。 ・計算式：営業キャッシュフロー（Cash flows from operating activities）－投資キャッシュフロー（Cash flows from investing activities）
				－1,753	百万円	2024				
25		営業キャッシュフロー・マージン		3191.42	%	2024			※	・売上高に対して、営業活動を通じた現金収入の割合を確認することで、経営状況を判断するための指標。営業利益（PLの数値）が高くと、本指標の数値が低い場合、債務支払いが滞る（マイナスの場合は黒字倒産する）可能性がある。 ・計算式：営業CF／売上高×100 [%] ・指標の目安：15%以上が目安（要精査）
分析欄・備考欄					—	—	—			

（留意点）
1. 水道事業体の発展段階に関わらず、全ての水道事業体で「最低限必要な指標」のデータは収集することを目指す。
2. ※の指標は、発展段階の高い水道事業体（水道事業体成長支援型、スケールアップ支援型）については最低限必要な指標とし、データの収集を目指す。

上水道案件 セクター／水道事業体 基本情報チェックシート

国名：カンボジア 水道事業体名：シェムリアップ水道公社 (SRWSA)

	指標・情報	重要度	数値・情報	単位	出典
セクター概要					
1	国家人口	★★	1,790	万人	国連人口基金、2025年 (World Population Dashboard)
	一人当たりGDP	★★	2,628	USD／人	WB, GDP per capita (current USD), 2024年
2	年間降水量	☆	1,400 - 2,000	mm／年	Climate Risk Country Profile: Cambodia, 2021 (WB & ADB)
	気候帯	☆	熱帯性		Climate Risk Country Profile: Cambodia, 2021 (WB & ADB)
3	国全体の水道普及率	★★	35.85	%	JPM、2024年 (Piped water supplyの普及率)
4	水道セクターのガバナンス	★★	同国の水道行政は、工業科学技術革新省(MISTI)の水道総局(GD/WAT)が所掌。 首都プノンペン市及びシェムリアップ市における2つの水道公社 (PPWSA及びSRWSA)に加え、2023年には、地方都市で水道事業を運営する計10の公営水道局が、独立採算制のPublic Water Utilities (PWUs) として公社化された。 公営水道の管轄区域外の地域では、400以上の民営水道事業体 (Private Water Operators: PWOs) が水道事業を運営している。PWOsの認可・規制・監督業務はGD/WATが担う。		カンボジア国全国水道事業計画策定プロジェクト 業務計画書、Sector Overview Reportなど
5	主要な開発方針、開発課題	★★	・ 'Cambodia Vision 2050' 及びその実現するための戦略 'Pentagonal Strategy' (2023) において「2030年までに水道普及率100%を達成」することが掲げられている。 ・ 全国レベルの水道普及率は依然として低く、民営セクターの果たす役割は大きい。しかし、PWOsへの規制監督体制が整っておらず、PWOsの事業運営能力は低い。 ・ 公営水道においては中長期計画の策定能力がなく、資金・予算不足も課題となっている。 ・ 水道法、水質基準等の主要な法制度は整っている。		カンボジア国全国水道事業計画策定プロジェクト Sector Overview Report
水道事業体の概要					
1	水道事業体の形態、監督・規制体制	★★	2006年にJICA無償の浄水場が完成後、2007年に公社化された（独立採算制）。MISTIが計画・予算の承認やモニタリング管理を行う。		カンボジア国全国水道事業計画策定プロジェクト Sector Overview Report
2	当該水道事業体の計画給水区域	☆	シェムリアップ市内23コミューンおよびSangkat		質問票回答（2025年7月実施）
3	水源	★★	地下水：約1/6 トンレサップ湖：約2/3 西バライ貯水池：約1/6		質問票回答（2025年7月実施）
4	水源開発余力	☆	－		
5	一日平均給水量	★★	2.95	万m ³ ／日	KPIs-PWUs (MISTI, GD/WAT), 2024 年間有収水量/366日で算出
6	一人一日平均給水量	★★	164.7	リットル／人／日	KPIs-PWUs (MISTI, GD/WAT, DPDM), 2024 一日平均給水量/給水人口で算出

	指標・情報	重要度	数値・情報	単位	出典
7	財務規模、収支	★★	総収入(Total revenue): 21,410 総費用(Total expenditure before tax): 23,542 営業費用(Total operational cost): 19,009 営業費用比率(Operating cost coverage): 168.8% ※営業費用比率=(Water sales + Service fees) / (Total operational expenses - depreciation)	百万KHR	SRWSA Audited Financial Statements and Independent Auditor's Report, 31 Dec. 2024
8	1,000接続当たりの職員数	☆	7.19	人／1,000栓	質問票回答（2025年7月実施）
9	施設の状況、施設の運転・維持管理状況	★★	2023年からJICA有償による新規浄水場（施設能力6万m3/日）を供用開始。計3か所の浄水場はいずれもSCADAによる運転・監視制御が可能であるほか、SOP類が整備されている。但し、新型コロナ拡大の影響で観光客需要が落ち込み、現在は顧客接続数の拡大が追い付いておらず、新規浄水場の稼働率が低い。配水管は比較的新しく、漏水調査を計画的に実施しており、漏水率は低い。給水圧、給水時間、浄水水質いずれも問題ない。		現地調査 質問票回答（2025年7月実施）
10	水道事業体の業務目標と課題	★★	ビジネスプランでは「2030年までに、給水区域内の全人口に高品質で清潔な水を持続可能かつ手頃な価格で供給する」ことをビジョンに掲げ、①給水区域の拡大/配水管網の拡張、②顧客接続数の拡大、③職員の人材育成と④財政管理能力の強化を主な課題に掲げている。 新規浄水場の供用開始以降、人件費・浄水費・電力費の増加、ならびに支払利息の負担増により純利益がマイナスとなっている。借款プロジェクトの返済など、施設整備のための自己資金は不足しており、中央政府からの補助金を減らし、財務の健全化が中長期的な課題となっている。		SRWSA Business Plan 2022-2026 (January 2022) 財務諸表など

資料- 9 : 質問票の回答 (SRWSA および BWSSB)

*Data Collection Survey on Enhancement of DX Utilization and
Preparation of Digital Architecture for Water Utilities*

Questionnaire for Identifying Issues and Assessing the Level of Digital Maturity

1. Background

In order to address increasingly complex development challenges, JICA launched 20 cooperation strategies in 2021 under the title of "JICA Global Agenda" (JGA). In the water supply sector, JICA developed the "Cluster Strategy for Supporting the Growth of Water Utilities"¹ under the JGA No.19 for "Sustainable Water Resources Management and Water Supply". This cluster strategy classifies water utilities into four development stages and outlines a policy to advance them to the next stage through tailored cooperation approaches.

To encourage the advancement of water utilities to the next development stage, while making effective and efficient use of their limited resources, JICA has published a strategic report titled "Digital Transformation for Growing Water Utilities"² and a reference document titled "JICA DX Approach for Water Utility". These documents introduce the data organization required for business operations, the digital maturity level to be achieved at each development stage, methods for assessing the digital maturity level of water utilities, and steps for considering proactive and strategic digital utilization, which is expected to accelerate their transition to the next development stage.

JICA aims to utilize these materials in the formulation of all funding and technical cooperation projects in the water supply sector. However, there are only two case studies of their applications, and there is a lack of insights into their effectiveness and usability in other water supply projects.

2. Purpose of Survey

This survey aims to inform the formation of projects incorporating a DX perspective in the target countries by conducting digitalization analyses using the aforementioned materials at two selected water utilities. The survey also aims to verify the effectiveness of the materials and gather feedback on how to improve their usability.

This questionnaire is to be completed before the first field visit, scheduled for late July to early August. The questionnaire is designed to collect information necessary to identify specific issues, assess the current digital maturity level, and prepare an as-is digital architecture³ for the target water utilities (see *Figure 1* and *Figure 2*).

¹ Link to the Cluster Strategy: [cluster water utilities.pdf](#)

² Release information: https://www.jica.go.jp/english/about/dx/information/2025/1571043_68031.html

Link to the material: [20250407 JICA BCG Water DX Report.pdf](#)

³ Digital architecture is the comprehensive design blueprint that encompasses the digital infrastructure necessary for realizing digital transformation. It includes services (e.g., applications and systems), data integration platforms, servers, storage, network devices, sensors, etc. It also includes their interactions (e.g., data flow, software integration, security protection, etc.)



