WATER LOSS CONTROL PROJECT IN ISTANBUL

Berkay ÖTÜMLÜ
Departmant Head of Subcriber Services 1

August 2023

History of Water

In 1933, the year of our establishment, the number of subscribers was 26,015 and the population was 734,000.

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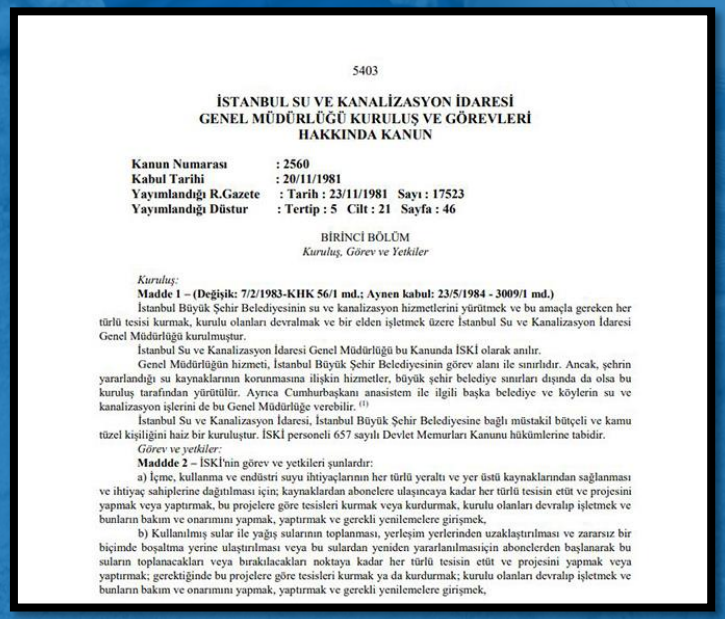

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İSTANBUL SU VE KANALİZASYON İDARESİ GENEL MÜDÜRLÜĞÜ KURULUŞ VE GÖREVLERİ HAKKINDA KANUN

Kanun Numarası : 2560
Kabul Tarihi : 20/11/1981
Yayımlandığı R.Gazete : Tarih : 23/11/1981 Sayı : 17523
Yayımlandığı Düstur : Tertip : 5 Cilt : 21 Sayfa : 46

BİRİNCİ BÖLÜM
Kuruluş, Görev ve Yetkiler

Kuruluş:

Madde 1 – (Değişik: 7/2/1983-KHK 56/1 md.; Aynen kabul: 23/5/1984 - 3009/1 md.)

İstanbul Büyük Şehir Belediyesinin su ve kanalizasyon hizmetlerini yürütmek ve bu amaçla gereken her türlü tesisi kurmak, kurulu olanları devralmak ve bir elden işletmek üzere İstanbul Su ve Kanalizasyon İdaresi Genel Müdürlüğü kurulmuştur.

İstanbul Su ve Kanalizasyon İdaresi Genel Müdürlüğü bu Kanunda İSKİ olarak anılır.

Genel Müdürlüğün hizmeti, İstanbul Büyük Şehir Belediyesinin görev alanı ile sınırlıdır. Ancak, şehrin yararlandığı su kaynaklarının korunmasına ilişkin hizmetler, büyük şehir belediye sınırları dışında da olsa bu kuruluş tarafından yürütülür. Ayrıca Cumhurbaşkanı anasistem ile ilgili başka belediye ve köylerin su ve kanalizasyon işlerini de bu Genel Müdürlüğe verebilir. (1)

İstanbul Su ve Kanalizasyon İdaresi, İstanbul Büyük Şehir Belediyesine bağlı müstakil bütçeli ve kamu tüzel kişiliğini haiz bir kuruluştur. İSKİ personeli 657 sayılı Devlet Memurları Kanunu hükümlerine tabidir.

Görev ve yetkiler:

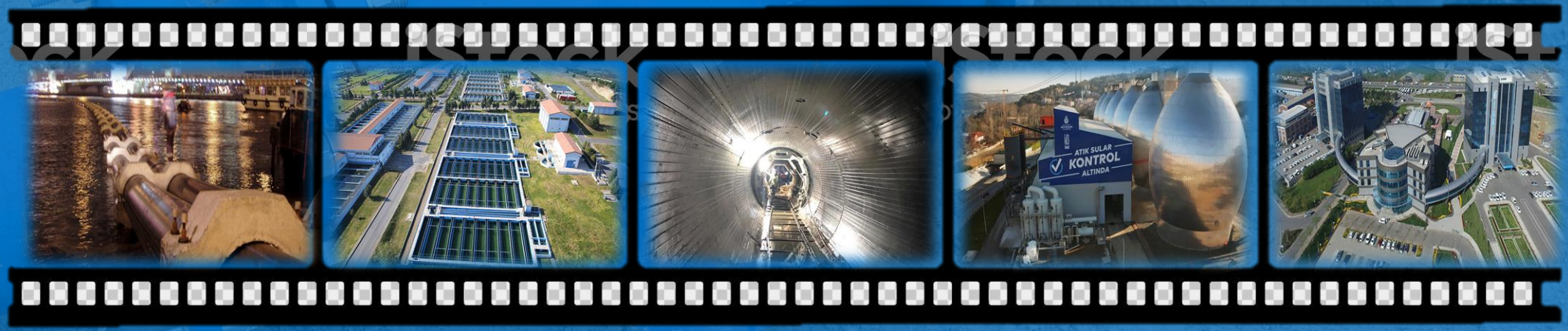
Maddde 2 – İSKİ'nin görev ve yetkileri şunlardır:

a) İçme, kullanma ve endüstri suyu ihtiyaçlarının her türlü yeraltı ve yer üstü kaynaklarından sağlanması ve ihtiyaç sahiplerine dağıtılması için; kaynaklardan abonelere ulaşıncaya kadar her türlü tesisin etüt ve projesini yapmak veya yaptırmak, bu projelere göre tesisleri kurmak veya kurdurmak, kurulu olanları devralıp işletmek ve bunların bakım ve onarımını yapmak, yaptırmak ve gerekli yenilemelere girişmek,

b) Kullanılmış sular ile yağış sularının toplanması, yerleşim yerlerinden uzaklaştırılması ve zararsız bir biçimde boşaltma yerine ulaştırılması veya bu sulardan yeniden yararlanılmasıçin abonelerden başlanarak bu suların toplanacakları veya bırakılacakları noktaya kadar her türlü tesisin etüt ve projesini yapmak veya yaptırmak; gerektiğinde bu projelere göre tesisleri kurmak ya da kurdurmak; kurulu olanları devralıp işletmek ve bunların bakım ve onarımını yapmak, yaptırmak ve gerekli yenilemelere girişmek,

On 23 November 1981, the Istanbul Water and Sewerage Administration (İSKİ) was established with the Law No. 2560 published in the Official Newspaper.

In 1984, it was incorporated into the Istanbul Metropolitan Municipality..



