SUE “Dushanbevodokanal” (DVK)  
- WSS operation and NRW reduction initiatives - 
- Activities undertaken under DWSP2 - 

Workshop on topic “Capacity Development, Water Operators’ Partnerships and Financing for Non-revenue Water Management”  
July 07-09, 2014
DVK provides water supply and sewerage services in the following districts of Dushanbe:

1. Sino;  
2. Firdavsi;  
3. Shokhmansur;  
4. Somoni;  

And in one district outside of Dushanbe:  
5. Rudaki

The total number of inhabitants amounts to **764,300** persons. Population data were received from the State Committee of Statistics. The data allow a spatial distribution of the inhabitants in Dushanbe and allocation of the population for each supply zone.

The specific consumption per person in Dushanbe is between **718 – 903 l/p/d**. This figure includes domestic demand, physical losses, commercial and institutional demand and demand for budget organisations and government.
WATER PRODUCTION

4 water production facilities:

- SAM Water Treatment Plant  \(\approx 228,9\) ths. m\(^3\)/day
- NAP Water Treatment Plant  \(\approx 55,8\) ths. m\(^3\)/day
- KAF Wellfield  \(\approx 211,9\) ths. m\(^3\)/day
- SW Wellfield  \(\approx 182,4\) ths. m\(^3\)/day

TOTAL PRODUCTION:

\(\approx 680 – 750\) ths. m\(^3\)/day
WATER SUPPLY NETWORK

1. Transmission mains - 173.7 km, DN = 300 – 1200 mm
2. Water main pipelines - 292.1 km, DN = 100 – 600 mm
3. Distribution network – 220 km, DN = 50 – 150 mm

TOTAL LENGTH: 675.8 km

Average age – 51 years
Tech. losses – 75%
Leakages – 3 leak./km
Difference in altitude – 200 m
Network – 8 pressure zones

Average pressure – 2÷6 bars in each zone
# WATER SUPPLY NETWORK – RESERVOIRS

<table>
<thead>
<tr>
<th>Name</th>
<th>Volume</th>
<th>Year of Commissioning</th>
<th>Altitude of Bottom</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ON WATER SUPPLY NETWORK</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>III. Zone</td>
<td>2 x 6,000m³</td>
<td>1975</td>
<td>876,5m</td>
</tr>
<tr>
<td>Kalinin</td>
<td>10,000m³</td>
<td>1967</td>
<td>846,3m</td>
</tr>
<tr>
<td>V. Zone</td>
<td>2 x 10,000m³</td>
<td>1975</td>
<td>805,8m</td>
</tr>
<tr>
<td>Surkhob</td>
<td>6,000m³</td>
<td>1980</td>
<td>846,3m</td>
</tr>
<tr>
<td></td>
<td>3,000m³</td>
<td>1970</td>
<td>846,3m</td>
</tr>
<tr>
<td>CDP</td>
<td>2 x 6,000m³</td>
<td>1977</td>
<td>811,7m</td>
</tr>
<tr>
<td>Bakhori</td>
<td>6,000m³</td>
<td>1980</td>
<td>846,3m</td>
</tr>
<tr>
<td></td>
<td>1,000m³</td>
<td>1970</td>
<td>846,3m</td>
</tr>
<tr>
<td><strong>ON WATER TREATMENT PLANTS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAM</td>
<td>2 x 2,000m³</td>
<td>1957-61</td>
<td>898,4m</td>
</tr>
<tr>
<td>NAP</td>
<td>1,000m³</td>
<td>1962</td>
<td>823,5m</td>
</tr>
<tr>
<td></td>
<td>500m³</td>
<td>1932</td>
<td>825,1m</td>
</tr>
<tr>
<td></td>
<td>60m³</td>
<td>1980</td>
<td>830,0m</td>
</tr>
<tr>
<td>SW</td>
<td>2 x 3,000m³</td>
<td>1977</td>
<td>743,1m</td>
</tr>
<tr>
<td></td>
<td>2,000m³</td>
<td>1979</td>
<td>743,1m</td>
</tr>
<tr>
<td>KAF (east)</td>
<td>3,000m³</td>
<td>2013</td>
<td>630,3m</td>
</tr>
<tr>
<td></td>
<td>2,000m³</td>
<td>1972</td>
<td>630,3m</td>
</tr>
<tr>
<td></td>
<td>1,000m³</td>
<td>1972</td>
<td>630,3m</td>
</tr>
<tr>
<td>KAF (west)</td>
<td>6,000m³</td>
<td>1987</td>
<td>755,7m</td>
</tr>
<tr>
<td></td>
<td>2,000m³</td>
<td>1967</td>
<td>755,7m</td>
</tr>
<tr>
<td></td>
<td>2,000m³</td>
<td>1972</td>
<td>755,7m</td>
</tr>
</tbody>
</table>
Water loss reduction strategy (WLRS)