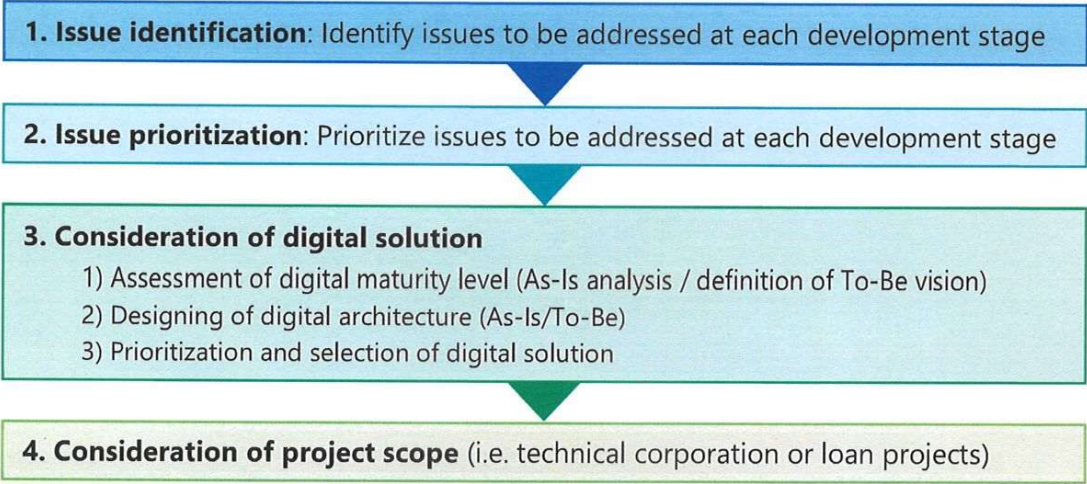


Figure 1 Steps in Project Formulation

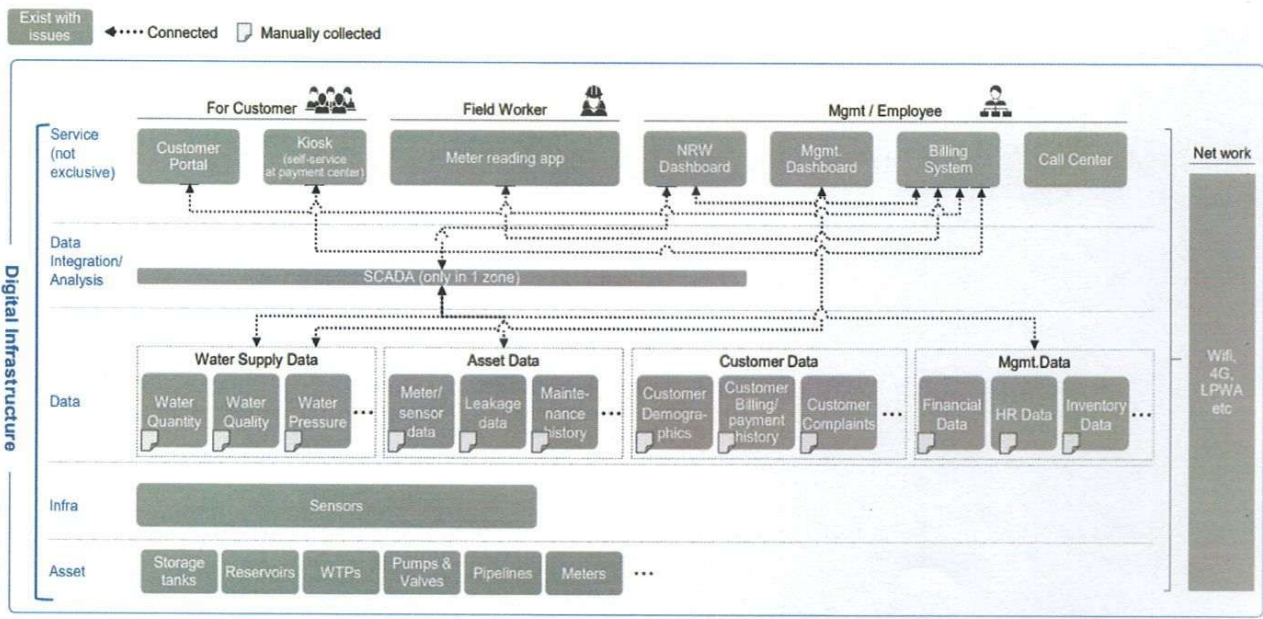


Figure 2 Sample of Digital Architecture (As-Is)

3. Survey schedule

Tasks	Period
Desktop survey - Data/information collection - Questionnaire survey	June to mid-July
1st field visit - Issue identification and prioritization - Assessment of digital maturity level	22 July to 8 August (tentative)
Project formation - Designing of digital architecture - Prioritization and selection of digital solution	Mid-August to early October
2nd field visit - Presentation of future projects incorporating a DX perspective - Consensus building	Mid-October
Improvement/updating of the reference material Debriefing session	By mid-January

4. Instruction

- If available, please provide digital copies of all the documents listed in **Section A**.
- If applicable, please click ☐ to change it to ☒ in the questionnaire. Also, please provide detailed explanations as much as possible.
- Please complete the form and submit it **by 14 July 2025** to:

To	- Atsuo Ohno (Mr.) <i>Leader of the survey team, Tokyo Engineering Consultants Co., Ltd.</i> ohno-a@tokyoengicon.co.jp
CC to	- Munehiro Teshima (Mr.) <i>Water Resources Group, Global Environment Dept., JICA HQs</i> Teshima.Munehiro@jica.go.jp - JICA Office in your country

5. Attachment

JICA DXLab, "JICA DX Approach for Water Utility" (Excerpted and edited)

Respondent Information

Utility Name	Siem Reap Water Supply Authority (SRWSA)
Country and City	Cambodia, Siem Reap
Contact Information	Name of contact person: Chan Sengla (Mr.) Position/Title: Director General E-mail address: srwsa_chan@yahoo.com

A. Documents Required

If available, please provide digital copies of all the documents listed below.

No.	Documents	Available
1	The latest Business Plan (or Strategic Plan) of utility	☒
2	The latest 3 years of annual reports of utility	☒
3	The latest 3 years of audited financial statements: - Profit and Loss Statement (Income Statement) - Balance Sheet - Cash Flow Statement	☒
4	System design documents (e.g. specification sheets, system diagrams) for installed platforms, apps, software, etc.	☒
5	Screenshots of the main screens of installed platforms, apps, systems, etc. - It would be desirable to have screenshots showing the specific data being collected and managed in the platform, apps, software, etc.	☒
6	Organization chart - A simple chart illustrating structures of departments is fine.	☒
7	Water treatment flow chart, facility diagram, etc. - A simple chart showing existing assets from the water sources and end-users is desirable. (Incl. boreholes, raw water tank, filtration tank, intake/booster pumps, reservoirs, valves, pipelines, public tap stands, meters, etc.)	☒

B. Basic Information

Year of establishment (Start of operation)	Operations resumed in 1998. SRWSA became an autonomous entity in 2007, following the completion of a water treatment plant funded through JICA grant aid in 2006	
Scope of services covered	☒ Water supply only ☐ Water supply and sewerage ☐ Other ()	
Water supply area	23 communes/Sangkat (1,027.66 km ²)	
Main types of water resources	<i>(Multiple selections are possible. Please also indicate the percentage distribution.)</i> ☒ Ground water (16.67%) ☐ River water (%) ☒ Lake water (66.66%) ☒ Other (West Baray Reservoirs 16.67%)	
Number and capacity of water treatment plants	(#1) WTP Name: Teuk Vil I Capacity: 15,000 m ³ /day (#2) WTP Name: Teuk Vil II Capacity: 15,000 m ³ /day (#3) WTP Name: Chreav Capacity: 60,000 m ³ /day <i>(If there are four or more WTPs, please add them.)</i>	
Water purification method	☐ Slow sand filtration, ☒ Sedimentation and rapid filtration, ☐ Membrane filtration, ☐ Seawater desalination, ☐ Other ()	
Distribution pipe length	881 km (as of June 2025)	
Number of employees	190 (48 females) as of June 2025	

C. Performance Indicators

Please provide data for last 3 years including the latest FY. If unavailable, please enter "N/A".

Category/Indicators	Unit	FY 2022	FY 2023	FY 2024
Service level				
1. Production capacity	m ³ /day	30,000	90,000	90,000
2. Water production	m ³ /day	20,132	25,343	29,513
3. Utilization ratio of production capacity (=Water production / Production capacity *100)	%	67.11	29.82	32.79
4. Continuity of service	Hours/day	24	24	24
5. Quality of water supplied (Compliance rate)	%	100	100	100
6. Water supply pressure	MPa	0.20	0.20	0.20
7. Leakage ratio (=Percentage of water leakage relative to system input volume, or number of pipe breaks per year)	% (or breaks/year)	272	430	771
Business scale				
8. Population served	People	130,116	160,258	179,186
9. Number of active connections	-	18,588	22,894	25,598
10. Service coverage (water coverage)	%	48.42	47.64	46.69
Select the calculation formula used.				
☒ Population served / Total population in the service area *100				
☐ Number of households connected to the network / Total number of households in the service area *100				
11. Customer satisfaction	%			
If applicable, please provide a brief description of the survey methods used to measure customer satisfaction, along with the definition of this indicator.				
Cost-effectiveness				
12. Collection ratio	%	99.39	97.70	99.89
13. Non-revenue water ratio	%	9.55	6.78	5.83
14. Metering ratio	%	100	100	100
15. Water tariff level (= Water tariff for domestic use when 6m ³ of water is consumed)	USD/6m ³	0.25	0.25	0.25
Profitability & financial soundness				
16. Net income from water services (Net income from other services, such as sewerage and electricity, is excluded.)	USD	102,158	688,595	550,404
17. O&M cost coverage ratio (= Total annual revenue of water service / Total annual operating costs for water service (excluding depreciation and interest) *100)	%	146.21	163.89	168.84
Human resources efficiency				

16. Net income: 本来は「税引後」の当期純利益だが、本質問票では営業利益(Profit from operation)が記入されている

18. Number of staff per 1,000 connections	persons	8.82	8.08	7.19
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Note: Please enter the unit that you usually use ($1\text{MPa} = 1000\text{kPa} = 10\text{bar} = 101.97\text{mH}_2\text{O}$). Ideally, monitoring points should be selected where the water pressure is lowest, such as on high ground or at the end of the network. A qualitative explanation is also applicable. (e.g., The water supply pressure at the tap is unstable, causing complaints from customers.)

