UE “Minskvodokanal”

April, 2017

MINSK WASTEWATER TREATMENT PLANT

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

RAMBOLL

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GLOSSARY OF ABBREVIATIONS

ACI	Assessment of the Cumulative Impacts
AEWA	Agreement on the Conservation of African-Eurasian Migratory Waterbirds
AIDS	Acquired ImmunoDeficiency Syndrome
AoI	Area of Influence
APC	Approximate Permissible Concentrations
APL	Approximate Permissible Levels
AVS	Aquatic Vegetation System
AWE	Adverse Weather Events
BAT	Best Available Technique
BOD	Biochemical Oxygen Demand
BREF	Best Available Technique Reference Documents
BSSR	Byelorussian Soviet Socialist Republic
CHP	Combined Heat and Power
CIA	Cumulative Impact Assessment
CIS	Commonwealth of Independent States
CJSC	Closed Joint Stock Company
COD	Chemical Oxygen Demand
CUP	Communal Unitary Enterprise
DCS	Digital Control System
EBRD	European Bank for Reconstruction and Development
EcoNiP	Environmental Norms and Rules
EGP	Exogenous Geological Process
EHS	Environmental, Health, and Safety
EIA, OVOS	Environmental Impact Assessment
EIB	European Investment Bank
ESAP	Environmental and Social Action Plan
ESDD	Environmental and Social Due Diligence
ESHS	Environmental, Social, Health and Safety
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESMS	Environmental and Social Management System
ESP	Environmental and Social Policy
EU	European Union
EUR	Euro
FEZ	Free Economic Zone
FMS	Fixed Monitoring Station

GHG	Greenhouse Gas
GII	Gender Inequality Index
GIIP	Good International Industry Practice
GIP	Good International Practice
GN	Health (Hygiene) Standards
GOST	State Standard
GPH	Good Practice Handbook
GRP	Gross Regional Product
H&S	Health and Safery
HIV	Human Immunodeficiency Virus
HR	Human Resources
HSMS	Health and Safety Management
IFC	International Finance Corporation
IFI	International Financial Instructions
ILO	International Labour Organisation
IP	Individual Interpreter
IPM	Institute for Privatization and Management
ISO	International Organization for Standardization
IT	Information Technology
IUCN	International Union for Conservation of Nature
JV	Joint Venture
KSUP	Communal Agricultural Unitary Enterprise
LTIP	Long Term Investment Programme
LTPC	Landscaped Territories of Public Centres
MAC	Minimum Alveolar Concentration
MAZ	Minsk Automobile Plant
MCHE ZD Minsk	Municipal Centre for Hygiene and Epidemiology of Zavodskoy District of
MOS	Minsk Wastewater Treatment Station
MPC	Maximum Permissible Concentrations
MRUP	Minsk District Unitary Enterprise
MSW	Municipal Solid Wastes
MTZ	Minsk Tractor Plant
MVK	Minskvodokanal
MWTTP	Minsk Wastewater Treatment Plant
OHS	Occupational Health and Safety
OHSAS	Occupational Health and Safety Assessment Series
OJSC, OAO	Open Joint-Stock Company

OOO, LLC	Limited Liability Company
PCB	Polychlorinated biphenyl
PIP	Priority Investment Programme
PLC	Programmable Logic Controller
PLHA	People Living with HIV/AIDS
PR	Performance Requirement
PS	Performance Standard
PSAoI	Project's Social Area of Influence
Q&A	Question and Answer
QMS	Quality Management System
RAP	Resettlement Action Plan
RB	The Republic of Belarus
RC	Reinforced Concrete
RCIA	Rapid Cumulative Impacts Assessment
SanPiN	Sanitary Regulations and Standards
SEP	Stakeholder Engagement Plan
SPNA	Specially Protected Natural Areas
SPZ	Sanitary Protection Zone
STB	State Standard of the Republic of Belarus
TKP	Technical Code of Common Practice
UE, UP	Unitary Enterprise
USD	United States Dollar
USSR	Union of Soviet Socialist Republics
UV	Ultra Violet
VEC	Valued Environmental and Social Component
VOC	Volatile Organic Compounds
WCRB	Water Code of the Republic of Belarus
WPI	Water Pollution Index
WWII	Second World War
WWTP	Wastewater Treatment Plant

1. INTRODUCTION

1.1 Introduction

UE "Minskvodokanal" (hereinafter referred to as "MVK" or "Company") is a municipal enterprise wholly owned by the City. The Company provides household-drinking and technical water supply services, as well as waste water pumping and treatment in the city of Minsk with the population number of almost 2 million.

MVK is a major modern water company which uses revamped energy saving equipment, process automation and centralized operations control systems. The Company operates over 3000 km of water distribution networks and more than 1800 km of sewerage pipelines. Total water consumption in Minsk is almost 500 000 m^3 per day.

The European Bank for Reconstruction and Development (EBRD) and the European Investment Bank (EIB) are considering co-financing of MVK project for reconstruction and optimisation of Minsk Waste Water Treatment Plant which is supported by the Government of the Republic of Belarus and Minsk City. The project is intended to reconstruct the plant to enhance waste water treatment efficiency and quality, and also provides for construction of sludge treatment complex (including digestion, dewatering, drying and incineration) at the site of existing wastewater treatment plant (MWWTP-1) in Zavodskoy District of Minsk (hereinafter "the Project").

The EBRD has assigned a Category A to the Project, in line with the 2014 Environmental and Social Policy, which means that the Project requires a comprehensive Environmental and Social Impact Assessment (ESIA) and the development of associated disclosure package, followed by their public disclosure for a minimum period of 120 days. The project must be designed to meet EU requirements for sludge incineration and wastewater treatment, and a fit-for-purpose ESIA disclosure package shall be developed to properly inform the stakeholder engagement and public consultations.

In November 2017 EBRD and MVK commissioned Ramboll CIS (hereinafter "Ramboll" or "Consultant") to review the available environmental and social documentation for compliance with the applicable international requirements, including lenders' requirements, and to provide supplementary environmental and social impact assessment (ESIA) of the proposed Project.

ESIA process has been conducted in coordination with the Project technical feasibility studies by the Technical Consultant – Sweco Danmark A/S. Results of the supplementary impact assessment have been used for preparation of the Project environmental and social disclosure package including the following documents:

- Supplementary ESIA Report;
- Environmental and Social Action Plan;
- Stakeholder Engagement Plan;
- Non-technical Summary.

1.2 Geographic Position and Administrative Division of the Project Area

Belarus is a unitary presidential republic which has national boundaries with the Russian Federation, Poland, Lithuania and Latvia. The Republic of Belarus (RB) consists of six regions being the 1st level territorial units:

- Minsk Region;
- Vitebsk Region;
- Grodno Region;
- Mogilev Region;
- Brest Region.

Each region is in turn divided into districts (total 118 districts in Belarus) and regional subordination cities (10 cities). Minsk District (Figure 1) being a territorial unit of Minsk Region is one of the country's largest districts and embraces the territory of the capital city of Minsk.

Minsk City bears a special status of the "city of republican significance" and is a separate territorial unit of the 1st level. The city occupies the territory of 348.85 km^2 and has a population of 1882.5 thousand (as by start of year 2017) which accounts for 20.78% of the total population number in RB.

Minsk City consists of 9 administrative districts (Figure 1.1):

- Tsentralny
- Sovetsky
- Pervomajsky
- Partizansky
- Zavodskoy
- Leninsky
- Oktiabrsky
- Moskovsky
- Frunzensky

Minsk waste water treatment plant (MWWTP) is located in Zavodskoy District in the south-east of Minsk City which adjoins Partizansky and Leninsky Districts of Minsk City and Minsk District of Minsk City. The territorial unit was established within its current administrative in 1997 (Presidential Decree of the Republic of Belarus of 10.11.1997). The urban settlement of Sosny which had been subordinated to Zavodskoy District Administration since 1982 is currently part of Zavodskoy District of Minsk. The District area is 5.8 thousand ha, population number is 236.581 thousand[1].

[1] Official web site of the Administration of Zavodskoy District of Minsk.
http://zav.minsk.gov.by/svedenija-o-rajone/sotsialnyj-pasport-rajona

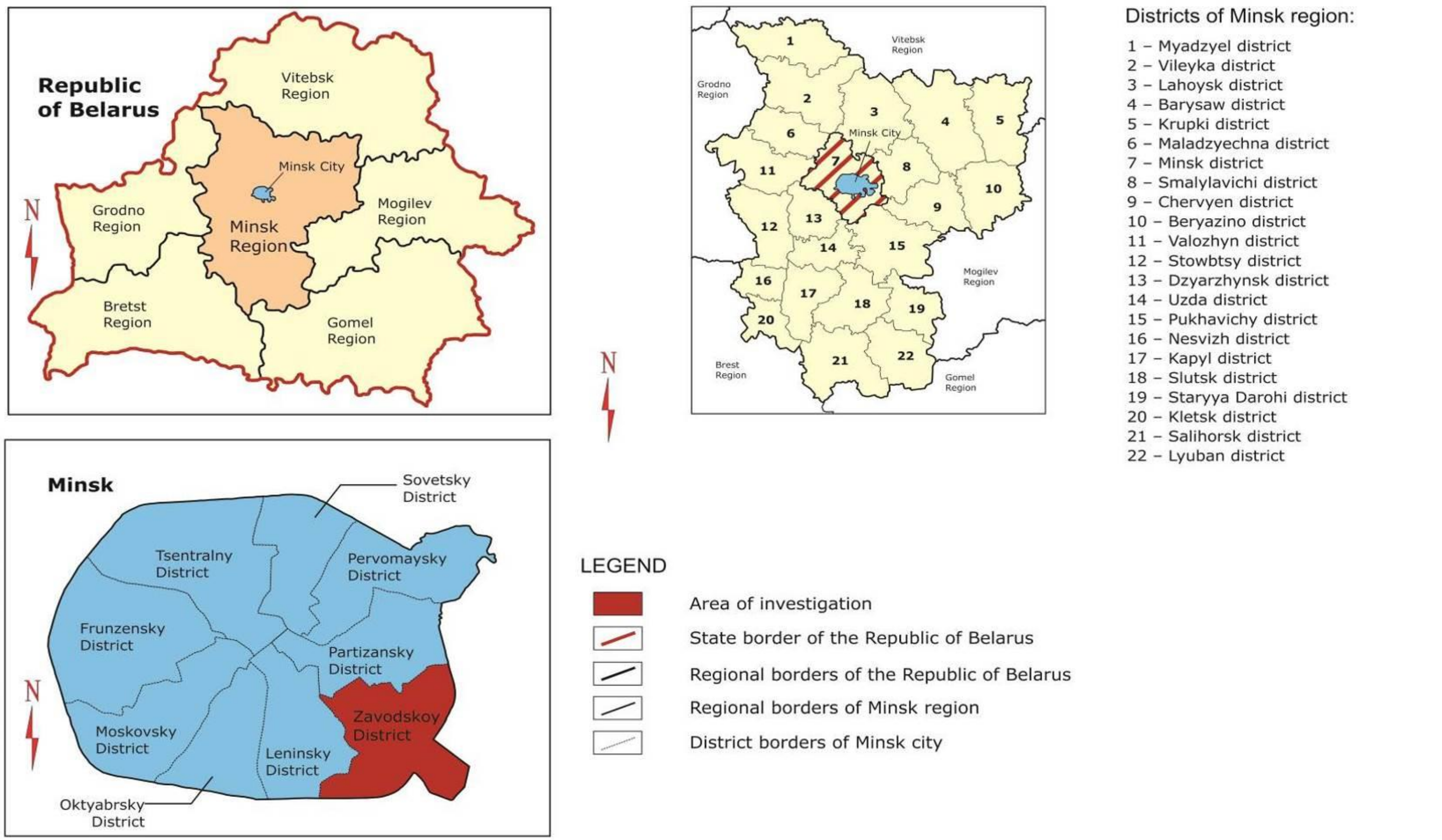

Figure 1.1: Schematic map of Project area location

Source: Ramboll

1.3 Project Overview

The Project owner is UE "Minskvodokanal" (MVK). The project is intended to reconstruct the existing Minsk Waste Water Treatment Plant (MWWTP) to enhance waste water treatment efficiency and quality, and also provides for construction of sludge treatment complex (including digestion, dewatering, drying and incineration) at the existing MWWTP-1 site in Zavodskoy District of Minsk.

According to the Master Plan of Minsk City, the MWWTP site is located in the industrial utility-and-storage zone P5-ks (П5-кс) which includes operational sites of low core-business significance. The Project area does not include any sanatoriums, holiday homes, cultural or architectural monuments, natural reserves or other recreational facilities. The nearest residential area is situated about 670 m to the north-east of MWWTP site. A part of the territory occupied by the existing treatment facilities is situated in the water protection area of River Svisloch, however it does not include the river bank strip.

The wastewater treatment plant plays an important role in protection of the environment against man-caused impacts. All design solutions for the Project are focused to protect surface and ground water, as well as land resources of Minsk city and district. Due to the anticipated participation of international financial institutions, namely EBRD and EIB, the design solutions will be developed taking into account the requirements of EU in the sphere of sludge incineration and waste water treatment, and the disclosure package shall support provision of meaningful information for stakeholder engagement activities and public discussions.

The two sites of waste water treatment plant (MWWTP-1 of 50.61 ha and MWWTP of 27.88 ha) are located in the Shabany industrial area. MWWTP-1 facilities were originally commissioned in 1963. The treatment capacity developed in several stages to cope with the increasing wastewater flows. Current capacity of MWWTP-1 is 470 thousand m^3/day (the actual capacity is 360-380 thousand m^3/day, including 30% of industrial effluents). Capacity of MWWTP-2 (commissioned at a later time) is 100-110 thousand m^3/day. The Minsk development plans which were developed before the technical feasibility studies envisaged increasing total MWWTP capacity to 750 thousand m^3/day (550 thousand m^3/day at MWWTP-1 and 200 thousand m^3/day at MWWTP-2)

The sector-specific wastewater disposal scheme of Minsk for the period until 2030 (developed by UP "MinskEngProject", approved by Minsk City Resolution of 25.10.2007 No.2424) provides for construction of wastewater sludge treatment facilities. This intention is dictated by the need to reduce the amount of wastewater treatment sludge storage and landfilling. MVK reports 266,933.17 tons of dewatered sludge that was disposed at sludge drying beds in 2014. The existing on-site sludge storage capacity is very limited and its further extension is not possible.

Description of the background for Project development, potential alternatives and proposed solutions is provided in chapter 4.

1.4 MVK Organization and Project Management Strategy

UE "Minskvodokanal" is a company with a history of 140 years. In 1871 the city authorities decided to build a water supply system which became the starting point for development of water services in Minsk. Two years later a few facilities became operational including the first shaft wells with the depth of up to 30 m, the first pumping station "Elvod" with the first steam pump, 1500 m of water pipelines with the capacity of 500 m^3 of water per day. On 11 December 1873 the system was started for test operation.

At present UE "Minskvodokanal" is a major modern water company which uses revamped energy saving equipment, process automation and centralized operations control systems. The Company successfully performs its kay functions which include household-drinking and technical water supply, waste water pumping and treatment, and provision of associated services for residential customers and entities in Minsk.

Overall organization chart of the Company is shown in Figure 1.2.

The core business of the Company is to satisfy community demand for its products, works and services by performing the following practical tasks:

- Continuous provision of water supply, wastewater disposal and treatment services;
- Efficient and effective operation of water supply, hydraulic, wastewater treatment facilities;
- Reasonable use of water resource;
- Running profit-oriented business operations.

Minsk City consumes almost 500,000 m^3 of water per day. Total length of distribution networks in the city area is over 3000 km, and the length of sewerage network is more than 1800 km. Continuous provision of water and wastewater services in the capital cities is ensured by the personnel which includes more than 3000 technicians, engineers and workers (Table 1.1).

Table 1.1: UE "Minskvodokanal" by numbers

Length of water networks, km	3077
Length of sewerage networks, km	1854
Length of Viliya-Minsk water system channel, km	63
Length of Slepnya water system, km	22
Total surface area of reservoirs within Vileika-Minsk water system, ha	10,251
Average daily supply to water distribution network, m^3/day	450,000
Number of artesian wells supplying water to the city, pcs	353
Number of booster pumping station, pcs	382
Number of waste water pumping stations, pcs	54
Number of specialists, persons	3000
Number of residential customers registered with customer service – ZRP "Vodosbyt", nr	771,354
Number of customer entities registered with ZRP "Vodosbyt", nr	8693

Source: UE "Minskvodokanal"

The anticipated Project owner is the Capital Construction Department of Minsk City, which must be taken into account in recommendations for the Project environmental and social management.

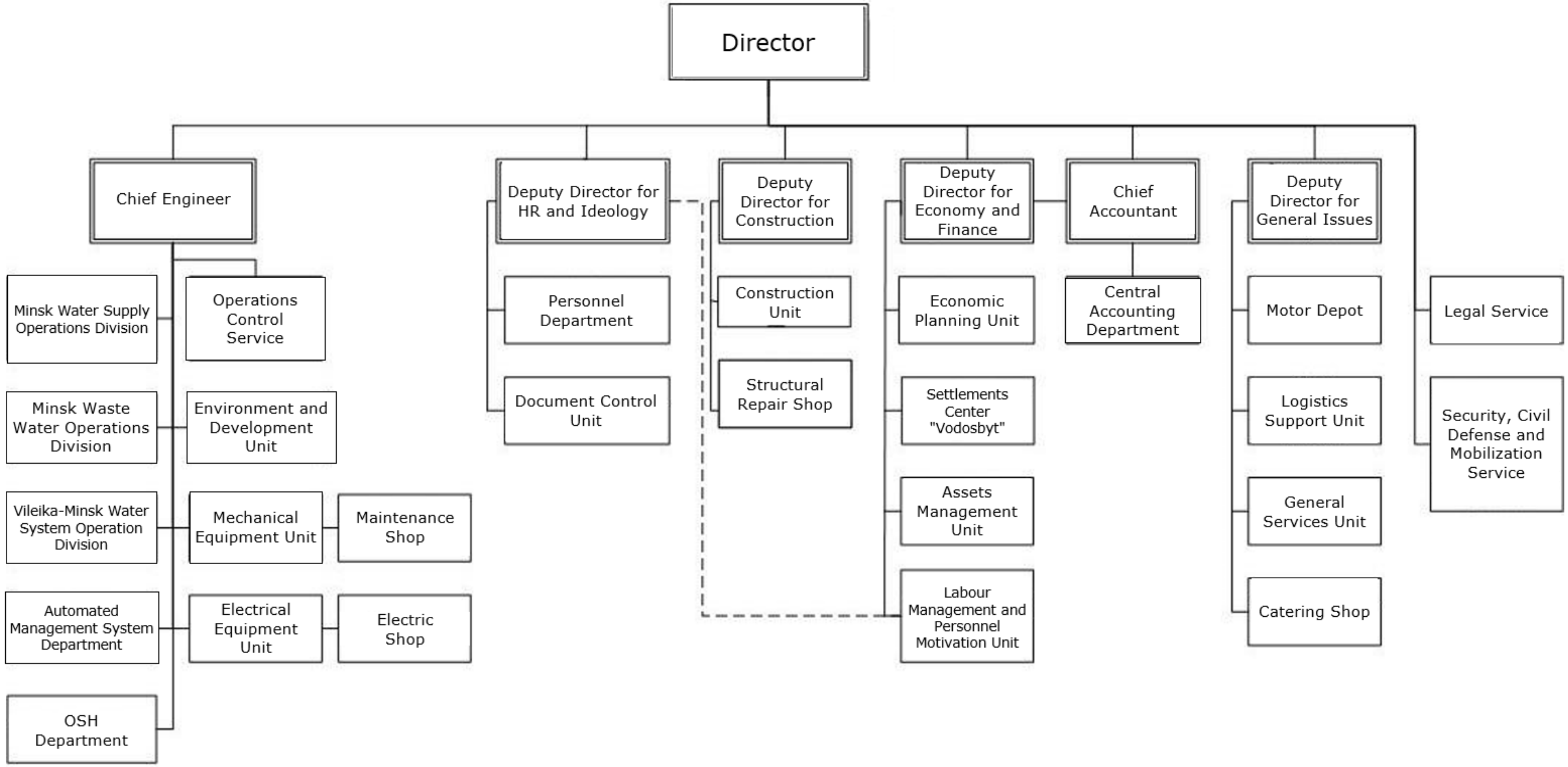

Figure 1.2: Organization chart of UE "Minskvodokanal"

1.5 Project Finance and Applicable Requirements

The European Bank for Reconstruction and Development and the European Investment Bank are considering providing co-financing (by the equivalent loans) for reconstruction and optimisation of Minsk Waste Water Treatment Plant facilities. The tentative total amount of loan funding is EUR 168 M. The loan funding will be provided on the basis of the cooperation document signed by the two financial institutions – "The Procedural Framework between EIB and EBRD in respect of Mutual Reliance for Procurement in joint co-financed public sector operations outside the European Union". The Project will be also financially supported by the Government of Belarus and the Minsk City.

In view of the intention to attract international finance, the Project, besides meeting the national environmental, social, health and safety requirements of the Republic of Belarus, is also expected to meet the applicable international requirements to the extent defined by EBRD guideline documents. The EBRD will seek to ensure that the projects it finances are designed and operated in compliance with applicable regulatory requirements and good international practice related to sustainable development. The main document, which determines conceptual requirements for the projects financed by the Bank, is the EBRD Environmental and Social Policy ("ESP") (2014). More detailed requirements covering key areas of environmental and social impacts and issues are established in a set of specific Performance Requirements ("PRs") included in the ESP document. The integral element of all PRs is the requirement for compliance with the national legislation and good international practice reflected in international standards and agreements and requirements of other international financial institutions (IFIs).

Consequently, for the success of the EBRD loan application the Project must meet the requirements and standards established in the following documents:

- EBRD Environmental and Social Policy and Performance Requirements[2];
- International Conventions;
- European Union (EU) Environmental and Social Standards;
- International Financial Corporation (IFC) Environmental, Health and Safety Guidelines;
- BAT Reference Documents;
- National laws and regulations;
- Corporate Policies and Standards.

More details of the applicable legal requirements are provided in chapter 2 below.

The MVK follows legislative and regulatory requirements of the Republic of Belarus in its operations and in general complies with the requirements of the national legislation. Based on the preliminary analysis of the Company documentation, organizational structure and operations, it is concluded that the Company has sufficient capacity to improve its compliance with EBRD ESP Policy and PRs and best international practice by integrating them into corporate policies, procedures and management practices pertaining to the proposed Project, and by ensuring adequate planning and implementation of stakeholder engagement activities.

1.6 Objectives and Development of Supplementary ESIA

MVK has been developing the WWTP reconstruction project for 10 years, including assessment of potential alternatives for the main process solutions and sludge disposal schemes. There are two national EIAs prepared for development of MVK waste water operations:

1) EIA for Reconstruction of Minsk Wastewater Treatment Station (2016, EIA 2016) which is approved by the State Environmental Review;

2) EIA for Construction of the Sludge Incineration Plant (2012, further on EIA 2012) which is rejected by the State Environmental Review.

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[2] http://www.ebrd.com/environmental-and-social-policy.html

Both national EIA packages have been prepared in line with national requirements of the Republic of Belarus and thus do not fully meet the requirements of EBRD ESP (2014) and the applicable international law.

Thus the supplementary environmental and social impact assessment (ESIA) is focussed to provide (as far as possible using the currently available information) a comprehensive and integrated assessment of negative impacts, benefits and potential risks of the Project, and to propose adequate prevention, mitigation and compensation measures to address the identified environmental and social effects.

Performance of the above scope has been structured in the following range of tasks:

- desk studies of the available Project studies and documentation;
- identification of compliance gaps in the existing EIA against the applicable national and international requirements;
- scoping for the international ESIA process;
- supplementary studies, collection of missing information and comprehensive review of all collected information, stakeholder consultations;
- analysis of potential Project ESHS effects, impacts and risks, including secondary, cumulative, combined impacts and potential long-term effects of the proposed activities;
- development and planning of further mitigations and stakeholder engagement activities for the Project.

The main efforts during the supplementary ESIA process were focused on socio-economic assessment, clarification of the range of environmental impacts and their significance, selection of appropriate environmental and social mitigations, assessment of residual impacts and identification of management decisions and procedures which would enable the Project implementation and address the existing limitations and applicable requirements.

Based on the EBRD Disclosure Process Requirements for Category A Projects (for clients and consultants, June 2016) and the Environmental and Social Due Diligence (ESDD) findings, the Project Supplementary ESIA disclosure package shall include the following parts:

- Supplementary ESIA report (including additional studies as described in section 6.3 below, to the extent possible with the obtainable data);
- Non-technical Summary;
- Environmental and Social Action Plan;
- Stakeholder Engagement Plan.

All documents for the Project Supplementary ESIA disclosure package have been prepared in Russian and English languages and published at the web-sites of EBRD and MVK for stakeholder engagement process.

1.7 Structure of the ESIA Report

In order to provide clear presentation of the ESIA and earlier national EIA procedures including their results, conclusions and recommendations, this Report is structured as follows:

Chapter 1 **Project overview** (this chapter). The chapter introduces the Project by providing details of its location, scope, owner, objectives, proposed approach to Project finance, and applicability of international standards.

Chapter 2 **Legal framework and Project standards.** This chapter provides an overview of the regional, national and international legal framework, within which the Project is to be developed and implemented. Legal framework in the Republic of Belarus is considered, together with an overview of applicable international Lender requirements.

Chapter 3 **ESIA Process**. This chapter provides an overview of the overall process of environmental and social impact assessment and applicability of the international methodology for the ESIA procedure. The chapter further addresses: definitions of key terms; identification of potential environmental and social impacts (through consultation and scoping process);

description of the criteria used to determine the significance of impacts for various environmental and social topics; and how mitigation measures are considered within the assessment process.

Chapter 4 **Project Description and Alternatives.** This chapter describes the background and phasing of the Project, including descriptions of the main and auxiliary facilities, infrastructure, associated facilities, as well as definition of the Project boundaries in the form of the Project influence area. The key process solutions are presented as they are seen at the current stage of planning, alongside with considered alternatives and justification of the preferred alternative. Tentative project implementation schedule is provided.

Chapter 5 **Environmental Baseline**. The existing environmental baseline is described and characterised in this chapter.

Chapter 6 **Socio-economic Baseline**. The existing social baseline is described and characterised in this chapter.

Chapter 7 **Stakeholder Engagement**. This chapter describes the stakeholder engagement process adopted by the Project. It describes the results of consultation activities undertaken earlier and as part of the ESIA process. It also provides stakeholder identification.

Chapter 8 **Environmental Impacts, Mitigation and Monitoring**. This chapter presents the assessment of potential environmental impacts, including identification of mitigation measures and monitoring requirements. Impacts of the Project are assessed separately for each component of the environment. Probability of transboundary impacts is also assessed.

Chapter 9 **Social Impacts Assessment.** This chapter presents the assessment of potential social impacts, including identification of mitigation measures and recommendations for monitoring. Impacts during the Project implementation are assessed on a topic-by-topic basis.

Chapter 10 **Decommissioning.** Potential impacts specifically associated with decommissioning, dismantling and disposal of the Project facilities and infrastructure are addressed in this chapter.

Chapter 11 **Cumulative Impacts.** This chapter addresses potential cumulative impacts of the Project and other third party anthropogenic activities in the region.

Chapter 12 **Environmental and Social Management.** This chapter describes the approaches to environmental and social management across all Project activities, and recommends the management procedures to be adopted to ensure compliance with the applicable international requirements throughout the life of the Project.

Chapter 13 **Conclusion** provides summary of the key significant impacts, mitigations and monitoring, as well as recommendations for further studies to remove uncertainties.

Chapter 14 **References** to various information sources which have been used for preparation of the ESIA report are listed in this chapter.

Additional graphical and text materials are provided in the Appendices of the report.

The Environmental and Social Action Plan is integrated in Chapter 12. The Stakeholder Engagement Plan and Non-technical Summary are provided as separate files.

2. REGULATORY REQUIREMENTS AND STANDARTS

2.1 Introduction

This chapter provides an overview of national and international environmental, social, health and safety legislation which requirements shall be taken into consideration during the Project implementation and ESIA procedure for EBRD loan application.

The EBRD will seek to ensure that the projects it finances are designed and operated in compliance with applicable regulatory requirements and good international practice related to sustainable development. The main document, which determines conceptual requirements for the projects financed by the Bank, is the EBRD Environmental and Social Policy (2014) ("ESP"). More detailed requirements covering key areas of environmental and social impacts and issues are established in a set of specific Performance Requirements ("PRs") included in the ESP document. The integral element of all PRs is the requirement for compliance with the national legislation and good international practice reflected in international standards and agreements and requirements of other international financial institutions (IFIs).

Consequently, for the success of the EBRD loan application the Project must meet the requirements and standards established in the following documents:

- EBRD Environmental and Social Policy (2014) and Performance Requirements established in this policy document[3];
- International Conventions;
- European Union (EU) Environmental and Social Standards;
- International Financial Corporation (IFC) Environmental, Health and Safety Guidelines;
- BAT Reference Documents;
- National laws and regulations;
- Corporate Policies and Standards.

2.2 International Treaties and Conventions

The Republic of Belarus (RB) has ratified a number of international conventions concerned with environmental and social protection, whose requirements need to be taken into account in developing and implementing the Project.

[3] http://www.ebrd.com/environmental-and-social-policy.html

Table 2.1: Summary of environmental and social international conventions related to the Project

Date of Signature	Name	Comments
Climate and Air		
May 9, 1992, New York	UN Framework Convention on Climate Change	Produced at the Earth Summit. It expresses in general terms the concern of the world community in view of climate changes, including global warming as a result of the greenhouse effect, and lays down general recommendations on cutting down greenhouse gas emissions. The Convention has relevance to this project, since some Project facilities may produce greenhouse gas emissions. The Client will evaluate predicted GHG emissions and provide for avoidance or mitigation of adverse effects.
22 March 1985, Vienna/ 16 September 1987, Montreal	Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer	The Convention has entered into force for the USSR 22.09.1988. No substances controlled by the Montreal Protocol will be used during Project implementation.
November 13, 1979, Geneva October 31, 1988, Sofia July 8, 1985, Helsinki	Convention on long-range transboundary air pollution: The Sofia Protocol concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes, The Helsinki Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent.	The Convention has entered into force for the USSR 22.09.1988. The Convention's primary objective is to protect the man and his environment from air pollution and to seek to limit, gradually reduce, and prevent the contamination of ambient air, including long-range transboundary air pollution. Long-range transboundary air pollution is not expected during Project implementation.
Flora and Fauna		
June 5, 1992, Rio de Janeiro	Convention on Biological Diversity	The Convention was ratified on 10 June 1993, by Resolution №2358 –XII of the Supreme Council of the Republic of Belarus. It sets out the following requirements to be met while pursuing economic activity so as to protect biodiversity: • carry out environmental impact assessment of all proposed projects that may have adverse effects on biodiversity; • ensure public participation in environmental assessment procedures; • take measures to ensure that the environmental consequences of programmes and policies that are likely to have significant adverse impacts on biological diversity are duly taken into account; • facilitate information exchange. The Convention is relevant to this project, since some

		natural ecosystems fall within the Project AoI.
June 23, 1979, Bonn	Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)	The Convention has entered into force for the Republic of Belarus 01.09.2003. The Project must be implemented with due regard to the principle of conservation of migratory species of wild animals and their habitats.
September 19, 1979, Bern	Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention)	The Convention has entered into force for the Republic of Belarus 01.06.2013. The Project implementation must ensure conservation of wild flora and fauna species and their habitats. Special attention is given to endangered and vulnerable species, including endangered and vulnerable migratory species.
2 February 1971, Ramsar	Convention on Wetlands of International Importance, especially as Waterfowl Habitat	The Convention has entered into force for the Republic of Belarus 10.09.1999. The Convention provides the framework for national action and international cooperation for the conservation and wise use of all wetlands and their resources through local, regional and national actions and international cooperation, as a contribution towards achieving sustainable development. There are no Ramsar (or candidate Ramsar) sites within the Project AoI.
June 16, 1995, Hague	Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA)	The Convention has entered into force for the Republic of Belarus 01.04.2016. The Project must be implemented with due regard to the following principles: Prevention of decline of waterbird species nesting, migrating and wintering within the African-Eurasian waterbird migration systems, Restoration of populations of already reduced species.
Environmental Impact Assessment		
February 25, 1991, Espoo	Convention on Environmental Impact Assessment in a Transboundary Context, (Espoo, EIA)	The Convention has entered into force for the Republic of Belarus 08.02.2006. The Convention has no relevance to this project since no transboundary impacts are expected.
Waste		
22 March 1989, Basel	Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal	The Convention has entered into force for the Republic of Belarus 09.03.2000. The provisions of the Convention center around the following principal aims: the reduction of hazardous waste generation and the promotion of environmentally sound management of hazardous wastes; the restriction of transboundary movements of hazardous wastes; and a regulatory system applying to cases where transboundary movements are permissible.
Social Aspects / Consultations		
June, 26 1998,	Convention on Access to Information, Public	The Convention has entered into force for the Republic

Aarhus	Participation in Decision-making and Access to Justice in Environmental Matters	of Belarus 30.10.2001. The Convention was ratified by the Decree of the President of the Republic of Belarus 'On approval of the Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters', No. 726 of 14.12.99 The Convention is relevant to the project in view of the need to inform the public of how the project bears on the state of the environment.
Cultural heritage protection		
16 November 1972, Paris	Convention Concerning the Protection of the World Cultural and Natural Heritage	The Convention has entered into force for the USSR 12.01.1989. Parties have a duty to the identification, protection, and conservation, of cultural and natural heritage covered by the Convention. In terms of natural heritage, this includes natural features that are of outstanding universal value from the aesthetic or scientific point of view, and areas that constitute the habitat of threatened species of animals and plants of outstanding value from the point of view of science or conservation.
Occupational health and safety		
1930, Geneva 1957, Geneva 1948, San Francisco 1949, Geneva 1951, Geneva 1958, Geneva 1973, Geneva 1999, Geneva	ILO Conventions 29 and 105 (Forced or Compulsory Labour), 87 (Freedom of Association), 98 (Right to Organise and Collective Bargaining), 100 and 111 (Discrimination), 138 (Minimum Age), and 182 (Worst Forms of Child Labour)	These Conventions are fundamental and shall be taken under advisement during project implementation, as hired labor of workers and employees will be used who have certain rights in accordance with the Conventions
1981, Geneva	ILO C155 - Occupational Safety and Health Convention	The Project will provide for measures to prevent accidents and injury to health arising out of, linked with or occurring in the course of work, by minimising, so far as is reasonably practicable, the causes of hazards inherent in the working environment.

2.3 EBRD Environmental and Social Policy and Performance Requirements (2014)

Under the EBRD Environmental and Social Policy (ESP) 2014, EBRD categorises projects as either A / B / C / FI based on environmental and social criteria to: (i) reflect the level of potential environmental and social impacts and issues associated with the proposed Project; and (ii) determine the nature and level of environmental and social investigations, information disclosure and stakeholder engagement required for each project, taking into account the nature, location, sensitivity and scale of the Project, and the nature and magnitude of its possible environmental and social impacts and issues.

According to the EBRD ESP, the project is classified as Category A when it "could result in potentially significant and diverse adverse environmental or social impacts and issues which, at the time of categorisation, cannot readily be identified or assessed and which require a formalised and participatory assessment process". A list of indicative Category A projects is presented in Appendix 2 to the ESP.

Consequently, the Project is categorised A based on at least two criteria: 10. Large-scale waste disposal installations for the incineration or chemical treatment of nonhazardous wastes and 18. Municipal wastewater treatment plants with a capacity exceeding 150,000 population equivalent.

According to the ESP Projects are expected to be designed and operated in compliance with good international practices relating to sustainable development. The EBRD Performance Requirements (PRs) comprise:

PR 1: Assessment and Management of Environmental and Social Impacts and Issues	This Performance Requirement establishes the importance of integrated assessment to identify the environmental and social impacts and issues throughout the life of the project. Category A projects will require the client to: carry out a comprehensive Environmental an Social Impact Assessment (ESIA), including a scoping stage to identify the potential future environmental and social impacts (scoping study), examination of alternatives to the source of such impacts, and development of recommended measures needed to avoid/minimise potential impacts; establish and maintain an Environmental and Social Management System (ESMS); establish as appropriate environmental and social policies; develop an Environmental and Social Management Plan; establish and maintain an organisational structure for ensuring on-going compliance with relevant national regulatory requirements and the PRs; identify risks associated with its supply chain and exercise reasonable control of primary suppliers; monitor the environmental and social performance of the project to determine whether the project is being implemented in accordance with the PRs or to take the necessary action to ensure such compliance.
PR 2: Labour and Working Conditions	This Performance Requirement establishes the need for establishing a human resources management system, which guarantees respect of workers' rights and provides them with safe and healthy working conditions.
PR 3: Resource Efficiency and Pollution Prevention and Control	This Performance Requirement recognises the need to adopt and adhere to the approach which enables the client to avoid (where possible) or control the harm to the environment caused by the project. The design and operation of a project should address the issues of resource efficiency, management of harmful and hazardous substances and materials, waste generation, emissions and discharges, including GHG emissions. Clients will structure the projects to meet relevant EU substantive environmental standards, where these can be applied at the project level. Certain projects that, due to their nature and scale, would be subject to the

	EU Industrial Emissions Directive and will be required to meet EU Best Available Techniques (BAT) and related emission and discharge standards, regardless of location. Where no EU substantive environmental standards at project level exist, the client will identify, in agreement with the EBRD, other appropriate environmental standards in accordance with good international practice (GIP). When host country regulations differ from the levels and measures presented in EU environmental requirements or other identified appropriate environmental standards, projects will be expected to meet whichever is more stringent. The client's environmental and social assessment process will consider alternatives and implement technically and financially feasible and cost-effective options to avoid or minimise project-related greenhouse gas (GHG) emissions during the design and operation of the project. For projects that currently produce, or are expected to produce post-investment, more than 25,000 tonnes of CO2-equivalent annually, the client will quantify these emissions in accordance with EBRD Methodology for Assessment of Greenhouse Gas Emissions. Quantification of GHG emissions will be conducted by the client annually and reported to the EBRD.
PR 4: Health and Safety	This Performance Requirement recognises the need to establish a system for managing health and safety of workers, consumers, and affected communities.
PR 5: Land Acquisition, Involuntary Resettlement and Economic Displacement	This Performance Requirement establishes the need to avoid or minimise involuntary resettlement and to ensure fair compensation to affected persons. The client will carry out a socio-economic baseline assessment and identification of potentially affected communities and individuals.
PR 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	This Performance Requirement establishes the need to assess the risks and impacts on biodiversity and develop biodiversity conservation measures.
PR 7: Indigenous Peoples	Not applicable
PR 8: Cultural Heritage	This Performance Requirement establishes the need to identify, as part of the environmental and social assessment process, potential adverse impact on cultural heritage. If the potential for such impacts exists, the client must develop measures to avoid/ mitigate such impacts and include these measures in the EMS and ESMP (including consultations with affected community groups). In addition, a Chance Finds Procedure will be required.
PR 9: Financial Intermediaries	Not applicable
PR 10: Information Disclosure and	This Performance Requirement recognises importance of a Stakeholder Engagement process. Stakeholder engagement will involve the following

Stakeholder Engagement	elements: • stakeholder identification and analysis; • stakeholder engagement planning and implementation of the Stakeholder Engagement Plan (SEP); • disclosure of information and reports related to the project in a manner that is accessible and culturally appropriate; • consultations and public involvement in the decision-making process; • establishing and maintaining of a Grievance Mechanism. For Category A projects the client will carry out a formalized, participatory ESIA process which provides for iterative consultation, incorporation of stakeholder views into the decision-making process, and disclosure of ESAP.

Other guidances prepared by EBRD[4] include:

- Guidance on EBRD's methodology for assessing greenhouse emissions, June 2010;
- Good Practices for the Collection of Biodiversity Baseline Data, July 2015;
- Good Practices for Biodiversity Inclusive Impact Assessment and Management Planning, July 2015;
- Workers' Accommodation: Processes and Standards (A guidance note by the IFC and the EBRD, 2009);
- Retrenchment and restructuring –labour and community issues, a brief guide, 2010.
- Labour and working conditions - range of guidance documents designed to help clients manage labour issues, including:
    - Labour policy: guidance for clients
    - Grievance Management guidance note
    - Employment documentation: guidance for clients
    - Forced labour: guidance for clients
    - Children, young people and work: guidance for clients
    - Non-discrimination and equal opportunity: guidance for clients.

2.4 European Union (EU) Environmental and Social Standards

In accordance with ESP and EBRD PR 3 the projects are to be to meet relevant EU substantive environmental standards, where these can be applied at the project level.

EU Directives applicable to the Project:

- Directive on the assessment of the effects of certain public and private projects on the environment (codification) (2011/92/EU) as amended by Directive 2014/52/EU;
- Directive on industrial emissions (integrated pollution prevention and control) (2010/75/EU);
- Directive providing for public participation in respect of the drawing up of certain plans and programmes relating to the environment and amending with regard to public participation and access to justice (2003/35/EC);
- Directive on ambient air quality (2008/50/EC);
- Water Framework Directive (2000/60/EC);

[4] http://www.ebrd.com/who-we-are/our-values/environmental-and-social-policy/implementation.html%20

- Directive on environmental quality standards in the field of water policy (2008/105/EC);
- Directive on the protection of groundwater against pollution and deterioration (2006/118/EC);
- Waste Framework Directive (2008/98/EC);
- Directive on the control of major-accident hazards involving dangerous substances (2012/18/EU);
- Directive on the conservation of natural habitats and of wild fauna and flora (92/43/EEC);
- Directive on the conservation of wild birds (2009/147/EC);
- Directive on the quality of water intended for human consumption (98/83/EC);
- Directive concerning urban waste-water treatment (91/271/EEC);
- Directive on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture (86/278/EEC);

Directive 2014/52/EU on the assessment of the effects of certain public and private projects on the environment (amending Directive 2011/92/EU) establishes the need to conduct mandatory EIA for the projects with the potential to result in significant adverse effects and is applicable to the Project in accordance with Annex I to the Directive.

The principal European regulatory document governing relations in the field of control and regulation of environmental impacts is **Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control).** Directive 2010/75/EU is a regulatory system based on the integrated approach to control and reduce environmental impacts from industrial installations. Directive 2010/75/EU establishes fixed emission limit values for waste incineration plants and lays out recommended schemes for equipment design and use to ensure a high level of protection of the environment as a whole through the use of the best available techniques (BAT). Air emission limit values are set out in Annex V to the Directive. They are defined for heavy metals, dioxins and furans, carbon monoxide (CO), dust, total organic carbon (TOC), hydrogen chloride (HCl), hydrogen fluoride (HF), Sulphur dioxide (SO2), and nitrogen mono- and dioxide (NO and NO2). In addition, there are special provisions relating to waste incineration plants.

Directive 2008/50/EC on ambient air quality establishes legal framework for air quality control in relation to concentrations of sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter (PM), lead, benzene, and carbon monoxide in ambient air, and emission reduction measures. Directive defines standards and criteria for the air quality assessment6 the level of air quality control, maximum permissible concentrations of pollutants (limit values).

Directive 91/271/EEC concerning urban wastewater treatment establishes quality requirements for treated waste water and sludge arising from waste water treatment. Annex I contains quantitative requirements for urban wastewater discharges/ limits on urban waste water treatment plants discharges.

Directive 86/278/EEC on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture seeks to encourage the use of sewage sludge in agriculture and to regulate its use in such a way as to prevent harmful effects on soil, vegetation, animals and man. Annexes to the Directive provide values for concentrations of heavy metals in sewage sludge, which may be introduced into soil intended for agriculture. This Directive also lays down requirements for sampling and analysis of sludge and soils.

Directive 2006/118/EC on the protection of groundwater against pollution and deterioration specific measures to prevent and control groundwater pollution, which include:

- criteria for the assessment of good groundwater chemical status;
- criteria for the identification of significant and sustained upward trends;
- preventing and limiting of indirect inputs of pollutants into groundwater.

2.5 IFC EHS Guidelines

The EBRD will seek to ensure that the projects it finances are designed and operated in compliance with applicable regulatory requirements and good international practice.

The IFC Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). The IFC EHS Guidelines applicable to the Project are listed below:

- General EHS Guidelines (April 2007);
- EHS Guidelines for Water and Sanitation (December 2007);
- EHS Guidelines for Waste Management Facilities (December 2007).

2.6 BAT Reference Documents

Within the scope of applicable to the Project national BAT guidances developed by the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus[5] the following ones have been approved to date:

- P-OOS 17.08-01-2012 (02120) 'Environmental Protection and Nature Management. Atmospheric Air. Emissions of Pollutants into the Atmospheric Air. Rules for Calculation of Emissions from Treatment Facilities';
- This Guidance establishes a procedure for calculation of maximum and total emissions of pollutants into the atmospheric air from designed and operating treatment facilities with a capacity of not more than 500 m3 per day, including from combined industrial and domestic wastewater treatment plants, storm sewage, treatment facilities of livestock-breeding and food processing industries.
- P-OOS 17.11-01-2012 (02120) 'Environmental Protection and Nature Management. Best Available Techniques for Waste Treatment'.
- This Guidance has been developed on the basis of the equivalent translation of the EU Best Available Techniques (BAT) Reference Document for Waste Treatment Industries.
- P-OOS 17.02-03-2012 (02120) 'Environmental Protection and Nature Management. Comprehensive assessment of technologies against Best Available Techniques'.
- This Guidance is developed on the basis of the EU Best Available Techniques Reference Documents. The Guideline contains a summary of the industry-specific best techniques used, including best available techniques in the field of waste incineration.
- EU BAT Reference Documents (BREF)[6] that may be applicable to the Project are:
- Waste Incineration, August 2006;
- Waste Treatment, August 2006;
- Energy Efficiency, February 2009.

2.7 National Legislation

In order to meet the ESP and EBRD PRs requirements the Project has to comply with requirements set by the national legislation.

This Section provides a review of the key laws and regulations of the Republic of Belarus which cover the following aspects of the Project implementation process:

- general environmental and community health requirements;
- State Environmental Review, environmental and social impact assessment, information disclosure;
- impacts on individual components of the natural environment;
- waste management;
- health and safety (industrial safety, health and safety of personnel and population);
- land management;
- impact on cultural and historical heritage.

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[5] http://www.ndtm.by/page/help.html

[6] http://eippcb.jrc.ec.europa.eu/reference/

Due to the large number of bylaws, which directly or indirectly apply to the Project, the documents listed in this Section are limited to the laws and regulations which establish the key limitations for environmental and social impacts of projects. The List of key applicable Belarussian regulations is given in Annex 1.

2.7.1 General environmental and community health requirements

Law of the Republic of Belarus of 26.11.1992 No. 1982- XII 'On Environmental Protection' of (as amended on 17.07.2017) defines general environmental requirements for allocation, design, construction, reconstruction, commissioning, operation, conservation, dismantling, and demolition of buildings, structures, and other facilities. By law legal persons and individual entrepreneurs shall ensure favourable environmental conditions, which includes providing for:

- preservation, recuperation and (or) remediation of the environment;
- mitigation (prevention) of adverse environmental impacts;
- application of best available techniques (BAT), low-waste, energy and resource saving technologies;
- rational use of natural resources;
- prevention of accidents and emergencies;
- physical, financial, and other means to compensate for potential environmental damage;
- financial guarantees for implementation of environmental protection measures planned.

The process of allocation of buildings, structures and other facilities shall meet the environmental requirements with due consideration to the immediate and delayed environmental, economical, demographical, and other impacts associated with their operations and with priorities being given to preservation of favourable environment, biological and landscape diversity, rational (sustainable) use of natural resources and their reproduction.

In the course of development of projects for construction, reconstruction, conservation, dismantlement, and demolition of buildings, structures, and other facilities the regulations on permissible anthropogenic load on environment shall be taken into account and appropriate measures aimed at prevention and remediation of environmental pollution, as well as waste management methods, shall be provided for; best available techniques, resource-saving, low- and no-waste technologies beneficial for environment, natural habitats restoration, rational (sustainable) use of natural resources and their reproduction shall be used.

