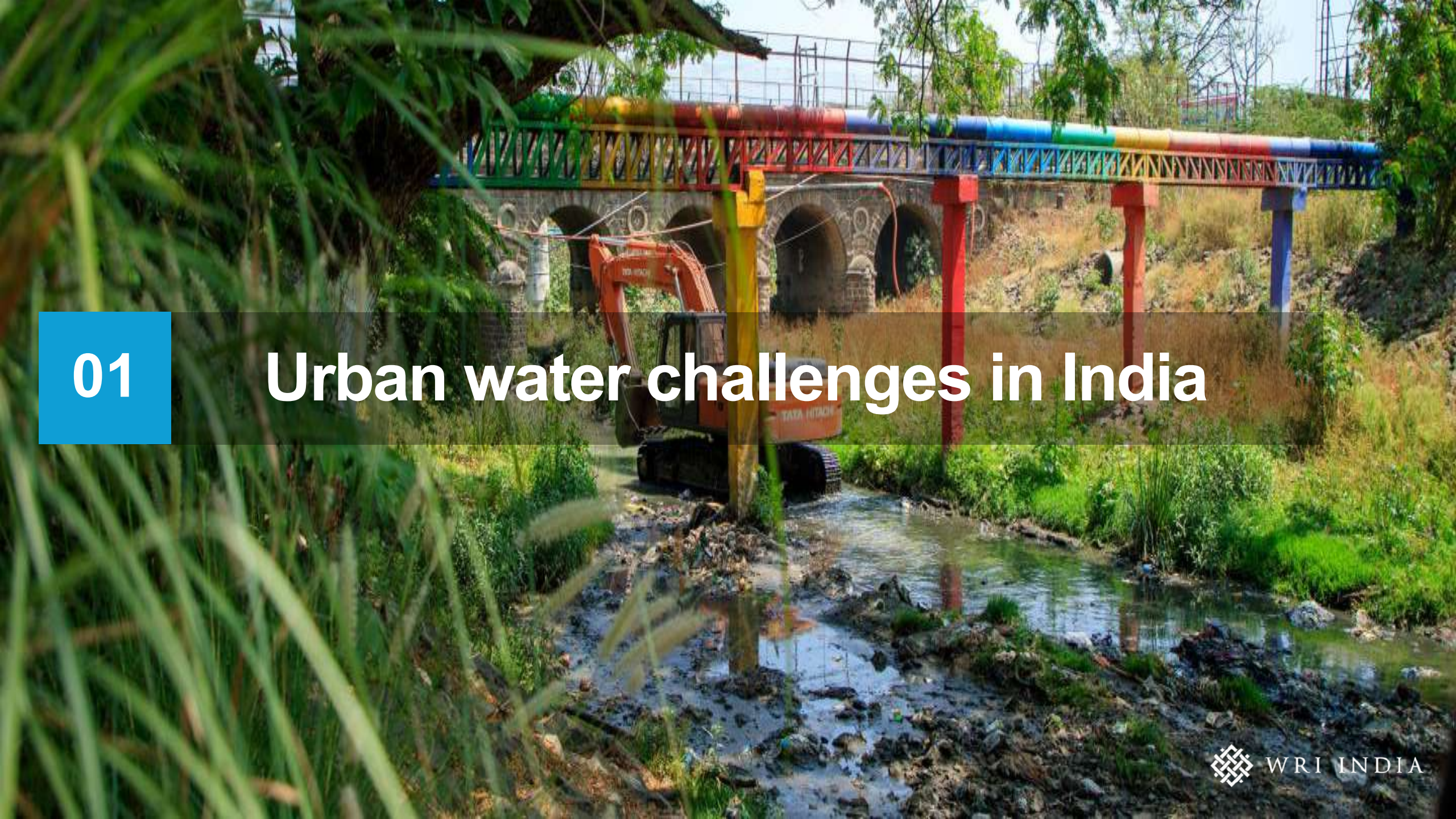
Smart Water Management

30 October 2025

Ashwathy Anand
WRI India

WRI INDIA

CONTENT

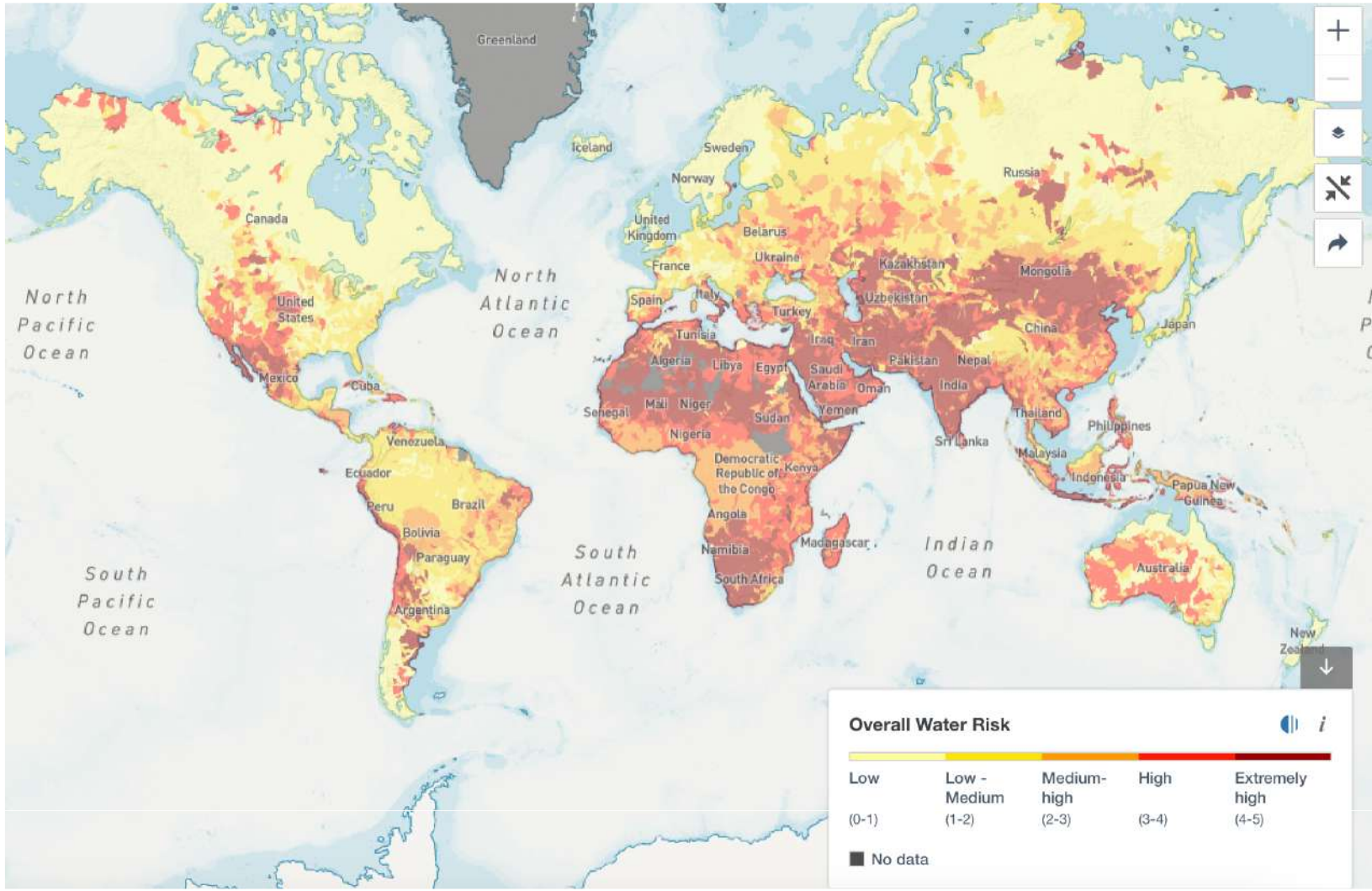


01 Urban water challenges in India

WRI INDIA

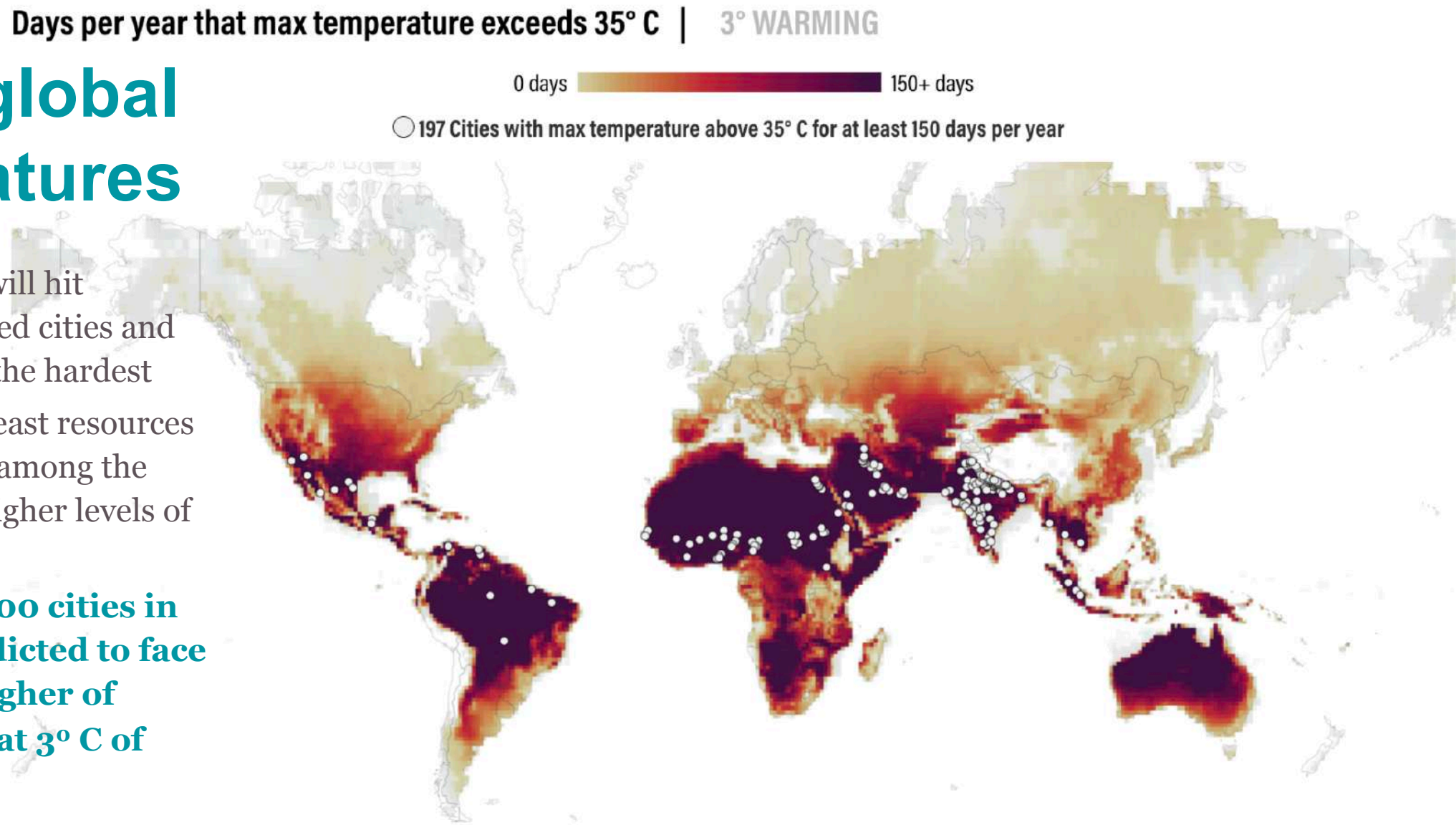
Global water stress

- **25 countries — housing one-quarter of the global population** — face extremely high water stress each year, regularly using up almost their entire available water supply
- India has **18 percent of the world's population, but only 4 percent of its water resources**, making it among the most water-stressed in the world.