Note: Please enter either the local currency or USD as the currency unit.



D. Status of Digital Tool Implementation

We would like to ask you about the acquisition of necessary data, data utilization, digital tool/system implementation, and data integration in the operation of your water supply business. Please provide a brief overview of your current situation by answering the following questions. Further details will be confirmed during the field visit.

1. Capital investment strategy			
1a. Project planning (incl. water resource development plan, facility development plan, and water supply & demand mgt.)			
1. Please indicate who is responsible for project planning (incl. water resource development plan, facility development plan, and water demand forecast).			
☐ Plans are prepared by the water utility independently. <i>(Please also indicate the dedicated department or section.)</i> ☒ Plans are prepared by an external consultant. ☒ Plans are prepared by a development partner. ☐ No water resource development plans or facility development plans have been formulated. ☒ Other (For the projects funded by SRWSA's own budget, the project planning was carried out by SRWSA using its own resources)			
2. If any, please provide a list of the digital tools or systems you use for project planning . Please also provide the following information:			
- The fiscal year when the system was installed, - Name of the manufacturer, - Name of the development partner who supported the installation.			
Examples: - Recording water resource information in electronic registers (Incl. Excel). - Identification of water resources using GIS and satellite data. - Automatic monitoring of customer water usage through the installation of smart meters, etc. - Pattern analysis and forecast of water demand and available water supply using simulation software. - Excel, GIS, AutoCAD			
3. Please select ALL the data you have obtained that is necessary for project planning, as well as the method for collecting and recording the data (Incl. handwritten and paper-based data).			
If you do not obtain or use the data, leave the checkbox blank (☐).			
Data	Data Collection/Recording Methods		
	Digital tool/ System	Excel/Word	Manual/ Paper-based
Meteorological data (e.g., rainfall, weather)	☐	☐	☐
Water level by water source (groundwater/river/lake)	☐	☒	☒
Available water intake volume by water source	☐	☐	☐
Water quality by water source	☐	☐	☒
Topographical data (e.g., location, elevation, geology)	☐	☐	☐
Population forecast	☐	☒	☐
Water demand forecast for domestic, agricultural,	☐	☒	☐



industrial, and other uses			
Agricultural/industrial planning, urban planning	☐	☐	☐
Capacity and specifications of existing facilities	☐	☒	☒
Other ()	☐	☐	☐

1b. Asset management, facility design, life cycle management

4. Please indicate the department or section involved in asset management.

Accounting and Finance Department

5. If any, please provide a list of the digital tools or systems you use **for asset management**.

Please also provide the following information:

- The fiscal year when the system was installed,
- Name of the manufacturer,
- Name of the development partner who supported the installation.

Examples:

- Recording asset information and trouble/repair information in electronic registers (Incl. Excel).
- Mapping of infrastructures using GIS.
- Real-time acquisition of asset information using sensors, cameras, or drones.
- Navision, installed in 2015, by JICA grant aid through Synergistic Utilities Management System (SUMS)
- Mapping system, installed in 2023 by JICA grant aid through GEOCRAFT Co., Ltd.
- State Assets Register Management Information System (SARMIS), Ministry of Economy and Finance

6. Please select **ALL** the data you have obtained that is necessary for asset management, as well as the method for collecting and recording the data (Incl. handwritten and paper-based data).

If you do not obtain or use the data, leave the checkbox blank (☐).

Asset information for:	Data Collection/Recording Methods		
	Digital tool/ System	Excel/Word	Manual/ Paper-based
Intake facility (e.g., location, specifications of pumps, and year of installation)	☒	☒	☐
Conveyance pipeline (e.g., location, diameter, length, pipe material, and year of installation)	☒	☒	☐
Water treatment plant (e.g., year of completion, capacity, material, and construction cost)	☒	☒	☒
Mechanical equipment, such as valves and chemical injection equipment (e.g., year of installation, manufacturer, etc.)	☒	☒	☐
Electrical equipment, such as power receiving equipment, flow meters, and pressure gauges (e.g., year of installation, manufacturer, etc.)	☒	☒	☐
Service reservoir (e.g., year of completion, capacity, and construction cost)	☒	☒	☐
Distribution pipeline (e.g., location, diameter, length, pipe material, and year of installation)	☒	☒	☐
Customer meters (e.g., location, type, diameter, and year of installation)	☒	☒	☒



Customer registry	☒	☒	☒
Service life of each facility & equipment (e.g., 50 yrs for concrete tanks, 40 yrs for pipes, etc.)	☒	☐	☐
Records of repair/upgrade/renewal of facility & equipment	☒	☐	☒
Records of trouble/failure of facility & equipment	☐	☒	☒
Other ()	☐	☐	☐

Issue identification in capital investment strategy

7. Have you secured sufficient financial resources to implement your planned projects?

☒ Yes, sufficient funding has been secured for all planned projects.

☐ Funding is partially secured, with gaps remaining.

☐ Funding is not secured at all.

☐ Other ()

If funding is insufficient, please describe the following:

- What kind of projects are affected? *e.g., construction of a new WTP, pipeline replacement, etc.*
- Why is funding insufficient? *e.g., lack of tariff revenue, delays in government grants, inability to access loans, etc.*
- What impact will these funding shortages have? *e.g., deterioration of water quality, frequent service interruptions, higher NRW ratio, etc.*

(Free description: _____)

2. Operation and maintenance

2a. Water flow management

8. Please indicate the department or section involved in water flow management (i.e. the management of water volume, quality, and pressure) from the water sources to the distribution network.

Water Supply Department

9. If any, please provide a list of the digital tools or systems you use **for water flow management**. Please also provide the following information:

- The fiscal year when the system was installed,
- Name of the manufacturer,
- Name of the development partner who supported the installation.

Examples:

- *Field Force Management System: Field engineers input data using tablets.*
- *Centralized monitoring of water treatment plants and distribution networks using SCADA.*
- *Using AI to analyse water quality data and optimize chemical injection amounts.*

WTP #3 (Chreav)

- Centralized monitoring of water treatment plants and distribution networks (pressure, flow rate) using SCADA, installed in 2023
- Manufacturer name: Mitsubishi Electric
- System integrator: Connytech Singapore

10. Please select **ALL** the data you have obtained that is necessary for water flow management, as well as the method for collecting and recording the data (Incl. handwritten and paper-based



data).

If you do not obtain or use the data, leave the checkbox blank (□).

Data	Data Collection/Recording Methods		
	Digital tool/ System	Excel/Word	Manual/ Paper-based
Water intake: • Intake volume (flow rates) • Water quality	☒ ☒	☐ ☒	☒ ☒
Treatment plant: • Water volume (flow rates) • Water quality at the entrance • Water quality at the exit	☒ ☒ ☒	☐ ☒ ☒	☒ ☒ ☒
Distribution reservoir: • Water volume (flow rates) • Water quality • Water pressure at the exit (or water supply pressure of distribution pump) • Water pressure at the entrance of each DMA • Distribution time	☒ ☒ ☒ ☒ ☒	☐ ☐ ☐ ☐ ☐	☒ ☒ ☒ ☒ ☒
Water tap: • Water volume (consumption) • Water quality • Water pressure • Usage time	☒ ☒ ☒ ☐	☐ ☒ ☐ ☐	☒ ☒ ☒ ☐
Other ()	☐	☐	☐

2b. Maintenance (incl. leakage control)

11. Please indicate the department or section involved in facility & equipment maintenance and leakage control.

Distribution Network Management Office/Water Supply Department

12. If any, please provide a list of the digital tools or systems you use **for the maintenance and leakage control**. Please also provide the following information:

- The fiscal year when the system was installed,
- Name of the manufacturer,
- Name of the development partner who supported the installation.

Examples:

- Sensors and an IoT gateway to collect and transmit data on flow rate, pressure, and water quality.
- Field Force Management System: Field engineers input data using tablets.
- Identification of leaking pipes using electronic leak detectors.
- Real-time monitoring of water usage and automatic detection of abnormal values using smart meters.
- Identification of water leakage areas and pipes using artificial satellites and AI.
- Pipe leakage and repair location data store in Aqua Crew (GIS System, established in 2024 by GEOCRAFT Co., Ltd.)
- There are only pressure and flow sensor installed at each 7 DMAs to detect flow rate and pressure head monitored by SCADA.

13. Please select **ALL** the data you have obtained that is necessary for the maintenance and leakage control, as well as the method for collecting and recording the data (Incl. handwritten and paper-based data).

