9. ENVIRONMENTAL IMPACT ASSESSMENT

9.1 Introduction

This chapter presents the assessment of the potential environmental impacts associated with the project, together with a description of the mitigation controls and monitoring measures that will be implemented throughout the lifecycle of the Project.

The impact assessment has been undertaken in line with the ESIA process described in Chapter 3, and is structured as follows:

Section 9.2	Air emissions	Includes consideration of impacts on air quality, atmospheric deposition and emission of greenhouse gases.
Section 9.3	Landscape, soils and land use	Considers landscape and soil impacts, with additional consideration of visual effects of land reinstatement
Section 9.4	Surface water	Considers impacts on quality of surface water bodies, including water supply and wastewater discharge issues
Section 9.5	Geology, geomorphology, soils and groundwater	Includes the assessment of mechanical and chemical impacts on geology, soils and groundwater
Section 9.6	Noise and vibration	Noise and vibration are considered
Section 9.7	Flora and fauna	Addresses impacts to flora and fauna, ecosystems and habitats
Section 9.8	Waste management	Describes the management of wastes during the lifecycle of the project and the associated impacts.
Section 9.9	Emergency situations	Considers impact on environment caused by possible emergency situations at Amur GPP facilities

Description of impacts has been carried out for construction and operation of industrial facilities and infrastructure of AGPP for all stage of project implementation. These are as follows:

- Stage 1. Early works
- Stage 2. Railway communications and facilities;
- Stage 3. Auxiliary facilities
  - 3.1. Auxiliary production facilities;
  - 3.2. Temporary jetty on the River Zeya;
  - 3.3. Access roads construction and upgrade;
  - 3.4. Extension of temporary jetty on the Zeya River;
- Stage 4. Gas processing plant;
- Stage 5. Microdistrict in Svobodny
- Stage 6. Solid domestic and industrial waste landfill.

Design documentation, National EIAs for different design solutions, state environmental monitoring data, sectoral standards and rules have been used to carry out impact assessment.

9.2 Ambient Air Quality

9.2.1 Introduction

This Chapter provides a description of air quality limit values, mitigation measures and controls for prevention, reduction or compensation of any adverse impact, and expected residual impact after implementation of these controls.

Air emissions include pollutants which affect air quality and also greenhouse gases (GHG). Pollutant air emissions will occur through the entire life of the Project, including:

- construction,
- operation, and
- decommissioning of the Project facilities.

This Chapter reviews air emissions of pollutants during construction and operation of the Project facilities. Air quality impacts associated with the decommissioning stage will be addressed in the project documentation that will be developed in due time before the decommissioning process of the Project facilities begins.

Pollutant emissions and dispersion modelling data were included in the Amur GPP Project documentation in accordance with the requirements of the current national legislation. The dispersion modelling and calculation of predicted air pollution levels (one-time maximum for 20 minutes) were carried out using software that implements the standard OND-86[1] technique. These software packages were approved by the Voyeikov Main Geophysical Observatory and the Atmosphere Research Institute, and were certified by Gosstandart of Russia:

- Stage 1, 3-6: Software package 'Ekolog' by Integral (St Petersburg);
- Stage 2: Software package 'Era' by Logos Plus (Novosibirsk).

This software enables calculation of one-time (averaged for intervals of 20-30 minutes) levels of pollutants in ground/surface air in adverse weather conditions based on data on specific emission sources and terrain features. The OND-86 model is used to estimate the distance at which pollutant levels will be below the established limit values and, consequently, determine the required size of the Sanitary Protection Zone (SPZ). The modelling includes atmospheric parameters, baseline concentrations of air pollutants, topographic features, and distance to the nearest settlement. Baseline (background) levels of air pollutants are described in Chapter 7 “Environmental Baseline”.

The air quality modelling which was undertaken as part of the national EIA process included assessment of impact on the ambient air quality during:

- construction at the peak of massive use of construction equipment with associated emission sources;
- operation to determine the SPZ size based on the analysis of worst-case scenarios, including operation of the facilities both in normal and peak emissions conditions.

9.2.2 Applicable air quality standards

Environmental and health effects of air pollution depend not only on pollutant concentrations but also on duration of exposure to these. International and Russian air quality criteria for pollutant levels in the ambient air of residential areas provide for the following limit values measured in mg/m^3:

1. *Limit value for short-term exposure to impact of pollutants*:

Maximum permissible concentration, maximum non-recurrent (MPC_{mnr}) is a concentration of a chemical substance in the air of residential areas which does not cause any reflex reactions in the human body, when inhaled for 20-30 minutes..

2. *Limit value for long-term exposure period (8 hours, 24 hours, or one year for some substances):*

[1] OND-86. Technique for calculations of harmful substances concentrations in the air emissions. Gidrometeoizdat, 1997

Maximum permissible concentration, daily average (MPC_{da}) is a concentration of a chemical substance which should not have any direct or indirect impact on a human being when inhaled for an indefinitely long period (years).

If an MPC limit value for a substance cannot be established, the level of its environmental and health impact is evaluated using such criteria as the Temporarily Permissible Concentration (TPC) or Safe Reference Levels of Impact (SRLI).

Information about air pollutants that will be emitted during construction and operation of the Project facilities and air quality standards is summarised in the Table 9.2.1. These standards are based on the formally approved national limit values and on the IFC General EHS Guidelines and the WHO Ambient Air Quality Guidelines referred to in the IFC document. As can be seen from this table, the limit values established in the national standards for most pollutants are stricter than those specified in the WHO Guidelines. The assessment of the Project's impact on ambient air was based on the limit values currently in force in the Russian Federation.

Table 9.2.1: List of air pollutants that will be emitted during construction and operation of the Project facilities and air quality standards

Pollutants (chemical substances)	CAS Number	Russian Standards[2]					WHO/IFC Guidelines[3], mg/m³			EU Guidelines[4], mg/m³		
		Code	Hazard Class[5]	SRLI, mg/m³	MPC_{mnr}, mg/m³	MPC_{day}, mg/m³	1-hour	24-hour	1-year	1-hour	24-hour	1-year
Iron oxide	1309-37-1	0123	3			0.04						
Manganese and its compounds		0143	2		0.01	0.001						
Sodium hydroxide	1310-73-2	0150		0.01								
Tin oxide (in tin equivalent)	21651-19-4	0168	3			0.02						
Lead and its inorganic compounds (in lead equivalent)	7439-92-1	0184	1			0.017						
Calcium hydroxide	1305-62-0	0214	3		0.03	0.01						
Nitrogen dioxide (NO_2)	10102-44-0	0301	3		0.2	0.04	0.2		0.04	0.2		0.04
Nitric acid (HNO_3)	7697-37-2	0302	2		0.4	0.15						
Ammonia	7664-41-7	0303	4		0.2	0.04						
Nitrogen (II) oxide	10102-43-9	0304	3		0.4	0.06						
Hydrochloric acid (HCl)	7647-01-0	0316	2		0.2	0.1						
Sulphuric acid (H_2SO_4)	7664-93-9	0322	2		0.3	0.1						
Carbon black	1333-86-4	0328	3		0.15	0.05						
Sulphur dioxide (SO_2)	7446-09-5	0330	3		0.5	0.05	0.5 per 10 min	0.02		0.35	0.125	
Dihydrogen sulphide	7783-06-4	0333	2		0.008	0.003						
Carbon monoxide (CO)	630-08-0	0337	4		5	3					10 (8 hrs)	
Gaseous fluorides - hydrofluoride, silicon tetrafluoride (in fluorine equivalent)	7664-39-3 7783-61-1	0342	2		0.020	0.005						
Fluorides		0344	2		0.2	0.03						

[2] Lost and Codes of Air Pollutants. NII Atmosfera , SPB, 2010
[3] IFC General EHS Guidelines
[4] EU Directive 2008/50/EC of 21 May 2008 'On ambient air quality and cleaner air for Europe'
[5] As per GOST 12.1.007-76 'Harmful substances. Classification and general safety requirements'

Pollutants (chemical substances)	CAS Number	Russian Standards[2]					WHO/IFC Guidelines[3], mg/m³			EU Guidelines[4], mg/m³		
		Code	Hazard Class[5]	SRLI, mg/m³	MPC_{mnr}, mg/m³	MPC_{dar} mg/m³	1-hour	24-hour	1-year	1-hour	24-hour	1-year
Carbon dioxide	124-38-9	0380	3									
Butane	106-97-8	0402	4		200							
Hexane	110-54-3	0403	4		60							
Pentane	109-66-0	0405	4		100	25						
Methane	74-82-8	0410			50							
Isobutane	75-28-5	0412	4		15							
Saturated hydrocarbons C_1-C_5 (by methane)		0415			50							
Saturated hydrocarbons C_6-C_{10} (by MPC for hexane)		0416			60							
Ethane	74-84-0	417		50.0								
Propane		418										
Pentenes (amylenes – isomer mixture)	109-67-1	0501	4		1.5							
Benzene	71-43-2	0602	2		0.3	0.1						
Xylene	1330-20-7	0616	3		0.2							
Toluene	108-88-3	0621	3		0.6							
Ethylbenzene	100-41-4	0627	3		0.2							
Benzo(a)pyrene	50-32-8	0703	1			1 µg/100m³						1 µg/m³
Chlorodifluoromethane (Freon 22)	75-45-6	0859	4		100	10						
Epichlorohydrin	106-89-8	0931	2		0.04	0.004						
Propylene glycol	57-55-6	1034		0.030								
1-Butanol (butyl alcohol)	71-36-3	1042	3		0.1							
Methanol (methyl alcohol)	67-56-1	1052	3		1	0.5						

Pollutants (chemical substances)	CAS Number	Russian Standards[2]					WHO/IFC Guidelines[3], mg/m³			EU Guidelines[4], mg/m³		
		Code	Hazard Class[5]	SRLI, mg/m³	MPC_{mnr}, mg/m³	MPC_{da}, mg/m³	1-hour	24-hour	1-year	1-hour	24-hour	1-year
Ethanol (ethyl alcohol)	64-17-5	1061	4		5							
2-(2-Butoxyethoxy)ethanol	112-34-5	1109		1.3								
Butyl acetate	123-86-4	1210	4		0.1							
Propionaldehyde	123-38-6	1314	3		0.1							
Formaldehyde	50-00-0	1325	2		0.035	0.003						
Acetone	67-64-1	1401	4		0.35							
Cyclohexanone	108-94-1	1411	3		0.06							
Pentanoic acid (valeric acid)	109-52-4	1519	3		0.03	0.01						
1-Butanethiol (butyl mercaptan)	109-79-5	1702	3		$4 \cdot 10^{-4}$							
Methanethiol (methyl mercaptan)	74-93-1	1715	4		0.006							
Mixture of natural mercaptans (in ethyl mercaptan equivalent)		1716	3			$5 \cdot 10^{-5}$						
1-Propanethiol	107-03-9	1720	3			0.15						
Ethanethiol	75-08-1	1728	3		$5 \cdot 10^{-5}$							
Dimethylamine	124-40-3	1819	2		0.005	0.0025						
Hydrocarbons (petroleum ether)	8032-32-4	2704	4		5	1.5						0.005
Hydrocarbons (kerosene)	8008-20-6	2732		1.2								
Petroleum-based oil		2735	0,05									
Solvent naphtha		2750		0.2								
Mineral spirit (white spirit)	8052-41-3	2752		1								
Alkanes C_{12}-C_{19} (saturated hydrocarbons C_{12}-C_{19})		2754	4		1							
Particulate matter		2902	3		0.5	0.150						
Inorganic dust: 70-20% SiO_2		2908	3		0.3	0.1						
Inorganic dust: ≤20% SiO_2		2909	3		0.5	0.15						
Abrasive powder (white alumina, monocrystalline alumina)		2930		0.04								

Pollutants (chemical substances)	CAS Number	Russian Standards[2]					WHO/IFC Guidelines[3], mg/m³			EU Guidelines[4], mg/m³		
		Code	Hazard Class[5]	SRLI, mg/m³	MPC_{mnr}, mg/m³	MPC_{da}, mg/m³	1-hour	24-hour	1-year	1-hour	24-hour	1-year
Particulate matter 2.5 µm ($PM_{2.5}$)*					0.16	0.350**		0.025	0.010			0.025
Particulate matter 10 µm (PM_{10})*					0.3	0.06**		0.05	0.04		0.05	0.02
N-Methyldiethanolamine	105-59-9	3401		0.05								
Dioxins (in 2,3,7,8-tetrachlorodibenzo-p-dioxin equivalent)	1746-01-6	3620	1			0.5 pg/m³						

*Decree of the Chief Sanitary Inspector of Russia No. 26 of 19.04.2010 'On the approval of Hygiene Standards GN 2.1.6.2604-10' ** 99 percentile

9.2.3 Construction

The Project facilities will consist of:

- Stage 1. Early works;
- Stage 2. Railway communications and facilities;
- Stage 3. Auxiliary facilities

3.1. Auxiliary production facilities;

3.2. Temporary jetty on the Zeya River;

3.3. Access roads construction and upgrade

3.4. Extension of temporary jetty on the Zeya River;

- Stage 4. Gas processing plant;
- Stage 5. Microdistrict in the town of Svobodny
- Stage 6. Solid domestic and industrial waste landfill.

Detailed description of the Project facilities is provided in Chapter 4.

Potential impacts on air quality at each stage and assessment of such impacts are discussed below.

9.2.3.1 Air emissions during construction site preparation (Stage 1.1)

Site preparation works (Stage 1.1) were completed in May 2016, i.e. before commencement of the ESIA process and, consequently, the impact of these works on the ambient air quality is not covered in this ESIA Report.

9.2.3.2 Air emissions during construction of the early works facilities (Stage 1.2)

Sources of air emissions during construction of the early works facilities will consist of:

- exhaust pipes of diesel generators and internal combustion engines of vehicles and construction equipment;
- tree clearance sites where petrol-driven saws will be used;
- mobile welding machines;
- areas used for filling construction equipment from fuel trucks;
- areas of handling operations;
- concrete mixing plant;
- bitumen spreading areas;
- painting operations on open construction sites.

Air emissions during construction will be generated by sources of periodic impact. It is assumed that the duration of construction at Stage 1 will total 17 months (442 days).

The following pollutants will be emitted into the ambient air during construction:

- nitrogen dioxide, nitrogen (II) oxide, black carbon, sulphur dioxide, carbon monoxide, hydrocarbons (petroleum ether and kerosene) – from exhaust pipes of combustion engines of construction and earth-moving machinery, vehicles, and rotary drills;
- nitrogen dioxide, nitrogen (II) oxide, black carbon, sulphur dioxide, carbon monoxide, formaldehyde, benzo(a)pyrene, hydrocarbons (kerosene) - from exhaust pipes of diesel generators;
- iron oxide, manganese and manganese compounds – from mobile welding machines;
- xylene, toluene, and white spirit – from painting shops;
- inorganic dust with 70-20% of SiO_2 – from concrete mixing plant;

- suspended solids and inorganic dust with 70-20% of SiO_2 – from material handling operations and surface levelling with sand and gravel mix;
- alkanes C_{12}-C_{19} (saturated hydrocarbons C_{12}-C_{19}) – from bitumen spreading operations; and
- alkanes C_{12}-C_{19} (saturated hydrocarbons C_{12}-C_{19}) and hydrogen sulphide – from areas used for filling construction equipment from fuel trucks.

Volumes of air emissions from construction of the early works facilities are detailed in Appendix 9.1, Table 1. Total pollutant emissions listed in this table will be considered as limits for maximum permissible emissions from construction Stage 1. Major pollutants will be carbon monoxide (34.7%), nitrogen dioxide (23.8%), nitrogen (II) oxide (14.2%), and hydrocarbons (kerosene) (1.4 %). Major sources of air pollution during construction will be construction and road building machinery, including vehicles.

In order to evaluate potential impact on air quality and determine emission limits for the construction period, several hypothetical construction sites were selected within the area allocated for the construction of the GPP and auxiliary facilities (buildings and structures) and on future access roads to these sites. These areas will be characterized by the maximum concentration of simultaneously operating construction and road building machinery, vehicles, and diesel generators.

The dispersion modelling enabled assessment of the maximum ground level concentrations of pollutants at the boundary of the nearest settlement, Yukhta. The air pollution modelling for the construction of the early works facilities was performed for:

- the cold period of the year when emissions from vehicles and construction equipment will be at their maximum; and
- the warm period of the year when bitumen spreading and painting operations will be carried out.

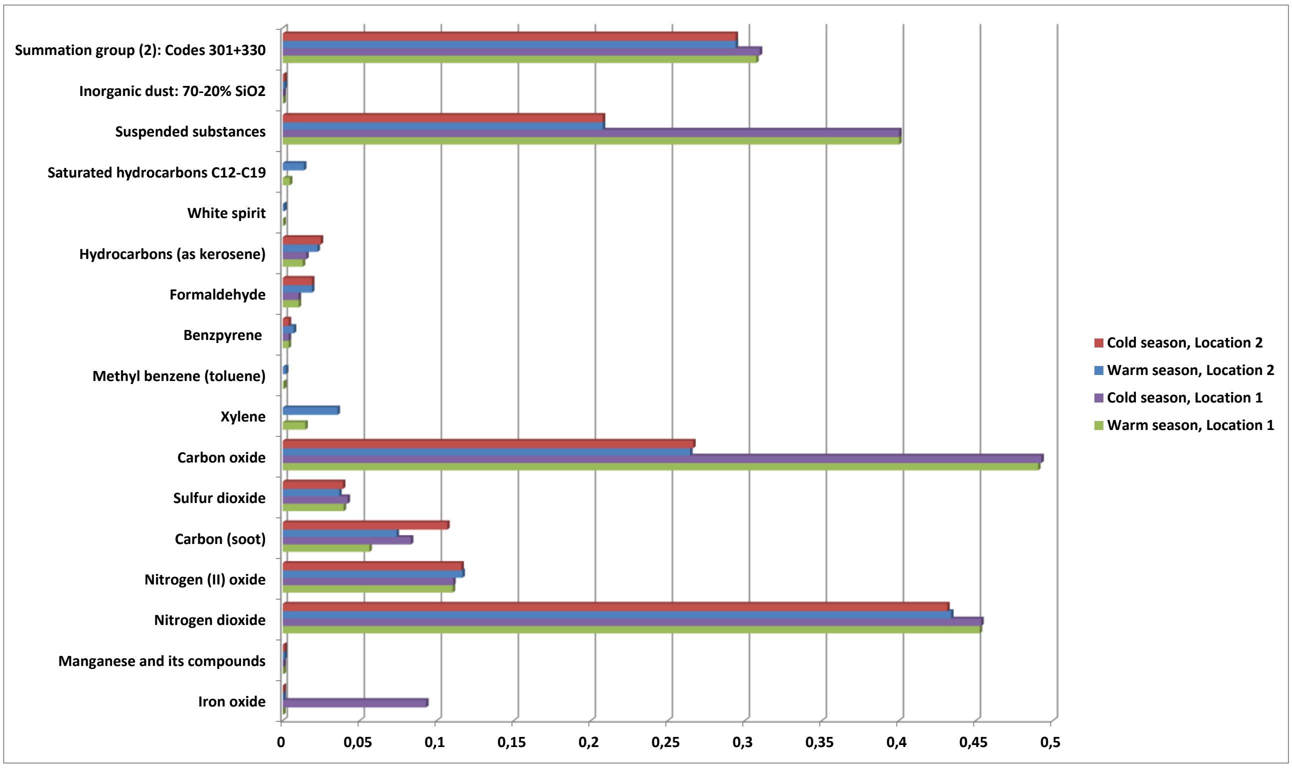

Figure 9.2.1: Estimated maximum ground concentrations of major pollutants at the Yukhta boundary, as MPC fraction (Stage 1)

Two reference points selected for the assessment of air pollution were located at the boundary of the nearest settlement, Yukhta, 2.3 km from the future construction site. The results of modelling of ground concentrations of major pollutants at these points during construction of the GPP, auxiliary facilities, and access roads are presented in Figure 9.2.1. As can be seen from this figure, estimated maximum ground concentrations of pollutants at the Yukhta boundary will not exceed the established limit values.

9.2.3.3 Air emissions during construction of the railway infrastructure (Stage 2)

Stage 2 provides for construction of:

- Railway infrastructure facilities required for delivery and supply of the Project materials and equipment, including:
    - public railway station "Ust-Pera" (modernisation);
    - railway stations "Zavodskaya" and "Zavodskaya-2";
    - connecting railway track from "Zavodskaya-2" to "Zavodskaya"; and
    - two connecting railway tracks from "Zavodskaya" to the loading/unloading racks and construction supplies unloading yard;
- loading/unloading racks for reception of empty tank cars and export of loaded cars from the GPP via the public railway network.

A detailed description of construction Stage 2 is provided in Chapter 4. The estimated duration of the "Ust-Pera" station modernisation works is 15 months and that of construction of "Zavodskaya" and "Zavodskaya-2" railway stations is 30 months.

The ambient air quality will be affected by pollutant emissions from:

- welding operations;
- traffic of vehicles delivering construction materials;
- operation of construction equipment and maintenance vehicles;
- painting of metal parts and marking;
- earthworks and site levelling.

Sources of pollutant emissions during construction of the railway infrastructure facilities will be:

- diesel generators;
- internal combustion engines of maintenance vehicles (diesel locomotives, motor cars, rail cars, etc.) and construction equipment;
- fuel trucks;
- mobile welding machines;
- tar (bitumen) boilers;
- soil/fill material loading/unloading yards; and
- painting shops.

Stationary sources of air emissions will include welding and painting shops and soil/fill material loading/unloading yards. Mobile emission sources will consist of vehicles, welding machines, fuel trucks, and construction machinery mobilised to the site. Equipment mobilised for construction will not be operated simultaneously.

The emission modelling was based on the worst-case scenario of maximum air emissions near residential areas. This scenario involves operation of grader and execution of earth and gravel moving works (site levelling or earth-moving works), maintenance vehicles, diesel power station, fuelling of vehicles, vehicular traffic, drilling works, painting and welding operations.

Volumes of air emissions during construction of the railway infrastructure facilities are detailed in Appendix 5, Table 1. Major sources of air pollution during construction will be construction machinery and vehicles.

Ground level concentrations of pollutants were estimated with consideration of the following:

- climate characteristics (air temperature, wind velocity, atmosphere stratification, and season);
- parameters of emission sources;

- background levels of pollutants;
- terrain factor; and
- distance to residential areas.

The modelling of air pollution from all sources and for all pollutants allowed obtaining data on distribution of maximum ground level concentrations within the area of influence of each railway infrastructure facility (see below).

Modernisation of the "Ust-Pera" railway station

The nearest residential facility are: stand-alone Building No. 1, 36 m from the rail tracks north of the station; stand-alone Building No. 2, 83 m from the rail tracks south of the station; and Building No. 3, 65 m from the rail tracks in front of the up neck.

The modelling included eight air pollution sources, including six sources of fugitive emissions. The worst-case scenario of maximum air emissions was based on simultaneous operation of maintenance vehicles (rail motor car), roller, motor grader, diesel generator, execution of painting and welding works, earth-moving work (site levelling or excavation), and refuelling. The modelling was performed for three reference points at the residential area boundary.

The modelling results indicate that the ground level concentrations of all pollutants and pollutant combinations (summation groups) at the residential area boundary will not exceed 0.74 MPC with the background level included. Within the construction site, ground concentrations of pollutants will not exceed 0.95 MPC with allowance for the background level (Figure 9.2.2: Estimated maximum ground concentrations of major pollutants at the "Ust-Pera" station residential area boundary, as MPC fractions (Stage 2)

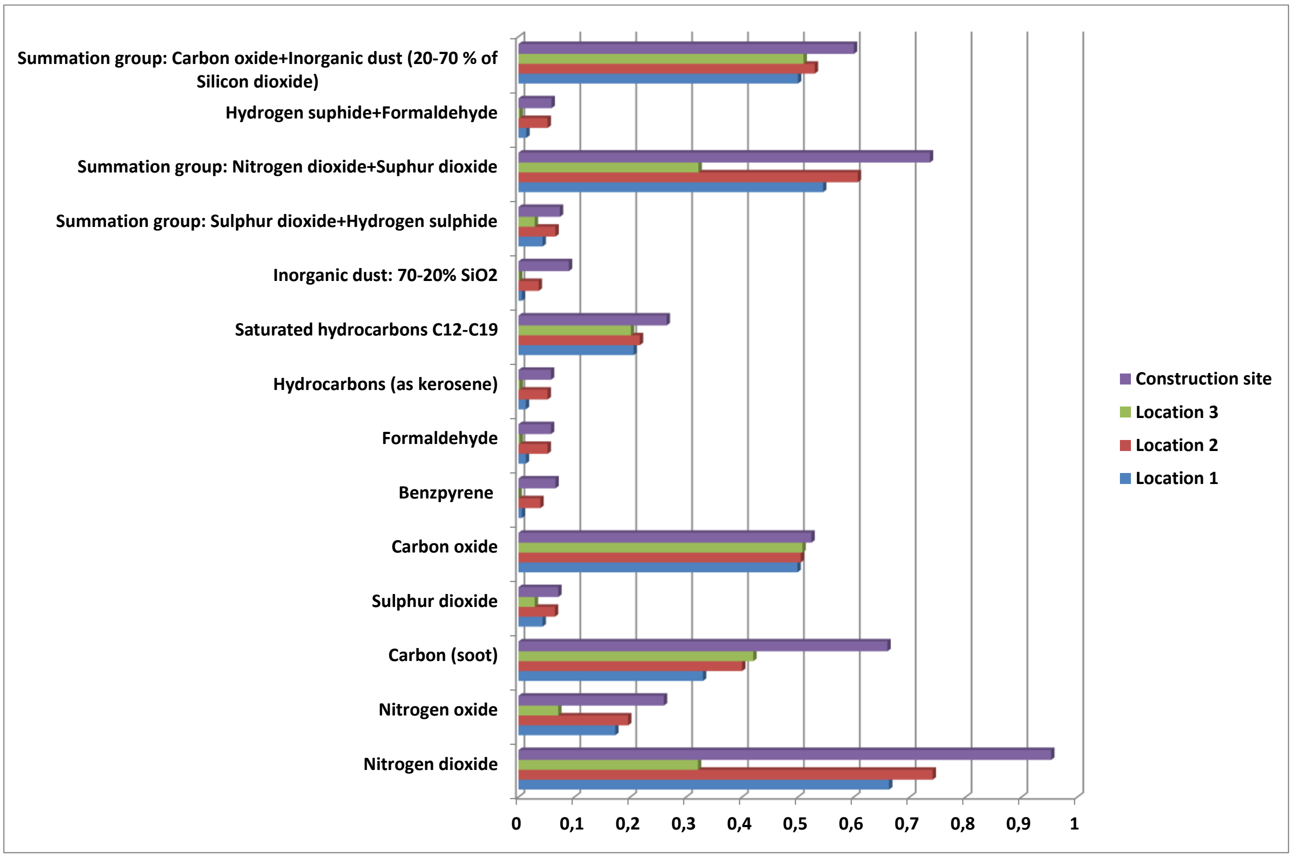

Figure 9.2.2: Estimated maximum ground concentrations of major pollutants at the "Ust-Pera" station residential area boundary, as MPC fractions (Stage 2)

Construction of the "Zavodskaya" railway station

The nearest residential area, the Yukhta community allotments, is located 5.7 km west of the "Zavodskaya" station boundary.

The modelling included 22 air pollution sources, including 19 sources of fugitive emissions. Stationary emission sources will consist of welding and painting shops, excavation sites, waterproofing operations, and construction equipment fuelling areas. Mobile emission sources will include vehicles and construction machinery operated on the construction site and railway maintenance vehicles.

The worst-case modelling scenario is based on simultaneous operation of cranes, diesel generator, construction equipment fuelling, earth works involving an excavator and grader, pile driving, vehicular traffic, operation of a bulldozer and a pipe-layer, passage of a diesel locomotive, painting and welding works, tar boiling, and earth moving works. Estimated ground concentrations of major pollutants at the Yukhta residential area boundary will not exceed the established limit values.

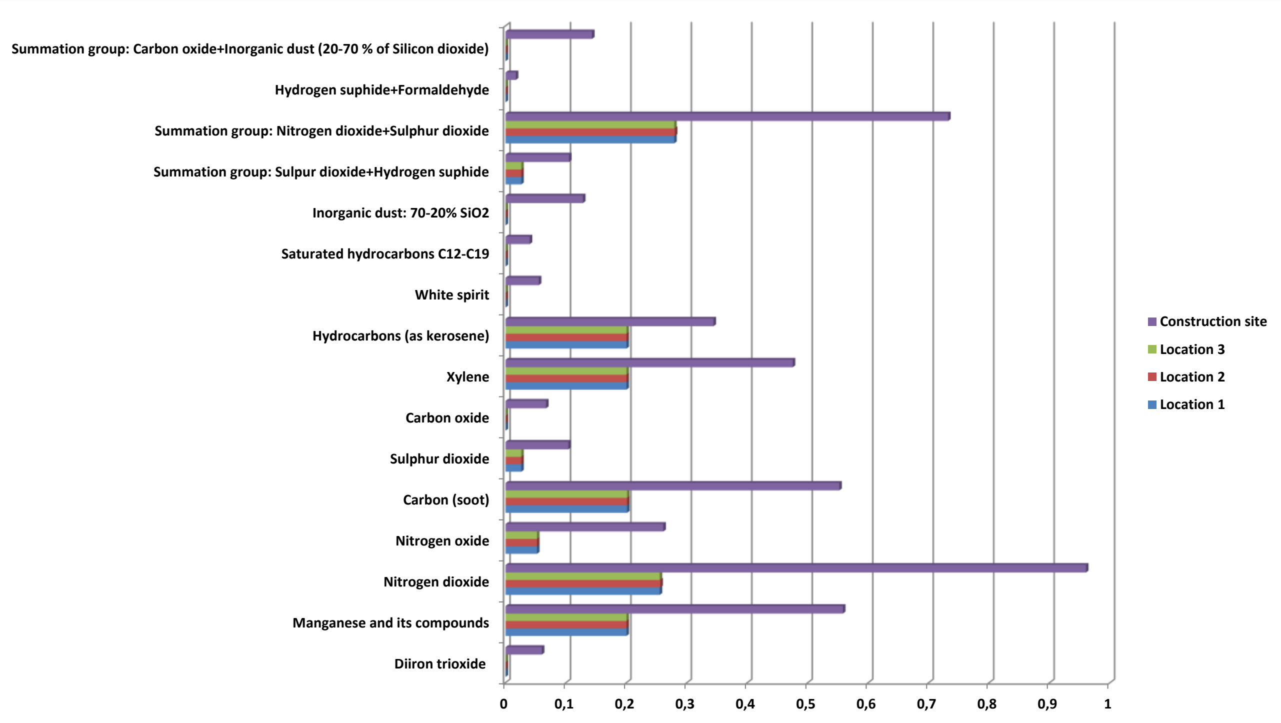

Figure 9.2.3: Estimated maximum ground concentrations of major pollutants at the boundary of community allotments in Yukhta during construction of "Zavodskaya" railway station, as MPC fractions (Stage 2)

Construction of the "Zavodskaya-2" railway station

"Zavodskaya-2" will be located near the "Ust-Pera" railway station. The nearest residential area is located west of "Zavodskaya-2":

- Ust-Pera Village east of Zavodskaya-2; the distance from the outermost track of "Zavodskaya-2" to the nearest dwelling houses is 190 m (Ust-Pera Village boundary, dwelling houses No. 4 and No. 5);
- standalone dwelling house No. 1, 100 m north of the existing station building of the "Ust-Pera" railway station; the distance from the outermost track of "Zavodskaya-2" is 140 m;
- standalone dwelling house No. 2, 170 m south of the existing "Ust-Pera" station building; the distance from dwelling house No. 2 to the outermost track of "Zavodskaya-2" is 60 m, to the block compressor station – 50 m;
- standalone dwelling house No. 3, north of the station building near the up neck of the "Ust-Pera" railway station; the distance from dwelling house No. 3 to the outermost track of the "Ust-Pera" station is 65 m, to the outermost track of "Zavodskaya-2" - 115 m.

The construction project will be divided in several operations areas: construction of rail tracks, construction of artificial facilities (including the crossover and the bridge), and construction site of "Zavodskaya-2". These operations areas will be scattered to avoid cross-effects. Operations associated with pollutant air emissions will not be carried out simultaneously, being distributed across the site area. Stationary emission sources will consist of welding and painting shops, excavation and backfilling sites. Mobile emission sources will include vehicles and construction machinery operated on the construction site and railway maintenance vehicles.

Preliminary modelling (Figure 9.2.4) of ground level pollutant concentrations demonstrated that it was necessary to allow for the background levels of nitrogen dioxide, nitrogen oxide, carbon black sulphur dioxide, carbon monoxide, and inorganic dust. The final estimates indicated that the highest ground levels would characterise summation group 41 (carbon monoxide + inorganic dust): 1.46 MPC within the construction site and 1.2 MPC within the residential area.

The exceedance of limit values is to be attributed to the high background levels (69% for carbon monoxide, and 30.7 % for inorganic dust).

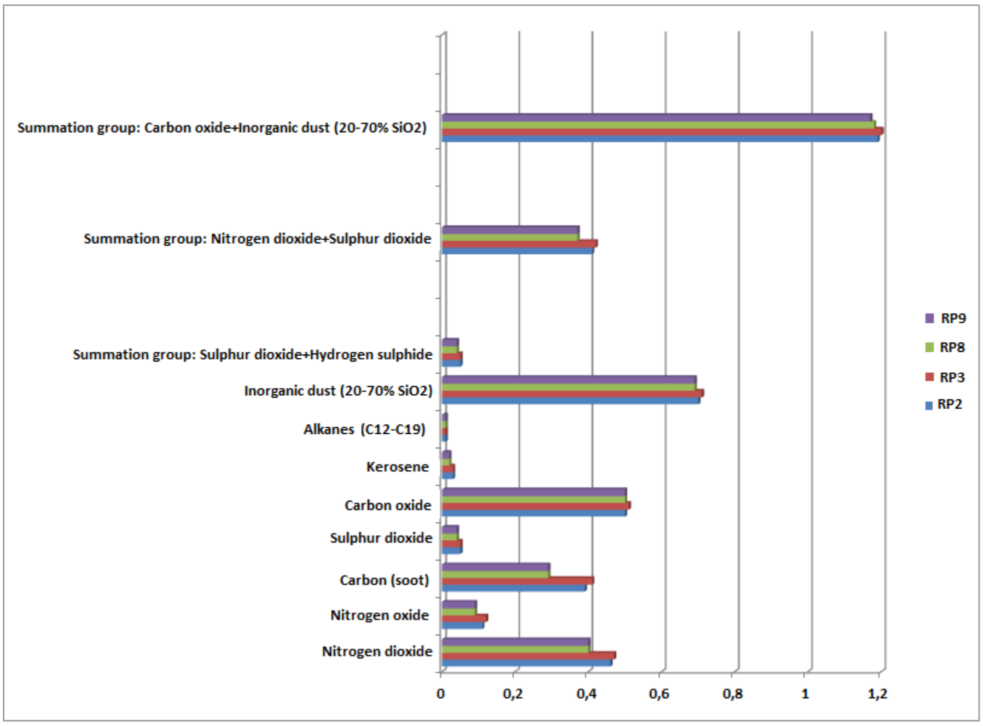

Figure 9.2.4: Estimated maximum ground concentrations of major pollutants at the site and residential area boundaries during construction of "Zavodskaya-2" railway station, as MPC fractions (Stage 2)

However, the actual levels for summation group 41 will not be as high as estimated because emission sources of pollutants comprising this group (inorganic dust from earth moving during earthbed construction and carbon monoxide from operation of the automatic tamping and levelling machine) will be operated subsequently rather than simultaneously. According to the construction schedule, these operations do not overlap.

Estimated ground level concentrations of other pollutants and summation groups within the construction site will not exceed 0.98 MPC with allowance for the background level (nitrogen dioxide). Ground concentrations at the residential area boundary will not exceed 0.7 MPC with allowance for the background level (inorganic dust).

Calculations of the total air emissions during construction of "Zavodskaya-2", which will be considered as limit values, are detailed in Appendix 5, Table 2. The calculations are based on 21 pollutant emission sources, of which 20 are sources of fugitive emissions.

9.2.3.4 Air emissions during construction of the auxiliary facilities (Stage 3.1)

Construction will involve operation of: excavators, bulldozers, motor graders, tractor towed rollers, tractors, truck cranes and tracked cranes, mobile compressors, concrete mixing trucks, etc. Vehicles and construction and road building machinery will be fuelled on the construction site from a fuel truck equipped with pump, meter, discharge hose and nozzle to prevent diesel fuel spills. Electrical power and heat will be supplied to construction facilities from diesel power generators DES-60, DES-100, and DES-1000.

Total duration of the rotation-based construction of the Stage 3 auxiliary facilities will be 35 months (910 days), including:

- 12 months (312 days) in 2017 and in 2018, and
- 11 months (286 days) in 2019.

Construction will be carried out in one 12-hours shift. .

Sources of air emissions during construction will consist of:

- exhaust pipes of diesel generators and internal combustion engines of vehicles and construction equipment;
- mobile welding machines and hand welding units;
- areas used for filling construction equipment from fuel trucks;
- areas of handling operations;
- concrete mixing plant;
- areas of bitumen laying;
- painting operations performed at outdoor construction sites.

Air emissions during construction will be generated by sources of periodic impact as specified in the design documentation.

The following pollutants will be emitted into the ambient air during construction:

- nitrogen dioxide, nitrogen (II) oxide, black carbon, sulphur dioxide, carbon monoxide, hydrocarbons (petroleum ether and kerosene) – from exhaust pipes of combustion engines of construction and earth-moving machinery, vehicles, and drilling machines;
- nitrogen dioxide, nitrogen (II) oxide, black carbon, sulphur dioxide, carbon monoxide, formaldehyde, benzo(a)pyrene, hydrocarbons (kerosene) - from exhaust pipes of diesel generators;
- iron oxide, manganese and manganese compounds – from mobile welding machines;
- xylene, toluene, and white spirit – from painting shops;
- inorganic dust with 70-20% of SiO_2 – from concrete mixing plant;
- suspended solids and inorganic dust with 70-20% of SiO_2 – from material handling operations;
- calcium oxide (quicklime) from the lime unloading facility;
- alkanes C_{12}-C_{19} (saturated hydrocarbons C_{12}-C_{19}) – from bitumen laying operations; and
- alkanes C_{12}-C_{19} (saturated hydrocarbons C_{12}-C_{19}) and hydrogen sulphide – from areas used for filling construction equipment from fuel trucks.

The emission data referred to below are based on the results of air emission calculations for construction Stage 3.1 included in the design documentation.

The ground concentration modelling was focused on two reference points at the boundary of the nearest settlement, Yukhta, located at the distance of 1.7 to 2.3 km from the Amur GPP site

The air pollution modelling for the construction period was performed for:

- the cold period of the year when emissions from vehicles and construction equipment will be at their maximum; and
- the warm period of the year when bitumen laying and painting operations will be carried out.

Figure 9.2.5: Estimated maximum ground concentrations of major pollutants at the Yukhta boundary, as MPC fractions (Stage 3.1)

indicates that the estimated maximum ground concentrations of pollutants at the nearest settlement (Yukhta) boundary during construction of the auxiliary facilities will not exceed the established limit values.

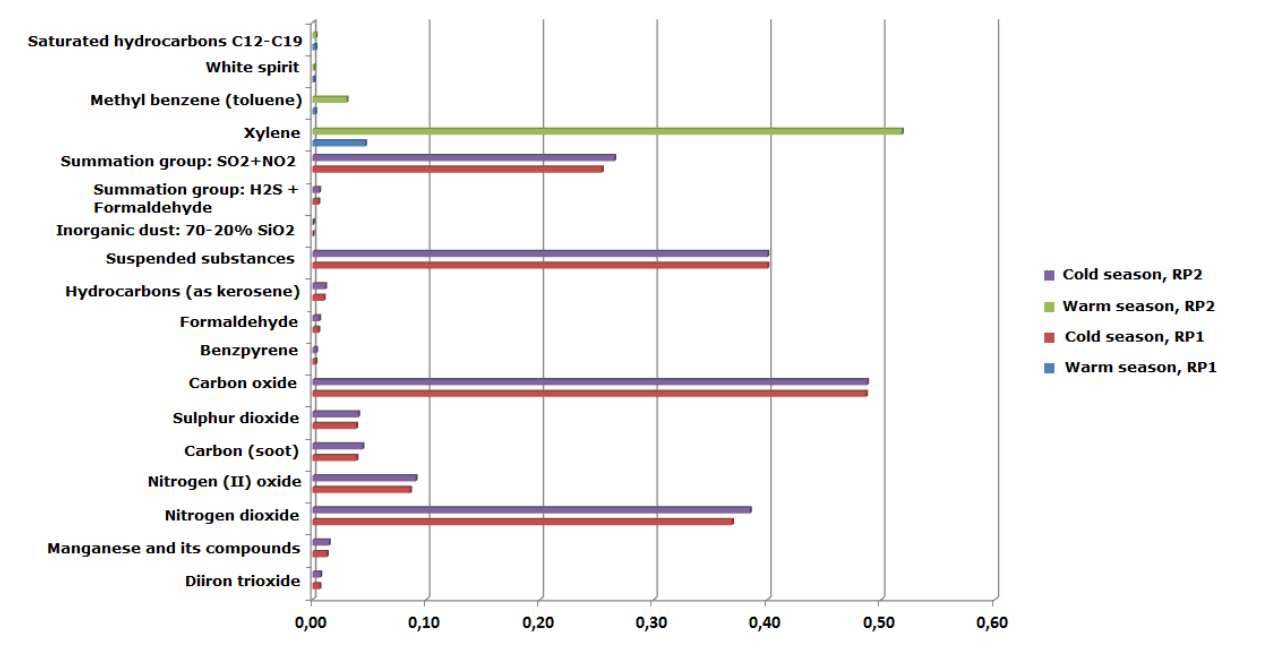

Figure 9.2.5: Estimated maximum ground concentrations of major pollutants at the Yukhta boundary, as MPC fractions (Stage 3.1)

Total emissions of pollutants during construction of the Stage 3 auxiliary facilities, which will be considered as limit values of permissible emissions for each construction year, are detailed in Appendix 5, Table 3.

According to Appendix 5, pollutant emissions during the entire period of the Auxiliary Facilities construction will total to 2,554.7 tonnes, including:

- 618.1 tonnes in 2017;
- 839.4 tonnes in 2018; and
- 1,097.2 tonnes in 2019.

Major pollutants will be xylene (38.9%), carbon monoxide (16.2%), nitrogen dioxide (12.0%), and nitrogen (II) oxide (7.2%). Major sources of air pollution during construction will be construction equipment and vehicles. Considerable xylene emissions are associated with the large volume of painting works.

9.2.3.5 Air emissions during construction of the temporary jetty on the Zeya River (Stage 3.2)

The temporary jetty will be constructed on 27,000 m^2 of the Zeya River floodplain. The estimated duration of construction is 8.7 months.

Pollutant emissions during Stage 3.2 construction works will be associated with the operation of construction equipment and vehicles (bulldozers, truck cranes, trucks, etc.). In addition, dust emissions will occur during earth-moving works, transportation and unloading of sand and other bulk materials, and from in-facility traffic. Sources of air emissions will also include the areas of deployment of various auxiliary equipment (welding stations, etc.) and the areas of operations involving special building materials (asphalt, bitumen, etc.).

Sources of air emissions during construction Stage 3.2 will consist of:

- construction site;
- dredging operations;
- diesel generators (2);
- barge landing (unloading);
- tractor cranes (2);
- road train unloading area;
- minibus and general parking area;
- water supply area;
- solid domestic waste storage;
- area for removal of treated effluents;
- area for removal of sewage from portable toilets; and
- area for removal of effluents from emergency tank.

Equipment and vehicles will be fuelled at filling stations and motor depots of construction contractors.

Ready-to-use concrete mixture will be brought to the site by mixer trucks. No onsite preparation of concrete using dry mixtures will take place.

Construction of the temporary jetty will require operation of tugboats, backhoe dredger, diving station, and floating crane. Construction equipment, excavators, and vehicles will run on diesel. Motor loaders and chain saws will be powered by petrol.

On completion of the main works the area will be asphalted.

The emission data referred to below are based on the results of air emission calculations for construction Stage 3.2 included in the design documentation[6].

The ground concentration modelling was performed using the EKOLOG-PRO software and focused on eight reference points at the boundary of the temporary jetty area. Figure 9.2.6: Estimated maximum ground concentrations of major pollutants at the boundary of the Temporary Jetty on the Zeya River, as MPC fractions (construction period)

indicates that the estimated maximum ground concentrations of pollutants at the boundary of the temporary jetty operations area will not exceed the established limit values.

Total air emissions of pollutants during construction of the temporary jetty, which will be used as limit values of permissible emissions, are detailed in **Error! Reference source not found.**

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[6] Amur GPP Project Documentation. Stage 3.2: Auxiliary Facilities. Section 8: Environmental protection activities

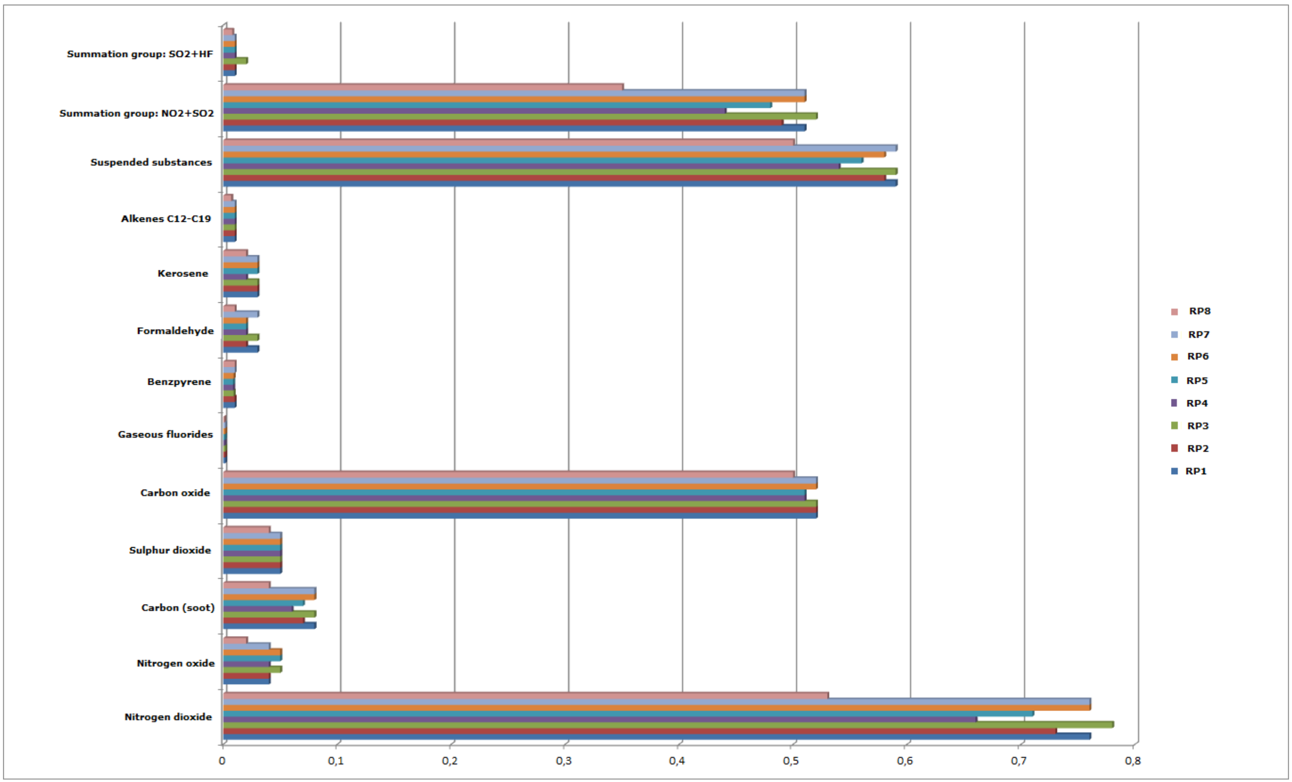


Figure 9.2.6: Estimated maximum ground concentrations of major pollutants at the boundary of the Temporary Jetty on the Zeya River, as MPC fractions (construction period)

9.2.3.6 Air emissions during construction and reconstruction of access motor roads (Stage 3.3)

Stage 3.3 will include construction of access motor roads (AMR).

The Project provides for the reconstruction of the section of the public road ("Access to Svobodny from the Amur Highway") and construction of new roads.

Impact on ambient air quality during Stage 3.3 construction and installation works will be associated with pollutant emission from the operation of construction equipment, excavation and earth moving works, reloading of dust generating materials and soil, painting works and other construction and installation operations.

The calculations are based on the Project requirements of construction and road building equipment, diesel generators, portable welding units, and other equipment required for road construction, and materials (bitumen, varnish, cement, rock, etc.) for Stage 3.3.

Figure 9.2.7. indicates that the estimated maximum concentrations of pollutants at the Yukhta boundary will not exceed the established limit values. The ground concentration modelling proved that levels of most pollutants during construction would not reach their limit values even within the area of construction sites.

According to these data, pollutant emissions during construction will total 125.6 tonnes. Major pollutants will be nitrogen oxides (20.6 %), carbon monoxide (18.3 %), hydrocarbons C_{12}-C_{19} (32.2 %), xylene (4.6 %), and inorganic dust with $Si0_2$ content of less than 20% (6.7 %). The above listed substances belong to Hazard Class 3 and 4. Emissions of other pollutants will account for a small percentage of the total emissions.

Impact on air quality at Stage 3.3 will be short-term and local.

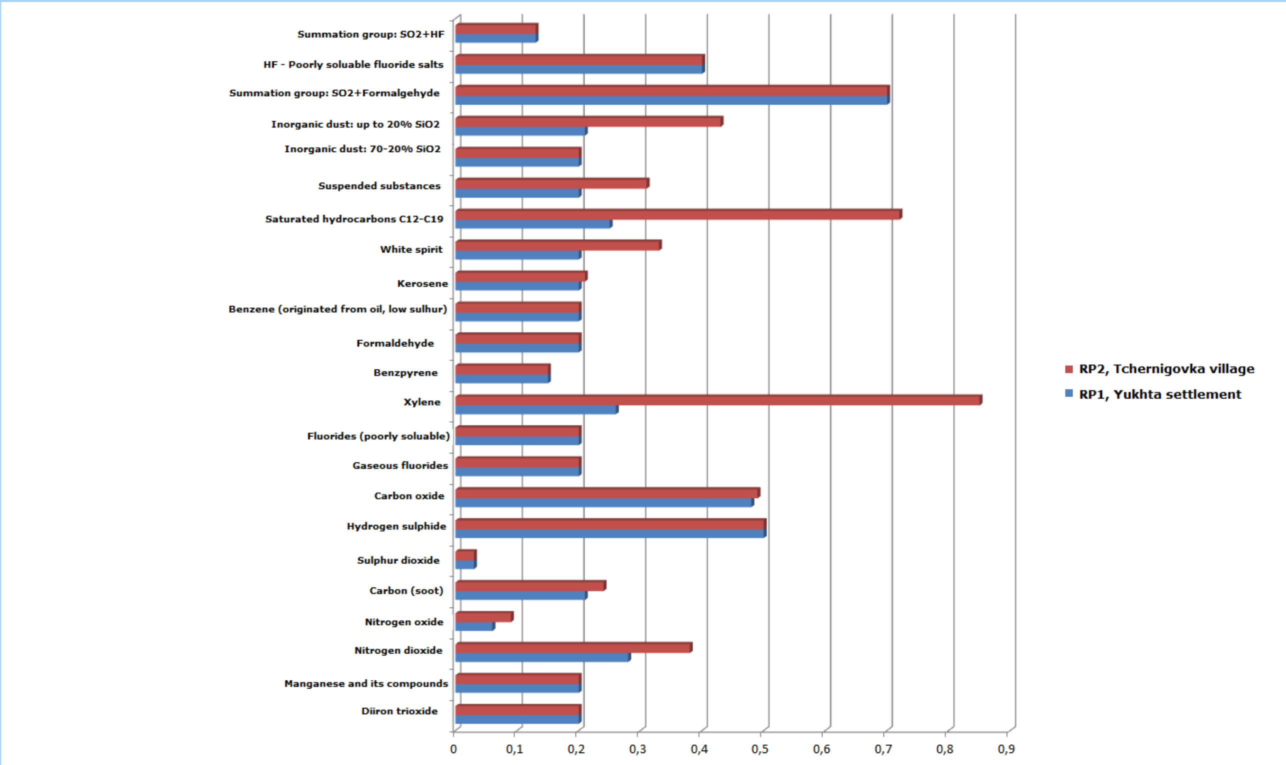


Figure 9.2.7: Estimated maximum ground concentrations of major pollutants at the boundary of the nearest settlements – Yukhta and Chernigovka, as MPC fractions

9.2.3.7 Air emissions during construction of the Min Production Facilities (Stage 4)

Sources of pollutant air emissions at this construction stage will consist of:

- exhaust pipes of diesel generators and engines of construction and road building machinery;
- mobile welding stations and manual welding units;
- areas used for filling construction equipment from fuel trucks;
- handling operations;
- concrete mixing plant;
- bitumen laying areas;
- painting operations performed at outdoor construction sites.

Air emissions during construction will be produced by sources of periodic impact as specified in the design documentation. The total duration of the rotation-based construction of the Stage 4 facilities will be

- Stage 4.1 - 49 months (1274 days);
- Stage 4.2 - 43 months (1118 days);
- Stage 4.3 - 43 months (1118 days);
- Stage 4.4 - 43 months (1118 days);
- Stage 4.5 - 43 months (1118 days).

Construction will be carried out in one 12-hours shift.

The following pollutants will be emitted into the ambient air during construction of the Stage 4 facilities:

- nitrogen dioxide, nitrogen (II) oxide, black carbon, sulphur dioxide, carbon monoxide, hydrocarbons (kerosene) – from exhaust pipes of combustion engines of construction and earth-moving machinery, vehicles, and drilling machines;

- nitrogen dioxide, nitrogen (II) oxide, black carbon, sulphur dioxide, carbon monoxide, formaldehyde, benzo(a)pyrene, hydrocarbons (kerosene) - from exhaust pipes of diesel generators;
- iron oxide, manganese and manganese compounds – from mobile welding machines;
- xylene, toluene, and white spirit – from painting shops;
- inorganic dust with 70-20% of SiO_2 – from concrete mixing plant;
- suspended solids and inorganic dust with 70-20% of SiO_2 – from material handling operations;
- alkanes C_{12}-C_{19} (saturated hydrocarbons C_{12}-C_{19}) – from bitumen laying operations; and
- alkanes C_{12}-C_{19} (saturated hydrocarbons C_{12}-C_{19}) and hydrogen sulphide – from areas used for filling construction equipment from fuel trucks.

In order to evaluate potential impact on air quality and determine emission limits for the construction period, a hypothetical site was selected within the area allocated for the construction of the main facilities. This area will be characterized by the maximum concentration of simultaneously operating construction and road building machinery, vehicles, and diesel generators, both during the cold and warm periods of the year.

The nearest settlements are: Yukhta (2.3 km from the site) and the Yukhta community allotments area (1.7 km from the site). Modelling was performed for two reference points at the boundaries of Yukhta and the Yukhta community allotments and for four reference points at the SPZ boundary. The ground level concentration modelling was performed using the EKOLOG-PRO software.

Pollutant emissions from areas used for reloading of loose construction materials and fuelling of construction equipment from fuel truck were also included in the dispersion modelling.

The air pollution modelling for the construction period was performed for:

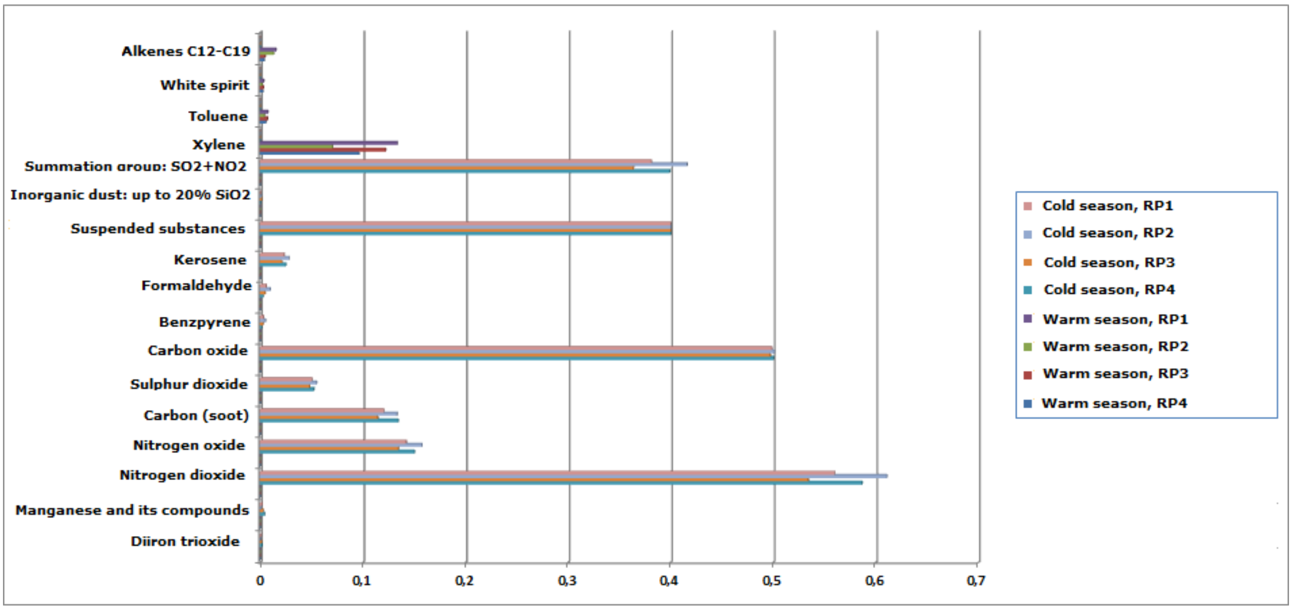
- the cold period of the year when emissions from vehicles and construction equipment will be at their maximum and work will be carried out in the bitumen laying and painting areas; and
- the warm period of the year when bitumen laying and painting operations will be carried out.

Figure 9.2.8. indicates that the estimated maximum ground concentrations of pollutants at the SPZ boundary and at the boundary of Yukhta and adjacent community allotments will not exceed the established limit values.

Figure 9.2.9: Dispersion maps for nitrogen dioxide (a) and carbon monoxide (b) during construction of the Main Production Facilities on the Amur GPP Project site

provides a visual illustration of dispersion of nitrogen dioxide and carbon monoxide the ground concentrations which will exceed 0.5 MPC at the SPZ boundary..

Total emissions of pollutants during construction Stage 4 are detailed in Figure 9.2.8 According to these data, pollutant air emissions during the entire period of construction of the main facilities of Stage 4 will total 11361.6 tonnes. Major air polluting substances will be: carbon oxide - 24.9%, xylene- 22.4 %, nitrogen dioxide - 17.9%, nitrogen oxide - 10.7%. Major sources of air pollution during construction will be construction equipment and vehicles. Emissions of these pollutants will be periodically controlled in accordance with the equipment maintenance and repair schedule.



(a)

(b)

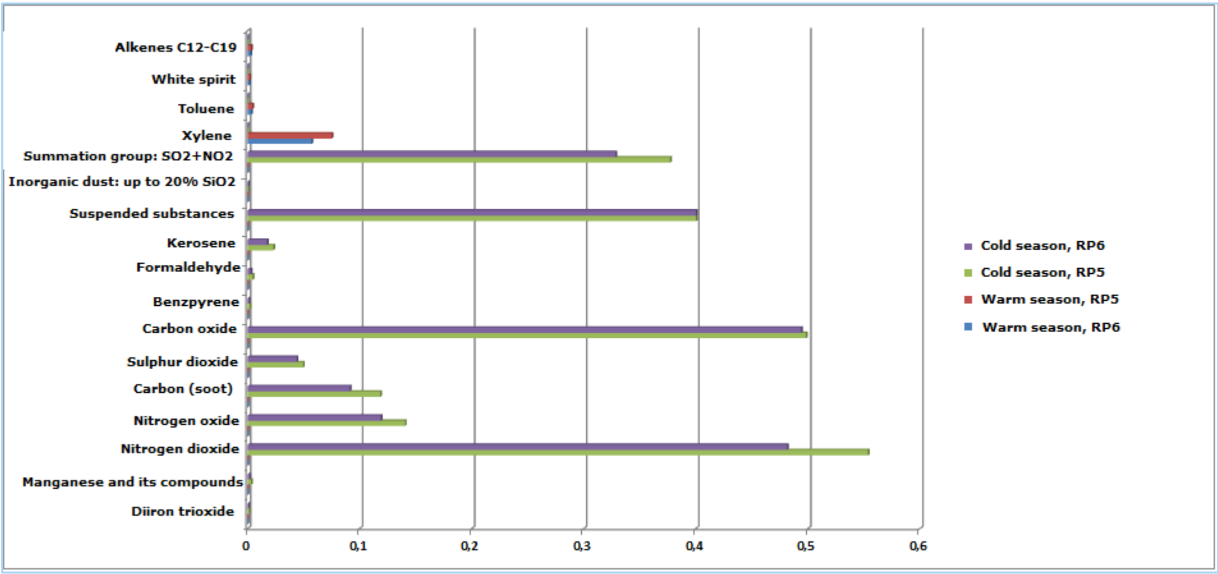
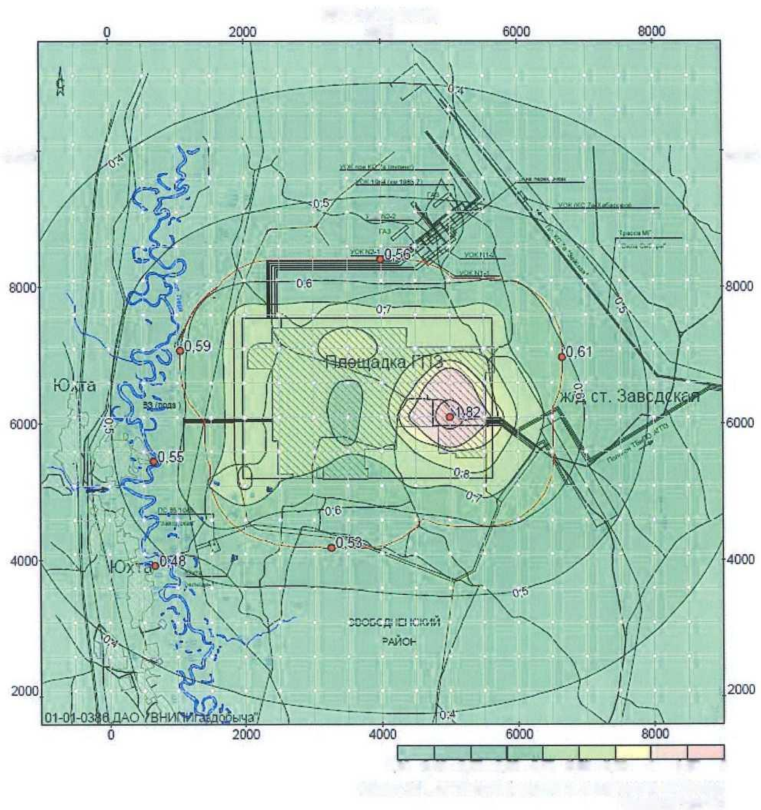


Figure 9.2.8: Estimated maximum ground concentrations of major pollutants at reference points at the GPP SPZ (a) and Yukhta boundaries (b), as MPC fractions

(a)



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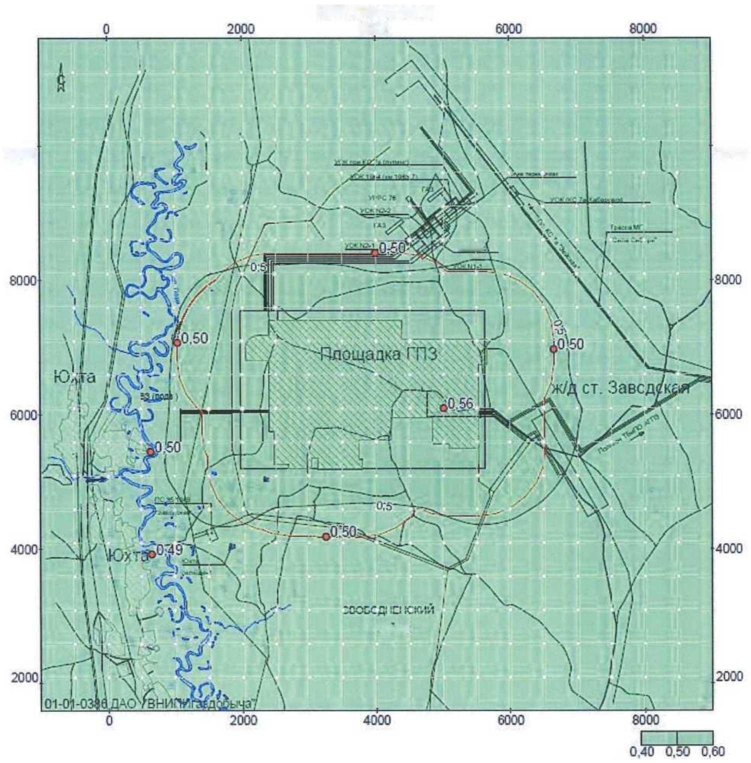

Figure 9.2.9: Dispersion maps for nitrogen dioxide (a) and carbon monoxide (b) during construction of the Main Production Facilities on the Amur GPP Project site

9.2.3.8 Air emissions during construction of the Housing Project: offices and residential buildings with associated infrastructure (Stage 5.1)

The Project provides for construction of the housing complex in Svobodny, including social infrastructure facilities (office centre, communication facility, boiler plant, kindergarten, school, policlinic, etc.) and independent utilities (power supply, water supply and discharge, heating system, etc.) The estimated duration of construction will be 2.4 years. The impact on air quality during Stage 5.1 may be defined as local and short-term.

