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ENVIRONMENTAL SCOPING STATEMENT:

FOR ONI WATER SUPPLY

GEORGIA MUNICIPAL INFRASTRUCTURE AND IDP HOUSING REHABILITATION PROJECT

DCN: 2010-GEO-033

Date: August 30, 2012;Revised October 4, 2012

DISCLAIMER

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TETRA TECH

4 October 2012

Mr. Bradley Carr
Water Irrigation and Infrastructure Advisor
Office of Economic Growth
US Agency for International Development
11 George Balanchine Street
Tbilisi, 0131
Georgia

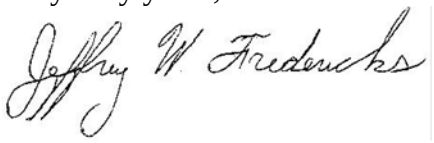
Re: Environmental Scoping Statement for Oni Water Supply

Dear Mr. Carr:

This Scoping Statement is being submitted to you in accordance with the requirements of task order no. AID-114-TO-11-00002 of contract AID-EDH-I-00-08-00027-00. It provides Tetra Tech's Environmental revised Scoping Statement for Oni Water Supply to address comments by BEO.

We look forward to your review and welcome your comments and suggestions.

Very truly yours,



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Environmental Scoping Statement for Oni Water Supply

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ABBREVIATIONS AND ACRONYMS

BEO	USAID Europe and Eurasia Bureau Environmental Officer
CFR	Code of Federal Regulations
CFR	Code of Federal Regulations
CO	USAID Contracts Office
COP	Chief Of Party
COR	USAID Task Order Cognizant Technical Officer
EA	Environmental Assessment
EC	European Commission
EGSSA	USAID/Africa Bureau Environmental Guidelines for Small-Scale Activities
EIA	Environmental Impact Assessment
EIP	Environmental Impact Permit
EMMP	Environmental Mitigation and Monitoring Plan
ESS	Environmental Scoping Statement
GEL	Georgian Lari
GMIP	Municipal Infrastructure And IDP Housing Rehabilitation Project (the project)
GoG	Government of Georgia
IDP	Internally Displaced Persons
IEE	Initial Environmental Examination
IL	Implementing Letters
LTTA	Long Term Technical Assistance
M&E	Monitoring and Evaluation
M&M	Mitigation and Monitoring
MDF	Municipal Development Fund
MEO	USAID/Georgia Mission Environmental Officer
MRA	Ministry of Refugee Affairs
NEPA	National Environmental Policy Act
O&M	Operation and Maintenance
OSC	Oni Service Center
NGO	Non-Government Organization
PEA	Programmatic Environmental Assessment
SEE	State Ecological Expertise
SOW	Scope of Work
SS	Scoping Statement
STTA	Short Term Technical Assistance
TBD	To Be Determined
Tt	Tetra Tech.
UNDP	United nations Development Programme
USAID	United States Agency For International Development
USG	U.S. Government
UWSCG	United Water Supply Company of Georgia

Environmental Scoping Statement for Oni Water Supply

1 BACKGROUND AND PURPOSE

Georgia's economic and political stability has been challenged by the 2008 conflict with Russia and the global economic downturn. The conflict, crisis, and subsequent slowdown in economic growth and foreign direct investment have strained Georgia's national budget and its ability to finance core investments in critical regional development initiatives. Many years of decline in the quality, coverage, and maintenance of basic services, including water supply, sewage, local roads, solid waste services, and irrigation systems have dramatically reduced Georgia's quality of life in rural areas and constrained private sector growth. Such degradation and instances of conflict-related damage have resulted in significant constraints to the productive capacity and quality of life of thousands of Georgians, including old and new Internally Displaced Persons (IDPs), rural poor, and persons directly or indirectly affected by the 2008 conflict with Russia.

USAID is providing assistance to the Government of Georgia (GoG) under the Georgia Municipal Infrastructure and IDP Housing Rehabilitation Project (GMIP). GMIP includes three components: Component 1, Municipal Infrastructure; Component 2, Rehabilitation of Irrigation Infrastructure; and Component 3, IDP (Internally Displaced Persons) Durable Housing. This Scoping Statement (SS) covers one municipal project under GMIP Component 1: Improvements to the Oni Water Supply System.

1.1 Project Description

Municipalities impacted by the 2008 conflict were identified by the GoG as priority targets for USAID technical assistance under GMIP Component 1. Oni municipality was invited to submit up to three infrastructure rehabilitation projects for GMIP financial assistance. Each project was expected to show evidence of civic participation, impact on significant municipal population, contribution to economic growth or greater efficiency, government commitment to maintain rehabilitated infrastructure and potential leverage of other donor funding.

Projects were evaluated based on potential for high positive impact and benefits. Two municipal projects were selected for Oni: (1) Improvements to Municipal Roads in Oni; and (2) Improvements to the Oni Municipal Water Supply System. This SS covers one municipal project: Improvements to the Oni Water Supply System. Under this project, USAID will improve the Oni's water treatment plant, adding sand filtration and chlorination disinfection. The project will also include construction of a new water supply reservoir. The project will benefit 2,300 residents in Oni as well as many tourists who come to Oni in the summer.

1.1.1 Project Purpose

The purpose of this project is to improve the quality and quantity of drinking water provided to the residents of Oni. New treatment will improve water quality and the new reservoir will provide a continuous supply of water. This infrastructure rehabilitation project will contribute to tourism and economic growth of Oni municipality and improve the social condition of the local population.

The Proposed Action includes construction of a new treatment plant and water storage reservoir. The treatment plant will include a high rate sand filter (reinforced concrete) and concrete chlorination chamber for disinfection. (See Appendix C for the detailed design of Oni's water supply scheme.) The reservoir will store 1000 m^3 of treated water. The filter will only be used during periods after storms when water turbidity exceeds allowable standards. These periods are esti-

mated at two months of each year. Excessive turbidity impacts not only the quality of the drinking water but can damage components of the distribution system and mitigating this impact will have a positive effect on both human consumption and the system's service life. The disinfection unit will be operated continuously. The Detailed Design of Oni's water supply scheme is provided in Appendix C. The Detailed Design was prepared by SakTskalProekti (Georgia Water Project) for the United Water Supply Company of Georgia (UWSCG).

1.1.2 Project Need

The August 2008 conflict with Russia and the global economic downturn have reduced Georgia's ability to finance core investments in critical regional infrastructure rehabilitation. Many years of decline in the quality, coverage and maintenance of municipal infrastructure have dramatically reduced Georgia's quality of life and constrained private sector growth. Such degradation and instances of conflict-related damage have significantly impacted thousands of Georgians. GMIP addresses these needs.

Specifically, the proposed project responds to the needs of Oni Municipality. Oni was impacted by the 2008 conflict and identified by the GoG as a priority target for USAID technical assistance to rehabilitate municipal infrastructure.

1.1.3 Technical Overview

USAID selected a GoG contracting arrangement with the Municipal Development Fund (MDF) as the financing vehicle for GMIP. Such an arrangement places the MDF in a key implementation role as this organization will be responsible for program management, procurement of goods and services, oversight and implementation. To support this arrangement, the MDF has been certified by USAID as having adequate financial, technical and procurement management capacity to perform its responsibilities under this program.

USAID contracted with Tetra Tech to support USAID in the oversight and monitoring of MDF activities. Tetra Tech will help select projects, monitor processes and practices, identify and mitigate areas of risk, and carry out oversight and quality control efforts to ensure that selected projects are implemented effectively and in accordance with both US and Georgian standards and regulations. Tetra Tech will also focus on the environmental aspects of the program, including development of an environmental scoping statement and environmental assessment for these flood protection activities.

An implementation contract for the municipal component of GMIP was signed between the MDF and Ltd Kavgiprotransi (Contract No. USAID/NS/02-2011). The Kavgiprotransi contract was designed to meet two major objectives as described below.

- *Objective A*. This objective is to obtain technical and logistical services to support USAID's efforts to carry out environmental scoping and develop a SS. This should identify significant environmental issues relating to Component 1, determine the range of alternatives, and identify those issues to be analyzed in the EA.

- *Objective B*. This objective is to carry out a technical assessment and prepare pre-feasibility studies (e.g., construction sustainability, cost, benefit) for future design of the rehabilitation projects, which will then be used for the tendering.

The United Water Supply Company of Georgia (UWSCG) used Georgian designers from SakTskalProekti (Georgia Water Project) to prepare the detailed design for improvements to the Oni municipal water supply system.

Most of Oni's water supply is obtained from Kvedrula, a Karst underground limestone drainage system that uses a trapezoidal structure to collect the water near the surface. (About 20 percent of Oni's water is Rioni River filtrate collected in 6 manhole-like structures at Zhizhoreti.) The Qvedrula water pipeline transports water 9.3 km from Kvedrula to the site of a new water treatment system. The treatment system will include sand filtration, chlorination disinfection and a water supply reservoir. Water from the reservoir will supply water to Oni's existing drinking water distribution system constructed in 2010.

1.2 22 CFR 216 Background

USAID's environmental regulations (22 Code of Federal Regulations 216 or Reg. 216) establish the conditions and procedures for environmental review. These procedures apply to new projects, programs, or activities authorized by USAID. Reg. 216 establishes a process for the review of environmental and social impacts; ensures that projects that are undertaken as part of programs funded under USAID are environmentally sound, are designed to operate in compliance with applicable regulatory requirements, and as required by the legislation are not likely to cause a significant environmental, health or safety hazard.

The Initial Environmental Examination (IEE) for GMIP was drafted and approved by the Europe and Eurasia Bureau Environmental Officer (BEO) on June 23, 2010 (DCN: 2010-GEO-033). Pursuant to Reg. 216 and the IEE's Positive Determination for Component 1, an Environmental Assessment (EA) is required. An EA is meant to ensure that environmental consequences and their significance are known and clearly identified prior to the approval of the final design and start of construction [216.3 (a) (4)].

Under the Positive Determination for GMIP, an EA is required and this SS is being prepared to determine the extent of and the approach to the EA [216.3 (a) (4)]. The scoping process should result in a written statement that includes the following:

(a) A determination of the scope and significance of issues to be analyzed in the EA, including direct and indirect effects of the project on the environment.

(b) Identification and elimination from detailed study of the issues that are not significant or have been covered by earlier environmental review, or approved design considerations, narrowing the discussion of these issues to a brief presentation of why they will not have a significant effect on the environment.

(c) A description of: (1) timing of the preparation of environmental analyses, including phasing (if/where appropriate); (2) variations required in the format of the EA; and (3) the tentative planning and decision-making schedule; and

(d) A description of how the analysis will be conducted and the disciplines that will participate in the analysis;

Georgian environmental legislation does not consider preparation of the SS as a part of the EA process, and thus, does not contain any specific requirements for the preparation of a Scoping Statement.

1.3 Purpose, Methodology and Findings of the Scoping Statement

This SS is being prepared in accordance with 22 CFR 216.3(a)(4) and the IEE. Reg. 216 stipulates scoping as a preliminary task within the EA process. The SS provides a mechanism for consulting on and agreeing to the content and methodology of the subsequent EA. The purpose and objectives of the GMIP scoping process are to identify the topics and significant issues for the EA, eliminate issues that are not significant and define the approach and methodologies to be applied to the EA process.

The Scoping Team consisted of Ltd Kavgiprotransi and Tetra Tech. To carry out the scoping process, the Scoping Team identified, reviewed, and prioritized environmental issues. This was accomplished through the following three tasks:

- Identifying and reviewing existing environmental information and studies related to GMIP Component 1;
- Carrying out site visit investigations to ascertain additional environmental issues; and,
- Obtaining stakeholder input and feedback in organized meetings to ensure that significant environmental issues are identified.

This SS describes the proposed project and alternative actions along with a brief description of the affected environment and significant issues to be analyzed further in the EA process. It then outlines the requirements of the EA team and EA schedule. This section describes the site visits and public meetings in the scoping process.

Site Visits

An Oni municipality site visit investigation was conducted in August, 2012. Visits were made to water sources and future sites for the water treatment plant and storage reservoir. Engineers from the UWSCG, Georgian designers from SakTskalProekti and the Oni Service Center participated in the site visit with Tetra Tech. The Oni Site Visit Inspection Report is provided in Appendix B.

Public Meetings

A public stakeholder scoping meeting was held on July 5, 2011 in Dusheti. The purpose of the meeting was to provide information and get feedback from the communities on the municipal infrastructure projects. Twenty-four local citizens attended the meeting. The meeting summary reflects the discussions and points raised by participants before and during the meeting. (See Appendix A for details about the Municipal Stakeholder Meeting in Dusheti.)

A second public stakeholder meeting will be conducted as part of the EA. The focus of this meeting is to obtain feedback from local citizens of Oni. Most of the participants at the Dusheti stakeholder meeting were from Gori Municipality, Dusheti and Kareli and they provided useful feedback on the municipal projects. This second meeting will insure that feedback is received from Oni residents. Minutes of the second meeting will reflect the discussions and points raised by participants before and during the meeting. Results of the Oni Stakeholder Meeting will be part of the EA.

The Scoping Team feels that through the site visits, document review, and meetings held during the scoping process, all potential concerns have been identified, and an additional stakeholder meeting is not expected to identify any outstanding significant issues for analysis in the EA. The stakeholder meeting during the EA process is expected to provide more detail on the potentially significant issues already identified in this SS. However, if additional significant impacts are

identified at the Oni stakeholder meeting or during the EA process, they will be evaluated in the EA.

Aim of the Stakeholder Meeting

- To inform the local community about the goal of the project and ensure their involvement;
- Identify community concerns, specifically related to environmental and social aspects of the project, and get their feedback;
- Ensure a collaborative approach towards the project and increase cooperation between the community and project developers.