If you do not obtain or use the data, leave the checkbox blank (☐)

Data	Data Collection/Recording Methods		
	Digital tool/ System	Excel/Word	Manual/ Paper-based
Frequency of sludge removal and cleaning of sedimentation tanks	☐	☐	☒
Frequency of cleaning filtration tanks and replacing filter sand	☒	☐	☐
Frequency of cleaning service reservoirs	☐	☐	☒
Condition of concrete structures (e.g., exterior damage)	☐	☐	☒
Amount of chemicals used and frequency of procurement	☐	☒	☒
Records of failures and repairs of mechanical and electrical equipment (e.g., valves, flow meters, chemical injection equipment, etc.)	☐	☒	☒
Records of water leakage (e.g., date, location, and repair records)	☐	☒	☒
NRW ratio for each DMA	☐	☐	☐
Frequency data of distribution pipes (not clear)	☐	☐	☐
Vibration data of distribution pipes (not clear)	☐	☐	☐
Other ()	☐	☐	☐

Issue identification in operation and maintenance

14. Are there any challenges or issues in the operation and maintenance (O&M) of your water supply facilities?

If so, please describe the following:

- What kind of problems are occurring? *e.g., Non-compliance with water quality standards, equipment breakdown, aging facilities, etc.*
- Why are these problems occurring? *e.g., insufficient staff skills, lack of spare parts, data insufficiency, unclear procedures, etc.*
- What impact will these problems have on your service provision? *e.g., customer complaints, frequent service interruptions, higher NRW ratio, etc.*

(Free description: _____)

N/A

3. Customer service (incl. meter reading, billing & collection, and complaint handling)

15. Please indicate the department or section involved in customer service.

Revenue management office, Customer Service Office/Commercial Department

16. If any, please provide a list of the digital tools or systems you use **for customer service**.

Please also provide the following information:

- The fiscal year when the system was installed,

- Name of the manufacturer,
- Name of the development partner who supported the installation.

Examples:

- Recording customer information and analogue meter readings in electronic registers (Incl. Excel).
- Recording water usage data using digital tools, such as QR codes and meter reading apps.
- Customer-oriented apps to receive enquiries, update enquiry response status, and carry out various procedures.
- Centralized management of customer services, incl. meter reading, billing, and complaint handling, using a data platform.
- Navison, installed in 2015, by JICA grant aid through Synergistic Utilities Management System (SUMS)
- Mapping system, installed in 2023 by JICA grant aid through GEOCRAFT Co., Ltd.

17. Please select **ALL** the data you have obtained that is necessary for customer service, as well as the method for collecting and recording the data (Incl. handwritten and paper-based data).

If you do not obtain or use the data, leave the checkbox blank (☐).

Data	Data Collection/Recording Methods		
	Digital tool/ System	Excel/Word	Manual/ Paper-based
Customer contract information (e.g., name, address, telephone number, etc.)	☒	☒	☒
Customer meter number (assigned to each household)	☒	☐	☒
Monthly water consumption	☒	☐	☒
Monthly billing amount	☒	☐	☒
Monthly collected amount	☒	☐	☒
Complaint/enquiry information (e.g., number of complaints/enquiries, date, location, time taken to resolve, etc.)	☐	☒	☒
Customer satisfaction score	☐	☒	☒
Termination of contract (e.g., number of terminations, and reason)	☒	☐	☒
Other ()	☐	☐	☐

Issue identification in customer service

18. Are there any challenges or issues in customer service, including meter reading, billing & collection, and complaint handling?

If so, please describe the following:

- What kind of problems are occurring? *e.g., inaccurate meter reading, low collection rates, many customer complaints, etc.*
- Why are these problems occurring? *e.g., human error, lack of customer awareness, inappropriate tariffs, etc.*
- What impact will these problems have? *e.g., revenue loss, customer dissatisfaction, higher NRW ratio, etc.*

(Free description: _____)

SRWSA is encountering several operational challenges in customer service:

- **Meter Reading:** Some meters are inaccessible due to being located inside locked fences or buried underground from backfilling. Many are also outdated and inaccurate—particularly 15mm meters over 10 years old, 25mm and 40 mm over 5 years, and 100 mm over 2 years (SRWSA's SOP). SRWSA regularly inspects these meters and replaces them if found inaccurate. These issues lead to incorrect consumption data, increased non-revenue water (NRW), and revenue loss.
- **Billing:** As the service area expands into remote locations, meter readers must travel long distances to read meters, return to the office to issue bills, and then travel again to deliver them. This manual process, caused by limited digital systems, results in inefficiencies, higher workload.
- **Customer Complaints:** Many complaints involve high monthly consumption caused by internal leaks within customers' premises, which fall outside SRWSA's responsibility. However, SRWSA provides assistance with leak detection upon request to support customers.

4. Support functions

4a. Business management, finance & treasury

19. Please indicate the department or section involved in business management.

Accounting and Finance Department

20. If any, please provide a list of the digital tools or systems you use **for business management, finance & treasury**. Please also provide the following information:

- The fiscal year when the system was installed,
- Name of the manufacturer,
- Name of the development partner who supported the installation.

Examples:

- Recording financial information in electronic ledgers (Incl. Excel).
- Visualization and management of KPIs using management dashboards.
- Monitoring of policy/project implementation using project management software.
- Navision, installed in 2015, by JICA grant aid through Synergistic Utilities Management System (SUMS)

21. Please indicate **ALL** the KPIs you have obtained and monitored in your business plan, as well as the method for managing the KPI data (Incl. handwritten and paper-based data).

(1) Operational KPIs:

Examples:

- No. of households supplied with water
- NRW ratio
- Tariff collection rate, etc.
- Number of water leakage per 1 km of pipeline (leakage/km)
- Old pipeline replacement ratio (%)
- Electricity consumption per 1 m³ of water sold (Wh/m³)
- Fuel consumption per 1 m³ of water sold (ml/m³)
- PAC (Poly Aluminium Chloride) consumption per 1 m³ of water sold (g/m³)
- Lime (or caustic soda) consumption per 1 m³ of water sold (g/m³)
- Chlorine consumption per 1 m³ of water sold (g/m³)

☐ Digital tool/System, ☒ Excel/Word, ☐ Manual/Paper-based

(2) Financial KPIs:

Examples:

- Net income
- O&M cost coverage ratio
- EBITDA, etc.

- Net income

☐ Digital tool/System, ☒ Excel/Word, ☐ Manual/Paper-based

4b. Human resources, talent development (incl. trainings)

22. Please indicate the department or section involved in HR management and talent development.

Administration Department

23. If any, please provide a list of the digital tools or systems you use **for HR management and talent development**. Please also provide the following information:

- The fiscal year when the system was installed,
- Name of the manufacturer,
- Name of the development partner who supported the installation.

Examples:

- Remote training via a video conference platform and/or e-learning platform.
- Visualization of employee certifications and training records through a skill management system.
- Internal knowledge management systems for manuals, training documents, etc., accessible to all employees on an intra-net.
- Excel
- Video conference
- Sharing documents through Telegram

24. Please indicate **ALL** the data you have obtained that is necessary for HR management and talent development, as well as the method for collecting and recording the data (Incl. handwritten and paper-based data).

If you do not obtain or use the data, leave the checkbox blank (☐).

Data	Data Collection/Recording Methods		
	Digital tool/ System	Excel/Word	Manual/ Paper-based
Number of employees in each department	☐	☒	☒
Salary and employment conditions	☐	☒	☒
Working hours and days of each employee	☐	☒	☒
Information on the qualifications and skills possessed by each employee	☐	☒	☒
Job description	☐	☒	☒
SOPs (Standard Operating Procedures)	☐	☒	☒
Training records (e.g. date, number of trainees, training hours, etc.)	☐	☒	☒
Other ()	☐	☐	☐

4d. IT/digitization, digital talent development

25. Does your utility have an IT department responsible for maintaining IT systems?

☒ Yes, with (2) staff members. *(Please indicate the number of dedicated staff members.)*

☒ Outsourced.

☐ There is no specific organizational structure for the maintenance of IT systems.

26. Does your utility have personnel assigned to promote digitalization?

☒ Yes, with (4) staff members. *(Please indicate the number of dedicated staff members.)*

☐ Outsourced.

☐ No.

27. Is there any integration and data exchange between the existing digital tools or systems you mentioned above?

☐ No

☒ Yes *(Please provide details of the integration and data exchange between the systems.)*

SUMS integrates with bank systems

Examples:

- Creation of integrated GIS maps of underground facilities, such as gas lines, sewers, power lines, and telephone cables.
- Integration of tariff billing system and customer service software.
- Linking municipal population forecast data with the utility's water demand forecast software.

Issue identification in support functions

28. Are there any challenges or issues in support functions (Incl. KPI monitoring, HR management, IT system maintenance, and digitalization)?

If so, please describe the following:

- What kind of problems are occurring? *e.g., insufficient staff skills, outdated IT systems, unintegrated data, cyber-security gaps, etc.*
- Why are these problems occurring? *e.g., lack of expertise, lack of training opportunities, organizational barriers, etc.*
- What impact will these problems have? *e.g., slow decision-making, data inconsistency, staff demotivation, vulnerability to cyber-attacks, etc.*

(Free description: _____)

- SRWSA currently has no human resources specialized in coding or software engineering.
- Several essential applications, such as AutoCAD, require costly licenses, posing a financial challenge.

5. Digital infrastructure and security management

29. Please describe the communication networks currently used by your operational and monitoring devices (e.g., SCADA, smart meters, pressure/flow sensors, etc.).

(Include types of connectivity (e.g., 4G/5G, LoRa, RF, or satellite), coverage area, bandwidth reliability, and connectivity in remote or difficult-to-access areas.)