The Law of the Republic of Belarus 'On Environmental Protection' requires to conduct the environmental impact assessment (EIA/*OVOS*) for the facilities, the list of which is established by the legislation of Belarus in the area of the state environmental expert review, strategic environmental assessment, and environmental impact assessment. The list of subjects and types of economic and other activities, for which it is mandatory to conduct environmental impact assessment, is provided in Article 7 of Law No. 399-Z of 18.07.2016 'On the State environmental expert review, strategic environmental assessment and environmental impact assessment'.

Planned activities of the Minsk wastewater treatment plant (*MWWTP*) being renovated fall into the List of operations subject to mandatory EIA (p. 1.1, 1.7, Article 7, Law No. 399-Z of 18.07.2016 'On the State environmental expert review, strategic environmental assessment and environmental impact assessment'), as it is planned to renovate sewage treatment facilities with the capacity of Minsk treatment plant-1 (*MWWTP-1*) being increased up to 500,000m3 per day, as well as the aspects of disposal of sewage sludge generated are being considered.

The new for the Republic of Belarus environmental technical regulation - 'Environmental Norms and Rules (EcoNiP) 17.01.06-001-2017' has entered into force on October 1, 2017, in accordance with the Resolution of the Ministry of Natural Resources and Environmental Protection of 18.07.2017 No. 5-T.

Environmental Norms and Rules (EcoNiP) are obligatory technical regulations in the area of environmental protection and management of natural resources, which define the environmental quality standards, the rules of establishment (calculation) of the limit values for permissible environmental impacts, and other environmental requirements.

In other words, EcoNiP is an integrated document, which includes all main environmental requirements for design, operations, and liquidation of the environmental impacts sources, as well as other environmental requirements.

In accordance with the Law of the Republic of Belarus of 26.11.1992 No. 1982-XII EcoNiP is a technical regulation in the field of environmental protection, which is legally binding.

2.7.2 Requirements for State Environmental Expert Review, environmental impact assessment, information disclosure

The EIA process and the process of public discussions on EIA report are based on the requirements of the following international agreements and regulations:

- Convention on Environmental Impact Assessment in a Transboundary Context, signed February 9, 1991, Espoo (Finland);
- The Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, which has entered into force for the Republic of Belarus on 30.10.2001, and was endorsed without reservation by the Decree of the President of the Republic of Belarus of 14.12.99 No. 726.;
- Law 'On the State environmental expert review, strategic environmental assessment, and environmental impact assessment', No. 399-Z of 18.07.2016.
- Resolution of the Council of Ministers of Belarus No. 47 of 19.01.2017 'On particular measures for implementation of the Law 'On the State environmental review, strategic environmental assessment, and environmental impact assessment', No. 399-Z of 18.07.2016"
- Resolution of the Council of Ministers of Belarus 'On the approval of the Regulations for the procedure for public consultations on decisions of environmental significance, ecological reports on strategic environmental assessment, environmental impact assessment reports, consideration of adopted decisions of environmental significance, and on amendments and supplements to some resolutions of the Council of Ministers', No. 458 of 14.06.2016.
- TKP 17.02-08-2012 (02120) 'Procedure for Environmental Impact Assessment (EIA/*OVOS*) and reporting'

The parties involved in EIA process are a client, a developer, the community, local bodies of the Ministry of Natural Resources and Environmental Protection, local executive and administrative authorities, as well as state authorities specially authorized to perform state control and supervision in the area of project decisions on the activities planned.

EIA is based on the principles of transparency and information disclosure, which indicate the right of stakeholders for direct involvement into decision making process during the discussion of the project and consideration of the public opinion on environmental impacts resulting from the activities planned.

Public participation is mandatory during the Belarusian environmental impact assessment (EIA or *OVOS*) process. Consultations with local communities take form of information disclosure and public discussions.

Overall EIA public discussions in Belarus involve the following:

- Notification on public discussions containing:
  - Information on a project proponent;
  - Justification and description of the planned economic activity;
  - Information on a decision made by a relevant authority in relation to the project;
  - Information on a planned location of the project;

  - Timeframes of a project;
  - Timeframes of public discussions to be held;
  - Information on the venue where EIA report is made available;
  - Information on a local executive and regulatory authority in charge of public discussions' arrangements;
  - Timeframes and procedure of an application to arrange EIA public discussions;
  - Date and venue of the notification.
- Distribution of an EIA report among relevant authorities and its placement in their offices and on the websites of these authorities;
- Ensuring that all interested parties have an opportunity to place their comments, concerns and propositions to an EIA report during the whole period of public discussions;
- In the event of public assembly application is submitted by citizens or organizations to relevant authorities in the period of 10 days after a start of public discussions, this assembly may be appointed to a date not earlier than 25 days after the start date of public discussions and not later than their end date;
- In case the assembly is called, its procedure will include:
  - Registration of the participants;
  - Report made by of the project representative (oral and/or in a format of presentation);
  - Design organization report (presentation format);
  - Participants' questions, comments and propositions (oral and written) and answers to them (if the questions cannot be answered immediately, the answers must be provided to relevant address or e-mail within 10 days after the date of the assembly);
  - Speeches made by citizens and organizations' representatives;
  - Assembly's log to be finalized within 5 days after the assembly.
- Public discussions' protocol to be finalized within 10 days after their end date and signed by the members of the commission of preparation and conduction of public discussions.

2.7.3 Air Protection

Law of the Republic of Belarus 'On Air Protection', No. 2-Z of 16.12.2008 (as amended on 13.07.2016) defines legal and organizational framework in the field of protection of the ambient air from pollutant emissions and is designed to preserve and restore the ambient air quality and ensure environmental safety.

The main principles of air protection are:

- state regulation and management of air protection aspect;
- mandatory performance of air quality impact assessment from economic and other activities in the process of making decision on its implementation.
- establishment of the permissible levels of impacts on the air quality from economic and other activities taking into account environmental requirements;
- charging air pollutant emissions in the course of economic and other activities;
- standardization in the field of ambient air protection;
- prevention of air pollution and environmental damage;
- compensation of environmental damage caused by air pollutant emissions, as well as damage caused to life, health, and property of the citizens, including individual entrepreneurs and legal persons, property owned by the state due to air pollution resulted from economic and other activities implementation.
- easy access to environmental information on ambient air quality, impact, and protection measures.

The requirements for development of the limit values for permissible air polluting emissions are established by law:

- the permissible air emission limits are developed for designed stationary sources of emissions and sources (facilities) of impact on the air quality as a part of a project documentation.
- the permissible air emission limits for operating stationary sources of emissions and sources (facilities) of impact on the air quality are developed within a project of permissible limits for air pollutant emissions.

The limit values for permissible air pollutant emissions are developed and established taking into account:

- ambient air quality standards;
- background concentrations of air pollutants;
- air pollutants concentrations at the border of the zone of influence of emission sources;
- predicted changes of business model, output, type of works performed, volume of services provided, raw and other materials used, best available techniques implemented;
- technological limits for air pollutants emissions;
- limit values for permissible anthropogenic load on the ambient air;
- indicators for reducing the air pollutant emissions established by sector-specific and local (regional) programmes aimed at ambient air protection;
- performance of start-up works during the commissioning of new stationary sources of emissions for each stage of construction and reaching the designed capacity;
- determination of qualitative and quantitative composition of air pollutant emissions and assessment of impacts on the ambient air from pollutants, which can be released into the air due to introducing new inventions, rationalization proposals, as well as new technologies, mobile sources of emissions, types of fuel, substances, and materials.
- establishment of technological limits for air pollutants emissions for new technologies, process or other equipment, and mobile sources of emissions;
- establishment of maximum permissible concentrations of air pollutants in emissions for new technologies, mobile sources of emissions, and types of fuel;
- complying with requirements of legal framework on ambient air protection and environment protection, including binding requirements of technical regulations.

The procedure for establishing the permissible air pollutant emission limits is regulated by the Resolution of the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus of 23.06.2009 No. 43 ‘On the approval of the Instruction on the procedure for establishing the permissible air emission limits’.

The list of pollutants and air impact sources (facilities), for which permissible air emission limits are being established, is adopted by the Resolution of the Ministry of Natural Resources and Environmental Protection ‘On the approval of the list of pollutants, categories of air impact sources (facilities) subject to the establishing of permissible air emission limits, and of the list of air impact sources (facilities) which do not require establishing of permissible air emission limits, and on the annulment of the Resolution of the Ministry of Natural Resources and Environmental Protection dated 28.02.2005’, No. 31 of 29.05.2009.

The procedure for issuing of permits for air pollutant emissions is established by the Resolution of the Council of Ministers of Belarus of 21.05.2009 No. 664 ‘On the approval of the Regulations on the procedure for issuing of permits for pollutant air emissions, introduction of changes and/or supplements to these permits, suspension, renewal and extension of the effective period of the permits, and cancellation of permits’.

2.7.4 Protection of subsurface, soils, and lands

Degradation of lands, forests, and ecosystems (natural complexes), as well as radioactive, chemical, and biological contamination of soils/lands are recognized as one of the main national security threat according to the Decree of the President of the Republic of Belarus of 09.11.2010 No. 575 'On the adoption of the Conception of National Security of the Republic of Belarus'.

The importance of land degradation issue is pointed out in the National Strategy for Sustainable Social and Economic Development for the period to 2030 of the Republic of Belarus approved by the Presidium of the Council of Ministers of Belarus on February 10, 2015.

State governance in the field of conservation and rational use of lands, including prevention of land degradation (including soils) is exercised in accordance with the Land Code of the Republic of Belarus, the Law of the Republic of Belarus of 26.11.1992 'On Environmental Protection' the Law of 23.07.2008 'On the reclamation of lands'.

National policies on protection and rational use of lands, including prevention of land degradation (including soils) are implemented by the Ministry of Natural Resources and Environmental Protection, The State Committee on Property, other republican authorities, local executive and administrative authorities, and other governmental organizations.

National priorities concerning prevention of degradation of lands (including soils) are defined in the Resolution of the Council of Ministers of Belarus of 29.04.2015 No. 361 'On certain issues in relation to prevention of land degradation (including soils)', including:

- achievement of a land degradation-neutral (zero growth) (including soils);
- restoration of degraded and transformed ecosystems.

Subsurface Code of the Republic of Belarus of 14.07.2008 regulates relations in the field of geological studies of subsurface resources, extraction of minerals, use and protection of other subsurface resources, and is aimed at creation and expansion of mineral and raw material base, protection of state interests, rights and legal interest of users of subsurface resources and other persons.

Use and protection of subsurface resources are to be based on the following principles:

- thorough and integrated performance of geological exploration of subsurface;
- rational use of subsurface resources and their protection;
- standardization in the area of subsurface resources use and protection;
- charging for the use of subsurface resources with the exception of cases provided for by the Code or other laws;
- Ensuring the safety of life and health of citizens and property of citizens, including individual entrepreneurs and legal persons, property owned by the state;
- preventing adverse environmental impacts.

2.7.5 Water protection

Legislation related to water use and protection is based on the provisions of the Constitution of the Republic of Belarus and Water Code requirements, international agreements ratified by the Republic of Belarus, and other laws and regulations.

Water Code of the Republic of Belarus No. 149-Z of 30.04.2014 (as amended and supplemented on 17.07.2017) regulates the relations in the area of ownership, use, and management of water resources and water bodies, and is aimed at protection and rational (sustainable) use of water resources, as well as at protection of rights and legal interests of water users.

Relations in reference to water protection and use arising in the field of drinking water supply, sanitary and epidemiological well-being of population, which are not covered by the legislation concerning water protection and use, are regulated within the legal framework on drinking water supply and sanitary and epidemiological well-being of population.

Water protection and use are based on the following principles:

- rational (sustainable) use of water resources;
- integrated use of water resources;
- prioritization of the use of groundwater for drinking purposes over any other water use purposes.
- improvement of ecological status of the surface water bodies (their parts);
- prevention of water pollution and clogging;
- basin approach to water management;
- standardization in the area of water protection and use;
- charging for the use of water resources with the exception of cases provided for by the Water Code;
- compensation of damage caused to the water bodies.
- separation of functions regarding state regulation, management, and control in the field of water use and protection and water use functions;
- involvement of citizens and public organizations into decision making process in relation to water use and protection.

The limit values for permissible discharges of wastewater containing chemical and other substances are established in order to prevent pollution of the surface water bodies.

The limit values for permissible discharges of waste water containing chemical and other substances are established for each pollutant included into the list of regulated pollutants in waste water adopted by the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus (Resolution of 26.05.2017 No. 16 'On certain aspects of regulation of discharges of waste water containing chemical and other substances').

The limit values for permissible discharges of wastewater containing chemical and other substances include:

- permissible concentrations of pollutants in wastewater discharged into a surface water body (milligrams per cubic decimeter);
- maximum permissible mass of pollutants in wastewater discharged into a surface water body for the assigned period (tonnes per year).

The establishment of the limit values for permissible discharges of wastewater containing chemical and other substances is carried out with respect to water quality standards for surface water bodies.

Requirements for the establishment of the limit values for permissible discharges of wastewater containing chemical and other substances are set by the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus.

The limit values for permissible discharges of wastewater containing chemical and other substances are developed by water users and established by the local bodies of the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus through special water use permits, integrated environmental permits.

When the achievement of the limit values for permissible discharges of wastewater containing chemical and other substances is not secured in the course of reconstruction, modernization, overhaul activities for waste water treatment facilities, as well as in the process of commissioning and start-up activities for such facilities or their reaching the designed capacity, temporary limit values for permissible discharges of waste water containing chemical and other substances can be established.

Temporary limit values for permissible discharges of waste water containing chemical and other substances are developed by water users and established by the local bodies of the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus through special water use permits and integrated environmental permits for the period of between 1 to 3 years.

In order to prevent pollution, clogging, silting of surface water bodies and depletion of their water resources, as well as to preserve natural habitats of aquatic biological resources and other flora and fauna species the water protection zones adjacent to the shore line (a water body boundaries) of rivers, streams, channels, lakes, water reservoirs are established around the water bodies in accordance with Article 5 of the Water Code of the Republic of Belarus. There is a special regime for economic and other activities enforced within a water protection zone.

Additional restrictions are imposed on economic and other activities on the territory of coastal protection belts established within the boundaries of water protection zones.

Design, construction, reconstruction, commissioning, and operations of facilities for economic and other activities is permitted within the boundaries of water protection zones, providing that such facilities are equipped with structures allowing for protection of the water bodies from pollution, clogging, silting, depletion of water resources. The choice of such water conservation structures is made taking into account the need to comply with the limit values for permissible discharges of pollutants, other substances, and microorganisms established in accordance with environmental legislation.

It is prohibited within the boundaries of water protection zones:

- to perform construction, operations, renovation, and overhaul of facilities for waste disposal, decontamination, and storage with the exception of authorized sites designated for temporary disposal/storage, which exclude the possibility of wastes being released into surface and groundwater);
- to store of snow containing sand and salt mixtures and deicers/anti-icing agents;
- to set up fields with wastewater irrigation, cemeteries, animal burial sites, sewage/infiltration fields, sludge beds (with the exception of those of waste water treatment facilities with full biological treatment and water intake facilities, providing that water protection measures set out by design documentation are carried out at those sludge beds);
- to wash vehicles and other technical equipment/machinery;
- to perform forest cutting/logging, transplantation of vegetation without forest management projects and project documentation approved in a manner determined by law, without a permission issued by local executive and administrative authority.

2.7.6 Waste management

Law of the Republic of Belarus of 20.07.2007 No. 271-Z ‘On Waste Management’ defines legal framework for waste management and aims to reduce the volumes of waste generation and prevent their adverse impact on environment, public health, property owned by the state, property of legal and natural persons, as well as maximally incorporate wastes into the stream of commerce as secondary raw materials.

The key principles in relation to waste management are:

- mandatory conduct of the studies of hazardous properties of wastes and establishment of the degree of their hazard, as well as the hazard class of hazardous wastes;
- standardization of industrial waste generation and establishment of the limits for storage and disposal of production wastes;
- use of the state of art science and technology in the course of waste management;
- prioritization of use of wastes over their decontamination/neutralization or disposal provided that the legal environmental requirements are met;

- prioritization of decontamination/neutralization of wastes over their disposal;
- economic stimulation in the field of waste management;
- charging for industrial waste disposal;
- responsibility for violation of environmental regulations in the course of waste management activities;
- compensation of damage caused to environment, health of citizens, and property during waste management activities;
- provide legal and natural persons including individual entrepreneurs with an access to information on waste management;

Economic stimulation in the field of waste management can be performed through:

1. Providing benefits in accordance with the law to legal persons and individual entrepreneurs engaged with waste management activities for the purpose of:

- construction of waste disposal, storage, and decontamination facilities and waste use facilities;
- improvement of technological processes aimed at reducing of volumes of production industrial waste generation (preventing their generation);
- implementing measures on collection, decontamination, use of wastes and (or) preparing wastes for use;
- implementing innovations in the field of waste management;

2. Providing state support in accordance with the law to legal persons and individual entrepreneurs, including through loans from budget on activities for decontamination of hazardous wastes and recovery of costs associated with collection, decontamination, use of wastes and (or) preparing wastes for use.

Industrial waste producers shall:

- ensure the development and approval of the limit values for industrial waste generation and compliance with them;
- ensure determination of hazard level of industrial waste and hazard class of hazardous industrial waste if neither hazard level nor class of the waste is not identified in the classification catalogue of waste generated in the Republic of Belarus.

The classification catalogue of waste generated in the Republic of Belarus is approved by the Resolution of the Ministry of Natural Resources and Environmental Protection of 08.11.2007 No. 85.

2.7.7 Cultural heritage

Convention on protection of intangible cultural heritage approved by the Decree of the President of the Republic of Belarus No. 627 of 29.12.2004 has entered into force for the Republic of Belarus on the 20th of April, 2006.

The objectives of the Convention pursues the following objectives:

- protecting intangible cultural heritage;
- respect of intangible cultural heritage of the respective communities, groups, and persons;
- drawing attention on the local, national, and international levels to the importance of intangible cultural heritage and its mutual recognition;
- cooperation and assistance on the international level.

Public relations in the field of culture are regulated by the Culture Code of the Republic of Belarus of 20.07.2016, which also establishes legal organizational, economic and social framework on activities associated with preservation and use of cultural values, culture development, and provision of public access to cultural benefits.

2.7.8 Health and safety

Cross-sector general rules on occupational health and safety (OHS) approved by the Resolution of the Ministry of Labour and Social Protection of the Republic of Belarus No. 70 of 03.06.2003 (as amended and supplemented on 30.09.2011), establish the OHS requirements aimed to ensure appropriate health and safety working conditions.

Processes subject to OHS requirements are:

- facilities design, construction and operations;
- development and execution of production and technological processes, as well as of management of labour;
- design, production, and operation of production and technological equipment.

Employer shall comply with the OHS requirements of the Republic of Belarus Law No. 356-Z of 23.06.2008 'On Labour protection', as well as other laws and regulations, including technical regulations.

Employers providing work on the basis of a labour contract (employment agreement) are obliged to conduct workplace assessment in relation to working conditions according to the procedure established by legislation.

Organization basing on the specifics of its operations lists hazardous works, which are not to be conducted without work permit for high-risk tasks, works that require specific organizational and technical measures implemented, as well as works in the require of permanent control (hot works at temporary workplaces, works at roofs of buildings, in reservoirs, wells, underground facilities, etc.).

Main directions of governmental OHS policies are:

- workers' life and health preservation priorities;
- employer's responsibility for provision of healthy and safe working conditions;
- integrated solutions for the OHS related issues based on national, sector-specific, and local targeted programs aimed at improvement of working environment and conditions in terms of health and safety taking into account other economical and social policies, scientific and technical achievements;
- social protection of workers, compensation to those suffered from work related accidents and (or) professional diseases;
- establishment of uniform OHS requirements for all employers;
- use of economical methods of OHS management, participation of government in financing OHS and working conditions improvement activities;
- raising of public awareness, OHS trainings for workers;
- engagement of national authorities and other state organizations subject to the Government of the Republic of Belarus, local executive and administrative bodies, supervisory authorities, professional unions (trade union), employers;
- cooperation between employers and workers;
- application of world experience in organization of efforts to improve working conditions and workers safety.

2.8 Company policies and standards

The Quality Management System (in compliance with the STB ISO 9001-2009 requirements), the Environmental Management System (in compliance with STB ISO 14001-2005 requirements), and the Occupational Health and Safety Management System (in accordance with OHSAS 18001:2007 requirements) have been implemented by the Company, in 2009, 2010, and 2015 respectively. Strategic development framework for the Company's activities in the field of EHS is defined by:

- General environmental protection policy;

- Occupational health and safety policy (adopted 01.11.2016);
- Quality policy (adopted 11.12.2015).

Detailed information on the Company's standards and procedures in the field of environmental protection and occupational health and safety is provided in Chapter 12.

3. ESIA PROCESS

3.1 Introduction

The ESIA process is a systematic approach to identifying, describing and evaluating the potential environmental and social impacts of a Project, and formulating measures that will be implemented to manage these impacts, for example, so that adverse impacts can be avoided or reduced to an acceptable level and beneficial impacts can be enhanced.

To ensure a robust and comprehensive impact assessment, the ESIA process is structured around a series of progressive and iterative stages (Figure 3.1). Stakeholders, the Project design/implementation team and the ESIA team provide inputs to these stages. The focus of this chapter will be on the scoping and impact assessment stages and the activity 'baseline studies (specialist studies)' that provides necessary data inputs to these two stages.

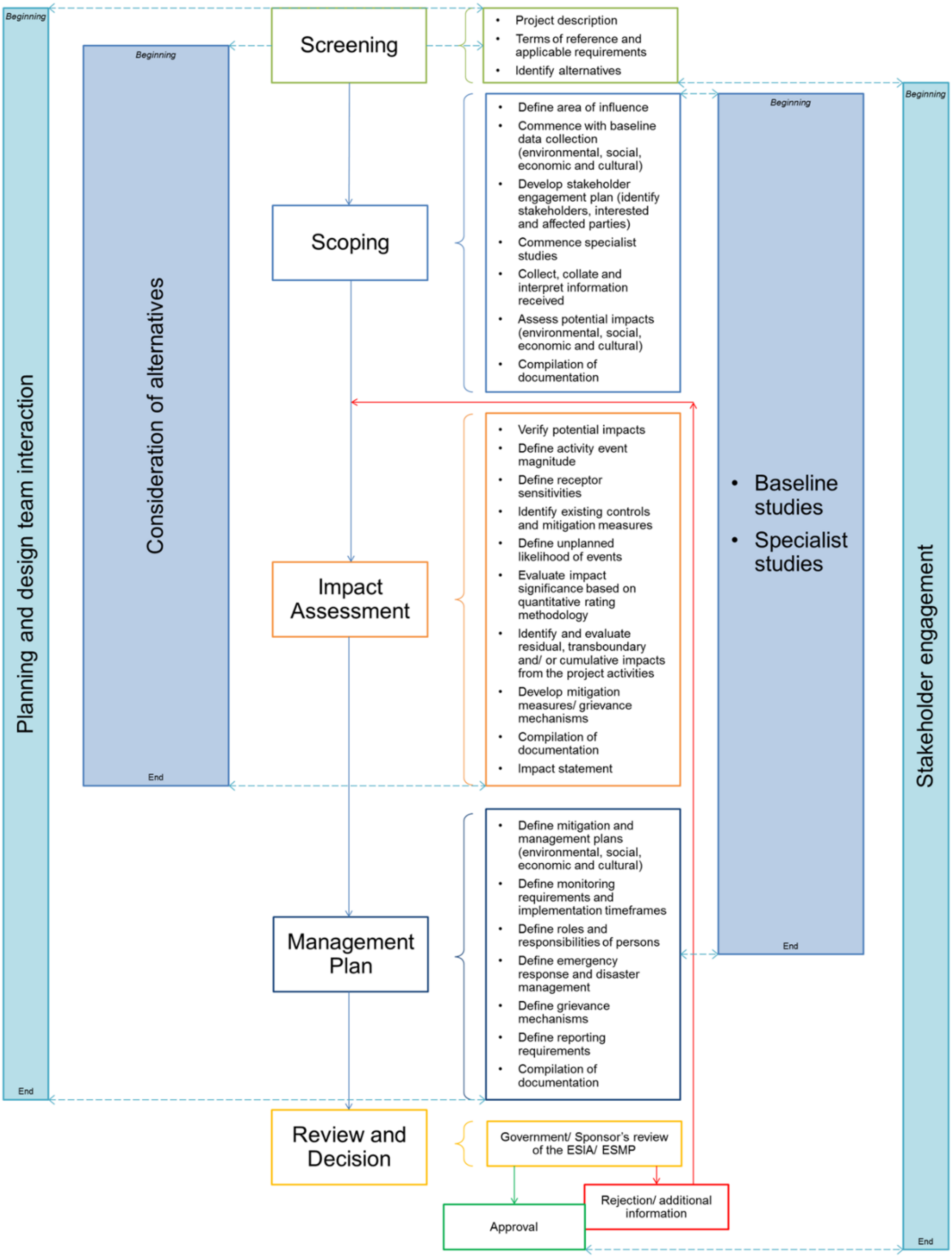

Figure 3.1: ESIA Process

This section provides an overview of the overall ESIA process and addresses:

- ESIA scoping (Section 3.2);
- Baseline studies (Section 3.3);
- Impact assessment (3.4);
- Consideration of mitigation measures in the assessment process (Section 3.5);
- Discipline specific criteria (Section 3.6);
- Approach to cumulative impacts (Section 3.7).

3.2 Scoping

ESIA Scoping results in the scope of the ESIA work being defined; using available information on the Project location and design, known baseline situation/trends, results of early stakeholder engagement and applicable legal requirements. This stage requires:

- Project design data including alternative sites; design configurations and construction methods;
- Initial baseline description including identification of potential environmental and social receptors, and known trends in the status of receptors, that may be affected by the Project; and
- Stakeholder engagement: views of stakeholders on the key impacts to be assessed. Stakeholder engagement can also provide useful baseline information and help to identify receptors.

During this stage, also, the Project Area of Influence is identified, according to the IFC criteria included in PS 1, which entails consideration of areas affected by a) direct and indirect impacts (inn terms of indirect impacts, the focus is specifically on impacts affecting biodiversity and ecosystem services upon which Affected Communities' livelihoods are dependent), b) impacts from unplanned, but predictable developments caused by the Project that may occur later or at a different locations, c) associated facilities and d) cumulative impacts arising from a Project and other existing, planned or reasonably defined developments at the time ESIA process is conducted.

3.3 Baseline Studies

Baseline studies are undertaken, primarily at two key stages (scoping and impact assessment); however as shown in Figure 1 they are a continuing input - almost throughout the entire ESIA Process. During scoping work relatively 'high-level' baseline data are required to assist identification of likely key impacts. Baseline data used for scoping forms the core of the baseline data used in the impact assessment. However, it is likely that the detailed baseline data needed to predict and assess impacts are unavailable at the scoping stage. Where gaps are identified between available baseline data, at the scoping stage, and the data required for the ESIA, then additional surveys or studies are undertaken to collect the needed data.

3.3.1 Identification of Receptors

Receptors are environmental and social components that may be affected, adversely or beneficially, by a Project. Potential receptors are identified, and their sensitivity determined in scoping work and baseline studies. Four high-level categories of Project receptors can be identified:

- Environmental (such as air quality, water bodies, landscapes, terrestrial soils, marine sediments and geology);
- Biodiversity and ecosystem services (such as habitats, species and ecosystem services, for example, flood protection provided by nearby wetlands); and
- Social (such as residents of local communities, businesses, land and other resource users, cultural heritage resources).

3.4 Impact Assessment

The actions undertaken to determine the significance (often termed 'evaluation') of potential Project impacts is illustrated in Figure 3.2 and involves four key steps:

- **Prediction**: What will happen to the status of specific receptors as a consequence of this Project (primarily; what is the magnitude of the impact?);
- **Evaluation of significance**: How significant is the impact? What is its relative significance when compared to other impacts?
- **Mitigation**: If there are impacts of concern (adverse), can anything be done to avoid, minimise, or offset the impacts? Or to enhance potential beneficial impacts?
- **Residual Impacts:** After mitigation, are the impacts still of concern? If yes, the process needs to be repeated at least once before the 'final' determination of residual impact significance occurs.

3.4.1 Prediction

Impact prediction involves determining the magnitude or extent of a change or changes in the status of a receptor or linked receptors resulting from a Project. To the extent possible these changes in status should be quantified. Impact prediction provides valuable information to determine the broader characteristics of impacts.

3.4.1.1 Impact Types and Characteristics

Impacts can be divided into types and, also, exhibit a number of characteristics. The degree to which an impact may be managed or modified by the mitigation measures is dependent upon the impact type and its characteristics. Table 3.1 provides definitions of key impact types.

Table 3.1: Impact Types

Term	Definition
Direct Impact	An impact that results from a direct interaction between a Project activity and the receiving environment.
Indirect Impact	An impacts that follows on from the primary interactions between the Project and its environment as a result of subsequent interactions within the environment.
Induced Impact	An impact that results from other activities that occur or are encouraged to occur as a consequence of the Project.
Reversible impact	An impact that can be changed (reversed) such that the original status of a receptor is restored to its condition prior to the impact occurring.
Cumulative Impact	A 'combined' impact which results from the interaction of two or more impacts, arising from a Project and one or more other Projects.

All of these impact types exhibit certain characteristics; they can be:

- Adverse or beneficial;
- Limited or extensive in scale (extent);
- Long or short-term in duration;
- Continuous or intermittent (frequency); and
- Reversible or irreversible.

3.4.2 Evaluation of significance

Impact significance needs to be assessed with and without mitigation measures in place (in both cases it is assumed that the 'design controls' are in place). A residual impact is the impact that remains following the application of mitigation measures, and is thus the final 'level' of impact. Residual impacts are the focus of management and monitoring activities during Project implementation.

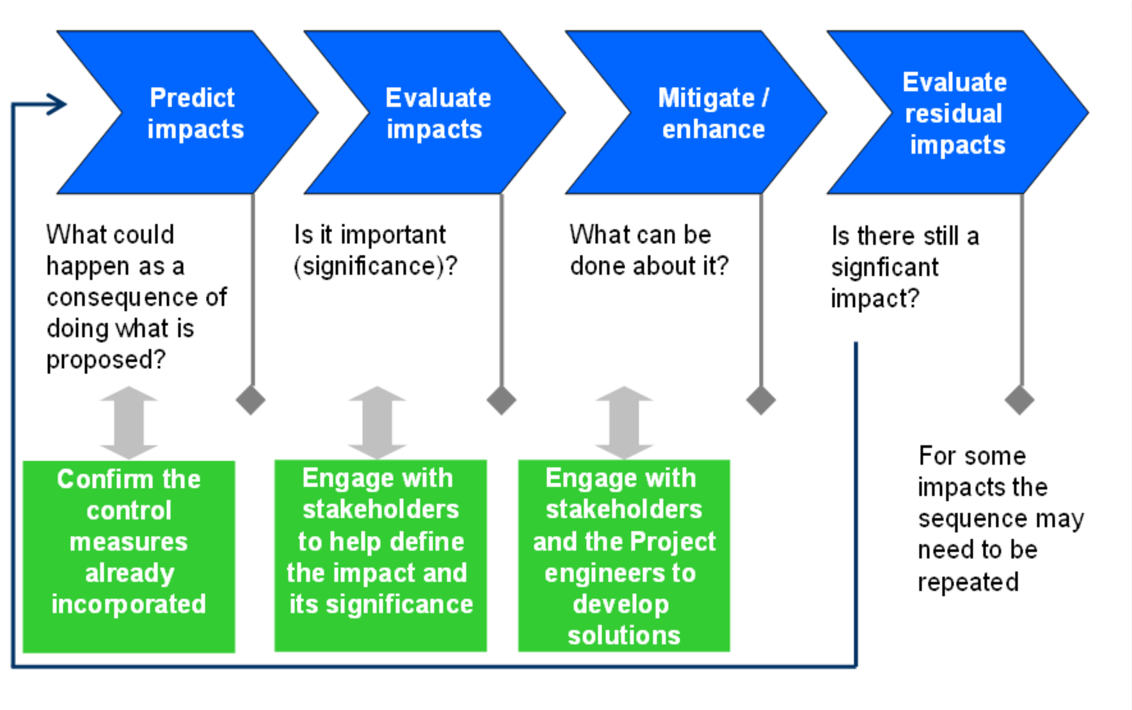

Figure 3.2: Impact Evaluation Framework Process

3.4.2.1 Assigning Impact Significance: Planned Events

For adverse impacts, significance is assigned, as presented below, based on determining impact magnitude and receptor sensitivity. Beneficial impacts are identified, assessed and evaluated, making use of impact magnitude (as per the guidance below), but not receptor sensitivity. Instead, beneficial impacts are described and evaluated on the basis of the available data, alignment with government policies/targets, stakeholder inputs and professional expert judgement. Measures to enhance them will be identified to try to maximise the expected benefits.

The first step is to determine impact magnitude.

The magnitude of an impact is a measure of the scale of a change from baseline conditions for a receptor. This measure of change can be described by considering the following factors in combination:

- **Extent**: Spatial extent (e.g. habitat impacted) or population extent (e.g. proportion of the population/ community affected);
- **Duration**: Period of time over which an impact will interact with a receptor;
- **Frequency**: How often the impact will occur; and
- **Reversibility**: Restoration of the pre-impact status of a receptor.

For each impact a decision needs to be made as to its extent, duration, frequency, and reversibility – on the basis of the information provided in Table 3.2.

Table 3.2: Impact Magnitude Factors

Factors	Elements	Explanation
Impact **Magnitude**		
Extent	Local	Impacts on divisional personnel including contractors, communities residing within SPZ; surface impacts in the areas of infrastructure facilities, water bodies and sections of water flows within the boundaries of the administrative territorial unit; the maximum depth of impact is determined by the depth of abstraction wells of the potable water supply system (up to

Factors	Elements	Explanation
		120 m from surface);
	Regional	Impacts on personnel of the Company and other entities, local communities; impact is present beyond the boundary of SPZ of the operational sites and linear infrastructure; impact extends to the depths below the potable water wells (i.e. more than 120 m from surface); impact affects regional-level water bodies and flows, nature conservation areas of regional significance, or territories of several administrative territorial units;
	National	Impacts that affect areas of several regions, i.e. at a national scale, water flows/bodies or nature conservation areas of national significance;
	Transboundary	Impacts that affect receptors, beyond the boundaries of the country in which the project is located and producing transboundary/ global effects (e.g. impacts of greenhouse gas emissions).
Duration	Short-term	Impacts that are predicted to last only for a limited period (e.g. during the period of a certain limited duration construction activity) but will cease either on completion of the activity or rapidly afterwards as a result of mitigation/reinstatement measures and/or natural recovery.
	Medium-term	Impacts that are predicted to last for a moderate period (up to two or three years on an average). Examples include impacts during the period of extended construction activities or impacts during limited duration activities but which extend for a moderate period after the completion of that activity.
	Long-term	Impacts that are predicted to continue over an extended period, (e.g. noise from operation of a development, impacts from operational discharges or emissions). These include impacts that may be intermittent or repeated rather than continuous if they occur over an extended time period (e.g. impacts resulting from annual maintenance activities).
Frequency	Infrequent	Impacts are predicted to be rare in nature over a certain period (see 'Duration' above).
	Periodic	Impacts are predicted to be recurring over a certain period (see 'Duration' above).
	Constant	Impacts are predicted to be permanent during a certain period (see 'Duration' above).
Reversibility	Irreversible	Impacts that cause a permanent change in the affected receptor
	Reversible	Restoration of the pre-impact status of a receptor as a result of mitigation/reinstatement measures and/or natural recovery. The time periods over which impacts may reverse link to the duration over which an impact is experienced (see 'Duration'

Factors	Elements	Explanation
		above)

The next step is to determine the impact magnitude itself.

Table 3.3 provides generic criteria to be used to determine the impact magnitude. Taking the results derived from the previous step a decision can be made on impact magnitude (negligible, low, moderate, high). Discipline specific criteria have been devised and these are presented in Section 3.6.

Table 3.3: Impact magnitude

Impact Magnitude	Criteria
Negligible	No discernible impact. Receptor change is essentially indistinguishable from natural background variation.
Low	Limited impacts which are: **Extent:** local **Duration:** short term **Frequency:** infrequent to periodic **Reversibility:** reversible
Moderate	Noticeable impacts which are: **Extent**: regional **Duration**: medium term **Frequency:** periodic to constant **Reversibility**: reversible
High	Prominent impacts which are: **Extent**: national or transboundary **Duration**: long term **Frequency**: constant **Reversibility**: irreversible

Once the respective magnitudes of each impact have been allocated the next step is to determine receptor sensitivity. Receptor sensitivity is based on two components: the degree to which a particular receptor is resilient to a change and the value attributed to the receptor by stakeholders or applicable regulations/policies.

Receptor resilience takes into consideration not only activity - receptor- impact pathways, but also the characteristics of a receptor that might make it more or less resilient to change. As such, a receptor can be considered as existing within a spectrum of 'vulnerable' to 'resilient'.

Receptor value takes into consideration its importance as represented, for example, by its conservation status, its socio-cultural importance and/or its economic value. Certain receptors are deemed to be of greater importance than other receptors.

For each impact the receptor sensitivity has to be determined. Table 3.4 provides generic criteria to be used when determining receptor sensitivity. Discipline specific criteria have been devised and these are presented in Section 3.6.

The final step is to combine the impact magnitude and receptor sensitivity results to determine impact significance. This is done by using an impact significance matrix (Table 3.4), whereby impact significance is determined by finding the cell where the impact magnitude and sensitivity results intersect, for example, an impact of low magnitude affecting a receptor of moderate sensitivity is an impact of low/moderate significance (the actual significance determination - low or moderate - in this case can be made by the ESIA team) or an impact of high magnitude affecting a receptor of moderate sensitivity results in an impact of high significance.

Table 3.5 provides an account of the key features (definitions) of each of the impact significance classifications (form Not Significant to High); specifically linking them to need for mitigation measures.

Table 3.4: Impact Significance Matrix

		Receptor Sensitivity			
		Negligible	**Low**	**Moderate**	**High**
Impact Magnitude	**Negligible**	Not significant	Not significant	Not significant	Not significant/ Low[7]
	Low	Not significant	Low	Low/Moderate[8]	Moderate
	Moderate	Not significant	Low/Moderate	Moderate	High
	High	Low	Moderate	High	High

Table 3.5: Impact Significance Definitions

Adverse Impacts	**High**	Impacts with a "High" significance are likely to disrupt the function and value of a receptor, and may have broader systemic consequences (e.g. ecosystem or social well-being). These impacts are a priority for mitigation in order to avoid or reduce the significance of the impact.
	Moderate	Impacts with a "Moderate" significance are likely to be noticeable and result in lasting changes to baseline conditions, which may cause hardship to or degradation of a receptor, although the overall function and value of a receptor is not disrupted. These impacts are a priority for mitigation in order to avoid or reduce the significance of the impact.
	Low	Impacts with a "Low" significance are expected to be noticeable changes to baseline conditions, beyond natural variation, but are not expected to cause hardship, degradation, or impair the function and value of receptor. However, these impacts warrant the attention of decision-makers, and should be avoided or mitigated where practicable.
	Not Significant	Not Significant. Any impacts are expected to be indistinguishable from the baseline or within the natural level of variation. These impacts do not require mitigation and are not a concern of the decision-making process.

[7] Allows technical discipline author to decide if impact significance is Not Significant or Low

[8] Allows technical discipline author to decide if impact significance is Low or Moderate

This method is applied twice: to both pre- and post-mitigation scenarios for all impacts identified. In general, residual impacts classed as "Not Significant" or "Low Significance" are not considered to be of concern for the Project[9]. For adverse impacts of "Moderate" and "High" significance, an iterative process is undertaken to further investigate opportunities for mitigation, according to the hierarchy above. Where the significance cannot be further reduced, an explanation is provided of why further reduction is not practicable. Monitoring may be required to confirm the measures used to mitigate adverse impacts are working properly and that the impact is not worse than predicted. Monitoring requirements are presented in the Environmental and Social Management Plan (ESMP) and Commitment Register.

3.4.2.2 Assigning Impact Significance: Unplanned Events

For unplanned events it is necessary to add the likelihood of an event occurring to the methodology. Table 3.6 provides definitions for the likelihood categories that need to be applied to all events.

Table 3.6: Likelihood categories for unplanned events

Likelihood	Definition
Certain	Events that will occur during normal operating conditions (i.e., they are inevitable).
Possible	Events that are likely to occur at some time during normal operating conditions.
Unlikely	Events that are unlikely but may occur at some time during normal operating conditions.
Improbable	Events that are extremely unlikely to occur during normal operating conditions.

Unplanned events will often result in a very High impact significance, even with mitigation/remedial measures in place e.g. major oil spills. In such cases, not only must measures be in place to manage an unplanned event, but the probability must be minimised to levels seen to represent good industry practice. In this table, unplanned events with a High residual impact significance would need to be categorised as 'Improbable'. In many cases quantified risks assessment will be required to quantify the probability of an event and this should be compared with industry good practice. Where quantification is possible, the likelihood criteria should include quantified probabilities i.e. Improbable equates to less than a $1x10^{-6}$ event.

3.5 Impact Mitigation

As part of the ESIA process, when adverse impacts are identified (which cannot be managed via design controls), mitigation measures are developed (including avoiding, management and monitoring actions). The process of identifying design controls and mitigation measures must follow the sequence of the mitigation hierarchy (Figure 3.3), as specified in IFC's PS 1, which is widely regarded as the best practice approach to managing impacts.

First, efforts are made to avoid or prevent, then minimise or reduce adverse impacts. Through the application of design controls. Subsequently, these "design controls" are supplemented by additional 'design controls' plus mitigation measures to be applied through the effective management of project-related activities during construction, operation and decommissioning. Any remaining significant residual impacts are then addressed via consideration of mitigation measures such as offsetting and compensation.

[9] A more stringent approach may applied for the assessment of ecological receptors of high sensitivity, such as critical habitat, or species classified as having vulnerable or above conservation status. In this case, residual impact significance of Low and above is very likely to be a concern to the further development of the Project.

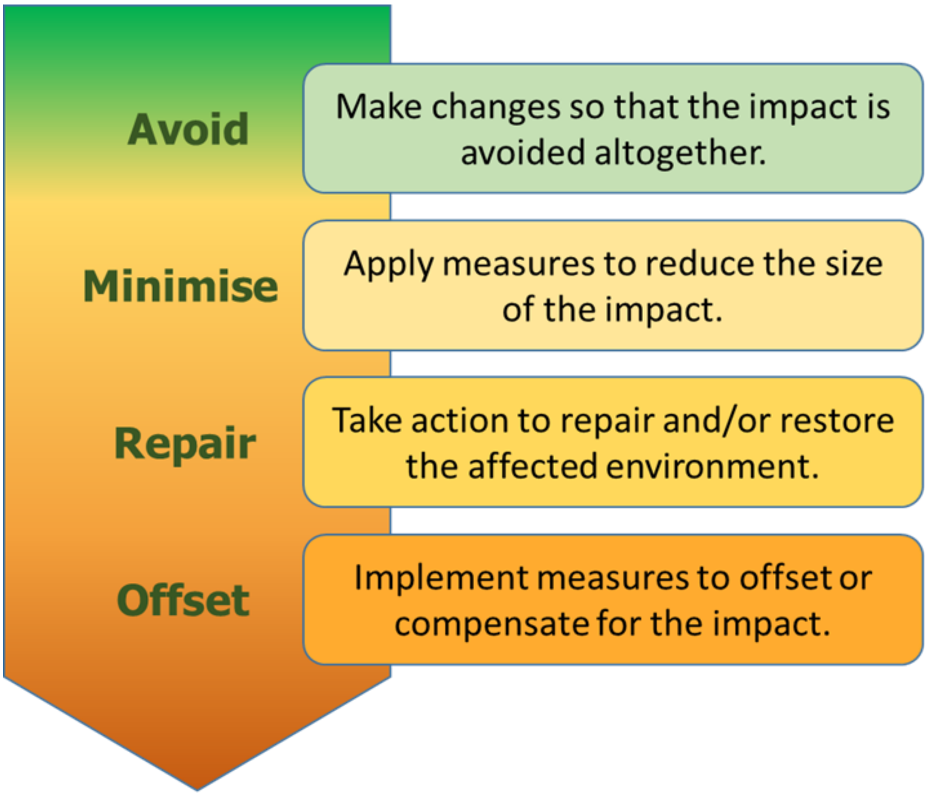

Figure 3.3: Mitigation Hierarchy

3.6 Discipline specific criteria

3.6.1 Significance of impact – air emissions

Table 3.7: Criteria to define significance of air quality impacts

Negligible	Low	Moderate	High Major
Air quality			
Trivial contribution (<1%/non-measurable) to background concentrations predicted at locations outside of the boundary of the Project assets/facilities[10]	Pollutants concentrations (including background concentrations) at nearest sensitive receptor well within (<50%) the threshold limit values. Pollutants concentrations (including background concentrations) at offsite locations (i.e. outside of the Project facility/asset boundaries) without sensitive receptors approaching but within (50 - 100%) the threshold limit values. Air quality impacts do not result in the sanitary protection zone (SPZ) extending beyond the	Pollutants concentrations (including background concentrations) at nearest receptor approaching but within (50 – 100%) the threshold limit values. Pollutants concentrations (including background concentrations) at offsite locations without sensitive receptors marginally above (<110%) the threshold limit values. SPZ for air quality purposes extends beyond Project facility/asset boundaries, but does not	Regular exceedance (including background concentrations) of air quality MPC at nearest sensitive receptor. SPZ for air quality purposes encompasses sensitive receptors and levels at the receptors with the SPZ may exceed the MPC on a regular basis.

[10] The boundaries of the Project assets/facilities are defined in the Chapter 4 ('Project Description') of the ESIA.

Negligible	Low	Moderate	High Major
	Project facility/asset boundaries.	encompass any sensitive receptors.	

3.6.2 Significance of impact –soils

Table 3.8: Criteria to define significance of impacts on soils

Receptor Sensitivity - Soil

Sensitivity	Description
High	Highly vulnerable to physical disturbance, structurally prone to compaction or erosion, and taking >10 years to recover. Highly leachable and amenable to contamination. The soil provides a substrate that has the physical qualities and/or degree of productivity to support the development of important (in terms of nature conservation or concentration of biomass) and/ or indigenous species of flora and fauna. The soil is intrinsically linked to the hydrological cycle; water is fundamental to its structure; and the soil plays a key ecosystem role in water regulation.
Moderate	Vulnerable to physical disturbance but able to recover by mitigation measures within a period of 10 years. Moderately leachable. The soil provides a substrate that has the physical qualities and degree of productivity to support the development of species of flora and fauna in some abundance and levels of diversity. The soil has some capacity for water retention and regulation and plays some role in the hydrological cycle in terms of a degree of water regulation and as a substrate for channelling run-off.
Low	Resilient to physical disturbance and/or impermeable to contamination. The soil constitutes no particular favourable substrate for the development of floral habitats, invertebrates and other fauna. The soil plays little or no role in the hydrological cycle or regulation of water.
Negligible	This category is considered not applicable to soil quality.

Soil Event Magnitude

Magnitude	Description
High	The potential for soil quality and/or physical structure to be permanently impacted. The area affected by the activity is predicted to be large (>10 ha).
Moderate	The impact on soil quality and condition may recover through natural processes and the impact will be medium term (several years). The area affected by the activity is predicted to be a medium extent (>1 ha and < 10 ha)
Low	The impact on soil quality and condition is predicted to recover rapidly through natural processes and the duration of impact is short (limited to the Construction Phase). The area affected by the activity is predicted to be a minor extent (<1 ha)
Negligible	No changes distinguishable from natural variability.