Sources of air pollution during construction will be construction sites and operation of construction and installation equipment (excavators, mobile machinery, compressor unit, welding and painting shops).

The emission data referred to below are based on the results of air emission calculations for construction Stage 5.1. No modelling of maximum ground concentrations of major pollutants at the residential area boundary was undertaken for this construction stage. Total air emissions of pollutants during construction

9.2.3.9 Air emissions during construction of the church in Svobodny (Stage 5.3)

The construction will consist of the preparation stage and the main stage. The estimated duration of construction will be 26 months.

Sources of impact on air quality during construction will be construction and road building equipment, welding operations, excavation and painting works.

The emission data referred to below are based on the results of air emission calculations for construction Stage 5.3 included in the design documentation [7].

The dispersion modelling results indicate that maximum ground concentrations of pollutants at the residential area boundary will not exceed 1 MPCmnr (Figure 9.2.10: Estimated maximum ground concentrations of major pollutants at reference points at the residential area boundary, as MPC fractions

Emissions during the construction period will total 4.261 tonnes per year. Emissions will include 15 pollutants and 4 summation groups (Appendix 5, Table 8).

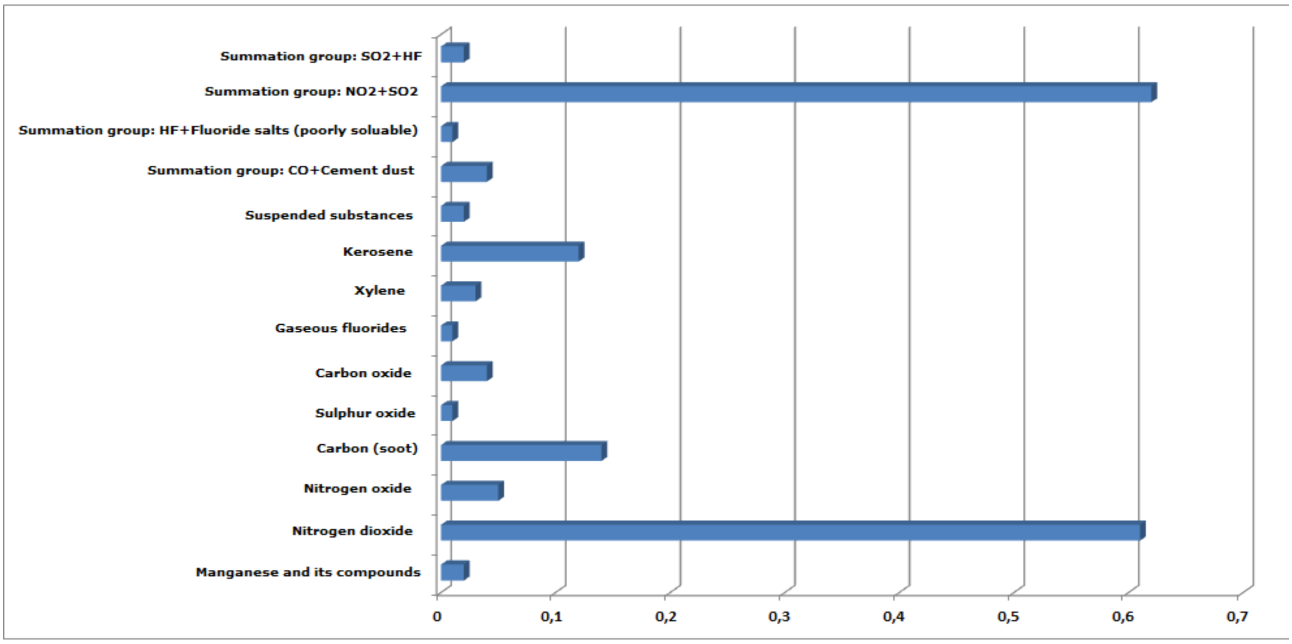

Figure 9.2.10: Estimated maximum ground concentrations of major pollutants at reference points at the residential area boundary, as MPC fractions

[7] Amur GPP Project Documentation. Stage 5.3: Orthodox Church for 500 attenders in Svobodny. Section 8: Environmental protection activities

9.2.3.10 Air emissions during construction of the Solid Domestic and Industrial Waste Landfill – SDIW Landfill (Stage 6)

The SDIW Landfill site will be located 17 km north of Svobodny and 8.1 km southeast of the AGPP site. The distance from the proposed SDIWL site to the nearest settlement (Gaschenka) is 3 km.

Air pollution during execution of construction works of Stage 6 will be primarily associated with:

- operation of vehicles and construction equipment on the construction site;
- operation of diesel generators (mobile power plants);
- earth-moving works and handling operations involving dust generating materials such as sand, crushed rock, etc.;
- filling of equipment and fuel storage tanks;
- welding operations; and
- painting operations.

The estimated duration of construction is 9 months.

The pollutant dispersion modelling for the area of 4.1 x 3.5 km was performed using the EKOLOG-PRO software. The dispersion modelling was based on simultaneous operation of all identified sources of pollutant emissions.

According to the modelling results, concentrations of pollutants at the boundary of Gaschenka settlement located 3 km from the construction site, will not exceed the MPCmnr (SRLI) limit values for the air quality in settlements (Figure 9.2.11: Estimated maximum ground concentrations of major pollutants at the residential area boundary (Gaschenka), as MPC fractions

The nitrogen oxide level of 1 MPC (including the background concentrations) will be reached at the distance of 530 m from the construction site.

The area of influence for the construction period, i.e. the distance to the 0.05 MPC isoline (established for nitrogen dioxide without allowance for the background level), will be 5.9 km.

The estimated total emissions are detailed in Appendix 5, Table 9.

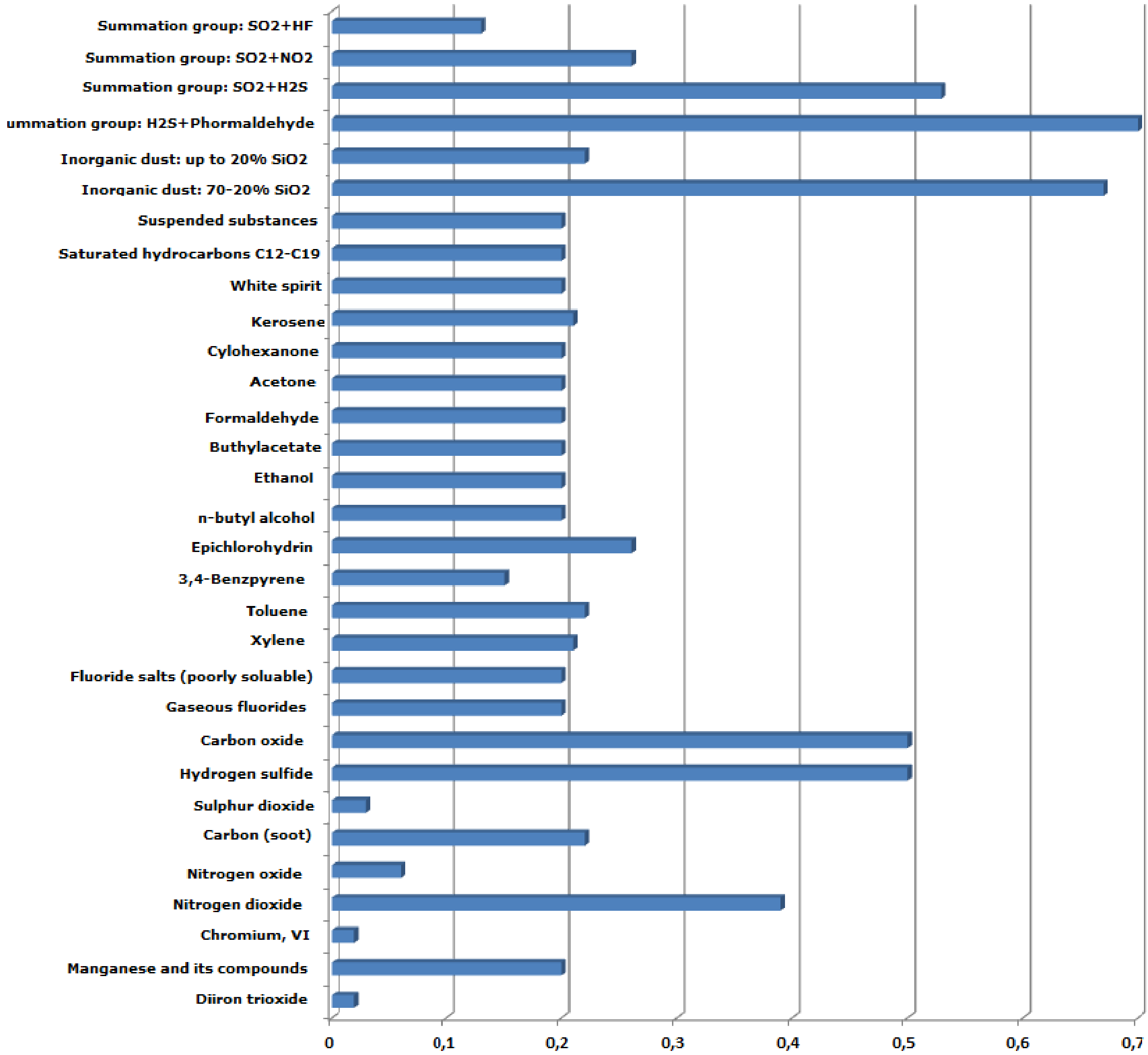

Figure 9.2.11: Estimated maximum ground concentrations of major pollutants at the residential area boundary (Gaschenka), as MPC fractions

9.2.3.11 Assessment of impact on ambient air during construction and impact mitigation measures

During construction, air impact mitigation measures will be primarily associated with reduction of harmful emissions from construction equipment and vehicles.

The assessment of pollutant emissions (see 9.2.3.1 - 9.2.3.10) enables the following general conclusions concerning the character and scale of impact of the Project construction on the ambient air quality in surrounding area:

- Maximum concentrations of pollutants at the boundary of settlements at all construction stages will not exceed the MPC_{mnr} (SRLI) limit values for the air quality in settlements. These levels will be used as the MPE limit values for the Project construction period. The Project does not provide for establishing SPZ at the project construction sites for the construction period.
- Major air pollution sources will be engines of construction equipment and vehicles, diesel generators, boiler plants, and painting operations.
- Major pollutants that will determine the level of impact on ambient air quality during construction will be nitrogen oxides, carbon monoxide, methanol, and particulate matter (suspended solids).
- Adverse impact will be local, short-term, and reversible (only during construction).

Special measures (embedded controls) aimed at reduction of adverse impacts on ambient air quality during construction will include:

- strict compliance with construction and installation process requirements established in the Construction Management Plan (CMP) and Work Execution Plan (WEP);
- use of state-of-the-art construction machinery equipped with engines complying with the European emission standards Euro III - Euro IV;
- preventive maintenance and technical inspections of construction machinery, mechanisms and vehicles, including control of exhaust gases from internal combustion engines at least once a year (scheduled monitoring) and after each repair and timing of engines;
- prohibition of operation of machinery/vehicles which were not subject to technical inspection and exhaust gases monitoring;
- avoidance of idle operation of engines (i.e. engines must be cut off if they are not in use for a continuous period of time);
- use of state-of-the-art diesel power plants which meet the Project's emission requirements;
- operation of diesel power plants in accordance with the operating manual;
- use of low sulphur diesel fuel;
- avoidance of simultaneous traffic of construction machinery and vehicles to/from construction sites;
- distribution of operation of machinery and equipment that are not involved in one continuous technological process;
- prohibition of construction waste burning (cable insulation, wood waste, oiled rags, etc.) unless special incinerators are used;
- use of sealed containers for storage of fuels and lubricants;
- storage of volatile chemicals and loose materials in sealed containers and within closed premises;
- use of canvas covers for transportation of dust generating materials; and
- use of dust suppression techniques in loading-unloading areas.

According to the impact assessment criteria used in this ESIA (Chapter 3), adverse impact on ambient air quality during construction can be assessed as ***short-term, local, reversible*** and, consequently, of ***low severity***. These impacts are also assessed as ***probable***. The overall impact of the Project construction on the ambient air quality in the surrounding area may be assessed as ***low*** or even ***negligible***, provided that embedded controls/ mitigation measures are implemented.

9.2.3.12 Monitoring of ambient air quality during construction

Since major air pollution sources during construction of the Project facilities will be construction equipment, vehicles, diesel power plants and loose material and soil handling operations, the monitoring of air quality will focus on the following pollutants: particulate matter, carbon monoxide, nitrogen oxide, and nitrogen dioxide. Control of exhaust gases from construction and road building machinery will be carried out as part of the maintenance and repair procedures and, therefore, will not be included in the environmental monitoring programme.

The air sampling schedule/intervals for each facility under construction will be determined in the Programme for Operational Environmental Control (OEC). The sampling process includes measurements of air temperature and humidity, wind velocity and direction, atmospheric pressure, and description of weather conditions.

Although specific points will be selected on location with account of the following:

- reference point must be located to allow for influence of existing infrastructure (motor roads, railway) on ambient air quality;
- control point must be located within the nearest settlement with reference to the facility under construction.

Air quality monitoring results will be included in the OEC reports that will be submitted to the Amur GPP administration and construction contractors for the purpose of construction process management[8].

9.2.4 Impact on ambient air during operation of the Project facilities

Impact on ambient air quality during operation will be evaluated for all sites and facilities of the Project discussed above for the construction period except for that responsibility for which will be passed to third parties after construction completion. Thus, emissions from the housing complex in Svobodny and associated infrastructure as well as from public facilities of the railway infrastructure ("Ust-Pera" railway station) are not discussed in this section.

Some facilities, such as the temporary jetty on the Zeya River and the TBI site, will be operated during construction only. Although emissions from these facilities are discussed in this section, according to the Project implementation schedule, this information refers to the construction period.

The emission data referred to below are based on the results of air emission calculations included in the design documentation. Unless specified otherwise, these calculations were made using the OND-86 model and the EKOLOG software package. No additional air emission modelling was undertaken within the framework of this ESIA.

9.2.4.1 Air emissions during operation of temporary buildings and installations (TBI)

This subsection is limited to discussion of the TBI sites which include air emission sources:

- *general infrastructure site* with a fire depot for four firefighting vehicles
- *temporary construction (mechanical) yard* with an open parking for vehicles and special equipment;
- *contractor's fuel storage facility* with an oil tank farm consisting of:
    - diesel supply tanks V=7*200 m^3;
    - diesel pumping unit;
    - diesel drainage tank V=50 m^3; and
    - fuel dispenser;
- *auxiliary area facilities*:
    - boiler plant;
    - cenclosed diesel power plant (DES-630);
    - auxiliary diesel power plants (Energo D1000) (9 operating + 1 backup.)

Emission sources during normal operation

Continuous pollutant emissions will be produces by stationary ('controlled') and fugitive ('uncontrolled') sources.

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[8] For example 'Final Technical Report on OEM for Construction Stage 1.1', Amur Regional Centre of Laboratory Analysis and Technical Measurements. Blagoveschensk, 2016

Stationary emission sources on the TBI site will consist of:

- smoke stacks of the boiler plant;
- ventilation stacks of the fire depot for 4 fire fighting vehicles;
- exhaust pipes of auxiliary diesel power plants;
- ventilation valves of diesel supply tanks.

Sources of fugitive ('uncontrolled') emissions on the TBI site will be the outdoor parking for vehicles and special equipment, diesel pumping unit and fuel dispensers.

Sources of instantaneous (peak) emissions

Sources of instantaneous (peak) emissions will include:

- exhaust pipes of the enclosed diesel power plant DES-630 during testing of the diesel engine;
- vent valves of diesel supply tanks , diesel drainage tank.

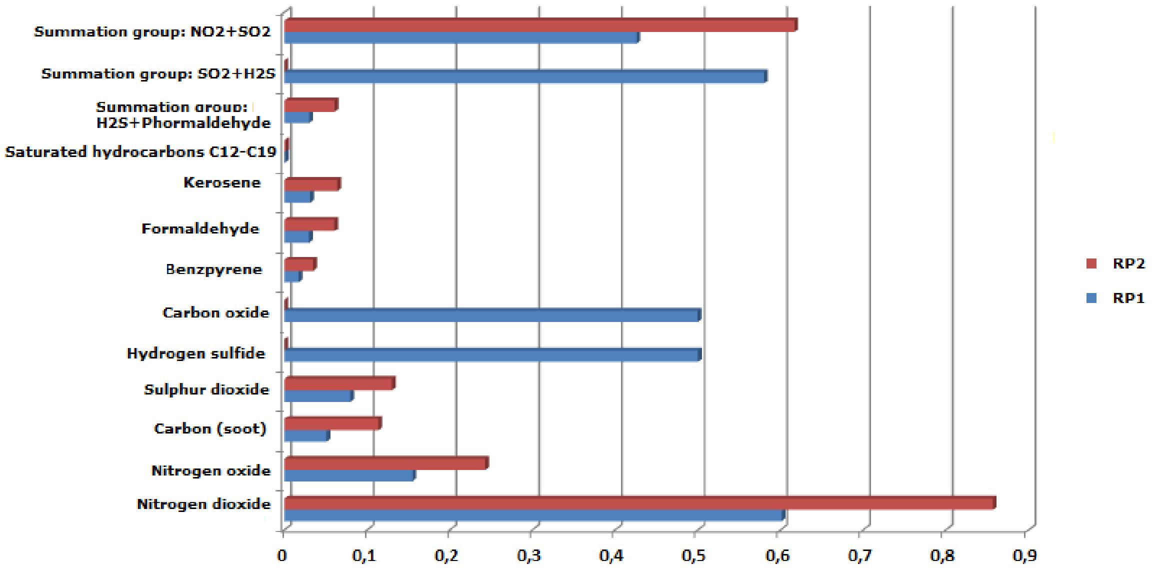
No sources of emergency emissions will be located on the TBI site.

Analysis of pollutant emissions dispersion

The modelling of dispersion of pollutants in surface air was undertaken to determine the level of air pollution and to evaluate its impact on the air quality in the area around the TBI sites. The modelling was performed for two reference points located at the boundary of Yukhta, the nearest settlement located at the distance of 1.4 km to 3.0 km from the TBI sites. The calculations were made for normal operation and peak emissions conditions (during testing of diesel power plants in the auxiliary facilities area).

The modelling results indicate that the concentration of pollutants at the nearest settlement (Yukhta) boundary during normal operation and peak emissions conditions will not exceed the MPCmnr (SRLI) limit values established for the air quality in settlements (Figure 9.2.12: Estimated maximum ground concentrations of major pollutants at the Yukhta boundary, as MPC .

(a)



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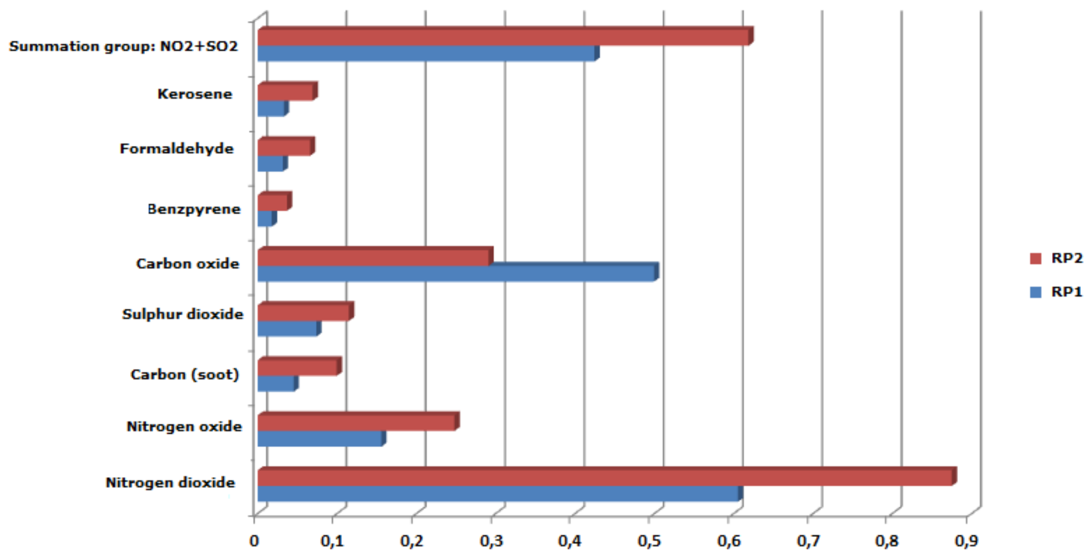


Figure 9.2.12: Estimated maximum ground concentrations of major pollutants at the Yukhta boundary, as MPC

Major contribution to the total emissions will be made by carbon monoxide (34.0%), nitrogen dioxide (26.4%), and nitrogen oxide (15.7%) from exhaust pipes of diesel power plants and smoke stacks of the diesel-powered boiler plant.

9.2.4.2 Operation of the Project's railway infrastructure

Impact on the ambient air quality during operation of the "Ust-Pera" public railway station is not discussed within the framework of this ESIA, due to the fact that after commissioning the facility will be handed over to the Trans-Baikal Railway (affiliate of the Russian Railways Company). In addition, the station tracks will be electrified, i.e. adapted for electric locomotives and, consequently, no air emission sources will be in use.

Air emissions at railway stations are generated by stationary and mobile sources. Mobile sources consist of vehicles in garages within the station area, buses and passenger vehicles delivering employees to work, and shunting diesel locomotives. Other emission sources will be stationary.

Air emissions during operation of the "Zavodskaya" railway station

The railway station will include the following facilities containing sources of air emissions:

1. Maintenance and test station (mechanical shop);
2. Garage;
3. Diesel-powered boiler plant (two boilers 3 MW and 1.5 MW);
4. Diesel generators (DES) for emergency power supply;
5. Diesel fuel storage;
6. Stationary rail tracks;
7. Locomotive depot with the associated office and amenity complex (OAC);
8. Testing of diesel locomotives.

After maintenance/repair, diesel locomotives will be subjected to full rheostatic tests. Emissions from full capacity tests of locomotives will be of a short duration (30 minutes) and will be conducted not more than 12 times per year in normal operation conditions. However, emissions from tests will exceed the average emission level.

Total 42 air pollution sources were identified, including three sources of fugitive emissions. Reference points for assessment of maximum emissions are located at the residential area boundary.

Modelling of ground concentrations of air pollutants during peak emissions

Peak emissions are characterised by very high levels. Embedded organisational controls for mitigation of air impact should provide for avoidance of simultaneous rheostatic testing and operation of other sources of emissions of the same pollutants. The rheostatic testing procedure will automatically stop or suspend the following operations and activities:

- maintenance of diesel power plants;
- warm-up of engines in the garage;
- use of test equipment for burner valves, plunger and barrel assemblies, and fuel feed pumps;
- shunting operations; and
- traffic of vehicles in the open parking area.

The modelling of ground concentrations for peak emissions also allowed for distributing of operations of the depot washing machines, blasting chambers (one machine producing maximum emissions and one chamber were included in the calculations) and battery maintenance (battery maintenance shop in the locomotive depot). The calculations were made for the summer period when the boiler plant is operated in accordance with the summer schedule.

The modelling results allowing for peak emissions are summarised in Appendix 6, Table 2.

Calculations allowing for peak emissions indicate that, while ground concentrations of all pollutants and pollutant combinations (summation groups) within the site may reach 13 MPC with allowance for the background level (carbon black), the concentrations of these at the residential area boundary will not exceed 0.3 MPC with allowance for the background level.

Modelling of ground concentrations of pollutants without allowance for peak emissions

The following scenario was modelled:

- oil storage facility is filled; a locomotive is being fuelled;
- engine warm-up and vehicle inspection operations are performed in the garage;
- both welding stations and a grinding machine are in simultaneous use in the mechanical shop;
- one washing machine is in use in the locomotive depot (cover cleaning machine characterised by high emissions);
- test facility for burner valves is in use in the fuel equipment maintenance and repair shop;
- emissions from the battery maintenance bench in the battery shop in the locomotive depot (batteries are charged separately on a different schedule);
- soldering operations are performed in the locomotive depot electrical shop;
- one of the blasting chambers in the locomotive depot is used;
- grinding machine is in use in the locomotive depot mechanical shop and welding is performed simultaneously on two work benches;
- rubber vulcanisation is in process;
- soldering operations are performed simultaneously at two working stations on office and amenity premises (AOC) of the locomotive depot;
- boiler plant is operated to full capacity in accordance with the winter schedule;
- maintenance works on diesel power plants are conducted (the diesel power plant with the highest emissions is selected);
- shunting operations are carried out by two diesel locomotives; and
- engines of cars and buses in the open parking area are running.

It was taken into account that all emission sources cannot be in simultaneous use. The calculations were made for the winter period when the boiler plant is operated in accordance with the winter schedule.

Modelling results indicate that ground concentrations of all pollutants and pollutant combinations (summation groups) will reach 0.98 MPC with the background level included (alkanes C_{12}-C_{19}). The levels at the residential area boundary will not exceed 0.48 MPC with allowance for the background level (carbon monoxide).

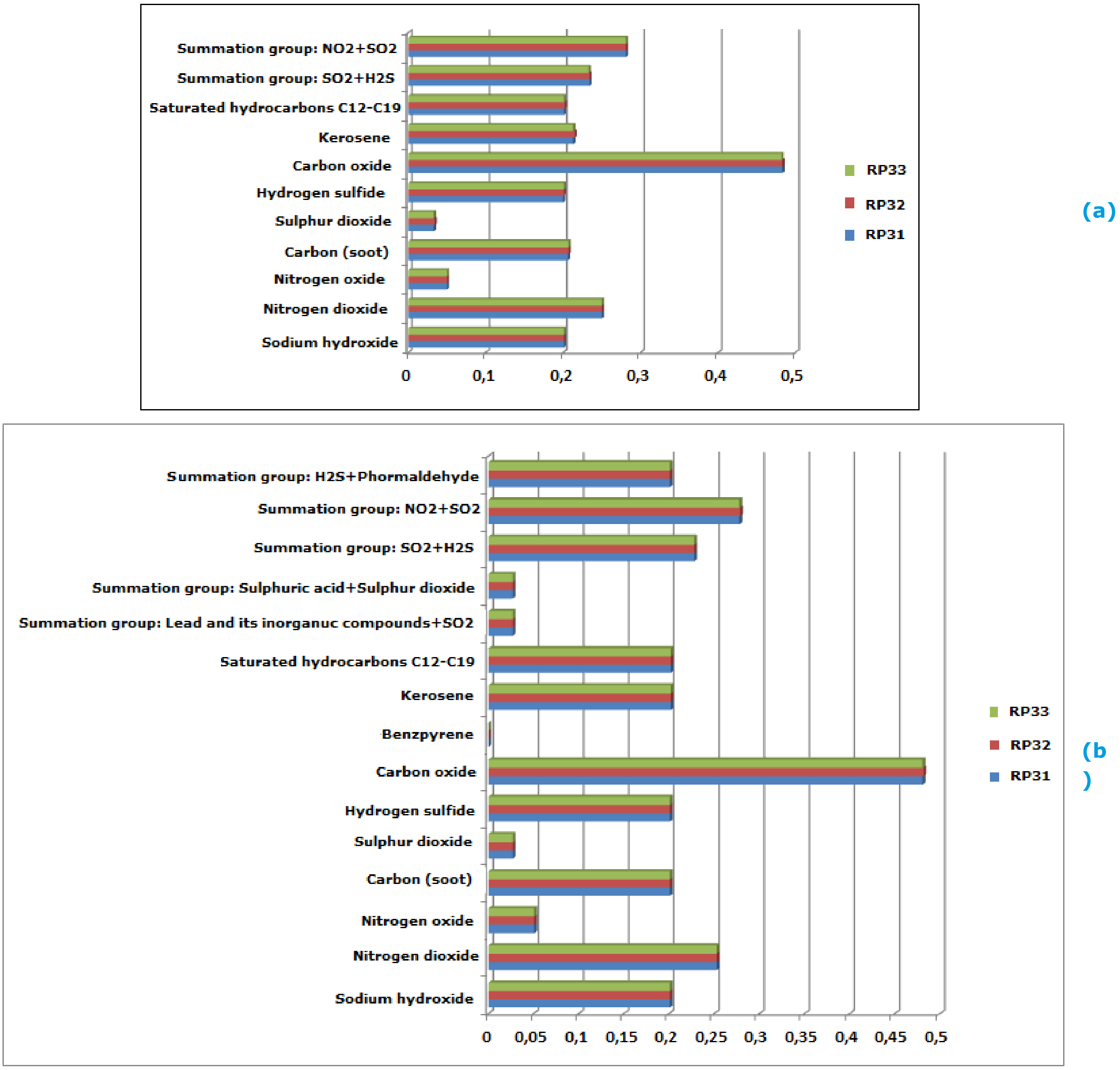


Figure 9.2.13: Maximum ground concentrations of major pollutants (as MPC fractions) at reference points at the residential area boundary: (a) in case of peak emissions and (b) w/o peak emissions

Air emissions during operation of "Zavodskaya-2"

The railway tracks at the station and haul lines will not be electrified. One diesel locomotive (TEM7) will be used for shunting operations and another will be used for haulage. The diesel locomotives will be in operation 24 hours per day 365 days per year and will be replaced with similar machines during maintenance/repair periods.

Emergency power supply for fire pumps will be provided from a 200 kW diesel power plant. The power plant will be equipped with a 10-m3 diesel storage tank.

The modelling of emissions during operation of "Zavodskaya-2" was performed for five sources, including two sources of fugitive emissions (diesel locomotives). The estimated total emissions during operation are summarised in Appendix 6, Table 2.

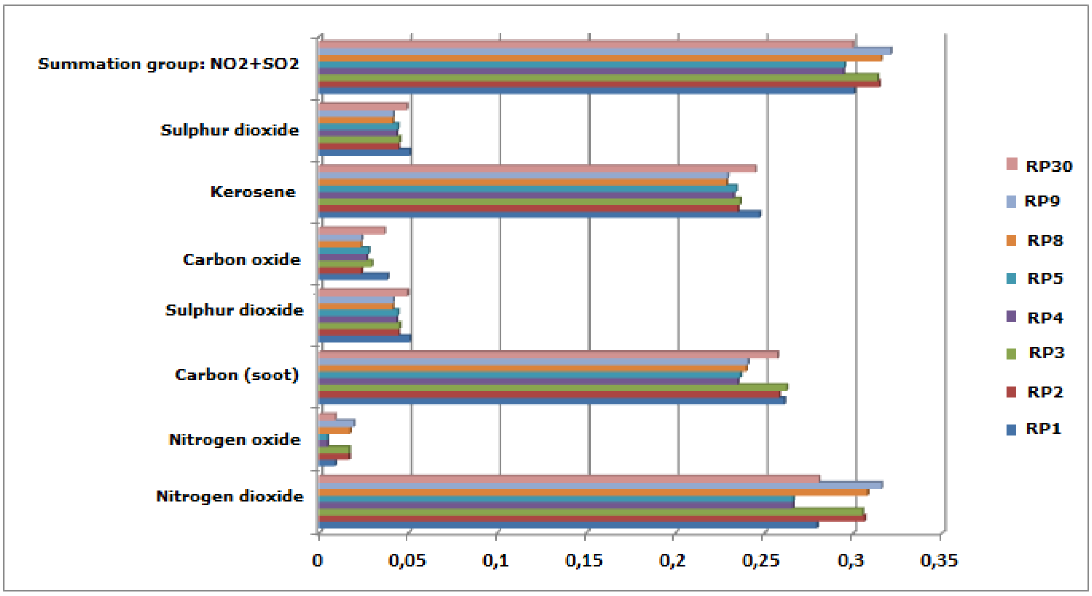
The ground concentrations were modelled for the worst-case scenario when the diesel locomotive from the haul line approaches the "Zavodskaya-2" station and, consequent, the impact on the residential area is at its maximum

The modelling enabled identification of ground concentrations of pollutants and assessment of their impact at the sanitary break boundary and at reference points at the boundary of the nearest residential area (Figure 9.2.14: Maximum ground concentrations of major pollutants at reference points at the boundary of (a) residential area and (b) sanitary break

Figure 9.2.14: Maximum ground concentrations of major pollutants at reference points at the boundary of (a) residential area and (b) sanitary break

(a) indicates that ground concentrations of pollutants at the residential area boundary will not exceed 1MPCmnr. The modelling results also indicate that the ground levels of pollutants at the haul line sanitary break will not be greater than 1 MPCmnr either (Figure 9.2.14: Maximum ground concentrations of major pollutants at reference points at the boundary of (a) residential area and (b) sanitary break

(b)). The latter result proves that the size of the haul line sanitary break (100 m on both sides), based on the chemical air pollution criterion, was determined correctly.



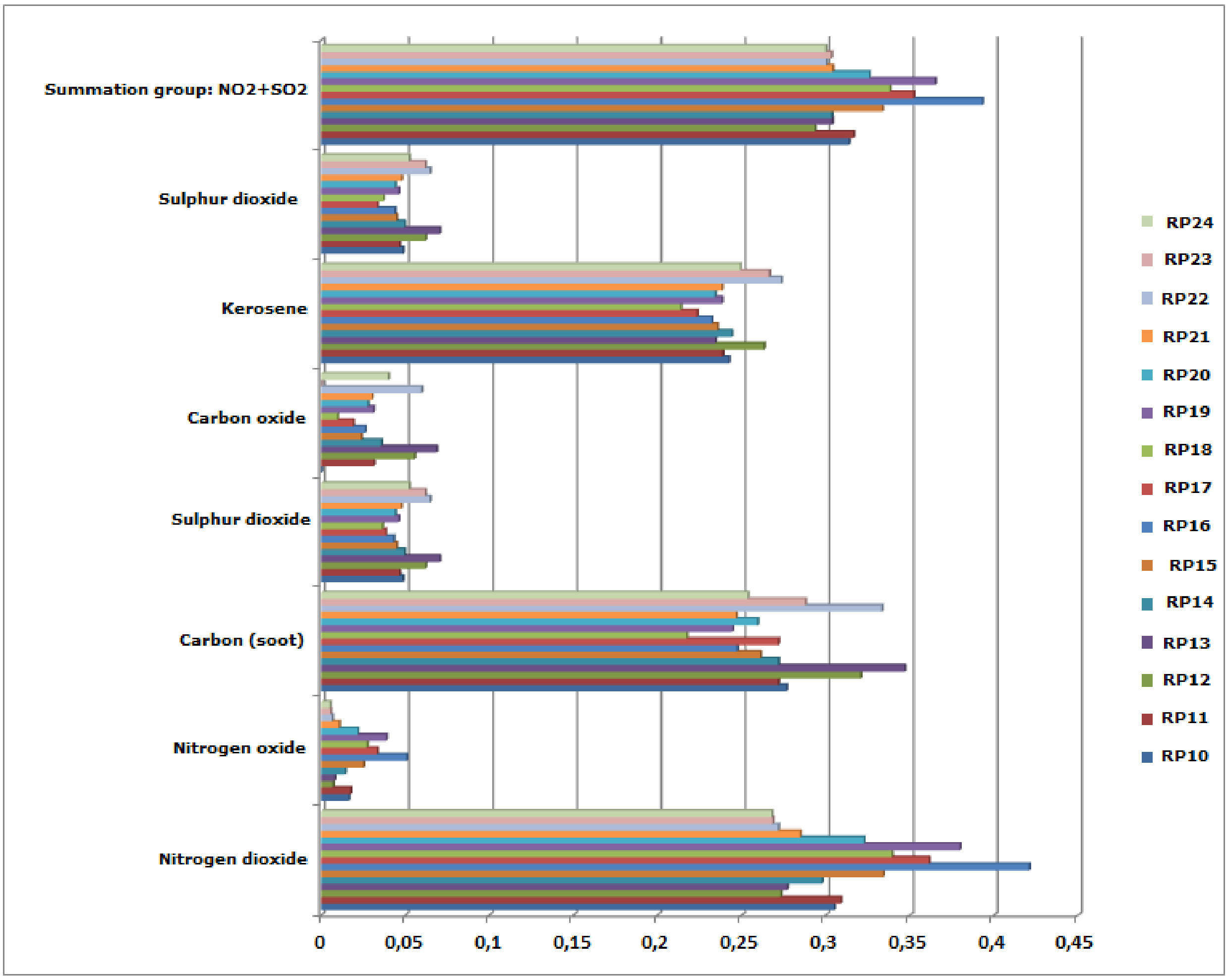


Figure 9.2.14: Maximum ground concentrations of major pollutants at reference points at the boundary of (a) residential area and (b) sanitary break

9.2.4.3 Operation of the Auxiliary Facilities

The assessment of air pollution level and it impact on the air quality in the surrounding area during operation of the auxiliary facilities consisted of identification of pollutant emission sources, modelling of dispersion of pollutants in the surface air, and calculations of the total emissions of pollutants. The calculations were made for the normal operation and peak emissions conditions[9]. The modelling was performed for six reference points located at the boundary of the nearest settlement, Yukhta (1.7 to 2.3 km from the Amur GPP site).

Normal operation of the auxiliary facilities

PContinuous emissions during normal operation of the auxiliary facilities will be generated by the following sources:

(1) Motor transport department site:

- *ventilation stacks* of the maintenance and repair shop, heated parking facilities, washing facility for vehicles and special equipment, tank truck parking facilities, garage for handling equipment;
- *vent valves* of diesel and petrol storage tanks at the filling station, diesel supply tanks, fuel and lubricant storage facility;
- *open areas for parking tracked vehicles (under cover), parking area at the filling station*.

(2) General plant facilities site:

- *smoke stacks* of Water Boiler Plant No. 3;
- *exhaust pipes* of the diesel power plant (Energo D1000/10.5);
- *ventilation stacks* of the emergency response and rescue depot;
- *vent valves* of diesel supply tanks, underground tanks for rainwater collection (if full);
- *pumping plant* at the fuel and lubricant storage facility.

The modelling results indicate that the estimated ground concentrations of all pollutants at the SPZ and Yukhta boundaries during normal operation of the Auxiliary Facilities will be below the MPC limit values:

- *Yukhta residential area boundary:*
  - 0.55 MPC for summation group 'sulphur dioxide+ hydrogen sulphide.
- *SPZ boundary of the Amur GPP:*
  - 0.89 MPC for nitrogen dioxide.

Operation of the auxiliary facilities during peak emissions

Sources of peak emissions will be:

- Motor transport department site:
  - *vent valves* of diesel and petrol storage tanks at the filling station, diesel supply tanks, drainage tanks (if full);
  - *filing station site*;
- General plant facilities site:
  - *vent valves* of diesel supply tanks, underground drainage tank, and underground tanks for rainwater collection (if full);
  - *exhaust pipes* of diesel power plants 'Zvezda-1000VK-02MZ-02' and DES-1600 during diesel engine testing;
  - *diesel pumping station site*;
- All sites in emergency operation conditions:
  - exhaust pipes of the emergency diesel power plant in the event of external supply cut-off.

The calculations results indicate that in the event of peak emissions associated with the blackout of the emergency diesel power plant the estimated ground level concentrations of all pollutants at the SPZ and Yukhta boundaries will be below the established MPC limit values:

- *Yukhta residential area boundary:*

[9] Amur GPP Project Documentation. Stage 3.1: Auxiliary Facilities. Section 8: Environmental protection activities

    - 0.55 MPC for summation group 'sulphur dioxide+ hydrogen sulphide.
- *SPZ boundary of the Amur GPP:*
    - 0.94 MPC for nitrogen dioxide.

The area of influence of the auxiliary facilities on the ambient air quality was determined for the peak emissions of nitrogen dioxide. The modelling results indicate that the boundary of impact of the proposed facilities (isoline 0.05 MPC) during operation will be located at the distance of 7.5 km to 9.8 km from the Amur GPP site boundary.

According to the calculations results, major pollutants during operation of the auxiliary facilities of the AGPP Project (Stage 3.1.) will be carbon monoxide (32.6%), nitrogen dioxide (25.3%), nitrogen oxide (15.1%), and sulphur dioxide (11.0%) from smoke stacks of the boiler plant and exhaust pipes of auxiliary diesel-fuelled power plants.

Assessment of the SPZ size for the auxiliary facilities

Sanitary regulations establish the following dimensions for the standard SPZ of auxiliary facilities:

- 100 m for motor transport department as the facility for maintenance of cars and trucks;
- 100 m for fuel and lubricant storage facilities.

The SPZ size for the Amur GPP will be 1,000 m, which is the standard for natural gas processing facilities.

Since the auxiliary facilities site will be located within the standard SPZ of the Amur GPP, no special SPZ allocation is required.

9.2.4.4 Operation of the temporary jetty on the Zeya River

The temporary jetty will be used for transhipment of heavy oversized equipment arriving for the Project construction from barges onto truck trains using tracked cranes. The jetty will be operated periodically, without permanent presence of personnel. Emissions of air pollutants will be produced by vehicles and transport equipment supporting the jetty operation. No emergency or peak emissions of air pollutants will occur during the facility operation.

Based on the technical solutions two periods of the jetty operations can be set:

1. Navigation (4 months); and
2. Assembly of the equipment and installations of the jetty.

The jetty will not be operated between the navigation periods.

Navigation period

Major sources of air emissions during navigation will consist of (Figure 9.2.2.15):

- exhaust pipes of diesel power plants DES 150 kW and DES 20 kW;
- tugboat RT-600;
- two tracked cranes (750 t and 800 t);
- truck trains for transportation of oversized equipment shipped by barges;
- vehicles used for water supply, removal of waste, storm water effluents and sewage from portable toilets;
- mcar parking areas.

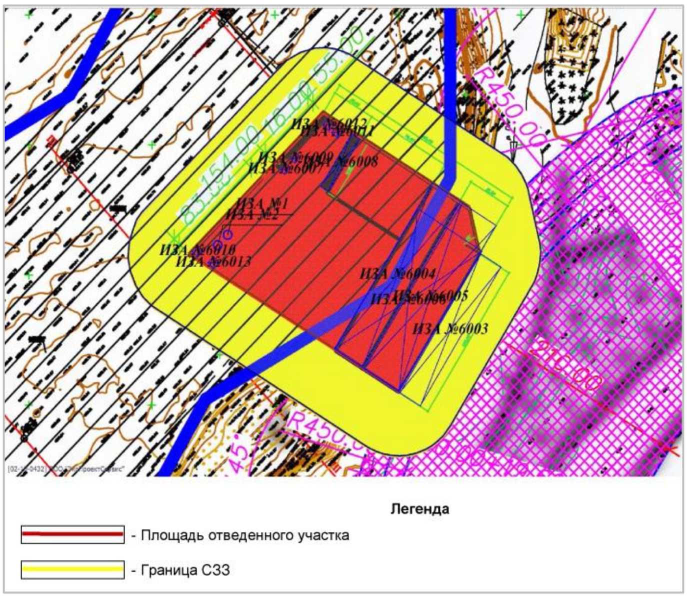


Figure 9.2.15: Plan of the Temporary Jetty the Zeya River indicating pollutant emission sources and SPZ

The modelling of ground concentrations of pollutants at the temporary jetty boundary was carried out for the peak operation period, i.e. unloading of barges.

Figure 9.2.16 indicates that the estimated maximum concentrations of pollutants at the Temporary Wharf operations boundary will not exceed 1 MPC (SRLI) for all pollutants. Since the distance to the nearest residential area will be 5 km, no exceedance of the sanitary limit values is expected.

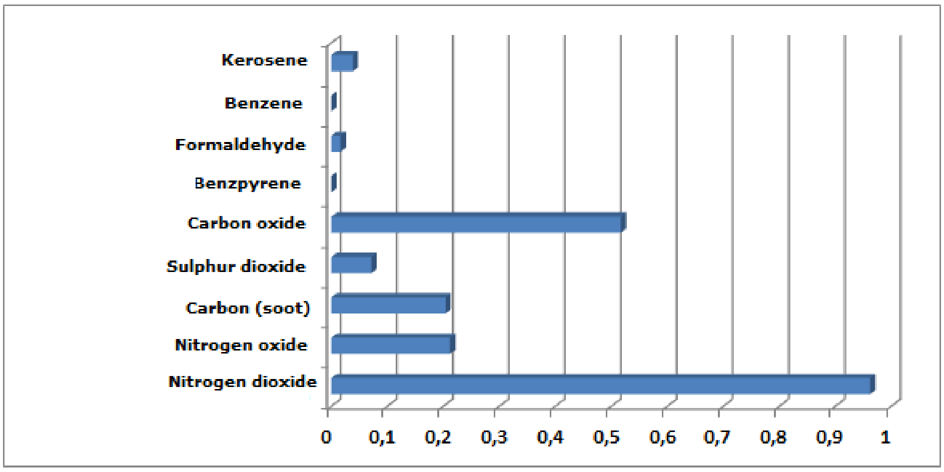


Figure 9.2.16: Estimated maximum ground concentrations of major pollutants at the site boundary of the Temporary Jetty on the Zeya River, as MPC fractions (navigation period)

According to 03 sanitary classification the Temporary Wharf belongs to Class V, i.e. the required size of the SPZ is 50 m (Figure 9.2.15: Plan of the Temporary Jetty the Zeya River indicating pollutant emission sources and SPZ

9.2.4.5 Operation of access roads

The modelling of pollutant dispersion during operation of the Project's AMR was undertaken to determine the impact of the proposed activities on the ambient air quality in the subject area.

The modelling focused on the most intensively used roads: section 1 of AMR 1 and AMR 3 near Yukhta. The reference point was set at the boundary of the nearest residential area of Yukhta located at the distance of 2.89 km. The MPC_{mnr} for the air in settlements were used as the criterion for assessment of impact on the ambient air quality.

The modelling results indicated that ground concentrations of pollutants at the reference point at the nearest residential area boundary during operation of section 1 of AMR 1 and AMR 3 will not exceed the existing background levels, i.e. the level of 1 MPC will not be reached by any pollutant. Consequently, the ARM operation will produce no material impact on the ambient air quality within the subject area.

9.2.4.6 Amur GPP operation

Air emissions during normal operation

Continuous air emissions during operation of the main production facility will be produced by the following sources:

- **Gas drying and mercury removal unit** (process trains 1 to 6):
  - continuous 'controlled' emission sources: smoke stacks of direct-fired gas heaters;
  - continuous 'uncontrolled' emission sources: sites of flare separators, mercury adsorbent vessels, drying (adsorption) vessels, heat exchanger and gas filter racks, regeneration and cooling gas filters, regeneration gas separation racks, drainage tank, feed gas separator filters, furnace shutoff valves;
- **Ethane and NGL separation, nitrogen removal and nitrogen-helium concentrate production unit** (process trains 1 to 6):
  - continuous 'controlled' emission sources: compressor plant ventilation stacks;
  - continuous 'uncontrolled' emission sources: ethane and NGL separation, nitrogen removal and nitrogen-helium concentrate production units; de-ethaniser unit; flare separator and drainage tanks; building of expanders and compressors of the ethane and NGL separation, nitrogen removal and nitrogen-helium concentrate production unit; air cooling system of the ethane and NGL separation, nitrogen removal and nitrogen-helium concentrate production unit; cool box of the ethane and NGL separation, nitrogen removal and nitrogen-helium concentrate production unit.
- **Gas fractioning unit** (process trains 1 to 3):
  - continuous 'controlled' emission sources: none;
  - continuous 'uncontrolled' emission sources: - cooling system racks, drainage tanks, feedstock tanks, cooling units and heat exchangers, columns, flare tanks.
- **WNGL treatment unit** (process trains 1 to 3):
  - continuous 'controlled' emission sources: smoke stacks of fuel gas heaters;
  - continuous 'uncontrolled' emission sources: pumping units, fuel gas preparation unit, NGL filters, drainage tanks, gas filters, absorbers, flare separators, loading/unloading tanks.
- **Methane fraction compression plant** (process trains 1 to 6):
  - continuous 'controlled' emission sources: exhaust pipes of gas compressor units GPA-32 MW, vent valves of condensate collecting tanks, oil drainage and flush liquid collection tanks;
  - continuous 'uncontrolled' emission sources: compressor shop with GPA-32 MW, condensate collecting tanks, oil drainage and flush liquid collection tanks, gas air cooling units, filter separators.
- **General plant process facilities:**
  - continuous 'controlled' emission sources: smoke stacks of fuel and impulse gas treatment plant, water boiler No. 2, vent valves of diesel storage tanks, underground drainage tanks, ventilation stacks of the laboratory building, fire and gas rescue depot;
  - continuous 'uncontrolled' emission sources: sites of diesel pumping unit, fuel and impulse gas treatment plant;
    - **flare system facility:**
      - continuous 'controlled' emission sources: flares (two operating units) during continuous purging of the flare header of the main flare system, flare header of the commercial product and feedstock facility and special flare system;
      - continuous 'uncontrolled' emission sources: sites of flare separators and pumping plant;
    - **commercial product and feedstock facility:**
      - continuous 'controlled' emission sources: ventilation stacks of the mechanical repair shop, vent valves of supply diesel tanks (when used);

- continuous 'uncontrolled' emission sources: sites of: tank farm No. 1 for PF*/NGL and tank farm No. 1 pumping unit; flare separator; tank farm No. 2 for PHF/NGL, BF/ NGL, PBF/ NGL and tank farm No. 2 pumping unit; tank farm No.3 for NGL and its pumping unit;

* PF – propane fraction, PHF – propane-hexane fraction, BF – butane fraction, PBF – propane-butane fraction

- **loading/unloading rack:**
  - continuous 'controlled' emission sources: none;
  - continuous 'uncontrolled' emission sources: double-service LPG loading rack, tanks for unloading defective tank cars, drainage tanks, single-service rack for loading highly flammable liquids (HFL), drainage tanks for spills recovery, flare separator.

Peak air emissions

All process operations at the Amur GPP will continue uninterrupted during 365 days per year. However, the equipment operating procedures provide for the scheduled shutdown periods for routine preventive inspection and maintenance, or for conversion to standby. These periods will be associated with controlled emissions of natural gas which are classified as 'peak emissions'.

Sources of peak emissions of air pollutants at the Amur GPP facilities will include:

- **Methane fraction compression plant:**
  - vent valves of condensate collecting tanks, oil drainage and flush liquid collection tanks (when filled);
  - vent stack during purging of the primary injector system when gas compressor units are started up, and during venting of gas from the heating system of the gas compressor housing when compressor units or booster module are being shut down;
- **Power generation sites:** exhaust pipes of diesel generators during test start-ups;
- **Flare system facility:** flares (two operating units) shutdown for maintenance of: gas drying and mercury removal unit; gas fractioning unit; NGL treatment unit; ethane and NGL separation unit; nitrogen removal and nitrogen-helium concentrate production unit; separate gas compressor units or the entire module of gas compressor units; commercial product and feedstock facility;
- **Commercial product and feedstock facility:**
  - vent stacks at Tank Farm No.1 for PF/ NGL; Tank Farm No.2 for PHF/ NGL, BF/ NGL, PBF/ NGL; and Tank Farm No.3 for NGL; during annual maintenance of one of the spherical tanks at each tank farm and venting of product/gas to stack;
  - exhaust pipe of the diesel generator at the diesel power plant during test start-ups;
  - vent valves of diesel supply tanks (when filled);
  - exhaust pipe of the diesel generator at the loading/unloading rack during test start-ups;
- **General plant facilities:**
  - exhaust pipes of the diesel generators during test start-ups;
  - vent valves of diesel supply tanks, underground drainage tank, and underground storage tanks for rainwater (when filled).

Air emissions during emergency operation

For emergency situations at the Amur GPP facilities, the design provides for discharge of gas from the process system to flares.

An emergency situation may occur if external power supply is cut off causing activation of emergency power plants. Sources of emergency emissions will be exhaust pipes of diesel generators at the power generation facilities, commercial product and feedstock facility, loading/unloading rack, and general plant facilities.

Sources of emergency emissions:

- power generation sites: exhaust pipes of diesel generators of diesel power plants if the main power supply source is cut off;
- flare system facilities: the flare of the plant flare system in the event of emergency shutdown of gas drying and mercury removal unit, gas fractioning unit, NGL treatment unit, ethane and NGL separation unit, or nitrogen removal and nitrogen-helium concentrate production unit;

- commercial product and feedstock facility, loading/unloading rack, and general plant facilities: exhaust pipes of diesel generators of diesel power plants if the main power supply is cut off.

Emission dispersion modelling

The air emission modelling was undertaken for the following modes of the process equipment operation:

- normal operation of the main and auxiliary process equipment;
- maximum peak emissions during discharge of gas mixture from the ethane and NGL separation, nitrogen removal and nitrogen-helium concentrate production unit to the flare and massive discharge of product from one of the spherical tanks to the vent stack of the commercial product and feedstock facility during tank maintenance;
- emergency situation at one of the gas drying and mercury removal units resulting in the maximum discharge of gas to the flare and activation of the emergency power plants at one of the power generation facilities (blocks).

Six reference points were identified to determine the level of air pollution at the SPZ boundary of the Amur GPP[10] and at the boundary of the nearest settlement, Yukhta, located at the distance of 1.7 km to 2.3 km from the Project site.

The modelling results for all conditions of the process equipment operation indicate that the estimated ground concentrations of all pollutants at the SPZ boundary, as well as at the boundary of the Yukhta community allotments and its residential area, will be below the MPC_{mnr} limit established for the air quality in settlements (9.2.17).

Dispersion maps in Figure 9.2.18: Pollutant dispersion maps for the operation of the Min Production Facilities: (a) normal operation, (b) emergency operation, and (c) the area of influence on ambient air quality during operation

provide a visual illustration of dispersion of some pollutants during normal and emergency operation conditions.

The area of influence of the proposed facilities on the ambient air quality was determined for the normal operation of the Project facilities at the 'full development' stage. The modelling results indicate that the size of this area will vary from 6.7 to 8.1 km for the mixture of natural mercaptans (Figure 9.2.18: Pollutant dispersion maps for the operation of the Min Production Facilities: (a) normal operation, (b) emergency operation, and (c) the area of influence on ambient air quality during operation

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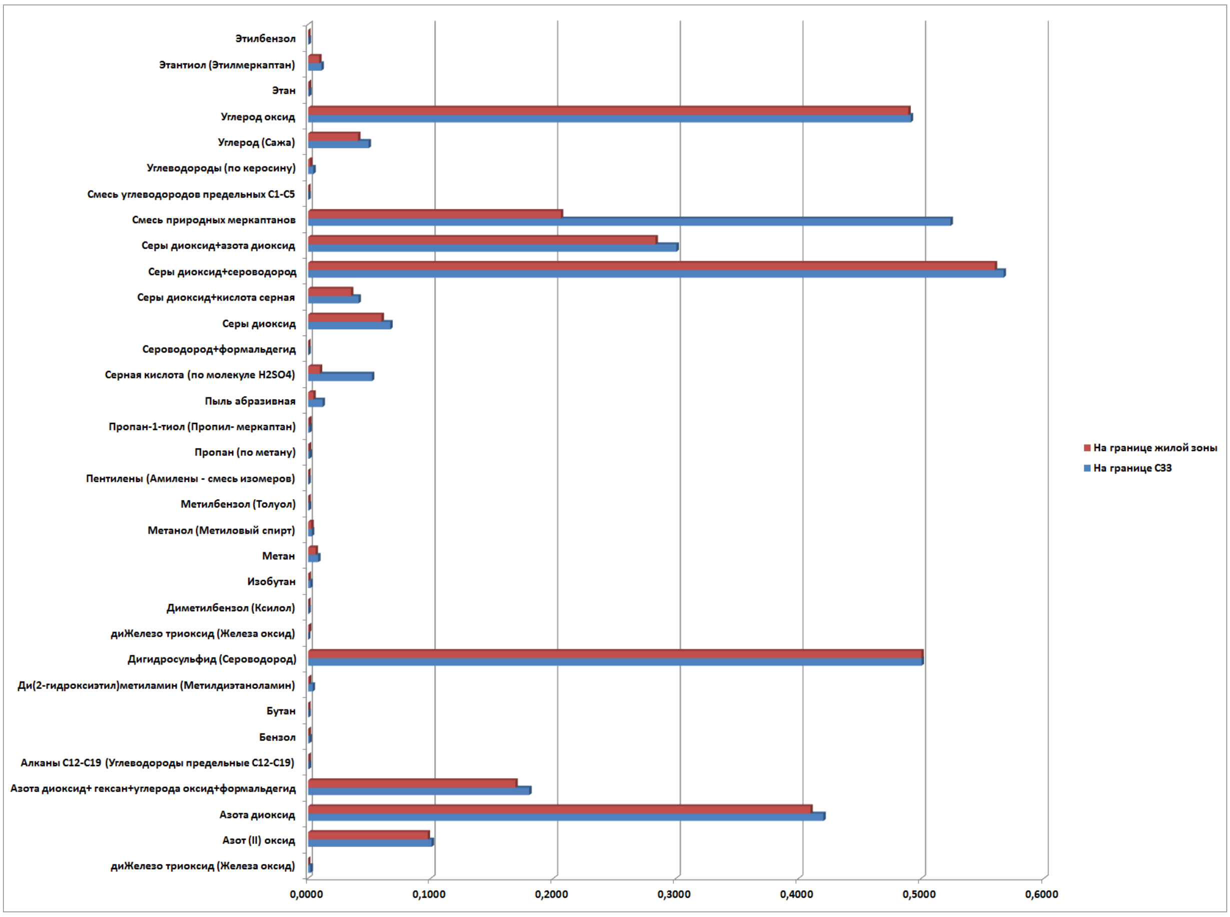
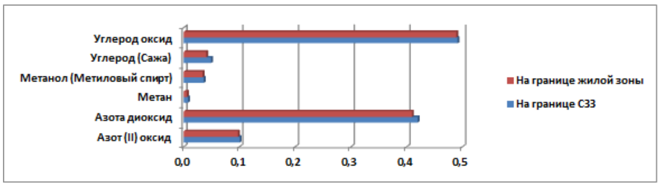
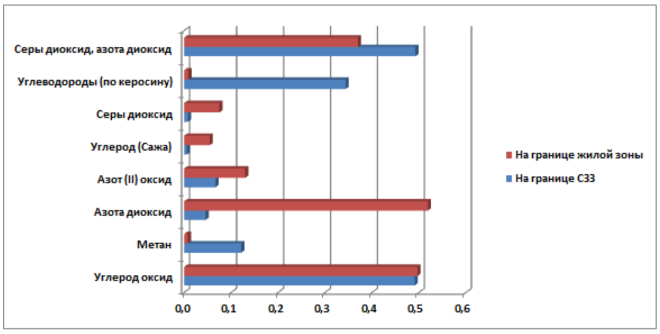
[10] 1000 m is the standard SPZ size for natural gas processing facilities (SanPiN 2.2.1/2.1.1.1200-03, Item 7.1.1, Class I, Sub-item 13)



(a)



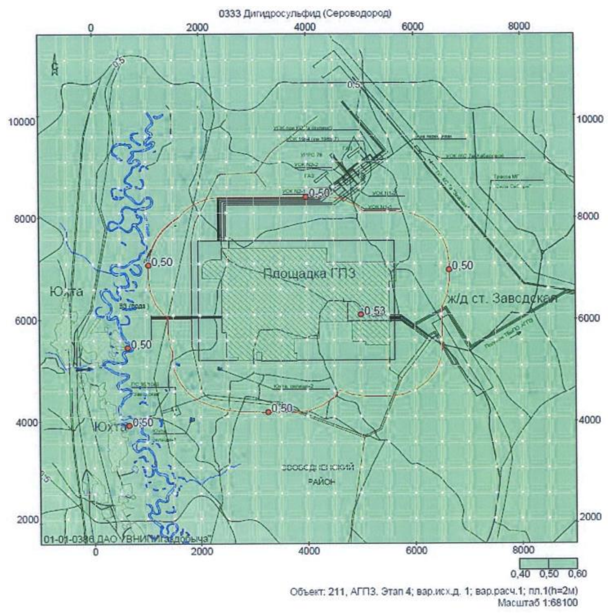
(b)



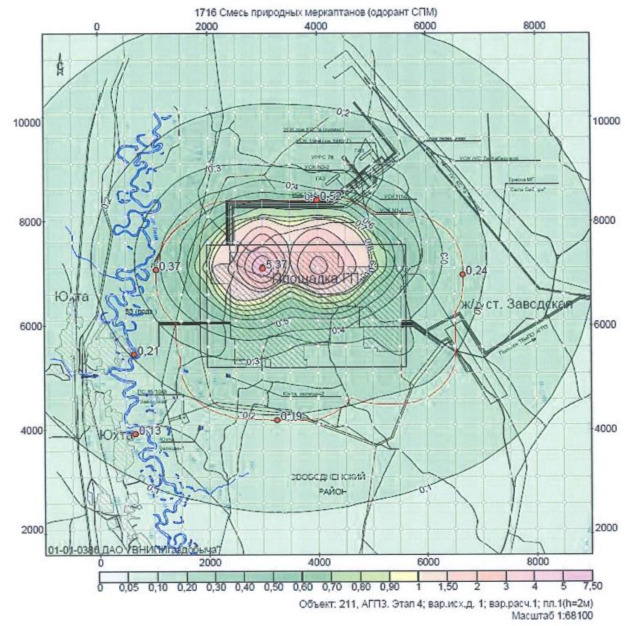
(c)

Figure 9.2.17: Estimated maximum ground concentrations of major pollutants at the SPZ and residential area boundary during operation of the AGPP Main Production Facilities (as MPC fractions), for normal (a), maximum peak emissions (b), and emergency operations

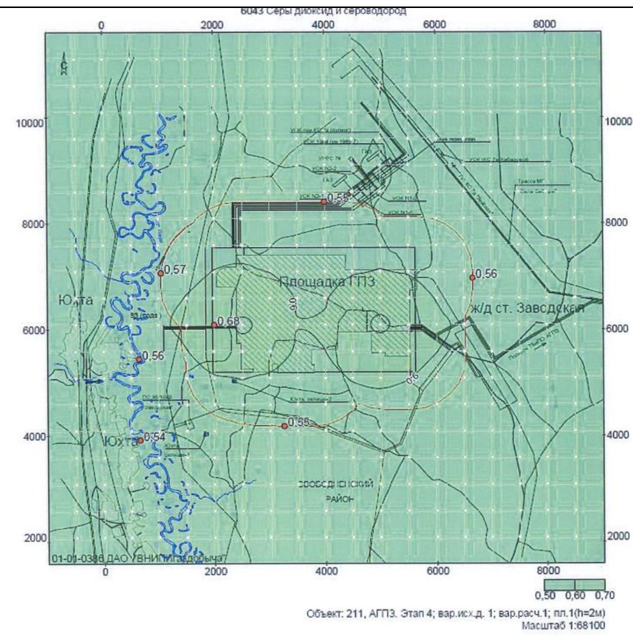
(a) Normal operation:



Hydrogen sulphide

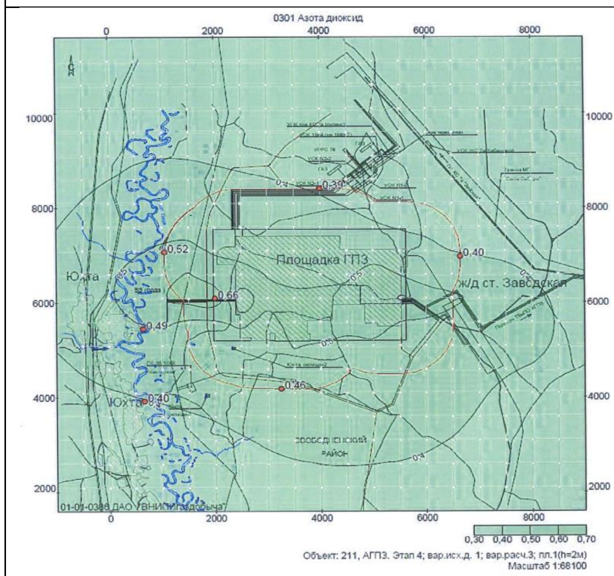


Mixture of natural mercaptans

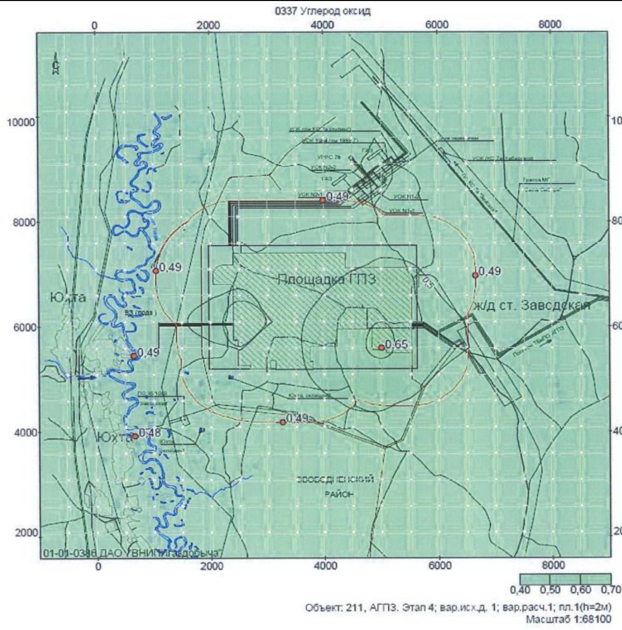


Summation group sulphur dioxide + hydrogen sulphide

(b) Emergency operation:

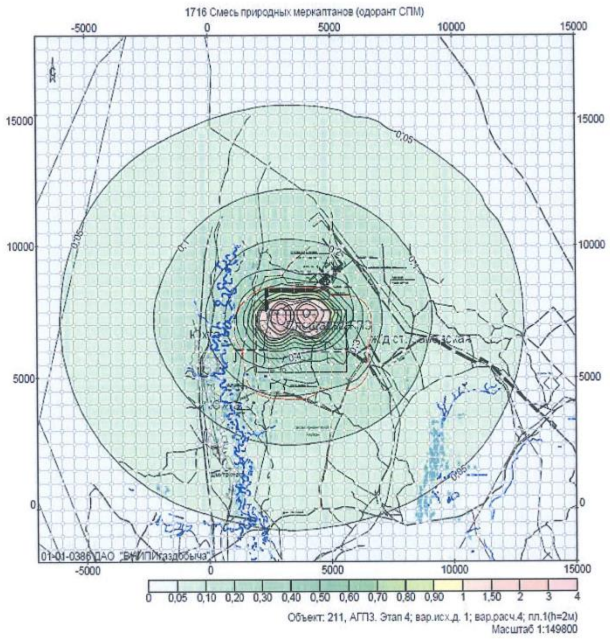


Nitrogen dioxide



Carbon monoxide

Area of influence of the Min Production Facilities:



Area of influence on ambient air quality

Figure 9.2.18: Pollutant dispersion maps for the operation of the Min Production Facilities: (a) normal operation, (b) emergency operation, and (c) the area of influence on ambient air quality during operation

It is proposed to use the dispersion modelling results as the MPE limit values for all pollutants during operation of the proposed Main Production Facilities. The MPE limit values for each pollutant are summarised in Appendix 7, Table 7. According to this table, emissions from the fully operational Amur GPP facilities will total 3,320.9 tonnes per year. Major pollutants will be carbon monoxide (33.7%), nitrogen dioxide (25.4%), nitrogen oxide (15.2%), and methane (11.2%).