1. WTP #1 (Teuk Vil I)

- SCADA with single PLC via Ethernet cable (MC protocol)
- Smart meters by pulse output
- Pressure/Flow sensors using analogue signal (4-20mA)

2. WTP #2 (Teuk Vil II)

- SCADA with multi-PLCs via Ethernet cable (Modbus TCP)

- Smart meter by pulse output - Pressure/Flow sensors by analogue signal (4-20mA)
3. WTP #3: (Chreav) - SCADA with multi-PLCs via Fiber optic and Media converter (MC Protocol) - Smart meter by pulse output - Pressure/Flow sensors by analogue signal (4-20mA)
30. Do you use any cloud platforms (e.g., AWS, Microsoft Azure, Google Cloud, or NIC Cloud) to host applications such as billing systems, GIS, analytics dashboards, or SCADA logs?
Yes, for DMA, communication between SCADA of WTP #3 and each Zone is established via a VPN tunnel using Westermo routers connected through the WeConnect cloud platform.
31. What mechanisms are in place for periodic data backup and archiving of historical data (e.g., customer billing, SCADA, and metering logs)?
☐ An automatic data backup system is in place. ☒ A manual data backup system is in place. ☐ No backup system is implemented. ☐ Unknown. <i>(If applicable, please include the frequency of backups, retention periods, and storage methods, such as cold storage, tape, cloud, etc.)</i> WTP #3 (Chreav): Manually export the report from SCADA as an excel file for daily report and Monthly report by operator.
32. How are employee and field-force mobile devices managed and secured when accessing utility apps?
<i>(If applicable, please include the use of Mobile Device Management (MDM) systems, BYOD (bring your own device) mechanism, remote wiping, and access restrictions.)</i> N/A
33. What authentication mechanisms are in place for staff accessing digital systems (e.g., SCADA, ERP, GIS, customer portals)?
<i>(If applicable, please include details on Single Sign-On (SSO), Multi-Factor Authentication (MFA), and Federated Identity Management (FIM))</i> For SCADA, each WTP has different user/password to sign-in.
34. What systems/tools are in place to monitor performance and faults in infrastructure components (e.g., pumps, sensors, meters, SCADA terminals)?
<i>(If applicable, please describe alerting mechanisms, dashboards, and response workflows.)</i> SCADA system for real-time and historical datalogging - Pump (status, current, runtime, faults) - Flow and pressure sensors - Tank/Reservoir levels - Meter reading
35. Do you have a disaster recovery system, an incident response plan, or a business continuity plan in place in the event of a cyberattack or natural disaster? If so, how often is it tested?
N/A



36. Do you conduct periodic cybersecurity awareness training for employees (e.g., phishing simulations, secure password use)?

☐ Periodic training is conducted.

☐ Not conducted on a regular basis.

☒ Not conducted at all.

E. Vision for Future Digitalization

1. Does your utility have a digital strategy?

☐ Yes. (Please provide a digital copy of your digital strategy document.)

☒ No.

2. What are the key issues your utility aims to address with digital/IT solutions?

(Please select up to three issues that you would like to see improved as a priority.)

☐ Reduction of non-revenue water (NRW)

☒ Leakage detection and countermeasures

☐ Improvement of customer service

☐ Financial soundness

☒ Advanced operation and maintenance (O&M)

☐ Strengthening of asset management

☐ Human resources development

☒ Development of digital infrastructure

☐ Others ()

(Please provide details of the priority issues you selected.)

- Leakage detection and countermeasures: To identify, locate, and repair leaks promptly to reduce non-revenue water (NRW) and improve water supply efficiency.
- Advanced operation and maintenance (O&M): To optimize the performance, reliability, and lifespan of water supply infrastructure through improved maintenance strategies.
- Development of digital infrastructure: To build a smart water utility system by integrating digital technologies for better management, monitoring, and customer service.

3. What is your vision for the future digitalization of your utility business?

Our vision is to build a smart, data-driven utility that improves service efficiency, enhances decision-making, and ensures sustainable water supply through digital tools such as GIS, mapping systems, SCADA, Automatic Meter Reading (AMR), and platforms for customer service, asset management, and network monitoring.

4. What is the biggest challenge in your digital transformation (DX)?

The biggest challenge is the limited human and financial resources for the operation and maintenance of digital systems.

5. What are your utility's expectations for future JICA projects in your digital transformation (DX)?

We hope JICA will support the installation of digital infrastructure and provide technical training through grant aid. This support will help strengthen our capacity, improve system efficiency, and advance our digital transformation goals.



F. Assistance of Development Partners

1. Regardless of DX initiatives, please provide a list of JICA projects in the past and currently underway.
(1) Infrastructure projects: - Project for Improvement Water Supply System for Siem Reap Town (JICA grant) - Siem Reap Water Supply Expansion Project, Phase 1,2&3 (Loan) - <i>The Project for Water Supply and Sanitation Improvement Preventing COVID-19</i> - <i>SDGs Business Verification Survey with the Private Sector for sustainable water supply by introducing water supply mapping system in Kingdom of Cambodia</i> (2) Capacity development projects/trainings: - Project for Capacity Building for Urban Water Supply in Cambodia Phase 2 - Project for Capacity Building for Urban Water Supply in Cambodia Phase 3
2. Regardless of DX initiatives, please provide a list of projects by other development partners (WB, ADB, etc.) in the past and currently underway.
(1) Infrastructure projects: - Siem Reap Emergency Bridging Project for Portable Water Supply, AFD loan project (2017-2020) - Urban Water Supply Project, ADB Loan Project (2018-2021) - The Project for Expansion of Distribution Network for Sustainable Water Supply in Siem Reap, (AFD loan project, in the Feasibility Study Phase) (2) Capacity development projects/trainings: N/A
3. Please provide a list of planned projects to be implemented by development partners, or specify the type of assistance you would like to receive.
(1) Infrastructure projects: - The Project for the Formulation of a Water Supply Master Plan for Siem Reap", JICA Technical Cooperation Project, (June 2025 to May 2028) (2) Capacity development projects/trainings:

Thank you for your cooperation.



*Data Collection Survey on Enhancement of DX Utilization and
Preparation of Digital Architecture for Water Utilities*

Questionnaire for Identifying Issues and Assessing the Level of Digital Maturity

1. Background

In order to address increasingly complex development challenges, JICA launched 20 cooperation strategies in 2021 under the title of "JICA Global Agenda" (JGA). In the water supply sector, JICA developed the "Cluster Strategy for Supporting the Growth of Water Utilities"¹ under the JGA No.19 for "Sustainable Water Resources Management and Water Supply". This cluster strategy classifies water utilities into four development stages and outlines a policy to advance them to the next stage through tailored cooperation approaches.

To encourage the advancement of water utilities to the next development stage, while making effective and efficient use of their limited resources, JICA has published a strategic report titled "Digital Transformation for Growing Water Utilities"² and a reference document titled "JICA DX Approach for Water Utility". These documents introduce the data organization required for business operations, the digital maturity level to be achieved at each development stage, methods for assessing the digital maturity level of water utilities, and steps for considering proactive and strategic digital utilization, which is expected to accelerate their transition to the next development stage.

JICA aims to utilize these materials in the formulation of all funding and technical cooperation projects in the water supply sector. However, there are only two case studies of their applications, and there is a lack of insights into their effectiveness and usability in other water supply projects.

2. Purpose of Survey

This survey aims to inform the formation of projects incorporating a DX perspective in the target countries by conducting digitalization analyses using the aforementioned materials at two selected water utilities. The survey also aims to verify the effectiveness of the materials and gather feedback on how to improve their usability.

This questionnaire is to be completed before the first field visit, scheduled for late July to early August. The questionnaire is designed to collect information necessary to identify specific issues, assess the current digital maturity level, and prepare an as-is digital architecture³ for the target

¹Link to the Cluster Strategy: [cluster_water_utilities.pdf](#)

²Release information: https://www.jica.go.jp/english/about/dx/information/2025/1571043_68031.html

Link to the material: [20250407_JICA_BCG_Water_DX_Report.pdf](#)

³Digital architecture is the comprehensive design blueprint that encompasses the digital infrastructure necessary for realizing digital transformation. It includes services (e.g., applications and systems), data integration platforms, servers, storage, network devices, sensors, etc. It also includes their interactions (e.g., data flow, software integration, security protection, etc.)

water utilities (see Figure 1 and Figure 2).

