Requirements for the Automation Design of a Water Supply Pumping Station

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1. **Date of Requirement:**
   Date: 07 / July / 2025

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2. Project Title:

Automation Design of Water Pumping Station

Station Name: Funicular I

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3. Project Objective:

The objective of the project is to develop an automation design for the existing pumping station, which will provide automatic control of the pumps, remote monitoring, and data logging. Additionally, it is necessary to design and develop protection systems for the station, including fire safety, surveillance, and flood protection.

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4. Description of the Current Situation:

The station currently operates in manual mode. The pumps are controlled manually by operators, which increases the risk of errors and inefficient operation of the pumping station.

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5. Scope of Design:

- Technical assessment of the current condition of the station.
- Development of the automation solution architecture.
- Planning of the SCADA/HMI system.
- Selection and placement of sensors and control elements.
- Definition of communication channels and protocols.
- Development of electrical/control system plans (CAD/schematics).

- Specification of required devices and materials for the project.
- Determination of the project budget.

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6. Expected Outcomes:

- Completed project documentation.
- System block diagram and technical drawings.
- Creation of SCADA/HMI architecture design.
- Definition of the list of materials required for automation.
- Specification of technical requirements.
- Development of the project implementation plan.

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7. Estimated Completion Time:

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8. Technical and Contact Persons:

- Project Manager: Valeri Khachidze
- Technical Coordinator: Levan Jamagidze: +995 558 33 17 33 / Erekle Matiashvili: +995 591 97 72 77
- Company/Department Name: GWP / Pumping Stations Department

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9. Notes and Additional Requirements:

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10. Annexes:

- Location of the station.

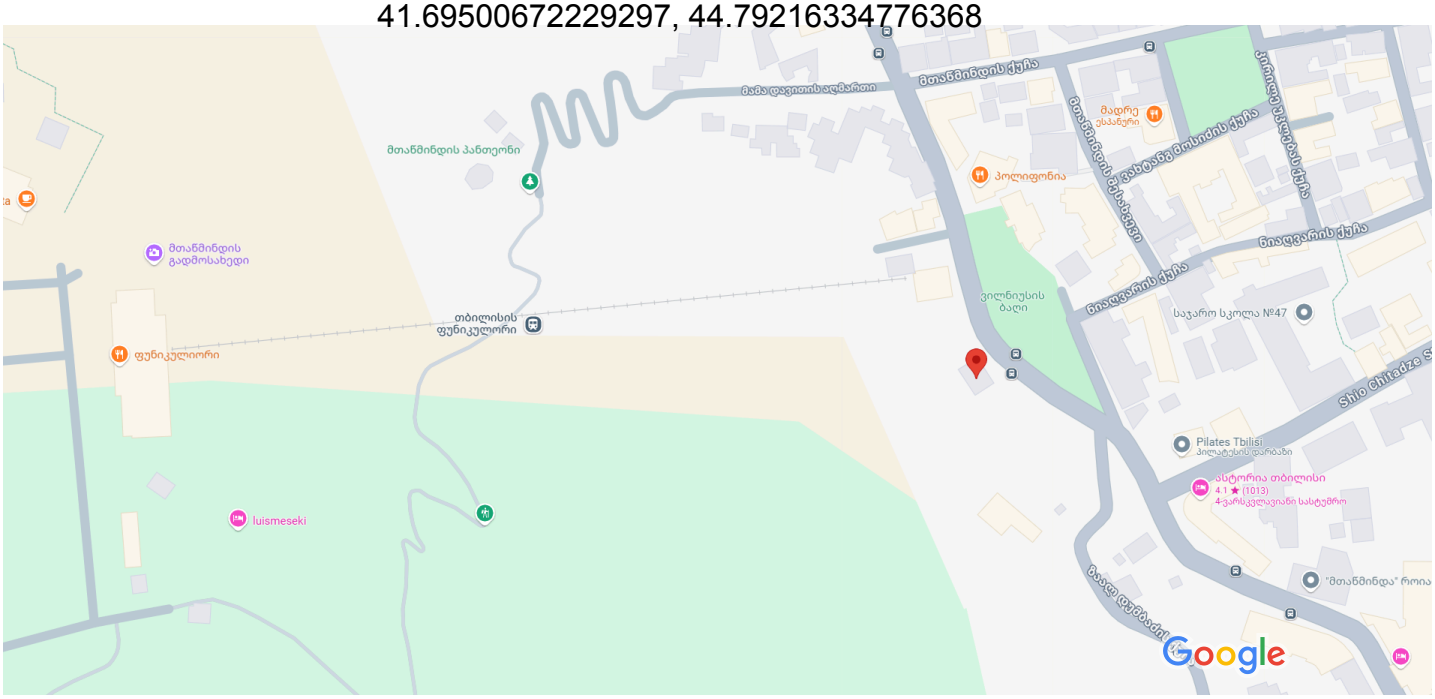
- Situational layout of the station.
- Technical assignment.

