NRW Master Plan
Water Management Initiative

SESSION 1
Amman, December 3, 2018
Outline

- Objective and Activities
- Assessment Approach
- Assessment Findings
- NRW Strategy
- Master Plan Summary
Objectives and Activities

Objectives

The NRW Master Plan aims to:

• Establish a unified framework for NRW management in Jordan.

• Define NRW management good practices in a responsible, accountable and sustainable way.

• Optimize investments in a strategic and aimful way.

• Plot a path forward that avoids previous pitfalls and mitigates challenges.
Objectives and Activities

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Objectives and Activities

Deliverables

• **Structured assessment of current situation**
  – System conditions
  – Practices
  – Capacity

• **Define a roadmap for improvement**
  – Path forward
  – Implementation strategy

• **Targeted actions per Governorate**
  – Capital investments
  – Operational activities
Objectives and Activities
National NRW Reduction Process

MWI NRW MP Development

Implementation – Monitoring – Evaluation

– Detailed Planning & Designs
  – Institutional Actions
    – Procurement
    – Projects execution

Current Situation in Jordan

NRW Master Plan for Jordan

Target NRW Management for Jordan
Objectives and Activities

Activities

1. Adapted ACWUA’s RESPONSIBLE IMPACT NRW assessment tools
2. Involved the WAJ NRW Committee and MESC
3. Visited utilities and conduct interviews and gather observations (1-3 days each, July-September 2018)
4. Collected utility data (simplified form: System components)
5. Completed NRW Strategy (end of September 2018)
6. Holding the Knowledge sharing workshop (Dec 3-4 2018)
7. To implement targeted capacity building (Starting in 2019)
Outline

• Objective and Activities
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Assessment Approach

Difficulties

**Planned approach**

• Establish a utility/WAJ assessment committee.

• Conduct committee training on NRW assessment using the ACWUA Diagnostic Tool.

• Utilities conducting detailed self-assessment.

• Diagnostic tool/assessment matrix completed.
Assessment Approach

Difficulties

Implementation

• Assessment committee criteria submitted.
• Insufficient staff availability to conduct the self-assessment.
• Late selection of staff and key staff not proposed.
• Delays due to Ramadan and holidays.
• ACWUA consultant conducted visits to utilities and held meetings.
• Simplification of data collection.
Assessment Approach

IMPACT

Prevent  “Operations under control”
Monitor  “Continuous surveillance”
Inspect  “Problems found”
Treat  “Problems solved”
Classify  “What, where, and why?”
Assess  “How much? How bad?”
Assessment Approach
RESPONSIBLE

Responsibility: Defined and enforced roles and targets

Employment: Quality and quantity of staff

Systems: Producing information from data

Policies: NRW-focused rules and principles

Op. Procedures: Clearly established operational steps

kN owledge: Hands-on NRW management knowledge

Standards: NRW-focused technical standards

Infrastructure: Optimum water system asset configuration

Business Process: Daily operations are aligned with NRW management

Leadership: Internal and external advocacy and collaboration

Equipment: The right set of tools
Outline

• Objective and Activities
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• Assessment Findings
• NRW Strategy
• Master Plan Summary
Assessment Findings

IMPACT

Prevent “Operations under control”

Physical Losses
• Pressure reduction
• Surge protection
• Asset quality control

Commercial Losses
• Reading and billing validation
• Automated reading
• Customer meter upgrade and sealing
Assessment Findings

IMPACT

Prevent “Operations under control”

Current efforts

• DZ level pressure control but sustained in one utility thanks to telemetry and 24/7 supply.

• Increasing use of SCADA control, VFD and soft starters.

• Meter and stop valve sealing, and most found unauthorized consumption is fined.

• Some Big-Customer static meters and increasing use of static metering in general.

• Automated and controlled billing process especially at water companies.
Assessment Findings

IMPACT

Prevent “Operations under control”

High priority needs

• Validated hydraulic assessment of networks.

• Network restructuring to apply and sustain strict pressure limits in distribution networks and to reduce and stabilize pressure.

