2011

# Energy Audit of Water and Wastewater Utilities in 6 towns of Moldova


## Final Report

# BALTI

Tehno Consulting & Design

December 2011

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# ABBREVIATIONS

| **Selected Definitions:** | **Abbreviation / Synonym Definition** |
|---|---|
| A.S.L. | Above Sea Level |
| BPS | Booster Pumping Station |
| WB | World Bank |
| IDA | International Development Association |
| Client | Water Supply and Sanitation Projects Implementation Unit |
| Auditor/Consultant | Tehno Consulting & Design |
| EE | Energy Efficiency |
| ECM | Energy Conservation Measures |
| EEP | Energy Efficiency Program |
| EMP | Energy Management Program |
| PS | Pumping Station |
| SPS | Sewage Pumping Station |
| MSPS | Main Sewerage Pumping Station |
| NWSSP | National Water Supply and Sanitation Project |
| RWTP | Raw Water Treatment Plant |
| WWTP | Waste Water Treatment Plant |
| O&M | Operation and Maintenance |
| BoQ | Bill of Quantities |
| VSD | Variable Speed Drive |
| HVAC | Heating, Ventilation, and Air Conditioning |
| WSS | Water Supply and Sanitation |

# EXECUTIVE SUMMARY

Present Energy Audit report summarizes Apa-Canal Balti facilities description, historical data, Auditor's findings, site measurements data, analyses and ECM proposals.
Our energy audit team visited Balti and collected historical water and energy usage data, as well as the existing equipment operating data. As a result of the site measurements we identified several ECM, which in our opinion will provide feasible opportunities for significant energy savings.
The feasibility of each proposed ECM was estimated through a payback analysis. The simple payback period was determined after establishing Engineer's estimation of capital investments, O&M equipment costs, projected annual energy savings estimates, and the potential value of energy tariff.

## Recommended ECMs for Balti

The following table presents the ranking of recommended ECMs identified for Apa-Canal Balti. The ECMs are ranked separately for Balti on a simple payback period basis.

| ECM description | Annual energy savings, kWh | Annual energy savings, MDL | Capital investment cost, MDL | Simple payback period, years | Ranking |
|---|---|---|---|---|---|
| **Optimization of existing water supply scheme from Soroca-Balti reservoirs** | 3,700,000. | 5,365,000 | 0 | 0 | **1** |
| **Optimization of pumping scheme Decebal – Upper reservoirs - Baza** | 1,113,600 | 1,670,400 | 2,236,575 | 1.3 | **2** |
| **Replacement of active sludge recirculation pump** | 210,000 | 315,000 | 1,010,000 | 3.2 | **5** |
| **Speed control for air blower at WWTP** | 184,000 | 276,000 | 380,000 | 1.4 | **4** |
| **Replacement of pump at BPS Iorga 6** | 26,200 | 47,160 | 61,050 | 1.3 | **3** |
| **Cogeneration plant for electrical and heat power production** | Electricity and heating | 608,165 | 1,922,702 | 3.2 | **6** |

## Recommended ECMs to be included in the EMP

In order to prioritize investments from different Project towns, the indicator for relative energy saving as % of total energy consumption of each separate water utility was used as the most fair and important indicator. Thereby, the investments bringing the highest relative reduction in energy consumption in the respective towns were prioritized. This selection criterion was applied as primary one, while the secondary criterion of simple payback period was applied after preliminary sorting.

Three ECMs have been shortlisted for the EMP investment package:

| ECM description | Annual energy savings, kWh | Annual energy savings, MDL | Savings in % compared to total power consumption | Capital investment cost, MDL | Ranking |
|---|---|---|---|---|---|
| **Optimization of existing water supply scheme from Soroca-Balti reservoirs** | 3,700,000 | 5,365,000 | **36.8%** | 0 | **1** |
| **Optimization of pumping scheme Decebal – Upper reservoirs - Baza** | 1,113,600 | 1,670,400 | **11.1%** | 2,236,575 | **2** |
| **Cogeneration plant for electrical and heat power production** | Electricity and heating | 608,165 | **3.4%** | 1,922,702 | **3** |

Total investment amount for selected Balti ECMs is **349,225 USD.**

# 1. INTRODUCTION

The IDA provided financing in the amount of 0.9 mln USD which will be used for investments to raise energy efficiency in 6 (six) water and wastewater utilities of Moldova. The EEP is expected to demonstrate and disseminate through energy audits and following investments the potential for increasing energy efficiency in municipal water and wastewater operations.

The program finances energy audits, hydraulic regime optimizations, and the selective rehabilitation of electromechanical equipment (equipment replacement) which are expected to increase energy efficiency in municipal water and wastewater operations in the cities Balti, Cahul, Orhei, Causeni, Floresti and Ungheni.

This Final Audit Report summarizes findings, proposals, planned activities, schedule for completion of audit components, staffing and submission deadlines of audit reports and other deliverables for Energy Audit of Water and Wastewater Utilities in 6 towns of Moldova.

The contract has been let for open international tendering for consultancy services.

The contract was awarded to Tehno Consulting & Design and became effective on 20th June 2011. The duration of the services is expected to be 6 months.

## 1.1 Draft Audit Report

In previous Draft Audit Report the Consultant has introduced his assessment of energy conservation measures and investment needs in the city of Balti. The Report includes conditional and operational analysis of existing water and wastewater facilities and energy conservation measures, as well as a financial assessment of the proposed investments.

The report also includes the Consultants proposal of ECM measures for the future EMP investments.

Furthermore, this Report includes the output from the Baseline Studies as presented in the Consultants Inception Report.

There is one separate report for each of the six cities covered by the project.

## 1.2 Final Audit Report

Present Final Audit Report includes comments and suggestions to the Draft Report from the World Bank experts, WSSPIU and Apa-Canal Balti.

The meeting with stakeholders was held on December 07, 2011. The agreed shortlist of the EMP investments for Balti contains the following:

**Table 1-1** *The Agreed EMP Investments for Balti*

| Rank | The proposed ECM description | Annual energy savings, kWh | Annual energy Consumption of Water Utility, kWh | Savings in %, as compared to total consumption | Capital investment cost, MDL | Simple payback period, years |
|---|---|---|---|---|---|---|
| 1 | **Optimization of existing water supply scheme from Soroca-Balti reservoirs** | 3,700,000 | 10,044,651 | 36.8% | 0 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2 | **Optimization of pumping scheme Decebal – Upper reservoirs - Baza** | 1,113,600 | 10,044,651 | 11.1% | 2,236,575 | 1.3 |
| 3 | **Cogeneration plant for electrical and heat power production** | 337,869 | 10,044,651 | 3.4% | 1,922,702 | 3.2 |

The overall amount of proposed EMP investments for Balti is 4,159,277 MDL or **349,225 USD** (USD current exchange rate 11.91).

Consultant will prepare the following submittals for the selected ECMs:

- BoQ and Cost estimate for Goods, Works and associated services;
- Technical Specifications for Goods and Works within proposed EMP;
- Draft EMP schedule of implementation

# 2. WATER SERVICES IN THE TOWN OF BALTI

## 2.1 General

Balti is a city in Moldova, the second largest in terms of area and economic importance after Chisinau, and the third largest in terms of population after Chisinau and Tiraspol. The city is one of the five Moldovan municipalities and it is a major industrial, cultural and commercial centre and transportation hub in the north of the country. It is situated some 130 km north of the capital Chisinau, and is located on the river Raut on a hilly landscape in the Balti steppe.


**Figure 2-1** *Location of Balti*

Central part of Balti is located along the Raut River at the altitudes of 90-120 m above sea level, highest regions being situated in the North-Western part of Balti, reaching up to 140-160 m a.s.l. The Raut River, a tributary to the Nistru River, flows (NW-SE) through the City. The railroad crosses the City.

## 2.2 Service Area Definition

The City of Balti is provided with water services by a municipal operator (I.M. Regia Apa-Canal Balti) covering main part of the city and neighboring villages of Sadovoe and Rautel.

The whole Town represents multi-pressure zone service area with private houses, multi-storey buildings and industrial areas. The whole service area is located at 90-160 m a.s.l. and is supplied from Soroca-Balti Water Main and several deep wells.

The areas of multi-storey buildings and elevated areas are provided with water by twenty-five (25) booster PSs.

The estimated extent of water services in Balti is presented in the following figure:

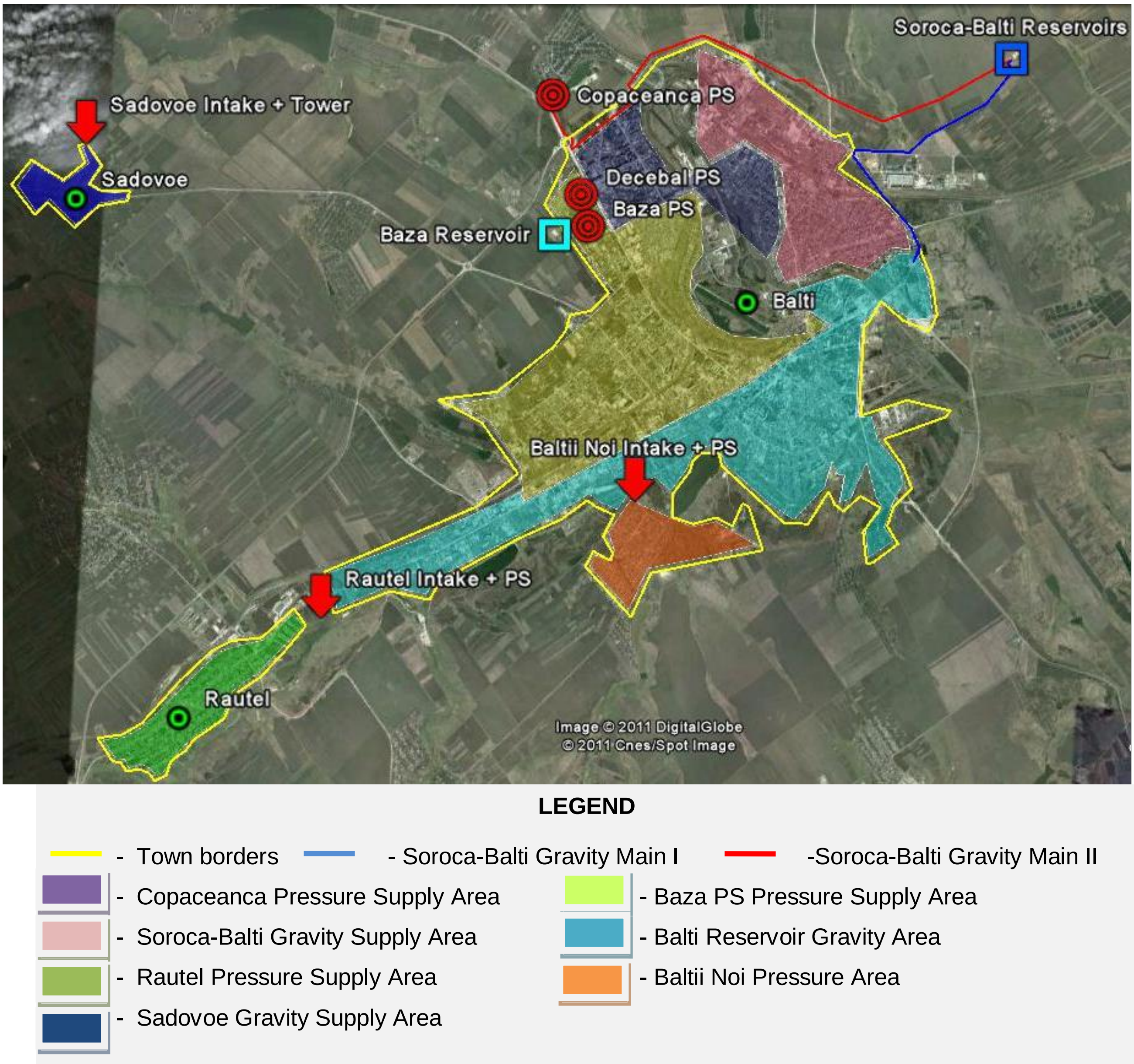



**Figure 2-2** *Estimated Extent of Water Service Areas in Balti*

This study covers Apa-Canal operations only. The possibilities of future water supply of uncovered areas by Apa-Canal shall be studied separately.

## 2.3 Population

The official population records for the City are summarized in the table below:

**Table 2-1** *Resident population in Balti Town, as of January1 by Years*[1]*, thou. people*

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|
| **Balti Municipality (incl. rural areas)** | 148.9 | 148.1 | 147.1 | 148.1 | 148.1 | 148.2 | 148.9 |
| **Balti City** | 144.2 | 143.2 | 142.2 | 143.2 | 143.2 | 143.3 | 144 |

[1] National Bureau of Statistics of the Republic of Moldova

As shown in the table, the official population number of the Town has been being rather stable over the last 6 years. Significant changes (especially growth) in population are not expected in the next years, as the average population growth rate for Moldova is estimated at -0.072% for 2011[2].

Notwithstanding the official statistical data, and taking into account high level of immigration, the real number of population (and consequently consumers) living in Balti is expected to be considerably lower.

## 2.4 Customers

The number of contracts (connections) by supply areas operated by the Apa-Canal is summarized in the following table.

**Table 2-2** *Water Supply Customers – Apa-Canal Balti*

| Supply Area | No of Water Customers (Contracts) | Estimated No. of population connected to water services (people) |
|---|---|---|
| **Balti Water Utility – whole supply area** | 48,000 | 108,000 |

As can be seen from the Table, the major number of consumers are private households. In total, as compared to the official population records, some 75% of the official area population is provided with water by Apa-Canal Balti. However, according to Balti Water Utility, some 89% of population are supplied with water.

This Audit Report covers ECMs for current consumption conditions only and does not envisage any considerable future extensions in terms of consumers.

Currently, only some 80% of total population are provided with sewerage services.

## 2.5 Preliminary Water Balance

The main source of water is Soroca-Balti water main. Balti water utility buys water from this water main, while own deep wells are used as a reserve. Only two (2) small wellfields are used for local water supply of two neighbouring villages.

The following table derives from information provided by the Apa-Canal.

**Table 2-3** *Reported Water Balance for Balti Apa-Canal*

| | 2008 | 2009 | 2010 |
|---|---|---|---|
| **Water Produced, $m^3$ including:** | - | - | - |
| ***Sadovoe Intake*** | 9,740 | 22,830 | 19,140 |
| ***Baltii Noi Intake – well 1*** | 53,874 | 53,431 | 53,306 |
| ***Baltii Noi Intake – well 2*** | 51,558 | 27,673 | 51,518 |
| ***Bought from Soroca-Balti*** | 7,443,574 | 6,494,140 | 6,483,850 |
| **Total Water Produced, $m^3$** | 7,558,746 | 6,598,074 | 6,607,814 |
| **Water Sold, $m^3$** | 3,855,300 | 3,819,800 | 3,772,600 |
| ***including to households, $m^3$*** | 2,458,200 | 2,601,500 | 2,590,500 |
| **Non-Revenue Water, %** | **49%** | **42%** | **43%** |

[2] Central Intelligence Agency, the World Factbook

The following Table provides information on water consumption pattern during the year 2010.

