KOCKS CONSULT GMBH KOCKS INGENIEURE

LLC "The United water Supply Company of Georgia"

Project on the Construction and Operation of Kutaisi Wastewater Treatment Plant

Environmental Impact Assessment Report

Urban Services Improvement Investment Program of Georgia

Funded by:

ADB

Government of Georgia

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Prepared by: Tomas Buti

Consulting Firm "Kocks Consulting"

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1. Introduction

1.1 General Overview

The Urban Services Improvement Investment Program funded by Asian Development Bank (ADB), involves the improvement of the drainage system in Kutaisi. Overall, the investment program includes the improvement of water supply and sewerage systems in seven cities / small towns, including Kutaisi, which will lead to the improvement of quality of life and optimization of socio - economic development. "The executive body" of the program is the Ministry of Regional Development and Infrastructure, while "the Implementing body" is "The United Water Supply Company of Georgia". This document is the Environmental Impact Assessment ("EIA") report for the project on the construction and operation of WWTP in Kutaisi.

The investment program will be funded by ADB with multitranche financing facility (MFF), which is divided into five tranches, each covering different projects that includes the construction and/or rehabilitation of water supply and sanitary - technical facilities and systems.

The investment program has been developed as a response of the Government to the absence of proper and/or safe water supply and sewerage systems throughout the urban areas of Georgia.

Wastewater treatment plant considered by the subproject will serve Kutaisi and adjacent villages. The wastewater discharge system and the treatment facilities are not available in these areas. Collection of contaminated waters is not organized. Therefore, there is a high risk of surface and groundwater, as well as soil contamination by pollutants.

This subproject will solve the problems related to the wastewater drainage system and the standards of services will be raised. The subproject is designed for the volume of services, which is required for meeting the forecasted demand by 2040 and includes the construction of (1) a new drainage system and (2) wastewater treatment plant ("Treatment Facility").

This document assesses the environmental impacts that are expected during the construction and operation of the treatment plant in Kutaisi. EIA report is prepared by the consulting firm "Kocks Consulting" under the requirements of Georgian environmental legislation and normative documents. The contact information of LLC "United Water Supply Company of Georgia" and "Kocks Consulting" Ltd is given in Table 1.1.

Table 1.1.

Executor company	LLC "United Water Supply Company of Georgia"
Legal address of the company	Vaja Pshavela Ave, 76-B, Tbilisi, Georgia, 0186
Address of the place where the activities are to be implemented	Tskaltubo Municipality, Tkachiri village
Type of activity	Construction of wastewater treatment plant
Contact information of LLC "United Water Supply Company of Georgia"	
E-mail	info@water.gov.ge
Contact Person	Ketevan Chomakhidze
Tel:	+995 577 380309
Consulting Company:	"Kocks Consulting"
Contact Person	Zurab Mgaloblishvili
Tel:	+995 599 504434

1.2 Basis for Preparation of EIA Report

The basis for preparation of EIA report for the project is the Law of Georgia on "Environmental Permit". "Arrangement of wastewater treatment plant (with a capacity of 1000m^3/ and more) and main sewer collector" is the subject to ecological expertise in accordance with the Article 4, Paragraph 1, subsection "O" of the Law. Therefore, the project of treatment plant in Kutaisi falls within the activities that are subject to ecological expertise and its implementation should be carried out based on the conclusion of ecological expertise. Conclusion of ecological expertise is issued by the Ministry of Environment and Natural Resources, based on ecological expertise of the environmental impact assessment report on the planned activities.

1.3 Objectives of EIA

Along with positive impacts, the project implementation will have some kind of negative impact on the natural environment and socio-economic conditions of the region. The main goal of the EIA report is to carry out quantitative evaluation and define the spatial boundaries of such negative impacts. The following activities have been carried out:

- Collection of technical documentation of the planned activity and obtaining the information on the natural and social environment conditions;
- Summarization and analysis of the obtained information. Identification of environmental and social impacts of the project and its potential alternatives at different stages of the project;
- Development of the environmental management and monitoring schemes. Informing the public on planned activities and ensuring their participation in the process;
- Development of effective mitigation measures aimed at reducing the environmental impact is the most significant goal of the EIA report.

2. Legal and Administrative Aspects

Georgian legislation comprises the Constitution, environmental laws, international agreements, subordinate legislation, normative acts, presidential orders and governmental decrees, ministerial orders, instructions and regulations. Georgia is signatory of a number of international conventions, including those related to environmental protection.

2.1 Law of Georgia on Environmental Protection

Environmental impact assessment of the project on construction and operation of the treatment plant should to be carried out under the following Laws of Georgia on Environmental Protection (see Table 2.1.1.).

Table 2.1.1. The list of environmental laws of Georgia

Year	Law	Registration code	Final version
1994	Law of Georgia on Soil Protection	370.010.000.05.001.000.080	14/06/2011
1994	Law of Georgia on Road Traffic	310.090.000.05.001.000.089	24/12/2013
1995	The Constitution of Georgia	010.010.000.01.001.000.116	04/10/2013
1996	Law of Georgia on System of Protected Areas	360.050.000.05.001.000.127	27/09/2013
1996	Law of Georgia on Environmental Protection	360.000.000.05.001.000.184	06/09/2013
1996	Law of Georgia on the Entrails	380.000.000.05.001.000.140	21/03/2014
1997	Law of Georgia on Wildlife	410.000.000.05.001.000.186	06/09/2013
1997	Law of Georgia on Water	400.000.000.05.001.000.253	06/09/2013
1998	The Law of Georgia on Creation and Management of the	360.050.000.05.001.000.456	24/12/2013

	Kolkheti Protected Areas		
1998	Law of Georgia on Protective Sanitary Zones of Health Resorts and Resort Localities	470.210.000.05.001.000.339	20/09/2013
1999	Law of Georgia on Protection of Atmospheric Air	420.000.000.05.001.000.595	05/02/2014
1999	Forest Code of Georgia	390.000.000.05.001.000.599	06/09/2013
1999	Law of Georgia on Compensation of Damage caused by Hazardous Substances	040.160.050.05.001.000.671	06/06/2003
2003	Law of Georgia on the Red List and Red Book of Georgia	360.060.000.05.001.001.297	06/09/2013
2003	Law of Georgia on Conservation of Soils and Restoration-Improvement of their Fertility	370.010.000.05.001.001.274	19/04/2013
2005	Law of Georgia on Fire Safety	300.310.000.05.001.001.914	20/02/2014
2006	Law of Georgia on Licenses and Permits	330.130.000.11.116.005.130	27/12/2006
2007	Law of Georgia on Regulation and Engineering Protection of Sea and River coasts of Georgia	360.130.000.05.001.003.079	25/03/2013
2007	Law of Georgia on Ecological Examination	360.160.000.05.001.003.078	06/02/2014
2007	Law of Georgia on Environmental Permit	470.000.000.05.001.002.920	13/12/2013
2007	Law of Georgia on Public Health	450.030.000.05.001.002.815	25/09/2013
2007	Law of Georgia on Cultural Heritage	370.060.000.05.001.003.003	20/09/2013
2013	Law of Georgia on Recognizing Property Rights Under the Possession (Ownership) of Physical and Private Legal Entities	360010000.05.001.017203	20/11/2013
2014	Law of Georgia on Civil Security	140070000.05.001.017468	01.07.14.

2.2 National Environmental Standards

The following environmental standards have been used in the process of evaluating the quality of environmental objects (soil, water, air) (see Table 2.2.1.):

Table 2.2.1. List of environmental standards

Year	Normative Documents	Registration code
31/12/2013	Technical Regulation – "Methods of calculation of maximum allowable discharges of pollutants together with wastewater into surface water bodies", approved by the order №414 of the Government of Georgia	300160070.10.003.017621
31/12/2013	Technical Regulation – " on the protection of surface waters against pollution", approved by the order №425 of the Government of Georgia	300160070.10.003.017650
03/01/2014	Technical Regulation – "on the protection of ambient air in unfavorable weather conditions", approved by the order №8 of the Government of Georgia	300160070.10.003.017603
31/12/2013	Technical Regulation – "Methods of calculation of maximum permissible emission of hazardous substances into ambient air", approved by the order №408 of the Government of Georgia	300160070.10.003.017622
06/01/2014	Technical Regulation – "on the methods for air pollutant emission inventory", approved by the order №42 of the Government of Georgia	300160070.10.003.017588
31/12/2013	Technical Regulation – "on air pollution quality in significantly polluted, highly polluted, polluted and non-polluted regions according to calculated air pollution indexes and level of air pollution with hazardous substances", approved by the order №448 of the Government of Georgia	300160070.10.003.017617

03/01/2014	Environmental Technical Regulation - approved by the order №17 of the Government of Georgia	300160070.10.003.017608
14/01/2014	Technical Regulation – "Environmental damage determination (calculation) method", approved by the order №54 of the Government of Georgia	300160070.10.003.017673
31/12/2013	Technical Regulation – "Methods of calculating the actual amount of emissions according to instrumental methods for determining the actual amount of emissions in ambient air from stationary sources of pollution, list of special measuring and controlling equipment for determining the actual amount of emissions in ambient air from stationary sources of pollution and technological processes from stationary pollution sources," approved by the order №435 of the Government of Georgia	300160070.10.003.017660
31/12/2013	Technical Regulation – provisions for "determination of soil fertility level" and "monitoring of soil conservation and fertility", approved by the order №415 of the Government of Georgia	300160070.10.003.017618
31/12/2013	Technical Regulation – "on the removal, storage, use and cultivation of topsoil", approved by the order №424 of the Government of Georgia	300160070.10.003.017647
15/01/2014	Technical Regulation – "Maximum Allowed Concentrations of harmful substances at work places", approved by the order №70 of the Government of Georgia	300160070.10.003.017688
15/01/2014	Technical Regulation – on drinking water, approved by the order №58 of the Government of Georgia	300160070.10.003.017676
31/12/2013	Technical Regulation – "on water protection areas", approved by the order №440 of the Government of Georgia	300160070.10.003.017640
03/01/2014	Technical Regulation – "sanitary rules for water sampling", approved by the order №26 of the Government of Georgia	300160070.10.003.017615

2.3 International Agreements

Georgia is signatory to many international conventions and agreements, including:

- **Protection of nature and biodiversity:**
  - The Convention on Biological Diversity, Rio de Janeiro, 1992;
  - The Convention on Wetlands of International Importance especially as Waterfowl Habitat Areas, Ramsar 1971;
  - The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Washington, 1973;
  - The Convention on the Conservation of Migratory Species of Wild Animals, (Bonn Convention), 1983
- **Climate Change:**
  - The UN Framework Convention on Climate Change, New York, 1994;
  - The Montreal Protocol on Substances that Deplete the Ozone Layer, Montreal, 1987.
  - The Vienna Convention for the Protection of the Ozone Layer, 1985;
  - Kyoto Protocol, Kyoto, 1997;
  - The United Nations Convention to Combat Desertification, Paris, 1994
- **Pollution and environmental hazards:**
  - The European and Mediterranean Major Hazards Agreement, 1987.
- **Cultural heritage:**
  - Convention for the Protection of the Cultural Heritage of Europe;
  - Convention for the Protection of the Architectural Heritage of Europe.

- **Public information:**
  - Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention, 1998).

3. Project Implementation Alternatives

Based on the requirements of environmental legislation of Georgia, project alternatives should be considered in EIA report. Due to the specifics of the planned activities, the following alternatives were deemed to be considered:

- No action alternative;
- Alternatives for the location of the treatment plant;
- Technological alternatives.

3.1 No Action Alternative

No action or zero alternative means that the project will not be implemented, that is, all problems concerning Sewage Wastewater Management issues will be left unresolved.

Kutaisi is the second city in Georgia according to population number. The water supply problems, as well as sewerage problems remained unresolved during years, that causes the dissatisfaction of population and hinders the social-economic development of the region.

The program covers improvement of basic urban infrastructure and service management in main and secondary cities. Construction of sewerage system and treatment facilities is envisaged not only in Kutaisi, but in such important settlements such as Anaklia, Marneuli, Mestia, Zugdidi, etc. Creating sewerage and treatment infrastructure will substantial positive effect on further development of the settlments, in terms of increased tourist potential and improved level of living of the local population. Accordingly, project implementation will significantly contribute to the whole socio-economic development of the country.

It is noteworthy, that Kutaisi Water Supply System Rehabilitation will be completed under the project of Asian Development Bank, which will ensure 100 % connection to the water supply system and 24 hours potable water service, as well as metering, putting in order the issues concerning potable water loss.

Kutaisi WWTP construction and operation project is an important component of the mentioned program. Implementation of the project, which can be assumed as an environmental activity on regional level, will practically solve existing dissatisfactory condition. After putting the plant into operation, the industrial-faecal waters of Kutaisi and its adjacent settlements will be collected in an organized way. WWTP will ensure treatment of sewage waters to standard level, after which wastewater will be discharged into one point of surface water body. Improved management of wastewater will result minimization of adjacent water pond pollution risks, which is very important as for biological environment protection, so for the further development of the settlements.

In addition, implementation of WWTP construction and operation project will contribute to the development of the local socio-economic situation, namely: it should be mentioned about creation of temporary and permanent job places and the high possibility of employment of the local population- according to the experience of analogous projects, only 5-10% of employed people are highly qualified specialists, invited from other regions. Remained 90% (non-qualified staff) is selected from the local

population through the competition, who will be provided with appropriate training. The high share of local population will be employed on operation stage as well.

After project implementation the impact on biological environment (soil, ambient air and water quality, etc.) is very important among other negative impacts. However, addressing appropriate mitigation measures will reduce the scale of the most part of the impacts, in some cases it will be minimized to zero level. In addition, large part of the impacts is expected on construction level, which will be short-term.

From all above-mentioned the following conclusion can be made: In case of implementation of no action alternative of the project, regulated treatment of the wastewater generated in Kutaisi and its surroundings, as well as minimization of surface water pollution risks will not be possible. Due to the reasonable project decision and appropriate mitigation measures, WWTP construction and operation will bring more important ecological and economic benefit, than in case of failure of the project implementation. Accordingly, the no-action alternative of the project will not be considered.

3.2 WWTP Location Alternatives

The selected area for WWTP has no alternative in terms of environmental issues.

Firstly, it is noteworthy that selected area is in state ownership and there was the treatment plant operated there during years. At present, building infrastructure is totaly destroyed and stripped. Area experiences high anthropogenic load. Therefore, the implementation of the project on the area concerned, on the one hand, significantly improve the poor sanitary-ecological situation here and on the other hand, exclude negative impact on other receptors of the environment (soil, groundwater, biodiversity and so on.) due to new plots.

Besides, the presence of sewer between the service zone and project area should be considered. In order to arrange sewer to the WWTP, utilization of new corridor will not be needed and accordingly, the impact risk on the state lands is very low.

The selected area is suitable in terms of other environmental factors, namely:

- There is significant distance between the area and the residential zone, that will substantially reduce emissions in ambient air (including odor dispersion), noise distribution impact risks on the population;
- The relief of the area is staright. The signs of development risks of geodynamic hazards are not revealed, that will provide safe implementation of the project in case of appropriate project decision;
- The project area is not distinguished with the biodiversity (vegetation, wild life);
- According to the engineering –geological study conducted, the ground water are very deep from the ground elevation within the project area, that reduces the risks of ground water pollution, etc.

On the basis of all above-mentioned facts, finding alternative area for WWTP and detailed discussion is not reasonable. Through appropriate mitigation measures, implementation of the project on the mentioned area will not cause significant environmental violations.

3.3 Technological Alternatives of the Wastewater Treatment Process

While discussion of technological alternatives of wastewater treatment process, it was considered the required parameters of water treatment, operational conditions of the plant, accass to the technology.

In addition to the selected alternative of the wastewater treatment option, the biological treatment using phytodepuration method can be also discussed. This method after pre-sedimentation, envisages

wastewater treatment in cannel and pond systems, where water plants and algae grow. On the basis of regional environment specification (climate conditions, etc.) such method is quite feasible.

However, alternatives has significant negative impacts, namely: this method is applicable for wastewater treatment of the small size settlements . Based on the number of Kutaisi population, application of the mentioned method will be quite complicated. Besides, the method requires flooding of large area, the operation of treatment system will be connected to the significant technical difficulties and systematic training of the majority of personnel. It should be considered that quite large artificial water pond of polluted water would be created. Open water pond would contribute to propagation of insects spreading various deceases, odour dispersion, etc.

Accordingly, the priority is given to the plant equipped with modern technology for biological treatment of wastewater, that will provide wastewater treatment using appropriate parameters.

4. Description of Selected Project Alternative

4.1 General Overview

The area selected for Urban Wastewater Treatment Plant of Kutaisi is situated to the South of Kutaisi city, near to the villages Tkashiri and Patriketi in Tskaltubo municipality, on the right bank of Rioni river, at 70-75 m a.s.l. The area of project site is about 13 ha. The coordinates of the selected area are as following (zone - 38T):

A. X - 305918; Y – 4667001;
B. X - 305824; Y – 4667328;
C. X - 306153; Y – 4667455;
D. X - 306315; Y – 4667162.

The old WWTP of Kutaisi city operated on the project area for decades. It had stopped functioning in 90s of the previous century. Today, basic infrastructure facilities of old building are damaged and it is not possible to restore or re-use them. More or less an administrative building and its adjacent auxiliary facilities are in normal condition.

On the old WWTP site approximately 100-1200 m^3 residual waters together with atmospheric waters are seen in the existing reservoirs (radial sedimentation tanks, contact reservoirs, etc.). After putting the new WWTP into operation, the above-mentioned fluid wastes can be extracted.

The construction of the new WWTP is projected in the north-western part of the area, where there is less infrastructure facilities of the old treatmet plant. The previous clorination and compressor buildings, boiler and black oil storage area will get within the project impact area. Prior to construction works, dismantling above-mentioned buildings and construction waste disposal is considered.

Generally, the project area was exposed to significant anthropogenic impact for decades and accordingly, typical technogenic landscape developed. Vegetation cover mainly consists of artificially grown trees and is presented by species of little value, originated after the treatment plant stopped operation.

Within the project area large ammount of construction waste is revealed including concrete reinforcement of old WWTP (total ammount ≈1700 m^3), ferrous metal scrap, etc.

The fencing of area is damaged and local population and domestic enimals can easily get inside.

Private agricultural lands are bordering the area from the west and north sides. Ground highway passes from the east and south. In the south, in 230 m from the border of the site Vartsikhe 2 HPP is situated and diversion channel of Vartsikhe HPP Cascade passes here, and Rioni river passes alongside (even

more to the south). The nearest residential house (village Tkachiri) is located to the north—west in about 700 m away from the site territory.

Project area layout plan is given on figure 4.1.1., and the general plan of the area – on fig. 4.1.2.

Figure 4.1.1. The Views of WWTP Location Area

Figure 4.1.1. Project Site Situation Plan

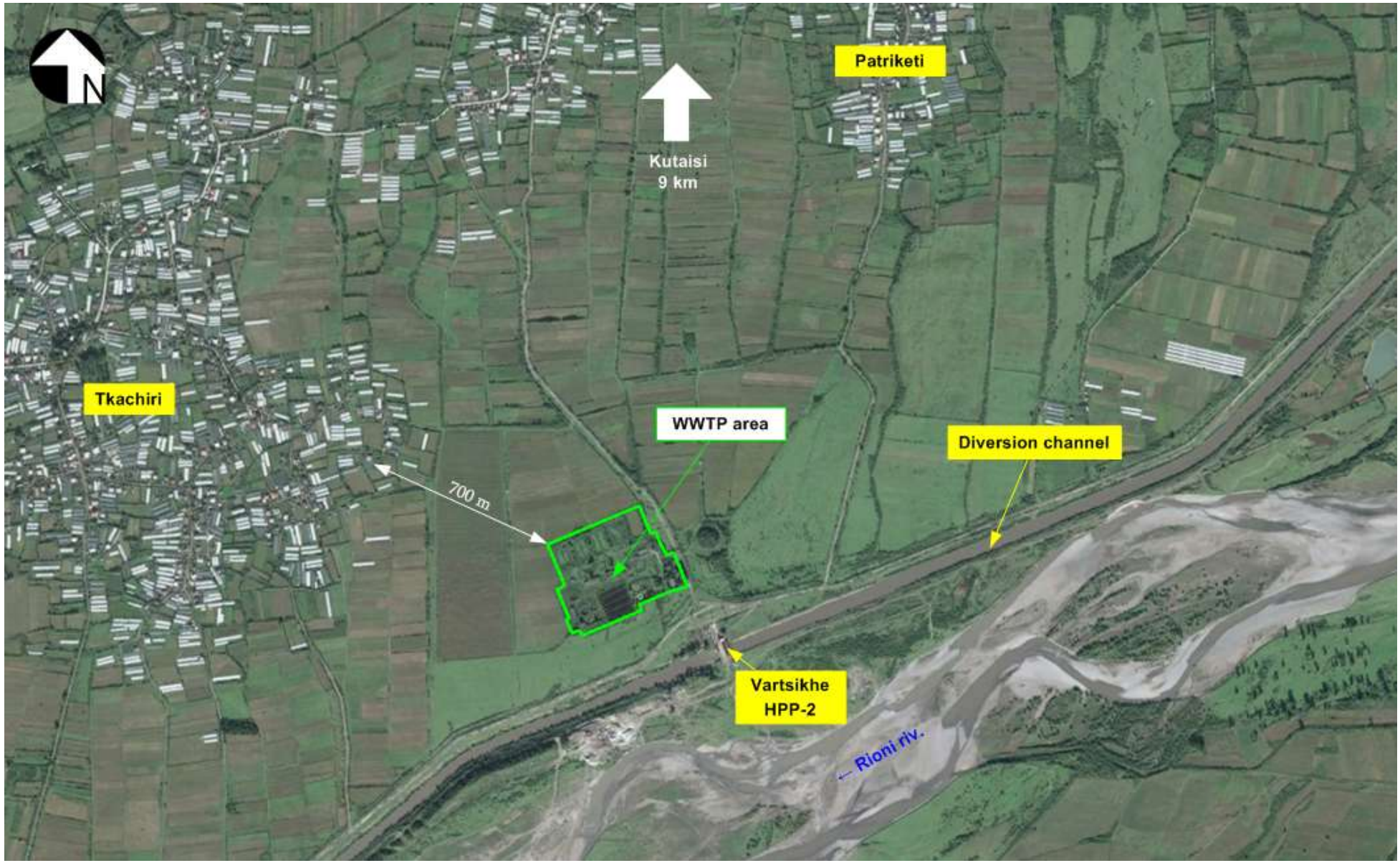
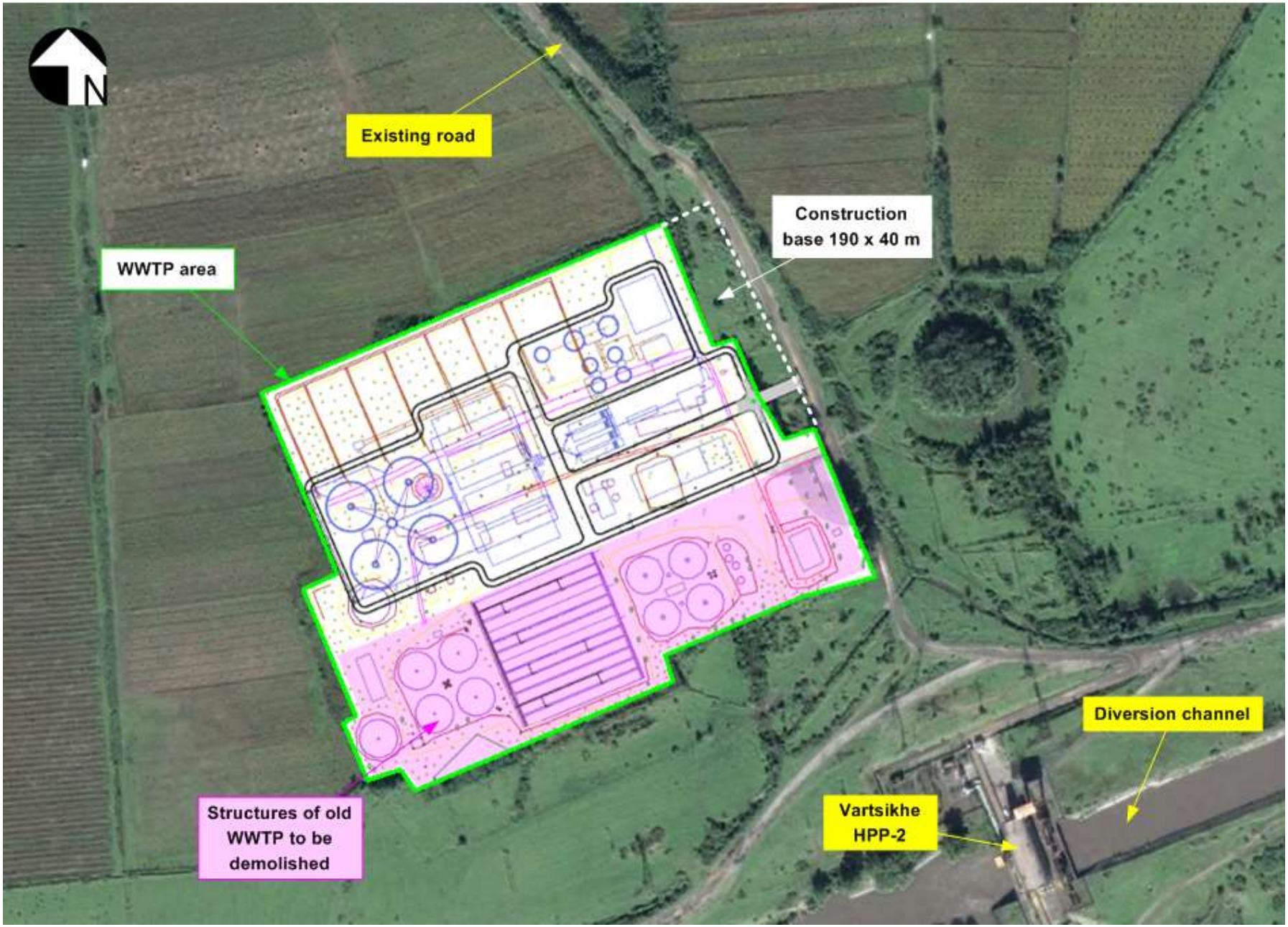


Figure 4.1.2. General Plan of the Project Site


N
Existing road
Construction base 190 x 40 m
WWTP area
Diversion channel
Structures of old WWTP to be demolished
Vartsikhe HPP-2

4.2 Project Criteria

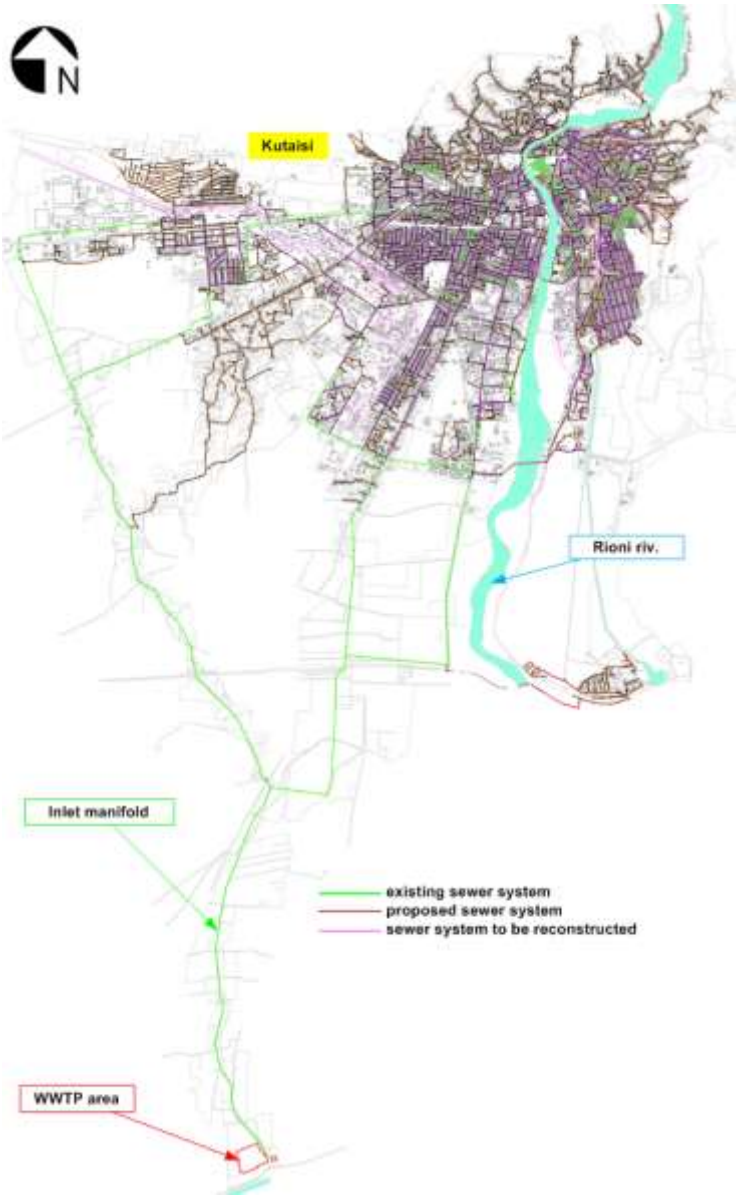
This section presents data considered during selection of the project parameters for treatment plant.

4.2.1 The Dynamic of Population Growth and Service Area

The table 4.2.1.1. shows the dynamic of population number within the project service area. The figure 4.2.1.1. service zone of projected WWTP is depicted.

Project Area	Previous Data	Forecast Data		
Year	**2010**	**2020**	**2030**	**2040**
Kutaisi City Population	192500	193224	193948	194671
Service Zone Village Population	4200	5109	6018	6927
Total	196700	198333	199966	201598

Fig. 4.2.1.1. Sewage Network Service Zone



4.2.2 Growth Dynamic of the Demand on Water Consumption

The table 4.2.2.1. shows main project parameters of 2010, 2020, 2030 and 2040 of Kutaisi water supply system.

Table 4.2.2.1. Water Consumption Dynamic within the Service Zone in 2010-2040

Title	Dimension	Year			
		2010	2020	2030	2040
Water Supply					
Population (Kutaisi)		192,500	193,224	193,948	194,671
Population (Sakuslia District)		1,800	2,600	3,400	4,200
Population (village Kvitiri)		700	709	718	727
Population (village Rioni)		1,700	1,800	1,900	2,000
Total Population	**person**	**196,700**	**196,533**	**198,066**	**201,598**
Specific water consumption (according to UWSCG data)	l/(p×d)	140	140	140	140
Water consumption of small commercial facilities/institutions - added	%	10%	10%	10%	10%
Share of existing network	%	80%	50%	25%	10%
New network share	%	20%	50%	75%	90%
Existing network loss	%	40%	40%	40%	40%
New network loss	%	25%	25%	25%	25%
Individual loss (leakage from existing network) _ *added*	%	37%	33%	29%	27%
Trunk main loss-added	%	2%	2%	2%	2%
Commercial loss_added	%	0%	0%	0%	0%
Technical water consumption for water treatment_added	%	8%	8%	8%	8%
Total specific water consumption	l/(p×d)	***220***	***214***	***208***	***205***
Sub-total-daily water consumption (population)	*m^3/d*	*43,235*	*41,960*	*41,247*	*41,348*
Water consumption of industrial facilities and large customers	*m^3/d*	2,300	2,300	2,300	2,300
Number of daily working hours	h/d	12	12	12	12
Total water consumption (average)	*m^3/d*	***45,535***	***44,260***	***43,547***	***43,648***
Daily consumption peak ratio	-	1,60	1,60	1,60	1,60
Hourly consumption peak ratio	-	2,40	2,40	2,40	2,40
Max. daily consumption	*m^3/d*	**55,173**	**55,128**	**55,540**	**56,489**
Max. hourly consumption	*m^3/h*	**4,783**	**4,656**	**4,585**	**4,595**
Average hourly consumption	*m^3/h*	**2,846**	**2,766**	**2,722**	**2,728**

4.2.3 Wastewater Flow

The wastewater flows necessary for the hydraulic calculation of project sewage network, depends on the water consumption data. While defining pipe sizes, it is considered that the amount of wastewater makes 90% of the volume of the water consumed. Taking into account daily wastewater flow variability, peak load ratio equal to 2.0 was used for hydraulic calculations.

Basic approach toward wastewater flow is as follows:

$$Q_{dw} = Q_d + Q_c + Q_{iw} \text{ (l/s)},$$

Where following values are used:

Q_d – Household wastewater flow;

Q_c – Commercial facility wastewater flow;

Q_{iw} – Filtration (inside the system) water flow;

The following initial parameters were used during calculations of wastewater flow:

- Specific water consumption per person 140,00 (l/person/day);
- Institutions 10,00%;
- Technical demand 8,00%;
- Water demand for wastewater flow ratio 90.00 %;
- connected coverage 95,00%;
- Peak load ratio 2.0.

The table 4.2.3.1. provides wastewater dynamic in 2020-2040 within the WWTP service zone.

Table 4.2.3.1. The Wastewater Dynamic for 2020-2040 years

Title	Dimension		Year		
		2010	2020	2030	2040
Water Supply					
Resident (permanent resident)	person	**195,000**	**196,533**	**198,066**	**201,598**
Max. daily water consumption	m^3/d	**54,716**	**55,128**	**55,540**	**56,489**
Max. hourly water consumption	m^3/h	**4,746**	**4,656**	**4,585**	**4,595**
Max. hourly water consumption	m^3/h	**2,823**	**2,766**	**2,722**	**2,728**
Maximum demand	l/(c*d)	269	269	269	269
Wastewater (separate sewage network)					
Connected coverage value	%	95%	95%	95%	95%
Equation between wastewater and consumed water amount	%	90%	90%	90%	90%
Household wastewater amount (average)	m^3/d	27,543	27,759	27,976	28,475
Industrial wastewater amount	m^3/d	2,300	2,300	2,300	2,300
Population equivalent (number)	PE	11,500	11,500	11,500	11,500
Peak load duration	h/d	16	16	16	16
Total amount of wastewater	***m^3/d***	***29,843***	***30,059***	***30,276***	***30,775***
Infiltration (0,5 m^3/(d- per well)					
Approximate number of wells	unit		5,200	5,200	5,200
Peak load ratio	-	2,0	2,0	2,0	2,0
Daily flow (average)	***m^3/d***	**29,843**	**30,059**	**30,276**	**30,775**
Max. daily flow (including daily peak water consumption)	***m^3/d***	**51,980**	**52,372**	**52,763**	**53,665**
Hourly flow (average)	**m^3/h**	**1,243**	**1,252**	**1,261**	**1,282**
Hourly flow in dry weather (max.)	**m^3/h**	**1,865**	**1,879**	**1,892**	**1,923**
Hourly flow (max.), only for hydraulic calculation	**m^3/h**	**2,487**	**2,613**	**2,631**	**2,673**

4.2.4 Design Loads

The Table 4.2.4.1. shows design load data defined for the household crude water. The values given in the table, are defined based on multiple measurements; they are internationally recognized and introduced in many countries as the standard values.

Table 4.2.4.1. Design Loads for Household Crude Water

Parameter	Dimension	Value
BOD_5 (Biochemical Oxygen Demand)	gr/(p/d)	60
Suspended Solids	gr/(p/d)	70
Total Nitrogen consistency according to Kjeldal	gr/(p/d)	11
Phosphorus	gr/(p/d)	1,8

4.2.5 Wastewater Pollutant Standard

The table 4.2.5.1. provides EU standards for water discharge into water bodies. The efficiency of project WWTP is given in the last column.

Table 4.2.5.1. Discharge Standards and Project Efficiency

	Parameter		Allowable Discharge Standard according EU Standards	Design
Discharge Standards	BOD_5,without nitrification		25 mg/l O_2	**25 mg/l**
	COD (Chemical Oxygen Demand)		90 mg/l	**90 mg/l**
	Suspended Solids		35 mg/l	**30 mg/l**
Additional standards for discharge into sensitive water bodies	Total Nitrogen (TN)	< 100,000 PE*	15 mg/l N	**15 mg/l N**
		> 100,000 PE	10 mg/l N	**10 mg/l N**
	Total Phosphorus (TP)	< 100,000 PE	2 mg/l P	**2 mg/l P**
		> 100,000 PE	1 mg/l P	**1 mg/l P**

River deltas, sea bays and other coastal waters are considered as sensitive sites together with other water bodies, where water exchange is limited or which receive nutrients in large numbers. Usually, water discharge from small settlements are of little significance for such sites, but in case of large settlements phosphorus and/or nitrogen removal need should be considered, unless it is not revealed that discharged water will not have an impact on eutrophication level.

Wastewater receptor water body is Rioni river. During WWTP design correspondent conditions for sensitive sites were applied.

4.3 Project decisions and Treatment Process

4.3.1 General Overview

WWTP construction will be implemented in two stages. On the first stage, infrastructural facilities will be arranged, which will provide full treatment of wastewater expected for 2020 (see the table 4.2.3.1.). Besides, according to the design, areas necessary for auxiliary infrastructure arrangement will be located inside WWTP building. As necessary (according to the growth of wastewater amount) the following will be added to the facility: aero tank, final sedimentation, sludge pumping station, sludge storage area, after which WWTP will provide wastewater treatment in an amount expected in 2040.

The general plan of WWTP design is presented on figure 4.3.1.1.

As well as in project cities, where population is more than (PE) 30 000, Kutaisi WWTP is expected to use active sludge method together with separate anaerobic decomposition (digestion) of the sediment. In general, above-mentioned process comprises the following elements:

- Screen filters;
- Aeration grit trap chambers;
- Primary sedimentation tanks;
- Aero tanks;
- Settler (final sedimentation tanks);
- Sludge (slime) thickening;
- Septic tank;
- Sludge dewatering facility;
- Gas storage;
- Torch bar (candle).

In the first stage of wastewater treatment the water passes through coarse screens in order to remove coarse material, which can damage equipment and cause a decrease in the efficiency of the process. In general, coarse and fine filters are arranged in front of the grit trap units. The grit traps are designed to remove granular solids from the wastewater like sand, gravel and other heavy solids, which have significantly higher subsiding velocities and specific weights, than decomposing organic solid waste with the same parameters.

The purpose of primary sedimentation is to remove unsolved organic material from wastewater, resulting in reduced pollution loads on the next biological treatment stages. Removed organic material, which is called the primary sludge, mainly contains biologically easily degradable compounds and is very well exposed to subsequent anaerobic decomposition with high methane yield.

The second stage of technological treatment on WWTP is water treatment using method of active sludge. This process is a wide-spread method and is applicable in many countries throughout the world. Aerotanks measures will be selected to ensure biochemical and chemical oxygen demand removal (90-95 percent removal), caused by organic compounds , that have carbon concentrations (BOD and COD) and nitrification. The system also includes the removal of phosphorus and microbial denitrifications.

After definite time biological solid compounds move from aerotanks to the settling tank, where certain portion of settled sludge is digested in bioreactor in order to maintain the desired concentration of microorganisms. The remained excess sludge is removed from the system.

The settling tank is designed considering following conditions:

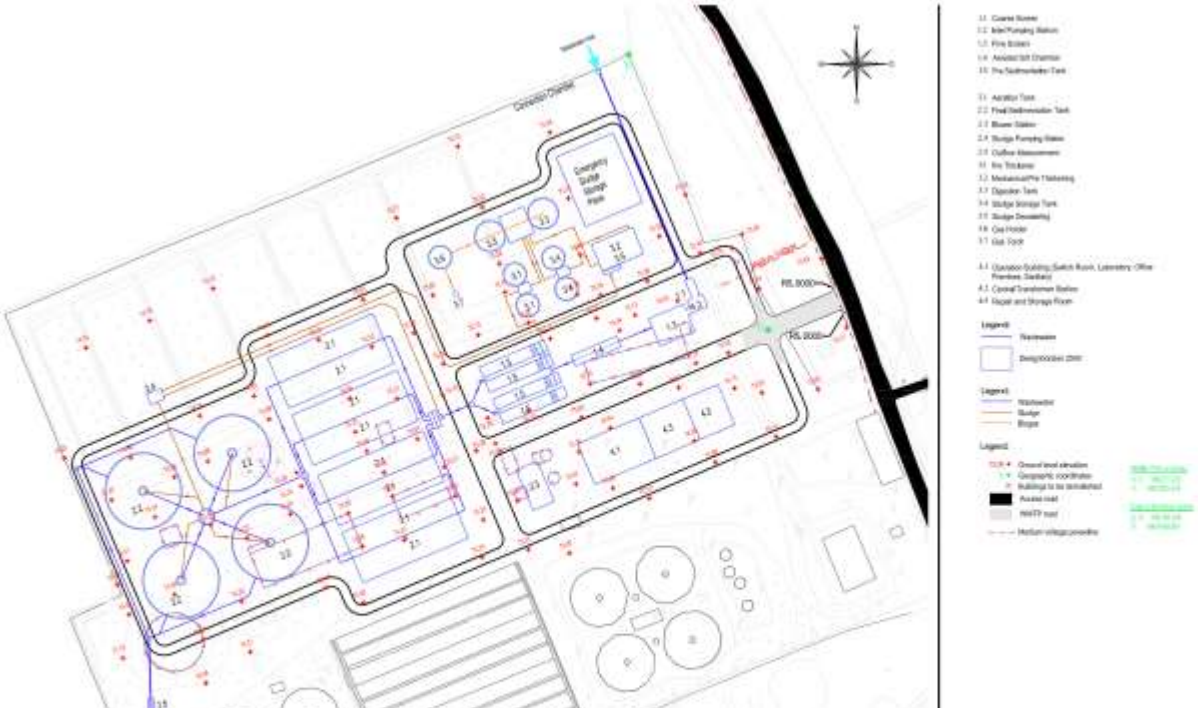
- Ensure high yield of active sludge to be discharged from the fluid of reactor pool;
- Paartial consolidation of settled solids to return to the reactor pool;
- Intermediate sedimentation of the sludge extracted from the aero tank.

The disinfection of the discharged fluid is not necessary.

Sludge processing stages are:

- Primary and excess sludge initial hardening (condensation)
- Sludge anaerobic stabilization
- Bring to the acceptable grade and dry at the centrifuge.

Figure 4.3.1.1.The General Plan of the Project Area



4.3.2 Water Inlet

Water intake unit comprises of coarse (with wide gaps) screens, water inlet pumping station, fine screen, aeration grit trap chamber and primary sedimentation tank.

Coarse Screen

The channel in front of the water inlet will be of rectangular cross-section. The depth of the outlet flow of the channel will be 1,10 m and the length - 1,90 m.

The channel can be temporarily caulked up from both ends. There will be an emergency spillway (bypass) canal along the channel, which will be used in case of device failure.

Large mechanical cleaning will be automatically bars, while the water level difference between the operation control means. Waste collected on the large side behind bars to restrain the bunkers.

Main design parameters:

- Design flow 3,088 m^3/h
- Minimal flow in dry weather 1,242 m^3/h
- Flow velocity in screen section 0,90 m/s
- Water depth 1,10 m
- Width of each screen section 1,90 m
- Screen gap size 20 mm
- Screen stem width 10 mm
- Congestion indicator 70%
- Number of screens 1
- Daily design number of waste detained by screens 4.52 m^3/d.

Inlet Pumping Station

Inlet pumping station will be built in very vicinity of the coarse screen. Five submersible bore-hole pumps (one stand-by pump) will be arranged in order to elevate water passed through the screens.

Main design parameters:

- Maximum flow 3,088 m^3/h
- Average flow 1,862 m^3/h
- Minimum flow in dry weather 1,242 m^3/h
- Number of pumps (including 1 stand-by aggregate) 5
- Approx. static head 6 m

Fine screen

Fine screen will be arranged behind the pumping station. The water depth and width in the fine screen rectangular channel will be respectively 0.50 m and 1,00 m. The channel will be temporarily caulked up from both ends. There will be an emergency spillway (bypass) canal along the channel, which will be used in case of device failure.

The fine screen will be treated automatically, and operation will be controlled by differences between water levels. The waste detained in the screens will be collected in the bunkers situated next to the fine screens.

Main design parameters:

- Design flow 3,088 m^3/h
- Minimum flow in dry weather 1,242 m^3/h
- Flow velocity in the screen section 0,90 m/s
- Water depth 0,50 m
- Width of each screen section 1,00 m
- Screen gap size 6 mm
- Screen stem width 3 mm
- Congestion indicator 70%
- Number of screens 4
- Daily design number of waste detained by screens 5,08 m^3/d

Aerated grit chamber

Rectangular reservoir will serve as a grit chamber, in which sectional flow transfer into spiral one by puishing pumped air. The sand (fine solid fraction), moving more slowly than the water, is settled in the cavity arranged at the bottom of the reservoir, and organic substances will remain in the condition of suspended solids.

The width of grit chamber is 3,00 m, the length – 26 m, and the water depth in the chamber will be – 3,50 m. In order to maintain organic substances in the condition of suspended solids, the outgoing water in the chamber will be aerated using air-blowers.

The sand and fine fraction will be automatically removed by raker attached to the movable bridge, which will be equipped by pump. The flow for sand withdrawal will pass through the open channel arranged alongside the chamber, which is connected with pump collector and from where the sand will move to the sand classification area.

Main design parameters:

- Design flow 3,088 m^3/hr
- Hydraulic retention time 10 s
- Number of chambers 2
- Required volume of each chamber 215 m^3
- Selected volume for each chamber 210
- Width 3,00 m
- Operation depth of the water 3,50 m
- Operation cross-section area 8,10 m^2
- Horizontal velocity at design flow 5,3 cm/s

- Length 26 m
- Aeration depth 2,50 m
- Total air consumption 372 Nm^3/h
- The number of air-blowers (1+1) 2
- Unit amount of generated sand 9 l/(PExm)
- Annual average amount of generated sand 1,856 m^3/m or 5,1 m^3/d
- Sand (fine fraction) removal mode uninterrupted

Primary Sedimentation Tank

Primary sedimentation will be designed in four lines. Undissolved organics contained in the wastewater will be settled in the settling tank. Settled solid mass (primary sludge/sediment) will be moved to the funnel using sludge rakers, where it will be condensed. The effluent treated in the primary sedimentation using the above-mentioned method, will overflow through the V-shaped hackly threshold into the primary sedimentation outlet channel.

Main design parameters:

- Design flow (average flow) 1,862 m^3/h
- Hydraulic retention time 1 h
- Number of tanks 4
- Total required volume of the tanks 1,862 m^3
- Water depth 3,00 m
- Length 30,00 m
- Width 6,00 m
- Length/depth equation 10
- Length/width equation 5,0

The reduction features of wastewater pollution in the primary sedimentation:

- Biochemical Oxygen Demand (BOD_5) 25%
- Chemical Oxygen Demand (COD) 25%
- Suspended Solids (SS) 50%
- Total Nitrogen according to Kjeldahl (TKN) 9%
- Phosphorus (P) 10%

4.3.3 Wastewater Treatment

Aerotanks, settling reservoirs, return sludge station, air-blower station and venturi flowmeter are involved in the treatment process.

Aero tank

Eight aerotanks will be built for biological treatment of waste water. These structures will be designed in the shape of rectangular basins, and their aerated sections will serve as carbon removal sites, and nitrogen removal will be carried out on aerated sites. Overall dimensions of pools are 60,0 x 14,0 m, and the water depth - 6,0 m.

Aeration will take place by bringing in the air pumped from compressors, which are arranged at the bottom of the aero tank. Air supply management will be provided using oxygen concentration measuring devices.

The continuous circulation of the flow in the aero tank is provided by the mixers, hinged on the concrete bridges.

Main design parameters:

Pollutant load according to BOD_5 9,742 kg/d

Load according to COD	19,483 kg/d
Load with suspended solids (SS)	7,577 kg/d
Load with Total Nitrogen (N)	2,268 kg/d
Load with TKN (Total nitrogen according to Kjeldahl)	2,268 kg/d
Load with NH_4-N	1,588kg/d
Load with organic nitrogen (N-organic)	680 kg/d
Load with total phosphorus (TP)	351 kg/d
Mixed liquid of suspended solids (MLSS)	3,15 \kg/m³
Design temperature	12°C
Required age of activated sludge for denitrification	13,23 day
Sludge load (Equation of organic substance amount with microorganism amount - F/M): 0,077kg Jbm5/(kg MLSS *d)	
Number of reservoirs	8
Length	60,0 m
Width	14,0 m
Depth	6,0 m
Total volume 40,320 ∂³	
Volume per reservoir	5,040 m
Hydraulic retention time for average daily water flow (DWF)	32,5 h

Design aeration parameters:

Oxygen transmission rate for aerated unit depth:	15 ∂ O_2/(Nm^3 x m)
Transmission ratio α	0,6
Aeration depth	5,60 m
Storage ratio	1,2
Required air flow (average)	17,345 Nm^3/h
Required air flow (peak)	26,370 Nm^3/h
Number of air-blowers (including 1 stand-by)	5

Final Sedimentation Tank:

Final sedimentation tank will be of circular shape and the liquid will be supplied from the distribution chamber. Like primary sedimentation tank, the settled sludge is moving continuously to the inlet chamber in the center of the tank, from where it is pumped to the return sludge pumping station. Rotating sludge rakers transfers the floating sludge into the collecting well, from where it gets to the fine screen (clarifier).

Main design parameters:

DDesign flow	3,088 l/s
Mixed liquid suspended solids (MLSS)	3,15 kg/m³
Sludge volume index	120 ml/g
Sludge surface volume load on the surface	230 l/m²h
Percentage share of return sludge	0,75
Return sludge MLSS	7,35 gr/l
Water depth	3,80 m
Tank diameter	40,00 m
Net general surface area	4,974 m²
Total volume	18,900 m³
Hydraulic retention time (at max. flow)	6,1 h
Number of tank	2

Return Sludge Pumping Station

Return sludge pumping station is located at the final sedimentation tanks. Four submersible pumps will be arranged here (including one hot stand-by), through which return sludge is supplied to the aero tank inlets. Each pump will be connected to the separate vertical penstocks in the separate vertical well.

Main Design Parameters:

Design flow (return sludge)	1,862 m^3/h
Number of pumps (including 1 stand-by)	4
Pump capacity per pump	621 m^3/h
Static head	approx. 5 m

Air –blower Station

Air-blower station will be arranged in the front side of aero tanks, next to the operational building. Five air-blower aggregates (one stand-by) will be arranged here for pumped air supply.

Main Design Parameters:

Average oxygen demand	17,345 Nm^3/h
Maximum oxygen demand	26,370 Nm^3/h
Number of aggregate (1 stand-by)	5
Capacity per aggregate	6,592 Nm^3/h

Venturi Flowmeter

Venturi flowmeter channel section will be arranged to measure wastewater inflow. It will be possible to measure up to 3,088 m^3/h flow in this section. The water level detector-sensor will be installed in the section in order to transfer data into the control room (in the operator room).

4.3.3.1 Wastewater Treatment Technology

Proposed WWTP operation principle is based on biological process involving various types of microorganisms. Wide range of bacteria are generally presented in industrial-fecal wastewater, which ensure degradation/dissolution of existing organics in the wastewater. WWTP structure and associated technological processes contribute to the creation of optimal conditions for the vitality and breeding of the bacteria. Following main biological processes take place involving bacteria activated in the WWTP:

- biological oxygen demand (BOD) reduction;
- chemical oxygen demand for oxidation (COD) reduction;
- decomposition of nitrogen-containing organic matter (nitrogen removal);
- decomposition of organic substances containing phosphorus (phosphorus removal).

Nitrogen Removal:

Nitrogen removal will be provided at different stages. At the first stage, organic nitrogen and ammonia is changed into nitrite, and then – nitrates. The process takes place in anaerobic environment, where nitrate is converted to gaseous nitrogen. At this point there should be no free oxygen and BOD needed bacterium. As a result, in the nitrogen removal process, also, the certain amount of BOD will be reduced. Above mentioned biological reactions are given below.