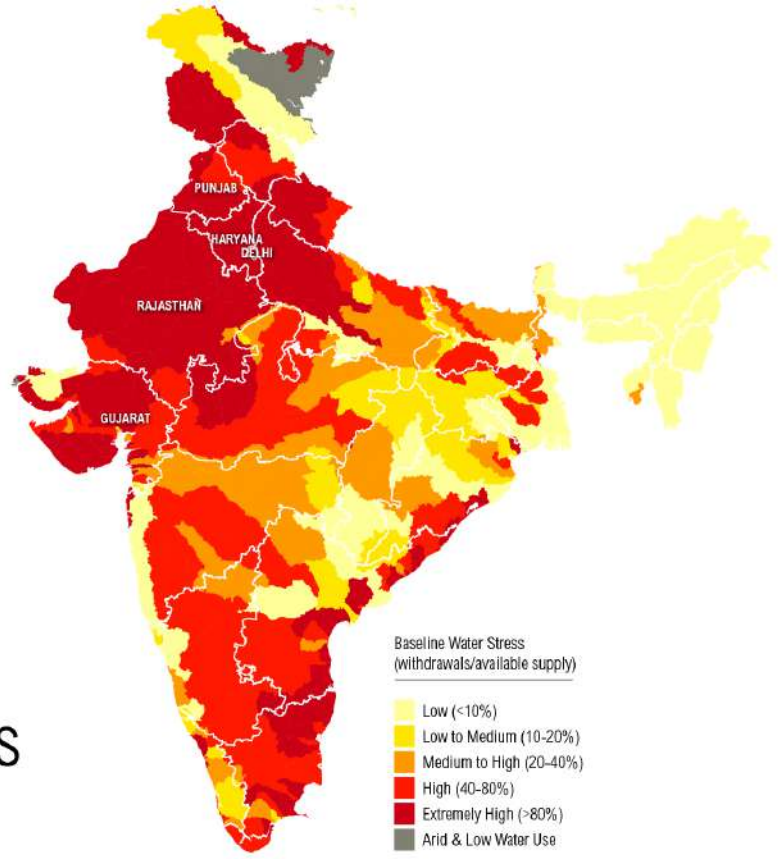
Rising global temperatures

- Excessive heat will hit resource-strapped cities and the urban poor the hardest
- Cities with the least resources to adapt will be among the hardest hit by higher levels of warming.
- **More than a 100 cities in India are predicted to face 150 days or higher of extreme heat at 3° C of warming**



Water stresses across India

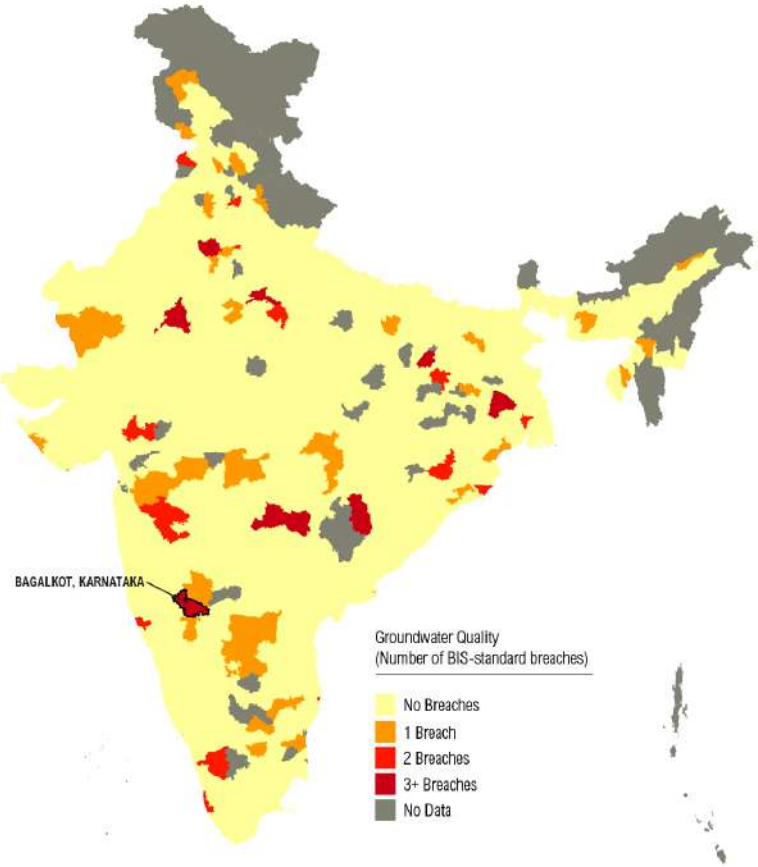
54%
of India
Faces
High to
Extremely
High
Water Stress



www.indiawatertool.in

WORLD RESOURCES INSTITUTE

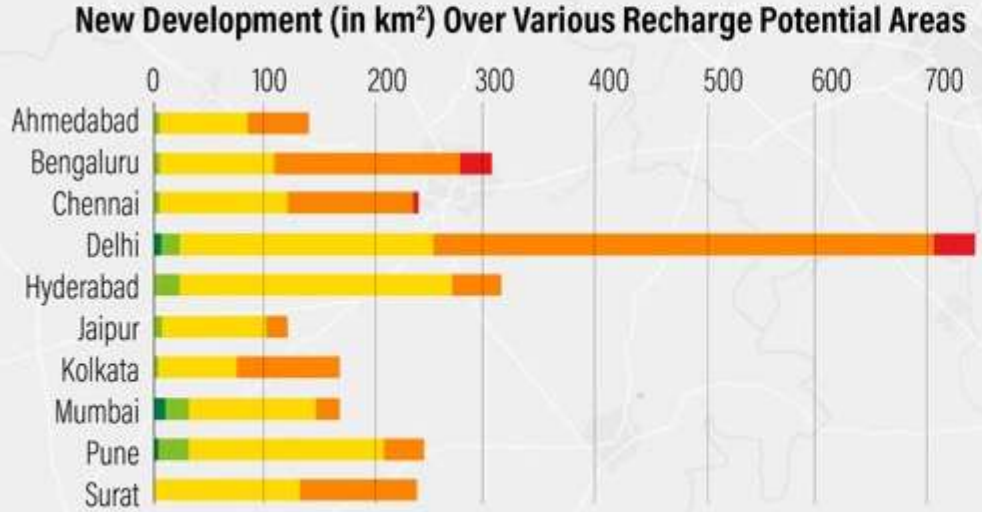
More than
100
MILLION
People Live
in Areas of
Poor Water
Quality