- **Goals of WLRS**
- **Types of water losses:**
  - **Commercial:**
    - Eliminate unauthorized consumers
    - Accurate consumption measurement
  - **Physical:**
    - Method for detection
    - Repairs
    - Success Control
    - Documentation
# Components of RW and NRW

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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Billed Authorized Consumption</td>
<td>Billed Metered Consumption</td>
<td>Billed Unmetered Consumption</td>
<td>Unbilled Metered Consumption</td>
<td>Unbilled Unmetered Consumption</td>
<td>Water</td>
</tr>
<tr>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Leakages on Main and Distribution Lines**
- **Leakages and Overflows from Storage Tanks**
- **Leakages on Service Connections up to the Consumer**
- **Customer Meter Inaccuracy and Data Handling Errors**
- **Unmetered Consumption**

**Water Losses**

- **Physical Losses**
  - **Leakages on Main and Distribution Lines**
  - **Leakages and Overflows from Storage Tanks**
  - **Leakages on Service Connections up to the Consumer**

**Commercial Losses**

- **Commercial Losses**
  - **Unauthorized Consumption**
  - **Customer Meter Inaccuracy and Data Handling Errors**

**Authorized Consumption**

- **Billed Authorized Consumption**
  - **Billed Metered Consumption**
  - **Billed Unmetered Consumption**

**Unbilled Authorized Consumption**

- **Unbilled Metered Consumption**
- **Unbilled Unmetered Consumption**

**Water**

- **Unmetered Consumption**
- **Unmetered Unmetered Consumption**

**Non-Rev. Water**

- **Unauthorized Consumption**
- **Customer Meter Inaccuracy and Data Handling Errors**

**Rev. Water**

- **Billed Authorized Consumption**
- **Billed Metered Consumption**
- **Billed Unmetered Consumption**

**Physical Losses**

- **Leakages on Main and Distribution Lines**
- **Leakages and Overflows from Storage Tanks**
- **Leakages on Service Connections up to the Consumer**

**Commercial Losses**

- **Commercial Losses**
  - **Unauthorized Consumption**
  - **Customer Meter Inaccuracy and Data Handling Errors**

**Authorized Consumption**

- **Billed Authorized Consumption**
  - **Billed Metered Consumption**
  - **Billed Unmetered Consumption**

**Unbilled Authorized Consumption**

- **Unbilled Metered Consumption**
- **Unbilled Unmetered Consumption**

**Water**

- **Unmetered Consumption**
- **Unmetered Unmetered Consumption**

**Non-Rev. Water**

- **Unauthorized Consumption**
- **Customer Meter Inaccuracy and Data Handling Errors**

**Rev. Water**

- **Billed Authorized Consumption**
- **Billed Metered Consumption**
- **Billed Unmetered Consumption**
Binokoron Pilot Area