3.6.3 Significance of impacts on groundwater

Table 3.9: Receptor Sensitivity – Groundwater

Sensitivity	Description
High	Productive strata of high conductance and good chemical quality with significant resource availability, or being within source (sanitary) I or II of a drinking water supply source protection zone. Presence of a groundwater dependent ecosystem of national and international importance within 1 km of the Project Area. The water resource is highly vulnerable to leaching and transportation of contaminants.
Moderate	Productive strata of medium conductance with limited resource availability and good chemical quality, or being within source (sanitary) III of a drinking water supply source protection zone. Presence of a groundwater dependent ecosystem of national and international importance within >1 km of the Project Area. The water resource is vulnerable to leaching and transportation of contaminants.
Low	Unproductive strata of low conductance with low resource availability and good quality. No designated groundwater fed ecosystems within 1 km of the Project Area The water resource has low vulnerability to contamination.
Negligible	Aquifer with negligible vulnerability and resource availability.

Table 3.10: Impact Magnitude - Groundwater

Magnitude	Description
High	There is a potential for water quality and/or quantity to be permanently impacted. There is a complete loss of integrity of a groundwater body or utilisation by receptors.
Moderate	Water quality and condition is likely to recover through natural processes and the impact is predicted to be medium-term (several years). There is a loss in integrity of a groundwater body or a loss of part of the groundwater body.
Low	Water quality and condition is predicted to recover rapidly through natural processes and the duration of impact is short (limited to the Construction Phase). There is a temporary impact on receptor.
Negligible	Results in an impact on receptor but of insufficient magnitude to affect its use and/or integrity

3.6.4 Significance of impacts on surface water resources

Table 3.11: Receptor Sensitivity - Surface Water

Sensitivity	Description
High	A water resource making up a vital component of a protected habitat or assemblage of species, which may have designated conservation status at an international and national scale The water resource supports important (e.g. protected and/or large populations) of flora and fauna. The water resource is highly important and relied upon locally or is important at a regional or transboundary level for providing services.
Moderate	The water resource supports populations of flora and fauna. The water resource has a local importance in terms of providing services, but there is ample capacity and/or adequate opportunity for alternative sources.
Low	The water resource has limited or no role in supporting flora and fauna. The water resource has little or no role in terms of providing services for the local community.
Negligible	This category is considered non-applicable to surface water.

Table 3.12: Impact Magnitude - Surface Water

Magnitude	Description
High	The potential for natural recovery of water quality, quantity and/or physical disturbance through natural processes is limited and the impact is predicted to be long term (several years). Predicted to affect an entire watercourse downstream of the landfall section
Moderate	Water quality, quantity and the condition of the watercourse is likely to recover through natural processes and the impact is predicted to be medium term (a year). Predicted to affect multiple or elongated stretches of a watercourse.
Low	Water quality, quantity and condition is predicted to recover rapidly through natural processes and the duration of impact is short (limited to the Construction Phase). Predicted to affect a limited stretch of a watercourse.
Negligible	No changes distinguishable from natural variability. Predicted to affect a single pool of a watercourse.

3.6.5 Significance of landscape and visual impacts

Table 3.13: Receptor Sensitivity – Landscape Character

Sensitivity	Description
High	Landscape of distinctive components and characteristics, or a relatively undisturbed, pristine landscape, where changes or disruptions to the existing landscape would be noticeable and difficult to mitigate or restore; a small change is likely to be prominent or even dominant; a change to the landscape could alter the classification and integrity of the landscape character or quality and its perceived value relative to the scale and openness.
Moderate	Landscape of relatively widespread, featureless, common components and characteristics, able to tolerate some changes or modifications without altering the classification of landscape character or quality. Landscape lacking in structural landform would also be considered of medium sensitivity.
Low	Landscape of relatively indiscernible components and characteristics, the nature of which is likely to be tolerant of substantial change, where modifications are unlikely to alter its character or quality classification. Landscape of poor condition, and low perceived value relative to their scale and form. Where a landscape holds a high potential for mitigation it would also be considered to be of low sensitivity.
Negligible	N/A – it is not considered appropriate to include this category since no landscape is considered so unimportant that it may safely be disregarded.

Table 3.14: Impact Magnitude – Landscape Character

Magnitude	Description
High	Ranging from a limited change in landscape and seascape characteristics over an extensive geographical area, to an intensive or pronounced change over a more limited area; impact is more likely to be high if change is long-term or permanent.
Moderate	Moderate change in a localised area (e.g. limited woodland clearance without compromising the overall integrity of the wider woodland area); could include high impact change of a short-term or temporary nature.
Low	Minor change in scale and geographical extent (e.g. loss of small areas of vegetation or indirect impact resulting from intervisibility with development in adjoining character type); impact is more likely to be low if change is short-term or temporary.
Negligible	Virtually imperceptible change to the baseline context.

Table 3.15: Receptor Sensitivity – Visual Amenity

Sensitivity	Description
High	Receptors with a key interest and expectation of enjoying the view (e.g. residential receptors, tourists or people engaged in outdoor recreation whose attention is focused on the landscape) and/or a greatly valued existing view (e.g. a designated landscape, unspoilt countryside, recognised viewpoint or conservation area).
Moderate	Receptors at locations where the view is valued but not fundamental to the location or activity (e.g. people engaged in outdoor recreation that does not focus on an appreciation of the landscape). Visual receptors are less sensitive to changes to their view if the quality, condition and extent of the existing view is unexceptional (e.g. some high density suburban townscapes).

Sensitivity	Description
Low	Receptors engaged in activities that either distract from the view or require concentration on the foreground, resulting in a minimal interest or appreciation of the view (e.g. people at work or motorists travelling through the area with the sole purpose of getting from one place to another and not for the specific enjoyment of the scenery). Receptors might very well appreciate the view if they chose to, but visual amenity is not the principal reason for them to be present. Visual receptors are less sensitive to changes to their view if the quality of the existing view is poor (e.g. industrial areas or derelict land).
Negligible	N/A – it is not considered appropriate to include this category since no visual receptor is considered so unimportant that it may safely be disregarded.

Table 3.16: Impact Magnitude – Visual Amenity

Magnitude	Description
High	Extensive change to existing view, loss of key characteristic features; introduction of anomalous and highly prominent or dominant new elements. Impact is more likely to be high if change is long-term or permanent.
Moderate	Notable change to existing view (e.g. partial loss of key characteristic features); introduction of prominent, but essentially localised new features or elements; could include high impact change of a short-term or temporary nature.
Low	Minor change to existing view (e.g. limited loss of characteristic features), changes are evident, but not especially prominent and are generally localised impact is more likely to be low if change is short-term or temporary.
Negligible	Barely perceptible change to existing view and/or very brief exposure to view.

3.6.6 Significance of impacts on biodiversity

Table 3.17:Receptor Sensitivity – Habitats

Sensitivity and Value	Description
High	An area which has designated conservation status categories Ia to IV under the IUCN Classification. Sites designated as Specially Protected Natural Areas (SPNAs).
Moderate	A site or habitat that has designated conservation status at a National scale. Undesignated habitats which are unmodified by human activity and comprise native species forming assemblages consistent with the prevailing environmental conditions (Natural habitats according to IFC PS6)
Low	Habitats occurring outside of any designation which are subject to active management or alteration through human activity, but with an assemblage of species which is predominantly native in origin (Modified Habitats according to IFC PS6).
Negligible	Habitats which are either appreciably degraded/disturbed by human activity or have high proportions of invasive/non-native species (Modified Habitats according to IFC PS6).

Table 3.18: Receptor Sensitivity – Species

Sensitivity and Value	Description
High	A species assessed as Endangered or Critically Endangered either at an international or national level.
Moderate	A species assessed as Vulnerable either at an international or national level. A species assessed as Vulnerable or Endangered at a regional level
Low	A species assessed at 'Near Threatened' internationally. A species assessed as rare at a National or Regional level.
Negligible	Non- red list species

Table 3.19: Impact Magnitude – Habitats

Magnitude	Description
High	The impact has the potential to adversely affect the integrity of an area/region, by substantially changing in the long term its ecological features, structures and functions, across its whole area, that enable it to sustain the habitat, complex of habitats and/or population levels of species that makes it important.
Moderate	The area/region's integrity is predicted to not be adversely affected in the long term, but the project is likely to affect some, if not all, of the area's ecological features, structures and functions in the short or medium term. The area/region may be able to recover through natural regeneration and restoration.
Low	Neither of the above applies, but some minor impacts of limited extent, or to some elements of the area, are evident but easy to recover through natural regeneration.
Negligible	Indiscernible from natural variability.

Table 3.20: Impact Magnitude – Species

Magnitude	Description
High	Impact on a species that affects an entire population to cause a decline in abundance and/or change in distribution beyond which natural recruitment (reproduction, immigration from unaffected areas) would not return that population or species, or any population or species dependent upon it, to its former level within several generations11, or when there is no possibility of recovery.
Moderate	Impact affects a portion of a population and may bring about a change in abundance and/or a reduction in the distribution over one or more generations*, but does not threaten the long-term integrity of that population or any population dependent on it. The size and cumulative character of the consequence is also important. A moderate magnitude impact multiplied over a wide area would be regarded as a high magnitude impact.
Low	A low magnitude impact on a species affects a specific group of localized individuals within a population over a short time period (one generation or less), but does not affect other tropic levels or the population itself.
Negligible	Indiscernible from natural variability.

[11] These are generations of the animal/plant species under consideration not human generations

3.6.7 Significance of impact – noise and vibration

Table 3.21: Criteria to define the significance of noise impacts

Negligible	Low	Moderate	High
Noise			
Noise levels remain at or close to ambient levels that are imperceptible to receptors.	Noise level increases detectable but remain below the threshold limit values. Increase at sensitive receptors <5dB above ambient background levels. Little or no adverse effect on sensitive receptors anticipated.	Noise levels at sensitive receptors occasionally exceed the threshold limit valuesduring exceptional events. Increase in noise levels at sensitive receptors 6 to 10dB above background. Moderate impacts to fauna.	Noise levels at sensitive receptors repeatedly or continuous exceed the threshold limit values. Increase in noise levels at sensitive receptors 11 to 15dB above background. High impacts to fauna.

3.6.8 Significance of impact – waste

The criteria to define the significance of waste impacts are defined in the Table 3.9 below.

Table 3.22: Criteria to define the significance of waste impacts

Negligible	Low	Moderate	High
No hazardous waste (Class I to III) and very limited non-hazardous (Class IV to V) generated. Approved disposal facilities available for all wastes. No impact on long term capacity of third party waste disposal/treatment facilities.	Limited hazardous waste (Class I to III) and moderate volumes of non-hazardous (Class IV to V) generated. Approved disposal/treatment facilities available for all wastes. No significant impact on long term capacity of third party waste disposal/treatment facilities.	Moderate volumes (requiring small-scale dedicated storage, transport and/or disposal facilities) of hazardous waste (Class I to III) and significant volumes (requiring large-scale dedicated storage, transport and/or disposal facilities) of non-hazardous (Class IV to V) generated. Approved disposal/treatment facilities available for all wastes. Moderate impact on long term capacity of third party waste disposal/treatment facilities.	Significant volumes of hazardous waste (Class I to III) and significant volumes of non-hazardous (Class IV to V) generated. Approved disposal/treatment facilities available for most wastes that generally meet the RF legal standards but minor deficiencies. Long term disposal/treatment options not available for small volumes of hazardous waste (Class I to III). Significant impact on long term capacity of third party waste disposal/treatment facilities.

3.6.9 Significance of impact - social

Table 3.23: Criteria to define the significance of social impacts

Negligible	**Low**	**Moderate**	**High**
Direct Impacts on Communities' Health, Safety and Security			
Marginal, readily reversible changes or imperceptible changes in the current health, safety and security status of local communities. Number of affected persons: very limited. Duration: very short-term.	Minor and readily reversible changes in the current health, safety and security status of local communities. Number of affected persons: limited. Duration: short-term.	Noticeable and reversible changes in the current health, safety and security status of local communities. Number of affected persons: moderate. Duration: medium-term.	Substantial changes in the current health, safety and security status of local communities. Reversibility of the changes depends on application of a range of technical, organisational, financial and other measures. Single case of serious injury. Number of affected persons: high. Duration: long-term.
Impacts on socio-economic resources (economic activities, governance practices and social infrastructure)			
No effect on social resources of critical[12] importance or primary livelihood assets of local communities (including indigenous communities). Number of affected users of socio-economic resources: very limited. Duration: short-term.	No effect on socio-economic resources of critical importance, non-replicable heritage (tangible and intangible), or primary livelihood assets of communities (including indigenous communities). Number of affected users of socio-economic resources: limited. Duration: short-term.	Potential effect on a limited range of valuable socio-economic resources or livelihood assets of communities (including indigenous communities) that are not of primary importance to community/individual subsistence. Core assets and resources of the local communities may be partially affected but this does not lead to overall deterioration of the main livelihood and its viability. Number of affected users of socio-economic resources: moderate. Duration: medium-term.	Socio-economic resources of critical importance, or primary livelihood assets of communities (including indigenous communities) are affected on the local, regional and national levels. Core assets and resources of the local communities are affected leading to irreversible disruption/ deterioration of the main livelihood. Number of affected users of socio-economic resources: high. Duration: long-term.
Impacts on cultural resources			
No effect on cultural resources of critical importance, non-replicable heritage (tangible and	No effect on cultural resources of critical importance, non-replicable heritage (tangible and	Potential effect on a limited range of valuable cultural resources of local communities (including indigenous communities)	Cultural resources of critical importance, non-replicable heritage (tangible and intangible) of communities (including indigenous

[12] The critically of resources is determined based on a combination of existing designations, expert judgment and stakeholder engagement as appropriate.

Negligible	**Low**	**Moderate**	**High**
intangible) of local communities, including indigenous communities. Number of affected users of cultural resources: very limited. Duration: short-term (.	intangible) of local communities, including indigenous communities. Number of affected users of cultural resources: limited. Duration: short-term.	that are not of primary importance to communities. Number of affected users of cultural resources: moderate. Duration: medium-term.	communities) are affected on the local and regional levels. Cultural resources of critical importance, non-replicable heritage (tangible and intangible) of various communities (including indigenous communities) are affected, including on the local, regional and national/international levels. The key resources and livelihoods of the indigenous population are affected, leading to an irreversible loss / depletion of the main sources of income. Number of affected users of cultural resources: high. Duration: long-term.
Physical Displacement			
No physical displacement entailed	No physical displacement entailed, apart from short-term/readily reversible (regular) movement of population employed by the Project as related to the rotation-based work	Short-term and reversible physical displacement of minimal extent (up to 10 households), without an effect on their traditional lifestyle and associated activities.	Permanent physical relocation (regardless of the number of households affected), resulting in the change of their traditional lifestyle and activities.

3.7 Cumulative impacts

3.7.1 Definition and Applicable Guidelines

CIA is one of the requirements set for a comprehensive ESIA. The relevant IFC Performance Standards are used as the main guideline for this purpose, including the following definition:

Cumulative impacts that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted.

3.7.1.1 IFC Guidance Notes: Performance Standards on Environmental and Social Sustainability, 2012

Recommendations relating to interpretation of CIA are provided in Guidance Note 1 to the IFC Performance Standards. Relevant text from this guidance has been summarized below again with emphasis added using bold text.

GN37. ….. Multiple environmental and social impacts from existing projects, combined with the potential incremental impacts resulting from proposed and/or anticipated future projects may result in significant cumulative impacts that would not be expected in the case of a stand-alone project or business activity.

GN38. … In those situations, where cumulative impacts are likely to occur from activities by third parties in the region and the impacts from the client's own operations are expected to be a relatively small amount of the cumulative total, a regional or sectoral assessment may be more appropriate than a CIA. [It should be noted that normally this is carried out by regional authorities as a strategic regional assessment].

GN40. At a practical level, the critical element of such an assessment is to determine how large an area around the project should be assessed, what an appropriate period of time is, and how to practically assess the complex interactions among different projects occurring at different times. Because a CIA transcends a single project development, the resulting potential management or mitigation measures typically require participation from a larger and more diverse number of stakeholders in order to be coordinated and implemented. Furthermore, the active participation of government authorities is typically required to assess the incremental contribution of each project to the cumulative impacts, monitor and enforce the implementation of the mitigation measures corresponding to each project, identify the additional mitigation measures required, and coordinate, ensure and document their implementation.

GN41. Paragraph 8 of Performance Standard 1 requires that…..the risks and impacts identification process ….. identifies and assesses cumulative impacts from further planned development of the project and other project-related developments, any existing project or condition whose impacts may be exacerbated by the project, and other developments of the same type that are realistically defined at the time of the risks and impacts identification process. Impacts from unplanned but predictable developments caused by the project that may occur later or at a different location should also be identified and assessed.

The assessment should be commensurate with the incremental contribution, source, extent, and severity of the cumulative impacts anticipated, and be limited to only those impacts generally recognized as important on the basis of scientific concerns and/or concerns from Affected Communities. Potential impacts that would occur without the project or independently of the project should not be considered.

… the client should ensure that its assessment determines the degree to which the project under review is contributing to the cumulative effects.

GN42. … In terms of anticipated future projects, priority should be given to assessing cumulative impacts stemming from the project being considered for financing, such as further planned developments associated with the project and other future developments of the same type in the project's AoI that are realistically defined at the time of the assessment (this may include any combination of developments which are either proposed, licensed or for which permits exist).

GN43. Where appropriate, the client should use commercially reasonable efforts to engage relevant government authorities, other developers, Affected Communities, and, where appropriate, other relevant *stakeholders, in the assessment, design, and implementation of coordinated mitigation measure to manage the potential cumulative impacts resulting from multiple projects in the same project's AoI.*

3.7.1.2 Good Practice Handbook on Cumulative Impact Assessment and Management Guidance for the Private Sector in Emerging Markets (August 2013)

IFC published in August 2013 the Good Practice Handbook (GPH) on Cumulative Impact Assessment and Management. This document is a supplement to the IFC Performance Standards and Guidance Notes and provides recommendations relating to practical assessment of cumulative impacts recognizing some of the uncertainties and constraints faced by private sector proponents. It also introduces the concept of valued environmental and social components (VECs) in the assessment of cumulative impacts.

The approach outlined in the Handbook comprises six steps consistent with IFC PS 1 and associated guidance note and is broadly applied in the methodology and approach presented in Section 13.4.

3.7.1.3 Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions, EU (1999)

Recommendations related to CIA are also provided in the EU commissioned document entitled 'Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions' (1999) applied extensively by European companies in the EIA process as a primary source of practical guidance.

Although a relatively old document, it advocates an approach that is consistent with more recent IFC guidance described above, including the following:

- Gathering of project information,
- A scoping phase (temporal and spatial scope),
- Scoping, to identify important issues for further assessment,
- Collection of baseline data, potentially over a wider geographic area than for the Project alone,
- Assessment of cumulative impacts (outlining a range of assessment tools and techniques) with consideration given to the carrying capacity of the receiving environment.

Recognizing that temporal boundaries need to be determined on a project-by-project basis, and that this is dependent upon the availability and quality of information, the Guidance states that *'In setting the future time boundary it is suggested that in general, beyond 5 years there is too much uncertainty associated with most development proposals. It is therefore recommended that in the majority of cases the limit does not exceed 5 years into the future.'*

3.7.2 Approach to CIA

The approach towards the assessment of cumulative impacts has evolved over recent decades as new guidance has been made available. The approach is therefore based primarily on the 2012 IFC Performance Standards and supplemented by the recommendations provided in the IFC GPH.

The GPH recognizes that where impacts are likely to arise from multiple projects at a regional level, or where there is uncertainty over potential impacts due to the longer-term timeframes involved, it would be more appropriate for a CIA to be undertaken by the relevant authorities. In recognition of the constraints often faced by private sector organizations when assessing cumulative impacts, the GPH introduces the concept of a simpler Rapid Cumulative Impacts Assessment (RCIA) based on a desktop review of readily available information.

For the purpose of this ESIA, the CIA will draw from the following information:

- Data and information received during the site visit in November 2017,
- Detailed primary baseline data gathered in the process of environmental engineering surveys and enabling a rather detailed characterization of the Project Area of Influence,
- Archives and literature data and information from other publicly available sources and used for characterization of a more extensive range of the territory, i.e. at a regional level, outside the Project Area of influence.

Further detail regarding the manner in which the two tiers of information will be applied is discussed below in the section dealing with the CIA methodology.

3.7.3 CIA Methodology

The CIA methodology is based on the guidances described previously and in particular follows the six step approach outlined in the GPH and includes the following six steps.

Step 1. Scoping Phase I – VECs, Spatial and Temporal Boundaries

The first stage of the CIA is aimed at identifying potential VECs and defining the spatial and temporal boundaries.

VECs

VECs are those receptors that are considered to be important when assessing the risks posed from cumulative impacts. VECs have been identified throughout the pre-ESIA process, including through consultations undertaken with stakeholders (e.g. see Chapter 7) and reviews and assessments undertaken as part of the pre-ESIA (see Chapters 5, 6, 8 and 9).

Consistent with the above-mentioned guidance, the assessment is limited to impacts generally recognized as important on the basis of scientific concerns and concerns from Affected Communities and excludes any potential impacts that would occur without the Project or independently of the Project. In addition, only those environmental and social receptors on which the Project itself is assessed to have potentially significant effects (see Chapters 8 and 9) are included in the CIA. In practical terms, this means that:

- If the impact of the Project on a receptor has been assessed Negligible then it is not considered as a VEC in the CIA (i.e. scoped out in all cases);
- Receptors on which the assessed Project impact is Low are considered on a case-by-case basis for inclusion as a VEC in the CIA.

Spatial Boundaries

The Project AoI defined in Chapter 4 in accordance with the IFC Performance Standards' guidance and with due consideration of potential cumulative impacts[13] . The pre-defined AoI includes:

- Project Area (areas directly affected by the Project include those affected by direct physical impacts from the Project or associated auxiliary facilities located within the Project boundaries),
- Areas adjacent to the Project Area where the Project facilities will have indirect impacts.

The CIA also considers a larger spatial area outside of the Project AoI. The precise spatial boundaries are defined on the basis of the geographic range of specific VECs as well as the spatial distribution of other third-party activities or influences that might impact the VECs.

Temporal Boundaries

Consistent with the EU guidance[14], consideration is normally given to existing projects or those expected to be initiated within a period of 5 years from the data of the CIA completion, with an exception of development projects that may be initiated after 5 years, but for which reliable information and certainty is available. The temporal boundary is therefore defined based on the availability and quality of information about existing and reasonably foreseeable projects or projects with a conceptual plan.

The overall Phase I scoping is undertaken through consideration of the VECs, spatial and temporal boundaries and also the Phase II scoping, in a systematic manner, taking the assessed Project impacts to

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[14] In the "'Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions" (1999), it is indicated that normally most of project proposals are associated with too many uncertainties outside of a period of 5 years. *It is recommended, therefore, to assume a time limit of maximum 5 years.*

each social and environmental receptor identified in Chapters 8 and 9, and taking into account the following aspects:

1. All the different types of Project impacts on those receptors and the assessed significance of the residual Project impact;
2. Spatial extent of a receptor in this particular region;
3. Consideration of how the spatial extent of the receptor may overlap with the influence of other industrial activities identified through the Phase II Scoping process;
4. Consideration of the relative temporal boundaries of the different stressors (e.g. whether or not such stressors are concurrent, consecutive etc.) and the duration of such impacts;
5. Other non-industrial influences that may affect a receptor (within the determined spatial and temporal boundaries).

The above aspects are determined, and the potentially affected receptors identified in the CIA process are taken into consideration for the above factors, which are then considered as VECs.

Step 2. Scoping Phase II – Other Activities and Environmental Drivers

This part of the scoping exercise identifies historical, existing and planned activities and the presence of natural influences and stressors that have the potential to affect the VECs identified in Step 1 that will require further assessment within the CIA.

Natural influences and stressors that are unrelated to the Project activities are also considered, for example, the potential impact of climate change in terms of the climatic extremes and impacts on permafrost, migratory and predatory animals. Given the inherent uncertainty and variability associated with climate change projections, these factors are only considered in terms of a high-level and qualitative assessment.

Step 3. Baseline Conditions

Baseline data for the Project AoI is based on detailed studies and survey works undertaken by the Project and as described in Chapters 5 and 6. These Project-specific studies are supplemented by readily available information at the regional scale beyond the Project AoI.

Step 4. Assessment of Cumulative Impacts

The Project CIA has adopted a VEC centric approach, i.e. VECs and their resilience have been identified / determined then the impacts from various activities on these VECs were assessed.

The assessment presented in this Chapter considers only the residual impacts associated with the Project, i.e. the impacts that will persist after implementation of the planned mitigation measures. The VECs, potentially affected according to the assessment to an insignificant degree, should not necessarily be included in the cumulative impact assessment (Table 3.24).

Table 3.24: Criteria for including valued environmental and social components

Residual impact			
Insignificant	Low	Moderate	High
Not included in CIA	Considered for assessing the potential cumulative impact	Included in CIA	Included in CIA

Predicted future conditions for VECs are analyzed taking into consideration all impact factors, including the contribution of this Project to the overall cumulative impacts.

Due to the inherent uncertainties in the nature of cumulative impacts, the CIA has by necessity been performed in a qualitative manner, but nevertheless provides useful context for determining the significance of the Project's contribution to the overall impacts.

Step 5. Significance of Cumulative impacts

The methodology described in Section 3.4 was developed primarily for assessing Project-specific impacts, although can be broadly applied to cumulative impacts.

Step 6. Management of Cumulative Impacts

Many of the mitigation measures defined during the assessment of Project impacts will also be applicable to the mitigation of cumulative impacts. However, it is also recognized that the cumulative impact assessment may generate additional mitigation measures and strategic or long-term actions, for example, the need to share findings of assessments and cooperate with third parties such as future developers and Irkutsk region authorities or local government bodies.

Consistent with the approach taken elsewhere in the ESIA and described in Section 3.4, the mitigation hierarchy, which broadly requires that consideration be given to avoidance, minimization, mitigation and offsetting in that order of preference, has been applied.

4. PROJECT DESCRIPTION

4.1 The Project Area

The proposed Project area is located in Zavodskoy District of Minsk, on the left bank of River Svisloch (Figure 4.1). The district occupies the area of 5.8 thousand ha and its population is 237.5 thousand. Details of the district location are provided in section 1.2.

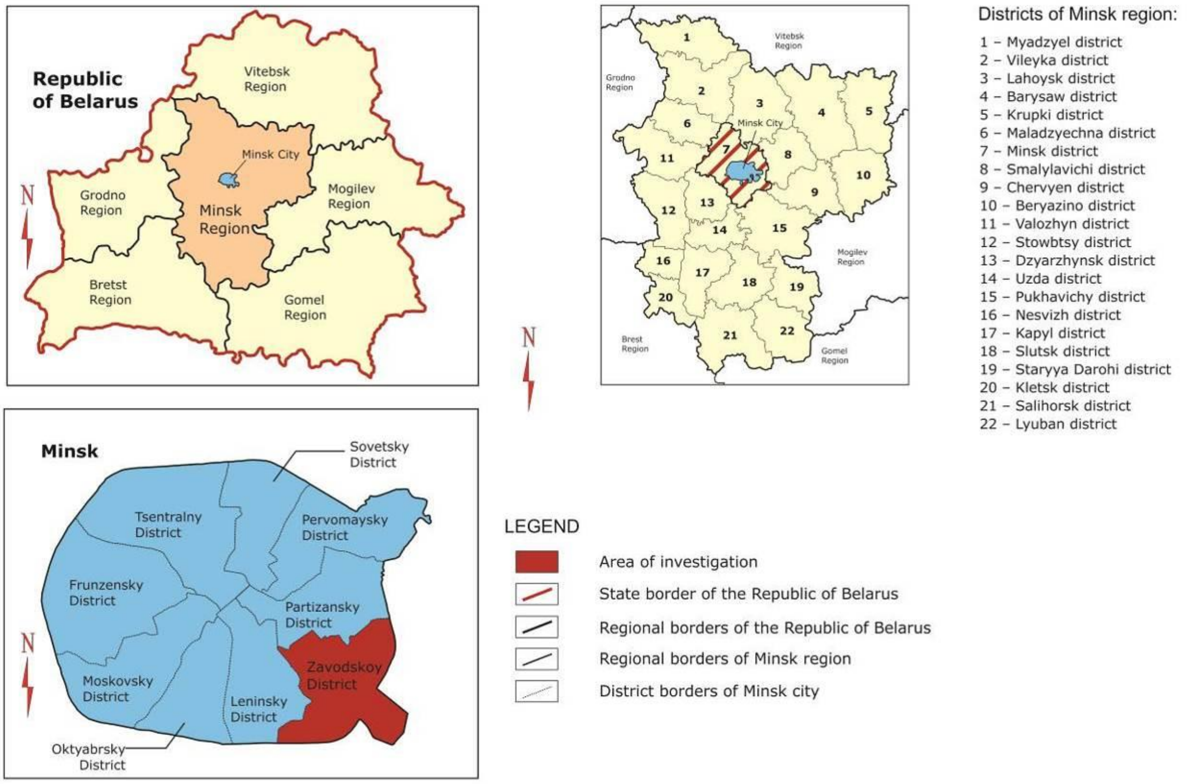


Figure 4.1: Proposed Project area

Source: Ramboll

Zavodskoy District is among the top rank areas of Minsk and Belarus in general in terms of industrial output, commodities production, provision of paid services to general public, and export sales. The district economy includes such industrial giants as Minsk Automobile Plant, Minsk Bearings Plant, Minsk Wheeled Tractor Plant, Automobile Trailer and Bodywork Plant "MAZ-Kupava", OJSC "Minskzhelezobeton" (RC products), OJSC "Minskdrev" (woodworking), OJSC "Gormolzavod No.2" (dairy), etc.

Minsk Waste Water Treatment Plant (MWWTP) of Minskvodokanal is located in the territory of the Shabany Industrial Hub. This area is part of Free Economic Zone (FEZ) "Minsk" (Site 1) comprising 142 industries. The proposed reconstruction Project considered by the ESIA will be implemented at the site of existing Minsk Waste Water Treatment Plant, more specifically site MWWTP-1.

The treatment plant occupies two sites: MWWTP-1 (50.61 ha) and MWWTP-2 (34.35 ha). MWWTP-1 facilities were first commissioned in 1963 followed by gradual development of treatment capacities required to treat the increasing waste water flows. Current design capacity of MWWTP-1 is 470 thousand m^3/day (actual treatment capacity is 360-380 thousand m^3/day including 30% of industrial effluents). Actual treatment capacity of MWWTP-2 facilities is about 100-110 thousand m^3/day. According to the Minsk development projection which was prepared before the technical feasibility studies provided for increasing MWWTP capacity to 750 thousand m^3/day (including MWWTP-1 – 550 thousand m^3/day, MWWTP-2 – 200 thousand m^3/day). At the moment all the figures are corrected based on the 420 thousand m^3/day as a target capacity for MWWTP-1

The main operational sites and groups of MWWTP facilities are shown in Figure 4.2 and description is provided in section 4.7. Detailed scheme of the project activities which is shown in Table 4.1 and Figure 4.4 is divided into three major parts – demolition, reconstruction and construction.

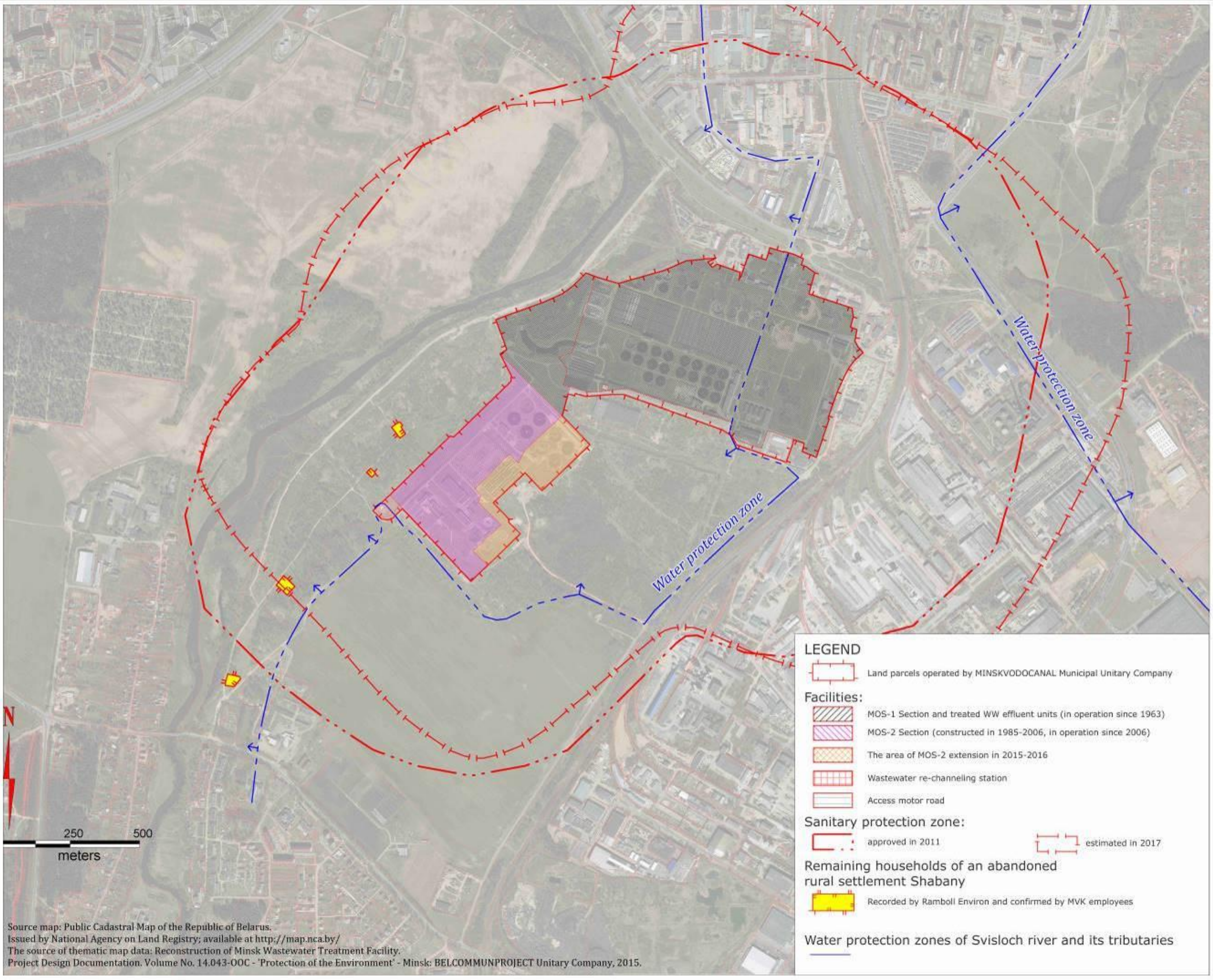


Figure 4.2: Land allocation and main operational sites

Source: Ramboll

Section 4.7 provides overview of the main Project facilities and infrastructure, as well as technological processes, based on the information available from the Client and Technical Consultant. This information is currently categorized as "pre-design solutions".

4.2 Project Area of Influence, Associated Facilities and Operations

Influence area of the Project includes the territories which are affected by the Project activities (either directly or indirectly) both inside and outside the operations site. The Project will also directly and indirectly influence other (associated) facilities and operations. Facilities and activities associated with the Project but not funded by EBRD are also covered by the supplementary ESIA process.

Current identification of Project associated facilities and operations takes into account the Priority Investment Programme (PIP) and the following anticipated changes in operations and MVK impacts which are related to implementation of the reconstruction Project:

- changes in pollution emissions to air at the Project construction and operation phase, with due consideration of reduction of emissions at the initial stages of treatment process, sludge incineration, and flaring of captured methane;
- reduction of odour emissions after commissioning of the Project facilities;
- potential decrease of number of claims about odour nuisance from MWWTP-1 and MWWTP-2 sites;
- daily generation of 27 t (10 m^3) of potentially hazardous waste ash at the sludge incineration plant;
- cessation of sludge disposal in lagoons at the Volma site;
- abandoning the practice of sludge transportation (about 650-700 ton/day) from WWTP to the sludge lagoons at the Volma site in open trucks by public roads;
- potential changes (in the long term – reduction) in use of pipelines for diversion of surface runoff water from sludge lagoons at the Volma site to the treatment facilities;
- improved quality of treated waste water discharged to River Svisloch (at present the effluent flow accounts for 18 to 60% of downstream river flow and causes significant impact on the water course).

The above changes in impacts mean that the immediate influence area of the Project will include the following facilities and territories:

- MWWTP-1 and MWWTP-2 sites;
- Volma sludge lagoons (associated facility);
- motor roads used for sludge transportation;
- pipeline for transportation of surface runoff water from the sludge disposal site;
- a section of River Svisloch;
- settlements where residents will be to a certain extent affected by immediate changes (the Project effects will be largely positive).

From the perspective of social impacts, the Project area of influence includes the following:

- Area of immediate (direct) influence:
  - Former Shabany village territory (potential recipients are local land users, temporary and/or permanent residents);
  - Novy Dvor agro-town (recipients – local residents);
  - Podlosye village (recipients – local residents);
  - Svislochskaya street, Inzhenernaya street, Partizansky avenue and Minsk Beltway (recipients – road network users);
  - Shabany neighbourhood (recipients – local residents and businesses);
  - Trostenets memorial site (recipients – visitors of the memorial site);
  - Areas directly adjacent to the Svisloch River (recipients – local amateurs and hobby fishers);
  - Territories used by Project personnel;
  - Area of consequential (indirect) influence:
  - Minsk population in general (recipients – consumers of Minskvodokanal, job seekers, business owners);
  - ‘Minsk’ Free Economic Zone (recipients – businesses operating in the zone);
  - Other settlements of Novodvorsky rural council;
  - Project personnel.

A fair indication of the boundaries of the area of air quality impacts with the site and its sanitary protection zone in the centre is provided by pollution dispersion analysis (SPZ Project Document, 2016[15]). The most significant impacts of air quality are caused by emissions of methane, hydrogen sulphide, ammonia and summation groups which include the above substances. The maximum size of significant impacts area does not exceed the SPZ as of 2017. Pollution dispersion simulations for the Project and conclusions about changes in the impact are provided in section 8.1.

The factors of physical impacts on the environment and communities have been identified: noise (acoustic) impacts; vibration; infrasound and ultrasound impacts; electromagnetic radiation; ionising radiation; thermal impacts. Effects of these impacts will be significant only in SPZ.

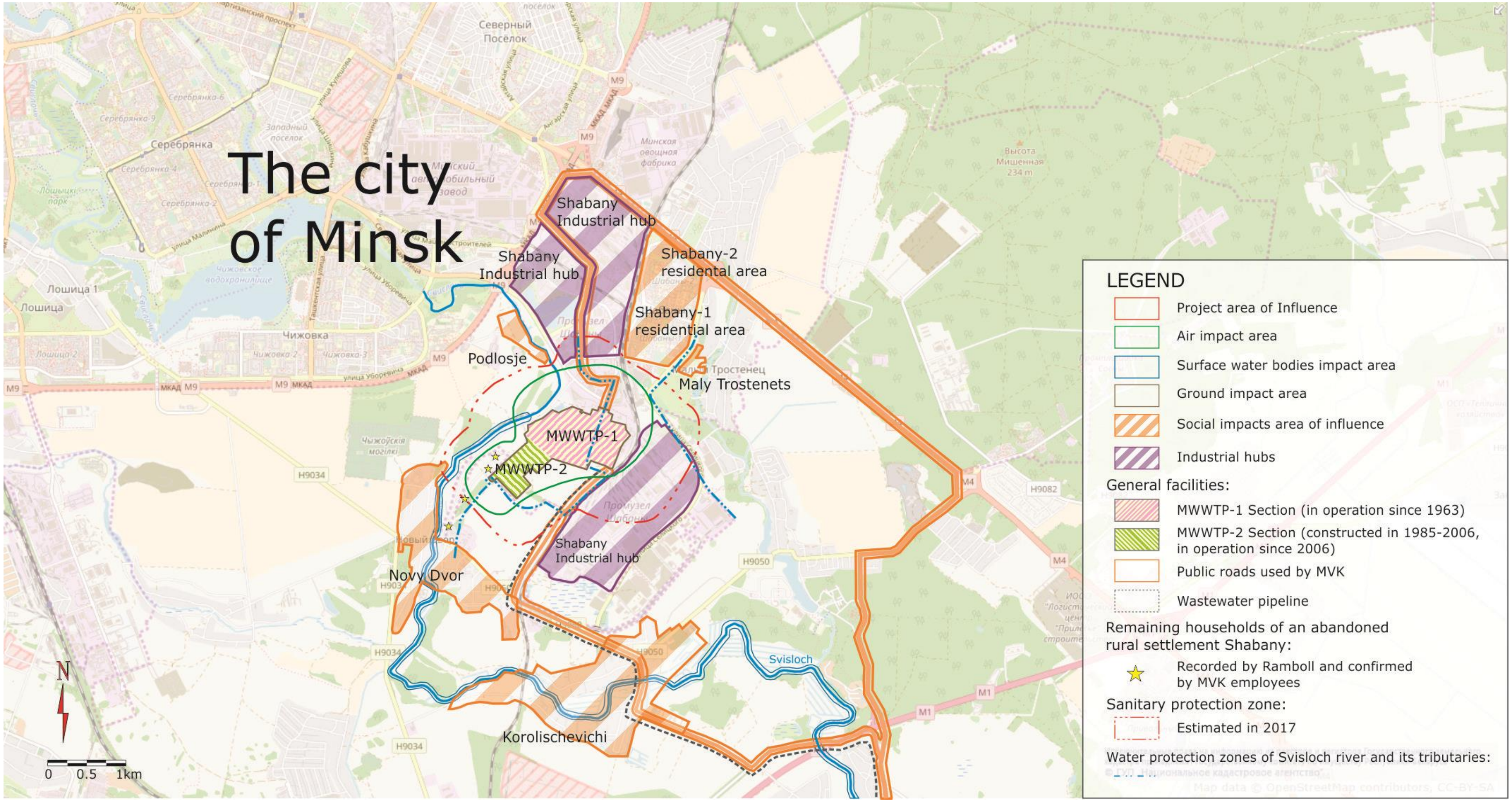
For the surface water body (River Svisloch) which is considered as recipient water course for waste water discharges, size of the influence area is defined by downstream propagation of pollution and physical impacts (warming effect, turbulence, increased flow; disturbance of bottom sediments, etc.). The competent authorities established the background and control sections for monitoring of MWWTP impacts on River Svisloch at the distance of 500 m up and down stream of the designed effluent discharge point. Ramboll recommends to adopt the monitoring section near the village of Korolischevichi (Figure 4.3) as the boundary of significant impact of the proposed Project. In this section treated effluent water account for about 45% of the total river flow downstream of the discharge point. Distance between the treated effluent discharge point to River Svisloch and the proposed monitoring section is about 5 km. Moreover, treated effluents make up 18% of the river flow in the section between the settlement of Novy Dvor and Osipovichi reservoir (Figure 4.3), and this area can be included into the zone of moderate impact.

The soil impact area will not exceed the MWWTP site territory (Figure 1). This territory has been used for industrial activities for a long time which resulted in local contamination of soil and ground. It is further expected that fertile soil will be cut prior to construction and subsequently utilized for arrangement of lawns. The Project implementation will not affect *subsoil and mineral resources* as none of those are present at the existing operational site.

As a result of cessation of the practice of dewatered sludge storage at the sludge lagoons of MVK (the Project provides for implementation of wastewater sludge (WWS) drying and incineration processes), the amount of wastes to be transported for off-site disposal will be reduced from 244 thousand t/a of WWS to 10 thousand tons of ash per annum (i.e. by 24 times). The benefits will further include a decrease of load on local roads which are shown in the scheme, including one of the access roads (northern gate, Figure 4.3), and reduction of haulage vehicle trips.

The integrated zone of influence of the Project is shown in Figure 4.3.

[15] SPZ Project Document of 11.12.2017. Municipal Operational Enterprise "Minskvodokanal". Private Scientific and Production Unitary Enterprise "Environmental Centre "Pylegazoochistka", Minsk, 2017. 292 pages


The city of Minsk
Shabany Industrial hub
Shabany Industrial hub
Shabany-2 residental area
Shabany-1 residential area
Podlosje
Maly Trostenets
MWWTP-1
MWWTP-2
Shabany Industrial hub
Novy Dvor
Korolischevichi
Svisloch
N
0 0.5 1km
LEGEND
Project area of Influence
Air impact area
Surface water bodies impact area
Ground impact area
Social impacts area of influence
Industrial hubs
General facilities:
MWWTP-1 Section (in operation since 1963)
MWWTP-2 Section (constructed in 1985-2006, in operation since 2006)
Public roads used by MVK
Wastewater pipeline
Remaining households of an abandoned rural settlement Shabany:
Recorded by Ramboll and confirmed by MVK employees
Sanitary protection zone:
Estimated in 2017
Water protection zones of Svisloch river and its tributaries:

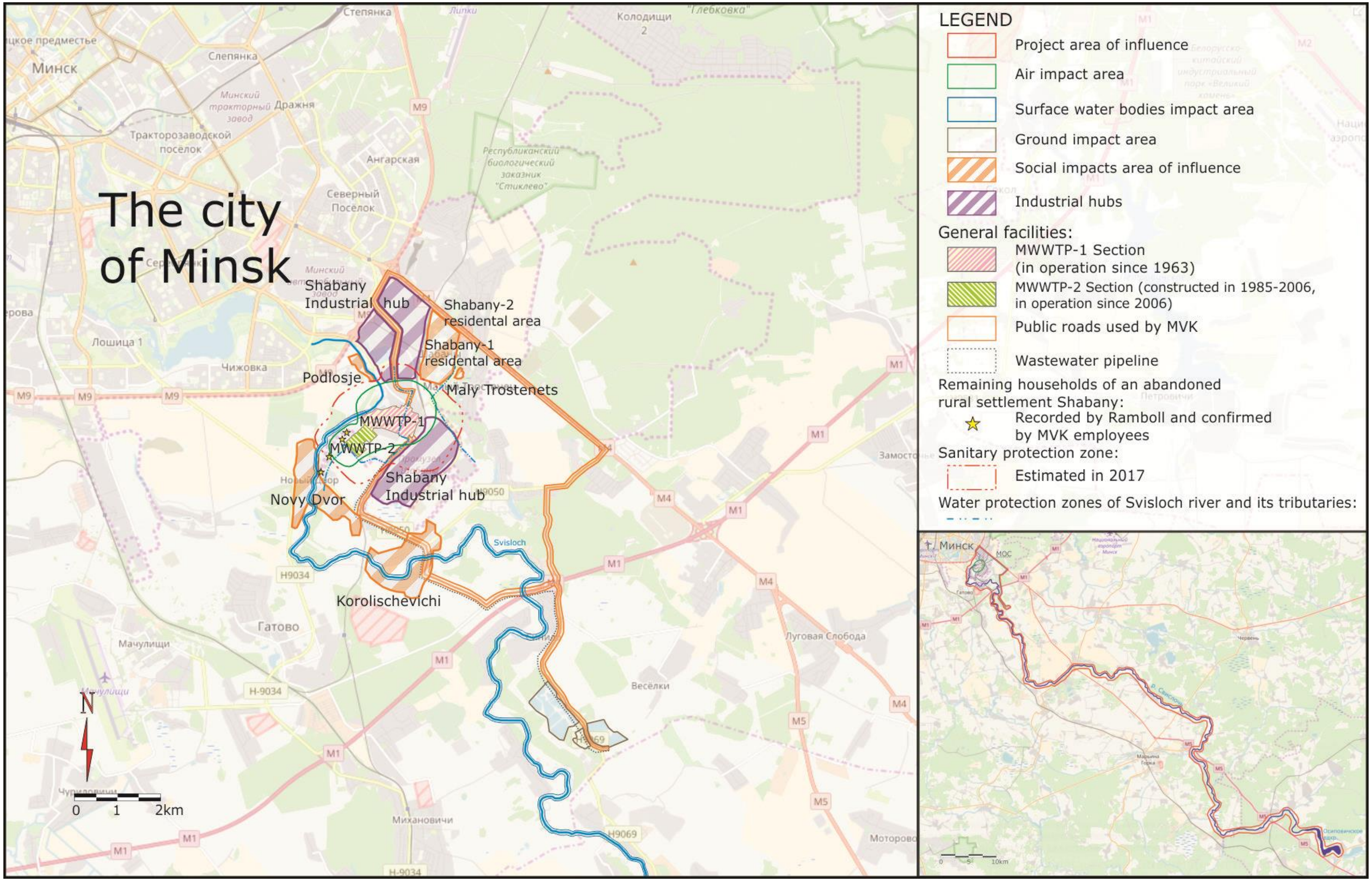


Figure 4.3: Influence area of the Minsk WWTP Reconstruction Project. Source: Ramboll

4.3 Project Categorization Rationale

The Project categorization has been reviewed by the Consultant in order to determine the scope and types of environmental and social studies, mitigations, disclosure and stakeholder engagement required for the priority investments selected for EBRD financing.