9.2.4.7 Operation of SDIW landfill

Operations and sources of air emissions

The following operations will be performed at the landfill:

- thermal destruction of industrial waste of Hazard Class III and IV (including oily waste), solid domestic waste of Hazard Class IV and V, and industrial effluents of Hazard Class IV;
- receiving, storage, and separation of industrial waste of Hazard Class IV and V, including effluent sludge of Hazard Class IV.

According to the landfill design, solid domestic waste will be brought in by waste trucks and industrial waste by dump trucks and skip trucks on a centralized basis.

Air pollution during the landfill operation will be primarily associated with the following processes:

- landfilling;
- operation of vehicles;
- entry and exit of garbage trucks and other waste management vehicles;
- fuelling of equipment; and
- operation of waste incineration units.

Modelling of emissions and dispersion of air pollutants

The maximum ground concentrations of major pollutants at the SPZ and residential area (Gaschenka) boundaries during the SDIW landfill operation will not exceed the established limit values (Figure.9.2.19).

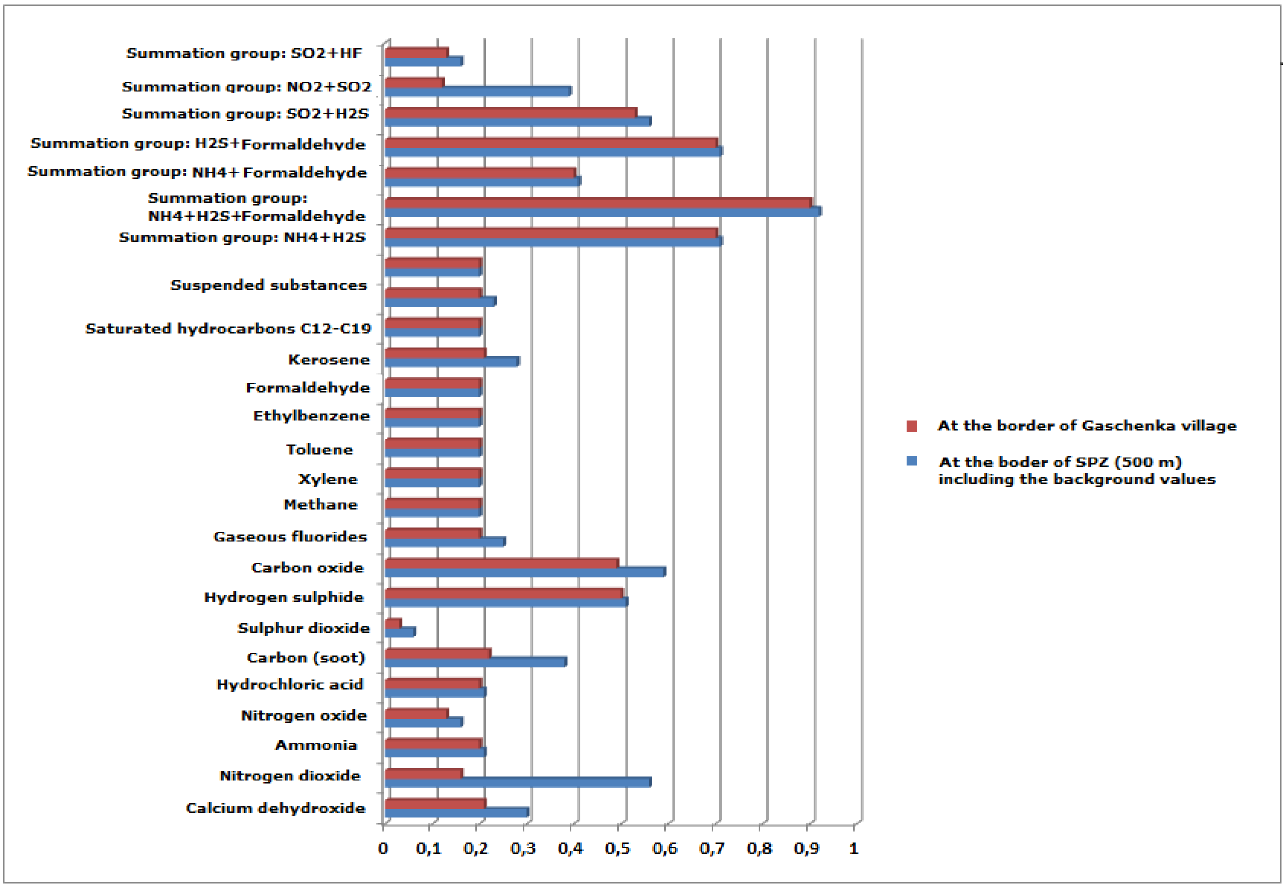


Figure 9.2.19: Estimated maximum ground concentrations of major pollutants at the SPZ and residential area (Gaschenka) boundary), as MPC fractions

The dispersion modelling was performed for the summer period when emissions from the SWL facilities will be at their maximum.

The following reference points were used:

- one reference point at the boundary of the Gaschenka Village, 3 km from the landfill site;
- eight reference points at the SWL's SPZ boundary (500 m from the landfill). The air pollution level of 1 MPC will be reached at the distance of 250 m from the site. The level of nitrogen dioxide at the Gaschenka residential area boundary will be 0.16 MPC.

The boundary of the area of influence, defined by the nitrogen dioxide level of 0.05 MPC, will be located at the distance of 2.8 km from the landfill site

The MPE limit values for the SDIW landfill are detailed in Appendix 2, Table 8.

9.2.4.8 Mitigation of impact on ambient air quality during operation of the Project facilities

In order to reduce pollutant emissions from the Project equipment and to ensure compliance with the sanitary standards within the subject area, the design provides for implementation of the following embedded controls of general technological character:

- ensure optimal operational mode of equipment in compliance with the process regulations;
- install and use of gas contamination control systems with the function of automatic gas supply cut-off in production premises where gas processing equipment is installed;
- maximum level of containment of the production process, including use of stop valve of leakage class 'A';
- use of pipes and fittings designed for maximum possible working pressure;
- maximum process automation: computer-aided process control system to reduce the probability of accidents/ emergency situations;
- discharge of liquid products (flammable and combustible liquids) from vessels and pipelines into drainage tanks before shutdown of this equipment for maintenance;

- use of equipment in which the level of NO_x and CO in exhaust gases does not exceed 150 mg/m^3 and 100 mg/m^3 respectively; the exhaust equipment must provide for dispersion of air pollutants during simultaneous operation of gas compressor units and booster plant to levels permissible for the working area and natural environment;
- use of process equipment with pressure relief valves or equipment designed for the maximum operating pressure;
- use of power-operated shut-off valves at the boundary of each process unit to enable isolation of individual process block if necessary (response time of power-operated valves should not exceed 12 seconds);
- monitoring of pollutant emissions and ambient air quality at emission sources and in the nearest residential areas;
- prohibition of the opening and purging of process vessels and tanks in adverse weather conditions to prevent dispersion of emissions;
- use of a closed flare system for safe flaring of all discharges; and
- selection of the optimal height of flares to facilitate dispersion of combustion products.

Each process unit will meet all safety requirements for the facilities of the Explosion Hazard Category I. The required level of explosion safety for the units of Category I will be provided by means of selection of adequate equipment, shutoff devices and places of installation, monitoring/ control and protection devices.

Development of special air protection/emission reduction measures for adverse weather conditions is not required, as the Amur GPP facilities will be in continuous operation. According to Russian regulatory requirements, permanent sources of air pollution will require development of measures of general character such as:

- enhanced control of strict compliance with the requirements of process regulations;
- enhanced control of instrumentation and performance of computer-aided process control systems;
- prohibition of: purging or cleaning of equipment, gas ducts, and tanks which were used for storage of pollutants; maintenance and repair works associated with air emissions of harmful substances;
- suspension of equipment tests associated with adjustment of process conditions resulting in increased air emission of pollutants.

Recommended measures for operation in adverse weather conditions for the sources of periodic environmental impact are: avoidance/suspension of works associated with pollutant air emissions, such as test start-up of diesel power plants, shutdown of process equipment with discharge of gas to flare.

Responsibility for implementation of air protection measures during adverse weather conditions will rest with the facility manager.

9.2.4.9 Assessment of the overall impact of the Project on ambient air quality during operation

In accordance with the impact assessment criteria used in this ESIA (Chapter 3), adverse impacts on the ambient air quality during operation of the Project facilities may be assessed as follows (before and after implementation of embedded controls/ mitigation measures):

Table 9.2.2: Assessment of impact on the ambient air quality during operation of the Project facilities

Conditions of operation	Duration	Extent	Reversibility	Severity	Likelihood	Significance	
						before mitigation	after mitigation
Normal	long-term	local	reversible	moderate[11]	probable	moderate	low
Peak	short-term	local	reversible	moderate	probable	moderate	low
Emergency	short-term	local	reversible	moderate	unlikely	negligible	negligible

Consequently, predicted impact associated with air emissions may be considered as 'acceptable', provided that the above-described mitigation measures and adequate and effective control are implemented.

[11] Moderate severity is defined as 'Noticeable effect but still within Project Standards' (Chapter 3).

9.2.5 Greenhouse gases

The project was thoroughly designed with a view of limiting emission volumes of greenhouse gases by choosing suitable highly-efficient equipment. In addition, the project provides for measures to minimize non-organized emissions of greenhouse gases. Yet it is expected that greenhouse gases will be emitted into the atmosphere at all the construction stages of the project as well as during the operation of the Amur GPP.

Greenhouse gases account for a significant portion of air emissions occurring during the operation of the Amur GPP facilities. The main sources of greenhouse gases during the operation of the Amur GPP are the main process facilities where natural gas will be used. Moreover, the use of purchased electrical power for the Project implementation will cause indirect greenhouse gases emissions, however, the share of indirect emissions after the commissioning of the first start-up complex of AGPP will not exceed 0.02% of total greenhouse gases emissions.

The consolidated data on the amounts of greenhouse gases emissions over the course of project development are given in Table 9.11. Those values are calculated based on direct greenhouse gases emissions related to the natural gas burning for the AGPP own needs, indirect emissions related to purchased electrical power consumption and taking into consideration the Project development schedule.

A graphical description of variations in greenhouse gases emission volumes over the course of project development is given in Figure 9.2.20.

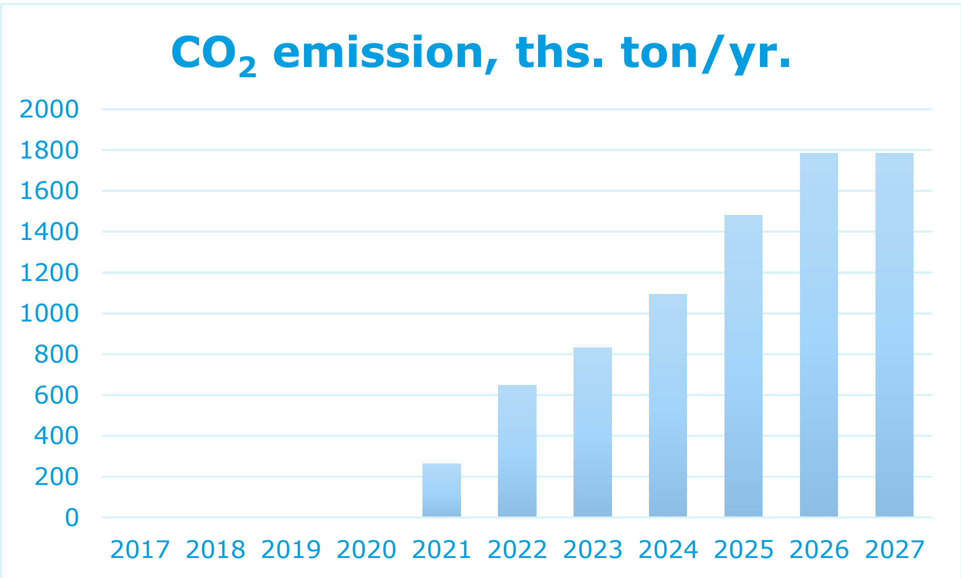


Figure 9.2.20: Greenhouse gas emissions over the course of project development (in CO2 equivalent units)

As shown on Figure 9.2.20, the amount of greenhouse gases emissions will gradually increase over the course of construction and commissioning of new production facilities reaching its peak in 2026 owing to the concurrency of the processes of construction and operation of the Project's main production trains.

As evident from Table 9.2.3, the annual amount of greenhouse gases will be around 1,780 thousand tons of CO_2 equivalent units per year, which is significantly higher than the required reporting threshold of 50 thousand CO_2 equivalent units set by RF Government Directive No. 716-r dated April 22, 2015. The value also exceeds the reporting threshold of 25 thousand CO_2 equivalent units set by the IFC Performance Standards. Therefore, the project provides for preparing annual statistical reporting on the actual amounts of greenhouse gases emissions; such reports to be submitted to the relevant credit institutions.

Table 9.2.3: Summarized data on greenhouse gas emissions from the Project facilities

Year	Direct emissions		Indirect emissions		
	Use of natural gas for own needs, thousand m^3	Total direct emissions, CO_2 equivalent, thousand t/ year	Amount of purchased electrical power, MWh	Total indirect emissions, CO_2 equivalent, thousand t/ year	Total CO_2 equivalent, thousand t/ year
2017			1,701	0.001	0.001
2018			19,322	0.014	0.014
2019			35,425	0.025	0.025
2020			38,058	0.027	0.027
2021	130,000	263	100,864	0.072	263.072
2022	320,000	648	242,202	0.173	648.173
2023	410,000	831	293,533	0.210	830.952
2024	540,000	1,094	357,922	0.256	1,094.404
2025	730,000	1,479	406,832	0.290	1,479.416
2026	880,000	1,783	406,832	0.290	1,783.346
2027	880,000	1,783	406,832	0.290	1,783.346

9.2.6 Monitoring of the ambient air quality during operation of the Project facilities

The primary objectives of environmental monitoring during operation of the Project facilities will be:

- regular and prompt acquisition of and provision of the Company's management and other stakeholders with reliable information about environmental situation at the Project facilities and in the area of their influence;
- control of compliance with the environmental protection requirements established by the national legislation, standards of Gazprom and International Finance Institutions; and
- support for implementation of activities aimed at environmental protection, sustainable management and restoration of natural resources.

The above objectives will be achieved through implementation of the Project's Operational Environmental Control/ Monitoring (OEC) Programme which includes control and monitoring of ambient air quality. The Programme will provide for control of pollutant emissions and concentrations of pollutants at major emission sources in order to establish the compliance of these with equipment specifications and the MPE limit values. Emission monitoring/control is required for the assessment of impact of the Project's emission sources on the ambient air quality within the subject area and prevention of exceedance of the sanitary limit values.

Major sources of emissions and resulting air pollution during operation will be gas compressor units, direct-fired/ combustion heaters of gas, boiler plants, and gas treatment units. Major pollutants of concern subject to monitoring will be:

- nitrogen dioxide;
- nitrogen (II) oxide;
- sulphur dioxide;
- carbon monoxide;
- benzo(a)pyrene;
- particulate matter;
- hydrocarbons (by components); and
- hydrogen sulphide.

Concentrations of pollutants in emissions from gas compressor units and water boilers (12,000 kW) will be continuously monitored by the stationary system for computer-aided control of industrial emissions. Control measurements of pollutant concentrations at gas compressor units and water boilers will be performed every three months using portable gas analysers.

Control measurements in the exhaust system of water boilers of the boiler plant (2,200 kW) and of the gas treatment unit will be conducted every three months.

Given the type, conditions of operation and specifics of pollutants, it is recommended to control emissions from other sources for compliance with the emission standards. The calculations must be prepared every three months and every year as part of the environmental reporting.

The sampling must be conducted simultaneously with the meteorological measurements of air temperature and humidity, wind velocity and direction, atmospheric pressure, and weather conditions.

The air quality monitoring in the residential area will be conducted during 25 days separately for the cold and warm periods of the year to verify and validate the size of the SPZ of the Amur GPP and the established MPE limit values.

In addition to the above, the ambient air quality must be also controlled during adverse weather conditions.

Full-scale observations must be conducted (sampling at 01:00, 07:00, 13:00, 19:00, local time) to obtain information about non-recurrent (one-time) and daily average concentrations. The maximum non-recurrent concentrations are to be determined using three samples from each measurement[12].

After the first year of observations, the Monitoring Programme may be revised to change periodicity of measurements.

In addition, discrete data on ambient air quality and the level of air pollution will be also controlled using gas analysing equipment which will be deployed at the water intake facility and will register concentrations of carbon monoxide, nitrogen oxide and dioxide, sulphur dioxide, hydrogen sulphide, ozone, methane. This equipment also provides for continuous measurement of meteorological and gamma-background parameters.

The results of monitoring of the ambient air quality will be included in the OEC reports that will be submitted to the executive staff of the Amur GPP for operational management purposes.

[12] RD 52.04.186-89 (Item 4.1)

9.2.7 Summary

Table 9.2.4: Summary of air emissions and impact mitigation measures

Receptor	Stage	Major sources of air emissions and respective impact mitigation measures	Residual impact
Population of the nearest settlements	Construction Stages 1-6	Major air pollution sources will consist of engines of construction equipment and vehicles, diesel generators, boiler plants, painting operations. Major pollutants which determine the level of impact during construction will be nitrogen oxides, carbon monoxide, methanol, and particulate matter. The estimated maximum concentrations of pollutants at the settlement boundaries at all construction stages will not exceed the MPC_{mnr} (SRLI) established for the ambient air quality in settlements. Special air impact mitigation measures for the construction period will consist of: • strict compliance with construction and installation process requirements established in the Construction Management Plan (CMP) and Work Execution Plan (WEP); • use of state-of-the-art construction machinery equipped with engines complying with the European emission standards Euro III - Euro IV; • preventive maintenance and technical inspections of construction machinery, mechanisms and vehicles, including control of exhaust gases from internal combustion engines; • use of state-of-the-art diesel power plants which meet the requirements for emission levels applicable to the Project; and • other emission control activities for the construction period (see 9.2.3.11).	The overall impact of construction of the Project facilities on the ambient air quality in the surrounding area may be assessed as 'low' before, and 'negligible' after implementation of impact mitigation measures
Population of the nearest settlements	Operation	Major sources of emissions producing maximum input in air pollution during operation of the Project facilities will be gas compressor units, combustion gas heaters, boiler plants, and gas treatment units. The estimated maximum concentrations of pollutants at the settlement boundaries during operation will not exceed the MPC_{mnr} (SRLI) established for the ambient air quality in settlements. Special air impact mitigation measures during operation of the Project facilities will consist of: • discharge of liquid products (flammable and combustible liquids) from vessels and pipelines into drainage tanks before shutdown of this equipment for maintenance; • use of equipment in which the level of NO_x and CO in exhaust gases does not exceed 150 mg/m^3 and 100 mg/m^3 respectively; the exhaust equipment must provide for dispersion of air pollutants during simultaneous operation of gas compressor units and booster plant to levels permissible for the working area and natural environment; • monitoring of pollutant emissions and ambient air quality at emission sources and in the nearest residential areas;	During the operation the overall impact of the Project facilities on the ambient air quality in the surrounding area may be assessed as 'low'

Receptor	Stage	Major sources of air emissions and respective impact mitigation measures	Residual impact
		• prohibition of the opening and purging of process vessels and tanks in adverse weather conditions preventing dispersion of emissions; • use of a closed flare system for safe flaring of all discharges; • selection of the optimal height of flares to facilitate dispersion of combustion products; and • other emission control activities for the operation period (see 9.2.4.8).	

Table 9.2.5: Summary of requirements for the monitoring of air emissions

Impact	Stage	Sources/ location	Pollutants	Periodicity
Air emissions	Construction	Exhaust pipes of construction and road building equipment and diesel power plants	• NO_x • CO • Particulate matter	Every 3 or 12 months in accordance with the individual schedule for specific facilities (depending on the Project schedule and regulatory requirements)
Air emissions	Operation	Gas compressor units, combustion gas heaters, boiler plants, and gas treatment units	• Nitrogen dioxide • Nitrogen (II) oxide • Sulphur dioxide • Carbon monoxide • Benzo(a)pyrene • Particulate matter • Hydrocarbons (by components) • Hydrogen sulphide	• Continuous (at the stationary monitoring facility) • Discrete (every 3 months or at shorter intervals in accordance with the individual schedule for specific facilities (depending on the Project schedule and regulatory requirements)

9.3 Impact on landscape, soils and land use

9.3.1 Transformation of landscape and land resources within the subject area in connection with implementation of the Amur GPP Project

In the physical geographical respect the Amur GPP Project AoI is located in the Amur-Zeya mountainous trough region near the boundary between two landscape provinces, i.e. the Middle Zeya province with Far Eastern sub-taiga forests and the Zeya-Bureya province with broad-leaved forests[13]. The historic prevalence of forest landscapes within this territory has been replaced at present with predominantly secondary forests with different degrees of disturbance and with various types of localized valley landscapes (including meadows and bogs), farming land and built up areas

The use of these lands is in general not associated with forestry management: the nearest forest fund land areas in the vicinity of the Amur GPP site are protective forests of the green belt (Compartment No.12 of the Svobodnensky forestry department[14] adjoining the right-of-way strip of the access railway track line) and the merchantable forests at a distance of 10km to 15km to the north-east of the GPP site (Compartment No.167 of the same forestry department).

A major part of the land allocated for the Amur GPP Project was categorized as '*farming land*' situated within the boundaries of two municipalities of Svobodnensky district, Amur Region, i.e. Zheltoyarovsky and Dmitrievsky rural councils[15]. The zones considered for future construction of the GPP facilities are designated in the respective schematic maps of territorial zoning as ПК-1 ("Zone for industrial, communal and storage facilities of Hazard Classes I and II) and as ИТИ-14 ("Zone for engineering, transport, communications and utility infrastructure"), whereas the host territory around them is categorized as forest land within the farming land areas (СХ-4).

The following favorable economic conditions had been taken into consideration in the process of the project site selection for the future gas processing plant and associated facilities[16]:

- Vicinity to the raw gas source, i.e. the "Power of Siberia" gas pipeline;
- Vicinity of the planned Sibur's deep hydrocarbon conversion plant using AGPP products as raw materials for their operations;
- Convenient location at the crossing of transnational and transregional transport corridors (Trans-Siberian railway line, federal highway M-58 "Amur", airports in the cities of Blagoveshchensk and Svobodny, four river ports: Blagoveshchensk, Svobodny, Poyarkovo and Zeya);
- Availability of the power supply infrastructure: electric power transmission lines and the planned Yerkovetskaya thermal power plant;
- Vicinity to the administrative district center (13 km to the town of Svobodny) as a potential source of workforce resources and a center of social, industrial, educational and medical infrastructure[17].

An important circumstance for the Project is the absence of any legally protected nature areas of local, regional or federal significance within and in the vicinity of the planned Amur GPP site; there are no land areas involved in the traditional usage of natural resources either. This fact has been confirmed by official letters from the relevant authorities.

An important local factor, which influenced the site selection for the planned project facilities was the presence of historic and cultural heritage objects, i.e. archeological sites assimilated to different degrees by the local landscapes. According to Letter AO No.09-18/1421 of 27.06.2014, there are several archeological

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[13] Map of physical geographical zoning of the USSR. Scale 1:8,000,000. Moscow, GUGK, 1986.
Landscape map of the USSR. Scale 1:4,000,000. Ed,. by A.G. Isachenko, Moscow, GUGK, 1988.

[14] Forestry management conditions defined by the GKU of Amur Region "Svobodny Forest Department", town of Svobodny: Subsidiary of GFUP "Roslesinforg" - AmurLesProyekt, 2015. Document is displayed in electronic format on the web-site of the Ministry of Agriculture and Fire Safety of Amur Region: http://www.amurleshoz.ru/

[15] Municipality "Zheltoyarovsky Rural Council", Svobodnensky district, Amur Region. Official website: http://www.zeltsvob.ru.
Municipality "Dmitrievsky Rural Council", Svobodnensky district, Amur Region. Official website: Официальный сайт: http://www.дмитриевский сельсовет.рф

[16] Amur gas processing plant. Project design documentation. Environmental Impact Assessment. Volume code: 4700-0095-OBOC. Ufa: Scientific Research Institute of Oil and Gas (NIPI-NG "Peton"), 2015.

[17] A residential settlement with a church complex will be located within the boundaries of the town of Svobodny.

sites in the immediate vicinity of the planned construction sites; they had been discovered earlier and require further conservation. Additional investigations conducted by GAU "CSN Amur Region" in 2015 permitted an assessment of the conservation status of the archeological sites identified earlier; in addition four new archeological sites were discovered (Table 9.3.1).

Table 9.3.1: Archeological sites (AS) located within the zone of the planned Amur GPP facilities and measures aimed at their conservation

AS description	Amur GPP facility nearest to the AS	Distance between the AS and the planned Amur GPP facility	Remarks
Ancient settlement "Ust-Pera-1"	Water pipeline and wastewater sewer line from the GPP site	200 m to the east-north-east	Archeological investigations conducted in 2015[18] indicated that the objects are located at a safe distance from the boundary of the planned activities.
Ancient settlement "Ust-Pera-2"		230 m to the north-west	
Ancient settlement "Ust-Pera-3"		800 m to the north-west	
Ancient settlement "Ust-Pera-4"		1170 m to the north-west	
Ancient settlement "Ust-Pera-5"	Water pipeline from the water abstraction facility to the GPP site	10 m to 20 m to the west	AS discovered in the course of investigations conducted in 2015. Special measures have been foreseen for the AS conservation.
Settlement "Ust-Pera-1"	Access railway track lines from the "Zavodskaya" station	Running along the southern boundary of the cultural heritage object	
Nomad camp Chernigovka-6	Access motor road to the provisional river jetty on the Zeya River	Along the western boundary of the cultural heritage object	The AS was not identified in the course of the archeological investigations conducted in 2015, which indicated that the site was destroyed in the process of previous farming activities.
Burial site Chernigovka -1"		200 m to the south	The archeological investigations conducted in 2015 confirmed that the AS is located at a safe distance from the boundary of the planned construction site.
Ancient settlement "Yukhta-1"	TBI at the GPP site	Approximately 50 m to the west	AS had been revealed in the process of the archeological investigations conducted in 2015. Special measures have been foreseen for the AS conservation.
Ancient settlement "Yukhta-2"	GAZ No.9 at the GPP site	10 n to 20 m to the south	

No protective zones for the archeological sites listed in Table 9.3.1 have been established. The conservation measures foreseen in the Project design documentation include the following:

- Archeological supervision at the respective sites during the construction and operational phases of the Project;
- Installation of temporary warning signs at the boundaries of an archeological site during the construction phase;
- Provision of written information for the construction contractors relating to the presence of archeological sites, applicable constraints and requirements relating to the use of the areas of the archeological sites;
- Submission of protection obligations to the agency in charge of cultural heritage protection to be fulfilled during the construction period.

In addition to the archeological sites, some important limitations relating to the surface water bodies are applicable in connection with the land use within the area allocated for the planned Amur GPP facilities. According to Article 65 of the RF Water Code, the Zeya and Bolshaya Pera have a 200m wide water protection zone (coinciding with the fishery protection zones of both rivers). The water protection zone of the Gashchenka River is 100 m wide and the water protection zones of the Rakusha River and other permanent watercourses is 50 m wide. The width of the riverside protection belts of all the above watercourses is 50 m (see Chapter 7).

[18] A residential settlement with a church complex will be located within the boundaries of the town of Svobodny.

[18] GAU CSN Amur Region (Governmental Agency "Amur Region Center for Cultural Heritage Protection"), 2015.

In the process of preparations for the Amur GPP Project design development, the municipal planning schemes were updated and their current revision provides for construction and operation of all planned Project facilities with appropriate changes in the land use terms and conditions within the affected areas (Table 9.3.2).

The dimensions of the sites for the Amur GPP facilities were determined by the organization in charge of the project design development to ensure minimal land withdrawal and the optimal width of the construction strip. For two and more engineering networks using the same corridor, the dimensions of the allocated area were determined with due consideration of their mutual relative positions. The location of the planned facility had been preliminary agreed upon with the respective land users and fixed in the Site Selection Protocols.

The site of the Amur GPP site and other associated areal facilities will be built up and fenced to restrict its accessibility for unauthorized persons. The current status of the use of the areas adjoining the GPP site will be also modified to comply with the regulatory requirements applicable to operation and protection of the facilities and receptors exposed to their impact (Table 9.3.2).

Construction of access motor roads and railway track lines connecting the GPP site with other planned Project facilities and elements of the existing transport system will improve the accessibility of the subject area, but on the other hand, it will affect the potential of its natural resources (forests, meadows, bogs) due to inevitable fragmentation and creation of new zones with special terms and conditions of their usage (Table 9.3 2).

Table 9.3.2: Land allocated for the planned Amur GPP facilities and associated zones with special status and applicable requirements

Planned facilities		Allocated land area, ha			Normative requirements to new zones with special status and other limitations of land usage
		Permanent (long-term lease)	Temporary (Lease for the construction phase)	Total	
Areal facilities					
Main site of the Amur GPP		659.23	12.81	672.04	The protection zone is encompassed by a line running at a distance of 100m from the site boundary (Par.4.1 of the "Rules for protection of trunk gas pipelines" approved by GosgortekhNadzor, Resolution No.9 of 22.04.1992, Revision of 23.11.1994). The tentative sanitary protection zone (SPZ) of the GPP site is 1000m wide from the site boundaries (Item 13, Par.7.1.1 SanPiN 2.2.1/2.1.1.1200-03, Rev. of 25.04.2014). According to Par.4.20 of SP 32.13330.2012, the SPZ of the sewerage treatment facilities to the boundaries of the residential buildings, public buildings and food industry factories should be established with due consideration of their prospective expansion and in accordance with the sanitary norms; any deviations from the latter are subject to approval by the sanitary and epidemiological supervisory agencies. The SPZ of the sewerage treatment facilities is 400 m wide, based on the following assumptions: maximum estimated throughput capacity 35,000 m^3/day; the facilities comprising mechanical and biological treatment sections and residue treatment modules (Table 7.1.2, SanPiN 2.2.1/2.1.1.1200-03, Rev. of 25.04.2014).
WI site		6.17	1.76	7.93	The design of the sanitary protection zone of the future water abstraction facility of the Amur GPP provides for the following dimensions. Belt 1: 30 m wide for each water well; Belt 2: 260m and 280m wide, downstream and upstream, respectively; Belt 3: 1330m and 2300m, respectively. Since the distance between the GPP facilities and the water abstraction facility is approximately 1 km, some of those facilities will be within Belt 3 of the sanitary protection zone, where it is possible to have fuel and lubricant depots, accumulating ponds for industrial effluents and other facility posing a threat of chemical pollution of underground waters only if special measures are taken to protect the aquifer from pollution and with an approval of the sanitary and epidemiological supervisory agency (SanPiN 2.1.4.1110-02).
Areal facilities of	"Zavodskaya"	47.34	1.34	48.68	The SPZ dimensions are established on the basis of calculations of pollutants

Planned facilities		Allocated land area, ha			Normative requirements to new zones with special status and other limitations of land usage
		Permanent (long-term lease)	Temporary (Lease for the construction phase)	Total	
railway stations	"Zavodskaya-2"	16.66	0.59	17.25	dispersion in the atmospheric air and physical impact factors (noise, vibration, electromagnetic fields, etc.) with subsequent field investigations and measurements (SanPiN 2.2.1/2.1.1.1200-03, Rev. of 25.04.2014, Par.2.6).
	"Ust-Pera"	0.67	0.25	0.92	
SDIW landfill site		20.00	0.91	20.91	According to Items q and 5, Par.7.1.12 of SanPiN 2.2.1/2.1.1.1200-03, Rev. of 25.04.2014, the normative SPZ width for this facility should be 1000 m
TBI site		0.00	67.24	67.24	The SPZ dimensions for the provisional buildings and structures are established on the basis of calculations of pollutants dispersion in the atmospheric air and physical impact factors (noise, vibration, electromagnetic fields, etc.) with subsequent field investigations and measurements (SanPiN 2.2.1/2.1.1.1200-03, Rev. of 25.04.2014, Par.2.6).
Welding and assembly site		0.00	0.18	0.18	
Site of the provisional river jetty on the Zeya River		0.00	25.21	25.21	
Microdistrict in the town of Svobodny		0.00	78.00	78.00	
Linear facilities					
Underground water pipelines	WIS – GPP	0.00	4.64	4.64	The following width of the sanitary protection strip for water pipelines is applicable at both sides of the external edge of the pipeline as follows: a) in case of no groundwater at least 10 m and at least 20 m for water pipeline diameters of up to 1,000mm and over 1,000mm, respectively.; b) in case of groundwater presence at least 50m regardless of the pipeline diameter (Par.2.4.3 SanPiN 2.1.4.1110-02, Rev. of 25.09.2014). According to Table 15 of SP 62.13330-2011, the zone free of any constructions is 5m wide at each side of the water pipeline.
	WIS – TBI	0.00	4.63	4.63	
Underground wastewater sewer lines	From connection point to railway stations "Zavodskaya" and from the "Zavodkskaya" station to GPP	0.00	12.67	12.67	SP 32.13330.2012, Par.4.20: "Sanitary protection zones between any sewerage facilities and the boundaries of residential buildings, public buildings and food industry enterprises should be established taking into consideration the prospects for their future expansion and in conformity with the applicable sanitary norms; any deviations from the sanitary norms are subject to approval by the sanitary and epidemiological supervisory agency" No SPZ is to be established for sewer lines. According to Table 15 of SP 62.13330-2011, the zone free of any buildings should be 5 m wide from the sewerage networks under pressure and 3 m wide from the free-flow sewerage networks.
	TBI – discharge outlet to Bolshaya Pera River	0.00	4.91	4.91	

Planned facilities		Allocated land area, ha			Normative requirements to new zones with special status and other limitations of land usage
		Permanent (long-term lease)	Temporary (Lease for the construction phase)	Total	
					The quality of water transported in a discharge sewer line should comply with the requirements applicable for discharge to a surface water body. According to Par. 10, Article 65 of the RF Water Code, no water protection zones are to be established for rivers or their sections covered in enclosed sewer lines.
Underground gas pipelines	Gas pipeline from node of primary valve site to the GPP (Two lines Ø1420x25.8 for inlet and outlet)	1.50	19.78	21.28	The protection zone of technical sites of trunk gas pipelines is limited by an enclosed line at a distance of 100m from the site boundaries; The protection zone of the linear part of trunk gas pipelines should be 25 m at each side from the pipeline axis (Par.4.1 of the Rules for protection of trunk gas pipelines" (approved by GosgortekhNadzor of Russia, Decree No.9 of 22.04.1992, Rev. of 23.11.1994). The minimal permissible distance from a trunk gas pipeline to facilities of Group A is 180 m (Table 3, STO Gazprom 2-2.1-249-2008; Table 2 of SP 36.13330-2011). The recommended minimal distance from a trunk gas pipeline of Class 1 with a pipe diameter of over 1200mm is 300m to individual low-rise buildings and farming facilities of various purposes, 350m to urban residential buildings, suburban areas and gardens, and 25m to rivers, water bodies and water abstraction facilities (Annex 1 to Par.2.7 of SanPiN 2.2.1/2.1.1.1200-03, Rev. of 2014).
	Gas pipeline to the landfill site	0.00	12.79	12.79	The protection zone of gas pipelines in gas distribution networks should be 2m wide at each side of the pipeline axis; clearings in areas with tree vegetation should be 6m wide (RF Government's Decree No.878 of 20.11.2000, Rev. of 22.12.2011). The recommended minimal distance from low-pressure gas pipelines to low-rise buildings and storage facility is 20 m (Annex 4 to Par.2.7 of SanPiN 2.2.1/2.1.1.1200-03, Rev. of 2014).
Areal power transmission lines	Two 10 kV power transmission lines "TBI – WIS"	0.06	4.94	5.00	The protection zone for electricity networks should be 10 m wide at each side from the axis line (for single-line power transmission lines) or from the external wires (RF Government's Decree No.160 of 26.02.2009, Rev. of 26.08.2013). There is no need for protection of local communities from impact of electrical fields of areal power transmission lines with a voltage of 220 kV and lower complying with the requirements of the Rules for electrical installations and the Rules for protection of high-voltage electrical networks (SNiP 2971-84); this implies that no sanitary protection zones are required for the planned power transmission lines.
	10 kV power transmission line to the landfill site	0.04	5.81	5.85	
AMRs	WIS site	2.28	0.24	2.52	The width of the wayside of motor roads should be 50 m (Article 26 of Federal Law

Planned facilities		Allocated land area, ha			Normative requirements to new zones with special status and other limitations of land usage
		Permanent (long-term lease)	Temporary (Lease for the construction phase)	Total	
	To the GPP site (AMR#1)	16.94	8.47	25.41	No.257-FZ of 08.11.2007 "On Motor Roads and Roadwork Activities in the Russian Federation") at both sides of the right-of-way strip (35m according to RF Government's Decree No.717 of 02.09.2009).
	To the GPP site (AMR#2)	5.95	1.80	7.75	
	To the "Zavodskaya" railway station	2.60	1.30	3.90	
	To river jetty on the Zeya River	15.02	7.51	22.53	
	To the landfill site	4.63	2.32	6.95	
	To the TBI site	0.00	0.47	0.47	
Sites for deep anodic grounding and underground cable lines of the electrochemical protection system		0.02	0.69	0.71	The protection zone of underground electrical cable lines should be 1m wide at each side from the axis line (for single-line cable lines) or from the external cables (RF Government's Decree No.160 of 26.02.2009, Rev. of 26.08.2013). The zone free from constructions should be 0.6m wide from an underground cable line (Table 16 of SP 62.13330-2011).
Railway tracks	Main track line	85.61	27.74	113.35	The sanitary distance is established based on the calculations of pollutants dispersion in the atmospheric air and physical impact factors (noise, vibration, electromagnetic fields, etc.) with subsequent field investigations and measurements (SanPiN 2.2.1/2.1.1.1200-03, Rev. of 2014, Par.2.6).
	Access track lines to the GPP site and to "Ust-Pera" station	15.67	3.47	19.14	

As a result, the land area required for construction of areal facilities will be 938.4 ha, of which approximately 80% (750 ha) are allocated on the basis of long-term lease agreements with reclassification of the land category to land for industrial, transport and communications needs, while the remaining 20% will be allocated on a short-term basis with subsequent land reclamation and return to the lessor. Construction of linear facilities will involve the use of a total land area of 275 ha; the proportions of the land areas for permanent and temporary land allocation are 55% and 45% or 150 ha and 124 ha, respectively.

In general, a total land area of approximately 900 ha is allocated for the planned areal and linear facilities of the Amur GPP; additional 313 ha will be used on a short-term basis during the construction phase of the Project. The main part of this land is situated in the Zheltoyarovsky and Dmitrievsky municipalities. The proportion of the withdrawn land within the total land areas of those municipalities is not significant (45,842 ha and 285,638 ha, respectively). At the same time, it is expected that the concentration of industrial and transport facilities to be constructed within that area will be high, including the Power of Siberia gas pipeline and a major gas chemical complex. This will result in a rather high degree of transformation and fragmentation of the local landscape. In the past, these land areas were used for farming and some technical facilities, so that the baseline status of the landscape can be characterized by a low, moderate and high degrees of modification using the terminology of GOST 17.8.1.02-88. The implementation of this Project will result in formation of highly modified landscapes within the Project area and moderately modified landscapes in the adjacent areas.

9.3.2 Modification of the landscape structure and the overall visual appearance of the landscape

In the structure of the local landscape forms, the proportion of forests within the Project area will be reduced to an especially high degree: within the land area allocated for the Project facilities and within the protective and fire prevention strips the forests will be completely replaced with industrial facilities, pavement and secondary meadows. This refers in the first line to the forest areas of white and river birch, bush-clover (*Lespedeza*) and reedgrass areas with typical brown soils, mor-humus brown soils and pseudo-fibrous brown soils; such areas are one of the dominants in the terrace complex of the Zeya and Bolshaya Pera valleys[19]. Significant will be also the loss of numerous natural secondary forest-meadow complexes, represented by sedge-graminoid assemblages with willow, pine and birch undergrowth on brown soils used to be ploughed in the past. It will be partially compensated for by artificial restoration of meadow communities as a result of reclamation of the land used for the Project needs on a short-term basis.

Certain modification of landscapes is planned also in the areas of bogs with plant assemblages consisting of reedgrass, cotton grass and sedge, as well as shrubs on eutrophic peat soils and associated soil types. Taking into consideration the relatively poor drainage of the subject area and its tendency to be exposed to floods and swamping, it can be expected that bogs of technogenic origin would form in the local landscape structure due to blockage of surface and subsoil drainage.

Unstable landscape forms of the floodplain willows on alluvial grey humus soils with variable particle size distribution will be affected to a lesser degree (mainly in the process of the river jetty construction and at crossings of watercourses by linear Project facilities).

The planned landscape modifications on the right bank of the Zeya River in the interfluve area of the Bolshaya Pera and Gashchenka rivers will not be limited to the construction of the Amur GPP and associated facilities: adjacent areas will be used for numerous associated facilities of the "Power of Siberia" gas pipeline and the Sibur's deep hydrocarbon conversion plant occupying a comparable area. Some of these facility will be located within the direct visibility range of the residential settlements in Svobodnensky district (Yukhta, Chernigovka, Gashchenka, Ust-Pera) and in the town of Svobodny (residential settlement).

Short-term (during the construction phase) and long-term adverse visual impacts will be insignificant for the facilities located outside of the direct visibility range of the nearby residential and recreational areas (e.g. the Amur GPP site, landfill and river jetty). At the same time, the overall decrease in the forested area, which is the most phyto-physiognomic landscape form, against the background of significant fragmentation of slightly and moderately transformed natural landscapes with areas of technogenic physiognomy will result

[19] Schematic map of the natural environment situation in the Amur Gas Processing Plant area. Saratov VNIPI Gazdobycha, 2016 (survey materials and project design documentation)

in the loss of the characteristic image of the forest-meadow landscape and initiation of mechanisms causing gradual transformation under the abruptly changed conditions. The assessment of this transformation will be one of the objectives of the operational environmental monitoring. Part of the planned facilities, such as the residential settlement and transport facilities, will affect directly the periphery of the residential zones, the communities of which had agreed in general to the existing layout plans in the process of the public hearings.

9.3.3 Impact on the soil cover

In the system of geographical soil zoning of the Russian Federation and Amur Region, the Amur GPP Project area belongs to the Eastern soil and bioclimatic region of brown and forest soils, brown soil and podzolic brown soil zone of mixed coniferous – broad-leaved forests and broad-leaved forests, the Zeya-Bureya province of slightly unsaturated brown soils and slightly unsaturated podzolized and meadow – chernozem-like soils, Amur-Zeya district of slightly unsaturated brown soils (including podzolized ones) clayey and sandy silt soils underlain by sand and silty sand ground, as well as gleyic and gley brown soils, clayey and heavy sandy silt soils over lacustrine-alluvial deposits[20]. According to the materials of the surveys preceding the Project design development, varieties of brown forest soils constitute the main soil fund of the Zeya and Bolshaya Pera terrace complex. Associated intrazonal soils are peaty bog soils; azonal soils are diverse alluvial soils of variable particle size distribution.

The disturbed condition of the soil cover within the Project area is attributable in the first line to the farming activities and operation of various technical facilities. No signs of chemical pollution of these soils have been detected in the process of the surveys. At the same time, elevated natural concentrations of a number of trace elements (zinc, nickel and arsenic) have been revealed in the lithogeochemical background of soils, which should be taken into account when monitoring the soil contamination with the above elements.

In the process of the construction of the Amur GPP facility (preconstruction work, earthmoving, construction and installation operations) the impact on land resources and soil cover will be in the form of the following consequences[21]:

- Withdrawal of some land areas during the construction phase;
- Mechanical disturbance and destruction of the soil cover;
- Disturbance of the fertile topsoil layer associated with potential blending with the underlying layer;
- Short-term storage of and potential contamination of the construction sites with construction and domestic waste;
- Potential contamination of the soil cover with substances affecting the biological, physical and chemical properties of the soils (wastewater, fuel and lubricants in the process of machinery operation, etc.).

All types of potential impacts on the soil cover can be divided into three following groups:

1. Impact on soil resources within the area associated with withdrawal of part of the soils for construction of the Amur GPP facilities. Prior to the commencement of the Project implementation most of the areas to be withdrawn had not been used (waste land, forests, sites of dismantled technical facilities, etc.). Due to this reasons, the commercial losses caused by allocation of these land areas for construction of industrial and transport facilities were not significant. To minimize these losses, the Project design provides for stripping of the fertile topsoil layer and its stockpiling in conformity with the applicable regulatory requirements. Land areas allocated on a short-term basis during the construction phase for BTI will be subjected to land reclamation and returned to the respective lessors taking into account their requirements to the land conditions and their plans for the future use of the reclaimed areas. The main purpose of the reclamation of the disturbed land areas is restoration of their properties to meet farming and environmental requirements. In some

[20] Map of environmental soil zoning of the Russian Federation. Scale 1:2,500,000. Moscow, Moscow State University, 2013.
Unified State Register of Soil Resources of the Russian Federation. Moscow, V.V. Dokuchayev Institute of Soils, Russian Academy of Agricultural Sciences, 2014.

[21] Amur Gas Processing Plant . Project design documentation. Environmental Impact Assessment. Volume Code: 4700-0095-OBOC. Ufa: Scientific Research Institute of Oil and Gas. (NIPI NG "Peton"), 2015.

areas, depending on an agreement with lessors it will be required to carry out reforestation, land reclamation for construction purposes (i.e. without biological reclamation) or sanitary and hygienic remediation (in areas of historic contamination and at the landfill site).

2. Mechanical disturbance of the soil cover. In the process of installation of the off-site engineering networks, road construction and installation of the main and auxiliary areal facilities, the soil and vegetation cover, which is the basic biocenosis component of the subject area will be impacted. The following aspects are considered in the project design documentation:
   - Planned soil cover disturbance within the areas leased on a long-term basis in the process of construction of areal project facilities and soil cover disturbance within the land area leased on a short-term basis for excavation of trenches for off-site engineering networks;
   - Unauthorized soil cover disturbance caused, for example, by unauthorized traffic of construction machinery and vehicles outside of the specially prepared road network and construction work outside of the boundaries of the allocated land areas.

   In case of mechanical soil cover disturbance, fragmentary destruction of the fertile humus and aggradational soil horizons it is possible, as well as blending of the materials from different soil horizons resulting in deterioration of the natural fertility of the soil cover. Movement of the construction machinery within the construction strip can destroy partially or completely the soil cover. Wind and water erosion processes can take place in the areas with disturbed soil cover, resulting in the loss of fertile soil.

   As a result, this type of impact will be limited to the allocated land areas and take place mainly during the construction phase of the Project. In the adjacent areas it can take place in the form of local physical soil cover disturbance, changes in the drainage conditions (water-logging) of the soils, changes in the heat conduction and hydrophobic soil properties, and harmful exogenous processes. Any direct physical and mechanical impact of the construction activities on the soil cover in the areas adjacent to the Project sites should be completely precluded.

3. The soil cover can be contaminated as a result of secondary migration of pollutants present in the soil cover and in the geological environment and induced by construction work or as a result of distributed (with atmospheric precipitation) or concentrated (spills, leakage, etc.) release in the process of pre-construction, construction and installation work, as well as in the process of the operation of the GPP and associated facilities.

Based on the available information related to the planned industrial activities, it may be assumed that any changes in the chemical composition of soils in the zone impacted by the planned facilities will be in the form of tendencies without exceeding the threshold limits and ensuring the conservation of the natural status of the local soils. No significant additional impact of the construction sites on the soil cover and land status in the adjacent areas (increase in the phyto-toxicity, release of pollutants to groundwater, etc.) is expected. In order to reduce the respective environmental risks, the construction plan should provide for measures ensuring compliance with the applicable civil engineering norms and codes, procedures for hazardous materials and waste handling and storage, adequate response to identified historic or current accidental contamination.

9.3.4 Soil and land resources conservation measures

In order to ensure protection and sound and consistent usage of land and soil resources and prevent their depletion and degradation, the following basic requirements should be met in the process of construction and installation activities[22]:

- Construction works should be performed in strict compliance with the construction time schedule;

[22] Amur Gas Processing Plant. Project design documentation. Environmental impact assessment. Volume code: 4700-0095-OBOC. Ufa: Scientific Research and Design Institute of Oil and Gas (NIPI NG "Peton"), 2015.

- The work should be executed strictly within the boundaries of the allocated land area, preventing any excessive use of additional areas due to inadequate organization of the construction process;
- All types of work should be performed in compliance with the timeframe agreed upon with the respective land users to minimize the damage inflicted to the latter;
- Strict compliance with the Project design requirements relating to clearing of sites and removal of woody plants;
- Prohibition of any traffic of transport vehicles off the approved transport routes;
- Prevention of any contamination of the construction sites with construction debris, waste insulating and other materials, with fuel and lubricants; prompt actions to eliminate such contamination;
- Strict compliance with all approved project design solutions, environmental protection measures, including anti-erosion and land reclamation measures;
- Sound and consistent use of material resources, minimization of waste generation, appropriate waste disposal and treatment.

In order to prevent any soil cover contamination, the following measures have been foreseen in the Project design documentation:

- Refueling of transport vehicles strictly within designated areas equipped with vessels for collection of spent fuel, lubricants and wiping materials;
- Refueling and lubrication of construction equipment and machinery only at operation sites and routes in an adequate manner to prevent spills of fuel and lubricants to the ground surface;
- Prohibition of equipment and machinery washing at construction sites;
- Storage of construction materials strictly in the designated area and within the boundaries of the approved construction sites.

In order to prevent disturbance and contamination of the soil cover in the process of drilling boreholes for deep anodic grounding, the following requirements should be met:

- Compliance with the general requirements of civil engineering norms VSN 012-88 "Construction of trunk and infield pipelines. Electrochemical protection means and installation", Part 1;
- Supervision over the condition and adequate sealing of drilling equipment in the process of drilling operations;
- Storage of fuel and lubricants required for the operation of drilling equipment in special vessels, which should be tested prior to their filling to make sure that there is no leakage and that the vessels are equipped with level gauges;
- Delivery of chemicals and clay powder to the drilling site in the manufacturer's package, polyethylene bags and in rubber-cord containers and their storage in covered premises;
- Use of a close water supply system; the excess clay mud should be used in the process of drilling of next boreholes;
- Timely collection and removal of construction debris and domestic solid waste. Prohibition of burning of spent tires and other combustible waste (wood, oily wiping materials, etc.) within the construction sites and in adjacent areas.

One of the main measures aimed at soil protection is land reclamation of the areas disturbed in the process of construction and installation work. The following objectives are to be attained in the process of land reclamation:

- Conservation of the balance of productive areas for fertility recovery within the disturbed land areas;
- Ensure restoration of the crop rotation in land areas allocated for the construction phase on a temporary basis;
- Minimization of adverse impact of technogenic processes on land resources.

Taking into account the soil and climatic conditions of the subject area and the commercial use of the Project area[23], it is planned to carry out land reclamation of the disturbed land areas in two stages:

- Technical reclamation including stripping of the fertile topsoil layer, stockpiling it on a temporary basis prior to the beginning of the construction and installation work and

[23] Amur Gas Processing Plant. Project design documentation. Environmental impact assessment. Volume code: 4700-0095-OBOC. Ufa: Scientific Research and Design Institute of Oil and Gas (NIPI NG "Peton"), 2015.

subsequent returning of this soil after the construction completion;

- Biological reclamation aimed at restoration of the soil fertility by addition of an integrated complex of mineral fertilizers and preparation of a reclaimed area for its intended use.

The technical reclamation operations should be carried out in the following sequence:

- Stripping of the fertile topsoil layer;
- Transportation of the stripped soil to a temporary stockpile;
- Compaction of the mineral ground after filling the trench and uniform distribution of the remaining ground throughout the zone subject to reclamation;
- Grading of the mineral ground within the zone subject to reclamation;
- Transportation of the fertile topsoil from the temporary stockpile;
- Final grading of the site.

The following sequence of work should be performed in the process of construction of areal facilities, motor roads and railway infrastructure facilities:

- Stripping of the fertile topsoil layer from the entire construction site and along the road route;
- Transportation of the stripped soil to a temporary stockpile;
- Formation of a sod layer over the soil stockpile to prevent blowing by wind and washing out of nutrients and conservation of the fertility of the stockpiled soil;
- Cutting, required moving and filling of mineral ground in conformity with the vertical profile design of sites and roads;
- Construction of the onsite roads, open areas, engineering networks, buildings and structures, footpaths, etc.;
- Final grading of the areas to be reclaimed prior to filling of the fertile soil;
- Return of the fertile soil from stockpiles to the areas to be reclaimed at industrial sites, along the road shoulders and on road embankment slopes and grading of the soil layer;
- Execution of works foreseen in the reclamation, greenery planting and improvement of the sites and sod layer formation on road shoulders and embankment slopes.

The thickness of the topsoil layer to be stripped is determined depending on the fertility of the soil. In the subject area it is on average 20cm to 30cm. The topsoil layer stripping is to be performed, as far as possible, during the warm season of the year; it can be performed in winter only with approval of the land users and the relevant governmental supervisory agencies.

The topsoil layer is to be stripped, if possible, to the full thickness by a single pass. The land reclamation should be carried out only during the warm season of the year. The excessive quantities of fertile soil are to be used for site improvement in other areas during the subsequent stages of the project construction. They can be also used for improvement of areas with topsoil of low fertility. It is up to the land user to determine the usage of excessive quantities of fertile soil.

Technical land reclamation (removal of construction debris and wastes and logging residues, grading of the area within the construction right-of-way) shall be performed immediately after the construction and installation completion by the same construction contractor.

Biological land reclamation shall be performed to attain the following goals:

- Reduction or prevention of consequences of technogenic disturbance of the soil and vegetation cover;
- Ensure suitability of the land for farming purposes (in case of farming land);
- Soil protection from water and wind erosion;
- Creation of landscapes meeting the relevant sanitary, hygienic and esthetic requirements;
- Maximum possible rehabilitation of the habitats for terrestrial wildlife.

All types of work for biological land reclamation shall be performed in conformity with the Technical Specifications for land reclamation (subject to preliminary approval by the lessor of a particular land area), the Guidelines issued by the Amur Region Ministry of Agriculture, Amur Agrochemical Service Station, and other relevant agencies.

The following measures are to be implemented in the course of the biological land reclamation stage:

- Addition of organic fertilizers to the soil (in case of arable farming land);
- Addition to an integrated complex of mineral fertilizers;
- Plowing of the soil down to a depth of 30 cm with subsequent harrowing;
- Cultivation of the soil with simultaneous harrowing;

- Seeding of perennial grass species in grazing land areas and in areas with trees and shrubs;
- Packing of soil after seeding to prevent wash out and blowing of seeds by wind.

To improve the fertility of the topsoil in disturbed land areas, it is recommended to use semi-seasoned manure at a rate of 50 to 80 t/ha of arable land. Mineral fertilizers should be used to improve the fertility of the topsoil layer in disturbed land areas at the following rates: 0.15 to 0.25 t/ha of ammonium nitrate and 0.15 to 0.25 t/ha of ammophos fertilizer.

Based on the species composition of graminoid plants suitable for land reclamation, the Project design foresees the use of native and zoned plant species (meadow clover, unbearded brome) highly resistant to frost in winter and night frost in spring and forming a dense sod.

The biological reclamation shall be carried out by specialist contractors having at their disposal appropriate equipment and machinery both for earthmoving operations and agricultural techniques. A contractor shall be selected using a tender procedure. The biological reclamation can be also performed by the land users at the expense of the Project.

Appropriate supervision over the quality of the work execution and compliance with the applicable requirements should be conducted in the process of the topsoil stripping and stockpiling operations, grading of sites and land reclamation procedures.

After the construction completion, the reclaimed land areas used on a short-term lease basis should be returned to their original land owners in a condition suitable for commercial utilization in accordance with the intended purpose. The reclaimed land should be presented to the land owner during a season when the ground surface is not covered with snow after the ultimate completion of the construction and installation work simultaneously with the acceptance of the main project facilities prior to their putting into operation. The acceptance should be conducted in conformity with the procedure approved by the RF Ministry for Natural Resources and the RF State Committee for Land Resources Management (Order No.525/67 of 22.12.1995 "On Approval of Basic Provisions for Land Reclamation and Fertile Topsoil Stripping, Conservation and Usage).

The measures to be implemented for improvement of the land areas used on a long-term basis and not occupied for any technical equipment and facilities will include:

- Construction of onsite driveways and footpaths;
- Covering the ground surface not used for any technical facility and without hard pavement with the fertile soil stored on a short-term basis in the stockpiles;
- Seeding of lawns in areas with open ground surface;
- Planting of trees and shrubs within the zone of auxiliary facilities.

In order to prevent contamination of the soil cover during the operational phase of the Project, the following technical measures have been planned in the Project design:

- The main equipment is to be installed in buildings and in modular units;
- The floors in the buildings should be properly sealed and equipped with valves for drainage and collection of spills;
- Accidental spills should be collected in special vessels;
- Underground drainage and spill collection vessels should be installed in by-pits to prevent ground contamination in case of leakages;
- Provision of secondary containment trays under diesel fuel tanks and installation of the latter in areas with secondary containment barriers;
- Hard pavement and secondary containment bunding of any process areas, where leakage of process fluids, fuel and lubricants is potentially possible; drainage of surface runoff from such areas to the stormwater sewer network and further to the sewerage treatment facilities;
- Regular inspections and checks of the tanks and pipelines in accordance with a time schedule approved by the plant manager.

The operating company will develop spill response plans and schemes for informing the relevant persons in case of accidents and conduct systematic drills for the operating personnel in accordance with these documents.

To avoid contamination of the sites of the industrial facilities, industrial wastes should be accumulated on a short-term basis in special areas designated for this purpose and in conformity with the applicable environmental norms. The accumulated wastes should be handed over to licensed organizations specializing in waste collection, disposal, processing, utilization and neutralization.

The summarized assessment of the significance of the expected impacts during the construction and operation of the Amur GPP facilities on the soil cover and landscapes including the recommendations aimed prevention, minimization and monitoring of the predicted adverse consequences is presented in Table 9.3.3.

9.3.5 Summary

The site selection for the future gas processing plant and associated facilities has been conducted taking into account the following aspects:

- A combination of favorable economic and geographical conditions;
- The existing regulatory constraints associated with the presence of a number of archeological sites, special conditions of water protection and fishery protection zones, riverside protective belts of watercourses;
- Planned regulatory limitations associated with the special status and conditions of the Amur GPP facilities (including sanitary protection zones, security zone, zone with limitations for construction of buildings, etc.).

An important environmental and landscape factor is the absence of any legally protected nature areas of local, regional or federal significance or any areas of customary use of natural resources within the Project site and in its immediate vicinity.

In the process of the preparations for the Amur GPP Project design development, the existing territorial planning schemes of the local municipalities had been adjusted in an adequate way to incorporate construction and operation of all planned project facilities and changes in the land use status of the involved areas. The dimensions of sites selected for the Amur GPP facilities have been determined by the design developers to ensure minimal withdrawal of land resources and optimal width of the right-of-way strips for linear facilities.

The total area allocated for the planned areal and linear Project facilities is approximately 900 ha; the additional land to be used on a short-term basis during the construction phase of the Project is 313 ha. The Project implementation will result in a significant transformation of the landscapes within the allocated land area and to moderate transformations of the landscapes in the adjacent areas.

In the structure of the landscapes in the Zeya-Bureya physical geographical province, the proportion of forests will decrease to an especially high degree: within the allocated land area and the associated protection zones and fire prevention strips they will be replaced completely by the facilities to be constructed, as well as by paved areas and secondary meadows. Partially this will be compensated for by restoration of meadow plant assemblages in the land areas used on a short-term basis during the construction phase and subject to land reclamation.

Short-term (during the construction phase) and long-term adverse visual impacts will be insignificant for facilities located outside of the visibility area of the nearest residential and recreational zones (e.g. the GPP site, landfill, river jetty). Part of the planned facilities (residential settlement and transport infrastructure facilities) will affect directly the periphery of the residential zones, the communities of which had approved in general the respective project layout design in the course of the public hearings.

Prior to the commencement of the Project implementation the allocated areas had not been used (wasteland, forests, sites of dismantled technical facilities, etc.). Due to this reason the commercial damage associated with allocation of the land areas for construction of industrial production and transport facilities will be insignificant. Nevertheless, it is planned to strip and stockpile the fertile topsoil layer and use in the future for reclamation of the disturbed land.

An essential components of the operational environmental monitoring and supervision program will be monitoring of the physical integrity and chemical pollution of the soil cover. The list of facilities to be subjected to such monitoring should include also the areas subjected to land reclamation.