Location on the station

Google Maps

22 დანიელ ჭონქაძის ქუჩა

41.69500672229297, 44.79216334776368



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22 დანიელ ჭონქაძის ქუჩა

კომპლექსის შენობა

მიმართულებები | შენახვა | ახლომდებარე | ტელეფონზე გაგზავნა | გაზიარება

22 დანიელ ჭონქაძის ქუჩა, თბილისი

ამ ადგილზე

Ltd. Georgian Water & Power

Situational layout of the station

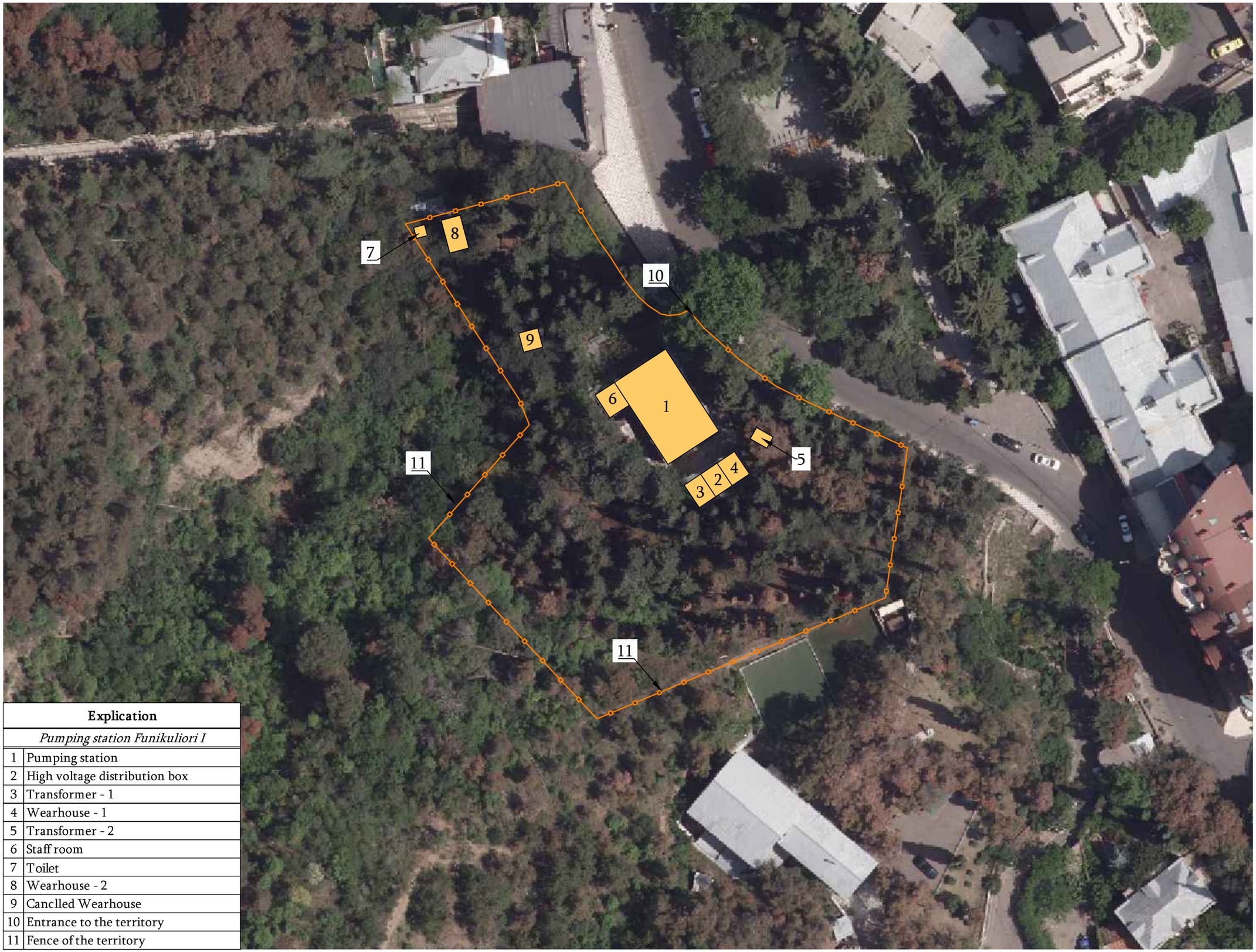
Pumping station "Funikuliori I"

Situational part

Tbilisi 2023

Pumping station "Funikuliori I"

Situation scheme of the territory



Explication	
Pumping station Funikuliori I	
1	Pumping station
2	High voltage distribution box
3	Transformer - 1
4	Wearhouse - 1
5	Transformer - 2
6	Staff room
7	Toilet
8	Wearhouse - 2
9	Cancelled Wearhouse
10	Entrance to the territory
11	Fence of the territory

Project code	GWP - 0005
Cadastral code	N 01.15.07.006.027
Address	Tbilisi Chonkadze Str. №22

Performer

Ltd. Georgian Water and Power

Tbilisi, Kostava I Turn #33

Operations Planning and Budgeting Division

Notes

Project Name

To make situation scheme of pumping station Funikuliori I

Drawing Name

Situation scheme of the territory

Performer	Shota Metreveli	
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A-3	6	1

Pumping station "Funikuliori I"

Situation scheme of the pipeline

Conditional designations	
	Inlet pipe the pumping station
	Outlet pipe the pumping station
	Discharge pipe the pumping station
	Valves of to paipe
	Pumps
	Booster pumps
	Transformer

Project code	GWP - 0001
Cadastral code	N 01.14.13.002.005
Address	Tbilisi, highway Tskneti #6