• Continuous water supply to prevent most bursts.

• Big-Customer static meter implementation and/or completion.
Assessment Findings

IMPACT

Monitor “Continuous surveillance”

Physical Losses

• Flow balance and DMA MNF
• Transient monitoring
• Noise logging

Commercial Losses

• Smart billing reports
• Smart meter alarms
Assessment Findings

IMPACT

Monitor

“Continuous surveillance”

Current efforts

• Passive monitoring through customer calls.
• Examples of successful SCADA monitoring of wells, reservoirs, and trunk mains.
• DMA testing and pilots, but often not sustained.
• Commercial reports, often during UAC campaigns.
Assessment Findings

IMPACT

High priority needs

• Source bulk metering and telemetry implementation and completion.
• Wider, NRW-focused SCADA implementation and completion.
• Continuous distribution network flow and pressure monitoring.
• Updated customer locations and network boundaries in GIS.
• Automated monitoring reports.
• Routine commercial metering and billing reports.

Monitor

“Continuous surveillance”
Assessment Findings

IMPACT

Inspect  “Problems found”

Physical Losses

• Sounding surveys
• Facility inspection

Commercial Losses

• Customer meter inspection and calibration
• Tampering inspection
Assessment Findings

IMPACT

Inspect “Problems found”

Current efforts

• Meter reader observation codes, if not systematically used.
• Unauthorized consumption campaigns in several utilities.
• Limited leak inspection efforts, often short-lived.
• Visible leak pinpointing.
• Some Big-Customer meter calibration.
Assessment Findings

IMPACT

Inspect

“Problems found”

High priority needs

• Routine observation code workflow.
• Routine leak inspection activities.
• Routine customer meter inspection and calibration.
• Mitigation of IWS crises that consume available capacity.
Assessment Findings

IMPACT

Treat

“Problems solved”

Physical Losses
• Partial replacement
• Clamping
• Reservoir structural repair

Commercial Losses
• Defective meter replacement
• Correction of billing errors
• Illegal connection disconnection
Assessment Findings

IMPACT

Treat

“Problems solved”

Current efforts

• Good level of coordinated network corrective maintenance at water companies.

• Response to most unauthorized use cases found.
Assessment Findings

IMPACT

High priority needs

• Improved corrective maintenance capacity in other utilities.
• Controlled quality of used fittings.
• Routine customer meter rehabilitation and replacement.
• Mitigation of IWS crises that consume available capacity.
Assessment Findings

IMPACT

Classify

“What, where, and why?”

Physical Losses

• Service connection leaks per 1000 connections
• Leaks per length of mains per DMA
• Leaks per pipe material/age

Commercial Losses

• Stopped meters per type/age
• Illegal connections per district
Assessment Findings

IMPACT

Classify

“What, where, and why?”

Current efforts

• Corrected bursts reported by pipe size, material and general location.

• Some investment decisions have been made based on analyzed data.
Assessment Findings

IMPACT

High priority needs

• Documentation and analysis of meter repair data and unauthorized consumption.

• GIS based work order documentation based on GPS/Lot ID.

• Systematic root-cause analysis of leakage and meter dysfunction.

Classify

“What, where, and why?”
Assessment Findings

IMPACT

Assess “How much? How bad?”

Physical Losses

• Top-down physical loss estimates (water balance)
• Physical loss in l/c/d w.s.p. per DZ
• Infrastructure Leakage Index (ILI) per DMA

Commercial Losses

• Average meter under-registration
• Apparent Loss Index
Assessment Findings

IMPACT

Assess

“How much? How bad?”

Current efforts

• Total NRW by percentage.
• Approximate cost of NRW calculated.
• Some attempts at DZ and district level NRW calculation.
Assessment Findings

IMPACT

High priority needs

• Accurate bulk water produced/imported/exported data.
• More suitable KPIs.
• Variable cost/price of water for physical/commercial losses.
• Average bulk and customer meter error study in most utilities.
• Accurate weighted-average of the hours of supply.
• Average pressure study.
Assessment Findings
RESPONSIBLE

Responsibility

• NRW targets are in ad hoc percentages.