Table 9.3.3: Predicted impacts of construction and operation of the Amur GPP facilities on the soil cover and landscapes, mitigation measures and monitoring

Environmental aspects	Predicted impacts	Recommended mitigation measures	Predicted residual impacts	Assessment of residual impact significance	Recommended monitoring and supervision measures
1. Air emissions	1.1. Contamination of soil cover with exhaust gas components	Regular diagnostic checks of the composition of exhaust gas released from transport vehicles, construction equipment and machinery, diesel-driven and other equipment and machinery with internal combustion engines.	Inevitable contamination of the soil cover with components of exhaust gas emissions from motor vehicles, railway and river transport, construction and other special machinery within the range permitted by the applicable technical norms.	Low significance	Development and implementation of an operational environmental monitoring program with due consideration of the parameters of the approved SPZ designs, including monitoring of the chemical pollution of the topsoil layer in test areas, the location of which should take into account the specific microclimatic features of the subject area, positional relationships of the pollution sources and the nearest normable sites. Supervision over compliance with the rules for work execution, occupational health and safety norms and fire safety requirements. Some of these measures should be incorporated in the operational environmental monitoring program.
	1.2. Contamination of soil cover with dust (fine particulate matter of materials used for road pavement, construction materials, loose substances, solid waste, welding aerosol, paint aerosols, etc.)	In summer: periodic water spraying of roads and stockpiles of loose and other materials stored in open areas and causing dust emissions. Speed limits for the traffic. Appropriate maintenance of the road pavement (on roads with hard pavement). Use of adequately equipped stations for wheel washing and other method to prevent contamination of paved areas. Grass seeding in areas with an open soil cover in order to minimize the deflation intensity.	Dust emissions and precipitation onto the soil cover (it will be minimized as a result of the planned mitigation measures).	Low significance	
2. Storage of raw and other materials	The conditions specified in the project design for handling of raw materials, reagents and other materials and wastes does not imply any significant environmental impacts	No additional measures (i.e. in addition to those foreseen in the Project design) are required.	No significant impacts are expected. Localized contamination of the soil cover is potentially possible as a result of infiltration of atmospheric precipitation in the areas used for materials and waste storage.		Periodic inspections of areas used for storage of raw materials, supplies, reagents and wastes by the OHS service of the operating company (construction organization).
3. Waste generation and management					

Environmental aspects	Predicted impacts	Recommended mitigation measures	Predicted residual impacts	Assessment of residual impact significance	Recommended monitoring and supervision measures
4. Land use	The Project design provides for alienation of a number of land areas for permanent and temporary use (for the construction phase). All areas to be used on a permanent basis will be reclassified to the category of land for industrial use. The main part of areas to be used on a short-term basis are categorized as farming land and are subject to land reclamation.	The Project design provides for supervision over compliance with the boundaries of the allocated Project sites throughout the Project lifecycle.	Damage inflicted to the soil cover will be minimized by fertile topsoil stripping and stockpiling.		Periodic monitoring of the topsoil stockpiles. Monitoring of land areas at the external side of the perimeter of the Project sites and associated facilities to identify any physical and mechanical disturbance of the soil cover. Monitoring of the soil cover in the area subjected to land reclamation.
5. Pre-construction work, excavation and earthmoving operations, melioration, construction and installation works	5.1. Changes in the thermal and water regimes and the physical properties of the soils within the Project sites and in adjacent areas. Partial destruction of the soil cover. Landscape transformation and development of adverse exogenous geological processes.	Site improvement and greenery planting should be carried out after the construction and installation completion within the areas used for the Project on a permanent basis. Land reclamation in areas used on a short-term basis. Sound use of the existing road networks and other infrastructure facilities. All types of work should be performed strictly within the boundaries of the allocated land areas.			Periodic investigation of the areas subjected to site improvement and greenery planting to be incorporated in the operational environmental monitoring program. The same goes for areas left for self-recovery (unused areas) within the land allocated for the GPP and associated facilities.
	5.2. Contamination of the sites with ferrous and nonferrous metal scrap, wiping materials, used tires, fragments of construction materials, etc.	Supervision over the condition of the Project area to identify any sites used for unauthorized waste disposal.	Compliance with the applicable civil engineering norms and rules, proper maintenance of equipment and machinery, timely implementation of measures to eliminate consequences of contamination will minimize the residual impact.		Periodic inspection of areas used for short-term waste accumulation.

Environmental aspects	Predicted impacts	Recommended mitigation measures	Predicted residual impacts	Assessment of residual impact significance	Recommended monitoring and supervision measures
6. Accidental spills of fuel, lubricants and other technical fluids	6.1. Contamination of the soil cover in case of accidental spills of fuel, lubricants and other technical liquids	Additional periodic inspection of equipment and machinery. Refueling, maintenance and repairs should be performed only in areas with hard pavement. Provision of secondary containment bunding and trays. Prompt response to accidental spills and their consequences.	Compliance with the applicable civil engineering norms and rules, proper maintenance of equipment and machinery, timely implementation of measures to eliminate consequences of contamination will minimize the residual impact.	Low significance	Supervision over compliance with the work execution procedures, occupational health and safety norms and fire safety requirements. Quality control of the soil cover in areas, where soil contamination has been identified.
	6.2. Impact of historic contamination of the construction sites	No historic soil cover contamination had been revealed in the course of the conducted surveys.		Moderately high significance	Monitoring of the soil cover quality in test areas and in baseline areas referred to the survey materials and in the project design documentation.

9.4 Impact on surface water bodies

9.4.1 Introduction

Surface watercourses in the vicinity of the Amur GPP facilities include the region's largest rivers, the Zeya and the Amur, and their tributaries. There are a lot of small lakes, some areas are swamped.

Main types of impact on water bodies during construction and operation of Amur GPP include abstraction of water from natural sources and discharge of wastewater into surface water bodies.

Impact on the aquatic environment during construction may lead to a disruption of natural surface drainage thereby speeding up bank erosion, transporting suspended solids from the construction site along with snowmelt and storm runoff and creating the risk of pollution of the aquatic environment by surface runoff, fuel and lubricants spilled due to improper storage or use. During construction, as a result of precipitation, a non-organized discharge of pollutants from the construction sites is possible along the natural downward grade of the terrain into roadside ditches and gullies outside the construction sites.

Impacts on the aquatic environment during the operation of the Amur GPP facilities are caused by the failure to observe regulations on the operation of water treatment plant, the littering of the riparian areas, emergency leaks of wastewater and process chemicals from pipelines and tanks, discharges of untreated effluent onto the ground.

An underground water intake structure located in the Bolshaya Pera valley and consisting of three clusters 180 m apart from each other will serve as the primary source of water supply to all the Amur GPP facilities. Two of the clusters have 3 wells each (2 operational and one standby), the third cluster has 1 observation well. The output of the proposed wells is as follows:

- operational wells: 2,850 m³/day;
- standby well: 1,750 m³/day.

Four additional wells will be constructed to meet the needs of the Amur GPP facilities operating at full capacity. The maximum output of the proposed wells will be 2,850 m³/day.

Given that the quality of the natural source water does not conform to the sanitary standards in terms of iron, silicon and manganese concentrations, an 800 m3/day water treatment facility (WTF) will be constructed at the GPP site with a possibility to increase its capacity to 2,600 m3/day. A fence will be built around the perimeter of the first belt of the WIS's SPZ calculated according to Russian sanitary and hygienic laws (50 m). To comply with the requirements, the following is not allowed within a water fenced-off area:

- setting up fuel and lubricant warehouses;
- setting up vehicle repair grounds;
- washing motor vehicles;
- discharging untreated effluent, including drainage water;
- storing wastes without proper permits;
- using fertilizers during land reclamation.

Separate water supply systems will be constructed at the Amur GPP site for the following types of water:

- domestic and drinking water,
- fire water,
- industrial water,
- recycled water.

Consumption of water during the construction and operation of the Amur GPP facilities will be determined by the technical conditions of the production process and the domestic and drinking needs of the Project staff.

Industrial water is used for main (process equipment washing) and auxiliary (own needs of WTF, WWTF, boiler plant, heat networks, heating system flushing, repairs and mechanical workshop, etc.) technological needs. The estimated industrial water demand is determined based on the production process.

The estimated fire water demand was determined based on regulatory documents. The estimated domestic/drinking water demand is determined based on the number of consumers.

Treated wastewater will be discharged into the Bolshaya Pera river. Wastewater will be sent via an underground pressure sewer to a discharge point on the bank of the river Pera. A reinforced concrete jet energy dissipation baffle will be installed at the discharge point; riprap will be used to prevent bank and riverbed erosion.

This section discusses impacts on surface water bodies during the construction and operation of the following Amur GPP facilities:

- Early work facilities (9.4.2);
- Railway infrastructural facilities (9.4.3);
- Auxiliary facilities (9.4.4);
- Temporary jetty on the Zeya River (9.4.5);
- Main production facilities (gas processing plant) (9.4.6);
- Social infrastructural facilities (residential housing project) (9.4.7);
- SDIW landfill (9.5.8).

9.4.2 Site grading

Preparatory work carried out during the construction of the Amur GPP facilities includes site grading which will remove the top layer of soil and change the site topography. The impact of construction work will result in riverbank erosion and the disruption of natural drainage lines. Pollution of water bodies by fuel and lubricants is also possible; water bodies and water protection zones may be littered by rubbish and construction debris.

Site grading operations and the deforestation of the pipeline construction corridor will involve tree cutting and collection of branches and felling residue. As a rule, tractors with front-mounted bulldozer rake blade are used for clearing and grubbing small trees. The construction corridor will be cleared from shrubs and small trees by bulldozers or using special DT-75 tractor mounted equipment. The cleared timber will be stored at a temporary yard near the Amur GPP.

Vertical site grading will be performed taking into account the existing topography and the local geological and hydrological features. Due to the abundance of buildings, installations, driveways and utility lines at the construction site the entire area will be graded. The height of embankment is chosen depending on the local topography, geological and hydrological conditions, technological and construction requirements. Fill material should meet specific requirements: it should consist of non-swelling soils with good permeability. Fine sands or coarser-grained sands with low clay content can be used.

To mitigate the environmental impact of site grading the following environmental monitoring and mitigation measures will be implemented:

- observing and monitoring work area boundaries;
- prohibiting vehicle traffic other than on temporary and permanent access roads;
- placing a ban on washing motor vehicles and other machinery outside designated areas with waterproof surfaces, etc.

Other surface water protection measures to be implemented during construction are as follows:

- performing preparatory work exclusively in winter (to minimize surface runoff);
- clear snow and ice and remove them to designated areas (to prevent runoff during snowmelt period) prior to commencing preparatory work;

- Constructing an artificial embankment to strengthen slopes thereby decreasing flooding risks (see also section 9.12).

The significance of impact for site grading operations on surface water bodies can be assessed as low.

The list of measures aimed at decreasing negative impact of site grading operations on water bodies is given in Table 9.5.40.

9.4.3 Early work facilities

9.4.3.1 Construction

Impacts on water bodies during the construction of the proposed facilities include:

- abstraction of water from natural sources;
- possible pollution of the aquatic environment;
- possible disruption of natural drainage lines;

Water use

During construction, water from natural sources will be used for:

- domestic/drinking needs;
- industrial needs (making drilling muds for drilling water wells; mixing mortar and concrete; pipelines and tanks hydrotesting)

Prior to putting into operation the Project's underground water intake structure it is planned to deliver water from Svobodny in tank trucks.

When the water intake structure is put into operation, water for domestic and drinking needs will be taken from the pipelines laid from the underground water intake facility to the Amur GPP site.

On construction sites, drinking water will be stored in cisterns installed in workers cabins. Excavator and vehicle operators will have access to drinking water in their workplaces.

Mortars and concrete will be produced by a contractor and delivered to the construction site by concrete transport trucks and mortar transport trucks.

Water use data for the period of early work facilities construction are given in Table 9.4.1 below.

Table 9.4.1: Water use during construction

Water use r	Volume of water used, m^3/y		
	Total, including:	domestic and drinking needs	industrial needs
2016			
Construction team	10,870	10,870	
Concrete batching	94	-	94
Mortar batching	27	-	27
Drilling mud preparation	303	-	303
Pipelines hydrotesting	525*	-	525*
Tanks hydrotesting	420*	-	420*
Temporary construction camp	50,010	50,010	-
Total in 2016	62,249	60,880	1,369
2017			

Water use r	Volume of water used, m^3/y		
	Total, including:	domestic and drinking needs	industrial needs
Construction team	2,722	2,722	-
Concrete batching	12	-	12
Mortar batching	3	-	3
Temporary construction camp	12,514	12,514	-
Total in 2017	15,251	15,236	15
Total during construction:	77,500	76,116	1,384

/ *indicates source water only, re-used in the amount of 2,000 m^3

The total volume of water used during the construction of the early work facilities will be 77,500 m^3, including

- 76,116 m^3 for domestic and drinking needs;
- 1,384 m^3 for industrial needs.

Wastewater removal

The following types of wastewater will be generated during construction:

- domestic wastewater– produced by everyday activities of construction workers;
- industrial wastewater – produced by hydrotesting of pipelines and tanks.

Wastewater removal data for the period of construction are given in Table 9.4.2 below.

Table 9.4.2: Wastewater removal during construction

Water user	Volume of water removed, m^3/y		
	Total, including:	domestic and drinking needs	Industrial needs:
2016			
Construction team	10,870	10,870	
Concrete batching	94	-	94
Mortar batching	27	-	27
Drilling mud preparation	303	-	303
Pipelines hydrotesting	525*	-	525*
Tanks hydrotesting	420*	-	420*
Temporary construction camp	50,010	50,010	-
Total in 2016	62,249	60,880	1,369
2017			
Construction team	2,722	2,722	-
Concrete batching	12	-	12
Mortar batching	3	-	3
Temporary construction camp	12,514	12,514	-
Total in 2017	15,251	15,236	15
Total during construction:	77,500	76,116	1,384

The total volume of wastewater removed during construction will be 77,008 m^3, including:

- 76,116 m^3 of domestic wastewater;
- 892 m^3 of industrial wastewater.

The water balance of water use and wastewater removal during the construction of the auxiliary production facilities is shown in Table 9.4.3 below.

Table 9.4.3: Water balance of water use and wastewater removal during construction

Water use, m^3/y						Wastewater removal, m^3/y			Consumptive water use and water losses, m^3
Total	Industrial needs				Domestic/drinking needs	Total	Industrial wastewater	Domestic wastewater	
	Fresh water		Recirculation water	Recycled water					
	Total	incl. drinking							
77,500	1,384	30.3	-	2,000*	76,116	77,008	892	76,116	492

/* - disregarded in water balance

Batching of concrete and mortars and preparation of drilling muds account for consumptive water use. Irretrievable water losses are determined by losses of recycled water during hydrotesting.

Wastewater treatment

No wastewater will be discharged into water bodies during the construction of the early work facilities. During the construction of the proposed facilities wastewater will be removed from the site in the following manner:

- domestic wastewater will be collected in storage tanks installed on the construction sites and then transported in tank trucks to the Khoz-Alyanc wastewater treatment plant in Svobodny.
- industrial wastewater from hydrotesting will be transported in tank trucks to the Khoz-Alyance wastewater treatment plant in Svobodny.

9.4.3.2 Operation

Water use

The early work facilities will be supplied with artesian water from the Amur GPP water intake structure. During the operation of TBI, water from natural sources will be used for:

- domestic/drinking needs of the construction teams (residing in TBI or working at the bases and construction sites);
- industrial needs, including the need of the WTF, boiler plant, heating system flushing, concrete and mortars batching.

Water use data for the period of early work facilities operation are given in Table 9.4.4 below

Table 9.4.4: Water use at the TBI facilities

Facility, process or user	Volume of water used, m^3/day/ m^3/y		
	Total, including:	domestic and drinking needs	industrial needs
Housing project #1	117.5/42,889	117.5/42,889	-
Housing project #2	320.1/116,859	320.1/116,859	-
Housing project #3	306.2/111,767	306.2/111,767	-
Common infrastructural facilities	16.2/5,917	16.2/5,917	-
Customer's base with equipment storage yard	10.6/8,403	10.6/8,403	-
Temporary Contactor inventory storage base	1.36/498	1.36/498	-
Contactor fuel and lubricant warehouse	0.08/29	0.08/29	-
WTF site	66/23,778	0.05/18	66/23,778
WWTF site	0.050/18	0.050/18	-
Construction site workers	14.2/3,026	14.2/3,026	-
Boiler plant make-up water	96/21,984	-	96/21,984
Boiler plant, own needs	5/1,178	290/106	5/1,072
Heating system flushing	10.2/1,325	-	10.2/1,325
Concrete and mortar batching water	75.2/27,452	-	75.2/27,452
TBI total	1,038/365,123	786/289,530	252/75,593
KC-7a	200/73,000	200/73,000	-
KC-7a total	200/73,000	200/73,000	-
Facilities total	1238.8/438,123	986.7/362,530	252.1/75,593

The total volume of water used during the early work facilities operation will be 1,038.8 m^3/day, 365,123 m^3/year, including

- 786.80 m^3/day, 289,530 m^3/y for domestic and drinking needs;
- 252.1 m^3/day, 75,593 m^3/y for industrial needs.

Wastewater removal

The following types of wastewater will be generated during the operation of the early work facilities:

- domestic wastewater– produced by everyday activities of construction workers residing at TBI and working at the bases and construction sites;
- industrial wastewater– produced by filter washing at the WTF, heating system flushing, and boiler plant operation;
- storm water.

Wastewater removal data for the TBI facilities are given in Table 9.4.5 below.

Table 9.4.5: Wastewater removal from the TBI facilities

Facility, process or user	Volume of wastewater removed, m^3/day/ m^3/y				
	Total, including:	domestic wastewater	wastewater removal plant	industrial wastewater, stormwater, meltwater	wastewater removal plant
Housing project #1	117/42,889	117/42,889	Adsorber unit	-	-

Facility, process or user	Volume of wastewater removed, m^3/day/ m^3/y				
	Total, including:	**domestic wastewater**	**wastewater removal plant**	**industrial wastewater, stormwater, meltwater**	**wastewater removal plant**
Housing project #2	320/116,859	320/116,859	Adsorber unit	-	-
Housing project #3	306/111,767	306/111,767	Adsorber unit	-	-
Common infrastructural facilities	16/5,917	16/5,917	Adsorber unit	-	-
Customer's base with equipment storage yard	11/8,403	11/8,403	Adsorber unit	-	-
Temporary Contactor inventory storage base	1.4/0,498	1.4/0,498	Adsorber unit	-	
Contactor fuel and lubricant warehouse	0.08/29,000	0.08/29	Adsorber unit		
WTF site	66/23,778	0.05/18	Adsorber unit	66/23,760	Adsorber unit
WWTF site	0.05/18	0.05/18	Adsorber unit	-	
Construction site workers	14/3,026	14/3,026	Adsorber unit	-	
Boiler plant	5/1,178	0.3/106	Adsorber unit	5.3/1,072	Adsorber unit
Heating system flushing	10/1,325	-	-	10/1,325	Unimet unit
Stormwater from the Project site	446/5,239	-	-	446/5,239	Unimet unit
TBI TOTAL	1314/320,926	787/289,530		527/31,396	

The total volume of wastewater removed during operational phase of early work facilities will be 1314 m^3/day, 320,926 m^3/y, including:

- 787 m^3/day, 289,530 m^3/y of domestic wastewater;
- 81 m^3/day, 26,157 m^3/y of industrial wastewater;
- 446 m^3/day, 5,239 m^3/y of storm water.

The water balance of water use and wastewater removal during the operation of the early work facilities is shown in Table 9.4.6 below.

Table 9.4.6: Water balance of water use and wastewater removal during the operation of the TBI facilities

Water use, m^3/y					Wastewater removal, m^3/y			
Total	Industrial needs			domestic/drinking needs	Total	Industrial wastewater and stormwater	Domestic waste water	Consumptive water use and water losses,
	Fresh water		Recirculation and recycled water					
	total	incl. drinking						
365,123	75,593	16,809	-	289,53	320,926	31,326	289,530	49,436

Batching of concrete and mortars and preparation of drilling muds account for consumptive water use.

Wastewater treatment

The following sewer systems will be constructed at the early work facilities site: sanitary sewer system (K1), storm water sewer system (K2), general purpose sewer system for unpolluted wastewater (K3), industrial sewer system (K4).

Domestic wastewater will be removed from buildings and installations via the sanitary sewer system (K1) and subsequently pumped to the WWTF site and fed into the proposed unit.

Industrial wastewater will be removed from buildings and installations:

- to two 200 m^3 tanks and subsequently pumped to the head of the WTF (from water treatment plant filters washing)
- to the proposed sanitary sewer system (K1) and subsequently pumped to the proposed plant (from the boiler plant);
- to the industrial sewer system (K4) and subsequently pumped to the WWTF site and fed into unit (from heating systems flushing).

Storm water from especially polluted areas will be removed:

- from the open motor vehicle and construction machinery parking lot into a 500 m^3 containment pond and subsequently pumped to the WWTF site and fed into the proposed unit;
- from the temporary production and consumption waste disposal site into a 205 m^3 containment pond and subsequently pumped to the WWTF site and fed into the proposed unit;
- from the diked fuel and lubricant warehouse area through a bottom valve into the proposed industrial sewer system (K4) and then pumped to the WWTF site and fed into the proposed unit.

A characteristic of the untreated wastewaters produced by the early work facilities is given in Table 9.4.7 below.

Table 9.4.7: A characteristic of untreated wastewater

Wastewater	Wastewater composition
domestic wastewater	organic substances, biogenic matter
industrial wastewater	suspended solids, total iron, manganese, salts
storm water	suspended solids, petrochemicals

A total of 791 m^3/day, 290,602 m^3/y of domestic and industrial wastewater with similar composition will be collected into a receiving storage tank and then sent to the proposed biological WWTF.

A total of 300 m^3/day (6,564 m^3/y) of industrial wastewater and storm water will be collected into a 100 m^3 receiving storage tank and then sent to the proposed WWTF for industrial wastewater/storm water treatment.

Industrial wastewater/storm water treatment facilities are intended for treating industrial wastewater, storm water, and meltwater which do not contain specific substances with toxic properties. The treatment will be based on thin-layer settling, flotation, filtering through a granular medium, after-treatment with sorption filters, decontamination by sodium hypochlorite. This will keep the concentrations of petrochemicals, suspended solids and BOD in treated wastewater below the standards for discharges into surface water bodies. A characteristic of the untreated and treated wastewaters produced during the operation of the proposed facilities and efficiency of the wastewater treatment facilities is given in Table 9.4.8 below.

Table 9.4.8: A characteristic of wastewater treatment methods, treatment facilities efficiency

Volume of wastewater sent for treatment, m3/day,· m^3/y	Polluting substances	PS amount		PS concentrations, mg/dm^3		Efficiency,%	PS amount after treatment, t/y	
		kg/day	t/y	Before treatment	After treatment		Before treatment	After treatment
WWTF site								
Domestic and industrial wastewater, Adsorber unit								
Mechanical, biological treatment								
791 290,602	suspended solids	196.7	72.2	248.5	3.0	98.79	2.37	0.87
	mineralization	375.1	137.7	473.9	473.9	-	375.08	137.72
	Total BOD	196.7	72.2	248.5	3.0	98.79	2.37	0.87
	ammonia nitrogen	23.6	8.7	29.8	0.4	98.66	0.32	0.12
	nitrates (N)	11.8	4.3	14.9	9.0	39.64	7.12	2.62
	nitrites (N)	1.6	0.6	2.0	0.0	98.99	0.02	0.01
	phosphates (P)	2.0	0.7	2.5	0.2	91.97	0.16	0.06
	chlorides	27.5	10.1	34.8	34.8	-	27.53	10.11
	total iron	2.4	0.9	3.0	0.1	96.64	0.08	0.03
	petrochemicals	1.6	0.6	2.0	0.1	97.49	0.04	0.01
	anionic detergents	1.6	0.6	2.0	0.1	94.97	0.08	0.03
Industrial wastewater and stormwater, UniRain unit								
Physical/mechanical treatment								
300 6,564	suspended solids	89.0	1.9	296.6	3.0	98.99	0.9	0.02
	petrochemicals	5.8	0.1	19.3	0.05	99.74	0.015	0.0003
	Total BOD	2.3	0.1	7.7	3000	61.19	0.9	0.02

Wastewater treatment efficiency is:

- up to 98.99% for domestic wastewater;
- up to 99.74% for industrial wastewater.

The efficiency of treatment makes it possible to discharge the wastewater into top-category fisheries water bodies.

Treated domestic and industrial wastewater and storm water will be discharged into the river Bolshaya Pera via the common release point #1.

A characteristic of the treated wastewaters released into the river is given in Table 9.4.9 below.

Table 9.4.9: A characteristic of released wastewater

Wastewater release point	Wastewater amount, m^3/day m^3/y	Polluting substances in wastewater at each release point	Concentration of polluting substances discharged with wastewater, mg/dm^3	Amount of polluting substances discharged with, t/y
Release point #1 – discharge of treated domestic, industrial wastewater and stormwater into the Bolshaya Pera	- 1091 297,166	suspended solids	3.0	91
		mineralization	343.65	102,121
		Total BOD	3.0	891
		ammonia nitrogen	0.29	86
		nitrates (N)	6.53	1,940
		nitrites (N)	0.015	4
		phosphates (P)	0.15	45
		chlorides	25.23	7,497

Wastewater release point	Wastewater amount, m^3/day m^3/y	Polluting substances in wastewater at each release point	Concentration of polluting substances discharged with wastewater, mg/dm³	Amount of polluting substances discharged with, t/y
		total iron	0.073	0,022
		petrochemicals	0.05	0,015
		anionic detergents	0.073	0,022

The wastewater content of the polluting substances is below the allowable discharge standards (ADS) (that correspond to the MACs applicable to fisheries); as a consequence, discharges of the wastewater will have no negative impact on the quality of surface water of the receiving watercourse.

9.4.4 Railway infrastructural facilities

9.4.4.1 Construction

Water use and wastewater removal

During the construction of the railway infrastructural facilities water for domestic and technical needs will be brought in from the nearest water supply sources (in Svobodny).

Drinking water will be delivered in bottles. Water for sanitary and drinking needs (including showering and handwashing) and for industrial needs will be brought in in cisterns.

According to the Construction Organization Plan section of the design documentation the consumption rate of water required

- for domestic needs (including drinking) will be 1.2 l/s.
- for industrial needs will be 0.04 l/s.

The total volume of water to be used during the entire construction period will be 16,500 m^3, including

- 14,500 m^3 for domestic needs;
- 2,000 m^3 for industrial needs.

The volume of domestic wastewater to be removed during the entire construction period will be 316 m^3. There will be no industrial wastewater at the site.

Wastewater treatment

The approximate composition of liquid domestic wastes is given in Table 9.4.10 below.

Table 9.4.10: Approximate composition of liquid domestic wastes during construction of railway infrastructural facilities

Polluting substance	Concentration, mg/l
Suspended solids	300
BOD20.	180
Aluminum	0.5
Ammonia nitrogen	18-20
Iron	1-2
Fats	30-50
Synthetic detergents	5-8
Copper	0.01-0.03
Sulfates	80-100
Chlorides	40-60

Polluting substance	Concentration, mg/l
Zinc	0.02-0.3

There will be no centralized sewer system or water supply system during construction phase. Modular cabins fitted with metal tanks for collection of liquid wastes from wash basins and showers are used to provide the staff with necessary accommodation space. Then wastes are collected into a hermetically sealed container and removed by special-purpose vehicles owned by Spetsavtokhozyaistvo.

Pollution of soil or groundwater by liquid domestic wastes can be avoided if the requirements outlined above are met.

9.4.4.2 Operation

Water use

"Ust-Pera" railway station

Water to be used in the existing building of the railway station and electric interlocking post will be brought in under a contact.

Water will be brought in from Svobodny to supply the proposed buildings. The required volume of water is 13 m^3/year.

"Zavodskaya" Railway Station

At the "Zavodskaya" station site, water will be required for the following needs:

- general and drinking water supply;
- water supply for industrial and operational needs;
- fire water supply;
- watering of green plants and improved grass cover.

The project design provides for the installation of the following water supply networks:

- general and drinking water supply network;
- firewater supply network;
- industrial water supply network;
- recycled water supply network;
- water pipeline for foam generation for fire suppression.

Water for the onsite water supply networks of the "Zavodskaya" railway station shall be supplied by the water pump stations of the Amur GPP.

The general and drinking water supply network will provide water for the personnel's general needs, for the canteen and for watering of green plants during the summer season. The requirement for water of potable quality has been estimated at 11,300 m^3/year.

The industrial water supply system will provide technical-grade water to the buildings of the locomotive shed and the repair and testing station for tank cars. The industrial water requirement has been estimated at 7,100 m^3/year.

The recycled water supply system will supply water to the firewater storage tanks. It is planned that 2,100 m^3 will be used annually to make up for firewater consumption.

"Zavodskaya-2" Station

At the "Zavodskaya-2" station site, water will be required for the following needs:

- general and drinking water supply;
- fire water supply;
- watering of green plants and improved grass cover.

The project design provides for installation of an external firewater supply network at the "Zavodskaya-2" station site. Water will be delivered to the "Zavodskaya-2" station site from the water supply network of the Amur GPP.

In case of fire, water will be supplied by the firewater pump station. Firewater will be stored and supplied to the firewater pump station from two firewater storage tanks each of 2,000 m^3 capacity. Treated recycled water from the Amur GPP will be used as make-up water for the firewater storage tanks.

Water for the needs of the central electricity supply station at the "Zavodskaya-2" railway station shall be delivered by water trucks. Three water storage tanks each of 4.8 m^3 capacity will be installed to ensure a daily water reserve.

The water requirement for general and drinking needs is estimated at 1,650 m^3/year. The water requirement for fire-fighting needs is estimated at 10 m^3/hour.

Wastewater Management

"Ust-Pera" Railway Station

It is planned to install a cesspool in the form of a steel tank for collection of sanitary and sewage wastewater, which will be removed periodically to the landfill for domestic and industrial solid waste disposal on the basis of an agreement conclude with a specialist company ("SpetsAvtoKhozyaistvo" LLC).

"Zavodskaya" Station

The following types of wastewater are to be removed from the "Zavodskaya" station site:

- sanitary wastewater;
- industrial wastewater from the equipment used in the repair and testing station and locomotive shed;
- wastewater from the canteen;
- industrial wastewater and stormwater from the loading trestle, tank farm and pump station;
- stormwater and snowmelt water from the station site;
- wastewater from water spraying of hard pavement;
- wastewater drained to the sewerage system in case of fire suppression.

The following external wastewater removal systems are planned:

- general sewerage system;
- stormwater drainage system;
- industrial and stormwater removal system.

The project design provides for installation of a general sewerage system based on the wastewater flow by gravity and including a sewage pump station. The estimated sewerage volume to be handled annually is estimated at 7,800 m^3.

The stormwater drainage system is designed to collect stormwater drained from the roofs of the buildings and from driveways for motor vehicles. An accumulating pond of 1,100 m^3 capacity is planned for stormwater runoff collection. The estimated stormwater volume is 68,000 m^3/year, including 53,000 m^3/year (i.e. 78%) during the warm season.

The industrial wastewater from the repair and testing station and the locomotive shed, as well as the stormwater with an elevated petroleum hydrocarbons content from the loading trestle section, storage tank farm and pump station will be drained to the industrial wastewater and stormwater drainage system designed for an estimated volume of 7,300 m^3/year.

All wastewater generated at the "Zavodskaya" Station site will be pumped to the wastewater treatment plant of the Amur GPP.

"Zavodskaya-2" Station

The following wastewater types are expected at the "Zavodskaya-2" station site:

- sanitary wastewater;
- stormwater and snowmelt water from the station site;
- wastewater from water spraying of hard pavement;
- wastewater drained to the sewerage system in case of fire suppression.

The following external sewerage and drainage systems have been foreseen in the project design:

- general sewerage system;
- stormwater drainage system;

Sanitary wastewater is to be removed from the toilets and shower rooms in the office and general-purpose buildings of the “Zavodskaya-2” station.

A tightly sealed cesspool of 12 m^3 capacity will be installed at the central electricity distribution station and the firewater pump station; its capacity is determined based on the maximum water consumption during two days. Cesspools made of prefabricated reinforced concrete elements will be installed at remote buildings with relatively small wastewater volumes (heating stations, building of the duty operator of the railway crossing).

The stormwater drainage system is designed to collect stormwater and snowmelt water with a relatively low pollutants content drained from the roofs of buildings, driveways for motor vehicles and graded site area. Two underground tanks each of 75 m^3 capacity have been designed for stormwater accumulation.

Any wastewater generated at the “Zavodskaya-2” station site will be transported to the sewerage treatment plant of the Amur GPP. The total general wastewater and sewerage volume is estimated at 1,830 m^3/year and the stormwater drainage volume is expected to be 6,650 m^3/year.

The following water protection measures will be implemented to avoid pollution of water bodies during the construction and operation of the railway infrastructural facilities:

(1) During construction:

- install a sufficient number of culverts through the bulk of linear facilities;
- make sure that construction debris and domestic garbage is collected in a designated area with a hard surface and stored in hermetically sealed containers. Garbage should be removed on a daily basis by a specialized company;
- install hermetically sealed containers for collecting liquid domestic wastes. As they fill up, they should be removed to the existing treatment facilities;
- make sure that no construction or transport vehicles or mechanisms are washed at the temporary parking lots;
- make sure that tracked construction vehicles and mechanisms are refueled at a designated area using a fuel truck which is equipped with a hose and has valves at the outlet, using trays to prevent fuel spills; road vehicles and wheeled construction machinery will be refueled at the nearest filing station;
- make sure that all the machinery and mechanisms involved in construction operations are in good repair and have been properly inspected and repaired to prevent fuel and lubricants from spilling onto the ground. Road vehicles and construction machinery will be serviced and washed at the owner’s production facilities;
- make sure that construction debris and unused materials are cleared from the construction site and that the catchment area is clean;

(2) *During operation*:

- make sure that garbage, leaks and spills from transported cargoes are cleared from railway tracks. No wastes should be buried within the construction site;
- make sure that the culverts and sewers are inspected in a timely and regular manner, restored to operability, if necessary, to avoid scour or silting, and cleared from rubbish;
- collect storm water into the station’s existing storm water drainage system;
- all underground utility lines should be laid in metal pipes with anti-corrosion coating or in polyethylene pipes.

A certain range of measures aimed at mitigating the impact on the water bodies and ecosystems will be taken in the process of construction of a railway bridge across the Bolshaya Pera River when performing work within the water protection zone and the riverside protection belt, including prohibition of:

- disposal of any industrial and domestic wastes, radioactive, chemical, explosive, toxic and poisonous substances;
- traffic and parking of any vehicles (except for special vehicles) with an exception of their movement toward roads and parking lots specially equipped with hard pavement;
- storage of any fuel and lubricants, location of vehicle maintenance workshops used for technical inspection and repair of transport vehicles, as well as washing of vehicles;
- discharge of any wastewater, including surface runoff drainage.

In the process of construction of the earth embankment in the water protection zone of the Bolshaya Pera River, no additional structures have been planned, because the catchment area is negligible and due to the use of the geo-synthetic material (MakMat) and the filled soil layer with vegetation cover over the entire area of the embankment slopes all stormwater runoff will be absorbed by the embankment soil and only an insignificant amount of water will drain over the embankment slope surface to a soil berm without its further migration over the ground surface.

In the course of the bridge operation, it is required to remove systematically and in due time contaminants from the ballast layer surface; in spring time, prior to snow melting, it is required to remove contaminated snow from the ballast section at the bridges.

To monitor the condition of the Bolshaya Pera river in the vicinity of the railway bridge, special surveys will be carried out in conformity with an operational monitoring program dedicated to this watercourse.

Provided that the measures outlined above are implemented, the impact on water bodies can be assessed as **low.**

9.4.5 Auxiliary facilities

9.4.5.1 Construction

Water use

During the construction of the auxiliary production facilities water from natural water sources will be used for:

- domestic and drinking needs of construction team workers;
- industrial needs:
  - preparing drilling muds for drilling water wells, wells for galvanic anodes for cathodic protection systems;
  - preparing mortars and concrete;
  - hydrotesting pipelines and tanks;
  - TBI infrastructural facilities' own needs.
- firefighting needs.

The following water supply sources will be used:

- for domestic/drinking needs:
  - imported water brought in by tank trucks from Svobodny (under a contract with Khoz-Alyans) to the construction sites;
  - underground water intake structure – for construction workers residing at TBI
- for industrial needs – groundwater from the underground water intake structure.

At the construction sites drinking water will be stored in cisterns installed in accommodation cabins. Mortars and concrete are prepared by a contractor at the mortar/concrete batching plants in Svobodny and delivered to the construction site by mortar/concrete mixing transport trucks.

Data on water use during the construction of the auxiliary facilities in 2017-2019 are given in Table 9.4.11 below.

Table 9.4.11: Water use during construction of auxiliary facilities

Water user	Volume of water used, m^3/y		
	Total, including:	domestic and drinking needs	industrial needs
2017			
Construction team	3,060	3,060	-
Mortar batching	20	-	20
Concrete batching	1,944	-	1,944
Drilling mud preparation	46	-	46
Hydrotesting	1,877	-	1,877
TBI	12,010	12,010	-
Total	18,957	15,070	3,887
2018			
Construction team	5,080	5,080	-
Mortar batching	207	-	207
Concrete batching	3,242	-	3,242
Drilling mud preparation	25	-	25
Hydrotesting	1,212	-	1,212
TBI	19,895	19,895	-
Total	29,661	24,975	4,686
2019			
Construction team	6,572	6,572	-
Mortar batching	507	-	507
Concrete batching	4,203	-	4,203
Hydrotesting*	6,280	-	6,280
TBI	25,799	32,371	-
Total	43,361	32,371	10,990
Total during construction	91,979	72,416	19,563

/* indicates source water only, re-used in the amount of 26,263 m^3

The total volume of water used during the construction of the auxiliary production facilities will be 91,979 m^3, including

- 72,416 m^3 for domestic and drinking needs;
- 19,563 m^3 for industrial needs.

Wastewater removal

Industrial wastewater is produced during the construction of the auxiliary facilities as a result of hydrotesting of pipelines and tanks and the operation of the TBI infrastructure (WTF, boiler plant, heating systems flushing).

Aside from industrial wastewater, the following types of wastewater is generated during the construction of the auxiliary facilities:

- domestic wastewater;
- stormwater from the diked fuel and lubricants warehouse area within the TBI site.

Wastewater removal data for the proposed auxiliary facilities are given in Table 9.4.12 below.

Table 9.4.12: Wastewater removal from the auxiliary facilities

Water user	Volume of water removed, m^3/y		
	Total, including:	domestic and drinking needs	industrial needs
2017			
Construction team	3,060	3,060	-
Hydrotesting	1,639	-	1,639
TBI	12,010	12,010	
Total	**16,709**	**15,070**	**1,639**
2018			
Construction team	5,080	5,080	-
Hydrotesting	1,110	-	1,110
TBI	19,895	19,895	-
Total	**20,085**	**24,975**	**1,110**
2019			
Construction team	6,572	6,572	
Hydrotesting*	9,880		9,880
TBI	25,799	25,799	
Total	**38,251**	**32,371**	**5,880**
Total during construction	**81,045**	**72,416**	**8,629**

The total volume of wastewater removed during the construction of the auxiliary facilities will be 81,045 m^3, including:

- 72,416 m^3 of domestic wastewater;
- 8,629 m^3 of industrial wastewater.

The water balance of water use and wastewater removal during the construction of the auxiliary facilities is shown in Table 9.4.13 below.

Table 9.4.13: Water balance of water use and wastewater removal during the construction of the Amur GPP auxiliary facilities

Water use, m^3/y						Wastewater removal, m^3/y			Imbalance, m^3/y
total	Industrial needs				drinking needs	Total	Industrial wastewater	domestic wastewater	
	fresh water		circulation	recycled					
	total	incl. drinking							
91,979	19,563	-	-	26,263	72,416	81,045	8,629	72,416	10,934

/*disregarded in balance

Batching of concrete and mortars and preparation of drilling muds account for consumptive water use. Irretrievable water losses are determined by losses of recycled water during hydrotesting.

Wastewater treatment

The composition of wastewater during the construction of the auxiliary facilities is given in Table 9.4.14 below.

Table 9.4.14: Wastewater composition during the construction of the Amur GPP auxiliary facilities

Wastewater source	Wastewater composition
Hydrotesting	mill scale, rust, welding burr, soil in the form of suspended particles and sediment up to 31.0 mg/dm^3
TBI infrastructural facilities	suspended solids from 200.0 to 2000.0 mg/dm^3
Stormwater from the fuel and lubricants warehouse diked area at the TBI site	suspended solids up to 300 mg/dm^3 and petrochemicals up to 20 mg/dm^3
Domestic wastewater resulting from the everyday activities of construction workers[24]	suspended solids up to 140 mg/dm^3 ammonia nitrogen up to 23.42 mg/dm^3 phosphates up to 3.02 mg/dm^3 chlorides up to 38.50 mg/dm^3 anionic detergents up to 0.905 mg/dm^3 Total BOD up to 178 mg/dm^3

The design documentation does not provide for any effluent discharges into water bodies. The following wastewater disposal procedures will be followed:

- domestic wastewater at the construction sites will be collected in storage tanks and then removed by special-purpose vehicles to the Khoz-Ayans treatment plant in Svobodny;
- domestic wastewater from the temporary construction camp will be sent to the TBI biological wastewater treatment plant;
- industrial wastewater from hydrotesting in the amount of 8,629 m3/y (for the entire construction period) will be removed to the TBI mechanical wastewater treatment plant. The process of mechanical treatment will include: thin-layer settling, flotation, filtering through a granular medium, aftertreatment with sorption filters, decontamination by sodium hypochlorite.

The WWTF is intended for treating industrial wastewater, stormwater and meltwater which do not contain specific substances with toxic properties. The treatment process is based on time-tested methods including mechanical and biological treatment, aftertreatment with filters, ultraviolet irradiation.

Using the WWTFwill will keep the concentrations of petrochemicals and suspended solids in the treated wastewater below the standards for discharges into fisheries surface water bodies.

A characteristic of the wastewaters produced during the operation of the auxiliary facilities before and after treatment is given in Table 9.4.15 below.

Table 9.4.15: A characteristic of wastewaters produced during the construction of the Amur GPP auxiliary production facilities

Wastewater stream	Treatment method	Volume of wastewater sent to WWTF m3/day//m3/y	polluting substances	PS amount		PS concentration, mg/dm3		Efficiency,%	PS amount after treatment, t/y	
				Before treatment	After treatment	Before treatment	After treatment		Before treatment	After treatment
2017										
Domestic wastewater, WWTF based on	mechanical, biological	33 //12,010	Suspended solids	8.23	3	250	3	98.8	0.099	0.036
			Total BOD	8.23	3	250	3	98.8	0.099	0.036
			Ammonium	0.99	0.36	30	0.4	98.67	0.130	0.005

[24] The data obtained at the rotational camp at the Zapolyarnoye Oil and Gas Condensate Field were used as analogous in terms of the composition and concentration of suspended solids in domestic wastewater.

Wastewater stream	Treatment method	Volume of wastewater sent to WWTF m3/day//m3/y	polluting substances	PS amount		PS concentration, mg/dm3		Efficiency ,%	PS amount after treatment, t/y	
				Before treatment	After treatment	Before treatment	After treatment		Before treatment	After treatment
the Adsorber unit			ion							
			Nitrate anion	0.49	0.18	15	40	-	1.316	0.480
			Nitrite anion	0.07	0.02	2	0.1	96	0.003	0.001
			phosphates (P)	0.08	0.03	2.5	0.2	92	0.007	
			Anionic detergents	0.07	0.02	2	0.1	95	0.003	0.001
			Petrochemicals	0.066	0.024	2	0.05	97.5	0.002	0.001
			Dry residue	13.16	4.804	400	400	-	13.160	4.804
			Total iron	0.099	0.036	3	0.1	96.67	0.003	0.001
			Chlorides	1.152	0.42	35	35	-	1.152	0.420
Industrial wastewater, WWTF based on the UniRAIN unit	mechanical	20,00 // 1,110	Suspended solids	0.62	0.034	31	3	90.32	0.060	0.003
2018										
Domestic wastewater, WWTF based on the Adsorber unit	mechanical, biological	55 // 19,985	Suspended solids	13.63	4.97	250	3	98.8	0.164	0.060
			Total BOD	13.63	4.97	250	3	98.8	0.164	0.060
			Ammonium ion	1.64	0.60	30	0.4	98.67	0.022	0.008
			Nitrate anion	0.82	0.30	15	40	96	0.022	0.008
			Nitrite anion	0.11	0.40	2	0.08	92	0.004	0.002
			Phosphates (P)	0.14	0.05	2.5	0.2	95	0.011	0.004
			Anionic detergent	0.11	0.04	2	0.1	97.5	0.005	0.002
			Petrochemicals	0.11	0.04	2	0.005	-	0.003	0.001
			Dry residue	21.80	7.96	400	400	96.67	21.800	7.958
			Total iron	0.16	0.06	3	0.1	-	0.005	0.002
			Chlorides	1.91	0.70	35	35	90.32	1.908	0.696
Industrial wastewater, WWTF based on the UniRAIN unit	mechanical,	20 // 1,110	Suspended solids	0.62	0.03	31	3		0.060	0.003
2019										
Domestic wastewater, WWTF based on the Adsorber unit	mechanical, biological	77 // 25,799	Suspended solids	19.28	6.45	250	3	98.8	0.231	0.077
			Total BOD	19.28	6.45	250	3	98.8	0.231	0.077
			Ammonium ion	2.31	0.77	30	0.4	98.67	0.031	0.010
			Nitrate anion	1.16	0.39	15	40	-	3.084	1.032
			Nitrite anion	0.16	0.05	2	0.08	96	0.006	0.002
			phosphates (P)	0.19	0.06	2.5	0.2	92	0.015	0.005
			Anionic detergents	0.15	0.05	2	0.1	95	0.008	0.003
			Petrochemicals	0.15	0.05	2	0.05	97.5	0.004	0.001
			Dry residue	30.80	10.32	400	400	-	30.840	10.320

Wastewater stream	Treatment method	Volume of wastewater sent to WWTF m3/day//m3/y	polluting substances	PS amount		PS concentration, mg/dm3		Efficiency,%	PS amount after treatment, t/y	
				Before treatment	After treatment	Before treatment	After treatment		Before treatment	After treatment
			Total iron	0.23	0.08	3	0.1	96.67	0.008	0.003
			Chlorides	2.70	0.90	35	35	-	2.699	0.903
Industrial wastewater, WWTF based on the UniRAIN unit	mechanical	20 // 1,110	Suspended solids	0.62	0.18	31	3	90.32	0.060	0.018

Wastewater treatment efficiency is:

- up to 98.8% for domestic wastewater;
- up to 90.32% for industrial wastewater.

The data on the amount of wastewater generated and discharged into water body during the construction of the auxiliary facilities are provided in Table 9.4.16 below.

Table 9.4.16: The composition of wastewater before its release into a surface water body during the construction of the Amur GPP auxiliary facilities (2017)

Polluting substance	Amount of PS discharged with wastewater, t/y, in 2017	Amount of PS discharged with wastewater, t/y, in 2018	Amount of PS discharged with wastewater, t/y, in 2019
suspended solids	0.041	0.063	0.010
total BOD[25]	0.036	0.060	0.077
ammonia nitrogen	0.005	0.008	0.010
nitrates (N)	0.480	0.796	1.032
nitrites (N)	0.001	0.002	0.002
phosphates (P)	0.002	0.004	0.005
total iron	0.001	0.002	0.003
petrochemicals	0.006	0.001	0.001
anionic detergents	0.000	0.002	0.003
dry residue	4.804	7.958	10.320
chlorides	0.420	0.696	0.903

If the appropriate standards are complied with, discharges of pollutants with wastewater will not have negative impact on the quality of the surface water of the receiving watercourse.

9.4.5.2 Operation

Water use

Water use during the operation of the auxiliary facilities is determined by the technical conditions of the production process and the domestic/drinking needs of the Project staff. Water from the water intake structure will be pumped to the Amur GPP TBI site and the KS-7 site of the "Power of Siberia" main gas

[25] BOD – biological oxygen demand – is the amount of oxygen needed by aerobic biological organisms to break down unstable organic material contained in a water sample.

pipeline. The facilities located at the railway stations “Zavodskaya”, “Zavodskaya 2”, “Ust-Pera” and the temporary jetty will be supplied with water from Amur GPP’s water supply system.

Water will be used for basic production needs (process equipment washing) and auxiliary needs (water and WWTF, boiler plant, heating system make-up water, heating system flushing, repairs and mechanical workshop, motor vehicles service and repair buildings, parking garage, car wash, laboratory building, plants and roads watering).

Water use during the operation of the auxiliary facilities is described in Table 9.4.17 below.

Table 9.4.17: Water use during operation of auxiliary facilities

Facility	Volume of water used, m³/day/ m³/y		
	Total	Including:	
		domestic/drinking	industrial
Mechanical repair center	140/47,612	52,125/19,026	87/28,586
Laboratory building	3/1,194		3/1,194
Industrial service and repair building	25/6,703	17/6,373	8/0,330
Boiler plant	201/46,124	0.3/0,104	201/46,020
Car wash	0.9/311	0.6/0,201	0.3/110
Parking garage	5/1,794	5/1,747	0.4/47
First responders building	7/2,637	7/2,637	
Domestic effluent treatment plant	4/1,486	4/1,486	
Water treatment plant	10/3,650		10/3,650
Heating systems flushing	10*/1,325		10*/1,325
Process equipment washing	120*/2,109		120*/2,109
Site watering	111/11,140		111/11,140
Total	400 /126,632	90/32,121	310/94,511

Sporadic water use is not included in the calculation of the daily water balance.

The continuous water use by the auxiliary facilities is 126,632 m³/y.

The following measures are proposed for saving fresh water:

- A recirculation water supply system developed by Deko will be used for the outdoor car wash; make-up water for the recirculation system is periodically supplied from the industrial water supply system.
- Fire water will be replenished with treated effluent from the WWTF site.

Wastewater removal

The total volume of wastewater removed from the Amur GPP auxiliary facilities is 13,160 m³/day (234,881 m³/y), including:

- 32,121 m³/y of domestic wastewater;
- 39,206 m³/y of industrial wastewater;
- 163,554 m³/y of storm water.

The following sewer systems are provided for collecting wastewater:

- industrial/storm water sewer system (K4) for mechanically polluted wastewater;
- saline wastewater system for the removal and treatment of saline wastewater;

- storm water drainage system (K2);
- sanitary sewer system (K1).

The water balance of water use and wastewater removal during the operation of the auxiliary facilities is shown in Table 9.4.18 below.

Table 9.4.18: Water balance of water use and wastewater removal during the operation of the Amur GPP auxiliary facilities

Water use, m³/y						Wastewater removal, m³/y			Imbalance, m³/y
total	Industrial needs				domestic /drinking needs	Total	Industrial wastewater	domestic wastewater	
	fresh water		circulation	recycled					
	total	Incl. drinking							
126,632	94,511	79,937	-	14,574	32,121	234,881	202,76	32,121	163,554

/*disregarded in balance

Walkways, driveways and plants watering accounts for consumptive water use. Irretrievable water losses are caused by losses in the heat networks and car washes.

Wastewater treatment

Domestic wastewater (K1), industrial wastewater (k4) and storm water (K2) are generated during the operation of the auxiliary facilities

The composition of wastewater from the auxiliary facilities is given in Table 9.4.19 below.

Table 9.4.19: Wastewater composition during the operation of the Amur GPP auxiliary facilities

Wastewater source	Wastewater composition
WTF equipment washing	Suspended solids
Mechanical repair workshop, industrial service and repair building	Suspended solids and petrochemicals
Car wash	Suspended solids and petrochemicals
Laboratory building	Suspended solids
Boiler plant	Salts
Heating systems flushing	Suspended solids
Process equipment washing	Suspended solids and petrochemicals

Wastewater treatment efficiency is:

- 98% for the domestic wastewater and industrial wastewater with similar composition treated using the "KSkomplek"t unit;
- 90-99.97% for the industrial wastewater and storm water treated using the "BM" unit;
- 85-99.90% for the storm water treated using the "BM" unit.

Part of the treated wastewater in the amount of 31,158 m³/y will be re-used for the needs of the Amur GPP's facilities; and the rest will be discharged.

A characteristic of the wastewater before its discharge into water bodies is given in Table 9.4.20 below.

Table 9.4.20: A characteristic of released wastewater from the Amur GPP auxiliary facilities

Wastewater release point	Wastewater amount, m^3/y	Polluting substances in wastewater at each release point	Concentration of polluting substances discharged with wastewater, mg/dm^3	Amount of polluting substances discharged with wastewater, t/y
Release - discharge of treated domestic, industrial wastewater and stormwater into the Bolshaya Pera	302,492	Suspended solids	3.0	0.907
		Dry residue	14.279	4.319
		Total BOD	3.0	0.027
		Ammonium ion	0.012	0.004
		Nitrates (N)	1.195	0.361
		Nitrites (N)	0.002	0.001
		Phosphates (P)	0.006	0.002
		Chlorides	0.504	0.152
		Total iron	0.008	0.002
		Petrochemicals	0.05	0.015
		Anionic detergents	0.073	0.022

The wastewater content of the polluting substances is below the ADS (that correspond to the MACs applicable to fisheries); as a consequence, discharges of the wastewater will have no negative impact on the quality of surface waters.

9.4.6 Temporary jetty on the River Zeya

9.4.6.1 Construction

The temporary jetty on the rRiver Zeya is located 3.5 km southwest of the existing bridge across the river Zeya. The facility will operate periodically, without constant presence of staff. The jetty’s quay length will be 125 m; the duration of construction of the jetty with the quay length of 100 m will be 11 months.

The impact on the aquatic environment during the construction of the temporary jetty on the river Zeya will be caused by

- fuel and lubricant leaks from operating equipment;
- discharges of polluted surface water;
- higher water turbidity during construction.

The impact will be of temporary character. During construction, water for domestic/drinking and industrial needs will be imported. Water re-treatment is not provided for.

The construction site is located outside the Zeya’s and Gashchenka’s buffer zone, and therefore storm runoff will not be collected or treated during construction. Domestic wastewater will be collected into sewer manholes and then removed by specialized companies to decontamination facilities.

Domestic wastewater from accommodation premises do not contain specific pollutants and can be characterized by the following parameters:

- Suspended solids - 65 g/day;
- Total BOD - 60 g/day;
- Total nitrogen - 13 g/day;
- Ammonium salt nitrogen – 10.5 g/day;

- Total phosphorus – 2.5 g/day.

During construction, wastewater will be treated using the Moidodyr-M-1 local treatment unit.

Wastewater treatment efficiency indicators are provided in Table 9.4.21 below.

Table 9.4.21: The Moidodyr-M-1 local treatment unit efficiency indicators

Polluting substances	Wastewater composition before treatment	Wastewater composition after treatment
suspended solids	2000 mg/l	40 mg/l
petrochemicals	80 mg/l	15 mg/l

9.4.6.2 Operation

During the operation of the temporary jetty the only type of wastewater will be surface runoff produced by the 2.868 ha catchment area. Rain and snowmelt run-off from the temporary jetty area will be collected on the tray and supplied to the local treatment facility with capacity of 15 l/s. Treated wastewater is discharged into the river Zeya.

The average annual volume of surface runoff from the berth territory is about 28,708 m^3.

The concentration of pollutants in the wastewater after treatment is:

- Suspended substances - 3 mg/l;
- Oil products – 0.05 mg/l;
- BOD20 (full) - 3 mgO_2 / l.

The polluting substances that are common for the runoff collected from the jetty's catchment area are suspended solids and petrochemicals whose presence in the runoff may be due to fuel and lubricant spills. The extent of surface runoff pollution is shown in Table 9.4.22 below.

Table 9.4.22: Jetty site surface runoff pollution indicators

Surface type	Weighted average concentration of polluted substance in surface runoff after LTF , mg/l		Runoff content of polluting substances, t/y	
	suspended solids	petrochemicals	suspended solids	petrochemicals
Hard surface	3	0.05	0.09	0.002

Regarding to domestic wastewater, the following design solutions for temporary jetty are planned:

- As part of the administrative and service buildings - modular toilet cabins with wash basin and a modular room for meal are planned.
- Cabins are equipped with tanks for receiving waste water volume of 300 liters.
- Disposal of waste is carried out by a specialized organization.

Subject to the proposed environmental protection measures the significance of negative impact during the construction and operation of the temporary jetty can be assessed as low.

9.4.7 Main production facilities

9.4.7.1 Construction

Water use

During the construction phase water will be required for the following needs:

- Domestic needs and drinking water for the construction workers;
- Industrial needs (drilling mud preparation for water well drilling and electrochemical protection borehole drilling; mortar and concrete preparation; hydraulic testing of pipelines and tanks).

The total water volume required for the entire construction phase has been estimated at 631,000 m^3, of which:

- for general and drinking needs 543,400 m^3;

- for industrial needs 87,799 m³.

Irrecoverable water consumption will be attributable to concrete, mortar and drilling mud preparation. Irrecoverable water loss is associated with hydraulic testing of pipelines and tanks.

In order to save raw water, wastewater accumulated in tanks after hydraulic testing of the first tank and the first pipeline section will be used for subsequent stages of hydraulic testing of other tanks and pipeline sections.

Wastewater removal

The following wastewater streams will be generated in the process of construction of the Project facilities:

- sanitary wastewater as a result of water use for general needs of construction workers;
- industrial wastewater as a result of hydraulic testing of pipelines and tanks.

The total amount of wastewater generated during the entire period of construction of the main Project facilities will be:

- sanitary wastewater 545,000 m³;
- industrial wastewater 48,000 m³.

The following wastewater management methods have been foreseen for the construction phase of the Project:

- sanitary wastewater generated at construction sites shall be accumulated in special tanks and transported by special trucks for biological treatment to the WWTF for the BTI;
- sanitary wastewater from the provisional accommodation camp for construction workers shall be pumped for biological treatment to the WWTF for the BTI;
- industrial wastewater from hydraulic testing shall be pumped to the WWTF of the Amur GPP for treatment in a unit designed for stormwater treatment.

If the proposed wastewater removal system is set up, no discharges of untreated effluent into water bodies will occur.

The water balance of water use and wastewater removal during the construction of the main production facilities is shown in Table 9.4.23 below.

Table 9.4.23: Water balance of water use and wastewater removal during the construction of the Amur GPP main production facilities

Water use, m³/y						Wastewater removal, m³/y			Consumptive water use and water losses, thousand m3/y
Total	Industrial needs				Domestic/ drinking needs	Total	Industrial wastewater	Domestic wastewater	
	freshwater		Recirculation	Recycled					
	total	incl. drinking							
631,070	87,700	-	-	95,539	543,370	591,722	48,352	543,370	39,370

/*disregarded in balance

Batching of concrete and mortars and preparation of drilling muds and use of recycled water during hydrotesting account for consumptive water use.

The total water use during the entire period of construction of the proposed Amur GPP facilities will be 631,070 m³ including:

- wastewater removal – 591,700 m³, non-recoverable losses – 39,370 m³.

Wastewater treatment

The wastewater removal arrangements during the construction of the main production facilities are the same as those during the construction of the auxiliary facilities. They include the following:

- Domestic wastewater from the construction sites will be collected in storage tanks and then transported in tank trucks to the Khoz-Alyance wastewater treatment plant in Svobodny;

- Domestic wastewater from the temporary construction camp will be removed in tank trucks to the biological wastewater treatment plant at the TBI site with the maximum capacity of 850 m^3/day;
- Industrial wastewater from hydrotesting in the amount of 11,124 m^3/y (for the entire construction period) will be removed to the mechanical WWTF at the TBI site.

A characteristic of the wastewaters produced during the construction of the main production facilities before and after treatment is given in Table 9.4.24 below.

Table 9.4.24: A characteristic of wastewaters produced during the construction of the Amur GPP main production facilities

Wastewater stream	Treatment method	polluting substances	PS concentration, mg/dm3		Efficiency, %
			Before treatment	After treatment	
Sanitary wastewater to the WWTP for BTI	mechanical, biological	Suspended solids	250	3	98.8
		Total BOD	250	3	98.8
		Ammonium ion	30	0.4	98.67
		Nitrate anion	15	40	-
		Nitrite anion	2	0.08	96.0
		Phosphates (P)	2,5	0.2	92.0
		Anionic detergents	2	0.1	95.00
		Petrochemicals	2	0.05	97.5
		Dry residue	400	400	-
		Total iron	3	0.1	96.67
		Chlorides	35	35	
Industrial wastewater to the WWTF of the Amur GPP for treatment in a unit designed for stormwater treatment	mechanical	Suspended solids	31	3	90.32

The effluent treatment efficiency is 98.98% for domestic wastewater, and 90.32% for industrial wastewater.

Treated wastewater shall be released to the Bolshaya Pera River through two outlets: from the WWTF for BTI after biological treatment and from the WWTF of Amur GPP after mechanical treatment.

The total amount of wastewater released to the Bolshaya Pera River in the process of construction of the main Project facilities will be 591,700 m^3. The maximum discharge amount is planned in 2018 (122,400 m3) and in 2019 (135,800 m^3).

Table 9.4.25: Volumes of wastewater discharges into Bolshaya Pera River during the construction of the main production facilities

Years	Wastewater volume,Thousand m^3		
	Outlet 1	Outlet 2	Total
2016	3.8		3.8
2017	58.2	6.8	65
2018	115.6	6.8	122.4
2019	135.8	2.5	138.3
2020	110.8	12.2	123
2021	54.4	5.4	59.8
2022	40.8	4.9	45.7
2023	19.4	4.9	24.3
2024	4.6	4.8	9.4
Total:	543.4	48.3	591.7

Table 9.4.26: A characteristic of wastewater from the construction of the main production facilities released into the Bolshaya Pera River

Wastewater release point	Wastewater amount m^3 / y	Polluting substance	PS concentration, mg/dm^3
Release from the WWTF and TBI site – discharge into the Pera river	232,125	suspended solids	3
		Total BOD	3
		ammonia nitrogen	0.4
		nitrates (N)	40
		nitrites (N)	0.08
		phosphates (P)	0.2
		total iron	0.1
		petrochemicals	0.05
		anionic detergents	0.1
		dry residue	400
		chlorides	35
Release from the WWTF and TBI site – discharge into the Pera river	48,300	suspended solids	3

The design documentation sets the ADS for treated effluent from the TBI WWTF at the same level as the MACs for fisheries, without regard for dilution.

9.4.7.2 Main production facilities operation

Water use

Water use during the operation of the main production facilities is determined by the technical conditions of the production process and the domestic/drinking needs of the Project staff.

The water requirements of the Amur GPP facilities during operational phase were calculated for both the auxiliary and main production facilities (Table 9.4.27).

Table 9.4.27: Water use at the Amur GPP main production facilities during operational phase

Facility	Volume of water used, m^3/day// m^3/y		
	total	including:	
		domestic/drinking	industrial
Gas processing plant			
GPP Control Center and Helium Production Plant	26//9,472	26//9,472	
Plant Management Building	29//10,075	29//10,075	

Facility	Volume of water used, m³/day// m³/y		
	total	including:	
		domestic/drinking	industrial
Infirmary	3//1,066	3//1,066	
Store	0.09//33		
Cafeteria building #1	90//32,074		
Cafeteria building #2	92.8//33,241		
Laboratory	0.73//259		
Communications center	0.75//274		
Automation, metrology and communications services building	7//2,504		
Flow meters repair, verification and calibration laboratory building	3.5//1,263		
Service-operational block building	39//14,411		
Gym	1.5//0,548		
Fire and gas response teams depot	8//3,041		
Helium fine purification, liquefaction and filling units control rooms (3 sites)	2.4//0,876		
Checkpoint buildings (8 sites)	1.12//0,408		
Water treatment plant	20//7,300		20//7,300
Boiler plant	294//67,344		294//67,344
Laboratory	38//13,768	11//4,012	27//9,756
Mercury drying and removal plant	0.115//38		0.115//38
Ethane and WFLH extraction, nitrogen removal, and helium concentrate production unit	6.5//2,160		6.5//2,160
Helium fine purification and liquefaction units	4.6//1,524	1.34//0,444	3.24//1,080
Cooling tower	505 // 168,000		505 //168,000
Recirculation water supply and filters pumping station	252//84,018	0.05//18	252//84,000
Steam cleaning and washing process equipment	120//2,100*		120//2,100
Watering plants	100//3,124*		100//3,124
Methane fraction booster compressors unit	51// 857		51// 857
RP-110 kV distribution substation	2.8//1,000	2.8//1,000	
Stockfeed base	18//4,164	18//4,164	
Loading/unloading rack	54.5//19,874	0.45//0,164	54//19,710
Flare units	120*//0,806		120 //0,806
Main production facilities total	**1550+120* //485,622**	**339//119,347**	**1212+120* //366,275**

(*) sporadic water use was disregarded in the daily water balance

The total volume of water used during the construction of the Amur GPP main production facilities will be 1550 m³/day and 485,622 m³/y, including

- 339 m³/day and 119,347 m³/y for domestic and drinking needs;
- 1,212 m³/day and 366,275 m³/y for industrial needs.

Volumes of water supplied to various water uses are registered with flow meters which remotely transmit their readings to the GPP Control Center.

Wastewater removal

The operation of the GPP main production facilities results in the generation of domestic wastewater, industrial wastewater/stormwater, and storm runoff that are collected by the sewer systems and sent to the WWTF site for further treatment.

The volumes of wastewater produced by the proposed Amur GPP facilities are shown in Table 9.4.28 below.