Performer

Ltd. Georgian Water and Power

Tbilisi, Kostava I Turn #33

Operations Planning and Budgeting Division

Notes

Project Name

To make situation scheme of pumping station Funikuliori I

Drawing Name

Situation scheme of the pipeline

Performer	Shota Metreveli	
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Format	Sheets	Page
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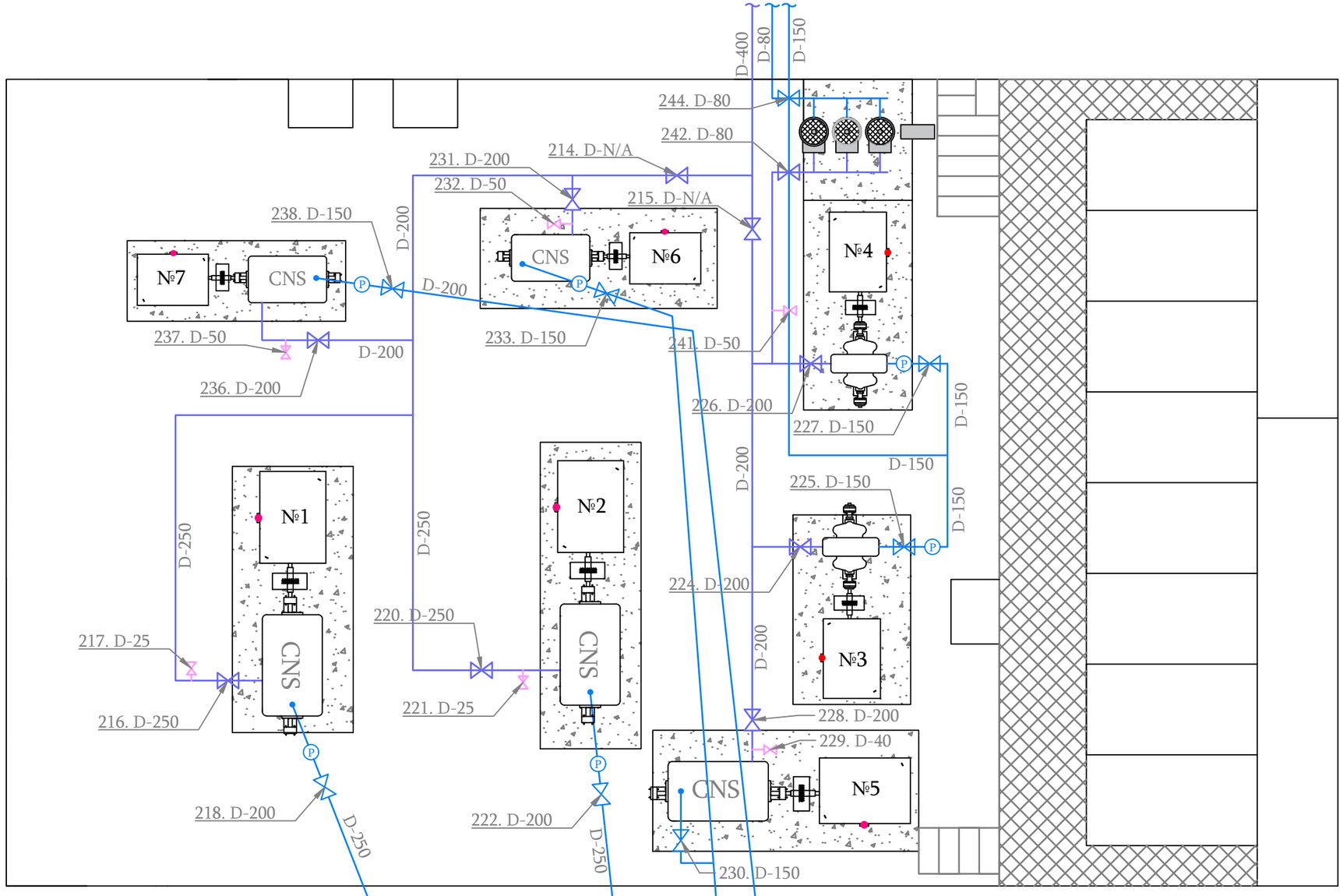
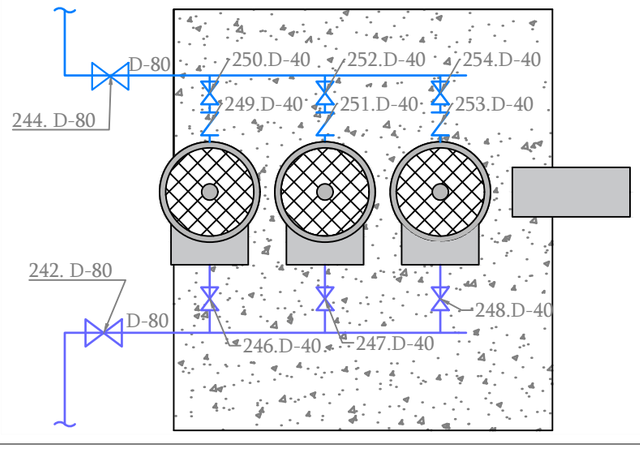
Pumping station "Funikuliori I"

Situation scheme of the pumping station



Booster pumping station



Conditional designations	
	Inlet pipe the pumping station
	Outlet pipe the pumping station
	Discharge pipe the pumping station
	Valves of to paipe
	Pumps
	Booster pumps
P	Barometer
F	Flowmeter

Project code	GWP - 0001
Cadastral code	N 01.14.13.002.005
Address	Tbilisi, highway Tskneti #6