WATER LOSS REDUCTION STRATEGY
BASIC DATA

Network length: 5,0 km
Material: carbon steel
Network topology: 52.4% DN 100/150
23.8% <DN 80
23.8% others
Age: >50 years
No. of customers: 1,227
No. of inhabitants: 3,611

*) DVK database 23/08/2013
WATER LOSS REDUCTION STRATEGY

Binokoron Pilot Area

OBJECTIVES

• Determination of the share of the different kind of losses (administrative/technical)
• Examination of the impact of different NRW reduction measures
• Derivation of a NRW reduction strategy for the whole network
METHODOLOGY

• Measurement of the daily consumption pattern
• Installation of new customer meters
• Leak detection and repair
Binokoron Pilot Area

MEASUREMENT OF THE DAILY CONSUMPTION PATTERN

• Metering of the total consumption of the pilot area
  ➔ Basic data for the NRW calculation

• Evaluation of the minimum night flow
  ➔ Indicator of real water losses

• Reference value for future measurements
  ➔ Success control
WATER LOSS REDUCTION STRATEGY

Binokoron Pilot Area

FIRST MEASUREMENT ON 25/09/2013

Average daily consumption: 7,377 m$^3$ (307.3 m$^3$/h)
Minimum night flow: p270 m$^3$/h ➔ real water losses

Estimation:

\[
\frac{(270 \text{ m}^3/\text{h} \times 24 \text{ h})}{7,377 \text{ m}^3} \times 100\% = 87.7\% \text{ real water losses}
\]
INSTALLATION OF NEW CONSUMER METERS

- Field Investigation – cleaning up the customer data base, determination of the number of not yet registered consumers

► Administrative losses by not registered consumption
Binokoron Pilot Area

INSTALLATION OF NEW CONSUMER METERS

• Comparison of previous and actual monthly consumptions

→ Administrative losses by wrong estimation and inaccurate consumer meters

→ Effect of water saving by billing based on really consumption, increase of the daily per–capita consumption

Status quo: Shortly before completion
Binokoron Pilot Area

LEAK DETECTION

• Detection and repair of all visible and hidden pipe and valve damages

→ Determination and reduction of technical losses

• Investigation of the causes

→ Elaboration of a sustainable rehabilitation strategy

Status quo: Equipment is procured/repaired
Stuff was trained in a training camp
Field training starts now
Binokoron Pilot Area

LEAK DETECTION

Attention!

An unique leak detection and repair campaign doesn’t reduce the technical water losses durably.

New damages because of the increasing pressure and the continuing aging

Therefore a permanent flow monitoring is required (District Metering).
**Binokoron Pilot Area**

**EMBEDDING INTO OVERALL STRATEGY**

- Step by step implementation in all isolable network districts (DMA´s)
- Continuously reduction of technical losses
- Improvement of the rehabilitation strategy
New Billing System
(for reducing NRW)

• Automated billing system will reduce the amount of unbilled consumption

• Regular updating of Database will reduce unauthorized consumption

• New methods of meter reading will reduce inaccuracies
SECOND DUSHANBE WATER SUPPLY PROJECT

Financial Agreement
13.06.2011

WB (IDA) & GoRT

DVK, PAU/PMC, DWSP2, MoD

Objectives

Component 1, Component 2, Component 3, Component 4
Project Development Objective (PDO):

To improve water utility performance and water supply services in selected areas of Dushanbe.