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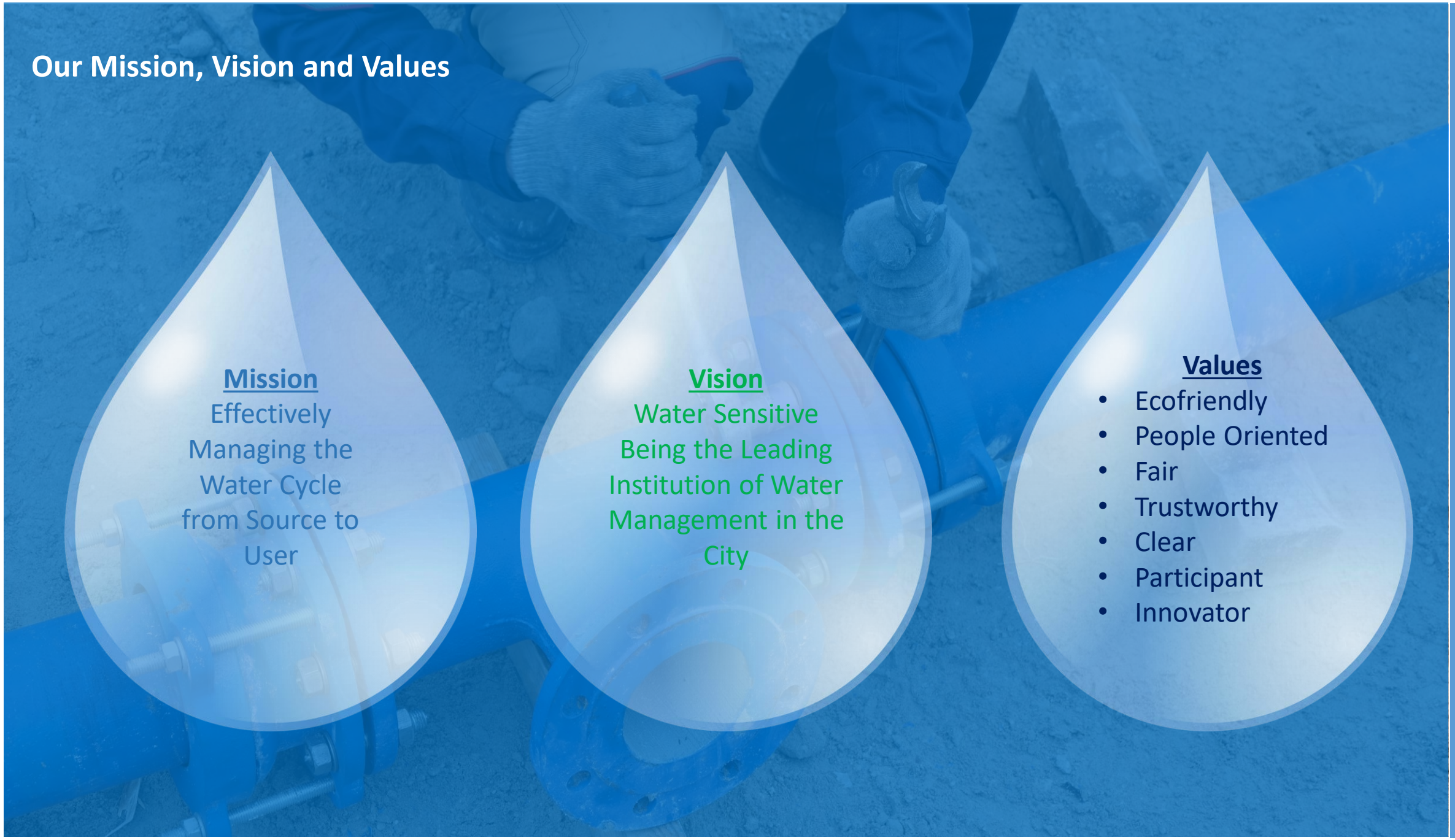
Our Mission, Vision and Values



Mission

Effectively Managing the Water Cycle from Source to User

Vision

Water Sensitive Being the Leading Institution of Water Management in the City

Values

- Ecofriendly
- People Oriented
- Fair
- Trustworthy
- Clear
- Participant
- Innovator

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Key Figures on İstanbul

Population Served	15.907.951
Total Service Area	5.461 km^2
Number of Subscribers	6.862.747
Length of Drinking Water Lines	23.082 km
Length of Wastewater Lines	18.210 km
Yield of Water Resources	1.695.000.000 m^3/year
Daily Water Supplied to the City	2.999.444 m^3/day
Daily Treated Wastewater	6.207.365 m^3/day
Number of Drinking Water Treatment Plants	24
Number of Waste Water Treatment Plants	90

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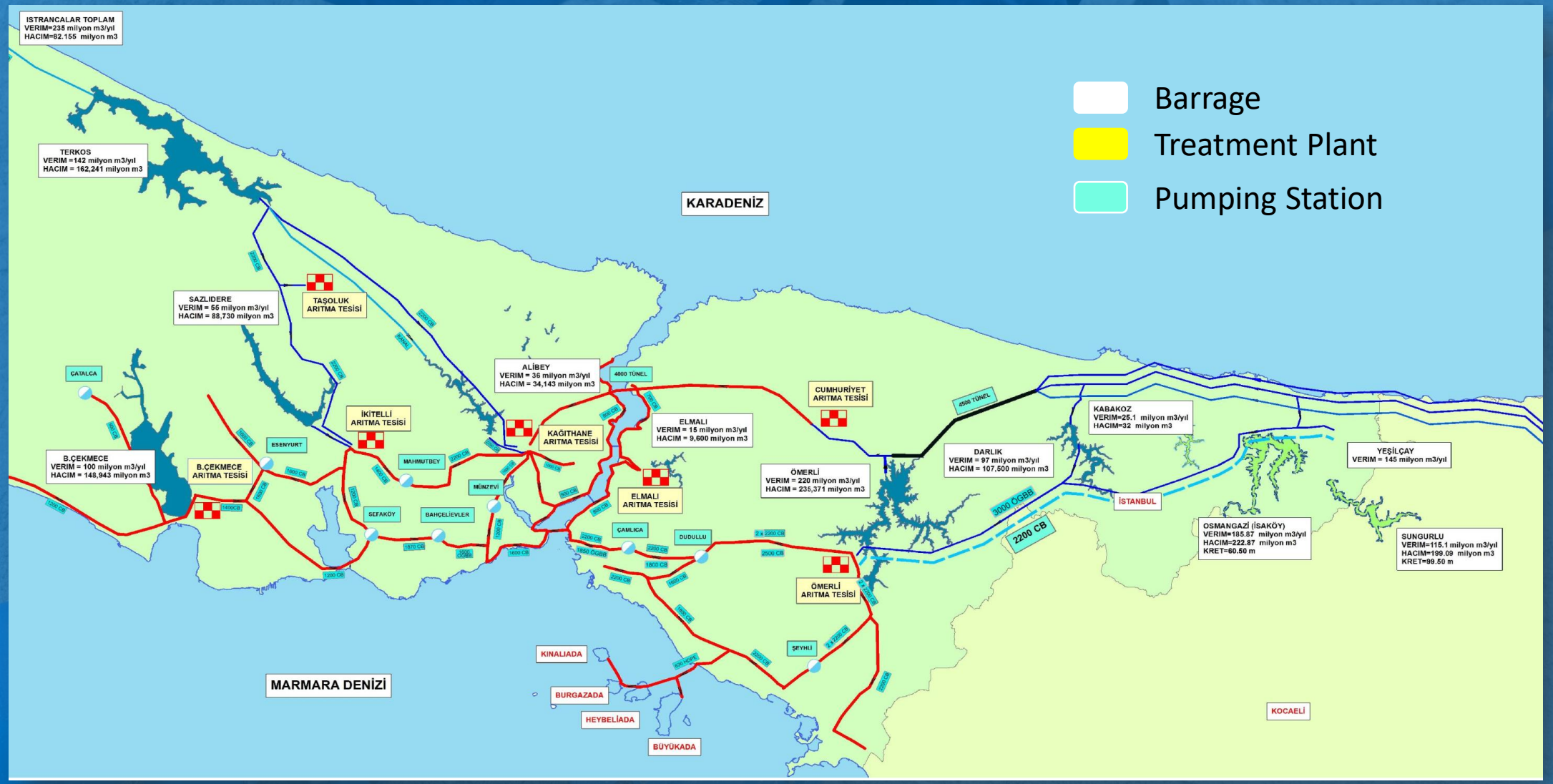
Water Network of Istanbul