1. Ammonia converted into nitrite

$$2\ NH_4^+ + 3\ O_2 = 2\ NO_2^- + 2\ H_2O + 4\ H^+$$

2. Nitrite converted into nitrate

$$2\ NO_2^- + O_2 = 2\ NO_3^-$$

1+2 ammonia converted into nitrate

$$NH_4^+ + 2\ O_2 = NO_3^- + H_2O + 2\ H^+$$

3. Nitrate converted into nitrogenous gas

$$2\ NO_3^- + BOD = N_2 + 4\ H_2O + 2\ OH$$

Phosphorus Removal:

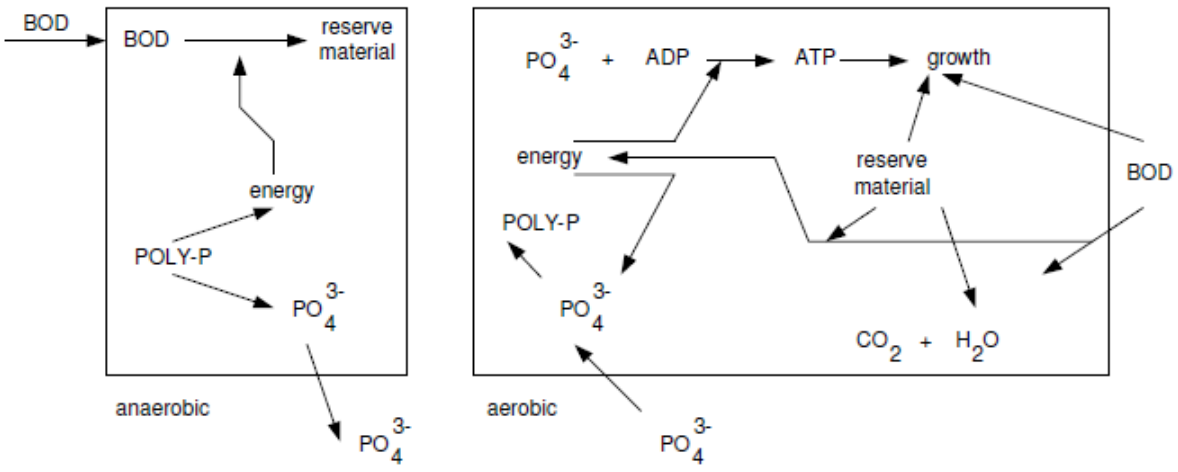
The removal of phosphorus is provided using two ways, chemical and biological. In case of chemical removal of phosphorus chemical reagents (iron chloride, iron sulfate or calcium salts), in the result of their activity, insoluble deposits are received,that will be settled in the sedimentation tank of the treatment facility. Typical chemical reaction, occurring in the process of chemical sedimentation is given below:

$$1\ metal^{+++} + PO4^{3-} = MPO_4$$

The used method for phosphate removal is insufficient, because it is connected to the high costs of using chemicals and generation of waste (sludge) in large amount.

The other way for phosphorus removal is biological method. In this case the phosphorus is incorporated in the biomass, already existing in the system. The ongoing processes in the WWTP provide reproduction of organisms (Acinetobacter) that facilitates phosphorus accumulation, in comparison with other bacteria. Bacteria for phosphorus accumulation can use more phosphorus, than it is needed for their growth. Excess amount of the phosphorus will be removed by the regular flow of waste. In order to stimulate phosphorus accumulation bacteria, they need products with easy fermentation (i.e. acids). Given that the acids are available for anaerobic system, the bacteria release certain amount of phosphorus ortopospatis; When the bacteria gets in aerobic conditions, it takes much more amount of phosphorus than is required for its growth. This biological process is described in the picture 4.3.3.1.1.

Figure 4.3.3.1.1. Biological Process for Phosphorus Removal with the Participation of Specific Bacteria (Acinetobacter)



To ensure availability of the required amount of fermentation products (acids), the tank (sedimentation tank) will be arranged in front of the activated sludge tank. The retention time in the tank is depended on the number of available products with easy fermentation features in the untreated wastewater, ex: large sewage system, equipped with many pressure pipelines, will have significantly higher concentration of acid, as biological reactions take place.

4.3.4 Sediment (sludge) Processing

Sludge(sediment) processing involves:

- Primary sludge pumping station
- Excess sludge pumping station
- Preliminary sludge mechanical thickening bed;
- Septic tank
- Sludge storage tank
- Sludge mechanical dewatering station.

Primary Sludge Pumping Station

Primary sludge pumping station will be arranged next to the primary sedimentation tanks. The primary sludge will be pumped to the preliminary condensation site. Three pumps will be installed at the station ((including one stand-by).

Main Design Parameters:

Number of pumps (including 1 stand-by)	3
Daily operation time	4 h/d
Capacity per pump	approx. 32 m^3/h
Static head	approx. 10 m
Primary sludge efficiency	7,577 kg/d
Dry solids concentration	3,0 %
Sludge volume	253 m^3/d

Excess Sludge Pumping Station

Excess sludge pumping station will be arranged at the return sludge pumping station. Excess sludge will be pumped to the preliminary sludge mechanical thickening bed. Three pumps will be installed at the station ((including one stand-by).

Main Design Parameters:

Number of pumps (including 1 stand-by)	3
Daily operation time	12 hr/day
Capacity per pump	Approx. 55 m^3/hr
Static head	Approx. 10 m
Primary sludge efficiency	9,702 kg/day
Dry solids concentration	0,73 %
Sludge volume	1,320 m^3/day

Preliminary Sludge Thickening bed

Primary sludge came out from primary sedimentation will be thickened (condensed) in two preliminary gravity thickener tanks with circular section, which is equipped with screens in the shape of fencing for liquid/solids separation. Sludge thickener will be built to the south of sludge mechanical dewatering station. Liquid floated on the surface of sludge (sediment), together with other waters generated in the result of turbulent processes, will move to the sludge processing station inlet. Thickened sludge pumping station will pump thickened sludge to the suction chamber of septic tank supplying pumps.

Main Design Parameters:

Primary sludge efficiency	7,577 kg/d
Solid concentration before thickening	3,00%
Solid concentration after thickening	5,00%
Sludge concentration before thickening	253 m^3/d
Sludge concentration after thickening	152 m^3/d
Volume of the liquid on the sludge surface	Approx. 101 m^3/d
Actual load on the tank surface	67,0 kg/m^{2*}d

Number of tanks	2
Diameter	12 m
Total surface area	113 m^2
Actual water depth average)	4,00 m

Thickened Sludge Pumping Station

Thickened sludge pumping station consists of two pumps with eccentric screw type conveyers (1 on-duty, and 1 stand-by). Pumps will be installed in the sludge dewatering facility, next to the sludge thickening bed.

Main Design Parameters:

Sludge volume	152 m^3/d
Solid concentration after thickening	5,00%
Number of pumps (including one stand-by)	2
Daily operation time	5,0 h/d
Capacity per pump	31,1 m^3/d
Static head	approx. 25 m

Sludge Mechanical Thickening Bed

Excess sludge thickener will be installed in the dewatering facility. The thickening system includes two belt filter presses. The system will operate for 13.2 hours every day. The dry solid concentration in the extracted sludge will be minimum 6%.

Thickeners will be supplied with sludge through eccentric screw type conveyers of feed pumps installed at the sludge dewatering station.

Main Design Parameters:

Total amount of solids	9,702 kg/d
Solid concentration before thickening	0,73%
Total sludge volume after thickening	6%
Sludge concentration after thickening	162 m^3/d
Number of devices (including one stand-by)	2
Daily operation time	13,2 h
Capacity per device	50 m^3/d
Working day number a week	7

Settler

Preliminary thickened sludge, as well as excess sludge finally will get into two settlers, where their anaerobic decomposition will take place at 35 ^{0}C temperature. Sludge will be pumped into settler through the thermal exchanger. The sludge will continuously be mixed with feed and circulation pumps. During decomposition in the settler organic substance concentration in the sludge will be reduced by 40%.

Main Design Parameters:

Total solid amount before decomposition	17,279 kg/d
Total organic solid amount before decomposition	12,095 kg/d
Total amount of mineral solids before decomposition	5,184 gr/d
Anaerobic decomposition (retention) time at35 ^{0}C	20 d
Required settler capacity	6,265 m^3
Number of settlers	2
Diameter of settler	16,0 m
Total settler height	23,00 m
Reduction of organic solid concentration	40%
Organics remained after decomposition	7,257 kg/d

Total amount of substances after decomposition	12,441 kg/d
Sludge (sediment) remained after decomposition	313 m^3/d
Specific yield of biogas	340 l/kg org.SS

Sludge Feeding Pumps:

- Number of aggregates (including one stand-by)	2
- Capacity per pump	30 m^3/h
- Static head	35,0 m

Sludge Circulation Pumps:

- Number of aggregates (including one stand-by)	2
- Capacity per pump	120 m^3/h
- Static head	5,0 m

Sludge Storage Tank

Sludge extracted from the settler should be temporarily collected in the sludge storage tank, which will be built near the sludge pre-thickening tank. The sludge storage will be equipped with mixer.

Main Design Parameters:

Solid amount after decomposition	12,441 m^3/d
Solid concentration before dewatering	3,98%
Total sludge amount before dewatering	313 m^3/d
Retention time in the sludge storage tank	12 h
Required capacity of sludge storage tank	481 m^3
Tank diameter	12,00 m
Tank depth	4,00 m

Sludge Mechanical Dewatering Site

After anaerobic decomposition of the sludge in the settler, the sludge will be thickened in the secondary thickener (thickener after decomposition). After that, the stabilized sludge will pass mechanical dewatering process, resulting in dry mass concentration reduction in the sludge to 20%.

Main Design Parameters:

Total solids after anaerobic decomposition	12,441 kg/d
Solid concentration before dewatering	3,98 %
Total sludge amount before dewatering	313 m^3/d
Solid concentration after dewatering	20%
Total sludge amount after dewatering	62,2 m^3
Daily operation time of dewatering device	12,5 h
Sludge volume per device operation hour	25 m^3/h
Capacity per dewatering device	25 m^3/h
Actual number of devices (including one stand-by)	2
Sludge solution volume generated by the process	251 m^3/d

4.3.4.1 Sludge Disposal after Dewatering

Dewatered sludge will be temporarily disposed on a special allocated site within the WWTP area.

At WWTP operation phase it is recommended to conduct laboratory examination to define toxic metal concentration in the sludge. If examination results show that there are no toxic pollutants in the sludge, the decision will be made to dispose the sludge to Kutaisi landfill (the mentioned landfill is situated to the south of the city, namely, on the area between Kutaisi and WWTP). In case of defining high

concentration of toxic metals in the sludge, it will be handed to the organization, holding the appropriate permit on hazardous waste management.

Besides, the alternative method for sludge extraction from WWTP is discussed for future perspective, namely: As it is known, after corresponding processing (composting) the sludge can be reused as the fertilizer on agricultural lands. In case of interest, the sludge stored on the temporary storage areas can be handed to the interested people after corresponding processing, free of charge. In such case, the pH characteristics and heavy metal concentration of the ground should be defined in order to reach the optimum level of dosing.

The important fact is that the Georgian legislation does not regulate the sludge usage issue for agricultural purposes. In order to regulate this field, the European legislation can be used, according to which it is forbidden to use the sludge:

- On lands, which are used for grazing or if 3 weeks are left before forage crop harvest;
- Vegetable cultivation plots during crop vegetation period;
- On plots, where cultivation of vegetables or fruits is planned, that are in constant contact with the soil or that are used for food in raw form, 10 months before harvest time and during the harvest period.

In case of using the sludge as a fertilizer, it is necessary to provide sludge sampling as well as the plot soil sampling and periodic laboratory tests should be implemented, where the sludge will be examined.

Considering the fact, that the demand on using the sludge as a fertilizer will be seasonal (in early spring and autumn), the main sludge management method is its disposal to the landfill.

4.3.5 Biogas Collection Ways

Released biogas in the result of anaerobic decomposition in the settler, prior to re-usage, will be temporarily collected in the tank for gas storage. The emergency torch bar (candle) of the gas will also be installed here.

Main Design Parameters:

Biogas efficiency (production)	4,112 m^3/d
The volume of gas storage tank	1,178 m^3
Tank diameter	10,0 m
Tank height	15,0 m
Calorific value of biogas (energy capacity)	6,4 kW/m^3

4.4 Organization of Construction Works

4.4.1 General Overview

As noted initially, the projected area is the territory of significant techno genic meaning. Accordingly, at the initial phase of project implementation it will be necessary to clean the area from wastes of old infrastructure and in a small amount from vegetation.

The ground road is arranged for the access to the area, which is in quite satisfactory condition. Consequently, the project does not require arrangement of new access roads.

The main works include:

- Ground works, the preparation of foundation for buildings, excavations etc.;
- Construction works of treatment plant;

After finishing construction works, recultivation will be provided prior to plant operation.

The works considered to be implemented in the preparation period, should be supplied with construction structures and handicrafts from the factories located within the district. The volume of preparation works and the order of their performance, as well as the types and number of machinery used, are defined by Constructor Contractor.

The types and number of machinery used during construction works are defined according to the structure and the amount of the works. Their number is calculated considering the variability in the rhythm of load supply and delivery.

4.4.2 Preparation Works

4.4.2.1 Cleaning the Area from Waste and Vegetation

The cleaning works of the area from existing infrastructure will be implemented in two stages.

At the first stage, the building situated in the north of the area will be demolished. According to preliminary assessment in the result of demolition approximately 450-500 m^3 concrete wastes 400-500 $∂^3$ will be generated. The existing construction waste (concrete waste, excess ground) or generated in the result of demolition, should be collected and disposed from the territory with trucks. They will be finally disposed at Kutaisi landfill for construction waste.

On the cleaned area the construction works of new WWTP facilities will be started. After completion of construction works the concrete reservoirs situated in the south of the site will be dismantled. Before starting demolition, the fecal waters in the reservoirs will be discharged in the operating WWTP and will be treated. .At the second stage, during demolition approximately 1000-1200 m^3 concrete waste will be generated.

After demolition 40-50 t metal waste can be produced. The metal wastes will be collected and passed to the contractor after implementation of corresponding procedures (scrapyards).

The selected area is not distinguished by multiple and diverse vegetation. Generally, low value bushes and grass plants are presented (the description of vegetation species are given in corresponding section of the EIA). Nevertheless, the vegetation clearance works at the preparation stage will be provided under relevant supervision, to ensure that all works are implemented within the designated area and to prevent additional damage of the plants.

The vegetation cover removal works will be implemented under the supervision of qualified personnel. Removed vegetation will be temporarily stored on the separated area.

4.4.2.2 Topsoil Removal/Storage

As it was mentioned, old structures are presented on the project area. Accordingly, topsoil removal works will be implemented on the part of the area (mainly in the north peripheries). The total area of the place where topsoil removal works will be implemented is nearly 2 ha. Considering the average topsoil depth (15 cm), the topsoil amount to be removed will be about:

$$20000 \times 0{,}1 = 2000\ m^3$$

The ground works will be implemented following the requirements of the regulation, approved by the decree No 424 of Georgian Government on “Removal, Storage, Usage and Recultivation of Topsoil”, dated by December 31, 2013.

Removed topsoil will be temporarily stored on the separated section (GIS coordinates of assumed area for temporary topsoil storage is attached to the EIA report), which will be protected from external

impact factors. After completion of construction works, the removed topsoil will be used for recultivation of degraded area or for improvement of less productive agricultural lands (see section 4.4.3.).

4.4.2.3 Construction Camp

Selection of suitable area for arrangement of the construction camp is the precondition for organized and timely implementation of plant construction works. This will reduce negative impact scope on the environment (the impacts related to the excessive traffic, etc.). It is vital to consider following recommendations from analogous plant construction results during selection of the area for the camp:

- Arranging of construction camp close to construction site and easy access of the territory, in order to limit traffic operation scope and to enable easy movement;
- To provide suitable engineering-geological conditions;
- Selected territory and relief must be favourable for arranging infrastructure without major ground works;
- Camp must be arranged on the territory where population disturbance due to pollutant substances emission in the air, noise propagation level and movement of machinery will be at minimum;
- To select the area poor with topsoil and vegetation;
- Keep distance between the area and the surface water body, that will lower the risk of surface water pollution;
- Construction camp must be easily supplied with potable and industrial water and must be ensured with power supply, as well as organized discharge of wastewater from the site;

The selection of the optimum area for construction camp and its organization is the prerogative of contractor constructor, selected by holding the competition. According to preliminary suppositions, all temporary infrastructures necessary for the construction will be arranged on the eastern periphery of the WWTP designated section (see then figure 4.1.2.). This decision will significantly reduce the scope of negative environmental impact.

Following infrastructural units will be included in the construction camp:

- Parking;
- Warehouse;
- Fuel and water tanks;
- Administration and workers resting units (containers);
- Workshop;
- Diesel-generator;
- Storage and others.

Inert materials and ready-made concrete mixture necessary for the construction works will be delivered from the industrial units of the natural and legal persons operating in the region. Considering the scope of construction works, there is no need in arrangement of crushing-grading mill and concrete plant. Arrangement of permanent housing containers is not planned either.

4.4.2.4 Power Supply

Power supply of the construction camp is assumed from the existing network, using temporary scheme. It is also assumed using movable power plant (diesel-generator).

4.4.2.5 Water Supply and Wastewater

Construction works will need as potable-industrial, so technical water supply.

The potable-industrial water will periodically delivered by tankers. The water storage reservoir will be installed on construction camp site, from where the separate units of the camp will be supplied by means of internal water supply system.

Considering the fact that the arrangement of the concrete plant and crushing-grading mill is not planned on the site during construction works, the technical water flow will not be high. If necessary, the technical water will be supplied from Rioni River and Vartsikhe HPP channel.

On the construction phase consumption of potable and industrial water depends on number of labourers and water consumption per person. Every working day approximately 60 people will work and potable-industrial water consumption per working day comprises 25 litres.

If calculate this for 300 work days per annum and considering single-shift working schedule, potable and industrial water design flow will be approximately:

$$60 \times 25 = 1500 \text{ l/d, or } \mathbf{1,5\ m^3d;}\ 1,5 \times 300 = \mathbf{450\ m^3/y.}$$

. Considering the duration of construction works (15 months, or considering holidays about 350 work days), total consumption amount of potable-industrial water will be 525 $m^{3.}$

In addition, it is possible to arrange showers, two points, on the construction camp. The water flow for one shower point per day will be 500 l. The required amount will be:

$$2 \text{ x } 500 = 1000 \text{ l/d, or } \mathbf{1\ m^3/d;}\ 1 \text{ x } 300 = \mathbf{300\ m^3/y}\ \textbf{and}\ 1 \text{ x } 350 = \mathbf{350\ m^3/dry\ weather.}$$

Total amount of potable-industrial water used during construction works will be:

$$\mathbf{525 + 350 = 875\ m^3}$$

The technical water will be needed for fire-fighting purposes. The approximate amount of the water necessary for fire-fighting water storage and for the training of the personnel will be approx.**1000-1500 m^3/y.**

For collection of faecal wastewater pressurized cesspool with the capacity of 20-25 m^3 is considered, which will be treated periodically by cesspoolage truck.

The volume of industrial-fecal wastewater is determined according to the volume of potable- industrial water consumed, minus 5% loss. Therefore, the approximate volume of industrial-fecal water during construction works shall be:

$$875 \text{ x } 0,95 = \mathbf{831,5\ m^3/y.}$$

During the year the construction camp cesspool will be discharged thrice a month, depending on the working day number.

4.4.3 Recultivation Works

After completion of the construction works, recultivation works will be implemented following the requirements of the regulation, approved by the decree No 424 of Georgian Government on "Removal, Storage, Usage and Recultivation of Topsoil", dated by December 31, 2013, namely:

All types of damaged and deteriorated soil, as well as the area adjacent to it, which partially or fully lost productivity under the negative impact of damaged and deteriorated soils, are subject to recultivation.

Recultivation of degraded soils is implemented for restoration for agricultural, forestry, water industry, construction, recreation, environmental, health and other purposes.

The operator company is obliged to ensure the maintenance of topsoil integration and its fertility nearly to its initial condition, which requires consideration of the following issues:

- To remove topsoil and fertile layer (see section 4.4.2.2.), store it on a special designated place and to protect from deterioration of topsoil quality (protection from mixing with other soil layers and rocks, pollution, washing out, dispersal and others) in order to protect and reuse it;
- In case of pollution of the area, liquidation of pollution sources and recultivation of polluted sections in the shortest period of time, by restoring integrity of the topsoil;
- Protect adjacent area from damage and degradation.

According to the same technical regulation, the recultivation works should be implemented according recultivation project. The recultivation project of Kutaisi WWTP will be developed after revealing the contractor constructor (since the area for construction camp and other technical issues will be defined), based on the active environmental, health, construction, water industry, forestry regulations and standards, considering regional natural climate conditions and the location of damaged land section. The project will cover technical and biological recultivation stages.

4.5 Working Mode and the Staff

WWTP construction works will last about 15 months (≈350 working days). 50-60 people will be employed on construction works.

Taking into account the specification of the works, the WWTP will be operated during the whole year, with 24-hour work mode. At operation phase about 15-20 people will be employed.

4.6 Fire-fighting Measures

In order to minimize the risks concerning fire emergence and spreading, the following is significant among planned activities:

- Electric devices Proper technical functionality control;
- Providing technical firefighting means in the workplace with fire risk,
- Provide regular training and testing of WWTP personnel on firefighting issues;
- Assign person responsible for fire safety.

It is noteworthy, that considering the specification of WWTP operation conditions, the fire emergence/spreading risk will be low.

5. Description of Baseline Condition of the Environment

5.1 General Overview

WWTP construction is planned to the south of Kutaisi, near the villages Tkachiri and Patriketi of Tskalutbo municipality. Accordingly, in the present chapter the baseline condition of Tskaltubo municipality will be described. The environmental-social conditions, characteristic for Kutaisi are also presented.

The information is based on literary sources and fund materials, statistic data, materials delivered by the client and field work results conducted within the study area. The given information later will be used to define possible impact types and scale of construction and operation of the plant.

Tskaltubo municipality is situated in the eastern part of Kolkheti Lowland, in the valley of rivers Rioni and Gubistskali. Kutaisi, Tkibuli and Terjola municipalities are bordering it from the east, Samtredia and Khoni-to the west, Tsageri and Ambrolauri from the North, and Baghdati and Vani municipalities from the south (see the figure 5.1.1.) .

Figure 5.1.1. Administrative Division Scheme of Imereti District

5.2 Description of Physical and Geographic Environment

5.2.1 Climate and Meteorological Conditions

Imereti is mostly located in the humid subtropical climate region. The impact of the sea is reduced in the low and medium mountain regions. however, humid climate is characterized. The winter is cold and the summer is relatively dry and hot here. The temperature in January is +2, +5, the maximum temperature in summer is +38, + 40C. Precipitation is 100-200 mm. Average number of days with precipitation is 150 per year.

The climate is subtropical in Tskaltubo municipality, with short winters and hot summers. According to the average annual air temperature, Tskaltubo is one of the warm regions of Georgia. The average annual temperature is +15 ^{0}. The average temperature of the hottest month- August is + 28^{0}. The average temperature of the coldest-January-February is -5^{0}. The average annual humidity is 76%. Eastern wind dominate from ambient flows, which are charecteraized by high temperature in the conditions of Tskaltubo. Western winds and sea breezes reduce the hot and bring Tskaltubo near to the comfortable cmiate zone.

Kutaisi climate characteristic features are: relatively dry and hot in summer, short droughts, mild winters, early spring, well-defined foehn winds and excessive precipitation. In Kutaisi slightly, but still it is revealed altitudinal climatic zonality, particularly, in the north and north-east, due to the elevation of the area, the air become cooler and accordingly the number of precipitation increases.

Rioni river valley is significantly broadened in the north and south and is characterized by good circulation of air masses. The temperature background is peculiar in the broadened part: during high waters it is somehow lower, and during shallowness, due to the warming of stony surface of Rioni riverbed, the temperature grows.

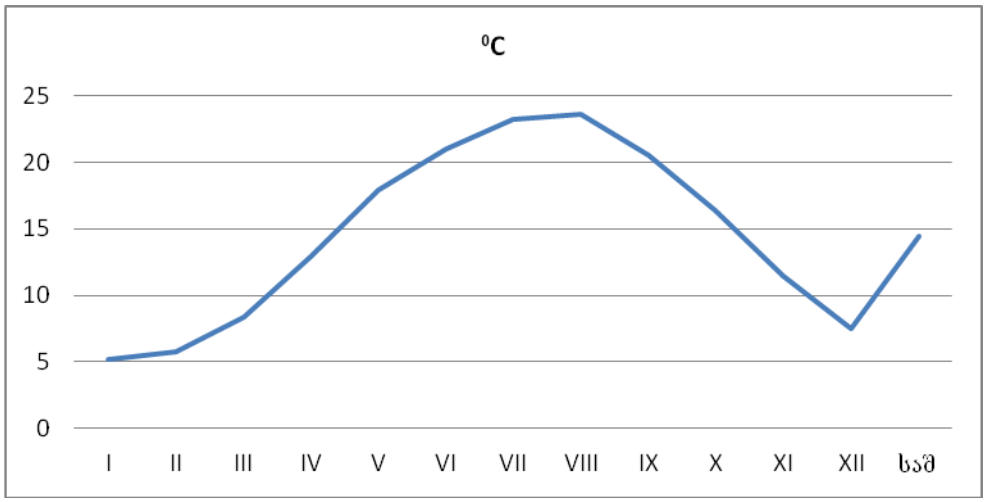
The climatic features of the study area and their recurrence parameters are presented in the following tables and diagrams, according to the closest meteorological stations of the project area – Kutaisi airport data.

5.2.1.1 Temperature

Ambient Air Temperature ^{0}C

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Ave.	Abs. Min. Ann.	Abs. max. Ann.
Kutaisi Airport	5,2	5,8	8,4	12,9	17,9	21,0	23,2	23,6	20,5	16,4	11,5	7,5	14,5	-17	42

Source: Construction Climatology (ბნ 01.05-08)



	Ave. max. of the hottest month	Ave. of the coldest 5 days	Ave. of the coldest day	Ave. of the coldest period	Period <8^{0}C with average monthly temperature		Average temperature at 13 o'clock	
					Duration in days	Average temperature	For the coldest month	For the hottest month
Kutaisi Airport	28,9	-3	-6	4,9	91	5,9	7,7	27,4

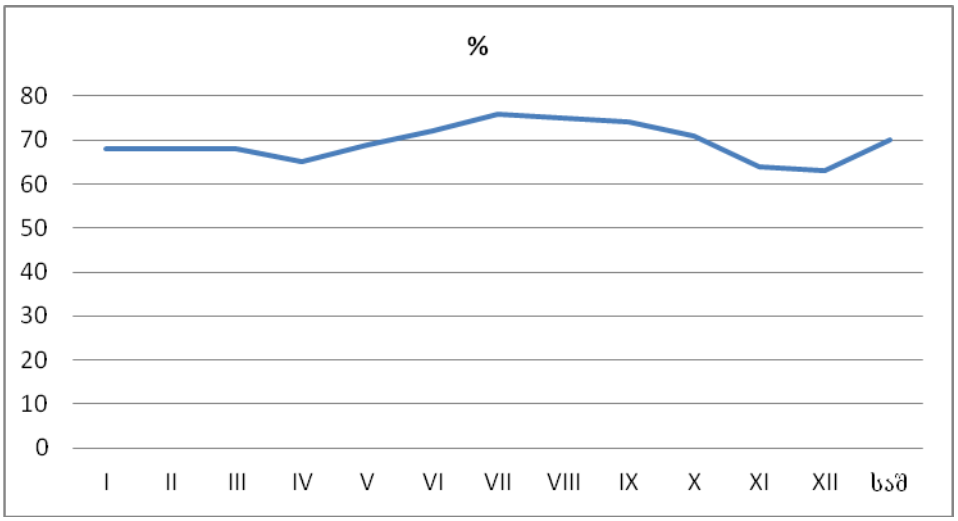
Source: Construction Climatology ბნ 01.05-08

5.2.1.2 Air Humidity

Relative Humidity According Months, %

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Ave
Kutaisi Airport	68	68	68	65	69	72	76	75	74	71	64	63	70

Source: Construction Climatology ᲘᲑ 01.05-08



	Average relative humidity at 13 o'clock		Average relative humidity per diem	
	For the coldest month	For the hottest month	For the coldest month	For the hottest month
Kutaisi Airport	60	58	11	29

Source: Construction Climatology ᲘᲑ 01.05-08

5.2.1.3 Precipitation

	Precipitation per annum, mm	Max. Precipitation per diem, mm
Kutaisi Airport	1386	166

Source: Construction Climatology ᲘᲑ 01.05-08

5.2.1.4 Wind Features

	Max. Wind velocity occurrence in 1,5,10,15,20 yy once in a year m/s				
	1	5	10	15	20
Kutaisi Airport	31	35	37	38	39

Source: Construction Climatology ᲘᲑ 01.05-08

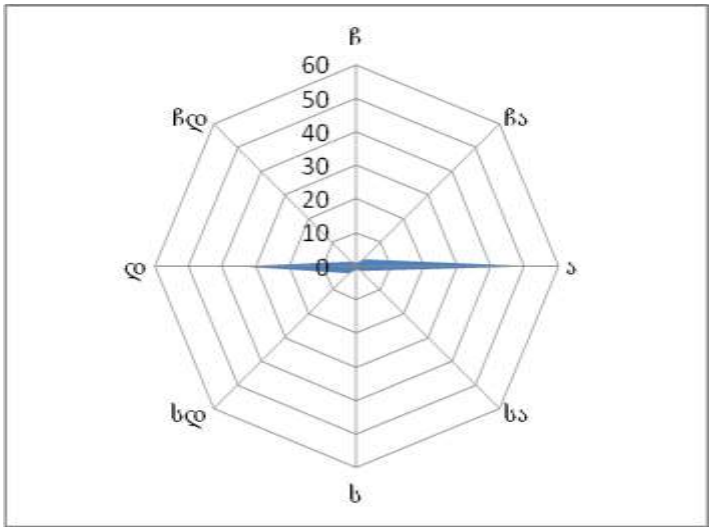
	Ave. Max. And min. wind velocity m/s	
	January	July
Kutaisi Airport	15,9/3,2	7,0/2,0

Source: Construction Climatology ᲘᲑ 01.05-08

	Wind directions and reoccurrence of windless days (%) per year								
	N	NE	E	SE	S	SW	W	NW	Calm
Kutaisi	1	3	53	2	1	3	35	2	27

Airport									

Source: Construction Climatology ЭБ 01.05-08



5.2.2 Geological Environment

5.2.2.1 Geomorphology

Within the lower part of Rioni River, fom geomorphological point of view, 3 main relief types is distinguished:

- Technogenic-accumulative relief;
- Technogenic-erosion relief of northern Kolkheti;
- South Imereti foothill relief.

– The study area lies within the technogenic-accumulative relief. This type of relief is distinguished by the following subtypes:

– Accumulative plains slightly inclined from the south to the east, within its borders marine-accumulative relief forms prevail.

– Rioni river and its tributaries Holocene-alluvial lowland. The inclination of the eastern part of the lowland is 0,005–0,008, which is reduced in the west to 0,0003–0,0005 m. The absolute elevation of the lowland ranges between 0-8 m. The low (0.5-1.0 m) and high (1.5-2.5 m) wetlands are developed on both banks of the current river-bed, which are 0.5 km at the beginning, and to the Black Sea – 4-5 km width. In the western part Rioni River wetlands are 1.0-4.5 m above the Kolkheti Lowland hypsometrically, which often cause flooding the lands. Till Samtredia town, Rioni riverbed lithology is represented by gravel, pebbles and sand, which change into relatively fine-grained material to the Black Sea confluence.

– The slightly inclined modern and quaternary alluvial lowland of Rioni river and its tributaries covers the major part of Kolkheti Lowland and is situated between the current riverbeds. The lowland surface is characterized by calm, straight relief. Absolute elevation ranges between 30 to 140 m. The average inclination - 0,02–0,05, which is reduced from the east to the west and from the south to the north. From Khanistskali confluence till Sajavakho, the left bank of the river is terraced lowland, where I terrace is distinguished between 2-4 m and so-called ,,Vartsikhe" terrace is mainly represented by gravel, pebbles and sands with clay fillers. In the upper part of 50 m depth section, the number of sandy fillers grows.

Within north Kolkheti technogenic-erosion relief, the following can be distinguished:

– Hilly relief, developed on the substrate of Neogene sand-clay carbonate rocks. It starts from Chishuri river and gradually increases to the west. Absolute elevation ranges between 130-200 meters.

– Kvirila River quaternary terraces.
– South Imereti foothill relief is developed on the Sarmatian clay-sandy horizon. It is represented in foothill line, in the surroundings of Pirveli Sviri and Meore Sviri villages, where in spite of dissected relief, subdued forms also are identified. The absolute elevation of the relief ranges between 150-300 m.

As it was mentioned, technogenic-accumulative relief is presented within the WWTP location area. The absolute elevation of the area ranges between 70-75 m. It is slightly inclined to the south (Rioni riverbed) and west.

5.2.2.2 Geological Structure

According to geotectonical zoning, study area (lower part of Rioni River) belongs to the west molasses depression (Rioni Intermontane Trough) of the Transcaucasian Intermontane Lowland. The overburden mainly consists of the Neogene-Quaternary molassas deposits overlaying the slightly dislocated Cretaceous and Paleocene strata.

Within the study region, the Neogene **(N_1)** is represented by 4 horizons:
Loamy deposits horizon (N_1^2 tr) - sandstones, clays, marls, total thickness of the horizon -10 m.

- Chockrak horizon (N_1^2C) -conglomerates, sandstones, limestones and marls. Total thickness - 35m;
- Karagan horizon (N_1^2kr) -sandstones, marls and shell limestones) Total thickness – 90 ;
- Sarmatian horizon (N_1^3S) - clays, sandstones– Total thickness – 300 m

The Quaternary deposits (Q) are extensively distributed within the large river basins (including Rioni River basin), where the recent deposits of the lower and upper Quaternary period are identified.

The lithological structure of the early and late Quaternary alluvial deposits (aQ_{I-III}) comprise the pebbles and cobbles with pebble-sandy, sandy, clayey and loamy filler. According to thickness, these deposits are divided in two parts: Rioni-Tekhura middle-river, where thickness is 250–300 m and Kvirila depression-the thickness ranges within 10 and 100 m.

The recent late Quaternary alluvial-delluvial deposits ($edoQ_{III-IV}$) overlay the preQuaternary deposits, which in turn as a rule are built by clays and loams along with the rubble. The thicknesses of such alluvial-delluvial formations vary in the range from 1m to 20m with maximum reached at the zone of development of the clay-marl and sandstone deposits.

Thickness of the Holocene (Q_{IV}) layer is 40-50 m generally including the alluvial, alluvial-marine, marine and biogenic deposits.

The area is mainly covered by alluvial deposits (aQ_{IV}), lithologically represented by: coarse grained, unclassified soils in the north-east and east of the area, and in the south-west - by sandstone and loamy-clayey well-developed material. The thickness of current bed and floodplain sediments is 10-20 m.

Alluvial-marine ($am(Q_{IV})$) and marine (mQ_{IV}) deposits are mainly distributed near the Black Sea coast, accordingly, it is far from study area. Lithologically these deposits are presented by different grained sans, clay, loamy-clayey material.

Quaternary biogenic deposits (bQ_{IV}) take place among modern marine, upper quaternary and modern alluvial deposits on the Kolkheti Lowland.

According to engineering-geological features, within lower part of Rioni river two types of ground can be distinguished: cemented deposits and uncemented deposits.

Sarmatian complex of cemented deposit soils ($(N_1^3S_1)$, In the lower part of Rioni River, are presented in Kvirila River basin and partially in the region of Meore Sviri village. There is the following lithological consistency: clay and sandstones. The total thickness of the complex – 300m.

Middle Miocene complex of cemented deposit soils (N12) are developed in Kvirila River basin and adjacent to Kveda Simoneti village. The complex is overlaid with clay-gravel material of alluvial-delluvial genesis. The lithology is represented by sandstones, marls, limestones, clays and conglomerates. Thickness - 10 to 90 meters.

Uncemented ground within the study area, particularly in the riverbeds of Rioni and its tributaries, floodplains and sometimes on the first terraces, are presented by modern alluvial (aQ_{IV}) deposits. The lithology of the complex is represented by loamy -clay, clays and sandstone, middle layers of sand and gravel and lenses.

In comparison with Rioni river and its tributaries, among uncemented soils on old terraces, it must be mentioned about early and late quaternary alluvial deposit (aQ_{I-III}), the lithology of which is represented by loamy-clay, clays, sandy material, the total thickness of the complex is 1-10 m.

5.2.2.3 Engineering-geological Survey Results of WWTP Area

5.2.2.3.1 Engineering-geological Survey Methods

Engineering-geological survey of WWTP area was conducted by BT LTD and GEOTECHSERVICE LTD.

The field works were carried out on 6-13 December of 2011, and laboratory examination – 13-22 December of 2011. Desk works were implemented on December 1523.

During field works 7 bore-holes were cut on the WWTP site (bore-holes №№136-142. Numbers are taken according to the bore-holes within the internal network) with total length of 43.9 m (approx. 6.3 m per bore-hole). Construction standards and rules (ЭЪ 02.01-08) have been applied for guidance

Samples of integrated and disintegrated structures were taken from waste rocks for their further laboratory examinations. The samples are taken from every type of the ground. The number of samples allowed describing all revealed engineering-geological elements in details.

5.2.2.3.2 Description of the Basic Rocks of the Study Area

Four main engineering-geological elements were distinguished in the boreholes drilled on WWTP site, namely:

- **EGE 1 –** boulder, gravel, grit and gravel with clayey filler. On average, the carbonate material is revealed in every borehole, except №138;
- **EGE 1a -** boulder, gravel, grit and gravel with clayey filler. On average, the carbonate material is revealed in every borehole;
- **EGE 2 -** clay - rusty brown, hard-plastic, with grit and gravel inclusions (15-20%). On average, the carbonate material is revealed in every borehole, except №138;
- **EGE 2a –** clay brown, soft-plastic, averagely carbonated. Revealed only in the borehole №138.

Cross-sections of the study area, based on the drilled boreholes, are given in the annex 5.

According to chemical consistency, EGE 2 grounds are very aggressive toward Portland and sludge-Portland cements, as for sulphate-resistant cement, EGE 2 reveales average and weak aggressiveness toward it. Grounds show average aggressiveness toward chlorides. EGE 2a is averagely and weakly aggressive only toward Portland cement. EGE 1 grounds are weakly aggressive toward Portland cement.

Established level of ground waters in the boreholes is 6,0 m and deeper.

Ground water reveal weak aggression toward hydrogen ion value. Environmental aggressive impact quality is average and weak to metal structures. The aggressive impact quality of rocks are average to carbon steel below the ground water, for those rocks with filtration ratio >0.1m/per diem.

The seismicity of soils were defined considering the location of the construction site within the 8 pont seismicity zone and their physical and mechanical properties („Seismically resistant construction" ðõ 01.01-09). Accordingly, based on seismicity: EGE 1 and EGE 1a belongs to the II category, while EGE 2 and EGE 2a belongs to the III category.

All design properties of the distinguished engineering-geological elements necessary for the construction, are given in the table 5.2.2.3.2.1.

Table 5.2.2.3.2.1.

EGE №	Ground Category by processing (drilling –explosion -IV-2-82)	Ground Category by Processing (mechanized, -IV-5-82)	Ground Category by Seismicity (õ 01.01-91)	Temporary Slope			Tightness □, gr/cm³	Mineral Part Tightness □s, gr cm³	Natural Humidity **W, %**	Plasticity Number **Ip**	Porosity Ratio e	Total Deformation Model, Water Saturated E0, KPa	Single Axis Compressive Resistance Rc, ðõ	Internal Friction Angle, Water saturated □, degree	Traction in water saturated condition, C, KPa	Design Ground Resistance СНиП-IV-2.02.01-85) **R0**, KPa
				1.5 ð	3.0 ð	5.0 ð										
1	-	6g-IV	II	1:0	1:0.25	1:0.5	1.94	2.72	22.5*	13.0*	0.719*	30000**	-	38.0**	4**	400
1a	-	6g-IV	II	1:0.5	1:0.75	1:1	1.63	2.65	14.7	-	0.864	40000**	-	40.0**	1**	500
2	-	8ð-III	III	1:0	1:0.25	1:0.5	1.85	2.72	33.7	22.0	0.961	8778	-	18.3	33.7	220
2õ	-	8ð-III	III	1:0	1:0.25	1:0.5	1.85	2.72	35.1	23.6	0.986	8516	-	12.9	30.8	180

5.2.2.4 Hydrogeology

In respect of hydrogeologic zoning, the given area is located in artesian zone of the Georgian block and is within the region of porous, fissure and fissure-karst waters of Tskaltubo Artesian basin. Artesian basin covers the major part of Imeretian lowland and Sagurali range. In this basin, as well as in neighbouring districts, the main artesian horizons are well-shaped: lower Cretaceous limestones, upper cretaceous-paleogenic limestones and quaternary gravel. Lower cretaceous limestones include fissure and fissure-karst pressurized underground water, including –low-radioactive therms of Tskaltubo. The radioactivity of underground waters of Tskatubo artesian basin is 5-7 Mache units and is characterized by high debits 200-220 l.s. Upper cretaceous-paleogenic limestones aquifer has limited distribution and insignificant capacity. This horizon contains fissure and fissure-karst ground waters.

There is a high consistency of porous ground water in quaternary sand-gravel horizon. The outlets are very different from quantitative point of view – outlets of Partskhanakanebi, Gocha-Jikhaishi and other streams are measured by several hundred liters per second. From north and north-eastern part to the west of the basin ground water becomes pressurized. The waters are of low mineralization, calcium bicarbonated, with good potable qualities.

Jurassic sediments are revealed by separate boreholes (Bajocian porphyritic series of sandstones and bathonian sandstone) containing highly mineralized waters with sodium chloride or calcium.

District undergroundwater resources is 15 m^3 / ms.

Within the hydrogeological district several aquifers and complexes are distinguished.

Modern alluvial aquifer sediments (aQIV) are developed in Rioni River and its tributaries, with the form of different width (0,2-2,5 km) stripes. The aquifer is a few kilometres down from the river mouths within boulder and pebble-boulder deposits, and lower sandstones, sands and loamy deposits are dominated in the basic rocks of the horizon.

Groundwater is characterized by a free mirror surface, which is inclined to the direction of flow of the rivers, i.e. from east to west. Mirror positioning depth is 0,5-2,0 m. Filtration characteristics depend on the type of basic rocks. In pebble layers filtration ratio is 3-300 m/days and in the sandy and loamy horizon - 1-3 m / days. The boreholes digged out within the distribution zone of pebble rocks, the ground water debit ranges from 5 to 30 l/s/. In sandy and loamy layers - 0,5-5 l/s. The total mineralization of waters is 0,3-1,0 gr/l, hardness- 3-8 mg/eqv. According to the chemical composition these waters are with calcium-bicarbonate, hydrocarbonate-magnesium and calcium-sodium consistency. The aquifer are mainly fed by river waters, precipitation represents the secondary feeder.

Aquifer of alluvial-delluvial deposits (ed Q_{III-IV}) are distributed in some places. Sporadic aquifer involves loamy-gravel deposits. The waters are fresh and without pressure. The depth of distribution is 1-15 m. Mineralization – 0,06-0,8 gr/l. Hardness-0,6-1,47 and 6,7-87 mg/eqv. According to the chemical composition these waters are with hydrocarbonate-calcium-natrium or magnesium and hydrocarbonate –sulphate-calcium-natrim consistency. Springs and wells represent the discharge areas.

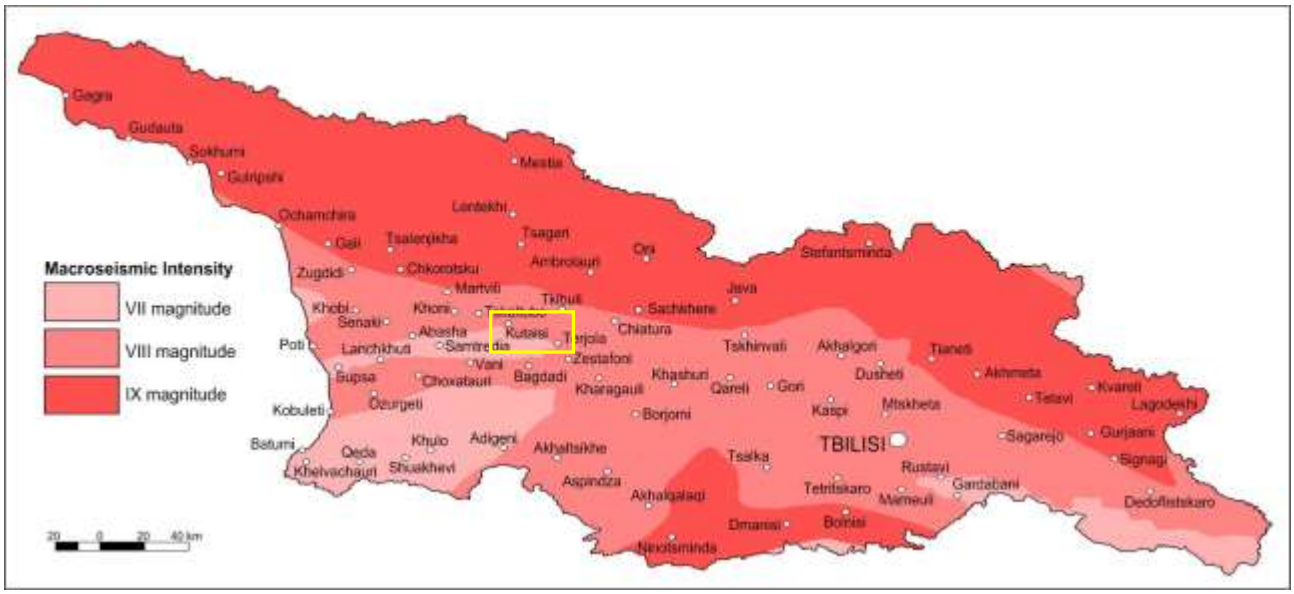
Aquifer of early and quaternary alluvial deposits (aQ_{I-III}) are wide-spread within the borders of Rioni river and Kvirila river alluvial slopes, where aquifer is presented by pebbles and boulder-pebbles, gradually submerging into alluvion loamy formation to the south-west of Samtredia. The capacity of these deposits changes from 5-20 m (Kvirila Depression) to 300 m (Rioni basin). The standing height of groundwater is 6,5-10,0 m. The ground filtration ratio is 5-10 and more m/days. According to the chemical composition these waters are with bicarbonate-calcium, bicarbonate-calcium-natrium and calcium-magnesium concentration. The total mineralization of groundwaters increases from the east to the north-east and south-west – from 0,1-0,3 to 0,5-1,0 gr/l. The hardness ranges between 1,5 and 6,0 mg/eqv. The horizon is mainly fed by the strong streams under the riverbeds of Rioni River, Gubistskali River and other rivers.

Water-bearing complex of Miocene deposits (N_1) is developed in the basin of Kvirila river and further to the west – to the village of Simoneti. Sandstones, limestones and conglomerates are water-bearing layers, which consist of porous-fissure unpressurized and pressurized waters. The water flow is 0,1-0,5 l/s. The water-bearing is reduced in the depth. Water mineralization is more than 0,5 g/l. According to the chemical composition these waters are with hydro calcium-natrium concentration. Water-bearing complex is mainly fed by ambient precipitation and river waters. According to the engineering-geological survey conducted on the study area, the established ground water level is 6,0 m and above.

5.2.2.5 Seismic Conditions

According to the corrected scheme of seismic zoning of the Georgian territory, Kutaisi and its surroundings belong to 8-point active seismic zone (Order №1-1/2284 of the minister of Economic Development of Georgia, dated on October 7, 2009, Tbilisi, on approval of construction regulations and rules- "Seismically-Resistant Construction" (ᲔᲑ 01.01-09)) (see the figure 5.2.2.5.1.).

Figure 5.2.2.5.1. Seismic Map of Georgia



The dimensionless ratio of the seismicity for the closest communities: Kutaisi - 0.13; Villages Patriketi and Tkachiri - 0.11.

5.2.2.6 Geological Hazards

Within the study area from geodynamic processes mudflows, erosive and flooding processes are mainly revealed, that is caused by the impact of Rioni river and its tributaies (Khanistskali, Sulori, Gubistskali rivers. Villages, agricultural lands and pastures, located on the wetlands and terraces of Rioni river and its tributaries are exposed to the risk related to the flooding and mudflow processes.

There is no geodynamic process is identified within the study area. The area is far enough from the surface water body and accordingly, flooding risk is not actually expected.

5.2.3 Hydrology

The nearest river to the study area, as well as the water body, receiver of treated water from WWTP is Rioni river.

Rioni river flows across the whole Georgia. The length is 327 km, basin area- 13400 km². The river Rioni heads at mount Pasi, on the southern slope of Caucasioni Ridge, at 2620 meters above sea level and flows into the Black Sea at the city of Poti.

The river flows from the mouth to the village Glola in the south-east broad, deep valley, which is U-shaped till the confluence with the river Zofkhituri. It develops the broad floodplain and forks. Below Saglolo it flows first to the south-west and develops narrow discontinuous floodplain. At Oni it turns to the west and flows till the village Alpana. Below Kutaisi, on Kolkheti lowland comes out and develops broad floodplain, forks and creates small islands.

Rioni turns to the west at the village Vartsikhe and flows in this direction until the confluence. The floodplain is especially broad from Vartsikhe to the village Basha. Here the river is expended and creates many islands, the part of them are flooded during the flood.

Below the village Bashi Rioni is less branched, below the village Sajavakho the riverbed becomes slightly deep, and intensively meanders. At the village of Japana it develops the former river lakes (Narionali). The river in the lower downstream is between artificial dikes and embankments, which is caused by the

fact that in case of the wind, the water becomes excessive and Rioni not only can not flow into the Black Sea, but also the unti- flow is developed on it, which is spred on the several kilometers from the confluence, the river is impounded and overflows the banks.

Rioni basin is characterized by diverse landscape. It has the substantial impact on its hydrological regime. It is fed by glacier, snow, ground and rain waters.

The river floods mainly in spring to summer, as the result of snow melt and rains.The flooding period starts in the early April, in the middle stream- in the first part of March, and in the downstream – at the end of February. The maximum flood period is in June, in the middle stream- at the last decade of May, downstream- in early May. The flooding period lasts till the end of August. The second period of flooding is the end of September, which reaches the maximum in October-June. The lowest level is in winter (December-February). In the downstream it is cut off due to the floods caused by heavy rains.

The average annual flow of Rioni River at Glola is 27,3 m³/s, at Kutaisi- 134 m³/s, at Sakochakidze- 406 m³/s, maximum flow at Glola- 345 m³/s, at Kutaisi- 1440 m³/s, at Sakochakidze- 3000 m³/s, minimum flow at Glola- m³/s, at Kutaisi– 22,0 m³/s, at Sakochakidze – 34,0 m³/s.

Rioni river flow according the water seasons: in spring it is 38,8% of annual flow, in summer- 28,5%, in autumn – 18,4%, in winter– 14,3%. Flow distribution according the feeding component is as following: Ground water – 34,7%, rain – 32,5%, snow – 28,2%, glacier water– 4,6%. Rioni annually discharges into the Black Sea 12,9 km³ water and large amount of solid runoff. The average annual solid runoff is increased from the mouth to the confluence: At the village Ghebi it is 96 thousand tones, at Khidikari – 2,2 b.t., at village Namokhvani- 4,9 b.t., at Sakochakidze – 6,9 b.t.

Rioni is characterized by icing at the edges,slush ice, pancake ice and, ice-drift. In the middle and upstream, in especially severe winter, the ice cover is created on some places.

Rioni river is characterized by average mineralization (150-300 mg/l)and in terms of ionic composition, it belongs to the bicarbonate class.

5.2.4 Soils

The soil cover of Imereti Lowland consists of podzol and alluvial mixture, their distribution depends mainly on the age of the relief. Relatively older elements of the surface consists of podzol soils, while alluvial, slightly developed soils dominate on the young (upper quaternary) river terraces.

Tgo the west and south-west of Kutaisi specific old alluvial soils are developed on the quaternary comglomerates, which are characterized by very thin layer thickness, weakly developed podzol features, large amount of the whole cobbles, lack of humus layer. These features give to the villages Kvitiri, Maghlaki and others such thermal properties, which is suitable for early vegetable crops. ,

The remains of old WWTP infrastructure are represented on the study area. The soil cover of this area has no significant value.

5.2.5 Biological Environment

5.2.5.1 Flora

The natural vegetation cover of Imereti plain is hardly preserved, - the former oak-hornbeam forests are almost completely destroyed by anthropogenic influence, and cultural vegetation takes their place. Due to organized protection, the significant section is preserved only in the eastern part of Imereti plain- on the left bank of Rioni-Kvirila. This is Adjameti forest, which is formed from Imereti and Georgian oak and Zelkova; Yellow Azalea (*Rhododendron luteum*,), Butcher's Broom (*Ruscus ponticus*), common

rhododendron (*Rhododendron ponticum*) and other species are presented in the sub-forest. The oak forest is presented with the fewer fragment on Saghoria terrace.

The dominated type of vegetation in the western part of Imereti plain is the broadleaf flora, which in the lower zone is presented by Oak, Hornbeam, Chestnut, and in the upper zone – by Beech. The sub-forest is well-developed, (including ever-greens) and lianas. In the major part of settled area the mentioned vegetation cover is devastated and modified by shrubs, meadows and crops and plantations. The existing favorable soil-climatic conditions allow the development of valuable agricultural crops, such as citrus, tea, laurel, orchards, vineyards, fruits and vegetables.