**Table 2-4** *Reported Volume of Water Produced in Balti for 2010*

| | 2010 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Source | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
| Sadovoe | 1,200 | 980 | 1,240 | 1,430 | 1,820 | 1,660 | 1,740 | 1,406 | 2,450 | 1,800 | 1,794 | 1,620 | 19,140 |
| Baltii Noi - 1 | | | 2,375 | 4,620 | 6,071 | 6,600 | 7,020 | 7,440 | 5,680 | 4,960 | 4,200 | 4,340 | 53,306 |
| Baltii Noi -2 | 3,809 | 2,688 | 3,141 | 3,986 | 4,620 | 4,958 | 5,983 | 5,884 | 4,154 | 4,328 | 3,690 | 4,277 | 51,518 |
| Soroca-Balti | 495,344 | 555,248 | 549,116 | 494,450 | 504,470 | 550,068 | 550,118 | 569,000 | 574,422 | 588,990 | 545,860 | 506,764 | 6,483,850 |
| TOTAL | 500,353 | 558,916 | 555,872 | 504,486 | 516,981 | 563,286 | 564,861 | 583,730 | 586,706 | 600,078 | 555,544 | 517,001 | 6,607,814 |

In respect of the water supply system, it is of note that the non-revenue water rate as estimated on the basis of the reported values over 3 years has relatively high values of 42-49% of produced water. High NRW rates are subject to this Energy Audit and a general NRW analysis is presented in the following Sections.

The city consumption pattern during the year is presented in the following Figure.

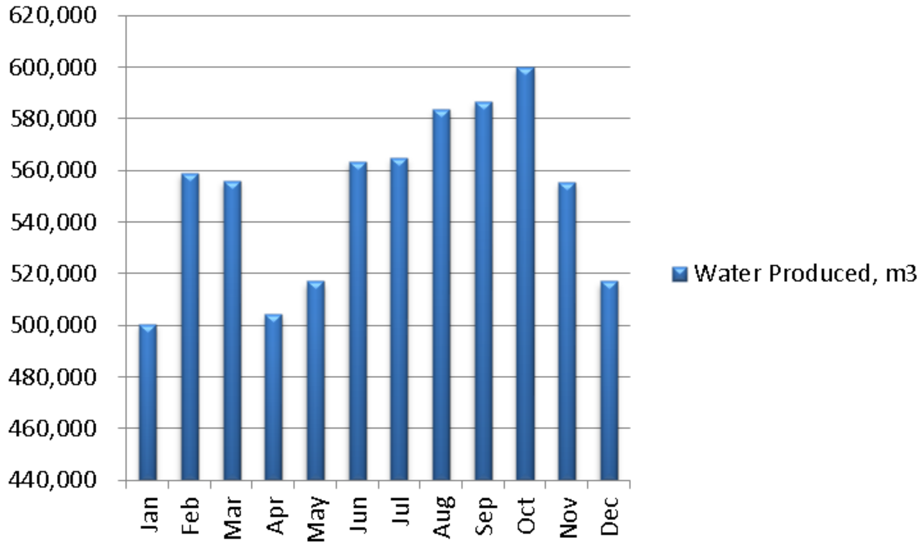



**Figure 2-3** *Reported Consumption Pattern for Balti for 2010*

As can be seen from the Figure above, the highest consumptions are typical for the period of June-October. Consultant carried out its measurements and analysis during the period of the highest consumption.
The reported volumes of the collected wastewater are presented in the Table below.

**Table 2-5** *Collected wastewater for 2008-2010*

| | 2008 | 2009 | 2010 |
|---|---|---|---|
| **Total Wastewater received, $m^3$ including:** | 7,106,900 | 7,354,600 | 7,683,000 |
| ***Wastewater from households, $m^3$*** | 2,121,900 | 2,220,800 | 2,244,300 |
| ***Wastewater from business/budget institutions, $m^3$*** | 1,187,500 | 1,069,500 | 1,049,900 |
| ***Stormwater/groundwater infiltrations, $m^3$*** | 3,797,500 | 4,064,300 | 4,388,800 |
| ***Household sewerage return rate, %*** | **86%** | **85%** | **87%** |

It shall be noted that besides household wastewater, WWTP receives drained storm-water and water from different industrial users. Overall the wastewater return rate is reasonably high reflecting good level of development of wastewater services.

# 3. WATER SUPPLY SYSTEM

## 3.1 General

The town of Balti is provided with water from one surface water source (the Nistru River) located in Soroca, through Soroca-Balti water main.

Southern and western parts of the town are supplied by gravity from the city reservoirs, while the northern part is supplied by several pumping stations.

Additionally, twenty-five (25) booster PSs are used to provide water to multi-storey buildings in the area. Two (2) separate PSs are used to supply water to neighboring village of Sadovoe and a new residential district Baltii Noi.

Some parts of networks and pressure mains are in poor condition due to its age and heavy use, generating high amounts of leakages.

## 3.2 Water Production and Treatment

The main volume of water supplied to consumers in Balti is provided from the Soroca-Balti surface water main. This water main is state-owned and operated by a state company Acva-Nord. Before the water enters into city reservoirs, it is treated at Soroca WTP and chlorinated by Acva-Nord. The water is stored into two (2) uphill reservoirs with capacity of 2 x 6,000 $m^3$, and thereafter supplied to the city networks/PSs. Balti Water Utility buys water from the water main and only a small volume of water is produced from its own deep wells, as follows:

- Sadovoe Intake: located in the area of the Village of Sadovoe. Consists of 2 deep wells, out of which one is in use. Water is stored to a water tower and thereafter supplied by gravity to the village network;
- Baltii Noi Intake: located in the southern part of the city and consists of 2 deep wells in operation. The deep wells have the yields of 10 $m^3/h$ and 25 $m^3/h$ respectively.

Also, there are some 60 deep wells within town area which were previously used as the main source of water. Currently these deep wells are used as reserve.

Both water intakes in use consume energy of less than 1% as compared to the total water consumption of Balti.

## 3.3 Historical Energy Consumption

The present section represents historical energy usage and associated Apa-Canal costs. It is important to establish at least 3 years patterns of mainly electric, as well as gas usage, if relevant, in order to be able to identify areas in which energy consumption can be reduced.

**Table 3-1** *Historical Energy Consumption Reported by Apa-Canal Balti for 2008-2010, kWh*

| | Facility | | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|
| 1 | **SEWERAGE** | *WWTP* | 2,922,217 | 2,723,530 | 2,710,614 |
| 2 | | *Main SPS* | 502,393 | 453,001 | 541,229 |
| 3 | | *District SPS1* | 152,289 | 147,896 | 143,116 |
| 4 | | *District SPS2* | 198,412 | 193,863 | 184,396 |
| 5 | | *District SPS3* | 9,681 | 8,698 | 9,653 |
| 6 | | *District SPS4* | 1,035 | 930 | 855 |
| 7 | | *District SPS5* | 8,822 | 11,763 | 12,715 |
| | **Sub-Total** | | **3,794,849** | **3,539,681** | **3,602,578** |
| 1 | **WATER MAIN PSs** | *Copaceanca PS* | 4,126,497 | 4,200,180 | 3,669,458 |
| 2 | | *Baza PS* | 1,751,207 | 1,381,758 | 1,198,993 |
| 3 | | *Baltii Noi PS* | 52,584 | 45,320 | 57,150 |
| 4 | | *Pogranicinaia PS* | 5,040 | 6,435 | 7,525 |
| 5 | | *PS 4* | 69,640 | 13,472 | 15,096 |
| 6 | | *Iunosti PS* | 1,115 | 870 | 320 |
| 7 | | *Reservoir PS* | 46,655 | 46,002 | 49,919 |
| 8 | | *Dom Veteranov PS* | 74,874 | 69,704 | 70,979 |
| 9 | | *Ment. Hospital PS* | 90,150 | 96,628 | 84,317 |
| 10 | | *Rautel PS* | 27,841 | 28,681 | 27,140 |
| 11 | | *Sadovoe PS* | 31,425 | 41,582 | 70,252 |
| 12 | | *Decebal 135 PS* | | | 660,553 |
| | **Sub-Total** | | **6,277,028** | **5,930,632** | **5,911,702** |
| 1 | **WATER BOOSTER PSs** | *1 Mai BPS* | 65,092 | 11,439 | 18,599 |
| 2 | | *Iorga 6 BPS* | 46,304 | 36,593 | 33,366 |
| 3 | | *Voroshilov 38 BPS* | 31,312 | 44,970 | 53,803 |
| 4 | | *Bulgara 25 PS* | - | - | - |
| 5 | | *Voroshilov 4 BPS* | 24,481 | 27,403 | 28,556 |
| 6 | | *Gagarina 23 BPS* | 65,201 | 53,400 | 46,380 |
| 7 | | *Hotinskaia BPS* | 49,710 | 34,455 | 31,564 |
| 8 | | *Ostrovskogo BPS* | 41,077 | 1,744 | - |
| 9 | | *Iorga 38 BPS* | 33,580 | 30,622 | 21,425 |
| 10 | | *Stamati 3 (Iachir) BPS* | 35,310 | 52,620 | 48,810 |
| 11 | | *Eminescu 13 BPS* | 24,444 | 1,296 | 3,984 |
| 12 | | *Koneva 28* | 19,414 | 20,127 | 19,318 |
| 13 | | *Caraseva BPS* | 7,710 | 16,509 | 16,657 |
| 14 | | *Bulgara 136 BPS* | - | - | - |
| 15 | | *Art. Koneva 5 BPS* | - | - | - |
| 16 | | *Pushkina BPS* | 6,172 | 3,155 | 4,534 |
| 17 | | *Suceava BPS* | 26,080 | 4,822 | 56,632 |
| 18 | | *Bulgara 118 BPS* | 14,597 | 18,901 | 14,353 |
| 19 | | *Leseciko 6 BPS* | - | - | - |
| 20 | | *Decebal-Buc BPS* | 14,850 | 14,054 | 14,430 |
| 21 | | *Glodenelor 83 BPS* | 3,029 | 3,713 | 4,322 |
| 22 | | *Deservire BPS* | 30,246 | 26,742 | 28,271 |
| 23 | | *Lesnaia BPS* | - | - | - |
| 24 | | *Koneva 16 BPS* | 26,418 | 25,318 | 24,017 |
| 25 | | *Uritskogo BPS* | - | - | - |
| | **Sub-Total** | | **565,027** | **427,883** | **469,021** |
| 1 | **Water Intakes** | *Rural Wellfields* | **65,000** | **55,950** | **61,350** |
| | **GRAND TOTAL** | | **10,701,904** | **9,954,146** | **10,044,651** |

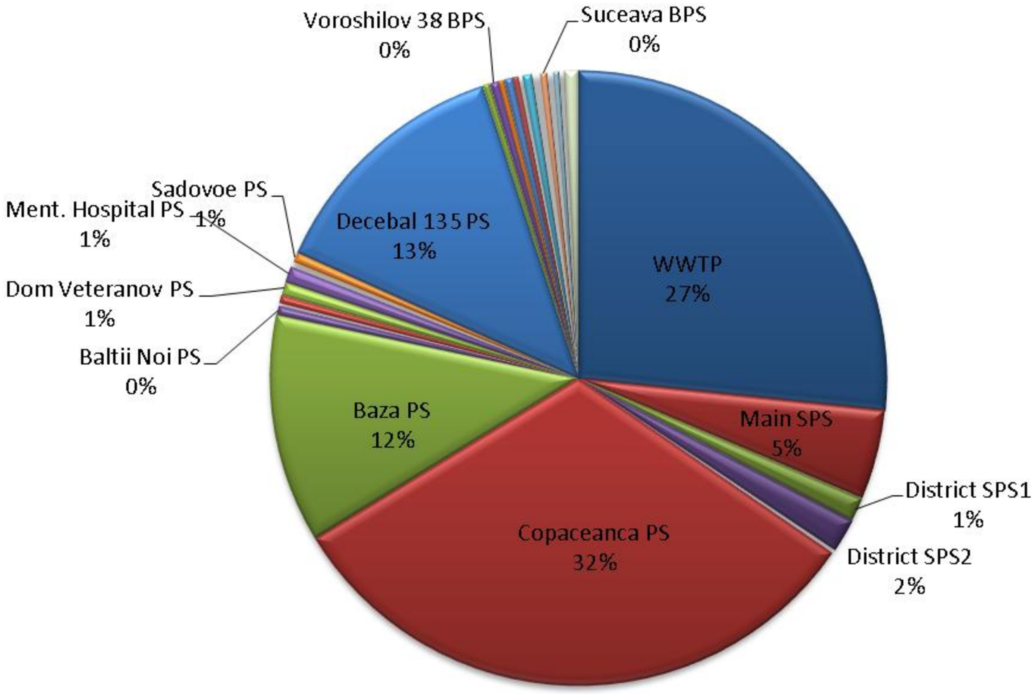



**Figure 3-1** *Distribution of Energy Consumption Reported by Apa-Canal Balti for July–December 2010*[3]

As can be seen from the Figure above, the main energy consuming facilities are Copaceanca PS (32%), Baza PS (12%), Decebal PS (13%) and WWTP (27%).

Distribution of Energy Consumption by Categories is shown in the next Figure.

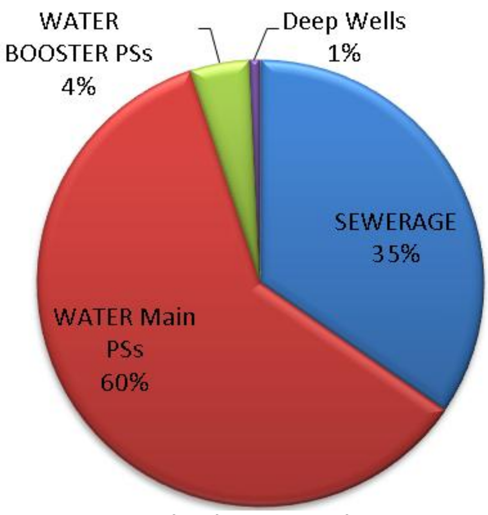



**Figure 3-2** *Distribution of Energy Consumption by Categories Reported by Apa-Canal Balti for 2010*[3]

Analysing the distribution of energy consumption by categories, it is of note that all town booster PSs and deep wells in use consume some 5% of the total energy consumption. Taking into consideration town scale and the system configuration, the Consultant has decided to concentrate its activity on

[3] Decebal PS was put into operation in July 2010. In order to have a clear picture of distribution of energy consumption, the Figure covers only last 6 months of 2010.

main energy consumers, avoiding minor consumers e.g. booster PSs and wellfields in use. However, this fact does not mean that the existing boosters PSs are operated efficiently. In order to provide a general picture of current condition of the booster PSs in use, the Consultant has organized site measurements for one of the existing PSs. The results and analysis are provided in the following Chapters.