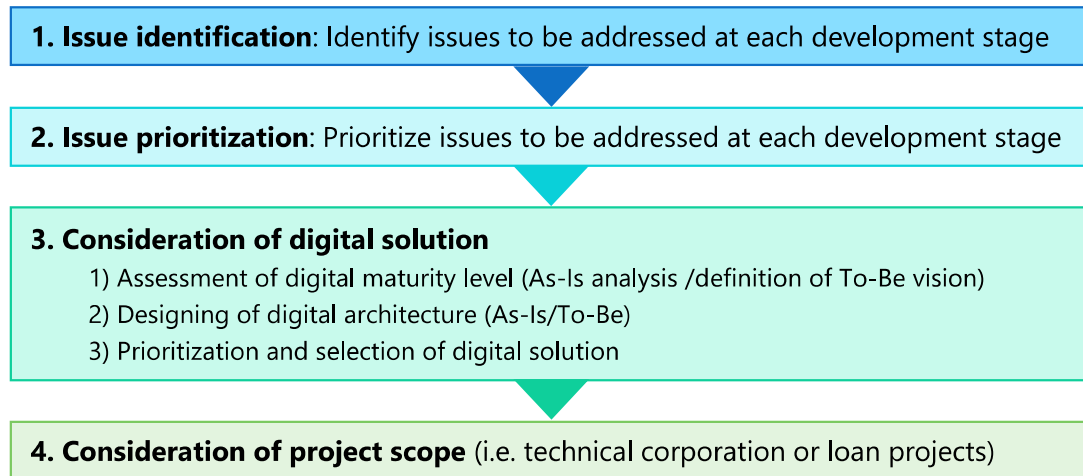


Figure 1 Steps in Project Formulation

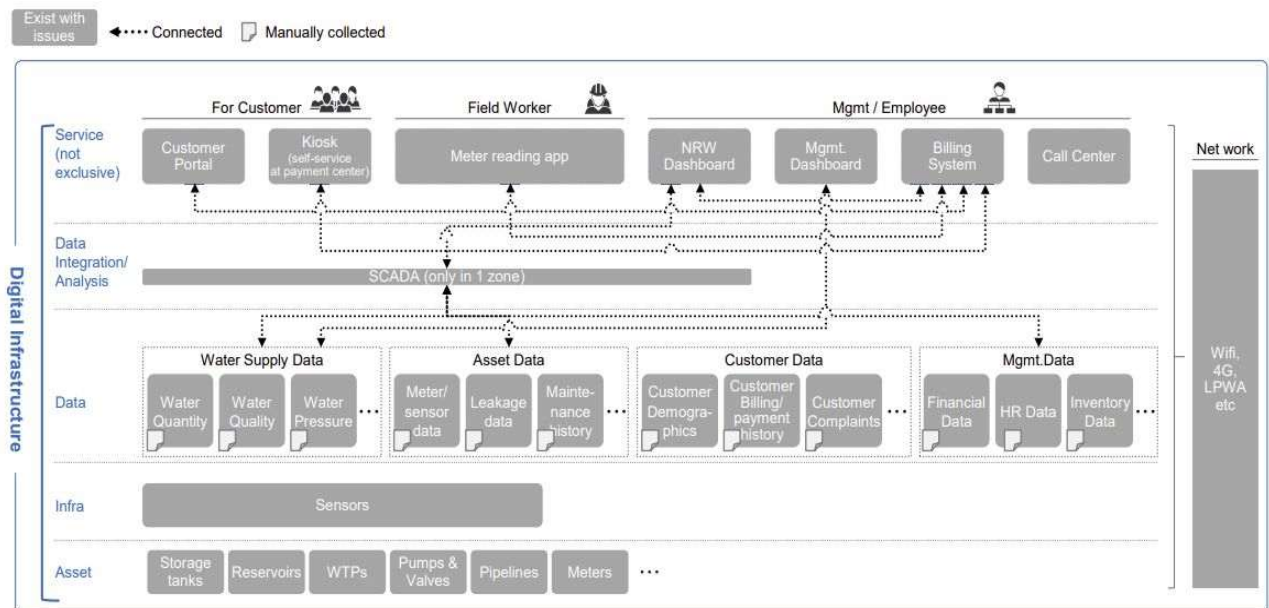


Figure 2 Sample of Digital Architecture (As-Is)

3. Survey schedule

Tasks	Period
Desktop survey - Data/information collection - Questionnaire survey	June to mid-July
1st field visit - Issue identification and prioritization - Assessment of digital maturity level	22 July to 8 August (tentative)
Project formation - Designing of digital architecture - Prioritization and selection of digital solution	Mid-August to early October
2nd field visit - Presentation of future projects incorporating a DX perspective - Consensus building	Mid-October
Improvement/updating of the reference material Debriefing session	By mid-January

4. Instruction

- If available, please provide digital copies of all the documents listed in **Section A**.
- If applicable, please click ☐ to change it to ☒ in the questionnaire. Also, please provide detailed explanations as much as possible.
- Please complete the form and submit it **by 14 July 2025** to:

To	- Atsuo Ohno (Mr.) <i>Leader of the survey team, Tokyo Engineering Consultants Co., Ltd.</i> ohno-a@tokyoengicon.co.jp
CC to	- Munehiro Teshima (Mr.) <i>Water Resources Group, Global Environment Dept., JICA HQs</i> Teshima.Munehiro@jica.go.jp - JICA Office in your country

5. Attachment

JICA DXLab, "JICA DX Approach for Water Utility" (Excerpted and edited)

Respondent Information

Utility Name	
Country and City	<i>e.g., Japan, Tokyo</i>
Contact Information	Name of contact person: <i>e.g., Atsuo Ohno (Mr.)</i> Position/Title: <i>e.g., Director of Engineering Services</i> E-mail address: <i>e.g., ohno-a@tokyoengicon.co.jp</i>

A. Documents Required

If available, please provide digital copies of all the documents listed below.

No.	Documents	Available
1	The latest Business Plan (or Strategic Plan) of utility	☒ ☐
2	The latest 3 years of annual reports of utility	☐
3	The latest 3 years of audited financial statements: - Profit and Loss Statement (Income Statement) - Balance Sheet - Cash Flow Statement	☐
4	System design documents (e.g. specification sheets, system diagrams) for installed platforms, apps, software, etc.	☒ ☐
5	Screenshots of the main screens of installed platforms, apps, systems, etc. - It would be desirable to have screenshots showing the specific data being collected and managed in the platform, apps, software, etc.	☒ ☐
6	Organization chart - A simple chart illustrating structures of departments is fine.	☐
7	Water treatment flow chart, facility diagram, etc. - A simple chart showing existing assets from the water sources and end-users is desirable. (Incl. boreholes, raw water tank, filtration tank, intake/booster pumps, reservoirs, valves, pipelines, public tap stands, meters, etc.)	☐

B. Basic Information

Year of establishment (Start of operation)	
Scope of services covered	☐ Water supply only ☐ Water supply and sewerage ☐ Other ()
Water supply area	km ²
Main types of water resources	<i>(Multiple selections are possible. Please also indicate the percentage distribution.)</i> ☐ Ground water (%) ☐ River water (%) ☐ Lake water (%) ☐ Other (%)
Number and capacity of water treatment plants	(#1) WTP Name: Capacity: m ³ /day (#2) WTP Name: Capacity: m ³ /day (#3) WTP Name: Capacity: m ³ /day <i>(If there are four or more WTPs, please add them.)</i>
Water purification method	☐ Slow sand filtration, ☐ Sedimentation and rapid filtration, ☐ Membrane filtration, ☐ Seawater desalination, ☐ Other ()
Distribution pipe length	km
Number of employees	

C. Performance Indicators

Please provide data for last 3 years including the latest FY. If unavailable, please enter "N/A".

Category/Indicators	Unit	FY ()	FY ()	FY ()
Service level				
1. Production capacity	m ³ /day			
2. Water production	m ³ /day			
3. Utilization ratio of production capacity (=Water production / Production capacity *100)	%			
4. Continuity of service	Hours/day			
5. Quality of water supplied (Compliance rate)	%			
6. Water supply pressure	MPa			
7. Leakage ratio (=Percentage of water leakage relative to system input volume, or number of pipe breaks per year)	%(or breaks/year)			
Business scale				
8. Population served	People			
9. Number of active connections	-	1068517	1088180	1117821
10. Service coverage (water coverage)	%			
<i>Select the calculation formula used.</i> ☐ Population served / Total population in the service area *100 ☐ Number of households connected to the network / Total number of households in the service area *100				
11. Customer satisfaction	%			
<i>If applicable, please provide a brief description of the survey methods used to measure customer satisfaction, along with the definition of this indicator.</i>				
Cost-effectiveness				
12. Collection ratio	%	100	100	100
13. Non-revenue water ratio	%			
14. Metering ratio	%			
15. Water tariff level (= Water tariff for domestic use when 6m ³ of water is consumed)	XXX/6m ³			
Profitability& financial soundness				
16. Net income from water services (Net income from other services, such as sewerage and electricity, is excluded.)	XXX			
17. O&M cost coverage ratio (= Total annual revenue of water service / Total annual operating costs for water service (excluding depreciation and interest) *100)	%			
Human resources efficiency				

18. Number of staff per 1,000 connections	persons			
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Note: Please enter the unit that you usually use ($1\text{MPa} = 1000\text{kPa} = 10\text{bar} = 101.97\text{mH}_2\text{O}$). Ideally, monitoring points should be selected where the water pressure is lowest, such as on high ground or at the end of the network. A qualitative explanation is also applicable. (e.g., The water supply pressure at the tap is unstable, causing complaints from customers.)

Note: Please enter either the local currency or USD as the currency unit.

D. Status of Digital Tool Implementation

We would like to ask you about the acquisition of necessary data, data utilization, digital tool/system implementation, and data integration in the operation of your water supply business. Please provide a brief overview of your current situation by answering the following questions. Further details will be confirmed during the field visit.

1. Capital investment strategy

1a. Project planning (incl. water resource development plan, facility development plan, and water supply & demand mgt.)

1. Please indicate who is responsible for project planning (incl. water resource development plan, facility development plan, and water demand forecast).