According to the project the new WWTP will be built on the area of old WWTP, which was exposed to high anthropogenic load for decades and today typical techogenic landscape is developed. Accordingly, artificially grown cultural and decorative plants are presented on the area, including: Fig, peach, apple, plum, peach and walnut trees. From decorative species cypress and pine should be distinguished. The mentioned plants are mainly gathered in the southern part of existing WWTP, where administrative building and other auxiliary warehouses are located.

It should be mentioned that new WWTP infrastructure is designed in the North part of the area (see the figure 4.1.1.) thus the destruction of above-mentioned vegetation is not expected.

Figure 5.2.5.1.1. The Adjacent Area to the Administrative Building

On the main part of the rest of WWTP site there are thorns, blackberry, pomegranate bushes and units of trees (including poplar, willow, black poplar and plane-tree), which grew following the suspension of the plant operation.

According to the audit results, conducted on the area, the species enlisted in the Red List of Georgia were not identified.

Finally, it is possible to assume that the vegetation presented on the project area is not distinguished with high conservation value and it is not required to carry out significant measures.

Figure 5.2.5.1.2. One of the Site Views of the Project Area

5.2.5.2 Fauna

Representative of the fauna characteristic to the Caucasus, are represented on Imereti lowland and in its surroundings. From large animals there are: the wolf, jackal, fox, marten, weasel, and squirrel. Birds are widely represented here: Eurasian Sparrow hawk, falcons, black kites, Eurasian jays. Passerines are represented with large number: In lowland areas and wetlands can be found Little Egret. There are gulls on the river banks.

From reptiles Sand Lizard and dice snake are identified.

In the rivers the following fish species are distributed: round goby, Wals Catfish, Danube bleak. Rioni River is the spawning place for many rare fish species inhabited in the Black Sea, that have commercial value. Five species of sturgeons should be mentioned: European sea sturgeon -Acipenser sturio, Russian sturgeon - A. guldenstadti represented by two species: Colchis sturgeon - A. colchicus and Persian - A. persicus), Spiny sturgeon - A. stellatus, Starry sturgeon - A. nudiventris and Beluga - uso huso.

From amphibian fauna frog, Green Toad, marbled newts, Caucasian salamander. Butterflies, insects, horse-flies and others are represented in large number.

The study area is located in the district with significant anthropogenic load. Therefore, there are only synanthropic species of wild animals presented here.

5.2.5.3 Protected Areas

The nearest protected area to the WWTP location site is Ajameti Managed Reserve (it sis situated to the east, in ≈6,5 km from the site).

The Managed Reserve was established in 1935, on the area of 4848 ha. It is formed from two massifs: Ajameti oakland (3742 ha, between the left conflueneces of Rioni river- Kvirila and Khanistskali) and Vartsikhe Massif (1106 ha, on the left side of Khanistskali).

Imeretian relic oak forests of Colchic type are preserved In Ajameti Managed Reserve (oak age ranges between 120-200), pure groves of Caucasian Zelkova (1.5 hectares) and also Hartwiss' Oak. There are other forest types represented in Ajameti State Reserve: ash, hornbeam, field maple trees, wild pear, and

wild chequer tree. From sub-forest types, the most common are azalea and hawthorn, which creates dense brushwood in some places.

From mammals roe deer, foxes, white-necked martens, badgers, rabbits, squirrels are found. From birds it is noteworthy the woodcock. The main goal of Ajameti Maneged Reserve is preservation, growth and scientific examination of Colchic forest samples and tertiary Imeretian oak, Hartwiss' Oak, Zelkova and also fauna. Ajameti Managed Reserve is the unique monument of Georgian nature.

Considering the separation distance, significant direct impact risks on protected area during work implementation, actually do not exist.

5.3 Description of Socio-economic Environment

5.3.1 Population

The number of population in Tskaltubo municipality is 73,5 thousand people (2014). In Imereti Region the highest population number is in Kutaisi - 197,0 thousand people.

Table 5.3.2.1. shows the number of population in Imereti Region, including Kutaisi and Tskaltubo municipalities (2004-2014).

Table 5.3.2.1. The Number of Population in Georgia, Study Area and Municipality (thousand perople).

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Georgia	**4315.2**	**4321.5**	**4401.3**	**4394.7**	**4382.1**	**4385.4**	**4436.4**	**4469.2**	**4497.6**	**4483.8**	**4490.5**
Imereti Region	690.2	689.0	700.1	697.6	694.2	693.5	700.4	704.5	707.5	703.9	703.3
Kutaisi City	183.8	184.5	190.1	189.7	188.6	188.6	192.5	194.7	196.8	196.5	197.0
Tskaltubo Municipality	72.9	72.7	73.9	73.6	73.2	73.0	73.6	73.8	74.1	73.6	73.5

According to the 2002 census, the population of the project area adjacent settlements are recorded in the following quantities:

- Patriketi village - 1412 (including men - 669, women - 743);
- Tkachiri village - 1741 including men - 841, women - 900).

The majority of population in the settlements are Georgians.

5.3.2 Employment

58,8% of Tskaltubo population are active economically, the majority of them are unemployed. According to economic activity, the large share comes for agricultural, hunting and forestry fields.

The majority of population in the adjacent settlements to the study area are involved also in agricultural activities. Many green-houses are arranged in the villages of Patriketi, Tkachiri, Ofshkviti and others.

5.3.3 Land Resources

The great importance is given to agricultural, partly agro-climatic and topsoil land resources for within the study area. The quantitative and qualitative values of land resources are revealed by slight

inclination of the relief and the variety of the soil. Ashy soils are mainly distributed here, which have 2–4% of humus layer. Significant changes are observed due to many years of anthropogenic impact.

The total land fund of Tskaltubo municipality, as of January 1, 2006, is 66848 hectares, the largest portion of which- 81.1% is still owned by the state. Agricultural lands holds 43.6% of the total land fund, where pastures are state-owned by 100%, as for arable lands, their 75.2% is privately owned, as well as 98% of orchards, , 59.6% of perennial plants, and 98.4% of vineyards are also in private property.

5.3.4 Healthcare

Medical services of Tskaltubo Municipality are represented by the following health facilities: "Tskatubo Regional Hospital" LTD, "District Policlinic" LTD, Tskaltubo Tuberculosis Center, Geguti Policlinic LTD and 10 rural clinics.

5.3.5 Infrastructure

The total length of irrigation channels in the municipality is 175 km, which is used for irrigation of the 10285 ha area, that is 36,1% of the whole territory supplied by the water; 5678 families of the municipality are provided with the irrigation water.

Potable water supply is guaranteed 24-hour a week for 4756 households, the total length of potable water network is 149 km. In spite of the fact that in 1999-2006, 496,3 thousand GEL were invested in irrigation and potable water networks, mobile connectivity is covered by 70% of the municipality.

The main line passes the area with 4 railway stops; Passengers are also provided by state-owned, as well as licensed private vehicles.

5.3.6 Tourism

Tskaltubo municipality is famous for mineral waters and resort infrastructure, which suffered a great damage during complicated political situation. Besides, balneological treatment with mineral bathes is provided for tourists.

The municipality is characterized by mountainous landscape, with forest and mountain massifs, rich flora and fauna, preserved areas and caves. The municipality includes famous Sataplia Preserved Area and the dinosaur trace discovered here. It is also well-known by Sataplia, Kumistavi and Tetra caves. The mountain riding, mountain walking and ecotourism can be developed here. The large range of karstic caves gives the possibility for speleo tourism development, as well as good opportunity for agro-tourism.

5.3.7 Historical-cultural and Archeological Monuments

Four active museums are on Tskaltubo municipality. These are: Giorgi Akhvlediani Museum of Regional Studies – in Tskaltubo city, the writer Niko Lordkipanidze House Museum in the village Chuneni, Giorgi Akhvlediani House Museum in the village Derchi and Soldier House Museum in the village Opshkviti.

From historical monuments it must be distinguished the following:

Epiphany Church of 11th century in the village Derch, the 12th century chateaux in Geguti village, the 12th-century church in the village of Zarati and unique 12th-century wooden churches in the village Partskhanakanevi, Zeda and Kveda Meskheti villages (Upper and Lower Meskheti).

Tskaltubo Municipality and its surroundings attract special attention with their historical, archeological sites. There are many Speleological Sites (crystalline caves, grots and abysses) along with residential areas, which are often combined with historic monuments and form natural and man-made fortifications complexes.
There are no historical architectural monuments identified on WWTP area and its surroundings. Due to the specification of the site, the late disclosure risks of archaeological monuments are very low.

6. Environmental Impact Assessment and Analysis

6.1 General Overview

Information submitted above has been discussed in this paragraph, on the basis of which the sources, types and objects of the impact, caused by the planned activities, have been established. Changes in quantitative and qualitative characteristics of the environmental condition have been predicted. Environmental impact has been assessed as for the construction (construction phase) as well as for the operation (exploitation phase).

6.2 General Principles of the Methodology of EIA

Approaches used for the environmental impact assessment, as well as the quantitative and qualitative criteria have been developed for unification and standardization, which ensures the objectivity. Impact assessment methodology has been developed based on the recommendations of the World Bank and other international financial institutions (EBRD, IFC, ADB).

For quantitative criteria are used values, established in normative documents of Georgia, EU and the International Finance Corporation / World Bank, for quality indicators of environment (air, water, soil, etc.) in case of those factors of impact for which no quality indicators are defined (e.g. impacts on ecosystems and population), quantitative criteria are defined on the basis of baseline data analysis, considering the value and sensitivity of the impact.

The following scheme has been used during the assessment of the environmental and social impact caused by the planned activities:

Stage I: Determination of the major types of the impact and analysis format

Determination of those impacts that may be significant for these types of projects based on the general analysis of the activities.

Stage II: Baseline study

Identification of the receptors, which are expected to be impacted by the planned activities; determination of sensitivity of the receptors.

Stage III: Characterization and assessment of the impact

Determination of the nature, probability, significance and other characteristics of the impact, taking into account the sensitivity of the receptor; Description of the expected changes in the environment and evaluation of their significance.

Stage IV: Identification of mitigation measures

Determination of mitigation, prevention or compensating measures for significant impact.

Stage V: Assessment of the rest impact

Identification of the magnitude of the expected changes in the environment after the implementation of mitigation measures.

Stage VI: Processing of monitoring and management strategies

Monitoring of the effectiveness of mitigation measures is needed to ensure that the impact does not exceed predetermined values, to verify the effectiveness of mitigation measures, or to identify the necessity of corrective measures.

6.2.1 Impact Receptors and their Sensitivity

The project may lead to a change in the qualitative and quantitative characteristics of physical and biological resources of the area of influence, such as:

- Ambient air quality and acoustic environment;
- Soil stability and quality;
- Surface and ground water quality;
- Visual changes in landscape;
- The quantity of habitats, flora and fauna;
- and others;

The populations, which may be affected by the planned activities include people living in the vicinity of the project area, workers and others (e.g. tourists, passengers). The staff is considered as potentially sensitive receptors.

Sensitivity of a receptor is related to the magnitude of the impact and to the ability of a receptor to resist change or recover after changes, as well as to its relative ecological, social or economic value.

6.2.2 Impact Assessment

The major influence factors have been identified for the environmental impact assessment during the construction and operation phase. Assessment of the expected impact has been implemented in accordance with the following classification:

- Nature - positive or negative, direct or indirect;
- Magnitude - very low, low, medium, high or very high;
- Probability of influence - low, medium or high risk;
- Impact area - district, area or region of activities;
- Duration - Short and long term;
- Reversibility - reversible or irreversible.

Expected changes in the environment and their nature, area of the influence and duration, reversibility and probability of risk realization have been determined for both phases of the project, based on which the significance of the impact has been assessed.

The impact is mainly determined quantitatively. Assessment of the impacted environment has been implemented based on their quality standards. When quantitative assessment was impossible, the impact has been evaluated qualitatively, taking into account its characteristics and pre-established criteria.

Below are the criteria established for the assessment of the impact on environmental and social receptors; Characterization of the impact; List of relevant mitigation measures; Using established criteria for determining significance and scope of the impact before and after the implementation of mitigation measures.

6.3 Impact on Ambient Air Quality

6.3.1 Impact Assessment Methodology

For the assessment of impact on ambient air quality normative documents of Georgia have been used, which determine the air quality standards. Standards are defined for the protection of health. As the impact on health depends on the concentration of harmful substances, as well as on the duration of the impact, evaluation criteria considers these two parameters.

Table 6.3.1.1. Assessment criteria for the impact on ambient air quality

Ranking	Category	Short-term concentration (< 24 h)	Unpleasant odor distribution (long-term, or frequent)	Dust distribution (long-term, or frequent)
1	Very low	C <0.5 MPC	10% of < OU_E/m^3	Unnoticeable increase
2	Low	0.5 MPC < C < 0.75 MPC	10-20% of OUE/m3 standard	Noticeable increase
3	Medium	0.75 MPC < C <1 MPC	20-50% of OUE/m3 standard	Slightly disturbs the population, though has no negative impact on health
4	High	1 MPC < C <1.5 MPC	50-100% of OUE/m3 standard	Quite disturbs the population, especially the sensitive individuals
5	Very high	C > 1.5 MPC	> 100% of OUE/m3 standard	Population is very disturbed, has negative impact on health

Note: C - Estimated concentrations in the environment, considering the baseline

6.3.2 Characterization of the Impact

6.3.2.1 Construction Phase

The approach, where the typical construction equipment operation is considered, has been used for the assessment of ambient air contamination.

Impact of emissions on ambient air quality expected from such technological processes, such as earth works have been estimated and calculated. Implementation of these operations requires the exploitation of a number of mechanisms and use of other necessary financial resources, including welding electrodes. Given that, the following sources of pollution have been identified: Excavator and bulldozer.

6.3.2.1.1 Emissions During the Operation of Road Construction Vehicle (Excavator)

Source of emission of the pollutant substances is road-construction vehicle engines, loading during the work and during idle mode.

The calculation is performed according to the following methodological guidelines [4, 5]

Quantitative and qualitative characteristics of emission of the pollutant substances from the road-construction vehicles, is given in the Table 6.3.2.1.1.1.

Table 6.3.2.1.1.1. Quantitative and qualitative characteristics of emission of the pollutant substances from the road-construction vehicles

Pollutants		Maximum emission, g/s	Annual emission, t/a
Code	Name		
301	Nitrogen dioxide (nitrogen (IV) oxide)	0,0327924	0,281436
304	Nitrogen (II) oxide	0,0053272	0,04572
328	Particulate	0,0045017	0,038632
330	Sulfur dioxide	0,00332	0,028467
337	Carbone oxide	0,0273783	0,234025
2732	Fraction of hydrocarbons kerosene	0,0077372	0,066308

Calculation is made in conditions of external temperature of construction sites of the road-construction vehicles (RCV). Number of work days – 300.

Initial data for calculation of emission of the pollutant substances is given in the Table 6.3.2.1.1.2.

Table 6.3.2.1.1.2. Initial data of calculations

Name of the road-construction vehicles (RCV)	Idle mode, minute	Number	One vehicle working time							Number of working days
			Per day, hr				In 30 min, min			
			Total	Without load	With load	Idle mode	Without load	With load	Idle mode	
	Caterpillar RCV, capacity 61-100 kW (83-136 horse-power)	1 (1)	8	3,5	3,2	1,3	13	12	5	300

Provisional marking, calculation formulas, calculating parameters and their explanation are given below:

The maximum of ***i***-type substance – one-time emission is performed by the following formula:

$$G_i = \sum_{k=1}^{k}(m_{ДВ\,ik} \cdot t_{ДВ} + 1{,}3 \cdot m_{ДВ\,ik} \cdot t_{НАГР.} + m_{XX\,ik} \cdot t_{XX}) \cdot N_k / 1800, \text{ g/s};$$

Where,

$m_{ДВ\,ik}$ – for ***k***-type group, ***i***- type substance specific emission during vehicle drive without loading, g/min;

$1{,}3 \cdot m_{ДВ\,ik}$ – for ***k***-type group, ***i***-type substance specific emission during vehicle drive with load, g/min;

$m_{ДВ\,ik}$ – for ***k***-type group, ***i***-type substance specific emission during vehicle idle mode, g/min;

$t_{ДВ}$ - vehicle working time with 30 minutes interval, without load, min;

$t_{НАГР.}$ - vehicle working time with 30 minutes interval, with load, min;

t_{XX} - vehicle working time with 30 minutes interval with idle mode, min;

N_k – ***k***-type group vehicle amount working simultaneously with 30 minutes interval.

i - type substance total emission from road-vehicles is calculated with the following formula:

$$M_i = \sum_{k=1}^{k}(m_{ДВ\,ik} \cdot t'_{ДВ} + 1{,}3 \cdot m_{ДВ\,ik} \cdot t'_{НАГР.} + m_{XX\,ik} \cdot t'_{XX}) \cdot 10^{-6}, \text{ t/a};$$

Where

$t'_{ДВ}$ – ***k***- type group vehicle total working time without load, min;

$t'_{НАГР.}$ – ***k***- type group vehicle total working time with load, min;

t'_{XX} – ***k***- type group total working time with idling drive mode, min.

Specific emissions of pollutants during the operation of road-construction vehicles are given in Table 6.2.1.1.3.

Table 6.3.2.1.1.3. Specific emissions of pollutants during the operation of road-construction vehicles, g/min

Type of road-construction vehicles (RCV)	Pollutant	Driving mode	Idle mode
Caterpillar RCV, capacity 61-100 kW (83-136 horse-power)	Nitrogen dioxide (nitrogen (IV) oxide)	1,976	0,384
	Nitrogen (II) oxide	0,321	0,0624
	Particulate	0,27	0,06
	Sulphur dioxide	0,19	0,097
	Carbone oxide	1,29	2,4
	Fraction of hydrocarbons kerosene	0,43	0,3

Calculation of annual and maximum single emission of pollutants is given below:

G_{301} = (1,976·12+1,3·1,976·13+0,384·5)·1/1800 = 0,0327924 g/s;

M_{301} = (1,976·1·300·3,5·60+1,3·1,976·1·300·3,2·60+0,384·1·300·1,3·60)·10^{-6} = 0,281436 t/a;

G_{304} = (0,321·12+1,3·0,321·13+0,0624·5)·1/1800 = 0,0053272 g/s;

M_{304} = (0,321·1·300·3,5·60+1,3·0,321·1·300·3,2·60+0,0624·1·300·1,3·60)·10^{-6} = 0,04572 t/a;

G_{328} = (0,27·12+1,3·0,27·13+0,06·5)·1/1800 = 0,0045017 g/s;

M_{328} = (0,27·1·300·3,5·60+1,3·0,27·1·300·3,2·60+0,06·1·300·1,3·60)·10^{-6} = 0,038632 t/a;

G_{330} = (0,19·12+1,3·0,19·13+0,097·5)·1/1800 = 0,00332 g/s;

M_{330} = (0,19·1·300·3,5·60+1,3·0,19·1·300·3,2·60+0,097·1·300·1,3·60)·10^{-6} = 0,028467 t/a;

G_{337} = (1,29·12+1,3·1,29·13+2,4·5)·1/1800 = 0,0273783 g/s;

M_{337} = (1,29·1·300·3,5·60+1,3·1,29·1·300·3,2·60+2,4·1·300·1,3·60)·10^{-6} = 0,234025 t/a;

G_{2732} = (0,43·12+1,3·0,43·13+0,3·5)·1/1800 = 0,0077372 g/s;

M_{2732} = (0,43·1·300·3,5·60+1,3·0,43·1·300·3,2·60+0,3·1·300·1,3·60)·10^{-6} = 0,066308 t/a;

Total emission during the operation of single-bucket excavator is determined by the following formula:

$M = Q_{exc} \times E \times K_{exc} \times K_1 \times K_2 \times N/T_{sb}$, g/s, where:

Q_{exc} = Specific emission of dust from 1m^3 loaded material, g/m^3 [4,8]

E - Bucket capacity, m^3 [0,7-1]

K_{exc} - Excavator coefficient [0,91]

K_1 - Wind speed ratio (K_1=1,2);

K_2 - Moisture ratio (K_2=0,2);

N – Number of simultaneously working techniques (unit);

T_{ec} - Excavator cycle time, sec.[30]

$M = Q_{exc} \times E \times K_0 \times K1 \times K2 \times N/T_{sb}$ = 4,8*1*0,91*1,2*0,2*1/30=0,035 g/s.

Total dust emission during the operation of single-bucket excavator is determined by the following formula:

$G = M \times 3600 \times T \times 10^{-6}$ = 0,035 x 3600s x 8hr x 300day x 10^{-6} = 0,303 t/a.

6.3.2.1.2 Emissions During the Operation of Road Construction Vehicle (Bulldozer)

Gaseous emission is identical to the excavator and the maximum emissions of suspended particles shall be calculated as follows:

$G = (Q_{bull} \times Q_{density} \times V \times K_1 \times K_2 \times N)/(T_{bc} \times K_{\partial 3})$, g/s;

where:

Q_{bull} - Specific emission of dust 1 t, from the transporting material, g/t - 0,74

$Q_{density}$ - Rock density (t/m^3-1,6).

K_1 – Wind speed ratio (K_1=1,2);

K_2 - Moisture ratio (K_2=0,2);

N- Number of simultaneously working techniques (unit);

V - Prism displacement volume (m^3) 3,5

T_{bc} - Bulldozer cycle time, sec. - 80.

K_{lr} - ratio of loosening the rock (K_{lr} -1,15)

$G = (Q_{bull} \times Q_{density} \times V \times K_1 \times K_2 \times N)/(T_{bc} \times K_{lr}) = 0,74*1,6*3,5*1,2*0,2*1/(80*1,15)=0,011$ g/s

Total dust emission during the operation of bulldozer is determined by the following formula:

$G = M \times 3600 \times T \times 10^{-6} = 0,011 \times 3600$ sec $\times 8$ h $\times 300$ day $\times 10^{-6} = 0,095$ t/year.

6.3.2.1.3 Emission During the Welding Works

For the identification of pollutants emission during the welding works, the calculation methods are used by the support of specific emission (by recalculating the used electrode on unit mass) of the pollutant substances.

Welding aerosol, metal oxides and gaseous compounds are emitted in ambient air during the welding works, quantitative characteristics of which depend on the elements existing in composition of the electrodes.

The calculation of emission of pollutants is performed in accordance with [6]. Quantitative and qualitative characteristics of emissions of pollutants are given in Table 6.3.2.1.3.1.

Table 6.3.2.1.3.1. Quantitative and qualitative characteristics of emissions of pollutants

Pollutants		Maximum single emission, g/s	Annual emission, t/y
Code	Title		
123	Iron oxide	0,0010096	0,0043615
143	Manganese and its compounds	0,0000869	0,0003754
301	Nitrogen dioxide	0,0002833	0,001224
304	Carbon oxide	0,000046	0,0001989
337	Gaseous fluorides	0,0031403	0,013566
342	Hardly soluble fluorides	0,0001771	0,000765
344	Inorganic dust (70-20% SiO_2)	0,0003117	0,0013464
2908	Iron oxide	0,0001322	0,0005712

Initial data for calculation of emissions is given in Table 6.3.2.1.3.2.

Table 6.3.2.1.3.2.

Name	Design parameters		
	Characteristics, indication	Unit	Significance
Electric arc welding with unit electrodes УОНИ-13/45			
	Specific indicators of emission of the pollutant substances("x") on per unit mass K^x_m of the consumption material;		
123	Iron oxide	g/kg	10,69
143	Manganese and its compounds	g/kg	0,92
301	Nitrogen dioxide	g/kg	1,2
304	Nitric oxide	g/kg	0,195
337	Carbon oxide	g/kg	13,3
342	Fluorides	g/kg	0,75
344	Hardly soluble fluorides	g/kg	3,3
2908	Inorganic dust (70-20% SiO_2)	g/kg	1,4
	Waste normative of a single used electrode, n_o	%	15
	Annual cost of used electrode, B''	g/kg	1200
	Cost of used electrode during intensive operation, B'	g/kg	1
	Intensive work time, τ	hr	1
	Simultaneousness of the operation	-	yes

Obtained provisional markings, calculation formulas, calculating parameters and their explanations are given below.

The volume of pollutants emitted in ambient air during the welding works is determined by following formula:

$$M_{bi} = B \cdot K^x_m \cdot (1 - n_o / 100) \cdot 10^{-3}, \text{ kg/hr}$$

Where,

B - Electrode consumption, (kg/hr);
"x" - Specific emission of pollutants at the expense of K^x_m - electrode unit mass, g/kg;
n_o - Used electrode residual normative %.

When technical equipment is equipped with local draft - emission of pollutant substance from this equipment equals to mass of emission of pollutant substance – times - local draft effectiveness (in unit portion). Calculation of annual emission of the pollutant substances during electrode usage is calculated with the formula:

$M = B'' \cdot K^x_m \cdot (1 - n_o / 100) \cdot \eta \cdot 10^{-6}$, t/year

where

B'' - Electrode annual consumption, kg/year;

η - Effectiveness of local draft (in unit portion)

Maximum emission is calculated with the formula:

$$G = 10^3 \cdot M_{bi} \cdot \eta / 3600, \text{ g/sec}$$

Calculation of maximum on-time and annual emission of the pollutant substances in air is given below:
Electric arc welding with unity electrodes УОНИ-13/45

$B = 1 / 1 = 1$ kg/hr.;

123. Iron oxide
$M_{bi} = 1 \cdot 10,69 \cdot (1 - 15 / 100) \cdot 10^{-3} = 0,0090865$ kg/hr;
$M = 1200 \cdot 10,69 \cdot (1 - 15 / 100) \cdot 0,4 \cdot 10^{-6} = 0,0043615$ t/a;
$G = 10^3 \cdot 0,0090865 \cdot 0,4 / 3600 = 0,0010096$ g/s.

143. Manganese and its compounds

$M_{bi} = 1 \cdot 0,92 \cdot (1 - 15 / 100) \cdot 10^{-3} = 0,000782$ kg/hr;
$M = 1200 \cdot 0,92 \cdot (1 - 15 / 100) \cdot 0,4 \cdot 10^{-6} = 0,0003754$ t/a;
$G = 10^3 \cdot 0,000782 \cdot 0,4 / 3600 = 0,0000869$ g/s.

301. 301. Nitrogen dioxide

$M_{bi} = 1 \cdot 1,2 \cdot (1 - 15 / 100) \cdot 10^{-3} = 0,00102$ kg/hr;
$M = 1200 \cdot 1,2 \cdot (1 - 15 / 100) \cdot 1 \cdot 10^{-6} = 0,001224$ t/a;
$G = 10^3 \cdot 0,00102 \cdot 1 / 3600 = 0,0002833$ g/s.

304. Nitric oxide

$M_{bi} = 1 \cdot 0,195 \cdot (1 - 15 / 100) \cdot 10^{-3} = 0,0001658$ kg/hr;
$M = 1200 \cdot 0,195 \cdot (1 - 15 / 100) \cdot 1 \cdot 10^{-6} = 0,0001989$ t/a;
$G = 10^3 \cdot 0,0001658 \cdot 1 / 3600 = 0,000046$ g/s.

337. Carbon oxide

$M_{bi} = 1 \cdot 13,3 \cdot (1 - 15 / 100) \cdot 10^{-3} = 0,011305$ kg/hr;

$M = 1200 \cdot 13,3 \cdot (1 - 15 / 100) \cdot 1 \cdot 10^{-6} = 0,013566$ t/a;
$G = 10^3 \cdot 0,011305 \cdot 1 / 3600 = 0,0031403$ g/s.

342. Gaseous fluorides

$M_{bi} = 1 \cdot 0,75 \cdot (1 - 15 / 100) \cdot 10^{-3} = 0,0006375$ kg/hr;
$M = 1200 \cdot 0,75 \cdot (1 - 15 / 100) \cdot 1 \cdot 10^{-6} = 0,000765$ t/a;
$G = 10^3 \cdot 0,0006375 \cdot 1 / 3600 = 0,0001771$ g/s.

344. Hardly soluble fluorides

$M_{bi} = 1 \cdot 3,3 \cdot (1 - 15 / 100) \cdot 10^{-3} = 0,002805$ kg/hr;
$M = 1200 \cdot 3,3 \cdot (1 - 15 / 100) \cdot 0,4 \cdot 10^{-6} = 0,0013464$ t/a;
$G = 10^3 \cdot 0,002805 \cdot 0,4 / 3600 = 0,0003117$ g/s.

2908. Inorganic dust (70-20% SiO_2)

$M_{bi} = 1 \cdot 1,4 \cdot (1 - 15 / 100) \cdot 10^{-3} = 0,00119$ kg/hr;
$M = 1200 \cdot 1,4 \cdot (1 - 15 / 100) \cdot 0,4 \cdot 10^{-6} = 0,0005712$ t/a;
$G = 10^3 \cdot 0,00119 \cdot 0,4 / 3600 = 0,0001322$ g/s.

6.3.2.1.4 Emission from Diesel Generator

In process of stationary diesel-generator operation, harmful (pollutants) substances are allotted in the exhaust gasses into the air.

Diesel-generator device data is used for maximum one-time emission calculation, in accordance with the technical documentation (operating capacity) and annual fuel cost – for annual emission calculation.

Calculation of emission of the pollutant substances is performed in accordance with [7]. Quantitative and qualitative characteristics of emission of the polluted substances is given in Table 6.3.2.1.4.1.

Table 6.3.2.1.4.1.

Pollutants		Maximum single emission, g/s	Annual emission, t/y
Code	Name		
301	Nitrogen Dioxide (nitrogen (IV) oxide)	0,0457778	0,2064
304	Nitrogen (II) oxide	0,0074389	0,03354
328	Particulate	0,0027778	0,012855
330	Sulfur dioxide	0,0152778	0,0675

Pollutants		Maximum single emission, g/s	Annual emission, t/y
Code	Name		
337	Carbon oxide	0,05	0,225
703	Benz(a)piren	0,0000001	0,0000002
1325	Formaldehyde	0,0005972	0,002565
2732	Fraction of hydrocarbons kerosene	0,0142917	0,06429

Initial data for calculation of emission of the pollutant substances is given in Table 6.3.2.1.4.2.

Table 6.3.2.1.4.2.

Data	Capacity, kW	Fuel consumption, t/a	Specific cost, G/kW*hr
Group A. Manufacturer: EU countries, USA, Japan. Small capacity, (Ne < 73, 6 kW; n = 1000-3000 turn/min). Before repair.	50	15	250

Calculation of maximum emission of the ***i***-type pollutant substances in air from stationary diesel-generator is given below:

$$M_i = (1 / 3600) \cdot e_{Mi} \cdot P_Э, \text{ g/sec};$$

Where:

e_{Mi} - ***i***-type emission of pollutant substances from diesel generators in nominal regime conditions, g/kW*hr;

$P_Э$ - Diesel generator operation capacity, kW.

(1 / 3600) – Recalculation coefficient from hour to seconds.

Maximum annual emission of ***i***-type pollutant substance from diesel generator is determined with the formula:

$$W_{Эi} = (1 / 1000) \cdot q_{Эi} \cdot G_Т, \text{ t/year} \qquad (1.1.2)$$

Where:

$q_{Эi}$ - ***i***-type emission of pollutant substances from diesel generators on 1 kg fuel calculation, g/kg;
$G_Т$ - diesel generator annual fuel consumption, t/y;

(1 / 1000) – Recalculation coefficient from kg to tone.

Flow of exhaust gases from diesel generator is determined with the formula:

$$G_{ОГ} = 8,72 \cdot 10^{-6} \cdot b_Э \cdot P_Э, \text{ kg/sec}; \qquad (1.1.3)$$

Where:

$b_Э$ - Fuel specific cost on operation regime, g/kW*hr.

Volumetric flow of exhaust gases from diesel generator is determined with the formula:

$$Q_{ОГ} = G_{ОГ} / \gamma_{ОГ}, \text{ m}^3\text{/sec} \qquad (1.1.4)$$

Where:

γ_{OG} – Exhaust gas specific weight is determined with the formula:

$$\gamma_{OG} = \gamma_{OG(t=0°C)} / (1 + T_{OG} / 273), \text{ kg/m}^3 \qquad (1.1.5)$$

Where:

$\gamma_{OG(t=0°C)}$ - Specific weight of exhaust gases on 0°C, $\gamma_{OG(t=0°C)}$ = 1,31kg/m³ ;

T_{OG} - Temperature of exhaust gases, K.

Calculation of maximum one-time and annual emission of the pollutant substances in air is given below:

Nitrogen Dioxide (nitrogen (IV) oxide)
M = (1 / 3600) · 3,296 · 50 = 0,0457778 g/sec;

$W_Э$ = (1 / 1000) · 13,76 · 15 = 0,2064 t/year;

Nitric oxide (nitrogen (II) oxide)

M = (1 / 3600) · 0,5356 · 50 = 0,0074389 g/sec;

$W_Э$ = (1 / 1000) · 2,236 · 15 = 0,03354 t/year;

Particulate
M = (1 / 3600) · 0,2 · 50 = 0,0027778 g/sec;

$W_Э$ = (1 / 1000) · 0,857 · 15 = 0,012855 t/year;

Sulfur dioxide
M = (1 / 3600) · 1,1 · 50 = 0,0152778 g/sec;

$W_Э$ = (1 / 1000) · 4,5 · 15 = 0,0675 t/year;

Carbon oxide
M = (1 / 3600) · 3,6 · 50 = 0,05 g/sec;

$W_Э$ = (1 / 1000) · 15 · 15 = 0,225 t/year;

Benz(a)piren

M = (1 / 3600) · 0,0000037 · 50 = 0,0000001 g/sec;

$W_Э$ = (1 / 1000) · 0,000016 · 15 = 0,0000002 t/year;

Formaldehyde
M = ((1 / 3600) · 0,043 · 50 = 0,0005972 g/sec;

$W_Э$ = (1 / 1000) · 0,171 · 15 = 0,002565 t/year;

Fraction of hydrocarbons kerosene
M = (1 / 3600) · 1,029 · 50 = 0,0142917 g/sec;

$W_Э$ = (1 / 1000) · 4,286 · 15 = 0,06429 t/year;

Volumetric flow of exhaust gases are given below.
G_{OG} = 8,72 · 10^{-6} · 250 · 50 = 0,109 kg/sec.

- Up to 5 meters height, T_{OG} = 723 K (450 °C):

γ_{OG} = 1,31 / (1 + 723 / 273) = 0,359066 kg/m³

Q_{OG} = 0,109 / 0,359066 = 0,3036 m³/sec

6.3.2.1.5 Emission from Diesel Fuel Tank

Ambient air pollution source is a breathing valve of the tank while conserving (small breathe) the oil product and when loading (big breathe). Climate zone – 3.

The calculation of emission of the pollutant substances is performed in accordance with [8]. Quantitative and qualitative characteristics of emission of the polluted substances are given in Table 6.3.2.1.5.1.

Table 6.3.2.1.5.1.

Pollutants		Maximum single emission, g/s	Annual emission, t/y
Code	Title		Code
333	Dihydrogen sulphide (Hydrogen Sulphide)	0,000055	0,00001
2754	Alkanes C_{12}-C_{19} (Saturated hydrocarbons C_{12}-C_{19})	0,0195	0,0038

Initial data for emission calculation is given in Table 6.3.2.1.5.2.

Table 6.3.2.1.5.2.

Product	Amount per year, t/y		Tank Design	Pump capacity, m^3/hr	Tank capacity, m^3	Number of tanks	Simultaneousness
	$B_{aut\text{-}win}$	$B_{sum\text{-}spr}$					
Diesel fuel. Group A. Fluid temperature is close to the ambient air temperature	150	150	Surface vertical. Operation regime – "measuring". No emission limiting system.	20	50	4	+

Obtained provisional marking, calculation formulas, calculating parameters and their explanations are given below.

Oil product vapor maximum emission is calculated with the formula:

$$M = (C_1 \cdot K^{max}_p \cdot V^{max}_ч) / 3600, \text{ g/s};$$

Oil product vapor annual emission is calculated with the formula:

$$G = (y_2 \cdot B_{оз} + y_3 \cdot B_{вл}) \cdot K^{max}_p \cdot 10^{-6} + G_{хр} \cdot K_{нп} \cdot N, \text{ t/a}.$$

Where:

y_2, y_3 – Average specific emission diesel fuel tank during a year for autumn-winter and spring-summer periods g/t is obtained according to Annex 12.

$B_{оз}, B_{вл}$ – Liquid amount to be loaded in diesel fuel tanks in autumn-winter and spring-summer periods, t.

K^{max}_p - Coefficient as a result of test is obtained according to Annex 8.

$G_{хр}$ - Oil product vapor emission while keeping per tank, t/y ; obtained according to Annex 13.

$K_{нп}$ - Coefficient as a result of test, obtained according to Annex 12.

N – Number of tanks.

Calculation of maximum one-time and annual emission of the pollutant substances in air is given below:
Diesel fuel

$M = 3,92 \cdot 0,9 \cdot 20 / 3600 = 0,0196$ g/s;

$G = (2,36 \cdot 150 + 3,15 \cdot 150) \cdot 0,9 \cdot 10^{-6} + 0,27 \cdot 0,0029 \cdot 4 = 0,0038759$ t/a;

333 Dihydrogen sulphide (Hydrogen Sulphide)

M = 0,0196 · 0,0028 = 0,0000549 g/s;

G = 0,0038759 · 0,0028 = 0,0000109 t/a;

2754 Alkanes C_{12}-C_{19} (Saturated hydrocarbons C_{12}-C_{19})

M = 0,0196 · 0,9972 = 0,0195451 g/s;

G = 0,0038759 · 0,9972 = 0,003865 t/a;

6.3.2.1.6 Maximum Permissible Concentrations of Harmful Substances in Ambient Air

Emission of harmful substances is expected during the operational phase of the plant. The maximum single and daily average maximum permissible concentrations are given in Table 6.3.2.1.6.1.

Table 6.3.2.1.6.1. Maximum permissible concentrations of harmful substances in ambient air

№	Harmful substances	Code	Maximum permissible concentrations mg/m³	
			Maximum single	Maximum daily
1	Nitrogen dioxide	0301	0,2	0,04
2	Nitrogen oxide	0304	0,4	0,06
3	Particulate	0328	0,15	0,05
4	Sulfur dioxide	0330	0,5	0,05
5	Hydrogen Sulfide	0333	0,008	-
6	Carbon monoxide	0337	5,0	3,0
12	Benz(a)piren	0703	-	0,000001
13	Hydrocarbon oil fraction	2732	1,2	-
14	Formaldehyde	1325	0,035	0,003
15	Saturated hydrocarbons C_{12}-C_{19}	2754	1,0	-
16	Dust: 70-20% SiO_2	2908	0,3	0,1
17	Dust: <70-20% SiO_2	2909	0,5	0,15

6.3.2.1.7 Conclusion

Based on the requirements of the Minister of Environment and Natural Resources Protection of Georgia, areas where there are resort areas, hospitals, outpatient facilities, etc., MPC accepted 20% more stringent (MPL 0.8) than the norm is adopted.

The calculations showed that ambient air pollutants emitted by pollution sources during the construction phase do not exceed maximum permissible concentrations of harmful substances. MACs will not be exceeded in standardized area of 500 meters as well.

6.3.2.2 Operation Phase

Usually, degradation of organic matter in the wastewater treatment process is accompanied by a large amount of hydrogen sulfide (H_2S) emissions, which is the source of foul odor spread. Hydrogen sulfide is generated mainly during anaerobic treatment of wastewater. Emissions of harmful substances during the operation of the treatment plant are calculated in the following Paragraph.

6.3.2.2.1 Calculation of Harmful Substances Emitted in Ambient Air

Ambient air pollution is expected due to the technological processes of Kutaisi wastewater treatment plant. Pollutants will be emitted into the ambient air from water surface and during its evaporation. These emissions are stationary sources of air pollution.

Emission sources are: Intake chamber, aerobic sand filter, primary settler (with pumping station), air tank, final settling tank (sludge tank), primary thickener (secondary settler), primary mechanical thickener (sludge compressor), sludge storage, sediment compressor (dehydration of sludge). (g-1).

The calculation is performed in accordance with [2, 3, 9].

Calculation of maximum emission of the ***i***-type pollutant substances in air is given below:

$$M_{ic}^{c} = M_{iB} + M_{is}, \text{ g/sec}$$

Where:

M_{iB} - ***i***-type emission of pollutant substances, emitted in a time unit as a result of evaporation from the surface of the device (g/sec).

M_{is} - ***i***-type emission of pollutant substances, emitted in a time unit from separate aerobic device (g/sec).

$$M_{iB} = 5{,}47 * 10^{-8} * (1{,}312+U) * F * C_i * K_2 / m^{0,5} * (t_{ж}+273) \text{ g/s}$$

Where:

U - wind speed m/sec;
F – total surface area of separate device m^2;
F_O - the area of open surface of separate device m^2;
K_2 - coefficient, depending on the device covered surface ratio F_0/F, which is obtained according to the Table;
C_i - concentration in saturated vapor of ***i***-type emission of pollutant substances (mg/m^3)
(C_i - in case of concentration absence, it is possible to calculate it)

$$C_i = 120 * (m_i * n_i/273 + t_{ж}) * 10^{A-B/(c+t)}$$

Where:

n_i - volumetric share of pollutant substances in water that should be treated;
A,B,C – Constants for the Antoine Equation;
m_i - Relative molecular mass of ***i***-type pollutant substances is given in Annex [10];
$t_{ж}$ - Waste water temperature,°C, average temperature of the flow 18 °C.

$$M_{is} = 0.001 \cdot Q_j \cdot C_i, \text{ g/sec.}$$

Where,
Q_j - Aeration air flow of purifying water for separate j-type devices (m^3/sec);

The total volume of ***i***-type pollutant substances that are emitted annually from separate devices, are calculated according to the following formula:

$$M_{ic}^{annual} = 0{,}0036 * M * t \text{ , t/a.}$$

Where,
t - annual operation time of the device, hr.

Coefficient of the covered surface of the device - K_2 – is determined by the ratio - F_0/F , Where F-is the total surface area of each device, while F_0 - is open surface area of separate device.

Table 6.3.2.2.1.1.

F_0/F	0,0001	0,001	0,01	0,1	0,5	0,8	>0,8
K_2	0	0,01	0,1	0,2	0,3	0,6	1,0

Intermediate value of coefficient **K_2** for **F_0/F** is determined according to the following formula:

Interval	Interpolarised formula K_2
$F_O/F <= 0,0001$	0
$0,0001<F_O/F<=0,01$	$10 \times F_O/F$
$0,01<F_O/F<=0,1$	$(F_O/F + 0,08) / 0,9$
$0,1<F_O/F<=0,5$	$0,25 \times F_O/F + 0,175$
$0,5 < F_O/F <= 0,8$	$F_O/F - 0,2$
$F_O/F > 0,8$	1

Table 6.3.2.2.1.2. Design parameters of pollutants emission

Name	Molecular mass	Constants for the Antoine Equation		
		A	B	C
Nitrogen dioxide	46,01	20,5324	4141,29	3,65
Ammonia	17,03	16,9481	2132,50	-32,98
Hydrogen sulphide	34,08	16,1040	1768,69	-26,06
Carbon oxide	28,01	14,3686	530,22	-34,44
Methane	16,03	15,2243	897,84	-7,16
Methyl mercaptan	48,11	16,1909	2338,38	-34,44
Ethyl mercaptan	62,13	16,0077	2497,23	-41,77

Concentration of pollutants in the saturated vapor (mg / m^3) in aerobic treatment facilities are given in Table 6.3.2.2.1.3.

Table 6.3.2.2.1.3.

№	Name of device	Hydrogen sulphide	Ammonia	Ethyl mercaptan	Methyl mercaptan	Carbon oxide	Nitrogen dioxide	Methane
1	Intake chamber	0,0032	0,022	0,0000021	0,0000037	0,069	0,0036	1,25
2	Aerobic sand filter	0,0014	0,014	0,0000013	0,0000027	0,065	0,0038	0,19
3	Primary settler - with pumping station	0,0012	0,01	0,0000015	0,0000027	0,068	0,0037	0,14
4	Air tank	0,0012	0,011	0,0000011	0,0000027	0,06	0,0038	0,17
5	Final settling tank - sludge tank	0,0022	0,018	0,0000014	0,0000028	0,068	0,0039	2,04
6	Primary thickener - secondary settler	0,0011	0,01	0,0000011	0,0000027	0,061	0,0035	0,15
7	Primary mechanical thickener - sludge compressor	0,0014	0,015	0,0000015	0,0000031	0,068	0,0035	0,33
8	Sludge storage	0,0010	0,01	0,0000013	0,0000027	0,060	0,0038	0,15

9	Sediment compressor - dehydration of sludge	0,0025	0,017	0,0000016	0,0000034	0,068	0,0032	2,13

6.3.2.2.2 Calculation of Emissions

Calculation of emission from intake chamber: 1

$M_{301} = 5,47 * 10^{-8} * (1,312+5,1) * 150 * 0,0036 * 1 / 46,01^{0,5} * (18+273) = 0.00000813$ g/s
$M_{301} = 0.00000813$ g/s * 3600 s * 24hr * 365day * $10^{-6} = 0.00026$ t/a

$M_{303} = 5,47 * 10^{-8} * (1,312+5,1) * 150 * 0,022 * 1 / 17,03^{0,5} * (18+273) = 0.0000816$ g/s
$M_{303} = 0.0000816$ g/s * 3600s * 24 hr * 365 day * $10^{-6} = 0.002533$ t/a

$M_{333} = 5,47 * 10^{-8} * (1,312+5,1) * 150 * 0,0032 * 1 / 34,08^{0,5} * (18+273) = 0.00000839$ g/s
$M_{333} = 0.00000839$ g/s * 3600s * 24 hr * 365 day * $10^{-6} = 0.0002645$ t/a

$M_{337} = 5,47 * 10^{-8} * (1,312+5,1) * 150* 0,069 * 1 / 28,01^{0,5} * (18+273) = 0.0001996$ g/s
$M_{337} = 0.0001996$ g/s * 3600s * 24 hr * 365 day * $10^{-6} = 0.0062945$ t/a

$M_{410} = 5,47 * 10^{-8} * (1,312+5,1) * 150 * 1.25 * 1 / 16,03^{0,5} * (18+273) = 0.0047798$ g/s
$M_{410} = 0.0047798$ g/s * 3600s * 24 hr * 365 day * $10^{-6} = 0.150735$ t/a

$M_{1715} = 5,47 * 10^{-8} *(1,312+5,1)* 150 * 0,0000037 * 1 / 48,11^{0,5} * (18+273) = 0.00000000816$ g/s
$M_{1715} = 0.00000000816$ g/s * 3600s * 24 hr * 365 day * $10^{-6} = 0.0000002573$ t/a

$M_{1728} = 5,47 * 10^{-8} * (1,312+5,1) * 150 * 0,0000021 * 1 / 62,13^{0,5} *(18+273) = 0.00000000407$ g/s
$M_{1728} = 0.00000000407$ g/s * 3600s * 24 hr * 365 day * $10^{-6} = 0.000000128$ t/a

Calculation of emission from aerobic sand filter: 2

$M_{301} = 5,47 * 10^{-8} * (1,312+5,1) * 60 * 0,0038 * 1 / 46,01^{0,5} * (18+273) = 0.00000343$ g/s
$M_{301} = 0.00000343$ g/s * 3600s * 24hr * 365 day * $10^{-6} = 0.0001081$ t/a

$M_{303} = 5,47 * 10^{-8} * (1,312+5,1) * 60 * 0,014* 1 / 17,03^{0,5} * (18+273) = 0.0000207$ g/s
$M_{303} = 0.0000207$ g/s * 3600s * 24hr * 365 day * $10^{-6} = 0.0006527$ t/a

$M_{333} = 5,47 * 10^{-8} * (1,312+5,1) * 60 * 0.0014 * 1 / 34,08^{0,5} * (18+273) = 0.00000146$ g/s
$M_{333} = 0.00000146$ g/s * 3600s * 24hr * 365 day * $10^{-6} = 0.00004604$ t/a

$M_{337} = 5,47 * 10^{-8} * (1,312+5,1) * 60 * 0,065 * 1 / 28,01^{0,5} * (18+273) = 0.0000752$ g/s
$M_{337} = 0.0000752$ g/s * 3600s * 24hr * 365 day * $10^{-6} = 0.002371$ t/a

$M_{410} = 5,47 * 10^{-8} * (1,312+5,1) * 60 * 0.19 * 1 / 16,03^{0,5} * (18+273) = 0.0002906$ g/s
$M_{410} = 0.0002906$ g/s * 3600s * 24hr * 365 day * $10^{-6} = 0.009164$ t/a

$M_{1715} = 5,47 * 10^{-8} * (1,312+5,1) * 60 * 0,0000027* 1/48,11^{0,5} *(18+273) = 0.00000000238$ g/s
$M_{1715} = 0.00000000238$ g/s * 3600s * 24hr * 365 day * $10^{-6} = 0.000000075$ t/a

$M_{1728} = 5,47 * 10^{-8} * (1,312+5,1) * 60 * 0,0000013 * 1/62,13^{0,5} * (18+273) = 0.00000000101$ g/s
$M_{1728} = 0.00000000101$ g/s * 3600s * 24hr * 365 day * $10^{-6} = 0.0000000318$ t/a

Calculation of emission from primary settler with pumping station: 3

$M_{301} = 5,47 * 10^{-8} * (1,312+5,1) * 300 * 0,0037 * 1 / 46,01^{0,5} * (18+273) = 0.0000167$ g/s
$M_{301} = 0.0000167$ g/s * 3600s* 24hr * 365fay * $10^{-6} = 0.000526$ t/a

$M_{303} = 5,47 * 10^{-8} * (1,312+5,1) * 300 * 0,01* 1 / 17,03^{0,5} * (18+273) = 0.0000742$ g/s
$M_{303} = 0.0000742$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.002339$ t/a

$M_{333} = 5,47 * 10^{-8} * (1,312+5,1) * 300 * 0,0012 * 1 / 34,08^{0,5} * (18+273) = 0.00000629$ g/s
$M_{333} = 0.00000629$ g/s * 3600s * 24hr* 365day * $10^{-6} = 0.0001983$ t/a

$M_{337} = 5,47 * 10^{-8} * (1,312+5,1) * 300 * 0,068 * 1 / 28,01^{0,5} * (18+273) = 0.0003934$ g/s
$M_{337} = 0.0003934$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.012406$ t/a

$M_{410} = 5,47 * 10^{-8} * (1,312+5,1) * 88,0 * 0.14 * 1 / 16,03^{0,5} * (18+273) = 0.00107$ g/s
$M_{410} = 0.00107$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.03374$ t/a

$M_{1715} = 5,47 * 10^{-8} * (1,312+5,1) * 300 * 0,0000027 * 1/48,11^{0,5} * (18+273) = 0.0000000119$ g/s
$M_{1715} = 0.0000000119$ g/s * 3600s* 24hr * 365day * $10^{-6} = 0.000000375$ t/a

$M_{1728} = 5,47 * 10^{-8} * (1,312+5,1) * 300 * 0,0000015 * 1/62,13^{0,5} * (18+273) = 0.00000000582$ g/s
$M_{1728} = 0.00000000582$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.000000183$ t/a

Calculation of emission from air tank: 4

$M_{iB\ 301} = 5,47 * 10^{-8} * (1,312+5,1) * 2880 * 0,0038 * 1 / 46,01^{0,5} * (18+273) = 0.000165$ g/s
$M_{is\ 301} = 0,001 * 7.85 * 0,0038 = 0.00002983$ g/s
$M_{ic}^{c} = 0.000165 + 0.00002983 = 0.000195$ g/s
$M_{301} = 0.000195$ g/s * 3600s * 24hr* 365day* $10^{-6} = 0.00615$ t/a

$M_{303} = 5,47 * 10^{-8} * (1,312+5,1) * 2880 * 0,011 * 1 / 17,03^{0,5} * (18+273) = 0.000783531$ g/s
$M_{is\ 303} = 0,001 * 7.85 * 0,011 = 0.00008635$ g/s
$M_{ic}^{c} = 0.000783531 + 0.00008635 = 0.000682$ g/s
$M_{303} = 0.000682$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.027184$ t/a

$M_{333} = 5,47 * 10^{-8} * (1,312+5,1) * 2880 * 0,0012 * 1 / 34,08^{0,5} * (18+273) = 0.0000604$ g/s
$M_{is\ 333} = 0,001 * 7.85 * 0,0012 = 0.00000942$ g/s
$M_{ic}^{c} = 0.0000604 + 0.00000942 = 0.00006982$ g/s
$M_{333} = 0.00006982$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.002202$ t/a