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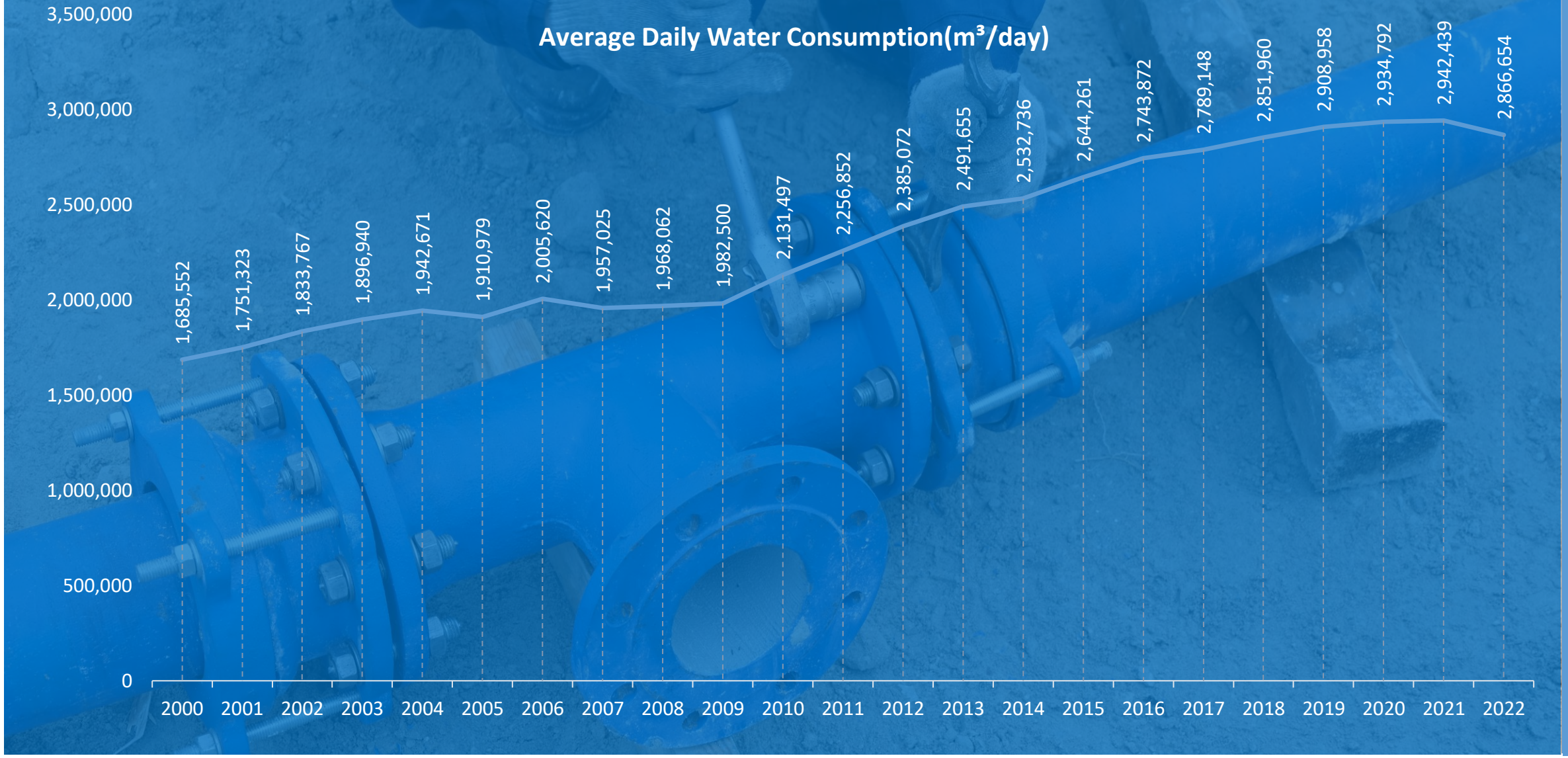
Average Water Consumption Of Istanbul By Years



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Istanbul Water Control and Automation Center (İSKOM)

An automation center has been established by our administration to carry out clean water and wastewater management from a single center.

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What Was The Situation In Our Drinking Water Network In 2019?

Water Loss Rate **%23**

High-Pressure Pipe Line> 3 bar

Mixed System Of Drinking Water Lines Over Time (Gravity/Pomping)

Insufficient Field Data

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What Was Targeted?

- Reduce The Water Loss Rate Below 15%
- Optimum Pipe Pressure~3 Bar
- Creating Managed Subregions (DMA)
- Reducing The Failures Of Water Supply With Pressure Optimization
- Online Monitoring Of Consumption And Pressures, Short And Long Term Water Loss Analysis
- Control The Failures Of Water Supply With Night Flow Monitoring
- Real water management with updating of field data

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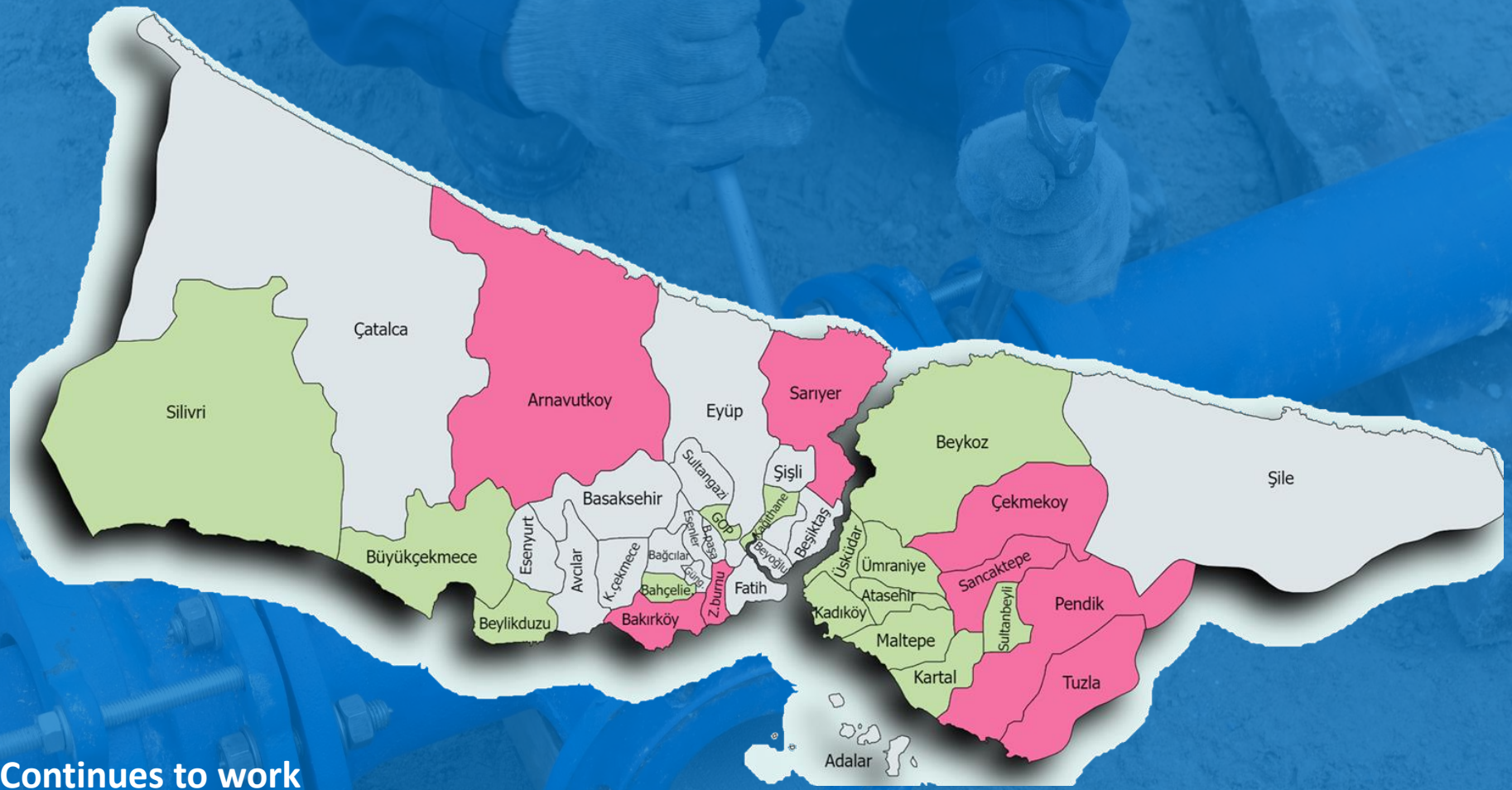
Workspace of Water Loss Project



Continues to work

Plans to work

Work completed

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Advanced Water Management Strategy

Step 1

GIS and SIMS (Subscriber Information Management System) Data Analysis

Line Detection, Open/Closed Position Detection
Malfunction Detection Tests etc.

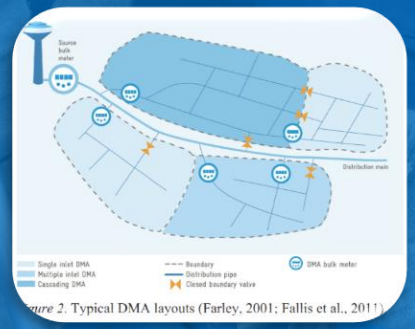

Figure 2. Typical DMA layouts (Farley, 2001; Fallis et al., 2011)

Hydraulic Modeling

Modeling the network with modeling services
Temporary Flow Pressure Measurements

Establishing Construction, Mechanical, Control and Communication Infrastructure

Establishing infrastructure with DMA room, instruments, and RTU units
PRV, Needle Valve etc.