Performer

Ltd. Georgian Water and Power

Tbilisi, Kostava I Turn #33

Operations Planning and Budgeting Division

Notes

Project Name

To make situation scheme of pumping station Funikuliori I

Drawing Name

Situation scheme of the pumping station

Performer	Shota Metreveli	
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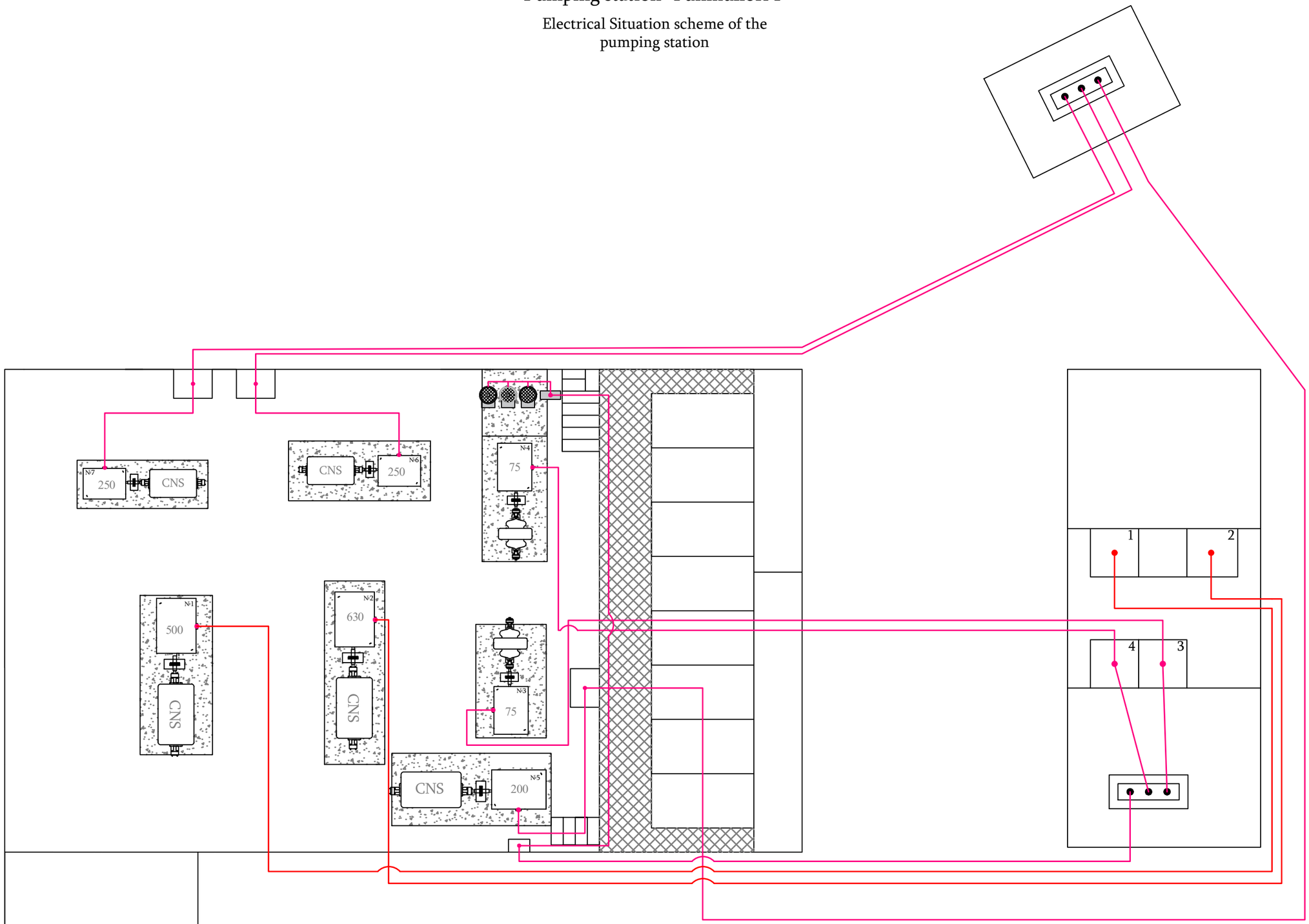
Pumping station "Funikuliori I"

Electrical Situation scheme of the pumping station



Conditional designations

	High voltage line
	Low voltage line
	Pumps
	Booster pumps
	Transformer

Project code	GWP - 0001
Cadastral code	N 01.14.13.002.005
Address	Tbilisi, highway Tskneti #6

Performer

Ltd. Georgian Water and Power

Tbilisi, Kostava I Turn #33

Operations Planning and Budgeting Division

Notes

Project Name

To make situation scheme of pumping station Funikuliori I

Drawing Name

Electrical Situation scheme of the pumping station

Performer	Shota Metreveli
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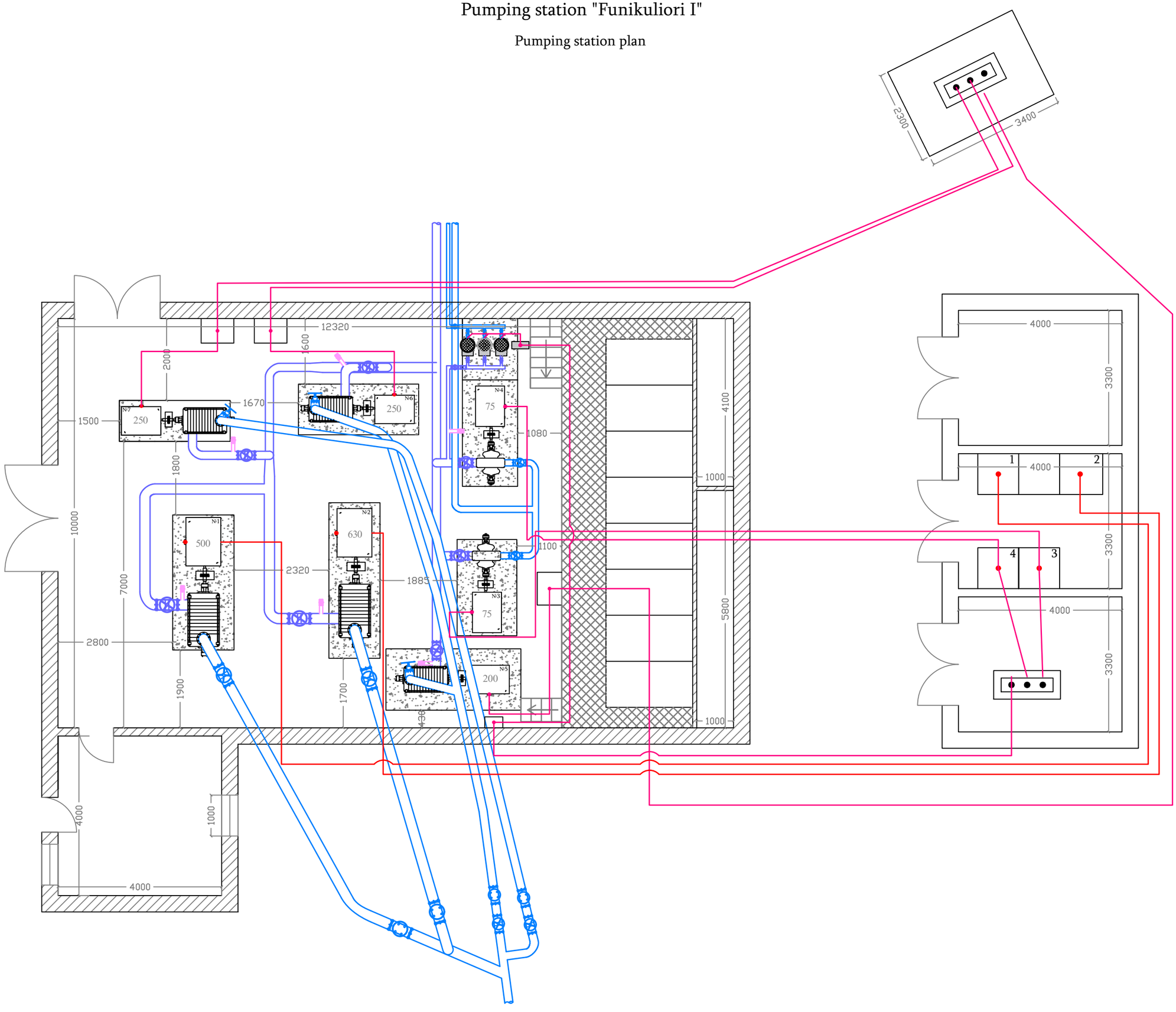
Pumping station "Funikuliori I"