$M_{337} = 5,47 * 10^{-8} * (1,312+5,1) * 2880 * 0,06 * 1 / 28,01^{0,5} * (18+273) = 0.003332$ g/s
$M_{is\ 337} = 0,001 * 7,85 * 0,06 = 0.000471$ g/s
$M_{ic}^{c} = 0.003332 + 0.000471 = 0.003803$ g/s
$M_{337} = 0.003803$ g/s * 3600s * 24hr* 365day * $10^{-6} = 0.119931$ t/a

$M_{410} = 5,47 * 10^{-8} * (1,312+5,1) * 2880 * 0.17 * 1 / 16,03^{0,5} * (18+273) = 0.012481$g/s
$M_{is\ 410} = 0,001 * 7.85 * 0.17 = 0.001334$ g/s.
$M_{ic}^{c} = 0.012481 + 0.001334 = 0.013815$ g/s
$M_{410} = 0.013815$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.43567$ t/a

$M_{1715} = 5,47 * 10^{-8} * (1,312+5,1) * 2880 * 0,0000027 * 1/48,11^{0,5} * (18+273) = 0.000000114$ g/s
$M_{is\ 1715} = 0,001 * 7.85 * 0,0000027 = 0.0000000212$ g/s
$M_{ic}^{c} = 0.000000114 + 0.0000000212 = 0.000000135$ g/s
$M_{1715} = 0.000000135$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.00000425$ t/a

$M_{1728} = 5,47 * 10^{-8} * (1,312+5,1) * 2880 * 0,0000011 * 1/62,13^{0,5} * (18+273) = 0.000000041$ g/s
$M_{is\ 1728} = 0,001 * 7.85 * 0,0000011 = 0.0000000086$ g/s
$M_{ic}^{c} = 0.000000041 + 0.0000000086 = 0.000000049$ g/s
$M_{1728} = 0.000000049$ g/s * 3600s* 24hr* 365day * $10^{-6} = 0.00000154$ t/a

Calculation of emission from final settling tank - sludge tank: 5

$M_{301} = 5,47 * 10^{-8} * (1,312+5,1) * 1430 * 0,0039 * 1 / 46,01^{0,5} * (18+273) = 0.0000839$ g/s
$M_{301} = 0.0000839$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.002645$ t/a

$M_{303} = 5,47 * 10^{-8} * (1,312+5,1) * 1430 * 0,018 * 1 / 17,03^{0,5} * (18+273) = 0.000636$ g/s
$M_{303} = 0.000636$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.020056$ t/a

$M_{333} = 5,47 * 10^{-8} * (1,312+5,1) * 1430 * 0,0022 * 1 / 34,08^{0,5} * (18+273) = 0.000055$ g/s
$M_{333} = 0.000055$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.001734$ t/a

$M_{337} = 5,47 * 10^{-8} * (1,312+5,1) * 1430 * 0,068 * 1 / 28,01^{0,5} * (18+273) = 0.001875$ g/s
$M_{337} = 0.001875$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.05913$ t/a

$M_{410} = 5,47 * 10^{-8} * (1,312+5,1) * 1430 * 2,04 * 1 / 16,03^{0,5} * (18+273) = 0.074367$ g/s
$M_{410} = 0.074367$ g/s * 3600s * 24hr * 365day * $10^{-6} = 2.34523$ t/a

$M_{1715} = 5,47 * 10^{-8} * (1,312+5,1) * 1430 * 0,0000028 * 1/48,11^{0,5} * (18+273) = 0.0000000589$ g/s
$M_{1715} = 0.0000000589$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.00000185$ t/a

$M_{1728} = 5,47 * 10^{-8} * (1,312+5,1) * 1430 * 0,0000014 * 1/62,13^{0,5} * (18+273) = 0.0000000259$ g/s
$M_{1728} = 0.0000000259$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.000000816$ t/a

Calculation of emission from primary thickener - secondary settler: 6

$M_{301} = 5,47 * 10^{-8} * (1,312+5,1) * 65 * 0,0035 * 1 / 46,01^{0,5} * (18+273) = 0.00000342$ g/s
$M_{301} = 0.0000753$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.000107$ t/a

$M_{303} = 5,47 * 10^{-8} * (1,312+5,1) * 65 * 0,01 * 1 / 17,03^{0,5} * (18+273) = 0.0000016$ g/s
$M_{303} = 0.0000016$ g/s * 3600s * 24hr * 365day* $10^{-6} = 0.0000504$ t/a

$M_{333} = 5,47 * 10^{-8} * (1,312+5,1) * 65 * 0,0011 * 1 / 34,08^{0,5} * (18+273) = 0.00000125$ g/s
$M_{333} = 0.00000125$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.0000394$ t/a

$M_{337} = 5,47 * 10^{-8} * (1,312+5,1) * 65 * 0,061 * 1 / 28,01^{0,5} * (18+273) = 0.0000764$ g/s
$M_{337} = 0.0000764$ g/s * 3600s * 24hr * 365day* $10^{-6} = 0.002409$ t/a

$M_{410} = 5,47 * 10^{-8} * (1,312+5,1) * 65 * 0.15 * 1 / 16,03^{0,5} * (18+273) = 0.0002485$ g/s
$M_{410} = 0.0002485$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.007837$ t/a

$M_{1715} = 5{,}47 * 10^{-8} * (1{,}312+5{,}1) * 65 * 0{,}0000027 * 1/48{,}11^{0{,}5} * (18+273) = 0.00000000258$ g/s
$M_{1715} = 0.00000000258$ g/s * 3600s* 24hr * 365day * $10^{-6} = 0.0000000813$ t/a

$M_{1728} = 5{,}47 * 10^{-8} * (1{,}312+5{,}1) * 65 * 0{,}0000011 * 1/62{,}13^{0{,}5} * (18+273) = 0.000000000925$ g/s
$M_{1728} = 0.000000000925$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.0000000291$ t/a

Calculation of emission from primary mechanical thickener - sludge compressor: 7

$M_{301} = 5{,}47 * 10^{-8} * (1{,}312+5{,}1) * 108 * 0{,}0035 * 1 / 46{,}01^{0{,}5} * (18+273) = 0.00000568$ g/s
$M_{301} = 0.00000568$ g/s * 3600s * 24hr* 365day * $10^{-6} = 0.0001791$ t/a

$M_{303} = 5{,}47 * 10^{-8} * (1{,}312+5{,}1) * 108 * 0{,}015 * 1 / 17{,}03^{0{,}5} * (18+273) = 0.00004$ g/s
$M_{303} = 0.000004$ g/s * 3600s * 24hr * 365day* $10^{-6} = 0.00126$ t/a

$M_{333} = 5{,}47 * 10^{-8} * (1{,}312+5{,}1) * 108 * 0{,}0014 * 1 / 34{,}08^{0{,}5} * (18+273) = 0.00000264$ g/s
$M_{333} = 0.00000264$ g/s * 3600s * 24hr * 365day* $10^{-6} = 0.00008325$ t/a

$M_{337} = 5{,}47 * 10^{-8} * (1{,}312+5{,}1) * 108 * 0{,}068 * 1 / 28{,}01^{0{,}5} * (18+273) = 0.0001416$ g/s
$M_{337} = 0.0001416$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.004465$ t/a

$M_{410} = 5{,}47 * 10^{-8} * (1{,}312+5{,}1) * 108 * 0{,}33 * 1 / 16{,}03^{0{,}5} * (18+273) = 0.000908$ g/s
$M_{410} = 0.000908$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.028634$ t/a

$M_{1715} = 5{,}47 * 10^{-8} * (1{,}312+5{,}1) * 108 * 0{,}0000031 * 1/48{,}11^{0{,}5} * (18+273) = 0.00000000492$ g/s
$M_{1715} = 0.00000000492$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.000000155$ t/a

$M_{1728} = 5{,}47 * 10^{-8} * (1{,}312+5{,}1) * 108 * 0{,}0000015 * 1/62{,}13^{0{,}5} * (18+273) = 0.00000000209$ g/s
$M_{1728} = 0.00000000209$ g/s * 3600s * 24hr * 365day* $10^{-6} = 0.0000000659$ t/a

Calculation of emission from sludge tank: 8

$M_{301} = 5{,}47 * 10^{-8} * (1{,}312+5{,}1) * 65 * 0{,}0038 * 1 / 46{,}01^{0{,}5} * (18+273) = 0.000003716$ g/s
$M_{301} = 0.000003716$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.000117$ t/a

$M_{303} = 5{,}47 * 10^{-8} * (1{,}312+5{,}1) * 65 * 0{,}01 * 1 / 17{,}03^{0{,}5} * (18+273) = 0.000016$ g/s
$M_{303} = 0.000016$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.000504$ t/a

$M_{333} = 5{,}47 * 10^{-8} * (1{,}312+5{,}1) * 65 * 0{,}0010 * 1 / 34{,}08^{0{,}5} * (18+273) = 0.00000113$ g/s
$M_{333} = 0.00000113$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.0000356$ t/a

$M_{337} = 5{,}47 * 10^{-8} * (1{,}312+5{,}1) * 65 * 0{,}060 * 1 / 28{,}01^{0{,}5} * (18+273) = 0.0000752$ g/s
$M_{337} = 0.0000752$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.002371$ t/a

$M_{410} = 5{,}47 * 10^{-8} * (1{,}312+5{,}1) * 65 * 0.15 * 1 / 16{,}03^{0{,}5} * (18+273) = 0.0002485$ g/s
$M_{410} = 0.0002485$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.007837$ t/a

$M_{1715} = 5{,}47 * 10^{-8} * (1{,}312+5{,}1) * 65 * 0{,}0000027 * 1/48{,}11^{0{,}5} * (18+273) = 0.00000000258$ g/s
$M_{1715} = 0.00000000258$ g/s * 3600s * 24hr* 365day * $10^{-6} = 0.0000000813$ t/a

$M_{1728} = 5,47 * 10^{-8} * (1,312+5,1) * 65 * 0,0000013 * 1/62,13^{0,5} * (18+273) = 0.00000000109$ g/s
$M_{1728} = 0.00000000109$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.0000000343$ t/a

Calculation of emission from sediment compressor - dehydration of sludge: 9

$M_{301} = 5,47 * 10^{-8} * (1,312+5,1) * 106 * 0,0032 * 1 / 46,01^{0,5} * (18+273) = 0.0000051$ g/s
$M_{301} = 0.000003716$ g/s * 3600s * 24hr* 365dat * $10^{-6} = 0.0001608$ t/a

$M_{303} = 5,47 * 10^{-8} * (1,312+5,1) * 106 * 0,017 * 1 / 17,03^{0,5} * (18+273) = 0.0000445$ g/s
$M_{303} = 0.0000445$ g/s * 3600s * 24hr* 365day * $10^{-6} = 0.001403$ t/a

$M_{333} = 5,47 * 10^{-8} * (1,312+5,1) * 106 * 0,0025 * 1 / 34,08^{0,5} * (18+273) = 0.00000463$ g/s
$M_{333} = 0.00000463$ g/s * 3600s* 24hr * 365day* $10^{-6} = 0.00014601$ t/a

$M_{337} = 5,47 * 10^{-8} * (1,312+5,1) * 106 * 0,068 * 1 / 28,01^{0,5} * (18+273) = 0.000139$ g/s
$M_{337} = 0.000139$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.004383$ t/a

$M_{410} = 5,47 * 10^{-8} * (1,312+5,1) * 106 * 2,13 * 1 / 16,03^{0,5} * (18+273) = 0.005755$ g/s
$M_{410} = 0.005755$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.18148$ t/a

$M_{1715} = 5,47 * 10^{-8} * (1,312+5,1) * 106 * 0,0000034 * 1/48,11^{0,5} * (18+273) = 0.0000000053$ g/s
$M_{1715} = 0.0000000053$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.000000167$ t/a

$M_{1728} = 5,47 * 10^{-8} * (1,312+5,1) * 106 * 0,0000016 * 1/62,13^{0,5} * (18+273) = 0.00000000219$ g/s
$M_{1728} = 0.00000000219$ g/s * 3600s * 24hr * 365day * $10^{-6} = 0.000000069$ t/a

Total Emission of Pollutants:

Name	Max. Single emission, g/sec	Total emission, t/a
Nitrogen dioxide	0,000325076	0,010253
Ammonia	0,001596	0,0559821
Hydrogen sulphide	0,0001506	0,0047491
Carbon oxide	0,0067784	0,2137605
Methane	0,101482	3,200327
Methyl mercaptan	0,000000231	0,00000729
Ethyl mercaptan	0,000000092	0,00000289

6.3.2.2.3 Parameters of Atmospheric Emissions

Parameters of atmospheric emissions are given in Tables 6.3.2.2.3.1.- 6.3.2.2.3.4.

Table 6.3.2.2.3.1. Characterization of sources of emissions of harmful substances

Name of the station, device or site	Source of emission of harmful substances			Source of generation of harmful substances					Harmful substances		Volume of harmful substances emitted from a source, t/a
	#*	Name	Number	#*	Name	Number	Daily working time	Number of working days in a year	Name	Code	
1	2	3	4	5	6	7	8	9	10	11	12
Aerobic wastewater treatment system	გ-1 გ-1	Unorganized	1 1	1	Intake chamber 150m²	7	24	8760	Nitrogen dioxide	301	0,00026
									Ammonia	303	0,002533
									Hydrogen sulphide	333	0,0002645
									Carbon oxide	337	0,0062945
									Methane	410	0,150735
									Methyl mercaptan	1715	0,0000002573
									Ethyl mercaptan	1728	0,000000128
				2	Aerobic sand filter 60 m²	7	24	8760	Nitrogen dioxide	301	0,0001081
									Ammonia	303	0,0006527
									Hydrogen sulphide	333	0,00004604
									Carbon oxide	337	0,002371
									Methane	410	0,009164
									Methyl mercaptan	1715	0,000000075
									Ethyl mercaptan	1728	0,0000000318
				3	Primary settler with pumping station 300m²	7	24	8760	Nitrogen dioxide	301	0,000526
									Ammonia	303	0,002339
									Hydrogen sulphide	333	0,0001983
									Carbon oxide	337	0,012406
									Methane	410	0,03374
									Methyl mercaptan	1715	0,000000375
									Ethyl mercaptan	1728	0,000000183
				4	Air tank 2880 m²	7	24	8760	Nitrogen dioxide	301	0,00615
									Ammonia	303	0,027184
									Hydrogen sulphide	333	0,002202
									Carbon oxide	337	0,119931
									Methane	410	0,43567
									Methyl mercaptan	1715	0,00000425
									Ethyl mercaptan	1728	0,00000154
ჩამდინარე წყლის აერაციული		არაორგანიზებული		5	Final settling tank (sludge tank) 1430 m²	7	24	8760	Nitrogen dioxide	301	0,002645
									Ammonia	303	0,020056
									Hydrogen sulphide	333	0,001734

სადგური									Carbon oxide	337	0,05913
									Methane	410	2,34523
									Methyl mercaptan	1715	0,00000185
									Ethyl mercaptan	1728	0,000000816
				6	Primary thickener (secondary settler) 65 m^2	7	24	8760	Nitrogen dioxide	301	0,000107
									Ammonia	303	0,0000504
									Hydrogen sulphide	333	0,0000394
									Carbon oxide	337	0,002409
									Methane	410	0,007837
									Methyl mercaptan	1715	0,0000000813
									Ethyl mercaptan	1728	0,0000000291
				7	Primary mechanical thickener (sludge compressor) 108 m^2	7	24	8760	Nitrogen dioxide	301	0,0001791
									Ammonia	303	0,00126
									Hydrogen sulphide	333	0,00008325
									Carbon oxide	337	0,004465
									Methane	410	0,028634
									Methyl mercaptan	1715	0,000000155
									Ethyl mercaptan	1728	0,0000000659
				8	Sludge storage 65m^2	7	24	8760	Nitrogen dioxide	301	0,000117
									Ammonia	303	0,000504
									Hydrogen sulphide	333	0,0000356
									Carbon oxide	337	0,002371
									Methane	410	0,007837
									Methyl mercaptan	1715	0,0000000813
									Ethyl mercaptan	1728	0,0000000343
				9	sediment compressor (dehydration of sludge)106m^2	7	24	8760	Nitrogen dioxide	301	0,0001608
									Ammonia	303	0,001403
									Hydrogen sulphide	333	0,00014601
									Carbon oxide	337	0,004383
									Methane	410	0,18148
									Methyl mercaptan	1715	0,000000167
									Ethyl mercaptan	1728	0,000000069

Table 6.3.2.2.3.2. Description of sources of emissions of harmful substances

# of emission sources	Parameters of emission sources		Parameters of dust/gas/air mixture near the outlet of the emission sources			Code of harmful substances	Volume of emitted harmful substances		Coordinates of emission sources in coordinate system of the facility, m					
									Point source		Linear source			
											First end		Second end	
	Height	Diameter or dimension of cross-section	Velocity, m/sec	volume, m^3/sec	Temperature, t^0C		g/s	t/a	X	Y	X_1	Y_1	X_2	Y_2
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
∂-1	2	-	-	-	18	301	0,000325076	0,010253	-	-	49,0	45,0	133,0	5,0
						303	0,001596	0,0559821						
						333	0,0001506	0,0047491						
						337	0,0067784	0,2137605						
						410	0,101482	3,200327						
						1715	0,000000231	0,00000729						
						1728	0,000000092	0,00000289						

Table 6.3.2.2.3.3. Description of air filter and dust collector

Harmful substance			Air filter and dust collector		Concentration of harmful substances, g/m^3		Quality of purification of air filter and dust collector, %	
# of source of generation of harmful substances	# of source of emission of harmful substances	Code	Name	Number, unit	Prior to the treatment	After the treatment	Design	Actual
1	2	3	4	5	6	7	8	9

Air filter and dust collector are not considered in technological cycle

Table 6.3.2.2.3.4. Atmospheric emissions, their treatment and utilization

Harmful substance		Volume of harmful substances emitted from sources (column 4 column 6)	Including			Trapped		Total volume of emissions (column 3-column 7)	% of trapped emissions compared to emitted (column 7/ column.3)X 100
Code	Name		Emitted without treatment		Passed the treatment facility	Total	Utilized Total		
			Total	From organized emission sources					
1	2	3	4	5	6	7	8	9	10
301	Nitrogen dioxide	0,010253	0,010253	-	-	-	-	0,010253	0,00
303	Ammonia	0,0559821	0,0559821	-	-	-	-	0,0559821	0,00
333	Hydrogen sulphide	0,0047491	0,0047491	-	-	-	-	0,0047491	0,00
337	Carbon oxide	0,2137605	0,2137605	-	-	-	-	0,2137605	0,00
410	Methane	3,200327	3,200327	-	-	-	-	3,200327	0,00
1715	Methyl mercaptan	0,00000729	0,00000729	-	-	-	-	0,00000729	0,00
1728	Ethyl mercaptan	0,00000289	0,00000289	-	-	-	-	0,00000289	0,00

6.3.2.2.4 Calculation of Atmospheric Emissions

Based on the visual audit, there are no stationary sources of air pollution within or in the vicinity of the project area. Therefore, recommendations provided in Article 5 Paragraph 8 of the № 408 Decree of the Government of Georgia (on the approval of technical regulations for calculating standards of permissible discharges of harmful substances in the ambient air) should be considered during the assessment of atmospheric ambient air pollution within the project area.

Based on the number of population, background values equal to zero. According to the Table 4.2.1 of the EIA, population of Kutaisi and its adjacent settlements by 2020 will be 75 000 people.

As the distance between the project area and the nearest settlement is 0.29 km (control point № 7) to the East and 0.25 km (control point № 6) to the West direction, modeling [11] the spread of hazardous substances performed with regard to the control points (N 1,2,3,4) located in 500 m standardized zone from additional sources.

Proposed rectangle - 1800 * 1400 meter, increment – 100m. Geometric center of the treatment plant is considered to be the source of coordinates.

Reference points

№	Coordinates (m)		Height (m)	Type of the control point	Comment
	X	Y			
1	48,00	607,00	2	On the border of 500 meters zone	To the North
2	653,00	-16,00	2	On the border of 500 meters zone	To the East
3	-10,00	-572,00	2	On the border of 500 meters zone	To the South
4	-493,00	64,00	2	On the border of 500 meters zone	To the West
6	391,00	7,00	2	Control point on the border of the populated area	Residential house to the East
7	-331,00	-57,00	2	Control point on the border of the populated area	Residential house to the West

7 individual substances were included in emission calculation. MPC criteria are adopted according to [5]. Baseline pollution is included in calculation according to [4].

6.3.2.2.5 Results and Analysis of Calculated Emissions

The summary table shows the maximum concentrations of contaminants within control points according to MPC.

Table 6.3.2.2.5.1.

Name of harmful substances	MPC of harmful substances from the object	
	On the border of the nearest settlement	On the border of the nearest settlement
1	2	3
Nitrogen dioxide	0,04	0,05
Ammonia	0,0058	0,0026
Hydrogen sulphide	0,01	0,0,0061
Carbon oxide	0,1	0,1
Methane	0,0015	0,00066
Methyl mercaptan	0,0017	0,00073
Ethyl mercaptan	0,0013	0,0006

Calculation results shows that during the operation of the treatment plant, air quality of the adjacent areas on the borders of 500 meters radius and residential zone will not exceed the limits prescribed by the law, namely: Concentration of pollutants in the 500 meters radius and near the residential zone is equal or less than 0.1 MPC. Therefore, the operation of the plant will not cause the deterioration of air quality. Emissions can be classified as maximum allowable emission.

Print version of emission calculations is given in Annex 2.

6.3.2.2.6 List of References Used in Calculations

1. საქართველოს კანონი „გარემოზე ზემოქმედების ნებართვის შესახებ“.
2. საქართველოს კანონი „ატმოსფერული ჰაერის დაცვის შესახებ“.
3. საქართველოს მთავრობის 2014 წლის 6 იანვრის დადგენილება № 42 „ატმოსფერული ჰაერის დაბინძურების სტაციონარული წყაროების ინვენტარიზაციის ტექნიკური რეგლამენტის დამტკიცების შესახებ“
4. საქართველოს მთავრობის 2013 წლის 31 დეკემბრის №408 დადგენილება „ატმოსფერულ ჰაერში მავნე ნივთიერებათა ზღვრულად დასაშვები გაფრქვევის ნორმების გაანგარიშების ტექნიკური რეგლამენტის დამტკიცების თაობაზე“.
5. საქართველოს შრომის, ჯანმრთელობისა და სოციალური დაცვის მინისტრის 2003 წლის 24 თებერვლის ბრძანება №38/ნ «გარემოს ხარისხობრივი მდგომარეობის ნორმების დამტკიცების შესახებ».
6. საქართველოს ეკონომიკური განვითარების მინისტრის 2008 წლის 25 აგვისტოს ბრძანება № 1-1/1743 „დაპროექტების ნორმების-„სამშენებლო კლიმატოლოგია“.
7. საქართველოს მთავრობის 2013 წლის 31 დეკემბრის დადგენილება № 435 „დაბინძურების სტაციონარული წყაროებიდან ატმოსფერულ ჰაერში გაფრქვევების ფაქტობრივი რაოდენობის განსაზღვრის ინსტრუმენტული მეთოდის, დაბინძურების სტაციონარული წყაროებიდან ატმოსფერულ ჰაერში გაფრქვევების ფაქტობრივი რაოდენობის დამდგენი სპეციალური გამზომ-საკონტროლო აპარატურის სტანდარტული ჩამონათვალისა და დაბინძურების სტაციონარული წყაროებიდან ტექნოლოგიური პროცესების მიხედვით ატმოსფერულ ჰაერში გაფრქვევების ფაქტობრივი რაოდენობის საანგარიშო მეთოდიკის შესახებ ტექნიკური რეგლამენტის დამტკიცების თაობაზე“.
8. «Методическое пособие по расчету, нормированию и контролю выбросов загрязняющих веществ в атмосферный воздух», СПб., 2005.
9. Методические указания по определению выбросов загрязняющих веществ в атмосферу из резервуаров".2000 г.
10. “Расчета количества загрязняющих веществ выделяющичся в атмосферныи воздух от неорганизованных источников загрязнения станций аерации сточных вод “ Москва 1994 год
11. УПРЗА ЭКОЛОГ, версия 3.00 ФИРМА "ИНТЕГРАЛ" Санкт-Петербург 2001-2005 г.

6.3.3 Mitigation Measures

Mitigation measures for air pollution have been developed for the construction and operation phases.

- Construction phase:
    - To ensure proper maintenance of the machinery;
    - To extinguish engines or working with a minimum rotation when they are not used;
    - To protect the optimal speed of the traffic (especially on earth roads);
    - Maximum limited use of roads in populated areas;
    - Precautionary measures (e.g. restriction of material dropping from height during the loading and unloading);

- To cover properly the vehicles while transporting materials from which dust is expected to be easily spread;
- In the storage areas for such materials from which dust is expected to be easily spread, a special pavement or watering is required in order to prevent windblown dust from spreading;
- To locate generators and other equipment away from sensitive receptors;
- Ensure personnel with an appropriate protection equipment (Respirators);
- Instruction of the personnel;
- Recording of complaints and relevant response to them.

- Operation phase
  - Mitigation measures for air pollution during the repair and maintenance work are identical of measures considered for the construction phase;
  - Planting of trees within the perimeter of the project area should be considered at the construction stage;
  - In order to prevent the spread of unpleasant odor, a systematic control of a proper operation of the plant is required;
  - In case of identifying some violations during the monitoring, relevant corrective measures should be developed and implemented. For instance: changing of operation conditions of the plant, covering-sealing the pollution sources, if necessary, coal filters should be used for gas purification, etc.

6.3.4 Impact Assessment

Table 6.3.4.1. Summary of impacts on ambient air quality

Description of impacts and impact sources	Impact receptors	Residual Impact Assessment					
		Nature	**Probability of influence**	**Influence area**	**Duration**	**Reversibility**	**Residual impact**
Construction Phase:							
Combustion products, welding aerosols and other harmful substances emitted into ambient air – Combustion products sources - activities requiring construction and special machinery. These include earth works, transportation of building materials, construction/arrangement of infrastructural units, diesel generators, etc. – Welding aerosols source - Installation of metal structures. – Other sources of harmful substances - Gaseous emissions of chemical substances (fuel - lubricants, fuel tanks, etc.).	Residents of nearby settlements, staff, biological environment	Direct, Negative	Medium risk	Construction site and adjacent areas	Medium term (Depends on the duration of construction works	Reversible	**Low,** Taking into account the mitigation measures - **very low**
Dust emissions – Source – earth works, transportation, storage and usage of bulk construction materials, movement of equipment and vehicles, and others.		Direct, Negative	High risk	Construction site and adjacent areas	Medium term	Reversible	**Medium or low,** Taking into account the mitigation measures - **Very low.**
Foul odor emission – Source - painting works.		Direct, Negative	Medium risk	Construction site and adjacent areas	Short term	Reversible	**Very low**
Operation phase:							
Combustion products, welding aerosols and other harmful substances emitted into ambient air during the maintenance works.	Population, technical staff, biological environment	Direct, Negative	Low risk	Construction site and adjacent areas	Short term	Reversible	**Very low**
Foul odor emission - Degradation process of organic matter in treatment plant.		Direct, Negative	Medium risk	Construction site and adjacent areas	Permanent	Irreversible	**Medium,** Taking into account the mitigation measures - **Low.**

6.4 Noise Propagation

6.4.1 Impact Assessment Methodology

Noise levels in Georgia are regulated by normative document – sanitary norms 2.2.4/2.1.8 003/004-01 "noise in workplace, in housing, public buildings and residential areas". The noise level should not exceed the values set by these standards.

Table 6.4.1.1. Evaluation criteria of the impacts related to the noise

Ranking	Category	Residential zone	Working, industrial or commercial zone
1	Very low	Acoustic background will increase by less than 3 dBA, at residential zone, during the daytime up to <50 dBA, while during night hours up to <45 dBA	Acoustic background will increase by less than 3 dBA and up to <70 dBA
2	Low	Acoustic background will increase by 3 – 5 dBA, at residential zone, during the daytime up to <55 dBA, while during night hours up to <45 dBA	Acoustic background will increase by 3 – 5 dBA and up to <70 dBA
3	Medium	Acoustic background with sensitive receptors will increase by 6-10 dBA, at residential zone, during the daytime up to <55 dBA, while during night hours up to <45 dBA	up to <70 dBA, Acoustic background with sensitive receptors will increase by 6-10 dBA
4	High	Acoustic background with sensitive receptors will increase by more than 10 dBA, at residential zone, during the daytime up to >70 dBA, while during night hours up to <45 dBA	up to >70 dBA, Acoustic background with sensitive receptors will increase by more than 10 dBA
5	Very high	Acoustic background with sensitive receptors will increase by more than 10 dBA, at residential zone, during the daytime up to <70 dBA and accompanied by a tonal or impulsive noise, while during night hours up to <45 dBA	up to >70 dBA, accompanied by a tonal or impulsive noise

6.4.2 Characterization of the Impact

6.4.2.1 Construction Phase

Construction of wastewater treatment plant includes intensive activities, which are likely to affect the background noise.

Calculation of noise emissions is implemented in the following sequence:

- Determination of noise sources and their characteristics;
- Selection of reference points on the border of protected areas;
- Determination of noise direction from noise source to the reference point and calculation of acoustic of the environmental elements, affecting the distribution of noise (natural screens, green plantation, etc.);
- Determination of noise levels at reference points and its comparison to allowable levels of noise;
- Determination of noise level reduction measures, if necessary.

The main sources of noise is assumed to be the machinery and transport equipment working simultaneously in construction sites and camps, namely:

- Bulldozer, the noise level of which is 90 dBA;

- Dump truck (85 dBA),
- Crane (92 dBA).

The reference point is the residential house to the northwest (Tkachiri village), which is 700 m away from the projectarea.

Octave sound pressure levels in the reference point are calculated according to the following formula:

$$L = L_p - 15\lg r + 10\lg \Phi - \frac{\beta_a r}{1000} - 10\lg \Omega, \quad (1)$$

Where,

L_p – Octave level of the noise source capacity;

Φ – noise source direction factor, non-dimensional, is determined through trial and changes from 1 to 8 (depends on spatial angle of sound radiation);

r – Distance from the source of the noise to the reference point;

Ω – Spatial angle of sound radiation, which will be: $\Omega = 4\pi$- when located in the space; $\Omega = 2\pi$- when located on the surface of the area; $\Omega = \pi$ - double ribbed angle; $\Omega = \pi/2$ – triple ribbed angle;

β_a – Sound damping in the air (dBA/km) tabular description.

Average geometric frequencies of the octave lines, H Hz.	63	125	250	500	1000	2000	4000	8000
β_a dBA/km	0	0.3	1.1	2.8	5.2	9.6	25	83

Noise source levels on the noise-generating section are summarized according to the formula:

$$10\lg \sum_{i=1}^{n} 10^{0,1Lpi} \quad (2)$$

Where:

L_{pi} – is i-type noise source capacity.

Following assumptions are made to perform the calculation:

1) If distance between some noise sources, located on the same site is less than distance to the reference point, sources are combined into one group.
2) To assess the total level of noise sources combined into one group, as a distance to accounting point was used their distance from geometric center;
3) For simplicity, the calculations are performed for the sound equivalent levels (dBA) and average value of its octave indicator is taken as sound damping coefficient in the air βave=10.5 dBA/km;

The calculation was conducted for simultaneous operation of all the machinery-equipment on the selected site, considering the minimum screening of the noise (worst case scenario).

By putting the data in the second formula, we will obtain the total noise level from the generation point:

$$10\lg \sum_{i=1}^{n} 10^{0,1Lpi} = 10\lg (10^{0,1x90} + 10^{0,1x85} + 10^{0,1x92}) = 94,6 \text{ dBA}$$

By putting the data in the first formula, we will obtain noise level from reference point, the nearest receptor:

Residential house. $L = L_p - 15\lg r + 10\lg \Phi - \frac{\beta_a r}{1000} - 10\lg \Omega,$ = 94,6 – 15*lg700+10*lg2–10.5*700/1000-10xlg2 π=39,6

The calculation results are given in Table 6.4.2.1.1., where the results are compared with the permissible levels.

Table 6.4.2.1.1. Noise propagation calculation results

Area	Main Machinery	Equivalent Noise Level at Generation Point [dBA]	Distance to the Nearest Receptor [m]	Equivalent Noise Level at Nearest Receptors [dBA]	Norm [1]
Construction camp and construction site	○ Bulldozer ○ Dump truck ○ Crane	94,6	700	**39,6**	During the day - 55 dBA. During the night time – 45 dBA

Based on the results of calculation, noise levels will not exceed neither daytime nor nighttime. Therefore, the risk of impact on the above mentioned receptors (nearest population) due to noise propagation is very low.

In addition, a number of circumstances should be considered that makes it possible to conclude that the construction activities will not cause a significant negative impact on residents. These circumstances are:

- Construction works will be conducted only in daytime;
- The main sources of noise are less likely to work simultaneously. Even then it will not be a long lasting process;
- The vegetation between the noise sources and referance points, which will be a noise prevention barrier;
- Impacts caused by noise during the construction will be of short term.

Noise propagation will cause negative impact on construction stuff. The noise level at the construction site may reach 95 dBA. Personnel employed on the construction (especially when working near the equipment causing significant noise), will be equipped with safety equipment (ear-flaps).

Noise propagation may have negative impact on local wildlife as well, which will be connected to the migration of animal species (especially birds). However, construction site and surrounding areas are not distinguished with diversity of animal species. Animal species that are spread within this area are adapted to the intensive activities of humans. The impact is temporary and after completion of the construction works, the majority of species will be returned to its old habitats.

6.4.2.2 Operation Phase

The main source of noise propagation during the operation of treatment plant will be electric engines of pumping stations.

3 pumps may work simultaneously within the treatment plant area. In addition, source of noise propagation may be electrical substation (transformer).

Based on literary sources, noise generated from pumping stations usually reach 60-90 dBA. Capacity of the proposed transformer would not be significant and its noise level will be about 81 dBA.

According to the second formula given in previous paragraph, total maximum noise level from the generation point will be:

$$10\lg\sum_{i=1}^{n}10^{0,1Lpi} = 10\lg\,(10^{0,1x90}+ 10^{0,1x90}+ 10^{0,1x90}+ 10^{0,1x81})= 95\ \text{dBA}.$$

Installations will be arranged in closed premises. Besides, noise propagation will be limited by the infrastructure of treatment plant. Overall, the total noise level at generation point will be reduced by 25 dBA and it will be 70 dBA.

[1] sanitary norms on "noise in workplace, in housing, public buildings and residential areas".

Obtained results are consistent with the established norms for both, the day and night hours. Therefore, impact caused by noise propagation will not be significant.

6.4.3 Mitigation Measures

It is recommended to implement the following mitigation measures in order to minimize noise levels during the construction phase:

- To ensure proper maintenance of the machinery;
- To implement works that cause noise during the daytime only;
- To limit implementation of noisy works simultaneously;
- Temporary barriers (screens) should to be arranged between a significant noise source and the houses, if necessary. The screens can be arranged by using a variety of structures (e.g. shields made from wood materials). The quality of noise protection depends on the material type and thickness of the boards. For instance:
  - Fencing by pine boards (with thickness of 30mm – 12 Dba);
  - Fencing by oak boards (with thickness of 45mm - 27 Dba);
- If necessary, equip personnel with proper protective equipment;
- Frequent change of personnel that are employed for noisy works;
- Instruction of the personnel prior to the beginning of construction works and then, after every six month;
- In case of complaints, they should be recorded and appropriate action should be taken.

Though, exceedance of noise levels near the sensitive receptors is not expected during the operation phase, following mitigation measures will be implemented:

- High-quality pump installations will be arranged within the territory of the treatment plant. Much less noise is generated from pumps, which are made of stainless steel or cast iron. Low-cost pumps, which are made of thin steel sheets produce more noise;
- During the installation of pumps, noise-insulating material such as foam plastic will be used as far as possible;
- Pumps will be arranged on vibration isolation platforms, for which thick rubber sheets can be used;
- If necessary, equip personnel with proper protective equipment;
- Frequent change of personnel that are employed for noisy works;
- Instruction of the personnel prior to the beginning of construction works and then, after every six month;
- In case of complaints, they should be recorded and appropriate action should be taken.

6.4.4 Impact Assessment

Table 6.4.4.1. Summary of the noise impact

Description of impacts and impact sources	Impact receptors	Residual Impact Assessment					
		Nature	**Probability of influence**	**Influence area**	**Duration**	**Reversibility**	**residual impact**
Construction phase:							
Noise Propagation in the Air – Noise propagation from construction equipment and construction operations; – Noise caused by construction/installation works; – Noise caused by vehicles.	Population, project stuff, animals inhabiting in adjacent areas.	Direct, negative	Adjacent to the populated area – medium risk. Area of activities – high risk.	About 0.35 km radius adjacent to construction site and construction camp.	Medium term (depending on the duration of the construction works)	Reversible	**Low or Medium.** Taking into account the mitigation measures - **low or very low**
Operation phase:							
Noise Propagation in the Air – Exploitation of electric engines; – During the maintenance / repair works - used vehicles and spec. technology	Population, project stuff, animals inhabiting in adjacent areas.	Direct, negative	Low risk	They are adjacent to the treatment plant	Long term	Reversible	**Very low**

6.5 Impact on Surface Waters

With regard to the impact on the surface waters only the risks related to the deterioration of water quality is discussed in this document. Due to the specifics of the planned activities, impacts, such as changes in water debit, limited movement of river sediment, violation of stability of river-bed and river banks and so on are not discussed.

6.5.1 Impact Assessment Methodology

Table 6.5.1.1. Assessment criteria of the impact on the surface waters

Ranking	Category	Water quality deterioration
1	Very low	Background concentrations of substances and water turbidity has changed unnoticeably
2	Low	Concentrations of substances or water turbidity have increased by less than 50%, though it does not exceed MPC.
3	Medium	Concentrations of substances or water turbidity have increased by 50-100%, though it does not exceed MPC.
4	High	Concentrations of substances or water turbidity have increased by more than 100%, or have exceeded MPC.
5	Very high	Concentrations of substances or water turbidity have increased by more than 200% and have exceeded MPC.

6.5.2 Characterization of the Impact

6.5.2.1 Construction Phase

The major impact receptor during the construction works will be Vartsikhe HPP channel and Rioni River.

Contamination of surface water bodies during the construction phase is possible in the following cases:

- Oil spill in case of violating the rules of their storage or the rules of construction equipment and vehicles maintenance;
- In case of contaminated water discharge during the earth works;
- In case of discharging vehicles or equipment wash down water;
- In case of improper management of construction waste;
- In case of improper management of agricultural-fecal and storm waters, etc.

Surface water contamination risk on construction phase is considerably depended on implementation of environmental management measures by building contractor as well as waste management and machinery maintenance quality. Soil protection from contamination is important as well.

According to the project, industrial- fecal wastewater generated from the construction camp area will be collected through sanitation pits. Potentially contaminating areas will be protected from atmospheric precipitation.

Based on the above mentioned, impact on the surface water during the construction phase will not be significant.

6.5.2.2 Operation Phase

During the operation of wastewater treatment plant, purified wastewater is planned to be discharged into one section of Rioni River. Consequently, the river water pollution risk is related to the discharging of untreated or incompletely purified wastewater.

An effective system is proposed for biological treatment of wastewater, which, in case of protecting the operational rules, provides standardized treatment of wastewater. Consequently, the risk of contamination of the river water will be minimized.

Implementation of the project will have significant positive impact on the quality of Alazani River and other surface waters of the region. At present industrial-fecal wastewaters are discharged into the above mentioned surface waters without any treatment, which cause their pollution. In total, implementation of the project will have highly positive impact on the quality of water bodies in region.

It should be noted that the project on "maximum permissible discharge of pollutants" from wastewater treatment plant will be developed and submitted to the Ministry of Environment and Natural Resources.

Impact on water quality may occur during the maintenance works as well. The impact will depend on the type and volume of works. Impact mitigation measure during construction works will be similar to the expected one.

6.5.3 Mitigation Measures

Surface water pollution prevention measures during the construction phase are:

- To ensure proper maintenance of vehicles / equipment;
- Vehicles / equipment and potentially polluting materials should be located less than 50 meters away from surface waters (where it is possible). If this is not possible, the permanent control and safety measures should be implemented in order to prevent water pollution (especially within the construction site);
- Prohibition of washing vehicles in river-beds;
- Management of contaminated wastewater generated from construction camps will be implemented in accordance to the conditions determined by the project (sanitation pits will be used, which will be cleaned timely);
- Drainage / water channels should to be arranged throughout the perimeter of potentially polluting sites of wastewater;
- Roofing of potentially polluting sites (arrangement of sheds);
- Proper management of materials and waste;
- All potential pollutants should be removed after the completion of works;
- In case of spillage of oil/lubricants, spilled product should be localized / cleaned;
- Implementation of mitigation measures related to the protection of soil quality;
- Instruction of the staff.

Surface water pollution prevention measures during the operation phase are:

- Maximum permissible discharge of pollutants will be protected;
- Possibility of sampling the wastewater, as well as purified water prior to the discharge into the river will be considered;
- Relevant authorities of the Ministry of Environment and Natural Resources of Georgia will be provided with an accurate information about the volume and composition of wastewater;
- In case maximum permissible discharge of pollutants are exceeded, appropriate measures will be taken to remedy the situation promptly (appropriate repairs and maintenance works will be implemented). At the same time, a person in charge of environmental protection should

immediately notify the Ministry of Environment and Natural Resources of Georgia about the existing situation. Information should contain the causes and preventive measures that will be implemented in order to eliminate the problem, as well as extreme levels of accidents and related pollution of water bodies;

- Systematic control over implementation of measures considered by the waste management plan;
- Control of the efficiency of wastewater treatment plant operation and in case of possible malfunction implementation of appropriate corrective measures;
- Appropriate drainage system will be arranged on the perimeter of the wastewater treatment plant. Atmospheric waters generated on sludge bed will be treated by technological process.
- Systematic supervision on fuel/oil storage and usage rules;
- In case of fuel/oil emergency spill, localization of the pollution and implementation of measures to prevent deterioration of the surface waters;
- According to the monitoring plan, laboratory analysis of wastewater will be carried out periodically;
- Instruction of personnel on environmental and safety issues.

6.5.4 Impact Assessment

Table 6.5.4.1. Summary of the impact on surface water quality

Description of impact and its sources	Impact receptors	Residual Impact Assessment					
		Nature	Probability of influence	Influence area	Duration	Reversibility	residual impact
Construction phase:							
Contamination of Alazani River water and related water bodies with suspended particles, hydrocarbons and other substances – Source of contamination with suspended particles - Contaminated surface runoff, construction works close to the river-bed; – Source of contamination with hydrocarbon / Chemical Substances - due to their spillage, inflow of contaminated surface water runoff, or their spillage in the water bodies; – Other pollution sources - Construction or household solid / liquid waste generated form construction camps.	Residents of nearby settlements, river inhabitants.	Direct. In some cases - indirect (e.g. inflow of contaminated surface water runoff in rivers, as a result of spilled pollutants). Negative	Medium risk, taking into account mitigating measures – low risk	Rioni River and Vartsikhe HPP channel, section adjacent to the project area and downstream	Medium term (The impact is limited with the construction phase)	Reversible	**Medium,** Taking into account the mitigation measures - **low**
Operation phase:							
Contamination of Alazani River water and related water bodies with suspended particles and organic substances – Source of contamination – wastewater discharged into the river from treatment plant	Residents of nearby settlements, river inhabitants.	Direct, Negative	Low risk	Rioni River water, downstream from the discharge point	Permanent	Reversible	**Very low**

6.6 Impact on Groundwater

6.6.1 Impact Assessment Methodology

Table 6.6.1.1. Assessment criteria of the impact on groundwater

Ranking	Category	Changes in groundwater debit	Deterioration of groundwater[2] quality
1	Very low	Debit has changed invisibly	The background concentration of substances have changed invisibly
2	Low	Ground-water levels has declined markedly, though, it has not affected water levels in wells or flow of water	Concentration of substances of the II group[3] is below the permissible limits for drinking water
3	Medium	Ground-water levels and water extraction from wells has declined markedly.	Concentration of substances of the II group is more than the permissible limits for drinking water
4	High	Wells are not working temporarily, discharge of water has reduced in surface water bodies, which will cause a seasonal drought.	Hazardous substances of I group is observed
5	Very high	Wells are drying, water is not discharging in surface water bodies, and there is a great risk of drought and ecological impact.	Concentration of substances of the I group is more than the permissible limits for drinking water

6.6.2 Characterization of the Impact

6.6.2.1 Construction Phase

There are certain risks of groundwater pollution at the construction phase (earth works). Deterioration of groundwater quality may be caused by accidental spillage of oil and movement of pollutants into the deeper layers of the soil, as well as by the excavations.

Due to the specifics of the project, direct impact of the wastewater treatment plant construction on groundwater debit is expected to be minimal. Though, there is a risk of indirect effects (e.g. reduced infiltration). The scale of the impact is very small and can be described as minor.

6.6.2.2 Operation Phase

Risk of groundwater contamination during the operational phase will be related to the damage of equipment and technological pipeline of the treatment plant, namely: Sewage spill within the territory of the treatment plant. At this phase, risks of negative impact on groundwater will be entirely related to the effectiveness of surface water and soil pollution preventive mitigation measures.

6.6.3 Mitigation Measures

In order to reduce the probability of groundwater pollution it is necessary to implement the measures related to the protection of soil and groundwater quality.

Construction Phase:

- To ensure proper maintenance of vehicles / equipment. In case of damage and fuel / oil spillage, they should be immediately repaired. Damaged vehicles are not allowed on the construction site;

[2] Groundwater quality is not regulated by the law of Georgia. Therefore, drinking water standard is used for the assessment
[3] EU Directive 80/68/EEC, December 17, 1979, "Protection of groundwater from contamination by certain hazardous substances"

- Strict observance of the boundaries of the corridor in order to prevent "neighboring" areas from possible contamination, topsoil damage and compaction;
- Machinery / equipment and potentially contaminating materials should be at least 50 meters away from surface water body (where possible). If it is not possible, control and safety measures should be taken in order to prevent water pollution;
- Prohibition of washing vehicles in river-beds;
- Proper management of contaminated wastewater generated from construction camps;
- Drainage / water channels should to be arranged throughout the perimeter of potentially polluting sites of wastewater;
- Proper management of materials and waste;
- All potential pollutants should be removed after the completion of works;
- Cleaning and recultivation of the area after the completion of works;

Operation Phase:

- Systematic control over the technical maintenance of equipment and technological pipelines of the treatment plant. If necessary, appropriate corrective measures should be taken;
- Insulating layer (clayey compacted soil) will be arranged within the territory of the treatment plant.

6.6.4 Impact Assessment

Table 6.6.4.1. Summary of the impact on groundwater

Description of impact and its sources	Impact receptors	Residual Impact Assessment					
		Nature	Probability of influence	Influence area	Duration	Reversibility	Residual impact
Constriction Phase:							
Changes in groundwater debit	Population, animals, surface waters with a hydraulic connection	Indirect	Low risk	Construction camps and construction sites	≈1 year	Reversible	**Very low,** or impact is not expected
Deterioration of groundwater quality – As a result of pollutants movement into the deep layers of soil, or contamination of surface waters; – Earth works	Population, animals, surface waters with a hydraulic connection (Alazani River)	Mostly indirect	Medium risk	Construction camps and construction sites	≈1 year	Reversible	**Medium.** Considering the mitigation measures – **low**
Operation Phase:							
– ***Changes in groundwater debit*** Reduced infiltration	Population, animals	Indirect	Low risk	Project area and surroundings	Long-term	Irreversible	**Very low**
Deterioration of groundwater quality – As a result of pollutants movement into the deep layers of soil, or contamination of surface waters	Population, animals, surface waters with a hydraulic connection (Alazani River)	Mostly indirect, in some cases direct and negative	Low risk	Project area and surroundings	Short-term	Reversible	**Low or very low**

6.7 Impact on Soil Stability and Quality

Negative impacts on soil during the construction and operation of wastewater treatment plant may be related to:

- Impact on soil integrity and stability. Topsoil loss and damage;
- Soil contamination.

6.7.1 Impact Assessment Methodology

Impact values on soil have been assessed by the following parameters:

- Intensity, scope and duration of the impact;
- Their sensitivity to the changes;
- Their ability to recover.

Table 6.7.1.1. Impact assessment criteria

Ranking	Category	Topsoil destruction	Soil contamination
1	Very low	Eternal destruction of less than 3% of the project area	Baseline of soil is changed invisibly
2	Low	Eternal destruction of 3-10% of the project area	Concentrations of pollutants is increased by less than 25%, though it is less than the allowable value; Soil / ground quality restoration could take up to 6 months
3	Medium	Eternal destruction of 10-30% of the project area	Concentrations of pollutants is increased by 25–100%, though it is less than the allowable value; Soil / ground quality restoration could take up to 6-12 months
4	High	Eternal destruction of 30-50% of the project area; small sections are damaged even outside the project area, recultivation of which is possible after completion of construction works	Concentrations of pollutants is increased by 100%, or exceeds the maximum permitable value; Soil / ground quality restoration could take up to 1-2 year
5	Very high	More than 50% of the project area is damaged or destructed; small sections are damaged even outside the project area, recultivation of which is possible after completion of construction works	Concentrations of pollutants is increased by more than 100% or exceeds the maximum permitable value; Soil / ground quality restoration could take up to 2 year

6.7.2 Characterization of the Impact

6.7.2.1 Construction Phase

Impact on Soil Stability:

As mentioned above, there are the remains of old structures on the proposed area, therefore the major part of the area is remained without topsoil, while the thickness of the observed topsoil is minor and less valuable (see paragraph 4.4.2.2.).

However, impact on soil stability should be considered during the construction phase. Impact on topsoil and soil stability is mainly expected during the preparatory and construction works, which will be caused by the arrangement of the construction camp, construction site, replacement of the equipment, earthworks, arrangement of temporary and permanent infrastructures, etc.

Places where topsoil is more or less represented should be marked during the preparatory stage. At these areas, topsoil should be removed and stored on the pre-selected area till the completion of construction works.

In process of removal of the fertile soil layer and temporary storage, soil erosion may occur. In addition, fertile soil layer removal and transfer into the bund may cause loss of its certain amount, reduce soil fertility, impoverish seed stock, change pH and chemistry and structure of the surface layer.

Soil Contamination Risks:

Soil contamination is expected during preparatory and construction works.

The following negative impacts are to be expected on soil quality during the construction phase:

- In case of oil spillage / leakage from vehicles or other equipment used throughout the project area;
- In case of misuse and spillage of such hazardous substances such as paints and other toxic substances;
- In case of improper management of a removed soil layer during the construction phase.
- In case of improper management of industrial-fecal waters generated during the construction phase.

6.7.2.2 Operation Phase

Impact on the integrity and stability of soil or the loss and damage of the topsoil is not expected during the operational phase.

Possible causes of soil contamination during the operational phase are:

- Violation of the rules of storage-usage of fuel and lubricants;
- Improper management of municipal and other solid wastes (contaminated wipes used for equipment cleaning, dirty work gloves);
- Emergency situations (spillage of wastewater in case of damage of pipelines or other infrastructures).

The impact is also expected during the maintenance works. During implementation of repairing works mitigation measures and impact avoidance measures should take place during construction phase.

6.7.3 Mitigation Measures

In order to prevent the damage and contamination of soil, the construction contractor will be required to take into account the following environmental requirements:

- Surface layer of the soil should be removed and stored temporarily in pre-selected locations. The soil should be stockpiled separately. Stockpiles should be protected from wind and atmospheric precipitation and should be at least 50 meters away from surface water body;
- Storage for topsoil should be arranged in accordance with the relevant rules: the height of stock pails should not exceed 2 meters; the tilt angles of the slopes of stock pails should be 45^0; If necessary, water discharge channel should be arranged; after the completion of the construction activities, stored soil should be used for recultivation works;
- Strict protection of the boundaries of construction sites in order to prevent possible contamination of "neighboring" areas, damage and compaction of topsoil;
- Protection of the roads used by the vehicles and techniques (prohibition of turning off from the road), in order to reduce the probability of soil compaction;

- Vehicles and equipment should be checked regularly. In case of damage and fuel / oil leakage, it should be repaired immediately. Damaged Vehicles should not be allowed on the construction sites;
- Waste should be collected and stored in a designated area;
- Materials / waste should be disposed so that to prevent erosion;
- Proper management of industrial and fecal wastewater according to the conditions provided by the project;
- In case of fuel tank arrangement, the tank should be fenced by concrete or clay material, inner volume of which should not be less than 110% the reservoir capacity. In this case it is possible to prevent the oil propagation during the accidental spillage of oil;
- In case of spillage of pollutants, spilled material should be localized and contaminated site should be immediately cleaned; Staff should be provided with appropriate means (adsorbents, shovels, etc.) and with personal protective equipment as well;
- Contaminated soil and ground for further remediation should be taken out from the territory by the contractor equipped with an appropriate permit on these activities;
- Staff should be instructed prior to the construction works;
- Area should be cleaned and recultivated after the completion of works.
- After completion of construction works, all kind of waste (including hazardous waste) will be collected and removed from the area. Hazardous waste should be removed for further management by the licensed contractor.