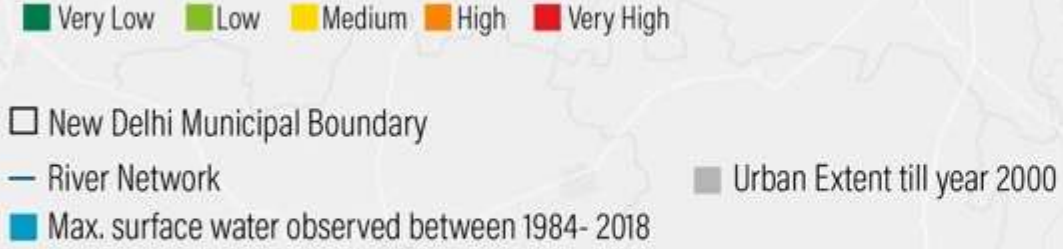


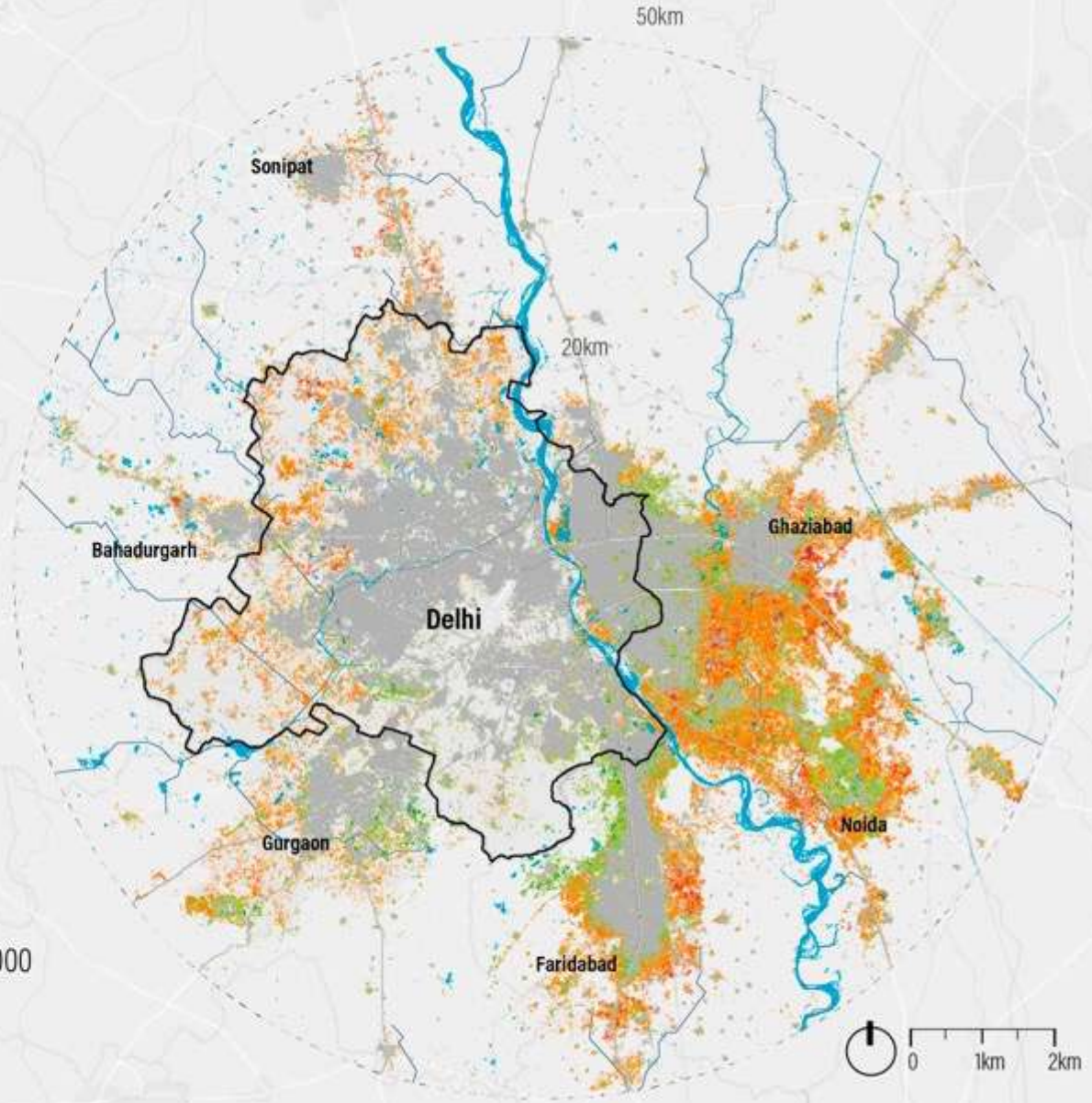
www.indiawatertool.in

WORLD RESOURCES INSTITUTE

Urbanization and Water Stress



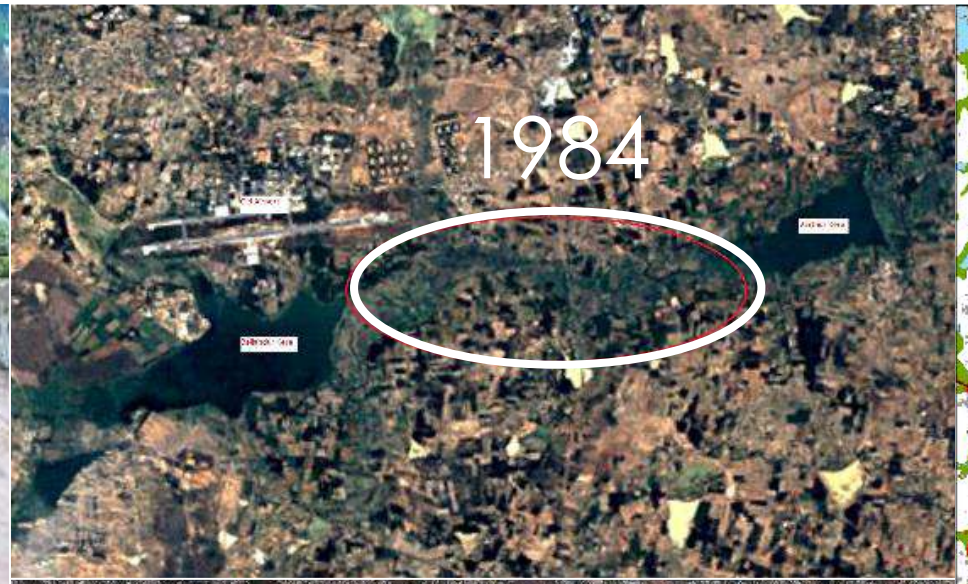


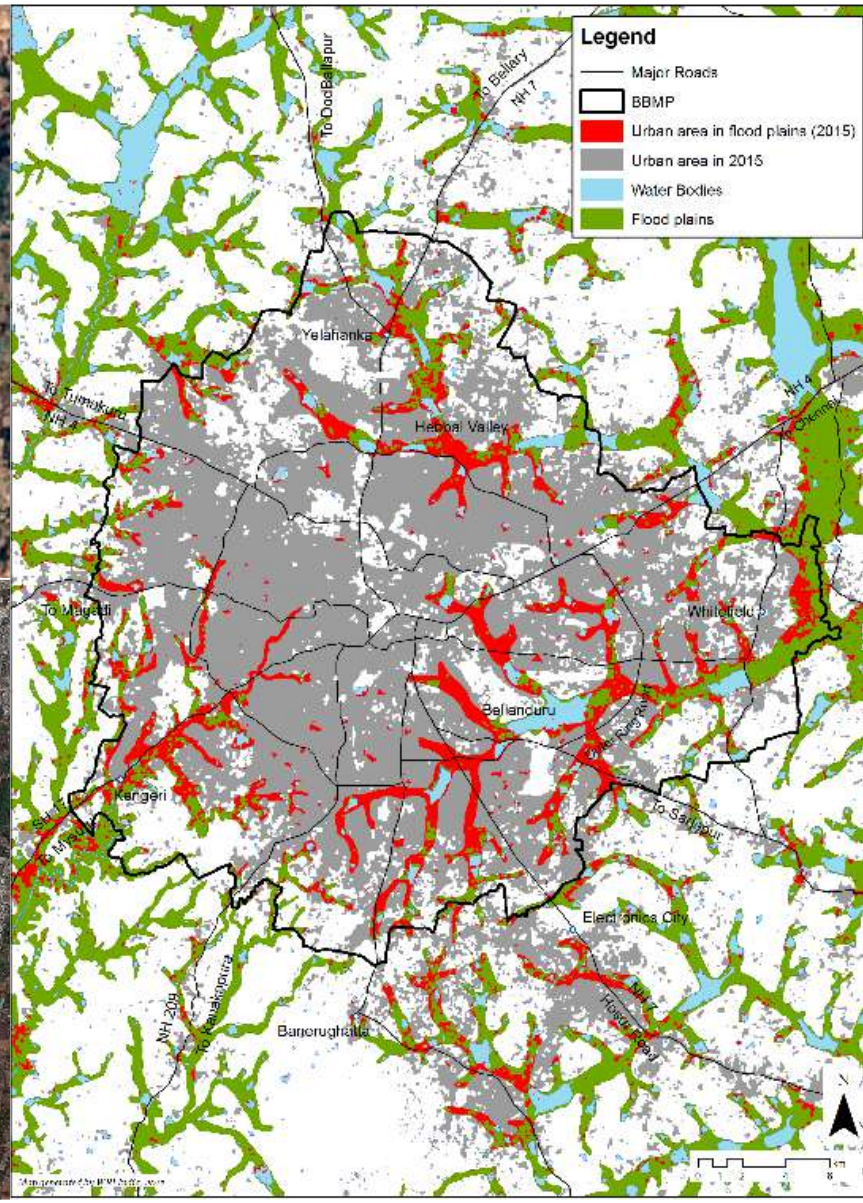


Source: WRI India, 2022

Where are we building out cities

85% of floodplains in Bangalore are encroached upon/built-up

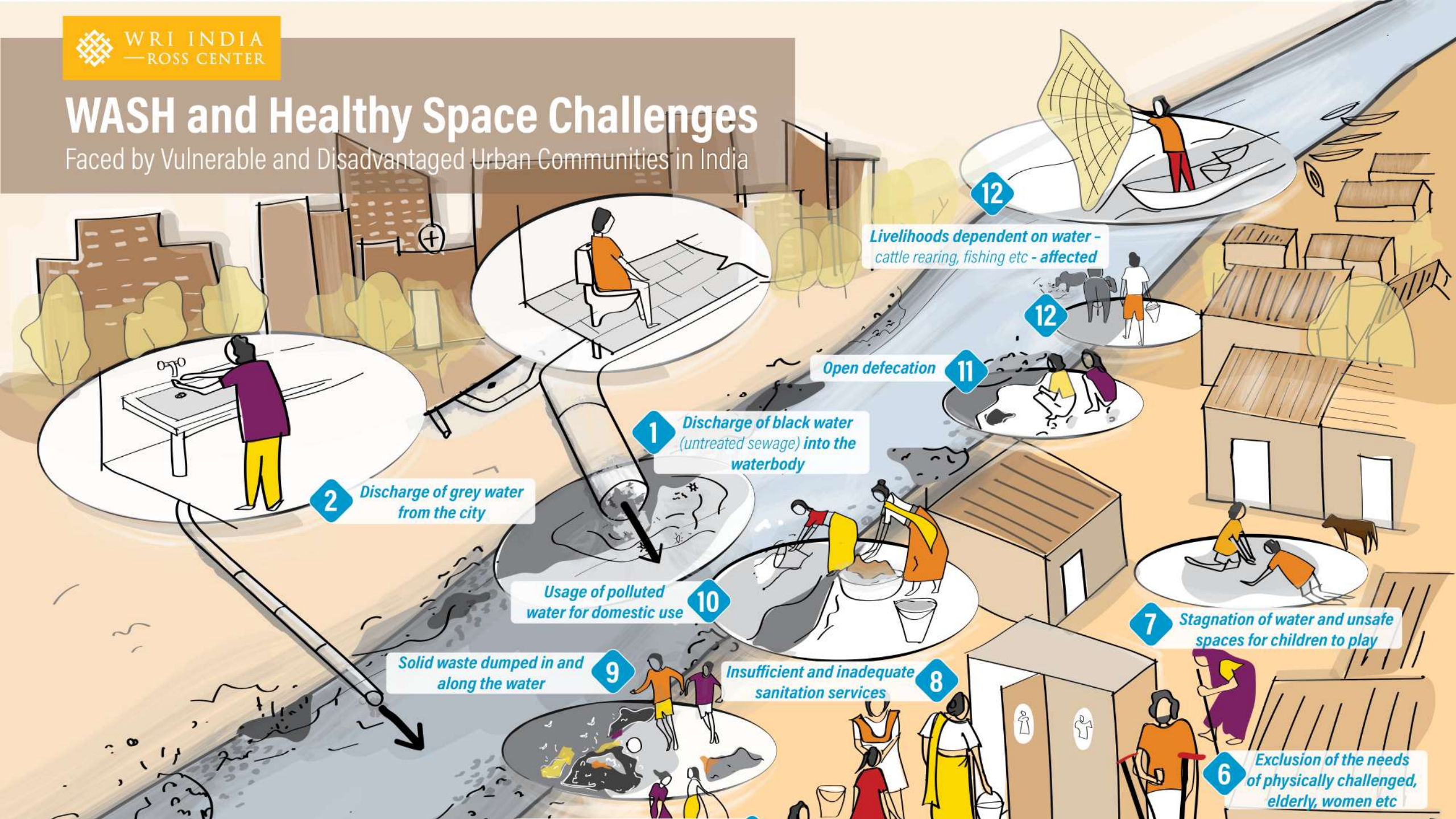




WRI INDIA
—ROSS CENTER

WASH and Healthy Space Challenges

Faced by Vulnerable and Disadvantaged Urban Communities in India

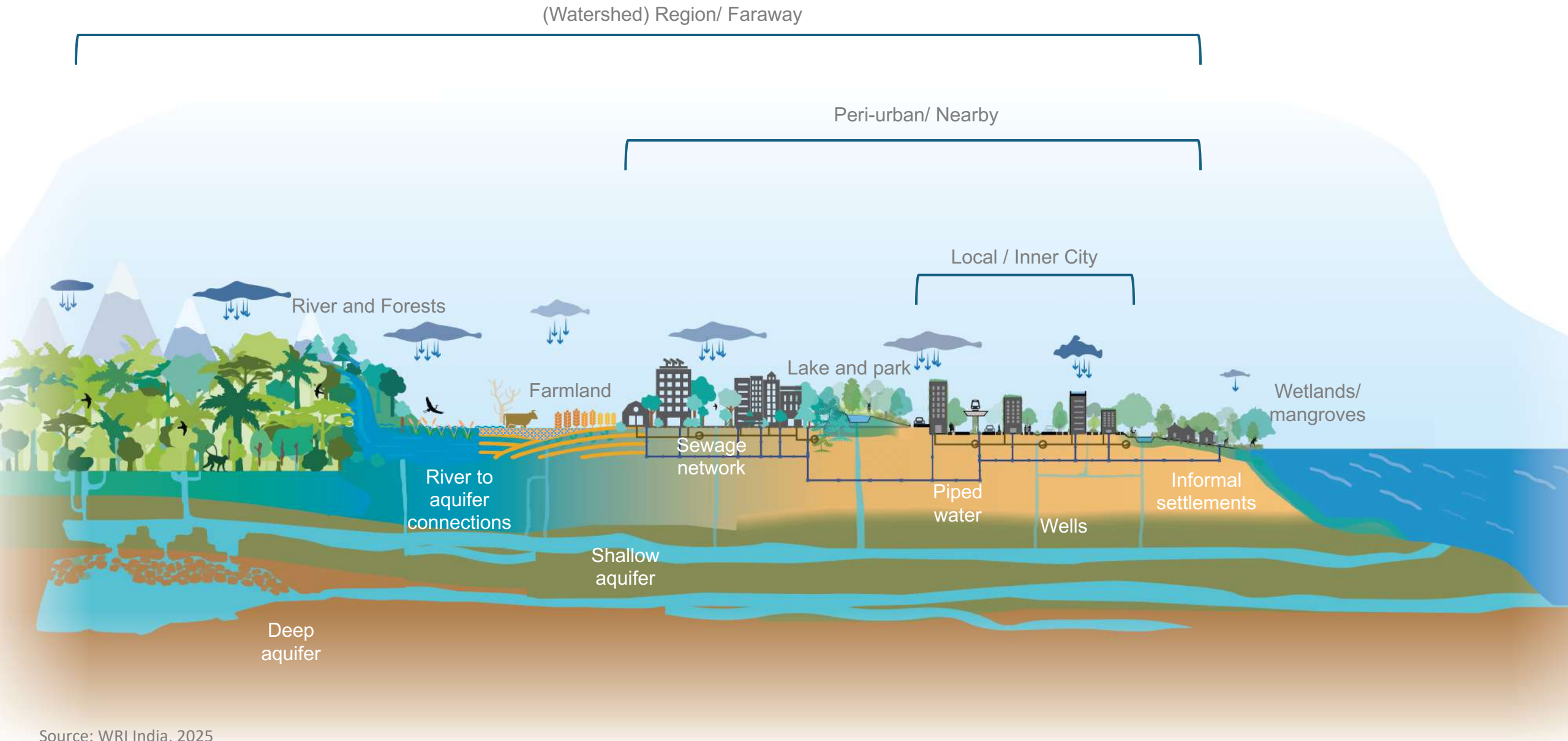


India’s Water Scenario in Nutshell

- India’s Water Sector Scenario India is blessed with an abundance of water resources and large rivers, but still it is currently facing the terrifying possibility of becoming a water scarce country by 2025.
- India is placed at **120th amongst 122 countries** in the water quality index, with nearly **70%** of water being contaminated
- **600 million Indians** face high to extreme water stress and about 0.2 million people die every year due to inadequate access to safe water
- The water requirement by 2050 is likely to be **1,180 BCM**, whereas the present-day availability is 695 BCM
- Cities are key in addressing climate change through integration of water energy nexus & climate resilience strategies into local development planning.