• Institutional responsibility over billing in companies.

• No clear responsibility for NRW monitoring and analysis (Responsible NRW unit vs. NRW KPI responsibility)
Assessment Findings
RESPONSIBLE

Employment

• Severe shortage in leak/meter/UAC inspection staff.
• No NRW reporting and analysis staff in most utilities.
• No capacity for sustaining the maintenance of needed instrumentations for NRW monitoring and control.
• Insufficient or missing GIS update surveyors.
Assessment Findings

RESPONSIBLE

Systems

• MMS used focused on electromechanical vs. metering and network maintenance (complaint and CIS systems insufficiently used instead).

• A good base for NRW related CIS reporting capabilities at some companies.

• Work is ongoing towards wider ERP/CIS implementation.

• SCADA HMI’s not designed with NRW monitoring in mind.

• No distribution monitoring/reporting systems (telemetry projects are not integrated).

• Birth of smart meter monitoring.
Assessment Findings

RESPONSIBLE

Policies

• Existing administrative regulatory policies.

• Improved de-facto customer account administration policies especially at companies.

• Need for non-traditional policies to address NRW given the severe water shortage in Jordan.

• Need for an updated and enforced bulk metering regulatory rules.
Assessment Findings
RESPONSIBLE

Operating procedures

• Need for practical crisis contingencies under IWS.
• Lack of procedures that serve monitoring, classification, and assessment procedures.
• Lack of regularly implemented inspection procedures in most utilities.
• Lack of clear NRW-related instrumentation and telemetry maintenance procedures and roles.
• Gradually developing daily GIS update procedures.
Assessment Findings

RESPONSIBLE

kNowledge

• Training in general NRW concepts and equipment use.
• Insufficient NRW analysis and monitoring knowledge.
• Insufficient practical knowledge in hydraulic analysis.
• Insufficient knowledge in network operation good practices.
Assessment Findings
RESPONSIBLE

Standards

• Applied pressure standard in ASEZ (1.5-7 bar, 24/6).
• Insufficient NRW-focused pressure design standards overall.
• Design standards developed through civil consultants instead of NRW and utility management consultants.
• Gradual optimization of pipe materials.
• Need for improved fittings and equipment specifications.
• No telemetry standards.
• No enforced network DMA/PMZ standard design.
Assessment Findings

RESPONSIBLE

Infrastructure

• Network and metering improvements in companies.
• Most networks lack working telemetry.
• Major infrastructure upgrade needs in YWC and WAJ utilities.
• Infrastructure data errors in most networks.
• Rare use of network pressure logging. No or rare average pressure logging.
• Frequent cross connections between networks.
• Customer data errors in most networks, with improvements under way in some utilities.
• Many customer meters dysfunctional or still need installation rehabilitation.
Assessment Findings

RESPONSIBLE

Business processes

• Customer billing areas do not match water zones.
• Bulk meter reading focuses on minimum needs of bulk purchase.
• NRW management not integrated across utility functions.
• Meter reader observations do not systematically produce work orders.
• GIS update is not part of the workflow of most field processes, yet improvements are being made.
• IWS forces network operations into crisis mode.
Assessment Findings
RESPONSIBLE

Leadership

• Examples of PPP.

• Ongoing attempts at sector-industry cooperation in metering and customer services.

• Potential for power/telecom utility data exchange partnerships.

• Well established customer reporting of visible leaks through the central call center.

• Customer outreach is used when needed.
Assessment Findings
RESPONSIBLE

Equipment

• No lack of NRW-related equipment in most cases and when needed.

• Need for high quality plumbing and support equipment in some WAJ utilities.