Table 9.4.28: Wastewater removal during the operation of the Amur GPP main production facilities

Facility/process	Volume of wastewater removed, m^3/day// m^3/y		
	Total	Including	
		domestic	industrial
Gas processing plant			
GPP Control Center and Helium Production Plant	26//9,472	26//9,472	
Plant Management Building	27//9,769	27//9,769	
Infirmary	3//1,062	3//1,062	
Store	0.09//33	0.090//33	
Cafeteria building #1	87//31,768	87//31,768	
Cafeteria building #2	89//32,409	89//32,409	
Laboratory building	0.73//259	0.730//259	
Communications center	0.75//274	0.750//274	
Automation, metrology and communications services building	7//2,504	7//2,504	
Flow meters repair, verification and calibration laboratory building	3.5//1,263	3.5//1,263	
Service-operational block building	40//14,411	39,480//14,411	
Gym	1.5//548	1,500//548	
Fire and gas response teams depot	8//3,041	8,330//3,041	
Helium fine purification, liquefaction and filling units control rooms (3 sites)	2.4//876	2.4//876	
Checkpoint buildings (8 sites)	1.12//408	1.12//408	
Water treatment plant	19.6//7,154		19.600//7,154
Boiler plant	13//3,041		13.280//3,041
Laboratory	48//13,078	10,990//4,012	36.580//9,066
Mercury drying and removal plant	0.115//38		0.115//38
Ethane and WFLH extraction, nitrogen removal, and helium concentrate production unit	48//15,840		47,520//15,840
Helium fine purification and liquefaction units	1.3//444	1,340//444	
Gas fractioning unit	32//10,500		
Recirculation water supply and filters pumping station	252//84,018	0.05//18	252//84,000
Steam cleaning and washing process equipment	120*//2,100		120,000*//2,100
Methane fraction booster compressors unit	51.18// 957		51.18//957
RP-110 kV distribution substation	2.8//1,000	2,800//1,000	
Stockfeed base	1,443// 17,720	3 // 936	1,440 //16,784
Loading/unloading rack	54//19,874	0.450//164	54//19,710
Flare units	120*// 806		120*// 806
Storm runoff from completed sites	6,134//58,776		6,134//58,776
Storm runoff from the site	38,459//586,458		38,459//586,458
Main production facilities total	**44,197+120* //919,353**	**315//114,123**	**46,883+120*\\805, 230**

All the wastewater streams generated by the Amur GPP facilities operation are sent to the WWTF site, 44,197 m^3/day (919,353 m^3/y) in total, including

- 315 m^3/day (114,000 m^3/y) of domestic wastewater;
- 8,400 m^3/day (229,000 m^3/y) of industrial wastewater;
- 38,500 m^3/day (586,000 m^3/y) of storm runoff.

Storm runoff is collected:

- from hard surface sites via storm drains into the KRS closed stormwater drainage systems and then pumped to the WWTF site and fed into the industrial wastewater/stormwater treatment plant;

- from diked areas via dump valves into the industrial sewer systems and then pumped to the SFT site and fed into the industrial wastewater/stormwater treatment plant.

Wastewater treatment during the operation of the Amur GPP facilities

Three sewer systems will be constructed for the Amur GPP site:

- Industrial/stormwater sewer system K4;
- Storm runoff drainage system K2;
- Sanitary sewer system K1

A characteristic of untreated wastewater generated by the Amur GPP facilities is given in Table 9.4.29 below.

Table 9.4.29: A characteristic of untreated wastewater

Wastewater	Wastewater composition
Domestic wastewater	organic substances, biogenic material
Industrial wastewater	suspended solids, total iron, petrochemicals, salts
Stormwater	suspended solids, petrochemicals

The following installations will be constructed at the WWTF site:

- Wastewater treatment plant for treating industrial wastewater/stormwater and storm runoff;
- Wastewater treatment plant for treating domestic wastewater
- Two 200 m^3 equalization tanks for domestic wastewater;
- One 2,000 m^3 equalization tank for industrial wastewater/stormwater;
- Two 5,000 m^3 equalization tanks for storm runoff;
- Two 5,000 m^3 treated effluent storage tanks;
- Untreated effluent pumping station;
- Domestic wastewater pumping station;
- One 2,000 m^3 vertical tank for industrial wastewater/stormwater;
- 8 5,000 m^3 vertical tanks for treated effluent.

The wastewater treatment facilities consist of the following blocks:

- mechanical treatment (automated screw screen, grit chamber);
- biological treatment (aeration and sedimentation tanks);
- aftertreatment (suspended-growth aeration tanks, sorption filters);
- decontamination (ultraviolet irradiation).

Domestic sewer system K1

Domestic wastewater from accommodation premises are gravity fed into receiving tanks of the sewage pumping stations, pumped to the WWTF site and fed into two 200 m^3 domestic wastewater tanks, and then fed by wastewater pumps into the domestic WWTF. Each sewage pumping station has 2 pumps (one operational, one standby) that are automatically triggered by the level of wasetwater in the receiving tank.

Saline wastewater from the boiler plants, recirculation water supply pumping station and filters is gravity fed into the domestic sewer system, then pumped to the WWTF site and fed into two 200 m^3 domestic sewage tanks, and then sent to the domestic WWTF.

Domestic sewage undergoes the complete cycle of biological treatment, including treatment by suspended autotrophic and heterotrophic microorganisms that are active in aerobic and anoxic conditions, with subsequent after treatment and decontamination. Treated domestic sewage is discharged into the Bolshaya Pera River without return to the GPP site.

Industrial/storm water sewer system K4

Industrial wastewater/storm water is generated by production processes, process equipment testing and washing; it is collected from diked or bunded areas occupied by fuel and lubricants warehouses. The industrial/storm water sewer system is designed to accommodate 50% of the fire water volume (1,150 m^3/h).

Two underground reinforce concrete tanks, with the respective capacities of 5,000 and 3,600 m^3, will be installed in Amur GPP's process zone for collecting industrial wastewater/stormwater. Industrial wastewater/stormwater from production processes are fed into the wastewater pumping station and then pumped into the 5,000 m^3 underground reinforced concrete tank.

From the tank, the wastewater is pumped to the WWTF site and fed into two 2,000 m^3 vertical tanks for industrial wastewater/stormwater. Form those tanks, the wastewater is sent for treatment to a BM-type unit designed by Ekologiya Vodstroi, Moscow.

To avoid emission of explosion hazardous fumes and gases from the industrial sewer system all the sewer inlets from process equipment will be fitted with water seals; linear sections will also be fitted with water seals spaced 400 m apart.

The size of the sewage pumping station sanitary protection zone will be 15 m.

Storm runoff drainage system K2

Storm runoff is collected via storm drains from roads, driveways, non-developed areas, rooftops, parking lots and sent into in the storm drainage system. 5,000 m^3 underground rectangular reinforced concrete tanks with inclined bottoms will be used for collecting storm runoff. The tanks are designed to accommodate 20% of the water volume.

Then, the storm runoff will be sent to the WWTF site and fed into the 5,000 m^3 storm runoff vertical tanks. From the tanks it will be pumped to the treatment facilities which will include:

- screening to remove large solids and rubbish;
- separation of the wastewater stream into polluted and unpolluted wastewater;
- removal of heavy mineral particles (grit) in horizontal flow grit chambers;
- removal of most organic and mineral pollutants by means of sedimentation and flotation;
- aftertreatment by removal of residual solids with absorbed petrochemicals organic matter;
- aftertreatment by absorption of residual dissolved petrochemicals and other organic matter;
- treated effluent decontamination.

After treatment, 272,604 m^3/y of treated industrial wastewater/stormwater (including 258,030 m3/y from the Project's main production facilities) is sent to the GPP and helium production plant site, as necessary, and fed into the storage tanks to be re-used as industrial fire water reserve. Excessive treated industrial wastewater/stormwater, that is not needed at the GPP site, in the amount of up to 30,000 m^3/day (958,179 m^3/y), will be discharged into water bodies.

A characteristic of wastewater treatment efficiency is provided in Table 9.4.30 below.

Table 9.4.30 : A characteristic of wastewater treatment efficiency during the operation of the Amur GPP facilities

Wastewater stream	Treatment method	Volume of wastewater sent to WWTF m^3/day // m^3/y	polluting substances	PS amount before treatment		PS concentration, mg/dm³		Efficiency,%	PS amount after treatment, t/y	
				kg/day	t/y	Before treatment	After treatment		kg/day	t/y
Domestic wastewater, WWTF based on	mechanical, biological	735// 256,388 , incl. 580	Suspended solids	71.7	25.0	97.6	3	96.93	2.21	0.77
			Total BOD	162.6	56.7	221.3	3	98.64	2.21	0.77
			Ammoniu	13.9	4.9	18.9	0.4	97.89	0.29	0.10

Wastewater stream	Treatment method	Volume of wastewater sent to WWTF m³/day // m³/y	polluting substances	PS amount before treatment		PS concentration, mg/dm³		Efficiency,%	PS amount after treatment, t/y	
				kg/day	t/y	Before treatment	After treatment		kg/day	t/y
the KSkomplekt vunit		//201,164 from stage 4 facilities	m ion							
			Nitrate anion	2.7	1.0	3.7	40	-	29.40	10.26
			Nitrite anion	0.7	0.2	0.9	0.08	91.36	0.06	0.02
			phosphates (P)	1.4	0.5	1.9	0.2	89.55	0.15	0.05
			Anionic detergents	0.7	0.2	0.9	0.1	89.22	0.07	0.03
			Petrochemicals	0.7	0.2	0.9	0.1	94.6	0.04	0.01
			Dry residue	344.4	120.1	468.6	468.6	-	344.37	120.14
			Total iron	3.2	1.1	4.4	0.1	97.72	0.07	0.03
			Chlorides	14.2	4.9	19.3	19.3	-	14.17	4.94
Industrial wastewater/stormwater, WWTF based on BM unit	physico-mechanical	4,200 //187,504 incl. 4,200 //131,733 from the proposed stage 4 facilities	Suspended solids	1357.7	60.6	323.3	3.0	99.07	12.60	0.56
			Petrochemicals	551.6	24.6	131.3	0.1	99.96	0.21	0.01
			Anionic detergents	1182.3	52.8	281.5	0.1	99.96	0.42	0.02
			Total iron	0.017	0.001	0.004	0.004	-	0.02	0.0002
			Total BOD	7.5	0.3	1.8	1.8	-	7.51	0.34
Storm runoff, WWTF based on BM unit	physico-mechanical	30,000 //845,832 incl. 30,000 //586,458 from the proposed stage 4 facilities	Suspended solids	18791.0	529.8	626.4	3.0	99.52	90.00	2.54
			Petrochemicals	1449.9	40.9	48.3	0.1	99.9	1.50	0.04
			Total BOD	256.9	7.2	9.9	3.0	64.96	90.00	2.54

Depending on the composition and the pollutant content the efficiency of treatment of domestic sewage and the industrial wastewater that is similar in composition to domestic sewage using the KSKomplekt unit is 89-98.64%.

Depending on the composition and the pollutant content the efficiency of treatment of industrial wastewater/stormwater using the BM unit is up to 99-99.66%.

Depending on the composition and the pollutant content the efficiency of treatment of storm runoff using the BM unit is as high as 64.96-99.90%.

Wastewater discharge

The total volume of wastewater from the Amur GPP facilities discharged into the Bolshaya Pera river is 1,007,120 m^3/y (including 671,323 m^3/y from the stage 4 main production facilities). An onshore release point will be set up according to the relevant wastewater discharge requirements.

A characteristic of the wastewater discharged in the Bolshaya Pera river is given in Table 9.4.31 below.

Table 9.4.31: A characteristic of the wastewater discharged into the Bolshaya Pera and the ADS values

Wastewater volume m3/s//thou. m3/y	Polluting substances	Hazard class	Polluting substance concentration, mg/dm3, actual	Polluting substance concentration, mg/dm3, ADS	Amount of polluting substance, t/y, actual	Amount of polluting substance, t/y, ADS
Amur GPP total: 300000,00// 1017,120	Suspended solids	4	3.00	3.25	3.05	4.92
	Total BOD	4	2.90		2.95	4.53
	Ammonium ion	4	0.01	0.40	0.01	0.24
	Nitrate anion	4	0.96	40.00	0.97	16.75
	Nitrite anion	4	0.00	0.08	0.002	0.03
	Phosphates (P)	4	0.01	0.20	0.01	0.12
	Anionic detergents	4	0.01	0.10	0.01	0.15
	Petrochemicals	3	0.05	0.05	0.05	0.08
	Dry residue		11.20	n/a	11.40	n/a
	Total iron	4	0.00	0.01	0.001	0.06
	Chlorides	4	0.46	300.00	0.47	181.89
Including stage 4 facilities: 30000,00//671, 323	Suspended solids		3.00		2.01	
	Total BOD		2.90		1.95	
	Ammonium ion		0.01		0.01	
	Nitrate anion		0.96		0.64	
	Nitrite anion		0.002		0.001	
	Phosphates (P)		0.005		0.003	
	Anionic detergents		0.01		0.01	
	Petrochemicals		2.90		2.95	4.53
	Dry residue		0.01	0.40	0.01	0.24
	Total iron		0.96	40.00	0.97	16.75
	Chlorides		0.00	0.08	0.002	0.03

In view of the proposed wastewater treatment measures, the surface water quality will comply with the MACs for fisheries at the point of release to the Bolshaya Pera River. The ADS values provided in the above Table were calculated based on this assumption.

9.4.8 Residential housing project

9.4.8.1 Construction

The land plot with the total area of 92 ha provided for the construction of residential housing is situated within Svobodny's town limits, in the town's northwestern suburb, approximately 13 km south of the main GPP construction site. The site grading solutions were chosen in order to ensure drainage of rainfall water which collects on the land surface.

All surface runoff is sent into a closed network of storm sewers laid along driveways (storm drains will be installed at runoff collection points) and then to the local surface runoff treatment plant.

To protect surface water and groundwater from pollution, the following measures will be implemented during construction:

- keeping strictly within the borders of the proposed construction sites;
- placing a ban on washing cars, trucks and machinery outside designated areas;
- fitting workplaces with containers for domestic and construction waste;
- refueling road and construction vehicles in designated and appropriately equipped areas;

- transporting domestic wastes to pre-assigned areas only.

Subject to the environmental protection measures outlined above the significance of possible adverse impact on surface water during the construction of residential housing can be assessed as low.

9.4.8.2 Operation

Due to the fact that the degree of surface runoff pollution strongly depends on the sanitary condition of the relevant catchment areas and ambient air the following organizational and technical measures will be implemented within the residential housing area:

- regular cleaning;
- timely road repairs;
- enclosing green areas with barriers preventing the soil from being washed off by rain and carried onto road surfaces.

9.4.9 SDIW landfill

9.4.9.1 Construction

The SDIW landfill site, the access road and the utility lines corridor are located outside the flood zones of major watercourses; only large gulches, gullies and temporary watercourses are located in the vicinity of the proposed facilities. The construction of the landfill will require a workforce of 76 people for the duration of 9 months.

The total volume of wastewater generated during the construction will be 21,578 m^3/y.

Water use and wastewater removal

Water during construction will be brought in to the construction site as follows:

- Drinking water in PET bottles;
- Utility water for industrial needs will be brought in by trucks in barrel trailers.

Water at the construction site will be mainly used by construction machinery, mechanisms, units and technological processes (concrete batching and watering).

Four 250 l chemical toilets will be installed for collecting sewage. As they fill up, domestic wastewater will be removed by a cesspool truck to a sewage treatment plant in Svobodny. Storm runoff will also be removed by vacuum trucks to the sewage treatment plant in Svobodny.

Based on the duration of the construction period and the number of the workforce a water balance of water use and wastewater removal has been calculated for the entire landfill construction period (Table 9.4.32)

Table 9.4.32: Water balance of water use and wastewater removal during construction

Required water quality	Water use, m^3			Wastewater removal, m^3	
	Total	Domestic/drinking needs	Industrial needs	Total	Domestic/drinking needs
Bottled drinking water	53	53	-	53	53
Drinking water imported in barrels	7,076	7,076	-	7,076.	7,076
Utility water imported in barrels	7,379	-	7,379	-	-
Total:	**14,509**	**7,129**	**7,379**	**7,129**	**7,129**

9.4.9.2 Operation

Water use

The following water supply systems are proposed for the SDIW landfill operational phase:

- domestic and drinking water supply;
- fire water supply.

Imported bottled drinking quality water will be used for drinking needs.

OP 5 fire extinguishers will be provided for internal firefighting needs at the checkpoint and office building. No external fire water supply system will be constructed.

A Fubag PTH 400 H motor pump will use water from two steel 100 m^3 tanks for external firefighting. The volume of water required for firefighting needs is 162 m^3.

Industrial water, i.e. storm runoff from the containment pond, will be used for dust suppression at the landfill site. During dry period water for dust suppression will be additionally taken from the two 1,000 m^3 industrial water tanks installed at the WTF site located within the Amur GPP auxiliary facilities area.

Wastewater removal

The following sewer systems will be constructed at the SDIW landfill site:

- sanitary sewer system (K1);
- storm drainage system (K2);
- pressurized storm drainage system (K2N);
- industrial sewer system serving industrial wastes burial sites (DR, K3);
- pressurized industrial sewer system (K3N).

Sanitary sewer system (K1) will be sued to remove domestic sewage from the checkpoint and accommodation building. The estimated water use will be 0.957 m^3/day (349.3 m^3/y). Greywater from wash basins and showers will be sent into a domestic sewage tank. As they accumulate, greywater from the tank and blackwater from the toilets will be removed by a cesspool truck to the proposed WWTF at the WWTF site.

Gravity-based storm drainage system (K2) will be used for the collection and removal of storm and snowmelt runoff from the landfill's accommodation and industrial zones via open drain ditches and gravity pipelines and from unfilled cells via the storm drains and the drainage system to the sewage pumping station.

Pressurized storm drainage system (K2N) will be used for the removal of storm and snowmelt runoff from the receiving sewage pumping stations into the storm water containment pond. From the containment pond the storm water will be pumped by sewage pumps via an offsite sewer to the WWTF site for further treatment.

Due to the region's seismicity, magnitude 7, industrial sewer systems K3 and K3H (both gravity-based and pressurized) should comply with the following additional requirements: flexible expansion joints compensating for pipe movement; flexible pump connectors for sewage pumping stations allowing for angular and lateral movement of pipe ends; wall penetration seals should be used in places where pipes penetrate tank walls.

The volume of storm water runoff sent to the treatment plant from the residential areas and production sites will be 5,518 m^3. The maximum daily volume of snowmelt runoff sent to the treatment facilities from the same areas in the middle of the snowmelt period will be 752 m^3.

Surface runoff is mainly polluted by polluting substances washed off from lawns and open ground surfaces, dust, rubbish, washed out road surface components, and petrochemicals leaked from malfunctioning motor vehicles and other machinery (Table 9.4.33).

Table 9.4.33: Approximate surface runoff composition for the landfill's catchment areas (according to the recommendations contained in Vodgeo Tables 2, 3)

Surface type	Drainage area, ha	Suspended solids,mg/l	Petrochemicals, mg/l	Filtered sample's COD, mg/l	Filtered sample's BOD20 ,mg/l
IW disposal cells	7.8	20	8	-	-
Asphalt and concrete surfaces and rooftops	4.780	400	18.	-	-

Surface type	Drainage area, ha	Suspended solids,mg/l	Petrochemicals, mg/l	Filtered sample's COD, mg/l	Filtered sample's BOD20 ,mg/l
Ground surfaces (graded)	0.59	300	1	-	-
Grass lawns	4.73	300	1		
Weighted average concentrations of polluting substances	-	205	8.55	-	-

Table 9.4.34: Approximate snowmelt runoff composition for the landfill's catchment areas (according to the recommendations contained in Vodgeo Tables 2, 3)

Surface type	Drainage area ,ha	Suspended solids,mg/l	Petrochemicals, mg/l	Filtered sample's COD, mg/l	Filtered sample's BOD20 ,mg/l
IW disposal cells	7.8	20	20	-	-
Asphalt and concrete surfaces and rooftops	4.8	2000	20	-	-
Ground surfaces (graded)	0.6	1500	1	-	-
Grass lawns	4.7	1500	1		
Weighted average concentrations of polluting substances	-	991.4	14.3	-	-

Storm and snowmelt runoff from the management area, industrial area and unfilled landfill cells are sent to the sewage pumping station down natural slope via storm drain, drain ditches and gravity pipelines. Then it is pumped to a 9,100 m^3 containment pond.

The pond has the plan size of 75.16x55.16m and is 3m deep. Its bottom and sloping sides are lined with precast reinforced concrete slabs laid on top of a layer of medium sand. Geomembrane and bentonite mats are used as waterproofing between the sand layers.

Before a cell is filled with wastes a cap is installed on the gravity pipeline in the cell's sump. The drainage system which collects storm runoff from an unfilled cell is used for collecting industrial wastes once the cell is filled. The isolated sump receives industrial wastewater generated in the cell being filled. Once the cell is filled, it is isolated.

Once the cells are filled surface runoff flows down natural slope via an open ditch made of half-pipes laid along the side of the road. Storm runoff from unfilled cells is sent into the retention pond via the drainage system.

Before the coming of winter the pond is emptied out and cleaned. In winter, snow from the roads and the management area is removed to an unfilled cell for natural melting.

Industrial sewer system serving waste burial cells

Gravity-based industrial sewer system (K3) is used to remove industrial wastes (leachate) from the landfill's cells being filled to the sumps via the drainage system. Industrial wastewater (leachate) consists of polluted storm runoff which flowed through the industrial wastes .

A drainage prism is designed for collecting leachate from the landfill's cells. It consists of:

- sandy layer (100 mm thick) on top of an anti-filtration screen, a 2 mm Carbofol HDPE 406 synthetic textured geomembrane and mineral waterproofing (Bentofix NSP 49000 bentonite mats);
- Dornit IP-200 geotextile;
- 20-40 mm crushed stone drainage layer on top of geotextile;
- D=160 mm RAUDRIL perforated drain pipes.

To prevent infiltration of leachate through the anti-filtration screen the pipe should be sealed.

The drainage system is designed in order to remove industrial wastewater (leachate) from the landfill cells and to avoid flooding the landfill.

According to the technological calculations 2 landfill cells are filled each year (1 cell for industrial wastes (IW) and 1 cell for wastewater sediments (WWS)). Leachate from the 2 cells being filled as described above is collected in sumps which are isolated with cups, with its subsequent removal by a vacuum truck for thermal decontamination on KTO-200.PS.NGM. Before the other cells (15 IW cells and 1 WWS cell) are filled, they are drained into the containment pond. No storm runoff is collected from the temporary sludge accumulation cell since it is fitted with a canopy which protects it from precipitation.

The approximate chemical composition of, and concentrations of polluting substances in, the leachate are shown in Table 9.4.35 below.

Table 9.4.35: Approximate chemical composition of the SDIW landfill's leachate and polluting substances concentrations

Polluting substance	Concentration, mg/l
Petrochemicals	4700
Cadmium	1.02
Manganese	14.4
Copper	78
Nickel	6
Zinc	54
Lead	6
Iron	3800
Aluminum	14.4
Total nitrogen	290
Total phosphorus	104
Virocid	70*
Suspended solids	5000

Water balance of water use and wastewater removal

The overall water balance of water use and wastewater removal during the operation of the SDIW landfill is given in Table 9.4.36 below.

Table 9.4.36: Water balance of water use and wastewater removal

#	Industrial or administrative building description	Technological process	Hours of operation	Water use standard	Total water use, m^3/day (M^3/y)	Water supply sources m^3/day (m^3/y)		Irretriev able losses, l/s	Wastewater removal, m^3/day (m^3/y)	
			Equipment units	Water volume per equipment unit, m^3/day		Imported water	Utility water supply		Domestic	Polluted
1	2	3	4	5	6	7	8	9	10	11
I. Administrative building w/checkpoint, B1, K1										
1.	Administrative staff	Domestic needs	3	0.015	0.045 (16.43)	0.045 (16.43)	-	-	0.045 (16.43)	-
2.	Shower stall	Domestic needs	2	0.3	0.6 (219)	0.6 (219)	-	-	0.6 (219)	-
3.	Break room	Domestic needs	24	0.010	0.24 (87.6)	0.24 (87.6)	-	-	0.24 (87.6)	-
	TOTAL:				**0.885 (323.03)**	**0.885 (323.03)**			**0.885 (323.03)**	
1.	Administrative staff and workers	Drinking needs	24	0.003	0.072 (26.28)	0.072 (26.28)	-	-	0.072 (26.28)	-
	GRAND TOTAL:				**0.957 (349.3)**	**0.957 (349.3)**			**0.957 (349.3)**	
II Firefighting (B2)										
1.	External	External firefighting		-	15 l/s	15 l/s	-	15	-	-
III Industrial/stormwater sewer system (K2, K2N, K3, K3N)										
1.	Dust suppression	Industrial needs	4.78 ha	-						28.68 (3,154.8)
2.	Storm runoff (K2, K2N)									5,518.48 (54,422.4;77)
3.	Industrial wastewater (K3, K3N)									47 (5,139;2)
	TOTAL:									**5,565.48 (62,716.2)**

9.4.10 *Summary*

The total continuous water use at all the Amur GPP facilities during operation period will be 31,123 m^3/day // 987,456 m^3/y, including:

- 1,270 m^3/day // 461,664 m^3/y for domestic and sanitary needs;
- 1,843 m^3/day // 525,795 m^3/y for industrial needs (Table 9.4.33).

The water use data for all the Amur GPP facilities are given in Table 9.4.37 below.

Table 9.4.37: Water use by the Amur GPP facilities during operational phase

Facility	Volume of water used, m^3/day// m^3/y		
	Total	including:	
		domestic/drinking	industrial
Gas processing plant			
Main production total	**1550.335+120.0*//485.622**	**338.69//119,347**	**1211.645+120.0*//366,275**
Amur GPP auxiliary facilities			
TBI site	982 //345,013	786 //289,530	196 //55,483
Auxiliary production facilities	398+120.00*//126,632	88 //32,121	310+120.0//94,511
"Zavodskaya 1" railway station	174//20,600	50 //11,300	123 //9,300
"Zavodskaya 2" railway station	6.5//1,950	4.5//1,650	2 0//0,300
Ust-Pera station	0.57//13	0.57//13	
Jetty	0.26//95	0.26//95	
SDIW landfill	0.8//302	0.8//302	
Previously designed facilities total	**1563//501,863**	**931 //342,317**	**631 //159,517**
Facilities total	**3113+120 *//987,456**	**1270 //461,664**	**1843 +120 //525,792**
KS-7a site	200.00//73,00	200 //73,000	
Total required water intake	**3313 +120 *//1060,456**	**1470 //535,664**	**1843 +120 //525.792**

Amur GPP water requirements (3,113 m^3/day) are below the production capacity of the water intake facilities (5,760 m^3/day, or 8,600 m^3/day at the time of equipment washing) and will not cause depletion of the water sources.

The total volume of wastewater removed from the Amur GPP facilities (Table 9.4.38) is 65,009 m^3/day or 1,590,467 m^3/y, including:

1,247 m^3/day (456,825 m^3/y) of domestic wastewater;

- 2,225 m^3/day (221,276 m^3/y) of industrial wastewater;
- 61,536 m^3/day (912,366 m^3/y) of storm runoff.

Table 9.4.38: Wastewater removal from the Amur GPP facilities during operational phase

Facility/process	Volume of wastewater removed, m^3/day// m^3/y		
	Total	including:	
		domestic	industrial
Gas processing plant			
Main production total	**46855+120 * //929,353**	**315//114,123**	**46540 +120 *\\815,230**
Auxiliary production facilities			
Auxiliary production facilities	205 +120 * //71,327	88 //32,121	117 +120.0 //39,206
Stormwater from the completed	105 //2,519		105 //2,519

Facility/process	Volume of wastewater removed, m³/day// m³/y		
	Total	including:	
		domestic	industrial
sites			
Stormwater from the site	12,850 //161,881		12,850 //161,881
Auxiliary facilities total	**13,160 +120.00 //234,881**	**88 //32,121**	**13,072 +120 *//202,760**
"Zavodskaya 1" railway station			
Production facilities	41//15,100	21//7.800	20//7,300
Stormwater from the site	186//68,000		186//68,000
"Zavodskaya 1" railway station total	**228//83,100**	**21//7,800**	**206//75,300**
"Zavodskaya 2" railway station			
Production facilities	5//1,830	5//1,710	
Stormwater from the site	18//6,650		18//6,650
"Zavodskaya 2 railway" station total	**23//8,480**	**5//1,710**	**18//6,650**
"Ust-Pera" railway station			
Production facilities	0.570//209	0.570//209	
Jetty			
Production facilities	0.260//95	0.260//95	
Stormwater from the site	1,121 /12,738		1,121 /12,738
Jetty total	**1,121 //12,833**	**0.260//95**	**1,121 /12,738**
SDIW landfill			
Production facilities	0.827//302	0.827//302	
Stormwater from hard surfaces			1,840.00//57,577
SDIW landfill total	**1,841 //57,879**	**0.827//302**	**1,840 //57,577**
TBI site			
Residential housing	811 //295,504	786 //289,530	24 //5,974
Stormwater from the site	445 //5,239		445 //5,239
TBI 2 total	**1257 //300,743**	**786 //289,530**	**470 //11,213**
Amur GPP facilities total	**65,008 +120 * //1,590,467**	**1,247 //456,825**	**63761. +120 *//1,133,642**

/*sporadic water use is disregarded in daily balance

The imbalance occurs due to the presence of condensate in the gas fractioning unit, condensate and water at the feedstock base, storm runoff.

The WWTFs are designed to ensure that the concentrations of polluting substances in the treated industrial, domestic wastewater and storm water collected from the Amur GPP facilities be in accordance with the MACs for fisheries. Provided that the wastewater treatment facilities are operated in the appropriate manner no polluted wastewater should end up in surface water bodies or groundwater.

On the whole, if the proposed technical and environmental protection measures are implemented the impact on surface water bodies can be assessed as low or negligible.

However, to prevent negative impact on surface water bodies during the construction and operation of the Amur GPP facilities a number of environmental protection measures should be implemented (see Table 9.4.39 below).General requirements for monitoring of the surface water bodies environmental impacts are presented in Table 9.4.40.

Table 9.4.39: Summary of Surface Water Bodies Impact and Mitigation Control

Impact	Receptor	Phase	Design and mitigation actions	Residual impact
Impact on water bodies during nearby construction	water protection zones	**Construction**	Ban on vehicle traffic other than on temporary and permanent access roads; Ban on washing motor vehicles or other machinery other than in designated areas with waterproof surfaces; Ban on setting up fuel and lubricants warehouses Perform soil excavation operations taking into account the time of year, the level of water in the river, the condition of soil Set up welding, pipeline sections insulation sites, parking lots, filling stations and motor vehicle repair shops outside floodplain areas Minimize the time that pipe trenches stand open before pipe-laying Construct dikes around, and install waterproof surfaces on, the production sites Removal of construction debris and waste, as well as unused materials after the construction work completion and cleaning of the adjacent catchment area.	low
Chemical and biological contamination of surface water bodies	surface water		Locate non-linear facilities outside water protection zones, Collect domestic and industrial wastewater in storage tanks and have third party organizations timely remove them to treatment facilities, Perform construction work in the Bolshaya Pera buffer zone as quickly as possible during the minimum flow period, unload pipes without dragging them over the ground, install temporary end caps (on individual pipes or pipe sections during temporary storage) to prevent snow, water, dirt from getting inside the pipelines, send the domestic wastewater generated at the temporary construction camp for treatment at the TBI WWTF send the domestic wastewater generated by hydrotesting for treatment at the TBI WWTF fit workplaces with containers for domestic and construction wastes keep strictly within the borders of the proposed construction sites; fit workplaces with containers for domestic and construction wastes; Installation of a required number of culverts under the embankments of linear facilities (motor roads and railway tracks); Refueling of crawler-type construction machinery and mechanisms in a specially equipped area using a refueler truck with a hose connection and a shut-off valve at the outlet end, as well as secondary containment trays to prevent any fuel spills; Refueling of transport vehicles and wheeled construction machinery at the nearest refueling station.	low

Chemical contamination of groundwater	groundwater		set up a sanitary protection zone for the water intake structure construct embankments for the sites and roads refuel motor vehicles only in designated areas deliver chemicals and clay powder to the drilling rig in original sealed packing, in polyethylene bags and rubber-cord casing; store in enclosed spaces	negligible
Water intake from aquifer	Water resources		install water flow meters on the WTF water supply system	negligible
Disturbance of the natural drainage	natural drainage lines		strengthen access road slopes taking into account weather conditions	negligible
		Operational		
Water intake from aquifer	Water resources		use closed-loop water recirculation system for vehicle washing maintain recirculation water quality by constructing local water treatment facilities for treating car wash water and returning treated water to the recirculation system continuously add fresh water to maintain a constant volume of water in the recirculation system continuously monitor the operation of local treatment facilities keep track of water flow rates by installing electromagnetic flow meters on the water intake pumps	negligible
Chemical contamination of groundwater	groundwater		refuel motor vehicles in designated areas only monitor the state of road and production site surfaces, timely repair damage, especially in parking lots, car washes and temporary waste storage areas	negligible
Chemical and biological contamination of surface water bodies	surface water		make sure that treated wastewater quality conform to the ADS standards for construction phase continuously monitor WWTF operations ensure automated monitoring of the volume of wastewater discharges by installing flow meters in pumping stations ensure regular site cleaning; ensure timely repair of roads surfaces; enclose green zones with curbing preventing the soil from being washed off onto road surfaces. prevent wastewater filtration and emergency leaks; prevent discharges of polluted domestic, industrial wastewater and stromwater onto the	low

			ground by sending them either for treatment or decontamination; in the process of the operation of the railway bridge across the Bolshaya Pera river it is required to remove contaminants systematically and timely from the ballast layer; in spring, prior to snow melting, it is required to clean the ballast section at the bridges to remove contaminated snow.	
	water protection zones		ban unauthorized storage of production and consumption wastes use fertilizers and ameliorants in the reclamation of disturbed lands discharge of untreated wastewater ban car washing and organized recreational activity in the riparian buffer zone	negligible
Disturbance of the natural drainage	natural drainage lines		conduct seasonal maintenance of culverts inspect culverts according to a special schedule	negligible
Contamination of water bodies and groundwater as a result of emergency situations	surface water bodies and groundwater	emergency wastewater leaks	take steps to prevent emergency leaks of wastewater and fuel/lubricants: use pipes with original heavy-duty anti-corrosion coating use thermal insulation for pipes and supply heat to sewer system tanks to prevent the transported fluid from freezing; waterproof sewage pipes to protect them from corrosion; waterproof fuel/lubricants storage containers; install impermeable anti-filtration screens in containment ponds for surface runoff; construct dikes around areas where fuel/lubricants leaks are possible; send polluted storm runoff to the WWTF via the industrial sewer system. install underground drainage tanks in reinforced concrete sumps at fuel/lubricants warehouses constructing dikes around process sites, send product leaks into drainage and emergency tanks with subsequent return to production, send storm runoff to WWTF for treatment fit motor vehicles intended for transportation of explosion and fire hazardous substances with spark arresters, casings, firefighting equipment; fit motor vehicles intended for transportation of highly flammable liquids with glass water gauges to monitor the level of liquid being transported	low

Table 9.4.40: Summary of requirements on water bodies impact monitoring

Aspect	Phase	Objective	Parameters	Periodicity
discharge	construction	Wastewater and surface water monitoring includes observing the flow, composition and physical/chemical properties of a water body's water		Once a year according to the approved industrial environmental monitoring program
	operational	Monitoring the volume of water used	for compliance with the water use limits set for the business, to be determined by using flow meters or water balance calculations methods	Once a quarter (pursuant to section 4 of Decree #205 dated July 8, 2009 of the Russian Federation government "Registration of Amounts of Water Resources Taken (Withdrawn) from Water Bodies and Discharges of Wastewater and/or Drainage Water, and the Quality Thereof, by Owners of Water Bodies and Water Users".
		Stationary observations of groundwater regime	hydrogeological observation wells to be drilled in places of potential pollution of a permanent groundwater aquifer (groundwater level 9.0-12.7 m) and in areas which are the most informative in terms of groundwater dynamics data. Observations are performed for establishing: groundwater level, chemical composition, and temperature; possible increase in the aggressive impact of groundwater; possible impact on the natural topography: heaving mounds, waterlogging, etc.; impact on the SDIW facilities: waterlogging, foundation undercutting, etc. In areas where groundwater pollution is possible lab tests of water samples include determining chemical composition and concentrations of polluting substances according to the applicable requirements. The list of components to be determined is made depending on the proposed set of pollutants subject to the types of activity which causes pollution During construction, groundwater regime is monitored via temporary hydrogeological wells that require no special equipment and, accordingly, no design solutions for equipment	Periodicity of groundwater level monitoring – 3. at the beginning and at the end of construction 4. according to the industrial environmental monitoring schedule during the operational phase.
		Wastewater	As they are generated, the amounts of wastewater are registered by flow meters or by water balance calculation methods wastewater composition is monitored for compliance with the prescribed standards by an in-company lab	at least once a month on a daily basis

Aspect	Phase	Objective	Parameters	Periodicity
Watercourse condition	Construction / Operation	Condition of the Bolshaya Pera River in the vicinity of the railway bridge	Monitoring of the specific morphometric parameters and hydrologic conditions of water bodies. Hydrologic and morphometric indicators: • Water discharge rate and water flow velocity; • Depth (minimal, maximum and average); Water level above the "0" level of the diagram.	In the process of the construction phase, monitoring is to be conducted once: • during the excavation of foundation pits and trenches in the bottom and in the riparian belt; • during backfilling of foundation pits and trenches; • after completion of the land reclamation in the riparian bet. During the operational phase once every 6 months.
Watercourse condition	Construction / Operation	Condition of the Bolshaya Pera River in the vicinity of the railway bridge	Hydrochemical monitoring of surface waters and bottom sediments. A point of observation is to be established at the boundary of the zone to be monitored. The boundary is located not more than 500 m downstream of the bridge and at the selected baseline area at a distance of at least 1 km upstream of the bridge. Simultaneously with water sampling, it is required to collect bottom sediments samples and determine the hydrologic characteristics of the watercourse. Parameters to be monitored: • Temperature; • pH value; • Suspended matter concentration; • BOD5; • COD; • Dissolved oxygen; • Dry residue. Associated measurements: • Floating impurities; • Water turbidity; • Color; • Odor. Pollutants concentrations: • Ammonium ion; • Nitrite ion; • Nitrate ion; • Hydrocabonates; • Total phosphorus; • Phosphate phosphorus;	During the construction phase: • Once during the excavation of foundation pits and trenches in the bottom and in the littoral belt; • During backfilling of foundation pits and trenches; • after completion of the land reclamation in the riparian bet. During the operational phase: once every quarter of a year.

Aspect	Phase	Objective	Parameters	Periodicity
			• Potassium; • Sodium; • Chloride ion; • Sulphate ion; • Total iron; • Total nitrogen; • Zinc; • Copper; • Nickel; • Anion-active surfactants; • Neutral surfactants; • Phenols; • Petroleum hydrocarbons; **For bottom sediments:** Summarized indicators: • pH value; • Particle size distribution; • Organic matter content. Pollutants concentrations: • Manganese; • Total iron; • Phenols; Petroleum hydrocarbons.	
Watercourse condition	Construction / Operation	Condition of the Bolshaya Pera River in the vicinity of the railway bridge	Monitoring of the water protection zone status. Water protection zones of water bodies are subject to monitoring within the water use boundaries. The dimensions of the area selected for integrated monitoring of a water protection zone is determined based on the size of the water protection zone and the size of the area within the land allocated for construction, as well as additional areas within which any potential adverse impact is possible during the construction phase. Methods to be used for monitoring of the water protection zone should include both traversing and remote monitoring methods Visual and remote monitoring of the following landscape characteristics: • Erosion processes, erosion network density; • Area covered with grass sod; • Area covered with trees and shrub vegetation. In case of presence of any areas polluted with petroleum hydrocarbons it is required to determine the following parameters: • Size of a polluted area; • Depth and degree of pollutants.	During the construction phase: • Once prior to the construction commencement; • Once after construction completion. During the operational phase: In conformity with the operational monitoring program, but at least once every 6 months.

9.5 Impact on the Geological Environment

9.5.1 Introduction

Main factors characterizing stability and vulnerability of the geological environment in connection with the anticipated impacts

As follows from the information presented in Section 7.1.1, the geological setting in the area selected for the Amur GPP Project and associated facilities is characterized by the following specific conditions important from the viewpoint of the impacts imposed by the planned operations.

1. Association of the subject area with the floodplain terrace complex of the right bank of the Zeya River and its tributaries predetermines the fact that the upper horizons of the cross-section are composed of alluvial deposits with limited proportions of lacustrine, bog, deluvial and proluvial ground.

   The data relating to deeper levels of the geological cross-section indicates that:

   - the Quaternary and Neogene deposits having a total thickness of 68-70m to 103-111m are underlain by Paleogene rocks of the Buzulinskaya rock series, also mainly composed of sands, but with interlayers of carbonaceous clays; in the area of the planned water abstraction facility of the Amur GPP the clayey horizon is reported within an interval from 70m to 110m, i.e. it is approximately 40m thick; it is underlain by a 5-6m thick layer of lignite changing over to interbedded clayey siltstones, clays and sandstones;
   - the rocks in the Buzulinskay rock series at a depth of 133-207m are underlain by Cretaceous-Paleogene clayey siltstones with inclusions of sands and sandstones and deposits of the Kivdinskaya rock series.

2. The hydrogeological conditions of the subject area are characterized by an elevated water content of the rocks with extensive occurrence of interstitial and stratal/interstitial water-bearing horizons:
   - The uppermost shallow water-bearing horizon is associated with alluvial Holocene deposits and in this connection its lateral extension is limited to the floodplain complex of the Zeya River and its tributaries; this horizon does not have any aquifuge roof. The thickness of this layer varies from 3m to 15m in the valleys of the tributaries and from 8m to 30m in the Zeya River valley. The water is unconfined and has close connection with both surface waters and with the water in the underlying horizon. It is freshwater (up to 0.1 g/l) of hydro-carbonate facies and is used for water supply in the town of Svobodny despite elevated iron and manganese concentrations (Ust-Pera water deposit).

   - Outside of the floodplain complex of the river valleys, the uppermost water-bearing horizon is the combined Middle- and Upper Quaternary alluvial horizon associated with the deposits of the above-floodplain terraces II and III. Unconfined water of this horizon has been exposed at a depth from 0.2-7m to 15-25m and occurs sporadically, because it is accumulated above occasional aquifuge rocks – sandy clay and clay lenses. This aquifer is recharged mainly by infiltration of atmospheric precipitation and snowmelt water. In this connection the dynamic conditions in the aquifer are of well-pronounced seasonal character and the water level is subject to significant variations from place to place.

     As far as the chemical composition of the water in this aquifer is concerned, it is similar to that described above and the water is extensively used for water supply (not centralized), mainly by digging shallow wells for individual households. The lack of consistent aquifuge structures at the foot of this aquifer ensures its hydraulic connection with underground waters in the underlying rock series. Part of the water is discharged to the valley network of the subject area.

   - The second water-bearing horizon is the Sazankovsky Miocene horizon occurring throughout the subject area and reported at depths from 5-15m to 90m. The water is predominantly unconfined, with variable water abundance. It is recharged to a significant degree by descending infiltration through the cross-section and due to this reason its chemistry is rather similar to that of the water in the overlying horizons; the water is discharged naturally to the hydrographic network of the subject area. Water from this aquifer is used extensively for water supply in the town of Svobodny.

- The third shallow Buzulinsky Oligocene-Miocene complex does not have any aquifuge roof in some places and is therefore connected hydraulically with the overlying Sazankovsky horizon and has a free surface; the water salinity increases up to 0.2-0.3 g/l. Despite the high iron and manganese concentrations, the water from this water-bearing horizon is used for water supply in the town of Svobodny and in some rural settlements in the subject area. This horizon is considered for use as the main water supply source for the planned Amur GPP facilities.

3. Out of hazardous endogenous geological processes the most characteristic feature of this region is high seismic activity, i.e. up to 7-8 points of the OSR-97C Scale, which means hazardous and very hazardous categories according to the terminology used in the SNiP 22-01-95.

4. Among other hazardous exogenous geological processes, especially significant are erosion and aggradational processes (moderately hazardous category according to SNiP 22-01-95), flooding (moderately hazardous category according to SNiP 22-01-95) and frost heaving attributable to deep ground freezing (down to 0.8m to 3m according to SP 50-101-2004 (hazardous category according to SNiP 22-01-95).

5. According to the information provided by the relevant agencies and presented in the Project design documentationthere are no proven mineral resources in the Project area selected for the construction of the Amur GPP and associated facilities.

Under the given conditions, the stability of the geological environment in relation to any technogenic impacts is predetermined to a significant degree by the fact that the underground waters are well protected from contamination. During the project design development phase this parameters were assessed for the exploited Buzulinsky aquifer classified as reliably protected due to its deep occurrence and protection provided by the overlying thick horizon with low permeability properties.

It is also mentioned in the sanitary protection zone design that a prerequisite for conservation of favorable underground water properties in the exploited aquifer is stability of the environmental situation. Currently, the sanitary and epidemiological situation in the subject area has been assessed as favorable because there are no potential sources of underground water pollution. The sanitary protection zone design for the future water abstraction facility of the Amur GPP provides for a range of 30 m for Belt I around each well; the dimensions of Belt II are 260m and 280m upstream and downstream of the underground water flow direction, respectively; the width of Belt III is 1330m and 2300m. Since the distance between the GPP facility and the water abstraction facility is approximately 1 km, some of those facilities will be situated within the outlines of the SPZ Belt III (Fuel depot, accumulating reservoirs for wastewater and some other facilities) which poses a threat of chemical pollution of the underground waters and will be permissible only in case of implementation of special measures for the aquifer protection and in case of an approval to be issued by the geological supervision agency (SanPiN 2.1.4.1110-02). The Amur GPP Project design has taken into account the above requirements related to the protection of the underground water abstraction facility.

The geological conditions of the first and second water-bearing horizons comply with Categories I and II according to V.M. Goldberg's terminology relating to the degree of their protection, which means that they are less protected and have a higher vulnerability degree with regard to chemical pollution from the day surface as compared to the more protected Buzulinsky horizon. Prevailing in the cross-section of Quaternary and Neogene rocks are sands, gravel and pebble deposits with high water permeability; clays and sandy silts occur only in localized areas and do not fulfill the function of barriers preventing descending infiltration of water within the geological environment. Due to these conditions, the project design provides for measures ensuring protection of the geological environment from contamination and monitoring during the construction and operational phases of the Amur GPP Project.

9.5.2 *Main types of expected impacts on the geological environment and mitigation measures*

9.5.2.1 Construction phase

The main part of inevitable impacts on the geological environment will be imposed during the construction phase in connection with drilling, excavation, earthmoving, piling and other operations. The expected potential consequences are:

- direct physical and mechanical disturbance of the integrity of the ground layer and water-bearing horizons;
- a complex set of static and dynamic ground loads;
- surface relief transformation;
- removal of a part of local ground and filling of imported ground;
- ground compaction as a result of the loads imposed by heavy construction machinery, buildings, installations and hard pavement;
- redistribution of the surface runoff and subsoil drainage streams, including barrage and drainage effects.

Most of the impacts imposed on the geological environment will be of physical and mechanical nature and facilitate development of exogenous geological processes. According to the Project design documentation, the typical dangerous impacts in the subject area will be erosion and aggradational processes, ground saturation with water and swamping and frost heaving of the ground. Furthermore, suffosion might also take place (in the area of the railway station "Zavodskaya-2"), as well as other engineering processes within the outlines of ground constructions and excavations.

In addition, construction and subsequent operation of the planned facilities will impact the thermal regime of the ground, but due to the fact that there is no permafrost ground in the subject area, the thermal impact will be limited to changes in the seasonal freezing and thawing of the ground and it is not expected that they would induce development of any hazardous exogenous geological processes and hydrologic phenomena (HEGP & HP).

At the same time, the construction and subsequent operation of the planned facilities will have impact on the thermal conditions of the ground, but due to the localized and insular type of the permafrost ground occurrence in the subject area the thermal impact will be in general limited to changes in the seasonal freezing and thawing conditions and, as it may be expected, it will not provoke any hazardous exogenous geological processes and hydrologic phenomena (HEGP & HP). An exception is some areas identified in the course of the surveys and characterized by chilled and frozen grounds (the sewer line route sections ПК 13+35 – ПК 16 and the railway bridge across the Bolshaya Pera River), where potentially formation of new permafrost ground areas can form in the process of construction and subsequent operation of the planned facilities, and as a consequence, intensification of frost heaving of the ground; permafrost degradation is potentially possible within the permafrost ground outlines accompanied with development of ground subsidence and intensification of ground washout.

Certain deviations from the project design solutions, i.e. impacts caused by accidents, can require intervention; they include the following:

1) Spills and leakage of fuel, lubricants, paints and other technical fluids resulting in their penetration into the geological environment with formation of infiltration bodies in the ground and in underground water contamination;
2) Unauthorized disposal of construction waste and debris in the geological environment;
3) Use of contaminated soils for creation of technogenic landforms;
4) Infiltration of contaminated surface runoff (stormwater and snowmelt water) into the ground;
5) penetration of leakage from water supply networks into water-bearing horizons and a decrease in the transpiration after removal of the natural vegetation;
6) Secondary intensification of HEGP & HP, the most acute of which in the subject area are erosion and aggradational processes, flooding and frost heaving within the freezing ground and newly-formed frost;
7) Contamination of underground waters in case of their level rise (saturation of the ground with water) and their contact with construction materials and structures and with construction wastes.

The mentioned impacts on the geological environment and development of HEGP & HP have been taken into consideration in the process of planning of environmental protection measures; most of the planned measures have only indirect relation to the geological environment and are related to the components having contact with geological structures: soil and vegetation cover, surface water bodies and constructions. In particular, the following measures have been foreseen in the Project design documentation to avoid adverse impacts on the geological environment:

- Execution of work strictly within the boundaries of the land areas allocated for construction; sound and consistent use of land and soil resources;
- Compliance with the construction time schedule taking into account the seasons suitable for execution of certain types of work;
- Use of only environmentally safe drilling mud types for borehole drilling to be prepared of clay powder and water; use of drilling technology not requiring any mud pits;
- Compliance with the norms and rules applicable in the RF for handling construction materials, fuel and lubricants, paints and wastes;
- Implementation of an integrated complex of anti-erosion measures (reinforcement of slopes) and measures for surface runoff management (drainage, stormwater drainage system, treatment of stormwater runoff);
- Establishment of a sanitary protection zone around any underground water supply source comprising three protective belts with special sanitary measures to be taken;
- Technical and biological land reclamation after the construction completion in areas allocated on a short-term basis;
- Site improvement and greenery planting within the Amur GPP sites located outside of buildings and installation;
- Arrangements to be taken to ensure monitoring of the conditions of the geological environment, forms and factors of its degradation within the framework of the overall operational environmental monitoring and supervision over construction and operation of the Amur GPP facilities.

In addition to the measures listed above and to be applied within the project area, the following special measures should be added for the area of the railway bridge across the Bolshaya Pera River, where permafrost ground still exists:

- ensure maximum possible degree of conservation and for disturbed areas restoration of the organogenic surface soil horizons within the floodplain complex of the Bolshaya Pera River valley;
- organize concentrated passing of water under the bridge structure; if necessary install a frost shield using cooling devices; prevent prolong accumulation of water along embankments and under the bridge;
- reinforce the river bed bottom to prevent its washout and deformation within the area used for the bridge construction;
- if the piles are driven within permafrost and chilled ground, ensure their penetration below the level of maximum possible ground thawing, i.e. down to a depth where they can withstand the design loads, including the frost heave force;
- locate of the pile elements outside of the outlines of underground ice or highly icy grounds; where it is impossible, the piles should be piled throughout the entire thickness of such ground.

9.5.2.2 Operational phase

During the operational phase of the Amur GPP Project certain stable inevitable transformations and tendencies will take place in the geological environment in connection with the following factors:

- Water abstraction from the exploited aquifer;
- Redistribution of the surface runoff and subsoil drainage streams due to buildings, constructions and hard pavement;
- Changes in thermal regime of the ground;
- Barrage and infiltration effects of technogenic soils and ground and other constructions, especially linear facilities and boreholes and wells drilled for different purposes.

Accidental situations might take place against the background of such transformations and changes with consequences to be monitored during the operational phase within the framework of the operational environmental monitoring and supervision program.

The water quality compliance with the applicable requirements of SanPiN 2.1.4.1074-01 has been confirmed for the exploited aquifer by experts' statement issued by the Amur Region Center for Hygiene and Epidemiology (No.5593 of 13.10.2015). The calculations have confirmed that the planned water abstraction volume of approximately 5,800 m^3/day will not impose any significant impact on the underground water condition because it will not exceed the permissible limit for natural recovery of water resources and cause any depletion of the so called 'elastic' underground water reserves. The mitigation measures planned in connection with the exploitation of these water resources are predominantly of preventive nature:

- Systematic monitoring of the water level and chemical composition to identify timely any trends toward depletion and/or contamination of the exploited aquifer;
- Systematic supervision over the compliance with the applicable requirements relating to the sanitary protection of the water abstraction facility in order to identify and eliminate timely any sources of chemical and biological contamination;
- Site improvement within Belt I of the SPZ and compliance with the applicable requirements to all three belts of the SPZ around the underground water abstraction facility.

9.5.3 Residual Impacts and Monitoring of the Geological Environment

The predicted impacts during the construction and operational phase of the Amur GPP Project on the geological environment will be mainly localized, i.e. associated with the respective technical sites and utility lines and insignificant with regard to their magnitude in comparison to the scale of the engineering geological district and sub-district (Table 9.5.1).

It is anticipated that especially significant will be secondary activation of HEGP & HP and first of all erosion/aggradational processes and saturation of the ground with water and cryogenesis. Such processes can impact the areas adjacent to the project sites. In case of intensive development of secondary exogenous processes, their expansion would be limited in the west, south and south-east by the river valleys and in the north and north-east by the natural ascending slope surface. The lateral component of the migration streams of pollutants into the geological environment can be associated with the first and second shallow water-bearing horizons discharging to the gully and valley network.

The main tool for assessing the geological environment condition and monitoring of its modifications, as well as supervision over the execution and assessment of the sufficiency of the project design solutions relating to the condition of the subsoil resources during the construction and operational phases of the Project will be operational environmental monitoring.

According to the Project design, the geological environment monitoring shall include interpretation of remote sensing imagery (designated as *RS* in Table 9.5.2), traversing surveys (*TS*) and stationary observations using hydrologic regime monitoring wells (*MW*). This monitoring can be performed by the developer, contractor or outsourced specialist organizations having required equipment, skilled personnel and accredited analytical laboratories.

The initial stage for the contractor in charge of the operational environmental monitoring shall be development of an appropriate program based on the project design solutions and the applicable regulatory requirements: SP 115.3330.2011 (updated revision of SNiP 22-01-95 "Geophysical Surveys for Construction. Basic provisions"); SP 47.13330.2012 "Engineering Surveys for Construction. Basic Provisions", Part I "General Rules for Work Execution" and Part II "Rules for Work Execution in Areas with Hazardous Geological and Engineering Geological Processes"; SP 11-104-97 "Engineering Geodetic Surveys for Construction"; SNiP SP 116.13330.2012 "Code of Rules. Engineering Protection of Sites, Buildings and Structures from Hazardous Geological Processes. Basic Provisions" (updated revision of SNiP 22-02-2003»); GOST R 22.1.06-99 "Monitoring and Prediction of Hazardous Geological Phenomena and Processes".

According to the Project design, the main objectives of the geological environment monitoring in the Amur GPP area are as follows:

- Assessment of the efficiency of the measures implemented for engineering protection of the project facilities and the general environmental safety level;
- Assessment of development and conditions of hazardous geological processes;
- Collection of information and data required for the decision making process related to engineering and environmental protection measures.

The core objectives of the geological environment monitoring will be:

- Monitoring of the geological environment condition and development of hazardous geological processes, both already identified and induced by the construction and operational processes at the Amur GPP sites;
- Analysis, processing and storage of collected data;
- Development of recommendations aimed at conservation and sound use of the geological environment and protection from impacts of HEGP & HP;
- Optimization of the monitoring network.

According to the materials of the engineering geological surveys, the following HEGP & HP can potentially take place within the subject area: gully erosion, flooding, frost heaving of the ground and newly-formed frost, contamination and changes in the reactivity of underground waters and geological processes induced by construction activities. In order to assess the areal extension of the above processes it is planned to use remote sensing imagery: purchase, processing, determination of geographical coordinates and interpretation of remote sensing imagery of very high and ultra-high resolution.

Verification and direct identification of geographical coordinates of the obtained data should be carried out by means of ground truthing and findings of visual observations in the process of engineering geological surveys. The boundaries of the imagery should be at a distance of at least 100 m from the outlines of the allocated land area used for the Project implementation on a temporary and permanent basis. The imagery to be used should be made during cloud-less periods of time or during periods with few clouds in spring (May, early June) and autumn (September, early October) especially suitable for identification of the outlines of areas affected by HEGP & HP. The following qualitative and quantitative parameters should be determined to characterize the identified hazardous geological processes and phenomena:

- Scale and development rate of processes (the affected area and the nature of processes);
- Areal extension of the affected area (%, area, km^2);
- Outlines and dimensions of the area where hazardous processes take place;
- Distances of the affected areas from buildings and installations;
- Visual features used for interpretation of the remote sensing imagery.

Based on the findings of the remote sensing imagery interpretation, thematic maps should be plotted to indicate the areas affected by HEGP & HP both during the construction and operation of the Amur GPP facilities.

The objective of the traversing engineering geological surveys during the first field phase of the operational environmental monitoring is the ground truthing of the space imagery with subsequent selective confirmation of the RS materials related to areas of the hazardous exogenous geological processes identified earlier. According to the Project design documentation, traversing surveys of the areal facilities shall be performed throughout the entire site area starting from a distance of 50-100m off the site boundary by parallel traversing each with an observation range of up to 100m. For linear facilities (connection gas pipelines), observations shall be carried out along the entire length of each route within a corridor at least 50m or 100m wide. In the process of the traversing surveys any signs of hazardous exogenous geological processes will be reported using field navigation means, photography and records in the field log of the indicators mentioned above.

In order to monitor the condition of the underground water level and to forecast processes associated with its changes, operating, stand-by and monitoring wells at the water abstraction facility site shall be used and additional observation hydrologic wells be drilled in most informative areas (flooded and boggy areas, high groundwater level, etc.). The parameters to be recorded are the underground water level, changes in the underground water temperature and chemical composition.

Comprehensive information about the types and scope of work to be performed within the framework of the geological environment monitoring foreseen in the Project design documentation is presented in Table 9.5.2. The right column contains a list of additional measures recommended by Ramboll-Environ CIS to be included in the operational environmental monitoring program.

9.5.4 *Summary*

Table 9.5.1: Assessment of the predicted significance of residual impacts on the geological environment in connection with construction and operation of Amur GPP facilities

Types of impacts and response of geological environment			Residual impacts in case of mitigation measures foreseen in the Project design	
			Assessment of their significance and spatial expansion	Monitoring objects
Physical and mechanical impacts	Areal transformation of the ground stratum as a result of earthmoving and associated operations (including fertile topsoil layer stripping, technical land reclamation)		**Moderate** - for upper horizons of the geological environment at the level of mesorelief of the terrace complex of the right bank of the Zeya river valley (the affected area is comparable with regard to its dimensions with individual segments of the high floodplain and above-floodplain terraces of the Zeya river, with gully systems).	The soil cover and ground horizons in areas barren of soil cover: physical integrity.
	Vertical transformation of ground stratum as a result of drilling and piling operations		**Negligible** – for the Amur GPP area as a whole; **Low** – for the water abstraction site (with a concentration of water well) and pile fields (localized within the Project area).	
	Loads imposed on ground stratum	Statical	**Low** – for areas with buildings and installations (localized within the Project area).	
		Dynamic	**Low to moderate** -– for areas with motor roads and railway tracks (localized within the Project area).	
	Development of hazardous exogenous geological processes and hydrologic phenomena (HEGP & HP)	Erosion and aggradational processes	**Low** – for the Project area as a whole; **Moderate to high** – in areas with development of erosion and aggradational surface relief (local level with potential possibility of extension to outside of the Project area).	Areas of existing and potential occurrence of HEGP & HP. Soil cover and ground areas impacted or vulnerable to HEGP & HP.
		Flooding and swamping	**Low** – for the Project area as a whole; **Moderate** – in depressions, along rear joints of above-plain terraces and within the floodplain complex; **to high** – along man-made embankments (local level with potential possibility of extension to outside of the Project area).	
		Gravitational and other processes	**Moderate** – in areas with technogenic surface relief and adjacent areas (local level with potential possibility of extension to outside of the Project area).	
		Cryogenic processes	**Low** (localized level) - **Low** (localized level) - Degradation of permafrost ground and an increase in the ground mobility; **Moderate** – Secondary development of frost heaving in connection with seasonal ground freezing; in areas with chilled ground it is also associated with new formation of permafrost ground.	
Chemical and biological contamination	Contamination of surface ground horizons within the aeration zone contacting with the soil cover or barren of soil cover with formation of secondary sources and/or infiltration bodies		**Moderate to high** – during the construction phase in connection with high concentration of construction machinery, transport vehicles, mobile buildings and installations, material resources, industrial and domestic wastes against the background of large scale of operations associated with soil cover destruction or disturbance.	Soil cover
	Contamination of the uppermost shallow water-bearing horizon		**Moderate to high** under the conditions of low degree of underground water protection conditions. There is potential possibility of contaminants migration from a localized source with underground waters to the lower horizons of the geological environment and/or discharge to surface water bodies.	Chemical composition of underground waters
	Contamination of the second shallow water-bearing horizon		**Low to moderate** in connection with low degree of underground water protection	

Types of impacts and response of geological environment		Residual impacts in case of mitigation measures foreseen in the Project design	
		Assessment of their significance and spatial expansion	Monitoring objects
	Contamination of the exploited aquifer	**Low** due to high degree of underground water protection	
Thermal impacts	Changes in the seasonal ground freezing | thawing conditions	**Low** due to the locality of the distribution of permafrost and chilled grounds. Localized changes in ground frost heaving potentially possible.	Underground water temperature
Exploitation of underground water resource	Depletion of underground water reserves	**Low** due to sufficiency of resources for natural replenishment and due to elastic water reserves.	Static and dynamic underground water level, yields of operating water wells.

Table 9.5.2: Requirements to geological environment monitoring (Beginning)

Types of work*	Requirements defined in the Project design to the operations to be performed			Additional recommendations proposed by Ramboll-Environ
	Location	Timeframe	Scope of work	
Stage 1.Early Works facilities				
No direct observations of the geological environment condition are planned. Traversing surveys foreseen during the construction phase to monitor the soil cover condition (physical integrity, chemical contamination) within the boundaries of the Project sites (Once per year).				HEGP & HP monitoring using RS and TS techniques within the timeframe similar to Stages 2, 4 and 6, within the boundaries of the allocated sites and adjacent 100m wide buffer zone. The scope and situational scheme of work are subject to clarification in the process of the operational environmental monitoring program.
Stage 2. Railway facilities. Development of the railway infrastructure facilities for public use at the "Ust-Pera" Station – RZhD Subsidiary				
TS	Allocated sites and adjacent 100m wide buffer zone	**Construction and operational phases:** Twice per year – in spring (after snow milting, May-June) and in autumn (September -early October, prior to snow cover formation)	To be specified by the contractor in the process of the environmental monitoring program development	Monitoring of hazardous exogenous geological processes and hydrologic phenomena using RS techniques at intervals similar for TS within the allocated sites and adjacent 100m wide buffer zone. The scope and situational scheme of work are subject to clarification in the process of the operational environmental monitoring program. When planning traversing surveys, special attention should be paid to areas with permafrost ground occurrence in the vicinity of the railway bridge across the Bolshaya Pera River.
Stage 3. Associated railway networks and facilities. Development of the special (non-public) railway infrastructure facilities. "Zavodskaya" and "Zavodskay-2" railway stations				
RS, TS	Allocated sites and adjacent 100m wide buffer zone	**Construction and operational phases:** Twice per year – in spring (after snow milting, May-June) and in autumn (September -early October, prior to snow cover formation) **Operational phase:** During the first 3 years – twice per year (see above), then once every 3 years in case of new signs of hazardous processes or once per year in case of new signs of hazardous processes	To be specified by the contractor in the process of the environmental monitoring program development	It appears that the scope of the measures foreseen in the Project design is sufficient. It is recommended to use at least 4 wells to monitor the hydrologic conditions. The location of the monitoring wells should take into account the natural sporadic occurrence of the first and second shallow water-bearing horizons (as established by engineering surveys) and barrage effects caused by the railway track embankments. The scope and situational scheme of work are subject to clarification in the process of the operational environmental monitoring program.
MW	The location of the monitoring wells is to be determined during the pre-construction phase taking into account potential underground water contamination and	**Construction and operational phases:** Quarterly – underground water level and temperature; Once per year (at the end of the snow melting period) – chemical composition indicators	The number and depth of the wells shall be determined by the contractor in the process of development of the operational environmental monitoring program.	