- ☐ Plans are prepared by the water utility independently. *(Please also indicate the dedicated department or section.)*
- ☐ Plans are prepared by an external consultant.
- ☐ Plans are prepared by a development partner.
- ☐ No water resource development plans or facility development plans have been formulated.
- ☐ Other ()

2. If any, please provide a list of the digital tools or systems you use **for project planning**. Please also provide the following information:

- The fiscal year when the system was installed,
- Name of the manufacturer,
- Name of the development partner who supported the installation.

Examples:

- *Recording water resource information in electronic registers (Incl. Excel).*
- *Identification of water resources using GIS and satellite data.*
- *Automatic monitoring of customer water usage through the installation of smart meters, etc.*
- *Pattern analysis and forecast of water demand and available water supply using simulation software.*

3. Please select **ALL** the data you have obtained that is necessary for project planning, as well as the method for collecting and recording the data (Incl. handwritten and paper-based data).

If you do not obtain or use the data, leave the checkbox blank ().

Data	Data Collection/Recording Methods		
	Digital tool/ System	Excel/Word	Manual/ Paper-based
Meteorological data (e.g., rainfall, weather)	☐	☐	☐
Water level by water source (groundwater/river/lake)	☐	☐	☐
Available water intake volume by water source	☐	☐	☐
Water quality by water source	☐	☐	☐
Topographical data (e.g., location, elevation, geology)	☐	☐	☐
Population forecast	☐	☐	☐
Water demand forecast for domestic, agricultural, industrial, and other uses	☐	☐	☐

Agricultural/industrial planning, urban planning	☐	☐	☐
Capacity and specifications of existing facilities	☐	☐	☐
Other ()	☐	☐	☐

1b. Asset management, facility design, life cycle management

4. Please indicate the department or section involved in asset management.

ACE(MIS)

5. If any, please provide a list of the digital tools or systems you use **for asset management**. Please also provide the following information: **Arc GIS**

- The fiscal year when the system was installed, **2000-2002**
- Name of the manufacturer, **French Fund**
- Name of the development partner who supported the installation.

Examples:

- *Recording asset information and trouble/repair information in electronic registers (Incl. Excel).*
- *Mapping of infrastructures using GIS.*
- *Real-time acquisition of asset information using sensors, cameras, or drones.*

6. Please select **ALL** the data you have obtained that is necessary for asset management, as well as the method for collecting and recording the data (Incl. handwritten and paper-based data).

If you do not obtain or use the data, leave the checkbox blank(☐).

Asset information for:	Data Collection/Recording Methods		
	Digital tool/ System	Excel/Word	Manual/ Paper-based
Intake facility (e.g., location, specifications of pumps, and year of installation)	☒ ☐	☐	☐
Conveyance pipeline (e.g., location, diameter, length, pipe material, and year of installation)	☒ ☐	☐	☐
Water treatment plant (e.g., year of completion, capacity, material, and construction cost)	☒ ☐	☐	☐
Mechanical equipment, such as valves and chemical injection equipment (e.g., year of installation, manufacturer, etc.)	☒ ☐	☐	☐
Electrical equipment, such as power receiving equipment, flow meters, and pressure gauges (e.g., year of installation, manufacturer, etc.)	☒ ☐	☐	☐
Service reservoir (e.g., year of completion, capacity, and construction cost)	☒ ☐	☐	☐
Distribution pipeline (e.g., location, diameter, length, pipe material, and year of installation)	☒ ☐	☐	☐
Customer meters (e.g., location, type, diameter, and year of installation)	☒ ☐	☐	☐
Customer registry	☒ ☐	☐	☐
Service life of each facility & equipment(e.g., 50 yrs for concrete tanks, 40 yrs for pipes, etc.)	☒ ☐	☐	☐
Records of repair/upgrade/renewal of facility	☒ ☐	☐	☐

&equipment			
Records of trouble/failure of facility & equipment	☒	☐	☐
Other ()	☐	☐	☐

Issue identification in capital investment strategy

7. Have you secured sufficient financial resources to implement your planned projects?

☐ Yes, sufficient funding has been secured for all planned projects.
☐ Funding is partially secured, with gaps remaining.
☐ Funding is not secured at all.
☐ Other ()

If funding is insufficient, please describe the following:

- What kind of projects are affected? *e.g., construction of a new WTP, pipeline replacement, etc.*
- Why is funding insufficient? *e.g., lack of tariff revenue, delays in government grants, inability to access loans, etc.*
- What impact will these funding shortages have? *e.g., deterioration of water quality, frequent service interruptions, higher NRW ratio, etc.*

(Free description: _____)

2. Operation and maintenance

2a. Water flow management

8. Please indicate the department or section involved in water flow management (i.e. the management of water volume, quality, and pressure) from the water sources to the distribution network.

9. If any, please provide a list of the digital tools or systems you use **for water flow management**. Please also provide the following information:

- The fiscal year when the system was installed,
- Name of the manufacturer,
- Name of the development partner who supported the installation.

Examples:

- *Field Force Management System: Field engineers input data using tablets.*
- *Centralized monitoring of water treatment plants and distribution networks using SCADA.*
- *Using AI to analyse water quality data and optimize chemical injection amounts.*

10. Please select **ALL** the data you have obtained that is necessary for water flow management, as well as the method for collecting and recording the data (Incl. handwritten and paper-based data).

If you do not obtain or use the data, leave the checkbox blank(□).

Data	Data Collection/Recording Methods		
	Digital tool/ System	Excel/Word	Manual/ Paper-based
Water intake:			
• Intake volume (flow rates)	☐	☐	☐
• Water quality	☐	☐	☐

Treatment plant:			
• Water volume (flow rates)	☐	☐	☐
• Water quality at the entrance	☐	☐	☐
• Water quality at the exit	☐	☐	☐
Distribution reservoir:			
• Water volume (flow rates)	☐	☐	☐
• Water quality	☐	☐	☐
• Water pressure at the exit (or water supply pressure of distribution pump)	☐	☐	☐
• Water pressure at the entrance of each DMA	☐	☐	☐
• Distribution time	☐	☐	☐
Water tap:			
• Water volume (consumption)	☐	☐	☐
• Water quality	☐	☐	☐
• Water pressure	☐	☐	☐
• Usage time	☐	☐	☐
Other ()	☐	☐	☐

2b. Maintenance (incl. leakage control)

11. Please indicate the department or section involved in facility & equipment maintenance and leakage control.

12. If any, please provide a list of the digital tools or systems you use **for the maintenance and leakage control**. Please also provide the following information:

- The fiscal year when the system was installed,
- Name of the manufacturer,
- Name of the development partner who supported the installation.

Examples:

- Sensors and an IoT gateway to collect and transmit data on flow rate, pressure, and water quality.
- Field Force Management System: Field engineers input data using tablets.
- Identification of leaking pipes using electronic leak detectors.
- Real-time monitoring of water usage and automatic detection of abnormal values using smart meters.
- Identification of water leakage areas and pipes using artificial satellites and AI.

13. Please select **ALL** the data you have obtained that is necessary for the maintenance and leakage control, as well as the method for collecting and recording the data (Incl. handwritten and paper-based data).

If you do not obtain or use the data, leave the checkbox blank(☐).

Data	Data Collection/Recording Methods		
	Digital tool/ System	Excel/Word	Manual/ Paper-based
Frequency of sludge removal and cleaning of sedimentation tanks	☐	☐	☐

Frequency of cleaning filtration tanks and replacing filter sand	☐	☐	☐
Frequency of cleaning service reservoirs	☐	☐	☐
Condition of concrete structures (e.g., exterior damage)	☐	☐	☐
Amount of chemicals used and frequency of procurement	☐	☐	☐
Records of failures and repairs of mechanical and electrical equipment (e.g., valves, flow meters, chemical injection equipment, etc.)	☐	☐	☐
Records of water leakage (e.g., date, location, and repair records)	☐	☐	☐
NRW ratio for each DMA	☐	☐	☐
Frequency data of distribution pipes	☐	☐	☐
Vibration data of distribution pipes	☐	☐	☐
Other ()	☐	☐	☐

Issue identification in operation and maintenance

14. Are there any challenges or issues in the operation and maintenance (O&M) of your water supply facilities?

If so, please describe the following:

- What kind of problems are occurring? *e.g., Non-compliance with water quality standards, equipment breakdown, aging facilities, etc.*
- Why are these problems occurring? *e.g., insufficient staff skills, lack of spare parts, data insufficiency, unclear procedures, etc.*
- What impact will these problems have on your service provision? *e.g., customer complaints, frequent service interruptions, higher NRW ratio, etc.*

(Free description: _____)

3. Customer service (incl. meter reading, billing & collection, and complaint handling)

15. Please indicate the department or section involved in customer service.

ACE(MIS)

16. If any, please provide a list of the digital tools or systems you use **for customer service**. Please also provide the following information:

- The fiscal year when the system was installed, 2007
- Name of the manufacturer, Keonics
- Name of the development partner who supported the installation.

Examples:

- Recording customer information and analogue meter readings in electronic registers (Incl. Excel).
- Recording water usage data using digital tools, such as QR codes and meter reading apps.
- Customer-oriented apps to receive enquiries, update enquiry response status, and carry out various procedures.
- Centralized management of customer services, incl. meter reading, billing, and complaint handling, using a data platform.

17. Please select **ALL** the data you have obtained that is necessary for customer service, as well as the method for collecting and recording the data (Incl. handwritten and paper-based data).

