



**RAND WATER**

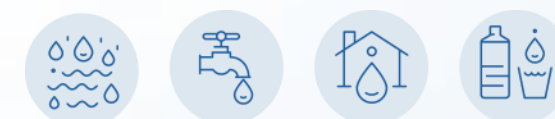


# **Women in Water Symposium**

**INNOVATIVE WATER SOLUTIONS**

**REFILWE BUTHELEZI PR.ENG**

**27 AUGUST 2025**



## Achievements

- 2024 – Chairman’s award SA Chamber of Commerce UK
- 2024 – Top 10 performing Presidents of Professional Bodies in Africa
- 2022 – UJ Dignitas Award
- 2022 & 2017 – Rand Water Mover and Shaker of the year
- 2022 Winner – SAIEE Women in Engineering Award
- 2021 Winner – Inspiring Fifty Women in STEM
- 2013 Winner – Keith Plowden Young Engineering Achiever Award
- 2012 Finalist – Most Promising Young Engineer: Group Five

## Education

- Bachelor of Engineering - Electrical & Electronics, UJ
- Masters in Engineering Management, UJ
- Masters in Business Leadership (MBL), UNISA
- Professional Business Coaching, GIBS
- Certified Director (SA), Institute of Directors SA, current

## Leadership Roles

### Current

- President Elect - Federation of African Engineering Organisations (FAEO)
- Immediate Past President – Engineering Council of South Africa
- NED – South African National Road Agency Limited (SANRAL) and Transnet
- Rand Water – SM - Operational Technology

### Previous

- Utility Technology Council (AUTC),
- Council Member – South African Institute of Electrical Engineers (SAIEE)
- Chairperson – Vaal University of Technology

# Why Water Innovation Matters (African lens)

- Climate variability and rapid urbanisation intensify scarcity, flood risk, and quality degradation

- Equity and inclusion: gender-responsive solutions improve access, safety, and local economic participation

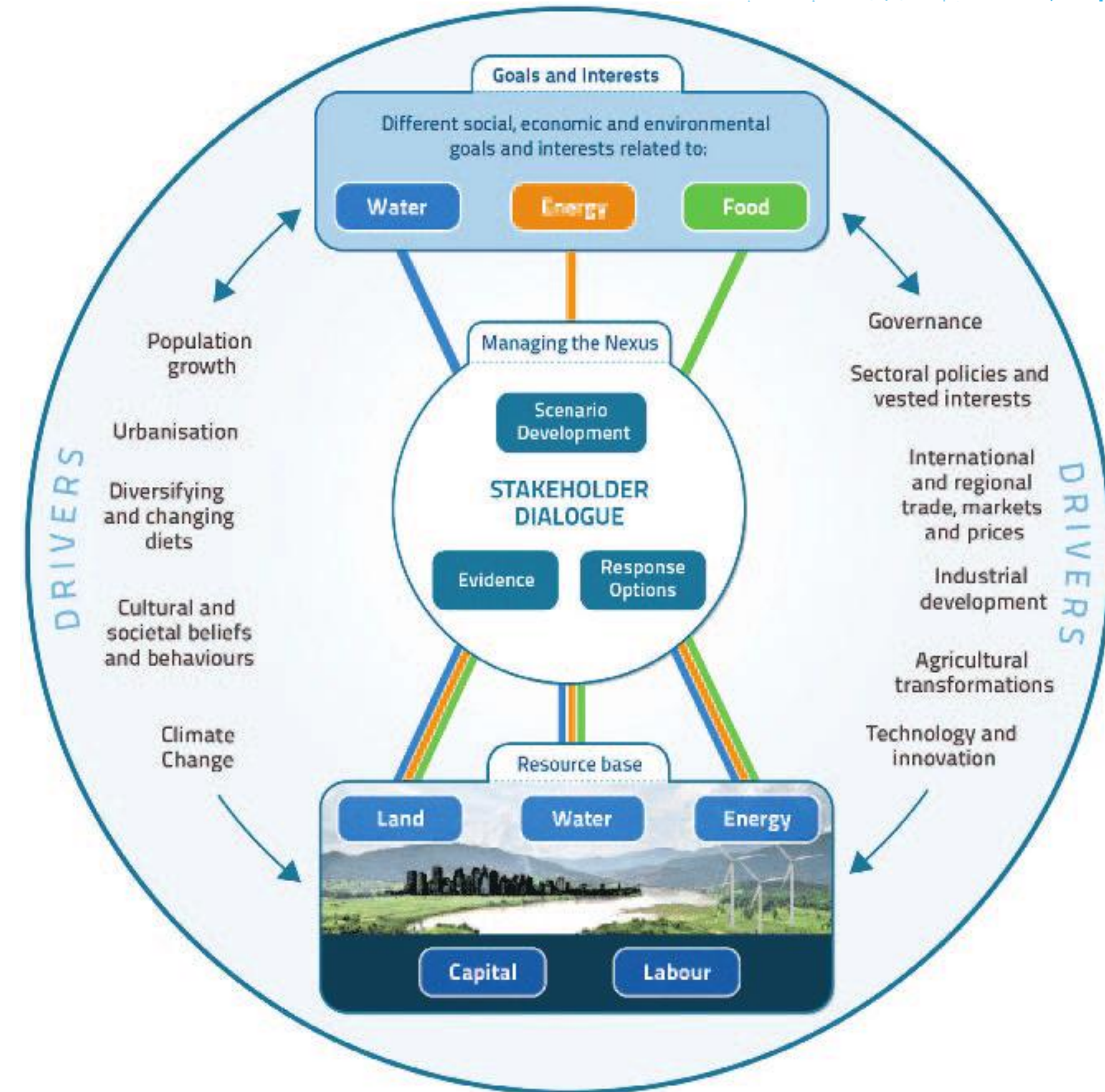
- Infrastructure gaps: non-revenue water (NRW) > 30% in many municipalities; intermittent supply affects health & economies



# Why Water Innovation Matters (African lens)

- Energy–water–food nexus: water systems drive/consume energy; circular solutions can unlock jobs and resilience.

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# RW- Innovation-driven Risk-based Strategy

**2022**

- Use of hyperspectral satellite imaging to identify and detect groundwater
- Beneficial use of scanning solutions to develop 3D and virtual reality models of assets
- Construction of vandal proof cathodic protection systems at Rand Water
- Water treatment residue removal and beneficiation
- Solar accelerated drying of water treatment residue

- Asset tracking of moveable assets via Internet of Things (IoT)
- Smart valve solutions
- Chemical recovery from the water treatment residue
- Advance leak repair of high pressure deep buried pipelines

- Virtual sensors for water quality and asset management monitoring
- 3D printing of infrastructure and assets
- Realtime assessment of pipelines using AI and machine learning methods
- Data management, data analytics, sensors, surge monitoring and predictive analytics
- Digital twins of infrastructure and assets

**2026**

- Fibre optic monitoring of pipelines and assets
- Hydrogen energy solutions
- Acid Mine Drainage (AMD) water treatment and recovery
- Full scale investigation of ceramic and polymeric membranes
- Ion exchange technology applications for water treatment
- New forms of renewable energy
- Online water quality monitoring of drinking water in the supply network
- Predictive analysis in finance
- Business case for wastewater sludge beneficiation
- Advanced biometrics security system