The following measures must be ensured by the operator company, in order to prevent soil contamination during the operational phase:

- Control of the fuel/oil storage and usage rules;
- Waste management plan provides the systematic supervision of fulfilling the measures;
- In case of fuel/oil spill, cleaning of the territory and withdrawal of the contaminated soil and ground for further remediation;
- Training of the personnel on environmental and safety issues during recruitment and then once a year;
- In process of repair works, implementation of the mitigation measures considered for the construction phase.

6.7.4 Impact Assessment

Table 6.7.4.1. Summary of the impact on soil

Description of impact and its sources	Impact receptors	Residual Impact Assessment					
		Nature	**Probability of influence**	**Influence area**	**Duration**	**Reversibility**	**Residual impact**
Construction Phase:							
Impact on integrity and stability of soil. ***Lose of topsoil*** – Vehicle and construction equipment movement; – Earth works, arrangement of access roads and various facilities; – Waste management.	Vegetation, animals, population	Direct, Negative	Medium risk, taking into account mitigation measures – low risk	Construction camp, construction sites and corridors of roads for vehicles	Medium or long-term	Reversible. In exceptional cases - irreversible	**Low -** taking into account mitigation measures – **very low**
Soil contamination – Spillage of oil or other chemical substances, pollution by waste.	Vegetation, surface and ground waters, population	Direct (in case of siltation with sediment contaminated water – indirect). Negative	Medium risk	Construction camp, construction sites and corridors of roads for vehicles	Medium-term (Limited to the duration of the construction phase)	Reversible	**Medium,** taking into account mitigation measures – **very low.**
Operation Phase:							
Soil contamination – Spillage of oil or other chemical substances, pollution by waste	Vegetation, surface and ground waters, population	Direct, Negative	Low risk	Areas adjacent to the treatment facility	Long-term	Reversible	**Low or very low**

6.8 Engineering-Geological Hazards, Risk of Flooding

6.8.1 Construction Phase

Based on the results of engineering - geological surveys, the risk of development of dangerous geodynamic processes preventing construction process is not expected.

Based on the above mentioned, in terms of development dangerous geodynamic processes during the construction of the treatment plant and diversion pipeline, impact can be assessed as very low.

6.8.2 Operation Phase

Vertical layout of the treatment plant area is one of the most important measures to prevent the flooding. In particular, the elevation of the area should be raised and the infrastructure should be arranged at an elevation of at least 0.5-1.0 m from the surface. In addition, insulating layer will be used, which includes clay roofing or arrangement of geo-membrane. Proper storm water drainage system will be arranged on the territory

6.9 Possible Landscape and Visual Impact

6.9.1 Impact Assessment Methodology

Visual-landscape impact assessment is more or less subjective. Impact area and duration, as well as the relative ecological value of the landscape is taken as an evaluation criteria.

Table 6.9.1.1. Assessment criteria of the impact on landscape and visual

Ranking	Category	Impact on visual receptors	Duration of landscape changes and spatial boundaries / landscape quality and value
1	Very low	Invisible change in the view	Invisible change in the landscape, or landscape is not valuable
2	Low	Some slight change of view is observed from certain points, which is easily adaptable	Insignificant change in the landscape, or landscape restoration takes 1-2 years
3	Medium	The view has changed noticeably from many points of view, though it is easily adaptable	Some sites of the natural landscape have changed, or landscape restoration takes 2-5 years
4	High	The view has changed noticeably from most of the points, though it is easily adaptable	A large area of natural or high-value landscape has changed, or landscape restoration takes 5-10 years
5	Very high	The view has completely changed from every place, hardly adaptable impact on receptors is expected.	A large area of natural or high-value landscape has changed, or landscape restoration is not possible

6.9.2 Characterization of the Impact

6.9.2.1 Construction Phase

There will be some visual and landscape impact during the preparatory and construction works due to the increased traffic flow, construction sites and working equipment and personnel, structures under construction, construction materials and waste. Implementation of the construction works will partially change the normal view and landscape.

Receptors sensitive to visual and landscape changes are the residents of the nearest settlement and passengers. In addition, potential receptors of visual changes will be animals inhabiting in the vicinity of

the project area. However, the project area is not a significant habitat for animals, so the impact is expected to be low.

After completion of construction works, vehicles and equipment, materials and waste will be removed from the construction sites, temporary structures will be dismantled and removed, workers will be withdrawn, the area will be recultivated.

6.9.2.2 Operation Phase

The major factor of visual and landscape changes during the operational phase will be the existence of the treatment plant, though it should be considered that currently sanitary and environmental conditions of the area is very poor, which cause negative impact on the visual receptors (population, passengers and animals). After the completion of the construction, a new building of treatment plant will be presented instead of old structures. In case of implementing planned recultivation and greening works, significance of a positive impact will be increased. Hence, the project will bring positive effects in terms of visual and landscape impact.

Some impacts are expected due to the maintenance and rehabilitation works. This impact is similar to the one of the construction phase, though much smaller.

6.9.3 Mitigation Measures

Visual and landscape impacts can be mitigated by reasonable selection of color and design for the structure. In addition, temporary structures, materials, and waste should be disposed so that to be less noticeable for visual receptors. Decorative trees and plants should be planted throughout the treatment plant area and its perimeter.

6.9.4 Impact Assessment

Table 6.9.4.1. Summary of the visual and landscape impact

Description of impact and its sources	Impact receptors	Residual Impact Assessment					
		Nature	Probability of influence	Influence area	Duration	Reversibility	Residual impact
Construction Phase:							
Visual and landscape impact: – Construction camp and temporary structures; – Waste disposal; – Works related to construction and transportation.	Animal species inhabiting in the vicinity, population	Direct, Negative	Medium risk	Areas adjacent to construction camps and sites. (Distribution area depends on local landscape, or visibility conditions)	Medium term	Reversible	**Medium.** In some sections **– low**
Operation Phase:							
Positive impact is expected							

6.10 Impact on Biological Environment

6.10.1 Impact Assessment Methodology

For the assessment of the impact on biological environment qualitative criteria are introduced for the following categories:

- Integrity of the habitat, where the possible loss or fragmentation of habitats, reduction of the potential capacity of ecosystem and the impact on natural corridors are estimated;
- The loss of species. Impact on species behavior, where the assessment is implemented about changes in their behavior that are caused due to the physical changes, including visual impact, noise and atmospheric emissions, as well as about the impact on breeding, nesting, spawning, daily and seasonal migration, activity, and mortality;
- Protected habitats, protected areas, protected landscapes and monuments of nature.

The criteria used to assess the environmental impact significance:

- The probability of the impact, intensity, scope and duration, which is used to determine the magnitude of the impact;
- Sensitivity of the habitat or species to the direct impact, or the impact caused by the change;
- Restoration capabilities of species and habitats;
- Ecological value of impact receptors, including species, populations, communities, habitats, landscapes and ecosystems;
- Impact on protected receptors is assumes as a high impact.

Criteria established for estimating impact on ecological systems are given in Table 6.10.1.1.

Table 6.10.1.1. Assessment criteria of the impact on biological environment

Category	Impact on habitat integrity	Loss of species. Impact on species behavior	Impact on protected habitats
Very low	Negligible impact on the integrity of the habitat. After the completion of recultivation works, recovery of the habitat in a short period of time (<1 year)	Changes in behavior are invisible; death of not valuable species of small mammals / fish is expected; there is no risk of spreading invasive species.	No impact is observed throughout the areas protected by country's legislation or international conventions
Low	Noticeable impact on the integrity of low-value habitat, including the loss of less valuable habitat of 10-20 acres of land. After the completion of recultivation works, recovery of the habitat in two years.	Changes in behavior may be revealed by standard methods; death of not valuable species of small mammals / fish is expected; there is no risk of spreading invasive species.	A temporary, short-term, minor impact is expected throughout the areas protected by country's legislation or international conventions, which will not cause a long-term violation of ecological integrity
Medium	Significant impact on the integrity of locally valuable habitat, its reduction, reduction of valuable habitats, or less valuable 20 - 50 ha of terrestrial habitat loss. After the completion of recultivation works, recovery of the habitat in 2-5 years	Changes in behavior of endemic and other valuable species may be revealed by standard methods; death of less valuable animal species are to be expected; appearance of invasive species is expected.	A minor impact is expected throughout the areas protected by country's legislation or international conventions, though ecosystem will be restored within 3 years.
High	Reduction of locally valuable habitats, or less valuable 50-100 ha of terrestrial habitat loss. After the completion of recultivation works, recovery of the habitat in 5-10 years.	Changes in behavior of protected species may be revealed by standard methods. The death and reduction of protected and valuable animal species is expected; Spread of invasive species	Impact is expected throughout the areas protected by country's legislation or international conventions. Mitigation measures are to be implemented in order to restore the ecosystem. It will need 5 years to be restored.
Very high	Reduction of locally valuable habitats, or less valuable more than 100 ha of habitats loss. After the completion of recultivation works, recovery of the habitat in more than 10 years.	Changes in behavior of an internationally protected species may be revealed by standard methods. Protected or valuable species of animals die and there is a probability of disappearing these species. Spread of invasive species	There is an impact on the areas protected by country's legislation or international conventions.

6.10.2 Impact on the Integrity of the Habitat and the Destruction of Vegetation

6.10.2.1 Construction Phase

Based on botanical studies, trees are less represented within the project area. Mostly, thorny and liana plants are common there. None of the Red List Species have been observed.

Therefore, only bushes and grass of low value will be subjected to the removal throughout ≈ 6000-7000 m^2 area, which is not a significant habitat for animal species.

After completion of construction works the area will be recultivated and this will significantly reduce the quality of the impact.

Based on the above mentioned, a medium impact is expected on vegetation and local habitats. Project-related impacts can be reduced by proper organization/management of the works and appropriate mitigation measures.

6.10.2.2 Operation Phase

Considering the specifics of the planned activities, negative impact on vegetation is not expected during the operational phase of the treatment plant. Indirect impact may occur during the performance of the maintenance works (propagation of dust and combustion products), but the impact will be short-term and low intensity.

Potential impacts on vegetation cover during the operation phase can be assessed as very low-quality impacts.

6.10.2.3 Mitigation Measures

Mitigation measures for the impact on vegetation and the integrity of habitat during the construction phase are:

- The issue related to the removal of vegetation from the proposed corridors should be agreed with the local self-governing bodies;
- After the completion of the construction works, recultivation and landscaping works should be carried out throughout the construction camp and treatment plant area, in order to compensate the damage caused to vegetation. Local decorative plants should be used for landscaping works;
- Besides, in order to avoid too much damage of plants, construction contractor must take into account the following environmental measures:
    - In order to protect vegetation from too much damage, the boundaries of construction sites and traffic routes should be strictly defined;
    - Prior to the construction works the staff should be instructed about the issues related to the protection of vegetation.

Mitigation measures for the impact on vegetation established for the construction phase should be carried out while performing maintenance works during the operational phase.

6.10.3 Impact on Wildlife

6.10.3.1 Construction Phase

There are no significant species of animals within the project area. There mainly inhabit animal species that are adapted to human activities (rodents, reptiles and so on.). Cleanup of the area (removal of construction and household waste) will reduce these species, which will lead to positive results on the one hand (reduces risk of disease spread by animals and population disturbance). On the other hand,

food base for animals species that are hunting on above mentioned species will be reduced as well.

Construction works might affect biodiversity:

- Increased disturbance of birds and chiropteran nesting in the vicinity of roads and construction site;
- During the excavation works, trenches create a certain risk for small mammals: they may fall into trenches, injure or die;

Also,

- Noise and vibration, emissions of dust and other harmful substances in the ambient air will be increased during the construction. Certain species of animals will migrate from the project site;
- Destruction of vegetation will have a negative impact on vertebrate and invertebrate animal feed base and their reproduction;
- Contamination of the environment by waste and visual-landscape changes may lead to animal death or migration;
- In case of polluting water and soil by harmful substances, populations of fish, amphibians, birds and otter inhabiting near the water, as well as the animals living near the contaminated area will be damaged;
- Due to the arrangement of temporary structures free movement may be restricted, a temporary fragmentation of habitats.
- Due to the artificial lighting at night, animals may be frightened, or disorientation of certain species of birds, which will cause their damage/death.

Therefore, the wildlife will be directly (collision / damage, habitat fragmentation) and indirectly (migration due to the noise / vibration, emissions, etc.) impacted. The major sources of the impacts are:

- Traffic;
- Vehicles and equipment, as well as the staff working on the construction site;
- Excavation works and construction of temporary structures;
- Artificial lightening system.

Based on the above mentioned, impact on the wildlife during the construction phase can be assessed as a medium. In case of implementing mitigation measures and constant monitoring, it will be possible to reduce impact to a “low” or “Medium” significance.

6.10.3.2 Operation Phase

Among the possible negative impacts on wildlife during the operational phase of the wastewater treatment plant the most noteworthy are:

- Impact related to noise propagation;
- Impact related to odor propagation;
- Impact on birds caused by night lighting systems;
- In case of contamination of surface water bodies, impact is expected on water related birds and animals.

It should be noted that the levels of noise propagation will not be high during the operational phase and that in case of implementing optimization measures for the night lightening system, impact would not be significant. The proposed effective and reliable system for wastewater treatment will minimize the risk of discharging incompletely treated water.

Based on the above mentioned, impact on the wildlife during the operational phase can be assessed as a low impact.

It should be noted that the project will have an important positive impact on the improvement of wildlife habitat environment. At present, due to the poor management of wastewater risks of polluting

individual components of the environment are quite high. Such risks will be significantly reduced in case of project implementation.

6.10.3.3 Mitigation Measures

Mitigation measures of the impact on terrestrial animals during the construction phase are:

- Strict observance of the boundaries of traffic routes and construction sites;
- Selection of the optimum speed for traffic in order to reduce the probability of direct impact on animals (collision);
- Pits and trenches should be fenced in order to avoid animals falling into them – a sharp-colored ribbon should be used for large-sized species, while for small animals all flat materials can be used - iron, polyethylene and others. Long boards or logs should be put into the trenches and pits at night time, so that small animals could come out of there. Inspection of pits and trenches before filling with soil;
- To use the minimum amount of light in order to reduce the spread of light;
- Activities causing too much disturbance of animals should be implemented in a short period of time;
- Recultivation of the construction camp and the treatment plant area after the completion of construction works;

In addition:

- Proper management of waste;
- Implementation of mitigation measures of the impacts on water, soil and ambient air, noise and so on (see the relevant chapters).

The most significant mitigation measures during the operational phase are: Systematic maintenance of the treatment plant and associated devices and optimization of night lightening systems. Systematic control of the efficiency of the treatment plant in order to minimize the impact on water related animal species.

6.10.4 Impact on Protected Areas

There are no protected areas in the vicinity of the project corridor. Therefore, the impact on protected areas is not expected.

6.10.5 Assessment of the Impact on Biological Environment

Table 6.10.5.1. Summary of the impact on biological environment

Description of impact and its sources	Impact receptors	Residual Impact Assessment					
		Nature	**Probability of influence**	**Influence area**	**Duration**	**Reversibility**	**Residual impact**
Construction Phase:							
Vegetation destruction / damage. Habitat loss / fragmentation. – Direct impact: o Vegetation removal from the area; o Damage of vegetation caused by violating traffic routes. – Indirect impact: o Water pollution; o Soil contamination and erosion.	Area selected for the construction of the treatment plant, wildlife, population	Direct and indirect, negative	Medium risk	– Direct impact area – construction camp and construction site – Indirect impact area – areas adjacent to the construction camp and construction site.	Medium term. Permanent on the construction site	Reversible. On construction site - irreversible	**Low.** Considering mitigation measures – **very low.**
Impact on terrestrial fauna, including: – Direct impact: o Traffic collision, falling down in trenches and others. – Indirect impact: o Damage of vegetation. o Ambient air pollution o Change in acoustic background o Change in background illumination at night; o Possible pollution of ground and surface waters; o Soil contamination and erosion o Visual impact	Animal species inhabiting in the project area	Direct and indirect, negative	Medium risk	Areas adjacent to the construction camp and construction site.	Duration is limited by the construction phase	Mostly reversible	**Mainly medium.** Considering mitigation measures – **low.**
Operation Phase:							
Impact on fauna, including: – Noise and odor propagation; – Contamination of Alazani River water; – Lightening; – Visual impact, etc.	Area selected for the construction of the treatment plant, wildlife	Direct and indirect, negative	Medium risk	Areas adjacent to the project area	Long term	Mostly irreversible	**Very low**

6.11 Impacts Caused by Waste Generation and Propagation

6.11.1.1 Construction Phase

Types and quantities of currently existing waste are described and their further management issues are described in paragraph 4.4.2.1.

Generation of a number of hazardous and non-hazardous waste is expected during the construction phase.
Inert waste:

- Inert waste generated in the process of excavation works;
- Packaging and sealing materials;
- Ferrous and non-ferrous scrap metal;
- Household waste and others.

Generated inert waste will be selected and disposed at construction waste landfill in Kutaisi. Part of the dumped soil may be used for construction works. Steel waste will be collected and transferred to the contractor after completing the formalities (iron reception).

Given that an average amount of per capita household waste collected per year is 0.7 m^3, total amount of household waste generated during the construction works is estimated to be 60*0,7=**42 m^3/a**. Household waste will be stored in closed containers with an appropriate marking. Accumulated household waste will be stored throughout the construction camps and then will be removed from the project area to the Kutaisi landfill. Packaging and sealing materials will be also disposed at Kutaisi landfill.

Hazardous waste:

- Paint waste and packaging - 120-150 kg/a;
- Fuel and lubricant waste - 140-160 kg/a;
- Outdated and damaged accumulators 10-12 unit/a;
- Oil filters of construction equipment and vehicles, etc. - 15-20 unit/a;
- Used rubber tires - 20-30 unit/a;
- Welding electrodes – 80-100 kg/a;
- Luminescent lamps - 20-25 unit/a;
- Laser Cartridges - 8-10 unit/a;
- In the case of accidental spill of oil, soil polluted with petroleum hydrocarbons – the volume depends on the magnitude of the spill.

A special storage should be provided for temporary disposal of other hazardous waste throughout the construction camp (preferably a container of 20-25 m^2 capacity), which will have an appropriate marking and will be protected from the impact of precipitation. Racks should be arranged for waste. Stored waste shall be labeled.

Waste should be removed from the temporary storage facility according to the accumulation, but no later than 3 days. Hazardous waste disposal from temporary storage facilities for further management (utilization, disposal) should be carried out by the appropriate licensed contractor. Recording of quantities and types of such waste is required.

In case of small spills, remediation of soil (3-5 m^3) contaminated by petroleum hydrocarbons is possible on site. In case of large spills, contaminated soil should be removed from the site and remediated outside the area. Recultivation works should be carried out throughout the contaminated area. Contaminated soil should be remediated by an appropriate licensed contractor.

Violation of the above mentioned terms of waste management may cause a number of adverse environmental impacts on different receptors, for example:

- Incorrect management of waste (dumping into water, scattering) may lead to water and soil pollution, as well as to deteriorated sanitary conditions and adverse visual changes;

- Improper disposal of construction waste and waste rock (generated during the excavation works) may cause damming of the roads and may lead to erosion processes, etc.

Therefore it is necessary to protect waste management conditions. Waste management terms are given in detail in Appendix №3.

6.11.1.2 Operation Phase

The annual amount of household waste generated during the operational phase will be about 20*0.7=**14 m³/a.** Based on the agreement, waste will be removed from the area to Alazani landfill.

The following hazardous waste is expected to be generated during the operational phase:

- Outdated and damaged accumulators 2-3 unit/a;
- Oil filters of vehicles, etc. – 4-6 unit/a;
- Used rubber tires – 8-10 unit/a;
- Welding electrodes -5-10 kg/a;
- Luminescent lamps – 10-15 unit/a;
- In the case of accidental spill of oil, soil polluted with petroleum hydrocarbons – the volume depends on the magnitude of the spill.

Further management of hazardous waste should be carried out by an appropriate licensed contractor.

Special attention should be paid to the issues related to the management of the waste accumulated on the grille of the shield system, as well as to the removed sludge. After the proper treatment (dehydration, drying), the sludge will be temporarily stored on a special bed and then will be removed from the area to the Kutaisi landfill.

The use of dehydrated sludge for agricultural purposes is also considered and in case of the relevant demand, pre-treated sludge will be given to interested persons free of charge. If we consider that the demand on using the sludge for agricultural purposes will be seasonal (early spring and fall), the main method of sludge management will be their disposal at the landfill (sludge management principles after dehydration are given in Paragraph 4.3.4.1.).

6.11.2 Mitigation Measures

Construction contractor is obliged to ensure that the waste management planned activities are implemented during the construction phase, including:

- Household waste generated within the construction camp will be removed to Alazani landfill;
- Labeled hermetic containers should be arranged in construction sites for a temporary storage of hazardous waste. Special storage facilities should be arranged on construction camps;
- Appropriate trained personnel should be hired for waste management; they should receive periodic training and testing;
- Hazardous waste for further management should be removed from the construction camp by the appropriate licensed contractor.

Special storage facility should be arranged for temporary disposal of hazardous waste during the operational phase, which should be in compliance with environmental requirements, namely:

- The floor and walls of the storage facility should be finished with ceramic tiles;
- The ceiling of the storage facility will be painted by waterproof paints;
- Storage should be equipped:
    - Exhaust ventilation system;
    - Wash stand and tap for irrigation;
    - Trap for intake.

- Shelves and racks for waste disposal;

Appropriate trained personnel should be hired for waste management; they should receive periodic training and testing. Hazardous waste for further management should be removed from the construction camp by the appropriate licensed contractor. Recording of quantities and types of such waste is required.

6.12 Impact on Socio - Economic Environment

6.12.1 Impact Assessment Methodology

Negative as well as positive aspects of the project have been discussed during the assessment of the impact on socio-economic environment. Impact is assessed according to three categories - **low impact, medium impact and high impact** (see Table 6.12.1.1.).

Table 6.12.1.1. Assessment criteria of the impact on socio-economic environment

Ranking	Category	Impact on socio - economic
Positive		
1	**Low**	– Employment rate in region has increased by less than 0.1%. – Average income of the local population has increased by 10%. – Budget revenues of the region has increased by 1%. – Local infrastructure / power supply has been slightly improved, resulting in improved local population living / subsistence and economic environment.
2	**Medium**	– Employment rate in region has increased by 0.1%-1%. – Average income of the local population has increased by 10-50%. – Budget revenues of the region has increased by 1-5%. – Local infrastructure / power supply has been significantly improved, resulting in significantly improved local population living / subsistence and economic environment, which contributes to the economic development of the region.
3	**High**	– Employment rate in region has increased by 1%. – Average income of the local population has increased by more than 50%. – Budget revenues of the region has increased by more than 5%. – Local infrastructure / power supply has been significantly improved, resulting in significantly improved local population living / subsistence and economic environment, which contributes to the economic development of the region.
Negative		
1	**Low**	– A short time delay in the availability of resources or infrastructure is expected, though it will not affect the income of the local population. In addition, it will not be followed by long-term negative impacts on the economic activity of the local population. – Quality of life of the local population will be lowered for a short period of time, though it will not be followed by a long-term negative results. – Health will not be affected. – Impact on safety is negligible. – A long-term, but easily adaptable impact on environment is expected. – Local population will increase by 10% due to migration.
2	**Medium**	– A short time delay in the availability of resources or infrastructure is expected, due to which the local population will have to change their lifestyle for a short period of time. However, it will not have any long-term negative impact on the economic activities of the local population. – Quality of life of the local population will be lowered for a short period of time, though it will not be followed by a long-term negative results. – A certain impact on health is expected, but there is no increased mortality risk. – There are some risks related to safety. – Complaints from citizens are expected about some of the impacts. – Local population will increase by 10-30% due to migration.
3	**High**	– A short time delay in the availability of resources or infrastructure is expected, due to which the local population will have to change their lifestyle for a short period of time, which will

		have a long-term negative impact on their economic activities. – Quality of life of the local population will be significantly lowered. – There is a significant impact on health. There is a high risk of increasing mortality rate. – There are some risks related to safety. – Corrupt deals related to employment or nepotism. – People are constantly complaining about the influence of certain factors. In this regard, conflicts arise between residents and staff. – Local population will increase by 30% due to migration. Cultural environment for the local population is significantly changed. Creation of new settlements is expected.

6.12.2 Characterization of the Impact

6.12.2.1 Impact on Land Ownership and Use

Area selected for the construction of treatment plant is a state-owned non-agricultural land. In the past, similar plant was operating on the project area. Currently, the area is used as an unlicensed dump area. It is important that none of the buildings are located within the construction zone.

Therefore, the planned activities will not be related to physical or economic resettlement.

6.12.2.2 Risks Related to Health and Safety

Except indirect impact (deterioration of air quality, spread of noise and electric fields, etc., which are described in the relevant subsections) there is a direct risks of impact on health and safety (residents and staff working within the project) during the construction phase.

Direct impacts may be: Vehicle collision, power hit, falling from height, injuries while working with construction techniques and others. Strict security measures and a permanent supervision should to be protected in order to prevent direct impacts. Security measures include:

- Personnel should to be trained on safety and labor protection issues;
- Personnel working at height must be secured with ropes and special mountings;
- Warning, prohibiting and indicative signs should to be arranged throughout the construction sites and camps;
- Maximum protection of safety rules during the transportation;
- Transportation should to be limited to a minimum in populated areas;
- Risk assessment should be conducted regularly in order to determine specific risk factors for the population and for appropriate management of such risks;
- Construction personnel shall be provided with personal protective equipment (special - clothing, helmets, etc.).

6.12.2.3 Impact on Employment and Economic Environment

A certain amount of local specialists and workers will be employed by the construction contractor, which is the positive impact on employment.

Building materials of local production (such as inert materials) will be required for construction works, which will also have a positive impact on activation of building materials manufacturing business.

6.12.2.4 Impacts on Transport Infrastructure, limited Traffic

Paved roads (Khubulava street, to the north of the project area) and earth roads, which joins the area from the paved road will be used for transportation of building materials and labor during the

construction phase. During the construction works road pavement will be damaged and traffic will be increased. The risk of accidents will be also increased.

The roads should be maintained throughout the construction phase. Blocking roads with construction and other materials is prohibited. After completion of construction works, local roads should be rehabilitated.

Taking into account the intensity of the background traffic flow, limited traffic on local roads (so called traffic jams) is less expected. The impact may be relatively noticeable on the road used for transportation of construction materials.

Construction contractor shall plan construction activities so as to minimize the impact on roads, namely:

- Selection of an optimal bypass route to the construction site;
- Possible restrictions on the movement of vehicles on public roads (especially paved roads of Alazani);
- Maximum limitation of the movement of crawlers;
- Population should be provided with the information about the time and duration of works, if necessary;
- All damaged sections of the road should be recovered, in order to make them available for the population;
- Specially designated personnel (standard bearer) should control the movement of vehicles, if necessary;
- Relevant banners will be arranged along the road, through which passengers will be informed about the ongoing works within the project area;
- Complaints should be recorded and an appropriate action should be taken.

The use of vehicles during the operational phase will be necessary for repair works. Accordingly, traffic will not be intensified and impacts on traffic are not expected.

6.12.2.5 Positive Impact of Treatment Plant Operation on Socio - Economic Environment

The project is expected to have a significant positive impact on social environment, namely:

- Issues related to municipal wastewater drainage and treatment will be regulated and sanitary and ecological situation will be improved in Kutaisi and adjacent settlements;
- Prevention of discharging untreated agricultural-fecal wastewater into the surface water bodies, which is important for the improvement of surface water quality in Kutaisi Municipality. Positive impact is expected on habitats of wildlife;
- Implementation of the project ensures the sustainable development of local infrastructure, which is important for socio-economic development of communities and regions;
- 15-20 people from local population will be employed during the treatment plant operation, which is a small though positive impact in terms of employment of local population.

6.12.3 Impact Assessment

Table 6.12.3.1. Summary of the impact on socio-economic environment

Description of impact and its sources	Impact receptors	Residual Impact Assessment					
		Nature	Probability of influence	Influence area	Duration	Reversibility	Residual impact
Construction Phase:							
Restriction of access to resources:: – Impact on land owners - implementation of any type of activity on their lands, or damage of their property; – Limited use of water resources, etc.	Local population	Direct, negative	Low risk	Area adjacent to the treatment plant	Duration is limited by the construction phase	Reversible	**Low**
Positive impacts related to the employment	Local population	Direct, Positive	High probability	Population of Alazani	Duration is limited by the construction phase	Reversible	**Medium**
Negative impacts related to the employment: • Expectations for employment and dissatisfaction of the local population; • Violations of workers' rights; • Reduction of employment after the completion of the project s and dissatisfactions; • Disagreement between the local residents and workers.	Construction staff and the local population	Direct, negative	Medium risk	Construction sites and nearby populated areas	Duration is limited by the construction phase	Reversible	**Low**
Risks related to health and safety: – Direct (e.g. Vehicle collision, power hit, falling from height, injuries while working with construction techniques and others.) and – Indirect (Atmospheric emissions, increased acoustic background, water and soil pollution).	Construction staff and the local population	Direct or indirect, negative	Medium risk, considering mitigation measures – low risk	Construction sites and nearby populated areas	Duration is limited by the construction phase	Reversible	**Low**

Damage of road pavement – Movement of heavy equipment ***loaded traffic flow*** – Movement of all types of vehicles and equipment ***Limitation of movement*** – Closing the local roads for the security purposes	Local infrastructure, population	Direct, negative	Medium risk	Roads used for the project activities, as well as by the population	Duration is limited by the construction phase	Reversible	**Low**
Contribution to the economy and employment – Activation and development of building materials manufacturing business and its satellite business; – Creation of jobs; – Increased budget revenues.	The city's economic activity, the local population	Direct, Positive	High probability	Impact area may be a city-wide	Duration is limited by the construction phase	-	**Medium**

Operation Phase:							
Risks related to health and safety of population: – Indirect - spread of unpleasant odor; In case of maintenance works atmospheric emissions, increased acoustic background, water and soil pollution	Plant staff and local population	Direct Negative	Low risk	Adjacent residential zone	Long-term	Irreversible	**Very low**
Employment – Creation of jobs;	Employment of local population	Direct positive	High probability	Alazani city	Long-term	-	**Low**
Improvement of local wastewater infrastructure (positive impact)	Local population and tourists	Direct positive	High probability	Alazani city and adjacent settlements	Long-term	-	**High**

6.13 Impact on Cultural and Archaeological Monuments

According to the results of fieldwork, there are not any historical-cultural monuments in the project area. It should be mentioned that previously an old treatment plant has been operating on the project area. Thus, late detection of archaeological sites during the construction phase is less expected.

However, during the implementation of excavation works some archeological sites can be discovered. Based on the requirements of the law of Georgia on "cultural heritage", in case of detection of an archaeological monument, construction works should be immediately stopped and the construction contractor shall invite the specialists of the competent authority in order to determine the significance of the archaeological monuments and make decision about the extension of works.

6.14 Cumulative Impacts

The main objective of the cumulative impact assessment is to identify those types of impact, which do not represent any serious risks to the environment, but together with the similar kind of effect that may be caused by other current or prospective projects, will cause a much higher and significant negative or positive consequences.

Any important industrial enterprises and other objects that will have significant effect on the environment, does not function in the vicinity of the project area. Based on the available information, similar projects are not planned to be implemented in the future as well. Only paved road adjacent to the area should to be considered. Construction works and traffic will have certain cumulative effect in terms of pollutants emission in ambient air and noise propagation. Due to the low intensity of construction works the cumulative impact will not be significant. Low-scale cumulative impacts are not subject to detailed consideration.

7. Environmental Impact Mitigation Measures

7.1 General Overview

Hierarchy of environmental measures is following:

- Impact prevention;
- Impact reduction;
- Impact mitigation;
- Compensation.

Prevention and mitigation of impact is possible by using best practice during construction and operation processes. Project development considers outlining mitigation measures. However, as it is impossible to prevent all impacts, in order to ensure maximum extent of environmental friendliness, corresponding mitigation measures were developed for all receptors during all life cycles of the project.

The plan is "live" document which will be detailed and adjusted on the basis of monitoring/observation. Responsibility for implementation of environmental monitoring and management lies on individual assigned to these task by the Customer. During construction stage, responsibility of environmental management is divided between construction contractor and the Customer.

7.2 Mitigation Measures for the Impact Expected during Construction and Operation Phases

Tables below give information concerning mitigation measures developed for construction and operation phases and necessary monitoring work, namely:

I. Column presents: description of expected impact according to specific receptor, due to which works may this impact occur and expected scale (classification was conducted according to 5 point scale): **„Very low", „Low", „Moderate", „High" or „Very high");**
II. Column - Description of mitigation measures' main goals and objectives;
III. Column - List of mitigation measures, which will prevent or mitigate expected impact, residual impact (after implementation of measures) which is also classified by aforementioned 5 point scale;
IV. Column -
   - Responsibility for implementation of mitigation measures;
   - On which phase of project implementation will the mitigation measure be most efficient;
   - Evaluation of costs necessary for implementation of mitigation measures (3 point classification system was used: **„Low"** - <25000$; **„Moderate"** - 25000-100000$; **„High"** - >100000$);
V. Column–Brief description of necessary monitoring work.

7.3 Mitigation Measures – Construction Phase

Impact/ Impact Description	Task	Mitigation Measures:		Monitoring
		Description	Responsibilities, Time-frames and Expenses	
Inorganic dust distribution in ambient air: • Dust due to earth works; • Dust due to transportation operation; • Dust due to inert material loading/unloading; • Dust due to construction works; **Significance: „medium“**	To minimize dust emission in order to reduce environmental impact, such as: • Disturbance of people (population, staff) and negative impact on their health; • Disturbance of animals and their migration;; • Dust vegetation cover and to prevent their growth and development.	**a.** Ensure that vehicle's speed is optimal (esp. on ground roads); **b.** To restrict traffic on the motorway that passes the settlements; **c.** Take preventive measures (e.g. prohibition of material dropping from height during loading/unloading); **d.** Water the work area and roads in dry weather; **e.** To cover properly the body of the vehicle during transportation of materials, that easily form dust; **f.** To use special covering or water the storage areas for easily dust-forming materials, to prevent their distribution by wind; **g.** Equip personnel with proper protecting equipment (masks) as needed; **h.** Instruct personnel; **i.** Identify/register and response properly to complaints; **Significance of residual impact : „low“**	**Responsible for implementation of mitigation measures:** Executor of works – work site managers **Time-frames for implementation of mitigation measures:** **a, b** – constantly during transport operations; **c –** During earth works and material loading/unloading; **d, e, f –** Periodically, esp., in dry and windy weather; **g, h –** Before starting works and then time to time; **i –** After entry of the complaints; **Cost for implementation of mitigation measures::** Activities considered by paragraphs **d, f, g ,** will be connected with **"low"** expenses	Environment and security manager designated by the executor of the works, will carry out daily visual examination, inspect transport operations, monitor issues, not related to the additional expenses
Distribution of combustion products in the ambient air: • Exhaust from vehicles, building machinery; • Exhaust from generators and other machinery; • Welding aerosols; **Significance: „low“**	To minimize exhaust in order to reduce environmental impact, such as: • Impact on human health; • Deterioration of animal habitat and migration;	**a.** Ensure proper working conditions of machinery; **b.** Arrange generators and other machinery far from sensitive receptors (residential zone, area covered with vegetation); **c.** To choose optimal route and speed during vehicle movement; **d.** To turn off the engines or work at minimum turn, when they are not in use; **e.** Instruct personnel; **j.** Identify/register and response properly to complaints; **Significance of residual impact : „very low“**	**Responsible for implementation of mitigation measures:** Executor of works – work site managers **Time-frames for implementation of mitigation measures:** **a, b** – Before starting works – on preparation stage, time to time; **c, d-** constantly during transport operations; **e –** Before starting works and then	Environment and security manager designated by the executor of the works will carry out visual examination of vehicles once in two weeks; record vehicle maintenance; inspect transport operations, monitoring are not related to expenses.

			time to time; **f -** After receiving claims; **Mitigation measure implementation costs:** Not related to additional costs.	
Noise in work zone : • Noise and vibration due to transportation operations; – Noise and vibration due to construction/dismantling works; • Noise and vibration due to building machinery and construction operations. **Significance: „medium“**	• Reduce impact on the health of the personnel	• Ensure proper working conditions of machinery; **a.** Arrange noisy machinery far from sensitive receptors (resting room for workers); **b.** Using special acoustic protector (noise suppressing hood, etc.) when necessary, with compressors, generators and other noisy devices; **c.** Often shift the staff executing the works related to the high level of noise; **d.** Monitor noise levels. **e.** Ensure personnel with personal protective equipment (ear-protectors); **f.** Instruct personnel; **Significance of residual impact : „ low“**	**Responsible for implementation of mitigation measures:** Executor of works – work site managers **Time-frames for implementation of mitigation measures:** **a, b, c**– On preparation stage; **d, e**- During intensive noisy work process; **f, g** – Before starting intensive noisy work . **Mitigation measure implementation costs:** Activities considered by paragraphs **c, f, g -** will be connected with **“low”** expenses	Control proper working of machinery; If necessary carry out instrumental measurements (during intensive noisy work process). Expenses will be related to instrumental measurements.
Spreading noise on the border of residential zone, impact on other receptors: • Noise and vibration due to transportation operations; • Noise and vibration due to building machinery and construction operations. **Significance: „medium“ or “low**	To minimize noise in order to reduce environmental impact, such as: • Disturb population; • Disturbed animals and migration.	**a.** Ensure proper working conditions of machinery; **b.** Arrange generators and other noisy machinery far from sensitive receptors (residential houses); **c.** Carry out noisy works and intensive transport operations only in the day-time; **d.** Define noisy work time considering social issues; **e.** Inform and give explanation to population about noisy works; **f.** Instruct personnel; **k.** Identify/register and response properly on claims; • Provide instrumental measurement at the border of sensitive areas (residential zones),	**Responsible for implementation of mitigation measures:** Executor of works **Time-frames for implementation of mitigation measures:** **a, b - -** On preparation stage; time to time; **c, d, e –** While planning and before starting of works; **f** - Before starting works and then periodically; **g- -** After receiving claims	Control proper working of machinery; If necessary, instrumental measurement. Expenses will be related to instrumental measurements.

		• As far as possible reduce noise on the place of its production (noise suppressing hoods) and restrict spreading using artificial screening. **Significance of residual impact : „low, very low“**	**Cost for implementation of mitigation measures::** Activities considered by paragraph ,,**g”** can be connected with **“low”** expenses.	
Pollution of surface waters: • Pollution due to improper solid and waste management; • Pollution by fuel/oil spilling;. **Significance: „medium“**	Prevention of surface water pollution and reduction of impact on the environment, such as: • Impact on water biodiversity; • Pollution of ground water; • Impact on receptors, depending on water resources (animals, population).	**a.** Ensure proper working conditions of machinery; **b.** Arrange machinery and potentially pollutant materials in not less than 50 m from surface water body (where possible). If impossible, carry out continuous control and security measures to prevent water pollution; **c.** Proper management of wastewater, produced on construction camp site; **d.** Arrange drainage / diversion channels along the areas, potentially polluting the storm waters; **e.** Roof the areas, potentially polluting the storm waters, as possible (to arrange building like a shed); **f.** Instruct personnel; **g.** Prohibit car-washing near the riverbeds; **h.** Remove all polluting materials after completion of works; **i.** Localize and clean spilt fuel/oil in case of fuel/lubricants spillage; **Significance of residual impact : „low“**	**Responsible for implementation of mitigation measures:** Executor of works – work site managers **Time-frames for implementation of mitigation measures:** **a, b, c, d, e, f** – Before starting works; **g** – During work process; **h –**After completion of works; **i –** In case of pollution, in the shortest period of time and as necessary. **Cost for implementation of mitigation measures::** Activities considered by paragraphs **c, d, e, i -** can be connected with **“medium”** expenses.	Control waste management plan implementation; Visual control of soil, water and wastewater condition.
Impact on the groundwater: • Quality deterioration due to polluted surface waters or soil; • Due to fuel/oil spilling during construction works(esp. earth works). **Significance: „medium“**	Reduce impact on receptors (population, biodiversity) depending on groundwater resources.	• Provide all measures avoiding soil quality deterioration (see the corresponding paragraph). • Provide all measures avoiding surface water quality deterioration (see the corresponding paragraph). **Significance of residual impact : „low“**	**Responsible for implementation of mitigation measures:** Executor of works **Time-frames for implementation of mitigation measures:** During work implementation process; **Cost for implementation of mitigation measures::** Not related to additional expenses.	Proper maintenance control; Control of waste management plan implementation; Visual control of soil, water condition. If necessary, conduct laboratory monitoring.
Soil/ground stability disruption, fertile soil layer destruction:	• Keep topsoil and use it while recultivation; • Prevention of	**a.** Follow safety norms introduced for the projected works; **b.** Strict adherence of the borders of the road and construction sites to prevent additional damage of the	**Responsible for implementation of mitigation measures:** Executor of works	Regular visual observation on the landfill for removed

• Disruption of stability during construction works; • Fertile layer destruction during cleaning of area for construction site preparation. **Significance: <u>„low“</u>**	soil/ground erosion processes	soil; **c.** Keep the integrity of the road surface by maintenance; **d.** Removal and temporary storage of the topsoil should be provided according to following rules: **e.** Height of the dumps shall not exceed 2 m; **f.** Slopes of the dump area should be given appropriate tilt (45^0) angle; **g.** Water discharge canals should be arranged within the dump area and it should be protected from wind dispersal. **h.** Instruct personnel. **Significance of residual impact : <u>„ very low“</u>**	**Time-frames for implementation of mitigation measures:** **a, b, c** – During construction works on a regular basis; **d** –During preparing construction sites; **e –** Before starting the works and then periodically; **Cost for implementation of mitigation measures:** Activities considered by paragraphs ,,**d** “can be connected with **<u>“low”</u>** expenses.	topsoil. Monitoring is not related to the additional expenses.
<u>Soil pollution:</u> • Soil pollution by wastes; • Soil pollution due to fuel/oil or other substance spilling. **Significance: <u>„medium“</u>**	<u>Prevention of soil pollution and accordingly, reduction of indirect environmental impact, such as:</u> • Deterioration of animal habitat; • Indirect impact on vegetation; • Pollution of ground and surface waters;	**a.** Ensure proper working conditions of machinery; **b.** Safe storage/placement of potential pollutants (oil, lubricants, etc.); **c.** In case of arrangement of storage reservoir, it will have concrete or clay fencing, with a capacity less than 110 % of the total volume of the reservoir; **d.** Ensure the gravel layer coverage for fuelling station; **e.** Provide corresponding equipment (containers, spill collection implements, etc.); **f.** Ensure proper waste management, including separation and reuse as possible, store waste not appropriate for reuse in special containers and move out of the territory ; **g.** Remove all potential pollutants when works are finished. **h.** If necessary, provide laboratory monitoring of soil quality; **i.** Localize and clean spilt fuel/oil; **j.** Instruct personnel ; **Significance of residual impact : <u>„ very low“</u>**	**Responsible for implementation of mitigation measures:** Executor of works – work site managers **Time-frames for implementation of mitigation measures:** **a, b, c, d, e** –On preparation stage , time to time; **f** – During waste handling process; **g –** After finishing the works; **h, i –** Promptly after pollution; **j -** Before starting the works and then periodically. **Cost for implementation of mitigation measures::** Activities considered by paragraphs **c, d, e, h, i** can be connected with **<u>“medium”</u>** expenses.	Maintenance control; Monitoring waste management plan implementation; Visual control of the soil condition and laboratory monitoring as necessary. Monitoring expenses can be related to laboratory control.
<u>Development of geodynamic and other dangerous events</u>	• Prevent waterlogging; • Safe implementation of	**a.** Temporary protective structure (clay diaphragm) arrangement;	**Responsible for implementation of the mitigation measures:**	Control over the groundwater inflows

Significance: **„Low“**	the construction activities.	**b.** Pumping the groundwater from the cavern; **Significance of the residual impacts:** **„Very low“**	Building contractor **Time frames for the implementation of mitigation measures:** **a** – After the cover arrangement; **b** – As required **The costs of the mitigation measures:** Implementation of the measures might be related to **“Low”** costs.	
Visual-landscape alteration: • Visual-landscape alteration due to construction site and construction camp. • Visual-landscape alteration due to increased traffic flow; **Significance: „medium“**	• Reduce dissatisfaction of people; • Prevention of alteration of animal habitat and migration.	**a.** During arrangement of temporary facilities, using natural materials and reasonable colouring, as possible; **b.** Storage of materials and waste in places invisible for visual receptors, as possible **c.** Choose optimal route while vehicle movement (bypassing settlements); **d.** Clear and recultivate the territory **Significance of residual impact : „low“**	**Responsible for implementation of mitigation measures:** Executor of works **Time-frames for implementation of mitigation measures:** **a, b -** On preparation stage , time to time; **c** – During transport operation; **d**–After finishing works. **Cost for implementation of mitigation measures::** Not related to additional expenses.	Visual monitoring to control sanitary-environmental condition of the area.
Impact on flora, loss, damage of habitats. • Cleaning from vegetation of projected area; • Impact related to the arrangement of the construction camp and temporary facilities. **Significance: „medium“**	• Minimize risks connected to loss and damage of habitats; • Conservation and corresponding management of habitats.	**a.** In order to minimize the risk of damage of the existing vegetation, strict protection of construction camp borders and definition of vehicle movement; **b.** Instruct personnel about the vegetation protection issues; **c.** Trees and plants cutting down works should be conducted under the supervision of authorized specialists; **d.** Landscaping works. In addition, • Carry out measures related to visual-landscape alteration (see the corresponding paragraph). • Carry out measures on water, soil and ambient air pollution (see the corresponding paragraph); **Significance of residual impact : „low“**	**Responsible for implementation of mitigation measures:** Executor of works **Time-frames for implementation of mitigation measures:** **a, b –** Before cleaning or work area from vegetation; **c** – During cleaning of area from vegetation; **d** – After finishing works. **Cost for implementation of mitigation measures:** **-Low**	Ensure daily monitoring during cleaning works of the area from vegetation to protect work scope and prevent additional damage of vegetation.
Impact on behaviour of species: • Impairment of reproduction and	• Minimize direct and indirect impacts on animal species.	**a.** Control traffic routes and building site borders; **b.** Define optimal vehicle speed to reduce direct impact (collision) risk;	**Responsible for implementation of mitigation measures:** Executor of works	Waste management control; Inspect periodically drivers.

habitability. Animal migration; • Direct impact – animal deaths, harm. **Significance: „medium“**		**c.** It is recommended to fence working sites, tranches and others to avoid animal falling in ditches; **d.** Minimize direct light usage to reduce light spreading; **e.** Provide implementation of works that cause animal disturbance, in the shortest period of time. In addition, • Proper management of waste;; • Carry out mitigation measures on water, soil and ambient air pollution (see the corresponding paragraph). **Significance of residual impact : „low“**	**Time-frames for implementation of mitigation measures:** **a, b –** During transport operations. **c, d, e,** -Regularly on construction phase. **Cost for implementation of mitigation measures:** Can be connected with low or medium expenses.	Monitoring is not related to additional expenses.
Risks of environment pollution with waste: • Construction waste; • Hazardous waste; • Domestic waste. **Significance: „High“ or very high**	Prevention of disorganized waste distributing into the environment and accordingly reduction of environmental impact, such as: • Negative impact on human health and security; • Pollution of water environment; • Direct negative impact on animals; • Negative visual-landscape alteration; • And others.	**a.** Adequate waste management generated due to the cleaning of the area and dismantling; **b.** Deliver materials necessary for construction and other purposes as many as required for the project; **c.** Use removed ground for the project. Storage of the remained part in pre-prepared places by following appropriate rules. **d.** Reuse of waste as, possible; **e.** Special warehouse storerooms should be arranged on the territories of construction camps for temporary disposal of hazardous waste and hermetic containers with special marking to be placed on the construction sites; **f.** Maximum protection of security norms while waste transportation (covering vehicle body, etc.); **g.** Removal of the waste from the construction camps for the further management to be done by the contractor having an appropriate permission on these activities. **h.** Establish appropriate recording mechanism and keep appropriate journal for waste generation, temporary storage and further handling processes; **i.** Appropriately trained staff to be provided for the waste management **j.** Instruct personnel. **Significance of residual impact : “medium”**	**Responsible for implementation of mitigation measures:** Executor of works –a person designated for waste management. **Time-frames for implementation of mitigation measures:** **a, b, e, i –** On preparation stage. **c, d, f , g, h** – During waste management process. **Cost for implementation of mitigation measures:** Activities considered by paragraphs **d, f, h** can be connected with **“medium”** expenses.	Waste management plan implementation control by the person, designated for waste management. Record waste volume and type, keep appropriate journal. Monitoring expenses can be related to the employment of additional staff.
Impact on land ownership and use. Availability of resources: • Impact on neighbouring land owners;	• Restrict local resources at minimum, for the short period of time.	**a.** Implementation of the works, related to restriction of the local resources, in the short period: **b.** Identify/record claims, set mechanism form their discussion and proper response;	**Responsible for implementation of mitigation measures:** Client, executor of works **Time-frames for implementation of**	Investigate opinion of population and set appropriate mechanism for

• Use of water and other resources due to construction works. **Significance: <u>„Low“</u>**		**Significance of residual impact: is not expected**	**mitigation measures:** **a -** During work process **b –** After receiving claims. **Cost for implementation of mitigation measures:** - It is likely not connected with additional expenses.	recording claims
<u>Employment and related negative impact risks, namely:</u> • Employment expectation of local population and dissatisfaction; • Violation rights of employees; • Shortage of job-places and dissatisfaction due to elimination of the project; • Disagreement between local population and employees(non-resident). **Significance: <u>„medium“</u>**	• Eliminate disagreement of project employees and local population.	**a.** Develop personnel hiring policy and publish in local(office), at municipal (building of Gamgeoba, etc.) and regional levels; **b.** Hiring personnel according appropriate testing; **c.** Sign individual contract with each employee; **d.** Include articles in employee's contract about all plans, procedures and mitigation measures, as well as including articles concerning security plan monitoring and accident reports. **e.** Provide personnel with information about their job – develop code of conduct; **f.** Inform all non-resident personnel about local customs and culture; **g.** While purchasing different materials, local products and support of local enterprises will have prevalence; **h.** Develop the mechanism of employees' claim review and its practical implementation; **i.** Keep record book for claims of personnel; **Significance of residual impact : <u>“ low“</u>**	**Responsible for implementation of mitigation measures:** Executor of works **Time-frames for implementation of mitigation measures:** **a, b, c, d, e, f, -** Before starting the works (before hiring and in the process of hiring personnel), as well as when taking decision about hiring new personnel during work process; **g, h, i –** During work implementation process. **Cost for implementation of mitigation measures:** Activities considered by paragraph “**g”** can be connected with “low” expenses (difference in prices).	Establish appropriate mechanism on recording and responding claims. Make disciplinary records.
<u>Impact on traffic flow and infrastructure:</u> • Damage of road surface; • Heavy traffic flow; • Obstruction of movement. **Significance: <u>„medium“</u>**	• Maintain road surface and facilitate the free movement; • Minimize traffic threats, traffic jams; • Eliminate dissatisfaction of population.	**a.** Ensure that population's passage is minimally obstructed; **b.** Choose optimal - bypass route to the access road to construction site; **c.** Limit vehicle movement on public roads, as possible; **d.** Maximum restriction of movement of caterpillar machine; **e.** Notify population about work time-frame; **f.** Maximum restoration of damaged sections of the road to	**Responsible for implementation of mitigation measures:** Executor of works **Time-frames for implementation of mitigation measures:** **a, b, c, d, e, -** During work process-transport operations; **f –** After finishing works; **g –** After receiving claims.	Continuous monitoring of road quality.

		ensure accessibility for population; **g.** Identify/record claims and proper response; **Significance of residual impact : " low"**	**Cost for implementation of mitigation measures:** Activities considered by paragraph "**f**" - can be connected with "low" expenses.	
Health and security hazards: • Possible impact on health and safety of population; • Possible impact on health and safety of employed personnel. **Significance: "medium" or „low"**	• Ensure human health and safety.	**a.** Personnel training on safety and labor issues; **b.** Equip personnel by personal protection equipment; **c.** Install warning signs on areas and roads dangerous for health; **d.** Fencing dangerous areas; **e.** Provide standard medical sets on the areas dangerous for health and on construction camp; **f.** Ensure proper working conditions of machinery **g.** Maximum observation of safety rules during transport operations; **h.** Restrict traffic on the roads, that pass the settlements; **i.** Control getting and moving of strangers at the workplace without special permit or without special protective equipment; **j.** Onsite risk assessment to identify certain hazards and appropriate handling of them for the security of population; **k.** Personnel insurance with ropes and special fasteners during the work on height; **l.** Keep register for accidents and incidents. **m.** In addition, carry out all measures to prevent ambient air, water and soil quality deterioration. Carry out noise mitigation measures. **Significance of residual impact : " low"**	**Responsible for implementation of mitigation measures:** Executor of works **Time-frames for implementation of mitigation measures:** **a –** When hiring personnel and further several times a year; - Before starting works; **b, c, d, e, -** Before starting works and continuous update; **f, g, h, i, j, k, l –** Continuously during work process. **Cost for implementation of mitigation measures:** Activities considered by paragraphs **b, c, d, e, f** can be connected with "medium" expenses.	Control of proper working of machinery. Record incidents and accidents. Unscheduled examination-inspect of personnel.
Impact on historical-cultural and archaeological monuments: • Damage of cultural heritage sites; • Damage of unrecorded archaeological heritage sites due to implementation of earth works; **Significance: „low"**	• Minimize the risks of damage/destruction of cultural and archaeological monuments	Stop works whenever any artefact is discovered. The National Agency of Cultural Heritage Preservation of Georgia should be informed about the discovery immediately. Qualified archaeologists should examine the artefact. Ensure its conservation or delivery to a vault. Continue works only after permission is obtained. **Significance of residual impact : " Not expected"**	**Responsible for implementation of mitigation measures:** Executor of works **Time-frames for implementation of mitigation measures:** In case of discovery of any artefact. **Cost for implementation of mitigation measures:** Not connected with expenses.	Visual control of earth works.