The relevant thresholds for the Project categorization have been considered to determine whether or not the Project may be considered to be Category A by the criteria specified in Appendix 2 of the EBRD Environmental and Social Policy (ESP), as well as the scale and reversibility of environmental and social impacts which also shall be taken into account.

The EBRD ESP specifies three key thresholds for wastewater treatment and waste incineration projects of Category A:

6. Waste-processing and disposal facilities for incineration, chemical treatment or landfilling of harmful, toxic or hazardous wastes;
7. Large-scale waste disposal facilities for incineration or chemical treatment of non-hazardous wastes (over 100 t/day under Directive 2011/92/EU of the European Parliament and Council of 13 December 2011 on the assessment of environmental impacts of certain public and private projects), and
8. Municipal waste water treatment plants with a capacity over 150,000 population equivalents.

The Feasibility Study proposed the following renovation and new construction activities within a Priority Investment Programme (as defined by the Minsk Vodokanal Technical Feasibility Study Gap Analysis prepared by the Project's Technical Consultant in December 2017, hereinafter – Technical Gap Analysis):

i) civil works for reconstruction and replacement of inefficient equipment;
ii) reconstruction of aeration tanks for nutrients removal;
iii) disinfection of effluent;
iv) gas capturing and treatment;
v) anaerobic digestion, sludge dewatering and drying, incineration and ash disposal.

The revised estimation of sludge production for year of 2030 is 150 tons of sludge per day (dry solids) which significantly exceeds the threshold for hazardous waste incineration. However, the primary anaerobic digestion of all solids suggested in PIP would reduce it to ~88t/day (dry solids). Further settling and removal of supernatant, dewatering and drying would reduce the sludge to be incinerated to ~67 t/day (dry solids). In both cases sludge quantity would be lower than the 100t/day threshold for incineration of non-hazardous wastes.

Currently the sludge composition defined in several analytical tests in 2016-2017 is considered being irregular and the sludge can be classified as low-hazardous waste due to the variations in heavy metal concentration values.

If MVK will improve its industrial customer management practice and develop appropriate requirements on such discharges and respective contract provisions, enhance monitoring and control on industrial waste water discharges to the sewer, it will result in more consistent composition of sludge with lower heavy metal concentrations, and the sludge can be classed as non-hazardous. However, other potential components of the sludge were not tested and therefore it shall be considered as potentially hazardous on a precautionary basis.

Wastewater treatment plants with a capacity over 150 000 population equivalent are defined as Category A projects in case of "greenfield" or major extension or transformation-conversion activities. MWWTP-1 is in excess of the established threshold but in respect to the wastewater treatment side, the Project under consideration includes renovation activities rather than new construction.

The review and preliminary assessment of the existing facilities and operations of the Company identified a potential minor economic displacement risk due to the anticipated increase of pollution emissions and, possibly, noise impacts from the new plants with potentially reduced sanitary protection zone.

The current assessment concluded that the Project shall be classified as Category A by introduction of *incineration of hazardous wastes* included in the wastewater treatment process in the PIP framework, under requirements of Appendix A of EBRD ESP 2014.

The Consultant will further monitor the categorization of the Project until the approval of PIP scope by MVK. In case the PIP scope changes, the Project category and assessment of the Project's potential effects, impacts and risks shall be reviewed, depending on the nature and significance of actual or potential adverse future environmental or social impacts, as determined by the specifics of nature, location, sensitivity and scale of the Project using the internationally recognized approach and methodology.

4.4 MWWTP History and the Project assets

The facilities subject to reconstruction under the proposed Project belong to Minsk Wastewater Treatment Plant (MWWTP) in the sewerage system of Minsk which is operated by Unitary Enterprise (UE) Minskvodokanal (MVK).

According to the information published at the official web-site of MVK[16], the design documents[17] and Project Feasibility Studies[18] (hereinafter – "the Technical Consultant's Report") the plant receives and treats about 95% of domestic wastewater from residential areas of Minsk, as well as industrial effluents from multiple industries and settlements in suburban areas. Estimated daily flow of 460-490 th. m^3 at the inlet of MWWTP by 30% consists of pre-treated industrial waste water. Average duration of treatment processes cycle at the plant is 12 hours.

Facilities at the first operational site – MWWTP-1 – designed for 470 th. m^3/day (originally – 670 th. m^3/day) were commissioned in 1963 and rely on the treatment train of conventional mechanical and biological treatment processes:

- a series of inlet chambers, mechanical step screens, grit removal basins and primary sedimentation tanks is intended to remove debris, mineral and organic particles and floating matter;
- the next treatment stage consists of a system of aeration tanks where activated sludge is added to clarified waste water flow to enable biological treatment, followed by secondary sedimentation tanks and then the collection channel with aeration bowl.

A mini-HPP is arranged at the effluent discharge point of MWWTP-1. The power plant is leased and operated by a third party.

[16] (https://minskvodokanal.by/)

[17] Reconstruction of Minsk Waste Water Treatment Plant. Justification of Investments. General Explanatory Note. – Minsk: Republican Unitary Design Enterprise "BELKOMMUNPROJECT", 2015

[18] Technical Feasibility Study & Gap Analysis. Long-term Investment Strategy and Priority Investment Programme Report. - SWECO with DiAr Klass CJSC. March 2017

Construction of MWWTP-2 facilities with similar treatment processes was started in 1985, and the treatment plant was commissioned in two stages with equal design capacities of 100 th. m^3/day, in 2006 and 2015. Treated effluent from MWWTP-2 is discharged to the common collection channel with MWWTP-1.

The actual load on the treatment facilities is at present 360-380 th. m^3/day at MWWTP-1 and 100-110 th. m^3/day at MWWTP-2.

The collection channel discharges to River Svisloch where treated effluent make up 45% of the river flow immediately downstream of the discharge point, and 18% of the flow in the river section between the settlement of Novy Dvor and Osipovichi reservoir.

Auxiliary process facilities at the treatment plant include channels and pipelines for waste water and sludge transportation between the treatment facilities, waste water, sludge, raw sludge and reject water pumping stations, grit drying beds, hydro-elevators, air blower stations and air supply systems of aeration tanks, sludge thickeners, sludge preparation shop, mechanical sludge dewatering shop.

Raw sludge from the primary sedimentation tanks MWWTP-1 and MWWTP-2 is mixed with thickened excess activated sludge before dewatering in centrifuges to the water content of 80% in the mechanical dewatering shop.

650-700 tons of dewatered sludge (cake) is produced every day, i.e. 240-255 thousand tons per year[19]. The sludge is transported to the Volma sludge disposal site also operated by MVK. The disposal facilities consist of 18 sand quarries filled with sludge. Reclamation activities at some of the quarries include planting of trees, while other quarries are water logged. The ponds and auxiliary facilities occupy the total area of over 150 ha, and estimated total volume of disposed sludge is 5 mln. m^3. Filling of quarry in the south-eastern periphery of the sludge disposal site which is currently in use started in 2013. The residual sludge disposal capacity is sufficient for next 4-5 years.

Sludge disposal site is provided with a drainage water collection system with pipeline transportation of drainage water to MWWTP for complete mechanical and biological treatment together with municipal wastewater flows.

4.5 Overall Technical Assessment of MWWTP in the Context of the Proposed Reconstruction Project

Current state of MWWTP and auxiliary facilities is not satisfactory, and changes are required in the waste water treatment processes, for the following reasons:

- the existing treatment processes are considered by supervising authorities as insufficient, as disinfection stage is missing in the process chain;
- air quality in the approved sanitary protection zone and adjacent regulated territories meets the formal requirements, however multiple complaints of local communities about frequent odour nuisances indicate the need for technical renovation of the plant facilities with open surfaces from which waste water and sludge may evaporate;
- some of MWWTP facilities have been decommissioned and have to be demolished;

19 According to a previous studies report (Environmental Impact Assessment for Proposed Project "Construction of Wastewater sludge Incineration Plant at the address 1 Inzhanernaya st." – Minsk Energy and Engineering Consulting Company ENECA, 2012), in some years of the first decade of 21st century annual sludge disposal volumes were in excess of 400 thousand tons. MVK reports that 267 thousand tons of dewatered sludge have been disposed at the Volma site, as of 2014.

- according to the technical survey conclusions which are provided in the materials of EIA 2012 and 2016, major part of operational buildings and structures at MWWTP-1 site are in need for either reconstruction or capital repair;
- despite satisfactory chemical property of treated effluents discharged to River Svisloch, state of the river downstream of the discharge point is poor, as a result of significant accumulated environmental damage and low self-purification capacity of the water course and its ecosystems[20]. The action plan for gradual pollution abatement in the River Svisloch – Osipovichi Reservoir water system which was adopted in 2013 includes a series of water protection activities for the period up to 2020 inclusive (in particular, consideration is given to possibility of topping up River Svisloch with water diverted from Vilejka-Minsk Water System);
- even though the Volma sludge disposal site is currently available for disposal of wastewater sludge, its capacity reserve is zero, and the remaining capacity is only enough to serve the needs during next 4-5 years; a new sludge disposal site would be unfeasible as no suitable sites are available in the vicinity of MWWTP, and such approach would entail high environmental risks, unreasonable use of land resource, extensive impacts on air and geology, requirement to monitor the site and surroundings, as well as high reclamation costs after decommissioning. The Technical Consultant21 also mention one more argument: sludge disposal to ground would mean wastage of the valuable energy content of wastewater sludge.

4.6 MWWTP Reconstruction: Objectives and Background

The above concerns have been discussed for some time and are reflected in the Minsk Development Master Plan which was approved by Presidential Decree of the Republic of Belarus No.165 of 23.04.2003 and inter alia provided for:

- advance construction of Minsk Wastewater Treatment Plant for gradual extension of treatment capacities to meet the growing needs;
- reduction of industrial effluent discharges to the municipal sewerage system;
- arrangements for disposal of sludge generated by wastewater treatment processes at MWWTP;
- reconstruction and upgrading of MWWTP-1.

The above provisions were subsequently incorporated in the Sector Development Scheme for Minsk sewerage system for the period until 2030 which was developed by UE MinskEngProject and approved by Minsk City Resolution No.2424 of 25.10.2007. Construction of sludge disposal facilities driven by the pressing need to reduce volumes of storage and burial of this type of wastes became the core element of the above Scheme and MWWTP reconstruction project.

Detailed assessment of environmental and economic performance of various sludge disposal solutions was conducted in 2001-2015[22]. Experts from a number of sector-specific research and design institutions contributed the review of potential process alternatives, including inputs from BGTU, BNTU, BrGTU and

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20 Draft Water Resource Management Plan (Upper Dnieper Pilot Basin, Belorussia. – Minsk, RUP ZNIIKIVR, 2014.

21 MINSKVODOKANAL. Technical Feasibility Study & Gap Analysis. Long-term Investment Strategy and Priority Investment Programme Report. - SWECO with DiAr Klass CJSC. March 2018

22 V.I.Romanovsky, A.D.Gurinovich, A.B.Bakhmat. Selection of wastewater sludge disposal routes in Minsk. // Topical issues of construction economy and municipal services. Papers of International Research to Practice Conference, 13-14 May 2014, Minsl, BNTU/Belorussian National Technical University, Construction Department. – Minsk: BNTU, 2015, p.156-162. Web resource: http://rep.bntu.by/handle/data/31208

BelGUT. After preliminary assessment of several alternatives, detailed comparative analysis of technical performance was provided for two sludge treatment options:

1) thermophilic digestion to produce biogas followed by incineration of digested sludge (proposed by STRABAG SE Group);

2) high-temperature drying of sludge and utilization of the product for cement production (proposed by VOMM Group).

The first option provided for construction of biogas units at MWWTP site and, after due consideration, it was concluded that this approach does not meet the requirements of environmental law of the Republic of Belarus, as the proposed process was mainly focused on electricity generation and disregarded the fact that biogas is only a by-product of anaerobic digestion. Anaerobic digestion may be used only as a method to dewater and stabilize sewerage sludge, and is only feasible if the product is subsequently used as a safe and high-quality fertilizer. At MWWTP implementation of this technology would be complicated, as the resulting sludge product would be toxic and contain a vast range of substances affecting hormone and endocrine system.

Thus the expert preferred the second option which provided for utilization of the whole amount of sludge through thermal drying with production of alternative fuel, and subsequent use in cement industry. Experts from the institutions listed above concluded that implementation of this option would yield the following benefits:

- complete and zero-waste utilization of the whole amount of sewerage sludge (i.e. not only sludge newly produced at MWWTP, but also the material that has been stored at the sludge disposal site);
- utilization of valuable mineral fractions of sludge for cement production;
- alternative renewable fuel produced from sewerage sludge;
- creation of new jobs at the alternative fuel production facilities;
- improved performance of railway rolling stock, as a result of reduction of empty runs.

The second option is also better in terms of natural gas costs. Thus the option proposed by VOMM was recognized as the best available technology for Minsk Waste Water Treatment Plant, and adopted as an energy and resource efficient option for the plant reconstruction to fully stop the practice of sludge disposal to ground.

Further development of MWWTP reconstruction approach took into account the need for extension of treatment capacity, to serve the urban areas and settlements newly connected to sewerage systems. The following targets were set in 2015 in the Terms of Reference for the design development:

- average design flow of waste water - 550000 m^3/day = 22917 m^3/h = 6366 l/s;
- maximum design flow of waste water - 28302 m^3/h = 7862 l/s23.

By the beginning of year 2018, MVK supported by Technical Consultants Sweco Danmark A/S and CJSC “DiArKlass” focused their attention on the reconstruction option where wastewater sludge would be incinerated at MWWTP site, assuming that having an own incinerator would be useful at subsequent stages of

23 Reconstruction of Minsk Waste Water Treatment Plant. Feasibility Study. General Explanatory Note. - Minsk: UE 'BELCOMMUNPROJECT', 2015

reclamation of Volma sludge disposal facilities. The supplementary ESIA process conducted by Ramboll relied on the feasibility studies reports issued by the Technical Consultant[24].

Based on the findings of the technical, environmental and social assessment, the following Project concept was determined for further development: reconstruction of MWWTP-1, including demolition of unused facilities and construction of sludge treatment complex, including digestion, dewatering, drying, incineration with heat and power generation for own needs of MWWTP.

The reconstruction component will include a number of measures aimed and wastewater treatment efficiency improvement in order to achieve the required parameters of the treated wastewater quality taking into consideration the corrected load on MWWTP-1 at 420 thous. m^3/day. The main technological processes remain unchanged.

4.7 Scope of Reconstruction, Alternatives and Main Solutions

4.7.1 Scope of the proposed activities

At present the project design proposals for reconstruction and modernization of wastewater treatment facilities are based on the recommendations issued by CJSC Ecopolymer-M (Russia, Moscow). The proposed project facilities are listed below (Table 4.1) with segregation into three groups – demolition, reconstruction and new construction.

Table 4.1: Project facilities

Фазы Проекта / Project Phases	Наименования объектов / Facilities		Обозначение объектов на схемах / Map Indexes
Демонтаж / Demolition	Преаэраторы	Pre-aeration basins	D1
	Песколовки	Grit/sand catchers	D2
	Метантенки	Methane tanks (digesters)	D3
	Газгольдеры	Gas holders	D4
	Песковые площадки	Grit/sand fields	D5
	Контактные резервуары	Contact tanks	D6
	Открытые каналы сточных вод между сооружениями (частично)	Open wastewater channels (in some locations)	D7
Реконструкция и техническое перевооружение/ Reconstruction	Здание решеток грубой очистки №1	Screening Chamber No. 1	R1a
	Здание решеток грубой очистки №2	Screening Chamber No. 2	R1b
	Первичные отстойники (14 ед.)	Primary sedimentation tanks (14 in total)	R2

24 MINSK VODOKANAL. Technical Feasibility Study & Gap Analysis. Long-term Investment Strategy and Priority Investment Programme Report. - SWECO with DiAr Klass CJSC. March 2017

MINSK VODOKANAL. Technical Feasibility Study & Gap Analysis. Inception Report. - SWECO with DiAr Klass CJSC. December 2017

Фазы Проекта / Project Phases	Наименования объектов / Facilities		Обозначение объектов на схемах / Map Indexes
and rehabilitation	Насосная станция сырого осадка №1	Primary Sludge Pumping Station No. 1	R3a
	Насосная станция сырого осадка №2	Primary Sludge Pumping Station No. 2	R3b
	Насосная станция сырого осадка №3	Primary Sludge Pumping Station No. 3	R3c
	Насосная станция сырого осадка №4	Primary Sludge Pumping Station No. 4	R3d
	Открытые каналы сточных вод между сооружениями (частично)	Open wastewater channels (in some locations)	R4
	Аэротенки-вытеснители (11 секций)	Aeration tanks (11 sections)	R5
	Вторичные радиальные отстойники (20 ед.)	Secondary sedimentation tanks (20 in total)	R6
	Воздуходувная станция №2	Air Blower Station No. 2	R7a
	Воздуходувная станция №3	Air Blower Station No. 3	R7b
	Насосная станция активного ила №1	Activated Sludge Pumping Station No. 1	R8a
	Насосная станция активного ила №2	Activated Sludge Pumping Station No. 2	R8b
	Насосная станция активного ила №3	Activated Sludge Pumping Station No. 3	R8c
	Иловая насосная станция	Sludge pumping station	R9
	Насосная станция фугата	Centrate pumping station	R10
	Насосная станция дренажных вод	Drainage water pumping station	R11
	Насосная станция фекальных вод	Raw wastewater pumping station	R12
	Илоуплотнители (4 ед.)	Sludge consolidation tanks (4 in total)	R13
	Насосная станция илоуплотнителей №1	Sludge Consolidation Pumping Station No.1	R14a
	Насосная станция илоуплотнителей №2	Sludge Consolidation Pumping Station No.2	R14b

Фазы Проекта / Project Phases	Наименования объектов / Facilities		Обозначение объектов на схемах / Map Indexes
	Цех подготовки осадка к механическому обезвоживанию	Sludge preparation unit	R15
	Цех обработки осадка	Sludge dewatering unit	R16
Новое строительство / Construction	Приемная камера	Raw sewage chamber	C1
	Здания решеток грубой очистки	Screen chambers	C2
	Аэрируемые песколовки	Aerated grit/sand catchers	C3
	Здания сепарации песка	Grit chambers	C4
	Перекрытия сооружений механической очистки с системой отвода и очистки воздуха	Odor control system (incl. covering of tanks and basins, a ductwork system and scrubbers for withdrawal and purification of emissions)	C5
	Здания УФ-обеззараживания	UV-disinfection facility	C6
	Канализационная насосная станция №1	Wastewater Pumping Station No. 1	C7a
	Канализационная насосная станция №2	Wastewater Pumping Station No. 2	C8b
	Дождевая насосная станция	Storm water pumping station	C9
	Аккумулирующие емкости	Equalization tanks	C10
	Биогазовые установки	Sludge digestion facilities	C11
	Газгольдеры	Gas holders	C12
	Газопоршневые установки	Gas powered electrical generators	C13
	Бункер с разделительной перегородкой для промежуточного хранения обезвоженного осадка	Sludge storage unit	C14
	Установка по сжиганию осадка с выработкой электрической и тепловой энергии, очисткой дымовых газов	Sludge incineration facility	C15
	Здание лаборатории	Testing laboratory building	C16

In the Technical Consultant's report the list of MWWTP facilities subject to demolition is extended to include:

- old inlet chambers;
- old transformer substation No. 88.

4.7.2 MWWTP reconstruction approach

To enable physical implementation of the proposed reconstruction project, the treatment plant has to be reconfigured for operation as four treatment streams which can be isolated from overall wastewater circulation and treatment systems one by one, for the period of reconstruction.

The main wastewater treatment processes are not subject to any substantial changes: the mechanical pre-treatment and full biological treatment will be complemented by ГМ disinfection, and the existing discharge sewer will still be used for effluent discharge to River Svisloch.

General MWWTP-1 reconstruction scheme is shown in Figure 4.4[25].

The design includes a range of solutions intended to enhance wastewater treatment processes and achieve the required effluent quality, with due consideration of the future load on MWWtP-1 by 420 th.m^3/day of wastewater:

- construction of new coarse screening chamber will improve removal of coarse particles (additional fine screens with bar spacing of 6 mm (3 operating and 1 backup) will be provided, as well as new coarse screens with bar spacing of 12 mm (3 operating and 1 backup);
- construction of new horizontal aerated grit removal basins with fat collection system (3 sections with two compartments, total length 60 m, width 6 m, water depth 4.5 m) instead of the existing ones which are too small to achieve the required treatment performance, will significantly enhance removal of insoluble mineral impurities (suspended solids) and fat;
- the new grit separation chamber which will be implemented instead of the existing grit beds will provide quick washing and drying of grit collected from the grit removal basins, thus the impact on air quality will be minimized, and grit transported to MSW landfill will be cleaner;
- rehabilitation of RC structures of the primary sedimentation tanks, replacement of sludge scrapers, provision of plastic central deflector bowls and saw-toothed weirs to equalize hydraulic load throughout the tanks area;
- reconstruction of concrete elements of aeration tanks to provide internal mixing zones and special partitions to guide the flow of mixed liquor;
- implementation of nitrification and denitrification technology for biological removal of phosphorus;
- provision of a set of aeration and mixing equipment, as well as instrumentation and control equipment to steer the biological treatment process;
- provision of plastic weirs, central inlet units, as well as sludge suction systems for removal of settled sludge from the secondary sedimentation tanks;
- implementation of effluent UV disinfection system using a gravity-flow unit based on trough-type module 88МЛВ-36А800- M-G (5 channels with EV disinfection modules, 4 operating sections and 1 standby section, 2 modules per section);
- reconstruction and technical renovation of primary sludge pumping stations Nos. 2, 3, 4, blower stations Nos. 2 and 3, activated sludge pumping stations Nos. 1, 2 and 3, sludge thickener pumping

25 The schemes in figure 4.4-4.9 are adopted from the EIA package (Reconstruction of Minsk Waste Water Treatment Plant. Feasibility Studies. Environmental Protection. Environmental Impact Assessment. – Minsk, UE BELCOMMUNPROJECT, 2016)

stations Nos. 1 and 2, sludge preparation and dewatering units, centrate pumping stations, waste water pumping stations (for local site needs);

- provision of cover of open mechanical treatment facilities integrated with waste gas collection system serving all buildings and facilities at MWWTP-1 site (inlet chamber, screen chambers, grit removal basins, primary sedimentation tanks, waste water transportation channels between the facilities), and waste gas delivery to the new air treatment facilities.

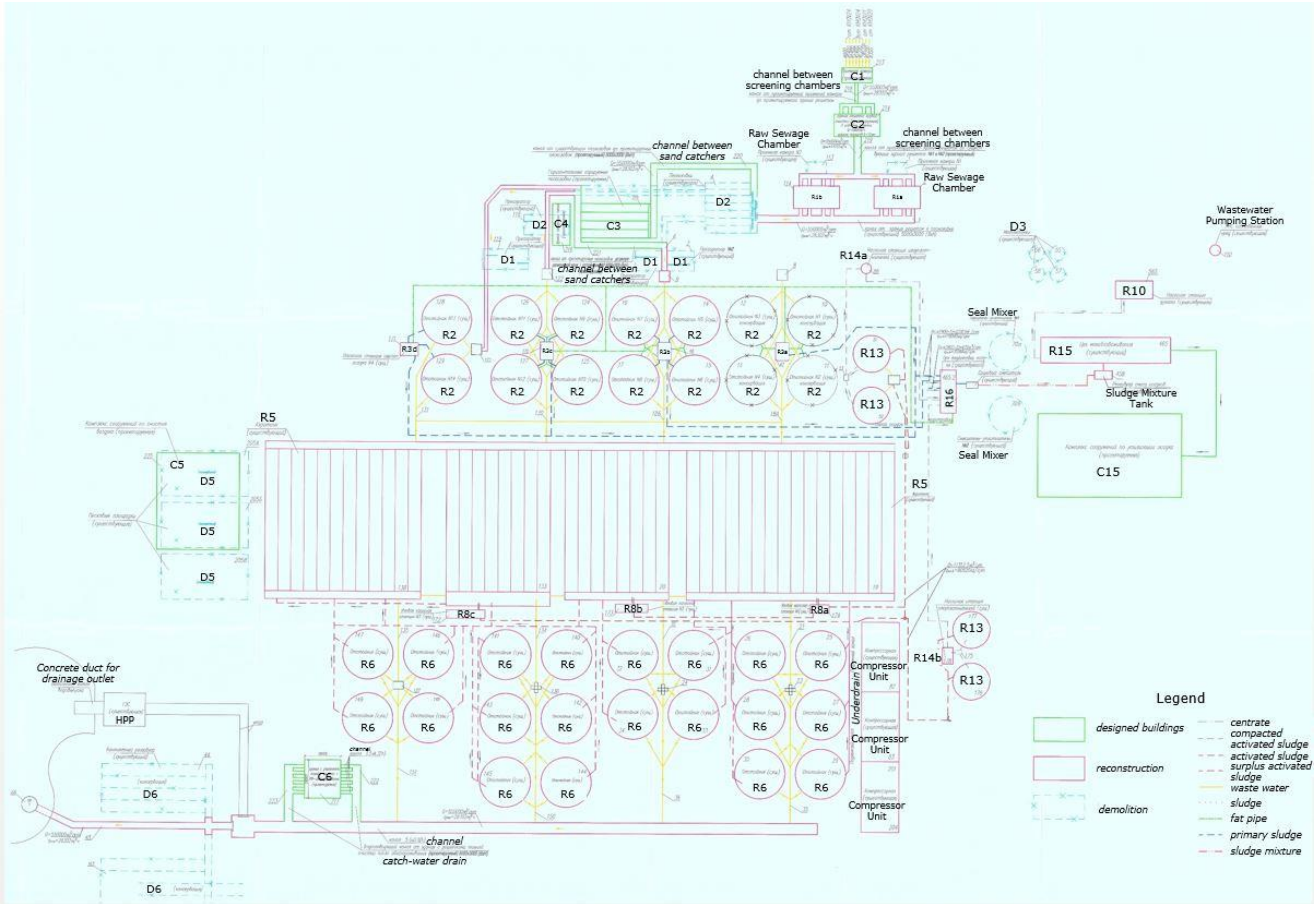

Figure 4.4: MWWTP-1 reconstruction scheme

4.7.3 Waste water treatment solutions

Process design for MWWTP reconstruction feasibility studies package was prepared by CJSC Ecopolymer-M (Russia, Moscow) in 2015. Several options were considered for biological treatment, in conjunction with the possible configurations of aeration tanks. The preferred solution (Figure 4.5) consists of two interconnected oxidizing loops with internal recycling through the connecting corridor.

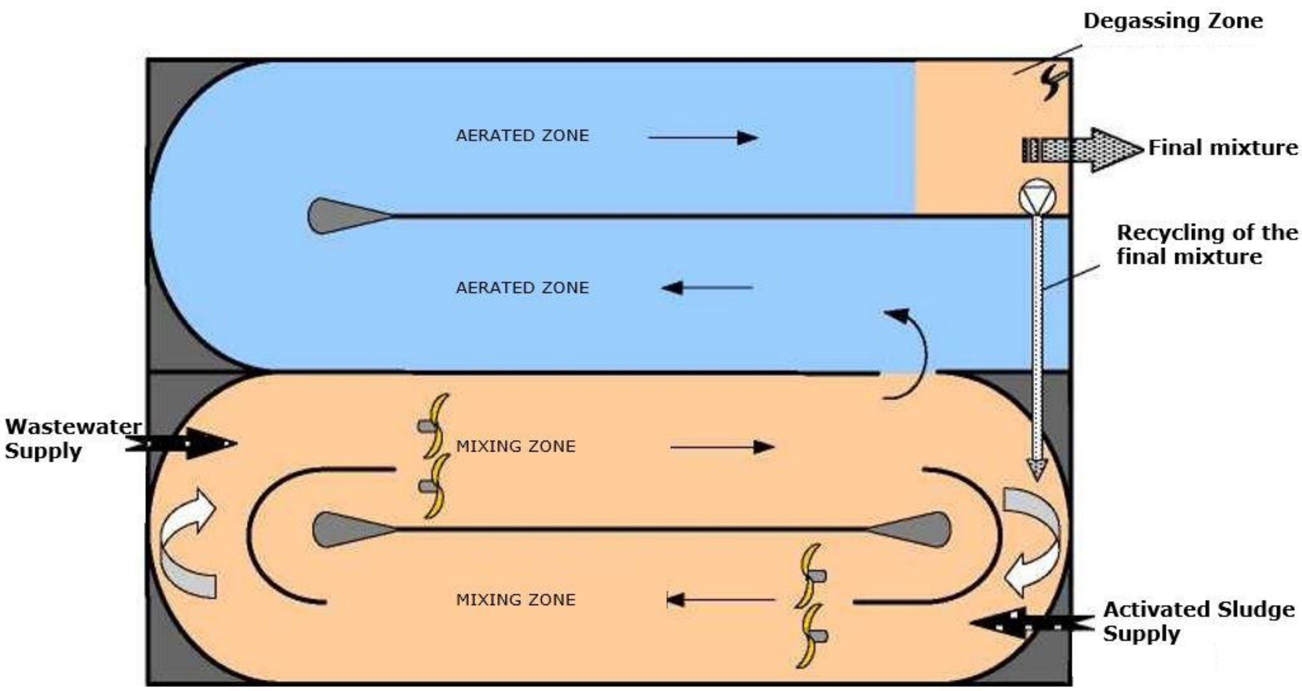

Figure 4.5: Aeration tank design scheme

The above scheme also known as "carrousel" scheme offers a number of advantages including flow variations resilience (both in terms of quality and quantity), absence of pumps (except for one pump used for internal circulation of sludge liquor), and high phosphorus treatment performance.

The disadvantages of the selected scheme include relatively high capital cost of civil and installation works, uncontrollable recirculation flows (unlike the pumped schemes), and unstable denitrification with performance not as high as that of the phosphorus removal process (Table 4.2).

Table 4.2: Performance aeration tanks and secondary sedimentation tanks

Quality parameters	Achievable level, mg/l	Maximum permissible values, mg/l
Nitrogen ammonia	0.4 max.	Not regulated
Nitrite and nitrate	14.0 max.	Not regulated
Total nitrogen	15.0 max.	15.0
Phosphate	0.5 max.	Not regulated
Total phosphorus	1.0 max.	2.0

The following elements will contribute to the high treatment performance of MWWTP-1 after reconstruction:

- Arrangement of mixing zones in the first and second corridors and provision of submerged agitator mixers to direct the waste water circulation flow;
- The designed rounded shape of aeration tank walls will enhance hydraulic performance of the tanks and reduced power consumption for operation of mixers;
- Guiding partitions inside the tanks will help to prevent slow-speed flow zones at the tank bottoms;
- Standard configuration will be maintained for supply of return activated sludge (to the start of the firs corridor) and waste water (to the start of the second corridor) (Figure 4.5); aeration zones will be arranged in the third and fourth corridors using membrane diffusers AQUA-TOR;
- Mechanical mixer at the end of the fourth corridor is intended to create a gas removal zone from which part of the sludge liquor will be recirculated by pump back to the mixing zone. The pump will be actuated by a variable speed drive, to control sludge liquor circulation proportionally to influent waste water flow.

The above process configuration is designed for increased flows of waste water, however forecast values of such flows are somewhat ambiguous. In the referenced reports, the Technical Consultant opines that the target mean flow value of 550000 m^3/day may be reduced to 418000 m^3/day, assuming that current population and industrial growth trends in Minsk city and district will be also maintained in the future. Current capacity of MWWTP-2 and MWWTP-1 expressed in population equivalent (p.e.) is 1583000 and 412000 p.e., and the future capacity forecasted by the Technical Consultant for year 2030 is 1742000 and 458000 p.e., respectively.

The preferred reconstruction option shall be reviewed against the most stringent treated effluent quality standards in Appendix 1 to the Guideline for Definition of Permissible Discharge Limits for Chemicals and other Substances Discharged with Waste Water (approved by the Ministry of Nature of RB, Resolution No.16 of 26.05.2017). Current treatment performance is largely compliant with the valid Special Water Use Permit, however p.17 of the above Guideline requires that pollution removal performance defined at the design phase of waste water treatment plant shall meet the limit values for treated effluent quality with safety factor 0.85. Both Technical Consultant and Ramboll consider Svisloch river valley downstream of MWWTP discharge point as a sensitive area (in the context of environmental regulations of EU). This means that target levels for certain effluent quality parameters should be lowered even further: to 10 mg/l of total nitrogen and 1 mg/l of total phosphorus. Reports of the Technical Consultant indicate target load on the treatment plant after reconstruction which is expressed as 5 basic parameters – biological (5 day) and chemical oxygen demand, suspended solids, total nitrogen and total phosphorus.

The reconstruction project provides for a substantial add-on to the existing treatment processes: elimination of microbiological contamination of waste water using UV radiation. Reports of the Technical Consultant highlight that effluent disinfection requirement is not covered by EU directives of EBRD requirements, and is rather dictated by the requirement of local authorities which supervise operations of MVK. The specific method of disinfection (UV) was proposed by BelCommunProject at the stage of pre-feasibility studies for the Project[26].

4.7.4 Main Project alternatives

Decision not to proceed with the Project (MWWTP reconstruction and construction of sludge disposal facilities) is considered as “zero” alternative. This option relies on continued landfilling (burial) of dewatered

26 Reconstruction of Minsk Wastewater Treatment Plant. Feasibility Study. - Minsk: UE 'BELCOMMUNPROJECT', 2015. As amended on March 2017

sludge as the disposal route. Options 1-4 include reconstruction of the waste water treatment facilities in accordance with description in section 4.7.4, however with different sludge treatment schemes:

- Option 1 – sludge drying and incineration, with utilization and/or sale of thermal and electric energy;
- Option 2 – sludge digestion, dewatering, drying and incineration, with utilization and/or sale of thermal and electric energy;
- Option 3 – sludge drying and pelletizing for subsequent disposal at MSW landfills or sale as alternative fuel for cement industry (pellets burning is used as a source of thermal energy for drying process);
- Option 4 – sludge drying with natural, pelletizing and sale as alternative fuel for cement industry (or landfilling).

Technical alternatives (main treatment technology, equipment, process parameters) for the plant reconstruction and sludge disposal routes are selected at the stage of feasibility studies, based on compatibility of the designed facilities with overall treatment scheme, and compliance with the best available technologies. This process considered options 1-4 which are described below.

Zero Alternative is present during the whole period of MWWTP operation and is unacceptable for the reasons listed in p. 4.5.

Option 1 provides for incineration of dewatered and dried primary and biological sludge in fluidized bed furnace and includes the following processes:

- Feed of cake (dewatered mixed primary and biological sludge) with residual water content of about 80%, from the existing mechanical dewatering facilities to intermediate storage hopper;
- Feed of cake from the intermediate storage hopper to drum drier where water is removed from the material by evaporation, to reduce water content to the level which meets the incineration requirements;
- Dried cake transportation by a system of screw conveyers to fluidized bed furnace;
- Incineration of dried cake in furnace, with utilization of heat in steam turbine and in the drier;
- Flue gas treatment;
- Ash collection.

The extent of sludge drying is controlled by adjustment of steam fed to the drier. The drier operates at reduced pressure, to prevent sludge entrainment by ambient air. The sludge incineration furnace is designed for optimum incineration of fuel and thus minimize emissions of nitrogen and carbon oxides, dioxins, volatile organic compounds. Sludge is fed by rotary loader directly to the fluidized bed air zone, for its optimum distribution over the fluidized bed. Fluidized bed is a layer of sand which is kept in suspension by upward air flow. It breaks sludge into small particles and burns its organic content. Mineral content of cake (in the form of ash) is removed from the furnace with flue gas stream. Combustion (fluidized bed) air is supplied by blower from the sludge hopper. Part of the air is used for cooling furnace injectors and sight glasses, and the rest is heated to 400°C in two stages of heat exchangers, to ensure fuel burning even if water content is high. The first heat exchanger heats air up to 150°C using steam from turbine. In the second exchanger air temperature is raised to 400°C using flue gas heat from waste heat boiler. For the furnace start-up, air is pre-heated with gas burner.

Natural gas may be used as additional fuel for combustion of cake (sludge) with calorific value lower or water content higher than the design values. No additional fuel is required to burn cake with parameters within the design range. The optimum incineration temperature is 850-950°C. During the process of incineration, waste heat boiler will utilize flue gas heat for preparation of superheated steam at 40 bar and 450°C. The steam will be supplied to turbine for generation of thermal energy which will be subsequently used for drying dewatered sludge, and for electric power generation. Condensate from the system will be returned to de-aerator.

Ash after sludge incineration will be carried by flue gas, together with minor fraction of suspended minerals – pulverized sand from fluidized bed. The loss of sand will be compensated by regular topping up of sand layer with sand fraction 1-2 mm, which is loaded into the hopper and fed to the waste heat boiler via rotary valve. An auxiliary manually controlled system is provided for the reverse task – i.e. removal of excess sand which is brought to the furnace together with sludge.

The flue gas treatment process is designed to fulfil the following tasks:

- Monitoring and reduction of nitrogen oxides in furnace flue gas;
- Ash removal in electrostatic precipitator;
- Flue gas cooling in heat exchanger;
- 1st stage acid scrubbing;
- 2nd stage scrubbing to remove sulphur dioxide, heavy metals, ash;
- Flue gas cooling to 50°C at the 2nd stage scrubbing, with condensation of large volume of vapour from flue gas;
- Removal of mercury and dioxins in adsorber.

Nitrogen oxide level in flue gas is reduced through a selective noncatalyzed reaction using ammonia water which is injected into flue gas flow at the furnace outlet. Ammonia water flow will be controlled by operator in the control room, by adjusting injector pumps operation to provide the desired volume flow.

The ash removal process in electrostatic precipitator is based on the use of electrostatic field effect. Electrically charged ash particles suspended in the flue gas flow are attracted by grounded electrodes. Settled ash is removed from the settling electrodes by a shaker system, and is pneumatically transported via rotary valve to special ash hopper. Ventilation system of the hopper includes a dust filter and self-cleaning system. Water sprinkling may be provided in the ash loading system to vehicles, to prevent dispersion of fine ash particles.

It is planned to utilize excess flue gas condensate from the cooling loop of the 2nd scrubbing stage as water for the 1st and 2nd stage scrubbers. The alkali and acidic parameters (pH) of scrubber water are adjusted by dozing of caustic soda dosed by pump from dedicated storage tank. Scrubber effluents are used as coolant in heat exchanger.

Treated effluent from the waste water treatment lines will be used as heat transfer medium for cooling of gas ducts, turbine condensers and drier. Excess effluents and waste heated water will be transported to the inlet chamber of MWWTP.

Mercury and dioxin adsorber consists of three filter layers. The first one is inert material which captures dust and provides even distribution of flue gas flow at subsequent filter layers. The second and third layers use activated carbon media.

Layout of sludge treatment process Option 1 is shown in Figure 4.6.

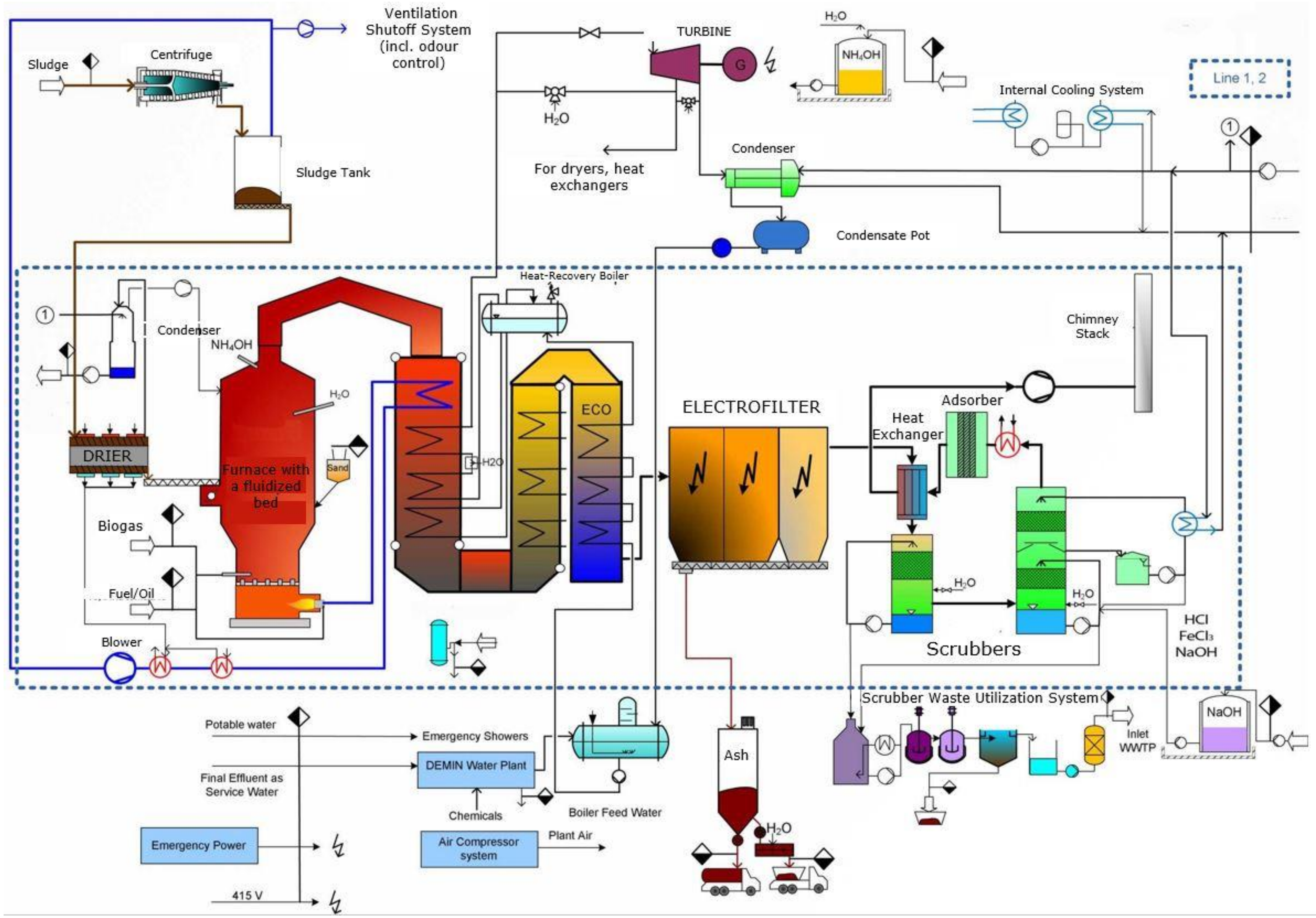

Figure 4.6: Sludge treatment process layout (Option 1)

The sludge treatment facilities are designed for continuous operation – 24 h/day, 8000 h/year. The facilities will be controlled through a central logic processor for continuous adjustment of the main parameters of incineration process, i.e. temperature, pressure, oxygen level, and flows. Any deviation from the set range of process parameters will be detected by processor, and the faulty units will be automatically shut down. Pollution emissions will be also continuously monitored by a dedicated system, based on the following parameters:

- Flue gas volume in actual conditions and reduced to normal conditions (0°C; 101.3 kPa, dry gas);
- Temperature in thermal treatment zone, at the mixed gas outlet from the thermal treatment zone, and at the outlet to atmosphere;
- Flue gas water content (at the concentrations measurement point);
- Concentration of suspended solids (dust), sulphur dioxide, carbon oxide, nitrogen oxide, hydrogen chloride, organic carbon (total), ammonia (in case of nitrogen oxide control with ammonia water) and other known impurities.

The main process parameters of the considered option for treatment of primary and activated sludge are summarized in Table 4.3.

Table 4.3: Parameters of sludge treatment system. Option 1

Process	Parameter	Value	Unit
Drying	Sludge input flow	273000	t/a
	Input sludge water content	80	%
	Outlet sludge water content	67	%
Incineration	Sludge input flow	165000	t/a
	Combustion temperature	850-950	ºC
	Quantity of collected ash	>13000	t/a

Option 2 includes digestion of primary sludge to produce biogas for subsequent generation of thermal and electric energy, dewatering of digested sludge together with biological sludge, drying and incineration in fluidized bed furnace. This option consists of the following processes:

- Treatment of primary sludge from the mechanical treatment processes in digesters (3 units) at +55°C (thermophilic process) to produce biogas;
- Biogas facilities comprising storage in gas holders (2 units) and treatment of biogas;
- Incineration of biogas to generate electric and thermal energy in modular gas piston CHP units;
- Dewatering of digested sludge and biological sludge at the existing mechanical dewatering facilities;
- Transportation of cake (dewatered sludge blend) with water content of 80% from the existing mechanical dewatering facilities to intermediate storage hopper;
- Cake feed from the hopper to drum drier for evaporation of water to meet the requirements of incineration process;
- Dried sludge feed to fluidized bed furnace by a system of screw conveyers;

- Utilization of heat from incineration of sludge and biogas on steam turbine and drier;
- Flue gas treatment;
- Scrubber effluent treatment;
- Collection of ash.

The facilities, like all other options, are designed for continuous operation: 24 h/day, 8000 h/year.

The Option 2 process scheme can be summarized as follows. Raw sludge from the existing primary sedimentation tanks is pumped to the holding tank with continuously rotating mixers which equalize and agitate the sludge. Sludge from the holding tank sludge is pumped to reactors (digesters). The pumps capacity is controlled by sludge level in the tank holding tank and digesters. $FeCl_3$ dozing to the feed pipes of digesters (i.e. prior to digestion) is provided, in order to control hydrogen sulphide content in biogas. Primary sludge is digested (fermented) in 3 digesters which are designed as in-situ RC structures with cylindric bodies, conic roofs (gas hoods) and slightly tapered bottoms, with inner diameter of 23 m, height about 36 m and effective volume 12,000 m^3 (each). Sludge retention time in digester is 12 days, at the operating temperature of +55°C and pressure 25 mbar. Mechanical mixing of material in digesters is provided by gas injection. Scum will be removed from digesters through a special pocket in the conic cover. Settled matter from the bottom will be removed via special nozzles, with the aid of bottom circulation pumps. A service platform is provided for gas hood and pocket maintenance. Process instrumentation and control equipment of digesters is provided for monitoring of parameters inside the reservoir (filling level, pH, gas pressure, medium temperature) and protection against process conditions beyond the preset range (overfilling, excessive pressure, etc.). The scope of digesters' equipment allows for independent operation of each tank.

Liquid organic wastes from a third party supplier will be used at the initial stage, to start up and maintain the digestion process. A dedicated RC tank 75 m^3 and a feed pump will be provided for feeding liquid wastes to digesters.

Digested sludge will be removed from digesters by means of pumps (42 m^3/h, 1 pump per digester, and 1 common backup pump for all digesters), passed through a heat exchanger and discharged to intermediate tank before pumped feed to the existing mechanical dewatering facilities. In the heat exchanger digested (stabilized) sludge is cooled by water to 25-30°C, with heat recuperation for process needs. Two centrifugal pumps capacity 20 m^3/h remove sludge from the digester loop, pass it through another heat exchanger and then return back to digester. Heated water from modular CHP unit is supplied to the same heat exchanger, to raise sludge temperature to +55°C.

The open intermediate tank is used for aeration and degassing of digested sludge, as required to stop the anaerobic biological process. Fermented sludge from digesters is fed to the tank by means of a special injector which produces a jet of sludge and pressurized air which is strong enough to support effective mixing of material inside the tank.