The following questions/issues used to try to elicit comments from stakeholders (These will also be used during the Oni Stakeholder Meeting to be conducted during the EA):

- *What are the expected problems associated with the planned rehabilitation? What are the benefits to local citizens?*
- *What impact will the rehabilitation have on surface waters, wetlands, and local ecosystems?*
- *Are there differences in men's and women's roles and relationships that may affect the long-term future of municipal improvements and the environment?*
- *What is happening to the quality of the soil in the area? Would this (and how would this) be affected by water system improvements?*
- *Are there any current problems with pathogens or water-borne diseases? Would this be affected by water system improvements?*
- *What are the long-term prospects for maintaining improvements? Who will maintain them? How? Who will pay for maintenance?*
- *What realistically may happen when the project ends? What will the project area look like in 30 years?*

Public Notice

A notice/advertisement on the planned stakeholder meeting, distributed as follows:

- A statement about the meeting placed on the web page of MDF
- A statement about the meeting was placed on the web pages of local municipalities
- A notice placed in the local press.
- Notices posted at prominent points.

The initial municipal stakeholder meeting was advertised using CENN's mailing list and Aarhus Centers web page: www.aarhus.ge. The date, place, and the scope of the meeting were agreed upon and local municipalities were requested to participate in the meeting. See Appendix A for meeting participants, minutes and summary of the Dusheti municipal stakeholder meeting.

2 SCOPE AND SIGNIFICANCE OF ISSUES TO BE ANALYZED IN EA

This section of the SS provides a description of Georgia's EIA legislation, the "Affected Environment" in the project area, and alternatives and significant environmental effects that will be analyzed in the EA.

2.1 Overview of National Environmental Legislation

Environmental Impact Permits are issued by the Ministry of Environment under a procedure involving (1) EIA, (2) ecological expertise and (3) public participation. The detailed procedures are mainly determined by the Law on Environmental Impact Permit (December 14, 2007), the Law on Licenses and Permits (June 25, 2004) and the Decree No 154 "On the Procedure and Terms for Issuance of an Environmental Permit" Sept 2005 amended February 3, 2006.

The Law on Environmental Impact Permit contains the list of activities subject to EIA and the related procedures and regulations governing the issuance of environmental impact permits (EIP). Municipal projects such as improvements to the Oni Water Supply System do not require an EIP and/or State Ecological Expertise (SEE) under Georgian legislation, since in accordance with Article 4 of the Law of Georgia on Environmental Impact Permits, this type of project is not listed as a type of project subject to EIP or SEE. Likewise, setting Norms for Maximum Permissible Level of air and water emissions specifically for the project is not required. According to current legislation, water and air emissions during rehabilitation and operation of the project facilities should therefore comply with the existing norms established by the Technical Regulations of the Environmental Protection (Order of the Minister of Environment Protection No. 745, dated 13.11.2008).

An overview of relevant national legislation will be provided in the EA.

2.2 Affected Environment

The scoping team conducted field visits in Oni during August 2012. (See Appendix B for the Oni Site Visit Inspection Report.) Desk studies were conducted to gather baseline information and available information was collected from published sources including books, periodic publications, scientific journals, etc. This section provides information on surface water and groundwater hydrology, biodiversity, geology and soils, seismic features, archeology and cultural heritage, public health and socio-economic issues. The section is a brief description of the affected environment; the EA Team will provide more detail in the EA.

Oni is in the western part of Georgia and is located on both sides of the Rioni River. (See Figure 1 for satellite image of Oni.) The elevation is 785-800 mamsl. The climate of Oni region is transitional towards humid subtropical and is characterized by long warm summers, cold winters and two minimums of precipitation. The annual amount of precipitation is 1048 mm. The maximum amount of precipitation comes in spring and at the beginning of summer. Duration of snow cover is 75-100 days per year.

Surface Water and Groundwater Hydrology. Georgia has about 25,000 rivers, some of which power small hydroelectric stations. Water drainage is into the Black Sea to the west and through Azerbaijan to the Caspian Sea to the east. The largest river is the Mtkvari (known also by its Turkish name, *Kura*, used in Azerbaijan, Turkey and Russia), which flows 1,364 km from north-

east Turkey across the plains of eastern Georgia, through the capital, Tbilisi, and into the Caspian Sea. The Rioni River crosses the Oni region from east to west. The Rioni is the largest

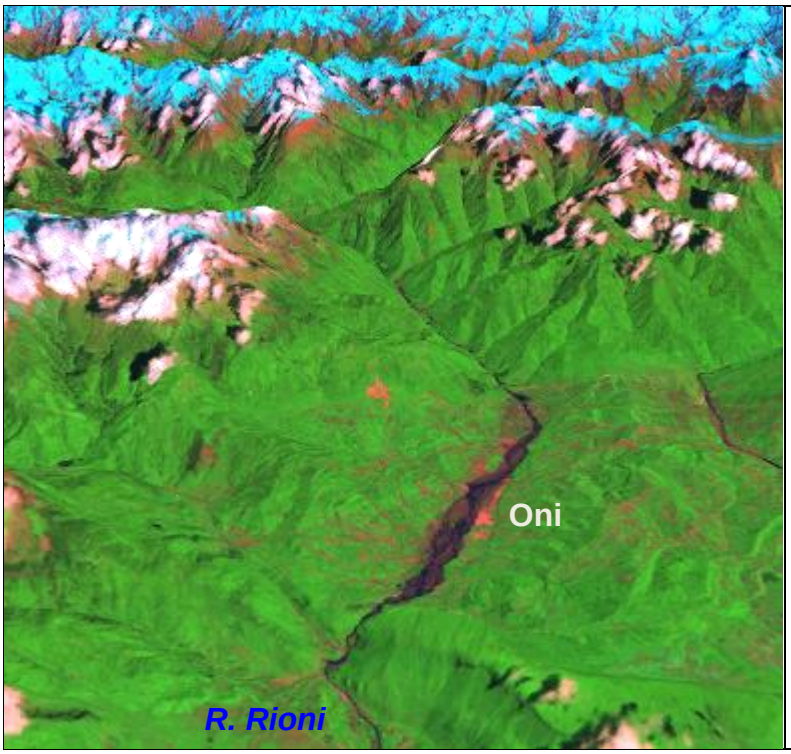

Figure 1: Satellite Image of Oni
(source: Landsat 5 TM, June 08, 2011)

river in west Georgia and empties into the Black Sea near Poti. The mouth of the river is located on the southern part of the Caucasus Mountain Ridge at the bottom of Mount Hasi. The length of the river is 327 km; average inclination (slope) – 7.2%; and the area of watershed is 13,400 km^2. The main tributaries of the Rioni River are Jejora (L=30km), Kvirila (L=140km), Khanistskali (57 km), Tskhenistskali (176 km), Noghela (59 km), Tekhuri (101 km) and Tsivi (60 km) – total 370 tributaries. The hydrological network of the basin is quite dense.

Georgia's renewable groundwater resources are estimated at 17.2 km^3/year, of which 16 km^3/year are drained by the surface water network. This is the equivalent of a total of 58.1 km^3/year as internal renewable water resources. The total actual renewable water resources are 63.3 km^3/year.

Biodiversity. Oni's variable climate, elevations, and soil conditions have produced a set of plant species that change with vertical zones of the mountain (300m-600m). Coniferous plants, such as fir-tree (silver and green), pine-tree, and juniper. The forests are characterized by their height. The forest massifs are located at 100 masl till subalpine zone. Aurochs (endemic to the Caucasus), chamois, roe, bear, wolf, jackal, fox, marten, Caucasian squirrel and rabbit are found in Oni region. The region is quite rich in birds with approximately 50 species of birds. Among the birds found in the region are several types of hawks, kite, and falcon. Mountain Eagle is found in the subalpine zone.

Soils and Geology. The relief of Oni region is mountainous with intervening plains and river terraces. The plains are mainly from Quaternary age alluvial sands, loamy sand and limestone. Tectonically the territory is a part of Lesser Caucasus Mountainous fold system. There are various types of soils spread in the region: weak gray forest and brown earth soils are found on the slopes of the mountains, while the tops of the mountains are covered by greensward and greensward–peaty mountain-meadow soils. Transitional black soils are found in the plains. The soil

cover in the upper part of the section is stony. At some places stones dia. 2m can be found. The valley is box-shaped and winding. It is constructed with sand and pebbles and stones. The bottom width of V-shaped valley ranges between 0.1-0.4 km. In the Oni region greensward-carbonate soils are common. In the zone of deciduous and coniferous forests, weak gray forest soils are found. They are formed in the forest zone on the rocks containing calcium carbonate. The zone of greensward-carbonate soils is characterized by erosion processes and landslides.

Geologically, the region includes Lower, Middle Jurassic and Quaternary deposits of the Gagra-Java zone. The Upper Jurassic period is represented with flysch alternation of sandy parts, argillaceous shales and argillites from the Toarcian stage. The Middle Jurasssic period is represented with flysch alternation of sandy and aleurolite parts and pelagic shale argillites from the Aalenian stage. Quaternary rocks are widely spread in the area and they are mostly represented with deluvium and proluvium-alluvium argillaceous coarse deposits. Modern deluvium yellow-grey strong plastic clays are found at the surface. Proluvium-alluvium yellow strong plastic clays with gruss and gravel inclusions in the upper and lower zones are found below the surface layer.

Seismic Features. The climate of the region is humid-subtropical with high levels of precipitation and high temperatures. The area has steep rocks. The high relief potential, high gradient and erosive breakup greatly promote the formation and activation of the whole spectrum of the geological processes – landslides, rock avalanches, erosion, mudflow and snowslides. In addition, it should be noted that the major part of the Oni area is located within the high-intensity (point 9) earthquake zone. An almost 9-point earthquake in April 1991 caused intense rockfalls at the edges of the limestone line of Racha ridge About 14000 buildings were destroyed. Landslides totally ruined village Chordi (Oni municipality).

Archeology and Cultural Heritage. Preliminary studies conducted by Kavgiprotransi indicated that municipal infrastructure activities would not be carried out within or in proximity to protected areas, and that there were no natural, cultural, and/or archeological monuments within the work areas. In addition, the project's construction activities will be implemented in areas with existing water infrastructure, reducing the chance of finding or impacting archeological monuments. Nevertheless, there may be important sites in proximity to the Oni site and thus, archeology and cultural heritage activities will be considered in more detail in the EA.

Air Quality. The monitoring of air pollution is carried out only in the following project cities: Tbilisi, Rustavi and Kutaisi. There is no data on air quality in other parts of the regions/cities. The only available data are those of stationary sources provided by the industry sector to the Ministry of Environment of Georgia. The EA will address potential air pollution impacts associated with construction activities and use of heavy equipment.

Socio-Economic Characteristics. Employment opportunities in Oni are limited. From a countrywide perspective, economic development has been uneven for the last decade. From 2004 to 2007, the country underwent rapid economic growth ranging between 5.9-12.3% per year. Some factors such as armed conflicts and global economic crises severely influenced the country, and GDP fell to 2.3% in 2008, and to 3.8% in 2009. Perhaps of more concern than actual numbers of employed is that according to UNDP (HDR, 2010), over 62% of employment countrywide is ranked as "vulnerable" or as unpaid family workers or self-employed. 17.4% of employed live on less than 1.25 US$/day. Even this data is misleading for the smaller municipalities like Oni. Most economic activity takes place in the capital city, Tbilisi. Oni has suffered more than Tbilisi in the global economic downturn. The EA will consider socio-economic issues in more detail in the EA.

2.3 Alternatives Including the Proposed Actions

Reasonable alternatives are defined (by NEPA) as those alternatives that meet the project purpose and need and address significant issues (as identified in this Scoping Statement). This section describes the alternative actions that meet the project's purpose and need. The purpose of this project is to improve the quality and quantity of drinking water in Oni Municipality. The project need is to rehabilitate the Oni municipal water system in order to help local residents, contribute to tourism and economic growth and improve the social condition of the local population.

Three alternatives have been identified: "No Action" (Alternative 1); "Proposed Action" (Alternative 2); and "Groundwater Source Water" (Alternative 3). The Scoping Team identified these alternatives as feasible alternatives which meet the project purpose. No other alternatives were identified that are feasible and meet the project purpose. The alternatives are described below.

2.3.1 Alternative 1 -- No Action

The No Action Alternative means that USAID will not support the water supply improvements in Oni and therefore, residents will continue to live without adequate water quality and quantity and tourism and economic growth would be reduced. This alternative provides a benchmark against which the action alternatives may be evaluated.

Under this No Action Alternative, GoG would be slowed in improving the conditions needed to improve tourism and economic growth in Oni. The employment opportunities that are expected as an indirect effect of rehabilitation are intended to benefit local residents in Oni. Without rehabilitation, employment opportunities will be lost and residents will not be able to improve their living conditions.

2.3.2 Alternative 2 -- Proposed Action

The purpose of this project is to improve the water supply system for 2,300 residents (and additional tourists) in Oni Municipality. Water is currently obtained from Kvedrula, a Karst system that intercepts underground spring water. Millions of people from Austria to Texas live in Karst areas and are supplied with drinking water from these aquifers. The existing Kvedrula water is of good quality but this system, like other Karst aquifers, has temporary turbidity problems caused by heavy rainfall. Rapid fluctuation of raw water quality is common during storms, especially in turbidity and sometimes with elevated concentrations of dissolved organic substances and bacteria.

Kvedrula has been in operation since the 1970's. A trapezoidal (7.4 m x 8.2 m) concrete structure collects the Karst water and feeds it into an intermediate chamber (4.2 m x 3.6 m x 1.6 m) where water overflows into the Qvedrula water pipeline. Water flows by gravity 9.3 km to just outside Oni Municipality. (See Figure 2.1 for schematic of water pipeline.) An old vertical settling basin, low rate filter, chlorination disinfection unit and water reservoir were built but they have not operated for a long time. (They are in such poor condition that they cannot be rehabilitated. For example, the reservoir has large cracks and its foundation is unstable.) Kvedrula water enters the Oni drinking water distribution network that was constructed in 2010.

The Proposed Action includes construction of a new treatment plant and water storage reservoir. The treatment plant will include a high rate sand filter (reinforced concrete) and concrete chlorination chamber for disinfection. (See Appendix C for the detailed design of Oni's water supply scheme.) The reservoir will store 1000 m^3 of treated water. The filter will only be used after

storms when water turbidity exceeds allowable standards estimated at two months of the year. Excessive turbidity impacts not only the quality of the drinking water but can damage components of the distribution system and mitigating this impact will have a positive effect on both human consumption and the system's service life. The disinfection unit will be operated continuously. The Detailed Design of Oni's water supply scheme is provided in Appendix C. The Detailed Design was prepared by SakTskalProekti (Georgia Water Project) for the United Water Supply Company of Georgia (UWSCG).