# Pilot Project Portfolios

**Predictive Catchment Water Quality Model**

**3D Scanning, Virtual Reality and Digital Twins**

**Advanced 3D Mapping of Sub-Surface Pipes Up To 20M Depth**

SUB SURFACE MAPPING OF THE BG1, BG2 AND BG3 PIPELINE

**Circular Economy**

**Alternative Water Sources - Ground water Groundwater Exploration Using Digitally Enhanced Technologies**

**Robotics Process Automation**

**Monitoring of Cyanobacteria Blooms in The Vaal Dam Using Satellite Remote Sensing**

**Use Of Satellite Technology to Detect Leaks on Drinking Water Pipelines**

**Real-time Monitoring of Network Hydraulic and Water Quality**

Transient Graph

Sharp drop in pressure

Increase in acoustic energy

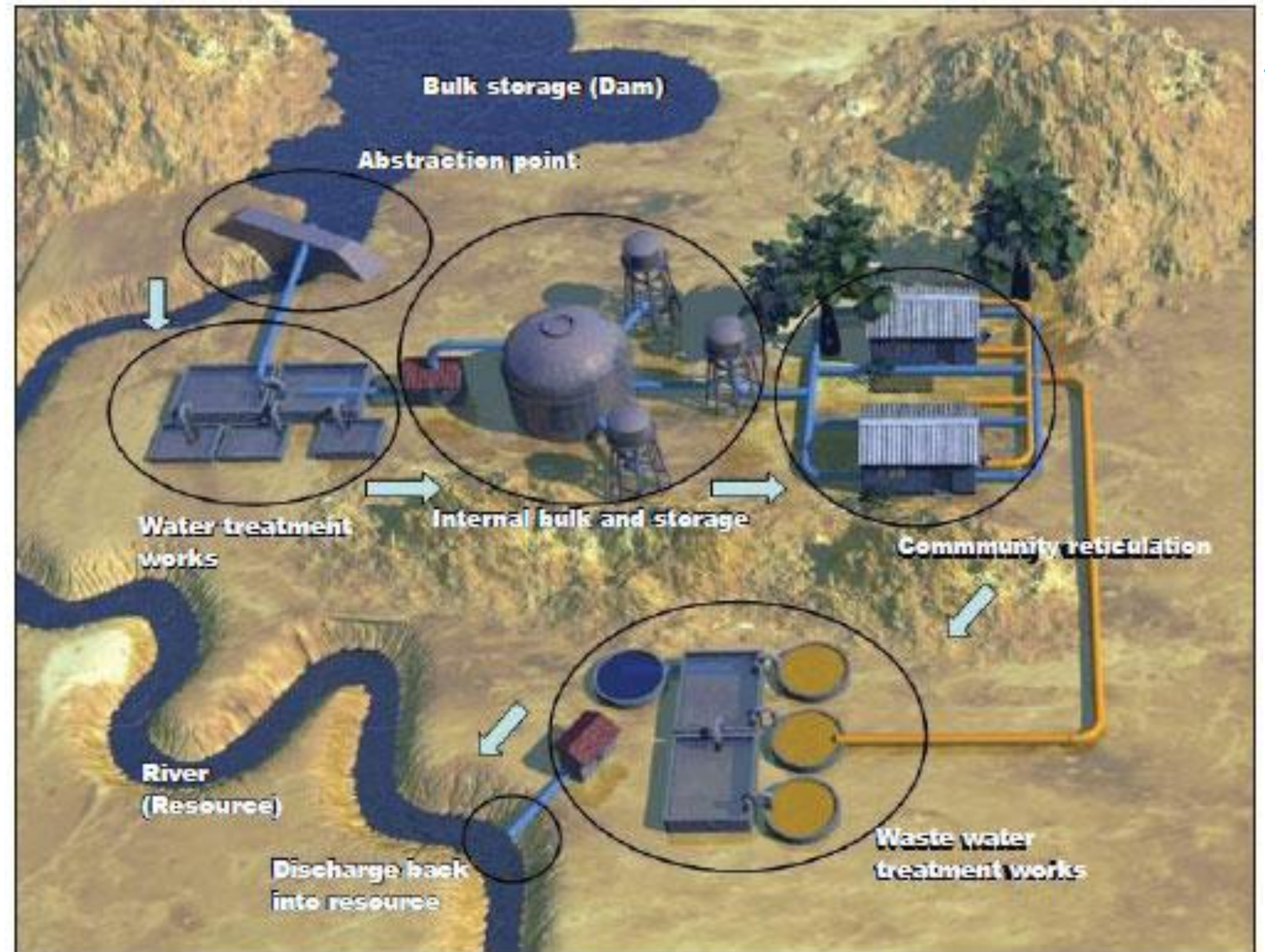
30% WATER LOST

# RW - Innovation-driven Risk-based Strategy - OT

The RW hydraulic network consists of two major water treatment sites, 13 booster pumping stations, 3660 km of pipelines, 60 storage reservoirs and approximately 1500 customer meters (e.g., municipalities).

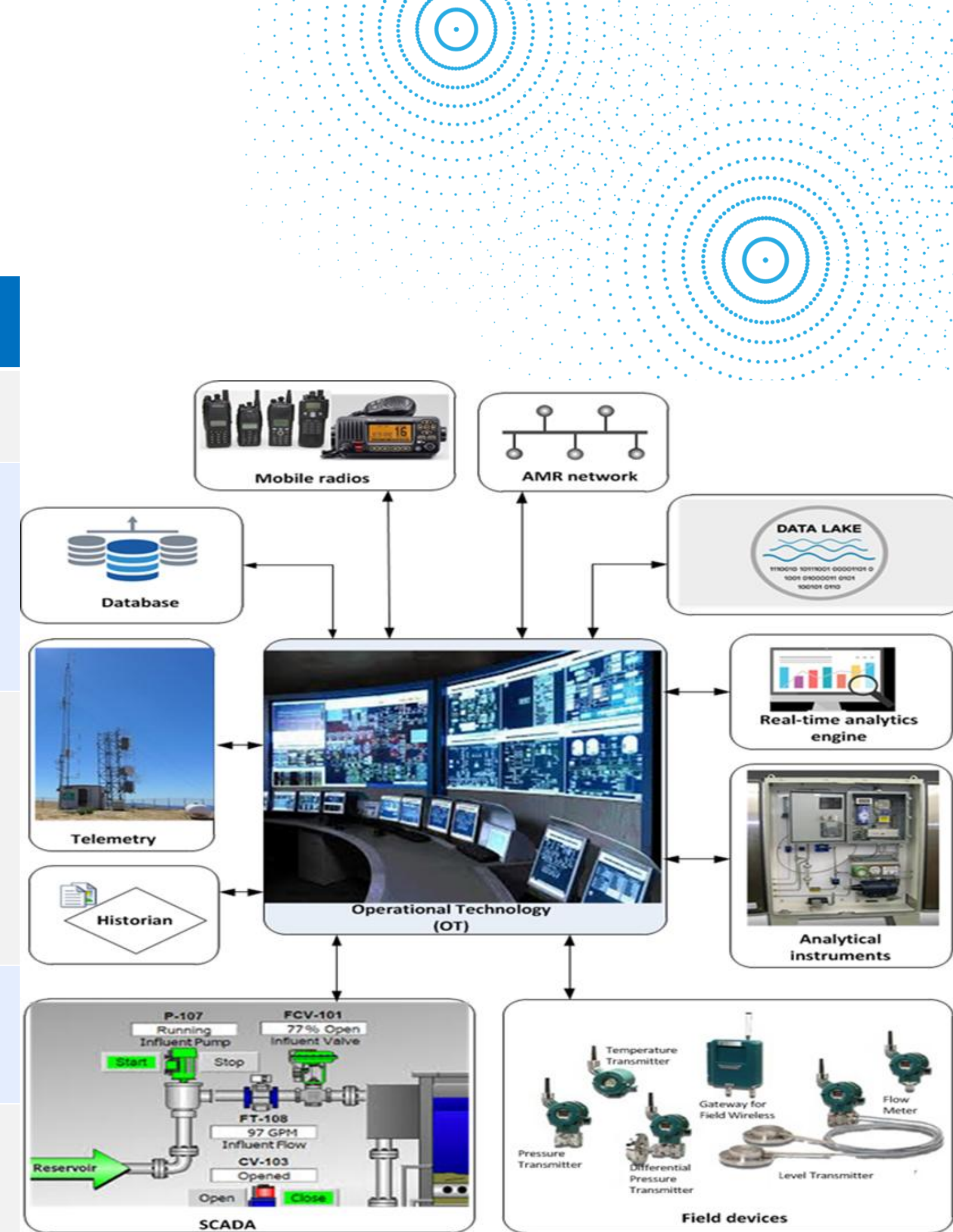
- This network is supervised through HMI and SCADA systems at the various sites, which are in turn connected to PLCs and sensors in the field sub-networks.
- OT systems in general need to be fully functional 24 hours a day – 365 days a year to ensure the integrity and reliability of Rand Water's plant, equipment and networks.
- A **failure in OT systems** means:
  - Loss of visibility of the operating statuses of water treatment plants and quality instruments
  - Impedes effective water supply and demand management
  - Impedes effective energy management
  - Loss of ability to monitor ingress and egress water quality parameters
  - Loss of ability to monitor reservoir levels

OT is instrumental with respect to **system, human** and **environmental safety**.