• Vehicle distribution issues complicating attempts at regular field inspection.
Assessment Findings
IWS and Physical Loss Management

Pressure management

• Impossible to stabilize pressure.
• Pipe sizing for IWS is not financially optimum.
• Extreme difficulty in stabilizing and pressure during supply periods.
• Crises-cause cross-connections reverse efforts.
• Feasibility studies using FAVAD calculations inaccurate.
Assessment Findings
IWS and Physical Loss Management

Active Leakage Control

• Extreme difficulty in using acoustic techniques.
• Difficulty in coordinating campaigns.
• Often impossible to apply DMA Minimum-Night-Flow monitoring.
• Extreme difficulty in using noise loggers.
Assessment Findings
IWS and Physical Loss Management

Speed and quality of repairs

• Repair is delayed according to the supply schedule.

• Difficulty in locating reported leakage when the network is depressurized.

• Difficulty in testing repair completion and success.

• Additional efforts needed to respond to IWS-caused complaints.
Assessment Findings
IWS and Physical Loss Management

Asset management

• High deterioration rate.

• Asset conditions not predictable by normal parameters.
Assessment Findings
IWS and Commercial Loss Management

Control over Metering

• High meter deterioration rate.
• Registration of air.
• Use of direct suction pumps.

Control over unauthorized consumption

• Extreme difficulty in locating illegal connections
• Dissatisfaction may rationalize theft.
Outline

- Objective and Activities
- Assessment Approach
- Assessment Findings
- NRW Strategy
- Master Plan Summary
NRW Strategy
Key Values

– Tackle and improve:

Assets
Maintenance
Asset protection
Data quality
Operating conditions
Staff

Reliability
Accountability
Sustainability
Holistic Approach
NRW Strategy
Key Values

– Tackle and improve:
  Data
  Best practices
  Benchmarks
  Implementation targets
  Auditing

Reliability
Accountability
Sustainability
Holistic Approach
NRW Strategy
Key Values

– Tackle and improve:
  Policies
  Standards
  Processes
  Procedures
  Reporting systems
  Sector leadership

Reliability
Accountability
Sustainability
Holistic Approach
NRW Strategy

Key Values

Integration of:

- Local conditions
- Sector needs & responsibilities
- Customer needs
- Technical solutions

- Reliability
- Accountability
- Sustainability
- Holistic Approach
NRW Strategy

Key Values

Traditional thinking

- meters
- new networks
- software licenses
- equipment

Performance Review
- NRW reduction
- increased billing
- energy saving
NRW Strategy

Key Values

Sustainable thinking

- meters
- new networks
- software licenses
- equipment

Proven evidence of:
- preventive control
- monitoring
- inspection
- treatment
- classification
- analysis

Independent Auditing

Performance Appraisal

= Best Achievable Performance

- NRW reduction
- increased billing
- energy saving
NRW Strategy
Roadmap

Current vs. short term potential
~3 years
(for illustration only)

Category A
Category B
Category C
Category D

Aqaba
WAJ
Yarmouk
Miyahuna
(Amman – Madaba – Zarqa)
NRW Strategy
Categorization of Water Supply Systems

**Category A**
- Problematic IWS Conditions

**Category B**
- Continuous supply

**Category C**
- Improved IWS Conditions

**Supply Continuity:**
- Problematic IWS Conditions
- Improved IWS Conditions
- Continuous supply

**Management of Primary Systems:**
- Incomplete metering of resources
- No monitoring and control
- Complete metering of resources
- SCADA monitoring and control
- Complete metering of resources
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- SCADA monitoring and control

**Management of Distribution Systems:**
- No flow and pressure monitoring
- No pressure control
- Distribution zone monitoring of flow and pressure by distribution area
- Distribution zone pressure control
- DMA monitoring of flow and pressure by distribution area
- DMA pressure control

**Management of Customer Metering and Billing:**
- Inaccurate customer locations
- No flow and pressure monitoring
- Accurate customer locations
- Functional customer metering
- Accurate customer locations
- Functional customer metering
- Smart static big customer meters
NRW Strategy
Transitioning from A to B

Category A

- Problematic IWS conditions
- No or incomplete monitoring and control of primary systems
- No or incomplete monitoring and control of distribution zones
- No or incomplete monitoring and control of metering and billing