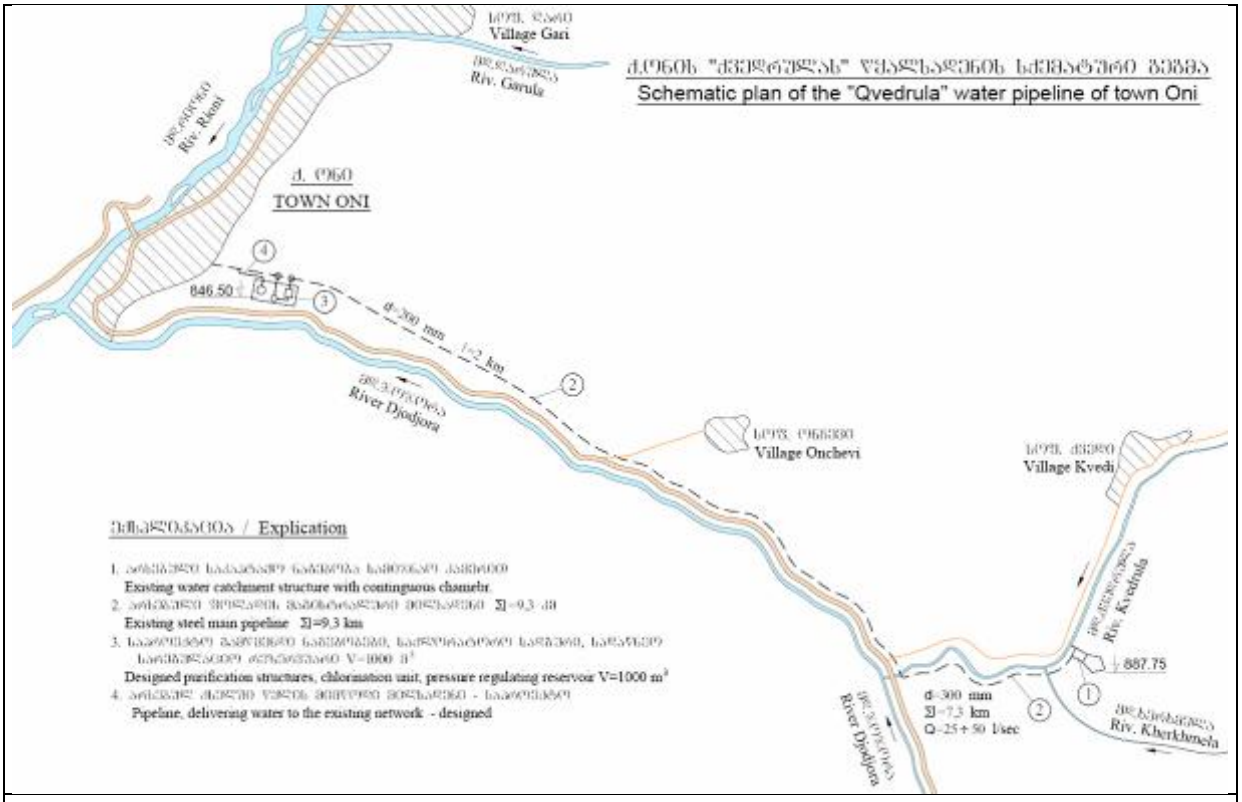

Figure 2.1. Schematic Plan for Qvedrula Water Pipeline in Oni

The design decisions were based on technological materials, Oni master plan, geology and geodetic survey and climatic and geophysical data for Oni. Construction activities include

- Pressure regulator well. Since in the existing pipeline at purification structure the hydrostatics head value is 16 atm it is envisaged in the design to mount pressure regulator in the reinforced concrete well. Capacity of water purification structures will be determined by water meter mounted in a reinforced concrete well.

- Settling basin. The cylindrical shape structure is 4.3 m deep. Its height above the ground level H=3.9 m, the underground conical shape part H=2.21 m deep. The structure is made with reinforced concrete reinforcement with a super plasticizing additive. At 2.9 m depth, quality embankment is made around high rate filter and settling basin.

- High rate filter. The rectangular structure dimensions are 5 x 6.5 m, depth 3.33m. The structure is made with reinforced concrete reinforced with a super plasticizing additive.

- Chamber for pumping unit: The pumping unit installation is in a reinforced concrete well. The well is equipped with metal ladder and light-weight raising cover made of sheet

iron. From reservoir to pumping units chamber water is supplied by d=400 mm pipe equipped with manually operated control valve. The chamber can be emptied by d=32 mm discharge pipe with control valve.

- Chlorination unit: Dimensions of structure are: 8.2 x 6.4m, H=3.3 m. Walls are built with thin m-50 concrete blocks with m-50 sand cement mortar with plasticizer additive, thickness up to 200 mm, floor is covered with ceramic tiles and linoleum. Corners are reinforced with fabric from top to bottom with 600 mm pitch. Partitions are fixed in walls and roof slab. Threshold of reinforced mass concrete and ceiling is made with standard precast reinforced concrete slabs. Ceiling slabs are tightened with mass reinforced concrete. Roof is covered with soft rolled paranite H=40 cm. Gutter of sheet steel. Structure surrounded with concrete side slope b=1.0 m. Construction works will be according to the safety engineering standard III-4-8 at construction site.

- Storage Reservoir V=1000 m^3 The cylinder shaped reservoir is: d=18.0 m and depth H=4.8 m. The entire structure is made with reinforced concrete with super plasticizer additive. Concrete is reinforced with steel fabric and separate rods. A drainage system is constructed around the reservoir.

About 20 percent of Oni's water is Rioni River filtrate collected in 6 manhole-like structures at Zhizhoreti. This system currently provides drinking water to the northeast side of Oni. The Zhizhoreti water system is not part of this project.

Day to day operation and maintenance (O&M) of the new treatment plant and storage reservoir will be the responsibility of the local Oni Service Center (OSC). OSC is currently operating the existing system and water distribution network. The Proposed Action includes training and assistance with startup and O&M of the new water system.

2.3.3 Alternative 3– Groundwater Source Water

This alternative considers using relatively deep wells to deliver groundwater to Oni. The Proposed Action utilizes underground spring water in a Karst aquifer where extraction is almost at the surface.

Groundwater is used as the drinking water supply in many parts of Georgia. Water wells are typically large, deep with turbine pumps that may be expensive to construct and operate. The system requires electricity, storage reservoirs, and a distribution system.

The groundwater alternative has several difficulties: (a) deep and limited aquifers; (b) high development cost, particularly for diesel pumps; and (c) need for reliable electric power source. Since existing water supplies in Oni will be adequate after rehabilitation, groundwater development would be more expensive than using the existing Kvedrula and Zhizhoreti water schemes.

2.4 Scope and Significance of Issues

An important factor in determining the scale and significance of the environmental and social impacts generated by alternative interventions is that all construction/rehabilitation activities are taking place within Oni municipality. It is already a built-up urban environment.

Environmental impacts are analyzed separately for the construction/rehabilitation phase and for the operational/maintenance phase. Impacts are assessed for the following environmental and social receptors:

- *Soils and Geology*
- *Water Resources*
- *Air Quality*
- *Biodiversity (flora and fauna)*
- *Community, Socio-Economic, and Public Health*

The Scoping Team reviewed the results of the Public Stakeholder Meeting held in Dusheti on July 5, 2011. Public comments are included in Appendix A. The Scoping Team also reviewed the USAID/Africa Bureau Environmental Guidelines for Small-Scale Activities (EGSSA), which makes note of potential significant effects for municipal rehabilitation projects. These issues were reviewed by the Scoping Team:

- *Degradation of water quality: a potential concern for GMIP water supply projects*
- *Adverse effects on quantities of water: a potential concern for GMIP water supply projects*
- *Damage to valuable ecosystems: a potential concern for GMIP water supply projects*
- *Soil erosion: a potential concern for Oni*
- *Deforestation: a potential concern for GMIP water supply projects*
- *Damage to scenic quality and tourism: a potential concern for GMIP water supply projects*
- *Adverse impacts on human health and safety: a potential concern for GMIP water supply projects*
- *Changes to local culture and society: a potential concern for GMIP water supply projects*
- *Cumulative Impacts: The Environmental Assessment needs to consider the cumulative impacts of municipal water supply projects.*

2.5 Identification of Concerns and Significant Effects

Below, Table 1 shows the social and environmental concerns, the origin of those concerns, and how the Scoping Team intends to respond to the concerns during the EA. The social and environmental concerns from water supply rehabilitation and operation are combined, as appropriate. Following this table, Table 2 describes the potentially significant impacts and specific issues that will be further evaluated in the EA. In Section 3, Table 3 shows concerns (from Table 1) that have been eliminated from further consideration in the EA.

Table 1: All Social & Environmental Concerns for GMIP Water Supply Activities

All Social & Environmental Concerns	Origin of Concern	Scoping Team's Response
Deterioration of upstream ecosystem that could result in contamination of Oni's Karst water source.	Local concern	Available information is insufficient to determine; to be investigated further in EA.
Impacts to threatened, endangered, and protected	Local concern	Available information is in-

species. Disruption of sensitive ecological habitats.		sufficient to determine; to be investigated further in EA.
Impacts to cultural resources such as Revaz Japaridze Home-Museum.	Local concern	Available information is insufficient to determine; to be investigated further in EA.
Human health impacts due to poor drinking water quantity or quality	Local concern	Available information is insufficient to determine; to be investigated further in EA.
Water losses due to leaks in Qvedrula water pipeline	Local concern	Sufficient information is available to develop Best Practices (BPs) to minimize this concern.
Damage caused by constructing temporary staging areas.	Local concern EGSSA	Sufficient information is available to develop BPs to minimize this concern.
Dust generation during rehabilitation; Air pollution from heavy equipment.	Local concern EGSSA	Sufficient information is available to develop BPs to minimize this concern.
Noise pollution from construction activities and use of heavy machinery.	Local concern EGSSA	Sufficient information is available to develop BPs to minimize this concern.
Construction camps could result in pollution of surface and groundwater if inadequate sanitary facilities are not provided. Altered landscapes if the site is not returned to previous conditions. Alcohol and socially destructive practices introduced via construction crews.	Local concern	Sufficient information is available to develop BPs to minimize this concern. Mitigations to be included in the bidding document.
Contamination from heavy equipment leaks and construction spills.	Local concern EGSSA	Sufficient information is available to develop BPs to minimize this concern.
Cumulative Impacts: The Environmental Assessment needs to consider the cumulative impacts of flood protection activities within the watershed.	Local concern EGSSA	Cumulative impacts will be evaluated in the EA.
Lack of environmental coordination. Lack of consultation. Participation and transparency. Lack of coordination. Inconsistent messages across projects.	NGO concern,	Scoping and EA processes encourage coordination, consultation, participation, and transparency and provide clear, consistent messages. no further assessment needed.
Project sustainability. Lack of effectiveness. High expectations for project benefits.	NGO concern,	The project is designed for sustainability, effectiveness, and to balance expectations with benefits; no further assessment needed.
Lack of understanding of environmental issues	NGO concern,	This is an issue nationwide and is beyond the bounds of the project.
Pedestrian and traffic safety. Worker and public health and safety.	Local concern	Sufficient information is available to develop BPs for inclusion in the bidding document.
Visual impacts due to water supply structures.	Local concern EGSSA	Sufficient information is available to develop BPs to minimize this concern.

2.6 Potentially Significant Impacts to be Analyzed in EA

Significant effects to be analyzed in the EA are based on the Scoping Team's assessment of water supply construction/rehabilitation and operation/maintenance effects as well as the direct effects. Table 2 provides the potentially significant issues to be evaluated in the EA and the EA work tasks for each social and environmental concern.

Table 2: Potential Significant Impacts for GMIP Water Supply Activities

Social & Environmental Concern to be evaluated in EA	Potentially significant issue to be evaluated in EA	EA Requirements/ Work Tasks
Deterioration of upstream ecosystem that could result in contamination of Oni's Karst water source.	Construction of villages and/or tourist hotels, deforestation, farming, animal grazing, etc. impact Karst water source.	Identify upstream land use and determine land use requirements.
Impacts to threatened, endangered, and protected species. Disruption of sensitive ecological habitats.	Rehabilitation, including construction and operation phases, could impact Threatened, Endangered & Protected Species (TES) and sensitive ecological habitats. This could occur through direct impacts (workers may disrupt habitats without oversight) or indirectly through habitat alterations during construction.	Identify presence of Threatened, Endangered & Protected Species (TES) and/or sensitive habitat; Determine possible short and long-term habitat alterations.
Impacts to cultural resources such as Revaz Japaridze Home-Museum.	During the construction phase, cultural resources may be found, disturbed, and/or destroyed.	Identify cultural resources of importance in the vicinity of the projects and as appropriate for the specific resources, measures to remove or protect.
Human health impacts due to poor drinking water quantity or quality	Collect water quality and quantity monitoring data to address the needs of Oni residents	Identify chemical and biological contaminants in water; identify water quantity availability and water needs of Oni.
Cumulative Impacts: The Environmental Assessment needs to consider the cumulative impacts of flood protection activities within the watershed.	Cumulative impacts may result from the combination of past, present, proposed, and reasonably foreseeable actions. A cumulative effects analysis is part of EA.	Identify the space, time, and assumptions to predict cumulative impacts.