## 3.4 Water Pumping – Copaceanca PS

In general, water supply network in the city of Balti is separated into two main zones – gravity zone in the south and pressure zone in the north. Also, there is a number of small PSs used to supply very limited areas. A number of booster PSs are used to provide water to multi-level residential buildings.

Northern part of Balti is supplied from a separate water main, conveying water from the Soroca-Balti city reservoirs to the Copaceanca PS reservoirs. Copaceanca PS is used to provide water to BAM District (north) of Balti, including reservoir from Decebal PS, and a small area on the left bank of the Raut River. The total number of area consumers was reported to be 10,786 (some 25,798 people).

City reservoirs are located at an elevation of 170 m above sea level (a.s.l.), while Copaceanca PS reservoirs are at 102 m a.s.l. The potential energy of gravity supply is dissipated in the reservoirs.

Pumping equipment at Copaceanca PS consists of eight (8) pumps separated into three (3) main groups of different pump types – Wilo, Д and НДВ. However, currently only pump 8-НДВ is in use. This is explained by fact that all pumps are oversized for current conditions and initially were designed to pump water to an uphill reservoir from Baza PS (190 m a.s.l.). Meantime, an intermediary PS, Decebal PS (143 m a.s.l.), was built and this allowed Apa-Canal to reduce the pump head at Copaceanca PS from 90 m to 60 m. However, Apa-Canal reduced the pump head through size reduction of the pump wheel (pump 8-НДВ), leaving the same size of the electric motor.

The only pump in use sucks water from the reservoirs and supplies it to a residential multi-level building area and an area of private houses, located on the left bank of the Raut. No frequency converters are used.

General data on installed pumping equipment are presented in the following Table.

**Table 3-2** *Design parameters of the existing pumping equipment at the Copaceanca PS in Balti*

| Pmp No | Model | Qty | Design Flow rate | Design Head | Design Motor Data | | | | | Control Panel | Operating | Year of instal-lation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | P | Voltage | Speed | cosφ | In | | | |
| | | | $m^3/h$ | m | kW | V | rpm | | A | | hrs /day | |
| **1** | 8-НДВ (Д630-90) | 1 | 630 | 90 | 250 | 6300 | 1480 | 0.9 | 10 | | 24 | |
| **2** | Д 200/90 | 1 | 200 | 90 | 55 | 380 | 2920 | 0.92 | 100 | | | |
| **3-6** | Wilo NP80/250V-75/2-12 | 4 | 200 | 90 | 75 | 400 | 2975 | 0.87 | 132 | | | |
| **7** | 8-НДВ (Д630-90) | 1 | 630 | 90 | 250 | 6300 | 1480 | 0.9 | 10 | | | |
| **8** | Д 200/90 | 1 | 200 | 90 | 55 | 380 | 2920 | 0.92 | 100 | | dismantled | |

Pump 8-НДВ is used to operate non-stop, while other pumps are used as reserve.

As the Main PS is the main energy consumer in Balti WSS, it is subject to further analysis, presented in the next Chapters.

## 3.5 Water Pumping – Decebal and Baza PSs

Decebal PS was built in 2010 as an intermediary PS between Copaceanca PS and Baza PS. Decebal PS reservoirs are located at an elevation of 143 m a.s.l.

Decebal PS consists of three (3) parallel centrifugal pumps of type 1Д 500/63, out of which 2 pumps are in permanent use.

Pumps in use suck water from the reservoir and lift it to the uphill reservoirs used by Baza PS. Baza PS reservoirs are located at 190 m a.s.l. No consumers are provided with water from Decebal PS. No frequency converters are used.

Baza PS is located at 156 m a.s.l. at Balti Apa-Canal office territory, while its reservoirs are at 190 m a.s.l. Baza PS is used to supply water to the northern part of the town, the supply area being limited by the Raut River in the east and Stefan cel Mare Main Street in the south. Supply area includes residential multi-level buildings, private houses and industry. The total number of area consumers was reported to be 14,093 (some 32,484 people). Pressure networks are interconnected with gravity networks from the south of the city, making it difficult to analyze the real area consumption.

Baza PS consists of three groups of pumps of different types, out of which only 2 groups are in use, pumping water in parallel into one common supply area. Two (2) pump of type D 320/50 are provided with frequency converters.

General data on installed pumping equipment are presented in the following Table.

**Table 3-3** *Design parameters of the existing pumping equipment at Baza and Decebal PSs in Balti*

| Pmp No | Model | Qty | Design Flow rate | Design Head | Design Motor Data | | | | | Control Panel | Operating | Year of instal-lation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | P | Voltage | Speed | cosφ | In | | | |
| | | | m³/h | m | kW | V | rpm | | A | | hrs /day | |
| | | | | | Decebal PS | | | | | | | |
| 1-3 | 1Д 500/63 | 3 | 450 | 53 | 110 | 380 | 1485 | 0.85 | 207 | | 24 (2/3) | |
| | | | | | Baza PS | | | | | | | |
| 1 | Д 500/ 65 | 2 | 500 | 65 | 125 | 380 | | | | | Standby | |
| 2 | Д 320/50 | 2 | 320 | 50 | 75 | 380 | 3000 | 0,87 | 125 | | 24 | |
| 3 | Д 200/65 | 1 | 200 | 65 | 55 | 380 | 2940 | 0,92 | 100 | | 16 | |

As these PSs are the main energy consumers in Balti WSS, they are subject to further analysis, presented in the next Chapters.

## 3.6 Water Pumping – Other network PSs

Besides three described main PSs, Balti water system has additional relatively smaller 9 PSs, which are used to maintain pressure in small limited areas of the network. These PSs were designed for the previous groundwater supply scheme. Currently, most of the PSs are used on irregular basis only in case of necessity. Small PSs are presented in the following Table.

**Table 3-4** *Existing small water PSs in Balti*

| No | PS Name | Location/Supply Area | Status |
|---|---|---|---|
| **1** | Baltii Noi PS | South of Balti – area of private houses | Operating |
| **2** | Pogranicinaia PS | Center of Balti – area of military service | Not in use |
| **3** | PS 4 | Center of Balti – area of multi-level buildings. Only when network pressure is not enough to reach exiting booster PSs | Irregular operation |

| No | PS Name | Location/Supply Area | Status |
|---|---|---|---|
| 4 | Iunosti PS | City Center | Not in use |
| 5 | Reservoir PS | Soroca-Balti city reservoir s – for internal use | Operating |
| 6 | Dom Veteranov PS | South of Balti – several buildings | Operating |
| 7 | Ment. Hospital PS | South-East of Balti. Only for local mental hospital area | Operating |
| 8 | Rautel PS | Rautel village | Not in use |
| 9 | Sadovoe PS | Sadovoe village | Not in use |

Estimated supply areas of the PSs in use are shown in the next Figure.

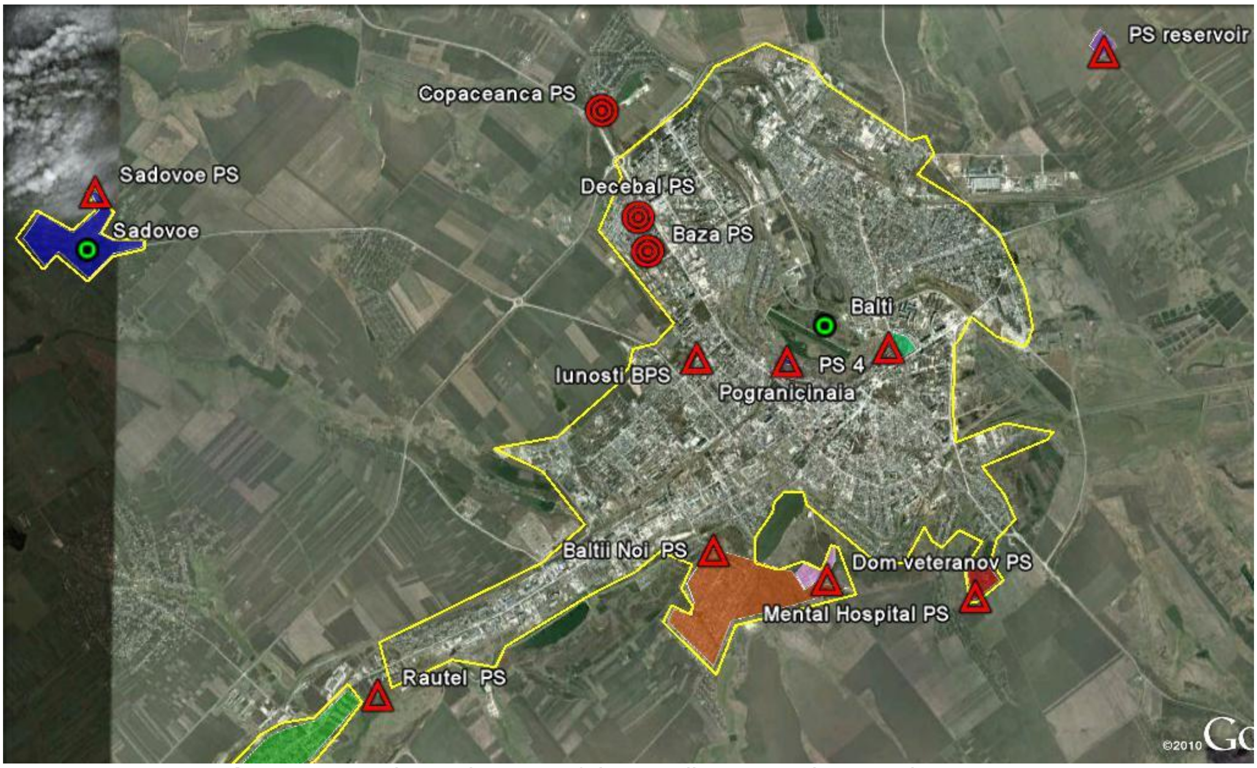



**Figure 3-3** *Estimated extent of the small PSs service supply areas*

General data on installed pumping equipment at PSs in use are presented in the following Table.

**Table 3-5** *Design parameters of the existing pumping equipment at PSs in use in Balti*

| Pmp No | Model | Qty | Design Flow rate | Design Head | Design Motor Data | | | | | Control Panel | Operating | Year of instal-lation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | P | Voltage | Speed | cosφ | In | | | |
| | | | $m^3/h$ | m | kW | V | rpm | | A | | hrs /day | |
| | | | | | **Baltii Noi PS** | | | | | | | |
| 1-2 | 3К-9 | 2 | 45 | 30 | 7.5 | 380 | 2900 | | 15 | | 24 | |
| 3 | 2К-6 | 1 | 20 | 30 | 4 | 380 | 1410 | 0,84 | 8,7 | | standby | |
| | | | | | **Reservoir PS** | | | | | | | |
| 1 | КМ 50/50 | 1 | 50 | 50 | 15 | 380 | 2900 | | | | standby | |
| 2 | К 90/35 | 1 | 90 | 35 | 18 | 380 | 3000 | | | | standby | |
| 3 | АИС 60 | 1 | 15 | | 1.8 | | | | | | standby | |
| | | | | | **Dom Veteranov PS** | | | | | | | |
| 1 | КМ 20/30 | 1 | 20 | 30 | 4 | 380 | 1410 | 0,84 | 8,7 | | standby | |

| Pmp No | Model | Qty | Design Flow rate | Design Head | Design Motor Data | | | | | Control Panel | Operating | Year of instal-lation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | P | Voltage | Speed | cosφ | In | | | |
| | | | $m^3/h$ | m | kW | V | rpm | | A | | hrs /day | |
| 2 | 3К-6 | 1 | 45 | | 11 | | | | | | standby | |
| 3 | Wilo COR MVI 805 | 1 | 2x8 | 45 | 2x1,85 | 400 | 2850 | | 3,9 | VSD | 24 | |
| **Mental Hospital PS** | | | | | | | | | | | | |
| 1 | КМ 100-65-200 | 2 | 100 | 50 | 45 | 380 | 2900 | | | | standby | |
| 2 | Wilo COR-MVI 805 | 1 | 2x8 | 45 | 2x1,85 | 400 | 2850 | | 3,9 | VSD | 10 | |

Distribution of the PSs energy consumption is shown in the following Figure.

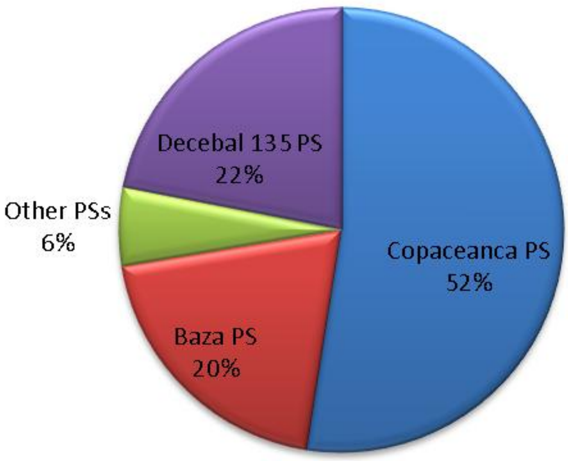



**Figure 3-4** *Shares of Energy Consumption by main PSs in Use Reported by Apa-Canal Balti for July – December 2010*

As these PSs are not the main energy consumers in Balti WSS (only 6% of PSs energy consumption and less than 4% of total Apa-Canal consumption), only some of them will be analyzed to have a clear picture of general condition of the existing PSs.

## 3.7 Water Pumping – Booster PSs

In total, there are twenty-five (25) booster pumping stations in Balti. In general all BPSs are divided into two groups by their geographic location / hydraulic condition.

First group of BPSs is located in the area of multi-storey residential buildings supplied from Copaceanca PS (north of Balti). Location of this group of pumps is shown in the following Figure.


**Figure 3-5** *Geographic location of Copaceanca area booster PSs*

The other group of BPSs is located in the central area of multi-storey residential buildings supplied from Soroca-Balti city reservoirs by gravity. Location of this group of pumps is shown in the following Figure.

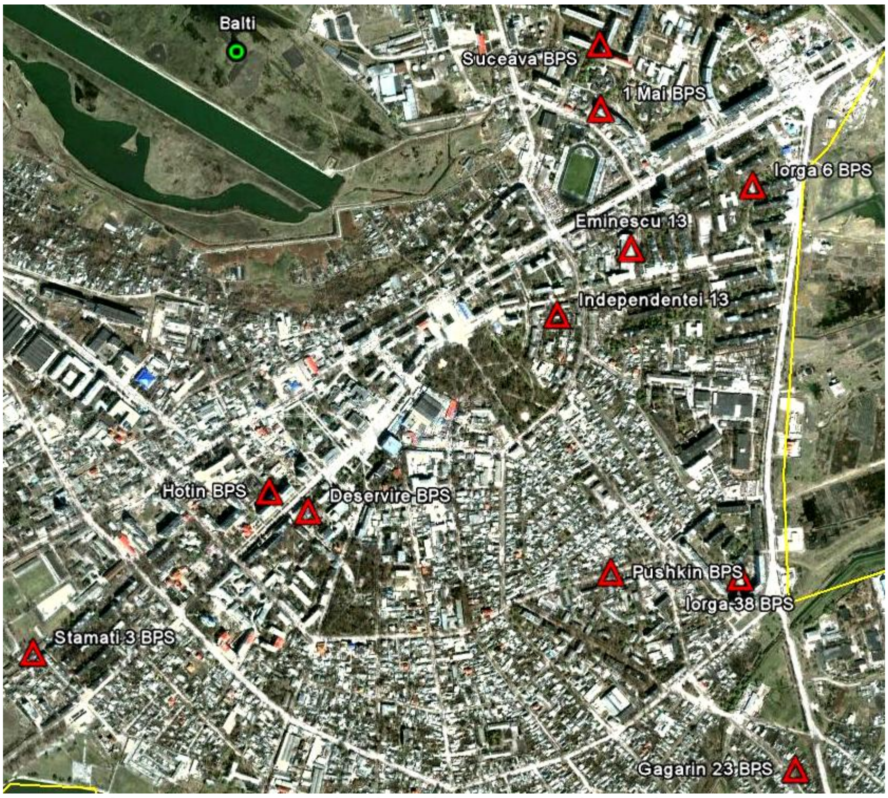



**Figure 3-6** *Geographic location of central area booster PSs*

Also, several separate BPSs, e.g. Glodenilor BPS, are used in different parts of the town. All BPSs are used to provide water to 5-, 9- and 16-floor apartment buildings.