Pumping station plan



Project code	GWP - 0001
Cadastral code	N 01.14.13.002.005
Address	Tbilisi, highway Tskneti #6

Performer

Ltd. Georgian Water and Power

Tbilisi, Kostava I Turn #33

Operations Planning and Budgeting Division

Notes

Project Name

To make situation scheme of pumping station Funikuliori I

Drawing Name

Pumping station plan

Performer	Shota Metreveli
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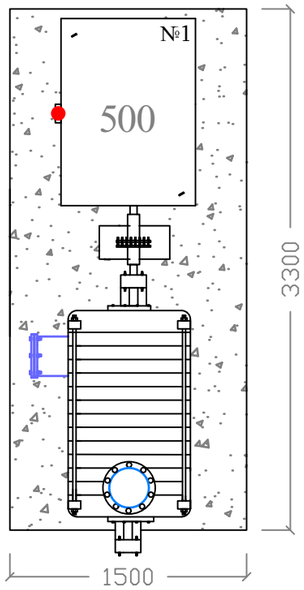
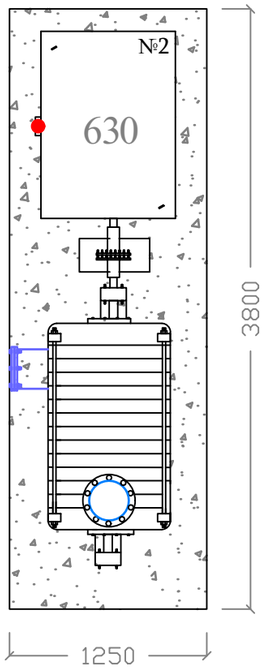
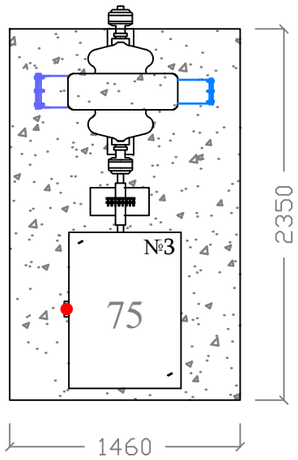
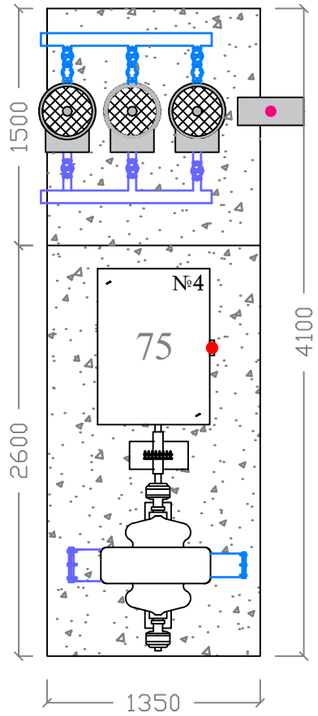
Pumping station "Funikuliori I"

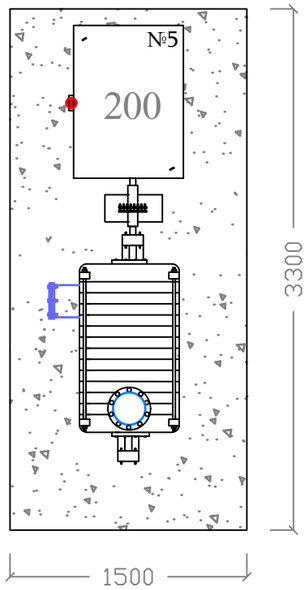
Pumps units



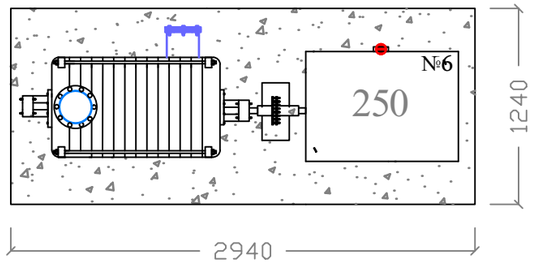


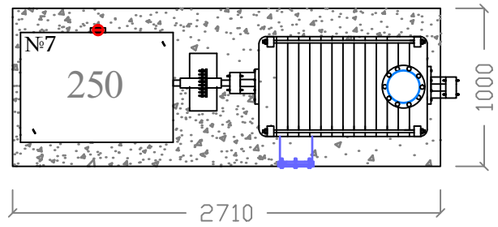






The Volumes		
Name	Quantity	Dimension
630 KVT Pump unit	1	PCS
500 KVT Pump unit	1	PCS
250 KVT booster Pump unit	2	PCS
200 KVT Booster Pump unit	1	PCS
75 KVT Booster Pump unit	2	PCS
Valve D=25 mm	2	PCS
Valve D=40 mm	1	PCS
Valve D=50 mm	2	PCS
Valve D=80 mm	3	PCS
Valve D=150 mm	7	PCS
Valve D=200 mm	7	PCS
Valve D=250 mm	2	PCS
Check valve D=150 mm	2	PCS
Check valve D=250 mm	2	PCS
Filter D=80 mm	1	PCS





Project code	GWP - 0001
Cadastral code	N 01.14.13.002.005
Address	Tbilisi, highway Tskneti #6

Performer

Ltd. Georgian Water and Power

Tbilisi, Kostava I Turn #33

Operations Planning and Budgeting Division

Notes

Project Name

To make situation scheme of pumping station Funikuliori I

Drawing Name

Pumps units

Performer	Shota Metreveli
Checked	

Format	Sheets	Page
A-3	6	6

Technical assignment

Description and Main Parameters of the Pumping Station

Pumping Station Name: **Funicular I**
Water Pumping Direction:
• Funicular I _ Funicular II.
• Funicular I _ Sololaki.
• Funicular I - nearby settlement.