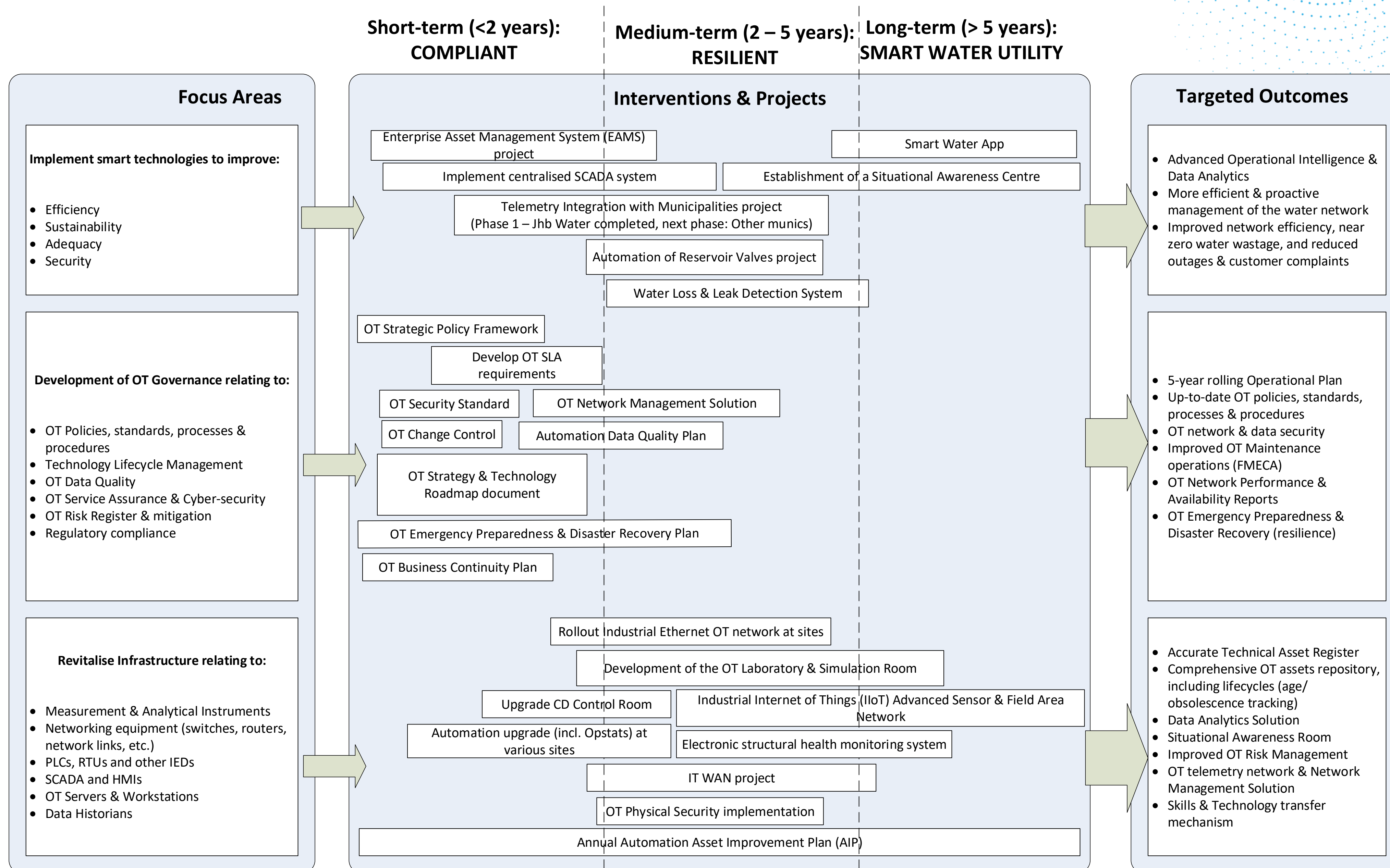


# Operational Technology in RW

OT Services	Support to SAM	Support to Operations	Support to IT	Support to Scientific Services
<b>Water Quality</b>	Reporting via SCADA	Reporting via SCADA	Avail data to warehouse	Online Lab data for Blue Drop reporting
<b>Operational data</b>	Provides real-time operational data (flow, pressure, cathodic protection, instrument measurements) from all production plants	<ul style="list-style-type: none"> <li>Operational site data</li> <li>OT Performance reports</li> <li>Disaster recovery</li> </ul>	OT Emergency preparedness & disaster recovery	Analytical Instruments provide data on Turbidity, pH, Conductivity, Chemical dosages and chemical composition, etc.
<b>Asset management</b>	<ul style="list-style-type: none"> <li>Plant condition assessments</li> <li>Automation standards, policies &amp; procedures</li> <li>Asset improvement plan</li> <li>Feed into RW Master Plan</li> </ul>	<ul style="list-style-type: none"> <li>Maintenance technical support</li> <li>Conduct RCAs, RCM, asset lifecycles</li> </ul>	<ul style="list-style-type: none"> <li>OT governance &amp; assurance</li> <li>Network architecture &amp; security</li> </ul>	Manage & maintain Online Labs
<b>SCADA &amp; Telemetry</b>	Plant health data from all production plants, reservoirs & pipelines	<ul style="list-style-type: none"> <li>Remote control of plant</li> <li>Opstats data</li> </ul>	Avail OT data to warehouse	Feed SCADA data into the LIMS platform
<b>Business Intelligence</b>	Monitoring & Evaluation dashboards (situational awareness)	<ul style="list-style-type: none"> <li>Control room &amp; plant visibility</li> <li>Plant health reporting</li> <li>Billing</li> </ul>	<ul style="list-style-type: none"> <li>BI reports</li> <li>Hydraulic Network performance reports</li> </ul>	Opstats data

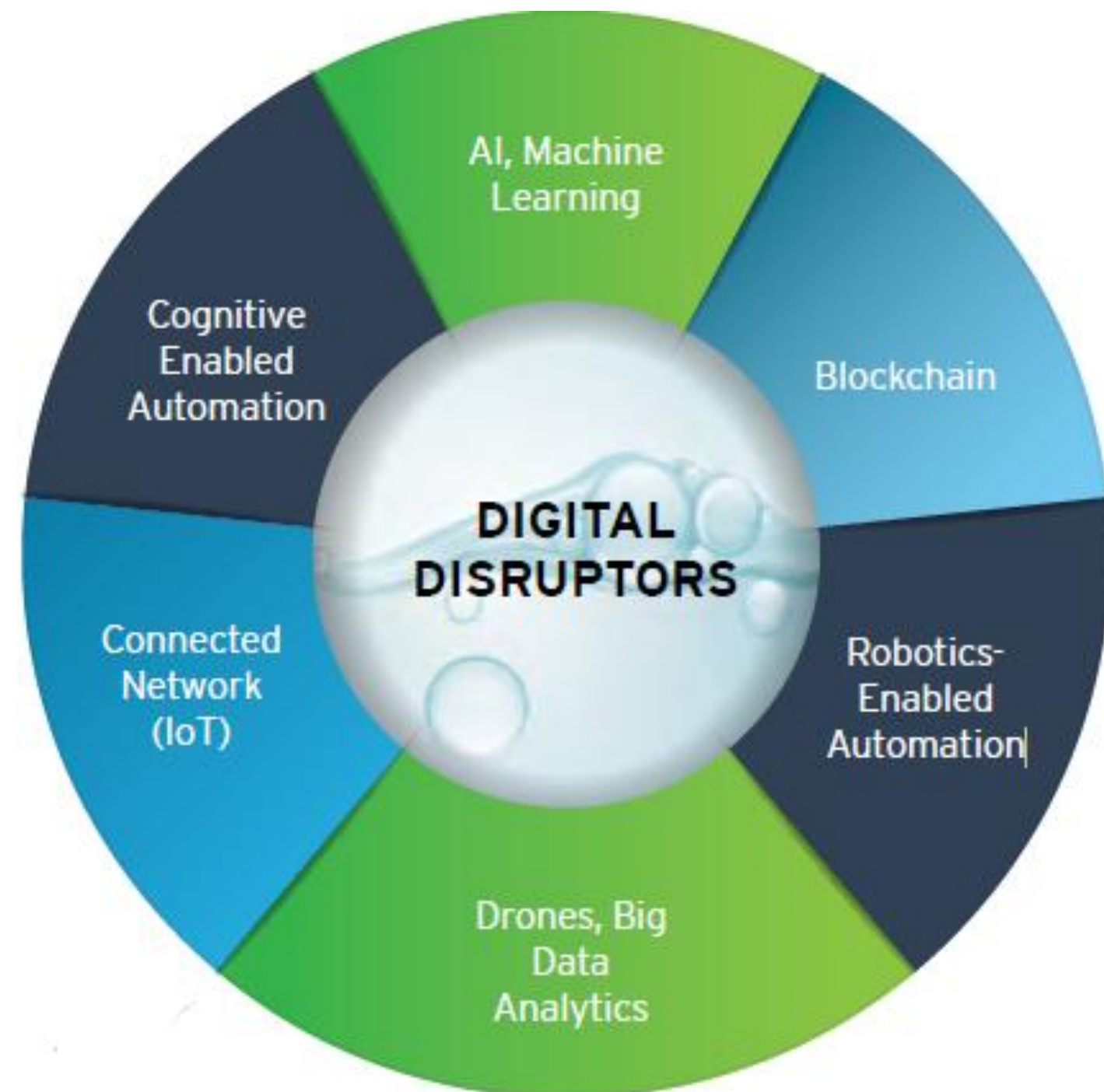


# OT Technology Roadmap – Proposed Initiatives



# Opportunity to Explore Digital Solutions

- Water needs to be managed in a way that is sustainable in the long run
- Rand Water acknowledges the need to get “smarter” (4IR), in line with our Innovation-driven Risk-based Strategy.
- There’s myriad of available disruptive digital technology options:



## Water Utility Business Challenges

## How Digital Technology Can Help

Demand Forecasting, Asset Failure

- Machine learning improves the accuracy of weather-related data, the impact on resources, and the predictions of asset failure.