Some pumps at the existing BPSs were replaced during last years with modern energy efficient pumping equipment. However, some PSs are still in need of urgent repairs.

It is clearly seen from the previous Sections that the total energy consumption of all existing 25 BPSs does not exceed 5% of total consumption reported by Apa-Canal. However, the Consultant decided to carry out additional site measurements at several existing BPSs in order to evaluate the real efficiency of the operating pumps. The results are presented in the following Sections.

## 3.8 Water Distribution Network

Town water distribution network is organized through multi-pressure zone areas covering all city consumers.

The town is mainly divided into two big zones – pressure zone in the North and gravity zone in the South. However the existing zones are interconnected in many places, making difficult separation of zones. The estimated limit between zones is Stefan cel Mare Main Street. Multi-storey buildings and some elevated areas are supplied by booster PSs, as described in the previous Sections.

The total network length is 250 km. During the last years some 10 km of town networks were replaced under the Pilot WSSP and National WSSP, financed by the World Bank. Still only some 5% of networks were renovated and good energy saving potential is seen in network renovation.

The reported current leakage rate is considered to be high, non-revenue water reaching 42-49%.

# 4. SEWERAGE SYSTEM

## 4.1 General

Currently, Balti sewerage collection system consists of five (5) drain areas and five (5) SPSs, pumping collected wastewater to the existing WWTP, located in the eastern part of the town at an elevation of 98 m a.s.l.

Given to the Town geographic situation, all wastewater is collected by gravity at the lowest points of the drain areas and thereafter pumped to the WWTP.

The principle scheme of sewerage system in Balti is presented in the following figure:


**Figure 4-1** *Principle Scheme of Sewerage System in Balti*

Currently, some 80% of the Town population are covered by the sewerage services.

## 4.2 Wastewater Collection

Town wastewater collection is separated in five (5) main drain areas, thereof collected wastewater is led to the WWTP through five (5) sewerage pumping stations.

The areas are, as follows:

- North-eastern part – area of multi-storey buildings, private households and industry. Collected wastewater is pumped by SPS2 directly to the WWTP;

- Eastern part – area of multi-storey buildings, private households and industry. Collected wastewater is pumped by SPS1 directly into the pressure collector from SPS2, and wastewater is consequently conveyed to the WWTP;
- Baltii Noi District (southern part) – area of private households. Collected wastewater is pumped by SPS3 into the main gravity collector conveying wastewater to the Main SPS inlet chamber;
- Western part 1 and 2 – areas of private households and industry. Collected wastewater is pumped by SPS4 and SPS5 into the main gravity collector conveying wastewater to the Main SPS inlet chamber.

The wastewater is collected through the central sewerage network of the town with a diameter of up to DN1600 mm and transmitted to the WWTP.

The main sewerage network originates from the 1970's and has not been renovated since. Most parts of networks are worn out generating high amounts of leakages. However, it is assumed that a considerable amount of groundwater infiltrations occur in the lower areas of the networks, dissolving pollutant content of the wastewater.

The existing sewerage gravity collection scheme is considered to be rather efficient and only interventions to the existing pumping equipment are subject to the Audit Report.

## 4.3 Wastewater Pumping

In total, there are six (6) wastewater PSs in use in Balti.

It shall be noted that all district SPSs do not present any significant energy consumption, while the Main SPS and WWTP are reported to consume some 5% and 27% respectively of total Apa-Canal energy consumption. These facilities are subject to further Energy Audit analysis.

## 4.4 Wastewater Treatment

The existing WWTP receives wastewater from the whole Town, and is located at the Eastern border of the Town, left bank of the Raut River. The WWTP inlet is situated at the elevation of some 98 m a.s.l.

The WWTP is fed with wastewater directly from the Main SPS and SPS1 (2).

WWTP was built in 1971 and has a design capacity of 60,000 $m^3$/day, consisting of the following units:

- Horizontal grit chambers with mechanical screens;
- Primary clarifiers;
- Aeration tanks;
- Sludge fermentation tanks;
- Secondary sedimentation tanks;
- Sludge pumping station;
- Sludge disposal site;
- Chlorination plant; and
- Contact stabilization tanks.

The wastewater treatment plant presents a complete biological treatment process. At present the treatment plant is in use and quality of discharged wastewater is reasonably good.

The main energy consuming installations from the WWTP are subject to this Energy Audit.

# 5. OTHER FACILITIES

The following transformer stations are used for power supply of the WSS facilities.

**Table 5-1** *Transformers used for WSS in Balti*

| Transformer name/type | Year | Capacity | Location |
|---|---|---|---|
| TS-128 "Baza" TM-630 10/0.4 No1 | | 630 | Cearupin str. (Baza PS) |
| TS-128 "Baza" TM-630 10/0.4 No2 | | 630 | Cearupin str. (Baza PS) |
| TS-13 "Copaceanca"TM-1000 10/6 No1 | | 1,000 | Copaceanca PS |
| TS-13 " Copaceanca"TM-1600 10/6 No2 | | 1,600 | Copaceanca PS |
| TS-13 TS-220 " Copaceanca"TM-180 6/0.4 No1 | | 180 | Copaceanca PS |
| TS-13 TS-220 " Copaceanca"TM-180 6/0.4 No2 | | 180 | Copaceanca PS |
| TS-119 TM-100 10/0.4 | | 100 | Copaceanca PS |
| TS-120 TM-100 10/0.4 | | 100 | Copaceanca PS |
| TS-121 TM-160 10/0.4 | | 160 | Copaceanca PS |
| TS-122 TM-100 10/0.4 | | 100 | Copaceanca PS |
| TS-329 TM-100 10/0.4 | | 100 | Copaceanca PS |
| TS-331 TM-160 10/0.4 | | 160 | Copaceanca PS |
| TS-330 TM-63 10/0.4 | | 63 | Copaceanca PS |
| TSH-18 TM-160 10/0.4 | | 160 | Cara-Ciobanu str. |
| TS-203 ГНС TM-630 10/0.4 No1 | | 630 | N. Iorga str. (Main SPS) |
| TS-203 ГНС TM-630 10/0.4 No2 | | 630 | N. Iorga str. (Main SPS) |
| TS-95 SPS1 TM-400 10/0.4 No1 | | 400 | Sorocii str. (SPS1) |
| TS-95 SPS1 TM-400 10/0.4 No2 | | 400 | Sorocii str. (SPS1) |
| TS-13 SPS2 TM-400 10/0.4 No1 | | 400 | Franco str. (SPS2) |
| TS-13 SPS2 TM-400 10/0.4 No2 | | 400 | Franco str. (SPS2) |
| TS-16 TM-1000 10/6 No1 | | 1,000 | WWTP |
| TS-16 TM-2500 10/6 No2 | | 2,500 | WWTP |
| TS-192 TM-250 10/0.4 No1 | | 250 | WWTP |
| TS-192 TM-180 10/0.4 No2 | | 180 | WWTP |
| TS TM-630 10/0.4 No1 | | 630 | WWTP |
| TS TM-630 10/0.4 No2 | | 630 | WWTP |
| TS-304 Reservoir TM-100 10/0.4 | | 100 | Soroca-Balti City Reservoirs |
| TS-212 TM-100 10/0.4 | | 100 | Balti-Chisinau highway |
| TM-160 10/0.4 No1 | | 160 | PS Rautel |
| TM-180 10/0.4 No2 | | 180 | PS Rautel |
| Deep wellNo9.10.10a. TM-100 10/0.4 | | 100 | Rautel Intake |
| Deep wellNo7.8. TM-100 10/0.4 | | 100 | Rautel Intake |
| Deep wellNo5.6. TM-63 10/0.4 | | 63 | Rautel Intake |
| Deep wellNo1.2. TM-100 10/0.4 | | 100 | Rautel Intake |
| TS-452 TM-100 10/0.4 | | 100 | Railway |
| TS-570 TM-630 10/0.4 | | 630 | PS Decebal 135 |
| TS-570 TM-630 10/0.4 | | 630 | PS Decebal 135 |

# 6. SITE MEASUREMENTS

## 6.1 Methodology

In order to assess the operating efficiency of the existing water and waste water systems and their elements and to identify energy saving potential, a selective site measurement campaign was organized by the Consultant. The measurement campaign was carried out in October-November 2011.

The Consultant has performed flow measurements at main water supply pumping stations, several booster pumping stations and WWTP.

Individual multi-story block water consumption was measured and analyzed also.

We have also carried out flow measurements of individual pumps to register actual pump flow rate to evaluate actual performance of pumping equipment.

Energy consumption of individual pumps and air blower was measured in details by a power analyzer. Actual power, as well as reactive, apparent, power factor, voltages and current on each phase have been measured and registered.

The Consultant's team used pressure measurements equipment at individual pumps suction and pressure sides in order to evaluate actual performance of pumps and pressure piping.

The Consultant's team also analyzed the existing water supply scheme and proposed two ECMs, optimizing gravity/pumping regime, which can bring to significant energy savings.

### Flow Measurement Sites

Flow measuring equipment was installed at the following sites:

- Copaceanca PS pipeline 1;
- Copaceanca PS pipeline 1;
- Decebal 135 PS;
- Cearupin PS (Baza);
- Iorga 6 BPS;
- Iorga 38 BPS;
- Hotin BPS;
- WWTP active sludge recirculation

Flow measurements protocols are presented in the electronic external Appendix to this Report.

### Pressure measurements sites

Electronic pressure transducers were installed at the following sites:

- Copaceanca PS suction collector;
- Copaceanca PS pressure collector;
- Cearupin (Baza) PS suction collector;
- Cearupin (Baza) PS pressure collector;
- Decebal PS suction collector;
- Decebal PS pressure collector;
- Iorga 6 BPS suction pipe of pump 3
- Iorga 6 BPS discarge pipe of pump 3

Pressure measurements protocol can be found in the electronic external Appendix to this Report.

Pressure manometers were installed at:

- Iorga 38 BPS;
- Hotin BPS

### Electrical power measurements sites

The power measurements were performed at the following sites:

- Copaceanca PS pump 1;
- Copaceanca PS pump 2;
- Copaceanca PS pump 7;
- Copaceanca PS Wilo pump 1;
- Copaceanca PS Wilo pump 2;
- Copaceanca PS Wilo pump 4;
- Decebal PS pump 2;
- Decebal PS pump 3;
- Cearupin PS pump 4;
- Cearupin PS pump 5;
- Cearupin PS pump 6;
- Iorga 6 BPS pump 3;
- Iorga 38 BPS pump;
- Hotin BPS pump;
- WWTP air blower;
- WWTP active sludge recirculation pump

Detailed power characteristic of each measurement point contains:

- frequency,
- phase voltage on each phase,
- linear voltage on each phase,
- current of each phase,
- active power consumption for each phase and all phases,
- reactive power consumption for each phase and all phases
- apparent power consumption for each phase and all phases
- power factor of each phase and all phases
- displacement factor or cos φ of each phase and all phases.

Power measurements protocols can be found in the electronic external Appendix to this Report.

Equipment used for site measurements

| | |
|---|---|
| Power analyzer | **Qualistar CA 8334 (Chauvin-Arnoux)** |
| Portable flow meter | **Prosonic Flow 93T (Endress + Hausser)** |
| Fixed-installation flow meter big size | **DigitalFlow DF868 (GE Measurement&Control Solutions)** |
| Pressure transducer | **Cerabar T PMP 131 (Endress + Hausser)** |
| Data storage | **Memorgaph M RSG40 (Endress + Hausser)** |
| Non-contact infrared thermometer | **OS562 (Omega Engineering)** |

All equipment used complies with the accuracy requirements and international technical standards.

## 6.2 Site measurement and analyses

### Flow and pressure measurements at Copaceanca PS

Flow measurements started on October 18, 2011 at 15:22 and finished on October 19 at 10:25. The time interval between instant flow measurements was set to 3 minutes.

Below graph illustrates the flow pattern from Copaceanca PS:

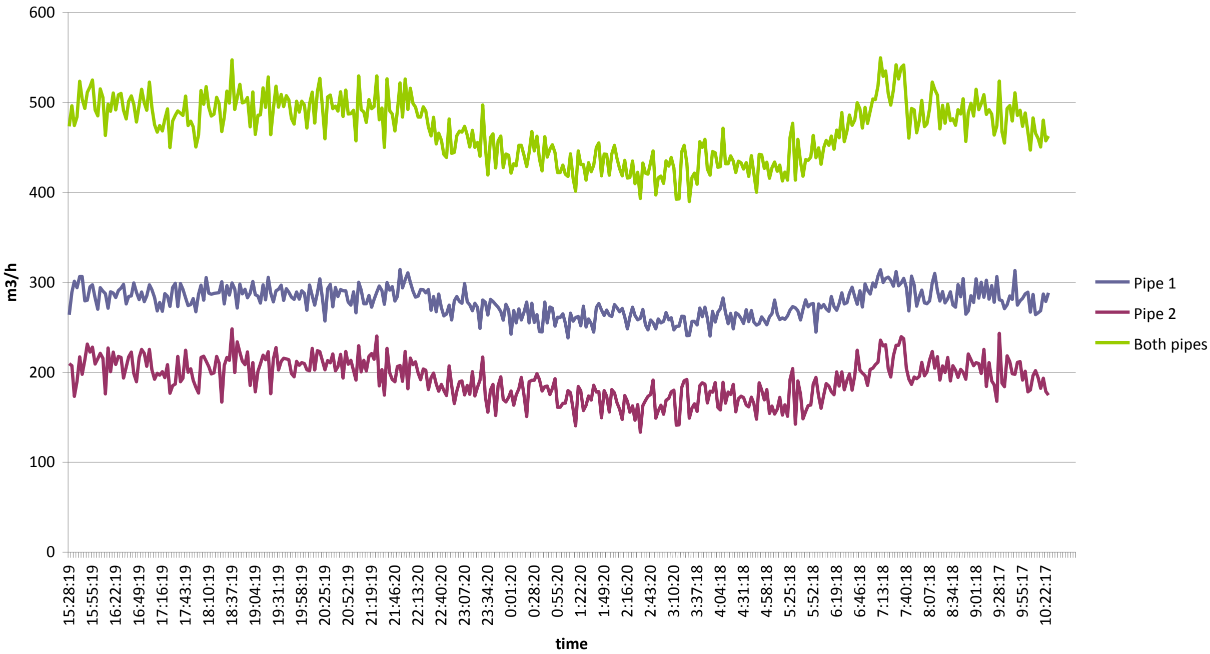



**Figure 6-1** *Measured Flow from Copaceanca PS*

The maximum registered morning/evening peaks are around 550 $m^3/h$, and minimum night flow is around 400 $m^3/h$.