Types of work*	Requirements defined in the Project design to the operations to be performed			Additional recommendations proposed by Ramboll-Environ
	Location	Timeframe	Scope of work	
	the most effective assessment of the trends.		A list of parameters to be monitored shall be prepared in conformity with the requirements of the Project design, SP 2.1.5.1059-01 and Annex H to SP 11-105-97	
Stage 3.1. Auxiliary facilities				
No direct monitoring of the geological environment has been planned. During the **construction phase** it is planned to carry out traversing surveys of the soil cover within the construction sites (physical integrity, chemical pollution) within the allocated land area according to the following schedule: once prior to commencement of construction; once during the construction period; once after construction (and land reclamation) completion. If any contamination sources would be identified, it is required to determine the depth of contaminants migration and carry out sampling of contaminated soils to assess the degree of contamination. During the **operational period**: during the first 2-3 years – soil sampling within the soil horizon of 0.0-0.3m at test sites of 5m x 5m located along the boundaries of the land area allocated for the Project on a permanent basis at a distance of 10m from the boundary using an eight-point system, as well as in area where contamination can be identified visually.				HEGP & HP Monitoring using RS and TS techniques within the timeframe similar to Stages 2, 4 and 5 within the boundaries of the allocated sites and adjacent 100m wide buffer zone. The scope and situational scheme of work are subject to clarification in the process of the operational environmental monitoring program.
Stage 3.2. Provisional river jetty on the Zeya river				
MW	The location of the monitoring wells is to be determined during the pre-construction phase (within the allocated sites or in their direct vicinity)	**Construction and operational phases** (The monitoring schedule shall be specified by the contractor in the process of development of the operational environmental monitoring program)	The number and depth of the wells shall be determined by the contractor in the process of development of the operational environmental monitoring program.	HEGP & HP Monitoring using RS and TS techniques within the timeframe similar to Stages 2, 4 and 5 within the boundaries of the allocated sites and adjacent 100m wide buffer zone. The scope and situational scheme of work are subject to clarification in the process of the operational environmental monitoring program.
Stage 3.3. Access roads				
No direct monitoring of the geological environment is planned. During the construction phase, some traversing surveys will be carried out to assess the soil cover condition (physical integrity, chemical contamination) within the construction zone and along the motor road routes, including sampling within the 0.0-0.3m horizon in stationary testing areas with the following periodicity: once prior to commencement of construction work; once during the construction phase; and once after the completion of construction (and land reclamation).				HEGP & GP monitoring using remote sensing and traversing survey methods within the timeframe similar to that for Stages 2, 4 and 6 within the allocated land area and adjacent buffer zone 100 m wide
Stage 4. Gas Processing Plant				
RS	GPP and water intake sites and	During the first 3 years – twice per year: in spring	Minimal area to be investigated = 9.53	The scope of the planned measures appears to be sufficient.

Types of work*	Requirements defined in the Project design to the operations to be performed			Additional recommendations proposed by Ramboll-Environ
	Location	Timeframe	Scope of work	
	adjacent area 100 m wide	(after snow melting, May-June) and in autumn (September-early October, prior to snow cover formation). During subseqent 3 years – once per year (in spring). Later in case of now occurrence (stabilization) of HEGP & GP – once every 3 years; in case of new HEGP & GP occurrence – once per year.	km^2	
	Gas pipelines with connections within the right-of-way strip 100 m wide		Minimal area to be investigated = 0.76 km^2	
TS	GPP and water intake sites and adjacent area 100 m wide		Minimal length of traversing = 87.85 km	
	Gas pipelines with connections within the right-of-way strip 100 m wide		Minimal length of traversing = 15.2 km	
MW	GPP site. The location of boreholes drilled mechanically L1 … L6 is indicated on the general layout map.	**Construction and operational phases:** quarterly	6 measurements of water level and temperature	On the basis of SP 2.1.5.1059-01 and Annex H to SP 11-105-97, it is recommended to add following the indicators to the list of the parameters to be determined: color; water turbidity; salinity (according to the dry residue); permanganate oxidizibility; Fe (with separate determination of reduced and oxidize forms); Si (total content and silicic acid content); CO_2 (dissolved); macroanions (HCO_3^-, CO_3^{2-}, SO_4^{2-}); macrocations (Na^+, K^+, Ca^{2+}, Mg^{2+}); ammonium (NH_4^+); trace elements (Mn, F).
		Construction and operational phases: once per year (at the end of spring floods)	6 underground water samples with quantitative determination of the following parameters: pH value, chloride, hardness (total, carbonate and permanent), nitrates (NO_3^-), nitrites (NO_2^-), total iron (Fe), total petroleum hydrocarbons.	
	Water intake facility site. The location of the boreholes (4 operational, 2 stand-by and 1 monitoring borehole) is fixed; by the time of the ESIA completion the boreholes had been drilled and equipped.	**Operational phase:** Once every 10 days (in case of continuous water abstraction on the 24-hour basis	Measurement of the water yield and dynamic level of underground water in 7 boreholes.	The scope of the planned measures appears to be sufficient.
		Operational phase: On the last day of each month	Recording of the total water abstraction in 7 boreholes.	
		Operational phase: At least once every 2 months.	Measurement of the static level of underground water in 7boreholes (after pump shutdown).	

Types of work*	Requirements defined in the Project design to the operations to be performed			Additional recommendations proposed by Ramboll-Environ
	Location	Timeframe	Scope of work	
		Operational phase: At least once per year.	Content of inorganic and organic substances, radioactive environmental characteristics of water in 7 boreholes.	
		Operational phase: At least four times per year (each season).	Microbiological, organoleptic and general (integrated) water quality parameters in 7 boreholes.	
Stages 5.1 and 5.2 (Residential area - Microdistrict), 5.3 (Church complex)				
No direct monitoring of the geological environment is planned.				HEGP & GP monitoring using remote sensing and traversing survey methods within the timeframe similar to that for Stages 2, 4 and 6 within the allocated land area and adjacent buffer zone 100 m wide.
Stage 6. SDIW Landfill				
RS	Allocated land area and adjacent buffer zone 100 m wide	**Construction phase:** 2 times (at the beginning and end of construction) **Operational phase:** During the first 3 years – twice per year (in spring and autumn); Later – once every 3 years in case of now occurrence (stabilization) of HEGP & GP or once per year (in spring) in case of new HEGP & GP occurrence	Minimal area to be investigated = 0,42 km^2	The scope of the planned measures appears to be sufficient.
TS	Allocated land area and adjacent buffer zone 50 m wide	**Construction phase:** 2 times (at the beginning and end of construction) **Operational phase:** Similarly to RS	Minimal length of traversing = 3,6 km	The scope of the planned measures appears to be sufficient.
MW	Landfill site. The location of the mechanically drilled boreholes L1 … L4 is fixed on the general layout map of the planned	**Construction phase:** Once after the borehole completion	Soil sampling throughout the ground layer in four boreholes (the number of samples is to be determined in the Specifications for	On the basis of SP 2.1.5.1059-01 and Annex H to SP 11-105-97, it is recommended to add the following indicators to the list of the parameters to be determined: color; water turbidity; salinity (according to the dry residue); permanganate oxidizibility; Fe (with separate determination of reduced and oxidize forms); Si (total content and silicic acid content); CO_2 (dissolved); macroanions (HCO_3^-, CO_3^{2-}, SO_4^{2-}); macrocations (Na^+, K^+, Ca^{2+}, Mg^{2+}); ammonium (NH_4^+); trace elements (Mn, F).

Types of work*	Requirements defined in the Project design to the operations to be performed			Additional recommendations proposed by Ramboll-Environ
	Location	Timeframe	Scope of work	
	facilities.		Operational environmental monitoring program) for determining the following parameters: particle size distribution; short list of physical and mechanical soil properties in the disturbed soil structure	
MW		**Construction phase:** 2 times (at the beginning and end of construction)	4 measurements of water level and temperature; 4 underground water samples for quantitative determination of the following parameters: pH value, chloride, hardness (total, carbonated and permanent), nitrates (NO_3^-), nitrites (NO_2^-), total iron (Fe), total petroleum hydrocarbons.	
		Operational phase: quarterly during warm season	4 measurements of water level and temperature	It is planned to make the measurements on a quarterly basis, including Quarters I and IV (March and October, respectively).
		Operational phase: Once per year (at the end of spring floods)	4 underground water samples for quantitative determination of the following parameters: pH value, chloride, hardness (total, carbonated and permanent), nitrates (NO_3^-), nitrites (NO_2^-), total iron (Fe), total petroleum hydrocarbons, suspended matter,	Due to the need to comply with the requirements specified in SP 2.1.5.1059-01, it is recommended to add the following the indicators to the list of the parameters to be determined: trace elements (Mn, F, Ni, Sb, Br), acrylamide, styrene, benzene, synthetic surfactants (in addition to the anion-active surfactants).

Types of work*	Requirements defined in the Project design to the operations to be performed			Additional recommendations proposed by Ramboll-Environ
	Location	Timeframe	Scope of work	
			BOD5, salinity (dry residue), COD, organic carbon (C), macroions (HCO_3^-, SO_4^{2-}, Mg^{2+}, NH_4^+), trace elements (Li, Cd, Cr, Pb, Hg, As, Cu, Ba), phenols, anion-active surfactants, indicators of bacteriologic and helminthological pollution	

*TS means traversing surveys for visual monitoring of development of hazardous exogenous geological processes and hydrologic phenomena, including flooding and swamping (throughout the subject area), erosion and aggradational processes (throughout the subject area), secondary engineering processes (throughout the subject area), suffusion (for railway facilities at "Zavodskaya-2" Station);

RS means remote sensing of HEGP & HP by means of interpretation of space imagery of very high and ultra-high resolution;

MW means monitoring wells specially equipped for monitoring of hydrogeological conditions (hydrologic regime).

9.6 Noise and vibration

9.6.1 Introduction

Noise and vibration will be occurring at all phases of the Project's lifecycle including construction, commissioning, operation, and decommissioning. Environmental impact of noise and vibration is different in duration, extent and amplitude at each phase of the Project's lifecycle.

Noise

Noise will have potential impact on:

- People employed by the Project, both during the construction and operation of the Project facilities and during the time people spend in their living quarters outside working hours. Such impact includes:
    - Noise impact associated with occupational health and safety matters,
    - Noise impact affecting the construction camps at the TBI site (during construction phase);
- The residents of the nearest population centers and people living near highways and railway lines that will be used for transporting cargoes and equipment (during the construction phase) and exporting finished products (during the operational phase);

Impact of noise on humans is assessed by comparing it to the proposed noise standards (see below and also the Project Environmental and Social Standards document in Appendix 1). Besides, the extent of noise impact is assessed and controlled within the sanitary protection zones (SPZ) around the Project's main facilities to be set up in accordance with the RF regulations in the field of protecting human health from noise (see also section 9.2). An SPZ will be set up for each of the following Project facilities:

- Gas processing plant;
- SDIW landfill.

In addition, sanitary gaps will be set up for the railway station "Ust-Pera"; they will possess the SPZ status but will not require a special design for their arrangement.

The allowable noise standards applicable to the Project are listed below.

Table 9.6.1: Project's allowable noise standards (equivalent continuous noise level, LA eq, dB(A))

Category	Daytime (07:00 – 23:00)	Nighttime (23:00 – 07:00)
Residential areas /dormitories	55	45
Office buildings	60	
Industrial facilities	80	

Where practicable, modeling was performed to predict noise levels in places where receptors are located, and, in particular, to determine the size of the SPZs.

Noise impact modeling was performed according to the methodology described in SNiP 23-03-2003 "Noise protection", M., 2004, using the Ekolog-Shum software developed by Integral.

Vibration

The only sources of vibration that may potentially affect the residents of areas located near the Project sites are connected with the operations of rail transport at "Ust-Pera" station.

Impacts connected with vibration caused by the movement of railway transport may disturb people due to noticeable ground vibrations.

It should be noted that since no sources exist that are capable of causing ground vibrations of an extent sufficient to cause substantial damage such sources are not discussed elsewhere in this report.

9.6.2 *Noise and vibration impact*

During the construction phase, the main noise and vibration sources will include:

- Motor vehicles;
- mobile and stationary construction equipment;
- Diesel power plant;
- Rail transport.

During the operational phase, the noise and vibration sources will include the gas processing plant's key process equipment, primarily gas compressor units (GCU), ventilation units and compressors.

Rail transport and motor vehicles used for transporting gas processing products (helium, propane-butane, etc.) are also considered noise and vibration sources during the Amur GPP operational phase although the impact will mostly result from the operation of Ust-Pera railway station due to the fact that the station's residential structures are located in close proximity to the railway tracks.

9.6.3 *Stage 1. Amur GPP and TBI construction site*

Noise pollution was calculated for the noise sources located within the Amur GPP and TBI sites and on the roads accessing those sites. The period of work with the maximum number of road construction machinery and vehicles was taken into account in the acoustic calculations.

Noise pollution levels were determined at the boundary of the nearest residential area, the settlement of Yukhta, and within the work area, the construction site, in a total of 4 control locations.

The calculation results show that the maximum noise levels will not exceed:

- 78 dB at the modular dorm boundary;
- 41 dB at the border of the Yukhta setttlement.

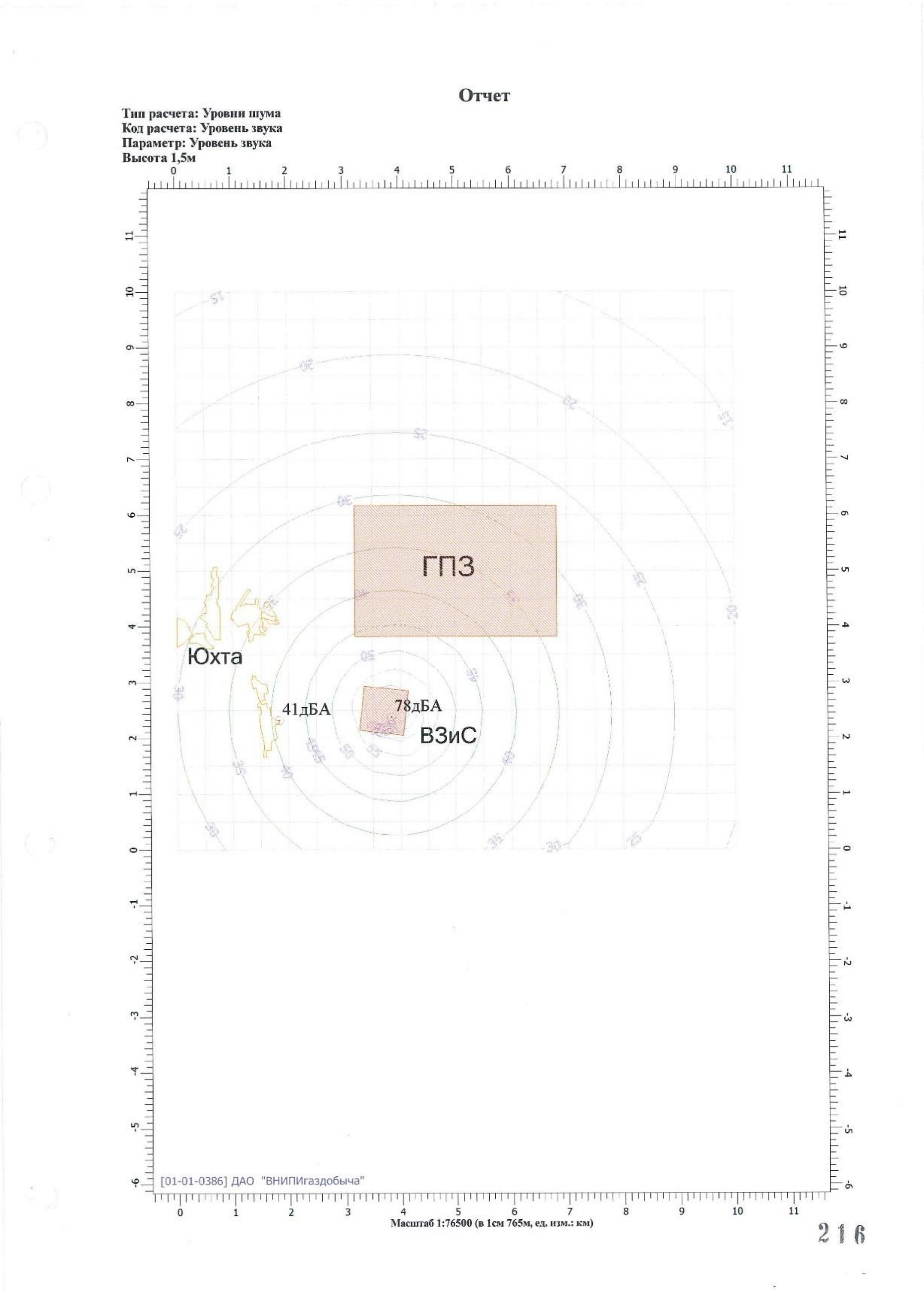

Figure 9.6.1: Calculated noise pollution levels from TBI site sources

Report
Calculation type: noise level
Calculation code: sound level
Parameter: sound level
Elevation: 1.5 m
GPP, Yukhta, TBI, 41dBA, 78 dBA
Scale: 1:76500 (1 cm equals 765 m, measurement units: km)

9.6.4 Stage 2. Railway lines and installations

9.6.4.1 "Ust-Pera" Upgrade

During the upgrade of "Ust-Pera" station the main sources of noise will include construction machinery and areas where crushed stone will be unloaded from dump trucks. Considering that the residential structures at "Ust-Pera" station are located 35 to 85 m from the existing railway tracks, the following two work areas were selected for the assessment of noise pollution during construction:

- An area in the middle of the station, near residential house #2, and
- An up yard area near residential house #3.

Due to the fact that railway traffic will not be halted during the station upgrade, the noise from passing trains was taken into account as background noise.

To mitigate the noise impact, two 2.5 m-high temporary wooden barriers, one 180 m and one 300 m in length, will be erected near the houses.

The calculation demonstrated that the equivalent noise levels at the control locations on the boundary of the residential area did not exceed the allowable daytime and nighttime standards (Table 9.6.2).

Table 9.6.2: Calculated noise levels during Ust-Pera upgrade (equivalent continuous noise level, LA eq, dB(A))

#	Control locations	LA eq dB(A)		Standards	
		Daytime	Nighttime	Daytime	Nighttime
5.	Residential house #3 area	43.4	43.3	55	45
6.	Construction site	63.9	63.9	80	80
7.	Residential house #1 area	49.7	42.6	55	45
8.	Residential house #2 area	45.5	44.7	55	45
9.	Construction site	73.2	73.1	80	80
10.	Construction site	60.7	60.7	80	80
11.	Construction site	57.9	57.8	80	80

Due to the fact that at control location #4 the equivalent noise level reaches the allowable standard values at night it is proposed that the rails at "Ust-Pera" station be polished prior to the upgrade. Rails will be polished using a special rail-grinding train. After the polishing, the estimated equivalent noise level will drop by 15 dB.

The maximum noise level calculations showed that the maximum noise levels in the vicinity of residential houses #1 and #2 will drop by 15 dB and will no longer exceed the allowable standard levels (Table 9.6.3).

Table 9.6.3: Calculated noise levels during Ust-Pera upgrade, after implementation of noise protection measures (maximum sound level LAmax, dB(A))

#	Control locations	LAmax dB(A)		Standards	
		Daytime	Nighttime	Daytime	Nighttime
1.	Residential house #3 area	48,3	45,0	70	60
2.	Construction site	65,2	65	95	95
3.	Residential house #1 area	67,8	44,3	70	60
4.	Residential house #2 area	62,8	43,2	70	60
5.	Construction site	73	63,5	95	95
6.	Construction site	62,2	56,5	95	95
7.	Construction site	60,9	68,8	95	95

9.6.4.2 "Ust-Pera" Operations

Sanitary gaps will be established for the operations of rail transport to diminish the impact of noise sources below the allowable standard levels.

Given that "Ust-Pera" station's residential structures are located 36, 65, and 83 m from the railway tracks, respectively, the following sanitary gaps will be set up:

- up to the boundary of the residential area from the east side of the station;
- 100 m from the railway tracks from the west side of the station.

Equivalent and maximum noise levels were calculated at the following control locations to assess the noise level on the sanitary gaps boundary:

- Two meters from the facades of the residential houses;
- Two meters from the facades of the station's administrative buildings;
- On the sanitary gap boundary west of the station.

The calculation took into account both the existing (trains moving on the "Ust-Pera" station tracks) and the proposed noise sources (trains moving on additional spur tracks).

The calculations of the equivalent noise levels showed that the equivalent noise levels at all the control points did not exceed the allowable standard levels either at night or during the day (Table 9.6.4).

Table 9.6.4: Calculated noise levels during Ust-Pera station operations (equivalent sound level LA eq dB(A))

#	Control locations	LA eq dB(A)		Standards	
		Daytime	Nighttime	Daytime	Nighttime
8.	Residential house #1 area	47.4	38.8	55	45
	Residential house #2 area	45.4	34.4	55	45
	Residential house #3 area	45.3	33.0	55	45
	Train station	38.2	29.0	60	60
	Interlocking center	33.8	24.5	65	65
	Table room	39.9	29.7	65	65
	East side sanitary gap	43.9	33.2	55	45
	West side sanitary gap	40.5	27.6	55	45
	East side sanitary gap	39.8	30.3	55	45
	West side sanitary gap	44.9	32.3	55	45

The 2015 measurements of actual noise levels showed that the maximum noise levels at the control locations on the sanitary gaps boundary exceeded the allowable standard levels in the daytime.

To reduce the maximum noise level during the "Ust-Pera" upgrade the following measures are proposed:

- Polishing the station's rails;
- Setting up noise protection screens 3.5 m from the axis of the outermost track:
  - opposite house #1 (3 m high, 300 m in length);
  - opposite house #2 (4 m high, 280 m in length).

The calculations showed that after the rails are polished and the noise protection screens are set up, the maximum noise levels will be below the standard values during "Ust-Pera" operations (Table 9.6.5).

Table 9.6.5: Calculated noise levels during "Ust-Pera" station operations (maximum sound level LAmax dB(A))

#	Control locations	LAmax dB(A)		Standards	
		Daytime	Nighttime	Daytime	Nighttime
9.	Residential house #1 area	65.9	38.7	70	60
	Residential house #2 area	65.8	36.4	70	60
	Residential house #3 area	60.3	38.3	70	60
	East side sanitary gap	60.3	38.3	70	60
	West side sanitary gap	55	34.6	70	60
	East side sanitary gap	55	34.6	70	60
	West side sanitary gap	60.1	33.1	55	45

Vibration

The main source of vibration during "Ust-Pera" operations will be the existing railroad.

Vibration spreads through both ground and construction structures fading relatively slowly. The 2015 vibration levels measurements showed that the actual levels were above the allowable ones.

In order to reduce vibration levels in the residential and administrative buildings nearest the railroad an anti-vibration screen will be built in close proximity to the protected structures. An anti-vibration screen is a series of 600 mm diameter augercast piles filled with concrete and placed back-to-back. The piles are driven to the depth of 3 m, the length of the screen exceeds the length of the protected structure by 3 m on each side.

The anti-vibration screen will reduce the vibration from passing trains felt in residential and administrative buildings.

Once the anti-vibration screen is set up, it will be necessary to conduct vibration studies (vibration acceleration) to determine the actual vibration in control locations.

During the operation of "Ust-Pera" station the following noise and vibration mitigation technical and organizational measures will be implemented as part of the Project activities[26]:

- Polish the station's rails to stop rail corrugation;
- Lay down a layer of track ballast made of crushed stone;
- Direct the longest and heaviest trains to the track farthest from the residential houses;
- Use the tracks closest to the residential buildings for long-time train stoppages;
- Refrain from directing trains to spur tracks 21 and 22 in the nighttime.

9.6.4.3 Construction of "Zavodskaya" Station

The proposed railway station "Zavodskaya" is an intricate set of buildings and installations interconnected by technological processes.

Construction work will be performed simultaneously on the entire station area. The noisiest construction operations will include:

- diesel power plant operation for power supply;
- loading and unloading operations performed using cranes with different load capacities;
- soil excavation operations performed using an excavator;
- pile driver operation;
- roadway traffic in connection with cargo deliveries, etc.;
- bulldozer operation;
- passage of a locomotive delivering construction materials;
- compressor operation in connection with general construction needs.

To assess the noise level, a calculation was performed of noise pollution at the control locations on the boundary of the nearest residential area (Yukhta, 5.7 km west of the construction site).

The calculation results demonstrated that the equivalent noise levels will be below the allowable standards, both daytime and nighttime, and will equal 13.3 – 14.6 dBA at the control locations on the residential area boundary.

The estimated equivalent noise level at the construction site will be below 63 dBA, which is lower than the standard value (80 dBA). The estimated maximum noise level will also be below the allowable standards.

Due to the fact that the estimated noise levels on the boundary of the nearest residential area will be below the allowable standard values, no additional noise level reduction measures will be implemented.

9.6.4.4 "Zavodskaya" Station operations

"Zavodskaya" station's buildings and installations are arranged in a manner that takes into account the principles of technological zoning and optimal provision of social services to the workers.

There is a lot of noise sources at the station, both indoors and outdoors, including:

- Railway tracks and road trains;
- Ventilation systems (mechanical exhaust fans);
- Process equipment (machine-tools, washing equipment, cranes' electric motors, compressor units, diesel power plants, diesel fuel pumps, transformer substation);
- Rheostat shop test facility where locomotives' diesel engines are tested after repair, etc.
- To assess the noise pollution levels during "Zavodskaya" station operations, a calculation was performed of the equivalent and maximum noise levels at night and during the day.

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[26] 4700P2-1.00.P.05.OOC1.PZ (1). Vol. 7.1. Rev.1. Stage 2. Railway lines and installations. Development of public railway infrastructure at station Ust-Pyora of the Trans-Baikal Railway, a branch of OAO Russian Railways. Design documentation. Part 7. Environmental protection measures. Part 7.1. Explanatory note.

The calculation results showed that if the proposed technological and organizational noise reduction measures are implemented, the estimated daytime and nighttime noise levels at "Zavodskaya" station and inside the buildings and premises will be below the allowable standard values (Tables 9.6.6 and 9.6.7).

Table 9.6.6: Calculated noise levels during "Zavodskaya" operations, daytime

#	Building	Premises	Calculated value 2 m from the façade, eq/max, dBA	Calculated penetrating noise levels, eq/max, dBA	Standard noise levels, eq/max (daytime), dBA
1	Repair and testing shop	Foreman's room	56.9/61,3	30.9/35,3	65/80
2	Logistics department	Assistant operator of pneumatic brake charging and testing unit	63.9/69.2	37.9/43.2	65/80
		Manager's office	63.9/69.2	37.9/43.2	60/75
3	Logistics department	Dispatcher's and warehouse clerk's offices	55.7/62.1	29.7/36.1	60/75
4	Checkpoint	Security post	48.8/56.9	22.8/30.9	80/95
58-9	Office building	Office premises	54.5/59.7	28.5/33.7	60/75
6	Office building	Office premises	57.9/65.1	31.9/39.1	60/75
		Cafeteria	57.9/65.1	31.9/39.1	55/70
7	Office building	Infirmary	58/65.2	32/39,2	35/50
10-11	Interlocking tower	Office premises	58/65,7	32/39,7	60/75
12-13	Power supply services office building	Office premises	63.9/69.5	37.9/43.5	60/75
14-15	Locomotive depot office wing	Office premises	65.2/72.2	39.2/46.2	60/75
		Infirmary	58.3/68.8	32.3/42.8	35/ 50
		Laboratory	58.3/68.8	32.3/42.8	60/75
16	Locomotive depot office wing	Office premises	61.9/67	35.9/41	60/75
		Auditorium	61.9/67	35.9/41	40/55
17	Garage	Drivers' room	57.2/67.4	31.2/41.4	60/75
18	Boiler plant	Control room	72.9/83.7	46.9/57.7	65/80
19	Rheostat shop	Control room	91.4/101.8	57.4/67.8	5/80
20-30	Proposed SPZ boundary, residential area boundary	-	46/56	-	55/70

Table 9.6.7: Calculated noise levels during "Zavodskaya" operations, nighttime

#	Building	Premises	Calculated value 2 m from the façade, eq/max, dBA	Calculated penetrating noise levels, eq/max, dBA	Standard noise levels, eq/max, dBA
1	Repair and testing shop	Foreman's room	56.9/60.9	30.9/34.9	65/80
2	Logistics department	Assistant operator of pneumatic brake charging and testing unit	63.8/68.3	37.8/42.3	65/80
		Manager's office	63.8/68.3	37.8/42.3	60/75
3	Logistics department	Dispatcher's and warehouse clerk's offices	55.51/59.8	29.51/33.8	60/75
4	Checkpoint	Security post	47.71/53.3	21,71/27.3	80/95
58-9	Office building	Office premises	54.4/59	28,4/33	60/75
6	Office building	Office premises	57.1/61.6	31,11/35.6	60/75
10-11	Interlocking tower	Office premises	57/61.5	31/35,5	60/75
12-13	Power supply services office building	Office premises	64/68.4	38/42.4	60/75
14-15	Locomotive depot office wing	Office premises	64.7/69.1	38.7/43.4	60/75
		Laboratory	58.7/60.5	32.7/34.5	60/75
16	Locomotive depot office wing	Office premises	61.8/66.3	35.8/40.3	60/75
17	Garage	Drivers' room	64.9/65.2	38.9/39.2	60/75
18	Boiler plant	Control room	59.9/61.9	33.9/35.9	65/80
20-30	Proposed SPZ boundary, residential area boundary	-	43.2/45.2	-	45/60

During "Zavodskaya" station operations a number of noise and vibration mitigation technological and organizational measures will be implemented:

- Reducing aerodynamical and mechanical noise of the ventilation units, including:
  - suction and discharge sections of air supply units are joined to other sections using flexible connectors;
  - silencers are installed on pressure air ducts;
- Indoor compressor units are enclosed in casings;
- The rheostat testing unit is located as far from the office premises as possible;
- Rheostat testing is conducted in the daytime only. During testing, the operation of outdoor pumps is halted, no routine maintenance is carried out on the diesel power plant, roadway traffic and shunting are limited;
- Employees conducting rheostat testing wear PPE (ear plugs or headphones);
- Locomotive speed limits are observed at the station;
- The station are is enclosed by a 3 m-high concrete fence;
- A layer of crushed stone ballast underlies the tracks;
- The rails are polished on a regular basis to prevent rail corrugation;
- The maintenance vehicles have quality certificates and is inspected on a regular basis.

9.6.4.5 Construction of "Zavodskaya-2" Railway Station

The Zavodskaya-2 Station is designed to serve as the railway terminal of the Amur GPP and is located parallel to the public railway station of "Ust-Pera".

Construction work shall be carried out throughout the entire station site, i.e. at its yard necks and in its middle. The construction procedure comprises a certain sequences of operations. An especially large number of construction machinery shall be employed during the second and the third month of the construction phase, when site preparation and the subgrade bed filling shall be performed. The highest noise level shall be generated at the station in the process of the following operations to be performed during the construction phase:

- clearing of the site using stubbing machines, bulldozers and tractors;
- site leveling with the aid of bulldozers;
- operation of excavators in the process of ground excavation;
- unloading of trucks delivering crushed stone for subgrade bed filling;
- compressor operation;
- operation of a truck crane for unloading of construction materials.

Calculation of acoustic parameters have been performed to assess the noise pollution level during the construction of the "Zavodskaya-2" station. Two construction sites nearest to the residential area have been considered for those calculations.

The first site is the middle part of the station located in the vicinity of the No.2 residential house and Nos.4 and 5 houses in the settlement of "Ust-Pera". Operations aimed at site clearing and subgrade bed filling, as well as compressor operation and unloading of construction materials shall be carried out simultaneously at that site.

The second site is located in an area adjacent to the even yard neck of the "Ust-Pera" station near the No.3 house. Site clearing, subgrade bed filling, compressor operation and unloading of construction materials shall be carried out simultaneously in that area.

During the "Zavodskaya-2" station construction, the railway traffic through the "Ust-Pera" station shall not be disturbed and the generated background noise level associated with the railway traffic through the latter station has been also taken into account.

Table 9.6.8: Estimated noise levels during the "Zavodkaya-2" station construction with due consideration of the planned noise abatement measures (equivalent noise level, LAeq., dBA)

Ser. Nos.	Monitoring points	$LA_{eq.}$, dBA		Regulatory norm	
		Daytime	Nighttime	Daytime	Nighttime
1.	No.1 residential house	35.8	31.6	55	45
2.	No.2 residential house	31.0	30.5	55	45
3.	No.3 residential house	28.3	28.3	55	45
4.	No.4 residential house	28.0	28.0	55	45

Ser. Nos.	Monitoring points	$LA_{eq.}$, dBA		Regulatory norm	
		Daytime	Nighttime	Daytime	Nighttime
5.	No.5 residential house	29.0	29.0	55	45
6.	Railway terminal	24	16	60	60
7.	Central electric interlocking station	33.8	24.5	65	65

A preliminary estimation has indicated that the indoor noise levels in the residential houses might potentially exceed the maximum permissible norms. Of important significance is the background noise level exceeding the permissible values.

To ensure compliance with the applicable sanitary norms, the following additional noise abating measures have been planned:

- Installation of four additional temporary fences 2.5m tall at the construction site;
- Preliminary grinding of rails at the "Ust-Pera" station to reduce the background noise level.

The construction site shall not be fenced along its entire perimeter, but four provisional wooden fences 2.5m tall shall be installed to reduce the noise impact on the residential houses.

The total length of the provisional fencing at the even yard neck shall be at least 400 m and at it shall be at least 2.5m tall. The fencing shall be provided opposite the No.3 house along the motor driveway used for construction needs.

The provisional fencing in the area of the No.21 and No.22 stub tracks of the "Ust-Pera" station shall be at least 180m long and at least 2.5m tall. It will be provided apposite the No.2 house to reduce the background noise level.

The provisional fencing in the area of the No.2 house shall be at least 220m long and at least 2.5m tall. It shall be installed apposite the No.2 house along the motor driveway used for construction needs.

The provisional fencing in the area of the No.4 and No.5 houses shall be at least 390m long and at least 2.5m tall. The fencing shall be installed opposite the No.4 and No.5 houses along the motor driveway used for construction needs.

Rail grinding shall be performed with the aid of a rail grinding train at the "Ust-Pera" station before the beginning of the "Zavodskaya-2" station construction. The calculations performed have indicated that this will reduce the generated noise level by 10 to 20 dBA.

The estimation has shown that the equivalent noise levels generated in the process of the "Zavodskaya-2" station construction shall comply with the applicable regulatory norms provided that the planned noise abatement measures be taken (installation of provisional fencing and rail grinding).

9.6.4.6 Operation of "Zavodskaya-2" Railway Station

In the process of the "Zavodskaya-2" station operation two locomotives shall be used for moving trains and railway cars along the station's railway tracks.

Two scenarios have been considered to assess the noise pollution level during the "Zavodskaya-2" station operation:

- The two locomotives are operating simultaneously, each moving along an outside track line to assess the noise impact imposed on the residential houses both at the eastern side and at the western side;
- One locomotive is moving along the track line adjacent to the even yard neck of the "Ust-Pera" station to assess the noise impact on the No.3 house. Another locomotive is moving along the outside western track line of the "Zavodskaya-2" station to assess the noise impact on the nearest houses.

For operation of the railway transport, a sanitary safe distance shall be established for railway track lines, i.e. a distance for abating the noise impact level to comply with the applicable permissible normative values.

The results of the noise pollution estimation have indicated that the boundary of the sanitary zone at the "Zavodskaya-2" station shall be located:

- At a distance of 100m from the outside rail along the entire length of the station at the station's eastern side;
- Parallel to the outside rail of the station at a distance of 28m to 65m from the station's outside rail (depending on a particular location).

To reduce the noise impact and comply with the applicable normative levels, it is planned to take the following noise-abating measures:

- rail grinding;
- installation of noise-abetment shields.

A special rail-grinding train shall be used for rail grinding; it shall perform regular (annual) grinding of rails as a preventive measure. The noise-abatement shields shall be installed along the boundaries of the "Zavodskaya-2" station at its eastern and western sides. The shields shall be 3m tall above the rail head of the outside track line.

The total length of the noise-abatement shields at the station's western and eastern sides shall be 1,225m and 1,343m, respectively.

Table 9.6.9: Estimated noise levels in the process of the "Zavodkaya-2" station operation with due consideration of the planned noise abatement measures (equivalent noise level, LAeq., dBA)

Ser. Nos.	Monitoring points	$LA_{eq.}$, dBA		Regulatory norm	
		Daytime	Nighttime	Daytime	Nighttime
1.	No.1 residential house	28.3	30.9	55	45
2.	No.2 residential house	31.2	30.5	55	45
3.	No.3 residential house	34.6	33.8	55	45
4.	No.4 residential house	35.9	33.7	55	45
5.	No.5 residential house	30.0	35.1	55	45

The results of the acoustic impact estimation have indicated that taking into consideration the planned noise-abatement measures the estimated equivalent and maximum noise levels generated in the process of the "Zavodskaya-2" station operation at the boundary of the sanitary distance, i.e. in the residential areas and indoors shall comply with the applicable daytime and nighttime norms.

Vibration

The main source of vibration impact during the "Zavodskaya-2" station operation will be the existing railway facilities at the "Ust-Pera" station.

The planned track lines are located at a distance of 115m (No.3 house), 139m (No.1 House) and 61m (No.2 house) from the existing residential houses. Since the planned track lines shall be located on an embankment and the traffic speed and intensity will be much lower than those at the "Ust-Pera" station it may be assumed that the impact caused by the planned track lines will be significantly lower.

Vibration propagates both within the ground and in the building structures with a relatively low attenuation. Due to this reason, it is required in the first line to take measures aimed at abating dynamic loads created by a vibration source or prevent transmission of such loads by means of vibration insulation of machinery and transport means.

The following vibration abating measures are planned for the operational phase of the "Zavodskaya-2" station:

- non-simultaneous passage of trains through the existing ("Ust-Pera" station) and planned ("Zavodskaya-2" station) track lines;
- Use of crushed stone for the track bed filling;
- Grinding of rails at the stations (elimination of the undulating wear pattern);
- compliance with the applicable speed limits and technical specifications of the railway equipment;
- any railway equipment shall have appropriate quality certificates and is subject to regular inspections at the owners' facilities.

After commissioning of the "Zavodskaya-2" station it is required to measure vibration levels at the boundary of a estimated sanitary strip and at the boundary of the adjacent residential areas.

9.6.5 Stage 3.1. Auxiliary facilities

9.6.5.1 Construction of auxiliary production facilities

The sources of noise during the construction of the proposed gas pipeline section include road construction machinery, motor vehicles, and diesel power plant operating at the construction site.

During construction phase the impact of the noise sources on the air in the work and residential housing areas were assessed using the Ekolog-Shum 2.0 software.

The period of operation of the maximum number of road construction machinery and motor vehicles was taken into account in the acoustic calculations. A certain area was selected within the Amur GPP construction site for calculation purposes.

The calculation determined the sound pressure levels (SPLs) on Amur GPP's SPZ boundary, on the boundary of the nearest residential area, and within the work area at the construction site.

The analysis of the acoustic calculation results showed that during the construction of the Amur GPP facilities (Stage 3.1, Auxiliary Production Facilities) the noise levels on the SPZ boundary and on the boundary of the nearest residential area in Yukhta were below the allowable standard values (Table 9.6.10).

Table 9.6.10: Calculated noise levels during construction of the auxiliary production facilities

#	Locations	Equivalent noise level LA eq dB(A)	
		Calculated	Standard
1	SPZ boundary	26.4	45
2	SPZ boundary	33.6	45
3	SPZ boundary	42.3	45
4	SPZ boundary	34.2	45
5	Yukta border	24.8	45
6	Yukhta border	22.7	45
7	Industrial zone boundary	55.20	80

9.6.5.2 Auxiliary production facilities operation

The sources of continuous noise during the operation of the Amur GPP auxiliary production facilities include the transformers of the integrated unit transformer substations and Energo-D1000/10.5 diesel power plant block containers.

The sources of recurring noise impact on the atmospheric air of the area adjacent to the Amur GPP construction site include rooftop ventilators and air conditioner units (for heated parking garages for buses, cars, trucks, special machinery, and tank trucks) and DES-1000 and DES-1600 emergency stationary diesel power plant block containers (during periodic diesel motors start-up) located at the infrastructural facilities site.

All the sources of continuous noise and all the sources of recurring noise, 34 in all, were taken into account for the acoustic calculation during the operation of the proposed facilities.

The following seven control locations were chosen to determine the SPLs generated by the sources of noise in the work area, on the residential area boundary and on the boundary of Amur GPP's SPZ:

- Locations 1 - 4 – on Amur GPP's prescribed SPZ boundary (1,000 m);
- Location 5 – on the border of the vegetable garden plots area in Yukhta
- Location 6 – on the border of the nearest population center, Yukhta
- Location 7 – at the industrial site.

The analysis of the calculation results showed that during the operation of the auxiliary production facilities, continuous noise sources, and recurring noise sources and during routine checks of the emergency diesel power plant the noise level on Amur GPP's SPZ boundary, on the border of the nearest population center, Yukhta, and inside the work area at the industrial site would not exceed the allowable standards (Table 9.6.11).

Table 9.6.11: Calculated noise levels during operation of the auxiliary production facilities, at night

#	Locations	Equivalent noise level LA eq dB(A)	
		Calculated	Calculated
1	SPZ boundary	29.0	45
2	SPZ boundary	36.2	45
3	SPZ boundary	43.2	45
4	SPZ boundary	38.5	45
5	Yukta border	27.1	45
6	Yukhta border	24.5	45
7	Industrial zone boundary	57.1	80

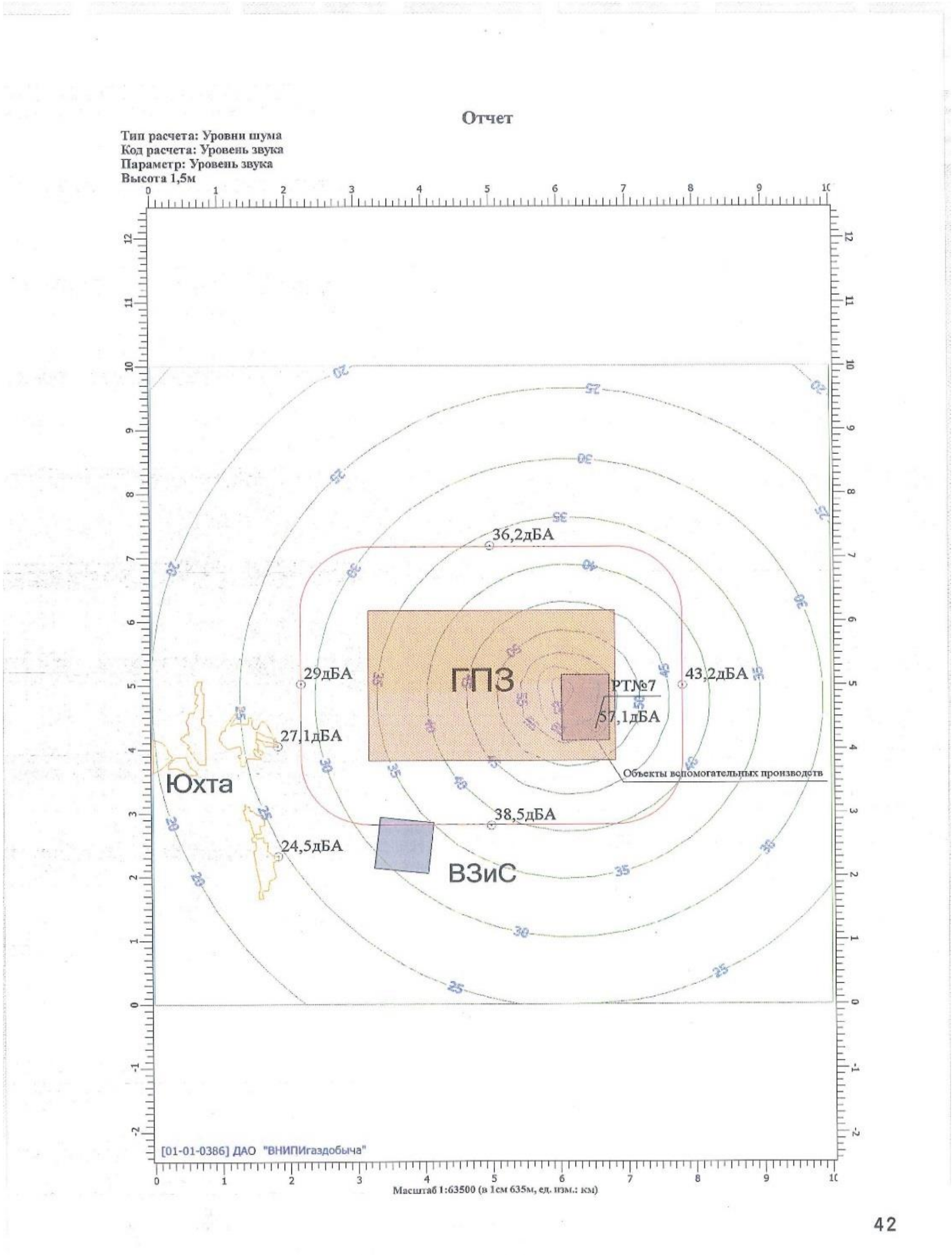

Figure 9.6.2: Calculated noise pollution levels during operation of the auxiliary production facilities

9.6.6 Stage 3.2. Temporary jetty on the River Zeya

9.6.6.1 Construction of the temporary jetty on the River Zeya

During the construction of the temporary jetty on the River Zeya noise pollution will be caused by the operation of construction machinery (excavators, bulldozers, cranes, compressor units, etc.) and motor vehicles.

Since construction machinery is not a stationary source of noise and can be stationed anywhere within the work area the assessment of the equivalent noise level was performed for an assumed noise source with an aggregate noise characteristic placed in the acoustic center of the site.

The calculation of noise levels at the control locations within the construction site shows that the equivalent and maximum noise levels are below the allowable standard values (Table 9.6.12).

Table 9.6.12: Calculated noise levels during construction of the temporary jetty on the River Zeya

Control location	Expected sound level at building's façade, dBA		Standard sound levels, dBA	
	L eq	Lmax	Leq	Lmax
CL-9	65	59	80	95
CL-10	68	58	80	95
CL-11	68	61	80	95
CL-12	72	60	80	95
CL-13	69	61	80	95
CL-14	70	58	80	95
CL-15	69	58	80	95
CL-16	69	60	80	95

9.6.6.2 Operation of the temporary jetty on the River Zeya

Roadway traffic will be the main source of noise during the operation of the temporary jetty on the River Zeya, including road trains transporting oversized equipment.

Noise pollution level calculations show that the equivalent noise levels on the boundary of the temporary jetty site are 45–80 dB, which is below the allowable standard noise levels for industrial sites.

9.6.7 Stage 3.3 Access roads

9.6.7.1 Stage 3.3 Road construction

During construction, the main sources of noise impact will be construction machinery and roadway traffic.

To determine the level of noise impact the equivalent and maximum sound pressure levels were calculated. For the calculation purposes, the following conditions were assumed:

- the period of maximum equipment load was used for the calculation;
- the calculation was performed for daytime conditions, in accordance with the working hours at the construction sites;
- simultaneous operation of all the noise sources was assumed.

The calculations were performed for two construction sites located near Yukhta and the village of Tchernigovka:

- AMRs ##1-4 construction sites;
- AMRs #5 and #6 construction site.

The calculations show that during construction the sound pressure level on the boundary of the nearest residential area will be as follows (Table 9.6.13):

Table 9.6.13: Noise level on the residential area boundary during construction of access roads

Population center border	Equivalent noise level, LA eq dB(A)		Maximum noise level, LAmax dB(A)	
	Calculated	Standard	Calculated	Standard
Yukhta	25.3	55	30.1	70
Tchernigovka	49.8	55	55.1	70

The calculations show that during construction the equivalent and maximum noise levels on the borders of the population centers (Yukhta and Tchernigovka) will be below the allowable standards.

9.6.7.2 Stage 3.3 Road operation

Roadway traffic will be the main source of noise during the operational phase.

The following factors affect the level of noise:

- Traffic speed;
- Longitudinal slope;
- Coarseness of the road surface;
- Traffic intensity;
- Traffic flow composition;
- Character of adjacent areas, and
- Geometric design of the road.

To assess the noise levels during the operation of the roads daytime and nighttime noise pollution levels were calculated using Version 2.3 of the Ekolog-Shum software.

The calculated sound pressure levels on the boundary of the nearest residential area (in Yukhta) during the operation of the roads will be as follows:

- 16.1 dB during the day;
- 13 dB at night.

The calculations show that the level of noise during the operation of the access roads will be below the allowable standards.

9.6.8 Stage 4. Gas processing plant

9.6.8.1 Construction of the gas processing plant

The noise sources during the construction of the proposed Amur GPP facilities include the road construction machinery, motor vehicles and diesel power plant operating at the construction site.

Version 2.0 of the Ekolog-Shum software was used to assess the noise impact on the ambient air of the work and residential areas during.

A work period with the maximum number of operating road construction machines was determined for the purpose of performing the acoustic calculations.

SPLs were calculated for the locations on the boundaries of Amur GPP's SPZ and the nearest residential area (in Yukhta) and within the work area, i.e. the construction site. The calculations were performed for nighttime conditions since the intensity of construction work was assumed to be constant during the day, and the allowable noise levels for nighttime conditions were stricter that the ones for the daytime.

Seven control locations were defined to assess the estimated sound pressure levels, including:

- 4 locations on Amur GPP's SPZ boundary;
- 2 locations on the Yukhta border, and;
- One location within the construction site.

The calculation showed that the equivalent noise levels on the SPZ boundary, on the Yukhta border and within the construction site were below the allowable standards in the nighttime (Table 9.6.14).

Table 9.6.14: Calculated noise levels during the construction of GPP

#	Control locations	Equivalent noise level, LA eq dB(A)	
		Calculated	Standard
1	SPZ boundary	35.70	45
2	SPZ boundary	42.20	45
3	SPZ boundary	39.70	45
4	SPZ boundary	39.10	45
5	Yukhta border	33.60	45
6	Yukhta border	31.30	45
7	Industrial zone boundary	55.50	80

9.6.8.2 Gas processing plant operation

The noise and vibration sources at the Amur GPP site include regulating and safety valves, pumps, GPA-32 gas compressor units, air coolers, and integrated unit transformer substations which are constantly in operation.

The design documentation provides for using control and safety valves whose noise characteristics do not exceed the allowable standards for noise in industrial zones and residential areas. Safety valves do not produce continuous noise since they are only triggered in emergencies the likelihood of which is extremely low as suggested by the practice of designing similar facilities.

The main noise sources at the Amur GPP facilities assumed to be operating at full capacity include:

- 12 operating GPA-32 gas compressor units at the Ladoga gas booster station (process trains #1 - #6);
- air coolers (7 for each operating GCU);
- filters-separators at the gas booster station (12 units);
- Pumps (24 units);
- Rooftop ventilators (11 units);
- Air conditioning units (11).

The sources of continuous noise also include:

- Transformers of the integrated unit transformer substations;
- TP-1, TP-2, TP-3 transformer substations;
- 110 kV distribution substation;
- GPP-1, GPP-2 main secondary substations.

The sources of recurring noise impact on the ambient air of the area adjacent to the Amur GPP site include:

- Feedstock base pumps: propane fraction and WFLH pumps, tank farm #1 propane/butane fraction pumps; tank farm #2 butane fraction pumps;
- Tank farm #3 WFLH pumps;
- Rooftop ventilator and air conditioning units for heated garages for buses, cars, trucks, special equipment, tank trucks;
- Container blocks of emergency stationary DES-1000 and DES-1600 deisel power plants (periodic diesel startups) located at energy blocks, feedstock base, loading racks and infrastructural facilities sites.

The calculation of the sound pressure levels created by Amur GPP noise sources at control locations was performed using version 2.0 of the Ekolog Shum software.

For the purposes of the acoustic calculation all the sources of continuous and recurring noise during the operational phase, 171 in all, were taken into account.

To confirm the sufficiency of Amur GPP's SPZ size for ensuring compliance with the noise impact sanitary standards for populated areas (for nighttime conditions due to the 24-hour operation of the plant) and industrial zones preliminary acoustic calculations were performed.

- Seven control locations were chosen on the boundary of the residential area and on Amur GPP's SPZ boundary to determine the SPLs produced by the sources of noise within the industrial zone:
- Locations 1 - 4 – on Amur GPP's SPZ boundary (1000 m as per applicable regulations);
- Location 5 – on the vegetable garden plots border in Yukhta;
- Location 6 – on the border of the nearest population center (Yukhta);
- Location 7 – within the industrial site.

The analysis of the calculation results showed that given the 24-hour operation of the proposed Amur GPP main production facilities the SPLs within the work zone, on the SPZ boundary and on the boundary of the nearest residential area would not exceed the allowable standard values (Table 9.6.15, Figure 9.6.3).

Table 9.6.15: Calculated noise levels during the operation of the GPP, nighttime

#	Control locations	Equivalent noise level, LA eq dB(A)	
		Calculated	Standard
1	SPZ boundary	37.9	45

#	Control locations	Equivalent noise level, LA eq dB(A)	
		Calculated	Standard
2	SPZ boundary	35.7	45
3	SPZ boundary	39.1	45
4	SPZ boundary	42.2	45
5	border of vegetable garden plots in Yukhta	33.6	45
6	Yukhta border	31.3	45
7	Industrial zone boundary	55.5	80

The design documentation provides for a number of technological and organizational measures to mitigate the noise produced by equipment and roadway traffic during the operation of the gas processing plant.

To reduce noise levels, space-planning solutions are being developed and appropriate soundproofing is being provided for. Windows and joints between windows and walls will be adequately soundproofed.

Especially noisy machines and units will be installed in enclosures.

- To reduce the level of noise produced by ventilation equipment the following measures have been proposed:
- All the equipment should comply with the sanitary standards in terms of its noise level;
- Suction and exhaust pipes of ventilator units will be connected to air ducts with flexible connectors;
- Ventilator units will be vibroinsulated using vibroinsulation spring pads;
- Ventilator units will operate at maximum efficiency;
- Operating fans will not create excessive pressure;
- The air velocity in air ducts, air distributors and ventilation grilles will not exceed the allowable values.

The following has been proposed to reduce the level of noise produced by the gas compressor units:

- Silencers will be installed on suction and exhaust piping of the gas compressor units;
- Suction air ducts, exhaust gas ducts and aboveground piping of the compressor units will be covered with soundproof material;
- The GCU equipment will include soundproof enclosures ;
- The GCU design will contain elements of a sound suppression system;
- The level of sound pressure in a free space 1 m from a GCU enclosure will not exceed 80 dBA;
- The level of sound pressure in the unit's exhaust and suction piping will not exceed 45 dBA at the distance of 700 m.

9.6.9 Stage 5. Microdistrict in svobodny

9.6.9.1 Construction of the residential microdistrict in Svobodny

During the construction of the residential district in Svobodny the noise sources will include construction machinery at the construction site and roadway traffic.

The noise level during construction was calculated for one particular stage of construction when the number of construction machines simultaneously in operation will be the highest.

The calculation results showed that the equivalent noise levels during the construction of the residential district in Svobodny will not exceed 37-40 dBA and will be below the allowable standard level set for residential areas in the nighttime (45 dBA).

9.6.9.2 Operation of the residential district in Svobodny

During the operation of the residential district in Svobodny the noise sources will include temporary and visitors' parking lots and roadway traffic.

Acoustic calculations of the equivalent and maximum noise levels were performed at 42 control locations to assess the noise levels during the operation of the residential district in Svobodny.

The acoustic calculations showed that the equivalent noise levels during the operation of the residential district in Svobodny would be 45-46.6 dBA and would thereby exceed the allowable levels set for residential areas in the nighttime (45 dDA).

For the operational period of the residential district in Svobodny the following special measures were proposed to reduce the noise impact to allowable levels:

- Limiting the speed of roadway traffic, setting up speed limit traffic signs.
- Noise protection screens will be constructed to reduce noise in the areas adjacent to the road. Noise screen efficiency is determined by the quality of the acoustic studies previously conducted, the accuracy of predicting traffic intensity variations, and the quality of materials and work.
- Planting of greenery.
- Soundproofing building elements (replacing windows).

9.6.10 Stage 6. SDIW landfill

9.6.10.1 SDIW landfill construction

Construction machinery and mechanisms will be the main noise sources during the construction.

A substantial number of noise sources of various acoustic power are concentrated on the construction machinery. They form the overall acoustic field of the environment.

They include the power plant, air intake and gas exhaust systems; hydraulic systems, transmissions, chain drives and gear trains, working and moving parts of the machines. The main source of acoustic radiation is the internal combustion engine housing in combination with the gas exhaust system.

An acoustic calculation was performed using Version 2.3 of the Ekolog-Shum software to assess the sound pressure level during the construction of the SDIW landfill.

The calculation was performed to assess the equivalent noise level on the border of the nearest population center, the village of Gashchenka, located 3 km from the SDIW landfill border.

The calculation results showed that the estimated equivalent noise level at Gashchenka's border would be 18.9 dB, which is below the allowable level for nighttime and daytime conditions. Thus, there will be no increase in sound pressure in the village of Gashchenka during the construction of the SDIW landfill.

To reduce the noise levels during construction the following measures were proposed aimed at controlling the noise sources during their operation:

- temporary shutdown of equipment used during construction;
- performing the most noisy work during the daytime;
- placing equipment in soundproofed premises;
- operating equipment fitted with pre-designed soundproof hoods and enclosures.

To ensure vibration-safe working conditions the following organizational and technical measures will be implemented:

- prevent the workers from getting in contact with vibrating surfaces outside their workplaces;
- making sure that all vibrating equipment is properly secured according to its operating instructions;
- ensuring vibroinsulation of mechanisms buy installing them on foundations, special shock absorbers, anti-vibration gels;
- using personal protective equipment for operators' hands and feet.
- One of the means of reducing the harmful effects of vibration and noise during operation of excavators is following the prescribed operational procedures, ensuring proper maintenance and timely repair of the mechanisms.

Harmful effects of vibration during operation of special equipment can be avoided by installing anti-vibration pads and handles in cabs.

No additional noise dampening measures will be required during construction work.

9.6.10.2 SDIW landfill operation

The main sources of noise adversely affecting the acoustic environment during the operation of the SDIW landfill will include mechanisms necessary for receiving, stockpiling and isolating wastes, self-contained thermal decontamination units (TDU), the integrated unit transformer substation (IUTS), the storm runoff pumping station, the pumping station for pumping storm runoff to the WWTF site, the pumping station for sending industrial wastewater to the TDUs, the pumping station for pumping liquid wastes to the TDUs.

A substantial number of noise sources of various acoustic power are concentrated on the machinery in question. They form the overall acoustic field of the environment.

They include the power plant, air intake and gas exhaust systems; hydraulic systems, transmissions, chain drives and gear trains, working and moving parts of the machines. The main source of acoustic radiation is the internal combustion engine housing in combination with the gas exhaust system.

The main noise impact sources on the TDU will include axial fans, chemicals supply ventilators, flue gas fans, waste incinerators, dosing pumps, dust collectors.

The process equipment is located indoors (container) and has contact with the environment via openings. The following impacts have a direct effect on the atmosphere:

- Noise from flue gas fans (transmitted to the ambient air through a flu gas exhaust pipe);
- Noise from axial fans.

Acoustic calculations were performed to assess the sound pressure level during the operation of the SDW landfill.

The calculation was performed for 9 control locations: one on the border of the village of Gashchenka situated 3 km of the landfill (CL #9) and eight on the boundary of the landfill's provisional SPZ, 500 m from the landfill border.

The calculation results showed that during the operation of the landfill the equivalent noise levels were below 37 dBA on the SPZ boundary, and 14.8 dBA on the Gashchenka border (Figure 9.6.3), which is significantly lower than the allowable noise level, 45 dBA for nighttime conditions.

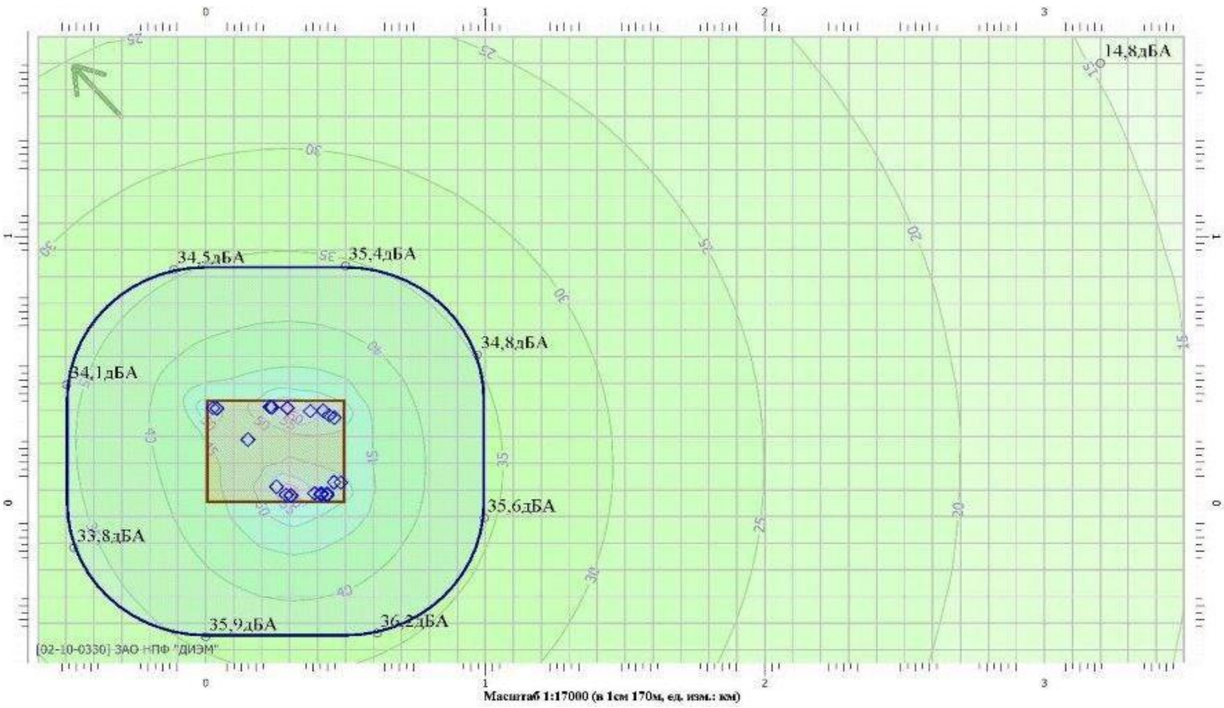

Figure 9.6.3: Calculated noise pollution levels during the operation of the SDIW landfill

Calculation software: Ekolog-Shum, default calculation
Calculation type: noise levels
Calculation code: La (sound level)
Parameter: Sound level
Elevation: 1.5

The results of the vibration level measurements performed at the workplace of the KTO-100.K40.P and KTO-2000.PS units operator were used to assess whether the impact level is allowable in terms of vibration.

The measurements proved that the overall vibration at the incinerator operator’s workplace does not exceed the allowable levels. Given the results, it can be concluded that vibration levels will not exceed the allowable standards on the landfill border and on the boundary of the provisional sanitary-protection zone.

9.6.11 Summary

To prevent negative noise impact on environment during the construction and operation of the Amur GPP facilities a number of environmental protection measures should be implemented (see Table 9.6.16 below). General requirements for monitoring of noise impacts are presented in Table 9.6.17.