Performance indicators:

• Quality of water

• Customer satisfaction with water supply service

• Improvement of financial performance of DVK
PROJECT COMPONENTS:

- Component 1: Metering and Demand Management
- Component 2: Water Quality Improvement
- Component 3: Institutional Strengthening and Capacity Building
- Component 4: Implementation Support
METERING AND DEMAND MANAGEMENT:

- Procurement of 76,500 residential water meters
- Installation of 76,500 residential water meters
- Proc. & installation of flow meters at 4 WTP
- Procurement of software for the NIS system (Establishing of NIS)
- Procurement and installation of SCADA (Installation of SCADA)
- Public communication and awareness program
- Customer Satisfaction Surveys
WATER QUALITY IMPROVEMENT:

- Cleaning network sections and reservoirs
- Design and Build of Rapid Sand Filters at SAM
- Design and Build of PS and two reservoirs at NAP
- Procurement of hydraulic excavator
- Procurement of laboratory equipment
- Procurement and installation of re-chlorination units at 5 reservoirs
- Procurement of Measuring Equipment for Leakage Detection
INSTITUTIONAL STRENGTHENING AND CAPACITY BUILDING:

- Institutional Assessment
- Revaluation of FA and Inventory
- Procurement of new accounting software
- Procurement of Customer Management System
- Technical Assistance for corporate development and financial performance
- Technical Assistance for operational improvements
- Training programs
<table>
<thead>
<tr>
<th>Programme</th>
<th>Training Programmes in Tajikistan</th>
<th>Training providing company</th>
<th>Status</th>
<th>Coordinated with the WB</th>
<th>Period of conducting</th>
</tr>
</thead>
<tbody>
<tr>
<td>DWSP2-TP0</td>
<td>Procurement of Equipment for Training program</td>
<td>ongoing</td>
<td></td>
<td>Not</td>
<td>июн.04</td>
</tr>
<tr>
<td>DWSP2-TP1</td>
<td>Courses of English for Businessmen</td>
<td>Mr. Nizomiddin Shobiddinov</td>
<td>ongoing</td>
<td>yes</td>
<td>Jan- Dec 2014</td>
</tr>
<tr>
<td>DWSP2-TP2</td>
<td>Comprehensive phased financial, accounting and HR course</td>
<td>Public Institute of professional Accountants, Tajikistan</td>
<td>ongoing</td>
<td>yes</td>
<td>May 2014- April 2015</td>
</tr>
<tr>
<td>DWSP2-TP3</td>
<td>Complex of technical trainings for electricians; plumbers; mechanics; welders</td>
<td></td>
<td></td>
<td></td>
<td>During 2015</td>
</tr>
<tr>
<td>DWSP2-TP4</td>
<td>Training course on AutoCAD software</td>
<td></td>
<td></td>
<td></td>
<td>During 2015</td>
</tr>
<tr>
<td>DWSP2-TP5</td>
<td>Training program on working with customers</td>
<td></td>
<td></td>
<td></td>
<td>During 2015</td>
</tr>
</tbody>
</table>
## Training Programmes abroad

<table>
<thead>
<tr>
<th>Training Programme</th>
<th>Description</th>
<th>Organizing Company</th>
<th>Status</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>DWSP2-TP6</td>
<td>Study tour on operation &amp; maintenance of Rapid Sand Filters</td>
<td>Veolia Water Solutions, Romania</td>
<td>Offer received</td>
<td>07.08-14.08.2014 or later</td>
</tr>
<tr>
<td>DWSP2-TP7, DWSP2-TP14</td>
<td>1. Study tour on Water Utility Management: finance &amp; accounting &amp; customer management 2. Study tour on HR issues (motivation of employees, attraction of qualified personnel, etc.)</td>
<td>Utility Company Sachsen Wasser, Leipzig, Germany</td>
<td>Offer received</td>
<td>09.10-15.10.2014</td>
</tr>
<tr>
<td>DWSP2-TP9, DWSP2-TP12</td>
<td>1. Study tour on specifics of SCADA in water supply utilities (network structuring, work flow optimization, etc.) Study tour on 2. Electromechanical Equipment: pumping machinery and automatization (2nd and 3rd level of pumps)</td>
<td>Utility Company Sachsen Wasser, Leipzig, Germany</td>
<td>Offer received</td>
<td>26.10-31.10.2014</td>
</tr>
<tr>
<td>DWSP2-TP11</td>
<td>Study tour on leak detection; pipe detection; pressure and flow measurements</td>
<td>F.A.S.T. GmbH, Germany</td>
<td>Completed</td>
<td>23.03-28.03.2014</td>
</tr>
<tr>
<td>DWSP2-TP13</td>
<td>Study tour on using of laboratory equipment</td>
<td>Utility Company Sachsen Wasser, Leipzig, Germany</td>
<td>Offer received</td>
<td>12.10-17.10.2014</td>
</tr>
<tr>
<td>DWSP2-TP15</td>
<td>Study tour on operation of tariff and billing system</td>
<td>Offer not yet received</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PROJECT IMPLEMENTATION SUPPORT:

- Design and supervision of works
- Consultancy, Audit
## Project Development Objective (PDO): Improve water utility performance and water supply services in selected areas of Dushanbe.

<table>
<thead>
<tr>
<th>PDO Level Results Indicators*</th>
<th>Baseline</th>
<th>Cumulative Target Values**</th>
<th>Responsibility for Data Collection</th>
<th>Description (indicator definition, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicator One: Water quality in the network:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parameter 1: Turbidity in the network. TARGETS</td>
<td>2009: 40% of samples comply with the standard (MAC* is 2mg/l)</td>
<td>To start the design of the SAM filters</td>
<td>To start construction of SAM filters</td>
<td>To start operation of the SAM filters; 99% of samples comply with the standard</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>40% of samples comply with the standard</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>To start design and construction of SAM filters</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>86% of samples comply with the standard</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>To start operation of the SAM filters;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DVK/PMC</td>
</tr>
<tr>
<td>RESULTS</td>
<td>47% Preparatory stage of the Project</td>
<td>49% Selection of Project Management Consultant</td>
<td>36.7% of the samples correspond. Bidding documents for construction of new filters were prepared and no objection of the WB was received.</td>
<td>Improvement of indicators is subject to successful operation of NAP filters, construction and operation of SAM filters, and partial washing of the network.</td>
</tr>
</tbody>
</table>
### Parameter 2: Residual chlorine in the network.

**TARGETS**

**RESULTS**

<table>
<thead>
<tr>
<th>2009:</th>
<th>98% of samples show residual Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design and installation of rechlorination equipment in the network</td>
<td>Completion and start up of the rechlorination equipment in the network</td>
</tr>
<tr>
<td>99% of samples show residual Cl</td>
<td>99% of samples show residual Cl</td>
</tr>
<tr>
<td>Design and installation of rechlorination equipment in the network</td>
<td>Completion and start up of the rechlorination equipment in the network</td>
</tr>
</tbody>
</table>

Note: sensitivity of the test is 0.02 mg/l of Cl concentration - this is a traceable border. The indicator is subject to installation of rechlorination systems and general reduction of turbidity in the network.

### Parameter 3: Bacteriological water quality:

**TARGETS**

**RESULTS**

<table>
<thead>
<tr>
<th>2009:</th>
<th>96% of samples comply with the standard (MAC* is 3 coli forms/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject to improvement of water treatment at SAM and NAP and rechlorination in the network</td>
<td>Subject to improvement of water treatment at SAM and NAP and rechlorination in the network</td>
</tr>
<tr>
<td>99% of samples comply with the standard</td>
<td>99% of samples comply with the standard</td>
</tr>
<tr>
<td>99% of samples comply with the standard</td>
<td>99% of samples comply with the standard</td>
</tr>
</tbody>
</table>

The indicators are subject to reduction of turbidity in the network and presence of residual Cl in the network.
**Second Dushanbe Water Supply Project**