Aging Infrastructure

- Robotics and big data analytics help assess the condition of the waste water pipeline.

Non-Revenue Water

- Artificial intelligence-based quantitative risk modeling can perform pipeline risk assessments and rehabilitation.

Asset Health Monitoring

- Drones-based inspection and LiDAR data analytics improve productivity by executing tasks faster and more accurately.

Electricity Consumption & Cost Optimization in Water treatment

- Smart sensors installed on the network improve data visibility through the Industrial Internet of Things (IIoT).

Contracts & Billing

- Blockchain concepts for smart contracts and billing reconciliation improve auditability and traceability.

Customer Consumption & Billing Patterns

- Outlier analysis based on cluster algorithms and big data analytics help uncover anomalies in consumption and billing.

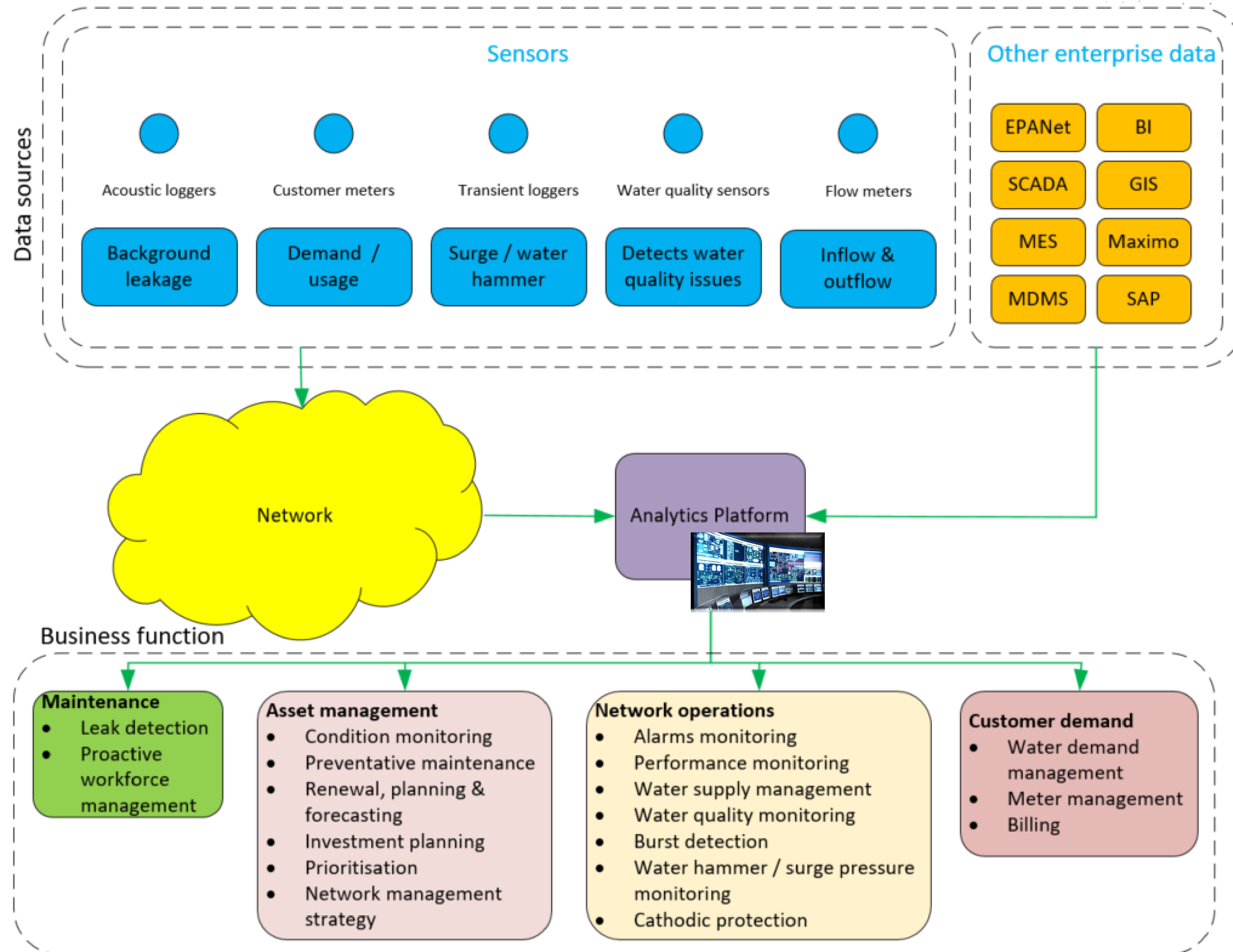
Water Production Planning

- Cognitive-based situational intelligence helps optimize water production planning.

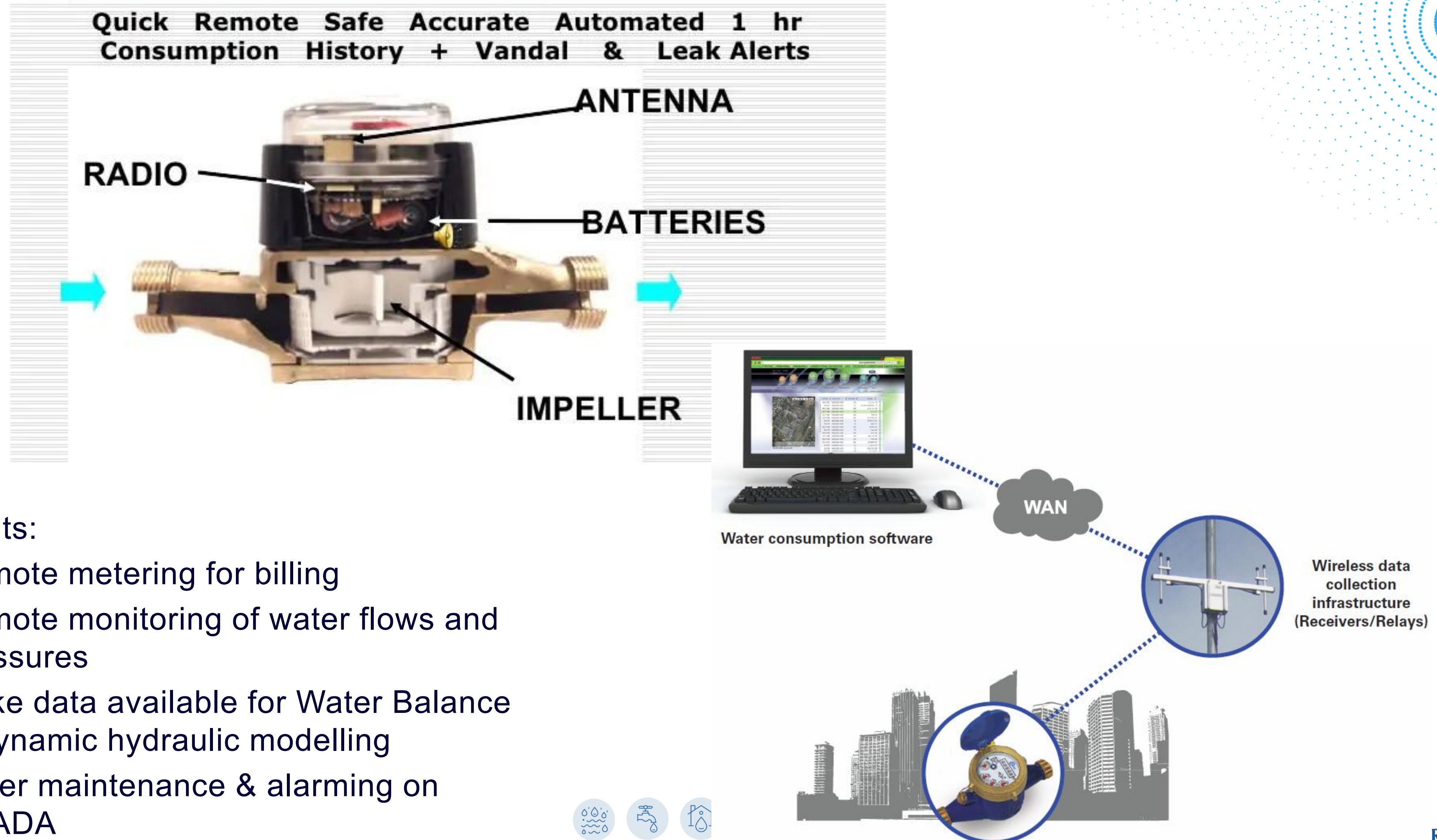


# Implementing Industry 4.0

Our Desired Future:



# Smart Water Metering



## Benefits:

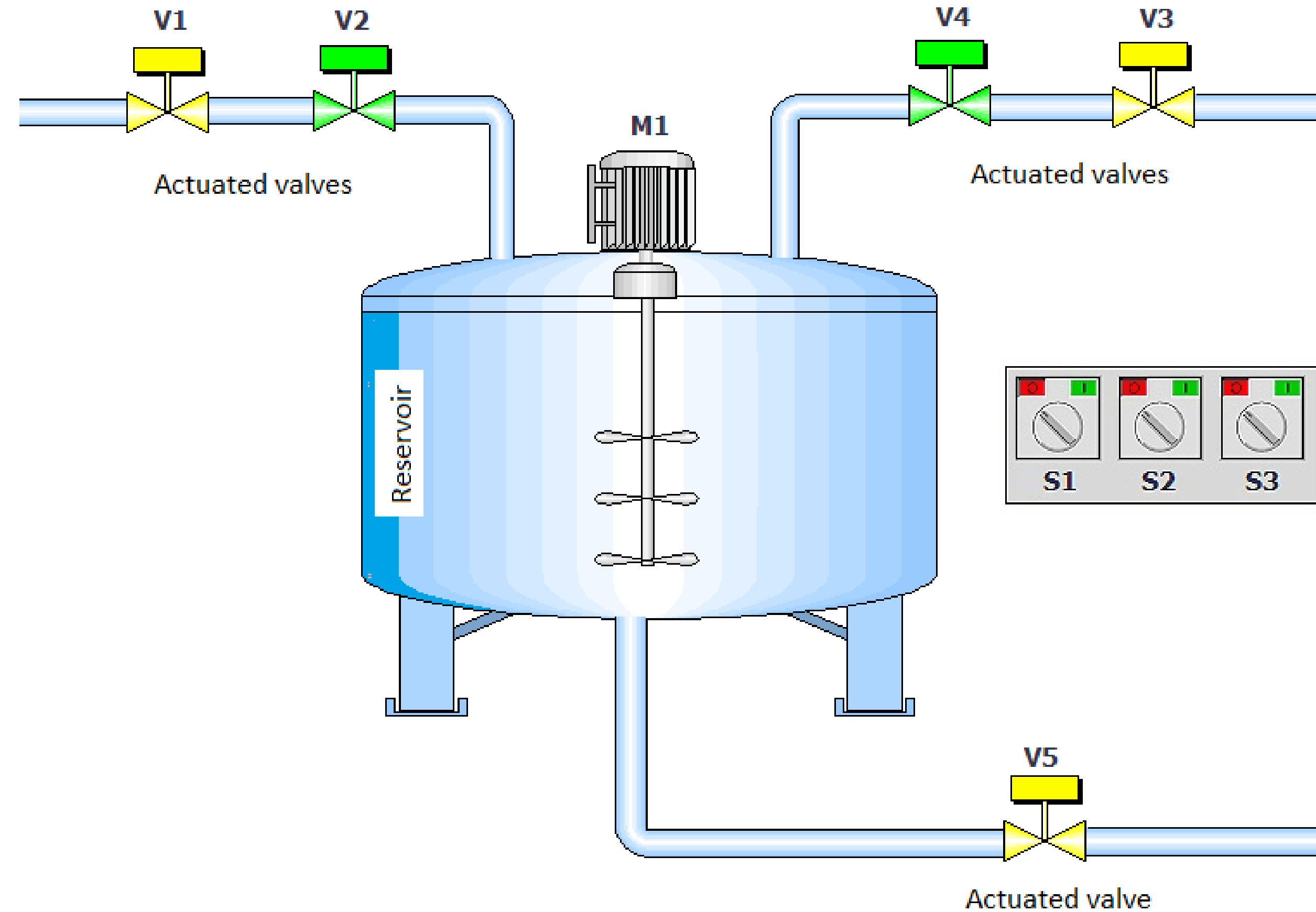
- Remote metering for billing
- Remote monitoring of water flows and pressures
- Make data available for Water Balance & dynamic hydraulic modelling
- Meter maintenance & alarming on SCADA



# Smart Water Valves

## Benefits:

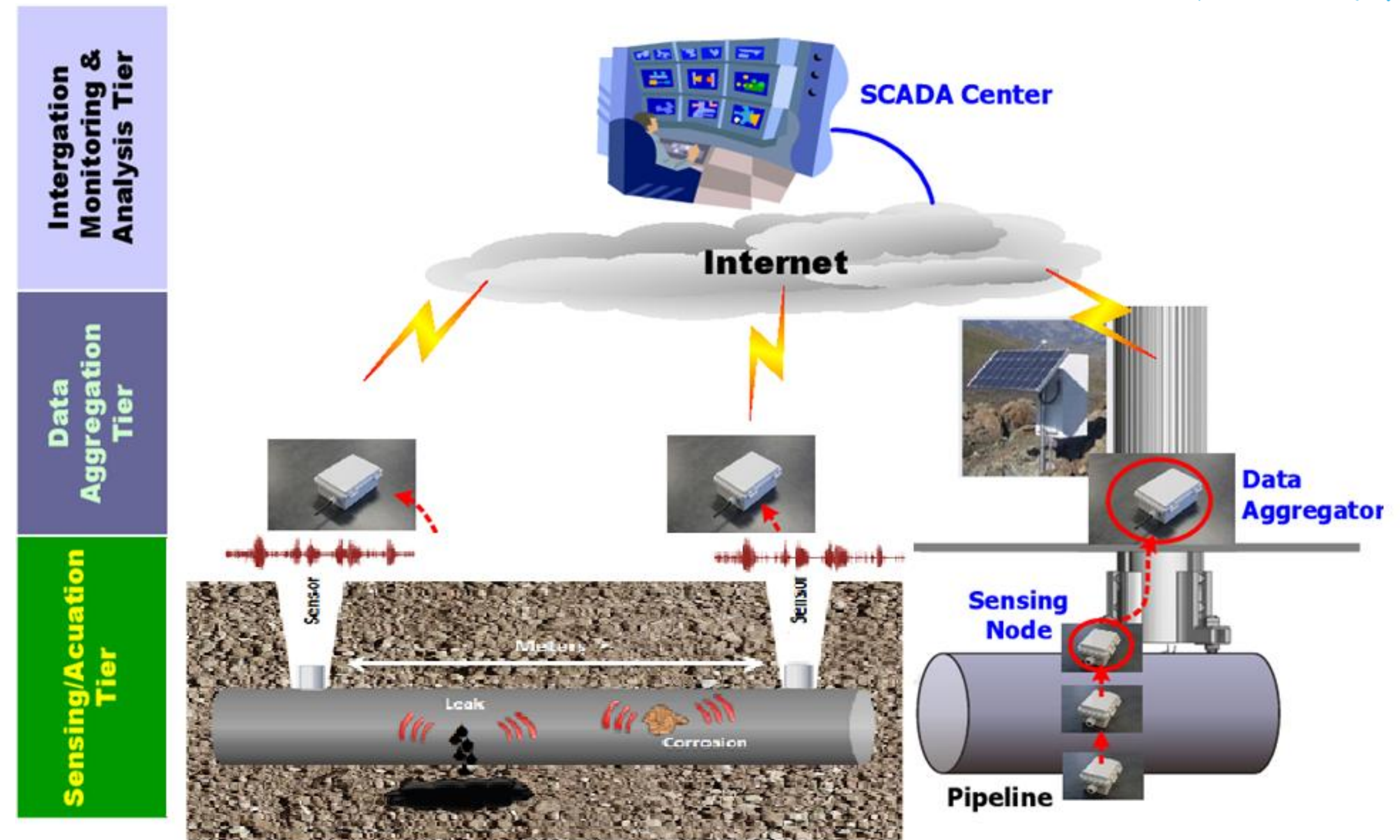
- Remote open & closing of valves
- Make data available for Water Balance & hydraulic modelling
- Valve maintenance & lifecycle management
- Visualisation on SCADA



# Pipeline Sinkholes, Corrosion & Leak Detection

Benefits:

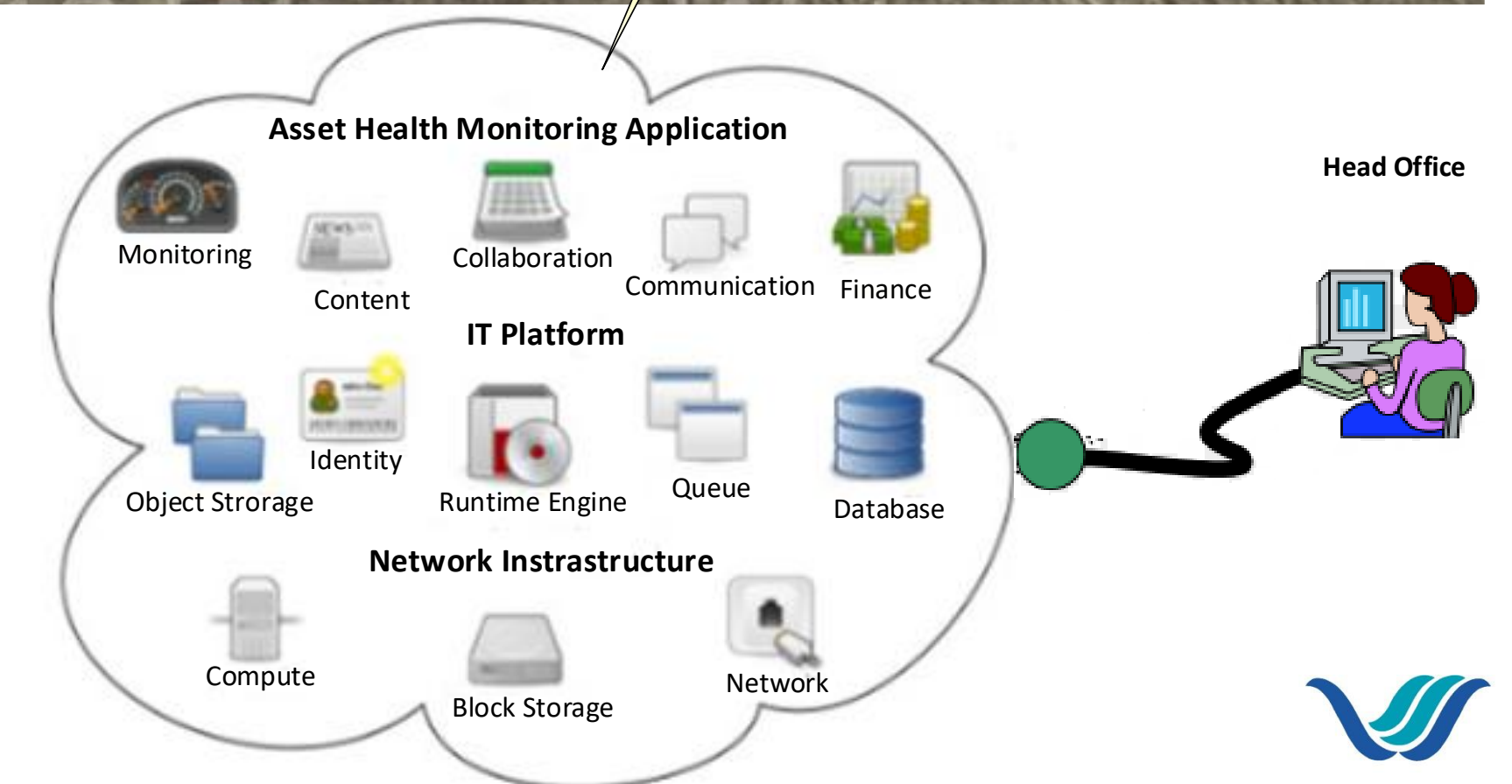
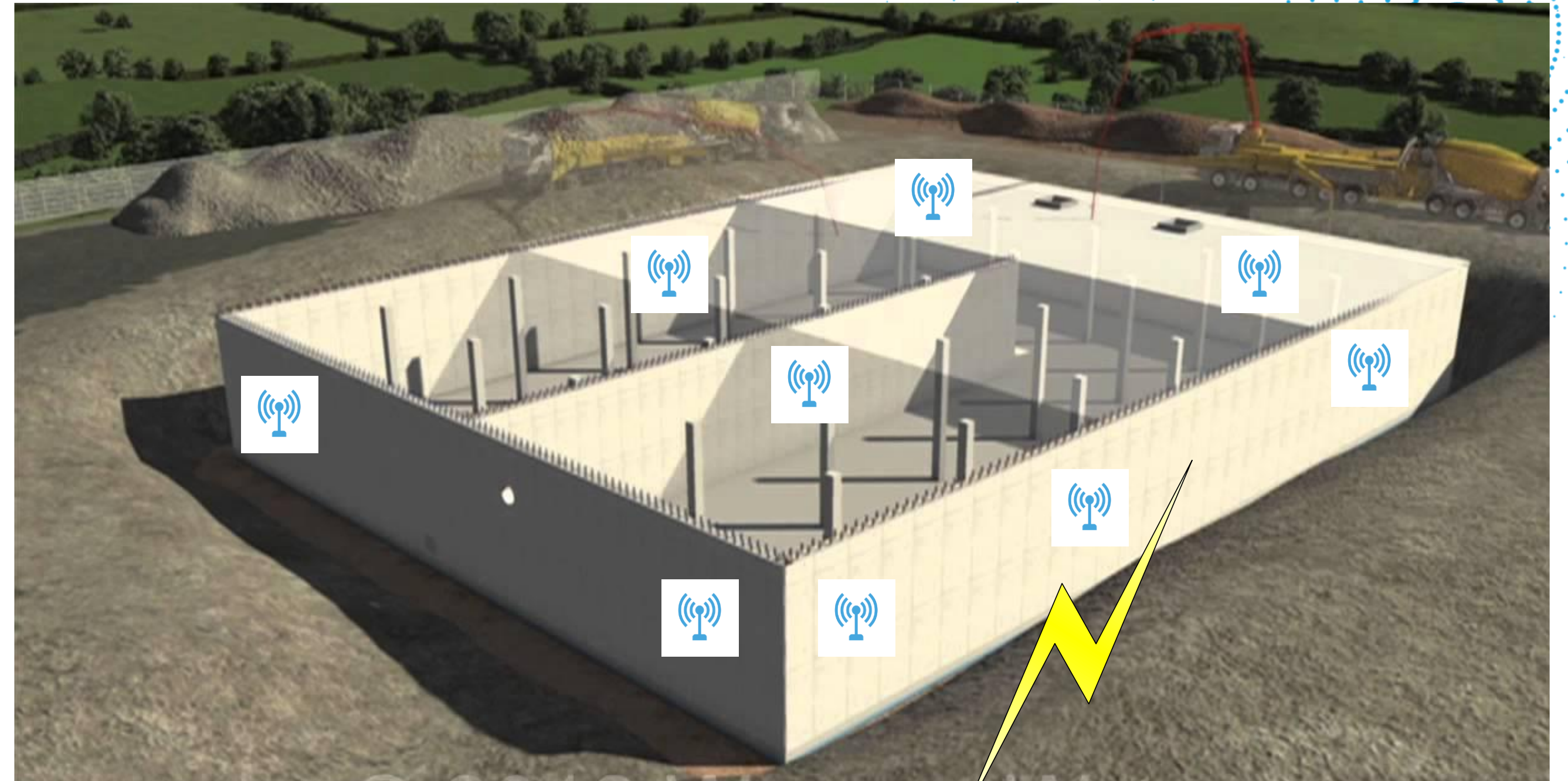
- Pipeline leaks and sinkhole detections & reporting
- Corrosion trending & reporting to SCADA
- Proactive works management



# Reservoir Structural Health Monitoring

## Condition Monitoring & Reporting Dashboard

- Structural defects & leak detection
- Structural impacts & vibrations
- Material integrity, cracks & structural deformations
- Load dynamics
- Corrosivity
- Proactive works management