Table 9.6.16: Noise impacts and mitigation control summary

Impact	Receptor	Phase	Design and mitigation actions	Residual impact
Noise and vibration impact	Contractor's employees	Construction	Noise impact during construction will be mitigated by implementing the following measures: • using modern equipment with noise output below 80 dB; • lining construction and road vehicles' hoods with sound absorbing materials; • fitting construction vehicles cabs with additional soundproofing if noise levels exceed the allowable 80 dB; • installing compressor units in tents thereby lowering the noise level by 18-22 dB; • installing especially noisy diesel power plant in areas remote from residential districts. • the following measures have been proposed to reduce the noise produced by ventilation equipment: o all equipment should comply with the sanitary standards in terms of its noise level; o suction and exhaust pipes of ventilator units will be connected to air ducts with flexible connectors; o ventilation units will be vibroinsulated using vibroinsulation spring pads; o ventilator units will operate with the maximum efficiency; o operating fans will not create excessive pressure; o the air velocity in air ducts, air distributors and ventilation grilles will not exceed the allowable values. • If possible, limit the traffic of construction vehicles and trucks in direct proximity to the residential area in the nighttime (from 23.00 till 7.00); • Plan work in such a way as to avoid extreme loads at one time and machinery downtime at other times, do not allow concentrations of a large number of simultaneously operating construction vehicles at the construction site; • Do not leave engines of road and construction vehicles running during long breaks; The following measures to reduce noise and vibrations will be implemented during the upgrade of "Ust-Pera" railway station: • Use mobile noise absorbing panels on construction site borders near residential districts; • When passing through the station, the longest and heaviest trains will be directed to the track farthest from the residential houses; • Temporary 2.5 m-high barriers will be installed along the construction sites.	Low
	AoI residents			Negligible

<table>
<tr><th>Impact</th><th>Receptor</th><th>Phase</th><th>Design and mitigation actions</th><th>Residual impact</th></tr>
<tr><td rowspan="2">Noise and vibration impact</td><td>Amur GPP and service contractors' employees</td><td rowspan="2">commissioning, operation</td><td>Main and auxiliary production facilities, SDIW landfill
The design documentation provides for a number of technological and organizational measures to reduce the level of noise produced by the functioning equipment during the operation of the gas processing plant:
All the equipment should comply with the sanitary standards in terms of its noise level;
Especially noisy machines and units will be installed in enclosures;
Suction and exhaust pipes of ventilator units will be connected to air ducts with flexible connectors;
Ventilation units will be vibroinsulated using vibroinsulation spring pads;
Ventilator units will operate at maximum efficiency;
Operating fans will not create excessive pressure;
The air velocity in air ducts, air distributors and ventilation grilles will not exceed the allowable values.
The following has been proposed to reduce the level of noise produced by the gas compressor units:
• Silencers will be installed on suction and exhaust piping of the gas compressor units;
• Suction air ducts, exhaust gas ducts and aboveground piping of the compressor units will be covered with soundproof material;
• The GCU equipment will include soundproof enclosures;
• The GCU design will contain elements of a sound suppression system;
• The level of sound pressure in a free space 1 m from a GCU enclosure will not exceed 80 dBA;
• The level of sound pressure in the unit's exhaust and suction piping will not exceed 45 dBA at the distance of 700 m.</td><td>Low (subject to the implementation of the proposed measures)</td></tr>
<tr><td>AoI residents</td><td>"Ust-Pera" and "Zavodskaya" railway stations
During the operation of "Ust-Pera" and "Zavodskaya" railway stations the following noise and vibration mitigation technological and organizational measures will be implemented:
Making sure that the process equipment meets the sanitary and hygienic requirements;
Reducing aerodynamical and mechanical noise of the ventilation units, including:
○ suction and discharge sections of air supply units are joined to other sections using flexible connectors;
○ silencers are installed on pressure air ducts;
Indoor compressor units will be enclosed in casings;
Technical inspections of maintenance vehicles will be conducted on a regular basis;
The rails will be polished on a regular basis to prevent rail corrugation;
A layer of crushed stone ballast will be placed under the tracks;
speed limits and technological regulations will be complied with during the operation of railway vehicles;
The longest and heaviest trains will be directed to the track farthest from the residential houses;</td><td>Low (subject to the implementation of the proposed measures)</td></tr>
</table>

Impact	Receptor	Phase	Design and mitigation actions	Residual impact
			The tracks that are the closest to the residential buildings will be used for long-time train stoppages; Trains will not be directed to spur tracks 21 and 22 during nighttime; Two noise protection screens will be installed (near residential houses #1 and #2, "Ust-Pera" station); An anti-vibration screen will be constructed in close proximity to the protected structure ("Ust-Pera" station); The rheostat testing unit will be located as far from the office premises as possible ("Zavodskaya" station); Rheostat testing will be conducted in the daytime only. During testing, the operation of outdoor pumps will be halted, no routine maintenance will be carried out on the diesel power plant, roadway traffic and shunting will be limited ("Zavodskaya" station); Employees conducting rheostat testing will wear PPE (hearing protectors) ("Zavodskaya" station)	

Table 9.6.17: Noise impact monitoring summary

Aspect	Phase	Location	Parameters	Periodicity
Noise	Construction	Yukhta border	• continuous noise sound pressure level; • recurring noise equivalent and maximum sound pressure levels	Once a quarter
		”Ust-Pera” station, near the residential houses		During the operation of the maximum number of construction mechanisms, for the duration of 6 days 2 times a day (daytime and nighttime)
	Commissioning	• SPZ boundary • borders of the nearest population centers (Tchernigovka, Dmitrievka, Ust-Pera)		Once a day during start-up and adjustment work for the duration of 6 days (daytime and nighttime)
	Operation	GPP plant: • SPZ boundary • borders of the nearest population centers (Tchernigovka, Dmitrievka, Ust-Pera)		Four days of measurements twice a year (daytime and nighttime)
		Gas analysis apparatus for monitoring air pollution at the water intake site		Continuously
		“Zavodskaya” station SPZ boundary		Once a quarter (daytime and nighttime)
		SDIW landfill: • SPZ boundary • border of the nearest population center, Gashchenka		50-day studies on the SPZ boundary (daytime and nighttime) Once a quarter on the Gashchenka border

9.7 Impact on flora and fauna

9.7.1 Introduction

Terrestrial flora and fauna, the state of aquatic biota in the Project area are described in detail in Chapter 7. During construction and operation of the AGPP facilities impact on flora and fauna is assessed by the following high value/high sensitivity environmental receptors:

- protected areas;
- critical habitats defined in accordance with IFC's Performance Standard 6 and based on important environmental features (e.g. presence of significant migratory bird populations);
- natural habitats defined in accordance with IFC's PS 6;
- threatened species listed on the IUCN Red List and the Red Data Books of the Russian Federation and Amur region;
- places or species deemed as significant in terms of provision of ecosystem services (e.g. fish).

The proposed methodology assesses impact on flora and fauna during the construction and operation of the Project facilities.

This discussion does not take into account complex interactions among aquatic organisms and is limited to protected and commercially valuable fish species. See Section 9. 6.4 for further detail concerning the impact on aquatic organisms, including zooplankton, phytoplankton, and benthic flora and fauna.

9.7.2 Construction stage

During construction phase there are several sites for early work, main production (gas processing and helium production plant), and auxiliary (water intake structures, sewer treatment plant, railway transport, SDIW landfill, temporary jetty on the River Zeya, etc.) facilities. A residential housing project will be developed to provide accommodation of the project staff and their families. See Chapter 4 for further detail on the Project composition.

Impact on flora and fauna from the construction of Amur GGG facilities will have the following effects, both direct and indirect:

- Direct effects may result in the irreversible and reversible loss of habitats, mortality of, or damage/injury to certain plants and animals, habitat fragmentation, migration routes blockage or change. Irreversible loss of habitats will be caused by the construction of the main production facilities, auxiliary facilities, residential housing, railway station, pipelines, permanent roads, and other infrastructural facilities. Reversible loss of habitats will be caused by the facilities that will be used only during construction.
- Indirect effects on habitats, plants and animals will manifest through air and soil pollution, loss of habitats or reduction of access to them.

9.7.2.1 Legally protected areas

There are no legally protected sites or areas within the Project area. The following protected areas are the nearest (see also section 7.6.2.3):

- State zoological reserve of regional significance Iverskiy located 45 km northeast of the main Project site;
- Natural landmark of regional significance Ykhta Pine Forest located 10 km northwest of the main Project site;
- Natural landmark of regional significance Buzuli Green Wood located 25 km north of the main Project site;
- Natural landmark of regional significance Nylynga ant colony located 37 km northeast of the main Project site;

- Natural landmark of regional significance Pine Forest on the River Zeya near the village of Bardagon, located 15 km south of the main Project site;
- Natural landmark of regional significance Malaya Sazanka White Hills and Pine Forest located 22 km south of the main Project site;
- Natural landmark of regional significance Korsakov riverbend on the Amur located 90 km southwest of the main Project site;
- Natural landmark of local significance Section of the River Golubaya located 37 km southwest of the main Project site.

Most of the landmarks listed above are quite distant from the project construction site, and no direct impact on them is anticipated.

At the same time, the nearest protected areas, the Buzuli Green Wood and the Pine Forest on the River Zeya near the village of Bardagon, are relatively close to the project facilities and may be exposed to a number of indirect impacts associated with air pollution caused by construction machinery and motor vehicles.

In particular, even low concentrations of nitrogen oxides (about 0.01 mg/m3) may disrupt nitrogen metabolism in plants and suppress protein synthesis. Continuous impact of such concentrations suppresses development and causes plant mortality. However, atmospheric air pollution outside the sanitary protection zone is expected not to exceed the standard values and standard air quality control measures will be in place, thus the impact on the legally protected areas is considered to be **negligible.**

9.7.2.2 Critical habitats

Within the Project area there are no habitats that might be classified as "critical" according to the definition provided in IFC's PS 6. No special impact mitigation measures are required.

9.7.2.3 Natural habitats

The range of habitats that will be lost during the construction of the AGPP facilities includes the 1,213 ha area occupied by the project site and the sanitary protection zone. The loss of those habitats will be associated with a series of direct and indirect impacts on various flora and fauna species. Temporary roads will be constructed along the pipeline route and power transmission lines. The project facilities (gas processing plant, TBI, SDIW landfill, WWTF) will be linked by permanent roads.

Figure 9.6.1 shows a vegetation map for the project site. Natural habitats that are exposed to the highest negative impact include:

- river birch-lespedeza;
- white birch- lespedeza-calamagrostis forests, and
- valley-floodplain complexes.

At the same time, remote probing shows that the main GPP construction site and the SDIW landfill site occupy previously transformed habitats (overgrown fallow lands) located on the former tank-testing range. Forests are but a small part of the entire land allotment.

The loss of valley-floodplain complexes affect only the construction site of the temporary jetty on the River Zeya and the treated effluent discharge site on the River Bolshaya Pera.

Given the considerable area of the habitats that will be irreversibly transformed due to the construction of the Project facilities, the overall impact from the loss of habitats is assessed as **high**. Land reclamation measures will lower the residual impact to **moderate**.

In addition to direct impacts, habitats may be indirectly affected by air pollution and generation of communal and industrial wastes.

A number of measures will be put in place during construction to mitigate air pollution from stationary and fugitive sources (for details see Section 9.2). Impacts of air pollution to habitats in case when all the listed measures are implemented can be assessed as **low.**

During construction there's a risk of potential impact on aquatic organisms habitats due to water pollution. Section 9.4 provides further detail on the results of assessment of potential impact on surface water bodies resulting from various activities. If appropriate mitigation measures are implemented, the residual impact on surface water bodies will be assessed as **low**.

Waste generation may result in potential pollution of natural habitats and surface bodies. Section 9.3 discusses assessment of waste-related impacts in more detail. If appropriate environmental impact mitigation measures are implemented, the residual waste-related impact, including the impact to habitats, will be assessed as **low**.

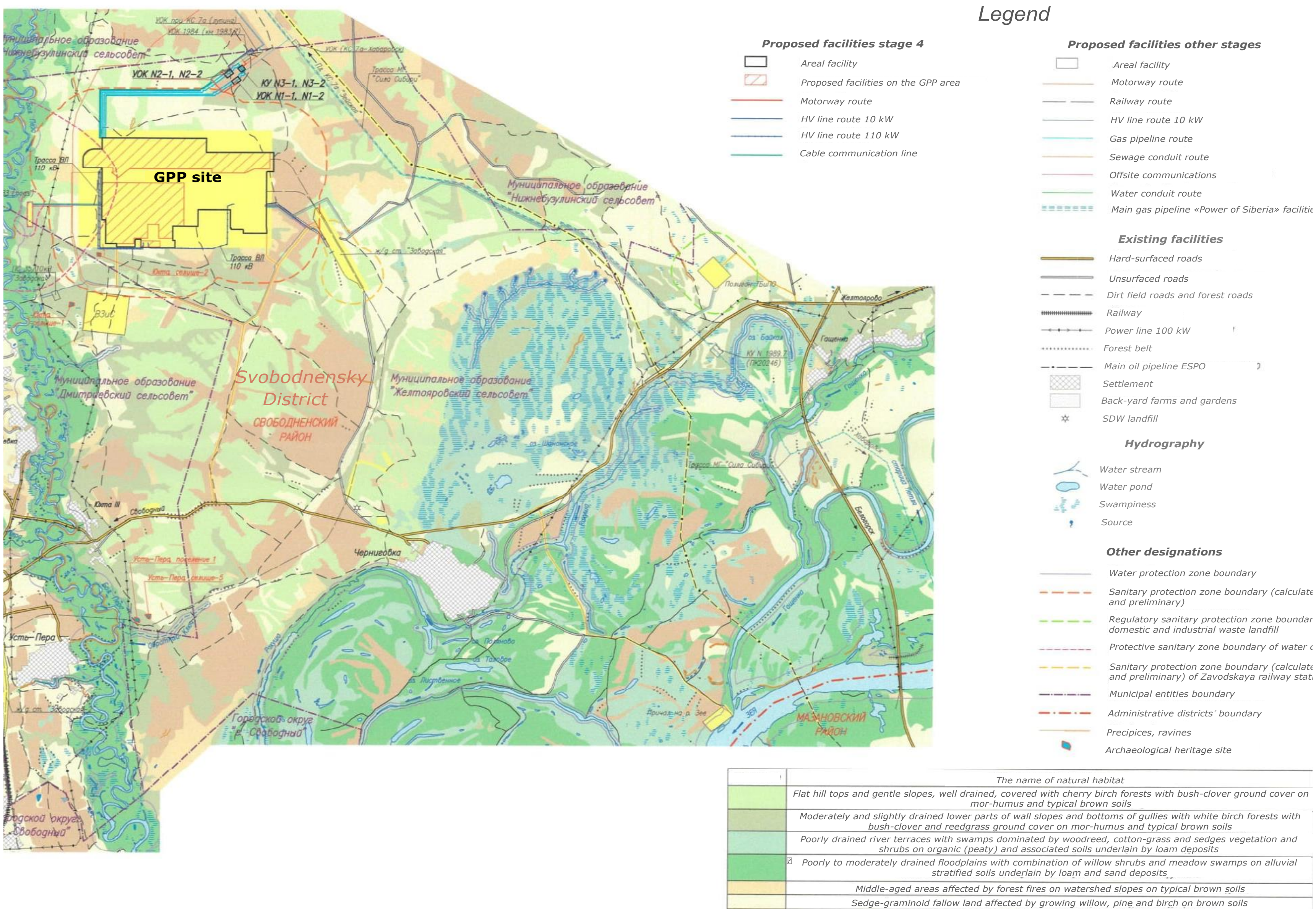

Figure 9.7.1: Vegetation map for the Amur GPP construction site

9.7.2.4 Protected species

No rare or protected plant or animal species have been identified within the proposed project construction site.

Yet, given the possibility of appearance of such species, especially birds, within the Project construction site, the impact on rare and protected species will be discussed in Section 9.6.2.7.

9.7.2.5 Impact on plants and animals

Plants

The development of the area is inevitably linked with the destruction and transformation of vegetation cover. Possible impacts on vegetation cover include loss and destruction of habitats, mechanical disturbance and pollution.

The most common types of plant communities adjacent to the construction site are fallow lands and anthropogenically disturbed lands overgrown with brush and tree saplings. Based on the areas of the habitats that will be lost during construction, if appropriate mitigation measures are put in place, the impact on vegetation cover from the loss of habitats may be assessed as **moderate**.

Mechanical disturbance will be intense but not lengthy in duration. Disturbance will be mostly connected with continuous fill construction and deforestation during grading operations. Serious impacts on vegetation cover may be caused by off-road traffic of construction machinery and motor vehicles, especially on slopes where removal of vegetation may lead to gullying. Non-organized disposal of solid construction wastes disturbs topsoil density and impedes recovery of vegetation cover. On the whole, mechanical impact on vegetation cover may be assessed as **moderate**. Implementation of mitigation measures will reduce the impact to **low**.

During construction, chemical impact on vegetation cover may be caused by:

- malfunctioning excavation, construction and road-building machinery;
- motor vehicle maintenance and repair carried out outside designated areas;
- the failure to observe regulations applicable to storage of fuels and lubricants and refueling of motor vehicles.

If the proposed environmental protection measures are implemented, chemical impact on vegetation cover will be assessed as **low**.

Invertebrates

Being closely tied to their habitats, invertebrates suffer the most from the loss of habitats. numerous invertebrate species directly depend on specific species or families of forage plants. Destruction of forage plants leads to extinction of invertebrates.

Chemical pollution is another important source of impact on invertebrates. Invertebrate animals, particularly insects, are highly susceptible to chemical factors and can be used for biotesting as model organisms.

Even though no rare or protected invertebrate animal species were identified during field survey within the construction area a number of protected insect species have been noted in the Svobodnensky district. It is discussed in more detail in Chapter 7. Although no generally accepted threshold exists for the significance of impact on invertebrates, given the extent of the direct loss of habitats the severity of impact can be assessed as **moderate**. If the proposed environmental protection measures, such as reclamation of disturbed lands, preservation of set-asides during land development, are implemented, the population of invertebrates will be partly restored and the residual impact will be reduced to **low**.

Chemical pollution during construction will be of a limited nature and its impact on invertebrates will be directly connected with the chemical impact on vegetation cover described in section 9.6.7.1. On the whole, chemical impact on invertebrates during construction can be assessed as **low**.

Fish

According to the Amurrybvod data ichthyofauna of the River Zeya and its tributaries is very diverse. All fish species use the rivers as their feeding, spawning and wintering grounds. There are no wintering pits within the project site.

The list of rare and protected fish species of the River Zeya includes the species listed in the Red Data Book of the RF and Amur region: Japanese sturgeon and kaluga (see Chapter 7).

Potential impact on fish may be connected with direct loss of habitats, construction of bridges across watercourses, pollution of water bodies and generation of wastes.

Construction of a sewer on the Bolshaya Pera and a temporary jetty on the Zeya will have the greatest impact on the ichthyofauna. Those construction projects will disturb Bolshaya Pera and Zeya floodplains which are part of the forage base for the fish and cause degradation of natural water clarity levels.

Direct loss of habitats in water bodies will be limited to an area no larger than 0.03 km^2 which is a minor fraction of the overall water surface. Given that it will be short-lived (10 months), the severity of the impact on fish from the loss and degradation of habitats in the short term can be assessed as **moderate**. If the proposed environmental protection measures are implemented, the impact significance can be reduced to **low**.

During construction there’s also a risk of potential impact on fish caused by surface water pollution. Section 9.4 provides detail on the assessment of potential impact on surface water as a result of various activities. If appropriate measures are implemented, impact of pollution on fish will be assessed as **low**.

Uncontrolled fishing as a source of food for construction workers may lead to depletion of fish reserves and cause absolute impact of **moderate** severity. If appropriate controls for fishing and procurement of fish from local fisheries are put in place, the impact will most likely be assessed as **low**.

Birds

According to the data supplied by the Amur Region Animals and Habitats Protection, Management and Use Directorate there are bird species in the Amur region that are listed in the Red Data Books of the RF and Amur region (see table in Chapter 7):

There is no generally accepted quantitative threshold for assessing the significance of impact on bird populations. As a useful reference, a threshold value of 1% is widely used (e.g. the loss of 1% of a species population in a given geographical area). Still, when analyzing decisions made by competent authorities concerning impacts on European sites (including legally protected territories that acquired the status due to their international significance for bird conservation) it was found that in many cases the loss of even a fraction much smaller than 1% may prove to be significant and have a negative effect on the protected site integrity (Hoskin and Tyldesley, 2006)[27].

Thus, the 1% threshold for bird populations is used as a value corresponding to a high degree of negative impact. Impact of construction work on birds will be mostly connected with the loss of habitats, noise, and visual disturbance. The bird habitats that may be lost during construction include lakes, rivers and streams for aquatic species and nesting and feeding grounds for terrestrial species. Direct loss of habitats makes up nearly 50% of the total land allotment. Assuming it will cause a proportional decrease in the populations of birds which nest in those areas, the severity of such absolute impact will clearly be high (even taking into account the current uncertainty in the exact numbers of nesting birds). Mitigation measures are described in detail in Table 9.7.1. Implementation of those measures will reduce residual impact to a level between **moderate** and **low**.

In addition to the loss of habitats negative factors may include the presence of man, construction work, motor vehicle traffic. As a rule, birds are not disturbed by traffic if people stay inside them. Cases when birds build their nests in close proximity to construction sites are commonplace.

[27] Hoskin, R., & Tyldesley, D. 2006. How the scale of effects on internationally designated nature conservation sites in Britain has been considered in decision making: A review of authoritative decisions. English Nature Research Reports, No. 704.

With the rise of pollution levels large-sized species may become endangered or fully extinct in all areas with tree and shrub vegetation: grouses, owls, a number of diurnal birds of prey, pigeons. It is caused not only by disturbance near emission sources (grouses) but also by the lack of nesting space (birds nesting in tree hollows), depletion of forage base for certain species. Decrease in the abundance of owls and diurnal birds of prey is connected with the shrinkage of the population of murine rodents due to human-caused stress.

Of all tree-layer species, only synanthropic crows benefit from the proximity of humans. The opening up of habitats leads to the increase in the number of species which nest on the ground or in soil cavities.

In the absence of impact mitigation measures the absolute impact of disturbance factors can be assessed as **high**. Impact mitigation measures are described in detail in Table 9.6.4. Their implementation will reduce residual impact to a level between **moderate** and **low**.

Amphibians, reptiles, mammals

Land development has negative impact on practically all wild animal species due to degradation of their habitats, reduction in their populations and direct animal mortality. Mammals are mostly exposed to impact from construction machinery, motor roads, and construction staff.

Impact types may be grouped as follows:

- Alienation and physical transformation of lands: impact on animals may be direct (as an obstacle) or indirect (change of nutrition sources and habitats);
- Noise: direct impact – loud noise has a direct effect, low noise has an oppressive effect, indirect impact – behavioral disorders;
- Chemical pollution: direct impact – animal mortality in emergency situations, indirect impact – dwindling forage base, degradation of forage organisms.

Even though no protected terrestrial animal species were identified by field survey near the Project site, the species listed in the Red Data Books of the RF and Amur region may be discovered in the Svobodnensky district (see Chapter 7.5).

The most significant types of human-caused impact on mammals are:

- Shrinkage of habitats due to acquisition of land plots by the Project with complete destruction of biotopes;
- Transformation of habitats adjacent to the construction site;
- Environmental pollution (pollution of soil and vegetation cover, air and water) leading to certain changes in the living conditions of background, commercially significant, recreationally significant, rare, and endangered species;
- Disturbance factor within the construction area forcing the majority of animals to abandon their customary biotopes;
- Animal mortality resulting from poaching, industrial activities, chemical intoxication, which has a negative effect on biodiversity in the vicinity of the construction site;
- Impact on established animal migration routes and directions.

Shrinkage of habitats and transformation of biotopes in the areas adjacent to the construction site are the most significant forms of impact on mammals. The same impact from the proposed industrial facilities will manifest differently for different groups of animals. For small-sized terrestrial vertebrates (insectivores, rodents, amphibians, reptiles) human-caused impact will be similar to the one to which invertebrates are exposed; a reduction in their population and biodiversity proportional to the area of land acquired by the Project may be assumed.

A specific type of animal habitat transformation is the burning out of vegetation due to human-caused fires. Fires mostly result through the negligence of the Project staff, the absence of spark arresters, the presence of litter, and a number of other factors. Aside from high animal mortality rate during fire, the habitats are transformed as well.

At the same time, as new territories are developed, a growth in the population of synanthropic animal species may be assumed (dogs, mice, brown rats, etc.). Stray dogs may appear in the vicinity of the construction sites which will result in a shrinkage of the population of ground nesters (grouses, certain duck species, waders) and furbearers due to complete destruction of their juveniles by dogs. Middle-sized and large mammals will be more vulnerable to the disturbance factor.

Commercially valuable animals will be exposed to impact over an area significantly larger than the construction area. To date, seasonal roaming of commercial animals has not led to the establishing of distinct migratory routes. Since all the proposed facilities are located within the already developed area (agricultural lands, local and regional roads) the impact the construction project will have on terrestrial vertebrate animals will be **low**, subject to implementation of the proposed environmental protection measures.

9.7.3 Operational stage

9.7.3.1 Legally protected areas

No possible impacts on legally protected have been identified due to their remoteness from the Project area. Thus it can be stated that no legally protected areas exist that could be exposed to negative impact from Project related activities.

9.7.3.2 Natural habitats

No further loss of habitats is expected during operational phase. Moreover, some of the habitats will be restored. Reversible loss of habitats during construction will be compensated immediately upon completion of the construction, particularly by way of planting aboriginal species in the corresponding areas.

Impacts on plants associated with air quality during operational phase are discussed in section 9.2. Analysis of air emissions shows that the projected sedimentation levels are significantly less than critical for all locations. On the whole, impact on vegetation caused by NO_x concentrations and nitrogen deposition can be assessed as **negligible**.

During operational phase there’s a risk of potential impact on freshwater habitats due to pollution of water bodies, particularly due to discharges of effluent into the Bolshaya Pera. Section 9.4 sets out the detailed results of the assessment of potential impact on surface water bodies associated with various activities. If appropriate impact mitigation measures are implemented, residual impact on surface water bodies will be assessed as **low**.

Waste generation during operational phase may cause potential impact on land and freshwater pollution. Issues relating to assessment and control of impacts connected with waste generation are discussed in detail in section 9.7. Without proper control, absolute impacts can be moderate. If appropriate impact mitigation measures are implemented residual environmental impact will be assessed as **low**.

9.7.3.3 Impact on flora and fauna

Rare plants

No direct impact on rare plant species is expected due to additional loss of habitats during operational phase. Indirect impact from lower air quality is unlikely since no critical values will be exceeded.

Fish

Since no hydromechanical work will be performed on water bodies during operational phase impact on ichthyofauna will only be associated with discharges of treated effluent into the Bolshaya Pera. Section 9.4 provides a detailed assessment of potential impact on surface water caused by various activities. If appropriate measures are implemented and treated water parameters conform to the standards applicable to fisheries, residual impact on fish caused by pollution can be assessed as **low**.

Birds

No direct impact on birds is expected in connection with additional loss of habitats during operational phase.

Impacts on birds associated with disturbance factors will be similar to the ones felt during construction phase. The majority of sparrows are resilient to disturbance if suitable habitats are available. An increase is expected in the number of synanthropic bird species, including crows, which will have negative impact on the survivability of the offspring in the areas adjacent to the Project sites.

To supply power to the gas processing plant facilities a 10kV overhead power transmission line will be constructed. During the operation of high voltage power transmission lines there's a chance that birds will build nests on tower cross-arms near strings of insulators. Therefore, birds may be exposed to the risk of fatal electrical shock. Large birds of prey are the most exposed to the risk of collision. This may lead to an absolution impact of **moderate** severity. The actual situation will be managed, and if serious problems are identified, the towers will be fitted with bird protection devices that will reduce the severity of residual impact to **low**.

Amphibians, reptiles, mammals

No direct impact on terrestrial animals is expected in connection with loss of habitats during operational phase.

Impacts on terrestrial animals caused by the disturbance factor will be similar to the ones felt during construction phase. A minor impact will be associated with noise caused by process equipment or motor vehicle traffic. However, if the proposed standards of noise pressure are complied with, estimated noise levels outside the production areas will not exceed proposed standards, and the traffic intensity will be significantly lower during operational phase than during construction. If the above conditions are met, the impact on terrestrial animals will be **low**.

During operational phase the most significant impact will be associated with uncontrolled hunting (poaching). If appropriate restrictive measures are implemented, the severity of residual impact will be reduced to **low**.

9.7.4 Impact on aquatic organisms

9.7.4.1 Construction phase

Potential impacts on aquatic organisms during construction are described in Table 9.7.1 below.

Table 9.7.1: Potential impacts on aquatic organisms during construction

Aspect	Stage
Dredging activities	Impact of sedimentation on benthic flora and fauna
	Impact of turbidity on pelagic fauna
	Underwater impact of noise on fish
Construction and installation activity at river crossings	Transport of sediments downstream to riparian zone
Pile driving (during jetty construction)	Underwater impact of noise on fish
Discharges into river	Changes in water quality that cause impact on flora and fauna
Water intake	River fauna (fish juveniles, phytoplankton, zooplankton) sucked in along with water

Impact of Sedimentation and turbidity caused by dredging operations

Dredging operations during the construction of a temporary jetty on the River Zeya will result in degradation of habitats (shrinkage of forage base for invertebrates) and, possibly, higher fish mortality.

Particulate matter released into water affects the water's optical properties reducing the depth of sunlight penetration and adversely affecting the photosynthetic activity of planktonic algae.

According to the data obtained by VNIRO from toxicology survey on natural suspended solids the minimum threshold concentration of suspended particles which may cause reduction in algal photosynthesis and impede filter feeding of invertebrates is 10 mg/l. This value was recommended and officially approved as the MAC for suspended particles in fisheries water bodies.

Higher concentrations of suspended particles during construction will cause reduction in water clarity and, as a consequence, will slow down normal development of phytoplankton and put it in a depressed state.

Zooplankton (crustaceans), especially in early stages of development, and saprophytes will be the most sensitive to the effects of suspended particles in water. Higher concentrations of suspended particles in water cause damage to filtration organs impeding nourishment and reproduction, changing zooplankton behavior, causing stress and mortality. Substantial shrinkage of zooplankton biomass in the natural environment was noted when the concentration of suspended particles (constant during the season) was more than 20 mg/l (Williams, 1984)[28].

Nor is ichthyoplankton less sensitive to the concentration of suspended solids. Development of eggs and juveniles is slowed down in areas with higher turbidity levels. Given the high clarity of the River Zeya (3 mg/dm^3 of suspended particles), increased turbidity may have negative impact on the river's phytoplankton and zooplankton.

The mechanism of impact of suspended mineral matter on zoobenthic organisms is the same as in the case of zooplankton – benthic communities are destroyed. In high turbidity areas the population of benthic organisms is expected to decline sharply.

According to the GosNIORKh data, mortality among benthic organisms buried during riverbed intervention under a layer of bottom sediments occurs when the layer thickness exceeds the vertical size of benthic organisms and sedimentation velocity exceeds 0.5 mm/day (Lesnikov, 1986)[29].

Other data indicates that many benthic species, especially burrowing infaunal organisms (bivalves-detritivores, gastropods, many species of the polychaeta, sea cucumbers, etc.), can reach the surface after being buried under a layer of bottom sediments (Maurer et all., 1980, 1986)[30][31]. With varying thickness of the layer the time it takes them to reach the surface ranges from several hours to several days for different species and depends on the size of the organism and the composition of riverbed soil. Dense clayey silt and sandy soils consisting of medium to large-sized particles are the hardest to burrow through (Maurer et all., 1980; 1986).

Accumulation of bottom sediments 1-5 cm thick is dangerous for small and medium-sized epifaunal organisms. Previous investigations involving modelling the effects of burial of zoobenthic organisms demonstrated that crabs and large mollusks can reach the surface burrowing through a layer of soil up to 30 cm thick. Strong suppression of biota occurs when the layer of anthropogenic sediments is 3 to 5 cm. Sediments 0.6 cm thick do not disturb species diversity. It is suggested that impact caused by re-sedimentation of a sand layer less than 1 cm thick be considered ecologically insignificant. In general, it is suggested that a soil layer 2 cm thick should be considered critical as far as small zoobenthic organisms are

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[28] Williams R. 1984. Zooplankton of the Bristol Channel and Severn Estuary // Mar. Poll. Bull., 1984. Vol. 15. No. 2. P. 66-70.

[29] Lesnikov L.A. Impact of transportation of soils on fisheries water bodies. // Collected research papers GosNIORKh, 1986 Issue 255 - P.3-9.

[30] Maurer D., Keck R.T., Tinsman J.C., Leathem W.A. Vertical migration and mortality of benthos in dredged material. Part 1: Mollusca // Marine Environmental Research, 1980– 81. Vol. 4. P. 299–319.

[31] Maurer D., Keck R.T., Tinsman J.C., Leathem W.A., Wethe C., Lord C., Church T.M. Vertical migration and mortality of marine benthos in dredged material: a synthesis //Int. Rev. Gesamt. Hydrobiol., 1986. Vol. 771, N 1. P. 49–63.

concerned. Natural recovery of biocenoses after completion of dredging and dumping operations will take over 5 years.

In areas where spoils are dumped and around the edges of the spoils hummocks form far in excess of 2 cm in size. Their subsequent re-colonization is mainly possible due to the presence of migrants from undisturbed areas; weakened organisms that climbed from under the spoils will quickly succumb to predators that gather in high turbidity zones.

Given the size and behavior of predominant benthic organisms within the proposed dredging operations area the following lethal threshold values for the thickness of bottom sediments common for the area’s benthic community should be adopted: 1-5 cm (50% mortality) and over 5 cm (100% mortality). Those values are adopted based on the precautionary approach (Medyankina, Cokolova, et al., 2010)[32].

Taking into consideration the factors mentioned above, the construction of the temporary jetty will result in the following types of adverse impact on aquatic organisms (see section 9.7.1.5 for a more detailed fish losses calculation):

-acquisition of the Zeya floodplain by the Project;

-mortality of benthic forage organisms caused by dredging operations;

-mortality of benthic forage organisms in the turbidity plume.

According to the Amurrybvod data, the extent of potential fish losses during temporary jetty construction will be 255.89 kg; the recovery time of the benthic forage community will be 3 years.

To restore disturbed aquatic communities to their original state Amurrybvod suggests measures involving artificial reproduction of fish resources by releasing 10,171 common carp juveniles weighing 3-5 kg into the Zeya river basin.

Given that the recovery time of benthic organisms after cessation of negative impact (completion of construction) is 3 years the severity of impact on aquatic communities can be assessed as **moderate**. In view of the proposed measures involving artificial reproduction of aquatic bioresources, short impact duration (122 days), and other environmental protection actions the significance of impact can be assessed as **moderate** to **low**.

Railway bridge across the Bolshaya Pera River

Adverse impact will be inevitably imposed on water bodies and aquatic bioresources in the process of work execution in the streambed and within the floodplain areas prone to flooding in connection with the bridge construction and installation of culverts under the linear facilities. The main types of negative impacts are listed below:

- withdrawal of riparian highly productive areas, disturbance of normal conditions for growth of aquatic flora as a substrate for formation of spawning zones;
- disturbance of the natural landscape and the existing river bank line, changes in the morphometric parameters of the affected watercourse section;
- formation of zones with elevated degree of water turbidity as a result of the work performed within the streambed and entrainment of suspended matter by the water stream affecting the qualitative composition of the water in the watercourse and disturbing the vital processes of the existing biocenoses;
- siltation of the surficial layer of the bottom sediments as a result of suspended matter deposition within the turbidity field; stunting or partial destruction of aquatic flora and changes (short-term or long-term) in the species composition and productivity of phytoplankton communities; changes in the species composition and productivity of zooplankton communities and zoobenthos stunting;
- destruction of highly productive stream bottom layers, deterioration of the conditions for recovery of the food resources for fish;

[32] Impact of transportation of bottom soil on zoobenthic organisms from riverbed intervention (an overview). Medyankina M.V., Sokolova S.A., et al. // Contemporary issues and prospects of the fisheries complex. Practical research conf. p. 81-83.

- noise impact on the fish, disturbance of their migration routes (feeding and spawning).

The following types of work will have adverse impact on the aquatic bioresources and habitats in the process of repairs:

- construction of road embankment and elements of the bridge (abutment and pillars) and provisional roads;
- preparation of a site for assembly operations within the catchment area of the river basin.

Within the project design, the specialists of the Khabarovsk division of the Federal Pacific Fishery Research Institute (KhF TINRO) presented their statement relating to the impact of the construction work on the status of the aquatic bioresources and habitats in connection with the construction of a railway bridge across the Bolshaya Pera River. According to the statement, these construction activities will inflict certain damage to the existing aquatic bioresources.

The consequences of the negative impact on the aquatic bioresources and habitats in the process of the bridge construction will be:

- localized with regard to the affected areas;
- long-term with regard to the impact duration'
- reversible with regard to the recovery ability of the original community of the bioresources;
- indirect with regard to the impact factor.

The loss of aquatic resources caused by the inflicted damage has been estimated at 225 km. The estimation has indicated that the quantity of young fish of European carp required for restoration of the disturbed condition of the aquatic bioresources by means of artificial fish hatching will be 11,000 fishes each weighing 5 g. The compensation will be provided by hatching of European carp at fish hatcheries available in Amur Region. The expenses to be compensated for have been estimated at RUR 330,000 (5,500 USD).

Impact on ichthyofauna

Embryos and especially larvae of the majority of fish species are highly sensitive to suspended particles. The available experimental data for ichthyoplankton (based on drill cuttings tests) suggest 100% mortality of pelagic fish eggs and larvae at particle concentrations over 25 mg/l (Kalinicheva, 1987)[33]. Similar results were obtained from observations of the distribution of pelagic fish eggs and larvae in natural conditions; a sharp decline in their number was noted when mineral particles concentrations exceeded 20-30 mg/l (Williams, 1984).

Based on pessimistic estimates by experts, in order to calculate the extent of damage to aquatic bioresources the threshold values of impact of suspended particles on ichthyoplankton should be the same as those used for zooplankton.

Adult fish are capable of avoiding high turbidity zones. However, the information available in this respect is quite controversial. On the one hand, certain observations demonstrate that fish tend to avoid areas where particulate matter concentrations are as high as 10 to 20 mg/l. It is believed that river sections where particle concentrations reach 40 to 60 mg/l are practically devoid of fish as far as salmonids are concerned[34]. On the other hand, there is evidence that the spawning run of salmon in river estuaries proceeds undisturbed despite extreme water turbidity levels, up to several grams per liter. Benthic fish are the most resilient to high particle concentrations while pelagic fish (especially phytophages) are more sensitive to such impact. Many researchers have pointed out harmful effects suspended particles have on fish gills and the intensification of motor activity resulting in overexertion and subsequent exhaustion[35][36][37]. When

[33] Kalinicheva V.G. Impact of suspended particles on fish (eggs, larvae, juveniles) // Impact of riverbed intervention operations on fisheries. Collected GosNIORKh papers, 1987-Issue 255 - C.55-58.

[34] Kaigorodov, N.E. Impact of suspended mineral particles on aquatic organisms and the distribution of suspended particles in the flow during dredging operations // Fisheries survey of Urals water bodies. – L., 1979. Issue. 2. P. 128-131.

[35] Lukyanenko, V.I. Fish toxicology. – M.: Food Industry, 1967. 216p

[36] Billard, R. Influence de scdiments argileux incirpores an milicud’ ensemination sur le success de la fecundation chez la truite arienciel (Salmo gairdnery) // Water Res. 1982. V. 16,№ 5. P. 725-728

particulate matter concentration in water are abnormally high the common cause of fish mortality is anoxia (lack of oxygen) which results from gill tissue damage and is accompanied by rapid changes in blood biochemistry.

No mish mortality is expected during underwater technical operations since adult fish are likely to be scared off by operating equipment. No spawning grounds have been identified within the proposed construction site.

Therefore, negative impact on ichthyofauna will manifest as the loss of feeding grounds for benthos-eating fish species which is estimated based on the loss of zoobenthic habitat areas, using the same coefficients for the recovery time of their forage base. For plankton-eating fish species it is tentatively assumed that the loss of their feeding grounds corresponds to the area of high turbidity plumes with particle concentrations in excess of 20-100 mg/l that have adverse effect on their forage base, zooplankton.

Given the scale of dredging operations and other riverbed intervention activities and the extent of the resulting negative impact on the fish's forage base (zooplankton and zoobenthic organisms) the significance of impact on ichthyofauna can be assessed as **high**. If the proposed impact mitigation measures (see section 9.7.3) are implemented, the residual impact will be reduced to **moderate**.

In order to assess the actual impact of dredging operations on the state of river biota regular monitoring activities should be carried out using the same observation points as are used for monitoring the quality of surface water within the Project site.

9.7.4.2 Impact mitigation measures

Measures aimed at limiting the size of high turbidity water areas during soil movement operations include:

- loading suction hopper dredgers without spilling process water overboard;
- unloading barges and hopper dredgers at dumping sites upon their coming to a complete standstill (drift excepted);
- lowering the bucket as close to the surface of water in the barge's hold as possible during backhoe dredge operation to avoid slurry spillage or splashing;
- using 75% bucket fill factors, without heap, to prevent the dredged material from dropping back into the water;
- carrying out Zeya water quality chemical tests prior to the commencement of, during, and upon completion of, dredging operations;
- continuously monitoring compliance with the technical requirements for riverbed intervention operations.

In addition, a series of measures should be developed in coordination with the fish protection authorities to compensate for the damage caused to fish resources involving release of valuable fish species into the River Zeya such as sturgeons or freshwater whitefish (coregonus, lenok). Those measures are discussed in more detail below.

Residual impact

Implementation of the measures outlined above will help manage the impact of dredging operations although it's unlikely that the residual impact will be reduced to a level much lower than the level of the absolute impact assessed above.

One exception is the impact on fish resources the loss of which will be compensated by releasing juvenile fish into the River Zeya; as a result, the residual impact can be assessed as **moderate**.

[37] Mallatt, J. Fish gill structural changes induced by toxicants and others irritants: a statistical review // Can. J. Fish and Aquat. Sci. 1985. 42. N4. P. 630-648.

9.7.4.3 Fish loss calculation

The quantitative assessment of the impact on marine biota was made by calculation of fish losses caused by riverbed intervention operations in Ob Bay during construction. The damage assessment was made according to the Methodology for Calculating Harm Caused to Aquatic Bioresources (Order #1166 dated November 25, 2011 of Rosrybolovstvo).

The loss of bioresources during construction phase will be contributed to by the following components:

- mortality of plankton-eating fish as a result of zooplankton mortality;
- mortality of benthos-eating fish as a result of zoobenthic organisms mortality.

According to the current methodology the calculation has been separately performed for reversible and irreversible damage. Irreversible damage occurs when seabed and water areas are acquired by the Project for waterworks construction resulting in a shrinkage of feeding grounds for benthos-eaters and plankton-eaters. Damage caused by the temporary shrinkage of feeding grounds and reduction of forage base productivity is reversible.

During dredging operation the uppermost layer of soil will be removed casing complete destruction of benthic ecosystems and temporary shrinkage of benthos-eaters' feeding grounds. High turbidity zones (resulting from dredging and dumping operations) create adverse conditions for all aquatic organisms, including fish and their forage organisms (zooplankton, zoobenthos), inducing temporary reduction in forage base productivity and shrinkage of plankton-eaters' forage grounds.

The key factors of negative impact on aquatic bioresources and habitats are as follows:

- acquisition by the Project of the Zeya floodplain with the area of 27,000 m^2 during the temporary jetty construction;
- 100% mortality of forage benthic organisms during dredging operations in the river Zeya over the area of 94,500 (210 x 450) m^2 over the period of 122 days;
- 50% mortality of benthic organisms in the turbidity plume during dredging operations over the area of 225,000 (500 x 450) m^2 in the river Zeya taking into account the transport of particulate matter 500 m downstream of the dredge site with the plume width being 450 m, over the period of 122 days.

Thus:

- the annual loss of aquatic bioresources in the River Zeya due to the adverse impact of the temporary jetty construction with full or partial irreversible loss of fisheries significance of the water body will be 148.5 kg;
- the loss of aquatic bioresources resulting from 100% mortality of forage benthic organisms that are unavailable for fish consumption during dredging operations in the River Zeya will be 53.15 kg;
- the loss of aquatic bioresources resulting from 50% mortality of forage benthic organisms that are available for fish consumption within the turbidity plume will be 54.24 kg.

The overall natural damage to aquatic bioresources and their habitats during construction of the temporary jetty on the River Zeya will be 255.89 kg.

Since the negative impact of the construction of the Project facilities on bioresources will be large-scale and quite lengthy certain compensatory measures have been proposed in coordination with the fish protection authorities involving artificial reproduction of bioresources.

In order to restore disturbed aquatic bioresources to their original state it is proposed to release 10,171 common carp juveniles, each weighing 3-5 g, into the Amur basin (Zeya). The cost of work involving hatching, artificial breeding, and release of juveniles is estimated at RUB 345,814.

Discharges into the Bolshaya Pera River

The Project provides for discharge of the effluent treated at the WWTFs into the river Bolshaya Pera at a point 21 km from where it meets the River Zeya.

It is assumed that the effluent treatment will ensure compliance with the maximum allowable concentration standards for fisheries. If the proposed wastewater quality standards are observed the significance of negative impact of discharges into the Bolshaya Pera River will be **low**.

9.7.4.4 Operational phase

Since no hydrotechnical operations will be carried out on the waterworks during operational phase impact on aquatic organisms may be largely connected with discharges of treated effluent into the Bolshaya Pera. It is assumed that the treated effluent will comply with the water quality standards applicable to fisheries.

Another possible source of impact on aquatic biota is chemical pollution caused by fuel and lubricant spills. This is discussed in more detail in section 9.5.1.

Implementation of the proposed environmental protection measures will reduce the operational phase impacts on aquatic bioresources to **low**.

9.7.5 Summary

Thus, the construction and operation of the Amur GPP will have diverse impact on living organisms. The strongest impact will be caused by the destruction and transformation of habitats and the resulting effects on plants and animals. The proposed impact mitigation measures will reduce residual impact.

A detailed description of measures necessary for the prevention, minimization, and compensation of impacts discussed above and residual impacts is given in Table 9.7.2 below.

A summary of impact monitoring measures is given in Table 9.7.3 below.

Table 9.7.2: Summary of Mitigation Actions and Residual Impact

Impact	Receptor	Phase	Design and Mitigation Actions	Residual Impact
Environmental impact	Legally protected sites	Construction	Not required	**Negligible**
	Legally protected sites	Operation	Not required	**Negligible**
Loss of habitats	Terrestrial habitats (natural habitats)	Construction	• All the construction sites will be linked by motor roads. Use of off-road routes and temporary rutways will be prohibited. • Areas of reversible habitat loss during construction (e.g. sand storage grounds) will be reclaimed immediately upon completion of the construction and will be seeded/planted with local plant species. • Burning grass in spring will be prohibited since it may cause animal mortality; • Road embankments will be strengthened by geogrids filed with crushed rock and turf. The will also be seeded. • To avoid swamping and waterlogging and to conserve natural plant communities culverts will be constructed across waterways and drainage ditches (1.50 m diameter steel water pipes); • Clearing out felling residue and construction debris; • Complying with fire safety regulations in order to protect tree shrub vegetation, placing firefighting equipment; • Using biopreparations (biodestructors) to clean oil polluted areas; • Remediated areas will be enclosed by temporary fences to avoid trampling the vegetation.	**Moderate**
	Aquatic habitats and fish	Construction	• Waterproofing pipes to avoid water infiltration into soil; • Preventing area swamping; • Preventing treated effluent not complying with the water quality standards for fisheries from being discharged into the Bolshaya Pera; • Preventing motor vehicles from parking outside designated parking lots; • Setting up a water jet energy dissipation structure at the discharge sewer outlet on the Bolshaya Pera to avoid bank scour; • Placing a strict ban on washing vehicles at the temporary jetty on the river Zeya; • Prohibiting the use of salt-based ice control chemicals in winter;	**Low**

Impact	Receptor	Phase	Design and Mitigation Actions	Residual Impact
			• Designing the jetty site with a counter slope, in the direction opposite to the river, to prevent spontaneous discharges of surface water into the river Zeya; • Refraining from taking washing and drinking water from the Zeya, using imported water instead; • Installing fish screens on the jetty face at the entrance to the fire water pond; • Measures aimed at speeding up recovery (release of fish juveniles) will be taken to restore fish populations.	
	Habitats	Operation	• Project activities should be strictly limited to the allotted area, e.g. traffic should be limited to constructed roads (no off-road traffic). • In future, any additional Project facilities should be constructed either within the existing development area or within previously disturbed areas, whenever possible.	**Low**
Bird collisions with PTL	Birds	Operation	• Electrocution of birds on high voltage power transmission lines will be monitored. Should any birds die, bird protection devices will be installed on PTLs.	**Low**
Loss of habitats	Birds	Construction and operation	• A speed limit will be imposed on access roads. • Project staff and construction works will receive training on the importance of bird populations (and other environmental impact receptors) and impact mitigation measures.	**Moderate to Low**
Disturbance factors	Terrestrial vertebrates	Construction and operation	• Placing a ban on pursuing animals, damaging or destroying birds' nests or sanctuaries, illegal bird hunting; • Installing chain link fences around Project sites to prevent animals from entering them; • Placing a ban on keeping domestic animals at temporary construction camps, exercising control over guard dog handling at the Project sites; • Placing a ban on abandoning open trenches and pits for long periods of time to prevent reptiles, amphibians or small mammals from falling into them; • Preventing illegal hunting by the Project staff; • Fitting all tanks at all the facilities with protective screens to prevent animals from getting into them	**Low**
Wastewater	Habitats and species	Construction and operation	• During excavation work conducted in close proximity to surface water bodies soil deposition will be managed as necessary, including the use of anti-sedimentation barriers. • Further detail on impacts on surface water bodies and impact mitigation measures is given in Table 9.4.15. • Minimizing the risk of aquatic habitats pollution by constructing dikes around temporary waste storage grounds, placing SDIW landfills outside water bodies'	**Low**

Impact	Receptor	Phase	Design and Mitigation Actions	Residual Impact
			sanitary protection zones, using waterproof lining when constructing SDIW landfills	
Water abstraction	Aquatic habitats and fish	Construction and operation	• Water intake structures will be fitted with filters and fish screens	**Low**

Table 9.7.3: Summary of environmental impact monitoring requirements

Aspect	Phase	Location	Parameters	Periodicity
Terrestrial habitats	Construction and operation	Any area where vegetation was exposed to impact and restored	Recovery of habitats Diversity of plant species, character and structure of terrain as captured by photography based on quadrants marked by survey points	Once every summer, once every two years.
	Construction	Any area where vegetation was exposed to impact	Monitoring of vegetation status separately for 10x10 m plots, separately for shrub, meadow and wetland associations.	Once a month during the growing season
Freshwater habitats	Construction and operation	Area including water bodies that were directly affected (e.g. waterlogged lands), water bodies that could have been affected (e.g. by surface runoff), and water bodies outside the area of influence used as reference habitats.	Recovery of habitats Monitoring of changes in aquatic environment, including hydrochemistry, water pollution, water temperature, water levels, river flow velocity, etc. Phytoplankton, zooplankton, zoobenthos, and fish (diversity, abundance and age structure of occurring species).	Once every summer, once every two years.
Alien-invasive species	Construction and operation	Project area	Alien-invasive species Discovery location, species and numbers / abundance. Any control/extermination measures.	Continuously

Table 9.7.4: Summary of mitigation actions and residual impact on aquatic organisms

Impact	Receptor	Phase	Design and Mitigation Actions	Residual Impact
Discharges from vessels	River water and biota	Construction and operation	No discharges of bilge water into the river Zeya will be allowed. Sanitary wastewater and oily bilge water from cargo delivery vessels will be collected by special bunker vessels based on relevant contracts.	**Low**
Effluent discharges into the Bolshaya Pera	Phytoplankton, zooplankton, phytobenthos, zoobenthos, ichthyofauna	Construction and operation	Monitoring of wastewater flow rate and composition; Monitoring of wastewater background composition at a point 500 m upstream of the wastewater discharge point and at the point where the wastewater fully mixes with the river water (500 m downstream of the wastewater discharge point)	**Low**
Water abstraction	Fish eggs and juveniles, phytoplankton, zooplankton, ichthyoplankton	Construction	Fitting fire water intake structures with fish screens.	**Low**
Emergence of high turbidity zones during dredging operations	Phytoplankton, zooplankton, ichthyoplankton	Construction	Measures aimed at limiting high turbidity zones during soil movement operations: Loading suction hopper dredgers without spilling process water overboard; unloading barges and hopper dredgers at dumping sites upon their coming to a complete standstill (drift excepted); lowering the bucket as close to the surface of water in the barge's hold as possible during backhoe dredge operation to avoid slurry spillage or splashing; using 75% bucket fill factors, without heap, to prevent the dredged material from dropping back into the water; Carrying out Zeya water quality chemical tests prior to the commencement of, during, and upon completion of, dredging operations; Continuously monitoring compliance with the technical requirements for riverbed intervention operations.	**Moderate**

Table 9.7.5: Summary of aquatic organisms impact monitoring requirements

Aspect	Phase	Location	Parameters	Periodicity
Discharges into the Bolshaya Pera	Construction and operation	See section 9.4	See section 9.4	See section 9.4
Mortality of phytoplankton, zooplankton, and fish juveniles at water intake structures	Construction	Temporary jetty on the River Zeya	Presence of dead fish hatchlings juveniles on fish screens	Once a year
Impact of hydrotechnical operations on river biocenoses (communities)	Construction	Temporary jetty on the River Zeya	Chemical and organoleptic water parameters; distribution and abundance of phytoplankton, zooplankton, and benthic biotope fauna.	Twice a year (before commencement and upon completion of work)
Aquatic biological organisms	Construction and operation	Effluent discharge site	Wastewater flow rate, composition and chemical/physical parameters.	Continuously
			Monitoring of wastewater background parameters at a point 500 m upstream of the wastewater discharge point and at the point where the wastewater fully mixes with the river water (500 m downstream of the wastewater discharge point).	Continuously
Benthic organisms	Construction and operation	Watercourse crossings	Monitoring of chemical composition of surface water and bottom sediments	Once after completion of construction, then once a month.
Fish and benthic dwellers	Construction and operation	Surface water bodies within the area of influence	Monitoring of species composition, intraspecific characteristics, morphological deviations frequency, commercial value assessment	Once every spring and once every summer for zooplankton and phytoplankton; once every feeding, migration and wintering period for fish

9.8 Waste management

9.8.1 Introduction

Construction and operation of the Project facilities will be associated with generation of various wastes which have the potential for adverse impact on the environment. This Chapter provides an assessment of waste generation and description of waste management methods which enable mitigation of adverse impacts to acceptable levels at each stage of the Project implementation.

In accordance with the national legislation, all industrial waste (IW) and municipal solid waste (MSW) are classified according to the following criteria:

- source;
- conditions of generation (specific operations or technology);
- chemical and/or component composition;
- state of matter; and
- physical shape.

This information is entered into the Federal Classificatory Catalogue of Wastes (FCCW).

The FCCW identifies five hazard classes which differ from those used in other countries, e.g. in the EU waste is divided into 'hazardous' and 'non-hazardous' groups. Table 9.8.1 provides a summary comparison of the FCCW hazard classes with the typical 'international' classification.

Table 9.8.1: Comparison of the national and international waste classifications

Waste hazard classes used in the RF			International classification equivalent
Hazard class	Hazard level	Examples	
I	Extremely hazardous	Devices and other products containing mercury: fluorescent lamps, thermometers, manometers, etc.	Hazardous
II	Highly hazardous	Batteries containing lead or sulphuric acid solution, alkali, alkalis, halogenated solvent, lead-acid batteries, dry batteries, etc.	
III	Moderately hazardous	Petroleum waste and oiled materials such as waste oils, waste car oil filters, oily rags, etc.	
IV	Low hazardous	Household rubbish, non-ferrous metal scrap, certain chemicals, certain construction waste, wastewater treatment sludge, treated medical waste, water-based drilling fluids, etc.	Non-hazardous
V	Practically non-hazardous	Inert waste: plastics, ferrous metal scrap, inert construction waste, food waste, brushwood, untreated wood waste	

The national legislation establishes special requirements for collection, storage, transportation, treatment, and disposal.

- Temporary waste storage and transportation are regulated by the sanitary regulations and standards SanPiN 2.1.7.1322-03 'Hygienic requirements for disposal and treatment of production and consumption waste'.
- Conditions for collection and accumulation of waste are determined by its physical and chemical properties and hazard class.
- Accumulation and temporary storage of waste must be confined within specially equipped sealed surface areas protected from wind and atmospheric precipitation. Separate storage of waste provides for better recycling.

- Temporary waste storage areas must be fenced along the perimeter and illuminated at night time.

Oversized non-hazardous waste is to be stored separately in open space of waste storage areas. Waste storage areas will be accessible only for authorised personnel involved in waste management.

Transportation of waste should be carried out using dedicated vehicles of the Company or waste management contractor. Waste packing will be inspected before shipping to prevent dust generation, spills or other losses and associated environmental pollution during transportation. Only authorised personnel of the Company will attend waste shipment.

The Project provides for embedded environmental controls and procedures aimed at mitigation of environmental, health, and safety impacts of waste that will be generated during operation.

The impact associated with production and consumption waste management has been evaluated for the periods of construction and operation of:

- Early Works Facilities;
- Auxiliary facilities;
- Temporary jetty on the Zeya River;
- Main Production Facilities;
- Residential microdistrict; and
- MSIW Landfill.

9.8.2 Construction stage

At the construction stage, waste will be generated during site preparation and construction of the Early Works Facilities. Construction will be preceded by the site development works.

Waste generation will be associated with the following operations:

- construction site levelling/ grading and improvement of the operations support area, roads and sites;
- construction of production facilities.

Main waste generation sources during construction of the Early Works Facilities will be:

- site clearance and construction operations;
- operation of vehicles;
- equipment maintenance and life activity of personnel.

Operation of vehicles and construction equipment during execution of construction and installation works will be associated with generation of such waste as waste batteries, tyres, ferrous metal scrap, waste filters and various lubricating oils, oiled rags, etc.

Waste generated by the life activity of personnel (construction workers) will include office and household garbage, sewage from cesspits, food waste from kitchens and catering facilities, cloth shreds and scraps, and worn-out work footwear.

Waste that will be generated during construction of the Early Works Facilities will consist of:

- municipal solid waste:
  - Hazard Class IV – household rubbish and waste from accommodation facilities;
  - Hazard Class V - food waste from kitchens and catering facilities;
- industrial waste from construction and installation works:
  - waste from wood clearance;
  - waste from drilling of water wells;

- waste products and materials used for the facility construction;
- waste from mechanical treatment of wastewater after hydrotesting of tanks and pipelines;
- waste from maintenance and repair of vehicles and equipment; and
- worn-out work clothing.

Production waste generated during construction is classified as follows:

- Hazard Class II: waste lead batteries;
- Hazard Class III: waste transmission mineral oils and synthetic motor oils; lacquer, waste paint and primer; copper scrap and waste; waste oil and fuel filters from vehicles;
- Hazard Class IV: waste drilling fluids; wood waste (chipboards and/or fibreboards); worn-out work clothing and footwear; waste PVC-based foam plastic; sludge from mechanical treatment of wastewater after hydrotesting; sewage from cesspits; gypsum board scrap; waste roofing paper; asphalt and asphalt concrete scrap; oiled wiping cloth; waste tyres; waste air filters from vehicles, etc.; and
- Hazard Class V: waste from limbing and topping of trees; waste from stump clearance; vulcanized-rubber scrap; waste wooden packaging materials; waste polyethylene film; polyethylene scrap and waste products; concrete fragments; waste welding rods/ stubs, etc.

The total quantity of waste that will be generated during all stages of the Amur GPP construction amounts to 50,566.6 tonnes. Most waste will belong to Hazard Class IV (44.5%) and V (52%) (Table 9.8.2).

Table 9.8.2: Waste generation at different stages of the Amur GPP construction

Construction stage/facility	Waste generation			
	Hazard Class II	Hazard Class III	Hazard Class IV	Hazard Class V
Early Works Facilities	8	12	1460	1267
Temporary berth (landing area) on the Zeya River	0.6	3	52	1394
Railway infrastructure		89	19171	4590
Access roads			211	14311
Auxiliary production facilities	10	241	2162	1573
Main production facilities	31	1599	10213	15696
MSIW Landfill	1	8	128	80
Total	**50.6**	**1952**	**33397**	**38911**

Waste that will be produced during construction will be accumulated within construction sites and in temporary buildings and structures. Conditions of temporary storage will depend on the type of waste and its Hazard Class.

All generated waste will be accumulated in accordance with the relevant regulations and will be stored:

on shelves in a closed space:

- waste lead batteries;

in metal 200 l drums in a closed space:

- waste transmission oils (mineral);

- waste motor oils (mineral); and
- waste halogen-free hydraulic oils;

in metal lidded boxes with the capacity of 0.17 m3:

- oiled wiping cloth;
- waste oil filters from vehicles;
- waste fuel filters from vehicles; and
- waste air filters from vehicles;

in a metal container with the capacity of 1 m3:

- waste paint cans (paint content of 5% or less);
- waste tyres;

in a metal container with the capacity of 1 m3 or in bulk on sealed surface under cover:

- wire and cable waste;
- steel scrap;

in bulk in a sealed surface area:

- waste tyres;

in a lidded container for MSW with the capacity of 0.8 m3:

- garbage from offices and amenities;
- worn-out work footwear;
- oiled work clothing made of natural, synthetic, artificial or wool fibre (with oil content of less than 15%); and
- food waste;

in an onsite container for construction waste with the capacity of 8 m3:

- asphalt and asphalt concrete scrap;
- concrete scrap and waste concrete fragments;
- unsorted sawdust and chips of clean natural wood;
- steel welding rod stubs;
- welding slag;
- clean cardboard packaging waste;
- polypropylene waste; and
- polyethylene waste;

in a tank of 10 m3:

- sewage from cesspits;

in areas specially designated for bulk storage of wood:

- waste from limbing and topping of trees; waste from stump clearance.

Transport of waste will require fulfilment of the following conditions:

- certificates for waste of Hazard Class II, III and IV must be in place;
- waste will be carried by specially equipped vehicles with appropriate signage;
- safety requirements for the transportation of waste of Hazard Class II, III and IV will be met;
- license for transportation and handover of waste of Hazard Class II, III and IV is in place.

The frequency of waste removal for disposal/treatment will depend on the waste type:

- household waste – every three days during the cold period and on a daily basis during the warm period;

- waste undamaged lead batteries containing electrolyte – as accumulated in quantity suitable for shipment; and
- other waste types – at least every six months.

Collection, recycling and disposal of waste will be managed by licensed contractors:

- Spetsavtokhozyaystvo LLC (Svobodny),
- AVTOSITI LLC (Blagoveshchensk), and
- Konsul LLC (Blagoveshchensk).

MSW landfills operated by Spetsavtokhozyaystvo and AVTOSITI are listed in the State Registry of Waste Disposal Facilities.

9.8.3 Operation stage

9.8.3.1 Early Works Facilities

Operation of the Early Works Facilities will be associated with generation of municipal solid waste consisting of:

- garbage from offices and amenities; food waste.

Dry sweeping of production areas and warehouses will produce:

- rubbish from production space and sweepings from the facility area.

Maintenance of the diesel power plant will be associated with production of:

- waste batteries, leftover diesel fuel, waste synthetic motor oils, etc.

Treatment of domestic sewage will produce:

- waste sludge from biological treatment facilities for domestic and mixed effluents.

Treatment of industrial wastewater will produce:

- oil film from oil traps, waste from mechanical treatment of oily effluents.

Water from artesian wells will be treated to the drinking quality using mechanical treatment, degassing, and double filtration. This process will result in production of *dewatered sludge (sludge from filter flushing).*

Work clothing and footwear used by personnel will wear out to produce:

- worn-out work clothing and footwear, including rubber waste.

Maintenance and repair of mobile equipment and vehicles will result in production of:

- waste lead batteries, waste mineral and synthetic motor oils, waste fuel filters, etc.

Machine treatment of metals will result in production professional:

- waste oils, abrasive material powder, oiled wiping cloth, etc.

Welding operations will produce waste welding rods and steel electrode stubs.

Painting operations will be associated with generation of paint, lacquer and primer waste, metal cans containing leftover paint.

Details of waste generation during operation of the Early Works Facilities are provided in Table 9.8.3

Table 9.8.3: Waste generation during operation of the Early Works Facilities at the Amur GPP

Waste description	Generation source	Hazard Class	Quantity, t
Consumption waste			
Waste from accommodation facilities	Hostels	IV	1,006.0
Waste from offices and amenities, including:	Cleaning of production space	IV	528.3
construction of project facilities			10.0

Waste description	Generation source	Hazard Class	Quantity, t
canteen operation			507.3
Low-hazardous waste and sweepings from production space cleaning	Cleaning of warehouses (storage space)	IV	583.0
Low-hazardous sweepings from the facility area	Cleaning of the facility area	IV	97.8
Total for Hazard Class IV:			2,215.2
Food waste	Canteen (temporary buildings and structures area)	V	169.1
Total for Hazard Class V:			169.1
Consumption waste total:			2,384.3
Production waste			
Waste lead batteries	Maintenance of the diesel power plant	II	3.52
Waste lead batteries	Maintenance of vehicles	II	1.4
Total for Hazard Class II:			4.9
Waste industrial mineral oils	Maintenance of machine tools	III	0.07
Waste transmission mineral oils	Maintenance of vehicles	III	3.4
Oil film from oil traps and similar facilities	Operation of wastewater treatment facilities (WWTF)	III	0.1
Diesel waste	Maintenance of the diesel power plant	III	0.3
Waste synthetic motor oils	Repair work	III	103
Waste paint and lacquer on acryl/vinyl polymer base (lacquer, paint, primer)	Paint/coating work	III	0.009
Non-ferrous metal packing cans containing leftover paint/lacquer (content of 5% or more)	Paint/coating work	III	0.008
Waste oil filters	Maintenance of the diesel power plant	III	0.176
Waste fuel filters		III	0.054
Ethylene glycol waste		III	3.245
Waste oil filters	Maintenance of vehicles	III	0.928
Waste fuel filters		III	0.762

Waste description	Generation source	Hazard Class	Quantity, t
Total for Hazard Class III:			112.4
Worn-out cotton work clothing (coveralls)	Wear of work clothing and footwear used by personnel within construction site	IV	0.64
Worn-out woollen fabric work clothing		IV	0.154
Worn-out work footwear		IV	0.224
Worn-out rubber products		IV	0.058
Abrasive material powder	Metal treatment, machine tools	IV	0.014
Waste from water treatment (sludge from filter flushing)	Operation of WWTF	IV	28.14
Excess sludge from biological treatment of domestic and mixed effluents		IV	427.24
Sludge from mechanical treatment of oily effluents with oil content of less than 15%		IV	4.9
Waste air filters	Maintenance of the diesel power plant	IV	0.023
Oiled wiping cloth	Maintenance/ repair works, wiping of hands	IV	0.7
Waste tyres	Maintenance of vehicles	IV	3.1
Waste air filters from vehicles		IV	0.2
Total for Hazard Class IV:			465.285
Vulcanized-rubber scrap		V	0.032
Clean iron shavings		V	0.006
Unsorted non-ferrous metal shavings	Metal working, machine tools	V	1.6
Brass shavings		V	0.05
Waste wooden packaging	Maintenance of vehicles	V	16.3
Clean packing paper waste		V	0.3
Clean polyethylene packing waste		V	0.1
Waste abrasive wheels, abrasive wheel scrap	Metal working, machine tools	V	0.001
Waste sandpaper		V	0.001
Nonferrous metal scrap	Repair works	V	3.3
Iron scrap	Metal working,	V	0.008

Waste description	Generation source	Hazard Class	Quantity, t
	machine tools		
Brass scrap	-*-	V	0.008
Waste plastic hats	Industrial site	V	0.04
Welding stubs and waste rods	Welding equipment operation	V	0.001
Worn-our brake pads	Maintenance of vehicles	V	1.2
Total for Hazard Class V:			23.03
Production waste total:			605.6
All waste total:			2,989.9

Waste generation during operation of the Early Works Facilities will total 2,989.903 tonnes, including:

- Hazard Class II – 4.919 t;
- Hazard Class III – 112.366 t;
- Hazard Class IV – 2,680.481 t; and
- Hazard Class V – 192.142 t.