7.4 Mitigation Measures – Operation Phase

Impact/ Impact Description	Task	Mitigation Measures:		Monitoring
		Description	Responsibility, time-frame and expenses	
Odor nuisance in the air within the work zone and in the ambient air. **Significance: „High“**	Minimize disturbance risks of workers engaged in construction and population, related to odor propagation .	**a.** Plant/grow of coniferous plants on the perimeter of treatment plant site (esp. on the North perimeter); **b.** Supervise observation of treatment plant operation rules; **c.** Provide appropriate monitoring. In case of revealing violations by monitoring, appropriate corrective measures should be developed and implemented (see, the corresponding paragraph) **Significance of residual impact : “ Low“**	**Responsible for implementation of mitigation measures:** Operator company. **Time-frames for implementation of mitigation measures:** **a-**Construction phase; **b –** Continuously while operation; **c** – In case of revealing violations by monitoring during operation; **Cost for implementation of mitigation measures:** Can be connected with **“low” or “medium** “expenses.	Control proper working of the machinery. Conduct a population and staff survey. Carry out corrective measures in case of failure, if necessary.
Noise propagation within the work zone. Impact on other receptors: On operation phase propagation of noise produced by the working of electric motors. **Significance: „Low“**	Minimize noise propagation. Reduce environmental impact, such as: • Impact on human health; • Animal disturbance and migration.	**a.** Installation of high quality pumping stations on treatment plant site; **b.** Using noise-insulation materials during installation of pumping station; **c.** Arrangement of pumps on vibro-isolating platform, for that thick rubber sheets can be used; **d.** Place pumps in closed containers, special shells. **e.** Frequent shift of workers, working with noisy devices. **Significance of residual impact : “ very Low“**	**Responsible for implementation of mitigation measures:** Operator company. **Time-frames for implementation of mitigation measures:** **a, b, c, d** –On design and construction phases; **e –** On operation phase. **Cost for implementation of mitigation measures:** Can be connected with **“low”** expenses.	Control proper working of the machinery. If necessary, carry out instrumental measurement.
Pollution of surface waters: Surface water pollution with untreated wastewater. **Significance: „High“**	Prevention of surface water pollution and accordingly, reduction of the environmental impact, such as: • Impact on water biodiversity; • Ground water pollution • Impact on receptors	**a.** Enable sampling prior to discharging wastewater, as well as treated water into the river; **b.** Instruct personnel on environmental and safety issues; **c.** Consider maximum allowable rates of discharge of pollutants with discharged wastewater; **d.** Control efficiency of plant operation; **e.** Regular supervision on observation of rules related to the fuel/oil storage and usage; **f.** Supervision on implementation of accident preventive	**Responsible for implementation of mitigation measures:** Operator company. **Time-frames for implementation of mitigation measures:** **a,–** On design and construction phases; **b** – Before launching to Operation; **c, d, e, f, -** On operation phase,	Control efficiency of plant operation; Periodically laboratory control of water. Control of waste management plan implementation. Control of

	depended on water resources (animals, population).	measures; **g.** In case of fuel/oil spill, localization of the spilled product and take preventive measures to avoid surface water pollution; **h.** Inform The Ministry of Environmental Protection and Natural Resources of Georgia about the amount and consistence of wastewater; Additionally, • Systematic control of implementation of measures, considered by waste management plan (see the corresponding paragraph); • Carry out mitigation measures considered for soil protection from pollution; (see the corresponding paragraph). **Significance of residual impact : "very Low"**	regularly. **g** – Promptly after oil spillage; **h** – As required.. **Cost for implementation of mitigation measures:** Can be connected with **"medium"** expenses.	observation of rules related to the fuel/oil storage and usage; Visual control of soil and water condition.
Deterioration of ground water quality: In case of pollutant movement in deep layers or due to surface water pollution. **Significance: „low**	In case of emergency situations, prevention of accidental pollution of ground water	**a.** Arrangement of hydro isolating layer on treatment plant site; **b.** Control of proper working of WWTP machinery and technological pipelines, and carry out appropriate corrective measures as required. **Significance of residual impact : "very Low"**	**Responsible for implementation of mitigation measures:** Operator company. **Time-frames for implementation of mitigation measures:** **a -** Construction phase ; **b**– On operation phase**,** regularly. **Cost for implementation of mitigation measures:** Can be connected with **"low"** expenses.	Control of proper working of WWTP machinery and technological pipelines
Soil pollution: Soil pollution with wastes; Pollution in case of fuel/oil spill. **Significance: „low**	Prevention of soil pollution and accordingly, reduction of environmental impact such as: • Deterioration of animal habitat; • Indirect impact on vegetation; • Pollution of ground and surface waters;	**a.** Provide the facility with appropriate technical equipment and inventory (containers, spill collector chambers , etc.). **b.** In case of pollution with fuel and oil spill , removal of polluted layer of the soil and carry out remedial measures; **c.** Proper waste management; **d.** Carry out mitigation measures considered for construction phase during repairing work process; **Significance of residual impact : low or " very Low"**	**Responsible for implementation of mitigation measures:** Operator company. **Time-frames for implementation of mitigation measures:** **a, b, c, d, e** –Operation phase; **Cost for implementation of mitigation measures:** Can be connected with **"low"** expenses.	Control of waste management plant implementation. Oil machinery maintenance control. Visual control of soil and ground water.

Visual- landscape alteration:	**Considering unsatisfactory sanitary-environmental condition on the area, the positive effect is expected.**			
Impact on behaviour of species: • Animal migration; • Deterioration of animal habitat due to the pollution of waters of River Alaskan. **Significance: „medium"**	Minimize indirect and direct impact on animal species.	**a.** Optimization of night lighting system; **b.** Protection of technological process of WWTP; Additionally, • Proper waste management; • Carry out mitigation measures on water, soil and ambient air pollution (see the corresponding paragraph). **Significance of residual impact : " very Low"**	**Responsible for implementation of mitigation measures:** Operator company. **Time-frames for implementation of mitigation measures:** **a -** Construction phase ; **b** – On operation phase, regularly. **Cost for implementation of mitigation measures:** Implementation of activities will not be connected to additional expenses.	Control of implementation of mitigation measures.
Risks of environment pollution with wastes: Hazardous waste; Domestic waste. **Significance: „medium"**	Prevention of system less waste distribution in the environment and environmental impact, such as: • Negative impact on human health; • Pollution of water environment; • Negative impact on animals; • Negative visual-landscape alteration, etc.	**a.** Disposal of dewatered sludge extracted from WWTP on Kutaisi landfill; **b.** Arrangement of appropriate storage infrastructure for temporary storage of hazardous waste on plant site; **c.** Place appropriate container for household waste; **d.** Appropriately trained staff to be provided for the waste management, which will be periodically trained and tested; **e.** Instruct personnel; **f.** Removal of the hazardous waste for the further management to be done by the contractor having an appropriate permission on these activities. **Significance of residual impact : " very Low"**	**Responsible for implementation of mitigation measures:** Operator company. **Time-frames for implementation of mitigation measures:** **a, b, c, d, e** – On operation phase, regularly. **Cost for implementation of mitigation measures:** Implementation of activities can be connected with **"low"** expenses.	Control of waste management plan implementation by the person designated for waste management; Record amount and type of waste, Keep appropriate register.
Health and safety risks: • Possible impact on health and safety of population; • Possible impact on health and safety of employed personnel.	• Ensure human health and safety .	**a.** Train personnel on health and labor protection issues; **b.** Provide staff with personal protective equipment; **c.** Fencing work areas dangerous for health; **d.** Provide medical kits on the plant; **e.** Ensure proper working of machinery; **f.** Control getting and moving of strangers at the	**Responsible for implementation of mitigation measures:** Operator company. **Time-frames for implementation of mitigation measures:** **a –** When hiring personnel and then several times a year;	Control proper working of machinery. Keep register for accidents and unscheduled examination of personnel.

Significance: <u>„medium"</u>		workplace without special permit or without special protective equipment; **g.** Onsite risk assessment to identify certain hazards and appropriate handling of them for the security of personnel; **h.** Keep register for accidents and incidents. In addition, • Carry out all measures to prevent ambient air, water and soil quality deterioration. Carry out noise mitigation measures. (see appropriate paragraphs). **Significance of residual impact : <u>" very Low"</u>**	**b , c, d, e, -** Before starting the works and continuous update; **f, g, h –** Continuously during work process. **Cost for implementation of mitigation measures:** Activities considered by paragraphs **b, c, d, e -** can be connected with **<u>"medium"</u>** expenses.	

8. Environmental Monitoring Plan

Environmental monitoring plan, developed for treatment facility construction and operation project aims at solving following problems:

- Monitoring of compliance with environmental legislation during construction and operation processes;
- Ensuring controllability of risks and environmental impacts;
- Provision of stakeholders with relevant environmental information;
- Confirmation of mitigation measures' implementation, determination of their efficiency and their adjustment whenever necessary;
- Permanent environmental control throughout the project implementation period (construction works and operation).

Environmental monitoring plans for construction and operation phases are given in paragraphs 8.1 and 8.2. It is noteworthy that this is a general plan and it may be detailed and adjusted during the working process.

8.1 Environmental Monitoring Plan-Construction Phase

Subject/action to monitor	Control/sampling spot	Method	Frequency/time	Goal	Responsible for monitoring
1	2	3	4	5	6
Air (emission and dust)	• Construction camp • Construction sites • The construction site access roads • The nearest receptor (residential zone)	• Visual • Monitoring the functionality of the equipment • Instrumental measurement	• In the process of groundworking, regularly in a dry weather; • During the construction; • During the intensive transport operations and in the dry weather; • Check for the technical functionality during pre-construction; • Measurement – if necessary (after receiving the grievances).	• Ensuring the compliance of ambient air quality to the normative one • Minimum public disturbance • Ensuring the personnel safety • Minimal effect on vegetation cover/flora and fauna	• Building contractor; • Client – "United Water Supply Company of Georgia" LLC.
Noise and vibration	• Construction camp • Construction sites • The nearest receptor (residential area)	• Monitoring the functionality of the equipment • Instrumental measurement	• Checking the functionality of the technology daily before the work gets started • Instrumental measurement regularly and/or after receiving the grievances.	• Meeting the health and safety standards • Ensuring the comfortable conditions for the personnel • Maintaining the state of buildings • Minimal disturbance of the fauna and population	• Building contractor; • Client – "United Water Supply Company of Georgia" LLC.
Soil	• Construction camp • Construction sites • Materials and waste storage area • The access roads' corridor	• Control, observation • Monitoring the functionality of the equipment • Lab control	• Regular check-up • Monitoring after the work finalization • Lab research in case the pollutants gets spilled	• Maintaining the soil stability and quality	• Building contractor; • Client – "United Water Supply Company of Georgia" LLC.
Water	• Construction camp • Vartsikhe HPP canal and Rioni river	• Visual • Monitoring the functionality of the equipment • Solid waste management monitoring • Monitoring the agricultural-fecal and storm water management • Lab control	• During the arrangement of the work site; • Through the working processes; • While transporting/warehousing the solids; • Check for the functionality of the equipment – before the work; • Lab research in case the pollutants gets spilled	• Ensure water quality maintenance	• Building contractor; • Client – "United Water Supply Company of Georgia" LLC.

Vegetation cover	• The areas of construction camp and construction sites; • The Surroundings • Access road corridors	• Visual monitoring • Inspection • Supervision over protection of the area borders	• Permenently, while cleaning the vegetation cover (by the quilifiesd personnel); • Regular inspection to protect the work area	• Preventing the excess damage of the vegetation cover; • Evaluating the effectiveness of mitigation measures;	• Building contractor; • Client – "United Water Supply Company of Georgia" LLC.
Animals/habitat	• The surroundings of construction camp and construction sites; • Access road corridors	• Observing the animal species and comparing to the baseline • Visual observation of the pits	• Observing the animal species (incl. The species near the water) – regularly during and after the construction; • Inspecting the pits – before they are filled	• Minimizing negative impact on the animal environment; • Evaluating the effectiveness of mitigation measures;	• Building contractor; • Client – "United Water Supply Company of Georgia" LLC.
Waste	• The surroundings of construction camp and construction sites; • Waste storage areas	• Visual observation of the area • Monitoring the waste management	• Regularly, especially through the windy weather	• Maintaining the quality of soil and water	• Building contractor; • Client – "United Water Supply Company of Georgia" LLC.
Occupational safety	• Work area	• Inspection • Regular check for the availability and usability of personal protection equipment	• A regular control during the works	• Ensure the compliance with health and safety standards • Avoid/minimize traumatism	• Building contractor; • Client – "United Water Supply Company of Georgia" LLC.

8.2 Environmental Monitoring Plan-Operation Phase

Subject/action to monitor	Control/sampling spot	Method	Frequency/time	Goal	Responsible for monitoring
1	2	3	4	5	6
Unpleasant odor spread	• Plant area • Nearest receptor (residential zone)	• Monitoring the functionality of the WWTP equipment; • Surveying the personnel and population.	• Regular control	• Minimal disturbance of the personnel/population	• - "United Water Supply Company of Georgia" LLC.
Noise	• Nearest receptor (residential zone)	• Ensuring technical functionality of the equipment • Instrumental measurement	• Regular control • Instrumental measurement – In case the grievances are received; • Or after the repair works	• Ensuring the compliance with health and safety standards • Minimal effect on fauna	• - "United Water Supply Company of Georgia" LLC.
Surface water quality	Rioni water 200 meters downstream the discharge point	• Lab analysis for the river water with the following parameters: o Suspended particles; o BOD; o COD; o Total Nitrogen; o Total Phosphorus; o Fat; o Detergents o Lactose Positive E. coli.	Once in a quarter	• Compliance of the river water with the Georgian environmental standards	• "United Water Supply Company of Georgia" LLC.
Quality of the treated wastewater	Near the discharge point	• Lab analysis for the treated wastewater:		• Standardized treatment of wastewater	• - "United Water Supply Company of Georgia" LLC.
		o Suspended particles;	Daily		
		o BOD;	Daily		
		o COD;	Daily		
		o Total Nitrogen;	Once a month		
		o Total Phosphorus;	Once a month		
		o Fat;	Once a quarter		
		o Detergents	Once a quarter		
		o Lactose Positive E. coli.	Once a quarter		
Soil quality	• Plant area; • Waste disposal sites.	• Visual monitoring • Lab analysis – if necessary	Lab research in case of the emergency spill of pollutants	• Soil quality protection • Avoiding risks of the surface water pollution with Surface runoff • Avoiding the groundwater	• - "United Water Supply Company of Georgia" LLC.

				pollution	
Biological environment	• Surroundings of the WWTP	• Researching the protected animal species	• Once a year	• Identifing the possible effects on the terrestrial and aquatic ecosystems	• - "United Water Supply Company of Georgia" LLC.
Waste	• WWTP area • Waste disposal areas	• Visual observation of the area • Waste management control	• Regularly	• Soil/water protection	• - "United Water Supply Company of Georgia" LLC.
Dewatered sludge from the WWTP	• The area for temporary placement of the dewatered sludge	• Analysis of the dewatered waste samples to identify the content of toxic metals	• Once a month - the first stage of WWTP operation. Later - once a year	• Soil/water protection; • Solving the dewatered sludge manamgement related issues (removal or/and agricultural use)	• - "United Water Supply Company of Georgia" LLC.
Occupational safety	• Working area	• Inspection • Existance of the individual safety equipement and regular check for its functionality	• Regular control in a working process	• Ensuring the compliance with health and safety standards; • Avoiding/minimizing the risks of traumatism	• - "United Water Supply Company of Georgia" LLC.

9. Residual Impact

According to the Environmental Impact Assessment, the residual impact of high and low levels, caused by the construction works is not expected. According to the international methodology, the impact of low-level residual impact is not subject to review.

10. Possible Emergency Situations

The possible options for emergency situation development were determined, according to which future emergency situations must be avoided. Before the formation of the preventive measures the evaluation of risk-factors should be assessed, which aims to facilitate decision-making in terms of the feasibility of the project on the one hand and on the other hand, to form the basis for the prevention of negative impacts or for development of significant mitigation measures.

Environmental impact on different receptors is the last link in the chain of cause and effect chain and its main components are:

- Development of risky situations (fire and etc.) associated with some activities outlined by the technological scheme;
- Negative impact on sensitive receptors (ambient air, soil, ground surface, some species of habitat).

Therefore, one side measures may aim at minimization of impact possibility, on the other hand – they may aim at minimization of impact levels. The best measures within our possibilities are ones that fully terminate negative impact.

Possible emergency situations:

- Fire (landscape fire);
- Spill of hazardous substances;
- Damage of the treatment facility and emergency discharge of wastewater;
- Accidents related to safety;
- Traffic accidents;
- Natural type emergency situations.

See Emergency Response Plan in Annex N4.

11. Determination of the Ways and Means of Restoring of the Environment in Case of Termination of the Treatment Plant Operation

11.1 Short-term Termination of the Treatment Plant or Repair Works

In case of temporary termination of the treatment plant operation or in case of maintenance (current and capital) of the existing facilities, operational service is obliged to develop operational plan related to a temporary suspension of activities or repair works, which should include security requirements in the first place and should be coordinated with the local self-government and all interested legal persons. Municipal wastewater discharge plan will include alternative ways.

11.2 Long-term Termination of the Operation of the Treatment Plant or Conservation

In case of long-term termination of the treatment plant operation or conservation, administration shall establish a liquidation body, which will develop the plan for long-term termination of the operation or

conservation. Long-term termination or conservation plan should be coordinated with the authorized agencies. The major content of the plan is safety requirements.
The following measures are to be carried out before the termination of the activities:

- Internal audit of the area – to record the technical condition of infrastructure, to identify the risks of emergency situations, as well as environmentally problematic areas and to solve the problem;
- Temporary demobilization of supporting infrastructure – to release the warehousing from stockpiled material, waste, as far as possible, and to allocate a special area for equipment and vehicles;
- To provide warning and prohibition signs throughout the outer perimeter of the area.

11.3 Liquidation of the Treatment Plant

In case of liquidation of the treatment plant, a special project should be developed in order to identify the ways and means of restoring previous condition of the environment.

This project should be developed by the operator company. Under the current rules, a special project of termination should be agreed with the competent authorities and the information should be provided to all interested individuals and legal entities.

The rules and the sequence of termination of technological processes, dismantle of facilities and equipment, terms and conditions of demolition works, safety and environmental protection, terms and conditions of neutralization and disposal of hazardous waste, recultivation works and other issues should be considered in this project.

12. Public Information and Study of Public Opinion

According to article 37 of Georgian constitution, the citizen of Georgia has a right to:

- All citizens of Georgia have right to live in harmless environment and use natural and cultural environment. Everyone is obliged to take care of natural and cultural environment;
- A person has a right to get full, objective and timely information about conditions of his/her working and living environment.

Considering aforementioned, during EIA process of treatment facility construction and operation project, population will be provided with objective, true and full information in order to exclude further discontent and ensure development of friendly relations between stakeholders.

Notifications about public hearings were published in ----- edition of the newspaper "24 hours". Public hearing will be held on ------, 2015 in Tskaltubo Municipality building (Address: ----------)

Documentation concerning planned activities is available at following addresses:

- Tskaltubo City, Tskaltubo Municipality building;
- The head office of Ltd United Water Supply Company – V. Pshavela ave. 76, Tbilisi, Georgia; Tel: +995 (32) 2 93 00 00.

13. Conclusions and Recommendation

The following key conclusions and recommendations have been developed during preparation of the present report on assessment of possible environmental impacts caused by WWTP construction and operation process:

Conclusions:

- According to the project, the normalized treatment of wastewater will be provided in Kutaisi and some other nearby settlements, if the effective system of wastewater treatment is implemented;
- The discharge of untreated wastewater into the reservoirs near Kutaisi will be minimized if the planned activity is implemented, which serves the improvement of the local water quality;
- WWTP project implementation serves the sustainable development of the local infrastructure, which holds a significant importance in terms of the social-economic development of the region;
- The selected area for WWTP is exposed to significant anthropogenic load. Reinforced concrete constructions of the old treatment plant have remained at the area, and most part is contaminated with the household and construction waste. The existing antisanitary state endangers individual environmental receptors (incl. impact on the animal habitats, surface water pollution risks, high chance of disease spread and the riscs of effecting the population health);
- Project implementation results in territory cleanup and significant improvement of the existing sanitary-ecological conditions, reducing the abovementioned risks considerably;
- Jobs will be created through the construction and operation phases of the treatment plant, which is important in terms of the employment of local population;
- According to the calculations made through the environmental impact assessment process, the impacts related to the decrease of ambient air quality will not be significant, during the construction and operation of the treatment plant;
- There is no high risk of the impact on water environment at the construction and operation phases in case the appropriate mitigation measures are taken and the terms of operation are satisfied; WWTP operation phase is assessed positively in terms of the impact on water environment;
- There is a small portion of fertile soil layer at the project area. The amount of soil is scarce and has no special value. The effect on ground and soil will not be significant;
- The engineering-geological researches made withing the area have revealed that there are minimal risks of dangerous processes to develop; There is no need to take significant mitigation measures in this regard;
- The cleanup of vegetation cover at the project area will not be necessary during the construction phase of the WWTP; Represented on ≈4000-5000 m2 area, the barbed and liana-like insignificant vegetation is a subject to cutting. No vegetation included in Red List was found. In terms of appropriate mitigation measures and monitoring, the impact on vegetation cover will be insignificant;
- The selected area has a high anthropogenic load and the existing animals are accustomed to the intensive anthropogenic activities. In case the project is carried out, the effect on animals will not be significant. Some positive impacts are expected as well;
- There are minor risks of negative impacts expected on protected areas, as they are significantly far from project area. Only the minor indirect impacts might occur;
- The plant construction process will be related to visual-landscape changes, which might reduce considering the planned mitigation measures. Overall, the project implementation is associated with positive consequences in this regard.
- No historical or cultural monuments have been spotted at the project area and it's surroundings to be effected by the project;

- The construction area is state owned, non-agricultural land. Project realization is not related with either physical or economical resettlement;
- Local, natural resources can be used for the plant construction (sand-gravel storages, water resources for industrial water and drink purposes, etc.), which is also notable in terms of the effect on local environment.

Recommendations:

1. Both the implementer company and the building contractor are obliged to establish a strict control over the implementation of the activities regarding mitigation measures defined by economic expertise as said in the environmental impact assessment report;
2. Provide the personnel working on construction site and those involved in later operation phase with periodic (once every 6 months) training and examinations regarding environmental protection and professional safety issues;
3. It is necessary to ensure the personnel engaged in construction and operation activities with individual protective equipment;
4. The project documentation should include the recultivation and greenery planting activities of the construction camp and site. The local varieties of trees and plants are preferable for greenery planting activities.
5. In case of the arrangement of the fuel storage reservoir at the construction camp, the reservoir should have concrete or clay fencing, with a capacity of no less than 110% of the tank volume. Fencing of the reservoir enables the prevention of spread in cases of accidental spills of oil.
6. During the construction process, the temporary storage for hazardous waste should be built on the constriction camp site, and during the exploitation process, the storage must be built on the area of wastewater treatment plant (WWTP); Hazardous waste storage must be arranged in the following conditions:
    - The storage must have waterproof bottom.
    - The ceiling will be painted with moisture resistant paint;
    - There will be the shelves and racks for disposal of the waste inside the storage;
    - The storage will be equipped with the following: Indoor and outdoor lighting systems exhaust ventilation system, wash stand and tap water for washing the area, water intake trap, fire stand, warning and prohibiting signs.
7. The disposal and management of the hazardous waste generated from the process of construction and operation should be carried out by the contractors with the appropriate, special license.
8. Dewatered sludge from the treatment plant, to be placed at Kutaisi sanitary landfill on the contractual basis.
9. Systematic monitoring of the technical soundness of the treatment plant system and the effectiveness of wastewater treatment is necessary for control management.
10. Periodic surveys should be conducted with the population and personnel regarding the spread of unpleasant odor in order to assess the effectiveness of the prevention measures;
11. Planting the pine trees on the perimeter of the site in order to prevent the spread of unpleasant odor.
12. Periodic laboratory tests of purified water and River Rioni in accordance with Monitoring Plan.

14. References

1. УПРЗА ЭКОЛОГ, версия 3.00 ФИРМА "ИНТЕГРАЛ" Санкт-Петербург 2001-2005г.
2. «Методическим пособием по расчету, нормированию и контролю выбросов загрязняющих веществ в атмосферный воздух», СПб., 2005.
3. საქართველოს გარემოსა და ბუნებრივი რესურსების დაცვის მინისტრის 28.07.03 წლის ბრძანება № 67 “დაბინძურების სტაციონარული წყაროებიდან ატმოსფერულ ჰაერში გაფრქვევების ფაქტობრივი რაოდენობის განსაზღვრის ინსტრუმენტული მეთოდის, დაბინძურების სტაციონარული წყაროებიდან ატმისფერულ ჰაერში გაფრქვევების ფაქტობრივი რაოდენობის დამდგენი სპეციალური გამზომ-საკონტროლო აპარატურის სტანდარტული ჩამონათვალისა და დაბინძურების სტაციონარული წყაროებიდან ტექნოლოგიური პროცესების მიხედვით ატმოსფერულ ჰაერში გაფრქვევების ფაქტობრივი რაოდენობის საანგარიშო მეთოდიკის შესახებ”;
4. МЕТОДИКА проведения инвентаризации выбросов загрязняющих веществ в атмосферу для баз дорожной техники (расчетным методом) Москва 1998.
5. Расчет выбросов загрязняющих веществ при проведении горных работ в соответствии с «Методикой расчета вредных выбросов (сбросов) для комплекса оборудования открытых горных работ (на основе удельных показателей)»: Люберцы, 1999.
6. Методика расчета выделений (выбросов) загрязняющих веществ в атмосферу при сварочных работах (на основе удельных показателей). СПб, 1997» (с учетом дополнений НИИ Атмосфера 2005 г.).
7. Методика расчета выделений загрязняющих веществ в атмосферу от стационарных дизельных установок. СПб, 2001
8. Методические указания по определению выбросов загрязняющих веществ в атмосферу из резервуаров». Новополоцк, 1997 (с учетом дополнений НИИ Атмосфера 1999, 2005, 2010 г.г.).
9. “Расчета количества загрязняющих веществ выделяющичся в атмосферныи воздух от неорганизованных источников загрязнения станций аерации сточных вод “ Москва 1994 год;
10. საქართველოს კანონი “ლიცენზიებისა და ნებართვების შესახებ“ თბილისი 2005 წ;
11. საქართველოს კანონი "გარემოს დაცვითი ნებართვის შესახებ". საქართველოს პარლამენტის ნორმატიული აქტები გარემოს დაცვის სფეროში. ასოციაცია "სამართლებრივი საზოგადოება", თბილისი, 2000.
12. საქართველოს კანონი "სახელმწიფო ეკოლოგიური ექსპერტიზის შესახებ". საქართველოს პარლამენტის ნორმატიული აქტები გარემოს დაცვის სფეროში. ასოციაცია "სამართლებრივი საზოგადოება", თბილისი, 2000.
13. საქართველოს კანონი "ატმოსფერული ჰაერის დაცვის შესახებ". საქართველოს პარლამენტის ნორმატიული აქტები გარემოს დაცვის სფეროში. ასოციაცია "სამართლებრივი საზოგადოება", თბილისი, 2000.
14. საქართველოს კანონი "წყლის შესახებ". საქართველოს პარლამენტის ნორმატიული აქტები გარემოს დაცვის სფეროში. ასოციაცია "სამართლებრივი საზოგადოება", თბილისი, 2000.
15. საწარმოების, ნაგებობებისა და სხვა ობიექტების სანიტარიული დაცვის ზონები და სანიტარული კლასიფიკაცია. სანიტარული წესები და ნორმები (სანწდან 2.2.1./2.1.1. 000-03).
16. ატმოსფერულ ჰაერში დამაბინძურებელ ნივთიერებათა ზღვრულად დასაშვები გაფრქვევის ნორმების გაანგარიშების მეთოდიკა. საქართველოს ბუნებრივი რესურსებისა და გარემოს დაცვის სამინისტრო, თბილისი, 1999.
17. კლიმატის ცნობარი – ჰაერი, ნიადაგი, ტემპერატურა. მე-14 გამოშვება, ჰიდრომეტგამი.
18. კლიმატის ცნობარი – ქარი. მე-14 გამოშვება, ჰიდრომეტგამი.
19. სნწ II-7-81*. მშენებლობა სეისმურ რაიონებში.
20. სნწ 2.01.02-85*. ხანძარსაწინააღმდეგო ნორმები.

21. სანიტარიული წესები და ნორმები _ «ჰიგიენური მოთხოვნები სასმელი წყალმომარაგების ცენტრალიზებული სისტემების წყლის ხარისხისადმი. ხარისხის კონტროლი» (სანწდან 2.1.4. 000 _ 00).
22. სანიტარიული წესები და ნორმები _ «ჰიგიენური მოთხოვნები არაცენტრალიზებული წყალმომარაგების წყლის ხარისხისადმი. წყაროების სანიტარიული დაცვა» (სანწდან 2.1.4. 000 _ 00).
23. სანიტარიული წესები და ნორმები _ «წყალმომარაგების წყაროებისა და სასმელ-სამეურნეო დანიშნულების წყალსადენების სანიტარიული დაცვის ზონები» (სანწდან 2.1.4. 000 _ 00).
24. სანიტარიული წესები და ნორმები _ «ზედაპირული წყლების გაბინძურებისაგან დაცვის შესახებ» (სანწდან 2.1.5. 000 _ 00).
25. მეთოდური მითითება _ «წყალმომარაგების სისტემებში გამოყენებული მასალების, რეაგენტების, მოწყობილობებისა და ტექნოლოგიების ჰიგიენური შეფასების შესახებ» (მმ მმ 2.1.4. 007-04).
26. გოსტი 17.1.3.03_77 “ცენტრალიზებული სასმელ _ სამეურნეო წყალმომარაგების წყაროები. შერჩევის წესები და ჰიგიენური და ტექნიკური მოთხოვნები».
27. დებულება “გარემოში მავნე ნივთიერებათა ემისიისა და მიკროორგანიზმებით გარემოს დაბინძურების ზღვრულად დასაშვები ნორმების შესახებ”, 1997 წელი.
28. დებულებით “მავნე ნივთიერების წლიური გაფრქვევის ზღვრული მნიშვნელობისა და მავნე ნივთიერების წლიური გაფრქვევის დროებით შეთანხმებული მნიშვნელობის გაანგარიშების მეთოდისა და ლიმიტის შევსების წესის შესახებ”, 2000 წელი.
29. დებულებით “დაბინძურების სტაციონარული ობიექტების იდენტიფიკაციისა და ინვენტარიზაციის წესის შესახებ”, 2001 წელი.
30. ინსტრუქციით "არახელსაყრელ მეტეოროლოგიურ პირობებში ატმოსფერული ჰაერის დაცვის წესების შესახებ", 2002 წელი.
31. ინსტრუქციით “ავარიის შედეგად ატმოსფერულ ჰაერში მავნე ნივთიერებათა ავარიული გაფრქვევის შემთხვევაში ატმოსფერული ჰაერის დაცვის წესების შესახებ”, 2002 წელი.
32. ხმაური სამუშაო ადგილებზე, საცხოვრებელი, საზოგადოებრივი შენობების სათავსოებში და საცხოვრებელი განაშენიანების ტერიტორიაზე, 2001 წ.
33. ჰიგიენური ნორმატივებით «დასახლებული ადგილების ატმოსფერული ჰაერის დამაბინძურებელი ნივთიერებების ზღვრულად დასაშვები კონცენტრაციები (ზდკ)» ჰ.ნ. 2.1.6. 002 - 01, 2003 წელი.
34. დასახლებული ადგილების წყალმომარაგებისა და წყალგამყვანი სისტემების ტექნიკური ექსპლოატაციის წესები, თბილისი 2000 წ.
35. მეთოდური მითითებები «დასახლებული ადგილების ნიადაგების მდგომარეობის ჰიგიენური შეფასების შესახებ» (მმ 2.1.7.003-02).
36. www.geostat.ge

15. Annexes

Annex 1. Software Printout of Air Pollutant Emission Report-Construction Stage

УПРЗА ЭКОЛОГ, версия 3.1
Copyright © 1990-2010 ФИРМА "ИНТЕГРАЛ"

Serial Number 01-01-2568, Scientific-Research Firm Gamma

Plant No 342; WWTP
Kutaisi City

Initial Data Option: 2, construction
Calculation Option: Construction
Calculation is implemented: For summer
Calculation Module "ОНД-86"
Calculation Constants: E1= 0, 01, E2=0,01, E3=0,01, S=999999,99 km².

Meteorological Parameters

Average air temperature for the hottest month	27° C
Average air temperature for the coldest month	4,9° C
Atmosphere stratification temperature depended ratio	200
Maximum Wind velocity for given area (exceeding temperature within 5%)	5,1 m/s

Plant Structure (Sites, workshops)

No	Site (workshop) title

Emission Source Parameters

Record:
"%" - The source is considered excluding the baseline condition;
"+" - The source is considered without excluding the baseline condition;
"-" The source is not considered and its share is not included in the baseline condition.
In case of absence of benchmarks the source is not considered.

Source types:
1 - Point;
2 -Linear;
3 – Non-organized;
4 – Set of point sources, united for one flat surface calculation;
5 – Non-organized, with changeable emission intensity;
6 – Point source, with horizontal(umbrella) dispersion;
7 – Set of horizontal dispersion point sources;
8 - Highway.

Record during reporting	Site №	Workshop №	Source №	Source Title	Alternative	Type	Source height (m)	Diameter (m)	Air-gas mixture consistency (m3/s)	Air-gas mixture velocity (m/s)	Air-gas mixture temperature (°C)	Relief ratio	Coord. X1 axis (m)	Coord. Y1 axis (m)	Coord. X2 axis (m)	Coord. Y2 axis (m)	Source width (m)
+	0	0	3	Diesel fuel storage	1	1	3,0	0,25	0,0083	0,16909	30	1,0	2,0	-68,0	2,0	-68,0	0,00

Substance code	Substance	Dispersion (gr/s)	Dispersion (t/y)	F	Summ.: Cm/MPC	Xm	Um	Wint.: Cm/ MPC	Xm	Um
0333	Hydrogen Sulphide	0,0000550	0,0000000	1	0,412	7,8	0,5	0,412	7,8	0,5
2754	Saturated hydrocarbons C12-C19	0,0195000	0,0000000	1	1,169	7,8	0,5	1,169	7,8	0,5

Record during reporting	Site №	Workshop №	Source №	Source Title	Alternative	Type	Source height (m)	Diameter (m)	Air-gas mixture consistency (m3/s)	Air-gas mixture velocity (m/s)	Air-gas mixture temperature (°C)	Relief ratio	Coord. X1 axis (m)	Coord. Y1 axis (m)	Coord. X2 axis (m)	Coord. Y2 axis (m)	Source width (m)
+	0	0	4	Excavator	1	3	5,0	0,00	0	0	0	1,0	29,0	112,0	34,0	112,0	5,00

Substance code	Substance	Dispersion (gr/s)	Dispersion (t/y)	F	Summ.: Cm/ MPC	Xm	Um	Wint.: Cm/ MPC	Xm	Um
0301	Nitrogen (IV) Oxide (Nitrogen Dioxide)	0,0330000	0,0000000	1	0,695	28,5	0,5	0,695	28,5	0,5
0304	Nitrogen (II) Oxide (Nitrogen Oxide)	0,0053000	0,0000000	1	0,056	28,5	0,5	0,056	28,5	0,5
0328	Carbon black (soot)	0,0045000	0,0000000	1	0,126	28,5	0,5	0,126	28,5	0,5
0330	Sulphur Dioxide	0,0033000	0,0000000	1	0,028	28,5	0,5	0,028	28,5	0,5
0337	Carbon Oxide	0,0270000	0,0000000	1	0,023	28,5	0,5	0,023	28,5	0,5
2732	Oil Fraction	0,0077000	0,0000000	1	0,027	28,5	0,5	0,027	28,5	0,5
2909	Inorganic Dust: up to 20% SiO2	0,0350000	0,0000000	1	0,295	28,5	0,5	0,295	28,5	0,5

Record during reporting	Site №	Workshop №	Source №	Source Title	Alternative	Type	Source height (m)	Diameter (m)	Air-gas mixture consistency (m3/s)	Air-gas mixture velocity (m/s)	Air-gas mixture temperature (°C)	Relief ratio	Coord. X1 axis (m)	Coord. Y1 axis (m)	Coord. X2 axis (m)	Coord. Y2 axis (m)	Source width (m)
+	0	0	5	bulldozer	1	3	5,0	0,00	0	0	0	1,0	38,0	97,0	23,0	56,0	10,00

Substance code	Substance	Dispersion (gr/s)	Dispersion (t/y)	F	Summ.: Cm/ MPC	Xm	Um	Wint.: Cm/ MPC	Xm	Um

Record during reporting	Site №	Workshop №	Source №	Source Title	Alternative	Type	Source height (m)	Diameter (m)	Air-gas mixture consistency (m3/s)	Air-gas mixture velocity (m/s)	Air-gas mixture temperature (°C)	Relief ratio	Coord. X1 axis (m)	Coord. Y1 axis (m)	Coord. X2 axis (m)	Coord. Y2 axis (m)	Source width (m)
0301	Nitrogen (IV) Oxide (Nitrogen Dioxide)	0,0330000	0,0000000	1	0,695	28,5	0,5	0,695	28,5	0,5							
0304	Nitrogen (II) Oxide (Nitrogen Oxide)	0,0053000	0,0000000	1	0,056	28,5	0,5	0,056	28,5	0,5							
0328	Carbon black (soot)	0,0045000	0,0000000	1	0,126	28,5	0,5	0,126	28,5	0,5							
0330	Sulphur Dioxide	0,0033000	0,0000000	1	0,028	28,5	0,5	0,028	28,5	0,5							
0337	Carbon Oxide	0,0270000	0,0000000	1	0,023	28,5	0,5	0,023	28,5	0,5							
2732	Oil Fraction	0,0077000	0,0000000	1	0,027	28,5	0,5	0,027	28,5	0,5							
2909	Inorganic Dust: up to 20% SiO2	0,0110000	0,0000000	1	0,093	28,5	0,5	0,093	28,5	0,5							
+	0	0	6	Generator	1	1	3,0	0,15	0,303	17,14629	450	1,0	20,0	-40,0	20,0	-40,0	0,00
Substance code	Substance	Dispersion (gr/s)	Dispersion (t/y)	F	Sum.:	Cm/ MPC	Xm	Um	Wint.:	Cm/ MPC	Xm	Um					
0301	Nitrogen (IV) Oxide (Nitrogen Dioxide)	0,0450000	0,0000000	1		0,557	51,7	3,2		0,555	51,8	3,2					
0304	Nitrogen (II) Oxide (Nitrogen Dioxide)	0,0074000	0,0000000	1		0,046	51,7	3,2		0,046	51,8	3,2					
0328	Carbon black (soot)	0,0028000	0,0000000	1		0,046	51,7	3,2		0,046	51,8	3,2					
0330	Sulphur Dioxide	0,0150000	0,0000000	1		0,074	51,7	3,2		0,074	51,8	3,2					
0337	Carbon Oxide	0,0500000	0,0000000	1		0,025	51,7	3,2		0,025	51,8	3,2					
0703	Benzo(a)pyrene (3,4-Benzipyrene)	0,0000001	0,0000000	1		0,025	51,7	3,2		0,025	51,8	3,2					
1325	Formaldehyde	0,0006000	0,0000000	1		0,042	51,7	3,2		0,042	51,8	3,2					
2732	Oil Fraction	0,0150000	0,0000000	1		0,031	51,7	3,2		0,031	51,8	3,2					
+	0	0	7	Welding	1	3	5,0	0,00	0	0	0	1,0	61,0	31,0	67,0	31,0	5,00
Substance code	Substance	Dispersion (gr/s)	Dispersion (t/y)	F	Sum.	Cm/ MPC	Xm	Um	Wint.:	Cm/ MPC	Xm	Um					
0123	Iron Oxide	0,0010000	0,0000000	1		0,011	28,5	0,5		0,011	28,5	0,5					
0143	Manganese and its compounds	0,0000080	0,0000000	1		0,003	28,5	0,5		0,003	28,5	0,5					
0301	Nitrogen (IV) Oxide (Nitrogen Dioxide)	0,0002800	0,0000000	1		0,006	28,5	0,5		0,006	28,5	0,5					
0304	Nitrogen (II) Oxide (Nitrogen Dioxide)	0,0000500	0,0000000	1		0,001	28,5	0,5		0,001	28,5	0,5					
0337	Carbon Oxide	0,0030000	0,0000000	1		0,003	28,5	0,5		0,003	28,5	0,5					
0342	Gaseous Fluorides	0,0001700	0,0000000	1		0,036	28,5	0,5		0,036	28,5	0,5					

Record during reporting	Site №	Workshop №	Source №	Source Title	Alternative	Type	Source height (m)	Diameter (m)	Air-gas mixture consistency (m3/s)	Air-gas mixture velocity (m/s)	Air-gas mixture temperature (°C)	Relief ratio	Coord. X1 axis (m)	Coord. Y1 axis (m)	Coord. X2 axis (m)	Coord. Y2 axis (m)	Source width (m)
0344				Slightly Soluble fluorides	0,0003000		0,0000000		1	0,006	28,5	0,5	0,006	28,5	0,5		
2908				Inorganic Dust: 70-20% SiO2	0,0001300		0,0000000		1	0,002	28,5	0,5	0,002	28,5	0,5		

Emission According to the Source Substances

Record:
"%" - The source is considered excluding the baseline condition;
"+" The source is considered without excluding the baseline condition;
"-" - The source is not considered and its share is not included in the baseline condition
In case of absence of benchmarks the source is not considered.

(-) marked or unmarked () In total sources are not considered

Source types:
1 - Point;
2 -Linear;

3 – Non-organized;

4 – Set of point sources, united for one flat surface calculation;
5 – Non-organized, with changeable emission intensity;
6 – Point source, with horizontal (umbrella) dispersion;
7 – Set of horizontal dispersion point sources;
8 - Highway.

Substance: 0123 Iron Oxid

№ Site	№ Workshop	№ Source	Type	Record	Dispersion (gr/s)	F	Summer			Winter		
							Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)
0	0	7	3	+	0,0010000	1	0,0105	28,50	0,5000	0,0105	28,50	0,5000
Total:					**0,0010000**		**0,0105**			**0,0105**		

Substance: 0143 Manganese and its Compounds

№ Site	№ Workshop	№ Source	Type	Record	Dispersion (gr/s)	F	Summer			Winter		
							Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)
0	0	7	3	+	0,0000080	1	0,0034	28,50	0,5000	0,0034	28,50	0,5000
Total:					**0,0000080**		**0,0034**			**0,0034**		

Substance: 0301 Nitrogen (IV) Oxide (Nitrogen Dioxide)

№ Site	№ Workshop	№ Source	Type	Record	Dispersion (gr/s)	F	Summer			Winter		
							Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)
0	0	4	3	+	0,0330000	1	0,6947	28,50	0,5000	0,6947	28,50	0,5000
0	0	5	3	+	0,0330000	1	0,6947	28,50	0,5000	0,6947	28,50	0,5000
0	0	6	1	+	0,0450000	1	0,5572	51,71	3,2004	0,5546	51,81	3,2314
0	0	7	3	+	0,0002800	1	0,0059	28,50	0,5000	0,0059	28,50	0,5000
Total:					**0,1112800**		**1,9526**			**1,9499**		

Substance: 0304 Nitrogen (II) Oxide (Nitrogen Dioxide)

№ Site	№ Workshop	№ Source	Type	Record	Dispersion (gr/s)	F	Summer			Winter		
							Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)

0	0	4	3	+	0,0053000	1	0,0558	28,50	0,5000	0,0558	28,50	0,5000
0	0	5	3	+	0,0053000	1	0,0558	28,50	0,5000	0,0558	28,50	0,5000
0	0	6	1	+	0,0074000	1	0,0458	51,71	3,2004	0,0456	51,81	3,2314
0	0	7	3	+	0,0000500	1	0,0005	28,50	0,5000	0,0005	28,50	0,5000
Total:					**0,0180500**		**0,1579**			**0,1577**		

Substance: 0328 Carbon black (soot)

№ Site	№ Workshop	№ Source	Type	Record	Dispersion (gr/s)	F	Summer			Winter		
							Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)
0	0	4	3	+	0,0045000	1	0,1263	28,50	0,5000	0,1263	28,50	0,5000
0	0	5	3	+	0,0045000	1	0,1263	28,50	0,5000	0,1263	28,50	0,5000
0	0	6	1	+	0,0028000	1	0,0462	51,71	3,2004	0,0460	51,81	3,2314
Total:					**0,0118000**		**0,2989**			**0,2986**		

Substance: 0330 Sulphur Dioxide

№ Site	№ Workshop	№ Source	Type	Record	Dispersion (gr/s)	F	Summer			Winter		
							Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)
0	0	4	3	+	0,0033000	1	0,0278	28,50	0,5000	0,0278	28,50	0,5000
0	0	5	3	+	0,0033000	1	0,0278	28,50	0,5000	0,0278	28,50	0,5000
0	0	6	1	+	0,0150000	1	0,0743	51,71	3,2004	0,0739	51,81	3,2314
Total:					**0,0216000**		**0,1299**			**0,1295**		

Substance: 0333 Hydrogen Sulphide

№ Site	№ Workshop	№ Source	Type	Record	Dispersion (gr/s)	F	Summer			Winter		
							Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)
0	0	3	1	+	0,0000550	1	0,4123	7,79	0,5000	0,4123	7,79	0,5000
Total:					**0,0000550**		**0,4123**			**0,4123**		

Substance: 0337 Carbon Oxide

№ Site	№ Workshop	№ Source	Type	Record	Dispersion (gr/s)	F	Summer			Winter		
							Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)
0	0	4	3	+	0,0270000	1	0,0227	28,50	0,5000	0,0227	28,50	0,5000
0	0	5	3	+	0,0270000	1	0,0227	28,50	0,5000	0,0227	28,50	0,5000
0	0	6	1	+	0,0500000	1	0,0248	51,71	3,2004	0,0246	51,81	3,2314
0	0	7	3	+	0,0030000	1	0,0025	28,50	0,5000	0,0025	28,50	0,5000
Total:					**0,1070000**		**0,0728**			**0,0726**		

Substance: 0342 **Gaseous Fluorides**

№ Site	№ Workshop	№ Source	Type	Record	Dispersion (gr/s)	F	Summer			Winter		
							Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)
0	0	7	3	+	0,0001700	1	0,0358	28,50	0,5000	0,0358	28,50	0,5000
Total:					**0,0001700**		**0,0358**			**0,0358**		

Substance: 0344 **Slightly Soluble Fluorides**

№ Site	№ Workshop	№ Source	Type	Record	Dispersion (gr/s)	F	Summer			Winter		
							Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)
0	0	7	3	+	0,0003000	1	0,0063	28,50	0,5000	0,0063	28,50	0,5000
Total:					**0,0003000**		**0,0063**			**0,0063**		

Substance: 0703 **Benzo(a)pyrene** (3,4-Benzopyrene)

№ Site	№ Workshop	№ Source	Type	Record	Dispersion (gr/s)	F	Summer			Winter		
							Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)
0	0	6	1	+	0,0000001	1	0,0248	51,71	3,2004	0,0246	51,81	3,2314
Total:					**0,0000001**		**0,0248**			**0,0246**		

Substance: 1325 **Formaldehyde**

№ Site	№ Workshop	№ Source	Type	Record	Dispersion (gr/s)	F	Summer			Winter		
							Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)
0	0	6	1	+	0,0006000	1	0,0425	51,71	3,2004	0,0423	51,81	3,2314
Total:					**0,0006000**		**0,0425**			**0,0423**		

Substance: 2732 Oil Fraction

№ Site	№ Workshop	№ Source	Type	Record	Dispersion (gr/s)	F	Summer			Winter		
							Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)
0	0	4	3	+	0,0077000	1	0,0270	28,50	0,5000	0,0270	28,50	0,5000
0	0	5	3	+	0,0077000	1	0,0270	28,50	0,5000	0,0270	28,50	0,5000
0	0	6	1	+	0,0150000	1	0,0310	51,71	3,2004	0,0308	51,81	3,2314
Total:					**0,0304000**		**0,0850**			**0,0848**		

Substance: 2754 Saturated Hydrocarbons C12-C19

№ Site	№ Workshop	№ Source	Type	Record	Dispersion (gr/s)	F	Summer			Winter		
							Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)
0	0	3	1	+	0,0195000	1	1,1694	7,79	0,5000	1,1694	7,79	0,5000
Total:					**0,0195000**		**1,1694**			**1,1694**		

Substance: 2908 Inorganic Dust: 70-20% SiO2

№ Site	№ Workshop	№ Source	Type	Record	Dispersion (gr/s)	F	Summer			Winter		
							Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)
0	0	7	3	+	0,0001300	1	0,0018	28,50	0,5000	0,0018	28,50	0,5000
Total:					**0,0001300**		**0,0018**			**0,0018**		

Substance: 2909 Inorganic Dust: up to 20% SiO2

№ Site	№ Workshop	№ Source	Type	Record	Dispersion (gr/s)	F	Summer			Winter		
							Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)
0	0	4	3	+	0,0350000	1	0,2947	28,50	0,5000	0,2947	28,50	0,5000
0	0	5	3	+	0,0110000	1	0,0926	28,50	0,5000	0,0926	28,50	0,5000
Total:					**0,0460000**		**0,3874**			**0,3874**		

Source Emissions according to Total Exposure Groups

Record:
"%" The source is considered excluding the baseline condition;
"+" The source is considered without excluding the baseline condition;
"-" The source is not considered and its share is not included in the baseline condition
The source is not considered if benchmarks are absent.
(-) marked or unmarked () In total sources are not considered

Source types:
1 - Point;
2 - Linear;
3 – Non-organized;

4 – Set of point sources, united for one flat surface calculation;
5 – Non-organized, with changeable emission intensity;
6 – Point source, with horizontal (umbrella) dispersion;
7 – Set of horizontal dispersion point sources;
8 - Highway.