Biogas which is produced during the digestion process is collected in gas hood at the top of digester. The hood is equipped with a sight glass, sampling valve and automatic gas release valve. Biogas is transported by pipelines via coarse filter to the diaphragm gas holders 2000 m^3. Part of the biogas is recirculated by gas compressor back to digesters, for mixing of their content. Prior to being fed to the modular CHP unit, biogas is further conditioned to acquire the required fuel characteristics. The conditioning system includes the following:

- 5 fine ceramic gas filters;
- 5 activated carbon filters;
- 5 gas blowers for biogas transportation from gas holder via the filters to modular CHP units.

Operation of modular CHP unit and emergency flaring system is adjusted depending on gas holder filling. Maximum set level of gas holder filling will trigger activation of emergency flaring system for safe flaring of excess gas.

The 5 modules of modular CHP unit with rated electric capacity of 1.08 MW use biogas as fuel for generation of electric and thermal energy. The modular CHP units are designed as independently operating units and equipped with exhaust gas heat exchangers, and cooling heat exchangers to cool down the engine in case of failure of internal and external heat consumers, input and exhaust ventilation system, control system, fresh oil supply and used oil storage system. Heated water flows from the five modules of CHP are directed to distributor.

Water condensate from gas holder and gas filter is collected in condensate shaft from which it is pumped by submersible pump 8 m^3/h to the domestic and operational sewerage system.

Technical characteristics of the digestion and biogas utilization processes are provided in Table 4.4.

Table 4.4: Parameters of sludge treatment system. Option 2

Process	Parameter	Value	Unit
Digestion	Sludge input flow	1606000	m^3/a
		4400	m^3/day
		150	t/day, dry solids
	Sludge outlet flow	1606000	m^3/a
		4400	m^3/day
		88	t/day, dry solids
	Input sludge water content	96,5	%
	Output sludge water content	98	%
	Biogas yield	13413000	m^3/a
	Digestion temperature	55	^{o}C
Biogas burning	Output capacity, electricity	24600	MWh/a
	Output capacity, thermal energy	45700	MWh/a
Incineration	Sludge input flow	40880	m^3/a
		67	t/day, dry solids
	Combustion temperature	850-950	^{o}C
	Quantity of collected ash after combustion	10000	t/a

Process parameters of incineration of dewatered and dried digested sludge and biological sludge are similar to those listed for Option 1 (refer to Table 4.3, Figure 4.7).

Digestion of primary sludge enhances ecological and process-economy advantages in terms of:

- Content of dry organic matter in digested sludge is decreased to 30%, with the following effects: smaller volume of sludge; better dewatering performance; smaller water content in dewatered sludge (up to 70%); reduced need for flocculation aids;

- Smaller odour emissions from stabilized sludge;
- Utilization of biogas for generation of electric and thermal energy, for the unit operating needs, and also to serve the needs of other site facilities.

Option 3 provides for drying of dewatered primary and activated sludge and production of pellets which can be utilized as fuel at cement plants or disposed at the landfills. This option relies on the following processes:

- Supply of cake (dewatered mixture of primary sludge and biological sludge) with water content of 80% from the existing mechanical dewatering shop to the intermediate storage hopper;
- Cake feed from the hopper to drier, for evaporation of water to meet the requirements of incineration process, and for disinfection;
- Dried sludge feed to pelletizing unit;
- Odour control of gas from the drier unit;
- Heat supply from dried sludge incineration (waste heat) boilers to the drier;
- Treatment of flue gas from waste heat boilers;
- Treatment of scrubber effluent;
- Collection of ash;
- Delivery of excess dried sludge to cement plant for use as fuel, or disposal at MSW landfill.

The mixture of primary sludge and biological sludge will be treated in two units comprising the following sections:

- Dewatered sludge drying and disinfection section which consists of six closed-cycle drying lines (based on turbo technology) and six pelletizing lines;
- Thermal energy section including two open-cycle waste heat boilers, and exhaust gas treatment system.

Operation mode of the facilities is similar to that of Options 1 and 2: 24 h/day, 8000 h/year.

Dewatered sludge is fed by screw conveyers from the mechanical dewatering facilities to the buffer tank with a heat exchanger to maintain the required temperature. A system of conveyers transport sludge from the buffer tank via a dozing pump to turbo drier.

The drying process is based on treating a thin film of dewatered sludge in turbulent conditions. Sludge continuously moves along cylindrical module of the drier, by the action of turbine rotation and the dry process gas flow. The heat transfer agent is diathermic oil circulating in the shell of the cylindrical module. Internal wall surface of the drying module heated with diathermic oil has a high heat transfer coefficient with the thin film of dewatered sludge. Every part of sludge is affected by a great number of heat shocks against the hot wall. As a result, the time of drying is as short as several minutes. In addition, no pre-treatment is required (re-mixing of dry and dewatered sludge) before sludge is fed to drier. At the same time uniformity of dry product is guaranteed, and microbiological hazard level of sludge is significantly reduced.

The dried sludge flows together with vapour produced in the process of drying which ensures translational movement of sludge inside turbine drier. The unit operates in a closed cycle where no uncontrolled emissions to air are possible. Process gas carries the dried fine-dispersion sludge to cyclone for separation of the dried product, process gas and vapour. Sludge particles are removed via sluice valves in the lower part of the conical section of cyclone. At the same time process gas and vapour are removed via cylindrical part of cyclone to the treatment section comprising the following elements:

- Venturi scrubber;

- Demister;
- Circulation fan;
- Performance gas heat exchanger;
- Heat recuperation heat exchanger;
- Condensation tower;
- Exhaust fan.

Gas-and-vapour mix from the cyclone with residual suspended particles is directed to Venturi scrubber and mixed with water. Mixture of vapour and suspended solids is collected in separation chamber. Inside the scrubber fine particles (together with liquid) are separated from the gas fraction. The liquid fraction collected at the bottom is returned to the separator by a centrifugal pump, in order to enhance scrubbing performance. Suspended particles are transported via pneumatic valve to the head of MWWTP. Gas is removed through the top part of Venturi scrubber which is equipped with demister – a static separator that catches water droplets in gas flow. Treated process gas is directed by circulation fan through performance gas heat exchanger and further to the turbo blower. A part of process gas which corresponds to the quantity of vapour produced in the course of drying is extracted from the closed circuit and directed to the heat exchanger for recuperation of thermal energy. The product of this process is hot water at the temperature of 80-85°C and associated partial condensation of vapour. The condensation process is completed in the condensation tower which is designed as a vertical cylinder and serves for process gas purification and cooling.

Dried sludge from the cyclones passes through a system of conveyers to the dozing system with macerator, and then is pressure-fed to pelletizer. Dried sludge pellets are discharged to the cooling unit and further transported by conveyer to the dosing devices of waste heat boilers. The excess material is kept in storage hopper before shipment to cement plant or MSW landfill. Air from the pelletizing system is pneumatically transported to cyclone filter for separation of solid dust particles. After that gas is directed by fans to odour control facilities which also threat gas containing non-condensing substances from the dewatered sludge hopper and drying section.

The odour control facilities provide two stages of gas treatment: alkali-oxidizing and acidic. Here the physical and chemical process is based on oxidation and neutralization reactions enabled by presence of sulphuric acid, sodium hydroxide (caustic soda) and sodium hypochlorite.

Heat for the drying process is supplied from the heat generation section.

Dozing units continuously feed dry sludge pellets to waste heat boilers. The latter are designed with flat traveling grates which makes them suitable for incineration of various combinations of products with similar parameters. The moving grate evenly distributes fuel in the furnace and optimizes utilization of primary combustion air. Secondary air is supplied into the chamber in specific points to cause turbulence and achieve complete combustion of fuel. This process relies on counterflows which support burning. Hot gases flowing on the cold and wet product prepare it for optimum and complete combustion and minimize the residual quantity of non-combustible material (ash). Ash is discharged automatically. The combustion chamber is designed in a way to keep flue gas in the chamber for at least 2 s, to minimize dioxin emissions (in accordance with the EU Directive applicable to waste incineration). 30% solution of carbamide is injected into the chamber of waste heat boiler, in order to minimize nitrogen emissions from incineration of the alternative fuel. The waste heat boilers are equipped with gas burners which are intended to start up the unit and maintain combustion if the low calorific value of dried sludge is too low. Flue gas at the temperature about 950°C from the waste heat boilers are directed to heat exchangers to warm up diathermal oil for the sludge drying process, and further to the treatment section comprising the following elements: cyclone, heat exchanger, reaction tower, bag filter, and flue gas fan.

Major part of ash is removed from flue gas in the cyclone. After the cyclone, treated gas with residual ash particles flows to the heat exchanger where flue gas heat is transferred to the air which is subsequently used to maintain combustion processes (heat recuperation system).

After cooling in the heat exchanger, flue gas is directed to the reactor tower for neutralization of acids (HCl, HF), removal of sulphur oxides and heavy metals with the aid of reagents – calcium hydroxide (caustic lime) and activated carbon. Special storage and dosing unit is provided for preparation of the chemicals powder and control of their dosing.

Table 4.5: Parameters of sludge treatment system. Option 3

Process	Parameter	Value	Unit
Sludge drying	Sludge input flow	270000	t/a
	Sludge outlet flow	61700	t/a
	Input sludge water content	80	%
	Output sludge water content	10	%
	Output sludge water content for utilization in waste heat boilers	20	%
	Drying temperature	280	ºC
Incineration of dried sludge pellets	Quantity of incinerated sludge	51400	t/a
	Combustion temperature	950	ºC
	Quantity of ash	13000	t/a

At the outlet of the reaction bower, gas containing some calcium compounds (products of acid neutralization) and activated carbon particles with adsorbed metals is passed through the bag filter and then emitted to atmosphere through a stack with emissions monitoring sensor.

The ash collection and transportation system provides collection of solid products of combustion from boilers and gas treatment system, their supply to the intermediate storage hopper and subsequent loading into containers for transportation to disposal (burial) facilities.

The whole system is controlled by means of electric control panel with programmable logic controller (PLC) which provides continuous measurement of the main process parameters (temperature, pressure, oxygen concentration, flows, etc.). In case of any departure from the setpoint values, the emergency procedure will automatically steer the system back to safe range. In addition, the facilities include a system which monitors pollution emissions to atmosphere during operation in automatic mode, based on the following parameters:

- Flue gas flow – actual and converted to normal conditions (0°C; 101.3 kPa, dry gas);
- Temperature in thermal treatment zone, downstream of thermal treatment equipment, after each treatment stage and in the stack;
- Flue gas water content (at the concentrations measurement point);
- Concentration of suspended solids, sulphur dioxide, carbon oxide, nitrogen oxide, hydrogen chloride, total organic carbon, ammonia (in case of nitrogen oxide control with ammonia water) and other known impurities.

Process layout of the sludge incineration line considered in this option is shown in Figure 4.7 and its key parameters are listed in Table 4.5.

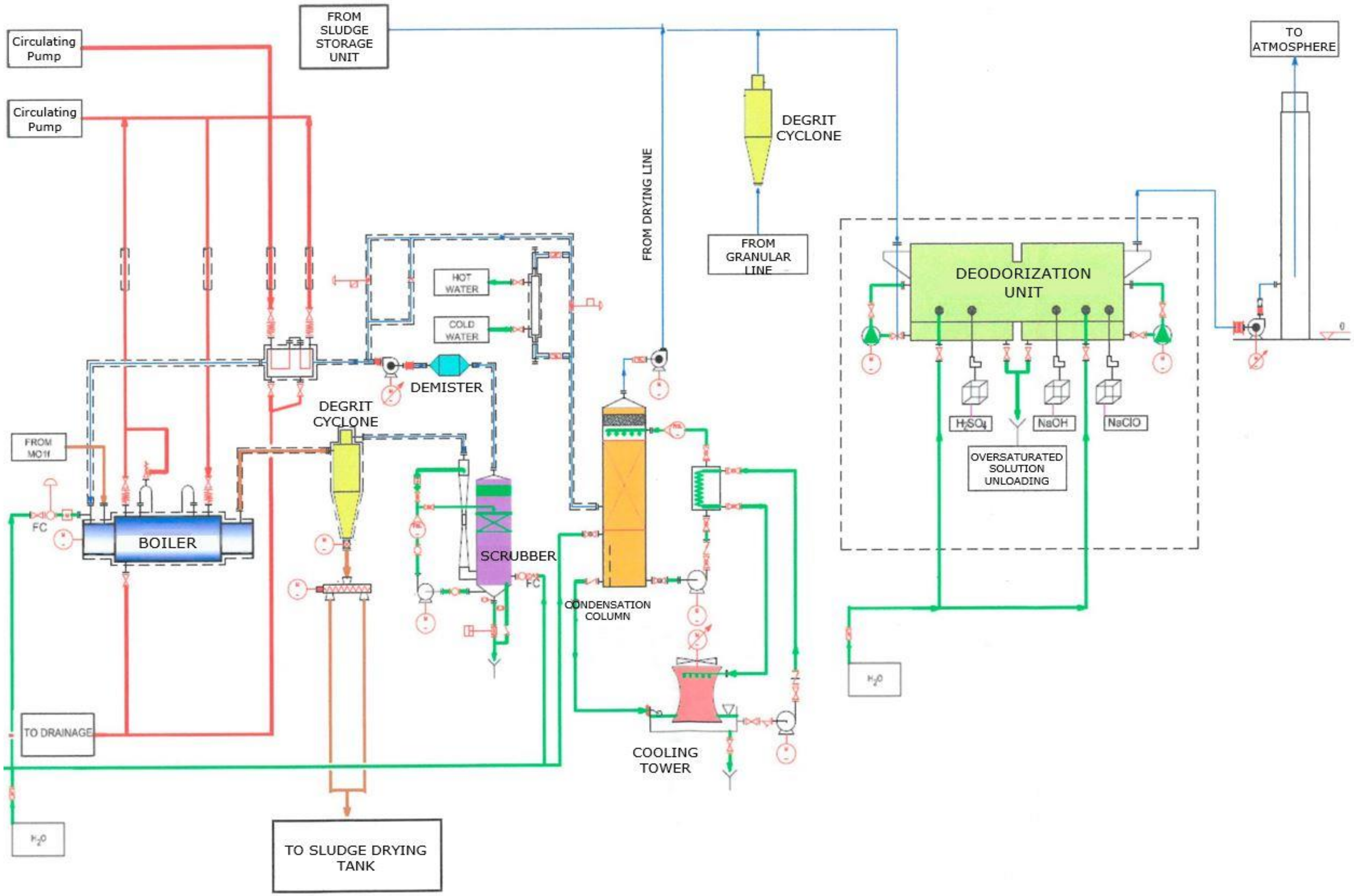

Figure 4.7: Sludge incineration process layout, Option 3

Option 4 provides for drying of dewatered sludge and biological sludge and production of pellets which potentially can be used as fuel in cement industry. Unlike the previous option, natural gas is used here as the main fuel for sludge drying process. Option 4 includes the following processes (Figure 4.8):

- Supply of cake (dewatered mixture of primary sludge and biological sludge) with water content of 80% from the existing mechanical dewatering shop to the intermediate storage hopper;
- Cake feed from the hopper to drier, for evaporation of water to meet the requirements of incineration process, and for disinfection;
- Dried sludge feed to pelletizing unit;
- Odour control of gas from the drier unit;
- Supply of heat produced by burning of natural gas to the drier;
- Dispatch of dried sludge pellets as alternative fuel for cement plant.
- The mixture of primary sludge and biological sludge will is treated in two units comprising the following sections:
- Dewatered sludge drying and disinfection section which consists of six closed-cycle drying lines (based on turbo technology) and six pelletizing lines;
- Thermal energy section including six boilers fired with natural gas.

The processes of dewatered sludge drying and disinfection, and production of pelletized alternative fuel are similar to those described for Option 3.

Heat for the drying process is supplied from the thermal energy section where thermal energy is produced by 6 boiler units (per block) fired with natural gas. The heat transfer agent (vapour) is directed to heat exchangers to heat diathermal oil for the sludge drying process. The gaseous products of combustion are emitted to atmosphere via stacks.

The main process parameters of Option 4 are listed in Table 4.6.

Table 4.6: Parameters of sludge treatment system. Option 4

Process	Parameter	Value	Unit
Sludge drying	Sludge input flow	270000	t/a
	Количество альтернативного топлива из осадка	53600	t/a
	Input sludge water content	80	%
	Output sludge water content when dispatched to cement plant	10	%
	Output sludge water content for utilization in waste heat boilers	20	%
	Drying temperature	280	ºC

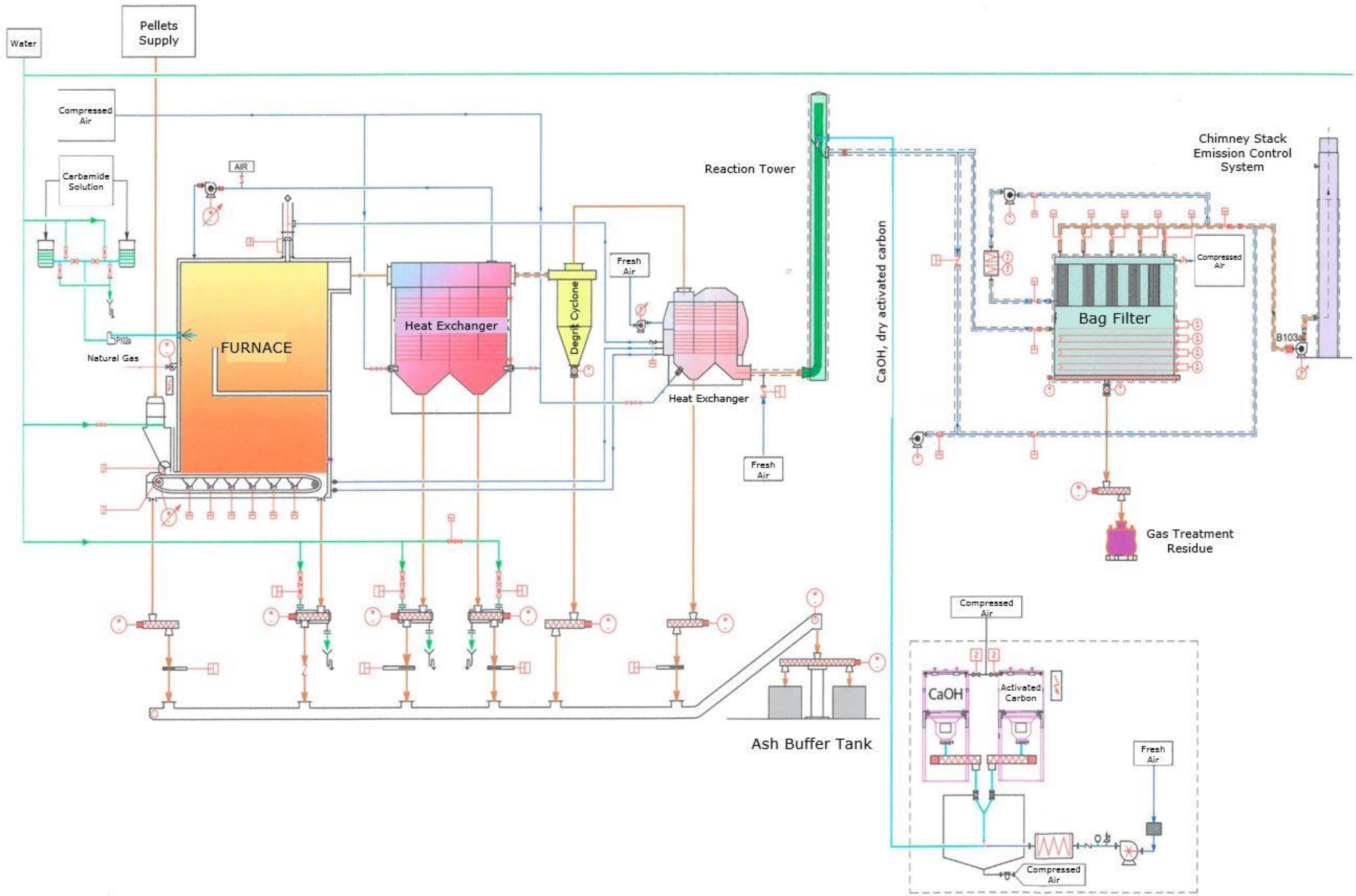

Figure 4.8: Sludge drying process layout, Option 4

4.7.5 Air treatment solutions

The air treatment facilities will be provided in the area which is currently occupied by the grit drying beds (to be removed). The system of air ducts will transport the whole volume of collected gas (500000 m^3/h) to high-pressure fans supplying air to the treatment facilities comprising three steps (Figure 4.5):

- sulphuric acid (H_2SO_4) gas scrubber;
- sodium hypochlorite ($NaClO$) gas scrubber;
- sodium thiosulphate ($Na_2S_2O_3$) gas scrubber.

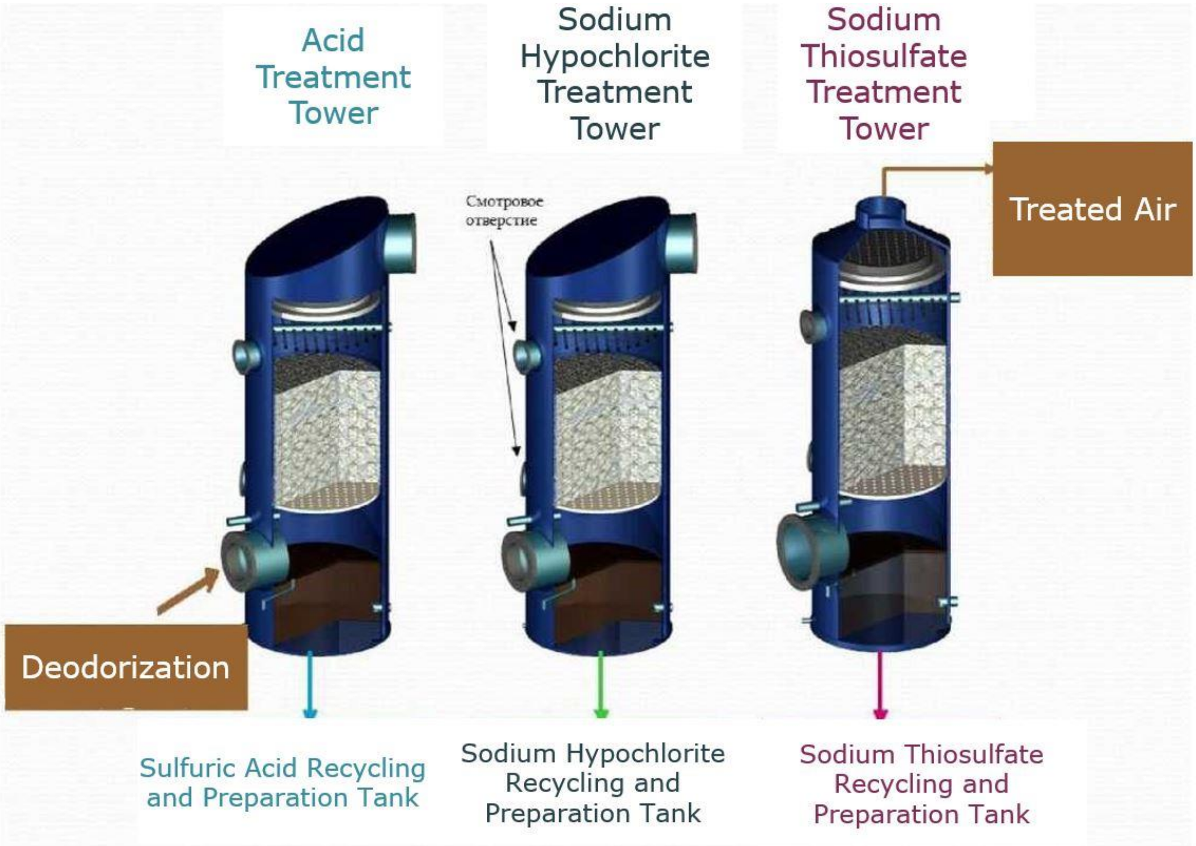

Figure 4.9: Air treatment design scheme

The proposed acid scrubber consists of three functional zones. Circulation pumps supply washing fluid (sulphuric acid solution) from the acid tank. Contaminated air flows through the reactor in the opposite direction (against the washing fluid) to demister where residual liquid is removed. After that air is successively passed through sodium hypochlorite treatment and sodium thiosulphate treatment stages.

The above process will remove 95% of impurities contained in air discharges of the waste water treatment facilities, and purified air will be extracted from the building by a system of fans.

4.7.6 Alternative locations for new MWWTP facilities

Materials of the previous impact assessment studies (2012, 2016) did not consider alternative locations for the project activities, as the design provides for the Project implementation within the boundaries of the sites currently occupied by MWWTP.

In 2017 UE Minskgrado developed a plan for extension of Shabany industrial area (refer to section 6.5.5) including inter alia alternative possibility of MWWTP extension in greenfield territories. Minsk City (Zavodskoy District Administration) jointly with UE Minskrado conducted public forum involving various communities after which the City and Minskgrado received multiple official queries and grievances from residents of Minsk City (Shabany neighbourhood) and Minsk District (Novodvorsky rural council).

It should be noted that the Project location has been finally selected by now, i.e. the Project will be implemented at the site of MWWTP-1. Construction of sludge disposal facilities beyond the boundary of MWWTP site is recognized as unsustainable from economic and environmental perspective, for the following reasons:

- Land allocation for construction of sludge disposal facilities outside the main sites of MWWTP would entail the need to establish a sanitary protection zone for the new facility and would extend overall area of environmental impacts of the Project;
- Significant unbuilt areas at the existing sites of MWWTP, as well as areas cleared after demolition of existing structures will not be used for the waste water treatment processes;
- This option would invalidate the benefits of cessation of sludge transportation from MWWTP.

The Project design allows for selection of alternative locations for individual Project facilities listed in Table 4.8 at the site of MWWTP-1. Detailed information about their final positions which will be defined at the next stage of design development will enable a more accurate assessment of Project impacts on air quality, and to a lesser extent on other components of the environment.

4.7.7 Alternative solutions for Volma Sludge Facilities

The existing Volma sludge facilities are located at the distance of 23 km (by road) from the main site of the wastewater treatment plant. Sludge disposal capacity of the facilities will be fully used up within next 4 to 5 years. The following operations can be considered for the sludge facilities in the future:

- Continuation of current sludge disposal practices is only possible during few years, as the disposal capacity is limited. Extension of sludge disposal grounds is not possible. Operating costs will remain at high level. The remaining period of the disposal facilities operation could be extended by reducing unit rates of sludge generation, however only minor extension would be achievable, thus this option is not acceptable.
- Cessation of use and decommissioning of the sludge disposal facilities will result in a long-term natural process of sludge transformation and production of methane. Operating costs will remain at the same average level during 3-4 years, when collection and treatment of drainage water from the sludge disposal site will still be required. The sludge incinerator will only treat the newly generated sludge. The territory of sludge disposal facilities could be restored and returned into the business circulation, provided that adequate reclamation plan is developed and implemented.
- In case of potential increase of sludge incineration capacity, sludge currently stored at the Volma sludge facilities could be returned for treatment. In this case again, the site territory could be restored for further use. However both capital costs (modification of sludge incineration facilities) and operating costs (transportation) would be high.

Currently the Project design provides for construction of incineration facility at the main MWWTP site for incineration of sludge in quantities equivalent to average daily sludge generation rates. This means that Volma sludge facilities will be gradually decommissioned, and the load on public roads caused by sludge transportation will decrease to the minimum. Subsequent reclamation of the sludge lagoons will help to minimize drainage water transportation from Volma facilities to MWWTP. The drainage water sewer will be decommissioned, and the land plots currently occupied by this facility will become available for other purposes.

4.7.8 Comparison of Main Alternatives and Selection of Preferred Option

For comparison of the above options, the Technical Consultant (Sweco and DiAr Klass) took into account such parameters as generation of thermal and electric energy for sale, natural gas costs and weight of generated ash (Table 4.7). Conclusions drawn by Ramboll take into account opinion of the Technical Consultant, as well as results of assessment of associated environmental effects.

Table 4.7: Comparison of main sludge treatment alternatives based on key parameters (information from Technical Consultant's Report)

<table>
<tr><th rowspan="2">Option</th><th colspan="2">Energy generation</th><th rowspan="2">Energy balance, th. GJ/a</th><th rowspan="2">Gas consumption, th. m³/a</th><th rowspan="2">Ash generation, t/a</th></tr>
<tr><th>Type and share</th><th>Quantity</th></tr>
<tr><td rowspan="3">1</td><td>Thermal - 80 %</td><td>$48.1 \cdot 10^3$ GCal/a</td><td rowspan="2">+250</td><td rowspan="2">1238</td><td rowspan="2"><30,000</td></tr>
<tr><td>Electric - 20 %</td><td>$13.24 \cdot 10^6$ kWh/a</td></tr>
<tr><td colspan="5">Advantages of the option: less wastes (ash instead of sludge), utilization of energy potential of sludge, more straightforward sludge treatment process compared to Option 2.

Disadvantages of the option: mainly thermal energy will be generated (with smaller proportion of electric energy), emissions from sludge incineration</td></tr>
<tr><td rowspan="3">2</td><td>Thermal - 34 %</td><td>$19.94 \cdot 10^3$ GCal/a</td><td rowspan="2">+250</td><td rowspan="2">1037</td><td rowspan="2"><25,000</td></tr>
<tr><td>Electric - 66 %</td><td>$46.23 \cdot 10^6$ kWh/a</td></tr>
<tr><td colspan="5">Advantages of the option: less wastes (ash instead of sludge), better utilization of energy potential of sludge; higher proportion of electric energy generation, less ash will be produced.

Disadvantages of the option: technically more complicated than Option 1; emissions from sludge incineration, quota system for power supply to grid in the Republic of Belarus</td></tr>
<tr><td rowspan="2">3</td><td>*Fuel pellets with residual water content of 20 %</td><td>$*19.04 \cdot 10^3$ t/a
Q=12.4 MJ/kg</td><td>*+236 (equivalent energy output of fuel pellets)</td><td>1238</td><td><25,000</td></tr>
<tr><td colspan="5">Advantages of the option: less wastes; utilization of energy potential of sludge will be possible provided that market for the alternative fuel is available.

Disadvantages of the option: technically more complicated than Option 1; emissions from sludge incineration; lack of market for sale of fuel pellets</td></tr>
<tr><td rowspan="2">4</td><td>Fuel pellets with residual water content of 10 %</td><td>$98.95 \cdot 10^3$ t/a
Q=14 MJ/kg</td><td>+267 (equivalent energy output of fuel pellets, corrected by natural gas consumption)</td><td>33,280</td><td></td></tr>
<tr><td colspan="5">Advantages of the option: less wastes, utilization of energy potential of sludge will be possible provided that market for the alternative fuel is available.

Disadvantages of the option: energy costs will be higher than for other options, technically more complicated than Option 1, lack of market for sale of fuel pellets 27</td></tr>
</table>

Based on the Technical Consultant's Report, Option 2 was recommended for implementation and approved by MVK. This option provides for digestion of newly generated sludge, followed by dewatering, drying and incineration at MWWTP site. For this option the Technical Consultant identified the following uncertainties to be clarified at the nest stage of design development:

- Ash which will be produced as a result of sludge incineration at the estimated rate of 27-30 t/day is subject to landfilling; other alternatives being considered include ash disposal at MWWTP site, at Volma sludge facilities, or handing over to third parties for utilization in road construction (refer to Chapter 9 for details of the selected approach to ash disposal);

27 Besides the disadvantages reported by the Technical Consultant, it should be noted that facilities considered by this option would consume the largest volume of natural gas.

- The estimates of influent waste water flows to treatment by MVK appear to be exaggerated, thus the target capacity of sludge treatment facilities has to be adjusted;
- In order to make anaerobic digestion of sludge compatible with the proposed biological nutrient removal processes, a further solution has to be developed to pre-treat supernatant water flow from the digestion processes before its recirculation to the main treatment processes;
- Some customers of MVK generate waste water with high organic content; after implementation of the preferred option such effluents should be either pre-treated by customers or pumped directly to the digestion system, otherwise their circulation in the common sewerage system will cause excessive acidification of waste water flow and consequential early degradation of the system elements due to extensive corrosion;
- In order to decrease content of contaminants in wastewater sludge and ash, the Technical Consultant recommends MVK to enhance quality monitoring of waste water discharges from customers, and to incentivize implementation of local pre-treatment facilities.

High level review of MVK upgrading options with the above options and conditions incorporated is shown in Table 4.8 (based on the Technical Consultant's Report and results of the analysis conducted by Ramboll).

Table 4.8: Main options for practical Project implementation: advantages and disadvantages

Index	Short description	Advantages	Disadvantages	Prerequisites
Reconstruction of MWWTP-1				
B.0	"Zero alternative" (no Project)	Zero capital cost	High probability of penal sanctions which will be imposed by supervising authorities for failure to comply with treated effluent and air quality standards, composition of facilities of MWWTP and Volma sludge facilities (capacity of existing sludge disposal facilities is enough only for 4-5 years of operation, after which new sludge lagoons will be required)	None identified
B2	Priority Investment Programme (PIP): reconstruction of waste water collection, treatment and disposal systems; implementation of new technical solutions for disposal of waste water sludge	Better quality of effluent discharged to River Svisloch and improved air quality, potential reduction of MWWTP SPZ. Lower cost of sludge transportation from MWWTP for disposal at the Volma sludge facilities	Significant capital investments and high operating costs	Studies to understand dispersion of substances emitted by sources at MWWTP which cause odour nuisances. Assessment of environmental and social impacts of the Project. Design development for disposal of end products of incineration of waste water sludge. Additional training of MWWTP personnel and supervision of their activities during the first period after commissioning of the new systems.
Reconstruction of waste water collection system (long-term programme)				
L2.0	"Zero alternative" (no Project)	Zero capital cost	Area coverage of the waste water collection and transportation will not match the population growth in the service area. Need to provide local systems for collection, treatment and disposal of waste water in new residential areas.	None identified

Index	Short description	Advantages	Disadvantages	Prerequisites
L2.1	Extension of waste water collection and transportation system to match the housing development prospects in the service area, within the planning horizon until year 2030	Full provision of waste water collection and transportation systems in line with the anticipated growth of population	High initial and operating costs, with increased number of users of services.	Survey of the existing waste water collection and transportation system, and development of design for its extension. Incorporation into the Long-term Investment Programme (LTIP)
L2.2	Ditto, with a longer planning horizon (also after 2030), and including connection of rural settlements of Minsk District to the sewerage systems	Ditto, with a longer planning horizon and provision of sewerage services to rural settlements in Minsk District		

5. ENVIRONMENTAL BASELINE CONDITIONS

5.1 Climate

The Project site is located in the moderate continental climate area. This type of climate is distinguished by warm summers and mild wet winters induced by the western disturbance of air mass. Monthly mean air temperature in Minsk is -4.5°C in January, 18.5°C in July (Table 5.1). Absolute maximum temperature is 35°C and absolute minimum is -39°C.

Table 5.1: Climate normal air temperature in Minsk, °C

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Год
Mean minimum	-6.7	-7.0	-3.3	2.6	8.1	11.7	13.8	12.8	8.2	3.6	-1.3	-5.5	3.1
Mean	-4.5	-4.4	-0.5	7.2	13.3	16.4	18.5	17.5	12.1	6.6	0.6	-3.4	6.7
Mean maximum	-2.1	-1.4	3.8	12.2	18.7	21.5	23.6	22.8	16.7	10.2	2.9	-1.2	10.6

Wind pattern is an important factor that influences air pollutants transport. Westerly winds with speed up to 6 m/s prevail in the Project area (Table 5.2). Average annual wind rose is shown below (Figure 5.1).

Table 5.2: Frequency of wind directions, %

	N	NE	E	SE	S	SW	W	NW	Calm
January	6	4	9	12	20	17	20	12	3
July	14	9	9	6	10	12	20	20	7
Year	9	8	11	11	16	13	18	14	5

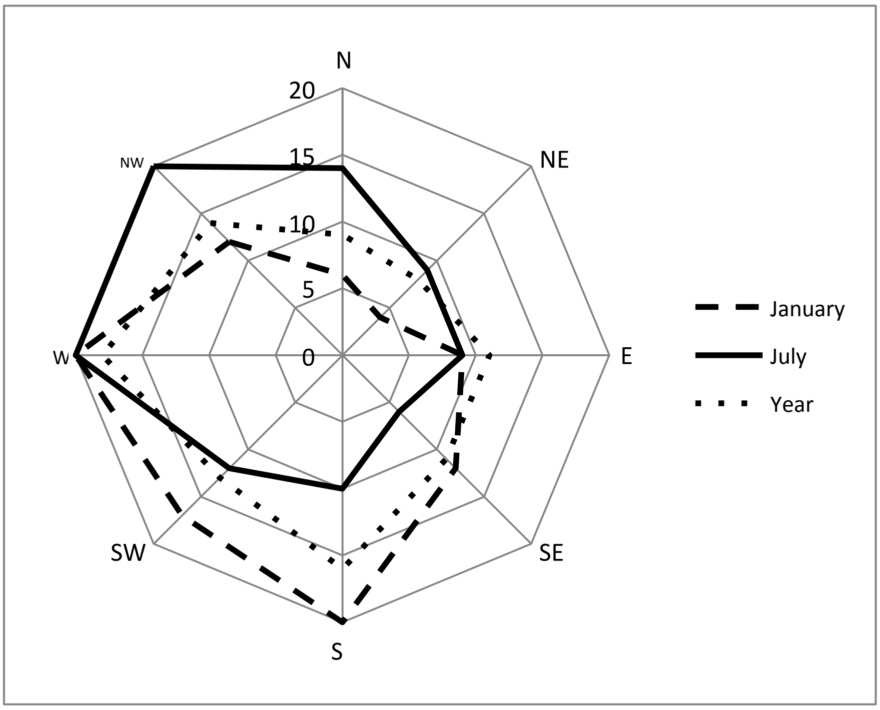

Figure 5.1: Average annual wind rose

By the precipitation quantity, the area is classified as being sufficiently humid. Precipitation is induced largely cyclonic activity. Long-time average annual precipitation is 698 mm. The annual variations of precipitation depths are within the range from 40 mm minimum in February to 90 mm maximum in July.

In the annual precipitation quantity, solid precipitation account for 12%, 13% of precipitation is mixed, and the remaining 75% is liquid precipitation. The longest precipitation events are recorded in winter. In summer precipitation events are shorter in time though precipitation quantity more than double. In autumn precipitation events grow longer.

Seasonal snow cover develops in the first decade of December and reaches its maximum thickness (up to 22 cm) at the end of February, just before start of snow melting. Snow blanket thickness depends on precipitation quantity and prevailing temperatures during the accumulation period. Snow cover completely disappears in the first decade of April.

Annual amount of direct horizontal solar radiation at average cloud amount is 1726 MJ/m^2.

The maximum freezing depth of sandy loam soil is 137 cm.

Adverse weather events are observed in the area which, in case of high intensity, may disrupt production operations. About 60 days with fogs are recorded each year, including 45 days in cold season (December-March), with average fog duration of 6.2 hr/day during cold period and 3.2 hr/day during warm period. Annual number of days with thunderstorms is 28, mainly in June and July. 20-25 days are with snow storms, and 5-6 days are with hail precipitation each year. Repeatability of years with ground frost in May is 60-70%, with strong winds and gusts (25 m/s or stronger) is 10% or less. Average annual number of days with ice crust is 24, with rime frost – 21 days.

Other adverse weather conditions include inversion temperatures which impede transport of pollutants and tropospheric purification. The number of days with surface inversions and raised inversions (with the lower boundary at a maximum height of 250 m) is about 20 each month. Raised inversions are more common in winter and raised inversions prevail in all other seasons. Most inversions occur at night time (radiation inversions induced by surface air cooling). Their repeatability at day time is small. Night time inversions are less dangerous as major part of pollution accumulation takes place in the afternoon.

Thus, taking into account the number of inversions, air basin purification capability through degradation of polluting substances is assessed as positive. Atmosphere self-purification capacity through pollution washout by precipitation is assessed as positive.

5.2 Air Quality

5.2.1 Pollution sources

The main point sources of air pollution are RUP Minsk Tractor Plant (MTZ), filials of RUP Minskenergo (CHP3, CHP4), Minsk heating networks, KUPP Minskvodokanal, OJSC Minsk Automobile Plant (MAZ), OJSC Minsk Heating Equipment Plant, OJSC Minsk Building Materials Plant, OJSC Keramin, CJSC Atlant, UP MinskKommunTeploset (municipal heating networks), OJSC Minsk Motor Plant.

In 2016 the following quantities of pollutants were emitted to air in Minsk, without treatment and recovery: gaseous and liquid pollutants – 4.596 thousand ton/a, other gaseous and liquid pollutants – 0.004 thousand ton/a, volatile organic compounds (VOC) – 0.192 thousand ton/a, nitrogen dioxide – 0.632 thousand ton/a, Sulphur dioxide – 0.036 thousand ton/a, carbon oxide – 3.161 thousand ton/a, hydrocarbons other than VOC – 0.570 thousand ton/a.

5.2.2 Air pollution level

Current extent of air pollution in the Project area is assessed by background pollution levels. The values below are based on the data reported by GU Republican Centre for Hydrometeorology, Radioactive Pollution Control and Environmental Monitoring of the Ministry of Natural Resources of the Republic of Belarus for year 2017[28] (Table 5.3).

[28] Belhydromet Statement No. 14.4-18/788 of 11.07.2017 "Background levels and estimated meteorological parameters"

Table 5.3: Estimated background air pollution levels in the Project area

Pollutant	Maximum permissible concentration (MPC) of pollutant in air, µg/m³			Background level	
	Short-term maximum	Mean daily	Mean annual	µg/m³	Share of MPCstm*
Particulate matter**	300	150	100	60	0.20
SP-10***	150	50	40	58	0.387
Sulphur dioxide	500	200	50	28	0.056
Carbon oxide	5000	3000	500	659	0.132
Nitrogen dioxide	250	100	40	57	0.228
Phenol	10	7	3	1.7	0.17
Ammonia	200	-	-	30	0.15
Formaldehyde	30	12	3	16	0.533
Lead or its inorganic compounds	1.0	0.3	0.1	0.079	0.079
Cadmium and its inorganic compounds	3.0	1.0	0.3	0.0016	0.001
Benz(a)pyrene	-	0.005	0.001	0.00175	0.35

** MPCmd for benz(a)pyrene*

*** Solid particles (non-differentiated dust/aerosol)*

**** Solid particles, fraction up to 10 micron*

Air monitoring in Minsk is provided at 12 permanent stations including five automatic on-line monitoring stations. The closest of them is located 8 km to the north of the Project area, at 50 Radialnaya St. in Minsk.

According to the stationary monitoring results, air quality in most surveyed territories has been good over past period. Percentage of samples with excessive concentrations of polluting substances at the stations with discrete sampling arrangement has been less than 0.1%.

Reported results of continuous monitoring at the automatic stations indicate sulphur dioxide, ground-level ozone, benzene and carbon oxide below the EU target levels.

Continuous measurements yield the following mean annual values in the area of station No.1 (Nezavisimosti pr.), No.4 (Timiriazev st.), No.11 (Korzhenevsky st.) and No.13 (Radialnaya st.): nitrogen dioxide (NO_2) 0.70-1.18 MPC, nitrogen oxide 0.10-0.35 MPC. The number of days with mean daily levels in excess of PMC is significantly smaller than in the previous year. However short-time air quality deterioration events (for the duration of 20 minutes) were still recorded in adverse smog-prone weather conditions. The maximum levels of nitrogen dioxide of 2.5-2.8 MPC were recorded at stations Nos. 13 and 4, and concentrations of nitrogen oxide of 2.5-3.7 MPC were recorded at stations Nos. 11 and 4.

As a pollution prevention measure, GU Republican Centre for Hydrometeorology, Radioactive Pollution Control and Environmental Monitoring (Hydromet) warns industries about adverse weather conditions. In addition, road police regularly arranges the “Clean Air” actions with mobile stations for testing of vehicles for conformity with environmental standards. In 2012 the Ministry of Natural Resource and Environmental Protection considered prohibiting access to the city centre for vehicles that do not meet emission standards. An intention was also announced to relocate industries of hazard class 3 (including MAZ and MTZ) from the city centre.

5.3 Physical Impacts

Levels of the physical impacts in the area of Minsk Waste Water Treatment Plant which are listed below have been assessed in detail as part of EIA 2016 and are presented here to describe the Project baseline:

- noise (acoustic) impacts;
- vibration impacts;
- infrasonic and ultrasonic impacts;
- electromagnetic radiation impacts;
- ionizing radiation impacts;
- thermal impacts.

5.3.1 Noise

Current sources of noise impacts at the site of MWWTP are the process plant, fans, vehicle motors. According to the datasheet information, noise levels of the process units used on site are within the permissible range established by health safety standards. The fans are provided with vibration dampers and connected to air ducts via elastic spacers. Silencers are provided for the exhaust fans and supply units. Air blowers, pumps, fans being the strongest sources of acoustic oscillations are installed indoors, mostly in sound-insulating rooms.

Measurements which were conducted by the Environmental Laboratory of SemigorEcologia LLC on 31.01.2011 demonstrated that day and night time noise levels and sound pressure levels in the residential areas near the sanitary protection zone of MWWTP do not exceed the permissible standard values (Noise at work place, vehicles, residential and public buildings, residential areas. Approved by the Ministry of Health of the Republic of Belarus of 16.11.2011 No. 115).

In 2017 Environmental Centre “PYLEGAZOOCHISTKA” assessed regulatory compliance by measuring actual noise levels in a series of monitoring points and comparing the measured values with the approved limits. No violations were identified[29]. Results of the above assessment and primary data on field measurements of noise and vibration, as well as reconnaissance survey undertaken by Ramboll in November 2017 indicate that sound pressure at some points at the boundary of the nearest to MWWTP regulated territories is to a larger extent caused by railroad and motor road traffic noise, with sources located close by residential buildings. On the Consultant’s opinion, for objective assessment of MWWTP contribution to the level of negative physical impacts at the boundary of estimated SPZ, it would be necessary to identify and prioritize the relevant sources throughout the industrial area (including MWWTP facilities), characterize their impacts by quality, and consider contribution of each source to the integral field of the respective physical parameter. As soon as design parameters of the equipment to be installed within the scope of the Project become known, it will be possible to prepare a more accurate assessment of contribution of the new facilities (refer to description of Project physical impacts in Chapter 8).

The Report of Environmental Centre “PYLEGAZOOCHISTKA” also mentions that inspection of MWWTP sanitary protection zone did not identify any residential or recreational facilities. On the Consultant’s opinion, this statement is not fully true in terms of land use within the boundaries of SPZ, as it is known that four households still persist in the former Shabany village to the soutn-west and west of MWWTP-2 site. As reported by Novodvorsky rural council, the respective land plots are used by nationals of the Republic of Belarus for living and subsidiary farming, without formal registration. The lack of legal grounds for such land use does not preclude the requirement to incorporate it into the process of impacts assessment, including acoustic impacts, of the existing and future facilities of MWWTP in the territory of SPZ (refer to Chapters 8 and 9 for more details).

[29] Development of project document for the sanitary protection zone of Minsk WWTP of UE Minskvodokanal. Phase 2. Justification and calculation of SPZ boundaries for the nature user’s operational site based on assessment of negative physical impacts. Report. – Minsk. Environmental Centre “PYLEGAZOOCHISTKA”, 2017

5.3.2 Vibtraion

According to EIA reports, the main sources of vibration at MWWTP sites are pumps and fans. Their vibration levels are assessed as negligibly low.

5.3.3 Infrasound and ultrasound

In the industrial environment the main cause of infrasound impacts is operation of heavy machinery and equipment (compressors, diesel engines, fans, etc.) which rotate or reciprocate with a frequency of less than 20 strokes per second. Probability of infrasonic radiation at MWWTP site is low for the following reasons:

- The existing process plant is designed for rotation speed of 1200 to 3000 rpm (20-50 rotations per second), thus operation of such equipment does not cause any infrasound emissions;
- Speed limits are established for vehicles traffic on site (5-10 km/h, maximum), thus no infrasound may be generated.