As provided in Table 2, the potential significant rehabilitation/operation effects to be analyzed in the EA include:

- **Deterioration of upstream ecosystem that could result in contamination of Oni's Karst water source.**
- **Impacts to threatened, endangered, and protected species. Disruption of sensitive ecological habitats.**
- **Impacts to cultural resources such as Revaz Japaridze Home-Museum.**
- **Human health impacts due to poor drinking water quantity or quality.**

- **Cumulative Impacts: The Environmental Assessment needs to consider the cumulative impacts of flood protection activities within the watershed.**

During the EA, meetings will be conducted with agencies/ministries, local governments, non-governmental organizations, donor organizations and others as needed to assess the significance of impacts identified above. Additional inspections of the project sites will be conducted as necessary. Each impact will be analyzed and the EA Team will identify mitigation measures to minimize adverse social and environmental effects and develop an Environmental Mitigation and Monitoring Plan (EMMP) for water supply activities. The EMMP will include best practices, as noted in Tables 1 and 3.

3 IDENTIFICATION AND ELIMINATION OF ISSUES THAT ARE NOT SIGNIFICANT

The identification of issues that are not significant is based on the analysis of direct effects, an analysis of comments received during scoping, review of literature and field visits. The analysis of environmental effects included consideration of both the construction/rehabilitation phase and the operational/maintenance phase.

The list of potential environmental impacts excluded from the EA is provided in Table 3. This table includes the issues identified as not significant as well as the reason they were excluded from further analysis in the EA.

Table 3: GMIP Concerns that have been eliminated from further evaluation

Social & Environmental Concern	Reason for Elimination
Water losses due to leaks in Qvedrula water pipeline	Information is sufficient to provide best practices to minimize this concern; BPs to be included in the bidding document. No additional investigation is needed.
Damage caused by constructing temporary staging areas.	Information is sufficient to provide best practices to minimize this concern; BPs to be included in the bidding document. No additional investigation is needed.
Dust generation during rehabilitation; Air pollution from heavy equipment. Noise pollution from heavy machinery.	Information is sufficient to provide best practices to minimize this concern; BPs to be included in the bidding document. No additional investigation is needed.
Construction camps could result in pollution of surface and groundwater if inadequate sanitary facilities are not provided. Altered landscapes if the site is not returned to previous conditions. Alcohol and socially destructive practices introduced via construction crews.	Information is sufficient to provide best practices to minimize this concern; BPs to be included in the bidding document. No additional investigation is needed. Mitigations to be included in the bidding document.
Contamination from heavy equipment leaks and construction spills.	Information is sufficient to provide best practices to minimize this concern; BPs to be included in the bidding document. No additional investigation is needed.
Lack of environmental co-ordination. Lack of consultation. Participation and transparency. Lack of co-ordination. Inconsistent messages across pro-	Scoping and EA processes are meant to encourage coordination, consultation, participation, and transparency and to provide clear, consistent messages;

jects.	no further assessment needed.
Project sustainability. Lack of effectiveness. High expectations for project benefits.	The project is designed for sustainability, effectiveness, and to balance expectations with benefits; no further assessment needed.
Lack of understanding of environmental issues	This is an issue nationwide and is beyond the bounds of the project.
Pedestrian and traffic safety. Worker and public health and safety.	Sufficient information is available to develop BPs for inclusion in the bidding document.
Visual impacts due to water supply structures.	Sufficient information is available to develop BPs to minimize this concern.

4 METHODOLOGY AND SCHEDULE FOR PREPARATION OF THE ENVIRONMENTAL ANALYSIS

This section covers the methodology that will be used for conducting the EA analyses.

4.1 Methodology for Conducting the Environmental Analysis

The scoping process has confirmed the utility of the EA methodology. The scoping process has also laid the foundation for the preparation of the EA by achieving the following:

- Preparing reports on existing technical and environmental information.
- Conducting site investigations and initial stakeholders meeting
- Determining the significant issues to be assessed during the EA.
- Identifying the EA team disciplines needed for key EA issues.

The analysis completed in this SS provides the framework that will guide the work of the EA team pursuant to the process described in USAID's environmental procedures.

4.1.1 Impacts Identification/Screening and Significance Determination

The EA will address the types of activities involved with improving Oni's water supply. Site visits have been made during scoping and additional site inspections will be conducted as necessary. A second stakeholders meeting will be conducted in Oni. Issues identified during the scoping process will be addressed in the EA in greater depth. Any additional issues raised during the Oni Stakeholders Meeting will also be considered in the EA.

The EA will evaluate potential significant impacts associated with each alternative. Attention will be given to direct, indirect and cumulative impacts within the project's influence area. Mitigation measures (and best practices) for each significant impact will be identified. All aspects of the project's life (design, construction, rehabilitation, operation and maintenance) will be considered in the EA. Based on a discussion of environmental consequences, the team will determine the need for mitigation measures and whether mitigation is practicable. Where mitigation is not possible or if it is inadequate to minimize concerns, the team will note this as an irreversible and unavoidable consequence.

The EA Team will: 1) based on the SS, evaluate the significant issues associated with rehabilitation/construction and/or operation/maintenance; 2) propose mitigations for significant adverse impacts; 3) make a determination of the significance of impacts with mitigation incorporated; and 4) develop an EMMP for Oni water supply improvements. The EA will include an EMMP for Oni water supply activities. Mitigation measures including best practices will be included in Environmental Mitigation and Monitoring Plans (EMMPs).

4.1.2 Data Sources

The EA team will use published sources including periodic publications, scientific journals, and internet websites and data sources. Due to the different projects already existing in this area, there is data already in place within the country. Fieldwork will involve visits to proposed sites and nearby areas. Appropriate government authorities, NGOs, and bilateral and multilateral donors will be consulted.

4.2 Schedules

In order to carry out the EA, the scoping team envisions the following additional arrangements, methods and timing to begin the EA.

4.2.1 Preparation of the EA

This SS will be reviewed and approved by the USAID/Georgia Mission Environmental Officer (MEO) and the Europe and Eurasia Bureau Environmental Officer (BEO). EA implementation covers the time for EA preparation.

EA Preparation: The proposed period for preparing the EA will be approximately three weeks broken down as described below. Throughout the process, meetings will be held with USAID to discuss results of each step.

- Week 1: Complete data analysis including baseline studies, information from reports and data from site visits and meetings with other projects. Conduct Oni Stakeholder Meeting. Visits to Oni water supply project sites. Begin writing EA.
- Week 2: Final site visits and field work at proposed project sites. Meetings with communities and others as needed. Continue EA writing.
- Week 3: Complete draft EA, complete site visits and field work. Additional meetings to fill critical information gaps as needed. Submit draft EA to USAID.

5 ENVIRONMENTAL ASSESSMENT FORMAT

5.1 EA Outline

This EA Outline describes the sections that will be part of the EA.

1. Summary
   - 1.1 Project Description
   - 1.2 Project Context
   - 1.3 Summary of 22 CFR 216 Requirements, IEE Summary, Scoping Process
   - 1.4 Major Conclusions
   - 1.5 Areas of Controversy and Issues to be Resolved

2. Underlying purpose and need to which the proposed action is responding.
   - 2.1 Project Description
   - 2.2 Purpose and Need for the Proposed Action
   - 2.3 Status of Environmental Compliance Documentation
     - 2.3.1 Summary of 22 CFR 216 Requirements and the IEE
     - 2.3.2 Environmental Scoping Statement
     - 2.3.3 Stakeholder Engagement and Host Government Consultations
     - 2.3.4 Host Country Environmental Context

3. Alternatives Including the Proposed Action
   - 3.1 Description of the Alternatives
     - 3.1.1 Proposed Action
     - 3.1.2 Groundwater Source Water
     - 3.1.3 No Action Alternative
   - 3.2 Alternatives Eliminated from Analysis and Rationale for Eliminating Alternatives
   - 3.3 Comparison of Environmental Impacts of Alternatives
   - 3.4 Discussion of Alternatives
   - 3.4 Ranking of Alternatives with Respect to Significance of Environmental Impacts

4. Affected Environment
   - 4.1 Population Characteristics
   - 4.2 Geographic Characteristics
   - 4.3 Environmental Baseline Information (Biological Diversity, Air, Water Resources, Soils, Geology, Topography, Seismicity, etc.)
   - 4.4 Policy, Legal, Regulatory and Permitting Requirements
     - 4.4.1 Host Country Government Policy, Legal and Regulations
     - 4.4.2 International Standards and Best Practices
     - 4.4.3 Relevant and Applicable Permitting Requirements

5. Environmental Consequences
   - 5.1 Environmental Impacts of Proposed Action and Alternatives
     - 5.1.1 Direct Effects and their Significance
     - 5.1.2 Indirect Effects and their Significance
     - 5.1.3 Cumulative Effects and their Significance
     - 5.1.4 Possible Conflicts between: Proposed Action and Land Use Plans
     - 5.1.5 Possible Conflicts between: Proposed Action and Policies and Controls
   - 5.2 Energy Requirements of Alternatives

6 ENVIRONMENTAL ASSESSMENT TEAM COMPOSITION

The EA team has been chosen based on the potential impacts identified in this SS. Data collection, field studies, analyses and EA preparation will be conducted by a specialized team of scientists and engineers from Tetra Tech. Each expert will focus on the impacts in their specialization areas and expertise. Backgrounds of principal members of the EA Team are highlighted below:

James Gallup, Ph.D., P.E., Team Leader and Environmental Specialist. Dr. Gallup is a senior environmental specialist with over 40 years of international experience, including projects in Georgia. He led a team that prepared a Programmatic Environmental Assessment (PEA) for the USAID AgVANTAGE Project implemented by ACDI/VOCA. He has provided direct technical support to the Europe and Eurasia Bureau Environmental Officer and he designed and implemented USAID's Global Environmental Pollution Prevention Project (EP3). Dr. Gallup, a registered professional engineer, earned his Ph.D. in Environmental Engineering from the University of Oklahoma. He holds a MS in Environmental Engineering and a BS in Microbiology.

Mamuka Gvilava, Ph.D., Environmental Specialist. Dr. Gvilava is an environmental specialist with fifteen year experience in field work, project management, policy and regional cooperation. He has experience with environmental and social impact assessment, remote sensing, and green design. He served as national focal point to the Black Sea Commission and project director of the World Bank and GEF Coastal Zone Management Project. He has a Ph.D. in physics and math.

7 APPENDICES

Appendix A: Details of Municipal Stakeholder Meeting

Appendix B: Oni Site Visit Inspection Report

Appendix C: Detailed Design of Oni's Water Supply Scheme

Appendix A: Details of Municipal Stakeholder Meeting

This appendix provides the details of the Municipal Stakeholder Scoping Meeting held in Dusheti on July 5, 2011. The appendix includes meeting participants, speaker information and opinions, proposals and recommendations, photos, agenda and list of participants.

A. Meeting Participants

Representative of USAID: Giorgi Kokochashvili.
Representative of Municipal Development Fund of Georgia:

- Kartlos Gviniashvili
- Zurab Baratashvili.

Representative of Tetra Tech:

- Jeffrey Fredericks;
- Ilia Eloshvili;
- Archil Lezhava;
- Mamuka Shaorshadze;

Representative of Kavgiprotransi-MG, Ltd:

- Kakhi Jashi – Director;
- Vazha Mirimanov – Chief Engineer;
- Vazha Kirmizov – Chief Specialist of Water Supply and Waste Water Projects;
- Nugzar Mirimanov – Chief Specialist of Road Projects
- Ilia Mtskhvetadze – Chief Environmentalist of the Project;

Representatives of local Executive Bodies:

- Tsaro Sadzaglishvili – Chairman of Dusheti Assembly
- Gia Natsvlishvili – Dusheti Assembly;
- Tamaz Akhalkatsi – Kareli Municipality;
- Gocha Nebieridze – Kareli Municipality;
- Iago Valishvili – Kareli Municipality;
- Hamlet Davrishelidze – Kareli Municipality;
- Kakha Lobzhanidze – Gori Municipality;
- Giorgi Shengelia – Gori Municipality;

Representatives of Population

- Nodar Kurtsikidze – C. Dusheti, Mtvareliant Settlement;
- Badri Tsotskolauri – C. Dusheti, Mtvareliant Settlement;
- Natela Verdzeuli – C. Dusheti, Mtvareliant Settlement;
- Ushangi Bezhanishvili – C. Dusheti, Mtvareliant Settlement;
- Omar Gogishvili – C. Dusheti, St. Ioseliani;
- Zina Zignesiani – C. Dusheti, Mtvareliant Settlement;
- Juli KashiaSvili – C. Dusheti, St. Parnavazi;
- Giorgi Tselashvili – C. Dusheti, St. Parnavazi;
- Tamaz Bulauri – Dusheti Autotransport Enterprise;
- Shota Kherkeladze – Dusheti Region
- Aleksi Narimanidze – C. Dusheti, Pensioner

B. Speaker Information and Opinions

The Chairman of Dusheti Assembly Tsaro Sadzaglishvili welcomed the participants and offered them to choose Mr. Kakhi Jashi as a chairman of the Meeting.

Mr. Kakhi Jashi introduced attendees with the general purposes of the project, emphasized the importance of the USAID activity and the importance of projects, reviewed the existing condition of the municipal infrastructure rehabilitation projects that are located in the five municipalities and thanked the attendants for participating in the meeting. He asked them to express their opinions and proposals and promised to consider their views in the scoping statement.

Mr. Nugzar Mirimanov presented technical-economic data regarding the rehabilitation of road and street pavement. Mr. Vazha Mirimanov mentioned two bridges built in violation of norms. The distance between the abutments is so small that stones, branches, and solid materials cannot pass through the cut, resulting in flooding of nearby yards and houses.

Mr. Vazha Kirmizov reviewed the issues of rehabilitation water supply and waste water systems and arrangement of water meters. He emphasized the importance of rehabilitating the waste water system and drainage system in the railway settlement. Mr. Ilia Mtskhvetadze reviewed the existing ecological condition of the site, the information gained during the site investigations and the benefits both for population and for ecological condition.

In the final part, the speaker mentioned that the rehabilitation projects for the eight municipal infrastructure units were acceptable and, if the mitigation measures are considered during the project implementation, the public health and environment will not be in danger. In addition, the speaker emphasized the importance of improvement of social conditions. This will particularly reflected on the population of vil. Dvani and its nearby villages, on families settled nearby the Dusheti Gorge and on inhabitants of railway settlement.

After the presentation the participants expressed their remarks and views.