Real-Time Flow Monitoring and Pressure Management with SCADA

Maintaining the network at optimal pressure based on daytime, nighttime, or in cases of critical pressure
Water Domain, short and long-term leak detections, Topology

Step 2

Water Loss Analysis with Advanced Network Management

Water Domain
Minimum Night Flow Analysis
Machine Learning

Step 3

Smart Meters

Real-time water balance and water loss analysis with meter information provided throughout the day

Strategy
DMA-Based
At Optimal Pressure
Manageable Sub-Networks

ACOS 7 Series

RTU Series

HIGH-LEIT W

Advanced SCADA

NPM W

Advanced network management

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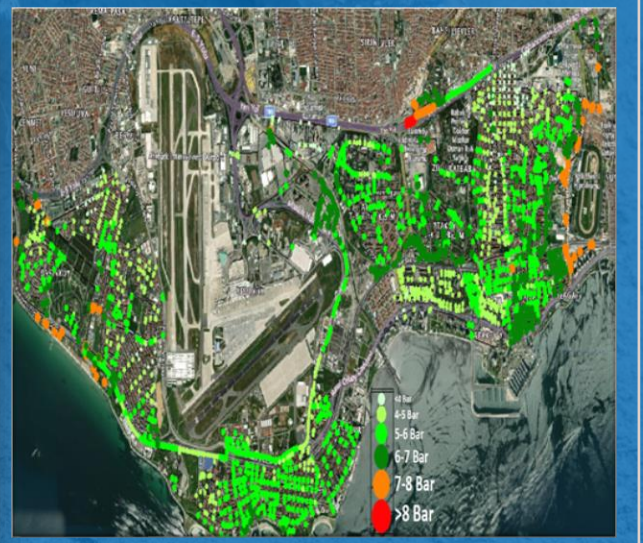
Step 1 - GIS Data Analysis and Hydraulic Modeling

-Line Detection

-Temporary Pressure Measurements

-Network Modeling

-Malfunction Detection Tests



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Step 1 - Establishment of Construction, Mechanical, Control, and Communication Infrastructure

-DMA room setup

-Installation of mechanical equipment

-Establishment of electrical infrastructure

-Installation of communication systems

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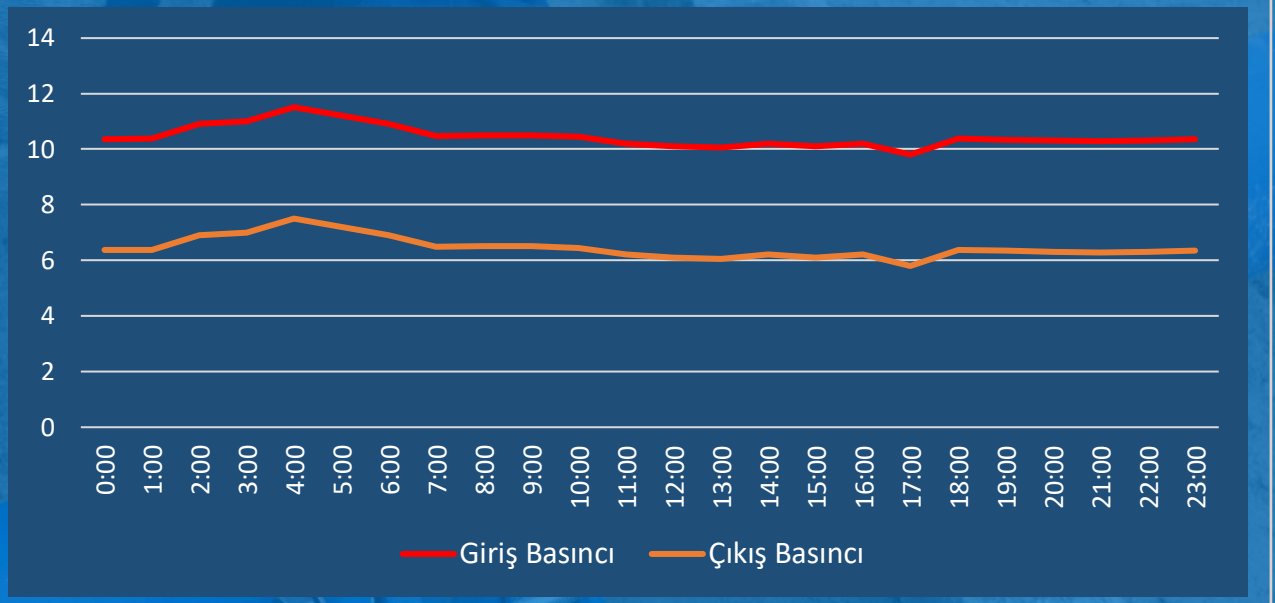
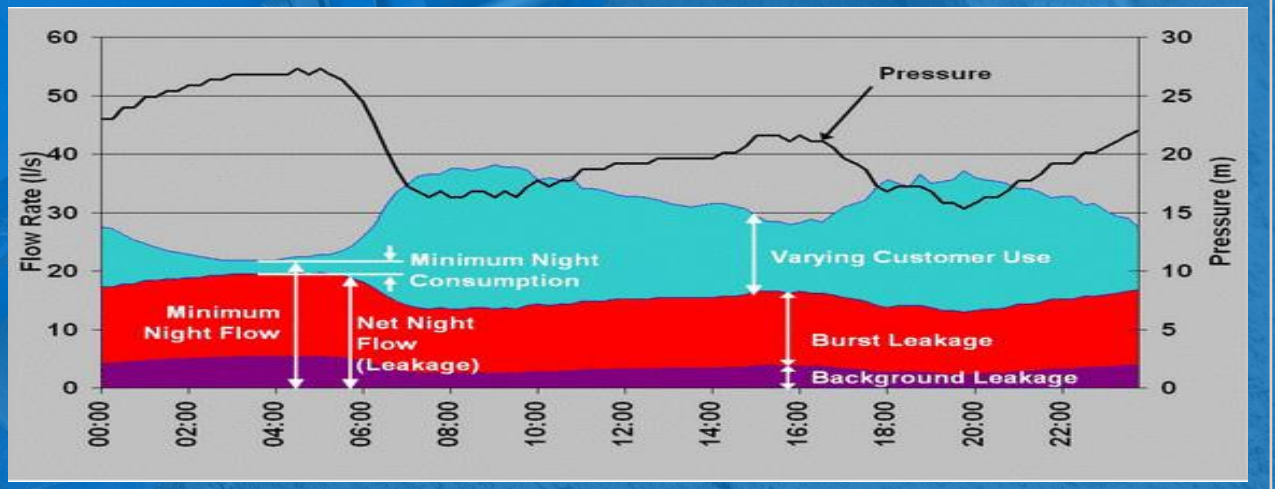
Step 1 - Real-Time Flow Monitoring and Pressure Management with SCADA

-Day and night pressure monitoring

-Monitoring critical pressure points

-Short and long-term water loss tracking





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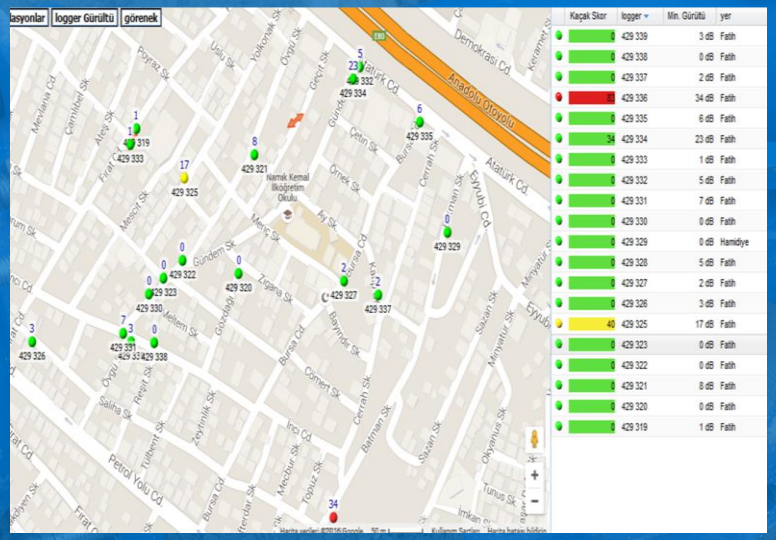
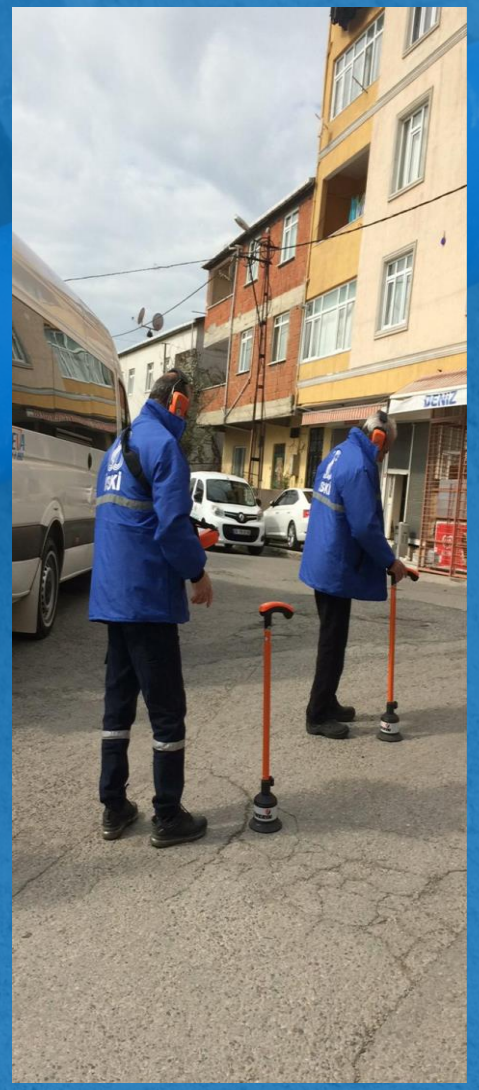
Step 1 - Leak Detection