**Indicator Two: Customer satisfaction with water supply services**

<table>
<thead>
<tr>
<th>Parameter 1: Improved water quality (in general) - Percentage of customers, satisfied with water quality.</th>
<th>2010 TBD by the Customer Satisfaction Survey, conducted under the DWSSP 1</th>
<th>No changes are expected</th>
<th>No changes are expected</th>
<th>Improved to 89%</th>
<th>Improved to 90%</th>
<th>DVK/ PMC</th>
<th>Note: the target value will be set after the baseline will be determined under the DWSSP 1.</th>
</tr>
</thead>
<tbody>
<tr>
<td>TARGETS</td>
<td>76% based on the 2011 Customer Satisfaction Survey</td>
<td>No changes are expected</td>
<td>No changes are expected</td>
<td>86.4% based on Customer Satisfaction Survey for 2013 (from Report on DWSP2-20.2)</td>
<td>90% of customers receive more than 12 hours in a day services; the final target will be revised after hydraulic model is in place</td>
<td>DVK/PMC</td>
<td>Hydraulic model will be developed by the project.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter 2: Availability of ws services - Percentage of customers with more than 12 h of ws service per day.</th>
<th>70% of population are satisfied with ws services; to be revised based on the results of 2011 Customer Satisfaction Survey (DWSP) 2</th>
<th>No changes are expected</th>
<th>No changes are expected</th>
<th>Improvements due to installed meters 80%</th>
<th>90% of customers have more than 12 hours of service per day (from Report on DWSP2-20.2)</th>
<th>DVK/PMC</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TARGETS</td>
<td>57% have more than 12 h of services per day, in 2011</td>
<td>No changes are expected</td>
<td>No changes are expected</td>
<td>72.1% of customers have more than 12 hours of service per day (from Report on DWSP2-20.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Indicator Three: Improvement of financial performance of DVK

### Parameter 1: Cash operating ratio has improved

- **Setting of project accounts, no target is imposed**
- **To reach 1**
- **Not higher than 0.9**
- **Financial working ratio of total cash operating expenses (excluding interest and other charges on debt) to total cash operating revenues; ideally should be less than 1; improvement of ratio means increase of revenues (if revenues grow faster than expenses).**

#### RESULTS

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.22</td>
<td>1.07</td>
<td>1.09 (according to preliminary data from DVK)</td>
<td></td>
</tr>
</tbody>
</table>

#### TARGETS

<table>
<thead>
<tr>
<th></th>
<th>2009: 154,000 residential customers or 340 495 people</th>
<th>Intensive inventorying of customers should take place</th>
<th>By the end of 2011 the baseline number should be increased to cover reflect the actual population of Dushanbe (plus the service area in Rudaki rayon)</th>
<th>To reach actual population of the DVK service area</th>
<th>To reach actual population of the DVK service area</th>
<th>To reach actual population of the DVK service area</th>
<th>DVK/PMC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Officially, population in Dushanbe is 720,000 people, plus the population in the service area in Rudaki rayon should be reflected. The baseline data are taken from the feasibility study report.</td>
<td></td>
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</tr>
<tr>
<td>RESULTS</td>
<td>176,443 residential customers or 410,000 people (Inventory of residential customers was not completed)</td>
<td>167,340 registered residential customers or 647,122 people (out of these 13,478 are in Rudaki district or 71,591 people)</td>
<td>167,001 registered residential customers or 539,876 people (including 13,494 customers or 75,938 people located in Rudaki district)</td>
<td>25% Gradual decrease towards 15%</td>
<td>15%</td>
<td>15%</td>
<td>DVK/PMC</td>
</tr>
<tr>
<td>--------</td>
<td>-------------------------------------------------</td>
<td>-------------------------------------------------</td>
<td>-------------------------------------------------</td>
<td>-----------</td>
<td>--------</td>
<td>--------</td>
<td>-----------</td>
</tr>
<tr>
<td>TARGETS</td>
<td>Parameter 3: Accounts receivable as % of revenue.</td>
<td></td>
<td></td>
<td>82%</td>
<td>48%</td>
<td>44.7%</td>
<td>(according to preliminary data from DVK)</td>
</tr>
</tbody>
</table>
THANK YOU!