Establish

Institutional
- Policies and standards
- SCADA NRW dashboard
- DZ dashboard
- GPS/real-time MMS tablets and system

Primary systems
- Hydraulic reinforcement and protection of transmission
- SCADA monitoring and control of transmission and sources

Distribution systems
- Hydraulic restructuring of distribution zones
- Distribution zone monitoring and pressure control

Customer metering and billing
- Customer survey
- Targeted meter rehabilitation

Category B

- Improved IWS conditions
- Resources and primary system monitored and controlled by SCADA
- Distribution zone monitoring and control
- Robust control over metering and billing

Sustain

NRW Unit
- NRW assessment procedures
- Leakage teams
- Inspection and repair procedures
- Unauthorized consumption teams
- Inspection and repair procedures
- Customer meter inspection and maintenance
- Inspection and repair procedures
- Operational GIS update
- Survey procedures
- SCADA network and instrumentation maintenance
- Preventive and corrective procedures
- DZ maintenance
- Preventive and corrective procedures
NRW Strategy
Transitioning from B to C

**Establish**

- Improved IWS conditions
- Resources and primary system monitored and controlled by SCADA
- Distribution zone monitoring and control
- Robust control over metering and billing

**Sustain**

- Continuous supply
- Resources and primary system monitored and controlled by SCADA
- DMA monitoring and control
- Robust control over metering and billing

**Institutional**
- DMA monitoring and reporting system
- Distribution systems
- Hydraulic restructuring of DMAs
- DMA monitoring and pressure control
- Intensive ALC
- Transition to 24X7

**Customer metering and billing**
- Smart static Big Customer meters
- Targeted demand management campaigns

**NRW Unit**
- NRW assessment procedures
- Leakage teams
- Inspection and repair procedures
- Unauthorized consumption teams
- Inspection and repair procedures
- Customer meter inspection and maintenance
- Inspection and repair procedures
- Operational GIS update
- Survey procedures
- SCADA network and instrumentation maintenance
- Preventive and corrective procedures
- DZ and DMA maintenance
- Preventive and corrective procedures
NRW Strategy
Transitioning from C to D

Improved IWS conditions
Resources and primary system monitored and controlled by SCADA
Distribution zone monitoring and control
Robust control over metering and billing

Establish
Distribution systems
- Further pressure optimization down to feasible limits
Customer metering and billing
- Static (electronic) customer meters for all customers
- Fixed network smart meter alarms

Sustain
NRW Unit
- NRW assessment procedures
Leakage teams
- Inspection and repair procedures
Unauthorized consumption teams
- Inspection and repair procedures
Smart meter inspection and maintenance
- Inspection and repair procedures
Operational GIS update
- Survey procedures
SCADA network and instrumentation maintenance
- Preventive and corrective procedures
DZ and DMA maintenance
- Preventive and corrective procedures
NRW Strategy

Phased Transition to 24/7

unoptimized primary system hydraulics
manual control
no monitoring

very high pressure during supply periods
high pressure fluctuations
high rate of new bursts
high leakage

supply slow to reach many customers
NRW Strategy
Phased Transition to 24/7

very high pressure during supply periods
good pressure fluctuations
high rate of new bursts
high leakage

supply slow to reach many customers
NRW Strategy

Phased Transition to 24/7

Distribution System Out of Control

critical point pressure monitoring

distribution flow monitoring

supply quick to reach most customers

hydraulic isolation of networks by elevation

hydraulic reinforcement of critical points

max point pressure monitoring

high pressure fluctuations due to IWS

high rate of new bursts due to IWS

NRW Strategy

Phased Transition to 24/7
NRW Strategy
Phased Transition to 24/7

Distribution System
Under Control

Primary System
Under Control

gradual transition to 24X7 supplied DMAs

intensive ALC

standard Elevation (20-30 m)

standard Elevation (40-50 m)

max point pressure monitoring

DMA Chart

Flow (m³/h)

Pressure (bar)