The opinion was expressed by:

Mr. Nodar Kurtsikidze mentioned that the rehabilitation of bridges arrangement of bank revetment structures is also necessary as the flood devastates the property of population and puts in danger their lives.

Mr. Tamaz Bulauri said, that there were not bridges before and the houses were not flooded as the population used inert materials taken by the water to construct buildings.

Mrs. Eter Totiauri mentioned that she does not know where to go when it rains as the water flows directly into her house.

Mr. Tamaz Akhalkatsi and Mr. Gocha Nebieridze mentioned the importance of rehabilitation of Sogolasheni-Dvani road as their population is separated from the rest of Georgia. He said that these villages may be left without population. The rehabilitation of the road is also necessary so that the population at the occupied territories will see how the rest of Georgia is being developed and express the willingness to live in Georgia.

Mr. Giorgi Shengelia mentioned that rehabilitation of waste water system in Railway Settlement and of road pavement in Gori will improve the social condition of population.

Mr. Kakha Lobzhanidze mentioned that the rehabilitation of water supply and waste water systems and arrangement of water meters will promote the rational use of water and water supply will improve for more inhabitants.

The Chairman summed up the results of the meeting, thanked the attendants for participation in the meeting and promised to consider all their proposals.

C. Proposals and Recommendations

№	**Proposal Recommendation**	**Result**	**Remark**
1.	Re-arrangement of two bridges over Dusheti Gorge and arrangement of bank revetment structures	Is considered in the Captioned Project	Only the selected projects will be implemented.
2.	Rehabilitation of Sogolasheni-Dvani motor road	Is considered in the Captioned Project	It will be rehabilitated in case it turns up between the selected projects. Otherwise it will be rehabilitated in the future in the scope of another project
3.	Rehabilitation of waste water system in Gori and arrangement of road pavement at Gori streets.	Is considered in the Captioned Project	It will be rehabilitated in case it turns up between the selected projects. Otherwise it will be rehabilitated in the future in the scope of another project
4.	Rehabilitation of water supply and waste water system in Gori and arrangement of water meters	Is considered in the Captioned Project	It will be rehabilitated in case it turns up between the selected projects. Otherwise it will be rehabilitated in the future in the scope of another project

D. Photos

Stakeholder Meeting

Stakeholder Meeting

Stakeholder Meeting

Stakeholder Meeting

E. Agenda

Stakeholder Meeting Organized for Municipal Project Recipients (July 2011)

Registration: from 9.30 to 10.00

Time	Subject	Reporter
10.00	Greeting	Chairman
10.15	Technical issues	Kakhi Jashi
10.35	Social and environmental issues	Ilia Mtskhvetadze
10.55	Discussion	Attendants
11.45	The final part of the meeting	Chairman

F. List of Participants

მუნიციპალური ინფრასტრუქტურის პროექტის კომპონენტებთან დაკავშირებით
საზოგადოების წარმომადგენლებთან მოწყობილ შეხვედრაზე მონაწილეთა სია

ქ. დუშეთი 5 ივლისი 2011 წ.

NN	გვარი, სახელი	ორგანიზაცია	საკონტაქტო ინფორმაცია (ტელეფონი, ელექტრონული ფოსტა)
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2	[illegible]	[illegible]	599333874
3	[illegible]	[illegible]	599-581486
4	[illegible]	[illegible]	599-58-61-46
5	[illegible]	[illegible]	577957222
6.	[illegible]	[illegible]	577957203
7.	[illegible]	Tetra tech	595364602
8.	[illegible]	Tetra tech Env. Specialist	595116071.
9.	[illegible]	Tetra Tech GEO	
10.	[illegible]	Tetra Tech	599788877.
11	[illegible]	[illegible]	595214112
12.	[illegible]	[illegible]	593191263
13	[illegible]	[illegible]	593630359
14	[illegible]	[illegible]	2-72-08
15	[illegible]	[illegible]	555-22-18-27
16	[illegible]	[illegible]	593-63-06-50
17	[illegible]	[illegible]	22-18-85
18	[illegible]	[illegible]	22-13-38
19	[illegible]	[illegible]	593-59-79
20	[illegible]	[illegible]	22-12-08
21	[illegible]	[illegible]	22-13-38
22.	[illegible]	[illegible]	22-13-36

NN	გვარი, სახელი	ორგანიზაცია	საკონტაქტო ინფორმაცია (ტელეფონი, ელექტრონული ფოსტა)
23.	[illegible]	[illegible]	599263042 5
24.	[illegible]	[illegible]	595531417

Appendix B: Oni Site Visit Inspection Report

August 14, 2012

To: Jeff Fredericks, Tetra Tech, GMIP COP

CC: Ilia Eloshvili, Tetra Tech, Deputy COP; Jim Gallup, Environment Team Leader

From: Mamuka Gvilava, Environmental Specialist, Givi Varduashvili, Project Engineer

Subject: GMIP, Environmental and Technical Site Visit Report for Proposed Oni Water Treatment Plant Construction (August 09-10, 2012).

I. Objectives

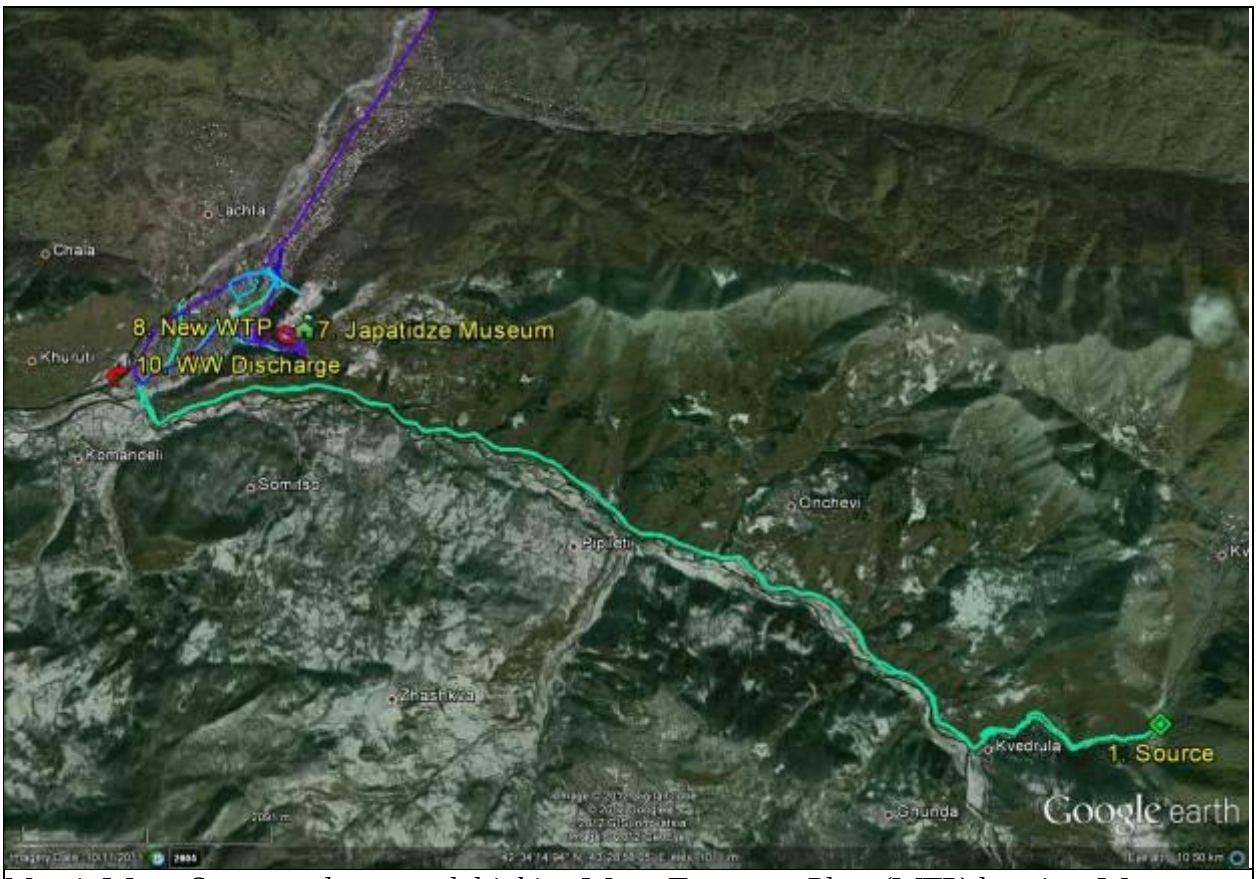
Two day environmental site visit to proposed Oni water supply construction to:
(1) Visually assess and report on site environmental conditions.
(2) Elaborate on regulations with regard to EIA requirements.
(3) Provide initial findings and recommendations on environmental safeguards.

II. Site Visit and Consultation Report

At the request of GIMP COP the environmental and technical inspection was performed by Mamuka Gvilava, Environmental Specialist and Givi Varduashvili, Project Engineer of TetraTech. The duration of the trip was 2 days including approx 2 x 6 hours for driving to and from Oni. One more day was devoted to report writing. On arrival (approx 18:00) Tt team was met by representatives of United Water Supply Company of Georgia (UWSCG), namely Giorgi Andguladze, Giorgi Murghulia (Chief Specialists of Projects Department from Tbilisi), Nodar Chkhikvadze (Technical Manager of Imereti and Racha-Lechkhumi Regional Branch), Michael Lobzhanidze (Head of Oni Service Center) and Korneli Darsavelidze (Chief Engineer of SakTskalProekti – Georgian Water Project), who kindly accompanied us at two sites to jointly visit first water source facility approx. 9 km upstream Jejora River (left tributary of Rioni River) and Kvedrula Stream (right tributary to Jejora) and then to visit proposed location for new water supply plant construction (to host 1,000 cub. m reservoir, filtration and chlorination units and other related facilities). UWSCG team and the design consultant then left for Tbilisi. Next day morning Head of Oni Service Center kindly accompanied us to visit old water supply reservoir location as well as lead Tt team to show Oni wastewater discharge point to Rioni. On the way back Tt team visited IDP housing construction site in Terjola (see findings separately).

First we report below site visits and on-spot discussions held with UWSCG representatives, then field observations as comments to photo illustration are provided. Please access all photos of the site visit at https://www.dropbox.com/sh/t9h16ox9pr7vlnh/LlRYWQojva (pictures will be available online one week via this dropbox link, and permanently stored with Tt DCC thereafter).

Map 1 depicts the location of Oni water source and proposed drinking water treatment plant. Each site presentation is accompanied by zoomed in Google Earth map as well.



Map 1. Water Source and proposed drinking Water Treatment Plant (WTP) location. Wastewater (WW) discharge point is also shown. Goggle Earth file can be accessed by clicking here: Oni WS.

Kvedrula water supply source (visited 20120809):

- Water is collected from Karst geological layer with trapezoidal abstraction concrete structure with attached distribution building with two chambers (for possibility of maintenance without interruption). As reported by design consultant, it is possible to repair the building/structure by switching waterflow between these two chambers.
- Earlier Karst stream was flowing from the mountain in this spot, with all stream water now being collected for Oni (min 15 l/sec, max 25-30 l/sec). During prolonged precipitation events water is reported to become turbid (probably with Karst limestone particles) so that in some cases turbidity levels are so high that for some time (can be days, even weeks), water reportedly becomes non-potable.
- Proposed rehabilitation works for the abstraction structure (in former Soviet countries referred to with French term 'Captage') are quite minimal and reportedly do not require any heavy equipment; rather hand labor and manual delivery of required materials.
- Initially the source site was provided with entire treatment process (filtration, chlorination, some settlement and storage capacity) but this is not functional for a long time now. The site was and is still protected by the concrete wall along the Kvedrula Stream.
- The Service Center Head informs that Oni does not have lab capacity, and they rely on Ambrolauri service center and Kutaisi regional branch to periodically check water quality.

Map 2. Layout of the water source and initial (now out of function) water treatment facilities (north is tilted). Goggle Earth file can be accessed by clicking here: Oni WS.

Landscape and mountain forest cover of Kvedrula catchment is beautiful.

Layout of headwork from access bridge. Visible also are Kvedrula Stream and its bank protection wall, guard room and old transformer. Other facilities, located just further from transformer, are screened by vegetation.

Filtering facility (cylindrical structure in the background) and settling reservoir.
(Can these structures be used to house some of the new treatment facilities?)

Chlorination facility at source site

Chlorination and check manhole (water was under good pressure, no noticeable turbidity).

Trapezoidal karst stream water abstractor. Below: reversed views towards the same structure.

Access to source structure
(not visible, it is screened by vegetation).

Access to source facility (no equipment access, only manual labor and had delivery foreseen to rehabilitate the source structure).

Access to chambers and valves (all in need of renewal) through damaged and unsafe ladder.

Typical damage to source building (including leaking). Bottom pipe is the Oni water supply. Spillover pipe also visible behind the ladder.

Pipe with water for Oni.

Spillover pipe.

Inside view of the source building with two chambers and control valves.

Landscape at the source.

Site access bridge, Kvedrula bank protection.

Access roads to source site (in reversed sequence, when leaving the site).
Rock fall is one of the safety hazards.

		
Bridge across Kvedrula, along the main access road (it goes parallel to Jejora River). Source site appears to be of hiking interest.		Water pipe crossing under the bridge over Kvedrula (water leak founting under pressure).