If you do not obtain or use the data, leave the checkbox blank(□).

Data	Data Collection/Recording Methods		
	Digital tool/ System	Excel/Word	Manual/ Paper-based
Customer contract information (e.g., name, address, telephone number, etc.)	☒ ☐	☐	☐
Customer meter number (assigned to each household)	☒ ☐	☐	☐
Monthly water consumption	☒ ☐	☐	☐
Monthly billing amount	☒ ☐	☐	☐
Monthly collected amount	☒ ☐	☐	☐
Complaint/enquiry information (e.g., number of complaints/enquiries, date, location, time taken to resolve, etc.)	☒ ☐	☐	☐
Customer satisfaction score	☐	☐	☐
Termination of contract (e.g., number of terminations, and reason)	☐	☐	☐
Other ()	☐	☐	☐

Issue identification in customer service

18. Are there any challenges or issues in customer service, including meter reading, billing & collection, and complaint handling?

If so, please describe the following:

- What kind of problems are occurring? *e.g., inaccurate meter reading, low collection rates, many customer complaints, etc.*
- Why are these problems occurring? *e.g., human error, lack of customer awareness, inappropriate tariffs, etc.*
- What impact will these problems have? *e.g., revenue loss, customer dissatisfaction, higher NRW ratio, etc.*

(Free description: _____)

4. Support functions

4a. Business management, finance & treasury

19. Please indicate the department or section involved in business management.

20. If any, please provide a list of the digital tools or systems you use **for business management, finance & treasury**. Please also provide the following information:

- The fiscal year when the system was installed,
- Name of the manufacturer,
- Name of the development partner who supported the installation.

Examples:

- *Recording financial information in electronic ledgers (Incl. Excel).*
- *Visualization and management of KPIs using management dashboards.*
- *Monitoring of policy/project implementation using project management software.*

21. Please indicate ALL the KPIs you have obtained and monitored in your business plan, as well as the method for managing the KPI data (Incl. handwritten and paper-based data).	
(1) Operational KPIs: <i>Examples:</i> - <i>No. of households supplied with water</i> - <i>NRW ratio</i> - <i>Tariff collection rate, etc.</i> ☒ Digital tool/System, ☐ Excel/Word, ☐ Manual/Paper-based	
(2) Financial KPIs: <i>Examples:</i> - <i>Net income</i> - <i>O&M cost coverage ratio</i> - <i>EBITDA, etc.</i> ☐ Digital tool/System, ☐ Excel/Word, ☐ Manual/Paper-based	
4b. Human resources, talent development (incl. trainings)	
22. Please indicate the department or section involved in HR management and talent development.	
23. If any, please provide a list of the digital tools or systems you use for HR management and talent development . Please also provide the following information: - The fiscal year when the system was installed, - Name of the manufacturer, - Name of the development partner who supported the installation.	
<i>Examples:</i> - <i>Remote training via a video conference platform and/or e-learning platform.</i> - <i>Visualization of employee certifications and training records through a skill management system.</i> - <i>Internal knowledge management systems for manuals, training documents, etc., accessible to all employees on an intra-net.</i>	
24. Please indicate ALL the data you have obtained that is necessary for HR management and talent development, as well as the method for collecting and recording the data (Incl. handwritten and paper-based data).	
<i>If you do not obtain or use the data, leave the checkbox blank(□).</i>	
	Data Collection/Recording Methods

Data	Digital tool/ System	Excel/Word	Manual/ Paper-based
Number of employees in each department	☐	☐	☐
Salary and employment conditions	☐	☐	☐
Working hours and days of each employee	☐	☐	☐
Information on the qualifications and skills possessed by each employee	☐	☐	☐
Job description	☐	☐	☐
SOPs (Standard Operating Procedures)	☐	☐	☐
Training records (e.g. date, number of trainees, training hours, etc.)	☐	☐	☐
Other ()	☐	☐	☐

4d. IT/digitization, digital talent development

25. Does your utility have an IT department responsible for maintaining IT systems?

☒ ☐ Yes, with () staff members. *(Please indicate the number of dedicated staff members.)*

☐ Outsourced.

☒ ☐ There is no specific organizational structure for the maintenance of IT systems.

26. Does your utility have personnel assigned to promote digitalization?

☐ Yes, with () staff members. *(Please indicate the number of dedicated staff members.)*

☐ Outsourced.

☒ ☐ No.

27. Is there any integration and data exchange between the existing digital tools or systems you mentioned above?

☐ No

☒ ☐ Yes *(Please provide details of the integration and data exchange between the systems.)*

Examples:

- *Creation of integrated GIS maps of underground facilities, such as gas lines, sewers, power lines, and telephone cables.*
- *Integration of tariff billing system and customer service software.*
- *Linking municipal population forecast data with the utility's water demand forecast software.*

Issue identification in support functions

28. Are there any challenges or issues in support functions (Incl. KPI monitoring, HR management, IT system maintenance, and digitalization)?

If so, please describe the following:

- What kind of problems are occurring? *e.g., insufficient staff skills,*
- Why are these problems occurring? *lack of training opportunities, organizational barriers, etc.*
- What impact will these problems have? *e.g., slow decision-making, data inconsistency, staff demotivation, vulnerability to cyber-attacks, etc.*

(Free description: _____)

5. Digital infrastructure and security management

29. Please describe the communication networks currently used by your operational and

monitoring devices (e.g., SCADA, smart meters, pressure/flow sensors, etc.).
<i>(Include types of connectivity (e.g., 4G/5G, LoRa, RF, or satellite), coverage area, bandwidth reliability, and connectivity in remote or difficult-to-access areas.)</i>
30. Do you use any cloud platforms (e.g., AWS, Microsoft Azure, Google Cloud, or NIC Cloud) to host applications such as billing systems, GIS, analytics dashboards, or SCADA logs?
State Data Centre and MEITY Empanelled Cloud
31. What mechanisms are in place for periodic data backup and archiving of historical data (e.g., customer billing, SCADA, and metering logs)?
☒ An automatic data backup system is in place. ☐ A manual data backup system is in place. ☐ No backup system is implemented. ☐ Unknown. As per Data Centre Norms <i>(If applicable, please include the frequency of backups, retention periods, and storage methods, such as cold storage, tape, cloud, etc.)</i>
32. How are employee and field-force mobile devices managed and secured when accessing utility apps?
<i>(If applicable, please include the use of Mobile Device Management (MDM) systems, BYOD (bring your own device) mechanism, remote wiping, and access restrictions.)</i>
33. What authentication mechanisms are in place for staff accessing digital systems (e.g., SCADA, ERP, GIS, customer portals)?
<i>(If applicable, please include details on Single Sign-On (SSO), Multi-Factor Authentication (MFA), and Federated Identity Management (FIM))</i> Two factor authentication
34. What systems/tools are in place to monitor performance and faults in infrastructure components (e.g., pumps, sensors, meters, SCADA terminals)?
<i>(If applicable, please describe alerting mechanisms, dashboards, and response workflows.)</i>
35. Do you have a disaster recovery system, an incident response plan, or a business continuity plan in place in the event of a cyberattack or natural disaster? If so, how often is it tested?
In process
36. Do you conduct periodic cybersecurity awareness training for employees (e.g., phishing simulations, secure password use)?
☐ Periodic training is conducted. ☐ Not conducted on a regular basis. ☐ Not conducted at all.

E. Vision for Future Digitalization

1. Does your utility have a digital strategy?
☐ Yes. <i>(Please provide a digital copy of your digital strategy document.)</i> ☐ No.
2. What are the key issues your utility aims to address with digital/IT solutions?
<i>(Please select up to three issues that you would like to see improved as a priority.)</i> ☐ Reduction of non-revenue water (NRW) ✓ ☐ Leakage detection and countermeasures: FIDO Plus AI-Powered Leak Detection Program which is aimed to systematically identify, locate and pinpoint leaks across the network and thereby designed to provide accurate, actionable data which enables in significant reductions in Non-Revenue Water (NRW) and creating long term operational efficiencies. ☐ Improvement of customer service Improvements based on the feedbacks for service provided by BWSSB from the consumers Empower employees to solve problems without excessive escalation. Reward and recognize staff for excellent customer service. Monitor, Measure & Improve Continuously KPIs to Track: Use data analytics to offer energy/water-saving tips based on usage. ☐ Financial soundness ☐ Advanced operation and maintenance (O&M) ☐ Strengthening of asset management ☐ Human resources development ☐ Development of digital infrastructure ☐ Others () <i>(Please provide details of the priority issues you selected.)</i>
3. What is your vision for the future digitalization of your utility business?
4. What is the biggest challenge in your digital transformation (DX)?
5. What are your utility's expectations for future JICA projects in your digital transformation (DX)?

F. Assistance of Development Partners

1. Regardless of DX initiatives, please provide a list of JICA projects in the past and currently underway.
(1) Infrastructure projects:
(2) Capacity development projects/trainings:
2. Regardless of DX initiatives, please provide a list of projects by other development partners (WB, ADB, etc.) in the past and currently underway.
(1) Infrastructure projects:
(2) Capacity development projects/trainings:
3. Please provide a list of planned projects to be implemented by development partners, or specify the type of assistance you would like to receive.
(1) Infrastructure projects:
(2) Capacity development projects/trainings:

Thank you for your cooperation.