Both pressure pipelines from Copaceanca PS supply water to the BAM service area and in parallel to the reservoir of Decebal PS. Therefore the main volume of water goes to Decebal PS.

Pressure measurements started on October 18, 2011 at 15:20 and finished on October 19 at 10:22. The time interval between instant pressure measurements was set to 1 minute.

Below graph illustrates daily pressure pattern:

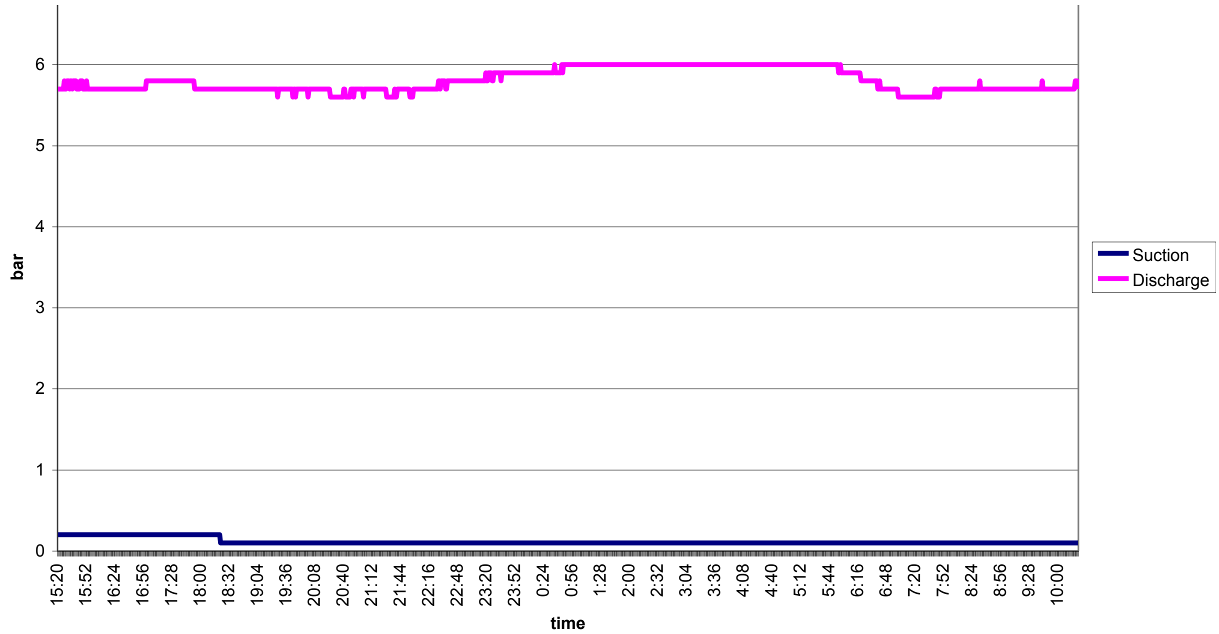



**Figure 6-2** *Pressure Measurements at Copaceanca PS*

In normal working regime just one pump runs for 24 hours. During measurements pump no. 1 was working. Reservoirs of Decebal PS assured constant pressure at Copaceanca PS, which just slightly fluctuated in dependence of BAM area water consumption. During the minimum night water demand discharge pressure at Copaceanca raised up to 6 bar. Evening/morning consumption peaks reduced Copaceanca pressure to 5.7 bar.

Suction pressure was constant as per water level in Copaceanca reservoir.

### Flow and pressure measurements at Decebal PS

Flow measurements started on October 20, 2011 at 14:54 and finished on October 21 at 14:30. The time interval between instant flow measurements was set to 1 minute.

Below graph illustrates flow pattern from Decebal PS:

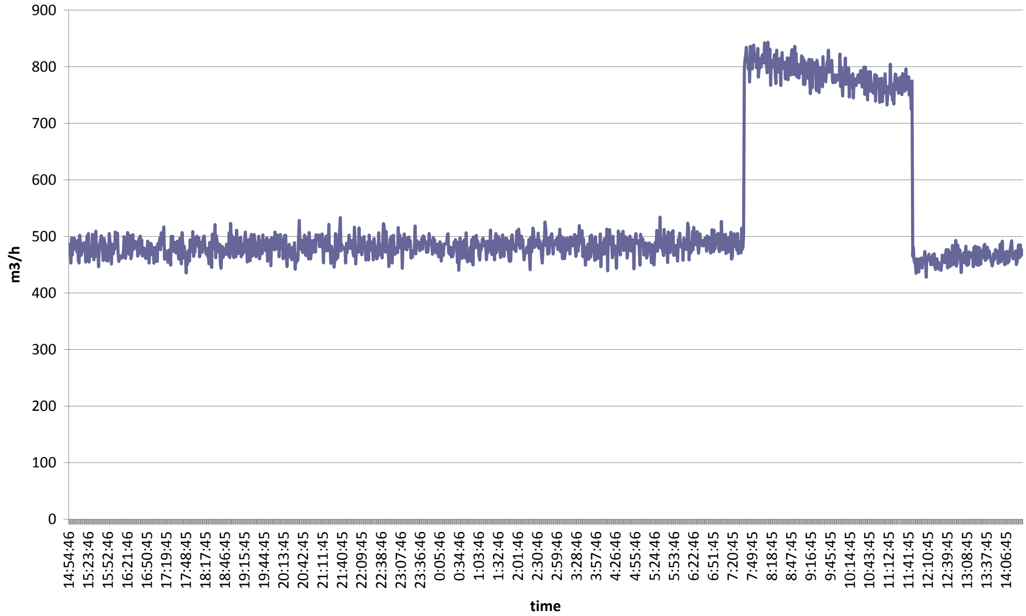



**Figure 6-3** *Flow Measurements at Decebal PS*

In normal operation regime one pump runs 24 hours. Peak on the graph represents two pumps parallel operation.

Pressure measurements started on October 20, 2011 at 15:07 and finished on October 21 at 13:24. The time interval between instant pressure measurements was set to 1 minute.

Below graph illustrates daily pressure pattern:

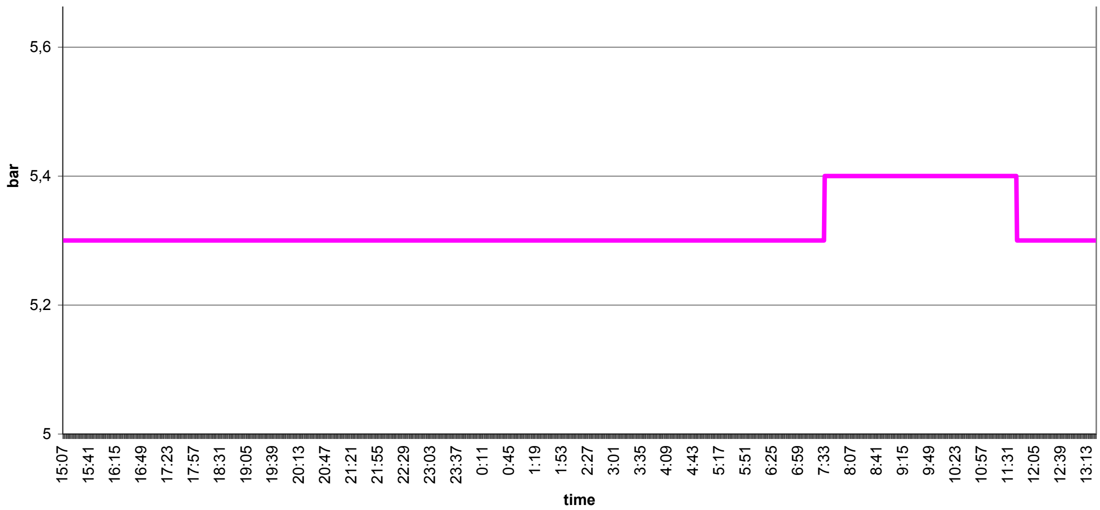



**Figure 6-4** *Pressure Measurements at Decebal PS*

Due to the direct pumping to the upper reservoirs pumping pressure is kept at constant level of 5.3 bar (one pump). Two pumps parallel operation raised pressure to 5.4 bar.

### Flow and pressure measurements at Baza PS

Flow measurements started on October 19, 2011 at 15:20 and finished on October 20 at 12:50. The time interval between instant flow measurements was set to 1 minute.

Below graph illustrates flow pattern from Baza PS:

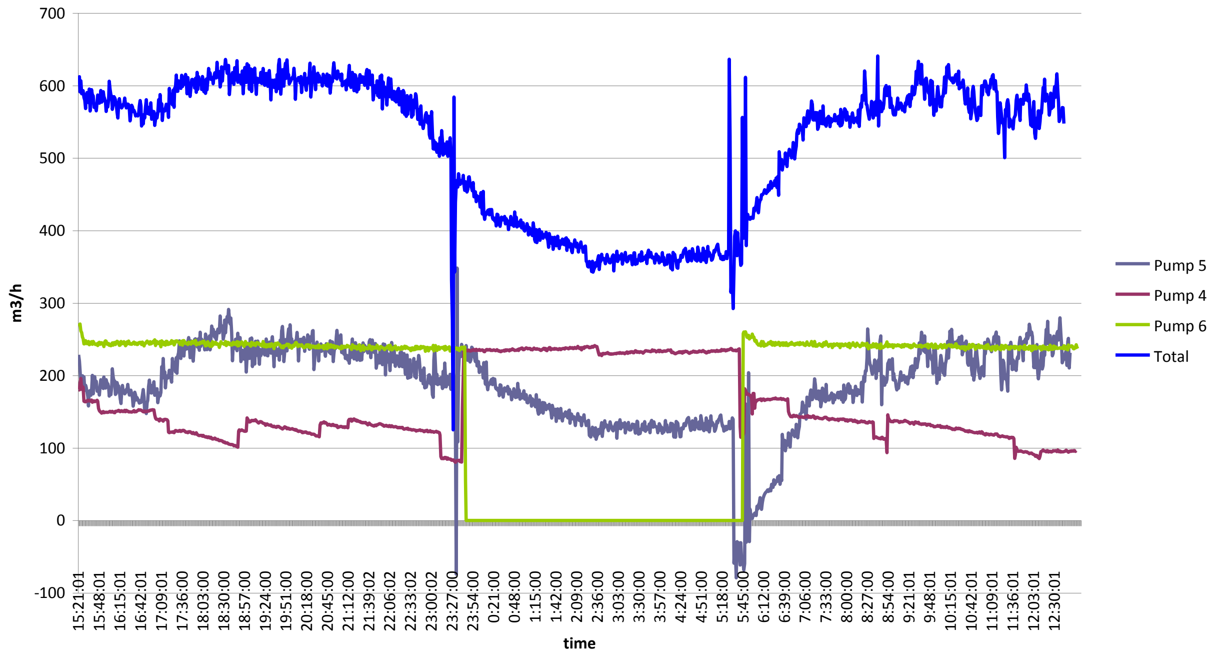



**Figure 6-5** *Flow Measurements at Baza PS*

In normal regime 3 pumps run in parallel. Pump no.6 works direct on-line, while pumps 4 and 5 are speed controlled. The pump no.4 frequency converter is regulated manually depending on pressure in the network, which is kept at 4.2 bar (our measurements showed 3.6 bar). Pump no.5 frequency converter is regulated automatically, also depending on discharge pressure.

Pressure measurements started on October 19, 2011 at 15:20 and finished on October 20 at 12:56. The time interval between instant pressure measurements was set to 1 minute.

Below graph illustrates daily pressure pattern:

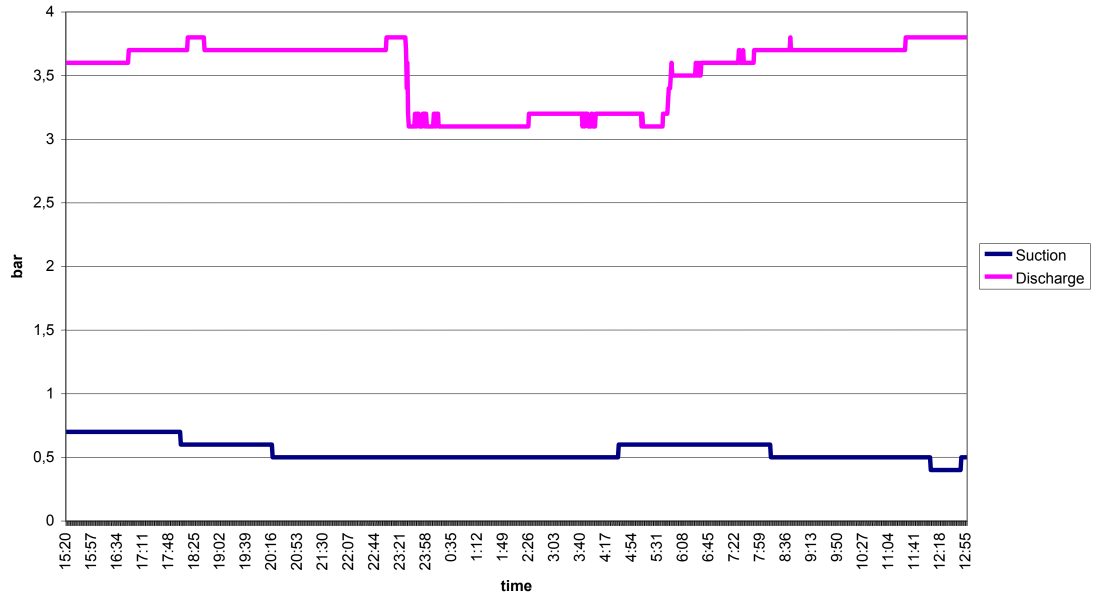



**Figure 6-6** *Pressure Measurements at Baza PS*

### Flow and pressure measurements at BPS Iorga 6

Flow measurements started on October 21, 2011 at 11: 57 and finished on October 25 at 16:00. The time interval between instant flow measurements was set to 1 minute.