Proposed Water Supply Plant location (visited 20120809):

- New reservoir (1,000 cub. m) and all related facilities (twin 'fast' treatment filters, pumps for filter cleaning, vertical settler, chlorination unit, control and guard house, fence, various manholes, valves and piping) are proposed in a new location, in place of the former Soviet-style tourist base (so called TurBaza), which were quite low impact buildings with point and strip foundations, now entirely dismantled to foundations, which remain in place. Name of the tourist base "Bolota" probably comes from Russian Bolota, because this flat terrace has some wetlands characteristics.
- The location is quite picturesque, and despite past impacts from tourism facilities, it can be considered as greenfield area, surrounded by beautiful vistas of mountainous Racha region.
- In addition to beautiful landscape, the site hosts the local heritage, the house-museum of the locally and nationally known contemporary writer Revaz Japaridze. It is quite probable that dwellers and owners of the house-museum may not want to have WTP development in front of their viewscape. In any case, clearance with the national and local authorities likely will be required as part of the construction permit, as well as settlement with house-museum owners.
- The treatment unit would function only during turbidity events. Most of the time water would be directly distributed without treatment. Reservoir would serve to regulate water supply/storage, considered particularly useful during high demand periods in summer, when population doubles due to summer holiday arrivals.
- Approx. 9 km steel pipe is delivering water to Oni. Despite observed leaks (seen at least one, but there can be many other leaks as well), it seems that due to elevation difference and hence high water pressure, there might be no contamination infiltrating the pipe on the way to Oni. Service Center Head informed that from time to time pipe sections are being repaired. It is laid in the Kvedrula gorge and then along the dirt road running parallel to Jejora River. Would be good to have alignment mapped.
- There is another source for Oni (at Zhozhoreti). There is a potential to explore this source as well, when considering project alternatives (this site was not visited/explored).

Map 3. Proposed WTP location (in proximity with R. Japaridze House-Museum) and location of the old reservoir (north is tilted). Goggle Earth file can be accessed by clicking here: Oni WS


R. Japaridze House-Museum (see item 7 on Map 3).


View towards the proposed WTP location (see item 8 on Map 3) from House-Museum point.

Proposed site for new WTP (item 8 on Map 3). Water mains from the WTP will decent few hundred meters through the pine tree slope, to connect with the network.

View towards House-Museum from proposed site for the new WTP.

180° viewscape towards North from proposed WTP site.

One of the most important impacts of New WTP is landscape and visual. This technique, currently applied in Oni (in front of hotel we stayed), can be used to mitigate visual impact. Cover seems fit for service roads on plant site.

Access road to Old WTP. Design engineers as an alternative should analyze whether some WTP facilities can be located in place of the hazardous old reservoir. Similarly, some items could be considered at the water source locale.

Old Water Supply reservoir (visited 20120810):

- Reservoir was constructed upstream Oni but it never functioned due to improper geological and geohazard assessment (landslide and subsidence) and poor construction quality.

120° panoramic view of the old WTP reservoir. Photo was taking from the edge of the reservoir, with due care for safe distance from the perimeter, but existing reservoir is clearly fall hazard. New WTP pipeline should descent on this landslide (the slope in the background) to connect.

Wastewater discharge point (visited 20120810):

- Head of Service Center reports that up to 8 km sewers were put in Oni in 2010 and that a water distribution system is also brand new. This makes Oni perfect location for WWTP, while impact of proposed new WTP should be analyzed in terms of potential for increased WW discharge into Rioni River.

Oni Wastewater discharge point (item 10 on Map 3).

Other observations (20120810):

- Currently some contractor is involved in major Oni-Utsera road works (could easily bid for Oni road works with all the equipment in the area). This asphalt plant located just few km south of Oni (near Shardometi Village) is very likely source of asphalt for GMIP road rehabilitation, but plant operation cannot be considered as in compliance with environmental requirements of BATNEEC.

Asphalt plant in few km distance south of Oni, emitting heavy air pollution.

III. National and International EIA Requirements

Georgian Law on Environmental Impact Permit (December 2007) in Article 4 (1) unfortunately does not provide for state ecological expertise and environmental impact assessment preparation for potable water supply. This is clearly omission of the Georgian legislation and USAID is kindly advised to engage with Government of Georgia whenever appropriate to leverage the renewal of national legislation and the list of activities subjected to environmental impact assessment, making it geared towards the recognized best practices.

Per USAID Regulation 216 'Potable water and sewerage projects other than those that are smallscale' require EA. This activity can hardly be considered as small scale, more over that development is planned in essentially the green field area, despite some residual impact from earlier tourism development and the local road.

IV. Findings & recommendations

These are the initial consideration, to be extended during environmental scoping and assessment:

- Georgian environmental impact permit and state ecological expertise legislation is not invoked with the proposed project, while USAID Reg 216 triggers EA preparation.
- USAID is advised to engage with Government of Georgia whenever appropriate to leverage the renewal of national legislation and the list of activities subjected to environmental impact assessment, implementing acceptable best practice.
- Like with many other Georgian utility companies, UWSCG does not have sound environmental and social management plans and practices in place for construction and operation. It is strongly advisable to develop such instruments for UWSCG and to obtain commitment from the UWSCG management that these rules would be institutionalized, including at least

the following themes: sound environmental assessment policies, HS plans and procedures, resettlement policies and procedures, set of various environmental plans (such as for reinstatement, pollution prevention and control, waste management, environmental emergency response, landscape protection, cultural heritage & archaeology). Application of all these instruments would be required from UWSCG and its contractors when implementing this and other similar projects.

- Important impact is likely to be on landscape and visual. Project design, as conceived currently, is not responsive to mitigating these impacts. EA should analyze landscape and viewscape mitigation measures and try to incorporate them at this very late stage of design.
- Potential solutions considered could be total topsoil preservation for revegetation, use of local architecture imitation for guard/control house (so called Oda houses, for instance) and to screen above ground facilities; using permeable structures for on-site service roads instead of gravelling; planting of local evergreen vegetation to shield structures; burying facilities deeper underground; considering some facilities at other locations (source, old reservoir).
- Water quality and water flow data is not available for the Oni area. Water quality testing and flow measurements should be considered to collect data documenting before and after project conditions.
- Water metering on a priority basis should be considered to mitigate wasteful practices such as water leakages and use for irrigation. This could be the condition agreed with UWSCG.
- Impact of proposed new WTP should be analyzed in terms of potential for increased wastewater (WW) discharge from Oni into Rioni River. Scheduling the WW treatment plant construction could also be considered as the condition of the project against the incentive of supporting the drinking water treatment plant.
- Baseline environmental (rapid biological assessment of flora/fauna/landscapes) and technical (soils, geology, hydrogeology) studies will be required to inform/complete the EA.
- It appears that water source is not contaminated by human activities. To prevent from future pollution risks it is advisable to connect the project support with conditionality of catchment management measures (through watershed and forest conservation). This is win-win solution.
- There is another source for Oni (at Zhozhoreti). There is a potential to explore this source as well, when considering project alternatives. Design alternatives were not actually analyzed.
- Project design do not contain any environmental considerations, just one general paragraph.
- Potential for problems with EA: design of the WTP and all its facilities and piping is already substantially completed and authors might be reluctant towards significant revision of the design. Beneficiary's commitment is required on substantial upgrade of the design solution, if so identified by the analysis of alternatives in the EA.
- Clearance with the national and local authorities on cultural heritage likely will be required as part of the construction permit, as well as settlement with house-museum owners.
- Old reservoir clearly represents the geotechnical hazard and should be dealt with appropriately.
- Bringing pipeline from proposed location to network connection should be conducted with extreme care and planning not to trigger the landslide and to preserve valuable evergreen vegetation (which, apart from vegetation integrity, protects land from slipping).
- On another note, please note the issue with Oni road rehabilitation and asphalt plant with unacceptable technology.

Appendix C: Detailed Design of Oni Water Supply Scheme

Improvement of Oni town water supply scheme
Detail Design
JSC "Saktskalproekti"

General Explanatory Note

Table of Contents

1. Introduction

"Detailed Design of Oni Water Supply Scheme" was made by "Saktskalproekti" JSC based on the Contract signed in 2012 with the "United Water Supply Company of Georgia" Ltd.

Oni is supplied with water from the springs of two water supply systems, namely "Zhizhoreti" and "Kvedrula". "Zhizhoreti" provides water to 20% of the population, while "Kvedrula" supplies water to 80%.

The water supply system of "Kvedrula" started operating in the 70's and its output is 25-45 l/sc. In the period of heavy atmospheric precipitations the debit increases to 50 l/sc, water becomes turbid and its quality dues not meet the standards of potable water and it is not used for drinking.

Due to above mentioned at the site of the capping there were built the vertical sand trap and slow filter, chlorination unit and reservoir of 2000 m^3 capacity; however, they are out of order and restoration is impossible. Hence the specialists of the Design Organization, together with the representatives of local municipalities, selected the new site for construction of the treatment plant and reservoir.

This design envisages water quality improvement through usage of the main treatment facilities and chlorinator with the following scheme: at the 9^{th} km of the existing pipeline of D=200 mm providing water from the capping to the reservoir of 2000 m^3 capacity (being out of order). There is envisaged as follows: design-construction of the treatment facilities, pressure-regulating reservoir of 1000 m^3 capacity, chlorinator, pump station for flashing of rapid filter, pressure discharging regulator and water meter wells, water pressure tank, pipeline utilities of various significance under the ground, sentry box and fence of sanitary protection zone.

Trapezoidal shape (7.4 x 8.2)m structure is used to intake karst water which is fed to intermediate chamber (4.2 x 3.6 x 1.6)m (Drg. N8), equipped with excess water discharger, water feeder to the scheme, discharging and flushing pipelines with depreciated valves.

Since the chlorinating unit is inoperative water is not disinfected at all.

To provide population with potable water corresponding to the state standard quality, Finnish make FENNO NATERON Ltd purification structure's design has been worked out and handed over to the customer according to the technical assignment of Contract N02-01337 with "United Water Supply Company of Georgia" in 2012. JSC "Construction Systems" has recommended to replace this water purification structure with comparatively simpler German make double block 24 moduli dirre 2.0 x L 1.5 MB40 purification units to be designed at the territory of V=2000m^3 capacity power regulating reservoir according to technical assignment of the additional agreement.

Topo-geodetic survey and engineering-geological study of the said territory as well as poor technical state of the reservoir all indicate to the developed landsliding phenomena there. It must be noted that since the day of its commissioning in the 70-ies of last century the reservoir never worked because of strong leakages of water and cracked structures.

After consideration of the said data with foreign experts it has been decided that construction of new purification structure and restoration of reservoir at the old site shall be cancelled.

That is why the experts of design organizations with the representatives of local municipality have chosen new construction site for purification structure and reservoir. According to recommendation of Mr. G. Soselia and Mr. L. Gabunia the experts of "United Water Supply Company of Georgia", it has been decided to design and build high rate filters already tested practically and similar to Anaklia-Ganmukhuri water supply scheme instead of German complex units.

2. Topo-geodetic substantiation

Topo-geodetic survey works for development of Oni town water supply scheme were fulfilled in compliance with the technical assignment coordinated with the customer.

According to the technical assignment the following types and scope of topo-geodetic works were fulfilled at the site:

Planning of existing and design reservoirs sites, scale 1:200, relief section 0.5m, at 1.7 ha area. Topographic works at the site were done by means of electronic tachometer, TPS series, TCR-407 power model. Its laser distance meter without reflector can be used for measurements up to 200-400m with 2-5 mm precision, while with reflector (standard prism GPR-111) up to 1800-3500 mm with precision 2-5 mm. The range of measurements depends on the air transparency and weather conditions..

During works measurements with EDM IR reflector and without RL reflector were done. The standard GPR-111 prism was used as a reflector.

Topo-geodetic works were fulfilled in the WGS-84 System of coordinates.

To establish position and elevations of planning network points theodolite traverses and leveling lines were done by electronic tachometer TCR-407 power model which are represented as closed polygons.

Quality indices of the said traverses and levelling lines are as follows:

Length of a traverse L=640m.
Absolute linear error fs=0.20
Relative linear error fs/L=1/3200
Levelling line discrepancy, accepted fh=+17 mm.
Levelling line discrepancy, assumed fh= ±24 mm.

According to the above, the quality and parameters of theodolite traverses and leveling lines meet requirements of topo-geodetic survey instructions.

The assumed errors in levelling lines are calculated by formula::

$$fh = \pm 30\sqrt{L}$$

where L is the length of levelling line in km.

In levelling lines the errors were distributed in proportion with the length of their sides.

The results of all measurements (names of points, codes, altitudes, coordinates) were recorded in the instrument job file similar to computer directions, transferred into computer by LGO tools program, processed in AUTO CAD 2007 System DWG format and handed over to the design department.

3. Engineering geology

3.1. Introduction

The existing water supply network of Oni town was commissioned in the 70-ies of XX century. Under testing water losses from regulation reservoir exceeded permissible volumes considerably and till today water is supplied to the users without reservoir.

It is believed that poor technical state of existing reservoir is caused by heterogeneity of ground under its foundation that cannot be remedied today. That is why it is decided to demolish the old and build new reservoir nearby.

3.2 General physical-geological description of the region

From the point of view of physical geography (by L. Maruashvili) Oni is located in the valley of river Rioni within the boundaries of Great Caucasus Range in the Upper Ratcha depression between Pasis Mta-Zekari, Lechkhumi and Ratcha Ranges. The depression is surrounded with Pasis-Mta-Kazikhokh section of the main range and Shoda-Kedela ranges.

Morphologically (by A. Javakhishvili, L. Maruashvili) the territory is attributed to intermontane zone of the Great Caucasus mountainous system southern slope – the Ratcha-Letchkhumi synclinal depression which is characterized with rocky, mountainous relief dissected with deep transversal gorges.

Climatically (construction climatology PN 01.05-08) the territory is attributed to the marine, humid subtropical zone with considerably humid climate, moderately cold winter and long warm summer.

The mean annual temperature of air is 10^0 C, negative temperatures are observed in January (-1.0^0C) and December (-0.8^0C). The maximum temperatures are in July (+20.4^0C) and August (+20.5^0C). The absolute minimum temperature is -27^0C and the maximum one +38^0C.

- The period without frosts is 200 days per year;
- The maximum freezing depth for the following soil is as follows:
- clay-argillaceous soil – 23 cm;
- sand-sandy soil – 28 cm;
- gravel-cobbly soil – 30 cm;
- coarse-detrital soil – 34 cm.

The annual sum of precipitations is 1048 mm, where during cold season (XI-III months) -420 mm, and warm season (IV-X months) -628 mm. Duration of snow cover is 75-100 days per year.

Tectonically (by P.Gamkrelidze) the territory is located within the boundaries of Great Caucasus southern slope folding system, porphyritic- jurrasic northern sub-zone of Gagra-Java zone.