Ultrasonic impacts on living organism are local by nature, as they are transferred by direct contact with ultrasound tools, components being processed or media in which ultrasonic oscillations are induced. No such equipment is in use at MWWTP site.

5.3.4 Electromagnetic radiation

Electromagnetic radiation sources at the given operational sites include all electric consumers, package transformer substations, power mains. The following measures are taken to prevent or minimize their harmful impact on MWWTP personnel:

- conductive parts of process units are located inside metal bodies and isolated from metal structures;
- metal bodies of standard equipment are earthed and function as natural fixed shields from electromagnetic fields;
- safety earthing and zero grounding, equipotential bonding, protective cutout devices;
- earthing of power and lighting equipment with zero protective earth (PE) conductors$
- lightning protection system.

5.3.5 Ionizing radiation

According to EIA materials, MWWTP site is located in territory which is not affected by radioactive contamination, and background radiation level here is similar to natural, contributed by cosmic and endogenous sources.

5.3.6 Thermal impacts

Operation of process plant and traffic at the site of MWWTP results in hot gas emissions to air and hence inevitable local thermal contamination of the environment. No quantitative data on this impact is available (EIA reports do not provide any measured or estimated results).

5.4 Surface Water Bodies and Water Quality

Treated effluent water from Minsk Wastewater Treatment Plant (MWWTP) is discharged to River Svisloch which flows from north to south at the distance of 100 m to the north-west of the MWWTP reconstruction site.

River Svisloch, right tributary of River Berezina, is situated in the north-western part of River Dnieper (Figure 5.2).

River Svisloch is 257 km long and has several tributaries including River Vyacha (runs into Zaslavl reservoir), River Volma, River Bolochanka (on the left-hand side), River Titovka, River Tilka, River Sinaya (on the right-hand side) (Source: National Statistics Committee of the Republic of Belarus, 2017).

Figure 5.2: WWTP position in catchment area of River Dnieper

Description in this section is based on previous EIA (OVOS) reports, scientific papers, national statistics, reports of the national monitoring network of the Republic of Belarus, and other available sources.

The nearest station of the national monitoring network on River Svisloch is located upstream of MWWTP effluent discharge point and 0.5 km downstream of Minsk, in Podlesje settlement (reference number of the monitoring station is 20212.3402). Monitoring station downstream of MWWTP is situated in Korolischevichi settlement (station reference number 20212.3403).

5.4.1 Hydrography and Hydrometry

Terrain in the catchment area of River Svisloch is hilly, with absolute heights within the range of 335 m in the upper reaches to 146 m at the embouchement to River Berezina. The river has its source in the highland of Minsk to the north-west of Zaslavl and 1.5 km to south-east of Shapovaly village of Volozhin District. The river mouth is situated in south-eastern outskirts of Svisloch village of Osipovichy District. The river flows through central part of Minsk highland and western side of Central Berezin Plain. In the upstream part the valley is a Y-shaped box canyon which is 0.4-0.6 km wide. In the middle part the valley is mostly trapezoidal, and in the downstream section it is characterless or trapezoidal, 1-2 km wide. Slopes in the upper and middle reaches are moderately steep, in the lower reaches – gentle, dissected by tributary valleys. The flood plain is double-side type (one-side in the lower reaches) with alternating banks, mostly open and dissected by old channels and ameliorative channels.

Total catchment area of the river is 5160 km^2 of which 78.5% belong to Minsk District (National Statistics Committee of the Republic of Belarus, 2017; Water Cadastre of the Republic of Belarus). Annual average water flow at the river mouth is 40-50 m^3/s, near Korolischevichi 16.9 m^3/s (Table 5.8). Average water surface slope is 0.5‰.

River Svisloch width in the upper reaches is 0.3-0.5 km, in the lower reaches 0.8-1.0 km. The watercourse is partially channeled in seven short sections with the total length of 7.9 km in Minsk and downstream of Korolischevichi. In the upper reaches, starting from Vekshitsy village the river is a part of Viliya-Minsk water system. River channel width at Zaslavl reservoir is 20-25 m wide. Svisloch makes eight meanders within the boundaries of Minsk city. In the city centre the banks are clad with concrete and landscaped. In the middle and lower reaches the river channel is meandering, with rugged banks and multiple curvatures. Channel width is 25-30 m, downstream of Osipovichi reservoir the width increases up to 50 m. The key hydrographic and hydrometric parameters are listed in Table 5.4.

Table 5.4: Hydrographic and hydrometric parameters of River Svisloch

Parameter	
Width, m	25-35
Average depth, m	1.5-2.0
Maximum depth, m	3.0-3.5
Average flow velocity, m/s	0.5-0.8
Maximum flow velocity, m/s	1.0-1.1
Volume flow, long-time average, m^3/s (at Korolischevichi)	16.9
Volume flow, annual average (2014 - 2015), m^3/s (at Korolischevichi)	12.6/10.7
Volume flow, maximum (September 28, 2015), m^3/s (Korolischevichi)	23.4
Volume flow, minimum (May 3, 2015), m^3/s (Korolischevichi)	5.71
Level, cm (Korolischevichi)	0.63

Source: OVOS, 2016[30]; Natural Environment in Belarus, 2015 [31]

Parameters of water catchment basin of River Svisloch in the area between Drozdy reservoir and Korolischevichi settlement are shown in Table 5.5. The area features complex topography composed of terminal moraine ridges and hills in combination with small river valleys, dells and ancient lake basins. Natural hydrographic network in the area has been transformed by operational activities, especially by construction of Viliya-Minsk water system. The main tributaries of River Svisloch in the study area are River Tsna (14 km), River Loshitsa (12 km), River Slepnya (17 km), unnamed creek near the village of Klimovichi. The catchment area covers almost whole built territory of Minsk 80% of which is served by storm water drainage systems. The river flow is affected by impacts of diversion through Viliya-Minsk water system, industrial and municipal water abstraction and wastewater discharges in Minsk, urban development in the catchment area, and ground water abstraction.

Table 5.5: Hydrographic parameters of River Svisloch in the area of Drozdy reservoir and Korolischevichi settlement

Parameter	Drozdy reservoir	Korolischevichi settlement
Average elevation of water catchment area above sea level, m abs.	248	240
Catchment area, km^2	625	1060

30 Reconstruction of Minsk Wastewater Treatment Plant. Feasibility studies. Environmental impact assessment (OVOS). Ref. 14.043. Vol. 14.-043-06. Environmental protection. Book 6. – Minsk: Ministry of Housing and Municipal Services of the Republic of Belarus. National Unitary Design Enterprise "Belkommunproekt", 2016.

31 Natural Environment in Belarus. Environmental bulletin 2015 – Minsk 2016 – 323 p.

Parameter		Drozdy reservoir	Korolischevichi settlement
Average river slope, ‰		1.97	1.11
Drainage network density, km/km^2		0.38	0.37
Percentage of catchment area occupied by	water surface	6	5
	bogs, wetlands	6	5
	forests and shrubs	22	17
	plough land	40	40

Source: OVOS, 2016[32]

5.4.2 Hydrology

River Svisloch and its tributaries feature distinct spring high-water period with high levels of water, relatively stable summer-autumn low-water period, winter low-water period when water levels are slightly higher due to frequent thaws, and flood events which happen almost every year.

Spring high water period is associated with snow melting and is observed every year in roughly same timeframe. River flow increases by multiple times from normal which intensified river bed evolution processes: caving of banks, reaches, islands, filling of bars, silt deposition in flood valleys, and even breakthrough phenomena at sharp bends.

Water level rise normally starts in the middle or end of March and continues for 20-30 days at the rate of 10-15 cm per day. The earliest recorded start time of high water period is early February; the latest time is the middle of April. The highest water level is normally observed in the first half of April when river is free from ice, however on some rare occasions water level may be maximum during ice drift or even more seldom during ice-covered period.

Spring high-water period is followed by summer-autumn low-water period which lasts till autumn high-water period (if present) or till river freezing. Both water level and volume flow are the lowest at this stage, due to dramatic reduction of surface water inflow from the drainage area.

Low-water period in the upper reaches starts in late May, and in the middle and lower reaches in June, and lasts for five months till end of November. In roughly half the instances low water levels are recorded in August and first half of September, and sometimes small rivers dry up in summer.

Cold period starts in the second-third decade of November. At the same time rains cease, water level starts to decline and normally reaches its minimum by the time of first ice formation, i.e. during the first days when shore fast ice or grease appear. Winter low-water period is established which may last during whole winter, however in 70% of instances it is observed in November-December.

Winter low-water level in the upper reaches is similar to that of summer low-water period, and in other parts of the river it is by 20-50 cm lower. In general water level in winter is stable with rare increases by 0.5-1.2 m during thaw periods. Average duration of winter low-water period is 3-3.5 months (from late November/early December till March).

Hydrological pattern of the river is heavily regulated by the cascade of reservoirs (Zaslavlskoye, Rinitsa, Drozdy, Komsomolskoye lake, Chizovskoye, Osipovichi) with resultant reduction of maximum flows during spring high water period and rainfall floods and increase of low-water flow. The maximum quantity of water that can be diverted from River Viliya via Viliya-Minsk water system (commissioned in 1976) in a dry year with 95% probability is about 380 million m^3. Such diversion together with reservoir-regulated river flow during low-water periods has supplemented water resource of River Svisloch and improved its sanitary state.

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[32] Reconstruction of Minsk Wastewater Treatment Plant. Feasibility studies. Environmental impact assessment (OVOS). Ref. 14.043. Vol. 14.-043-06. Environmental protection. Book 6. – Minsk: Ministry of Housing and Municipal Services of the Republic of Belarus. National Unitary Design Enterprise "Belkommunproekt", 2016.

5.4.3 Water flow

River Svisloch is fed by mixed sources however groundwater feed prevails. About 68% of total annual flow is attributed to spring high-water period. Snow feed plays significant role during the whole winter season and accounts for roughly one third of the total river feed. As soon as snow cover is completely melted, the river is fed only by ground and storm water. At that groundwater runoff is more stable and evenly distributed between seasons. Storm runoff is significant only during long rains and rainstorm events. In December storm runoff gives place to snow runoff, as ground surface is covered with persistent snow blanket.

According to the National Water Cadastre of the Republic of Belarus, long-term average annual flow in River Svisloch is 1.1 km^3/year, and annual flow with probability 95% is 0.9 km^3/year. Flow variations observed during the period 2000-2015 were insignificant: from 0.8 km^3/year in 2015 to 1.5 km^3/year in 2010 (Figure 5.3).

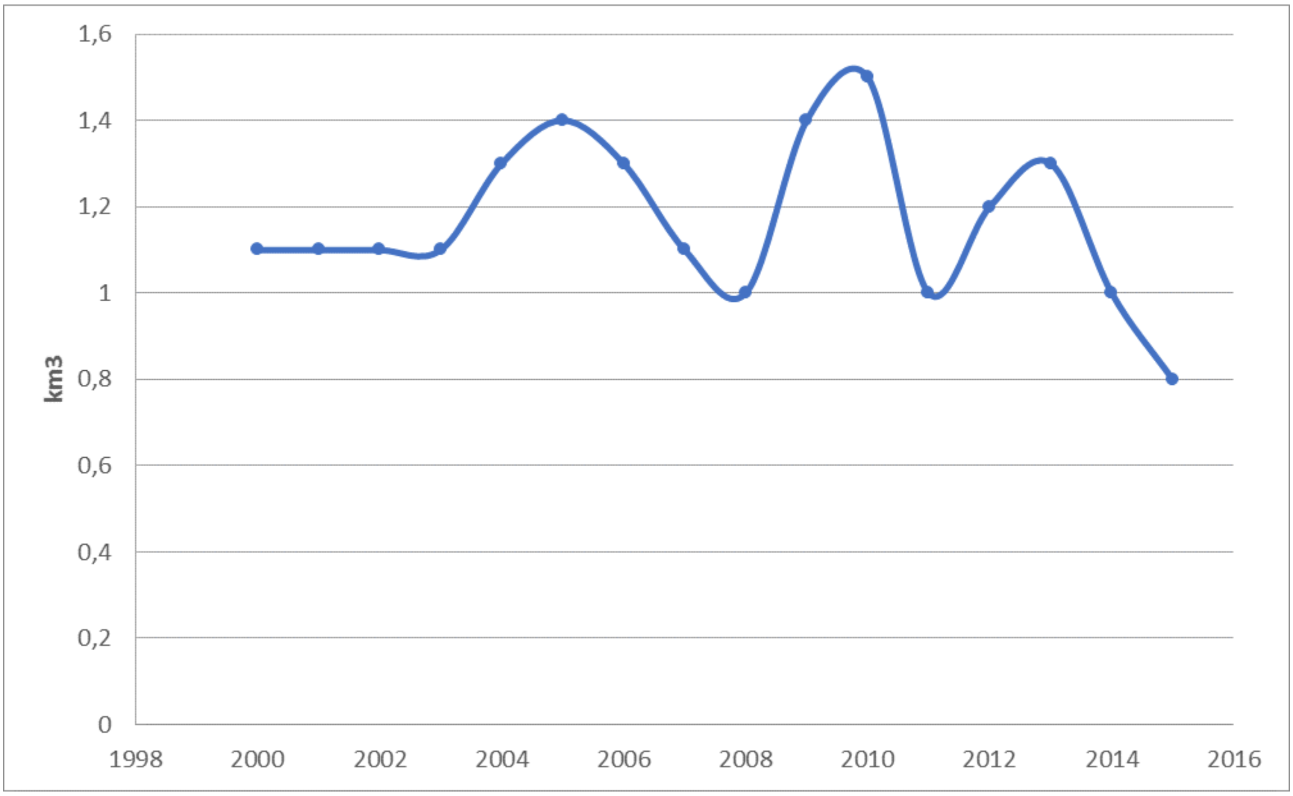

Figure 5.3: River Svisloch flow variations over the period 2000-2015

Source: National Water Cadastre of the Republic of Belarus[33]

Flow distribution pattern of the river is affected by the system of reservoirs which regulate its natural flow. Human interference has caused average annual flow of River Svisloch to increase by more than two times, and leveled the flow variations. On the one hand, minimum monthly flow has increased; on the other hand maximum water flows have become smaller. The river flow is also influenced by diversion of water from River Viliya via Viliya-Minsk water system. Part of water from Drozdy reservoir is supplied to Slepnya water system and in the future it will be also supplied to Loshitsy water system. Thus a water loop with the total length of about 50 km will be provided in Minsk.

5.4.4 Ice conditions

Ice conditions have significantly changed after commissioning of Viliya-Minsk water system. Before the system was commissioned the river normally froze-up by middle of December, ice cover broke in second

33 http://www.cricuwr.by/gvk/default.aspx

half of March, the highest water levels were recorded in first decade of April, and high-water period lasted for 50 days. Conditions after commissioning of the water system have not been thoroughly studied.

5.4.5 Navigation

River Svisloch is not used for shipping operations.

5.4.6 Land use restrictions related to surface water bodies

In accordance with Water Code of the Republic of Belarus (RB), Art. 52, water protection zones are established along shore lines (water body boundaries) of rivers, creeks, channels, lakes, reservoirs, in order to prevent pollution, contamination, deposition of silt in surface water bodies and their depletion[34]. Special restrictions are applied to business operations and other activities in water protection zones.

Even more stringent restrictions are applied in protected shoreline belts within water protection zones.

The width of water protection zones and protected shoreline belts of rivers, creeks, channels, lakes and reservoirs in any areas outside cities or other settlements is measured from water body boundary.

As reported by the National Land Management Design Institute “Belgiprozem”, River Svisloch water protection zone in Minsk District of Minsk Region is 500 m wide, and the width of protected shoreline belt is 20-40 m, as of 1987. According to the Upper Dnieper Water Resource Management Plan, the width of water protection zone of River Svisloch is 700-2100 m, and width of protected shoreline belt is 125-180 m.

River Svisloch is classified as category two fishery water body and in accordance with Resolution of the Ministry of Natural Resource and Environmental Protection of the Republic of Belarus of March 30, 2015 No.12 (On definition of list of surface water bodies used for reproduction, feeding, wintering, migration of salmonid and sturgeon fish species) it is not used for reproduction, feeding, wintering, migration of salmonid and sturgeon fish species. Perch, roach, pike, crucian carp, tench live in the upper reaches of the river, upstream of Minsk.

5.4.7 Surface water quality

Chronic impacts of contaminated wastewater downstream of municipal wastewater treatment plants, as well as surface runoff from urban territories within the river catchment area are the main risks for functioning of river ecosystems. Herewith extent of river contamination depends on amount of man-caused pollutants discharged directly into water course. For instance, in 2009 the total volume of discharges into water bodies within catchment area of River Dnieper was 642 million m^3, and the greatest volume was discharged to River Svisloch - 221 million m^3 (Khomich, 2013).

Flow of River Svisloch which drains the territory of Minsk has been extensively transformed. Its chemical composition is influenced by both natural (low self-regeneration capacity of biota and poor self-purification capacity to recover after man-caused impacts) and anthropogenic factors (industrial and municipal wastewater discharges, flow regulation).

Based on annual average hardness levels (2.73-4.96 mg_{eq}/dm^3), water of River Svisloch is described as “soft” and “moderately hard”. By chemical composition water is classified as hydrocarbonaceous-calcic.

The following materials with information on different parts of the river (upstream, downstream and immediately near the study area) were used for assessment of surface water quality in River Svisloch:

- Materials of OVOS[35], including analysis of background water samples;

[34] Water Code of the Republic of Belarus of 30.04.2014 No.149-Z (as amended by RB Law of 18.07,2017 No.399-Z, RB Law of 17.07.2017 No.51-Z)

35 Reconstruction of Minsk Wastewater Treatment Plant. Feasibility studies. Environmental impact assessment (OVOS). Ref. 14.043. Vol. 14.-043-06. Environmental protection. Book 6. – Minsk: Ministry of Housing and Municipal Services of the Republic of Belarus. National Unitary Design Enterprise “Belkommunproekt”, 2016

- Long-term monitoring data from water monitoring stations (National Water Cadastre of the Republic of Belarus[36], GU Belhydromet[37]) located upstream and downstream of MWWTP facilities. One station is located upstream of MWWTP discharge point, in Podlesje settlement (station reference 20212.3402). Other one (station reference 20212.3403) is located downstream of MWWTP discharge point, in Korolischevichi settlement, 10 km downstream of Minsk. The third station is located in Svisloch settlement, upstream of the confluence point of River Svisloch and River Berezina (station reference 20212.3450);
- Statistical Book of the National Statistics Committee of Belarus[38] with analysis of pollutants concentrations.

Background section is located 500 m upstream of the discharge point of Minsk Wastewater Treatment Plant. Background pollution levels in River Svisloch which are shown in Table 3 are adopted from materials of SI NCHRPCEM (letter No.09-10/1460 of 10.12.2012). Data in Table 5.6 demonstrate that background pollution level exceeds the maximum permissible concentration (MPC) standards for surface water bodies for the following substances: ammonium ion – 1.64MPC, nitrite ion - 1.79MPC, total iron – 2.33MPC, copper – 1.78MPC, zinc – 1.88MPC, total chromium – 1.60MPC, manganese – 1.55MPC, oil products – 1.60MPC.

36 RUP "Central Scientific Research Institute for Comprehensive Management of Water Resource" (CSRICMWR). Ministry of Natural Resource and Environmental Protection of the Republic of Belarus: Water Cadastre of the Republic of Belarus

37 State Institution "National Centre for Hydrometeorology, Radioactive Pollution Control and Environmental Monitoring" (SI NCHRPCEM, Ministry of Natural Resource and Environmental Protection of the Republic of Belarus

38 National Statistics Committee of the Republic of Belarus. Environmental protection in the Republic of Belarus. Statistical book. – Minsk, 2017. 235 p.

Table 5.6: Background concentrations in River Svisloch

No.	Parameter	Concentration in River Svisloch water, mg/dm³	Surface water quality standard[39], mg/dm³
1.	Suspended solids	13.7	25 background+5
2.	Dissolved oxygen, mgO_2/dm^3	8.01	Ice-cover period: 4, minimum Free water period: 6, minimum 6
3.	Hydrogen index (pH)	-	6.5-8.5
4.	Ammonium ion, mgM/dm^3	0.64	0.39
5.	Nitrate ion, mgM/dm^3	1.44	40.0 (9.03 as N)
6.	Nitrite ion	0.043	0.08 (0.024 as N)
7.	Mineral content (dry residue)	317.0	<1000
8.	Chloride ion	41.7	300
9.	Sulphate ion	30.7	100
10	Phosphate ion, mgP/dm^3	0.035	0.066 (as P)
11	Chemical oxygen demand, bichromate oxidability COD_{Cr}	22.5	30.0
12	Biochemical oxygen demand BOD_5, mgO_2/dm^3	3.5	6
13	Total phosphorus, mgP/dm^3	0.107	0.2
14	Total Kjeldahl nitrogen	2.52	5.0
15	Total iron	0.630	0.270
16	Copper	0.008	0.0045
17	Zinc	0.030	0.016
18	Nickel	0.004	0.034
19	Total chromium	0.008	0.005
20	Lead	0.003	0.014
21	Cobalt	0.003	0.010
22	Cadmium	0.0001	0.005
23	Manganese	0.059	0.038
24	Petroleum products	0.080	0.050
25	Anionic surfactants	0.064	0.1

Source: SI NCHRPCEM[40]

Hydrochemical monitoring data from Podlosje station on River Svisloch (0.5 km downstream of Minsk, reference 20212.3402) have been analysed for the period 2011-2015 (Appendix C, Tables C.5.6.1-4).

39 Resolution of Ministry of Natural Resource and Environmental Protection of the Republic of Belarus of 30 March 2015 No.13 "On approval of surface water quality standards"

40 SI RCRCM letter on background concentrations of chemical substances in River Svisloch of 10.12.2012 No.09-10/1460

Both total iron (Figure 5.4) and copper levels (Figure 5.5) recorded at hydrochemical monitoring station Podlosje were higher than MPC, however iron concentrations declined since 2012 (from 0.93 to 0.447 mg/dm^3) whereas copper levels demonstrated a growth trend (from 0.007 mg/dm^3 in 2007 to 0.019 mg/dm^3 in 2015). Zinc concentrations exceeded MPC in 2011 and 2015. Other measured parameters stayed within MPC limits. Hydrochemical status of river section at the location point of the monitoring station is characterized as good (2014-2015).

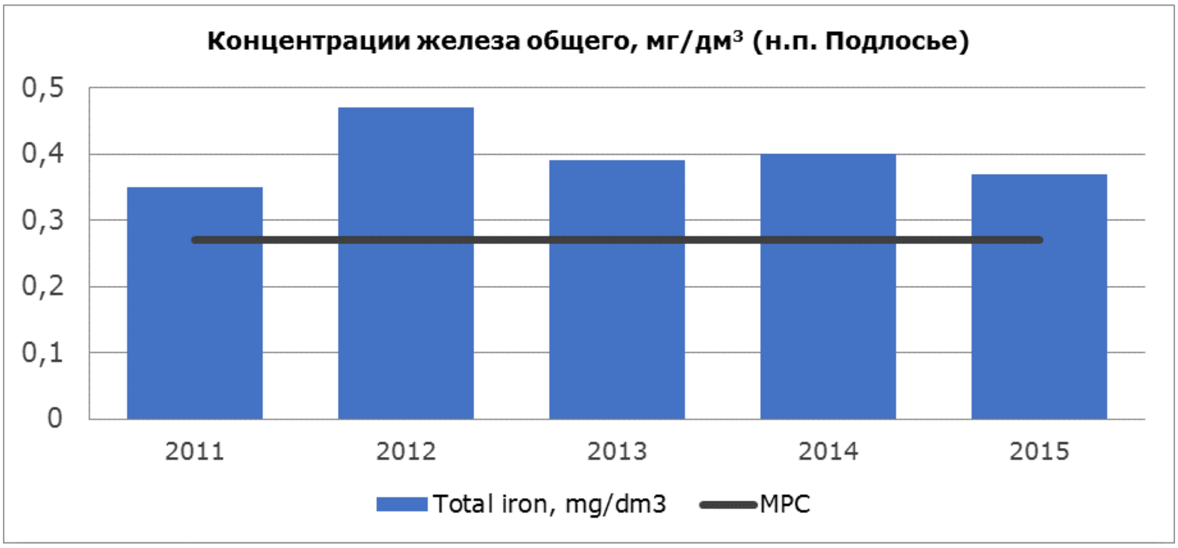

Figure 5.4: Annual average iron levels in River Svisloch, mg/dm^3 (Podlosje)

Data for Figures 5.3-5.4 is sourced from the National Water Cadastre of the Republic of Belarus[41] and Surface water quality standard[42].

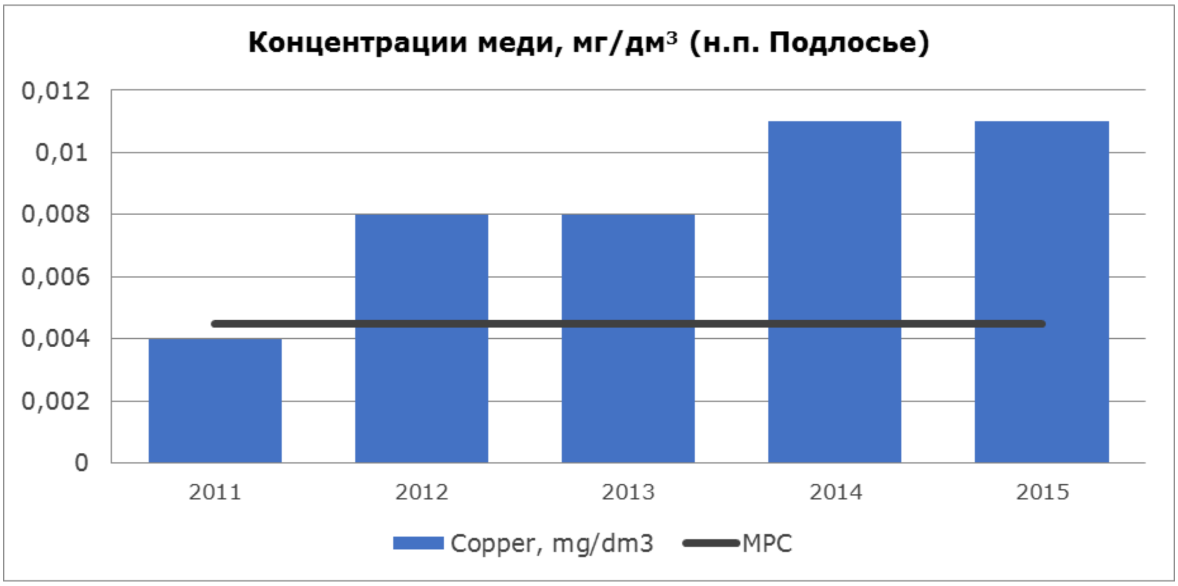

Figure 5.5: Annual average copper levels in River Svisloch, mg/dm^3 (Podlosje)

[41] RUP "Central Scientific Research Institute for Comprehensive Management of Water Resource" Ministry of Natural Resource and Environmental Protection of the Republic of Belarus: Water Cadastre of the Republic of Belarus

[42] Resolution of Ministry of Natural Resource and Environmental Protection of the Republic of Belarus of March 30, 2015 No. 13 "On establishing water quality standards for surface water bodies"

Hydrochemical monitoring data from Korolischevichi station is available for the period 2000-2015 (Appendix C3, Tables 3, 4).

At Korolischevichi monitoring station (reference 20212.3403) phosphate ion concentrations (Figure 5.6) exceeded MPC level by 2-11 times (11MPC levels were recorded in 2009) throughout the surveyed period (except for year 2012 when no excessive levels were recorded).

Ammonium ion levels (Figure 5.7) stayed above MPC during the whole 15-year period and demonstrated decline trend until year 2009 (from 5.48 to 2.38 mg/dm^3). Then concentrations of ammonium ion stayed at roughly same level during the period 2009-2001, declined until 2013 and started to grow in 2014-2015 (to 2.07 mg/dm^3 in 2015).

The greatest annual average concentrations of nitrite ion (Figure 5.8) above MPC levels were recorded during the period 2001-2011 (up to 4MPC). In 2014-2015 the levels significantly exceeded MPC.

Concentrations of copper (Figure 5.9) and zinc (Figure 5.10) exceeded PMC by 1.5-3 times throughout the monitoring period: copper concentrations stay at the level of 3MPC since 2014, while zinc dramatically increased between years 2014 and 2015 and reached the level of 2MPC.

Annual average concentrations of total iron (Figure 5.11) recorded during past 7 years are by 1.2-1.8 times greater than MPC.

Recorded excessive values of annual average bichromate oxidability (Figure 12) exceed MPC level by maximum 1.5 times, however this parameters stayed within MPC limit since 2012. Hydrochemical status of water body at this monitoring station is assessed as satisfactory (2014-2015).

Petroleum products concentrations exceeded MPC in almost all years. Excessive content of synthetic surfactants was registered once, in year 2001.

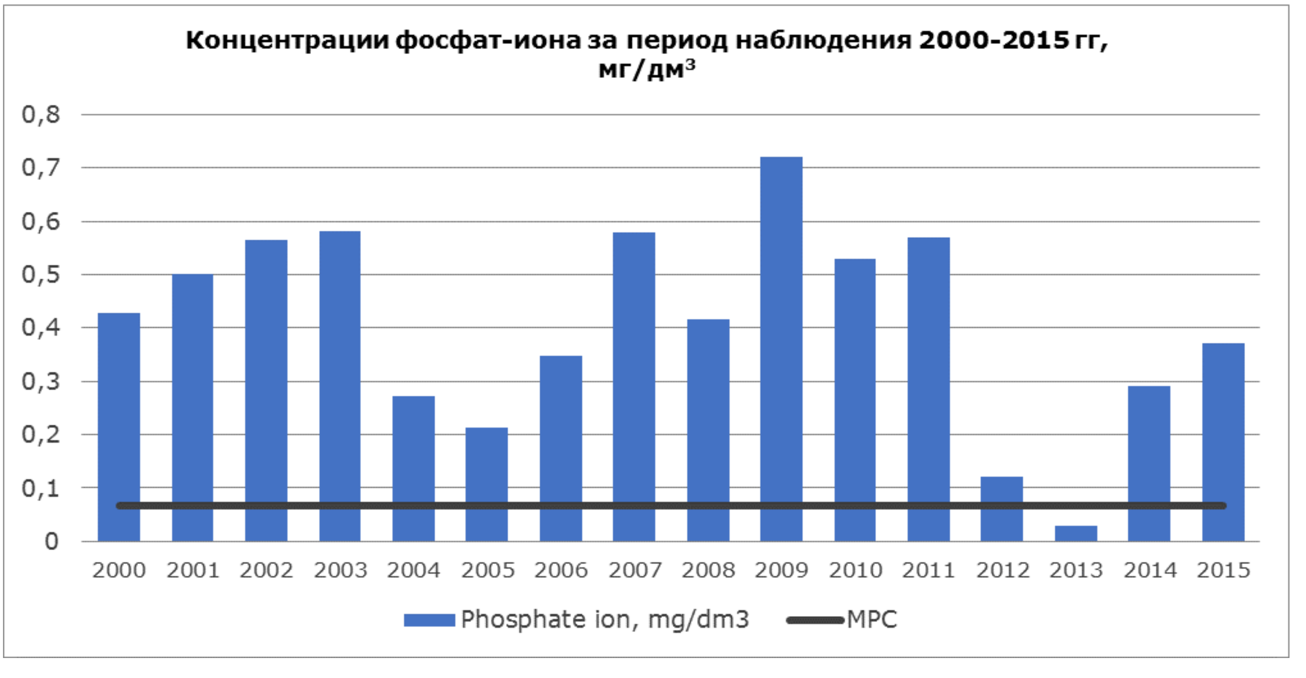

Figure 5.6: Annual average levels of phosphate ion in River Svisloch, mg/dm^3 (Korolischevichi)

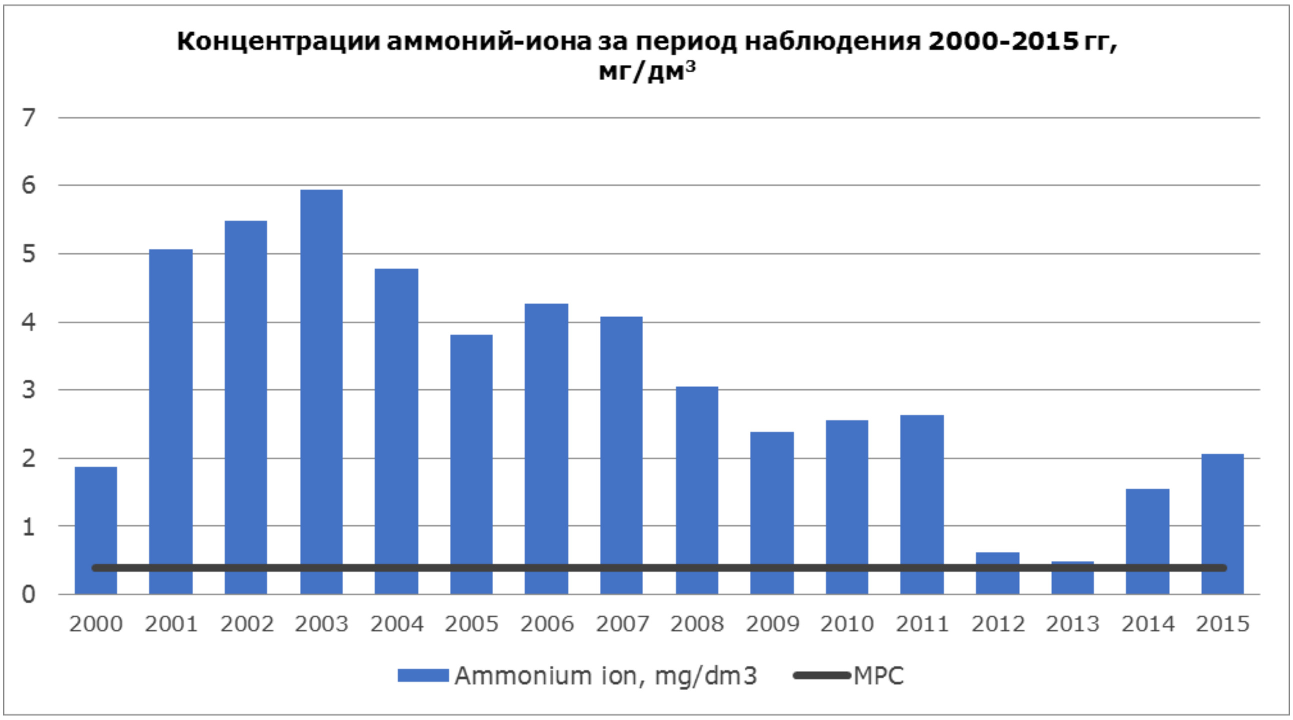

Figure 5.7: Annual average levels of ammonium ion in River Svisloch, mg/dm³ (Korolischevichi)

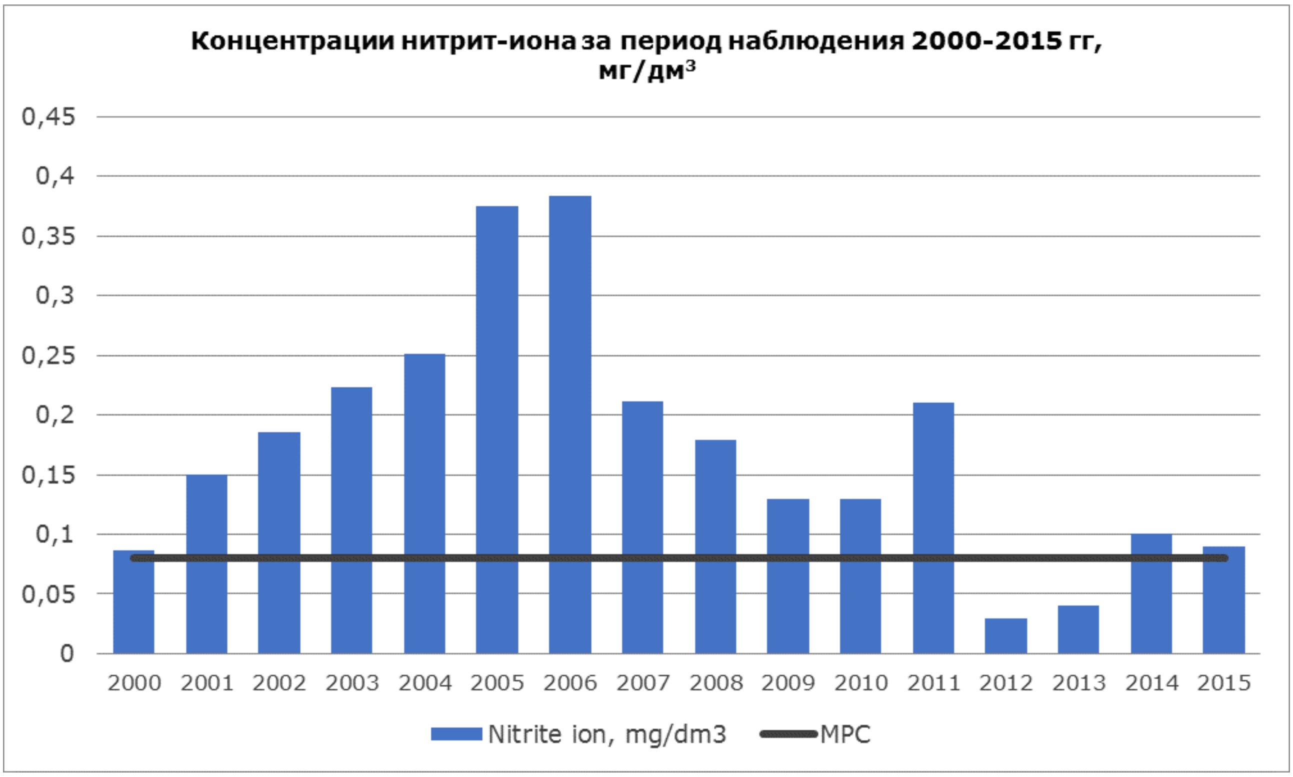

Figure 5.8: Annual average concentrations of nitrite ion in River Svisloch, mg/dm³ (Korolischevichi)

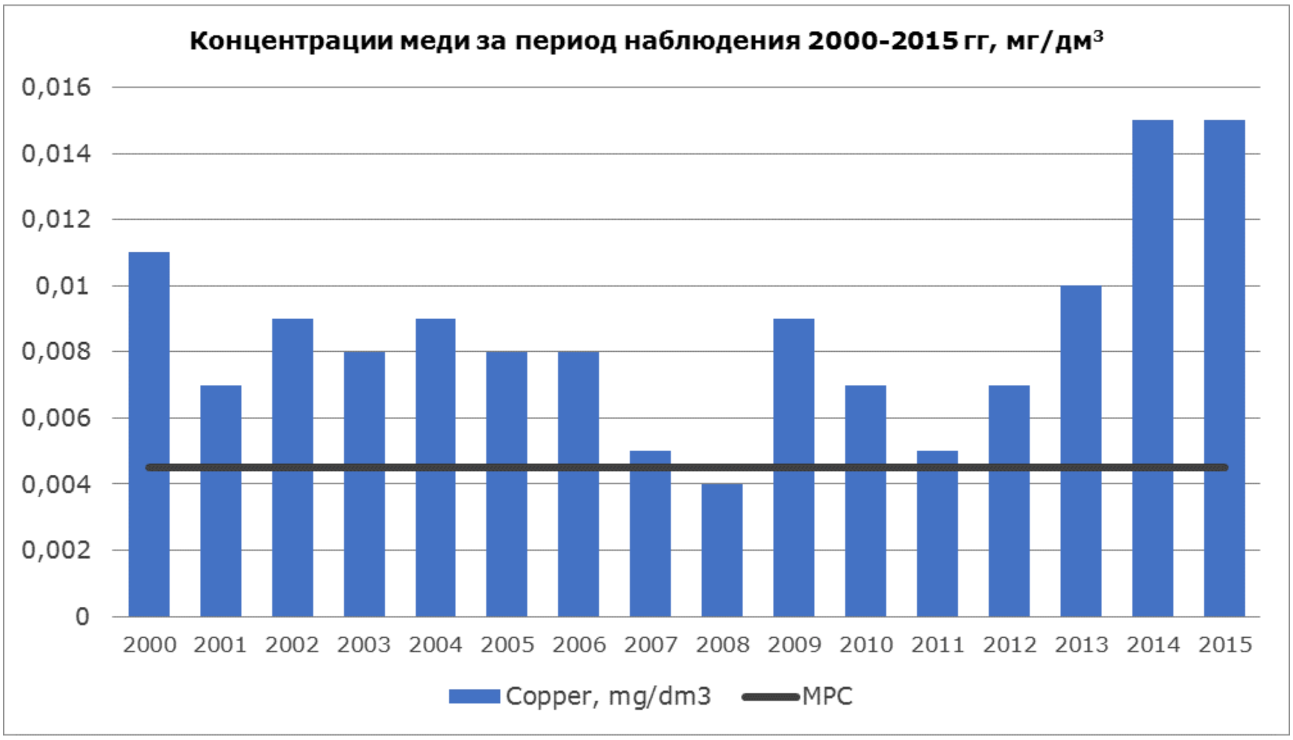

Figure 5.9: Annual average copper concentrations in River Svisloch, mg/dm³ (Korolischevichi)

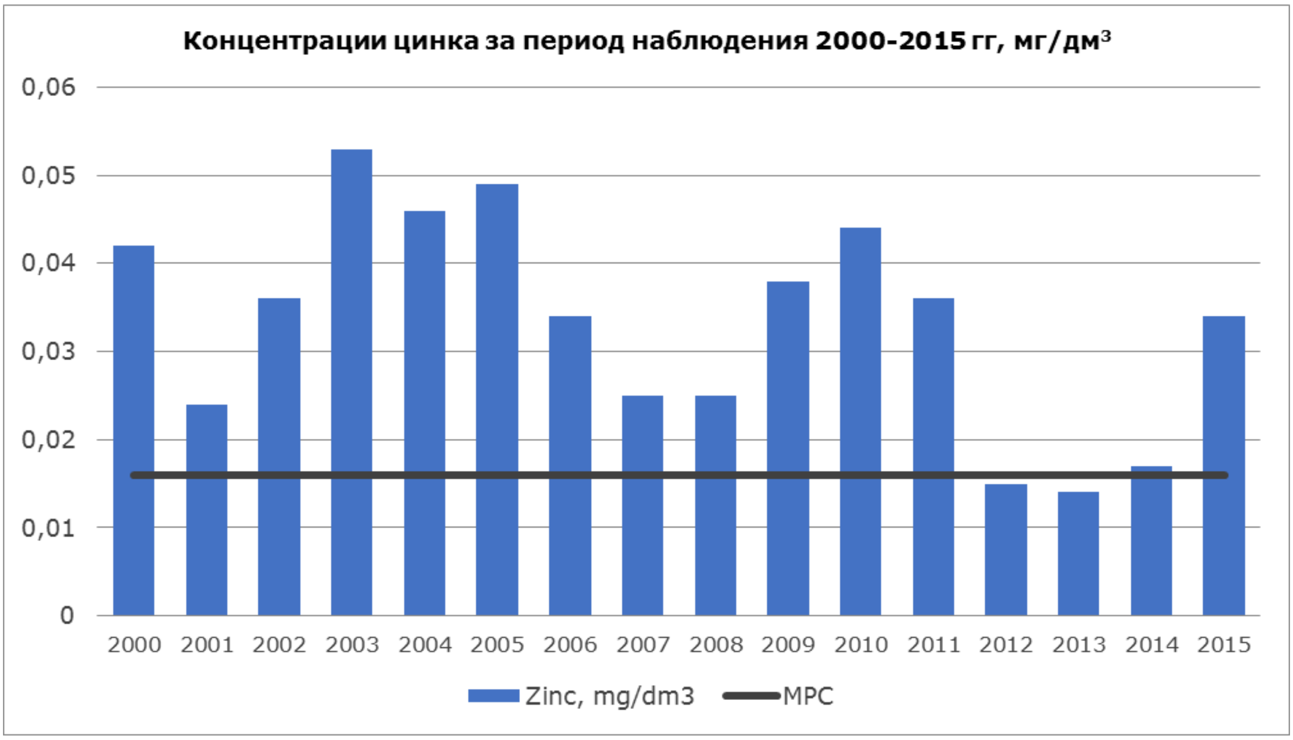

Figure 5.10: Annual average zinc concentrations in River Svisloch, mg/dm³ (Korolischevichi)

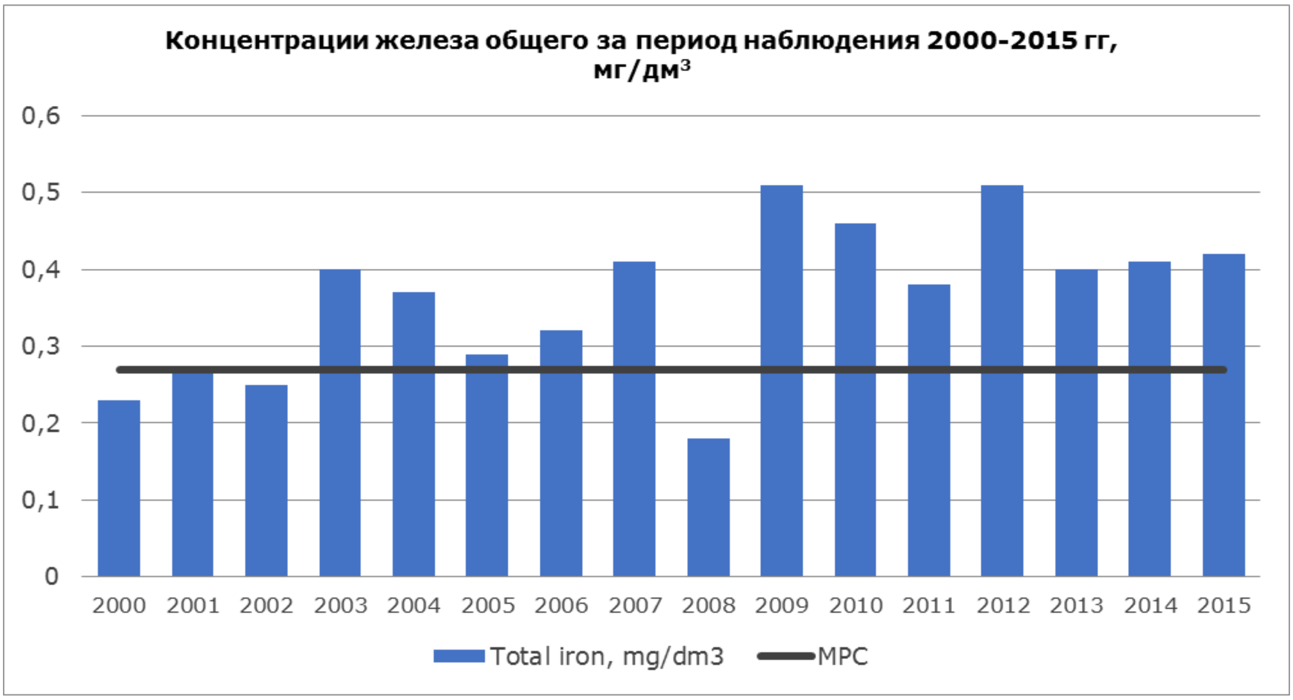

Figure 5.11: Annual average concentrations of total iron in River Svisloch, mg/dm³ (Korolischevichi)

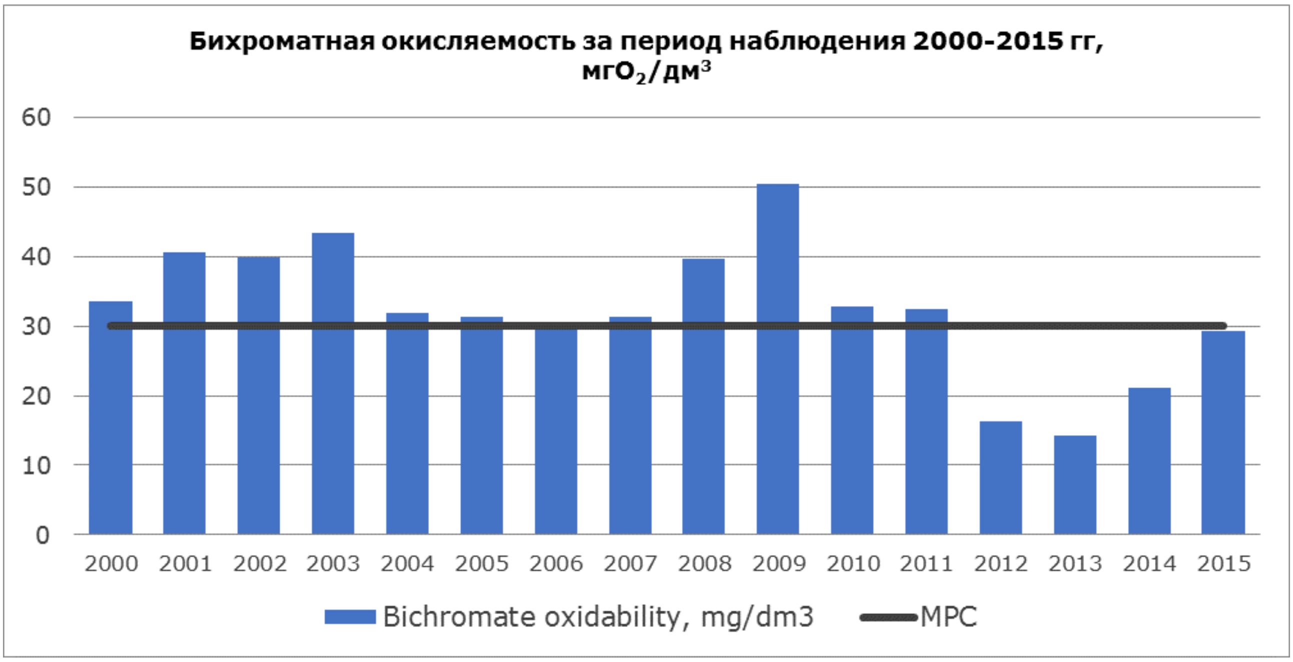

Figure 5.12: Annual average levels of bichromate oxidability in River Svisloch, mg/dm³ (Korolischevichi)

Hydrochemical monitoring data from the station in Svisloch settlement is available for the period 2000-2015 (Appendix C1, Tables C.5.6.5, 6).