Total Exposure Group: 6009

№ Site	№ Workshop	№ Source	Type	Record	Code в-ва	Dispersion (g/s)	F	Summer			Winter		
								Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)
0	0	4	3	+	0301	0,0330000	1	0,6947	28,50	0,5000	0,6947	28,50	0,5000
0	0	4	3	+	0330	0,0033000	1	0,0278	28,50	0,5000	0,0278	28,50	0,5000
0	0	5	3	+	0301	0,0330000	1	0,6947	28,50	0,5000	0,6947	28,50	0,5000
0	0	5	3	+	0330	0,0033000	1	0,0278	28,50	0,5000	0,0278	28,50	0,5000
0	0	6	1	+	0301	0,0450000	1	0,5572	51,71	3,2004	0,5546	51,81	3,2314

0	0	6	1	+	0330	0,0150000	1	0,0743	51,71	3,2004	0,0739	51,81	3,2314
0	0	7	3	+	0301	0,0002800	1	0,0059	28,50	0,5000	0,0059	28,50	0,5000
Total:						**0,1328800**		**2,0825**			**2,0795**		

Total Exposure Group: 6035

№ Site	№ Workshop	№ Source	Type	Record	Code в-ва	Dispersion (gr/s)	F	Summer			Winter		
								Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)
0	0	3	1	+	0333	0,0000550	1	0,4123	7,79	0,5000	0,4123	7,79	0,5000
0	0	6	1	+	1325	0,0006000	1	0,0425	51,71	3,2004	0,0423	51,81	3,2314
Total:						**0,0006550**		**0,4547**			**0,4545**		

Total Exposure Group: 6039

№ Site	№ Workshop	№ Source	Type	Record	Code в-ва	Dispersion (gr/s)	F	Summer			Winter		
								Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)
0	0	4	3	+	0330	0,0033000	1	0,0278	28,50	0,5000	0,0278	28,50	0,5000
0	0	5	3	+	0330	0,0033000	1	0,0278	28,50	0,5000	0,0278	28,50	0,5000
0	0	6	1	+	0330	0,0150000	1	0,0743	51,71	3,2004	0,0739	51,81	3,2314
0	0	7	3	+	0342	0,0001700	1	0,0358	28,50	0,5000	0,0358	28,50	0,5000
Total:						**0,0217700**		**0,1657**			**0,1653**		

Total Exposure Group: 6043

№ Site	№ Workshop	№ Source	Type	Record	Code в-ва	Dispersion (gr/s)	F	Summer			Winter		
								Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)
0	0	3	1	+	0333	0,0000550	1	0,4123	7,79	0,5000	0,4123	7,79	0,5000
0	0	4	3	+	0330	0,0033000	1	0,0278	28,50	0,5000	0,0278	28,50	0,5000
0	0	5	3	+	0330	0,0033000	1	0,0278	28,50	0,5000	0,0278	28,50	0,5000
0	0	6	1	+	0330	0,0150000	1	0,0743	51,71	3,2004	0,0739	51,81	3,2314
Total:						**0,0216550**		**0,5422**			**0,5418**		

Total Exposure Group: 6046

№ Site	№ Workshop	№ Source	Type	Record	Code в-ва	Dispersion (gr/s)	F	Summer			Winter		
								Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)
0	0	4	3	+	0337	0,0270000	1	0,0227	28,50	0,5000	0,0227	28,50	0,5000
0	0	5	3	+	0337	0,0270000	1	0,0227	28,50	0,5000	0,0227	28,50	0,5000
0	0	6	1	+	0337	0,0500000	1	0,0248	51,71	3,2004	0,0246	51,81	3,2314
0	0	7	3	+	0337	0,0030000	1	0,0025	28,50	0,5000	0,0025	28,50	0,5000
0	0	7	3	+	2908	0,0001300	1	0,0018	28,50	0,5000	0,0018	28,50	0,5000
Total:						**0,1071300**		**0,0746**			**0,0745**		

Calculation Conducted According to Substances (according to Total Exposure)

Code	Substance	Maximum Permissible Concentration			*MPC adjustment ration /Organizational safety impact level	Baseline Concentr.	
		Type	Reference Value	Used in the report		Record	Interpretation
0123	Iron Oxide	MPC ave. d/v	0,0400000	0,3200000	0,8	No	No
0143	Manganese and its compounds	Max. U.	0,0100000	0,0080000	0,8	No	No
0301	Nitrogen (IV) Oxide (Nitrogen Dioxide)	Max. Unit	0,2000000	0,1600000	0,8	Yes	No
0304	Nitrogen (II) Oxide (Nitrogen Oxide)	Max. U.	0,4000000	0,3200000	0,8	No	No
0328	Carbon black (soot)	Max. U.	0,1500000	0,1200000	0,8	No	No
0330	Carbon Dioxide	Max. U.	0,5000000	0,4000000	0,8	Yes	No
0333	Hydrogen Sulphide	Max. U.	0,0080000	0,0064000	0,8	No	No
0337	Carbon Monoxide	Max. U.	5,0000000	4,0000000	0,8	Yes	No
0342	Gaseous Fluorides	Max. U.	0,0200000	0,0160000	0,8	No	No
0344	Slightly Soluble Fluorides	Max. U.	0,2000000	0,1600000	0,8	No	No
0703	Benzo(o)pyrene (3,4-benzopyrene)	MPC ave. d/v	0,0000010	0,0000080	0,8	No	No
1325	Formaldehyde	Max. U.	0,0350000	0,0280000	0,8	No	No
1715	Methanethiol (methyl mercaptan)	Max. U.	0,0001000	0,0000800	0,8	No	No
1728	ethanethiol (ethyl mercaptan)	Max. U.	0,0000500	0,0000400	0,8	No	No
2732	Oil fraction	Organizational safety impact level	1,2000000	0,9600000	0,8	No	No
2754	Saturated Hydrocarbons C12-C19	Max. U.	1,0000000	0,8000000	0,8	No	No
2908	Inorganic Dust 70-20% SiO2	Max. U.	0,3000000	0,2400000	0,8	No	No
2909	Inorganic Dust: 20% SiO2	Max. U.	0,5000000	0,4000000	0,8	Yes	No
6009	Incomplete total exposure group, ratio "1,6": Total exposure group (2) 301 330	Group	-	-	0,8	Yes	No
6035	Total exposure group: (2) 333 1325	Group	-	-	0,8	No	No
6039	Total exposure group (2) 330 342	Group	-	-	0,8	No	No
6043	Total exposure group (2) 330 333	Group	-	-	0,8	No	No
6046	Total exposure group (2) 337 2908	Group	-	-	0,8	No	No

*Applicable when significant regulatory requirement is needed to use. Parameter “correction ratio/organizational safety impact level”, In case adjustment of the value, the standard meaning of which is 1, calculated maximum concentration values should be compared not with ratio value, but with 1.

Background Concentration Measurement Point

Point №	Title	Point Coordinates	
		X	Y
0	New point	0	0

Subs. code	Substance	Background Concentration				
		Calm	North	East	South	West
0301	Nitrogen (IV) Oxide (Nitrogen Dioxide)	0,015	0,015	0,015	0,015	0,015
0330	Sulphur Dioxide	0,02	0,02	0,02	0,02	0,02
0337	Carbon Monoxide	0,4	0,4	0,4	0,4	0,4
2909	Inorganic Dust: up to 20% SiO2	0,15	0,15	0,15	0,15	0,15

Selection of Design Meteorological Parameters
Automatic Selection

Automatic Selection of Wind Velocities

Wind Direction

Sector Beginning	Sector Ending	Wind selection bid
0	360	1

Calculation Area

Calculation Sites

№	Type	Full Description of the Site				Width (m)	Bid (m)		Height. (m)	Note
		Middle Point Coor. I side (m)		Middle Point Coor. II side (m)						
		X	Y	X	Y		X	Y		
1	Given	-800	0	1000	0	1400	100	100	2	

Claculation Point

№	Point Coordinates (m)		Height (m)	Point Type	Note
	X	Y			
1	48,00	607,00	2	At 500 m zone border	North
2	653,00	-16,00	2	At 500 m zone border	East
3	-10,00	-572,00	2	At 500 m zone border	South
4	-493,00	64,00	2	At 500 m zone border	West
6	391,00	7,00	2	Point at the settlement border	Residential house to the East
7	-331,00	-57,00	2	Point at the settlement border	Residential house to the West

Substances, calculation of which is not feasible
Calculation Feasibility Criteria E3=0,01

Code	Title	Sum Cm/MPC
0143	Manganese and its Compounds	0,0042106
0344	Slightly Soluble Flourides	0,0078948
2908	Inorganic Dust: 70-20% SiO2	0,0022807

Calculation Results according to the Substances
(Calculation Points)

Point Types:
0 – User Calculation Point
1 – Point at the protection zone border
2 – Point at the industrial zone border
3 – Point at the sanitary safety zone border
4 – Point at the settlement zone border
5 –At the Development border

№	Coord. X(m)	Coord. Y(m)	Height (m)	Concentr. (MPC share)	Wind Direction	Wind Velocity	Background (MPC share)	Before excluding the background	Point type
Substance: 0123 Iron Oxide									
5	318	66	2	1,6e-3	262	1,60	0,000	0,000	1
6	391	7	2	1,1e-3	274	3,82	0,000	0,000	4
7	-331	-57	2	8,4e-4	77	5,10	0,000	0,000	4
4	-493	64	2	5,4e-4	93	5,10	0,000	0,000	3
1	48	607	2	5,1e-4	178	5,10	0,000	0,000	3
2	653	-16	2	4,9e-4	275	5,10	0,000	0,000	3
3	-10	-572	2	4,7e-4	7	5,10	0,000	0,000	3
Substance: 0301 Nitrogen (IV) Oxide (Nitrogen Dioxide)									
5	318	66	2	0,28	267	0,64	0,094	0,094	1
6	391	7	2	0,24	273	0,64	0,094	0,094	4
7	-331	-57	2	0,24	80	1,27	0,094	0,094	4
1	48	607	2	0,22	182	5,10	0,094	0,094	3
3	-10	-572	2	0,21	3	5,10	0,094	0,094	3
4	-493	64	2	0,19	95	0,64	0,094	0,094	3
2	653	-16	2	0,17	273	0,64	0,094	0,094	3
Substance: 0304 Nitrogen (II) Oxide (Nitrogen Oxide)									
5	318	66	2	0,02	266	0,64	0,000	0,000	1
6	391	7	2	0,01	273	0,64	0,000	0,000	4
7	-331	-57	2	0,01	79	0,64	0,000	0,000	4
1	48	607	2	0,01	182	5,10	0,000	0,000	3
3	-10	-572	2	9,5e-3	3	5,10	0,000	0,000	3
4	-493	64	2	8,3e-3	95	0,64	0,000	0,000	3
2	653	-16	2	6,5e-3	273	0,64	0,000	0,000	3
Substance: 0328 Carbon Black (Soot)									
5	318	66	2	0,03	273	0,92	0,000	0,000	1
6	391	7	2	0,02	278	0,92	0,000	0,000	4
7	-331	-57	2	0,02	74	0,92	0,000	0,000	4
1	48	607	2	0,02	182	5,10	0,000	0,000	3
3	-10	-572	2	0,01	3	5,10	0,000	0,000	3
4	-493	64	2	0,01	92	0,92	0,000	0,000	3
2	653	-16	2	0,01	275	0,92	0,000	0,000	3
Substance: 0330 Sulfur Dioxide									
5	318	66	2	0,07	250	5,10	0,050	0,050	1
7	-331	-57	2	0,07	86	1,02	0,050	0,050	4
6	391	7	2	0,07	265	1,02	0,050	0,050	4

4	-493	64	2	0,06	100	1,02	0,050	0,050	3
3	-10	-572	2	0,06	3	1,02	0,050	0,050	3
1	48	607	2	0,06	182	1,02	0,050	0,050	3
2	653	-16	2	0,06	270	1,02	0,050	0,050	3

Substance: 0333 Hydrogen Sulphide

7	-331	-57	2	5,4e-3	92	5,10	0,000	0,000	4
5	318	66	2	5,1e-3	247	5,10	0,000	0,000	1
6	391	7	2	3,9e-3	259	5,10	0,000	0,000	4
3	-10	-572	2	2,8e-3	1	0,67	0,000	0,000	3
4	-493	64	2	2,7e-3	105	0,67	0,000	0,000	3
2	653	-16	2	2,1e-3	265	0,67	0,000	0,000	3
1	48	607	2	2,0e-3	184	0,67	0,000	0,000	3

Substance: 0337 Carbon Oxide

5	318	66	2	0,11	262	0,71	0,100	0,100	1
7	-331	-57	2	0,11	81	0,71	0,100	0,100	4
6	391	7	2	0,11	270	0,71	0,100	0,100	4
1	48	607	2	0,10	182	5,10	0,100	0,100	3
3	-10	-572	2	0,10	3	5,10	0,100	0,100	3
4	-493	64	2	0,10	97	0,71	0,100	0,100	3
2	653	-16	2	0,10	272	0,71	0,100	0,100	3

Substance: 0342 Gaseous Fluorides

5	318	66	2	5,4e-3	262	1,60	0,000	0,000	1
6	391	7	2	3,8e-3	274	3,82	0,000	0,000	4
7	-331	-57	2	2,9e-3	77	5,10	0,000	0,000	4
4	-493	64	2	1,8e-3	93	5,10	0,000	0,000	3
1	48	607	2	1,7e-3	178	5,10	0,000	0,000	3
2	653	-16	2	1,7e-3	275	5,10	0,000	0,000	3
3	-10	-572	2	1,6e-3	7	5,10	0,000	0,000	3

Substance: 0703 Benzo(a)pyrene (3,4-Benzopyrene)

5	318	66	2	6,9e-3	250	5,10	0,000	0,000	1
7	-331	-57	2	5,8e-3	87	5,10	0,000	0,000	4
6	391	7	2	5,3e-3	263	5,10	0,000	0,000	4
4	-493	64	2	2,9e-3	101	5,10	0,000	0,000	3
3	-10	-572	2	2,8e-3	3	5,10	0,000	0,000	3
2	653	-16	2	2,0e-3	268	5,10	0,000	0,000	3
1	48	607	2	1,9e-3	182	5,10	0,000	0,000	3

Substance: 1325 Formaldehyde

5	318	66	2	0,01	250	5,10	0,000	0,000	1
7	-331	-57	2	1,0e-2	87	5,10	0,000	0,000	4
6	391	7	2	9,0e-3	263	5,10	0,000	0,000	4
4	-493	64	2	4,9e-3	101	5,10	0,000	0,000	3
3	-10	-572	2	4,8e-3	3	5,10	0,000	0,000	3
2	653	-16	2	3,5e-3	268	5,10	0,000	0,000	3
1	48	607	2	3,3e-3	182	5,10	0,000	0,000	3

Substance: 2732 Oil Fraction

5	318	66	2	9,0e-3	261	0,74	0,000	0,000	1
7	-331	-57	2	7,9e-3	82	0,74	0,000	0,000	4

6	391	7	2	7,7e-3	269	0,74	0,000	0,000	4
1	48	607	2	5,6e-3	182	5,10	0,000	0,000	3
3	-10	-572	2	5,6e-3	3	5,10	0,000	0,000	3
4	-493	64	2	5,5e-3	97	0,74	0,000	0,000	3
2	653	-16	2	4,4e-3	272	0,74	0,000	0,000	3

Substance: 2754 Saturated Hydrocarbons C12-C19

7	-331	-57	2	0,02	92	5,10	0,000	0,000	4
5	318	66	2	0,01	247	5,10	0,000	0,000	1
6	391	7	2	0,01	259	5,10	0,000	0,000	4
3	-10	-572	2	7,9e-3	1	0,67	0,000	0,000	3
4	-493	64	2	7,7e-3	105	0,67	0,000	0,000	3
2	653	-16	2	5,8e-3	265	0,67	0,000	0,000	3
1	48	607	2	5,6e-3	184	0,67	0,000	0,000	3

Substance: 2909 Inorganic Dust: Up to 20% SiO2

5	318	66	2	0,42	278	1,60	0,375	0,375	1
6	391	7	2	0,41	285	3,82	0,375	0,375	4
7	-331	-57	2	0,40	66	3,82	0,375	0,375	4
1	48	607	2	0,40	182	5,10	0,375	0,375	3
4	-493	64	2	0,40	86	5,10	0,375	0,375	3
2	653	-16	2	0,39	281	5,10	0,375	0,375	3
3	-10	-572	2	0,39	3	5,10	0,375	0,375	3

Substance: 6009 Total Exposure Group (2) 301 330

5	318	66	2	0,22	266	0,66	0,090	0,090	1
7	-331	-57	2	0,19	79	0,66	0,090	0,090	4
6	391	7	2	0,19	272	0,66	0,090	0,090	4
1	48	607	2	0,17	182	5,10	0,090	0,090	3
3	-10	-572	2	0,17	3	5,10	0,090	0,090	3
4	-493	64	2	0,16	95	0,66	0,090	0,090	3
2	653	-16	2	0,15	273	0,66	0,090	0,090	3

Substance: 6035 Total Exposure Group (2) 333 1325

5	318	66	2	0,02	249	5,10	0,000	0,000	1
7	-331	-57	2	0,01	89	5,10	0,000	0,000	4
6	391	7	2	0,01	262	5,10	0,000	0,000	4
4	-493	64	2	8,3e-3	103	0,75	0,000	0,000	3
3	-10	-572	2	8,3e-3	3	0,75	0,000	0,000	3
2	653	-16	2	6,4e-3	267	0,75	0,000	0,000	3
1	48	607	2	6,2e-3	183	0,75	0,000	0,000	3

Substance: 6039 Total Exposure Group (2) 330 342

5	318	66	2	0,02	255	0,86	0,000	0,000	1
6	391	7	2	0,02	267	0,86	0,000	0,000	4
7	-331	-57	2	0,02	84	0,86	0,000	0,000	4
4	-493	64	2	0,01	99	0,86	0,000	0,000	3
3	-10	-572	2	0,01	4	0,86	0,000	0,000	3
1	48	607	2	0,01	182	0,86	0,000	0,000	3
2	653	-16	2	0,01	270	0,86	0,000	0,000	3

Substance: 6043 Total Exposure Group (2) 330 333

5	318	66	2	0,03	250	5,10	0,000	0,000	1

7	-331	-57	2	0,02	87	0,87	0,000	0,000	4
6	391	7	2	0,02	264	0,87	0,000	0,000	4
3	-10	-572	2	0,01	3	0,87	0,000	0,000	3
4	-493	64	2	0,01	101	0,87	0,000	0,000	3
1	48	607	2	0,01	183	0,87	0,000	0,000	3
2	653	-16	2	0,01	269	0,87	0,000	0,000	3

Substance: 6046 Total Exposure Group (2) 337 2908

5	318	66	2	7,8e-3	262	0,70	0,000	0,000	1
6	391	7	2	6,4e-3	271	0,70	0,000	0,000	4
7	-331	-57	2	6,4e-3	81	0,70	0,000	0,000	4
1	48	607	2	4,8e-3	182	5,10	0,000	0,000	3
3	-10	-572	2	4,7e-3	3	5,10	0,000	0,000	3
4	-493	64	2	4,4e-3	97	0,70	0,000	0,000	3
2	653	-16	2	3,5e-3	272	0,70	0,000	0,000	3

Annex 2. Software Printout of Air Pollutant Emission Report-Operation Stage

УПРЗА ЭКОЛОГ, версия 3.1
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Serial No 01-01-2568, Scientific-Research Firm Gamma

Plant No 342; WWTP
Kutaisi City

Initial Data Alternative: 1, new alternative of initial data
Calculation Option: New calculation option
Caculation is implemented: For summer
Calculation Module "ОНД-86"
Calculation Constants: E1= 0,01, E2=0,01, E3=0,01, S=999999,99 km².

Meteorological Parameters

Average air temperature for the hottest month	27° C
Average air temperature for the coldest month	4,9° C
Atmosphere stratification temperature depended ratio	200
Maximum Wind velocity for given area (exceeding temperature within 5%)	5,1 m/s

Plant Structure (Sites, workshops)

No	Site (workshop) title

Emission Source Parameters

Record:
"%" - The source is considered excluding the baseline condition;
"+" - The source is considered without excluding the baseline condition;
"-" The source is not considered and its share is not included in the baseline condition.
In case of absence of benchmarks the source is not considered.

Source types:
1 - Point;
2 -Linear;
3 – Non-organized;
4 – Set of point sources, united for one flat surface calculation;
5 – Non-organized, with changeable emission intensity;
6 – Point source, with horizontal(umbrella) dispersion;
7 – Set of horizontal dispersion point sources;
8 - Highway.

Record during reporting	Site №	Workshop №	Source №	Source Title	Alternative	Type	Source height (m)	Diameter (m)	Air-gas mixture consistency (m3/s)	Air-gas mixture velocity (m/s)	Air-gas mixture temperature (°C)	Relief ratio	Coord. X1 axis (m)	Coord. Y1 axis (m)	Coord. X2 axis (m)	Coord. Y2 axis (m)	Source width (m)
%	0	0	1	Torch	1	1	12,0	0,50	1	5,09296	150	1,0	0,0	0,0	0,0	0,0	0,00

Substance code	Substance	Dispersion (gr/s)	Dispersion (t/y)	F	Summ.: Cm/MPC	Xm	Um	Wint.: Cm/MPC	Xm	Um
0301	Nitrogen (IV) Oxide (Nitrogen Dioxide)	0,0013000	0,0000000	1	0,002	105	1,4	0,002	109,8	1,5
0337	Sulphur Dioxide	0,0032600	0,0000000	1	0,000	105	1,4	0,000	109,8	1,5

Record during reporting	Site №	Workshop №	Source №	Source Title	Alternative	Type	Source height (m)	Diameter (m)	Air-gas mixture consistency (m3/s)	Air-gas mixture velocity (m/s)	Air-gas mixture temperature (°C)	Relief ratio	Coord. X1 axis (m)	Coord. Y1 axis (m)	Coord. X2 axis (m)	Coord. Y2 axis (m)	Source width (m)
%	0	0	2	Open Surface of WWTP	1	3	2,0	0,00	0	0,00000	0	1,0	49,0	45,0	133,0	5,0	120,00

Substance code	Substance	Dispersion (gr/s)	Dispersion (t/y)	F	Summ.: Cm/MPC	Xm	Um	Wint.: Cm/MPC	Xm	Um
0301	Nitrogen (IV) Oxide (Nitrogen Dioxide)	0,0000325	0,0000000	1	0,006	11,4	0,5	0,006	11,4	0,5
0303	Ammonia	0,0015966	0,0000000	1	0,285	11,4	0,5	0,285	11,4	0,5
0333	Hydrogen Sulphide	0,0001506	0,0000000	1	0,672	11,4	0,5	0,672	11,4	0,5
0337	Carbon Oxide	0,0067784	0,0000000	1	0,048	11,4	0,5	0,048	11,4	0,5
0410	Methane	0,1014820	0,0000000	1	0,072	11,4	0,5	0,072	11,4	0,5
1715	Methanethiol (Methyl Mercaptan)	0,0000002	0,0000000	1	0,083	11,4	0,5	0,083	11,4	0,5
1728	Ethanethiol (Ethyl Mercaptan)	9,200000e-8	0,0000000	1	0,066	11,4	0,5	0,066	11,4	0,5

Record during reporting	Site №	Workshop №	Source №	Source Title	Alternative	Type	Source height (m)	Diameter (m)	Air-gas mixture consistency (m3/s)	Air-gas mixture velocity (m/s)	Air-gas mixture temperature (°C)	Relief ratio	Coord. X1 axis (m)	Coord. Y1 axis (m)	Coord. X2 axis (m)	Coord. Y2 axis (m)	Source width (m)
-	0	0	3	Diesel fuel storage	1	1	3,0	0,25	0,0083	0,16909	30	1,0	2,0	-68,0	2,0	-68,0	0,00

Substance code	Substance	Dispersion (gr/s)	Dispersion (t/y)	F	Summ.: Cm/MPC	Xm	Um	Wint.: Cm/MPC	Xm	Um

Record during reporting	Site №	Workshop №	Source №	Source Title	Alternative	Type	Source height (m)	Diameter (m)	Air-gas mixture consistency (m3/s)	Air-gas mixture velocity (m/s)	Air-gas mixture temperature (°C)	Relief ratio	Coord. X1 axis (m)	Coord. Y1 axis (m)	Coord. X2 axis (m)	Coord. Y2 axis (m)	Source width (m)
0333				Hydrogen Sulphide	0,0000550			0,0000000	1		0,412	7,8	0,5		0,412	7,8	0,5
2754				Saturated Hydrocarbons C12-C19	0,0195000			0,0000000	1		1,169	7,8	0,5		1,169	7,8	0,5
-	0	0	4	Excavator	1	3	5,0	0,00	0	0,00000	0	1,0	29,0	112,0	34,0	112,0	5,00
Substance code				Substance	Dispersion (gr/s)			Dispersion (t/y)	F	Summ.:	Cm/MPC	Xm	Um	Wint.:	Cm/MPC	Xm	Um
0301				Nitrogen (IV) Oxide (Nitrogen Dioxide)	0,0330000			0,0000000	1		0,695	28,5	0,5		0,695	28,5	0,5
0304				Nitrogen (II) Oxide (Nitrogen Oxide)	0,0053000			0,0000000	1		0,056	28,5	0,5		0,056	28,5	0,5
0328				Carbon Black (soot)	0,0045000			0,0000000	1		0,126	28,5	0,5		0,126	28,5	0,5
0330				Carbon Dioxide	0,0033000			0,0000000	1		0,028	28,5	0,5		0,028	28,5	0,5
0337				Carbon Oxide	0,0270000			0,0000000	1		0,023	28,5	0,5		0,023	28,5	0,5
2732				Oil Fraction	0,0077000			0,0000000	1		0,027	28,5	0,5		0,027	28,5	0,5
2909				Inorganic Dust: up to 20% SiO2	0,0350000			0,0000000	1		0,295	28,5	0,5		0,295	28,5	0,5
-	0	0	5	Bulldozer	1	3	5,0	0,00	0	0,00000	0	1,0	38,0	97,0	23,0	56,0	10,00
Substance code				Substance	Dispersion (gr/s)			Dispersion (t/y)	F	Summ.:	Cm/MPC	Xm	Um	Wint.:	Cm/MPC	Xm	Um
0301				Nitrogen (IV) Oxide (Nitrogen Dioxide)	0,0330000			0,0000000	1		0,695	28,5	0,5		0,695	28,5	0,5
0304				Nitrogen (II) Oxide (Nitrogen Oxide)	0,0053000			0,0000000	1		0,056	28,5	0,5		0,056	28,5	0,5
0328				Carbon Black (soot)	0,0045000			0,0000000	1		0,126	28,5	0,5		0,126	28,5	0,5
0330				Carbon Dioxide	0,0033000			0,0000000	1		0,028	28,5	0,5		0,028	28,5	0,5
0337				Carbon Oxide	0,0270000			0,0000000	1		0,023	28,5	0,5		0,023	28,5	0,5
2732				Oil Fraction	0,0077000			0,0000000	1		0,027	28,5	0,5		0,027	28,5	0,5
2909				Inorganic Dust: up to 20% SiO2	0,0110000			0,0000000	1		0,093	28,5	0,5		0,093	28,5	0,5
-	0	0	6	Generator	1	1	3,0	0,15	0,303	17,14629	450	1,0	20,0	-40,0	20,0	-40,0	0,00
Substance code				Substance	Dispersion (gr/s)			Dispersion (t/y)	F	Summ.:	Cm/MPC	Xm	Um	Wint.:	Cm/MPC	Xm	Um
0301				Nitrogen (IV) Oxide (Nitrogen Dioxide)	0,0450000			0,0000000	1		0,557	51,7	3,2		0,555	51,8	3,2
0304				Nitrogen (II) Oxide (Nitrogen Oxide)	0,0074000			0,0000000	1		0,046	51,7	3,2		0,046	51,8	3,2
0328				Carbon Black (soot)	0,0028000			0,0000000	1		0,046	51,7	3,2		0,046	51,8	3,2
0330				Carbon Dioxide	0,0150000			0,0000000	1		0,074	51,7	3,2		0,074	51,8	3,2

Record during reporting	Site №	Workshop №	Source №	Source Title	Alternative	Type	Source height (m)	Diameter (m)	Air-gas mixture consistency (m3/s)	Air-gas mixture velocity (m/s)	Air-gas mixture temperature (°C)	Relief ratio	Coord. X1 axis (m)	Coord. Y1 axis (m)	Coord. X2 axis (m)	Coord. Y2 axis (m)	Source width (m)
0337				Carbon Oxide	0,0500000			0,0000000	1	0,025	51,7	3,2		0,025	51,8	3,2	
0703				Benzo(a)pyrene (3,4-Benzopyrene)	0,0000001			0,0000000	1	0,025	51,7	3,2		0,025	51,8	3,2	
1325				Formaldehyde	0,0006000			0,0000000	1	0,042	51,7	3,2		0,042	51,8	3,2	
2732				Oil fraction	0,0150000			0,0000000	1	0,031	51,7	3,2		0,031	51,8	3,2	
-	0	0	7	Welding	1	3	5,0	0,00	0	0,00000	0	1,0	61,0	31,0	67,0	31,0	5,00
Substance code				Substance	Dispersion (gr/s)			Dispersion (t/y)	F	Summ.: Cm/MPC	Xm	Um	Wint.: Cm/MPC		Xm	Um	
0123				Iron Oxide	0,0010000			0,0000000	1	0,011	28,5	0,5		0,011	28,5	0,5	
0143				Manganese and its Compounds	0,0000080			0,0000000	1	0,003	28,5	0,5		0,003	28,5	0,5	
0301				Nitrogen (IV) Oxide (Nitrogen Dioxide)	0,0002800			0,0000000	1	0,006	28,5	0,5		0,006	28,5	0,5	
0304				Nitrogen (II) Oxide (Nitrogen Oxide)	0,0000500			0,0000000	1	0,001	28,5	0,5		0,001	28,5	0,5	
0337				Carbon Oxide	0,0030000			0,0000000	1	0,003	28,5	0,5		0,003	28,5	0,5	
0342				Gaseous Fluorides	0,0001700			0,0000000	1	0,036	28,5	0,5		0,036	28,5	0,5	
0344				Slightly Soluble Fluorides	0,0003000			0,0000000	1	0,006	28,5	0,5		0,006	28,5	0,5	
2908				Inorganic Dust: 70-20% SiO2	0,0001300			0,0000000	1	0,002	28,5	0,5		0,002	28,5	0,5	

Emission According to the Source Substances

Record:
"%" - The source is considered excluding the baseline condition;
"+" The source is considered without excluding the baseline condition;
"-" - The source is not considered and its share is not included in the baseline condition
In case of absence of benchmarks the source is not considered.

(-) marked or unmarked () In total sources are not considered

Source types:
1 - Point;
2 -Linear;

3 – Non-organized;

4 – Set of point sources, united for one flat surface calculation;
5 – Non-organized, with changeable emission intensity;
6 – Point source, with horizontal (umbrella) dispersion;
7 – Set of horizontal dispersion point sources;
8 - Highway.

Substance: 0301 Nitrogen (IV) Oxide (Nitrogen Dioxide)

№ Site	№ Workshop	№ Source	Type	Record	Emission (gr/s)	F	Summer			Winter		
							Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)
0	0	1	1	%	0,0013000	1	0,0020	105,04	1,4120	0,0019	109,79	1,4919
0	0	2	3	%	0,0000325	1	0,0058	11,40	0,5000	0,0058	11,40	0,5000
0	0	4	3	-	0,0330000	1	0,6947	28,50	0,5000	0,6947	28,50	0,5000
0	0	5	3	-	0,0330000	1	0,6947	28,50	0,5000	0,6947	28,50	0,5000
0	0	6	1	-	0,0450000	1	0,5572	51,71	3,2004	0,5546	51,81	3,2314
0	0	7	3	-	0,0002800	1	0,0059	28,50	0,5000	0,0059	28,50	0,5000
Total:					**0,0013325**		**0,0078**			**0,0077**		

Substance: 0303 Ammonia

№ Site	№ Workshop	№ Source	Type	Record	Emission (gr/s)	F	Summer			Winter		
							Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)
0	0	2	3	%	0,0015966	1	0,2851	11,40	0,5000	0,2851	11,40	0,5000
Total:					**0,0015966**		**0,2851**			**0,2851**		

Substance: 0333 Hydrogen Sulphide

№ Site	№ Workshop	№ Source	Type	Record	Emission (gr/s)	F	Summer			Winter		
							Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)
0	0	2	3	%	0,0001506	1	0,6724	11,40	0,5000	0,6724	11,40	0,5000
0	0	3	1	-	0,0000550	1	0,4123	7,79	0,5000	0,4123	7,79	0,5000
Total:					**0,0001506**		**0,6724**			**0,6724**		

Substance: 0337 Carbon Oxide

№ Site	№ Workshop	№ Source	Type	Record	Emission (gr/s)	F	Summer			Winter		
							Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)
0	0	1	1	%	0,0032600	1	0,0002	105,04	1,4120	0,0002	109,79	1,4919
0	0	2	3	%	0,0067784	1	0,0484	11,40	0,5000	0,0484	11,40	0,5000
0	0	4	3	-	0,0270000	1	0,0227	28,50	0,5000	0,0227	28,50	0,5000
0	0	5	3	-	0,0270000	1	0,0227	28,50	0,5000	0,0227	28,50	0,5000
0	0	6	1	-	0,0500000	1	0,0248	51,71	3,2004	0,0246	51,81	3,2314
0	0	7	3	-	0,0030000	1	0,0025	28,50	0,5000	0,0025	28,50	0,5000
Total:					**0,0100384**		**0,0486**			**0,0486**		

Substance: 0410 Methane

№ Site	№ Workshop	№ Source	Type	Record	Emission (gr/s)	F	Summer			Winter		
							Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)
0	0	2	3	%	0,1014820	1	0,0725	11,40	0,5000	0,0725	11,40	0,5000
Total:					**0,1014820**		**0,0725**			**0,0725**		

Substance: 1715 Methanethiol (Methyl Mercaptan)

№ Site	№ Workshop	№ Source	Type	Record	Emission (gr/s)	F	Summer			Winter		
							Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)
0	0	2	3	%	0,0000002	1	0,0825	11,40	0,5000	0,0825	11,40	0,5000
Total:					**0,0000002**		**0,0825**			**0,0825**		

Substance: 1728 Ethanethiol (Ethyl Mercaptan)

№ Site	№ Workshop	№ Source	Type	Record	Emission (gr/s)	F	Summer			Winter		
							Cm/MPC	Xm	Um (m/s)	Cm/MPC	Xm	Um (m/s)
0	0	2	3	%	9,200000e-8	1	0,0657	11,40	0,5000	0,0657	11,40	0,5000
Total:					**9,200000e-8**		**0,0657**			**0,0657**		

Calculation Conducted According to Substances (according to Total Exposure Groups)

Code	Substance	Maximum Permissible Concentration			*MPC adjustment ratio /Organizational safety impact level	Baseline Concentr.	
		Type	Reference Value	Used in the report			Type
0301	Nitrogen (IV) Oxide (Nitrogen Dioxide)	Max. Unit	0,2000000	0,1600000	0,8	Yes	No
0303	Ammonia	Max. Unit	0,2000000	0,1600000	0,8	No	No
0333	Hydrogen Sulphide	Max. Unit	0,0080000	0,0064000	0,8	No	No
0337	Carbon Monoxide	Max. Unit	5,0000000	4,0000000	0,8	Yes	No
0410	Methane	Organizational safety impact level	50,0000000	40,0000000	0,8	No	No
1715	Methanethiol (methyl mercaptan)	Max. Unit	0,0001000	0,0000800	0,8	No	No
1728	ethanethiol (ethyl mercaptan)	Max. Unit	0,0000500	0,0000400	0,8	No	No

*Applicable when significant regulatory requirement is needed to use. Parameter “correction ratio/organizational safety impact level”, In case adjustment of the value, the standard meaning of which is 1, calculated maximum concentration values should be compared not with ratio value, but with 1.

Background Concentration Measurement Point

Point №	Title	Point Coordinates	
		X	Y
0	New point	0	0

Subs. code	Substance	Background Concentration				
		Calm	North	East	South	West
0301	Nitrogen (IV) Oxide (Nitrogen Dioxide)	0,015	0,015	0,015	0,015	0,015
0330	Sulphur Dioxide	0,02	0,02	0,02	0,02	0,02
0337	Carbon Monoxide	0,4	0,4	0,4	0,4	0,4
2909	Inorganic Dust: up to 20% SiO2	0,15	0,15	0,15	0,15	0,15

Selection of Calculating Meteorological Parameters

Automatic Selection

Automatic Selection of Wind Velocities

Wind Direction

Sector Beginning	Sector Ending	Wind selection bid
0	360	1

Calculation Area

Calculation Sites

№	Type	Full Description of the Site				Width (m)	Bid (m)		Height. (m)	Note
		Middle Point Coor. I side (m)		Middle Point Coor. II side (m)						
		X	Y	X	Y		X	Y		
1	Given	-800	0	1000	0	1400	100	100	2	

Claculation Point

№	Point Coordinates (m)		Height (m)	Point Type	Note
	X	Y			
1	48,00	607,00	2	At 500 m zone border	North
2	653,00	-16,00	2	At 500 m zone border	East
3	-10,00	-572,00	2	At 500 m zone border	South
4	-493,00	64,00	2	At 500 m zone border	West
6	391,00	7,00	2	Point at the settlement border	Residential house to the East
7	-331,00	-57,00	2	Point at the settlement border	Residential house to the West

Calculation Results and Shares according to the Substances (Calculation Points)

Point Types:
0 – User Calculation Point
1 – Point at the protection zone border
2 – Point at the industrial zone border
3 – Point at the sanitary safety zone border
4 – Point at the settlement zone border
5 –At the building border

Substance: 0301 Nitrogen (IV) Oxide (Nitrogen Dioxide)

№	Coord. X(m)	Coord. Y(m)	Height (m)	Concentr. (MPC share)	Wind Direction	Wind Velocity	Background (MPC share)	Before excluding the backgroun	Point type

								d	
2	653	-16	2	0,06	272	2,54	0,062	0,094	3
4	-493	64	2	0,05	97	2,54	0,053	0,094	3
3	-10	-572	2	0,05	1	2,54	0,047	0,094	3
1	48	607	2	0,04	184	2,54	0,044	0,094	3
6	391	7	2	0,04	269	2,02	0,034	0,094	4
7	-331	-57	2	0,04	80	2,02	0,034	0,094	4
5	318	66	2	0,02	258	2,02	0,019	0,094	1

Substance: 0303 Ammonia

№	Coord. X(m)	Coord. Y(m)	Height (m)	Concentr. (MPC share)	Wind Direction	Wind Velocity	Background (MPC share)	Before excluding the background	Point type
5	318	66	2	8,6e-3	261	0,89	0,000	0,000	1
6	391	7	2	5,8e-3	274	0,89	0,000	0,000	4
7	-331	-57	2	3,8e-3	79	5,10	0,000	0,000	4
2	653	-16	2	2,6e-3	274	0,67	0,000	0,000	3
1	48	607	2	2,5e-3	176	0,67	0,000	0,000	3
4	-493	64	2	2,5e-3	94	0,67	0,000	0,000	3
3	-10	-572	2	2,4e-3	10	0,67	0,000	0,000	3

Substance: 0333 Hydrogen Sulphide

№	Coord. X(m)	Coord. Y(m)	Height (m)	Concentr. (MPC share)	Wind Direction	Wind Velocity	Background (MPC share)	Before excluding the background	Point type
5	318	66	2	0,02	261	0,89	0,000	0,000	1
6	391	7	2	0,01	274	0,89	0,000	0,000	4
7	-331	-57	2	9,1e-3	79	5,10	0,000	0,000	4
2	653	-16	2	6,1e-3	274	0,67	0,000	0,000	3
1	48	607	2	5,9e-3	176	0,67	0,000	0,000	3
4	-493	64	2	5,9e-3	94	0,67	0,000	0,000	3
3	-10	-572	2	5,7e-3	10	0,67	0,000	0,000	3

Substance: 0337 Carbon Oxide

№	Coord. X(m)	Coord. Y(m)	Height (m)	Concentr. (MPC share)	Wind Direction	Wind Velocity	Background (MPC share)	Before excluding the background	Point type
2	653	-16	2	0,10	274	1,05	0,098	0,100	3
4	-493	64	2	0,10	94	1,05	0,098	0,100	3
3	-10	-572	2	0,10	9	1,05	0,098	0,100	3
1	48	607	2	0,10	177	1,05	0,098	0,100	3
6	391	7	2	0,10	273	1,05	0,097	0,100	4
5	318	66	2	0,10	261	1,05	0,096	0,100	1
7	-331	-57	2	0,10	80	5,10	0,097	0,100	4

Substance: 0410 Methane

№	Coord. X(m)	Coord. Y(m)	Height (m)	Concentr. (MPC share)	Wind Direction	Wind Velocity	Background (MPC share)	Before excluding the background	Point type
5	318	66	2	2,2e-3	261	0,89	0,000	0,000	1
6	391	7	2	1,5e-3	274	0,89	0,000	0,000	4
7	-331	-57	2	9,8e-4	79	5,10	0,000	0,000	4
2	653	-16	2	6,6e-4	274	0,67	0,000	0,000	3
1	48	607	2	6,4e-4	176	0,67	0,000	0,000	3
4	-493	64	2	6,3e-4	94	0,67	0,000	0,000	3
3	-10	-572	2	6,1e-4	10	0,67	0,000	0,000	3

Substance: 1715 Methanethiol (methyl mercaptan)

№	Coord. X(m)	Coord. Y(m)	Height (m)	Concentr. (MPC share)	Wind Direction	Wind Velocity	Background (MPC share)	Before excluding the background	Point type
5	318	66	2	2,5e-3	261	0,89	0,000	0,000	1
6	391	7	2	1,7e-3	274	0,89	0,000	0,000	4
7	-331	-57	2	1,1e-3	79	5,10	0,000	0,000	4
2	653	-16	2	7,5e-4	274	0,67	0,000	0,000	3
1	48	607	2	7,3e-4	176	0,67	0,000	0,000	3
4	-493	64	2	7,2e-4	94	0,67	0,000	0,000	3
3	-10	-572	2	6,9e-4	10	0,67	0,000	0,000	3

Substance: 1728 Ethanethiol (Ethyl Mercaptan)

№	Coord. X(m)	Coord. Y(m)	Height (m)	Concentr. (MPC share)	Wind Direction	Wind Velocity	Background (MPC share)	Before excluding the background	Point type
5	318	66	2	2,0e-3	261	0,89	0,000	0,000	1
6	391	7	2	1,3e-3	274	0,89	0,000	0,000	4
7	-331	-57	2	8,9e-4	79	5,10	0,000	0,000	4
2	653	-16	2	6,0e-4	274	0,67	0,000	0,000	3
1	48	607	2	5,8e-4	176	0,67	0,000	0,000	3
4	-493	64	2	5,7e-4	94	0,67	0,000	0,000	3
3	-10	-572	2	5,5e-4	10	0,67	0,000	0,000	3

Maximum Concentrations and Shares by Substances (Calculation Sites)

Substance: 0301 Nitrogen (IV) Oxide (Nitrogen Dioxide)

Site: 1

Maximum Concentration Line

Coord. X(m)	Coord. Y(m)	Concentr. (MPC share)	Wind Direction	Wind Velocity	Background (MPC share)	Before excluding the background
1000	-700	0,08	305	0,50	0,081	0,094
Site	Workshop	Source	Share in MPC	Share %		
0	0	1	2,0e-4	0,24		
0	0	2	2,1e-5	0,03		
1000	700	0,08	235	5,10	0,081	0,094
Site	Workshop	Source	Share in MPC	Share %		
0	0	1	2,0e-4	0,25		
0	0	2	1,8e-5	0,02		
1000	-600	0,08	301	0,50	0,080	0,094
Site	Workshop	Source	Share in MPC	Share %		
0	0	1	2,1e-4	0,26		
0	0	2	2,3e-5	0,03		
1000	600	0,08	239	5,10	0,080	0,094
Site	Workshop	Source	Share in MPC	Share %		
0	0	1	2,2e-4	0,27		
0	0	2	1,9e-5	0,02		
900	-700	0,08	308	5,10	0,080	0,094
Site	Workshop	Source	Share in MPC	Share %		
0	0	1	2,3e-4	0,29		
0	0	2	1,5e-5	0,02		

Substance: 0303 Ammonia

Site: 1

Maximum Concentrations Line

Coord. X(m)	Coord. Y(m)	Concentr. (MPC share)	Wind Direction	Wind Velocity	Background (MPC share)	Before excluding the background
100	100	0,04	190	0,50	0,000	0,000
Site	Workshop	Source	Share in MPC	Share %		
0	0	2	0,04	100,00		
0	0	0,03	82	0,50	0,000	0,000
Site	Workshop	Source	Share in MPC	Share %		
0	0	2	0,03	100,00		
100	0	0,03	352	0,50	0,000	0,000
Site	Workshop	Source	Share in MPC	Share %		
0	0	2	0,03	100,00		
100	-100	0,02	356	0,67	0,000	0,000
Site	Workshop	Source	Share in MPC	Share %		
0	0	2	0,02	100,00		
200	100	0,02	236	0,67	0,000	0,000
Site	Workshop	Source	Share in MPC	Share %		
0	0	2	0,02	100,00		

Substance: 0333 Hydrogen Sulphide

Site: 1

Maximum Concentrations Line

Coord. X(m)	Coord. Y(m)	Concentr. (MPC share)	Wind Direction	Wind Velocity	Background (MPC share)	Before excluding the background
100	100	0,09	190	0,50	0,000	0,000
Site	Workshop	Source	Share in MPC	Share %		
0	0	2	0,09	100,00		
0	0	0,07	82	0,50	0,000	0,000
Site	Workshop	Source	Share in MPC	Share %		
0	0	2	0,07	100,00		
100	0	0,07	352	0,50	0,000	0,000
Site	Workshop	Source	Share in MPC	Share %		
0	0	2	0,07	100,00		
100	-100	0,06	356	0,67	0,000	0,000
Site	Workshop	Source	Share in MPC	Share %		
0	0	2	0,06	100,00		
200	100	0,05	236	0,67	0,000	0,000
Site	Workshop	Source	Share in MPC	Share %		
0	0	2	0,05	100,00		

Substance: 0337 Carbon Oxide

Site: 1

Maximum Concentrations Line

Coord. X(m)	Coord. Y(m)	Concentr. (MPC share)	Wind Direction	Wind Velocity	Background (MPC share)	Before excluding the background
1000	-700	0,10	308	0,53	0,099	0,100
Site	Workshop	Source	Share in MPC	Share %		
0	0	2	1,8e-4	0,18		
0	0	1	1,9e-5	0,02		
1000	700	0,10	234	0,53	0,099	0,100
Site	Workshop	Source	Share in MPC	Share %		
0	0	2	1,9e-4	0,19		
0	0	1	1,9e-5	0,02		
1000	-600	0,10	304	0,53	0,099	0,100
Site	Workshop	Source	Share in MPC	Share %		
0	0	2	2,0e-4	0,20		
0	0	1	2,0e-5	0,02		
1000	600	0,10	238	0,53	0,099	0,100
Site	Workshop	Source	Share in MPC	Share %		
0	0	2	2,0e-4	0,20		
0	0	1	2,0e-5	0,02		
900	-700	0,10	311	0,53	0,099	0,100
Site	Workshop	Source	Share in MPC	Share %		
0	0	2	2,0e-4	0,20		
0	0	1	2,1e-5	0,02		

Substance: 0410 მეთანი

Site: 1

Maximum Concentrations Line

Coord. X(m)	Coord. Y(m)	Concentr. (MPC share)	Wind Direction	Wind Velocity	Background (MPC share)	Before excluding the background

	100	100	9,5e-3	190	0,50	0,000	0,000
Site	Workshop	Source	Share in MPC	Share %			
0	0	2	9,5e-3	100,00			
	0	0	7,9e-3	82	0,50	0,000	0,000
Site	Workshop	Source	Share in MPC	Share %			
0	0	2	7,9e-3	100,00			
	100	0	7,5e-3	352	0,50	0,000	0,000
Site	Workshop	Source	Share in MPC	Share %			
0	0	2	7,5e-3	100,00			
	100	-100	6,0e-3	356	0,67	0,000	0,000
Site	Workshop	Source	Share in MPC	Share %			
0	0	2	6,0e-3	100,00			
	200	100	5,5e-3	236	0,67	0,000	0,000
Site	Workshop	Source	Share in MPC	Share %			
0	0	2	5,5e-3	100,00			

Substance: 1715 Methanethiol (Methyl Mercaptan)

Site: 1

Maximum Concentrations Line

Coord. X(m)	Coord. Y(m)	Concentr. (MPC share)	Wind Direction	Wind Velocity	Background (MPC share)	Before excluding the background
100	100	0,01	190	0,50	0,000	0,000
Site	Workshop	Source	Share in MPC	Share %		
0	0	2	0,01	100,00		
0	0	9,0e-3	82	0,50	0,000	0,000
Site	Workshop	Source	Share in MPC	Share %		
0	0	2	9,0e-3	100,00		
100	0	8,5e-3	352	0,50	0,000	0,000
Site	Workshop	Source	Share in MPC	Share %		
0	0	2	8,5e-3	100,00		
100	-100	6,8e-3	356	0,67	0,000	0,000
Site	Workshop	Source	Share in MPC	Share %		
0	0	2	6,8e-3	100,00		
200	100	6,3e-3	236	0,67	0,000	0,000
Site	Workshop	Source	Share in MPC	Share %		
0	0	2	6,3e-3	100,00		

Substance: 1728 Ethanthiol (Ethyl Mercaptan)

Site: 1

Maximum Concentrations Line

Coord. X(m)	Coord. Y(m)	Concentr. (MPC share)	Wind Direction	Wind Velocity	Background (MPC share)	Before excluding the background
100	100	8,6e-3	190	0,50	0,000	0,000
Site	Workshop	Source	Share in MPC	Share %		
0	0	2	8,6e-3	100,00		
0	0	7,2e-3	82	0,50	0,000	0,000
Site	Workshop	Source	Share in MPC	Share %		
0	0	2	7,2e-3	100,00		
100	0	6,8e-3	352	0,50	0,000	0,000

Site	Workshop	Source	Share in MPC	Share %
0	0	2	6,8e-3	100,00

	100	-100	5,4e-3	356	0,67	0,000	0,000

Site	Workshop	Source	Share in MPC	Share %
0	0	2	5,4e-3	100,00

	200	100	5,0e-3	236	0,67	0,000	0,000

Site	Workshop	Source	Share in MPC	Share %
0	0	2	5,0e-3	100,00

Maximum Concentrations and Shares by Substances (Calculation Sites)

Point Types:
0 – User Calculation Point
1 – Point at the protection zone border
2 – Point at the industrial zone border
3 – Point at the sanitary safety zone border
4 – Point at the settlement zone border
5 –At the building border

Substance: 0301 Nitrogen (IV) Oxide (Nitrogen Dioxide)

№	Coord. X(m)	Coord. Y(m)	Height (m)	Concentr. (MPC share)	Wind Direction	Wind Velocity	Background (MPC share)	Before excluding the background	Point Type
2	653	-16	2	0,06	272	2,54	0,062	0,094	3

Site	Workshop	Source	Share in MPC	Share %
0	0	1	5,5e-4	0,88
0	0	2	4,3e-5	0,07

4	-493	64	2	0,05	97	2,54	0,053	0,094	3

Site	Workshop	Source	Share in MPC	Share %
0	0	1	8,1e-4	1,50
0	0	2	4,0e-5	0,07

3	-10	-572	2	0,05	1	2,54	0,047	0,094	3

Site	Workshop	Source	Share in MPC	Share %
0	0	1	6,7e-4	1,41
0	0	2	2,4e-5	0,05

6	391	7	2	0,04	269	2,02	0,034	0,094	4

Site	Workshop	Source	Share in MPC	Share %
0	0	1	1,1e-3	3,08
0	0	2	9,8e-5	0,28

7	-331	-57	2	0,04	80	2,02	0,034	0,094	4

Site	Workshop	Source	Share in MPC	Share %
0	0	1	1,3e-3	3,65
0	0	2	6,7e-5	0,19

Substance: 0303 Ammonia

№	Coord. X(m)	Coord. Y(m)	Height (m)	Concentr. (MPC share)	Wind Direction	Wind Velocity	Backgroun d (MPC share)	Before excluding the backgroun d	Point Type
6	391	7	2	5,8e-3	274	0,89	0,000	0,000	4
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		5,8e-3	100,00				
7	-331	-57	2	3,8e-3	79	5,10	0,000	0,000	4
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		3,8e-3	100,00				
2	653	-16	2	2,6e-3	274	0,67	0,000	0,000	3
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		2,6e-3	100,00				
1	48	607	2	2,5e-3	176	0,67	0,000	0,000	3
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		2,5e-3	100,00				
4	-493	64	2	2,5e-3	94	0,67	0,000	0,000	3
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		2,5e-3	100,00				

Substance: 0333 Hydrogen Sulphide

№	Coord. X(m)	Coord. Y(m)	Height (m)	Concentr. (MPC share)	Wind Direction	Wind Velocity	Backgroun d (MPC share)	Before excluding the backgroun d	Point Type
6	391	7	2	0,01	274	0,89	0,000	0,000	4
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		0,01	100,00				
7	-331	-57	2	9,1e-3	79	5,10	0,000	0,000	4
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		9,1e-3	100,00				
2	653	-16	2	6,1e-3	274	0,67	0,000	0,000	3
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		6,1e-3	100,00				
1	48	607	2	5,9e-3	176	0,67	0,000	0,000	3
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		5,9e-3	100,00				
4	-493	64	2	5,9e-3	94	0,67	0,000	0,000	3
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		5,9e-3	100,00				

Substance: 0337 Carbon Oxide

№	Coord. X(m)	Coord. Y(m)	Height (m)	Concentr. (MPC share)	Wind Direction	Wind Velocity	Backgroun d (MPC share)	Before excluding the backgroun d	Point Type
2	653	-16	2	0,10	274	1,05	0,098	0,100	3
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		4,3e-4	0,43				
0	0	1		4,1e-5	0,04				

4	-493	64	2	0,10	94	1,05	0,098	0,100	3
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		4,1e-4	0,41				
0	0	1		6,3e-5	0,06				
3	-10	-572	2	0,10	9	1,05	0,098	0,100	3
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		3,9e-4	0,40				
0	0	1		4,3e-5	0,04				
6	391	7	2	0,10	273	1,05	0,097	0,100	4
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		9,6e-4	0,98				
0	0	1		8,6e-5	0,09				
7	-331	-57	2	0,10	80	5,10	0,097	0,100	4
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		6,5e-4	0,67				
0	0	1		9,1e-5	0,09				

Substance: 0410 Methane

№	Coord. X(m)	Coord. Y(m)	Height (m)	Concentr. (MPC share)	Wind Direction	Wind Velocity	Background (MPC share)	Before excluding the background	Point Type
6	391	7	2	1,5e-3	274	0,89	0,000	0,000	4
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		1,5e-3	100,00				
7	-331	-57	2	9,8e-4	79	5,10	0,000	0,000	4
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		9,8e-4	100,00				
2	653	-16	2	6,6e-4	274	0,67	0,000	0,000	3
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		6,6e-4	100,00				
1	48	607	2	6,4e-4	176	0,67	0,000	0,000	3
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		6,4e-4	100,00				
4	-493	64	2	6,3e-4	94	0,67	0,000	0,000	3
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		6,3e-4	100,00				

Substance: 1715 Methanethiol (methyl mercaptan)

№	Coord. X(m)	Coord. Y(m)	Height (m)	Concentr. (MPC share)	Wind Direction	Wind Velocity	Background (MPC share)	Before excluding the background	Point Type
6	391	7	2	1,7e-3	274	0,89	0,000	0,000	4
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		1,7e-3	100,00				
7	-331	-57	2	1,1e-3	79	5,10	0,000	0,000	4
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		1,1e-3	100,00				
2	653	-16	2	7,5e-4	274	0,67	0,000	0,000	3
Site	Workshop	Source		Share in MPC	Share %				

0	0	2		7,5e-4	100,00				
1	48	607	2	7,3e-4	176	0,67	0,000	0,000	3
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		7,3e-4	100,00				
4	-493	64	2	7,2e-4	94	0,67	0,000	0,000	3
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		7,2e-4	100,00				

Substance: 1728 Ethanethiol (Ethyl mercaptan)

№	Coord. X(m)	Coord. Y(m)	Height (m)	Concentr. (MPC share)	Wind Direction	Wind Velocity	Background (MPC share)	Before excluding the background	Point Type
6	391	7	2	1,3e-3	274	0,89	0,000	0,000	4
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		1,3e-3	100,00				
7	-331	-57	2	8,9e-4	79	5,10	0,000	0,000	4
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		8,9e-4	100,00				
2	653	-16	2	6,0e-4	274	0,67	0,000	0,000	3
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		6,0e-4	100,00				
1	48	607	2	5,8e-4	176	0,67	0,000	0,000	3
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		5,8e-4	100,00				
4	-493	64	2	5,7e-4	94	0,67	0,000	0,000	3
Site	Workshop	Source		Share in MPC	Share %				
0	0	2		5,7e-4	100,00				

15.1 Annex 3. Waste storage, transportation and disposal conditions,generated during construction and operation of the plant

№	Waste Title	Waste Management	Safety conditions during storage and transportation	Waste processing, burial or utilization conditions
1	2	3	4	5
1. Domestic Waste				
1.1.	Domestic and food waste	**Waste collection and delivery to DSWL [8]** • Collection and disposition of waste – in special containers placed in construction sites. • Removal from operation grounds by municipal trucks under agreement. * **DSWL** - **Domestic Solid Waste Landfill**	• It is prohibited to put 1, 2 and 3 hazard class waste in solid domestic waste containers, including luminescent bulbs, oily waste and others, those are not allowed for disposal to domestic solid waste landfill. • Solid domestic waste shall be transported to final disposal site by special vehicles to avoid pollution of environment.	Burial: According to sanitary and landfill operation rules. Responsibilry: contractor organization
1.2.	Paper and cardboard pieces, plastic bags			
1.3.	Crushed glass, rubber and plastic waste, used and defective incandescent bulbs			
1.4.	Swept waste, fallen leaves			
2. Hazardous class 3 and 4 waste allowed for disposal to domestic waste landfill				
2.1.	Broken roofing slates, asbestos-cement waste	**Waste collection and delivery to DSWL** • collection in the area of the production unit and disposal • broken roofing tiles, asbestos waste – to be packed in plastic bags and kept in enclosed open-air sites. • paronite, plastic and rubber pipes, glass fibre, foam plastic waste – within bounded open ground. • wood waste, chips – under shed or open areas covered with plastic. Delivery to domestic solid waste landfill using private transport.	It is pprohibited: • Placement of industrial waste in containers allocated for domestic solid waste. • Removal of 3 and 4 hazard class is done only following consent from the landfill management and availability of relevant 'control slip' • During transportation safety measures required to avoid pollution of environment must be put in place.	Burial: According to sanitary and landfill operation rules. Responsibilry: contractor organization
2.2.	Paronite, plastic and rubber waste			
2.3.	Paper and wooden packaging waste			
2.4.	Wood waste, chips			
2.5.	Plastic pipes, glass fibre, sandpaper, abrasive dust waste			
3. Industrial waste prohibited for disposal to domestic waste landfill				
3.1. Mercury containing and material waste:				
3.1.1.	Luminescent tube waste	**Collection - accumulation – removal to storage** • Collection on operation grounds: • Placement of used luminescent tubes in dry, integer packaging, which exclude the risk of any damage during transportation; • Damaged or broken lamps must be placed in plastic bags, tied up and placed in cardboard boxes. Premises – ventilated. • Accumulation of this type of waste on operation ground is prohibited.	• Burned out luminescent tubes, used or broken tubes containing mercury are replaced and collected by adequately trained staff. It is prohibited: • Storage in the open air; • Storage in open premises; • Storage unpacked; • Piling; • Placement on the ground; • Handing over to organization not authorized	Shall be delivered to temporary storage facility. Handed over to authorized contractor for subsequent utilization.