02 Smart Water Management Framework

Scales of Water Management



Source: WRI India, 2025

AIM for Smart Water Management

Data Analytics and Tools

Policy, Finance and Governance

Protect, conserve, restore and manage water systems

Scale — Region/ Faraway → City/ Nearby → Local/ Inner City

Circular
Regenerative
Resilient
Equitable

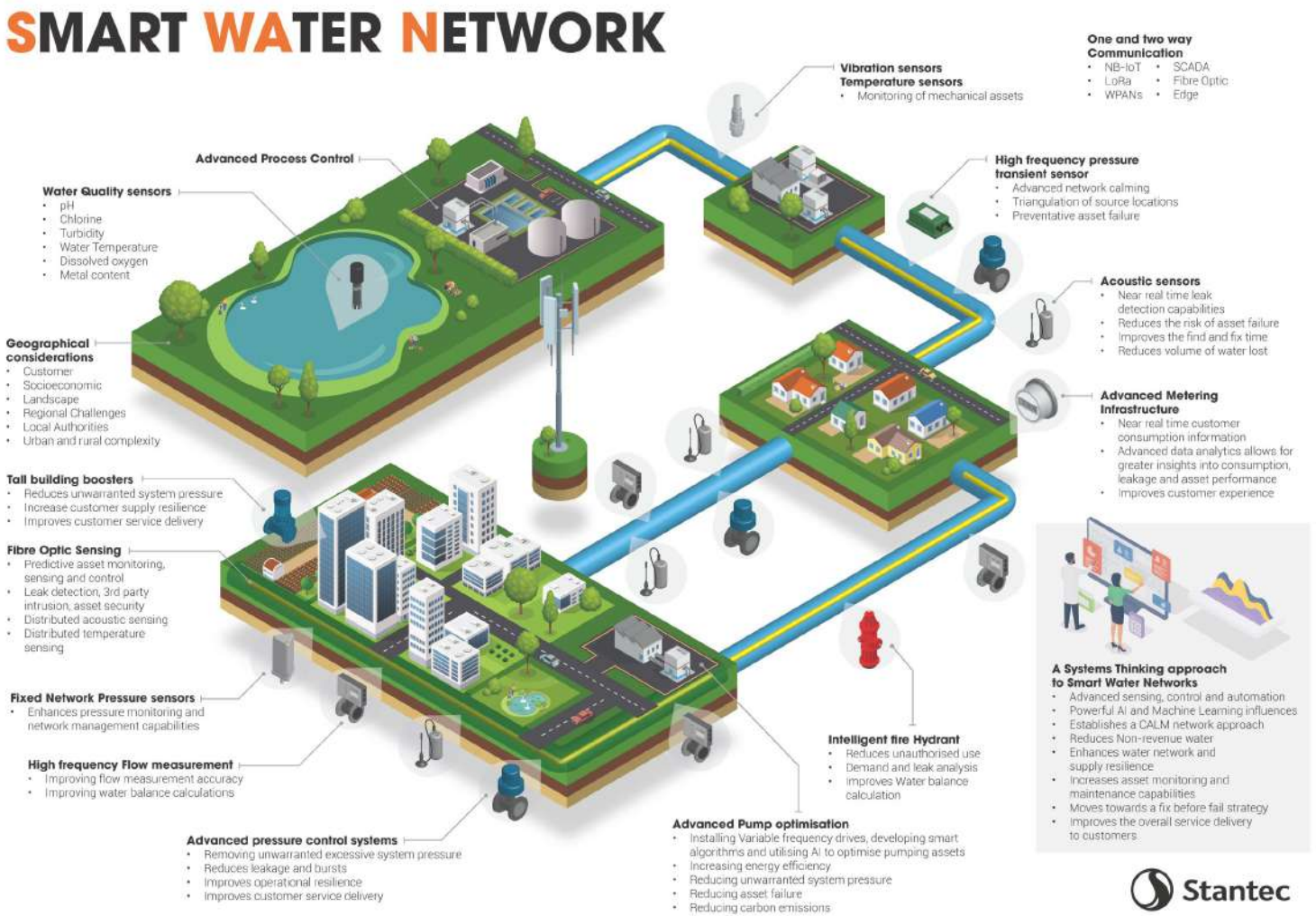
A. Natural water ecosystems		B. Integrated water resources management			C. Climate resilient and adaptive WASH systems (infrastructure and services)		
Watershed	**Forest**	**Rainfall / stormwater**	**Surface/ subsurface**	**Used water/ Wastewater**	**Equitable and safe access**	**Management/ availability**	**Safety**
• *Regulate* • *Managed use* • *Treat and rejuvenate*	• *Protect* • *Conserve* • *Restore*	*Treated* *Stored* *Used (fit for purpose)*	*Replenished* *Stored* *Used (fit for purpose)*	*Treated* *Stored* *(Re)used (fit for purpose)*	*Equitable* *Universal*	*Reliable* *Efficient use*	*Water quality fit for purpose*