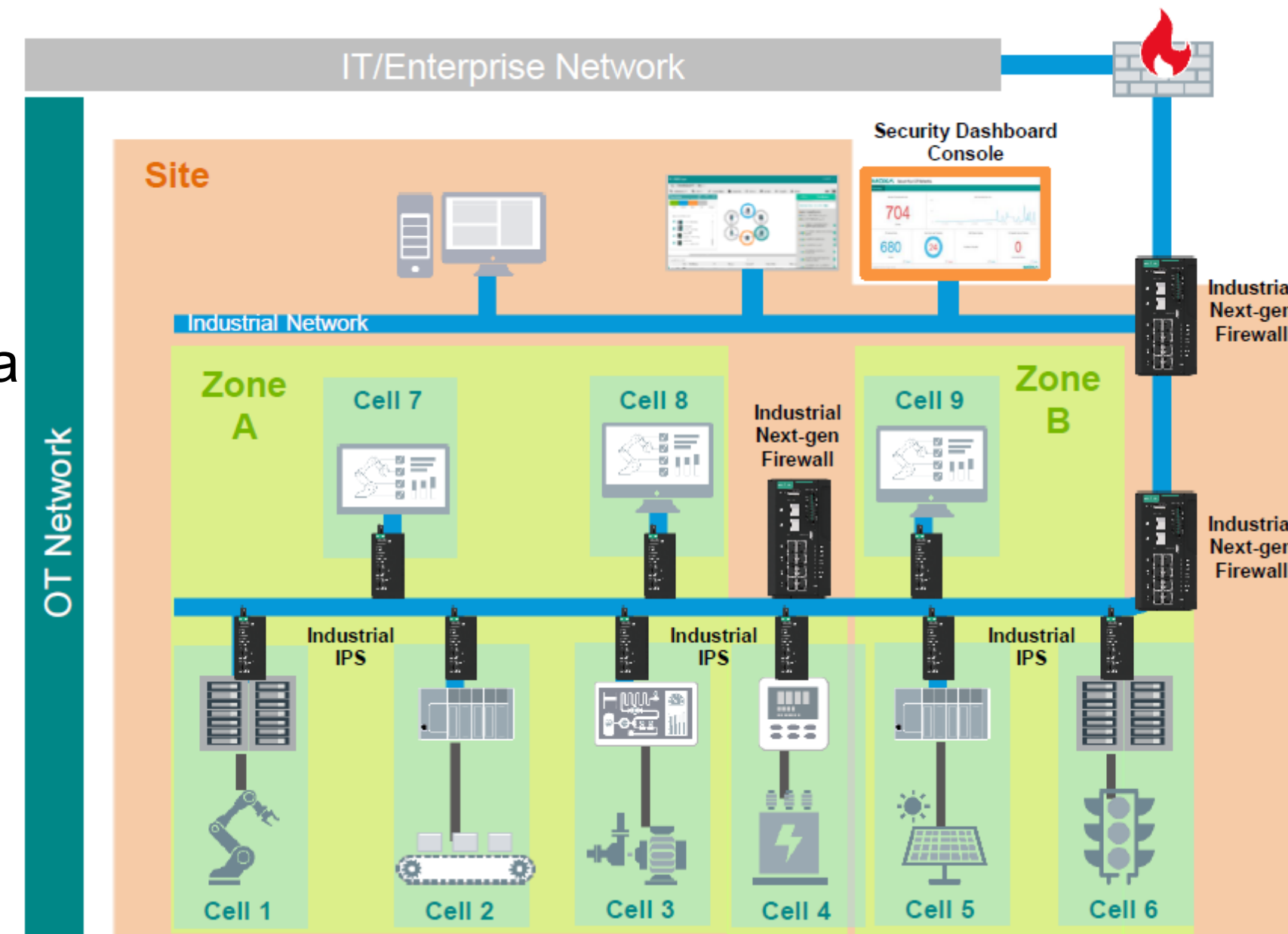
# Industrial Cyber Security

## Challenge:

- Automation and electronic networks are vulnerable to cyber attacks. We have noted an increase in cyber threats against critical infrastructure utilities across the globe
- Rand Water needs an OT cyber resilience strategy

## Proposed Research Focus Area:

- Conduct benchmark study against peers, and develop a roadmap towards OT cyber resilience
- Develop a robust training programme, and train the OT personnel (cyber-security technical skills)



## Site Protection

Security Dashboard Console (SDC)



## Zone Protection

Industrial Next-Gen Firewall (NGFW)



## Cell Protection

Industrial Intrusion Protection System (IPS)



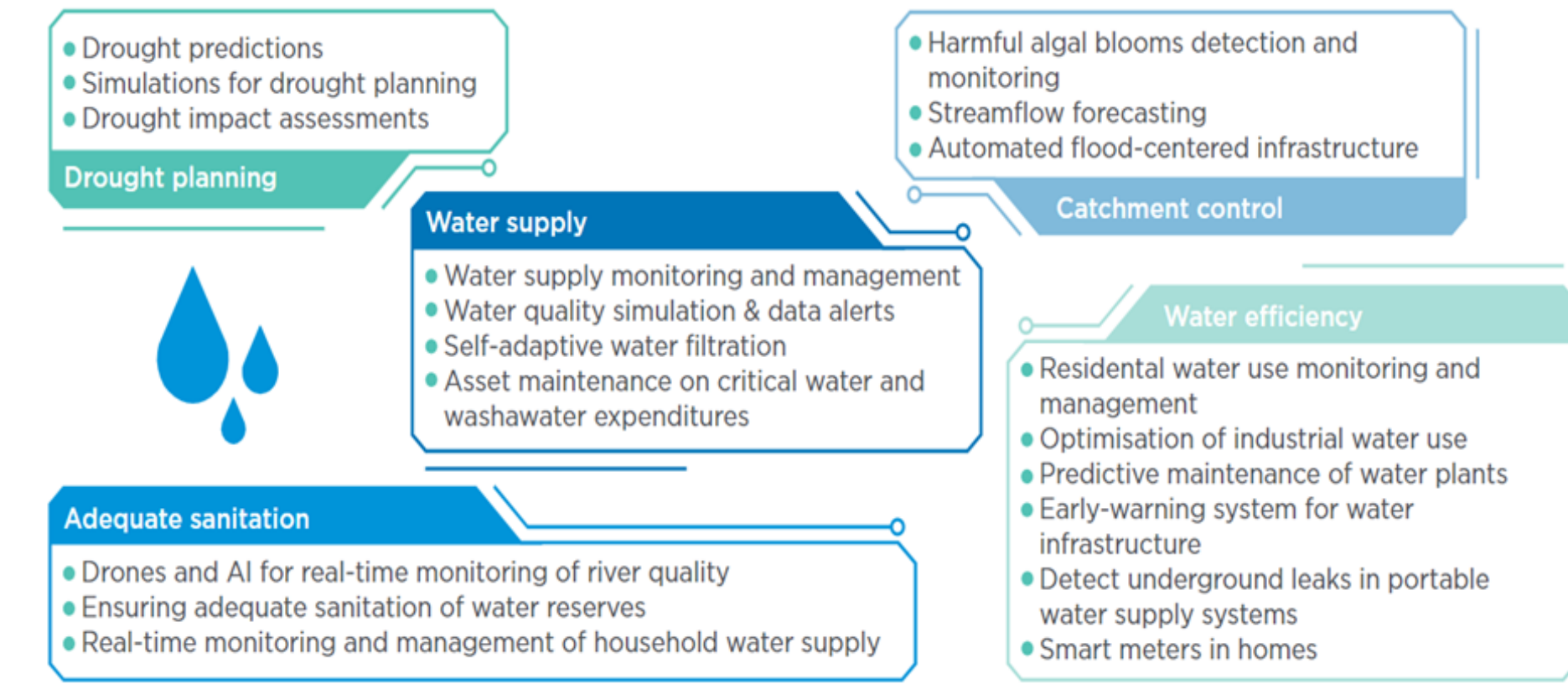
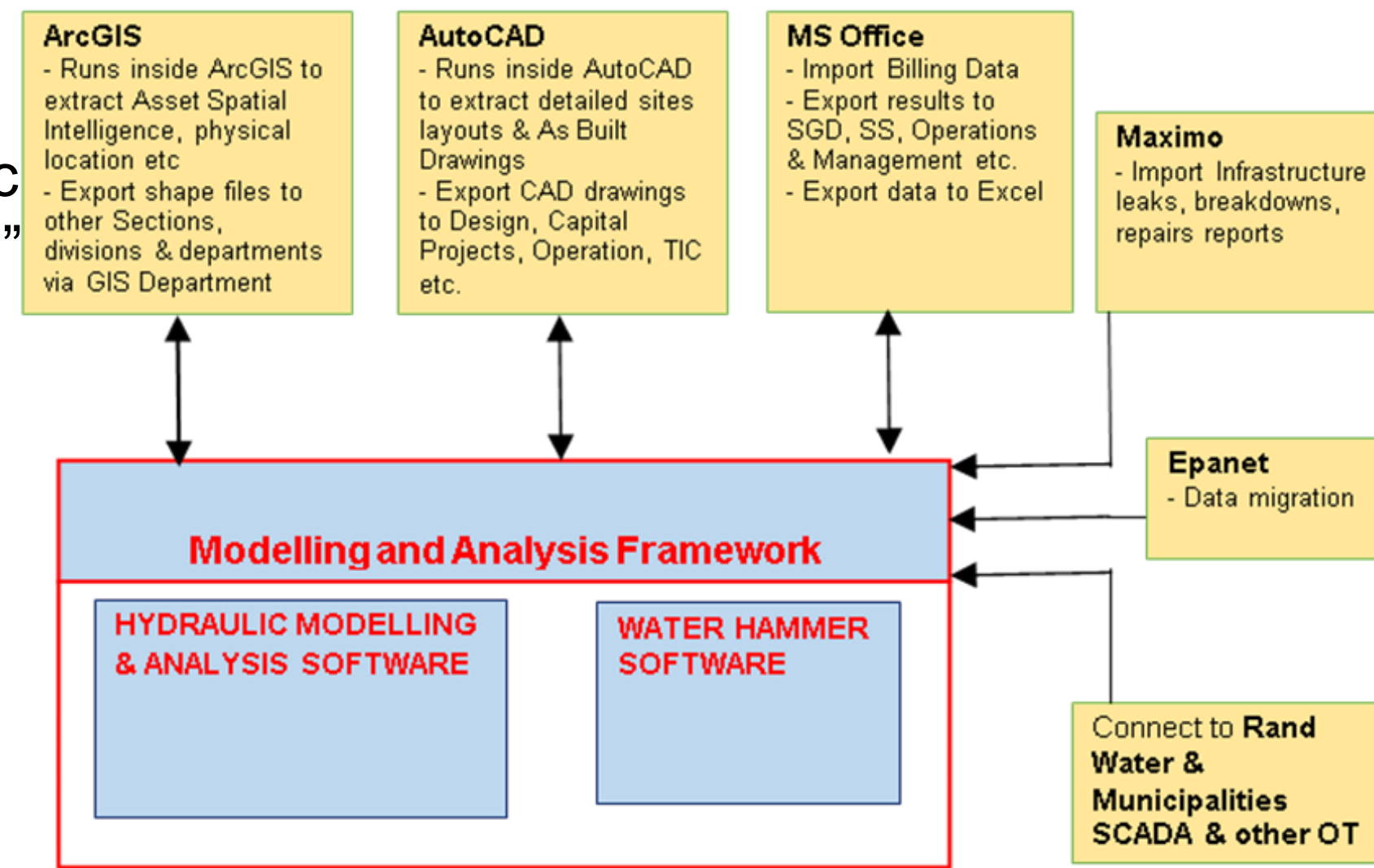
# Water Hammer Analysis & Hydraulic Impact Assessment