Below graph illustrates flow pattern from BPS Iorga 6:

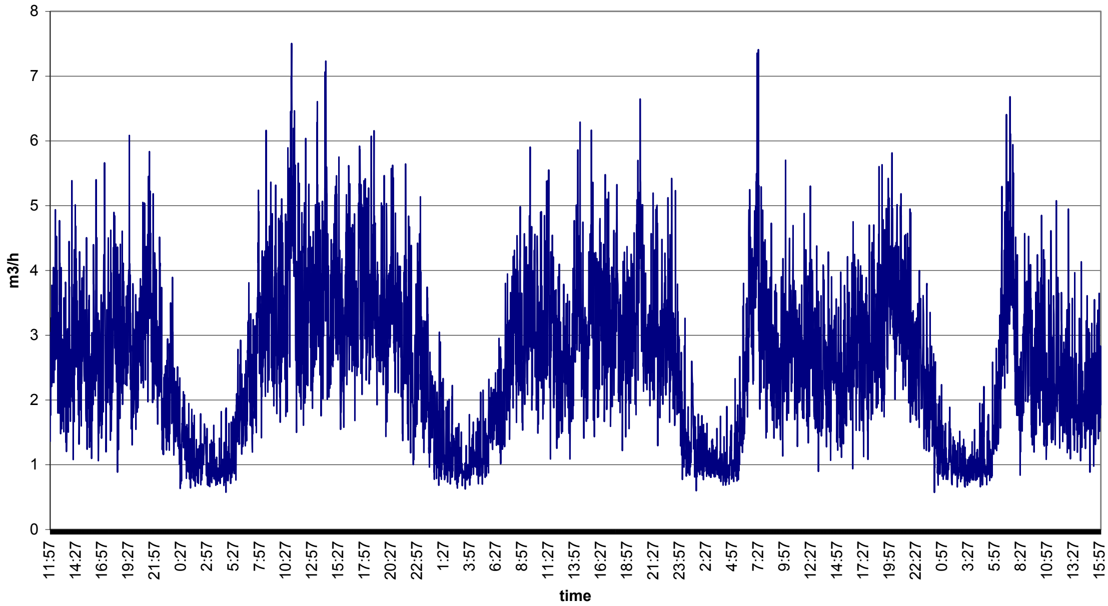



**Figure 6-7** *Flow Measurements at Iorga 6 BPS*

BPS Iorga 6 supplies water to one 16-story block. Long term flow measurements were performed during 4 days and represent multi-story building water demand in Balti. Night deep around 0.7 $m^3/h$ is internal block losses. Average daily flow in the blosk is 3 $m^3/h$.

Pressure measurements at BPS Iorga 6 started on October 21, 2011 at 14:09 and finished on October 25 at 16:02. The time interval between instant pressure measurements was set to 1 minute.

Below graph illustrates daily pressure pattern at BPS Iorga 6:

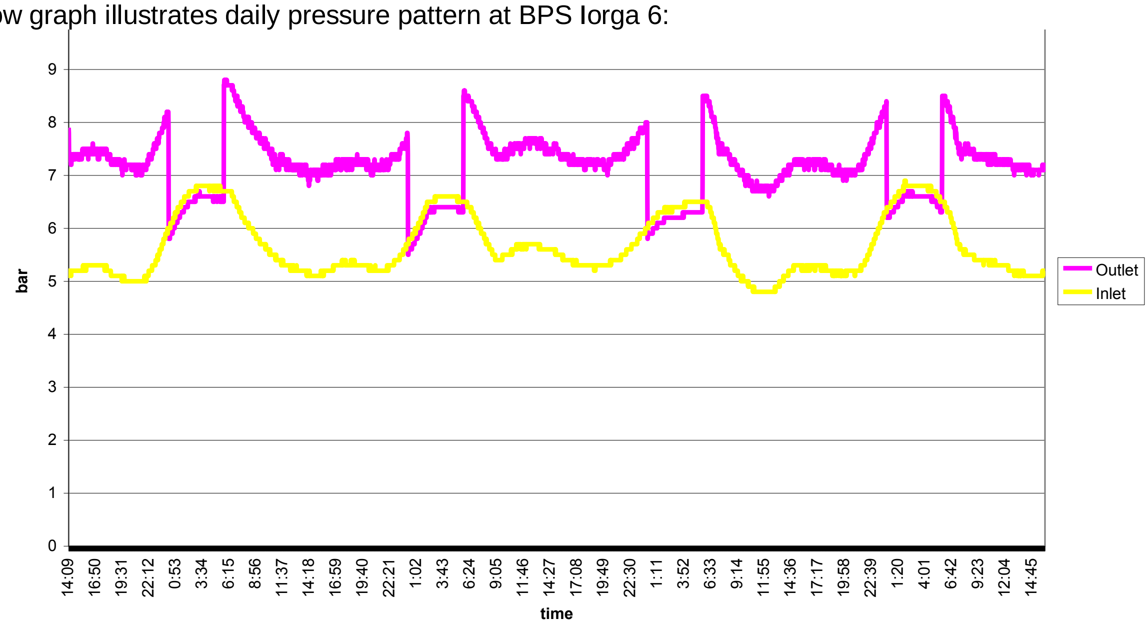



**Figure 6-8** *Pressure Measurements at Iorga 6 BPS*

One can notice that inlet pressure is high enough to deliver water to the 12 or 13 floor of 16th story block. During the night pressures in the water distribution network reached 68 m. High pressure of discharge line can create leaks in sanitary facilities of low located apartments. For 16-story block necessary pressure shall not be more that 70 m.

Individual measurements of pump performance showed that pumping efficiency of existing boosting installation is very low (please see below chapters)Measured Current Water Balance

Water balance based on selective measurements of pumping to the water supply system is shown in the following table:

| Water production, $m^3$/day | Supply area | | | Real losses<br>Distribution | | Apparent losses + unbilled | Revenue Water | Non-revenue water |
|---|---|---|---|---|---|---|---|---|
| 18,400 | Soroca-Balti trunk main | | | 500 | BAM | 3,170 | 10,500 | 7,900 |
| | | Copaceanca pumping zone | 11,000 | 3,200 | Baza pumping zone | | | |
| | | Gravity zone | 7,140 | 1,000 | Gravity zone | | | |
| | Balti source | Wells new Balti | 260 | 30 | Wells new Balti | | | |
| | | | | 4,730 | | | | |
| Revenue water | 57% | | | | | | | |
| Apparent losses | 17% | | | | | | | |
| Real losses | 26% | | | | | | | |
| Overall non-revenue water | 43% | | | | | | | |

### Measurements of operating parameters of pumping equipment

The summary table of design and actual operating parameters of existing pumping equipment:

**Table 6-1** *Data on main pumps in use in Balti Water Supply System*

| Balti | | | | | Copaceanca | | | |
|---|---|---|---|---|---|---|---|---|
| **Design parameters** | **Units** | **Pump 1** | **Wilo 1** | **Wilo 2** | **Wilo 3** | **Wilo 4** | **Pump 7** | **Pump 2** |
| Pump type | | Д630-90 | NP80/250V-75/2-12 | NP80/250V-75/2-12 | NP80/250V-75/2-12 | NP80/250V-75/2-12 | Д630-90 | D200-90 |
| Flow | m3/h | 500 | 200 | 200 | 200 | 200 | 500 | 200 |
| Head | m | 60 | 90 | 90 | 90 | 90 | 60 | 90 |
| Impeller diameter | mm | 426 | | | | | 426 | |
| Number of impellers | | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Shaft power | kW | 112 | | | | | 112 | |
| Pump efficiency | | 0.73 | | | | | 0.73 | |
| Pump + motor efficiency | | 0.68 | | | | | 0.68 | |
| | | | | | | | | |
| Motor type | | АЭ113-4У | SM280 S2 LL NS | SM280 S2 LL NS | SM280 S2 LL NS | SM280 S2 LL NS | АЭ113-4У | 4AM 225 M2У3 |
| Rated power | kW | 250 | 75 | 75 | 75 | 75 | 250 | 55 |
| Nominal voltage | V | 6300 | 400 | 400 | 400 | 400 | 6300 | 380 |
| Nominal current | A | 10 | 132 | 132 | 132 | 132 | 10 | 100 |
| Rotation Speed | rpm | 1480 | 2975 | 2975 | 2975 | 2975 | 1480 | 2920 |
| Cos ϕ | | 0.9 | 0.87 | 0.87 | 0.87 | 0.87 | 0.9 | 0.92 |
| Motor Efficiency | | 0.93 | 0.9 | 0.9 | | 0.9 | 0.93 | 0.9 |
| | | | | | | | | |
| Measured parameters pump | | | | | Impossible to perform measurements | | | |
| Actual flow | m3/h | 432.6 | 245 | 173 | | 216 | 594 | 214 |
| Suction pressure/dynamic level | m | 1 | 1 | 2 | | 2 | 2 | 2 |
| Discharge pressure | m | 57 | 42 | 40 | | 40 | 62 | 42 |
| Actual pump head | m | 56 | 41 | 38 | | 38 | 60 | 40 |
| | | | | | | | | |
| Measured parameters motor | | | | | | | | |
| Active power consumption | kW | 157 | 81.76 | 66.4 | | 71.7 | 160 | 61.43 |
| Reactive power consumption | kVAr | Power meter readings only due to high voltage motor | 44.71 | 33.76 | | 34.9 | Power meter readings only due to high voltage motor | 31.15 |
| Apparent power | VA | | 93.2 | 74.5 | | 79.7 | | 68.91 |
| Power factor | | | 0.88 | 0.89 | | 0.9 | | 0.89 |
| | | | | | | | | |
| Calculated pumping efficiency | | | | | | | | |
| Hydraulic power | kW | 65.97 | 27.36 | 17.90 | | 22.35 | 97.06 | 23.31 |
| Overall pumping efficiency | | **0.42** | **0.33** | **0.27** | | **0.31** | **0.61** | **0.38** |
| Pump Efficiency | | 0.45 | 0.37 | 0.30 | | 0.35 | 0.65 | 0.42 |
| Specific power consumption | kW/m3 | 0.36 | 0.33 | 0.38 | | 0.33 | 0.27 | 0.29 |

**Table 6-2** *Data on main pumps in use in Balti Water Supply System*

| **Balti** | | **Decebal 135** | | | **Cearupin PS (Baza)** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Design parameters** | **Units** | **Pump 1** | **Pump 2** | **Pump 3** | **Pump 1** | **Pump 2** | **Pump 3** | **Pump 4 (Azer)** | **Pump 5 (Rom)** | **Pump 6** |
| Pump type | | 1Д500-63 | 1Д500-63 | 1Д500-63 | Д500-65 | 1Д500-63 | | Д320-50 | Д320-50 | 1Д200-90 |
| Flow | m3/h | 450 | 450 | 450 | 500 | 500 | | 320 | 320 | 200 |
| Head | m | 53 | 53 | 53 | 65 | 65 | | 50 | 50 | 90 |
| Impeller diameter | mm | 404 | 404 | 404 | | | | | | |
| Number of impellers | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Shaft power | kW | 80 | 80 | 80 | | | | | | |
| Pump efficiency | | 0.77 | 0.77 | 0.77 | | | | | | |
| Pump + motor efficiency | | 0.71 | 0.71 | 0.71 | | | | | | |
| | | | | | | | | | | |
| Motor type | | 5AMH 250 M4 У3 | 5AMH 250 M4 У3 | 5AMH 250 M4 У3 | | | | | ASI 1280375-4 | 4A 1225 M292 |
| Rated power | kW | 110 | 110 | 110 | 125 | 125 | | 75 | 75 | 55 |
| Nominal voltage | V | 380 | 380 | 380 | 380 | 380 | | 380 | 380 | 380 |
| Nominal current | A | 207 | 207 | 207 | | | | 125 | 125 | 100 |
| Rotation Speed | rpm | 1485 | 1485 | 1485 | | | | | 3000 | 2940 |
| Cos ϕ | | 0.85 | 0.85 | 0.85 | | | | | 0.87 | 0.92 |
| Motor Efficiency | | 0.92 | 0.92 | 0.92 | | | | | | |
| | | | | | | | | | | |
| **Measured parameters pump** | | This pump is being repaired | | | Standby pump | Standby pump | Pump is dismantled | | | |
| Actual flow | m3/h | | 470 | 475 | | | | 230 | 300 | 270 |
| Suction pressure/dynamic level | m | | 3 | 3 | | | | 7 | 6 | 6 |
| Discharge pressure | m | | 53 | 53 | | | | 21 | 18 | 17 |
| Actual pump head | m | | 50 | 50 | | | | 14 | 12 | 11 |
| | | | | | | | | | | |
| **Measured parameters motor** | | | | | | | | | | |
| Active power consumption | kW | | 101.95 | 101.15 | | | | 74 | 34.07 | 41.05 |
| Reactive power consumption | kVAr | | 67.46 | 69.51 | | | | 33.44 | 19.25 | 10.15 |
| Apparent power | VA | | 122.26 | 122.73 | | | | 81.21 | 39.13 | 42.34 |
| Power factor | | | 0.83 | 0.82 | | | | 0.91 | 0.87 | 0.97 |
| | | | | | | | | | | |
| **Calculated pumping efficiency** | | | | | | | | | | |
| Hydraulic power | kW | | 64.00 | 64.68 | | | | 8.77 | 9.80 | 8.09 |
| Overall pumping efficiency | | | **0.63** | **0.64** | | | | **0.12** | **0.29** | **0.20** |
| Pump Efficiency | | | 0.68 | 0.70 | | | | | | |
| Specific power consumption | kW/m3 | | 0.22 | 0.21 | | | | 0.32 | 0.11 | 0.15 |

**Table 6-3** *Data on main pumps in use in Balti Water Supply System*

| Balti | | BPS Iorga 6 | BPS Iorga 38 | BPS Hotin | WWTP | |
|---|---|---|---|---|---|---|
| **Design parameters** | **Units** | **Pump 3** | | | **Air blower** | **Active sludge recirculation pump** |
| Pump type | | K 45/30 | K 45/30 | K 45/30 | TB-175-1.6 | 400D190A |
| Flow | m3/h | 45 | 45 | 45 | | 1,600 |
| Head | m | 30 | 30 | 30 | | 10 |
| Impeller diameter | mm | | | | | |
| Number of impellers | | 1 | 1 | 1 | | 1 |
| Shaft power | kW | | | | | |
| Pump efficiency | | | | | | |
| Pump + motor efficiency | | | | | | |
| | | | | | | |
| Motor type | | | | | | |
| Rated power | kW | 7.5 | 7.5 | 7.5 | 250 | 110 |
| Nominal voltage | V | 380 | 380 | 380 | 380 | 380 |
| Nominal current | A | 15 | 15 | 15 | | |
| Rotation Speed | rpm | 2900 | 2900 | 2900 | | 980 |
| Cos φ | | | | | | |
| Motor Efficiency | | | | | | |
| | | | | | | |
| **Measured parameters pump** | | | | | | |
| Actual flow | m3/h | 2.07 | 8.2 | 5.66 | | 1,067 |
| Suction pressure/dynamic level | m | 52 | 48 | 45 | | |
| Discharge pressure | m | 77 | 80 | 79 | | |
| Actual pump head | m | 25 | 32 | 34 | | 10 |
| | | | | | | |
| **Measured parameters motor** | | | | | | |
| Active power consumption | kW | 3 | 3 | 4.5 | 212 | 79.28 |
| Reactive power consumption | kVAr | | | | 116.14 | 49.75 |
| Apparent power | VA | | | | 241.65 | 93.6 |
| Power factor | | | | | 0.88 | 0.85 |
| | | | | | | |
| **Calculated pumping efficiency** | | | | | | |
| Hydraulic power | kW | 0.14 | 0.71 | 0.52 | | 29.06 |
| Overall pumping efficiency | | **0.05** | **0.24** | **0.12** | | **0.37** |
| Pump Efficiency | | | | | | |
| Specific power consumption | kW/m3 | 1.45 | 0.37 | 0.80 | | 0.07 |