Funicular I _ Funicular II
Number of Installed Pump Aggregates: 4
Pumping Capacity and Lifting Height:

	Q (m^3/h)	H (m)	P (kw)	voltage, v
PUMP N1	300	360	500	6000
PUMP N2	300	360	630	6000
PUMP N3	180	340	250	380
PUMP N3	180	340	250	380

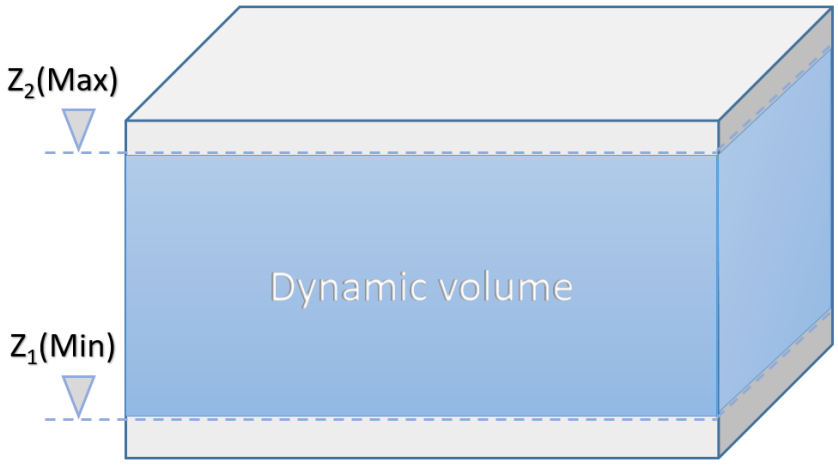
Pressure on the Suction Collector: (1.5Bar)
Pressure on the Discharge Collector: (36 Bar)
Direction: **Funicular II** ;

- Reservoir Bottom Mark: 792 m above sea level;
- Reservoir Maximum Mark: 4.3 m;
- Reservoir Minimum Mark: 1 m;

Existing Equipment:

- Analog Pressure Sensor 4-20 mA: 2 units
- Ultrasonic Flow Meter: 1 unit
- Dry Run Protection Sensor with Dry Contact: 1 unit
- Pump Power Control Panel: 2 units (0.4KW)
- Electrically Controlled Valves: 2 units
- Regulator: 1 unit
- VFD: 0 unit
- Electrical Parameter Measuring Instrument (Multimeter): 4 units
- SOFT STARTER : 2 units (0.4KW)

Operating Principle of the Pumping Station:

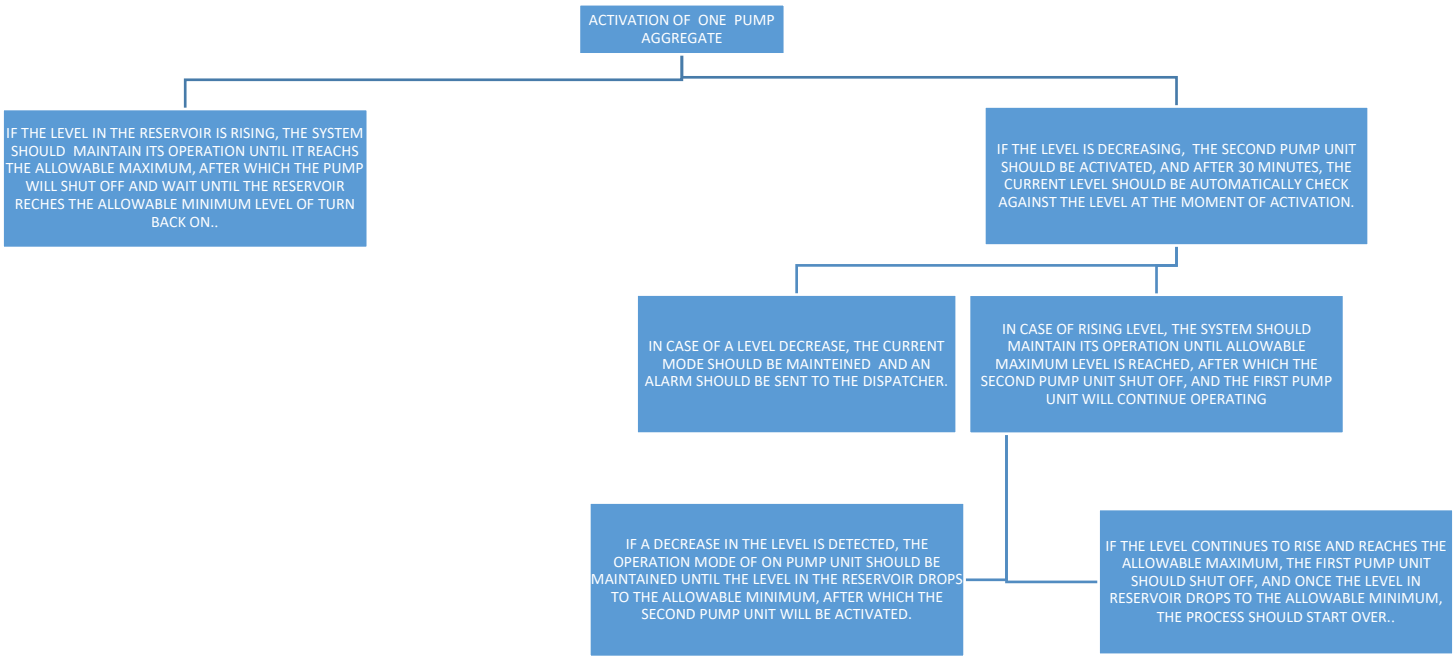


The supply of reservoirs at "Funicular II" by the pumping station "Funicular I" is carried out in all seasons. Due to the specifics of the station, control is performed mechanically, based on direct instructions from the dispatcher.

Z1 (Min) = 1 m
Z2 (Max) = 4.3 m

When there is a demand for flow, the operating principle of the pumping station is 0-1, during which the station supplies the reservoirs using one pump.