## Challenge:

- Currently, Rand Water does not have a live and dynamic picture of the hydraulic network. Everything is “historised” on a static GIS, and there are Spreadsheet drawings giving a snapshot of the network as at time of producing the said drawing.
- Also, Rand Water currently uses a freeware software (EPANet) to simulate very limited hydraulic impact assessments, not giving a full & accurate picture of the immediate situation on the ground under the prevailing conditions

## Proposed Research Focus Area:

- Either develop or source a hydraulic network software from the market
- Plot Rand Water’s hydraulic system on the network software program that must have geographic, hydrologic and hydraulic ability
- Integrate with GIS data and package into a live dynamic water hammer analysis and hydraulic impact assessment tool



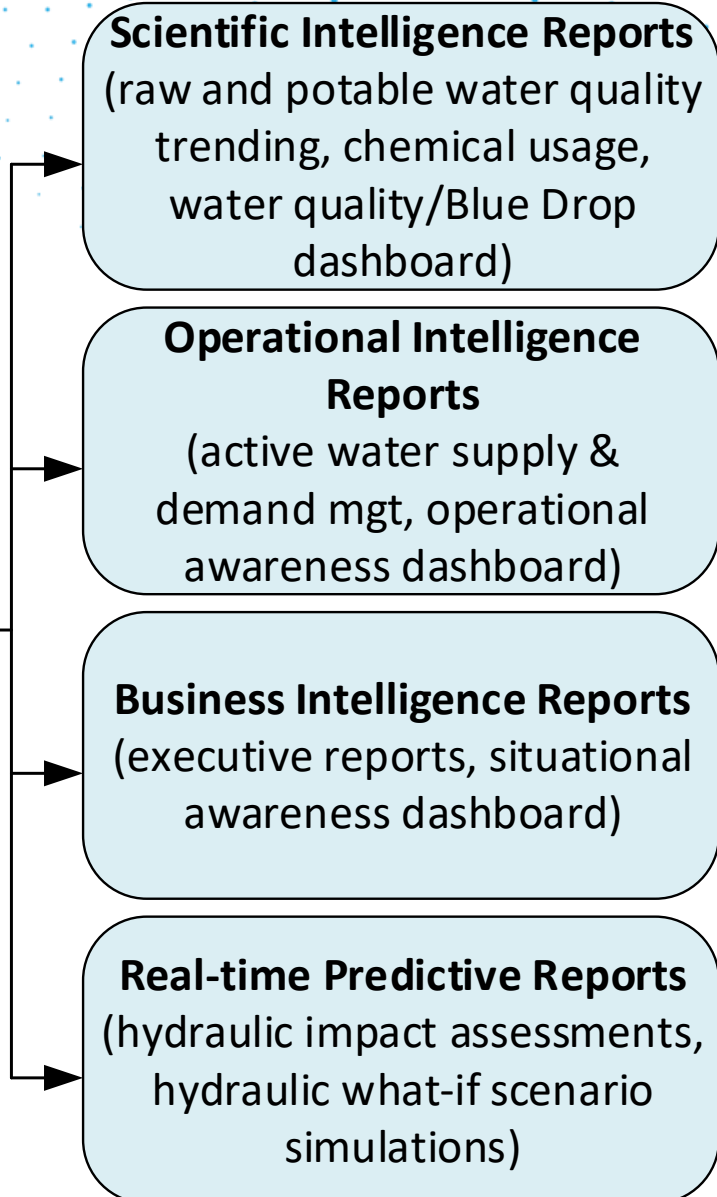
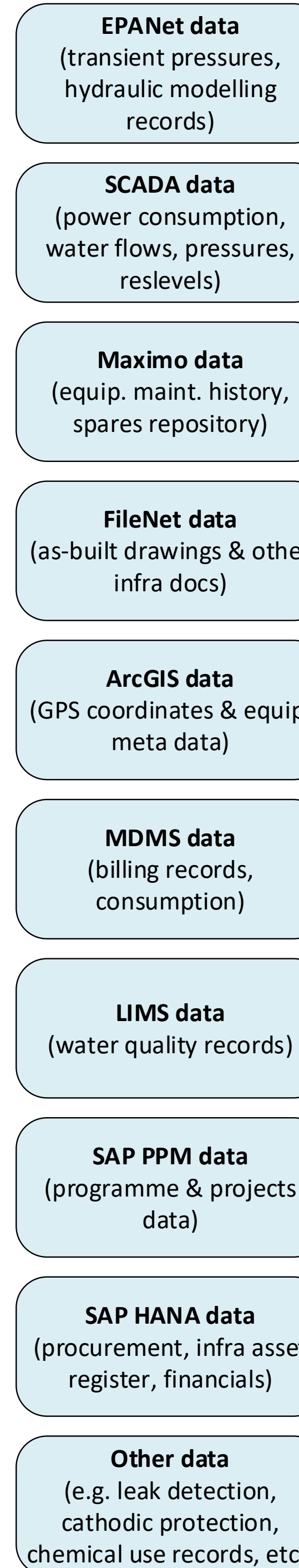
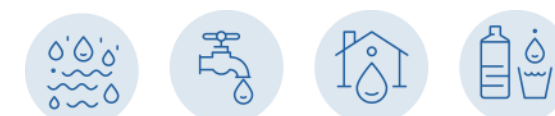
# Big Data Analytics & Intelligence Reports

## Vision

- Pull data from various existing repositories into a big data analytics platform
- Leverage technology (cloud computing, AI & ML) to generate intelligence reports, based on scientific, engineering, business and scenario planning

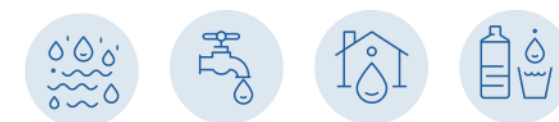
## Proposed Research Focus Areas

- Construct a Data Lake, and Structure all data repositories into suitable format for integration and dumping the data into the data lake.
- Mine the data lake, ingesting the data into an AI-based analytics platform
- Use AI and ML technologies to train the analytics platform into generating intelligence reports and dashboards



# Thank you!

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**RAND WATER**