# 7. FINAL ECM PROPOSALS

## 7.1 Proposed ECM1 - Optimization of existing water supply scheme from Soroca-Balti reservoirs

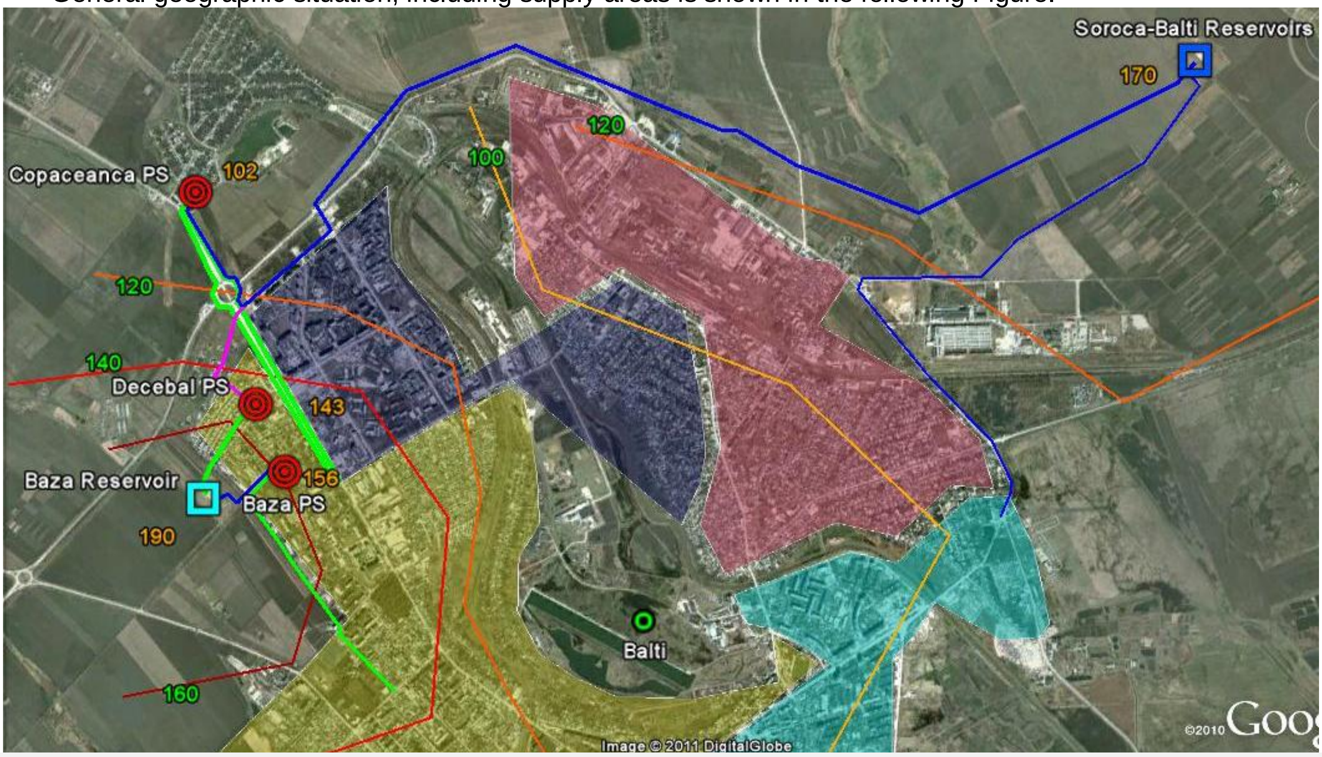
### Present situation

Initially, water supply system in the City of Balti was organized from groundwater sources located in different parts within city boundaries. One of the wellfields in use was situated North of the city, at Copaceanca region, and Copaceanca PS was used to supply the abstracted groundwater to the city networks.

However, following Parliamentary Decree in 2006, Balti switched to the surface water, abstracted from the Nistru River at Soroca Town and conveyed to Balti through a 50 km water main. Currently, treated surface water is stored into two (2) uphill city reservoirs with total capacity of 2 x 6,000 $m^3$, at an elevation of 170 m a.s.l.

BAM supply area covered directly by Copaceanca PS is located at 92–100 m a.s.l. (left bank of the Raut River) and 100-150 m a.s.l. (right bank of the Raut), while Copaceanca PS is situated at an altitude of 102 m a.s.l.

General geographic situation, including supply areas is shown in the following Figure.




**LEGEND**

- Pressure Main
- Gravity Main
- Gravity/Pressure Main
-Ground Level Curve
- Copaceanca Pressure Supply Area
- Baza PS Pressure Supply Area
- Soroca-Balti Gravity Supply Area
- Soroca-Balti Reservoir Gravity Area

120 – Isoline elevation
170 – Point elevation

(102 m a.s.l.), which is close to the lowest elevation point of the whole north supply area, thereby losing the potential energy of **68 m** brought from Soroca-Balti main.
From the Copaceanca PS reservoirs, water is pumped into the BAM supply area and Decebal PS reservoirs (143 m a.s.l.). However, it shall be mentioned that Decebal PS reservoirs can also be supplied directly from the Soroca-Balti city reservoirs by gravity.

Existing situation of supply and distribution of water in Nortern part of Balti is illustrated in below scheme:

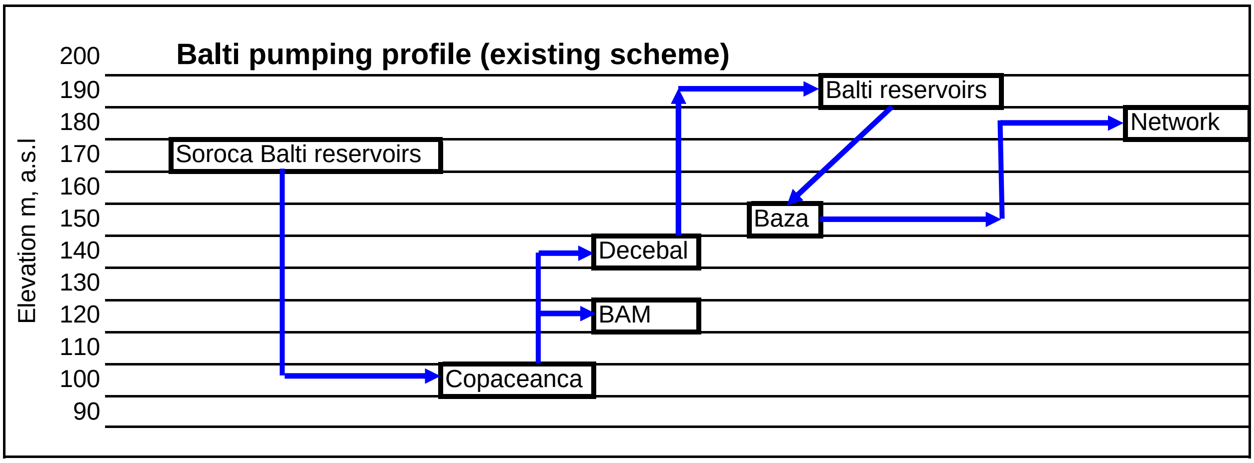



**Figure 7-1** *Balti Pumping Profile (Existing Chain)*

### Proposed Improvement

In order to avoid wastage of energy we strongly recommend establishing direct gravity supply of Decebal PS (143 m a.s.l) from Soroca-Balti reservoirs (170 m a.s.l).

Copaceanca PS shall stop its operation as soon as possible, since it is the biggest energy consumer in Apa Canal Balti and it is not necessary for water supply from Soroca-Balti reservoirs. In the future Copaceanca PS can be used for standby pumping regime from existing wells in case of interruption of water supply from Soroca main.

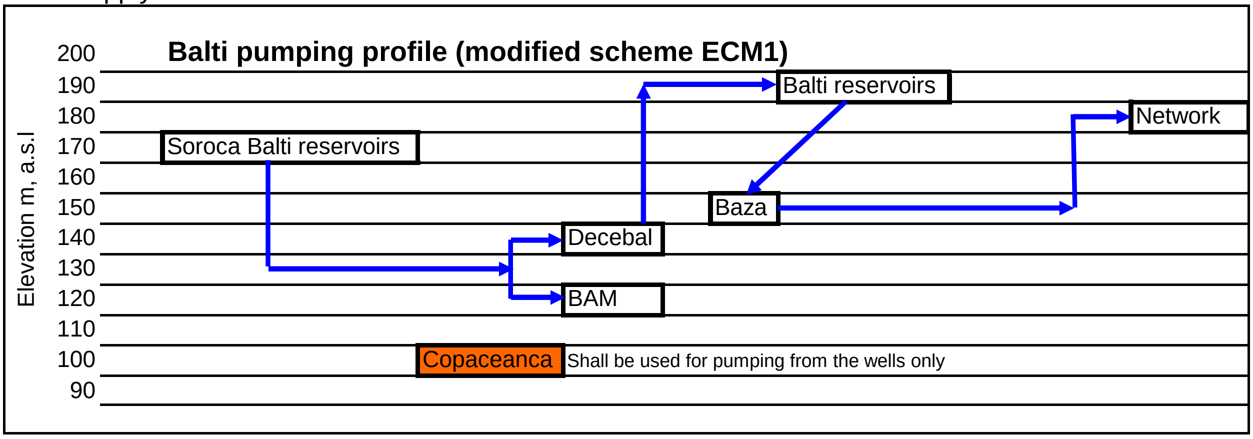



**Figure 7-2** *Proposed scheme of hydraulic optimization*

### Estimation of Savings

| | |
|---|---|
| Existing power consumption of Copaceanca PS | = 3 700 000 kWh/year |
| Power consumption of gravity supply from Soroca-Balti reservoirs | = 0 kWh/year |
| Power saving | = 3 700 000 kWh/year |
| Assuming 1.45 MDL per 1 kWh | = **5 365 000 MDL/year** |

### Estimation of investment cost

Since all necessary valves for establishment of gravity water supply are already installed on the trunk main from Soroca-Balti reservoirs, proposed ECM measure belongs to **NO COST** category.

| | |
|---|---|
| **Payback period** | **= 0 years** |

### Additional constrain to be considered

A small rural district adjacent to Copaceanca pumping station currently supplied from Copaceanca requires to keep water supply services after stoppage of Copaceanca PS. For this purpose Apa Canal Balti proposed to construct separate pipeline DN100 to the rural district from gravity main Soroca-Balti reservoirs – Decebal PS.

We recommend to study this issue separately. In our opinion there are several solutions to keep water supply of rural area near Copaceanca PS.

One of possible solutions is to keep existing pressure trunk main at Copaceanca under pressure from Soroca-Balti reservoirs and thus ensuring water supply to the mentioned area.

## 7.2 Proposed ECM2 - Optimization of pumping scheme Decebal – Upper reservoirs - Baza

### Present situation

Decebal PS lifts water to the upper reservoirs at 190 m a.s.l, which feed Baza PS reservoir via gravity. However Baza PS is placed at 156 m a.s.l. and potential energy of **34 m** is lost between upper reservoirs and Baza reservoir. Baza PS supplies water to the north/central part of the town. Its supply area is located at 95 – 180 m a.s.l. Design pump head is 50 m. Actual pumping head is kept at 42 m.

### Proposed Improvement

We propose to decommission Baza PS and establish of gravity water supply to the Northern/Central part of Balti from upper reservoirs (190 m a.s.l). In order to ensure necessary pressure for 9-story buildings in the upper part of Baza supply area (180 m a.s.l), we propose to build boosting pumping station to lift water to the upper located buildings.

Proposed modifications of water supply scheme are shown in below scheme:

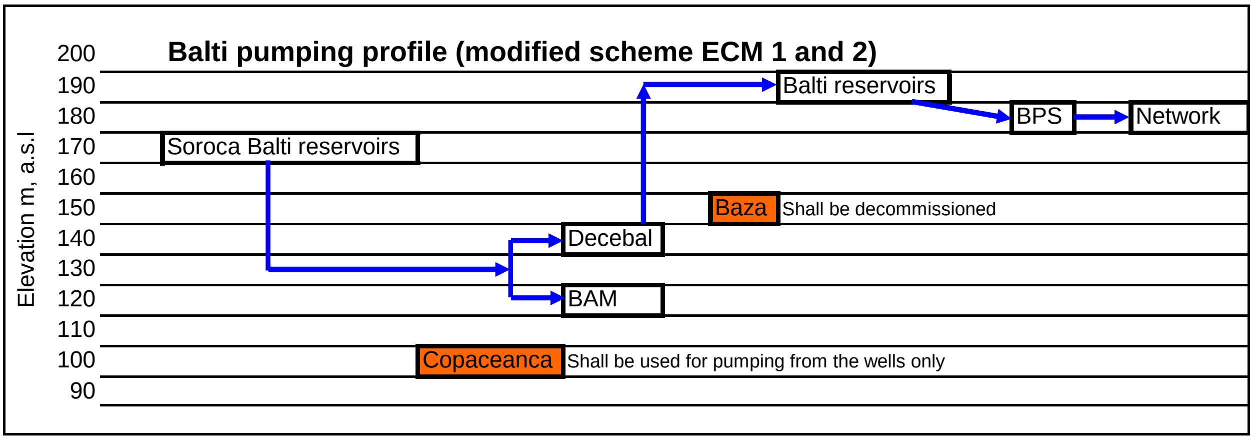



**Figure 7-3** *Proposed modifications for supply scheme of the Northern Balti*

New BPS will serve several multistory buildings along Colesov Street, which are located within elevation range 162 and 180 m a.s.l.

Due to the difficulties with available land for new pumping station and power connection from the grid, it is proposed to allocate boosting PS at the territory of upper reservoirs. Proposed allocation requires construction of approx. 2 km pipeline from upper reservoirs to the block district to be supplied by new booster PS.

**Figure 7-4** *Multi-Storey Buildings along Colesov/Decebal Streets*

Proposed modification of pumping regime will bring to significant reduction of amount of water pumped into the network:

Actual average flow currently pumped by Baza PS = 520 $m^3/h$
Estimated average flow to BPS area = 60 $m^3/h$

Most of the water will be supplied by gravity to the lower located areas, previously supplied by pumping from Baza PS.

New BPS pump set will consist of two pumps with the following parameters of each pump:

| | |
|---|---|
| Rated flow | = 60 $m^3/h$ |
| Rated head | = 25 m |
| Motor rated power | = 2 x 7.5 kW |
| Actual power max | = 15.2 kW |
| Actual power min | = 6 kW |
| Actual power average | = 9.6 kW |

Pump set shall be equipped with frequency converter to maintain the minimum required pressure in the system at various water demands during the day and night.