In winter mode, due to the low demand for flow, the pumping station operates in a variable mode, based on the 0-1 principle. In this mode, the station fills the reservoirs using one pump, and after filling, the pumping station stops operating until the minimum level of the "Funicular II" reservoirs is reached again. Under winter operating conditions, the pumps must operate alternately and sequentially.



In summer mode, due to the relatively higher demand for flow, the pumping station operates in a variable mode, based on the 1-2 principle. In this mode, the simultaneous operation of two pumps is required to fill the reservoirs. After filling is completed, one pump remains in operation. If the maximum emergency level is reached, the remaining pump unit is also shut down.

Once the minimum level of the "Funicular II" reservoirs is reached again, the pump restarts, and the process is continuously repeated. Under summer operating conditions, the pumps must operate alternately for filling purposes.

Funicular I _ Sololaki.

Number of Installed Pump Aggregates: 2
Pumping Capacity and Lifting Height:

	Q (m^3/h)	H (m)	P (kw)	voltage, v
PUMP N1	320	50	75	380
PUMP N2	320	50	75	380

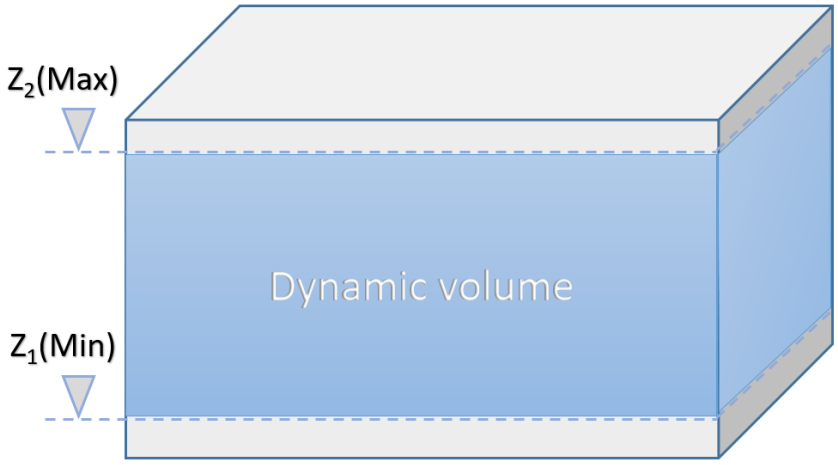
Pressure on the Suction Collector: (1.5Bar)
Pressure on the Discharge Collector: (4 Bar)
Direction: **Sololaki reservoir** ;

- Reservoir Bottom Mark: 515 m above sea level;
- Reservoir Maximum Mark: 4.5 m;
- Reservoir Minimum Mark: 1 m;

Existing Equipment:

- Analog Pressure Sensor 4-20 mA: 1 units
- Ultrasonic Flow Meter: 0 unit
- Dry Run Protection Sensor with Dry Contact: 1 unit
- Pump Power Control Panel: 1 units (0.4KW)
- Electrically Controlled Valves: 1 units
- Regulator: 1 unit
- VFD: 0 unit
- Electrical Parameter Measuring Instrument (Multimeter): 2 units
- SOFT STARTER : 2 units (0.4KW)

Operating Principle of the Pumping Station:



The supply of the "Sololaki" reservoirs by the pumping station "Funicular I" is carried out throughout all seasons.

Z1 (Min) = 1.5 m
Z2 (Max) = 4.5 m

When there is a demand for flow, the operating principle of the pumping station is 0-1, during which the station supplies the reservoirs using one pump.

After automation, the pump must start and stop automatically within the specified reservoir level thresholds. It is necessary to have information about the control process, including:

- suction pipe pressure,
- discharge pipe pressure,
- operating pump unit number,
- consumed power,
- warning,
- alarm.

Funicular I - nearby settlement.

Number of Installed Pump Aggregates: 3
Pumping Capacity and Lifting Height:

	Q (m^3/h)	H (m)	P (kw)	voltage, v
PUMP N1	12	104.5	5.5	380
PUMP N2	12	104.5	5.5	380
PUMP N3	12	104.5	5.5	380

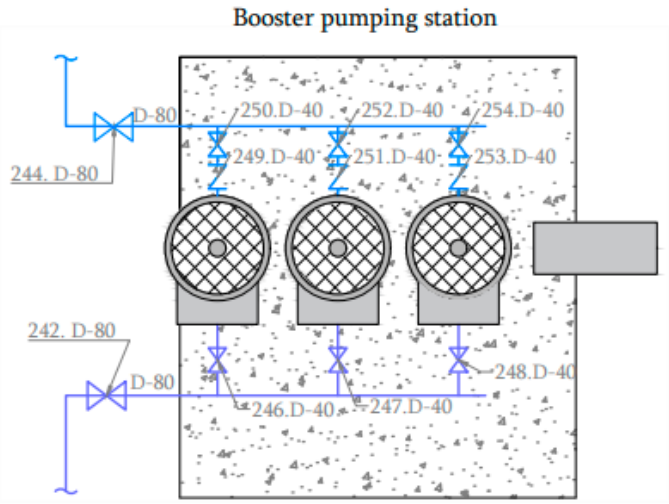
Pressure on the Suction Collector: (1.5Bar)
Pressure on the Discharge Collector: (6 Bar)

Direction: Funicular I – nearby Settlement supplies the population living within the station's service area.

Existing Equipment:

- Analog Pressure Sensor 4-20 mA: 1 units
- Ultrasonic Flow Meter: 0 unit
- Dry Run Protection Sensor with Dry Contact: 1 unit
- Pump Power Control Panel: 1 units (0.4KW)
- Electrically Controlled Valves: 1 units
- Regulator: 0 unit
- VFD: 1 unit
- Electrical Parameter Measuring Instrument (Multimeter): 0 units
- SOFT STARTER : 0 units (0.4KW)

Operating Principle of the Pumping Station:



The pumping station **"Funicular I – Adjacent Settlement"** supplies the population connected to the network. The station is controlled by an automatic control panel manufactured by **Grundfos**, which maintains constant pressure in the discharge network. The control process is fully automated.