Projects, Tech Solutions

Community Stewardship and Coalitions

SMART

Smart Water Management



SMART

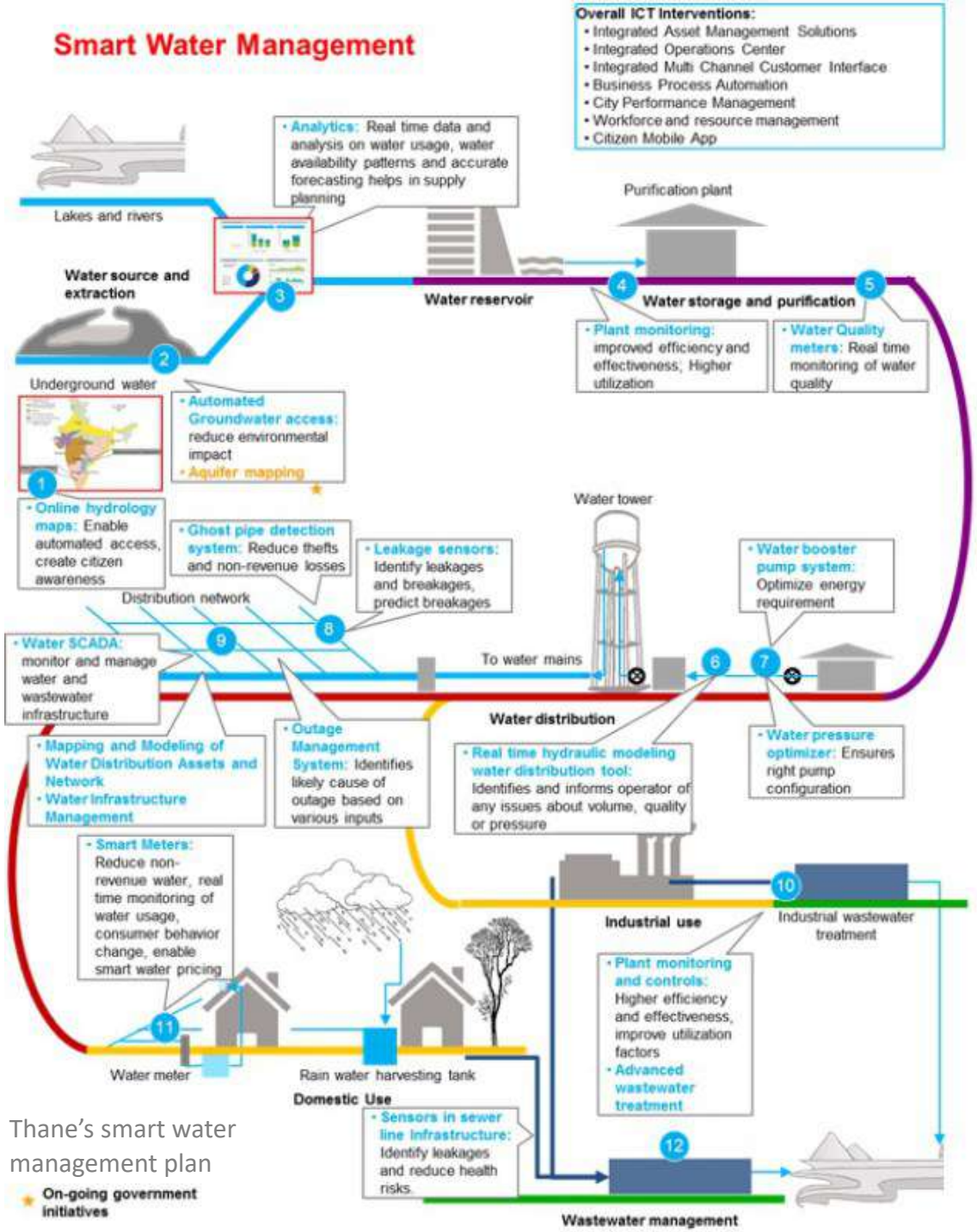
Data Analytics, Tools and IoT for PMEL

Policy, Finance and Governance

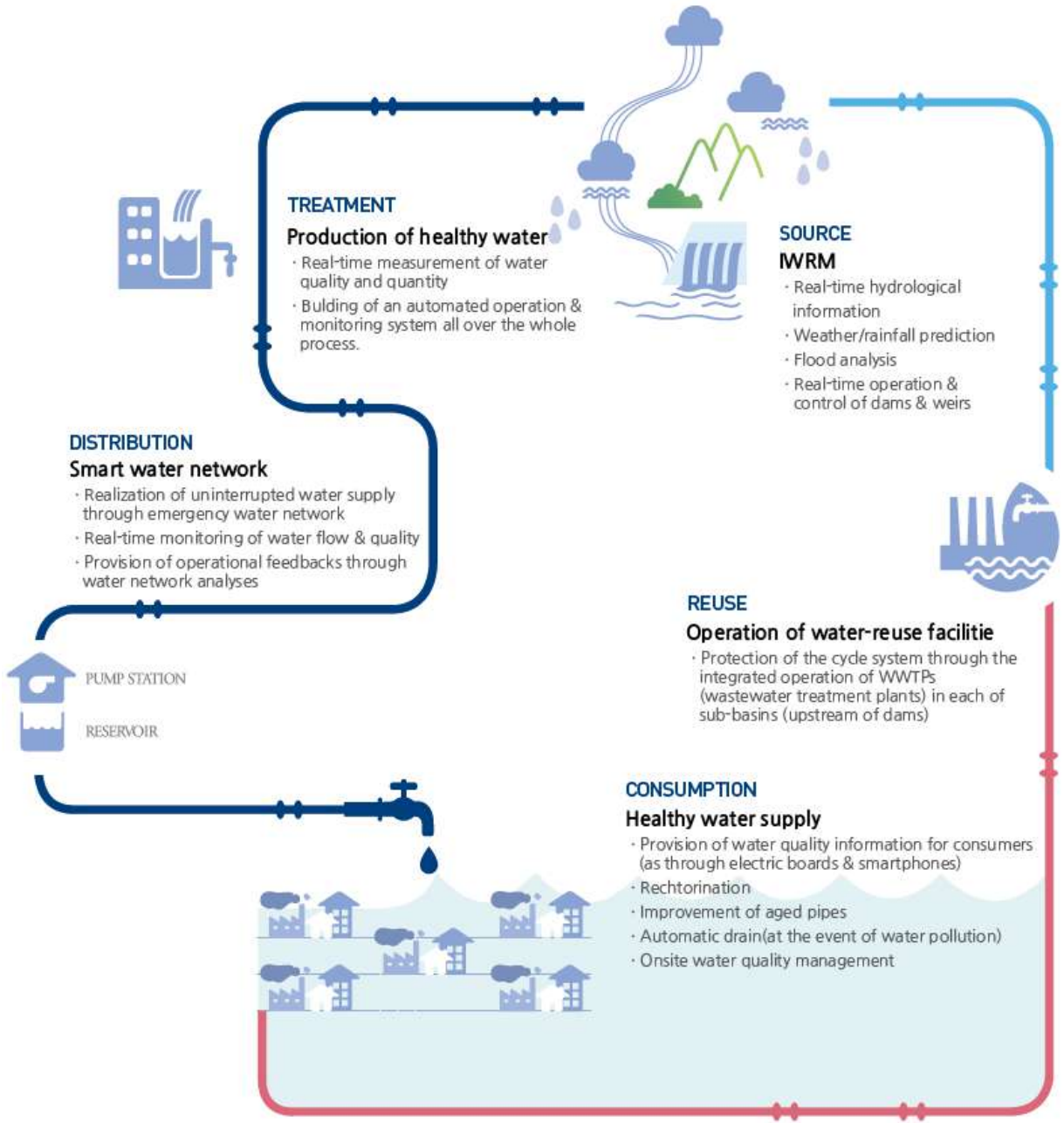
Projects and Tech Solutions

Community Stewardship and engagement

Tools



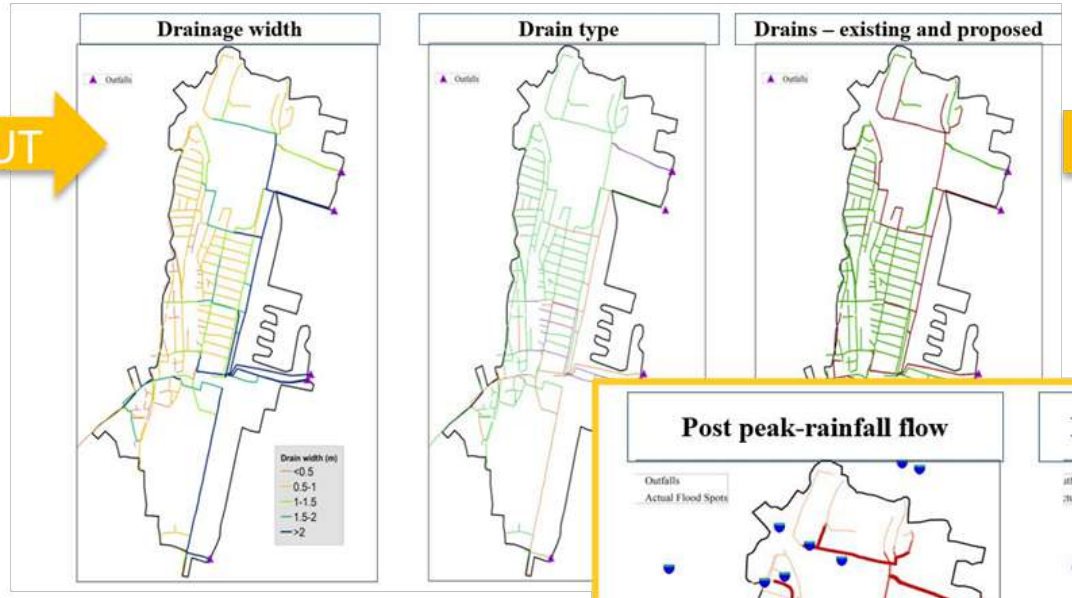
Thane's smart water management plan



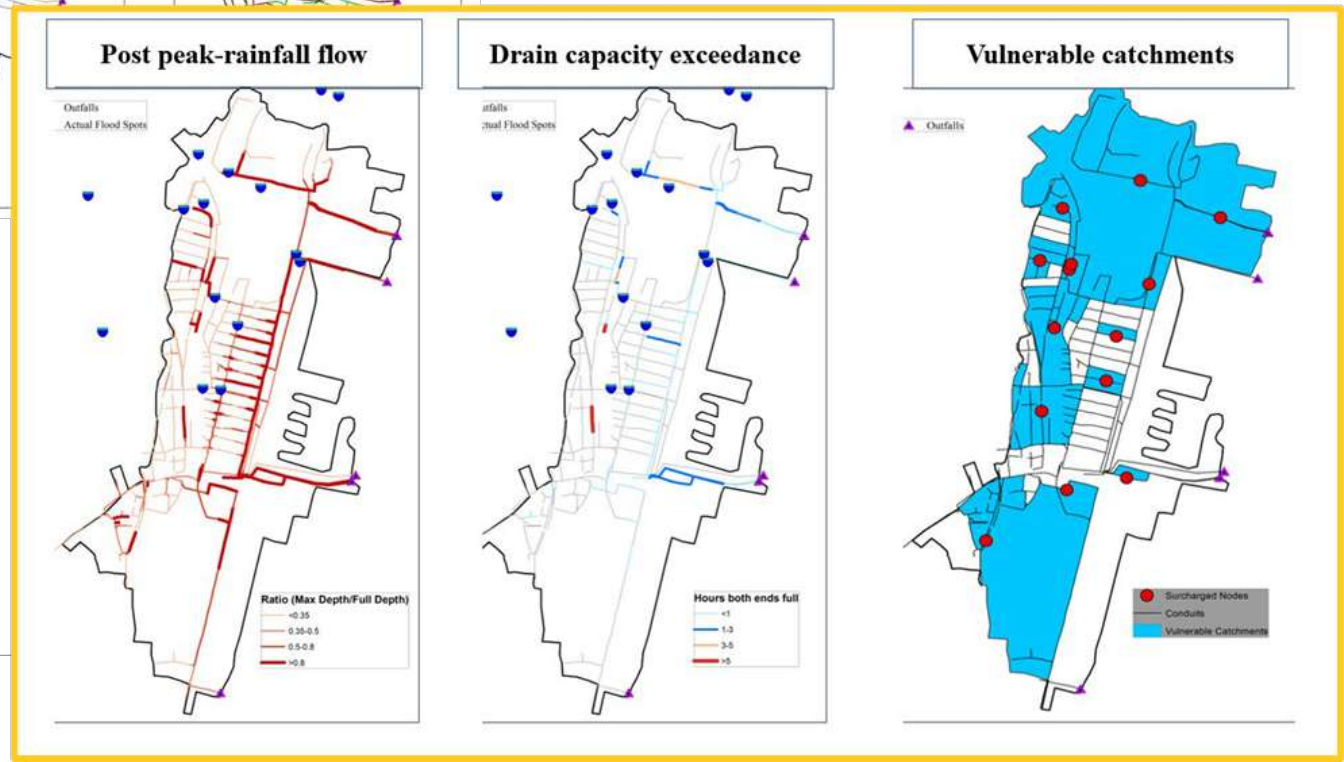
Catchment based flood modelling and analysis including underground stormwater infrastructures

Data Analytics

INPUT



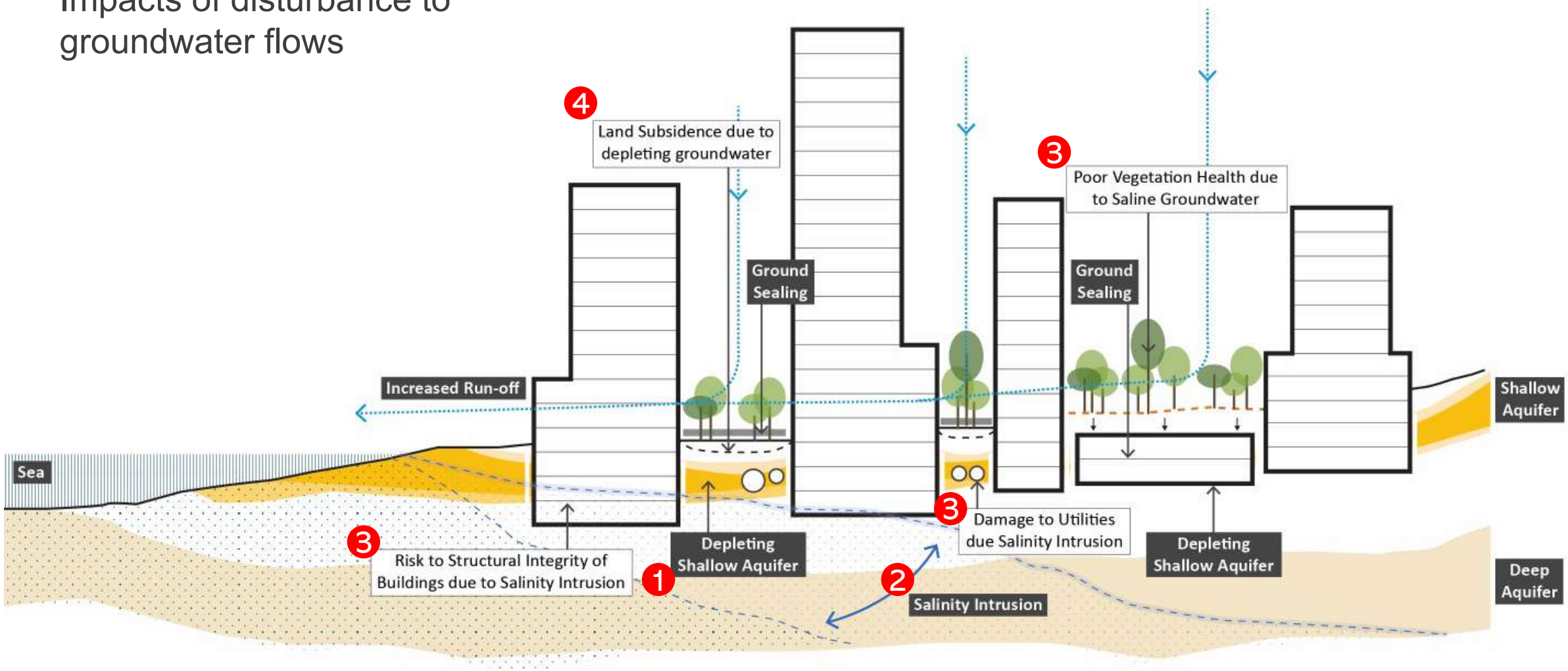
ANALYSIS



Source: WRI India

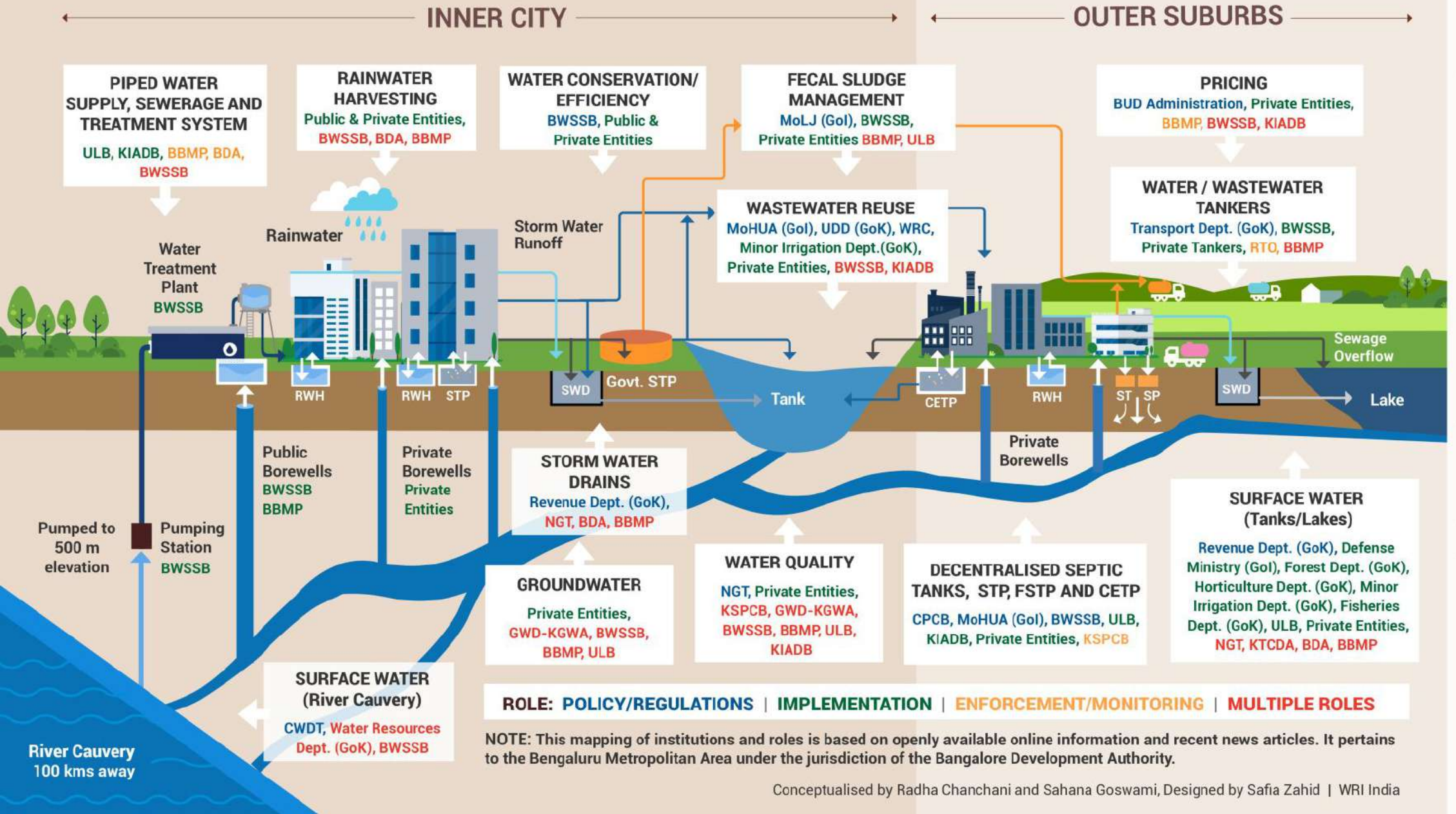
Groundwater Mapping In the Upper Mithi Catchment

Impacts of disturbance to groundwater flows



Source: WRI India, 2025

WATER GOVERNANCE AND MANAGEMENT IN BENGALURU



ROLE: POLICY/REGULATIONS | IMPLEMENTATION | ENFORCEMENT/MONITORING | MULTIPLE ROLES

NOTE: This mapping of institutions and roles is based on openly available online information and recent news articles. It pertains to the Bengaluru Metropolitan Area under the jurisdiction of the Bangalore Development Authority.

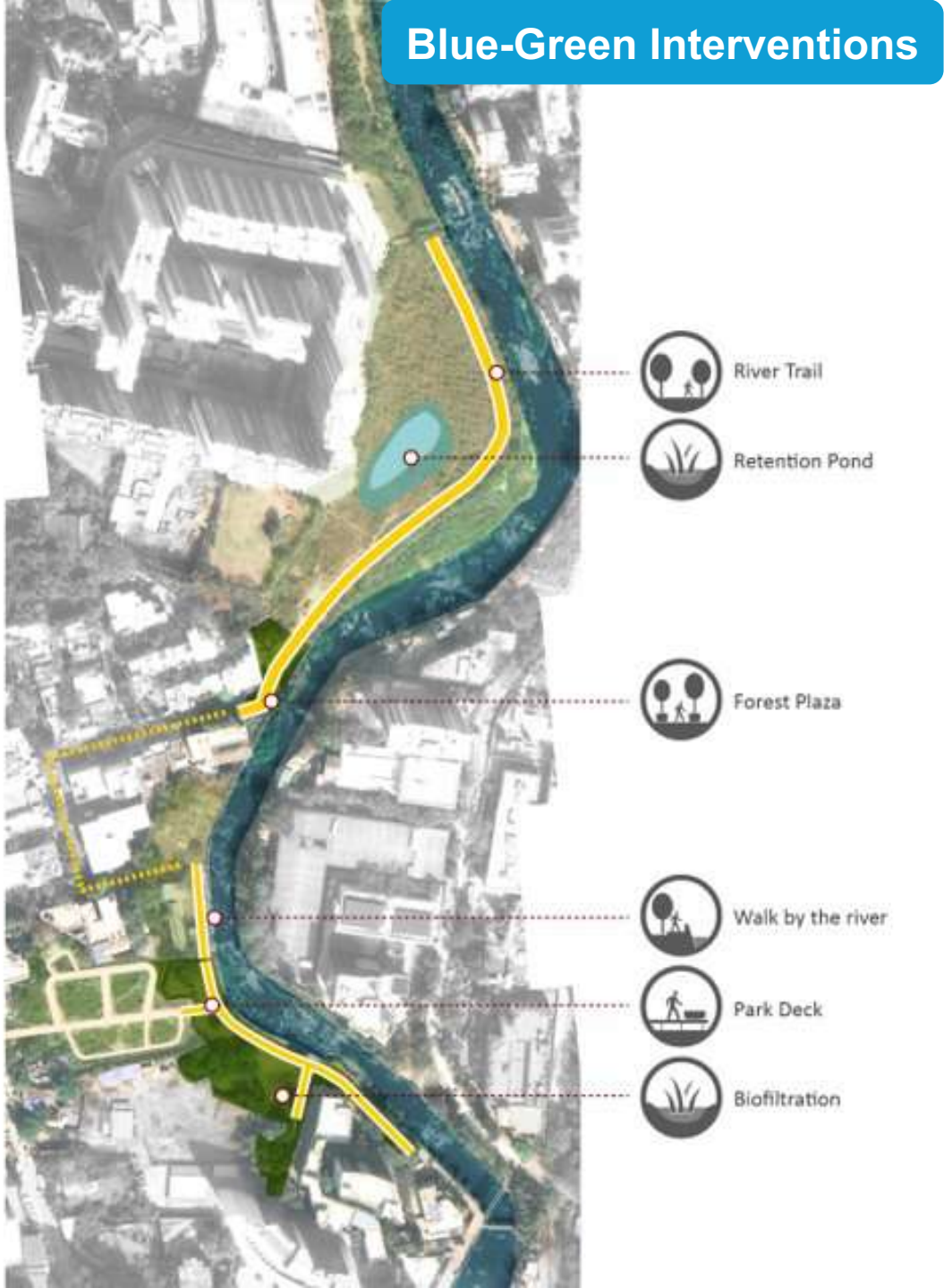
Conceptualised by Radha Chanchani and Sahana Goswami, Designed by Safia Zahid | WRI India