-Acoustic Listening - Noise Recording Logger

-Fault Detection and Troubleshooting





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Step 1 – Types of Malfunctions

- Pipe Breakage
- Outlet Malfunction
- Malfunction of Branch Lines

Step 1 – Identified Malfunctions

DIAMETER	PIECES	Estimated Leak Amount m^3/hour	WATER SAVED DAILY (m^3)	WATER SAVED MONTHLY (m^3)	WATER SAVED YEARLY (m^3)
Ø900 mm	1	421	10,104.00	303,120.00	3,637,440.00
(Ø100-Ø300 mm)	138	22.735	75,298.32	2,258,949.60	27,107,395.20
Ø32 mm crack leakage	923	1.265	28,022.28	840,668.40	10,088,020.80
Ø32 mm connection malfunction	19	0.95	433.20	12,996.00	155,952.00
Ø32 mm valve malfunction	162	1.89	7,348.32	220,449.60	2,645,395.20
TOTAL	**1243**	-	**121.206,12**	**3,636,183.60**	**43,634,203.20**

Step 2 - Water Loss Analysis with Advanced Network Management

Real-Time Monitoring and Management
Operation

DMA Management, Scheduled Pressure Management
Pressure and Flow Management

Pressure Management Considering Critical Points
Pressure Management

Night Flow Monitoring (MNF)
Leak Management Module

Water Domain (Special Solutions for Water Networks)
Real-Time, Short and Long-Term Leak Analysis

Analyses, Reports
In accordance with IWA Standards

Integration of SCADA, ERP, GIS, Hydraulic Model, Data Logger Integrations, Data Sharing

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Step 2 - Water Loss Analysis with Advanced Network Management

DMA Management
Pressure and Flow Management

Critical Point Pressure Management
Pressure Management

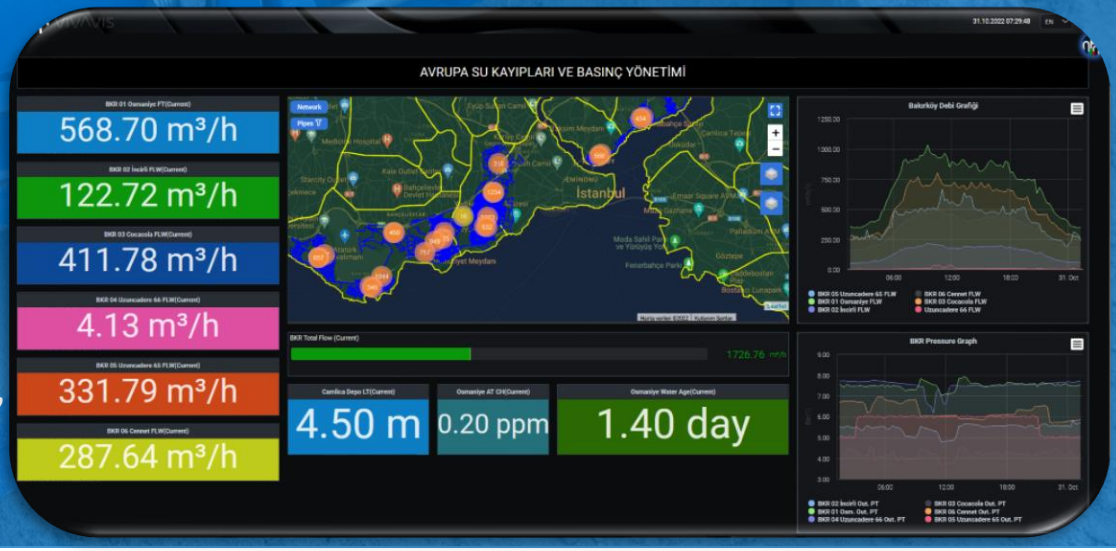
Night Flow Analysis (MNF)
Leak Management Module

IWA Water Balance Table
Water Loss Leakage Rate Calculations

Analyses, Reports, Dashboards
In accordance with IWA Standards

Real-Time Monitoring and Management
In accordance with IWA Standards

Integration of SCADA, ERP, GIS, Hydraulic Model, Data Logger Integrations



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Step 3 – Smart Meters

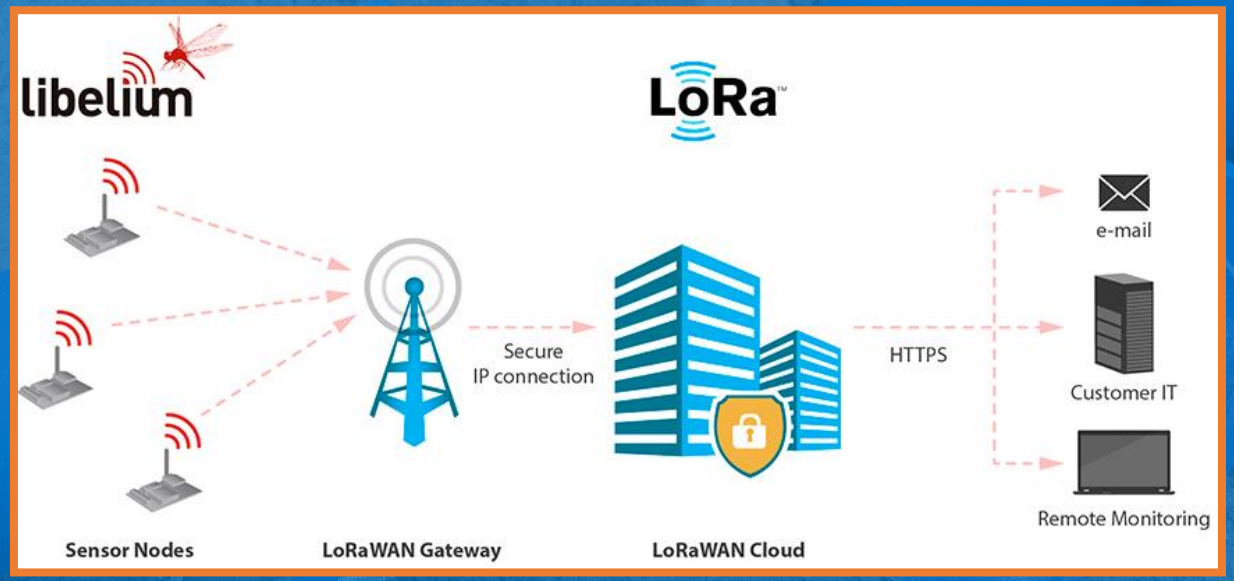
In our administration, Smart Meters with Remote Reading, On/Off Valve capabilities and equipped with NB-IoT and LoRaWAN communication technologies have been implemented. These technologies provide the ability to reach long distances and ensure secure data transfer.