- Flow
- Target MNF
- P high
- P avg
- P low

12/6/2018
NRW Strategy
Target Primary System Management

SCADA monitoring and control

additional reservoirs for gravity supply

reinforcement and restructuring

Air Valve

Inlet Pressure Monitoring

Level Monitoring

DZ flow monitoring

field leak inspection

DZ flow monitoring

Pumping Monitoring and Control

Control

Control

Control

verification of system operation

Pumping Monitoring and Control

well-equipped and responsive treatment of bursts

classification and documentation of leaks and overflows

assessment of losses

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NRW Strategy
Target Distribution System Management

- DMA monitoring
- Critical Point pressure monitoring
- Air Valve
- Standard Elevation ≤ 30 m
- Reinforcement and restructuring
- Max Point pressure monitoring
- PRV
- Private Secondary
- Flow monitoring

- Classification and documentation of leaks
- Well-equipped and responsive treatment of bursts
- Field leak inspection
- Verification of pressure and isolation

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12/6/2018
NRW Strategy
Target Customer Meter Management

enforced deterrence against illegal use
validated and automated billing transactions
well-equipped and responsive treatment of metering and billing issues
classification and documentation of commercial losses
assessment of losses
smart meter monitoring

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smart meter monitoring

AM/AMR
Tamper-proof stop valves
tampering and illegal connection inspection

NRW Strategy
Target Customer Meter Management

enforced deterrence against illegal use
validated and automated billing transactions
well-equipped and responsive treatment of metering and billing issues
classification and documentation of commercial losses
assessment of losses

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12/6/2018
Outline

• Objective and Activities
• Assessment Approach
• Assessment Findings
• NRW Strategy
• Master Plan Summary
Master Plan Summary

Plan Components

- **Policies**
- **Standards**
- **Responsibility framework**
- **Systems**
- **Business process Upgrade**
  - Network operations
  - Customer operations

Each Primary/Distribution system

- **Infrastructure**
  - Civil works
  - Targeted rehabilitation
  - Instrumentation
  - Telemetry
  - Data update

- **Leadership**

Sustaining Practices
(proportional to system size and level)

- **Employment**
- **Equipment**
- **Operating Procedures**
- **kNowledge**
## Master Plan Summary

### Plan Components A to B

<table>
<thead>
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<th>Sector</th>
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<th>Sustain</th>
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12/6/2018
## Master Plan Summary

### Plan Components B to C

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12/6/2018
## Master Plan Summary
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12/6/2018
Master Plan Summary
Infrastructure Alternatives

Category A
- Primary System SCADA
- Establish and restructure DZ

Category B
- Design – Procurement - Execution

In-House Option
- DMA 1
- DMA 2
- DMA 3
- DMA 4
- DMA 5
- DMA 9
- DMA 13
- DMA 17

Turn-Key Outsourcing Option
- DMA 1
- DMA 2
- DMA 3
- DMA 4
- DMA 5
- DMA 6
- DMA 7
- DMA 8
- DMA 9
- DMA 10
- DMA 11
- DMA 12
- DMA 13
- DMA 14
- DMA 15
- DMA 16
- DMA 17
- DMA 18
- DMA 19
- DMA 20

Category C
- Design – Procurement - Execution

In-House Option
- DMA 1
- DMA 2
- DMA 3
- DMA 4
- DMA 5
- DMA 6
- DMA 7
- DMA 8
- DMA 9
- DMA 10
- DMA 13
- DMA 14
- DMA 15
- DMA 16
- DMA 17
- DMA 18
- DMA 19
- DMA 20

Targeted Customer Smart Meters
Big Customer Smart Meters
Smart Meters for DMAs with 24/7

Sustain
Master Plan Summary
Cost budgeting (to undergo continuous update)

– Capital fixed cost budgeting
– Capital maintenance cost
– Annual operating costs
Implementation Auditing

- Defining data collection methods
- Defining quantitative and qualitative targets for utilities
- Assisting regulators in performance assessments
THANK YOU FOR ATTENTION!!

Amman, December 3, 2018