Governance

BBMP-Bruhat Bengaluru Mahanagara Palike
BDA-Bangalore Development Authority
BWSSB-Bangalore Water Supply and Sewerage Board
BUD-Bangalore Urban District
CETP-Common Effluent Treatment Plants
CPCB-Central Pollution Control Board
CWDT-Cauvery Water Disputes Tribunal
FSTP-Fecal Sludge Treatment Plants
GoI-Government of India
GoK-Government of Karnataka
GWD-KGWA-Groundwater Directorate – Karnataka Ground Water Authority
KIADB-Karnataka Industrial Area Development Board
KSPCB-Karnataka State Pollution Control Board
KTCDA-Karnataka Tank Conservation and Development Authority
NGT-National Green Tribunal
MoHUA-Ministry of Housing and Urban Affairs
MoLJ-Ministry of Law and Justice
RTO-Regional Transport Office
RWH-Rainwater Harvesting
ST/SP-Septic Tank/ Soak Pit
STP-Sewage Treatment Plants
ULB-Urban Local Bodies
UDD-Urban Development Department
WRC-Wastewater Resources Cell
* **Private Entities**-include builders/developers, individuals, community-based organisations, industrial and commercial establishments, borewell drilling/water tanker/ sludge cleaning agencies and other businesses.

Hybrid Blue-green- grey solutions

- Integration of **natural** (green/blue) **and engineered** (grey) infrastructure to harness benefits from both systems.
- Combines **resilience and ecosystem services** of green infrastructure with the **reliability and capacity** of grey infrastructure.
- Optimizes stormwater management adapting to varying rainfall patterns and urban landscapes.
- Supports climate change adaptation while enhancing urban aesthetics and public health.
- **Smart sensors, IoT, and data analytics** monitor performance and coordinate operation of hybrid systems for efficiency and responsiveness.



Marol Urban Forest Project

Community Stewardship

- Builds **trust and accountability** through open communication and transparency.
- Involves communities in planning and **decision-making** to ensure solutions fit local needs.
- Encourages **behavioral change for water conservation** via awareness and real-time data feedback.
- Shares **water data openly**, empowering residents to monitor and support water systems.
- Leverages partnerships with local groups to **integrate traditional knowledge and mobilize resources**.

Source: WRI India, 2023

03 Case Studies

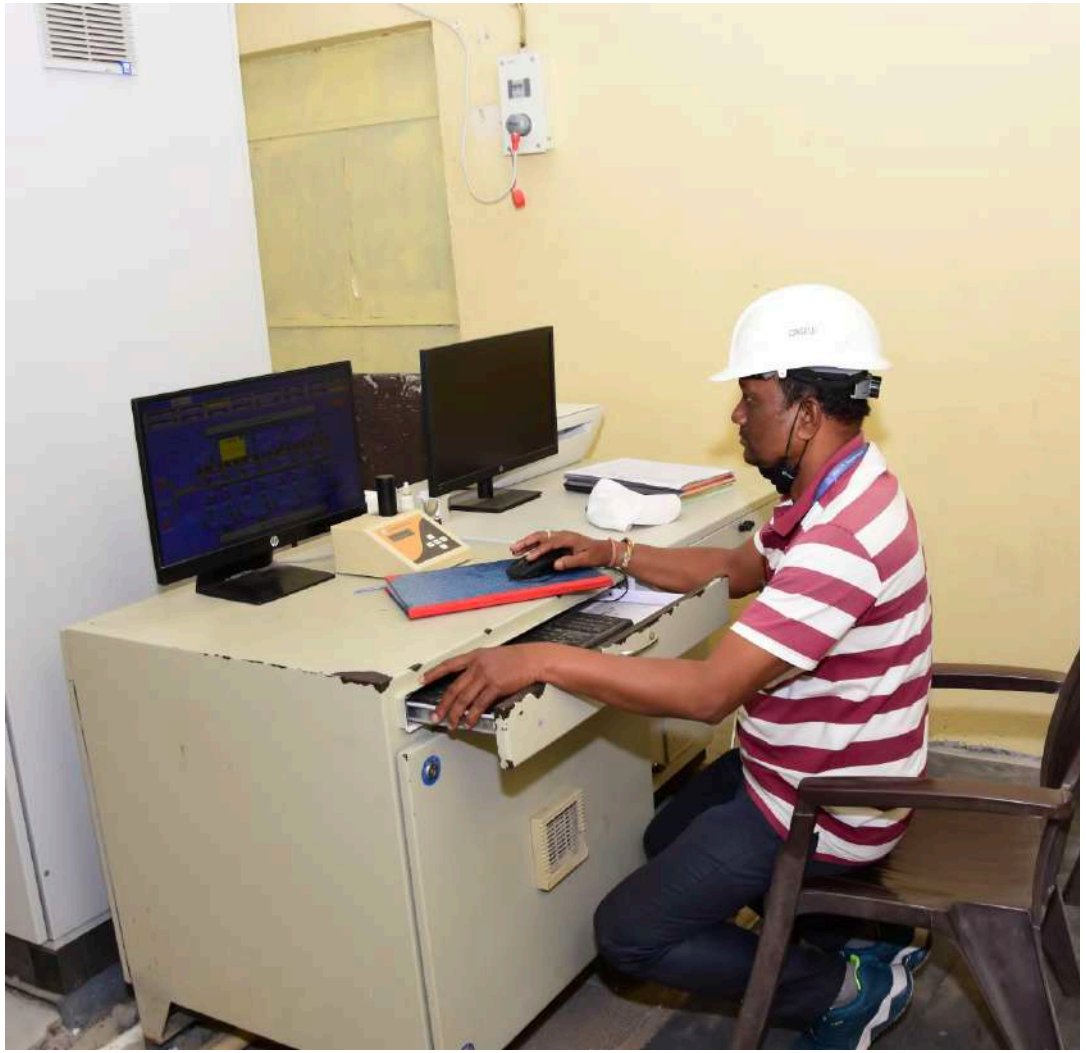
WRI INDIA

Thane's Smart Water Management Initiative

- Under India's Smart City Mission, Thane **installed 105,000+ smart water meters with Automatic Meter Reading (AMR) technology** for real-time consumption data, tamper-proof monitoring, and leak detection.
- Transitioned from flat-rate **to volumetric billing**, leading to:
  - **Repair of 7,500+ leak points**
  - **Water savings of 10 million liters/month**
  - **Targeted 15% reduction in NRW**
  - **8–10% drop in household consumption in pilot zones**
  - **60% fewer billing disputes**
  - **25–30% revenue increase via accurate billing**
- Complemented technology rollout with extensive citizen engagement

Source: https://thanesmartcity.in/smart-water-meters/

Puri's "Drink from Tap" Mission



- First city in India to provide round-the-clock, **quality drinking water directly from taps in 2021**, **benefiting 2.5 lakh residents**, including vulnerable communities.
- Ensure **IS 10500 quality water** is available for drinking and cooking without further treatment.
- Integrate state-of-the-art technologies with strong community participation and governance.
- Reduce leakages and Non-Revenue Water (NRW) **from 47% to below 15%.**
- Advanced water treatment (membrane filtration) & smart IoT-enabled monitoring **(SCADA).**
- Community engagement through **Jal Saathis** (women-led groups), awareness campaigns, and public dashboards.

Source: NIUA and WATCO, The water supply story of Puri, Odisha – Drink From Tap (2022)

Puri's "Drink from Tap" Impacts

- **Universal access to safe water,** especially for urban poor and slum households.
- Time savings **for women**, improved health, and reduced plastic waste (~400 tonnes/year).
- Increased system efficiency and consumer satisfaction with real-time quality surveillance.
- Critical role of long-term vision, government commitment, and **community engagement**.
- Successful integration of **technology, policy, and ground-level action** as a model for other Indian cities.
- Strengthening **cost recovery** & exploring alternate water sources, including treated wastewater.

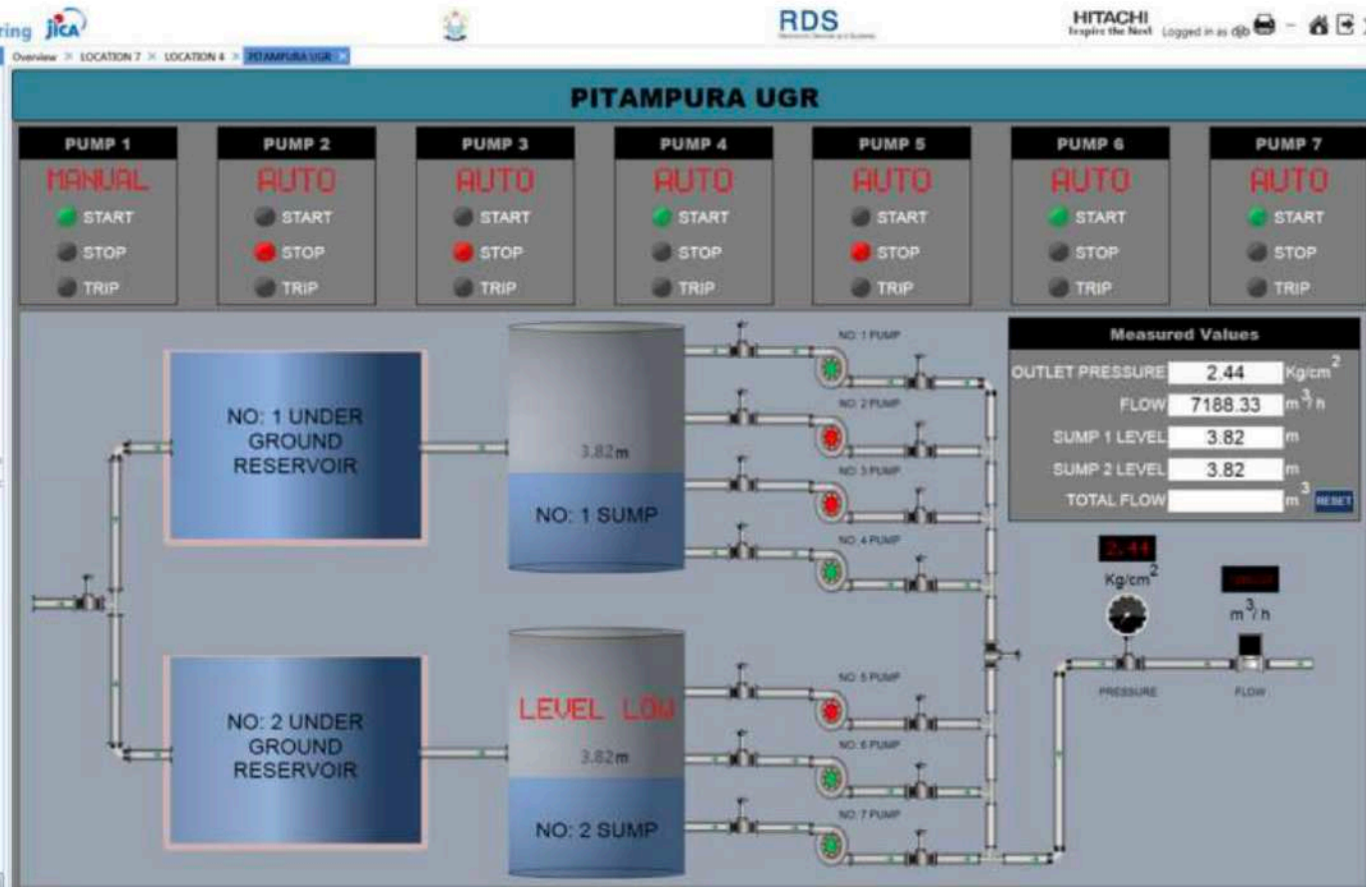
Source: NIUA and WATCO, The water supply story of Puri, Odisha – Drink From Tap (2022)

Bengaluru- Digital Innovation for Water Security

- Coverage: Over **150,000 smart meters installed citywide as of 2025**, covering 30% of ULB water consumers.
- Water Loss Reduction: Leak detection and timely repairs reduced Non-Revenue Water (NRW) by an estimated **12–15% in pilot zones**.
- Consumption Impact: Average household water **consumption dropped by 8–10%** within 12 months in targeted areas.
- Revenue Improvement: Improved billing accuracy increased **revenue collection by 18–20%.**
- Community Engagement: Mobile app usage reached over 50,000 active users, fostering behavioral change toward conservation.
- Climate Resilience: Groundwater monitoring combined with rainfall forecasting improved **drought management response times by 25%.**

Source: https://www.frontiersin.org/journals/environmental-science/articles/10.3389/fenvs.2022.816824/full

Delhi - Advanced Water Distribution Management



- **Population Impact:** Provides smart distribution monitoring for approximately **2 million residents** in Pitampura and adjoining zones.
- Loss Reduction: Water loss from leakage reduced from an estimated **35% to below 20% in managed zones.**
- Operational Efficiency: Automated controls **reduced manual intervention by 40%,** decreasing response times for fault rectification by 50%.
- Billing Accuracy: Shifted from flat-rate to volumetric billing, **reducing billing disputes by over 60%.**
- **Water Supply Reliability:** Documented improvements in supply pressure and continuity with 24/7 service in several sectors.