LoRa

Long Range

NBIOT

GSM Network Based



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Step 3 – Smart Meters

Prevention of Water Loss

Wide Data Analysis and Reporting through Real-Time Data Monitoring

Full Protection against Unauthorized Interventions

Reduced Operational Costs through Remote Reading and Remote On/Off

Elimination of Reading Errors Due to Personnel

Real-Time Monitoring and Management

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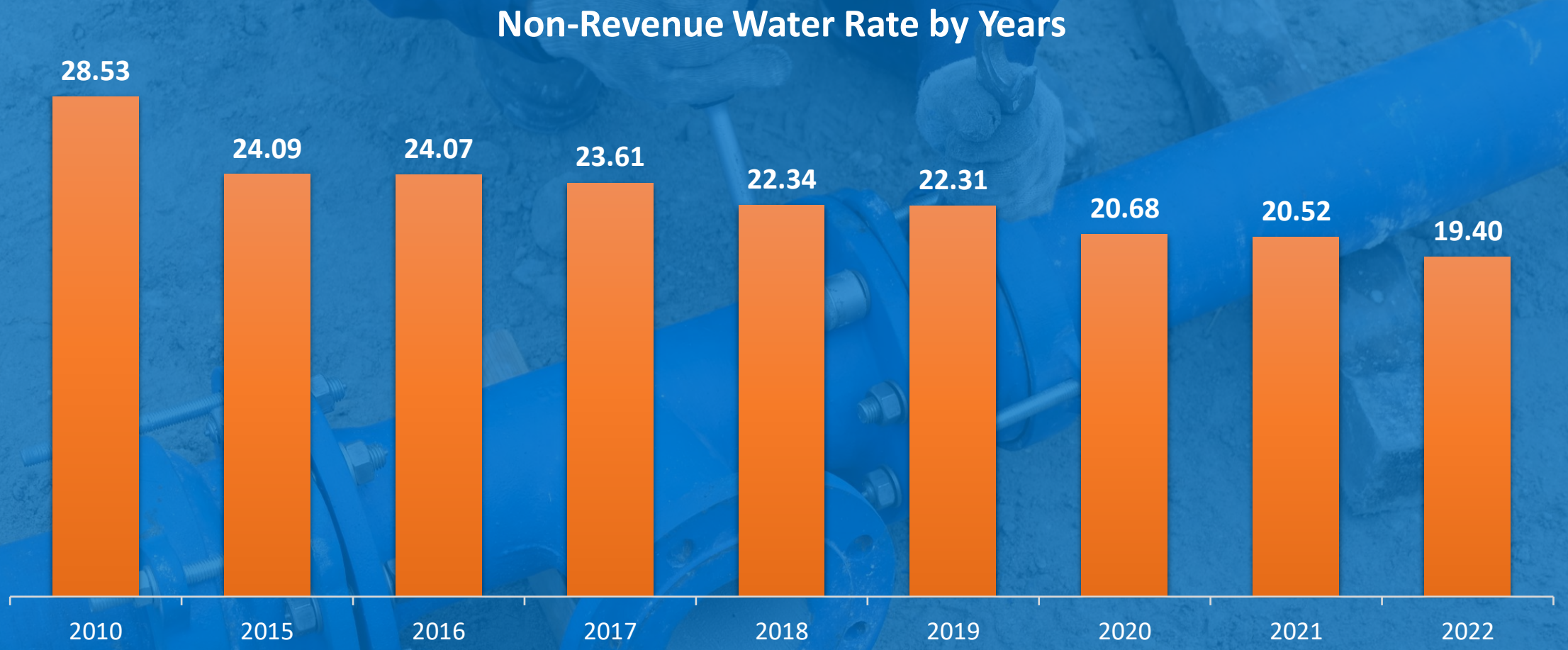
Conclusion


Non-Revenue Water Rate by Years
28.53
24.09
24.07
23.61
22.34
22.31
20.68
20.52
19.40
2010
2015
2016
2017
2018
2019
2020
2021
2022

Trenchless Technologies Effects

Social Effects

- No or Less Traffic Disruption.
- No dig so no muds or dirts
- Low noise process
- No Excavation, so no any repair reqiured
- Very Fast process, Long lengths in short time

Economical Effects

- Cheaper production
- Less disruption of around trade market
- No inturruption in eixisting process.
- Lifetime of the pipeline is increased economically

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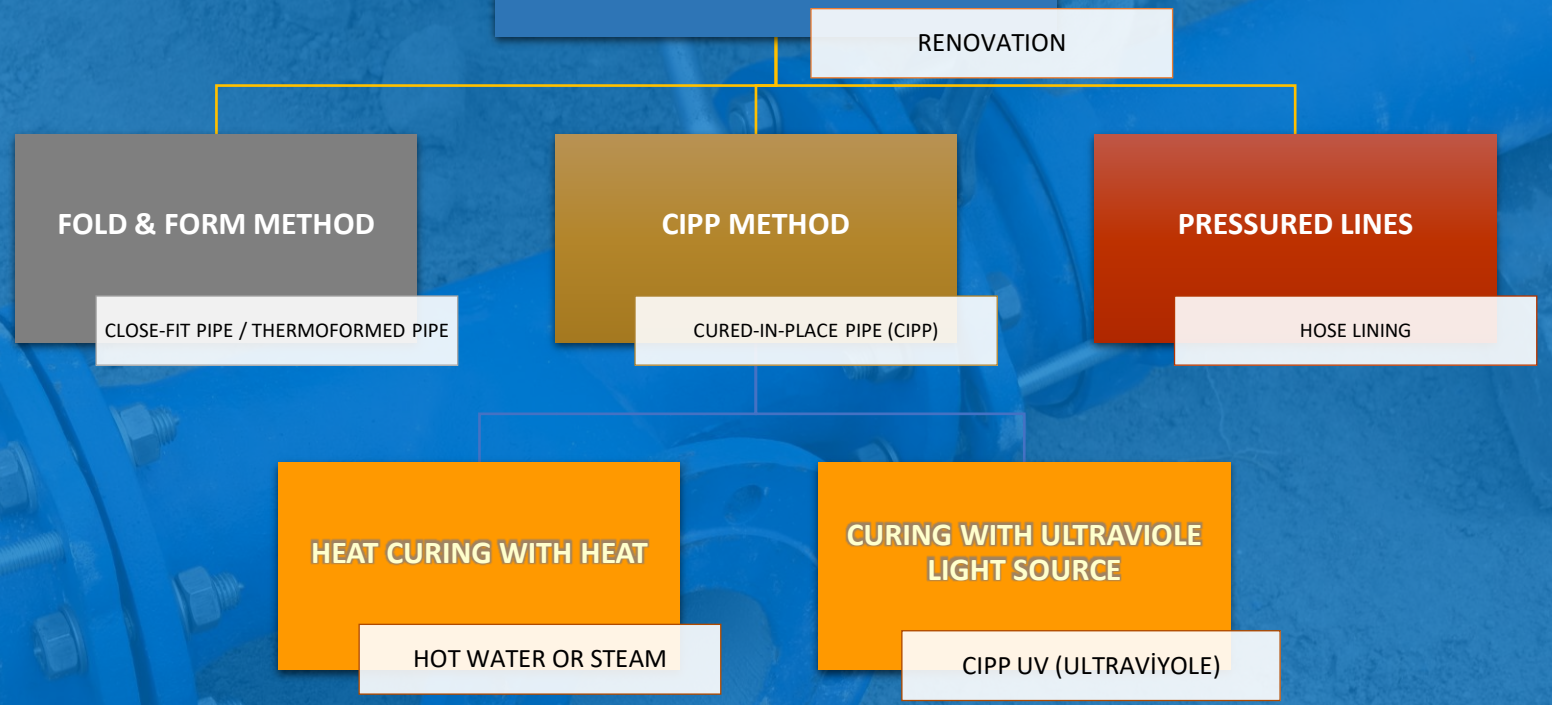
REHABILITATION TECHNIQUES APPYLIED AT ISKI



Fold & Form (Clos-fit) Technology

- Creation of the safety strip and gas measurement
- Interruption of flow by duct plugging pillows
- Establishment of a bypass line with waste water pumps
- Setting up the material crane

- at first, the material is softened by heating .
- the softened material is pulled into the existing line with the help of a crane
- reheating process started in the line
- pulled material is inflated in line with the help of high pressure and heat.
- after inflated, pvc pipe is taken to rest and cooled.
- connections are properly cut after coating
- with the cctv camera robot, the final state of the pipeline is displayed for reporting.
- **Since there is 175 meters of wound material on the reel, this is also the maximum capacity that can be drawn on the existing line**

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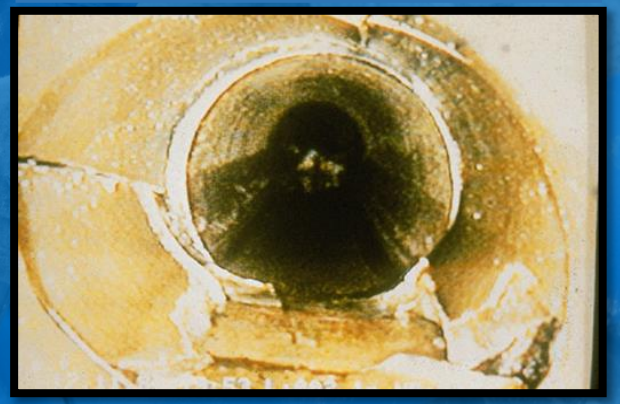
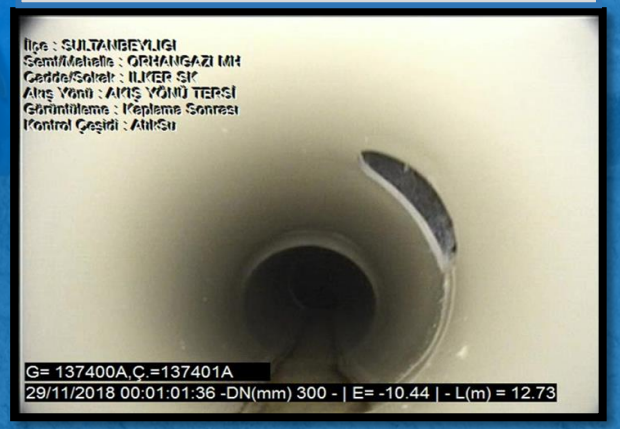
Fold & Form (Clos-fit) Technology