At Svisloch settlement monitoring station (reference 20212.3550) annual average concentrations of ammonium ion (Figure 5.13) exceeded MPC level by 1.5-2.3 times throughout the surveyed period.

Excessive concentrations of copper at the level of 1.2-3MPC were recorded in 2000-2011 however this parameter stayed within the permitted range over past 4 years.

Phosphate ion concentrations (Figure 5.14) exceeded MPC by more than two times. The greatest exceedence is reported for year 2003 (7MPC). In 2004 this parameter dropped to 4MPC and remained at the same level till 2015.

Zinc levels (Figure 5.15) exceeded MPC by 2 times only in year 2000 and decreased to 1MPC by 2005 after which they remained equal or slightly greater than MPC until year 2013. In 2014-2015 concentrations of zinc increased dramatically (to 1.6 MPC).

Bichromate oxidability and nitrite ion concentrations were higher than permissible levels in some years but never exceeded 2MPC. As of 2015 these parameters of River Svisloch water are reported to be within MPC limits or slightly greater. Other measured parameters did not exceed the limits. Hydrochemical status of water body at this monitoring station is assessed as satisfactory (2014-2015).

Excessive concentrations of petroleum products MPC were registered in 2002 and 2012.

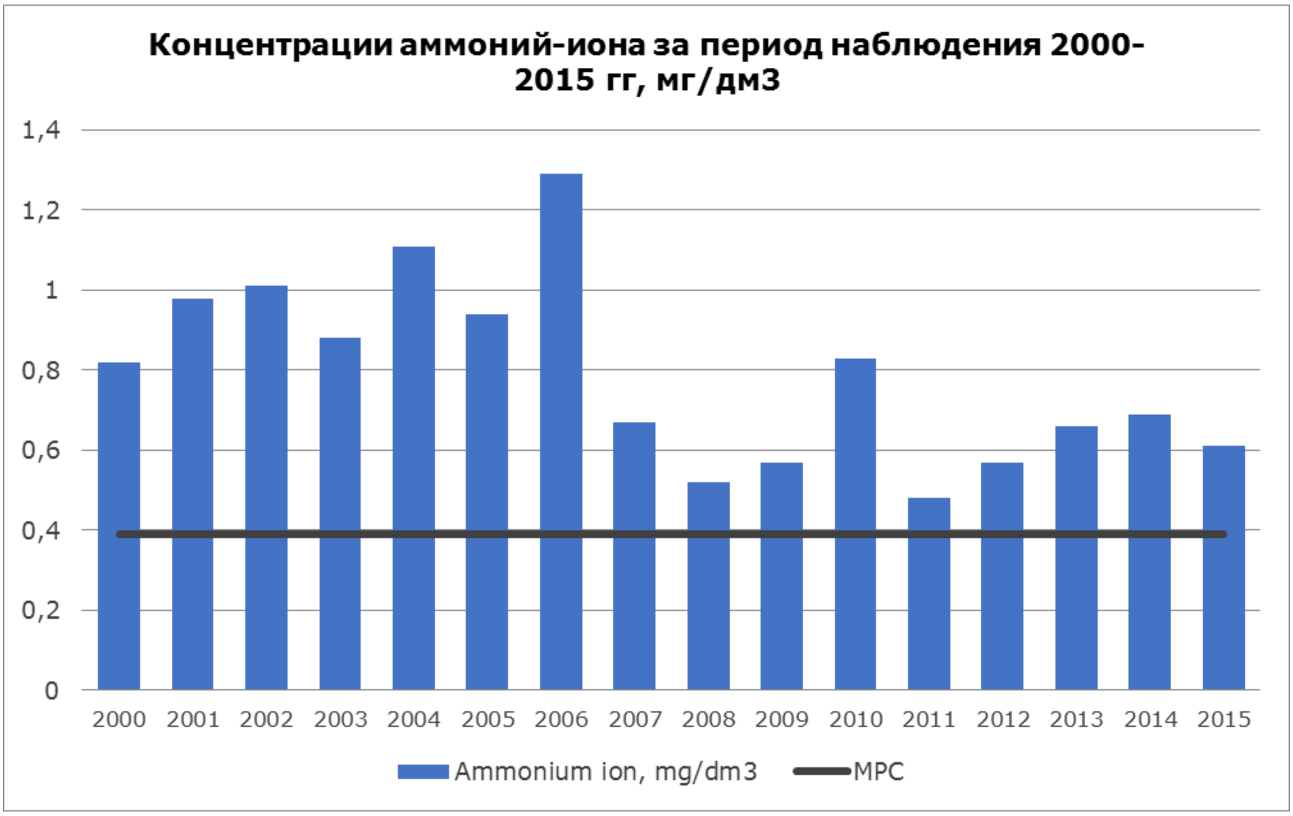

Figure 5.13: Annual average concentrations of ammonium ion in River Svisloch, mg/dm³ (Svisloch settlement)

Figure 5.14: Annual average concentrations of phosphate ion in River Svisloch, mg/dm³ (Svisloch settlement)

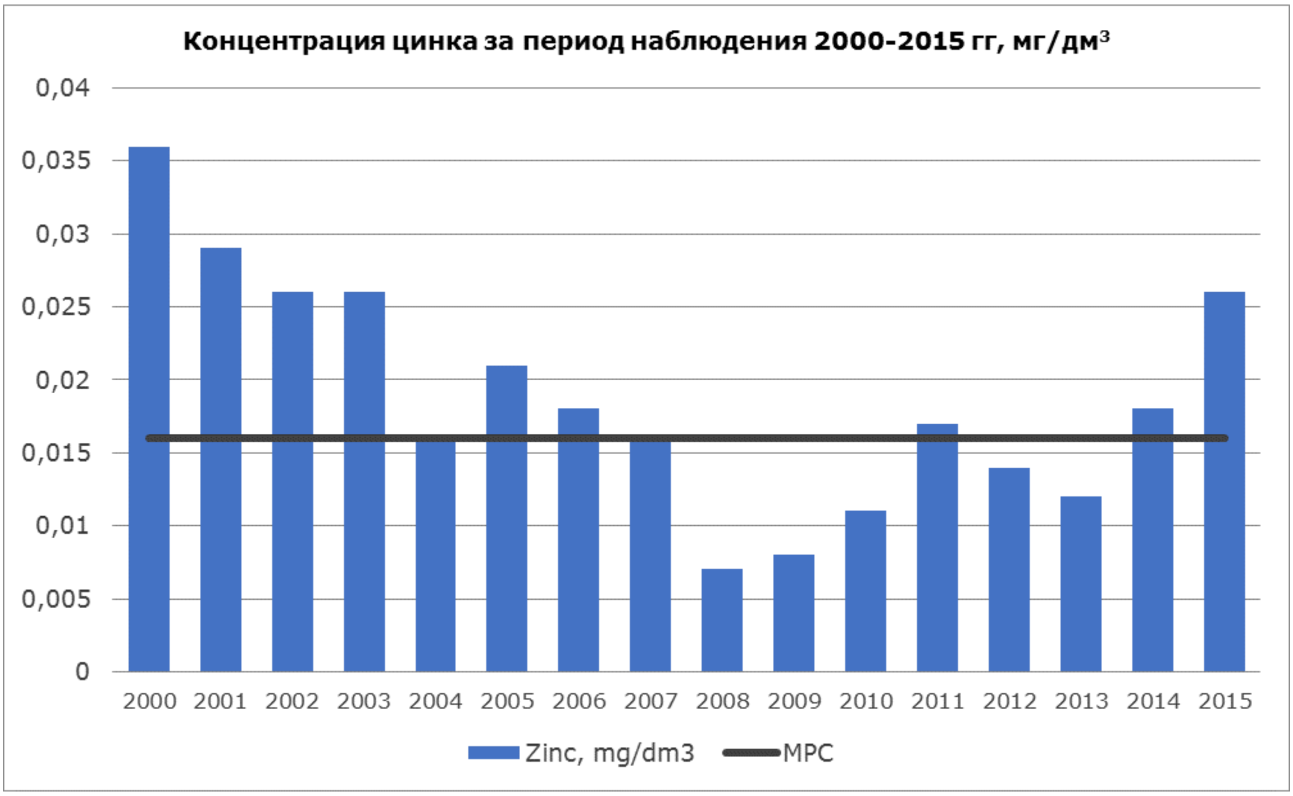

Figure 5.15: Annual average concentration of zinc in River Svisloch, mg/dm³ (Svisloch settlement)

5.4.8 Integrated status assessment of River Svisloch

Indicator used for integrated status assessment of surface water bodies is water pollution index (WPI). WPI is derived from annual average concentrations of six ingredients - dissolved oxygen, readily degradable organic matter (as BOD5), nitrogen ammonia, nitrogen nitrite, phosphorus phosphate and petroleum products – using formula (1):

$$ИЗВ = \frac{1}{6}\sum_{i=1}^{6}\frac{C_i}{ПДК_i} \quad (1),$$

where Ci – concentration of "i" parameter, MPCi – maximum permissible concentration of "i" parameter. Water quality classification by WPI is shown in Table 5.7.

Table 5.7: WPI-based water quality classification

Water quality class	WPI	Water quality description
I	0.3 or less	Clean
II	more than 0.3 to 1.0	Fairly clean
III	more than 1.0 to 2.5	Moderately polluted
IV	more than 2.5 to 4.0	Polluted
V	more than 4.0 to 6.0	Dirty
VI	more than 6.0 to 10.0	Very dirty
VII	more than 10.0	Extremely dirty

Comprehensive assessment of status of River Svisloch is based on data from two monitoring stations (the river monitoring posts near Podlosje village and Korolischevichi village) up and down stream of the MWWTP effluent discharge point, respectively. Results of water quality analysis in the two sections of River Svisloch indicate that annual average pollution concentrations upstream of MWWTP discharge point (Podlosje) are within the range of 1.6-3.3MPC. The resultant value of water pollution index (WPI=1.7) means that the river is moderately polluted.

Section downstream of Minsk wastewater treatment plant (monitoring station in Korolischevichi) is exposed to greater anthropogenic pollution load and WPI values varied within the range of 2.5 to 6.5 (Figure 5.16). WPI peak in 2003 was followed by a decline trend, and in 2015 the index dropped to 3 (moderately polluted water, Figure 5.16). In 2012-2013 WPI was as low as 1.2-1.5, which is the minimum level. By the pollution index over the past 5-year period, river water in the study area is assessed as polluted. As of 2014-2015, hydrochemical status of River Svisloch at the monitoring section of Korolischevichi is assessed as satisfactory.

To summarize the above, water quality in River Svisloch varies between sections and also in time. The worst contaminated section in the study area is located near Korolischevichi, and the greatest load on this section was recorded 15 years ago when River Svisloch was characterised as very dirty.

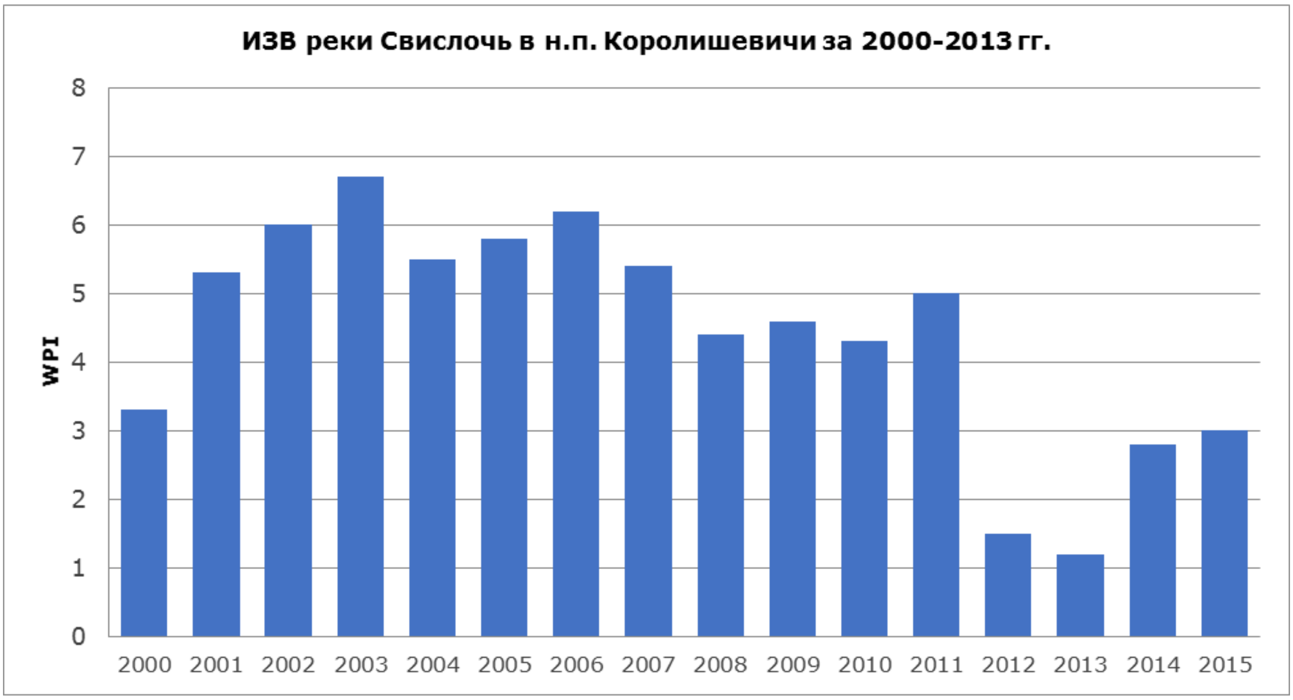

Figure 5.16: Variations of WPI in River Svisloch section downstream of Minsk (Korolischevichi) over the period 2000-2015

Assessment of surface water quality is based on long-term monitoring data collected by RUP "Central Scientific Research Institute for Comprehensive Management of Water Resource" (at the monitoring stations in Podlosje and Korolischevichi), as well as previous OVOS studies of year 2016 and other official statistical information of the Republic of Belarus. The following conclusions can be drawn from review of the above materials:

- MPC levels were exceeded in the background monitoring section of the river for the following parameters: ammonium ion, nitrite ion, total iron, copper, zinc, total chromium, manganese, petroleum products;
- Excessive levels of the following monitored parameters were found in water samples taken from River Svisloch in Podlosje settlement (upstream of MWWTP effluent discharge point) during the period 2011-2015: copper, iron, zinc;
- Pollution levels in the section of River Svisloch in Korolischevichi (downstream of MWWTP effluent discharge point) were higher than in other sections. Excessive levels above MPC are reported over the period 2000-2015 for the following parameters: phosphate ion, ammonium ion, nitrite ion, copper, iron, zinc, bichromate oxidability, petroleum products, synthetic surfaces;
- WPI index also slightly varies between sections. Upstream of MWWTP effluent discharge point (Podlosje) river water is assessed as class 3, moderately polluted. In downstream section (Korolischevichi) water is assessed as class 4-6, polluted or very dirty.

5.5 Geological Setting

5.5.1 Geomorphological Conditions and Relief

In terms of geomorphology, the area under survey pertains to the region of uplands and flatlands of Central Belarus and is located within the south-eastern part of the Minsk marginal glacial accumulative upland. The upland is composed of a massive complex-structured system of moraine ridges and undulating masses formed during the Minsk stage of Sozhsk glacier retreat 43.

43 Губин В.Н. и др. Геоэкология Минского региона. - Минск: ЮНИПАК, 2005. 116 с. V.N. Gubin et al. Geoecology of the Minsk Region. – Minsk: UPAC, 2005, p. 116

V.N. Gubin et al. Geoecology of the Minsk Region. – Minsk: UPAC, 2005, p. 116

The Minsk agglomeration is assigned to the eastern slope of the solid known as Ivenetsk-Minsk mass that forms the upper Svisloch River basin. Genetic relief types are diverse: older glacial and fluvioglacial deposits are compounded by modern fluvial, lacustrine, biogenic, erosion accumulative and manmade forms. Most of them, except for the manmade, have a propensity for a regular layered structure: the upper layer with absolute altitudes of above 260 m is formed by glaciers, the middle layer at 220-260 m is characteristic of fluvioglacial forms, and underlying surfaces are composed of fluvial, erosion accumulative and biogenic species.

Natural relief of the Minsk city area is characterized by predominating gently sloping hills grouped in ridges, heavily dissected glacial and denuded hollows and gulches, and sublatitudinal trending of basic forms. Absolute elevations of the interfluve surface tend to recede from 280 to 182 m in the south-east direction and are 180-210 m in the area of the Minsk wastewater treatment station (MOS-1). The Svisloch River valley downstream from the city forms a large meander directed south-westward. Shabany, an industrial hub, is located in its central part and the Minsk wastewater treatment station sits in the northern part. (see map in Figure 5.51). The Svisloch standing water level in this section is 178-180 m above sea level and that of the highest sections of the "peninsula" formed by the Svisloch and its left tributary Trostyanka is 200-210 m.

By engineering survey data, relief elevations within the MWWTP-1 boundaries vary from 187.75 to 197.65 мasl. Partly, this elevation differential is related to the fact that the facility is situated within the terrace complex of the large flood plain with the intrinsic combination of different-level low inclined surfaces and erosion slopes that separate them (Appendix 1, Photographs 11, 12, 16). The terraced fluvial mesorelief is compounded by numerous technogenic (industry-related) features originated from construction and multi-year operation of sewerage and wastewater treatment systems such as randomly alternating traces of earthworks of various purposes, artificially planned surfaces, and stabilized slopes.

The Svisloch flood plain is located outside of the MOS area and consists of a series of bilateral regularly flooded surfaces whose current geomorphological regime is dictated by the over-regulated river runoff due to a cascade of reservoirs and intensive utilization of the river valley.

5.5.2 Geology and Hydrogeology

The below engineering and geological elements in the area of the projected reconstruction of MOS-1 to the depth of 15 m have been identified by the preliminary survey:

- *Technogenic formations (tIV)* are comprised of filled-up soils made up of coarse and medium slightly wet sand with inclusions of construction waste, crushed stone, slag, and wood waste; in some wells, filled-up soils are impregnated with petroleum products; penetrated soil thickness varies from 0.8 to 8.5 m.
- *Fluvioglacial deposits of the Sozhsk horizon (fllsz)* are represented by fine, medium, coarse, gravelly and slightly wet, and wet and water-saturated sands of 1.2 - 7.1 m depth.
- *Morainic deposits of the Sozhsk horizon (gllsz)* are represented by sandy loam with inclusions of gravel and pebbles of up to 15% plastic and hard consistency interlaid by water-saturated and slightly wet sands and medium sands, mostly water-saturated, with thickness of around 10-11 m.

Due to high filtration performance of surficial grounds, stormwater and snowmelt runoffs are largely absorbed by soil and replenish water reserves of the upper groundwater aquifer. In January 2015, drilling in the area of MOS-1 tapped up sporadic perched water (5.7-8.4 m) assigned to supramoraine sands in local depressions of the moraine top. The fist lateral water-saturated layer was found at the depth of 6.7-12.7 m and ascribed to sand interlayers in the moraine mass. Assumingly, over snow-melting periods and during summer and autumn rainfall floods, the groundwater level can be 0.5-0.7 m higher than the above values.

Геология Беларуси. - Минск: Институт геологических наук НАНБ, 2001. 816 с. Geology of Belarus. – Minsk: Institute of Geology, NASB, 2001. P. 816.

Geology of Belarus. – Minsk: Institute of Geology, NASB, 2001. P. 816.

Critical specific features of engineering-geological and hydrogeological conditions in the MOS area in the context of the projected activities are:

- great compartmentalization of the relief with up to 9.9 m difference in elevation;
- nonuniformity of the composition, structure and density of widely spread technogenic soils whose thickness in individual sections exceeds foundation depths;
- possible emergence of perched water in filled-up soils and supramoraine sands of the bed;
- possible emergence of groundwater sporadically distributed inside of the mass of moraine deposits;
- seasonal soil freezing down to 120-140 cm; *and*
- heaving properties of sandy loams and fine sands common for the area.

Stemming from the above conditions, recommendations for the MOS reconstruction design have been given in the engineering and geological survey materials. In particular, it is advised to use natural occurrence soils for foundation beds. Also, it is noted that actions for water drawdown and protection from minor flooding as well as for preventing erosion, wetting and flooding of enclosing strata may appear necessary. No prospected reserves of mineral resources and protected geological features have been identified within the project boundaries.

Ramboll advises to supplement the list of potentially hazardous conditions of the geological environment with presence of gas-generating soils which origin may be associated with the past use of some part of the MWWTP area as filtration fields, solid waste disposal and local pollution of technogenic soils by petroleum products, as marked in the survey materials.

According to the site visit findings, the proposed site for construction of sludge incineration facilities is composed of technogenic filled-up soils that incorporate numerous fragments of solid construction and household wastes. To improve aeration capacity of the soils their deep loosening is carried out which creates the characteristic ridge-like nanorelief (Appendix B, Picture 15).

Important hydrological conditions for the projected reconstruction include not only superficial bedding of water-saturated horizons but also their local feeding by leaks from water communications and other infrastructure, both accidental (Picture 12) and chronic. The aeration zone is exclusively composed of soils with high filtration properties, which testifies to the weak protection of the upper groundwater aquifer from pollutants penetrating from the surface. This, in combination with the local presence of contaminated technogenic soils in the geological environment and multi-year ingress of a vast variety of pollutants with air precipitations, creates conditions for chemical pollution of soil-ground waters. The latter act as a transit medium for the transfer of pollutants from sources and hotspots to the flood plain network.

The above geological parameters of MWWTP site have been identified by preliminary studies and supplemented by Ramboll. This information shall be used at the subsequent stages of Project development, including final selection of preferred option for reconstruction, layout of new buildings and facilities, foundations design. It is also recommended to arrange a series of further (more detailed) survey activities to assess thickness and mechanical properties of filled soil in the building footprint area. It is further recommended to conduct a systematic soil vapour and gydrogeological monitoring, in order to prevent potential hazardous impacts associated with properties of soil in the zone of aeration, near-surface water and first from surface aquifer on the proposed Project facilities and operations.

5.5.3 Topsoil

According to EIA 2012 and 2016, the Minsk wastewater treatment station is located within the Oshmyansk-Minsk area of sod-podzolic clay loamy and sand loamy soils of the Central region of the Central (Belorussian) soil-geographical province. The topsoil of this area prior to its development was marked with predominating sod-podzolic sand loamy and clay loamy soils combined with gley sods in closed depressions and small erosion forms, alluvial soils of the bottomland complex of the river valleys, and different variants of boggy soils in interfluves[44].

Natural topsoil within the area of projected reconstruction is non-extant and was replaced by a combination of differently disturbed sod-podzolic and associated soils, technogenic soils with topsoil formation signs in surficial layers, and topsoil-free solid pavings and built-over areas. Predominating topsoil formation processes in the project area are humus accumulation assisted by widespread meadow vegetation and gleying related to seasonal fluctuations of air and ground moistening of soils against the background of comparatively frequent occurrence of perched water and weak common drainage of the landscape. As reported in EIA 2016, in the MWWTP area, fertile properties are inherent in the surficial soil and soil-ground horizon 10-20 cm deep.

Soil and ground pollution in the MWWTP area is conditioned by multi-year impacts from a few groups of sources. Local pollution sources are solid waste components, such as particles of various dispersity grades, and wastewater in their disposal and infiltration sites; the overall area is exposed to precipitation of pollutants from the air carried by suspended solids and liquid aerosols.

Surfaces of evaporation from open wastewater channels, air-tanks, and primary and secondary sumps occupy a large area, which is favorable for the carryover of wastewater components by aerosols and their leaching by air precipitations. Furthermore, a close neighborhood of industrial zones of Minsk attaches particular importance to industrial air pollution of the MWWTP area by heavy metals and polyaromatic hydrocarbons from remote sources.

Since the program of pre-project surveys had not provided for a topsoil study, including its current chemical and microbiological pollution level, references to available data on urban soil properties in Minsk were included in EIA 2016. In particular, there are indications of the soil alkylation level as compared to soils of weakly disturbed ecosystems, low humus content, low capacity of the cationic exchange and elevated concentrations of polyaromatic hydrocarbons, heavy metals (Table 5.8), petroleum products, and other contaminants.

Concentrations of heavy metals in Minsk soils reported in EIA are compared to the national average, maximum and tentatively permissible values as well as to published data on background soil pollution of weakly disturbed areas north-eastward from Minsk (Table 5.8).

Table 5.8: Content of heavy metals in topsoil: background concentrations and regulatory values in the Republic of Belarus

Data sources	Chemical elements					
	Pb	Zn	Cu	Ni	Mn	Cd
Maximum and tentatively permissible concentration established by national regulations GN 2.1.7.12-1-2004	32	55	33	20	1000	
Average concentration in soils for the Republic of Belarus	12	35	13	20	NA	
Average concentration in soils in the area of the projected Second Ring Road around Minsk[45]	12	29	8	9	511	NA

44 Номенклатурный список почв Беларуси / Н.И. Смеян и др. Минск: 2003. 43 с.
Nomenclature List of Soils in Belarus / N.I. Smeyan et al. Minsk: 2003. 43 p.
Смеян Н.И. Классификация, диагностика и систематический список почв Беларуси / Н.И. Смеян, Г.С. Цытрон; Институт почвоведения и агрохимии. – Минск, 2007. 220 с.

N.I. Smeyan. Classification, Diagnostics and Systematic List of Soils in Belarus / N.I. Smeyan, G.S. Tsytron: Institute of Soil Science and Agrochemistry, 2077. 220 p.

45 Отчет о НИР «Оценка воздействия на окружающую среду планируемой хозяйственной деятельности по строительству Второй кольцевой дороги вокруг г. Минска на участке от автомобильной дороги М-3 "Минск-Витебск" до автомобильной дороги М-6/Е 28 "Минск-Гродно-граница Республики Польша" (I этап строительства)». - Минск: РУП «Бел НИЦ «Экология», 2010

Data sources		Chemical elements					
		Pb	Zn	Cu	Ni	Mn	Cd
Concentration in soils of Minsk46	Average	21	39	13	9	NA	0.53
	Maximum	491	1077	716	217		8

It follows from the tabulated data that heavy metal concentrations within the city can be ten-fold higher than background and regulatory values. By the cited data, major pollution causes are associated with longstanding impacts of industry and transport. Hence, topsoil in the area of the Minsk wastewater treatment station is most likely to be above-MPC polluted with microelements because it is adjacent to one of the largest industrial zones of Minsk and has accommodated the wastewater disposal and treatment infrastructure over a few dozens of years.

Materials of engineering and geological surveys indicate that there is likelihood of local soil pollution within the project boundaries: it may be concluded from characteristics of grounds from some wells that they are impregnated with liquid hydrocarbons. MPC for this group of pollutants in soils of the Republic of Belarus is established at 100 mg/kg (Act of the RB Ministry of Health No. 17/1 as of 12.02.2012); however, their impact can manifest itself not only in toxic effects for vegetation and water ecosystems (carryover by groundwater to the flood plain network) but also in the accumulation of hydrocarbons and associated volatile compounds in the gas phase of soils and grounds.

It is anticipated that some excess volume of soil and under-surface strata materials will be excavated during construction of the Project buildings and facilities, it would be advisable to test the soil and ground within the footprint of the future earth works to the depth of projected excavation, in order to assess the level of chemical, biological and radiation contamination, and identify the soil suitability for local site reclamation and landscaping, or for its disposal by third parties.

5.6 Waste Management

5.6.1 Current waste management practices in Minsk city and district

Legal base for management of wastes in the Project area is provided in the following regulations:

- Law of the Republic of Belarus of 20 July 2007 "On waste management";
- Decree of RB President of 11 July 2012 No.313 "On certain issues of managing consumption wastes";
- Decree of RB President of 28 July 2014 No.381 "On changes and amendments to RB President Decrees relating to enhancement of consumption wastes management system";
- Resolution of RB Council of Ministers of 23 July 2010 No.1104 "On certain issues in the sphere of waste management".

The applicable requirements in the sphere of collection, transportation, treatment and disposal of wastes are subject to continuous upgrading. The main changes applicable during the Project implementation period are defined by the Waste Management Programme of Minsk City for the period 2015-2019 (approved by the Resolution Minsk City Council of Deputies of 09.02.2015 No.103).

Report "Environmental Impact Assessment of Planned Construction of the Second Ring Road around Minsk at the Section from the Motor Road M-3 Minsk-Vitebsk to the Motor Road M-6/E Minsk-Grodno-Border with the Republic of Poland (Construction Phase 1)". – Minsk: R&D Center Ekologia, 2010.

46 Реконструкция Минской очистной станции. Обоснование инвестиций. Охрана окружающей среды. Отчет об оценке воздействия на окружающую среду. - Минск: Проектное республиканское унитарное предприятие "БЕЛКОММУНПРОЕКТ", 2016

Reconstruction of the Minsk Wastewater Treatment Station. Pre-Investment Feasibility Study. Environmental Protection. Report on Environmental Impact Assessment. – Minsk: BELKOMMUNPROEKT, 2016.

The main features of RB regulation in this sphere include restriction (and even ban) of landfilling of secondary resource and the principle of extended producer responsibility for the system for collection and recycling of commodity and packaging wastes.

Municipal solid wastes (MSW) are the main solid wastes flow in Minsk city and district. A system of regular scheduled cleaning operations is provided to manage MSW collection and transportation for disposal. MSW collection functions are performed by legal entities and individuals (entrepreneurs). Contractors providing waste transportation services are UE SpetsKommunAvtotrans, SOOO REMODIS Minsk, various entities under the umbrella of Minzhylkomkhoz, and a dozen of private operators. The sole operator of waste burial services at landfills is UE Ecores.

UE Ecores operates three MSW landfills in Minsk district – Trostenetsky, Severny and Prudische. According to the official web site of Minsk City (https://minsk.gov.by/), the total volume of MSW buried at the above landfills in 2013 was 7.7 M m^3, including 59% (or 4.6 Mm^3) from residential areas, and 1.2 Mm^3 of domestic wastes from industries. In addition, the landfills accepted for disposal 1.5 Mm^3 of industrial solid wastes and 0.4 Mm^3 of soil during the same year.

Overview of the three existing waste disposal sites in Minsk district is provided below.

Trostenetsky Landfill operates since June 2007 and is the most up-to-date and environmentally friendly landfill in the Republic of Belarus. The landfill occupies the area of 30.8 ha and is designed for 22 years of service life. The third line of the landfill was commissioned in 2016. A waste treatment plant with a capacity of 327 tons MSW per day was commissioned at the landfill in 2017. The annual average volume of sorted waste is 100 thousand tons, and the future plans provide for recycling of up to 30% of this volume as secondary resource, including waste paper, PET bottles, PE film, plastics, glass chips, scrap metal, textile, wood wastes. The landfill accepts fragments of RC articles for temporary storage and future processing.

Prudische Landfill occupies the area of 22 ha in the territory of Kolyadichi settlement. The landfill has been used for disposal of industrial solid wastes since 1968, and by present it has accumulated about 20 Mm3 of wastes. The facility is scheduled for decommissioning in 2018.

Severny Landfill (in the area of the Northern Cemetery) with the area of 23.4 ha was the largest recipient of municipal wastes from the city since 1981. The landfill was closed in October 2017 as its design capacity was used up by that time (67 Mm^3).

The structure of UE Ecores also includes a specialist radioactive wastes operator with operations history dating back to 1963. The main task of this entity is to ensure radiation safety for communities, territories and objects of the environment in Minsk city and the Republic of Belarus, by disposal of radioactive wastes and used sources of ionizing radiation in compliance with the applicable regulations.

In general, the landfill capacities which are currently available for disposal of municipal and industrial wastes in Minsk city and are insufficient. The existing plans provide for decommissioning of two waste disposal sites – Severny Landfill and Prudische Landfill, and commissioning of two new landfills at the allocated former quarry sites with the area of about 33 ha in the territories Vankovschina (Pukhovichi district) and Dubovlyany (Severny-2, Minsk district). Designs for the new landfills are due for completion in 2017-2018, thus no technical details of these facilities are available for review by the time of this Report.

5.6.2 Waste treatment and disposal facilities of UE Minskvodokanal

The total number of officially registered sites for storage and burial of industrial wastes in Minsk city and district is 24, including sludge lagoons, industrial waste landfills, ash disposal sites, PCB wastes storage sites, toxic wastes storage sites, storage facilities for sludge containing halogenated solvents, galvanic sludge, etc. (as reported by RUP BelNIZ Ecologia).

The list includes the Volma sludge facilities being the largest waste disposal site operated by MVK. The site is located near the rural settlements of Sinelo, Mikhanovichi, Veselki of Minsk District, about 7 km to the south-east of Minsk city boundary and the proposed Project area. The sludge facilities are intended for storage of “sludge from biological processes of sewerage water treatment” (waste reference code

8430200) and consist of sludge lagoons in the area of former sand and gravel quarries, and a pumping station. The facilities are arranged as a system of 18 sand quarries, with some quarries recultivated with planting of trees, and other quarries water logged.

After at the Minsk WWTP, primary sludge and biological sludge are treated at the mechanical dewatering facilities, and the dewatered material (cake) with residual water content about 80% is transported by MVK vehicles to the sludge lagoons for disposal. Every day 3-4 specialist vehicles of the Company make 11-14 trips and transport 18 tons of cake each. Total area of the sludge lagoons is 111.1 ha. Estimated total amount of stored sludge is 5 Mm3. The quarry in the south-eastern periphery of the sludge lagoons site which is currently used for disposal of sludge was put into operation in 2013 and its remaining capacity is sufficient to support the operations during next 2-3 years. Additional area has been allocated for arrangement of another sludge lagoon. The available reserve capacity of the sludge facilities is such that the site will last for 5 more years, at the same sludge disposal flows as at present.

Besides the landtake implications, operation of the sludge lagoons results in emissions of methane, hydrogen sulphide, CO_2 and other gaseous products of decomposition of organic content of sludge, with the annual emissions quantities measured in multiple tons. Accumulation of such significant volumes of biologically and chemically active wastes inevitably causes pollution of geological elements (ground and ground water) which contact the wastes. The site location in a major river valley further increases the risk of pollution transport with ground water to the bed of River Svisloch, and of secondary contamination of soil and ground in the areas prone to water logging and flooding.

MVK monitors chemical composition of the disposed waste water sludge. In particular, sludge is regularly (6 times per year) tested for residual heavy metals. Reported data for the period 2016-2017 [43] indicate relatively high levels of iron (13 g/kg in average, with variations of about 25%) and zinc (about 1.5 g/kg, K_{var}=50%) in sludge. Other elements which are found in excessive quantities are copper (330 mg/kg, 23%), chromium (140 mg/kg, 40%), manganese (250 mg/kg, 40%) and nickel (40 mg/kg, 40%). Highly toxic lead (26 mg/kg, 70%) and cadmium (3 mg/kg, 100%) are present in notable however vastly variable quantities.

15 pollution monitoring wells and 2 background monitoring wells have been established to monitor ground water levels and contamination, and further 8 monitoring wells are provided at near Matsevichi village near the sludge lagoons. The following ground water parameters are measured on a monthly basis: level, temperature, pH, dry residue, ammonium, nitrate, phosphate, chloride, chromium, nickel, copper, zinc, iron, sulphate, cobalt, lead, cadmium, petroleum products, synthetic surfactants, aluminium, manganese, phenol, mercury, arsenic. The available results of hydrogeochemical monitoring of 2017 do not allow making any conclusions re. pollution development in geological environment within the area of influence of the sludge facilities.

By the law of the Republic of Belarus, waste water sludge disposal facilities (sludge drying beds, fields or lagoons) can be considered either as long-term waste placement facilities, or as temporary storage facilities. In the first case owner of the wastes is required to have a waste disposal license from the territorial body of the Ministry of Natural Resource. In the second case the owner should define the waste management procedures in a formal instruction document. Decision about category attribution of the facilities shall take into account the technical operation process of waste water treatment plant. In particular, if the process does not provide for removal of sludge from the drying beds (accumulation ponds) and its transfer for burial or disposal, such sludge facilities should be considered as a long-term placement facility. However, if dewatered sludge is fully removed from a sludge cell during 3-5 years and transported for burial in accordance with a comprehensive or other permit, such sludge facility can be regarded as a temporary sludge storage facility, in which case the Company operations are seen as accumulation of the sludge quantity which is intended for off-site disposal.

MVK is required to hold a license for long-term storage of wastes in relation to operation of its sludge lagoons. The company has a comprehensive environmental permit No.5 of 13.07.2016 from the Ministry of Natural Resource and Environmental Protection of the Republic of Belarus which allows for temporary storage of 348,449 thousand tons waste water sludge per year at the Volma sludge facilities during the period until 2025. At present the remaining sludge storage capacity at the Volma facilities is 650-700 tons (or 260-275 th.t/year)47 which is below the maximum level established in the comprehensive permit.

5.6.3 Waste management system of UE Minskvodokanal

Waste management operations at all MVK sites are based on a common Waste Management Regulation approved by the local authorities (Minsk City Committee for Natural Resource and Environmental Protection) on 20.09.2017. In order to make sure that all wastes that are generated at the Company facilities are identified and classified in accordance with the wastes classification nomenclature of the Republic of Belarus, and to verify quantity and quality of waste streams, the Company conducts inventory checks of wastes every five years (or more frequently, if needed) which are reported in standard format (in accordance with Resolution of RB Ministry of Nature No.17 of 29.02.2008).

At present MVK generates 81 types of solid and liquid wastes with hazard class ranging from class 1 to no-hazardous. The most hazardous wastes are used luminescent and mercury lamps (hazard class 1, total number of units in operation – 4500-5000, annual replacement rate – 350-400 units), used lead accumulators (hazard class 2, about 3.5 tons, maximum 4 tons). The wastes of hazard class 3 include used oils and oily wastes, oil sludge, polyethylene and plastic wastes, wood burning ash, screenings, sludge from washing of iron removal filters, as well as wastes from biological waste water treatment facilities which make the largest contribution to the total amount of wastes, in absolute terms. In 2016 the Company generated 350,625.277 tons of wastes of hazard class 3. Wastes of hazard class 4 (21,341.23 tons) include grit from grit removal basins, sludge from sewer pipelines, construction wastes, wood wastes, paper, sweepings from industrial site territories. The non-hazardous wastes are mainly inert materials – uncontaminated ground, RC fragments, vegetation wastes (trees cutting wastes, etc.), ferrous and non-ferrous metals, sweeping from streets (Appendix to the Act of Inventory Inspection of Operational Wastes of 2016).

22 types of wastes which belong to hazard categories 3 and 4, as well as non-hazardous wastes are subject to removal from the territory of MVK for off-site disposal or burial. Quantities of such wastes are restricted by the approved limit values (specified in the Comprehensive Environmental Permit). Wastes of other categories are handed over for decontamination or recycling.

Storage of wastes at MVK sites is permitted only in approved and specially equipped areas: long-term disposal facilities specified in the Comprehensive Environmental Permit (Volma sludge facilities), and the temporary accumulation sites mentioned in the Waste Management Regulation (approved by Deputy Chairman of Minsk City Committee for Natural Resource and Environmental Protection on 20.03.2017, hereinafter “the Regulation”). In the latter case the wastes accumulation volume may not exceed the volume of single transport load specific value of which is legally defined for each type of wastes.

Waste generation and temporary storage areas are clearly defined and marked in schematic maps of waste storage facilities which are attached to the Regulation. The storage methods depend on hazard class of wastes:

- hazard class 1 wastes shall be stored in tight containers;
- hazard class 2 wastes shall be stored in tight containers;
- hazard class 3 wastes shall be stored in closed or open containers, barrels, cisterns, tanks, polyethylene, plastic, textile and paper bags, boxes and other containers, or without containers;
- hazard class 4 wastes shall be stored in closed or open containers, or in heaps, in bulk, in dumps, as piles, rolls, bales, on trays, pads.

In case of temporary storage of wastes at nonpermanent stores, open sites without packaging or in non-tight containers, the site surface shall be hard paved. Waste storage containers shall be marked to

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[47] According to materials of previous studies (Environmental Impact Assessment of Proposed Construction of Sludge Incineration Plant at the address: 1 Inzhenernaya St. – Minsk. Energy Engineering and Consulting Company “ODO ENECA”, 2012) annual quantity of waste water sludge disposal in some years of the first decade of 21st century exceeded 400 thousand tons per year. MVK reports disposal of 267 thousand tons of dewatered sludge at the Volma sludge facilities in 2014.

indicate the type of waste and its class of hazard. An accompanying certificate is issued for each batch of waste to record its transportation route, using the standard form approved by Resolution of RB Ministry of Nature of 09.12.208 No.112.

MVK waste management operations meet the above requirements. The proposed reconstruction of Minsk WWTP is intended inter alia to reduce generation of solid wastes, primarily waste water sludge, and provides for decommissioning of the Volma sludge facilities and reclamation of old sludge drying beds in the future.

5.7 Flora and Fauna

5.7.1 Vegetation

Planted vegetation in Minsk play an important role in the urban landscape and perform multiple functions including sanitary-hygienic, recreational, aesthetic, noise attenuation, protection of soil and water, and environment-forming function. Provision of environmentally balanced landscaping and recreational features is a key factor of comfortable living environment for all residents.

In Minsk about 44% of territory is covered with vegetation, however specific vegetation rates vary between districts – 35.8 m^2 of green areas per resident in Partizansky District, and 3.8-4.8 m^2 in Moskovsky and Frunzensky District.

Landscaped recreation areas are of the greatest recreational value, i.e. parks, forest-parks, green squares, boulevards, gardens, landscaped territories of public centres, aquatic-vegetation systems [1].

Table 5.9 provides details on the number and size of landscaped recreational territories (i.e. public areas with planted vegetation) and forests in Minsk City.

Table 5.9: Landscaped recreational territories in Minsk

Landscaped recreational territories	number	ha
Parks*	21	807
Green squares	160	429.3
Boulevards	25	114
Gardens	11	90
Landscaped territories of public centres (LTPC)	62	106
Aquatic-vegetation systems near water bodies (AVS)**	-	679.4
Beaches	2	17.3
Conservation areas	4	253
Forests, forest-parks, arboretums	-	2854.8
* - Sevastopolsky Park included, Botanic Garden and Zoo excluded; ** - Including Slepyanskaya and Svislochskaya aquatic-vegetation systems.		

River Svisloch and its tributaries flow through Minsk territory from the north-west to south-east, and the city's position in the river floodplain is beneficial for its aquatic and vegetation landscape which includes a number of water bodies (Chizhovskoye, Drozdy, Komsomolskoye lakes), parks (Pobedy, n.a. Kupala, n.a. Kolas) and green areas in the course of 20 km.

The landscape and recreational features are unevenly distributed throughout the city, with well landscaped planted territories concentrated in the city centre, eastern and north-eastern areas. In the western and north-western most natural territories are not landscaped for recreational use.

The deficit of landscaped public recreational territories is most notable in the Zapad, Yugo-Zapad, Kuntsevschina, Loshitsa, ul. Aerodromnaya areas with multiple-floor residential buildings, as no landscaped recreational facilities are available in the vicinity of such areas. This gap can be closed by provision of local parks, gardens, green squares, boulevards in the future. In view of the large number of population in the areas listed above and the high rate of further residential development in such areas, provision of planted green areas with all amenities should be included as a top priority into the city landscape development plans for recreational purposes [2].

Trees planted in the city are chestnut (*Castánea)*, maple (*Ácer)*, linden (*Tília)*, several species of poplar (*Pópulus)*, hawthorn (*Crataégus)*, willow (*Sálix)*, drooping birch (*Bétula péndula*), pubescent birch (*Bétula pubéscens)*, apple tree (*Mālus)*, larch (*Lárix)* and other. According to published studies, the most gas-resistant species are maple (*Ácer)*, Siberian larch (*Lárix sibírica)*, hawthorn (*Crataégus)*, willow (*Sálix)*, poplar (*Pópulus)*, while linden (*Tília)* and birch (*Bétula)* are reported to have the greatest gas absorbing capacity. For combination of gas resistance and gas absorbing capacity, the most advantageous species are drooping birch *(Bétula péndula)*, pubescent birch (*Bétula pubéscens)*, pedunculated oak *(Quércus róbur)*, white willow *(Sálix álba)*, Norway maple (*Ácer platanoídes)*, white fir (*Ábies cóncolor)* and several species of poplar (*Pópulus)* (balsam (*balsamifera*), Berlin (*berolinensis)*, cottonwood (*deltoides)*, fragrant (*suaveolens)*).

Figure 5.17: Drooping birch (Bétula péndula)

Figure 5.18: Pedunculated oak (Quércus róbur)

Figure 5.19: White willow (Sálix álba)

Figure 5.20: Norway maple (Ácer platanoídes)

Figure 5.21: White fir (Ábies cóncolor)

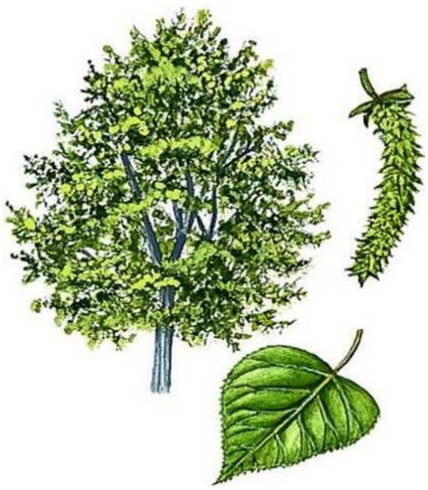


Figure 5.22:Balsam poplar (Populus balsamifera)

Besides the forests, the natural landscapes in Minsk include significant amount (by area size) of reserve vegetation areas. Those are largely undeveloped or partially developed natural territories (dry meadows, floodplain meadows, bogs, tree and shrubbery vegetation near rivers and water bodies). People living in the areas with deficit of planted and landscaped recreational territories actively use such natural territories for daily recreation needs.