Waste accumulation methods and procedures during operation of the Early Works Facilities will be similar to those of the construction stage:

- use of lidded metal containers installed in sealed surface areas;
- use of lidded containers installed in sealed surface areas and designated for specific waste.

More specifically, waste management will also include the following methods.

- *Bulk storage of sorted waste in sealed surfaces areas:* waste tyres; wooden packaging waste; scrap and waste containing clean nonferrous metals in the form of products or fragments; scrap iron and brass fragments.
- *Storage in metal containers at the site of the WWTFs:* oil from oil traps and similar facilities.
- *Storage in facility transport containers at the site of the WWTFs:* excess sludge from biological treatment process; sludge from mechanical treatment of oily effluents with oil content of 15% or greater;
- *Storage in bags on pallets at the site of the WTFs:* waste from water treatment (sludge/sediment from filter flushing).

The area of temporary buildings and structures will have the following facilities for temporary waste accumulation/storage:

- waste container areas;
- temporary waste storage areas;
- waste storage areas at the WWTFs and WTFs sites.

Open areas for waste accumulation will be:

- located downwind from housing facilities and enclosed within a fence or fencing mesh with the height of 1.2-1.3 m;
- waterproofed using asphalt, concrete, reinforced concrete, ceramsite concrete, etc.;
- bunded or curbed to establish a waterproof barrier; and
- protected from being flooded with surface water.

All containers will have lids for protection from atmospheric precipitation.

Methods and procedures for the transportation of waste that will be generated during operation of the temporary buildings and structures will be similar to those used at the construction stage.

Collection, storage, treatment and utilisation of waste will be carried out by licensed contractors.

- *Spetsavtokhozyaystvo LLC (Svobodny) and AVTOSITI LLC (Blagoveshchensk) will manage*: domestic waste, rubbish from offices and amenities; low-hazardous rubbish and sweepings from production space cleaning; food waste from kitchens and catering facilities; abrasive material waste (powder), waste work clothing and footwear; waste rubber products; excessive sludge from biological treatment facilities; sludge from mechanical treatment of oily wastewater with oil content of less than 15%; vulcanised rubber scrap; wood, paper and polyethylene packaging waste; waste abrasive wheels and abrasive wheel scrap; waste protective hats; brake pads.
- *Konsul LLC (Blagoveshchensk) will manage:* waste lead batteries, waste industrial mineral oils and mineral transmission oils, oil film from oil traps and similar facilities; leftover diesel, synthetic and semisynthetic motor oil; waste paint and lacquer on acryl/vinyl polymer base (lacquer, paint, primer); nonferrous metal packing scrap, waste oil/fuel/air filters; oiled wiping rags; waste metal cord tyres.
- *AVTOSITI LLC (Blagoveshchensk) will also manage*: iron/nonferrous metal/brass shavings and scrap; unsorted nonferrous metal scrap; iron scrap and waste; welding stubs and waste rods.

9.8.3.2 Operation of auxiliary facilities

Waste generated by life activity of operation personnel will consist of waste from offices and amenities. Accommodation and meals for the Amur GPP personnel will be provided in a housing complex in Svobodny. Waste will also include rubbish and sweepings from the cleaning of production space and site area.

Maintenance of backup diesel power plants, mobile compressors and welding equipment will produce:

- waste batteries; leftover diesel fuel, waste oil/fuel/air filters; waste diesel; waste synthetic motor oils; oiled wiping cloth.

Routine maintenance and repair of vehicles will produce:

- waste synthetic motor oils; waste transmission mineral oils; oiled wiping cloth; waste tyres; copper scrap and waste; aluminium scrap and waste; nonferrous metal scrap; vulcanised rubber scrap; wooden packaging; clean polyethylene and paper packing waste; waste lead batteries; waste brake pads; oiled sand.

Maintenance of mechanical treatment machine tools will produce:

- industrial mineral oil waste; oiled wiping cloth; waste wooden packaging; packing paper and polyethylene waste.

Mechanical treatment operations will be associated with generation of:

- abrasive natural powder; nonferrous metal shavings; waste abrasive wheels and wheel scrap; nonferrous metal scrap.

Welding works will be associated with generation of welding slag, waste steel welding rods and stubs. Work clothing and footwear used by personnel will wear out to produce:

- worn-out work clothing, leather footwear, and plastic hard hats.

All water supplied to the facility will be treated at the water treatment facilities. The process of drinking water treatment will include stage 2 iron removal filters. Flushing of filter units will produce sludge.

Operation of wastewater treatment facilities will be associated with generation of:

- sludge from mechanical treatment of oily effluents with oil content of less than 15%; excessive sludge from biological treatment of domestic and mixed effluents; low-hazardous waste from drain grates of domestic and mixed effluent sewer system.

Waste from treatment of rainwater and snowmelt at the wastewater treatment facilities and from car washing at local treatment facilities will consist of:

- oil from oil traps and similar facilities; sludge from mechanical treatment of oily effluents with oil content of less than 15%.

Waste generation details, including classes of hazard, are provided in Table 9.8.4.

Table 9.8.4: Summary of waste generation during operation of the Auxiliary Facilities at the Amur GPP

Waste description	Generation source	Hazard Class	Quantity, t
Consumption waste			
Waste from offices and amenities	Cleaning of production space	IV	25.652
Low-hazardous waste and sweepings from production space	Cleaning of warehouses (storage space)	IV	453,447
Low-hazardous sweepings from the facility area	Cleaning of the facility area	IV	600.833
Total for Hazard Class IV:			1,079.932
Consumption waste total:			1,079.932
Production waste			
Waste non-automotive batteries (undamaged lead batteries containing electrolyte)	Maintenance of the diesel power plant	II	0.862
Undamaged lead batteries containing electrolyte	Maintenance of vehicles	II	0.897
Total for Hazard Class II:			1.759
Leftover diesel fuel unfit for use	Maintenance of the diesel power plant	III	0.211
Waste mineral transmission oil	Maintenance of vehicles	III	6.060
Surfaced oil from oil traps and similar facilities	Operation of the WWTFs	III	21.110
Waste synthetic motor oil	Maintenance of vehicles Maintenance of the diesel power plant	III	44.733
Waste mineral industrial oil	Maintenance of machine tools	III	0.470
Other waste from maintenance of machines and equipment (waste oil filters)	Maintenance of the diesel power plant	III	10.121
Other waste from maintenance of machines and equipment (waste fuel filters)	Maintenance of the diesel power plant	III	2.249
Clean unsorted copper scrap and waste	Maintenance of vehicles	III	0.018
Oily sand (oil content of 15% or greater)	Maintenance of vehicles	III	1.890
Waste oil filters	Maintenance of vehicles	III	0.395
Waste fuel filters	Maintenance of vehicles	III	0.285
Total for Hazard Class III:			87.542
Oiled work clothing made of natural, synthetic, artificial and wool fibre (oil content of less than 15%)	Industrial site	IV	2.644
Waste leather work footwear unfit for wear	Industrial site	IV	0.712
Abrasive material waste (powder)	Metal working, machine tools	IV	0.110
Waste from water treatment (sludge from filter flushing)	Water treatment	IV	73.000
Rubbish from drain grates of domestic and mixed effluents sewer system	Operation of WWTFs	IV	3.012

Waste description	Generation source	Hazard Class	Quantity, t
Excess sludge from biological treatment of domestic and mixed effluents	Operation of WWTFs	IV	78.813
Sludge from mechanical treatment of oily effluents with oil content of less than 15 %	Operation of WWTFs	IV	775.239
Waste air filters	Maintenance of the diesel power plant	IV	0.562
Oiled wiping cloth with oil content of less than 15 %	Maintenance of machine tools Maintenance of vehicles Maintenance of the diesel power plant	IV	0.324
Waste tyres	Maintenance of vehicles	IV	1.959
Waste automotive air filters	Maintenance of vehicles	IV	0.082
Total for Hazard Class IV:			936.457
Vulcanised rubber scrap	Maintenance of vehicles	V	0.024
Clean unsorted ferrous metal shavings	Metal working, machine tools	V	4.490
Waste wooden packaging / containers	Maintenance of vehicles	V	9.312
Clean packing paper waste	Maintenance of vehicles	V	0.219
Clean polyethylene packing waste	Maintenance of vehicles	V	0.087
Waste abrasive wheels and wheel scrap	Metal working, machine tools	V	0.028
Ferrous metal scrap	Maintenance of vehicles	V	2.304
Unsorted aluminium scrap and waste	Maintenance of vehicles	V	0.043
Waste plastic hard hats	Maintenance of vehicles	V	0.142
Waste steel welding rods and stubs	Maintenance of vehicles	V	0.012
Waste brake pads	Maintenance of vehicles	V	0.449
Total for Hazard Class V:			17.110
Production waste total:			1,042.868
WASTE TOTAL:			2,122.800

Table 9.8.5 provides data on the quantity of waste of different hazard classes that will be generated during operation of the Auxiliary Facilities.

Table 9.8.5: Quantity and hazard class of waste that will be generated during operation of the Auxiliary Facilities

Waste Hazard Class, tonnes			Total, t /year
	Consumption	Production	
Hazard Class II		1.759	1.759
Hazard Class III		87.542	87.542
Hazard Class IV	1079.932	936.457	2016.389
Hazard Class V		17.110	17.110

Waste generated during operation of the Auxiliary Facilities will be accumulated and stored:

in closed metal containers on sealed surface:

- waste from accommodation facilities, household waste; food waste; waste work clothing and footwear;
- non-hazardous sweepings from the facility area; various wood scrap; waste plastic hard hats; welding slag; automotive air filters; wooden packaging materials; gypsum board scrap; packing paper and polyethylene waste; waste abrasive wheels and wheel scrap; roofing paper scrap; waste brake pads;

in sealed chemically resistant containers in covered areas with sealed surface (sorted by types):

- leftover diesel, waste machine and transmission mineral oil; waste synthetic motor oil;

in closed containers in sealed surface areas (sorted by waste types):

- oil waste from oil traps and similar facilities; waste paint and lacquer on acryl/vinyl polymer base; copper scrap and waste; non-ferrous metal packing cans containing leftover paint/lacquer (content of 5% or more); waste oil and fuel filters; oiled sand; waste from water treatment (sludge from filter flushing); sludge from biological water treatment; sludge from mechanical treatment of oily effluents; nonferrous metal shavings; aluminium scrap and waste; insulated cable and wire scrap;

in covered sealed surface areas (sorted by waste streams):

- waste lead batteries; waste tyres; nonferrous metal scrap; aluminium scrap and waste.

The design provides for a temporary waste storage area at the Auxiliary Facilities. The surface will be sealed with reinforced concrete road slabs and the site perimeter will be fenced with wire mesh. The area will be curbed and drainage of rainwater and snowmelt into the stormwater sewer will be provided.

Transportation of waste generated during operation of the Auxiliary Facilities will require fulfilment of the following conditions:

- certificates ('passports') for waste of Hazard Class II, III and IV must be in place;
- waste will be carried by specially equipped vehicles with appropriate signage;
- safety requirements for the transportation of waste of Hazard Class II, III and IV will be met;
- license for transportation and handover of waste of Hazard Class II, III and IV is in place;
- waybill indicating waste quantity, purpose of transportation and destination.

The frequency of waste removal will depend on the waste type:

- household waste – every three days during the cold period and on a daily basis during the warm period;
- waste undamaged lead batteries containing electrolyte – as accumulated in quantity suitable for shipment; and
- other waste types – at least every 11 months.

Collection, recycling and disposal of waste will be managed by licensed contractors:

(1) AVTOSITI LLC (Blagoveshchensk), TDM LLC (Blagoveshchensk, Svobodny), LOMPROM LLC (Belogorsk) – waste brake pads; copper scrap and waste; aluminium scrap; nonferrous metal scrap; insulated cable and wire waste;

(2) Konsul LLC (Blagoveshchensk) – waste mineral oils, waste lead batteries, and waste tyres.

The Amur GPP Project provides for construction of a landfill for disposal of municipal solid waste and industrial waste of Hazard Class III to V, including thermal destruction of municipal solid waste of Hazard Class IV-V and industrial waste of Hazard Class III–V.

9.8.3.3 Operation of the Railway Infrastructure Facilities

The Railway Infrastructure Facilities will consist of the railway line that will connect the Project site with the "Ust-Pera" station of the Trans-Siberian Railway (approximately 15 km), including two railway stations, "Zavodskaya 1" and "Zavodskaya 2".

The following amounts of wastes will be generated in the process of operation of the railway infrastructure facilities: 952.6 t/year of wastes of Hazard Classes III to V, of which 67% are wastes of Hazard Class IV and 30% of wastes of Hazard Class IV (Table 9.8.6).

Table 9.8.6: Amounts of wastes to be generated in the process of operation of the railway infrastructure facilities of Amur GPP

Railway infrastructure facilities	Quantity of wastes generated annually, tonnes		
	Hazard Class III	Hazard Class IV	Hazard Class V
"Ust-Pera"		55.6	
"Zavodskaya"	16.6	520.7	151
"Zavodskaya-2"	7.7	60.4	140.6
Total:	24.3	636.7	291.6

The list of major types of wastes and their quantities that will be generated in the process of operation of the railway infrastructure facilities is presented in Table 9.8.7.

Table 9.8.7: List of main types of wastes and their quantities that will be generated during the operational phase at the railway infrastructure facilities of Amur GPP

Waste description	Hazard Class	Quantity, t/year	To be handled by the following contractor organizations
Sludge from cleaning of tanks to remove residues of oil and oil products	III	17	"Konsul" LLC, Blagoveshchensk
Railway sleepers (wooden sleepers impregnated with antiseptic composition)	III	7.7	"Konsul" LLC, Blagoveshchensk
Welding slag	IV	0.1	"TDM" LLC, Svobodny
Oil-polluted wiping material	IV	5.6	"Avtositi" LLC, Belogorsk
Garbage from offices and general facilities	IV	162	"SpetsAvtoKhozyaistvo" LLC, Svobodny
Spent cartridges for printing devices	IV	0.4	"SpetsAvtoKhozyaistvo" LLC, Svobodny
Sweepings from the site	IV	457	"SpetsAvtoKhozyaistvo" LLC, Svobodny
Wastes (residue) from wastewater	IV	13	"SpetsAvtoKhozyaistvo" LLC, Svobodny
Растительные отходы при уходе за газонами	V	152	"SpetsAvtoKhozyaistvo" LLC, Svobodny
Residues of welding electrodes	V	0.1	"TDM" LLC, Svobodny
Kitchen refuse	V	5.5	"SpetsAvtoKhozyaistvo" LLC, Svobodny
Ferrous scrap, steel cutting chips	V	1.9	"TDM" LLC, Svobodny
Branch wood generated during tree felling	V	107	"SpetsAvtoKhozyaistvo" LLC, Svobodny

Municipal solid waste and sweepings from the site will be collected in metal containers installed in specially designated areas. Waste will be removed by Spetsavtokhozyaystvo, a licensed waste management contractor.

Liquid waste will be collected in metal containers and removed by a dedicated vehicle (vacuum truck) every three days during the cold period and on a daily basis during the warm period.

Other waste will be accumulated in metal containers installed in sealed surface areas. Waste will be removed from the site at least every six months.

Removal of all waste types shall be performed by companies licensed for specific activities. Before the commissioning of the landfill for disposal of domestic solid waste generated at the Amur GPP and associated infrastructure facilities, it is planned to commission a specialist company ("SpetsAvtoKhozyaistvo" LLC, Svobodny) on a contractual basis.

Handling of medical wastes is specified by the relevant Russian regulatory documents. All medical wastes of Class B generated at the Company's medical station located in the office complex of the locomotive shed and in the GPP Office Building shall be collected after their disinfection in a non-reusable container. Sharp medical instruments (needles, cutting inserts, etc.) shall be collected after their disinfection separately from other waste types in a non-reusable hard container.

Transportation of all types of medical wastes shall be performed in non-reusable tightly sealed packaging, which should be placed in a hard container designate only for medical wastes. Medical wastes shall be handed over to a specialist company for disposal.

9.8.3.4 Operation of the Temporary Jetty on the Zeya River

Details of waste generation during operation of the Temporary Jetty are presented in Table 9.8.8.

Table 9.8.8: Summary of waste generation during operation of the Temporary Jetty on the Zeya River

Description	Hazard Class	Quantity, t/y
Waste mineral motor oil	3	1.9
Sweepings from the facility area	4	41.25
Waste from offices and amenities	4	0.4
Sewage (sludge) from cesspits	4	4.335
Oiled sawdust and chips	4	0.060
Rubbish from stormwater drain grates	4	8.908
Oiled wiping cloth	4	0.703
Waste work footwear	4	0.068

Waste that will be generated during operation of the Temporary Jetty will total 57.635 tonnes, including:

- 1.9 tonnes of Hazard Class III;
- 55.724 tonnes of Hazard Class IV.

All waste from the Jetty operation will be transferred to specialised contractors or for disposal area the landfill of "Spetsavtokhozyaystvo" LLC.

Waste disposal awaiting removal will be temporarily accumulated in specially designated and equipped areas. Municipal solid waste will be collected in standard lidded containers of 0.8 m3 which will be installed within a specially covered area provided with surface runoff drainage. Oiled sawdust and cloth will be stored in lidded metal containers within a covered MSW storage area.

9.8.3.5 GPP Operation

Operation of the Min Facilities will be associated with generation of various production and solid municipal (domestic) waste (Table 9.8.9).

Table 9.8.9: Types of waste from operation of the Main Facilities of the Amur GPP

Waste generation source	Waste types
Life activity of operation personnel	• Waste from offices and amenities • Food waste from kitchens and catering facilities • low-hazardous rubbish and sweepings from production premises
Maintenance of backup diesel power plants	• Waste batteries • Leftover diesel • Waste fuel/oil/air filters • Waste synthetic motor oil • Oiled wiping cloth
Maintenance of mechanical treatment machine tools	• Waste industrial mineral oil • Oiled wiping cloth • Waste wooden crates • Waste packing paper • Waste polyethylene packing
Mechanical treatment of materials	• Waste abrasive material (powder) • Non-ferrous metal shavings • Waste abrasive wheels
Welding works	• Welding slag and waste welding rods and stubs
Wear of work clothing	• Waste work clothing • Waste work footwear • Waste plastic hard hats
Water treatment	• Sediment/sludge from filter flushing
Wastewater treatment	• Sludge from mechanical treatment of oily effluents with oil content of less than 15% • Sludge from biological treatment of domestic and mixed effluents • Low hazardous rubbish from drain grates of domestic and mixed sewerage system • Surfaced oil from oil traps and similar facilities • Sludge from mechanical treatment of oily wastewater with oil content of less than 15%
Office equipment replacement	• Waste printer cartridges, keyboards, mouses (manually operated user-select equipment), cables, etc.
Main Operations (GPP)	
Replacement of sorber filling	Waste sorbents contaminated with hazardous substances: waste silicon and aluminium oxide catalysts (ceramic balls); waste oiled zeolite with oil content of less than 15%
Catalyst replacement	Waste active aluminium oxide catalysts containing palladium
Adsorber filling	Uncontaminated waste silica gel and activated carbon from air and gas dehydration

Hazard classes of waste are indicated in Table 9.8.10.

Table 9.8.10 Summary of waste generation during operation of the Main Facilities of the Amur GPP

Waste description	Generation source	Hazard Class	Quantity, t
Consumption waste			
Waste from offices and amenities	Cleaning of accommodation premises	IV	94.8
	Cleaning of production space		61.9
	Canteens		32.9
Low-hazardous waste and sweepings from production space	Cleaning of warehouses (storage space)	IV	17.8
Low-hazardous sweepings from the facility area	Cleaning of the facility area	IV	430.7
Food waste	GPP canteen	V	21.9
Production waste			
Waste non-automotive batteries (undamaged lead batteries containing electrolyte)	Maintenance of the diesel power plant	II	0.39
Waste mineral industrial oil	Equipment maintenance	III	216.3
Waste mineral turbine oil	Maintenance of GTU engines	III	343.5
Surfaced oil from oil traps and similar facilities	Operation of wastewater treatment facilities (WWTF)	III	46.9
Leftover diesel fuel unfit for use	Maintenance of diesel power plant	III	0.09
Waste synthetic motor oil	Maintenance of diesel power plant	III	2.4
Waste active aluminium oxide catalysts containing palladium	Main production process	III	22.0
Waste oiled zeolite with oil content of 15% or greater		III	180.0
Oiled activated carbon with oil content of 15% or greater		III	10.8
Waste sorbents contaminated with hazardous substances (aluminosilicate-based sorbent from the gas cleaning and dehydration installation)		III	12.0
Oiled nonwoven synthetic filter fabric with oil content of 15% or greater		III	0.3
Other equipment maintenance waste (waste oil filters)	Maintenance of diesel power plant	III	0.045
Other equipment maintenance waste (waste fuel filters)		III	0.01
Other equipment maintenance waste (ethylene glycol antifreeze)		III	1.9
Waste cotton work clothing	Production site	IV	7.5
Waste woollen work clothing		IV	3.0
Waste work footwear		IV	3.0
Waste rubber products		IV	0.4
Waste silicon and aluminium oxide catalysts (ceramic balls)	Main production process	IV	96.9
Waste oiled zeolite with oil content of less than 15%		IV	631.8
Waste printer cartridges with toner content of 7% or greater	Production space	IV	0.4
Waste keyboards and mouses with cables	Production space (indoor and outdoor)	IV	0.04
Electrical equipment unfit for use (waste LED lamps and spotlights)	Production space (indoor and outdoor)	IV	3.4
Low-hazardous waste from drain grates of domestic and mixed effluent sewer system	WWTF operation	IV	15.5
Sludge from mechanical treatment of oily effluents with oil	WWTF operation	IV	2066.6

Waste description	Generation source	Hazard Class	Quantity, t
content of less than 15%			
Waste air filters	Maintenance of diesel power plant	IV	0.007
Welding slag	Operation of welding equipment	IV	0.04
Oiled wiping cloth with oil content of less than 15 %	Maintenance of compressor equipment	IV	0.960
			0.08
	Maintenance of diesel power plant		0.01
	In-container oil depot		0.6
	Maintenance of machine tools		0.3
Clean unsorted ferrous metal shavings	Metalworking machines	V	0.06
Uncontaminated silica gel waste from air and gas dehydration	Main production process	V	48.8
Uncontaminated waste activated carbon from air and gas dehydration		V	22.3
Waste abrasive wheels and wheel scrap	Metal working, machine tools	V	0.03
Waste plastic hard hats	Production space	V	0.3
Sludge from biological treatment of domestic and mixed effluents	WWTF operation	IV	145.3
Waste steel welding rods and stubs		V	0.07
WASTE TOTAL:			4,447.7

Waste that will be generated during operation of the Main Facilities will total 4,447.7 tonnes, including:

- 0.392 tonnes of Hazard Class II;
- 836.2 tonnes of Hazard Class III;
- 3,372.5 tonnes of Hazard Class IV; and
- 238.6 tonnes of Hazard Class V.

All waste generated during operation of the Main Facilities will be accumulated in specially designated areas in accordance with waste management procedures similar to those provided for the Auxiliary Facilities. Waste will be accumulated/ stored in:

- mixed waste in closed metal containers on sealed surface;
- sealed chemically resistant containers in covered areas with sealed surface (sorted by types);
- closed metal containers in sealed surface areas.

Temporary storage of waste from the Main Facilities will be provided in the waste storage area of the Auxiliary Facilities which will be equipped with impermeable screen (membrane) and a mesh wire fence.

Transportation of waste generated during operation of the Main Facilities will require fulfilment of the following conditions:

- certificates ('passports') for waste of Hazard Class II, III and IV must be in place;
- waste will be carried by specially equipped vehicles with appropriate signage;
- safety requirements for the transportation of waste of Hazard Class II, III and IV will be met;
- license for transportation and handover of waste of Hazard Class II, III and IV is in place;

The frequency of waste removal will be similar to that planned for the construction period.

Collection, recycling and disposal of waste will be managed by licensed contractors: Spetsavtokhozyaystvo LLC (Svobodny), AVTOSITI LLC(Blagoveshchensk), TDM LLC(Blagoveshchensk, Svobodny), LOMPROM LLC (Belogorsk), and Konsul LLC (Blagoveshchensk).

9.8.4 SDIW landfill (Landfill)

The SDIW landfill is a part of the Amur GPP Project. The Landfill will be used for disposal of industrial waste of Hazard Class III-V and for thermal treatment of municipal solid waste of Hazard Class IV-V and industrial waste of Hazard Class III-V that will be generated during operation of the Amur GPP Project.

The Landfill will be capable of accommodating 371 thousand tonnes of waste, of which 166 thousand tonnes will be buried and 205 thousand tonnes will be subjected to thermal destruction (including waste generated by the landfill operation). These data are for the entire life cycle of the Landfill.

In accordance with common waste management technique the operational area, which occupies most of the Landfill, is divided into the waste burial and thermal destruction zones.

The waste burial zone accounts for most of the operational area and consists of:

- 16 specially equipped cells (compartments) for landfilling of Hazard Class IV-V industrial waste;
- two cells for disposal of wastewater sludge of Hazard Class IV; and
- insulating earth bunding.

Industrial waste and bagged wastewater sludge will be unloaded by dump trucks into specially equipped cells with plan size of 88 x 44 m. The landfill cells will be enclosed within earth bund/dam and equipped with impermeable screen (membrane) and a drainage system.

Waste will be dumped by truck in the unloading area of the current working cell and moved by a bulldozer onto the working cell creating a bank with a flat slope 2.5 m above the dump truck unloading level. The bank of the next working cell will be moved towards the previous one, i.e. the landfilling will be carried out by the 'floatover' method.

The thermal destruction zone for industrial waste of Hazard Class III-IV (including oil containing waste) municipal (domestic) waste of Hazard Class IV-V and medical waste will consist of:

- area for containers with the landfill waste;
- unloading area for thermal destruction waste; and
- three thermal destruction units KTO-100.K40.P.

Thermal destruction of landfill effluents of Hazard Class III and liquid industrial waste of Hazard Class III-IV from the Amur GPP will be carried out in the industrial effluent treatment area which will include:

- thermal destruction unit KTO-2000.PS.;
- industrial effluents tank V=100 m3;
- liquid waste tank V=10 m3;
- pumping plant for the transfer of industrial effluents to KTO;
- pumping plant for the transfer of liquid waste to KTO; and
- reserve tank for industrial effluents V=25 m3.

The Landfill waste management procedure is summarised in Table 9.8.11.

Table 9.8.11: Waste management procedures at the Amur GPP Landfill

Waste stream/type	Management method	Delivery	Quantity (volume) delivered	Quantity of vehicles employed
Municipal solid waste from temporary storage area during operation of the Amur	Landfilling (burial)	Rubbish truck	6551 t/y or 18 t/day	4 trucks per day

Waste stream/type	Management method	Delivery	Quantity (volume) delivered	Quantity of vehicles employed
GPP Project facilities				
Solid industrial and medical waste	Thermal destruction	Waste disposal trucks or garbage container trucks	244 t/y (305 m^3)	38 trucks per year or one truck per week
Liquid industrial waste	Thermal destruction (KTO-2000.PS.NGM)	Tank trucks	383 t/y (383 m^3)	45 trucks per year or one truck per week
Industrial waste, including dewatered wastewater sludge	Burial in specially designated cells	Dump trucks	1,425 t/y	110 trucks per year or 2-3 trucks per week 2
Material for earthen bunding from borrow pits	Isolation within bunding	Heavy dump trucks 11.7 t	1,023 m^3/y	157 trips per year or 3-4 trips per week
Solid waste not intended for landfilling in cells	Thermal destruction (KTO-100.K40.P)	Vacuum trucks KO-523		
Industrial effluents	Thermal destruction (KTO-2000.PS.NGM)	Vacuum trucks KO-523	47 m^3/day	2-3 trips per day (110 days during the warm period)

The following waste will be delivered to the Landfill from the Amur GPP Project facilities:

Hazard Class III:

- surfaced oil from oil traps and similar facilities;
- leftover diesel fuel unfit for use;
- waste paint and lacquer on acryl/vinyl polymer base (lacquer, paint, primer);
- oiled zeolite with oil content of 15% or greater;
- oiled activated carbon;
- oiled nonwoven synthetic filter fabric with oil content of 15% or greater;
- oil sludge from tank and pipeline cleaning;
- waste oil filters;
- waste fuel filters;
- oily sand with oil content of 15% or greater;

Hazard Class IV:

- waste cotton work clothing;
- waste woollen work clothing;
- waste work footwear;
- waste rubber products;
- waste abrasive materials (powder);
- uncontaminated thermal insulation materials on mineral fibre base;
- waste printer cartridges with toner content of 7% or greater;
- keyboards and mouses with cables unfit for use;

- waste LED lamps and spotlights;
- low-hazardous rubbish from drain grates of domestic and mixed effluent sewer system;
- sludge from mechanical treatment of oily effluents with oil content of less than 15%;
- waste from accommodation facilities;
- waste from offices and amenities;
- low-hazardous rubbish and sweepings from production premises;
- low-hazardous sweepings from the facility area;
- solid residue from oiled waste incineration;
- waste air filters;
- welding slag;
- oiled wiping cloth;
- waste air filters from vehicles;

Hazard Class V:

- plant waste from lawn and flowerbed care;
- vulcanised rubber scrap;
- food waste;
- waste wooden crates;
- clean packing paper waste;
- clean polyethylene packing waste;
- uncontaminated silica gel waste from air and gas dehydration; adsorbent;
- uncontaminated waste activated carbon from air and gas dehydration;
- waste abrasive wheels and wheel scrap;
- waste insulated wires and cables;
- waste plastic hard hats;
- stabilised sludge from biological treatment of domestic and mixed effluents.

In addition, medical waste of Class A and B will be delivered for thermal destruction.

Table 9.8.12 provides a summary of types, quantity, and management methods for waste that will be delivered to the landfill from the Amur GPP facilities and waste generated from the landfill operation.

Table 9.8.12: Waste quantity and treatment methods at the Amur GPP Landfill

Waste types and management methods	Quantity	
	t/y	Total for 25 years of operation
Thermal destruction:	8,192	138,053
• liquid waste of Hazard Class III-V	5,522	138,053
• solid waste of Hazard Class III-V	2,268	66,709
• medical waste	1.4	33.8
Landfilling (burial) in cells:	6,658	371,255
Sludge from effluents - Hazard Class	979	24,467

Waste types and management methods	Quantity	
	t/y	Total for 25 years of operation
IV		
Industrial waste of Hazard Class III-V	5,680	166,459
Total	**14,850**	**371,255**

Unloaded vehicles leaving the Landfill will pass through wheel decontamination facility (concrete tray filled with sawdust impregnated with 0.5% solution of virucidal disinfectant).

Environmental impact of the Landfill operation will be minimised provided that all embedded controls relating to accumulation, collection, transportation, utilisation, treatment, and disposal of production and consumption waste are implemented

9.8.5 Summary

Environmental impact of production and consumption waste during construction and operation of the Project facilities will be minimised provided that all embedded controls relating to waste accumulation, collection, transportation, utilisation, treatment, and disposal are implemented.

A summary of information on the waste management and mitigation measures during construction and operation of the Project facilities is given in Table 9.8.13, and general requirements for monitoring of the waste-related environmental impacts - in Table 9.8.14.

Table 9.8.13: Summary of waste management information and impact mitigation measures

Impact	Receptor / Resource	Stage	Embedded controls (Impact mitigation measures provided for in the design)	Residual Impact
Waste management facilities	Waste management facilities of the Project/Company and third parties	Construction and Operation	Regular collection of waste by licensed contractors. Separation of hazardous waste according to type. Disposal/recycling of most waste at licensed (specialised) facilities. Minimisation of waste generation (including recycling, incineration, compaction, and minimisation of drilling waste generation). Limited quantities of hazardous waste. All third-party facilities must be entered in the State Register of Waste Management Facilities.	Moderate to low provided that waste disposal facilities are operated in accordance with the established regulatory requirements
Impact on human health	Construction and operation personnel	Construction and Operation	Safe temporary storage of waste within specially designated areas. Regular collection of waste by licensed contractors. Separation of hazardous waste according to type. Waste management training of personnel. Removal of waste by type to specialised disposal facilities / landfills. Pest control by means of removal of waste that serves as a source of food for rodents. Deratisation, including setting of traps around kitchens and canteens. Provision of biotoilets and removal of sewage by specialised contractors. Provision of containers for collection of municipal solid waste. Accumulation of waste/rubbish outside of the site boundaries will be prohibited. Containers for municipal solid waste will have close lids. Domestic waste containers, skips and surface under these will be washed and disinfected every 10 days during the summer period in accordance with the requirements of the State Sanitary and Epidemiological Supervision authority.	Low
Impact on surface water and groundwater	Surface water and groundwater	Construction and Operation	The Landfill for solid municipal and industrial waste will be located in the area of relatively impermeable soil outside of buffer zones of water bodies and water intake facilities. Roads will be sealed with strong oil resistant materials. Provisions for recovery of accidental spills will be in place. Special equipment of waste storage areas (lidded metal or plastic containers, special leakproof bags, etc.). Waste container area will have asphalt or concrete surface and will be fenced on three sides to the height of 1.0-1.2 m to prevent impact of waste on the surrounding area.	

Impact	Receptor / Resource	Stage	Embedded controls (Impact mitigation measures provided for in the design)	Residual impact
			Each temporary waste storage area will be accessible via special driveways and pathways.	
Environmental impact	Terrestrial fauna	Construction and Operation	Removal of feeding resources for rodents: safe temporary surrounding of kitchen and canteen waste within specially designated areas; regular collection and removal of waste by licensed contractors. Sewage from cesspools will be collected in special containers and duly removed by vacuum trucks for utilisation.	
Environmental impact	Ambient air	Construction and Operation	Rubbish and soil will be watered before transportation to prevent dusting and will carried by dump trucks with canvas cover. Waste will be transported by dedicated vehicles of the Company or by special vehicles of the waste management contractors. Waste shipment will be attended only by authorised personnel of the Company/Contractor. Waste packing will be inspected before shipping to prevent dust generation, spills or other losses and associated environmental pollution during transportation.	
Environmental impact	Environment in general	Construction and Operation	Separate waste collection. Control of temporary storage, collection, and removal of all waste types. Timely conclusion of contracts for treatment and disposal of waste with licensed organisations possessing waste management facilities entered into the State Register. Hazardous waste will be carried by specially equipped vehicles with appropriate signage. Requirements for safe transportation of hazardous materials will be observed. Assignment of personal responsibility for waste management at each independent facility of the Amur GPP. Timely training of personnel responsible for waste management.	

Table 9.8.14: Summary of requirements for the monitoring of waste-related impacts

Aspect	Stage	Location	Parameters	Frequency
Landfill	Entire life of the Project	Landfill for solid municipal and industrial waste – assessment of waste management procedures to determine compliance with the existing environmental protection requirements	Assessment of compliance of waste collection, accumulation, and storage procedures with environmental protection, sanitary-epidemiological, and fire safety requirements. Documenting of waste quantity (volume), type and hazard class. Documenting of presence or absence of waste outside of designated temporary storage areas. Documenting of the type and quantity of waste found outside of the designated temporary waste storage areas. Inspection of the waste management facility.	As generated and accumulated but at least every three months
Production and consumption waste	Entire life of the Project	Temporary waste storage (accumulation) areas	Assessment of compliance of waste collection, accumulation, and storage procedures with environmental protection, sanitary-epidemiological, and fire safety requirements. Documenting of waste quantity (volume), type and hazard class. Documenting of presence or absence of waste outside of designated temporary storage areas. Documenting of the type and quantity of waste found outside of the designated temporary waste storage areas. Inspection of the waste management facility.	As generated and accumulated but at least once a month

9.9 Environmental impact of potential emergency situations

The review of primary activities and operations at the Amur GPP facilities indicates that the risk of a potential emergency situation is associated with operation of road building and construction machinery, storage of fuels and lubes, and management of industrial waste.

Primary receptors and resources exposed to impact of potential accidents will be air, surface water, geological environment, soil, flora, and fauna. Major factors that will determine the scale of environmental damage resulting from emergencies are:

- oil pollution of water bodies and soil and pollution of ambient air in the event of ignition of oil products;
- shockwave and thermal impact of explosions and fires.

9.9.1 Construction stage

Emergency situations, which may occur during construction, include:

- leaks and spills of diesel fuel, including ignition of diesel;
- scattering of construction sites and adjoining areas with domestic solid waste and construction rubbish.

The major environmental risk is associated with the presence of diesel in the Temporary Facilities (TF) area and on construction sites, e.g. at oil depots, in tanks of fuel trucks, and fuel tanks of construction machinery and equipment.

Potential causes of oil spill related accidents are:

- damage oil/ fuel storage and transportation tanks;
- personnel errors;
- equipment defects; and
- extreme weather conditions.

The probability of potential accidents was assessed using available national statistics for accidents and safety of oil and fuel depots. The frequency of accidents occurring at fuel depots is as follows:

- storage tanks: $9.0*10^{-5}$ for leaks and $1.0*10^{-5}$ for total structural failure
- tank cars: $1.5*10^{-4}$ for leaks

The above assessment is assumed to be the predicted probability of an accident resulting in diesel spill from one tank.

The risk of major accidents during construction is associated with oil/fuel storage facilities. Scenarios of such accidents include:

- oil spill resulting from instantaneous structural failure of oil storage and transfer tanks;
- fire at an oil storage tank; and
- explosion of an oil storage tank.

Temporary oil storage depot of the construction contractor will be installed in a sealed surface area which will be bunded and provided with rainwater and snowmelt drainage to the wastewater sewer and wastewater treatment facilities, i.e. environmental pollution of the surrounding area in the event of accident at these facilities is unlikely.

Since diesel fuel will be brought to construction sites by fuel tank truck carrying 5.5 m3, accidental leaks or spills during fuel dispensing or resulting from a loss of containment at a truck tank will be relatively small.

9.9.2 Operation stage

Operational hazards at the Amur GPP Project facilities will be primarily associated with large quantities of flammable gases and combustible fluids that will be used in the production process, stored at material depots, or loaded in tank cars at the loading/unloading rack.

The probability of failures, especially those of catastrophic character, will be undoubtedly reduced due to the use of automated control systems, multifunctional systems for control of process parameters of blocks and vessels of main and auxiliary equipment, and the presence of adequately trained service personnel. However, the possibility of incidents or accidents occurring at the subject facilities cannot be excluded completely as these may be caused by extreme weather conditions, construction errors/ defects, deviations from process procedures, failure to meet equipment maintenance schedule, inadequate training of personnel, etc.

Factors increasing the risk of accidents at the subject facility include:

- presence of explosion and fire hazardous components within production environment, including transport operations;
- operation and maintenance of pressure equipment (vessels, pipelines, etc.) containing explosion and fire hazardous substances;
- large quantities of explosion and fire hazardous substances in process blocks and pipelines with high energy potential and, consequently, high TNT-equivalent values of potential explosions, density and velocity of energy release, excess blast pressure, and other shockwave parameters;
- multiple flange connections and weld joints as most likely sources of leakage of explosion and fire hazardous substances;
- potential for formation of combustible explosion and fire hazardous environment in the event of leaks, loss of containment or ruptures at process train sections which may result in catastrophic consequences in case of ignition;
- execution of gas hazardous work, i.e. works performed in gas contaminated environment or, conversely, those associated with release of explosion hazardous gaseous substances from pipelines, vessels and equipment; and
- high indoor and outdoor concentration of process equipment contributing to the risk of cascading failures.

Among other factors and causes of potential accidents of various scale that may occur during operation of the Project facilities are:

- errors, delays or inaction/negligence committed by personnel during normal operation of the facilities;
- lack or defects of combustion engine spark arresters;
- failure to perform job duties and operational procedures (lack of visual control of emergency shutdown system, absence of the operator in the process control room, etc.);
- failure to adhere to the routine equipment maintenance schedule and procedures;
- maintenance and repair errors; and
- major violations of the process discipline.

Major hazardous substances that will be present at the Project facilities are combustible fluids and flammable gases of human health Hazard Class 3 and 4[38]. Characteristics of hazardous substances and information about levels of hazard and effects on human health are provided in Table 9.9.1.

[38] Hygiene Standards GN 2.2.5.1313-03, GN 2.1.6.1339-03

Table 9.9.1: Characteristics of combustible fluids and flammable gases present at the Project facilities

Description	Level of hazard and health and environmental impact
Natural gas	Flammable gas of Hazard Class 4. Major damage effects of accidents involving natural gas are shockwave, direct flame impact, thermal radiation, and impacts by fragments. Leaks without ignition may result in physiological disorders and hypoxia followed by asphyxia at 10% to 20% decrease of oxygen displaced by gas. Accidents with ignition may result in burning out of surrounding forests and farmland. Air impact is associated with air pollution from leaks or instantaneous releases of gas.
Ethane	Flammable gas of Hazard Class 4. May cause irritation of ocular mucosa and conjunctivitis. Heavy poisoning symptoms include pneumonia and loss of consciousness. Major hazards are associated with potential leaks and ignition of ethane followed by fire and thermal impact on people.
Propane	Flammable gas of Hazard Class 4. Major hazards are associated with potential leaks and ignition of ethane followed by fire and thermal impact on people. Concentrations exceeding MPC limit values may cause drug effects, headaches, dizziness, suppression of breathing, and blood circulation disorder. Skin contact results in damage similar to burns.
Unstable condensate	Combustible fluid of Hazard Class 4. Major damage effects of accidents involving unstable condensate are impacts of direct flame and thermal radiation. In case of spills without ignition, small concentrations of condensate in the ambient air may cause hypoxia. High concentrations cause asphyxia due to lack of oxygen. Continuous inhalation of condensate vapours may cause irritation of upper respiratory passages and drug effect. Environmental impact of accidents with ignition consists of burning-out of surrounding vegetation. Spills will result in pollution of vegetation and soil.
Butane	Combustible fluid of Hazard Class 4. Major damage effects of accidents involving butane are impacts of direct flame and thermal radiation. Spills without ignition may cause irritation of ocular mucosa and skin, dizziness, rapid heartbeat, weakness, intoxication, unprovoked hilarity, and, ultimately, loss of consciousness Environmental impact of accidents with ignition consists of burning-out of surrounding vegetation. Spills will quickly evaporate and cause air pollution.
High-temperature organic heat transfer fluid (HTF)	Combustible fluid of Hazard Class 4. Characterised by low toxicity. May cause minor irritation of skin. Environmental impact of accidents with ignition consists of burning-out of surrounding vegetation. Spills will result in pollution of vegetation and soil.
Turbine oil	Combustible fluid of Hazard Class 3. Major hazards are associated with potential leaks and ignition of oil followed by fire and impact of thermal radiation on people. Environmental impact of accidents with ignition consists of burning-out of surrounding vegetation. Spills will result in pollution of vegetation and soil.
Methyldiethanolamine	Combustible fluid of Hazard Class 3. Causes severe eye irritation. Thermal decomposition may lead to the release of irritating gases and vapours. Burning produces carbon monoxide and nitrogen oxides. Bio-destructible (presumably).
Diesel fuel	Combustible fluid of Hazard Class 4. Major damage effects of accidents involving diesel are impacts of direct flame and thermal radiation. Continuous inhalation or swallowing may cause death. Causes eye and skin irritation. Affects nervous, respiratory, and cardiovascular systems, blood, gastrointestinal tract, and liver. Inhalation or swallowing of diesel vapours may cause intoxication, dizziness, disturbance of muscular coordination, low body temperature, slow pulse, and nausea. Environmental impact of accidents with ignition consists of burning-out of surrounding vegetation. Spills will result in pollution of vegetation and soil.

Accidents at some of the Project facilities may result in environmental damage.

Analysis of the layout of equipment, buildings and structure and location of personnel relative to the source of hazard and the probability of accidents enabled identification of the worst-case and most probable scenarios of potential accidents that may occur during operation of the Project facilities (Table 9.9.2).

Table 9.9.2: Worst-case and most probable scenarios of potential accidents that may occur during operation of the Amur GPP facilities

Project components	Worst-case scenario	Most probable scenario	Probability and area of impact
Gas pipeline – connections	Complete pipeline rupture: • fragment dispersion, shockwave from expanding gas energy; • release of gas in two free jets; • burning of two independent high-speed jets of gas being released from both ends of the ruptured pipeline; • direct flame impact; • thermal impact.	Pipe crack, hole or leaking joint: • loss of containment of the pipeline or valves; • release of raw gas; • 'safe' dispersion in the atmosphere	$3.5 \cdot 10^{-4}$ 1/year Area of thermal radiation impact: from 204 m to 275 m. Area of shockwave impact: from 17 m (boundary of complete destruction area) to 142 m (boundary of minimum damage area)
Process area	a) Loss of containment of gas-filled equipment or pipeline: • blowout of gas into open space; • formation of explosion hazardous gas-air mixture (vapour cloud – VC); • VCE – vapour cloud explosion (deflagration) if ignition source exists; • shockwave impact on equipment and personnel. b) Large-scale catastrophic structural failure of equipment: • blowout of overheated vapours into the atmosphere; • mixing of vapours with air to concentration exceeding higher explosion limit; • ignition and subsequent burning of the external cloud surface with formation of a ball of fire; • thermal impact on personnel and equipment.		$8.5 \cdot 10^{-5}$ 1/year Area of thermal radiation impact: from 214 m to 590 m. Area of shockwave impact: from 104 m (boundary of heavy destruction area) to 1380 m (boundary of minimum damage area)
Storage area (merchantable product and raw material storage facility)	Loss of containment of a tank: • blowout of gas into open space through the roof; • formation of explosion hazardous gas-air mixture (vapour cloud – VC) • VCE – vapour cloud explosion (deflagration) if ignition source exists; • shockwave impact on equipment and personnel.	Pipe crack, hole or leaking joint: • loss of containment of pipelines or valves • gas release • evaporation of gas from the spill pool • 'safe' dispersion in the atmosphere	$1.5 \cdot 10^{-4}$ 1/year Area of shockwave impact: from 108 m (boundary of heavy destruction area) to 510 m (boundary of minimum damage area)

Potential accidents associated with diesel spills also include the rollover of a fuel truck due to human error, extreme weather conditions, etc.

Scenario I. Fuel truck rollover resulting in a diesel spill without ignition

The level of air pollution from diesel spills will be determined by the weight of volatile low-molecular hydrocarbons that will evaporate from the oiled ground[39]. In case of a loss of the entire content of the tank of 7,800 l (7.8 m3) the approximate spill area will be 50 m2. Pollutant emissions will consist of the mixture of saturated hydrocarbons C12-C19 and some hydrogen sulphide[40]. The weight of emitted pollutants may reach:

- 4.5 kg at evaporation surface temperature of 5°C;
- 51.05 kg at evaporation surface temperature of 20°C.

Scenario II. Fuel truck rollover resulting in a diesel spill with ignition

Quantities of pollutants released into the air from diesel burning are detailed in Table 9.9.3.

Table 9.9.3: Results of calculations of pollutant emissions from burning diesel

Description	Weight, kg/h
Carbon dioxide	0.6972
Carbon monoxide	0.00495012
Carbon black	0.00899388
Nitrogen oxides (in NO_2 equivalent)	0.01819692
Hydrogen sulphide	0.0006972
Sulphur oxides (in SO_2 equivalent)	0.00327684
hydrocyanic acid	0.0006972
Formaldehyde	0.00076692
Organic acids (in CH_3COOH equivalent)	0.00250992

Potential accidents during operation of the solid municipal and industrial landfill may be associated with:

(1) *Ignition of waste as the result of spontaneous combustion or deliberate acts of third parties*

Due to the staged landfilling the maximum volume of waste that can be affected by spontaneous combustion will be 100 m3 and the maximum weight will not exceed 25 tonnes.41

Specific emission values from combustion of one tonne of solid waste and estimated weight of pollutants are presented in Table 9.9.4.

Table 9.9.4: Quantitative characteristics of emissions from combustion of waste at the landfill

Description	Specific emission value (t per t of solid waste)	Estimated air emissions, tonnes
Sulphur dioxide	0.003	0.075
Particulate matter (PM)	0.00125	0.03125
Nitrogen oxides	0.005	0.125
Carbon monoxide	0.025	0.625
Carbon black	0.000625	0.015625

[39] 'Methods for the assessment of environmental damage from main and field pipelines', approved by Mintopenergo on 01.11.1995

[40] 'Guidelines for calculating pollutant emissions from storage tanks'

[41] 'Provisional recommendations for estimating pollutant air emissions from solid waste combustion at landfills and calculating sums of claims for ambient air pollution', approved by the Ministry of Ecology and Natural Resources on 02.11.1992

(2) *Scattering of solid waste and construction waste resulting from rollover accidents with garbage trucks and dump trucks delivering waste to the landfill*

The maximum quantity of waste that will be lost due to the garbage truck accident will total 4.7 tonnes (truck capacity). The maximum weight of waste that will be lost due to the dump truck accident will total 12 tonnes (dump truck capacity).

(3) *Accidents during operation of high pressure gas pipeline*

Accidents at high pressure gas pipelines may be caused by:

- defects of material (welding or rolled metal defects, stress cracking, etc.); in this case, accidents occur during pipe manufacturing or pipeline construction;
- corrosion defects; accidents may occur during operation of the gas pipeline;
- external impacts of construction machinery; and
- natural environmental factors, such as soil subsidence, scouring by rainwater, etc.

Loss of containment at the pipeline containing compressed gas may result in instantaneous ignition and subsequent burning of lost gas (if an ignition source exists).

9.9.3 Accident prevention and response

International and national experience in operation of hazardous industrial facilities, including gas pipelines, indicates that the frequency of accidents can be significantly reduced through strict requirements for non-destructive condition control of the facilities (operation within 'life limit'). Technical condition control must be in place at all stages of construction and operation of facilities where the risk of accidents exists. This control must provide for early and routine diagnostics.

The main method for containment of oil spills on soil is construction of earth or snow bunding and catch pits. Spilled oil will then be recovered from bunded areas and pits. Cleanup will also include collection and removal of oiled soil, vegetation, and snow. Soil may be cleaned from residual oil by burning (in consultation with and approval of fire services, land users, and regulators). Methods for cleaning oiled soil that have been developed in recent years and are widely used now include application of microbiological and bacterial preparations. Biopreparations are applied to contaminated surface or mixed with oiled substrates with addition of common mineral fertilizers containing biogenic elements (e.g. nitrogen, phosphorus, potassium, etc.). The process involves intensive aeration. Biopreparations consist of environmentally friendly biomass of saprophytic bacteria strains (producers). End products of oil decomposition are carbon dioxide and water. The growth of biomass will stop once the food (oil) is depleted and microorganisms will later turn into humus.

Oil traps and containment and recovery facilities must be provided in areas at risk of oil spills in water bodies. In Ice conditions containment booms can be deployed in ice leads or natural ice-free backwater pockets. Oil can be contained from under the ice using booms deployed in cracks. Snow berms or trenches may also prevent the spread of spilled oil during the ice period. In-situ burning is the most effective method for removing small spills both in ice conditions and from open water. Decisions on shoreline cleanup are to be made with consideration of local specifics.

Recovered oil, oiled soil and snow will be transferred to licensed contractors for treatment, recycling or disposal. The scope of cleanup work will be evaluated based on the actual condition of the area affected by oil pollution. Cleanup operations must be financed by contractors during construction and by the operator during operation (as part of operating costs). Results of the cleanup will be evaluated based on residual level of pollutants (hydrocarbons) in soil.

Embedded controls for reduction of the risk of accidents during operation of the Amur GPP facilities include the following design decisions:

- materials and design of vessels and pipelines provide for strength and reliable operation within the working pressure and temperature range;
- external surfaces of equipment and pipelines have anti-corrosion coating;
- valves are designed for the maximum working pressure and maximum and minimum temperatures they may be exposed to during operation;

- design of heat exchangers in process equipment prevents contact of heat transfer fluid with the process environment;
- equipment involving gas phase processes and gas pipelines where partial condensation of vapours occurs as part of the process will be equipped with devices for collection and removal of liquid phase;
- explosion hazardous process systems which include equipment and pipelines exposed to routine vibration impact will be provided with protection from the impact of vibration on sealing elements and with devices reducing impact on adjacent parts of the process system and building structures;
- process equipment will be provided with all necessary instrumentation, control devices, and safety valves (blowdown and back-flow valves, etc.) to ensure reliable and failure-free operation;
- technical emergency shutdown devices (including stop valves, gate valves, cutoff valves, etc.) for disconnection of process units will meet safety requirements for equipment operation in explosion hazardous environment and will provide for protection of process systems in the event of emergency in accordance with designed response speed;
- equipment and pipelines will be provided with protection against secondary action of lightening and static electricity;
- product leaks will be prevented due to discharge of fluids in drainage or emergency tanks and release of gas to a cold vent of flare;
- during equipment maintenance liquid products will be evacuated into drainage tanks;
- process areas will be sealed with concrete and bunded to prevent production spills/ leaks;
- use of non-combustible materials for thermal and sound insulation of pipelines and equipment;
- indoor detectors of explosion hazardous levels of gas will send signals to the control room which will automatically activate the emergency exhaust ventilation;
- gas pipelines and other process pipelines will be assembled from steel seamless pipes individually hydrotested by the manufacturer;
- use of factory-made shaped pipeline connection pieces (branch pipes, T-bends, adaptors, etc.) tested by the manufacturer; and
- use of appropriate security equipment to prevent unauthorised access to/entry into the facility.

Embedded procedures and organisational measures for prevention and mitigation of effects of major accidents must provide for:

- timely commissioning and maintenance of the process safety facilities;
- systematic inspection of containment of the process equipment operated under pressure, including condition monitoring of instrumentation;
- regular testing of personnel knowledge of industrial safety standards and regulations, rules of safe equipment operation, occupational health and safety requirements;
- preparedness of civil defence and emergency response resources for response to natural and man-caused emergencies;
- liaison and engagement with the civil defence and emergency response authorities, neighbouring industrial facilities, regular testing of reliability of emergency alarm and warning systems;
- maintaining of PPE in good condition.

Recommended measures aimed at reduction of risk of accidents at the facility include:

- timely technical maintenance, routine and scheduled maintenance of valves and equipment in accordance with manufacturers' guidelines and regulations on maintenance and repair procedures;
- regular inspection of foundation supports for overhead gas pipelines and stop valves to identify signs of subsidence or other defects; annual non-destructive control of pipe wall thickness at locations exposed erosion and corrosion wear;
- reconditioning of process equipment and auxiliary facilities must be conducted in strict compliance with industrial safety requirements;
- systematic condition monitoring of process facilities, corrosion condition of metal constructions, foundation settlement, condition of heat insulation, and timely repair of these structural elements;

- provisions for good condition and constant preparedness of fire control and fire alarm equipment and automatic gas contamination alarm systems;
- provisions for good condition of backup power supply and emergency lighting sources, including periodical operability testing;
- regular training, testing and exercises of personnel of all business units in emergency response and methods of protection from damaging factors in emergency situations;
- 24-hour duty schedule for control personnel.

Operators of gas distribution and gas consumption facilities must ensure compliance with the requirements of Federal Law 116-FZ 'On industrial safety of hazardous industrial facilities'. Prior to commencement of operation of gas facilities the operator must prepare the following documentation:

- Order for establishing of a Gas Service;
- Order for establishing of a permanent commission for the testing of knowledge of regulations, guidelines, and safe operation methods by personnel operating gas facilities;
- orders for the appointment of the person responsible for safe operation of gas facilities and his/her deputy from among technically qualified management personnel;
- Order for the appointment of persons authorised to issue work-permits for execution of gas hazardous operations;
- Order for the appointment of persons permitted to manage and perform gas hazardous works;
- job descriptions and operational instructions for workers operating gas equipment, gas pipelines, and boilers;
- list of gas hazardous works which may be performed without special supervision or permits in accordance with the approved operational and safety instructions for each job;
- emergency response plan for accidents at gas facilities; and
- plan for engagement and coordination of different services.

Operators must keep the following documentation during the entire life of the facility:

- specification for connection of gas consumers to the gas distribution system;
- design and as-built documentation for construction of the gas consumption system;
- reports for completion of construction and acceptance of gas consumption systems prepared in accordance with regulatory requirements for construction projects;
- commissioning reports for intrasite gas pipelines and electrochemical protection; and
- permit for initial gas feeding for commissioning of the gas consumption system and respective commissioning reports.

Personnel of the facilities containing explosion and fire hazardous equipment must receive training and certification in accordance with the requirements of guidelines RD-03-19-2007 'Regulations for training and testing of knowledge of personnel of organisations supervised by the Federal Service for Ecological, Technological, and Nuclear Supervision'. Managers and specialists must also receive primary and refresher OHS training.

Oil spill response plans are to be developed in accordance with Government Decree 240 of 15.04.2002 (as amended by Decree 1188 of 14.11.14) 'On the procedure for organisation of oil spill prevention and response activities in the Russian Federation', MChS Order 621 of 28.12.2004 (as of 12.09.2012) 'On the approval of the Regulations for development and approval of oil spill prevention and response plans in the Russian Federation', R Gazprom 2-1.2-285-2008 'Recommendations for response to land oil spills', R Gazprom 2-1.3-284-2008 'Recommendations for response to oil spills at pipeline crossings over watercourses'.

9.9.4 Summary

Results of quantitative assessment of consequences of potential accidents at the proposed Amur GPP facilities are deemed 'acceptable' and are in compliance with the national and international industrial safety standards for similar facility in gas industry. This enables conclusion on the sufficient level of safety of the proposed facilities.

The construction and operation of the Project facilities should incorporate specific accident prevention measures in order to improve reliability, environmental performance, and to reduce the risk of emergency situations.

Specific measures, which, if implemented, may reduce the probability of accidents and prevent/ reduce potential damage, are summarised in Table 9.9.5.

The Emergency Response Plan for the Amur GPP facilities provides for emergency notification of the management and emergency response services. This will be followed with the assessment of hazards within the emergency area, identification of sources and scale of pollution, and decision on the scope of response and cleanup operations and required response resources. If the scale of the accident is such that it cannot be adequately controlled by response resources available at the facility, personnel will request mobilisation of additional equipment and other response resources (Table 9.9.6)

Table 9.9.5: Summary of information about personnel emergency situations and relevant prevention measures

Impact source	Receptors/ resources	Stage	Embedded controls	Residual impact
Accidents	Facility personnel, soil, geological environment, vegetation	Construction and Operation	1. Development of necessary guidelines, regulations/procedures and plans for the actions of personnel aimed at prevention of and response to emergency situations, including the plan for hazardous material management (diesel and oil (fuels&lubes)), plan for emergency notification, fire response plan, diesel spill response plan. 2. Use of road building machinery and construction equipment which have all necessary operation certificates. 3. Personnel have all necessary work permits and will receive all necessary safety training and instruction in occupational H&S, fire safety, response to oil (diesel) spills. 4. Construction sites will be provided with emergency alarm and communication facilities, as well as primary fire control equipment, including extinguishers. 5. Operation of hazardous facilities in strict compliance with safety standards and process requirements. 6. Regular diagnostics of process blocks, units, and pipelines with the use of modern test equipment. 7. Continuous control of pipe wall insulation coating and comprehensive inspection of cathodic protection facilities. 8. Use of non-destructive testing instruments. 9. Improvement of methods and performance of leak control services and regular condition monitoring of pipelines and equipment. 10. Electrochemical corrosion protection system of the facilities will be commissioned and functional before commencement of production operations. 11. After completion of pipelaying in protective casing electrical contact between the pipeline and casing will be checked and removed if detected. 12. Control after completion of installation of the electrical insulating joint will include measuring of voltage between the pipes on both sides of the joint, measurement of current between the pipes and resistance of the insulating joint (between the pipes on both sides). Measurement results must be in compliance with the requirements of technical regulations. 13. Acceptance examination of the facilities will be conducted in accordance with STO Gazprom 2-2.3-310 and STO Gazprom 9.2-002 within 12 months from the commissioning date to evaluate the level of protection of underground facilities, condition of protective coating, to check and optimise performance of electrochemical protection facilities. Results of the examination will be documented in the system certificate. 14. Compliance of the corrosion protection facilities with the established requirements and sufficiency of documentation for certification of these facilities will be checked during corrosion inspection and tests.	low

			15. Condition of corrosion protection of the gas pipeline will be inspected in accordance with the requirements of STO Gazprom 2-2.3-310-2009. Inspections must be conducted every 10 years. The frequency of inspections is established in VRD 39-1.10-006-2000. 16. Corrosion condition of buried services and performance of the electrochemical protection facilities will be controlled regularly in accordance with the 'Regulations for operation of corrosion protection facilities at pipelines' (M.: OAO Gazprom, OOO "VNIIgaz, 2004). 17. Measures will be undertaken to reduce specific resistance of soil in areas of electrochemical protectors installation. Clay-salt solution will be injected into boreholes before and after installation to create artificial 'taliks'. 18. Regular functional testing of safety valves, emergency shutdown equipment, and backup power supply facilities. 19. Prevention of ignition, fires and explosions: • continuous monitoring of loading and unloading of oil products; • provision of secondary containment (bunding) for oil tanks designed for total loss of the tank content; • temperature in diesel tanks will be maintained at the level exceeding the pour point; • provision of tanks with level control, fire and lightening protection devices; • all tanks will have anticorrosion coating; • prompt identification and response to/cleanup of small oil spills; • strict compliance with fire safety requirements in oil storage areas and during operations involving oil products; and • implementation of 'no smoking' rules in oil storage tank areas. 20. Prevention of diesel leaks and spills: • regular inspections and control of the level of diesel or wastewater in storage tanks; • control of compliance with speed limit regulations for diesel and oil carrying vehicles; and • timely clearance of snow and ice from roads to ensure accident-free transportation. 21. Prevention of leaks or spills at equipment refuelling facilities and in diesel storage areas: • compliance with requirements of technological procedures for management of hazardous substances; • refuelling of stationary machinery and equipment with limited mobility (excavators, bulldozers, etc.) directly on the construction site with the use of fuel trucks equipped with pumping and metering devices, loading hose and fuel nozzle in order to prevent diesel spills; • certification of all types of hoses, connections, accessories, and other equipment used for diesel and oil management operations; • availability of sorbents (oil-absorbing material, rags, etc.) in areas of diesel, oil and hazardous substances management; and • availability and implementation of plans for response to diesel and oil spills.	

			22. Prevention of waste scattering: • compliance with requirements of waste collection and storage procedures; • use of lidded containers for collection and transportation of waste; • control of containers to ensure that lids are always closed; • appropriate marking of waste containers; • all waste management operations will be performed only by specially trained personnel.	
	Personnel		• Personnel will be instructed in emergency prevention and response and fire safety measures and requirements directly on site in accordance with the approved programmes. • Regular emergency drills/exercises in accordance with plans for containment of and response to accidents at hazardous industrial facilities; preparedness of personnel for the rescue of people affected by the accident. Results of emergency exercises will be documented in reports which may include recommended corrective actions, if required.	

Table 9.9.6: Emergency response

Emergency response	**Soil pollution**: • containment of polluted area; construction of earth or snow berms and catch pits; • recovery of spilled oil (diesel), waste, oiled ventilation and snow; • removal of recovered liquid (diesel/oil) or waste from the industrial site; • clean-up and rehabilitation of affected areas; • additional cleaning using sorbents; • burning of oiled soil in areas difficult of access (requires approval). **Pollution of a water body** • deployment/ construction of oil traps and devices for containment and recovery of spilled oil; • in ice conditions, deployment of booms in ice leads or natural ice-free water areas (backwater); • in-situ burning of oil; recovered oil and oily soil must be transferred to a licensed contractor for recycling/ disposal.