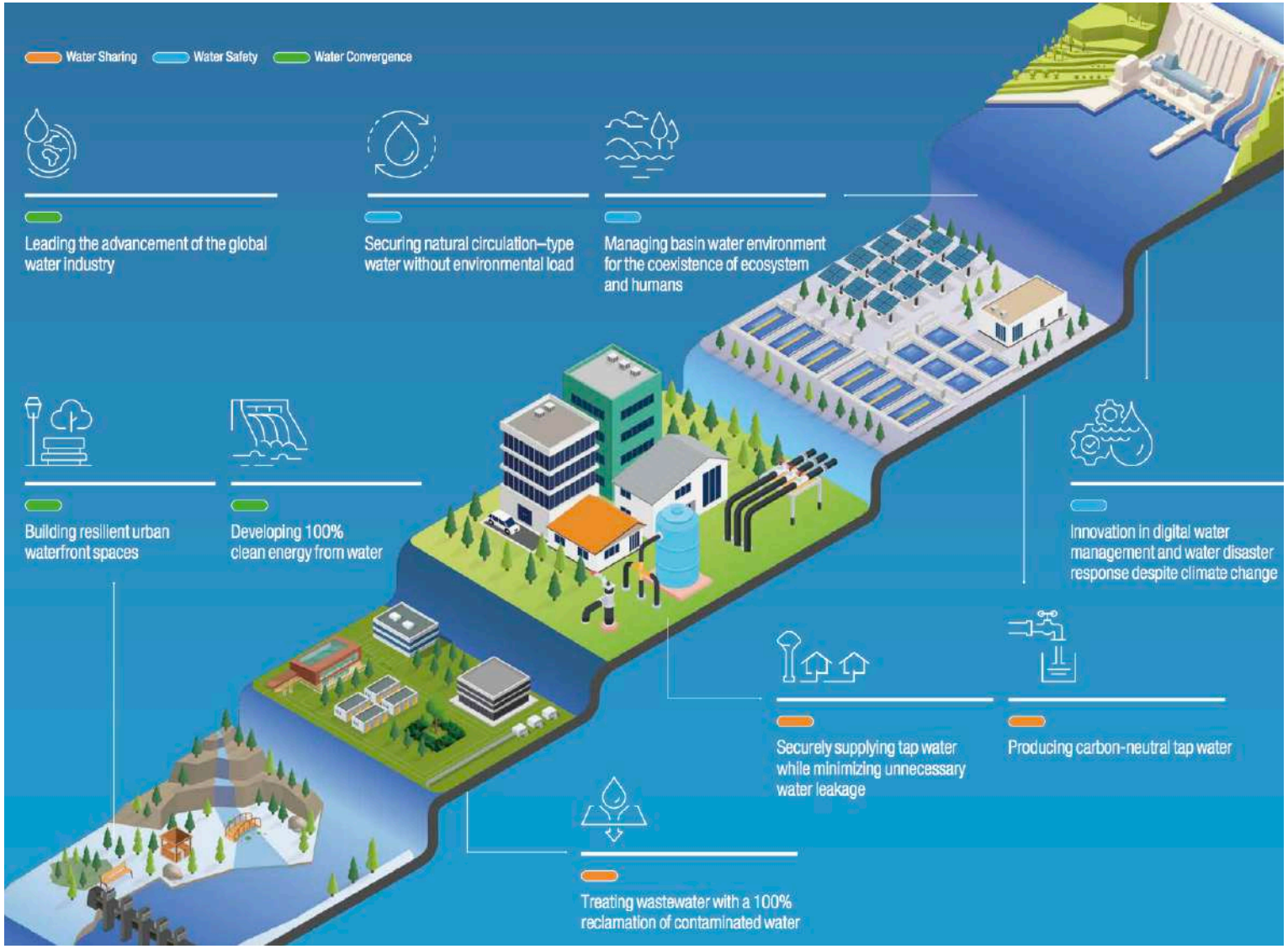
Source: https://openjicareport.jica.go.jp/pdf/12305603_01.pdf

Varanasi- Smart River and Urban Water Management

- **Managing the Varuna River**, a critical urban water body prone to pollution and flooding.
- Technology: Implementation **of IoT sensors and real-time data collection** for monitoring water quality and flow.
- **Decision Support System (DSS):** Uses predictive analytics for flood forecasting, pollution control, and river management.
- **Collaboration:** Public authorities, local research institutions (including IITs), and international partners jointly operate the system.
- Replicability: **A model for cities dependent on urban rivers** facing environmental and climate challenges.

Source: https://www.slcrvaranasi.com/

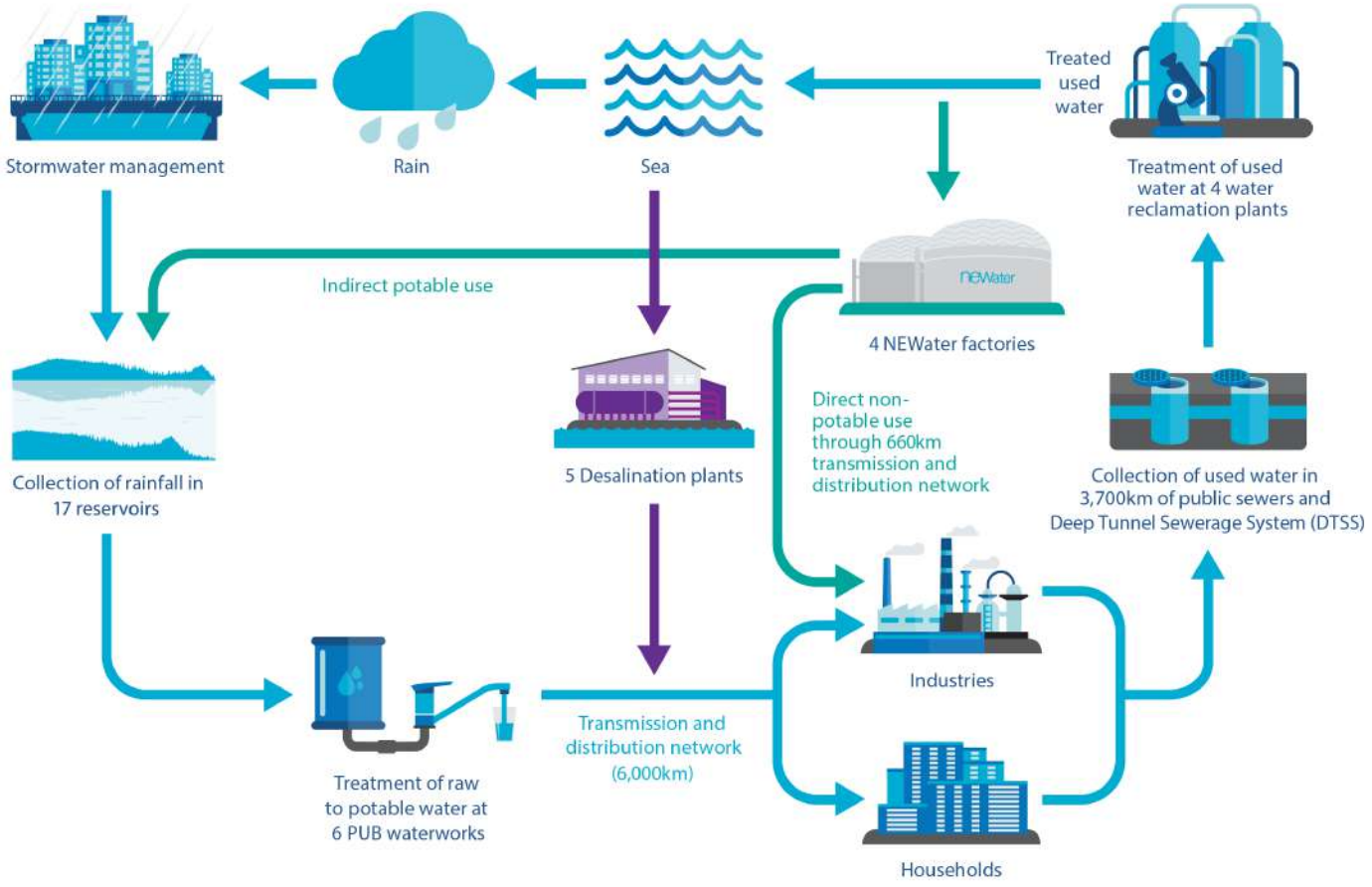
K-Water (Korea Water Resources Corporation)



- Established in **1967**
- Pioneered integration of IoT sensors, real-time monitoring, and Big Data analytics across water treatment plants, dams, and distribution networks.
- Developed smart systems for water quality surveillance, leak detection, and energy-efficient operations.
- **Advanced digital twins** for predictive maintenance and optimized asset management.