From the point of view of seismic civil engineering (PN 01.01-09) the territory is attributed to the 9^{th} point zone of seismic intensities (MSK scale), the non-dimensional coefficient of seismicity is 0.38.

Geologically (by P.Gamkrelidze) the Lower, Middle Jurassic and Quaternary deposits of Gagra-Java zone are spread in the region.

The Upper Jurassic period (J_1t) is represented with flysch alternation of sandy turbidits, argillaceous shales and argillites of Toarcian stage.

The Middle Jurasssic (J_2a) period is represented with flysch alternation of sandy and aleurolite turbidits and pelagic shale argillites of Aalenian stage. These rocks are widely spread in the vicinity of Oni.

Quaternary rocks (Q) are mostly represented with deluvium and proluvium-alluvium argillaceous coarse deposits.

At the surface modern deluvium (dQ_4) yellow-grey strong plastic clays are spread. Below proluvium-alluvium (paQ_4) yellow strong plastic clays with gruss and gravel inclusions in the upper and lower zones correspondingly are spread.

3.3 The state of existing reservoir

The existing reinforced concrete cylindrical reservoir, diameter 24m, height 4.4m, capacity $200m^3$ is hypsometrically located above Oni.

River Jejora, water abundant tributary of Rioni river flows along the south-east side of the reservoir site.

The territory of existing reservoir site is lithologically composed with Quaternary alluvium-proluvium and deluvium boulders, pebbles, rubble and gruss. The coarse fraction diameter often exceeds 1 m. That material is filled with clay, argillaceous and coarse sand.

The presence of alluvial deposits at the steep slope is associated with old river beds of Jejora and its right tributary Tsiliskhevi. According to L.Maruashvili (The Geomorphology of Georgia) Tsiliskhevi river was a tributary of Rioni river in the vicinity of Oni at village Tsola where about one km long dry river bed still exists at 50-75 elevation mark above the thalweg of Jejora and Rioni rivers.

The southern slope at reservoir site is unstable with small and medium size landslide hillocks and negative topography sections. Dense forest growing at the slope prevents development of active landslide processes, otherwise it local soils could be moved by gravitation towards the slope bottom, i.e. to the reservoir.

Technical state of existing reservoir is not satisfactory today. There are cracks at 4.9m high circular wall at the northern (settlement) side and water leaks at its bottom. Cracks are not excluded at its southern wall which is entirely covered with soil and the bottom as well.

The existing cracks and deformations indicate to the settling of structure in grounds of different resistance that is prohibited by construction norms and rules. The above defects were detected under testing of reservoir that is why it was not operating since the day of its construction. Even in case of its filling with water after rehabilitation it is extremely difficult to predict the expected results.

3.4 Engineering geology of design reservoir, chlorinating and water –purification structures.

The site of said structures is located to the South of Oni, within 1 km distance from village Tsmendauri, in the vicinity of former tourists base “Bolotha” which does not exist today and only some 0.5m high concrete supports indicate to its former area.

The absolute elevation mark of reservoir is between 845.25-845.30 m.

The both chlorinating and water purification structures will be located to the East from reservoir. The chlorinating unit within 20 m distance at 845.00 m elevation, while water purification unit within 40 m from chlorinating unit.

The sites of all three structures are at the western end of ridge between Rioni and its left tributary Jejora river, gently sloping from West to East, i=0.025(1.5^0).

Geological workings were excavated at the site of each structure. Working N1 at reservoir site, working N2 at chlorinating unit site and working N3 at water purification unit site. N1 and N2 workings are 5.0 m deep while N3 is 3.0 m deep.

Lithological composition of the structures site (see appendix) is as follows:

- Modern deluvium (dQ_4) yellow-grey strong plastic clays are spread from 0.0 to 1.5-1.7 m depth;
- Proluvium-alluvium (paQ_4) yellow strong plastic clays with gruss inclusions in the upper and gravel inclusions in the lower zones are spread from 1.5-1.7 m to 3.0-5.0 m depth.

Under the above said conditions foundations of structures will be deepened at least up to 1.5-2.0 m to rest on proluvium-alluvium soils strata.

Characteristics of soils are given according to the existing materials and documents.

Description of soil	Density kg/m^3	Processing group and category	Deformation modulus, MPa	Internal friction angle, degree	Viscosity, KPa	Design resistance, KPa	Temporary slope of depression side up to 3m depth	Aggression of soils agains reinforced concrete	Seismicity of soil group	Maximum freezing depth
Deluvium, yellow-grey, strong plastic clay	1900	$ 8-g II	12	15	50	200	1:0,25	Not agressive	II	23
Proluvium-alluvium yellow strong plastic clay with gruss in the upper and gravel inclusions in the lower zone.	1950	$ 8-d III	20	18	50	300	1:0,25		II	23

4. Present conditions

It has been said above that "Kvedrula" scheme is supplied with karst water that is received in trapezoidal shape reinforced concrete catchment structure while water is regulated in intermediate chamber by means of technological pipelines and valves.

An inspection of catchment structure sections revealed the following defects:

The structure and intermediate chamber walls are cracked here and there, water leaks, bottom has hollows, valves are in poor repair and must be replaced, walls in the top part of the chamber, roof, floor, doors and windows, iron staircase and handrails need restoration.

At the purification structure: settling tank, low-rate filter, main wells, regulating reservoir, chlorinating unit building are destroyed and cannot be restored. Moreover, technological conditions of purification structure do not meet rate and high-quality water purification requirements of today.

Since in the main pipeline at the territory of design purification structures water pressure is above 16 atm., it is envisaged to arrange at the purification structures supply branch water pressure regulator and water meter q=15-17l/sec wells (Drg N1-1, 2-1, 2-3).

5. Design arrangements

According to the technical assignment, it is envisaged in the design to improve potable water quality received from the existing "Kvedrula" scheme according to the state standard requirements.

However, since disinfection and turbid water (caused by heavy precipitations) purification units do not operate in the supply scheme, water quality is poor and it cannot be used for drinking.

It must be taken into account that because of poor technical state of water intake catchment structure creation of additional contamination sources is expected. Besides, considerable volumes of water are lost from damaged parts of catchment structure. Because of the said reasons it is envisaged in the design to carry out rehabilitation works at the site (Fig. N8).

Works connected with the improvement of water quality will be basically realized at water purification structures and water chlorinating unit in the following scheme:

At the 9^{th} km of existing d=200 mm pipeline supplying water from the catchment structure to the damaged 2000m^3 capacity reservoir design and construction works of the following structures and units are envisaged: the complex of water purification structures, V=1000m^3 capacity head-regulating reservoir, chlorinating unit, high rate filter flushing pumping station, water pressure regulator and water meter wells, elevated water tank, various underground pipelines at the site, sentry box, sanitary zone protecting fence, etc (Drg 1-1).

Under operation of water purification structures d=150 mm valve is opened in the main well N1 while the valve supplying clean water to reservoir is closed in the well N19.

As water purification structures are operating periodically they are mostly closed and clean water is supplied to the reservoir by the existing main pipeline and control valves in main wells N12 and N13. At that time water supplying valve in the main well N1 at purification structures is closed, etc (see Drg 1-1).

6. Designed discharge of water

It has been said above that Oni town is supplied with water by "Zhizhoreti" (20 l/sec) and "Kvedrula" (25-45 l/sec) schemes. The latter provides mostly so-called "upper zone" users. It must be mentioned that the debit of both schemes varies sharply so "Kvedrula" scheme is considered as the basic water supply source of the town while "Zhizhoreti" is the reserve one.

Hence the total demand of the town is calculated according to the volumes received from "Kvedrula" scheme.

According to technical assignment population of Oni is 2300 persons in total, that under consideration of the coefficient of growth 1.25 is 2875 persons.

It is assumed that the daily water requirement norm is 250 l per capita. It has been calculated on the basis of JSC "United Water Supply Company of Georgia" and the "European Investment Bank" water requirements typical forecast data form for the existing networks (Table N1) thatdesigned discharge of water from the source will be 15,06 l/sec while in peak hours q_{max}=29.25 l/sec (Table N2) that will be received by a user from regulated water reserve in reservoir in case of need.

The said will take place when water is turbid and according to the capacity of purification structures 15 l/sec volume is supplied to the reservoir. Otherwise, except the period of intense and long precipitations 30-40 l/sec clean water will be supplied directly into the reservoir.

Table 1

Projects of the United Water Supply Company of Georgia and European Investment Bank
Future water requirements typical forecast data for existing projects

Distribution scheme — Presumable, future state after rehabilitation works

Group of users	Population	Unit requirement	Average daily requirements		Maximum daily requirements*	
Predesigned water discharge data	Forecasted number of water provided population	Day/per capita m^3	Predesigned requirement m^3/day	Average designed l/sec*** supply	Predesigned requirement m^3/day	Maximum designed l/sec*** supply
Household requirements	2875	0.25	718.75	8.32	862.5	9.98
Small commercial/industrial requirements**	% Of the above	10%	71.9	0.83	71.9	0.83
Large users (big volume supply + 10 to20% to existing data)	-	-	-	-	-	-
New water requirements in distribution scheme			790.65	9.15	934.4	10.81
Evident losses (% of net requirements ****	(% of net requirement)****	6.0%	47.4	0.55	47.4	0.55
Real losses (leakages)		40.0%	316.26	3.7	316.26	3.7
Total design requirement for distribution scheme			1154.31	13.4	1298.1	15.06
* The seasonal factor for the maximum daily requirements 1.2 calculated for requirements and not for leakage		1.20				

** When meter data is available, is added 10-20% to the actually used volume
*** Without the factor of peak/hour
**** When there is no extraordinary situation in the town the following percentage values are used: fro evident losses 4% of total demand or 6% of net demand; For real losses (leakage 27% of total demand or 40% of net demand; For losses in the main pipelines 4% of total demand or 5% of net demand;
***** Technical water for services 8^ of total demand or 9% of net demand, losses inclusive.

Total water discharge of “Kvedrula” scheme

Table №2

№	Sector name	Population number	Total average discharge l/sec	αmax.	βmax.	Kmax.	Total discharge l/sec	Max discharge l/sec for Sectors	Fire fighting discharge l/sec	Max. discharge fire purposes inclusive l/sec	Water supply source	NoteSeniSvna
1	2	3	4	5	6	7	8	9	10	11	12	13
	“Kvedrula” scheme, Oni	2875	15.06	1.3	1.5	1.95	29.52	-	-	-	“Kvedrula” karst water	

7. Water purification structures

Since the standard three years observation cycle on "Kvedrula" water quality (turbidity) does not exist and to avoid higher costs and complexity of operations it is envisaged to purify water without reagents. That is why according to the standard 2.04.2012-84 water turbidity supplied to the filter for purification must be preliminarily reduced to 8-12 mg/l in the settler. Thus, construction of vertical settling basin is envisaged in the design.

- Calculation of vertical settling basin Q_{calc}=1298m^3/day =54m^3/hr =15 l/sec

by settling zone area $F = \frac{Q_{calc}}{3.6 \times V_{av} \times N}$ m^2, where V_{av}=0.5÷0.6 mm/sec is the stream upward velocity in settling zone mm/sec. N is the number of settling tanks and we need two units. Substituting the values into formula $F = \frac{54}{3.6 \times 0.6 \times 2} = 12.5$ m^2, chamber area $f_{k.x}. = \frac{q \times t}{60 H_1 \times 2}$, where $f_{k.x}.$ is the chamber area m^2, t is the delay time of stream in chamber t=15 min, H_1 is the height of chamber in m, H_1= $H_{settl.x0.8,}$ where H=3.5m, the height of settling tank from water surface up to conical part, then H_1=3.5 x 0.8=2.8m. N=2. Substituting the values into formula

$$f_{k.x}. = \frac{54 \times 15}{60 \times 2.8 \times 2} = 2.4 \text{ m}^2.$$

Diameter of settling basin $D_{b} = \sqrt{\frac{\sum F \times 4}{\pi}} = \sqrt{\frac{12.5 + 2.4 \times 4}{3.14}} = 4.3$ m. d:H=4.3:3.5=1.23<1.5. the height and diameter ratio is observed.

Diameter of chamber $D_{ch} = \sqrt{\frac{D_{ch} \times 4}{\pi}} = \sqrt{\frac{2.4 \times 4}{3.14}} = 1.8$ m.

To make the structure simpler it is envisaged to replace reinforced concrete chamber with plastic one.

Vertical settling basin is equipped with supply, discharge, flushingand excess water discharging pipelines and control valves. There are two operating and reserve structures (Fig. 4.1).

- High rate filter (Drg. 5.1÷5.8).

Q_{calc}=1298 m^3/day =54m^3/hr=15l/sec.

According to the state standard for purification structures use 10-14% are assumed. Then

Q_{calc}=Q_{day} .x 1.14=1298x1.14=1479m^3/day=62m^3/hr=17 l/sec.

High rate filter area $F = \frac{Q_{calc}}{T_{vp \cdot H} - 3.6 n w t_1 - n t_2 v p \cdot H}$,

where

T – operation time of filer during 24 hrs;

$V_{l.H}$=5-6 filtration velocity m^3/hr;

n – number of filter flushings 2-3 times/day depending on water turbidity;

w – intensity of filter flushings l/sec/m^2$_{=12;}$

t_1- duration of filter flushing 0.1 hr;

t_2 – delay of filter operation under flushing – 0.33 hr;

Substituting the said values in formula the area of high rate filter is

$$F = \frac{1479}{24x6 - 36x3x12x0.1 - 3x0.33x6} = \frac{1479}{125.1} = 11.8 \text{ m}^2$$

The number of filter sections $NF_F = 0.5\sqrt{11.8} = 1.72$. Double section is accepted in the design with total area $\sum F \cong 12x2 = 24$ m^{2,}, section dimensions l=4m, b=3m, h=3.33m (Drg N5-1 ÷ 5-8)

8. Head regulating reservoir

It has been mentioned above that the existing reservoir (V=2000m^3) is so damaged that it cannot be restored and engineering-geological conditions of the site are not reliable. That is why it was envisaged in the design to build new reservoir at water purification structures site.