Following the automation of the pumping station, it is necessary to have a **mechanical/remote control mode**, which will allow for the **start/stop** of the pumping station, as well as the ability to **remotely reset** the system.

In addition, it is essential to have access to information about the control process, including:

- pressure on the suction pipe,
- pressure on the discharge pipe,
- number of operating pump units,
- power consumption,
- warnings,
- alarms

Data exchange

Local Control:

A main control cabinet must be installed at the “Funicular II” pumping station, equipped with a controller (PLC/RTU device), through which the rest of the equipment will be managed using a **Master & Slave** configuration. The control cabinet must include an **HMI panel**.
In addition to remote control via the **SCADA system**, it must also be possible to operate and monitor all control devices locally through the panel.

Communication Protocols:

- MODBUS
- Profibus
- Ethernet/IP

Telemetry:

Data transmission must be performed via both **SIM card** and **LAN** (GSM/GPRS or Ethernet). The information must be sent to the company’s server, and communication must be secured using **certificates issued by a Certification Authority**.

- GSM/GPRS
- Ethernet
- SMS / Email / Call

Database:

Data must be stored on an **SQL Server**, and there must also be **Backup Servers**, where information will also be stored. During the data or server update process, information must be transmitted to the backup server.

- SQL Server
- Backup Server
- RDBMS – MySQL

SCADA System:

Information processing and visualization must be carried out through the **central SCADA system**. Every department that requires access to specific data will be given **user accounts with passwords**. Users will

be able to view information through the **web server**.
The SCADA system must include all necessary functions: **alarm, control, monitoring, and data analysis**.

- All control devices installed in the pumping station must be **integrated** with the central SCADA system.

General Principles of Pumping Station Control:

Control of the pumping station must be performed either remotely or locally, according to the operating principles described above.

Remote Control:

- Automatic control
- Manual (mechanical) control

Local Control:

- Automatic control
- Manual control

Remote Automatic Control:

This type of control involves automatic management of all devices participating in the process (pumps, electrically controlled valves, regulators, etc.) based on signals received from various sensors and control devices, following the required operating principles. Remotely, it must be possible to:

- Select the number of operating pumps
- Change the minimum/maximum level settings in the reservoir

Selection between local and remote modes must be made via the main control panel located at the station.

Emergency full stop conditions for the pumping station:
In the presence of any of the following conditions, all operating pumps must immediately stop:

- Critically low pressure detected on the suction pipeline of the pumping station
- Loss or phase failure in the electrical power supply network
- Fire safety system alarm signal

- Flood protection system alarm signal

Note: During any emergency or complete shutdown of the pumping station, it is mandatory to close both the discharge and suction electrically controlled valves.

Remote Mechanical Control:

Remote mechanical control means that all devices involved in the control process (pumps, electrically controlled valves, etc.) are managed manually by a SCADA operator. Signals from sensors or other control devices are ignored, and the operator has full responsibility for control. This mode must allow the following operations:

- Start/stop the pumping station
- Restart the pumping station
- Start/stop individual pumps
- Regulate motor speed (if VFD is available)

The selection between local and remote modes must be made via the main control panel at the station.

Emergency full stop conditions are identical to those described in remote automatic control.

Local Automatic Control:

This control type involves automatic management of all devices based on signals from sensors and control devices, following the required operating principles. Locally, it must be possible to:

- Select the number of operating pumps
- Change minimum/maximum reservoir level settings

Mode selection (local or remote) must be done via the main control panel at the station.

Emergency stop conditions are the same as above.

Local Mechanical Control:

Local mechanical control means that all devices are controlled manually by an on-duty operator or qualified maintenance personnel. Signals from sensors or other control devices are ignored, and the operator is fully responsible. This mode must allow:

- Start/stop the pumping station
- Restart the pumping station
- Start/stop individual pumps

- Regulate motor speed (if VFD is available)

Mode selection must be done via the main control panel at the station.

Emergency full stop condition:

- Activation of the mechanical emergency stop button

Note: During any emergency or complete shutdown of the pumping station, it is mandatory to close both the discharge and suction electrically controlled valves

Principle of Pump Unit Start/Stop Operation:

When starting the pump, the pressure on the suction pipe must be checked. If the pressure is below the allowable norm, the pump must not start. If the pressure is within the acceptable range, the pump will start. At the moment of startup, the discharge valve and/or regulator must be in the closed position. After this, they should be gradually opened according to the motor overload protection settings.

To protect the motor from overload, the main controller on the control panel must monitor the motor's current (amperage) or flow rate, based on which the valve(s) or regulator opening/closing process will be managed.

When stopping the pump, the discharge valve and/or regulator must close, and the motor must stop.

Safety:

To ensure safe operation of the station, the following systems must be installed:

- **Flood Protection System:**
  At the lowest point inside the building, a sump pit must be installed along with a drainage pump. The flood protection system should operate based on two water levels:
  Lower Level: Defined for normal operation. When this level is reached, the drainage pump must activate and pump the accumulated water into the stormwater system.
  Upper Level: Defined for emergency operation. If water reaches this level, the electrically controlled valves on the pump's suction and discharge pipelines must close. Information about the emergency must be sent to the company server and an SMS notification sent to authorized personnel.
- **Fire Safety System:**
  This system is for fire detection only. Upon fire detection, electrically controlled valves on the pump's suction and discharge pipelines must close. Emergency information must be sent to the company server, and SMS alerts sent to authorized personnel.
- **Video Surveillance System:**
  Cameras must be installed inside the building to monitor the pump units. Cameras should be positioned so that all pump units can be easily monitored.
- **Temperature and Noise Level Monitoring:**
  Temperature sensors must be installed at two locations inside the building and one outside. For noise monitoring, one sensor must be installed inside the building.

Notes:

- **A project design is required to implement the safety systems.**

- **The project must consider backup power generators for the following devices: drainage pump, seven electrically controlled valves, surveillance cameras, and the PLC/RTU control panel.**
- **Any disorder or irregularity at the station must trigger a text message notification to the responsible technical personnel.**

The technical solution must utilize devices produced by the company listed below in the control/transmission section.

- **SOFREL**