- Before coating, all indentations in the line must be milled.(Pvc, corugated or concrete parcel connections and gaskets)
- After Rehabiltation, connections should be cut properly

BEFORE



AFTER



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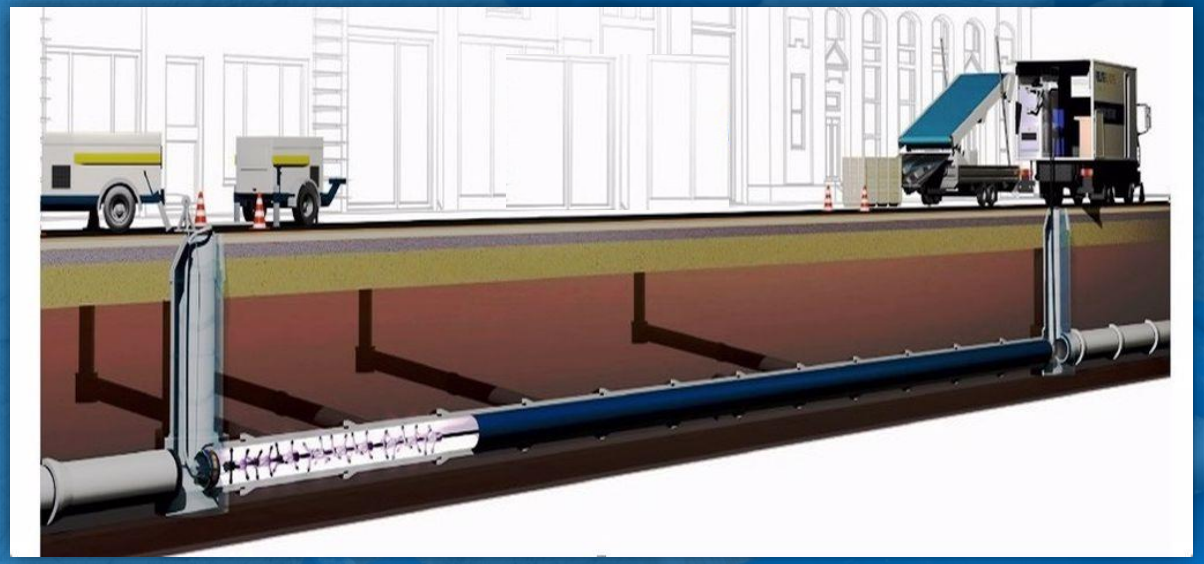
Fold & Form Method

- In this rehabilitation projects; Fold & Form techniques has been used.
- Grand Bazaar' network lines are existing from storm and waste water non-circular lines.
- Total Length of this non-circular lines is 3.0 Km.

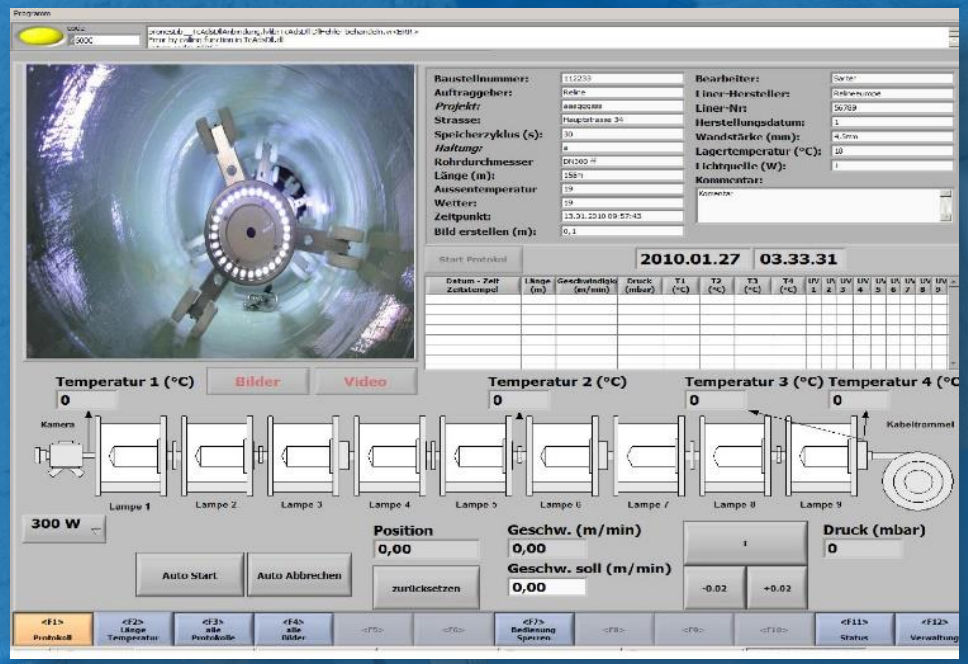
Cured - In- Place Pipe (Glass Fiber Reinforced Composite Primer Material)
Cipp – Uv Technology



Over 450 km of waste water lines have been rehabilitated using the CIPP - UV Method.

- It is the process of placing a resin-impregnated glass fiber liner on the SEWAGE LINES and tightly wrapping the existing pipe inner wall by curing with Ultraviolet (UV) light.
- Since the cable of the UV Light curing device is 200 meters, maximum 200 meters of curing can be done at once.

Cured - In- Place Pipe (Glass Fiber Reinforced Composite Primer Material)
Cipp – Uv Technology



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Pressure Pipe (Potable) Rehabilitation

General Properties of the Material :

- Line is a flexible sliplining solution for the trenchless rehabilitation of pressure pipes. The system consists of a flexible Kevlar reinforced liner and specially developed end fittings

Deactivation of the Line :

- In order to rehabilitate the old line, the water flow will be cut off and the line will be disabled (By-Pass).

Cleaning And Milling The Pipeline :

- Before the rehabilitation application, line cleaning will be done by applying hydraulic force, by high speed water jet or by mechanical means (milling).

Pipeline Inspection:

- The image of the existing line will be taken with a CCTV camera and checked before rehabilitation.

Placing the Hose Liner Material:

- Rehabilitation is completed by pulling material into the line.
- Drinking water line is commissioned after it is assembled to the pipeline running with the fittings.

BEFORE CLEANNING

AFTER CLEANNING

AFTER PULLING MATERIAL

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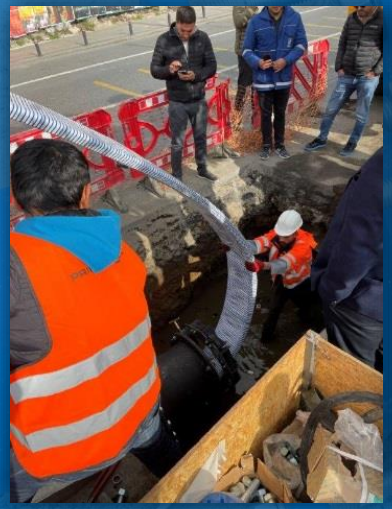
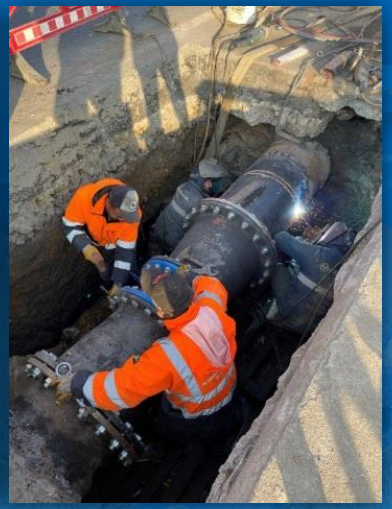
Pressure Pipe (Potable) Rehabilitation