Estimation of booster pumping set power consumption:

**Table 7-1** *Estimation of Energy Consumption by Booster PS*

| Pump type (analogue) | Rated power, kW | Actual power, kW | Working hours per day | Energy used, kWh/year | Overall energy used, kWh/year |
|---|---|---|---|---|---|
| GHV20/66SV2/2AG075T maximum | 7.5 | 15.2 | 3 | 16,644.00 | **86,395.50** |
| GHV20/66SV2/2AG075T minimum | 7.5 | 7.5 | 5 | 13,687.50 | |
| GHV20/66SV2/2AG075T average | 7.5 | 9.6 | 16 | 56,064.00 | |

## Estimation of Savings

| | |
|---|---|
| Estimated power consumption of existing pumping regime | = 1 200 000 kWh/year |
| Estimated power consumption of new pumping regime | = 86 400 kWh/year |
| Power saving | = 1 113 600 kWh/year |
| Assuming 1.5 MDL per 1 kWh | **= 1 670 400 MDL/year** |

## Estimation of investment cost of new BPS

**Table 7-2** *Estimation of Investment Costs*

| No. | Description | Unit | Qty | Unit price, EUR | Total price, EUR |
|---|---|---|---|---|---|
| | **Mechanical** | | | | |
| 1 | BPS building | Lump sum | | | 30,000 |
| 2 | Construction of 2 km HDPE 160 mm pipeline | Lump sum | | | 80,000 |
| 3 | Pumping booster set of 2 pumps Q=60 m3/h H=25 m | set | 1 | 16,000 | 16,000 |
| 4 | Piping and fittings | set | 1 | 700 | 700 |
| 5 | Gate valve DN100 | pcs | 2 | 150 | 300 |
| 6 | Gate valve DN150 | pcs | 2 | 200 | 400 |
| 7 | Check valve DN100 | pcs | 2 | 200 | 400 |
| 8 | Pressure gauge mechanical | pcs | 1 | 100 | 100 |
| | **Electrical** | | | | |
| 9 | Pump control unit with frequency converter | pcs | 1 | 5,000 | 5,000 |
| 10 | Earthing and cables | set | 1 | 500 | 500 |
| | **Auxillary** | | | | |
| 11 | Installation | Lump sum | | | 1,500 |
| 12 | Tools | set | 1 | 200 | 200 |
| 13 | Consumables | set | 1 | 140 | 150 |
| 14 | Mandatory spare parts | set | 1 | 500 | 200 |
| 15 | O&M manuals | set | 1 | 100 | 100 |
| | **Grand total EUR** | | | | **135,550** |
| | **Grand total MDL** | | | | **2,236,575** |

**Payback period** **= 1.3 years**

## 7.3 Proposed ECM3 - Replacement of active sludge recirculation pump

### Present situation

Design capacity of WWTP Balti is 60 000 m3/d. Actual present capacity is only 20,000 $m^3$/d. Therefore all treatment facilities are oversized and part of them does not function.

WWTP consist of:

- Inlet chamber
- Screen building (3 screens МГ-11Т)
- Horizontal sand traps of 2 sections
- Primary clarifiers D=28 m (only 1 of 4 in operation)
- Primary sludge pumping station (2 pumps ФГ-216-22)
- Aeration tanks mixing type of 4 corridors in total 4 sections (3 sections in operation)
- Secondary clarifiers D=40 m (only 1 of 2 in operation)
- Sludge thickeners D=24 m (do not operate)
- Air blower station (3 air blowers ТВ-175-1,6, 4 air blowers ТВ -300- 1,6). Presently in operation 2 air blowers ТВ-175-1,6.
- Secondary sludge pumping station (3 pumps 400Д190А, 1 pump 8-Ф12, 2 pumps ФГ 216/22,5)
- Chlorination station
- Drainage pumping station (4 pumps ФГ - 216-22,5)
- Sludge beds 53.2 hectares

Currently 3 out of 4 aeration tanks and 1 secondary clarifier are in operation at WWTP. Active sludge is being constantly pumped from secondary clarifier back to aeration stage of treatment. Existing pump 400D190A with the following parameters:

| | |
|---|---|
| Nominal flow | =1,600 $m^3$/h |
| Nominal head | =10 m |
| Motor power | =110 kW |

The pump runs continuously 24/24. Due to the reduced volume of aeration tanks amount of returned sludge is also reduced and pump operates against throttled valve (3/4 closed).

### Measurements results

Measured actual pumping flow Q = **1,067 $m^3$/h**.

Estimated pumping head is **10 m**

The measured active power consumption of pump in the operating regime $P_{con}$ = **79.28 kW.**

### Calculation of pumping efficiency of recirculation pump

The calculated hydraulic power $P_{hyd}$ = Q x H/367.2 = **29.06 kW**

The actual pumping efficiency of first pumping group $P_{hyd}$ / $P_{con}$ = **37 %**

We consider that pumping efficiency is reduced due to the throttled valve. Actual flow is only 60% of design flow.

### Proposed Improvement

We propose to replace existing inefficient pump with the new pumps with the following parameters (analogue S3.120.300.500.8.66M):

| | |
|---|---|
| Rated flow | = 334 l/s |
| Rated head | = 10.7 m |
| Motor rated power | = 50 kW |
| Actual power at duty point | =48.2 kW |
| Pump efficiency | =80.8 % |
| Pump+motor efficiency | =72.8 % |

#### Estimation of Savings

| | |
|---|---|
| Estimated power consumption of existing pumping regime | = 630 000 kWh/year |
| Estimated power consumption of new pumping regime | = 420 000 kWh/year |
| Power saving | = 210 000 kWh/year |
| Assuming 1.5 MDL per 1 kWh | = **315 000 MDL/year** |

#### Estimation of investment cost

| | |
|---|---|
| Sludge pump for horizontal dry installation incl. mounting frame and base | = 830 000 MDL |
| Pump control panel and cables | = 100 000 MDL |
| Valves, fittings, piping | = 60 000 MDL |
| Installation works | = 20 000 MDL |
| **Total investment cost** | **= 1 010 000 MDL** |
| **Payback period** | **= 3.2 years** |

## 7.4 Proposed ECM4 - Speed control for air blower at WWTP

#### Present situation

Please see the description of WWTP operation in previous sections.

As present capacity of treatment plant is just 1/3 of its design capacity. Waste water is not pumped continuously and sewage concentrations may vary significantly during the day. Moreover Balti bread factory often discharge highly concentrated waste waters. In order to buffer the shot concentrations, dissolve and mix domestic and industrial waste waters, Apa Canal Balti keeps 3 sections of aeration tanks in operation, although just one section would be enough to treat incoming flows.

Concentration of dissolved oxygen is constantly monitored. Amount of air supplied to aeration treatment is controlled manually, by “small” air blower with motor 160 kW and “bigger” air blower with motor 250 kW. The biggest air blowers with 6 kV motors of 320 kW are not in operation.

#### Proposed Improvement

We propose to establish speed control of air blower based on dissolved air concentration in aeration tanks. This measure would require installation of frequency converter, dissolved oxygen sensor, sensor control module, signal/power line between speed control and sensor.
Actual power consumption of air blower TB-175-1.6 with motor 250 kW will be reduced in accordance with actually needed concentration of dissolved oxygen in aeration tanks.

#### Estimation of Savings

| | |
|---|---|
| Estimated power saving 10% of current power consumption 1 840 000 kW/year | = 184 000 kWh/year |
| Assuming 1.5 MDL per 1 kWh | = **276 000 MDL/year** |

#### Estimation of investment cost

| | |
|---|---|
| Frequency converter for 250 kW motor | = 320 000 MDL |

| | |
|---|---|
| Dissolved oxygen sensor and control module | = 50 000 MDL |
| Installation and cables | = 10 000 MDL |
| **Total investment cost** | **= 380 000 MDL** |
| **Payback period** | **= 1.4 years** |

## 7.5 Proposed ECM5 - Replacement of pump at BPS Iorga 6

### Present situation

BPS Iorga 6 boosts water to one 16-story block only.
Presently 3 pumps K 45/30 installed and one pump is in continuous operation.
Apa Canal staff reported that existing pumps are oversized and nominal flow is much higher than needed flow for one block.

### Measurements results

### Pump no. 3

Measured actual pumping flow Q = **2.07 $m^3$/h**.

Measured suction pressure **52 m**.

Measured discharge pressure **77 m**.

Overall pumping head is H = 77 - 52 = **25 m.**

Measured active power consumption in the testing regime $P_{con}$ = **3 kW.**

### Calculation of pumping efficiency of pump no.3

The calculated hydraulic power $P_{hyd}$ = Q x H/367.2 = **0.14 kW**

The actual pumping efficiency of existing pump $P_{hyd}$ / $P_{con}$ = **0.05 %**

We consider that existing pump is extremely oversized and shall be replaced by smaller unit.

### Proposed Improvement

We propose to install booster pump set in order to cover the actual water consumption in one block. New booster pump set consist of 2 pumps (analogue BLOCK BGM 7/A) with the following parameters:

| | |
|---|---|
| Rated flow | = 3 $m^3$/h |
| Rated head | = 20 m |
| Motor rated power | =0.775 kW |

### Estimation of Savings

| | |
|---|---|
| Estimated power consumption of existing pump | = 33 000 kWh/year |
| Estimated power consumption of new pump | = 6 800 kWh/year |
| Power saving | = 26 200 kWh/year |
| Assuming 1.8 MDL per 1 kWh | **= 47 160 MDL/year** |

### Estimation of investment cost

**Table 7-3** *Estimation of Investment Costs*

| No. | Description | Unit | Qty | Unit price, EUR | Total price, EUR |
|---|---|---|---|---|---|
| | **Mechanical** | | | | |
| 1 | Boosting pump set Q=3 m3/h H=20 m with hydrophore | psc | 2 | 320 | 640 |
| 2 | Piping, fittings and connection to the block plumbing | set | 2 | 500 | 1,000 |

| No. | Description | Unit | Qty | Unit price, EUR | Total price, EUR |
|---|---|---|---|---|---|
| 3 | Ball valve DN50 | psc | 4 | 40 | 160 |
| | **Electrical** | | | | |
| 4 | Control panel and cables | set | 2 | 400 | 800 |
| 5 | Earthing | set | 2 | 100 | 200 |
| | **Auxillary** | | | | |
| 6 | Installation | Lump sum | 2 | 300 | 600 |
| 7 | Mandatory spare parts | set | 2 | 100 | 200 |
| 8 | O&M manuals | set | 1 | 100 | 100 |
| | | | | | |
| | **Grand total EUR** | | | | **3,700** |
| | **Grand total MDL** | | | | **61,050** |

| **Payback period** | **= 1.3 years** |
|---|---|

In general booster pumping stations in Balti do not operate efficiently (please see measurements data of actual pumping parameters) due to the old, oversized and obsolete pumping equipment. As pressures in the lower parts of Balti are high (approx. 50 m), necessity of BPS is justified just for 14 or 16-story buildings. Since electric consumption of all boosting pumping stations is around 5% of overall power consumption of Apa Canal Balti, detailed analysis of BPS performance has not been performed.

## 7.6 Proposed ECM6 - Cogeneration plant for electrical and heat power production

### Present situation

There are several buildings at the territory of Baza PS (administration block, garage, warehouse, etc.)

Below table shows electrical and heating energy consumption of building complex:

**Table 7-4** *Current Power and Heat Energy Consumption*

| | kWh | MDL/kWh | Total cost, MDL | Average cost, MDL/kWh |
|---|---|---|---|---|
| Yearly electrical power consumed | 1,198,993.0 | 1.450 | 1,738,540 | |
| Yearly heating power consumed | 625,216.8 | 0.910 | 569,163 | |
| **TOTAL:** | **1,824,209.8** | | **2,307,703** | **1.27** |

### Proposed Improvement

We propose to install mini cogeneration power plant for production of electrical and heating energy, which will cover overall heating power consumption and partial electrical power consumption[4]

**Table 7-5** *Estimation of the Average Production Cost*

| | | |
|---|---|---|
| Annual production of electrical power | 1,095,000 | kWhe |
| Annual production of heating power | 722,009 | kWht |
| TOTAL: | 1,817,009 | kWh |
| Average production cost | 0.93 | MDL/kWh |

[4] Implementation of the ECM2 will eliminate pumping from Baza PS. Produced electrical power can be used by Decebal PS or supplied to the grid

### Estimation of Savings

Saving of heating and electrical power = 1 817 009 kWh/year*(1.27-0.93) = **608 165 MDL**

### Estimation of investment cost

Mini power plant (analogue TEDOM Cento120) 110 794 Euro or 1 772 702 MDL

**Table 7-6** *Parameters of the Proposed Mini Power Plant*

| Type | Electrical power rate, kW | Heating power rate, kW | Gas consumption , nm3/h | Efficiency |
|---|---|---|---|---|
| Analogue **Cento T120** | 125 | 181 | 36.9 | 88% |

Design, installation, testing and running-in = 150 000 MDL

**Total investment cost** **= 1 922 702 MDL**

**Payback period** **= 3.2 years**

## 7.7 Economic Assessment of the Proposed ECMs.

The calculated payback period for the proposed ECMs is presented in the following Table.

| ECM description | Annual energy savings, kWh | Annual energy savings, MDL | Capital investment cost, MDL | Simple payback period, years | Ranking |
|---|---|---|---|---|---|
| Optimization of existing water supply scheme from Soroca-Balti reservoirs | 3,700,000. | 5,365,000 | 0 | 0 | **1** |
| Optimization of pumping scheme Decebal – Upper reservoirs - Baza | 1,113,600 | 1,670,400 | 2,236,575 | 1.3 | **2** |
| Replacement of active sludge recirculation pump | 210,000 | 315,000 | 1,010,000 | 3.2 | **5** |
| Speed control for air blower at WWTP | 184,000 | 276,000 | 380,000 | 1.4 | **4** |
| Replacement of pump at BPS Iorga 6 | 26,200 | 47,160 | 61,050 | 1.3 | **3** |
| Cogeneration plant for electrical and heat power production | Electricity and heating | 608,165 | 1,922,702 | 3.2 | **6** |

## 7.8 Summary reduction in Energy Consumption

The average reductions in energy consumption for each site were estimated in previous Sections. A summary is given in the table below.

| Site | Estimated average yearly power demand (in kWh) | |
|---|---|---|
| | Before improvement | After improvement |
| Copaceanca PS | 3,700,000 | **0** |
| Baza PS | 1,200,000 | **86,400** |
| WWTP sludge recirculation | 630,000 | **420,000** |
| WWTP air blower | 1,840,000 | **1,656,000** |
| BPS Iorga 6 | 33,000 | **6,800** |
| Total power consumption | 7,403,000 | **2,169,200** |
| Saving in kWh | **5,233,800** | |
| Overall saving in percent | **71%** | |
| Estimated savings of overall Apa-Canal Balti power consumption (data of 2010 year 10,044,651 kWh) | 52% | |