According to the state standards it is envisaged to build head-regulating reservoir.
The total volume of reservoir contains regulation, emergency and fire-fighting water storages.
$\Sigma w = w_{reg} + w_{em.} + w_{ff.}$ Q=1298m

It is assumed that regulation storage equals to 30% of the maximum daily discharge, then

w_{reg}=1298 x -0/3=389m3

$W_{em.}$ – An emergency storage is assumed for elimination of an accident during 8 hours with reduction of the maximum water use by 28%. Then W_{em}=1298:24 x 8=433m^3.
$W_{f.f.}$-fire-fighting storage is determined by the number of population and the number of building floors. It is assumed for indoor and outdoor fire-fighting cases as 15 l/sec during 3 hours. Then $W_{f.f.}$=15 x 3.6 x 3=162m^3.

In total $\Sigma w = w_{reg} + w_{em.} + w_{ff.}$=389+433+162 =984m^3

It is envisaged in the design to build one round shape reservoir (d=18m, h=4.4m, h_t=4.8m) with specific volume 1000m^3 according to the typical 901-4-2c design and corresponding remaking of the Construction part.

The reservoir will be built at the site of purification buildings with its bottom at 842.20 absolute elevation. It will be equipped with water inlet from the source, excess water discharger, regulating emergency and fire-fighting outlets, flushing and discharging technological pipelines and main wells with their control valves (Drg.1-1, 9-1 and 9-2).

Fire-fighting, emergency and flushing pipeline valves are closed usually and will be opened in case of need only.
The reservoir will be located in a hollow with 0.5m thick earth embankment on the roof to preserve needed temperature of water (See Drg N9-1, 9-2).

9. Disinfection of water

By the coefficient of growth the number of Oni population is 2875 persons.
According to the technical assignment daily consumption rate is 25 l per person or 15 l/sec.

That volume is calculated for a case when water becomes turbid and it is necessary to purify it which happens during intense precipitations only. Thus the capacity and construction cost of water purification structure depend on the volume of water to be purified or the capacity of 15 l/sec. Usually, there is no need to purify water and its discharge from the catchment basin is rising above 30-35 l that is supplied to reservoir and further to the users.

In such cases one person can use 400-500 liters of water daily. It must be taken into consideration that considerable part of Racha population live in big cities all the year round and go to their native villages or towns in summer time only. During that season the number of water users is more than double and so water requirements sharply increase.

That is why it is envisaged in the design to disinfect 45-50 l/sec water discharged from the reservoir during peak hours for drinking and household purposes.

Thus for disinfection of the above said water volumes two sets of anolyte type production units are envisaged in the design – one unit with capacity 100 m^3/hr during peak hours. According to the given scheme and the required water discharge the units will be on /off automatically to supply water from reservoir to network by valves mounted on pipeline in wells N1 and N2 (Drg.1-1).

Calculation of oxidants for water purification network received by electrolysis from table salt water solution is given in the explanatory note of chlorinating unit.

10. Construction part

1. The design decisions are based on:
   - Technological materials;
   - Master plan of design object;
   - Topo-geodetic survey materials;
   - Engineering-geology study materials;
   - Climatic and geophysical data of the area.
2. According to "Collection of climatic and geophysical data for construction design at the territory of Georgia" published in 2008 by the Ministry of Economic Development of Georgia the following loads are assumed for construction sites:
   - Wind velocity rated head 3.5 kg/m^2;
   - Snow cover rated weight 85 kg/m^2;
   - Ground freezing rated depth 37 cm;
   - Winter design temperature -15^{0}C;
   - Summer design temperature +28^{0}C;
   - Region design seismicity 9.
3. Foundation base is yellow-gray strong plastic clay i=1900 kg/m^3; E=12 mPa; φ=15^0; C=50KPa; R=300KPe;

Pressure regulator well

Since in the existing pipeline at purification structure the hydrostatics head value is 16 atm it is envisaged in the design to mount pressure regulator in the reinforced concrete well (3.4 x 2.2. x 2.32)m.

Water meter well

Capacity of water purification structures is 15 l/sec that will be determined by water meter mounted in reinforced concrete well (2.2 x 1.5 x 2.4)m.

Vertical settling basin

The cylindrical shape structure d=4.3 m. Its height above the ground level H=3.9 m, the underground conical shape part H=2.21 m deep. The structure is made with reinforced concrete (concrete brand 25(m-325) class W-6, F=100 reinforcement A=III, A-I) with super plasticizing agent additive. At 2.9 m depth quality embankment is made around high rate filter and vertical settlers.

High rate filter

The rectangular structure dimensions are 5 x 6.5 m, depth H=3.33. It is made the structure is made with reinforced concrete (concrete brand 25(m-325) class W-6, F=100 reinforcement A=III, A-I) with super plasticizing agent additive.

Chamber for pumping unit

The pumping units installation is envisaged in reinforced concrete well (3x4)m, h=4.3 (Drg.6-1, m-1, m-2). Its bottom elevation mark is 842.16 while that of roof – 846.16.

The well is equipped with metal ladder and light-weight raising cover made of sheet iron.

From reservoir to pumping units chamber water is supplied by d=400 mm pipe equipped with manually operated control valve. The chamber can be emptied by d=32 mm discharge pipeline with control valve.

It is envisaged to switch over the head pipeline of two simultaneously operating pumping units to the mass concrete slide gate chamber (Drg.m-1) From the chamber water is supplied to the filter by pipeline d=300 mm, l=54 m (Drg.6-3).

Two pumps are mounted in the well with total discharge capacity q_t=144 l/sec, pumping lift H=18 m, power N_t=25 x 2=50 kwt.

Chlorination unit

- Dimensions of structure (8.2 x 6.4)m, H=3.3 m;
- Reinforcement of strip foundation;
- Walls are built with thin m-50 concrete blocks with m-50 sand cement mortar with plasticizer additive, thickness up to 200 mm, floor is covered with ceramic tiles and linoleum;
- Corners are reinforced with fabric from top to bottom with 600 mm pitch;
- Partitions are fixed in walls and roof slab;
- Threshold of reinforced mass concrete;
- Ceiling is made with standard precast reinforced concrete slabs;
- Ceiling slabs are tightened with mass reinforced concrete;
- Roof is covered with soft rolled paranite H=40 cm;
- Gutter of sheet steel;
- Structure is surrounded with concrete side slope b=1.0 m;
- Construction works should be realized according to the safety engineering standard III-4-8- at construction site.

Reservoir W=1000 m^3

The cylinder shape reservoir d=18.0 m, depth H=4.8 m. The entire structure is made with reinforced mass concrete, brand 25(m-325) with super plasticizer additive. Concrete is reinforced with steel fabric and separate rods brand A-III, A-1 W-6, F-100. Drainage system is made around the reservoir.

Potable water supply to the design object

To regulate and supply water to the design object and chlorination unit it is envisaged to install elevated water tank made of steel pipe d=800 mm, height – 3.5 m (Drg. 6-4) capacity 1.8 m^3

The tank will be equipped with supplying, discharging, and emptying pipelines with corresponding valves.

From the tank water will be supplied to chlorination unit (Drg. 1-1) and the personnel users.

The tank will be filled with water in two cases.

When water is clean in the source d=150 mm valves in the main N1 and N20 wells will open. At that time the valves in N18 and N13 main wells are closed and water is supplied into the tank until the

excess water begins to flow from its discharging pipeline. At that time d=150 mm valve in well N1 will close, etc..

To supply water to chlorination unit it is necessary to open d=400 mm valve in N18 well and to close d=100 mm valve. Water is supplied in the said way until it flows clean through the main pipeline from the source.

When water becomes turbid at the source the purification structures are started and d=150 mm valve in N20 main well is closed.

Sentry box

- Dimensions of structure 4.0 x 3.0 m;
- Height H=2.85 m;
- Strip foundation of mass concrete m-500, bottom reinforced;
- walls are built with thin hollow up 25% concrete blocks brand n-50, sand cement m-25 with plasticizer additive;
- Corners are reinforced with fabric from top to bottom with 600 mm pitch;
- Threshold of reinforced mass concrete;
- Floor concrete with planching;
- Doors and windows metal laminated;
- Roof reinforced mass concrete brand m-200;
- Structure is surrounded with concrete side slope 0.8 m wide.

Toilet with cesspit

- Dimensions of structure 3.3 x 1.1.m;
- Height H=2.45 m;
- Walls and ceiling wooden with sheet metal roof, cesspit of mass concrete.

Selection of filter flushing pumps

According to the state standard filters must be flushed with clean potable water. It is assumed that for $1m^2$ filter flushing 12 l/sec of water are required during 6 minutes. When it is envisaged to flush one $F=12\ m^2$ area filter the total volume of water consumption will be q_f=12 x 12 144 l/sec.

In the head pipeline: d=300 mm, l=54 m, q=144 l/sec the quantity of longitudinal losses Σh_l=l x 1000 I x 1.1=0.054 x 17.6 x 1.1=1.05 m, where 1.1 is value of local pressure losses in the pipeline; In filter distribution system h_l= 4m, the value of pressure losses in filter h_l=0.70 m; in gravel trapping layer h_l=0.4 m; under simultaneous operation of two pumps h_l=0.5 m; in valves (5 pcs) h_l=0.75 m. In total pressure losses Σh_l=l.05 + 4 +0.7 + 0.5 + 0.5 + 0.75 =7.4 m. The pumping lift geometrical difference value h_g=849.32 – 843.04 =6.28 m. Total height of the pumping lift $h_t=h_g+ \Sigma h_l + h_f$ = 6.3 + 7.4 +2 = 15.7 m where h_f=2 m that is the value of free pressure at the filter at the end of head pipeline.

We choose S type submerged pump for clean water, capacity q = 72 l/sec, pumping height 18 m; pressure will be controlled by valves (when needed).

It is envisaged in the design to mount two pumping units operating simultaneously with total capacity 72 x 2 =144 l/sec (Drg.m-1).

11. Environment Protection Measures

Under improvement of Oni town water supply scheme and in particular in case of water turbidity caused by heavy precipitations in the existing "Kvedula" water supply scheme it is envisaged to build water purification structures, disinfection-chlorination unit and v=1000 m^3 capacity power-regulating reservoir.

Under realization of the said works negative impact on the environment will certainly take place. However, because of low intensity of transport operations it will be insignificant and will not exceed the valid norms.

The contractor organization should pay due attention to normal operation of transportation and mechanical machinery with a view to minimize contamination of the area with fuel and lubricants. However, if that happens the contaminated site must be immediately localized, dirty boil must be removed and dumped at the site indicated by the regional environment protection service personnel under strictly observed rules of environment protection.

12. Organization of construction

The total period of construction works envisaged to the improvement of Oni population water supply is 4 months that account for 122 calendar or 100 working days inclusive preliminary and contractor's mobilization periods – 17 days and the main working 83 days.

The standard working regime is assumed for execution of works: 25 eight-hour working days a month.

The total cost of construction works is laris. The maximum number of personnel proceeding from the calendar schedule of construction is 43 persons (Table 12.1)

Labour consumption for execution of construction and erection works is 2723 man/day (Table 12.2). Demand for technical resources is given in Table 12.3.

13. Purification structures control

Karts waters are the source of "Kvedrula" scheme which supplies potable water to Oni population.

The debit of "Kvedrula" karst water source varies sharply within the range of - 25÷50 l/sec that is caused by heavy precipitations fall when water becomes turbid and useless for drinking.

With a view to avoid the said problem it is envisaged in the design to build water purification structures, such as the vertical settling tank and high-rate filter which will operate in case of water turbidity.

Prior to operation of purification structures under clean water supply from catchment structure D15NP type pressure regulator with 16 bar input and 1.0÷1.5 bar output pressures must be prepared and calibrated. The water meter capacity range Q=15 l/sec, which will not be changed for a long time, will be determined by means of control values in the main N1 well – d=200 mm and d=150 mm and water meter well d=150 mm.

The sequence of purification structures operations beginning and termination (one filter and one vertical settler are working, the second one is in reserve):

Since the distance between purification and catchment structures is 9 km the operator in catchment structure chamber is permanently testing water quality samples during atmospheric precipitations (in a special transparent glass flask) and as soon as water color is changed informs the purification structure operator.

The purification structure operator immediately closes in main well N19 clean water valve supplying water to the reservoir and opens d=200 mm calve on – 15 - pipeline in the same well. Simultaneously in the main well N 13 the valve is closed on the pipeline – 7 – supplying clean water from the

source and the valve on pipeline – 1 – supplying clean water from purification structure to reservoir is opened.

Then in the main well N1, d=150 mm valve is opened on – 4 – pipeline (according to the preliminary control data). In pressure control N2 and N 3 main wells valves d=150 mm on – 4 - pipelines are opened (depending on which vertical settler and filter are operating).

From vertical settler water is automatically supplied to the corresponding high-rate filter by – 4 – pipeline.

Water cleaned in the high-rate filter is supplied to reservoir. At that time d=150 mm valves in the main wells (N9 and N10 are opened depending on which filter is working, while in the wells N8, N11 and N12 the valves are closed.

From reservoir the controlled volumes of water are supplied to the scheme according to the corresponding demands by means of valves on regulating, accident, and firefighting pipelines.

At the beginning of the above said cycle in the main well N1 the valve opened according to the preliminary determined degree supplies excess water to existing pipeline – 15 -, etc.

Operation of valves in the main well N18 does not depend on purification structures operation or inoperation. Valve d=100 mm will open when water is turbid and its supply for drinking or chlorination unit needs is impossible. To supply clean water from reservoir to tank the pump will be started for a short period. At that time in the same well valve d=40 mm on – 29 – pipeline as well as valves 2d=300 mm in N8 and N12 wells must be closed without fail. In the main well N18, d=100 mm valve is opened and as soon as the tank is filled and excess water starts to run from its overflow drain the pump is switched off, valve d=100 mm in N18 well is closed and valve d=40 mm is opened.

Under supply of clean and turbid water from the source – catchment structure and flushing of high-rate filter the full cycle of valves control and regulation sequence at corresponding technological pipelines is given in Table N4.

Control and regulation sequence of technological pipelines and valves of the purification structure territory