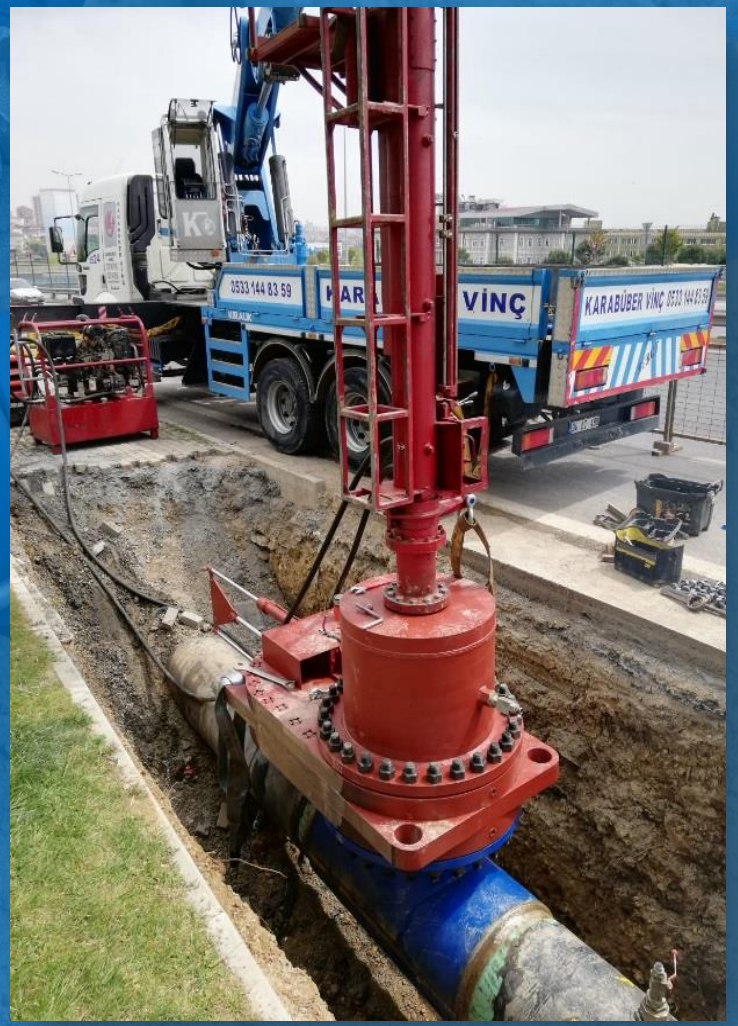




- The rehabilitation of the transmission line located on haydar aliyev avenue in Sarıyer district was made with this method.
- In this project, 2 km. drinking water line was rehabilitated.

Inovative Applications Of Water And Waste Water System Hot-tapping Technology

- With this method, we perform the operations of placing valves in the existing drinking water network lines and taking branches from the existing network lines.
- Due to Hot-Tapping technology, water cut is minimized during maintenance works in Istanbul.
- Since 2017; 146 pcs of insert valves (on the network lines) / 220 pcs of branches (on the network lines) / 5 pcs of big diameter insert valves (on the transmission lines) operations were succesfully completed by ISKI



NEW INSTALLATION APPYLIED AT ISKI

- HORIZONTAL DIRECTIONAL DRILLING (HDD)
- MICROTUNNELLING / PIPE JACKİNG
- TUNNEL BORING MACHINE (TBM)

Horizontal Directional Drilling (HDD)

HDD especially is used for construction of infrastructure for passing the special areas as follows;

- Heavy Trafic,
- Heavy Underground Lines & Facilities
- Historical Places,
- Natural Site Zone
- Accrossing River
- Accrosing Railways & Roads

- Between 2017-2023, 7 Km pipelines has already been installed with HDD Technology
- Until today, 50 km sewer lines has already been installed with HDD Technology

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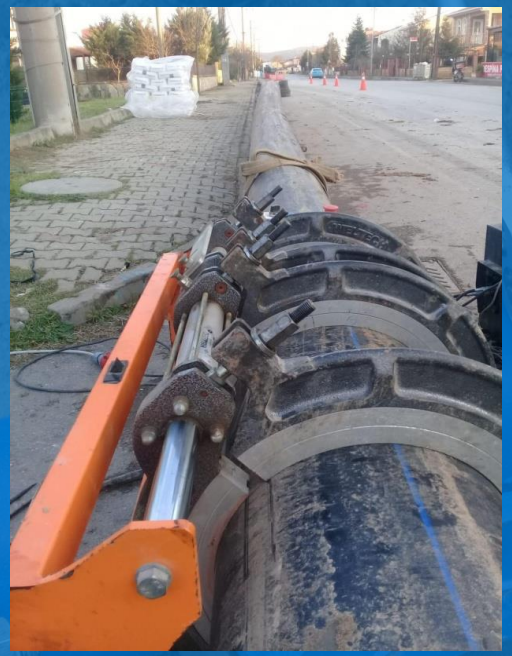
Horizontal Directional Drilling Stages

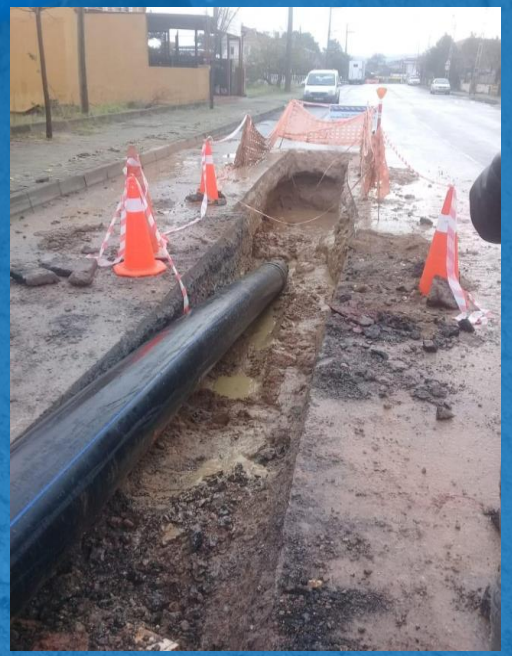
1. GUİDE DRILLING STAGE

2. WELDING PROCESS



3. REAMING DIAMETER

4. PIPE PULLING



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Yavuz Sultan Selim Mosque

With this method, a new waste water line was built for Yavuz Sultan Selim Mosque, one of our historical mosques.

Microtunnelling Pipe Jacking

- Microtunnel system; It is a remote-controlled method used for laying concrete and steel pipes under the ground.
- This system is generally applied in areas where open excavation is risky with highway, railway, metro lines, airports and river crossings.

Microtunnelling Pipe Jacking

- Goksu River Sewage Collector Project is a waste water collecting project which aims to collect and transfer sewage to Kucuksu Waste water Treatment Plant.

- The sewage collector project is constructed alluvial sand soil, parallel to the Bosphorus strait and below the ground water table- Göksu River

GOKSU RIVER : Ø 1400 mm L= 3.087 m

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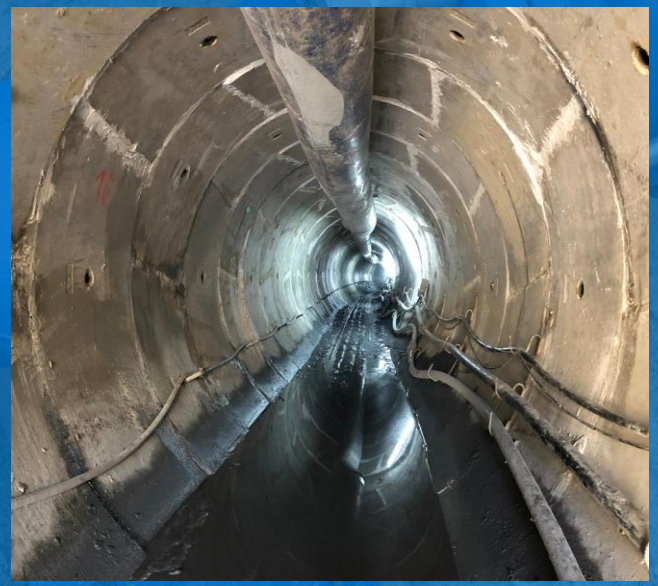
Tunnel Boring Machine (TBM)

- TBM is a circular excavation machine with a diameter of 1 meter (micto tunneling) up to 19 meters and can be applied on various rock and sand floors. The TBM works as a full-surface excavator and always moves forward. While digging with the cutters in front of it, it makes precise direction determination with the laser system. After this process, it continues by creating a temporary tunnel with the hydraulic system in the body section of the machine.



Tunnel Boring Machine (TBM)

Content of the Work:

- Construction of a segmented drinking water tunnel with Ø 4000 mm inner diameter in Kağıthane – Bahçelievler & Bahçelievler – Sefaköy.
- Within the scope of the work, the production of input-output shafts (11 shafts), cathodic protection, evacuation, suction cups and valves and tunnel outlet connections.

Content of the Work:

- Kağıthane & Münzevi : Ø 4000 mm L= 7.616,31m
- İslambey & Kocasinan : Ø 4000 mm L= 8.136,90 m
- Kocasinan & Sefaköy : Ø 4000 mm L= 4.861,24 m
- Total length of segmented drinking water tunnel with inner diameter of Ø 4000 mm, is **20.600 Km.**
- Ø3000 mm steel drinking water pipe will be installed in the tunnel.

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August 2023

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