Source: K-Water summary report- 2023

NEWater- Singapore

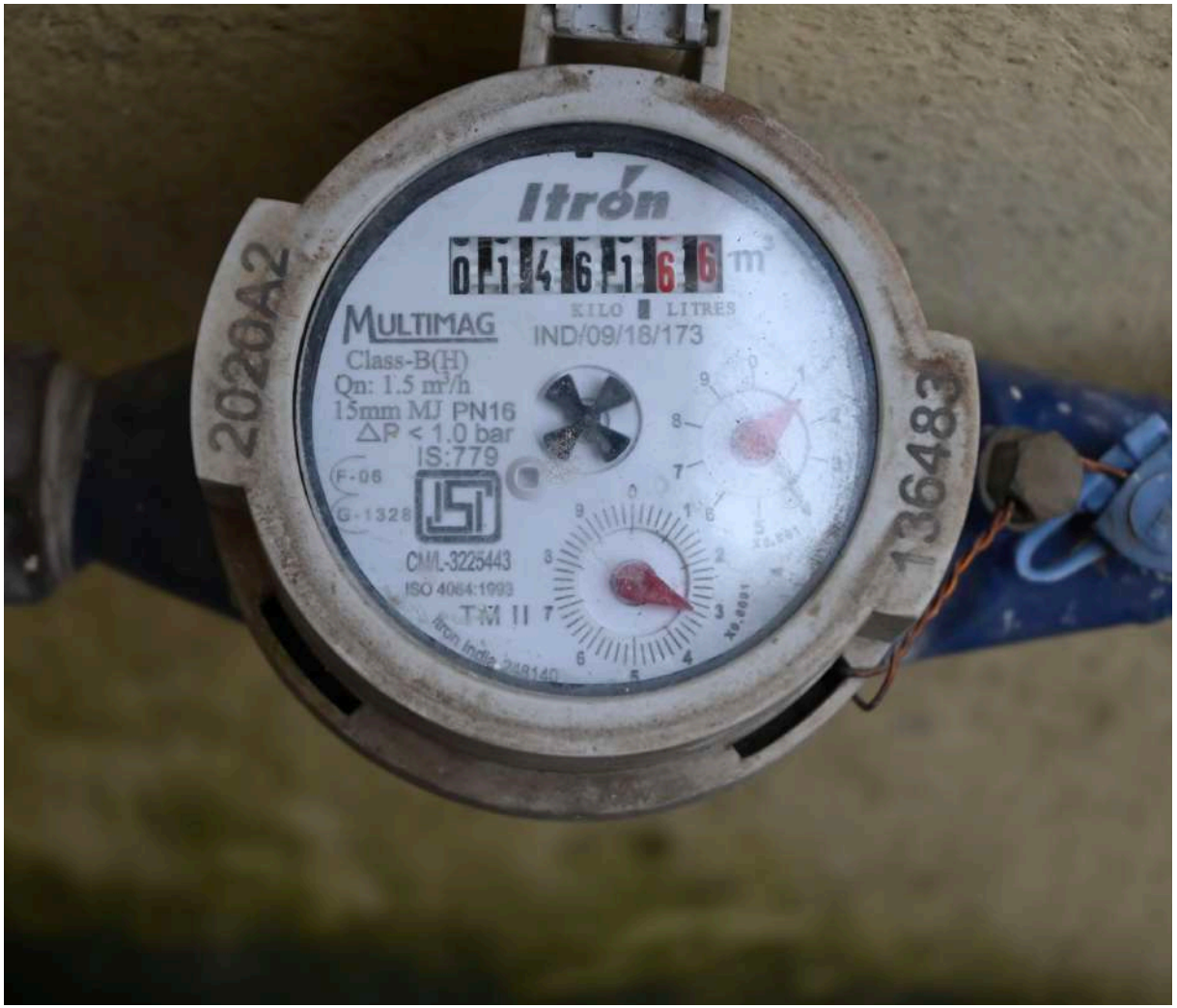


- **Four National Taps:** Diversified water supply from imported water, NEWater (highly treated recycled water), desalination, and rainwater catchment covering around 430 million gallons/day.
- **Advanced Technologies:** Integrated smart water grid with sensors and analytics enables real-time monitoring and efficient network management.
- **Stormwater Management:** Separate drainage and sewer systems, extensive canals, and green reservoirs reduced flood-prone areas from 3,200 ha to just 49 ha despite urbanization.
- **Water Conservation:** Target to reduce per capita use to 140 liters/day by 2030 through pricing reforms, efficient appliances, and awareness campaigns.
- **Water Self-Sufficiency Goal**: Aim to provide 85% of water from NEWater and desalination by 2061, reducing reliance on imports.

Source: https://www.pub.gov.sg/public/waterloop

04 Way Forward

Challenges



- Poor and fragmented infrastructure in informal settlements makes it difficult to install and maintain sensors, meters, or IoT devices.
- Many areas lack stable power supply, reliable connectivity, and formal water lines, which hampers the deployment of end-to-end digital systems.
- Absence of formal records and unregulated water sources create gaps in data collection, impeding real-time monitoring, loss detection, and demand forecasting.
- Low literacy levels, lack of awareness and access may restrict community participation and acceptance of these technologies.
- Vulnerable populations, often lack legal access to formal water services, making it politically sensitive and ethically complicated to upgrade systems or enforce metering.

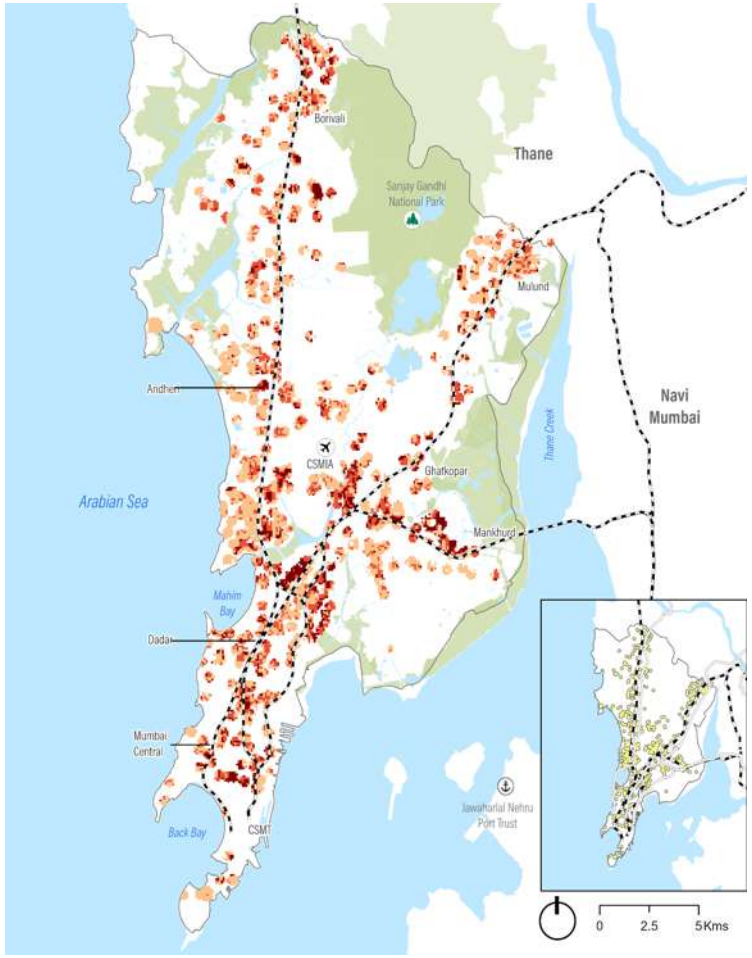
Source: WRI India, 2025

Challenges (contd.)

- High costs of installing digital infrastructure and ongoing maintenance are barriers in low-income
- Local governance bodies often lack capacity, funding, or institutional frameworks to sustain smart water initiatives in informal settlements, risking incomplete or inefficient implementation.
- Sensors and IoT devices may not be robust enough for harsh environments or heavy pollution, which are common in informal settlements.
- Use of surveillance and data collection in vulnerable communities raises ethical questions around privacy, consent, and data security.

Source: WRI India, 2025

Way Forward



699 flood hotspots and **287 landslide** prone areas recorded by BMC

Extreme flooding impairs the city and results in recurrent loss and damage

Routine waterlogging is a daily stressor in some areas, and a result of poor infrastructure & SWM services

Framing the Complexities of Urban Flooding in Mumbai With Diverse Stakeholders

FLOOD RISK IN MUMBAI—CONSULTATIVE STAKEHOLDER WORKSHOP

A workshop for framing urban flooding issues through analytical methods and data, ethnographic research, catalog of personal experiences, and available financial toolkits

Executive Summary

Brihanmumbai Municipal Corporation (BMC) hosted a two-day consultative stakeholder workshop, with support from WRI India as the knowledge partner, to engage with stakeholders who have analyzed the flooding issue from various perspectives. The goal of the workshop was to scope the problem and develop an informed, comprehensive, and transparent roadmap to make Mumbai flood-resilient, in light of new constraints and available innovative solutions.

The workshop participants comprised experts in flood risk assessment, meteorology and hydrology, social sciences and community organizations, urban design, architectural and development policy; BMC officials from the Storm Water Drainage Department and Disaster Management and Mumbai Metropolitan Region Development Authority (MMRDA); citizens impacted by Mumbai's floods; C40 Cities; and the Asian Development Bank.

The consultative discussion dove into the issues that are key to assessing and adapting to the emerging flood risk in Mumbai, such as the changing demands on storm water drainage due to various types of flood risk (coastal inundation, perennial risk to low-lying areas, terrain close to previously natural drainage channels, and concretization) and outlined the added risk for vulnerable communities, which was highlighted by first-person accounts from citizens impacted by Mumbai's floods.

28-29 APRIL, 2022

FLOOD RISK IN MUMBAI—CONSULTATIVE STAKEHOLDER WORKSHOP, MUMBAI

The contents of this report reflect the views of the workshop participants and do not necessarily reflect the views of the World Resources Institute or other conference partners. The content of this report aims to faithfully reflect the conversations and content generated at the workshops, but some text has been edited for readability.

For questions or comments about this report, contact Kartiki Naik, PhD, Program Manager-Urban Development, at: kartiki.naik@wri.org
Sahil Kanekar, Senior Program Associate–Urban Development, at: sahil.kanekar@wri.org

Transforming Approach for Flood Management

Holding ponds

Pumping stations

Retaining walls

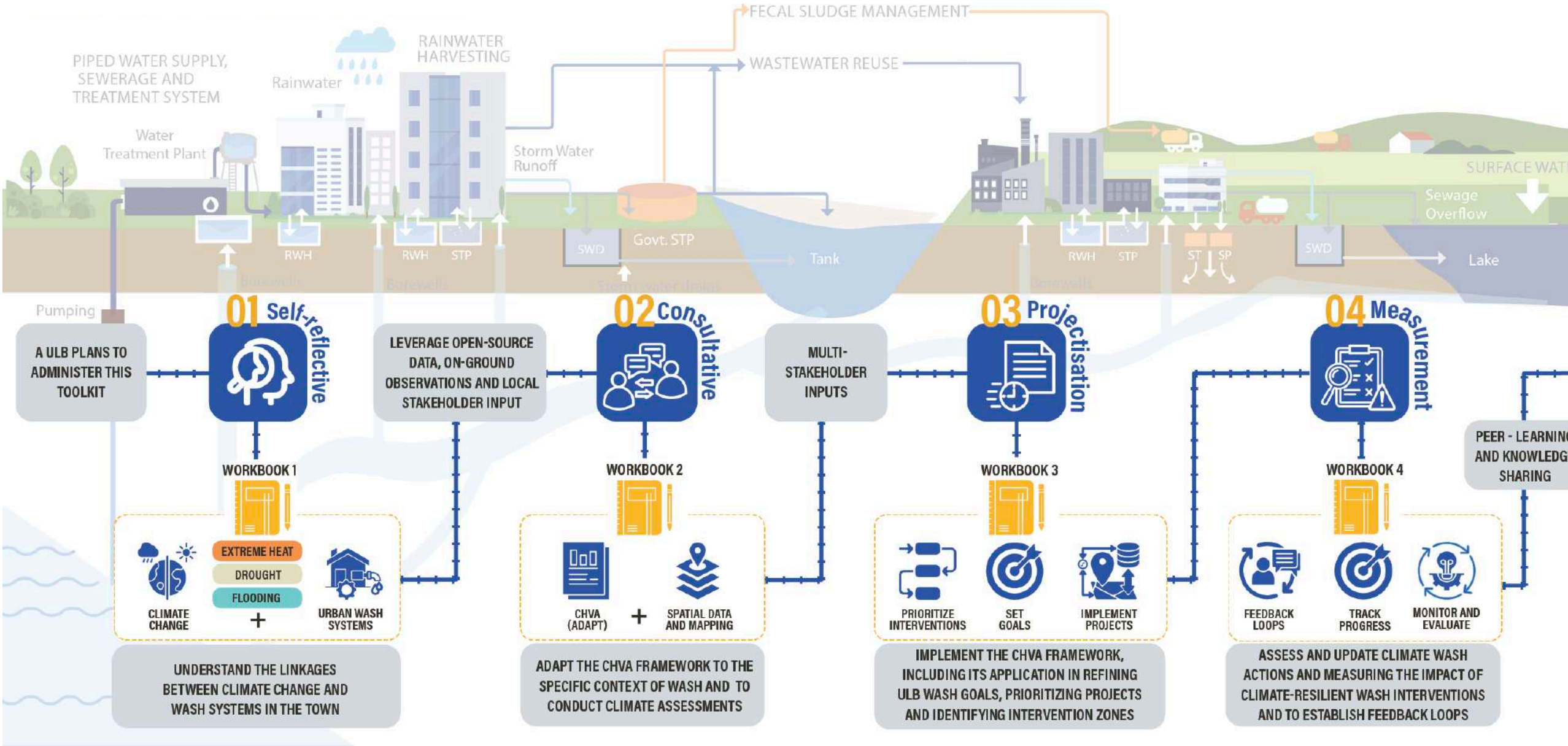
Routine desilting of rivers & nallahs

HYBRID Solutions

Channelising flows towards natural landscapes/ sponge infrastructure

Data-driven catchment models for flood management and IoT based monitoring of the SWD

Climate Resilient and Adaptive Toolkit for WASH systems in small towns in India



Roadmap for Indian Cities

- Scale up **IoT-enabled infrastructure** for real-time monitoring and **adaptive water distribution**.
- Integrate **hybrid solutions** combining decentralized, blue-green, and grey infrastructure for climate resilience.
- Develop **adaptive governance frameworks** to manage **climate uncertainties and cyber risks** with robust data security.
- Promote **multi-sector collaboration** among water, energy, agriculture, and urban planning sectors for holistic resource management.
- **Enhance energy efficiency in water treatment** and distribution, adopting renewable energy and recovery systems.
- Ensure **equity and inclusion** by engaging vulnerable communities and enabling access to technology.
- Foster **public-private partnerships** to mobilize investment, innovation, and operational excellence.
- Drive **citizen participation and behavior change** for conservation and sustainable use.

Image Source: NIUA and WATCO, The water supply story of Puri, Odisha – Drink From Tap (2022)

THANK YOU

ashwathy.anand@wri.org

WRI INDIA