		• Delivery to the temporary storage facility is done on private vehicles in compliance with the completed document.	for processing of this type of waste. • During transportation of mercury containing lamps safety measures required to avoid pollution of environment must be put in place.	
3.1.2.	Mercury thermometer waste	**Collection - accumulation – removal to storage** • Accumulation on production sites in tight plastic bags and then in integer cardboard boxes; • Accumulation of this type of waste on operation ground is prohibited; • Removal – to temporary storage on the basis of necessary formal documents.	It is prohibited: • Placement of mercury thermometers in containers allocated for domestic solid waste disposal. • Storage in the open air and without packaging. • Litter around. • In case of damage and spillage of mercury treatment/neutralisation of premises must be carried put.	Shall be delivered to temporary storage facility. Handed over to authorized contractor for subsequent utilization.
3.2. Waste Chemicals				
3.2.1	Chemical salts and substances, medicine with with passed expiry date	**Collection - accumulation – removal to storage** • Collection – in tight plastic bags and then into undamaged boxes correspondingly labelled with weight and date indicated. • Storage – in premises with adequate ventilation. Relevant record made in register. • Removal to storage with appropriate documentation.	It is prohibited: • Disposal of chemicals in containers allocated for domestic solid waste disposal. • Storage in the open air and without packaging. • Litter around. • During transportation of waste chemicals safety measures required to avoid pollution of environment must be put in place.	Shall be delivered to temporary storage facility. Handed over to authorize contractor for subsequent utilization.
3.3. Lead Containing Waste				
3.3.1	Waste lead accumulators (not drained of accumulator acid)	**Collection - accumulation – removal to storage** • Accumulation – on maintenance site, in premises to be ventilated. • Collection – in premises to be ventilated, in wooden boxes placed on metal support. • Removal to waste storage based on relevant documents	It is prohibited: • Placement of accumulator waste in containers allocated for domestic waste disposal; • Disposal of accumulator acid into sewer. • Mechanical processing of accumulators. • Long-term storage on the spot of generation (>1 week).	Shall be delivered to temporary storage facility. Handed over to authorize contractor for subsequent utilization.
3.4. **Waste slightly contaminated with oil (oil content <15%)**				
3.4.1	Oily rags	**Collection - accumulation – removal for utilization** • Accumulation – in special labeled container, on the spot of generation. • Removal for utilization (incineration) under agreement with contractor	It is prohibited: • placement of oily waste in containers allocated for domestic waste disposal • Scattering around • During transportation safety measures	Handed over to authorized contractor for subsequent utilization.

			required to avoid pollution of environment must be put in place.	
3.4.2	Used oil filters	**Collection - accumulation – removal to storage** • Accumulation – on the spot of generation, in plastic bags placed in cardboard boxes • Removal to waste storage based on relevant documents.	It is prohibited: • Placement of oily waste in containers allocated for domestic waste disposal • Scattering around • During transportation safety measures required to avoid pollution of environment must be put in place.	Shall be removed to temporary storage. Handed over to authorized contractor for subsequent utilization.
3.5. **Waste Oil and Petroleum Products**				
3.5.1	Used industrial oils and lubricants	**Collection - accumulation – removal to storage** • Aaccumulation - on the spot of generation, in closed plastic or metal containers. • Removal to waste storage based on relevant documents.	It is prohibited: • Spillage of oil. • Disposal of waste oil into industrial-storm water drainage system, pouring on soil or disposal into water body.	Shall be removed to temporary storage. Handed over to authorize contractor for subsequent utilization.
3.5.2	Used transformer oils, which do not contain stable organic pollutant, in particular PCB	**Collection - accumulation – removal to storage** • Accumulation - on the spot of generation, in closed plastic or metal containers. • Removal to waste storage based on relevant documents.	It is prohibited: • Spillage of oil. • Disposal of waste oil into industrial-storm water drainage system, pouring on soil or disposal into water body. • Waste oil transportation with other materials or substances.	Shall be removed to temporary storage. Handed over to authorized contractor for subsequent utilization.
3.6. Plastic and rubber waste				
3.6.1	Waste tyres	**Collection - accumulation – removal to storage** • Collection – on the spot of generation in premises under solid cover. • Accumulation on site- not recommended. • Removal to waste storage based on relevant documents.	Burning of rubber articles is strictly prohibited.	
3.6.2	Waste laser printer cartridges	**Collection-disposal to SDWL*** • Accumulation - on the spot of generation, in plastic bags. • Accumulation – in long-term storage. • Removal – by their own vehicle	• Placement of used cartridges in containers allocated for domestic solid waste. • Removal of waste is done only following consent from the landfill management and availability of relevant 'control slip' During transportation safety measures required to	• Burial: According to sanitary and landfill operation rules. Responsibilry: contractor organization

		* **SDWL** – Solid Domestic Waste Landfill	avoid pollution of environment must be put in place.	
3.7. **Medical Waste**				
3.7.1	Used cotton wool and syringes.	**Collection - accumulation – removal for utilization** • I plastic bags, on the site of generation. • Removal for utilisation (incineration) under agreement with contractor.	It is prohibited to dispose medical waste in containers allocated for domestic waste or scattering around.	Utilization is carried out by contractor organization
3.7.2	Expired medical supplies			
3.8. Waste paint and paint cans		**Collection - accumulation – removal to storage** • Collection – in wooden boxes, on the spot of generation. • Accumulation – on the spot of generation, in closed premise or under a shed on solid base, until completion of works. • Removal - to long-term waste storage facility based on relevant documents.	It is prohibited: • Placement of paint and metal drums in containers allocated for domestic waste disposal. • Scattering/spilling around.	Shall be removed to temporary storage. Handed over to authorized contractor for subsequent utilization.
3.9. Waste metal				
3.9.1	Scrap metal	**Collection - accumulation – removal to storage** • Collection – within specially allocated area on the spot of generation. • Accumulation - within specially allocated area on the spot of generation until completion of maintenance works. The area must be sloped towards industrial-storm water collector well. • Removal – to long-term waste storage based on relevant documents	It is prohibited: • Placement of metal waste in containers allocated for domestic waste.	Shall be removed to temporary storage. Handed over to authorized contractor for subsequent utilization.
3.9.2	Waste welding electrodes	**Collection - accumulation – removal to storage** • Collection – on the spot of generation. • Accumulation – in metal drums or wooden boxes, on the spot of generation up to completion of maintenance works. • Removal – to waste storage based on relevant documents.	It is prohibited: Placement of metal waste in containers allocated for domestic waste.	Shall be removed to temporary storage. Handed over to authorized contractor for subsequent utilization.
3.10. Wood Waste				
3.10.1	Wooden pieces	**Accumulation – removal by private persons** ・Collection – in situ, at certain places ・Removal – delivery to pre-agreed place using the company's or rented vehicles	It is prohibited: • Placement of wood waste in domestic waste containers	Handed over private persons on contractual basis or terms established by the company

3.11. **Waste heavily contaminated with oil**				
3.11.1	Contaminated soil and sand	**Collection – accumulation – removal of petroleum-contaminated soil to temporary storage** ・Collection – in metal tanks (on the spot of generation). ・Accumulation - on the site of generation is not recommended. ・Placement – in temporary storage of petroleum-contaminated soil, based on relevant documents	It is prohibited: • Placement on soil or open ground. • Discharge into collecting system. • Pouring on the ground or discharge into the water body. • During transportation –spill prevention measures put in place.	• Is subject to removal to temporary storage of contaminated soil. • Is subject to remediation
3.12.	**Solid Waste Generated on the WWTP Shield System Screens and Extracted Activated Sludge**			
1.12.1.	Solid Waste Generated on the Screens	**Collection – accumulation – removal by authorized contractor** • Collection on plant site in special containers; • Accumulation in situ is not recommended; • Disposal on domestic waste landfill possessing environmental permit.	It is prohibited: • Placement on soil or open ground. • Discharge into collecting system. • Pouring on the ground or discharge into the water body. • During transportation –spill prevention measures put in place.	• To be handed for further utilization to authorized organization having appropriate permit; • Disposal on domestic waste landfill possessing environmental permit.
1.12.2.	Extracted Activated Sludge	**Extraction – dewatering – removal by authorized contractor** • After dewatering, placement in special closed containers; • Accumulation on WWTP site is not recommended; • Composting and re-using in agriculture as the fertilizer is possible.	It is prohibited: • Placement on soil or open ground. • Discharge into collecting system. • Pouring on the ground or discharge into the water body. • During transportation –spill prevention measures put in place.	• To be handed for further utilization to authorized organization having appropriate permit; • Subsequent management – composting or disposal on the landfill possessing special permit.

15.2 Annex 4. Emergency Response Plan

15.2.1 Emergency Response Plan Aims and Objectives

The aim of Emergency Response Plan is to establish and define guidelines for personnel of Wastewater Treatment Plant construction and operation, in order to ensure managing activities of the people and other personnel engaged in any large-scale technogenic incidents and accidents, and other emergency situation response and liquidation process in a reasonable, coordinated and effective way, to protect personnel, population and environment security.

The objectives of Emergency Response Plan are:

- To define types of expected emergency situations considering the specification of planned works during work implementation (WWTP construction and operation);
- To define the staff, equipment, emergency response plan and responsibility for each emergency response team; ;
- To define internal and external communication systems, their consiquence, communication ways and methods and to ensure notification (information) about emergency situations;
- Prompt activation of internal resources and mobilization of additional resources under established rules, if necessary, and to determine appropriate procedures;
- To provide emergency response management system;
- To provide compliance with legislative, regulatory and industrial safety bylaw requirements during emergency response process.

Emergency Response Plan envisages requirements of Georgian laws and legislative acts.

15.2.2 Types of Emergency Situation expected during project implementation

Considering specificities of planned activities, following types of emergency situations are expected:

- Fire / explosion;
- Spill of hazardous substances, including oil spill;
- Accidental damage of WWTP and accidental discharge of untreated wastewater;
- Personnel traumatism and incidents related to their health safety;
- Traffic accidents;
- Emergency situations of natural character (marginal weather conditions, earthquake, flood, etc.).

It is noteworthy, that emergency situations, listed above, may be subsequent and development of one emergency situation may initialize another one.

15.2.2.1 Fire/Explosion

Risk of fire eruption-propagation and explosion occurs both during construction and operation phases. The main factor of accident may be anthropogenic, namely: indifference of personnel and violation of safety norms, violation of storage rules for fuels, oils and other explosive substances and etc. However, fire and explosion may also be caused by the natural disaster (e.g. earthquake).

Subsequent process of fire/explosion may be:

- Salvo emission/spill of hazardous substances;
- Traumas of personnel or population and accidents related to their health.

15.2.2.2 Salvo Spillage of Hazardous Substances including Oil Products

Oil spill risk may be related to a violation of the conditions of their storage, fuel or oil leakage from vehicles and equipment and so forth during construction and operation process of the plant. This may cause hazardous substance spillage and spreading in the soil and water.

Sensitive districts, where hazardous substances spill may occur are construction camps and all construction sites, where machinery and other equipment are intensively used.

High-risk areas during the operation phase are oil products and other hazardous materials storage areas.

Subsequent processes of such emergencies may be:

- Fire/explosion;
- Poisoning of personnel or population.

15.2.2.3 WWTP Damage and Accidental Discharge of Wastewater

During WWTP operation process the reason of accidental discharge of wastewater may be technical malfunctioning, inadequate attention of the staff or insufficient knowledge, natural disasters, etc.

In case of accidental discharge of wastewater, Chkhoushi River will be severely polluted, which will be especially active for tourist season.

The main mitigation measure to minimize negative impact on the environment, is the prevention of WWTP accidental damage, and in case of emergency situation, immediate repairing of the damaged treatment plant. Besides, one of the mitigation measures can be using reservoir volumes of the treatment plant and pumping station of sewer for temporary retention of the wastewater. In low season the wastewater retention in the reservoirs is possible for about 12-24 h, while in the high season only for 1,5-2,5 h.

15.2.2.4 Personnel Traumatism and Risks Related to their Health Safety

Except incidents related to other emergency situations, personnel traumatism may also be related to:

- Incidents related to heavy machinery/equipment used for project implementation;
- Fall from large heights;
- Poisoning with used chemical substances;
- Electric shock, during working near aggregates under high voltage.

15.2.2.5 Traffic Accidents

Trucks and heavy machinery will be used during construction works. During their movement on public and access roads, following are expected:

- Collision with transport means, real estate or livestock of local population;
- Collision with local population;
- Collision with project personnel;
- Collision with other project machinery;
- Collision with local infrastructure facilities;

As a rule, during operation of the plant the intensive transport operations are not planned, so traffic accident risks will not be high.

Subsequent possible processes of emergencies may be:

- Fire/explosion;
- Traumatism and incidents related to the health issues of personnel or population.

15.2.2.6 Emergency Situation of Natural Character

During work implementation, it is very important to provide timely, proper and orderly response on emergency situations of natural character, as the natural disaster may be the foregoing factor of any of the above-listed emergency situations.

15.2.3 General Preventive Measures for Different Emergency Situations

Preventive measures for fire/explosion:

- Periodical training and testing of personnel on fire prevention issues;
- Storage of easily flammable and explosive substances at safe places. Installation of corresponding warning signs at their warehouses;
- Implementation of fire safety rules and arrangement of functional fire-fighting equipment at the territory;
- Implementation of electricity safety rules; Arrangement of lightning conductors in open substations and monitoring their functionality.;
- During operation inadvertently scattered fire-hazardous, flammable substances should be carefully collected and placed in a waste box. Places where there were remains of fire-hazardous substances or where these substances were spread, must be thoroughly cleaned until removal of the debris.

Preventive measures for hazardous substance spill:

- Strict supervision over implementation of fuel and chemicals' storage and use terms. Fitness of storage vessel must be checked before storing;
- The technical functionality of oil containing equipment should be periodically monitored;
- Termination of works / suspension of equipment and machinery operation and implementation of maintenance work after detection of minor spill, so that incident would not become large-scale.

Preventive measures for WWTP damage and accidental discharge of wastewater:

- Systematic control of the technical functionality of the plant and following operation rules;
- Periodical training and testing of personnel on technical safety issues;
- Periodical training and testing of personnel on environmental issues;
- Scheduled and if necessary current repairing of technological systems of the plant;
- Promptly correction of technical failure causing emergency situations.

Preventive measures for personnel traumatism/injury:

- Periodical training and testing of personnel on labor safety issues;
- Provision of personnel with individual protection equipment;
- Dangerous place should be fenced and warning signs should be arranged within the dangerous zones, easily visible at night (at night, besides the fencing, it is necessary to install lightning around the excavations);
- Personnel must be insured by special ropes and cartridges during implementation of high elevation works;
- In appropriate places arrangement of medical boxes;
- Arrangement of warning signs and safety lightning in dangerous places;
    - Safety lightning should provide minimal illumination of the work surface, within the 5% of work surface normalized illumination meaning and less than 2 luxes inside and 1 lux outside of the building perimeter;
- Preparation of special staff, which will control implementation of safety norms at construction sites and will register facts of violation

Preventive measures for traffic accidents:

- Any vehicle should go through technical inspection prior to the starting the works. Especially the brakes should be checked. Dumpers will be checked for functionality of body lifting mechanism;
- Selection of optimal transport movement routes and speed restrictions (the speed of transport movement should not exceed on straight sections – 10 km/h, and on turnings – 5 km/h);
- It is prohibited working of excavators, cranes and other machinery under any voltage, transmission lines.
- Loading ground on vehicles is permitted only from the side or back of the board;
- Material for concrete trenching -silos, grits, and ladle must be equipped with shutters, preventing accidental giving out of the mixture. Concrete discharge height should not exceed 1.0m. In case of exceeding 30^0 of inclination of the surface, that has to be concreted, works are carried out in the using protecting belt;
- Improvement of temporary and permanent access roads and their maintenance throughout the whole cycle of the project;
- Installation of warning, prohibiting and pointing road signs at access roads and construction camps;
- During movement of special and oversized machinery they should be escorted by specially equipped machinery and trained experienced personnel.

15.2.4 Approximate Scale of Incidents

Considering the expected emergencies, liquidation resources and legislative requirements during construction and operation of the plant, accidents and emergency situations are sorted according 3 main levels. Table gives description of emergency situations according to their level, indicating corresponding reaction.

Table 14.3.4.1. Description of Emergencies according to their Levels

Accidents	Level		
	I level	II level	III level
General	The internal resources are sufficient for emergency liquidation	External resources and workforce are needed for emergency liquidation	Involvement of regional and country resources for emergency liquidation
Fire /Explosion	Local fire, which does not need any external interference and is easily controlled. The meteorological conditions are not conductive to the rapid spread of the fire. There are no inflammable and explosive sections/ warehouses and materials.	Comparatively large fires, which spread quickly due to the weather conditions. There are inflammable/explosive areas/ warehouses and materials. It is necessary to call the local fire squad.	A large fire, which spread rapidly. The ignition risk of surrounding neighbourhoods and provocation of other emergencies is high. The approach to the territory is complicated. The inclusion of the regional fire service for the liquidation of the incident is necessary.
Hazardous substance spillage	Local spillage, which does not need external interference and can be eliminated with internal resources. The risks of spreading of the substance on large areas and river contamination do not exist.	Large spills (spills of hazardous substances 0.3 tons to 200 tons). There are risk of substance spreading in the area and the risk of the river pollution.	Large spills (more than 200 tons). As during construction and operation, use and storage of hazardous substances in large amount is not planned, III level emergency risks are minimal.
WWTP damage and accidental discharge of wastewater	Damage of technological units of the plant, which can easily be repaired in a short period of time.	Damage of plant tanks and technological pipelines, which will be connected with the long-term discharge of wastewater without treatment	-
Personnel injury / Traumatism	• One incident of traumatism; • Light fracture, bruises; • I degree burns (skin surface layer damage); • Assistance to injured personnel and the liquidation of the incident is possible by on-site medical service.	• Individual cases of traumatism; • Severe fracture - a fracture of the joints of the middle; • II degree burns (deep layer of the skin lesions); • There is the need to move injured personnel to the local medical facility.	• Several traumatic accidents; • Severe fracture - Articular fracture etc.; • III and IV degree burns (skin, hypodermic tissues and muscle lesions); • There is the need to move injured personnel to the regional or Tbilisi medical service centres with relevant profile.
Traffic Incidents	The damage of equipment, vehicles, infrastructure and non-valuable items. Human health is not in danger.	The damage of the equipment, vehicles, infrastructure and valuable objects. There is the threat to human health or II level traumatism is registered.	The damage of the equipment, vehicles, infrastructure and highly valuable objects. There is the high risk of development of other emergencies. There is the threat to human health or III level traumatism is registered.
Emergency of natural character	Natural phenomenon, that is characteristic to the region on a seasonal or occasional basis (heavy rain, snow, and flood). It is necessary to provide standard measures, to ensure security of machinery and human health.	Natural phenomenon, the scale of which is unusual for the region. The damage is posed to the stability of structures and security of machinery. It is necessary to eliminate the risk in the shortest period, in order to prevent provocation of other emergencies. Additional resource engagement is recommended.	Very dangerous natural phenomenon, for e.g.: earthquake and others, that poses a danger to the stability of structures and safety of machinery. The personnel or population security risks are high. It is necessary to call for regional and central rescue teams to response emergency situation.

Note: Considering the specification of the planned works and project area location, , the anticipated emergency situations will be mainly of I levels and less likely of II level.

15.2.5 Emergency Situation Response

15.2.5.1 Response on Fire

The strategic actions of the person and the personnel working in the vicinity, who detected fire or smoke, are as follows:

- Termination of works on every site, except for safety measures;
- Assessment of the situation, reconnaissance of fire hearth and adjacent territories;
- Withdrawal of the equipment-devices from the areas, where the fire spreading is possible;
- Electrical equipment should be turned out from the circuit;
- In case if fire is strong and it is hard to approach the fire hearth, some kind of fire or explosive hazardous sites/substances are located adjacently, then:
  - Get away from the danger zone:
  - During evacuation follow indications of the evacuation plan/billboards of the building;
  - If you need to cross smoky space, lean down as the air is the freshest near the floor, put wet piece of cloth on your mouth and nose;
  - If you cannot evacuate because of the inflamed exit, call loudly for help;
  - Inform senior manager/operator about the accident;
  - Wait for emergency service and when they appear, inform them about the fire reasons and the situation in the vicinity of fire hearth;

- In case if the fire is not strong, the fire hearth is easily approachable and getting near to it is not dangerous for your health. At the same time, there are certain risks of fire distribution on adjacent territories, then, act as follows:
  - Inform senior manager/operator about the accident;
  - Search for the nearest fire stand and supply yourself with necessary fire inventory (fire extinguisher, axe, crowbar, bucket and etc.);
  - Try to liquidate fire hearth with fire extinguisher, in accordance with the instruction shown on the fire extinguisher;
  - In case if there is no fire stand on the site, use sand or water for fire hearth liquidation or cover it with less flammable thick cloth;
  - In case if the electrical equipment turned into the circuit are near the fire hearth, it is prohibited to use water;
  - In case of fire in the closed space, do not window the room (except for special needs), because the fresh air supports fire and fire scale growth.

Strategic actions of site manager/chief operator in case of fire:

- Gathering detailed information on fire hearth location, existing/stored devices-equipment in the vicinity and substances;
- Inform personnel and fire service;
- Visiting the accident place and reconnaissance of the situation, risks analysis and assessment of expected fire scales (I, II or III scale);
- Ask whole personnel to use vehicles and fire extinguishing equipment;
- Controlling and managing the personnel actions.

Strategic actions of work manager/chief of the facility in case of fire:

- Inform the fire service;
- With H&SE officer monitor internal personnel activity and manage hem until local and regional fire teams will arrive (after that fire team head manages the staff) ;
- Support fire team activity (additional equipment which is not on the site may be needed, etc.);

- To carry out liquidation measures after elimination of the incident with H&SE officer;
- Preparing the report and deliver to the executor company/operator company;

In case of landscape fire, emergency service is participating in fire liquidation measures. As well as involving WWTP personnel and local population in case of necessity. During forest fire extinguishing, except for the above listed instruction, also are used the following basic approaches:

- Forest fire lower boundaries sweeping with green branches, brooms and bag cloths;
- On the low fire boundaries of the forest, throwing ground with shovels and spades;
- Blocking line or channel arrangement to stop the fire distribution;
- Inhibiting channel arrangement must take place in direction of construction camps, construction sites and in direction to the territories where easily flammable and explosive substances are disposed, in case of fire distribution risks.

15.2.5.2 Response on Spillage of Hazardous Substances

This section discusses only I and II scale emergency response strategy. The types of hazardous substances spill response are significantly determined by ground surface, also, the initial condition. Consequently, emergency response is presented for the following scenarios:

- Hazardous substances spill on impervious surface (asphalt, concrete cover);
- Hazardous substances spill on pervious surface (ground, gravel, vegetation)
- Spill of the hazardous substances in the river.

In case of hazardous substances (mainly oil products) spill on the impervious surface, it is necessary to implement the following strategic actions:

- Inform other personnel or rescue team;
- Stopping every device-equipment working on the site;
- Blocking the pollution source (if any);
- Ask personnel to mobilize equipment and personal protection means for emergency response;
- Block the entrances of household-fecal sewage systems (lids of wells);
- In case of necessity, it is necessary to arrange barriers with suitable impervious material (sand bags, plastic sheets, plastic coat and others) in such way, that it will stop spilled material or limit its movement;
- Barriers must be arranged in shape of horseshoe, so that the open side will be directed to meet the substances flow;
- Gather the spilled oil products by using brooms and linens;
- For drying in the spilled substances, absorbent pads usage is necessary;
- Gather the oil products in such way, that it will be possible to collect them in container and then remove;
- After absorption of the oil, these pads should be placed in polyethylene bags (if needed, these pads might be reused);
- The site should be completely cleaned from residual oil products, in order to exclude the wash-off of the pollutants by the rain water;
- After completion of cleaning operations, every cleaning material must be collected, wrapped and warehoused in relevantly safe areas.

In case of hazardous substances spill on the pervious surface, it is necessary to implement the following strategic actions:

- Information transfer to other personnel and emergency service;

- Stopping every device-equipment working on the site;
- Ask personnel to mobilize equipment and personal protection means for emergency response;
- Block the entrances of household-fecal sewage systems (lids of wells);
- Absorbents should be placed together in such way to create continuous barrier (fence) in front of the edge of moving oil products. Ends of the barrier must be folded in front, so that it will have a shape of a horseshoe;
- Spilled oil products containment place must be covered with polyethylene membrane sheets, in order to prevent the oil occurrence in the lower layers of soil;
- It should be noted, that if it is not available to lay down the polyethylene sheets, then the barrier arrangement will cause the oil accumulation on one place, which in turn will cause soil saturation with oil and oil products occurrence in the lower layers;
- For drying in the spilled substances, absorbent pads usage is necessary;
- Gather the oil products in such way, that it will be possible to collect them in container and then remove;
- After absorption of the oil, these pads should be placed in polyethylene bags (if needed, these pads might be reused);
- The site should be completely cleaned from residual oil products, in order to exclude the wash-off of the pollutants by the rain water or reaching the lower layer of the soil;
- After completion of cleaning operations, every cleaning material must be collected, wrapped and warehoused in relevantly safe areas.
- Processing of vegetation and upper layer of the soil on existing on the ground surface must begin right after removal of the pollution source or after stopping the leakage;
- When the whole spilled oil products will be cleaned, removal and remediation works implementation must start under supervision of construction works manager/head of the facility and invited specialists with a relevant competence.

In case of oil products spill in the river or drainage channels, it is necessary to implement the following strategic actions:

- Information transfer to the other personnel or emergency service;
- Information of population living downstream the river about the spill;
- Stop every device-equipment working on site;
- Blocking the pollution source (if any);
- Ask personnel to mobilize the necessary equipment for emergency response and personal protection means;
- Clear the vegetation existing on the river bank with the scythe;
- Immediately fence the polluted section of the river with wood boards. In case of additional necessity, usage of ground filled bags is available;
- Removal of oil products gathered on the river surface must be carried out with sanitation vehicles;
- Absorbent pads must be used for drying the oil products spilled on the soil;
- After absorption of the oil, pads must be placed in polyethylene bags for waste.

15.2.5.3 Response on WWTP Damage and Wastewater Accidental Discharge

WWTP damage and accidental discharge risks can be represented as the I and II emergency situation levels. In the first case, it will be possible to solve emergency situation in a short period of time by plant personnel, and in the second case, emergency service may be needed.

One of the measures of emergency response is its timely liquidation and elimination wastewater discharge into Chkhoushi River. There are no reducing measures for river water pollution quality during emergency situation. The water will be treated by self-treatment process.

15.2.5.4 Response during Accidents Related to Human Injuries and Incidents Related to Their Health and Safety

The person, who is taking care of injured person, must notify ambulance about an accident as a first action. Before the rescue will appear, injured person must receive first aid service in accordance with the tactics given below in following chapters. Before carrying out medical service, it is necessary to assess the situation and determine if approaching and helping an injured person might create some threat.

15.2.5.4.1 First Aid during Bone Fracture

Open and closed bone fractures are being distinguished:

- For the open fracture is characterized the violence of skin cover integrity. In this case, there is wound and bleeding in the damaged area. There is a high risk of infection in case of open fracture. In case of open fracture:
  - Promptly call helper, so that helper will immobilize the damaged area of the injured person, while you will process the wound;
  - Cover the wound with clean cloth and directly press on it to stop the bleeding. Do not press directly on broken bone fragments;
  - Without touching the wound with fingers, surround the damaged area with a clean cloth and fit ix;
  - If the broken bone fragment is seen in the wound, place the soft cloth around the bone fragment in such way, that the cloth will not be removed and the bandage would not impact on bone fragments. Fix the bandage in such way, that it will not disrupt the blood circulation below the wrapped place;
  - Carry out a broken bone immobilization, in the same way as during covered fracture;
  - Check pulse, capillary filling and sensitivity below the wrapped place once in every 10 minutes.
- We are dealing with a closed fracture, if the skin integrity is not damaged in the injured area. In this case, haemorrhage and edema are observed in the injured area. In case of closed fracture:
  - Ask injured person to stay still and fix the damaged part of the fracture above and below it by hand, before it will be immobilized (fixed);
  - For a good fixation, fix the injured part of the body on uninjured part. If the fracture is on the hand, fix it on the body with triangle bandage. If the fracture is on the leg, fix the damaged leg on another leg;

Check pulse, sensitivity and capillary filling below the wrapped place once in every 10 minutes. If the blood circulation or sensitivity is reduced, make a less tight bandage.

15.2.5.4.2 First Aid during Wounds and Bleeding

There are three types of bleeding:

- There is a little blood. In this case there is infection risk:
  - Clean the wound of injured person with any colourless liquid suitable for drinking;
  - Wrap the wound with clean cloth.
- There is a lot of blood. In this case there is a risk of blood loss:
  - Cover the wound with several layers of cloth and make press bandage;
  - If the blood is still leaking, tight the cloth to the wound again (do not take of the blood-drenched cloth) and strongly press on blood source area.

- The blood is pouring like a fountain from the wound. In this case the blood loss is very fast. In this case you must push finger (or fingers) on the artery projection area to avoid this and then put a bandage.

The areas of load on the artery are: the lower third of an arm and upper third of the thigh. The bandage should be fixed like this:

- The bandage is fixed only in extreme case, because often it leads to irreversible damage;
- The bandage is fixed above wound;
- The location where the bandage will be fixed must be covered with cloths. If the wound area is bare, we should place clean cloth under the bandage;
- First bandage must be tight (fixed as possible), then the bandage is getting tight and in addition placed 3-4 times (rope, belt and etc. can be used instead of bandage);
- The bandage should be fixed for 1 hour in winter and for 2 hours in summer. Then we should release and after 5-10 minutes fix it slightly above from the original location;
- Check if the bandage is properly fixed – if it is properly fixed, there should be no pulse on limb;
- What we should not do;
- Do not put a hand in the wound;
- Do not take anything from the wound. If some foreign body is seen in the wound, we should try to maximally fix it (put a bandage around this body).

- Internal bleeding is hardly determinable damage. Suspect internal bleeding, when the shock signs are observed after getting injured, but there is no significant blood loss. In case of internal bleeding:
  - Lay injured person on his back and rise his legs up;
  - Release tight clothes on neck, chest, waist;
  - Do not give food, medicine or drinks to injured person. If injured person is conscious and is very thirsty, just wet his lips;
  - Warm injured person – cover with blanket or cloth;
  - Check the pulse in every 10 minutes, as well as breathing and consciousness. If the person is losing mind, place him in safe location.

15.2.5.4.3 First Aid in Case of Burn

The burn might be developed by hot objects and steam impact (thermal burn), by chemical substances impact on the skin (chemical burn), electricity impact (electrical burn). In order to properly carry out first aid, you must determine the degree of burn, which depends on damage depth and damage area (on what part is the burn distributed).

The first aid measures during the burn are:

- It is dangerous to breath in the smoke, so if there is a smoke in the room and it is not available to air quickly, remove the injured person on a safe place, on a fresh air;
- If the clothes are burning on the person, do not start to roll his body, pour the water on the body (in case of electrical burning, usage of water next to the equipment in the circuit, is prohibited);
- If there is no possibility to use water, cover the body with non-synthetic cloth;
- It is necessary to start cooling the burnt area in time with cold water (in case of I and II scale burn, water it for 10-15 minutes, in case of III and IV scale burn wrap it with clean wet cloth and then cool it in the stable water in such wrapped conditions);
- Remove the cloth and other objects, from the damaged area, which may interrupt blood flow. Do not remove cloth pieces, which are stick to the damaged area;

- Cover the damaged area with sterile wrapping. This would reduce the likelihood of infection;
- Breathing in a hot air is possible when burnt, which leads to the burning of respiratory tracts. If the victim has hard noisy breathing, facial or neck burn, singed hair cover of face and nose, swelled mouth and lips, swallowing difficulty, cough, hoarseness voice – suspect the respiratory tracts burn and wait for the medical service;
- Constantly check breathing and pulse before the medical service will come, be ready to carry out reanimation measures;
- It is not allowed to take off the clothes particles from the burnt skin, cause this may lead to the deepening of the damage;
- It is not allowed to destroy the integrity of blebs, because the skin cover is damaged and it makes a favourable conditions for the invasion of infection in the body;
- Do not use ointments, lotions or oils for processing the damaged parts;
- It is prohibited to process the chemical burn areas with neutralizing solutions/ For example, alkaline caused burn treatment with acid.

15.2.5.4.4 First Aid in Case of Electrical Trauma

There are three types of electrical trauma:

- The trauma caused by high-voltage electricity. The damage developed as a result of high voltage traumas, are fatal in most cases. Severe burns are being developed at this time. Due to the strong muscle compression the injured person is often threw away on a significant distance, which leads to serious injuries. In case of high-voltage power trauma:

  - It is prohibited to get close to the injured person, before the electricity will be turned off and if necessary, the isolation will be made. Remain 18 m radius safe distance. Do not let other witnesses to approach the injured person;
  - After receiving electric trauma, as soon as approaching the injured person, open the breathing ways without moving head back, by moving the lower jaw in front;
  - Check breathing and circulation signs. Be prepared to make reanimation measures;
  - If the injured person is unconscious but is breathing, place him in a safe location;
  - Carry out first aid in case of burns and other injuries.

  The electrical trauma caused by low-voltage electricity. Low-voltage electricity trauma may turn into serious damages and even death reason. Often, this kind of electrical trauma is caused by damaged plugs, wiring and equipment. When standing on a wet floor or touching undamaged electrical wiring with wet hands, the risks of getting the electrical trauma are sharply increasing. In case of low-voltage power caused trauma:
  - Do not touch the injured person, if he is touching the power source;
  - Do not use metal object for removing the power source;
  - If you are able, stop power supply (turn off the power switch). If it is not available, turn off the electrical equipment from the power source;
  - If you are not able to switch off the electricity, then stand on dry insulation thing (for example: a plank of wood, on rubber or plastic pad, on book or pile of newspapers);
  - Remove the victim's body from the power source by broom, stick, and chair. You can move the victim's body away from the power source, or vice versa, the power source away from the body, if it is more convenient;
  - Without touching the body of injured person, tie a rope around his foot and shoulders and move away from the power source;
  - At least, grab the injured person in dry not-tight cloth and move him away from the power source;

- If the victim is unconscious, open the airways, check the breathing and pulse;
- If the victim is unconscious, is breathing and has a pulse, place in a safe location. Cool the burned areas and wrap it;
- If the visible injuries are not seen on the victim and he feels good, advice to take a rest.

- The electrical trauma caused by lightning/thunder:

Various traumas, burns, face and eyes damage is often by the electrical trauma. Sometimes the lightning may cause a sudden death. Quickly move damaged person from the place of the accident and serve with first aid as in case of different type of the electrical trauma.

15.2.5.5 Response on Traffic Incidents

During the accident of road transport, it is necessary to implement the following strategic actions:

- To stop vehicles/equipment;
- Transmission of information to the appropriate services (police, emergency medical service);
- In case if there is no danger for human health and there are no risks of provoking other emergency situations (for example: collision of other vehicles, explosion, fire, oil spill, or others), then:
  - Get out of the vehicle/equipment or get away from the accident place and stand on a safe distance;

Wait for the police/rescue team to come.

- In case of further threats, act as follows:
  - Get out of the vehicle/equipment or get away from the accident place and stand on a safe distance;
  - In case of fire, oil spill, act in accordance with the strategy given in the relevant paragraphs;
  - In case if there is a threat on the health of a person, do not try to move the body;
  - If the injured person is lying in the middle of the street, cover him with something and confine the accident location, so that it will be seen from a distance;
  - Remove everything from him, which might be making asphyxia (belt, scarf);
  - Provide first aid to the injured in accordance with the first aid strategy given in the relevant paragraphs (but remember, by extra movement of the injured person, you might create additional risks to his health).

15.2.5.6 Response on Emergencies of Natural Character

15.2.5.6.1 Response in Case of Earthquake

Response on earthquake begins promptly after the very first pull is felt, if earthquake is weak, stay where you are and do not panic. After the staff feel safe, it should act according the following strategy:
• Ask all personnel to switch off all construction equipment, machinery, construction and operation with appropriate sequence;
• Prior appearing the rescue team, operation manager/ chief of the facility leads the earthquake result liquidation measures following the strategy:

- To take injured people out of the ruins and save those you get into partly destroyed and inflamed building;
- Liquidate and eliminate emergencies of those technological lines, which pose a threat to human life;
- Easily inflammable and explosive materials should be removed from dangerous zones;

- Reinforcement or compulsory destruction of building and structures in dangerous condition;
- It is prohibited during emergencies, without necessity, to walk on ruins, go into destroyed buildings, be near them when there is the threat of their further demolition, ,
- In case of getting in heavily smoky and blocked buildings, it is necessary to fasten the rope around the waist, the end of which will be in the hand of a person, who will be standing in the entrance;
- It is necessary to use personal protection equipment during rescue and liquidation operations.

15.2.5.6.2 Response on Sudden Case of Flooding

Personnel being near natural disaster, should act using following strategy:

- Provide immediate evacuation from dangerous zone in case of threat;

After the staff feel safe, it should act according the following strategy:

- If necessary ask personnel to switch off all construction devices and machinery, as well as switching off devices operating during operation of the plant with appropriate consequence;
- Prior appearing the rescue team, operation manager/ chief of the facility leads the earthquake result liquidation measures with the following strategy:
  - To take personnel out of dangerous zone;
  - Easily inflammable and explosive materials should be removed from dangerous zones;
  - სამაშველო და It is necessary to use personal protection equipment during rescue and liquidation operations.

15.2.6 Equipment Necessary for Emergency Response

In process of construction and operation, in terms of accident development, the standard equipment must exist on high risk sites, namely:

Personal protection means for emergency response: on construction stage – on construction camps; on operation stage – in special room in power house. Personal protection equipment is:

- Helmets;
- Safety glasses;
- Uniforms with reflective stripes;
- Waterproof boots;
- Gloves.

Fire extinguishing equipment:

- Standard fire extinguisher:
- Buckets, sand, shovels and etc.;
- Properly equipped fire stands;
- Fire truck – the local fire fighters team truck will be used.

Emergency medical service equipment:

- Standard medical boxes;
- Ambulance car – the ambulance car of local medical center will be used.

Spill response equipment:

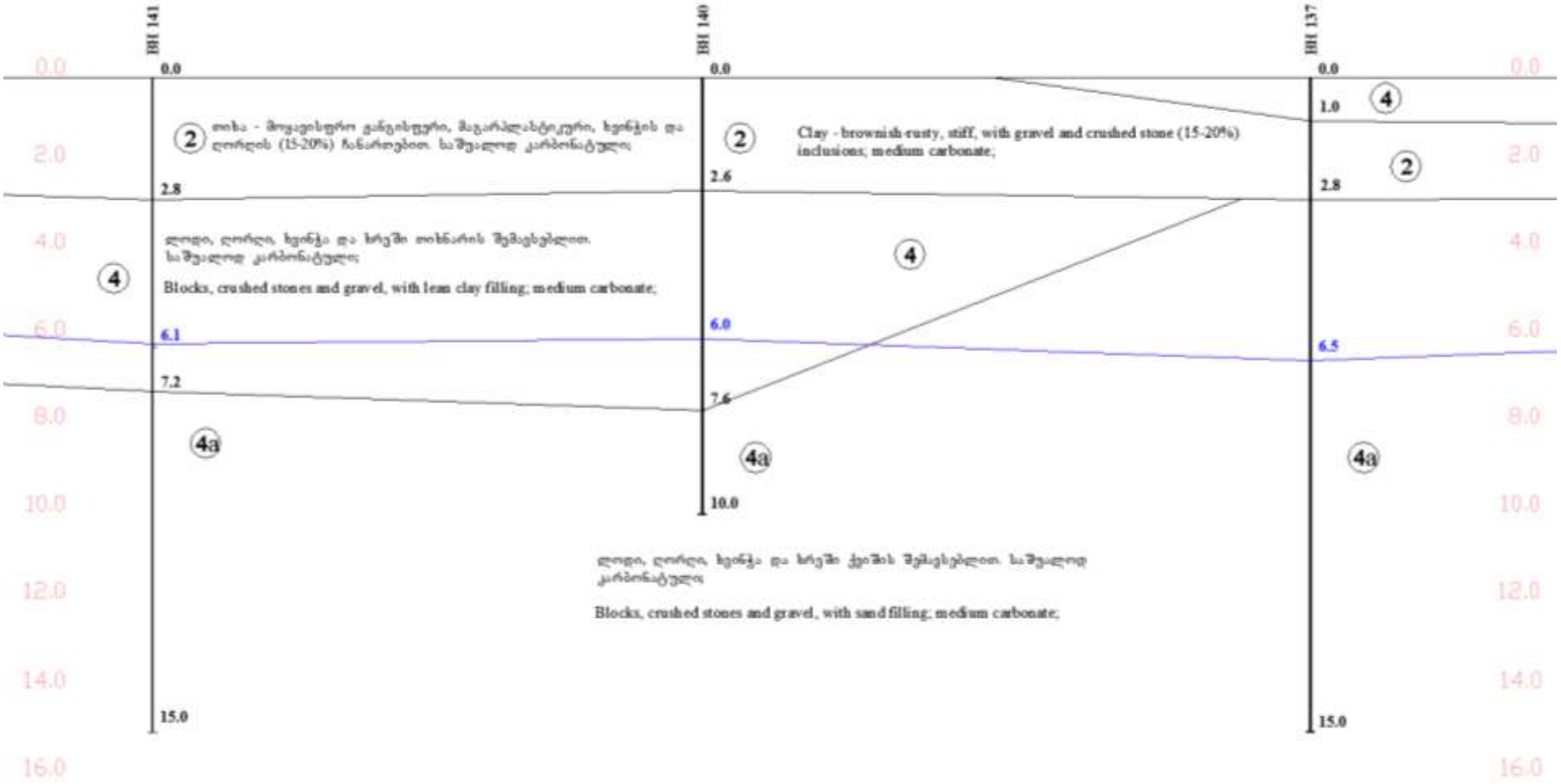
- Heavy duty plastic bags;
- Absorbent pads;
- Gloves;
- Drip trays;

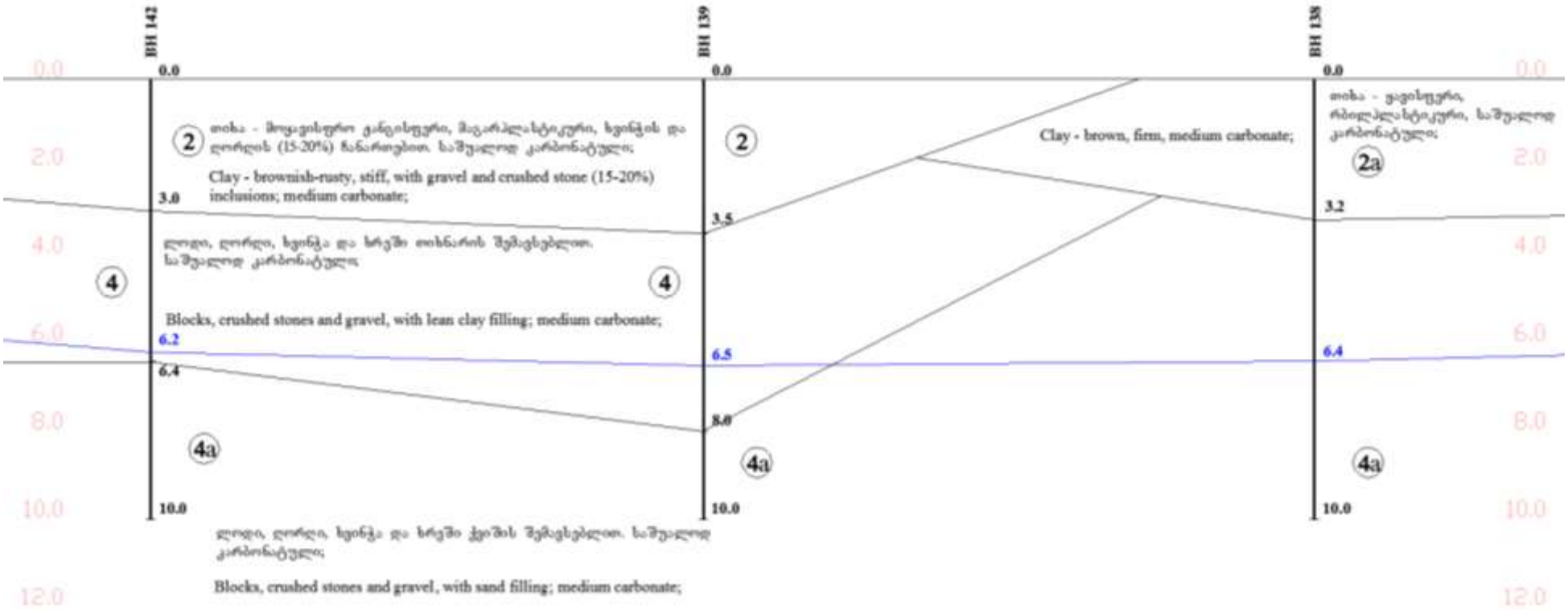
- Buckets;
- Polyethylene film.

15.2.7 Necessary Qualification and Personnel Instruction

Testing of each system of emergency response must be periodically implemented, obtained experience must be documented and weak spots should be improved in Emergency Response Plan (the same should take place in case of accident realization).
The whole staff of the project must undergo introductory training. Personnel additional training registration system should exist and be kept at offices of customer or contractors.

15.3 Annex 5. Engineering-Geological Cross-Sections of Study Area




BH 142
BH 139
BH 138
0.0
0.0
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12.0
2
თიხა - მოყავისფრო ყავისფერი, მაკარბონატირებელი, ხვინჭის და ღორღის (15-20%) ჩანართებით. საშუალოდ კარბონატული;
Clay - brownish-rusty, stiff, with gravel and crushed stone (15-20%) inclusions; medium carbonate;
3.0
3.5
4
ლოდი, ღორღი, ხვინჭა და ხრეში თიხნარის შემავსებლით. საშუალოდ კარბონატული
Blocks, crushed stones and gravel, with lean clay filling; medium carbonate;
6.2
6.5
6.4
6.4
8.0
4a
10.0
10.0
10.0
ლოდი, ღორღი, ხვინჭა და ხრეში ქვიშის შემავსებლით. საშუალოდ კარბონატული;
Blocks, crushed stones and gravel, with sand filling; medium carbonate;
Clay - brown, firm, medium carbonate;
თიხა - ყავისფერი, რბილპლასტიკური, საშუალოდ კარბონატული;
2a
3.2