A special category of natural ecosystems which still remain in the territory of Minsk is bogs and waterlogged territories with specific moor vegetation which is uncommon for urban environment. At present such areas are the least disturbed natural sites in Minsk, due to their high water content, difficulty of urban development, and location in the water protection zones (shore belts) of rivers and water bodies [3].

Bogs and waterlogged territories perform several functions of which the most notable are accumulation, climate-and-environment regulation, gas-regulation, hydrological, geochemical, and culture-recreational. In addition, such areas play an important role in landscape and biological diversity in the city. The bogs territories support diverse plant associations with presence of sedge (*Cárex)*, rush (*Júncus)*, cotton grass (*Erióphorum)* and bedstraw (*Gálium)*, cruciferous loosestrife (*Lysimáchia thyrsiflóra)*, marsh hoarhound (*Lycopus europaeus)*, blueberry (*Vaccínium uliginósum)*, andromeda (*Andrómeda)*, sphagnum moss (*Sphagnopsida), etc*. which in general are not common in urban environment. The rare protected species recorded in the area is broad-lived marsh orchid (*Dactylorhiza majalis)* (protection category III). Also many medicinal plants grow in the urban bogs (marsh cinquefoil (*Comarum palustre)*, garden heliotrope (*Valeriána officinális)*, cultivated angelica (*Archangélica officínalis)*, bean trefoil (*Menyanthes trifoliáta)*, water plantan (*Alisma plantago-aquatica)*, sedge cane (*Ácorus cálamus), etc.*).

Figure 5.23: Broad-leaved marsh orchid (Dactylorhiza majalis)

Figure 5.24: Marsh cinquefoil (Cómarum palústre)

Bogs are valuable for conservation of biological and landscape diversity in the territory of Minsk. Masiukovskoye bog within partial reserve Lebyazhyj (total area 50.3 ha) is worth special notice.

Boggy floodplain of Svisloch River in Serebryanka area includes dead stream branches, open, shrubby and forested land, and a variety of grass-bog associations. Another example of such objects is Drazhya bog (area 1 ha), the sole remaining raised bog in the city territory, which is connected to water bodies of intermediate type bogs of Sukharevo (area 1.5 ha) and Kuntsevschina (area 1 ha), as well as restoring Ozerische bog (area 8 ha). Almost all bog systems are parts of the landscape-recreation zones shown in the Master Plan, i.e. their anticipated main function is recreation.

Transformation and destruction of bog ecosystems deplete landscape diversity in the city, and reduce the number of plant species and habitats for waterfowl, including rare species of birds.

Overall status of trees in forests and forest-parks in Minsk and immediate suburbs is satisfactory. Oak and old spruce forests to the south-west and south of the city are more damaged than other vegetation areas, and forest sanitation measures are required. Oaks and aspens are mostly damaged by insect pests. Spruces deterioration is mainly due to their old age and extremely adverse climatic situation (draughts) during vegetation periods.

Contamination with industrial, construction and household wastes is a serious problem, as, besides aesthetic degradation, the wastes contain toxic substances and compounds which become engaged in biological cycle and leak into ground water. Much of the wastes dumped in forests (e.g. plastic articles) are not degradable by forest floor microorganisms and occupy significant areas in forests. The areas most exposed to littering are those adjacent to motor roads and utility lines, and areas near residential quarters.

Thus current satisfactory status of forests and forest-parks in Minsk is not sustainable, as major part of such territories is affected by degression of different extent, and this process is most visible in the vegetation communities with low resistance to recreational and other man-caused impacts [3].

The National Academy of Science of the Republic of Belarus is in charge of vegetation monitoring, in accordance with Resolution of the Council of Ministers of the Republic of Belarus of April 14, 2004 No. 412 "On vegetation and geophysical monitoring within the scope of the National Environmental Monitoring System of the Republic of Belarus, and use of the monitoring data".

Vegetation monitoring is a system for observation of status of vegetation and its habitats, as well as analysis and forecasting of changes therein.

Observations of meadow and meadow-bog vegetation. Meadow vegetation occupies 2737.6 thousand ha in Belarus, which is 13.2% of the total area of the republic. Bog vegetation occupies 809.7 thousand ha or 3.9%, helophytic vegetation covers 92.4 thousand ha or 2.4% of the whole area. Natural meadow vegetation in Minsk Region is scattered in multiple small areas. Thus, according to monitoring data, vegetation in forage grasslands is characterized by highly intensive progressive successions. Trees, shrubs and ruderal grass are the first to expand. In some places total cover degree of tall grasses is as high as 90%. The main factors that influence composition, condition, productivity of communities and forage value of herb layer are: complete or partial cessation of meadow-pasture mode of land use, expansion of tree and grass vegetation; weed infestation of herb layer. It is the disruption of historical haymaking and meadow-pasture modes of use that supports weed infestation and overgrowth with trees and shrubs of all types of forage grassland – dry meadows, lowland and floodplain meadows [4].

The Protected Plant Species Monitoring Programme covers populations of plants (including mushrooms) registered in the Red Book of the Republic of Belarus or protected in accordance with international obligations of the Republic of Belarus, and their habitats.

In 2016 the network of fixed monitoring stations (FMS) was further extended with 13 FMSs that are used for assessment of status of 7 plant species, including 2 species of category II in terms of their national environmental significance (polyporus roesus (*Fomitopsis rosea*) and little orchis (*Anacámptis mório*)), 3 species of category III (multipartite grape fern (*Botrȳchium multifīdum)*, long-leaved helleborine (*Cephalanthéra longifólia)* and green-flowered rain orchid (*Platanthera chlorantha)*), and 2 species of category IV (pasque flower (*Anémone pátens*) and и sparassis radicata (*Sparassis crispa)*).

Schematic map of FMS locations in Belarus is provided in Figure 5.25.

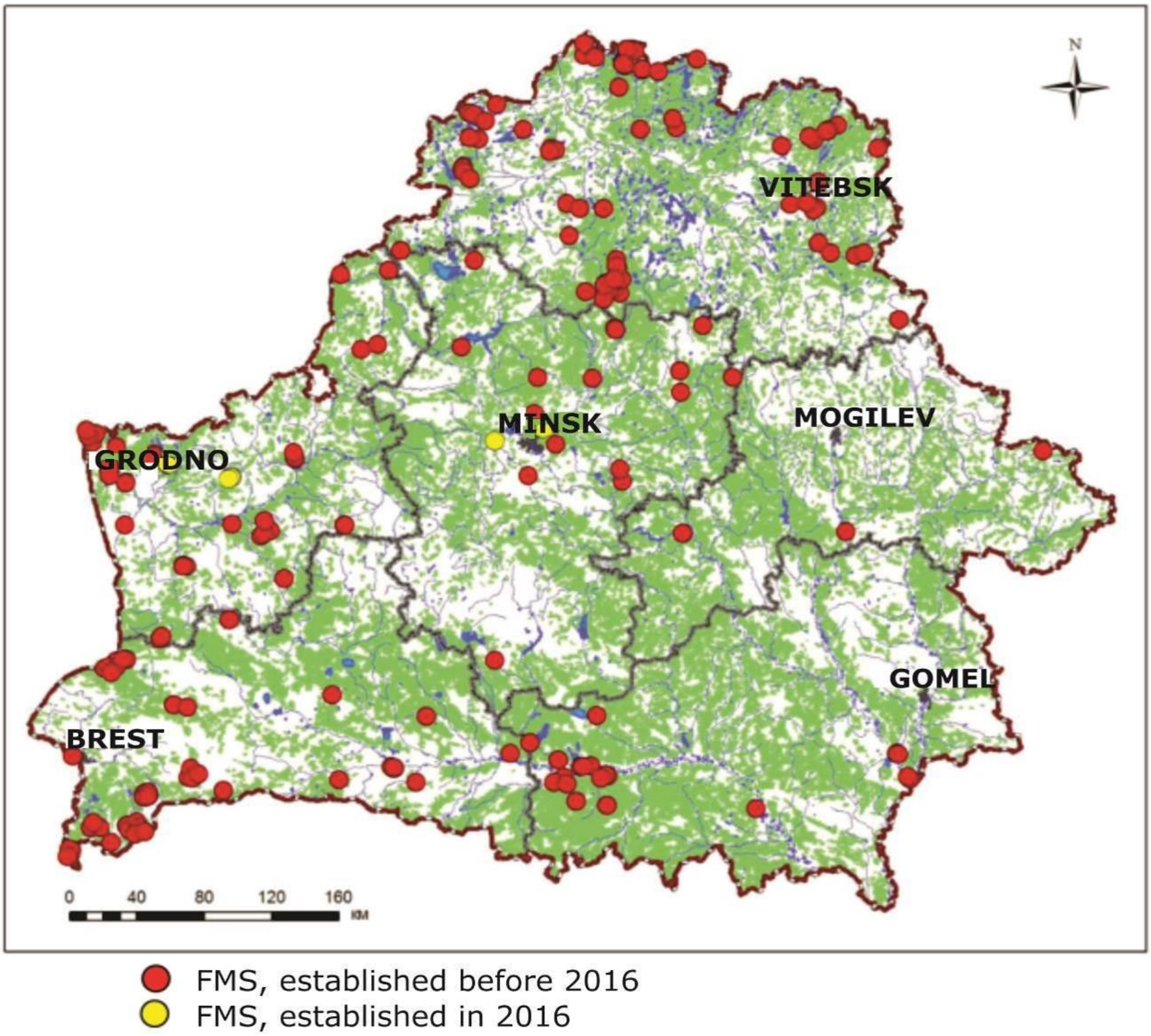


Figure 5.25: Monitoring (FMS) network for protected plant species, as by 01.01.2017

Thus as of 01.01.2017 the protected plant species monitoring network consists of 259 FMS stations which collect data for viability assessment of 121 species of protected plants registered in the Red Book of the Republic of Belarus: 19 protected species of vascular plants (*Tracheophyta)*, 3 bryophytic species (*Bryophyta)*, 7 lichen species (*Lichenes*), and 2 fungi species (*Mycota)*. The monitoring stations are distributed in different regions as follows: Vitebsk – 81, Brest – 66, Grodno – 50, Gomel – 34, Minsk – 20, Mogilev – 8.

No protected plant species have been detected in the area of Minsk Wastewater Treatment Plant (address: 1 Inzhenernaya St., Industrial Area "Shabany", Zavodskoy District, Minsk) [4].

A log sheet has been prepared for UP Minskvodokanal, to record flora objects identified in certain types of settlement land for the purposes of Utility Service of MWWTP. According to the log sheet, the following trees are present at the site of Minsk Wastewater Treatment Plant at the address 1 Inzhenernaya St., Industrial Area "Shabany", Zavodskoy District, Minsk (as of 24.05.2013):

- Ash tree (*Fraxinus*) – 8 pcs, state – good;
- Chestnut (*Castánea*) – 1 pc., state – good;
- Thuja (*Thúja)* – 8 pcs, state – good;
- Willow (*Sálix)* – 3 pcs, state - satisfactory;
- Apple tree (*Mālus*) – 1 pc., state – good.

State of the tree plantations is assessed using the flora assessment criteria.

Plantation balance of the operational site is shown in Table 5.10.

Table 5.10: Area plantation balance

Area plantation balance	sq. m	%
Total area of the land plot or water body where flora objects are recorded	50800	100
Including: area occupied by flora objects (except for wall gardens):		
trees	20.0	0.036
shrubs	22.0	0.043
flower beds	61.0	0.012
lawns	25400	50

Thus the total planting rate of the territory of Minsk Wastewater Treatment Plant is 50.091% [5].

The area of planned operations is classified as oak and dark coniferous forest of Oshmyany-Minsk geobotanical region, Minsk-Borisov geobotanical area. The two main types of vegetation in the area of Minsk Wastewater Treatment Plant are forest and ruderal, of which the predominant one is ruderal type of vegetation associated with wastelands, refuse dumps and other disturbed lands is the dominating. The main representatives of this type of vegetation are stinging nettle (*Urtíca dióica)*, great bur (*Arctium láppa)*, greater celandine (*Chelidónium május)*, door-weed (*Polýgonum aviculáre)*, greater plantain (*Plantágo májor)*, absinth (*Artemísia absínthium)*, upland cress (*Barbaréa vulgáris)*, ditch-bur (*Xánthium strumárium)*.

Forest vegetation is present in the project area as clusters which belong to Sosnensky forest district.

Group II forests prevail in Sosnensky forest district, with the protection category of "Urban forests" and "Forest-park parts of green areas". The prevailing tree species is pine, with some birches (*Bétula)* (up to 20%) and spruce (*Pícea*) (up to 10%). Compartments and quarters are fully occupied by European alder (*Álnus glutinósa)*, pedunculated oak (*Quércus róbur)*, pubescent birch (*Bétula pubéscens)*, European spruce (*Pícea ábies)*. Willow (*Sálix)*, grey alder (*Álnus incána)*, aspen (*Pópulus trémula)*, oak (*Quércus)*, maple (*Ácer)* also participate b biocoenosis. Dominating species in underwood are Persian berry (*Frángula álnus)*, mountain ash (*Sórbus)*, cobnut (*Córylus)*. Ground vegetation generally consists of berry subshrubs, wild strawberry (*Fragária vésca)*. Green mosses are common: red-stemmed feathermoss (*Pleurozium schreberi),* rugose fork-moss (*Dicranum polysetum),* broom fork-moss (*Dicranum scoparium)*, big shaggy-moss (*Rhytidiadelphus triquetrus)*. Forest vegetation consists mainly of middle-aged plants (60-65 years), with bonitet grade I. Average forest yield is within the range of 270-320 m^3/ha. Signs of forest disease are minor. In sanitary terms the forest is assessed as class II.

To the east of MWWTP, at the distance of 3.5 km, there is protected habitat of bitter vetch (*Lathyrus linifolius)* registered in the Red Book of the Republic of Belarus. Current level of MWWTP impact on protected flora is zero, due to the long distance to the protected habitat. The area immediately adjacent to MWWTP site is wasteland with sprouts of willow (*Sálix)* and aspen (*Pópulus trémula)*.

General view of MWWTP site at 1 Inzhenernaya St. in Zavodskoy District of Minsk, Industrial Area Shabany, is shown in Figures 5.26-29.

Figure 5.26: Site plantation

Figure 5.27: Site plantation

Figure 5.28: Site plantation

Figure 5.29: Site plantation

5.7.2 Fauna

Minsk is situated in central zoogeographic area of mixed forests of Holarctic Palaearctic region. Fauna in Minsk consists of about 25 mammal species (*Mammalia)*, 102 nesting bird species (*Aves*), about 10 amphibian species (*Amphibia)*, as well as reptiles (*Reptilia)*, insects (*Insécta)*, crustaceans (*Crustacea*). The above diversity is due to large territory of the city and animals' ability to adjust to urban environment (for some species such conditions are even more beneficial than natural environment).

The most common species in the city are gnawing animals (*Rodentia*), some of which represent forest fauna, and other are synanthropic. Landscape-recreation areas are populated with animals which normally belong to forest ecosystems: herb field mouse (*Apodemus uralensis*), Old World harvest mouse (*Micromys minutus)*, field vole (*Microtus arvalis)*, bank vole(*Myodes glareolus)*, highland grass mouse (*Microtus agrestis)*, squirrel (*Sciurus vulgaris)*. The most common sysnanthropic species are brown rat and house mouse which collect in residential quarters, as well as food storage and processing facilities [6].

Figure 5.30: Herb field mouse (Apodemus uralensis) **Figure 5.31: Squirrel (Sciurus vulgaris)**

Bird species and populations significantly vary between different functional areas. The most common bird species are hooded crow (*Corvus cornix)*, jackdaw (*Coloeus monedula)*, rook (*Corvus frugilegus)*, house sparrow (*Passer domesticus)*, common starling (*Sturnus vulgaris)*, spotted woodpecker (*Dendrocopos major)*, chaffinch (*Fringílla coélebs)*, white wagtail (*Motacilla alba)*, blackcap (*Sylvia atricapilla)*, willow warbler (*Phylloscopus trochilus)*, wood warbler (*Phylloscopus sibilatrix)*, robin (*Erithacus rubecula)*, half-collared flycatcher (*Ficedula hypoleuca)*, spotted flycatcher (*Muscicapa striata)*, great tit (*Parus major)*, Eurasian blue tit (*Cyanistes caeruleus)*, icterine warbler (*Hippolais icterina)*.

Figure 5.32: White wagtail (Motacilla alba)

Figure 5.33: Blackcap (Sylvia atricapilla)

Figure 5.34: Willow warbler (Phylloscopus trochilus)

Figure 5.35: Robin (Erithacus rubecula)

Figure 5.36: Half-collared flycatcher (Ficedula hypoleuca)

Figure 5.37: Eurasian blue tit (Cyanistes caeruleus)

Urban water bodies of various origins (natural or transformed) are habitats for over 40 bird species, including waterfowls, e.g. mallard (*Anas platyrhynchos)*, common coot (*Fulica atra)*, black-headed gull (*Chroicocephalus ridibundus)*. Some species which are uncommon for urbanized areas are also encountered in Minsk, like bittern (*Botaurus stellaris)*, spotted crake (*Porzana porzana)*, Savi's warbler (*Locustella luscinioides)*, common tern (*Sterna hirundo)*, black tern (*Chlidonias niger)*, as well as protected rare species of mute swan (*Cygnus olor)*, little tern (*Sterna albifrons)*, little dabchick (*Podiceps ruficollis, Tachybaptus ruficollis), etc.*

Figure 5.38: Mute swan (Cygnus olor)

Figure 5.39: Little tern (Sterna albifrons)

Figure 5.40: Little dabchick (Podiceps ruficollis, Tachybaptus ruficollis)

In residential and public areas of Minsk few bird species are present, and density of nesting birds population is high. Blue rock pigeon (*Columba livia)* and house sparrow (*Passer domesticus)* account for 70% of the total population of nesting birds [7].

Natural water-logged green areas near rivers and other water bodies offer the best habitats for amphibians and reptiles.

Herpetofauna is represented by smooth newt (*Lissotriton vulgaris)*, fire-bellied toad (*Bombina bombina)*, spade-footed toad (*Pelobates fuscus)*, green toad (*Bufotes viridis)*, moor frog (*Rana arvalis)*, brown frog (*Rana temporaria)*, edible frog (*Pelophylax esculentus)* and pool frog (*Pelophylax lessonae)*.

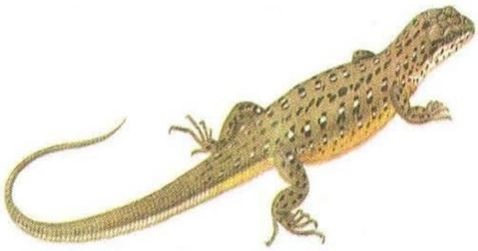
Figure 5.41: Smooth newt (Lissotriton vulgaris)

Figure 5.42: fire-bellied toad (Bombina bombina)

Figure 5.43: Spade-footed toad (Pelobates fuscus)

Figure 5.44: Moor frog (Rana arvalis)

Notable reptile species are common lizard (*Zootoca vivipara)*, green snake (*Natrix natrix)*, adder (*Vipera berus)* with the main habitat in partial reserve Lebyazhyj. Common toad (*Bufo bufo)*, natterjack (*Bufo calamita)*, common tree frog (*Hyla arborea)* are seldom encountered and have no permanent habitats in the city area [8].



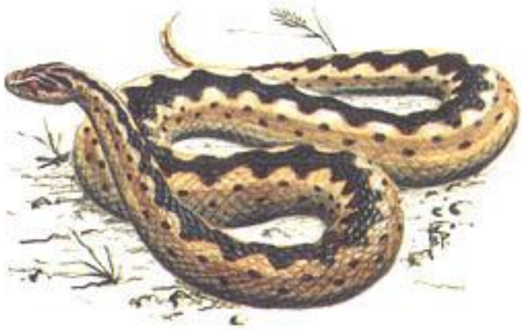


Figure 5.45: Common lizard (Zootoca vivipara)

Figure 5.46: Adder (Vipera berus)

Even though River Svisloch is more exposed to human impacts than any other river in Belarus, it has always been and still remains a fairly rich in fish and attended water body. Total length of River Svisloch is 327 km including 22 km in Minsk. Fish species that populate the river are white bream (*Blicca bjoerkna)*, pope (*Gymnocephalus cernuus)*, crucian carp *(Carassius carassius)*, rudd (*Scardinius erythrophthalmus)*, common bream (*Abramis brama)*, rivers perch (*Perca fluviatilis)*, roach (*Rutilus rutilus)*, ablet (*Alburnus alburnus)* and pike (*Esox lucius)*. At present River Svisloch is used for recreation functions (only in upper reaches, as downstream river is heavily polluted) and for industrial water supply.

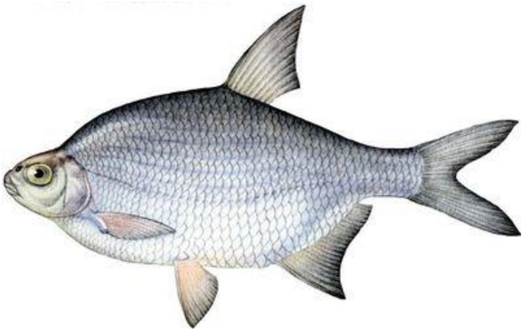


Figure 5.47: White bream (Blicca bjoerkna)

Figure 5.48: Ablet (Alburnus alburnus)

Figure 5.49: Crucian carp (Carassius carassius)

Figure 5.50: Pike (Esox lucius)

No rare and/or protected animal species are present in MWWTP territory. Insects species composition is typical, and amphibians are encountered throughout the area and are represented by three species: brown frog (*Rana temporaria)*, green toad (*Bufotes viridis)* and common toad (*Bufo bufo)*. The most common reptile is sand lizard (*Lacerta agilis)*.

Mammals diversity is poor. Game species are represented by elk (*Alces alces*), red fox (*Vulpes vulpes)*, wild boar (*Sus scrofa)*. Bird fauna diversity is poor too. Small numbers of migrating birds are encountered here on their spring passage. Autumn migration is even less notable as no large groups of birds are seen. Among nonmigrating birds the most important are woodpeckers (*Picidae)*, crested tit (*Parus cristatus)*, Eurasian jay (*Garrulus glandarius)* and Eurasian siskin (*Carduelis spinus)*. The migrating species are mavis (*Turdus philomelos)*, common chaffinch (*Fringílla coélebs)* and wood warbler (*Phylloscopus sibilatrix)*. Whitethroat (*Sylvia communis)* and yellowhammer (*Emberiza citrinella)* are encountered in vast areas but their populations are small. The area has fairly large populations of larids (*Laridae*) and crows (*Corvidae)*. No protected species recorded in the Red Book of the Republic of Belarus are present in the area of Minsk Wastewater Treatment Plant [9].

5.8 Land Use

As shown in the master plan of Minsk (Figure 5.51), the site of Minsk Wastewater Treatment Plant (MWWTP) is situated in south-eastern suburban area with predominantly industrial and commercial operations. The original site of absorption fields was selected in the terrain with the lowest position relative to the main urban territories, in order to reduce wastewater transportation costs and prevent the risk of pollution of local watercourse.

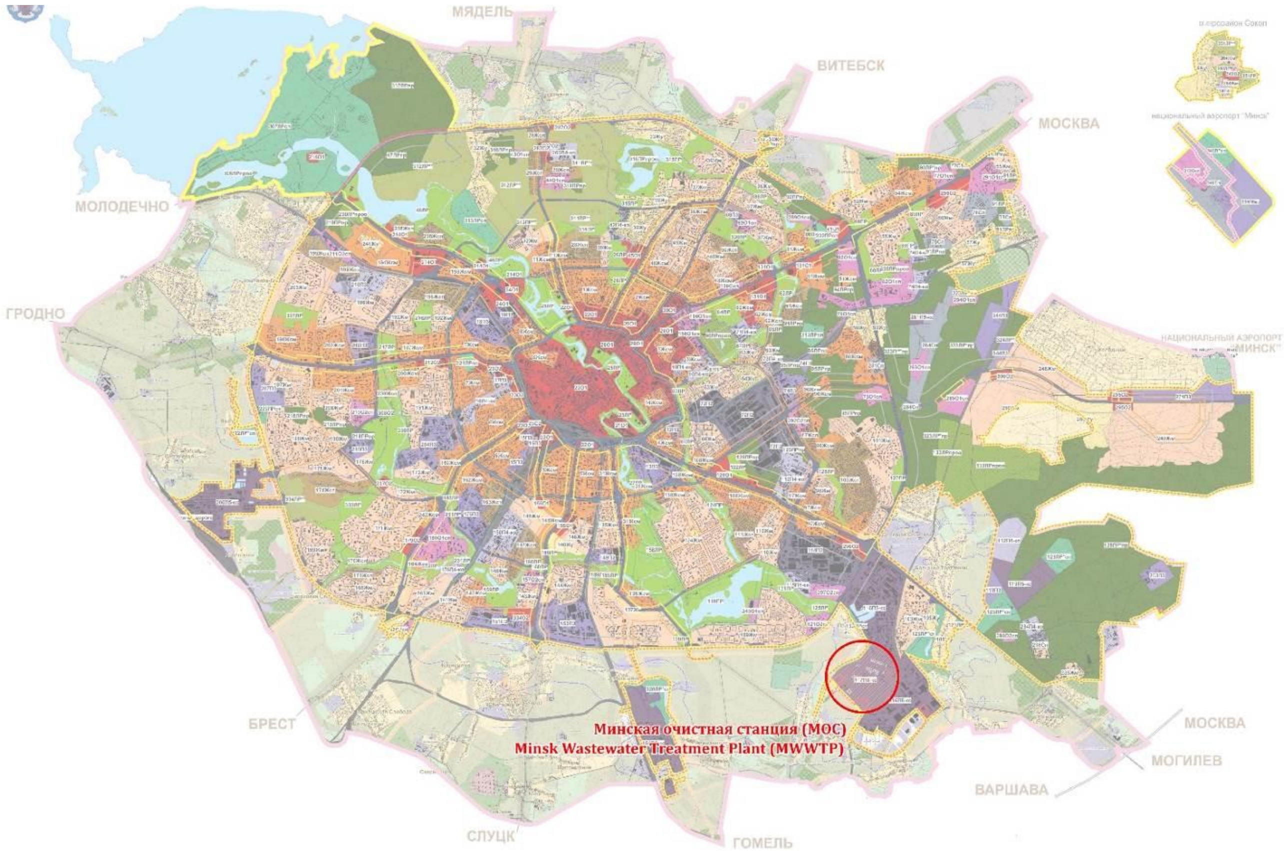


Figure 5.51: Minsk Wastewater Treatment Plant in the master plan of Minsk

After commissioning of MWWTP in 1960-s, wastewater discharge on absorption fields gradually ceased, and further land allocations along the course of River Sviloch were only required for arrangement of sludge ponds. Sludge holding facilities were arranged in abandoned sand and gravel quarries to the south of Sinilo settlement, Lugovoslobodsky Rural Municipality of Minsk District (Figure 5.52).

The main site of WWTP consists of two parts - MWWTP1 and MWWTP2. The area of MWWTP1 is occupied by the first treatment line dating back to 1963, and facilities commissioned in 2006-2015 are located in MWWTP2 (Figure 5.52).

According to the cadastral records, the treatment plant occupies several land plots, the largest of which with the area of 50.6139 ha (yellow contour line in Figure 5.53) accommodates MWWTP1 facilities. The titleholder of this land plot is Municipal Unitary Production Enterprise "Minskvodokanal" (Certificate No. 500/1719-1479 dated 19.05.2017). The only encumbrance of the permanent right of use of the land plot is associated with the fact that a part of it (31.3012 ha) is situated in water protection area of River Svisloch. Configuration of the water protection area is shown in Figure 5.52.

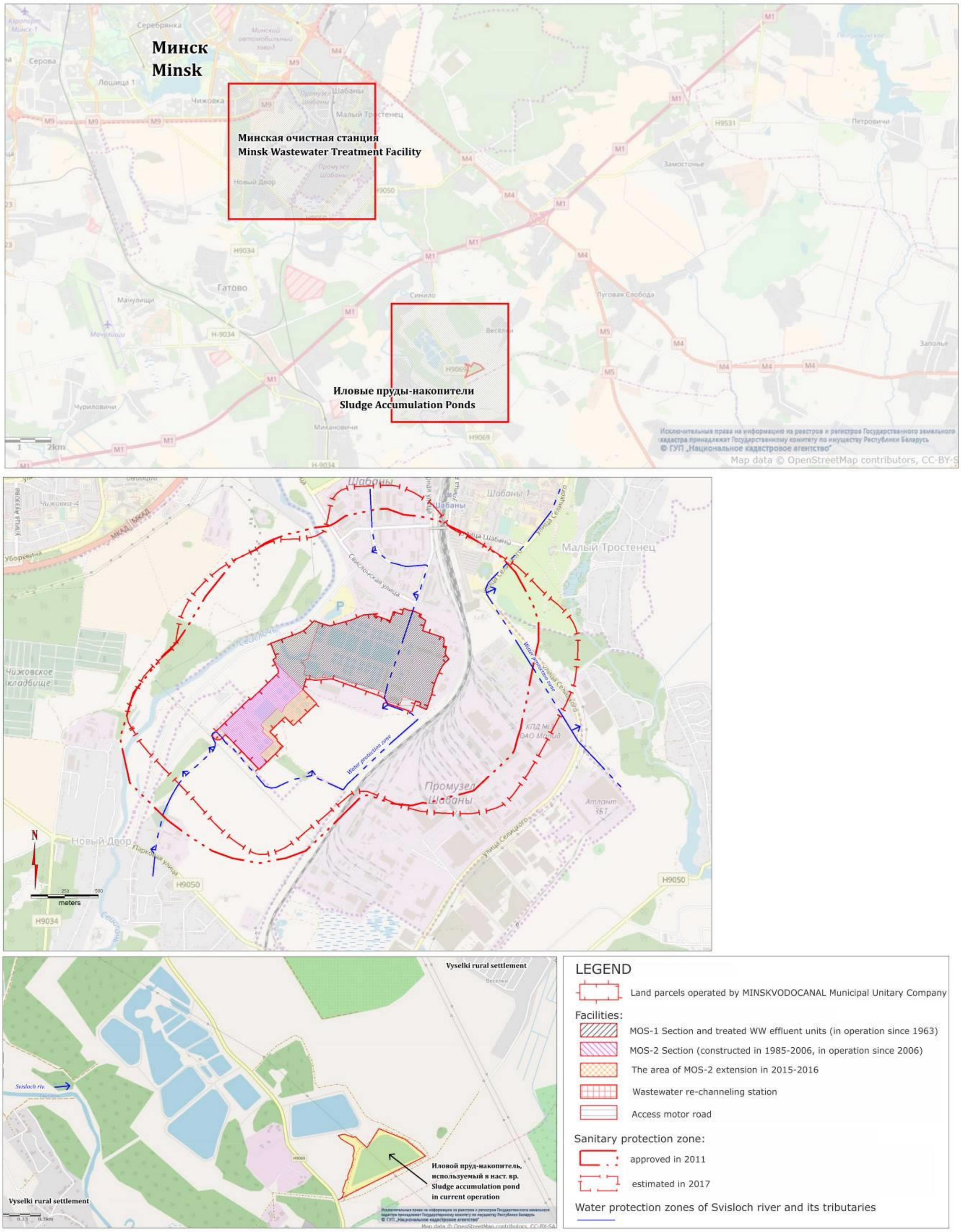


Figure 5.52: Minsk Wastewater Treatment Plant and sludge facilities Volma in the public cadastre map Minsk District

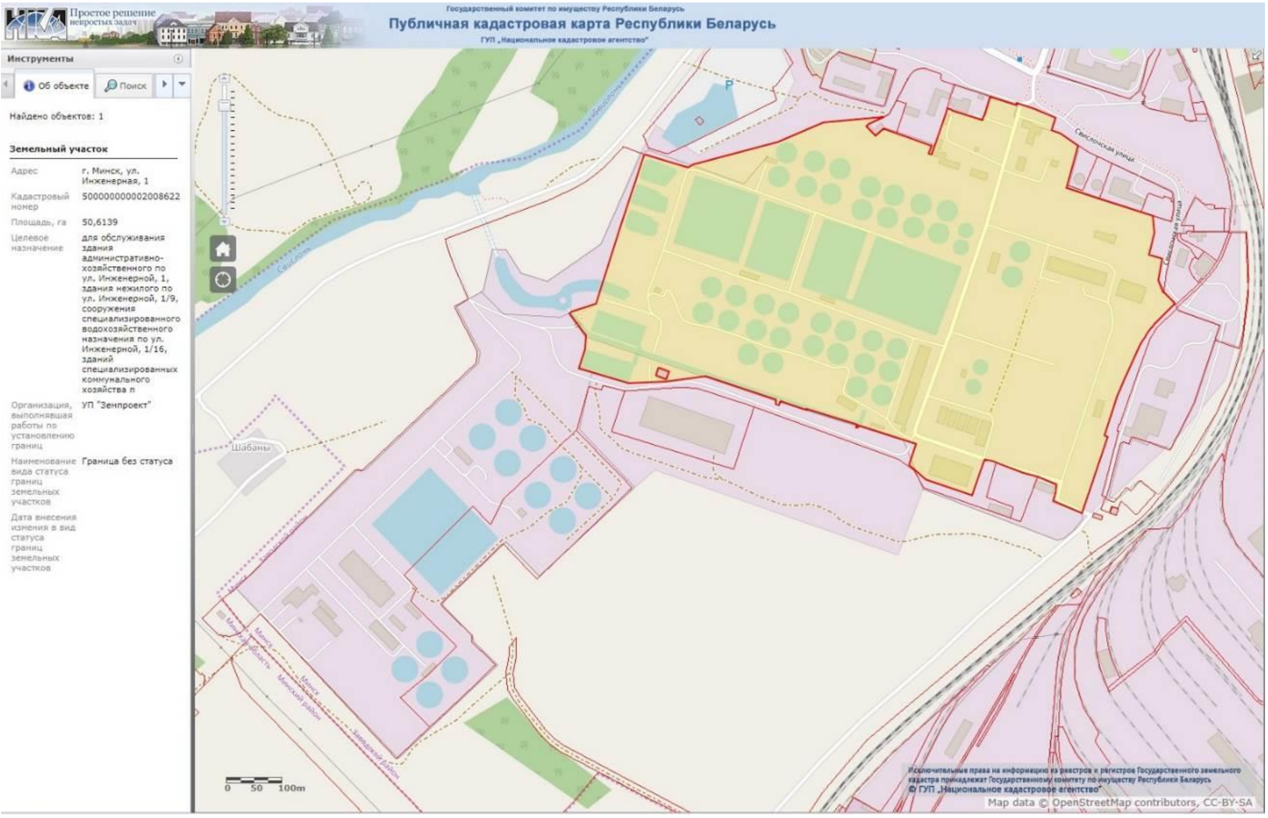


Figure 5.53: Proposed Project site in the public cadastre map of Minsk City

The site of MWWTP is situated within a future development area of the Free Economic Zone "Minsk" – so called "Shabany industrial area" which is also mentioned in urban development documents as "MSA Site 1" (Figure 5.54).

Minsk City Committee for Architecture and Urban Development commissioned UP Minskgrado to develop planning design for this area, and in 2017 the planning design was developed and submitted for review to stakeholders in Zavodskoy District of Minsk and Minsk District. According to this document, reconstruction of MWWTP will be implemented as part of comprehensive development of Shabany industrial area, with potential extension of MWWTP-2 facilities (Figure 5.54).

The proposed reconstruction project will not affect facilities of MWWTP-2 and, as discussed in Sections 1 and 4, will be implemented within the borders of the land plot shown in Figure 5.53. Facilities of MWWTP-1 will be partially removed, and the other part will be reconstructed. The cleared area will be used for construction of new buildings and facilities, with no need for acquisition of additional land plots. It is anticipated that sanitary protection zone of MWWTP after reconstruction will be reduced from 700 metres to 500 metres (Figure 5.52). Such reduction will significantly ease restrictions on land use in the area and thus facilitate further development.

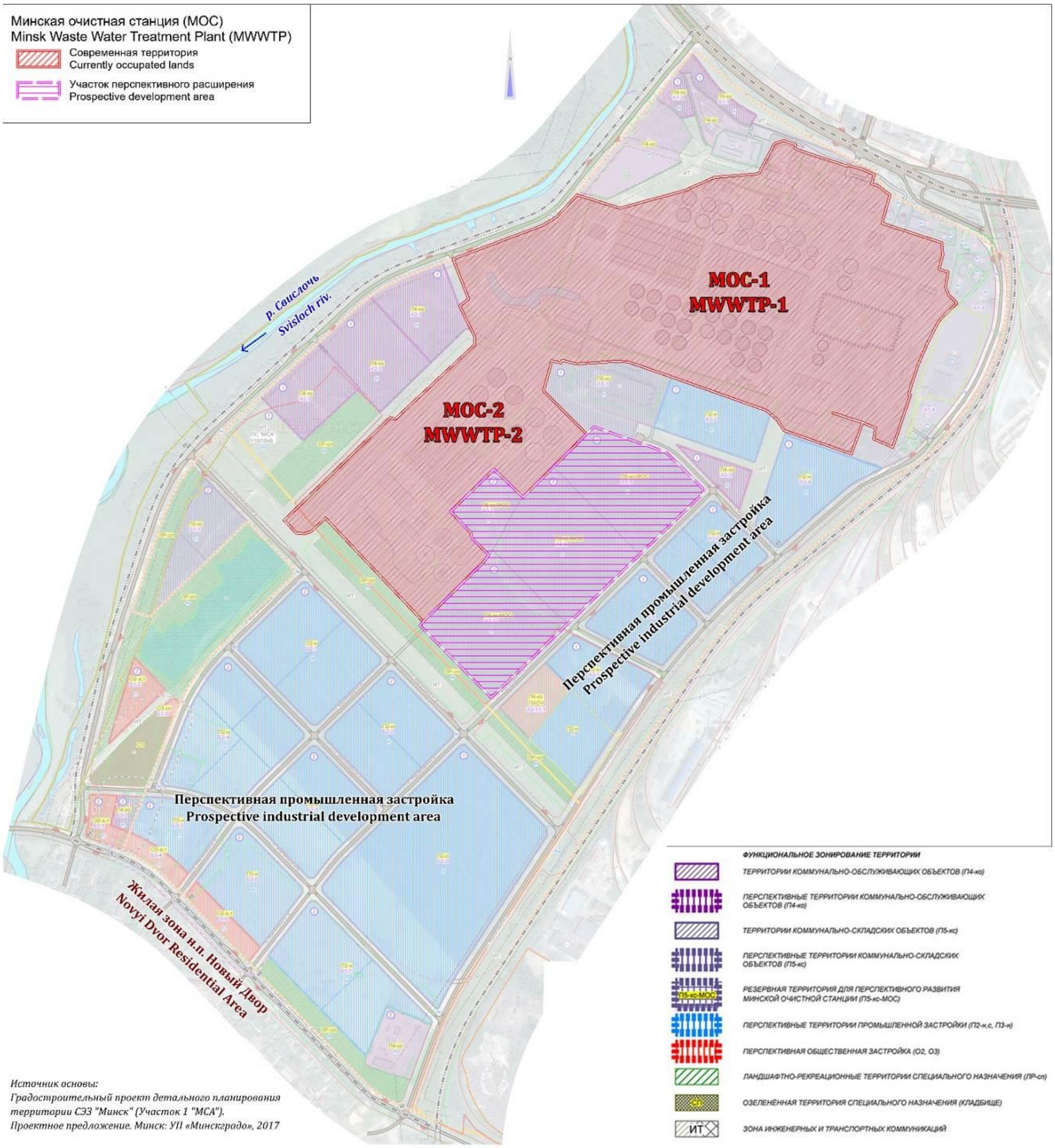


Figure 5.54: MWWTP site and prospects of its development as part of Industrial Area "Shabany"

As reported by Environmental Centre PYLEGAZOOCHISTKA"48, no residential or community recreation facilities have been identified in the area of MWWTP sanitary protection zone (SPZ). In our view, this conclusion does not fully reflect actual land use situation in SPZ, as some properties still persist in the former settlement of Shabany, to the south-west and west of MWWTP2 site (Figure 5.55). According to Novodvorsky rural council, the land plots are used by citizens of the Republic of Belarus for seasonal residence and auxiliary farming. Even though such land use is not supported by any legal documents, it

[48] Development of sanitary protection zone project for Minsk Wastewater Treatment Plant of UP Minskvodokanal. Stage 2. Justification and calculation of sanitary protection zone boundaries for land user's operational site, on the basis of assessment of physical impacts. Report. – Minsk. Environmental Centre PYLEGAZOOCHISTKA, 2017.

should be taken into account in assessment of impacts of MWWTP facilities and planned reconstruction on recipients in the sanitary protection zone.

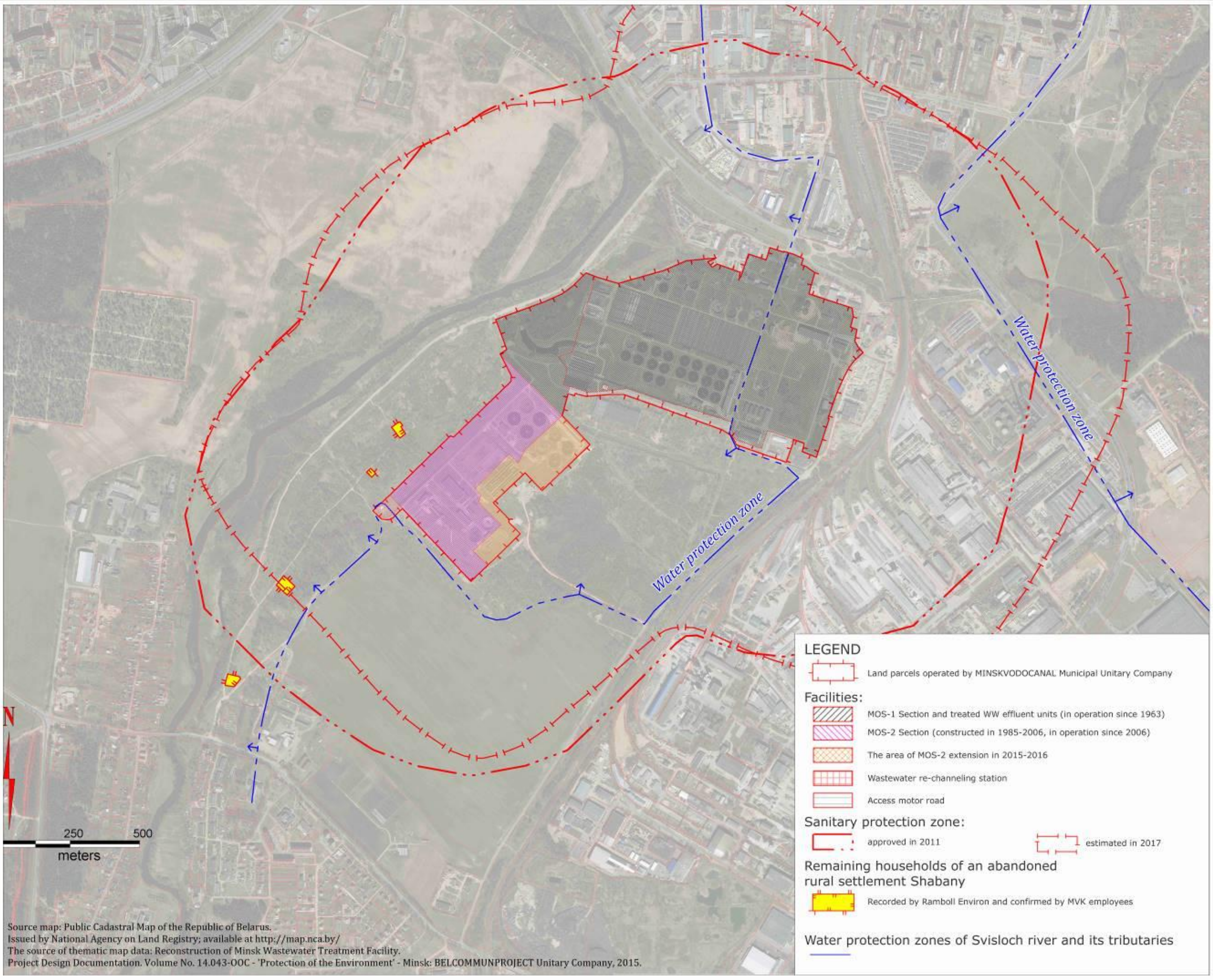


Figure 5.55: Land use in MWWTP sanitary protection zone and adjacent territories

6. SOCIAL AND ECONOMIC BASELINE CONDITIONS

6.1 Introduction

This chapter provides an overview of socio-economic situation in Minsk Region, and more specifically in Minsk District and Minsk City. Information discussed in this chapter was sourced from the following documents and activities:

- Desk studies of Project-related documents (e.g. OVOS) by experts of Ramboll Environ;
- Review of consultations and stakeholder engagement activities conducted by UP Minskvodokanal;
- Joint consultation activities with Ramboll as part of ESIA process in November 2017;
- Project site visit;
- Review of publicly available information.

During the Project site visit in November 2017 and remote consultations, Ramboll met and interviewed the following stakeholders:

- UP Minskvodokanal;
- Administration of Zavodskoy District of Minsk;
- UP Minskgrado;
- Administration of Novodvorsky Rural Municipality of Minsk District.

Desk studies covered a range of documents, including reports of national, regional and local authorities, statistical reviews and bulletins, scientific publications, and media publications.

6.2 Socio-economic Situation in the Region

6.2.1 Demography

Minsk Region is the second largest region (after Minsk) which accounts for 15% of the total population of the Republic of Belarus (Figure 6.1).

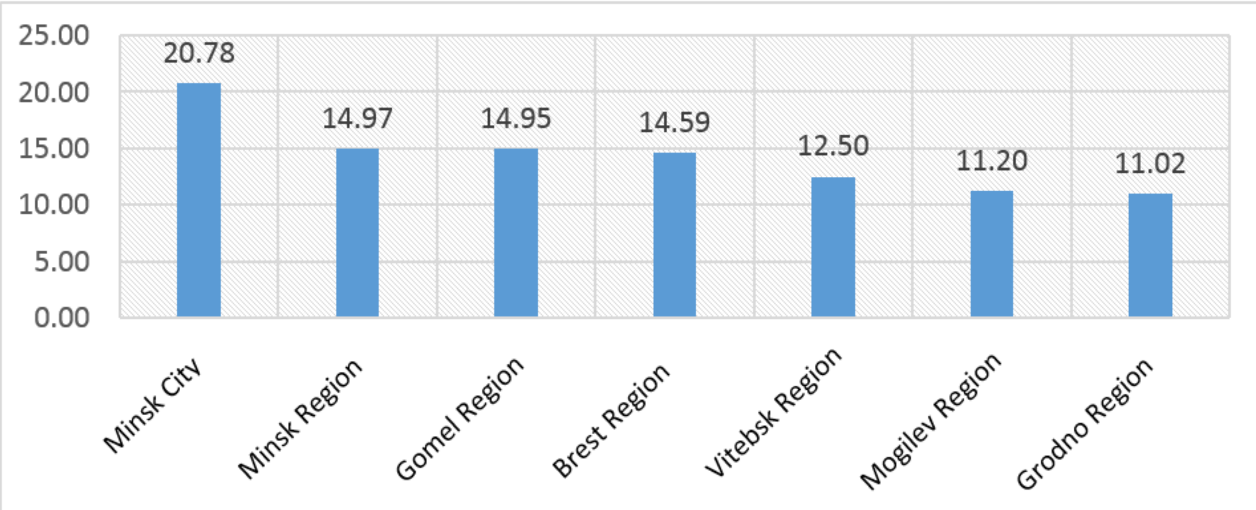


Figure 6.1: Regional distribution of population in the Republic of Belarus, %

Source: National Statistics Committee of the Republic of Belarus

The region's population number is 1423.1 thousand, as by 1 January 2017. Both positive and negative demographic trends were recorded in Minsk Region over the recent years. Population decline was reported until 2013, however situation changed in 2014 and population number in Minsk Region grew by 1.5% compared to the level of 2013, due to the positive migration balance (Figure 6.2).

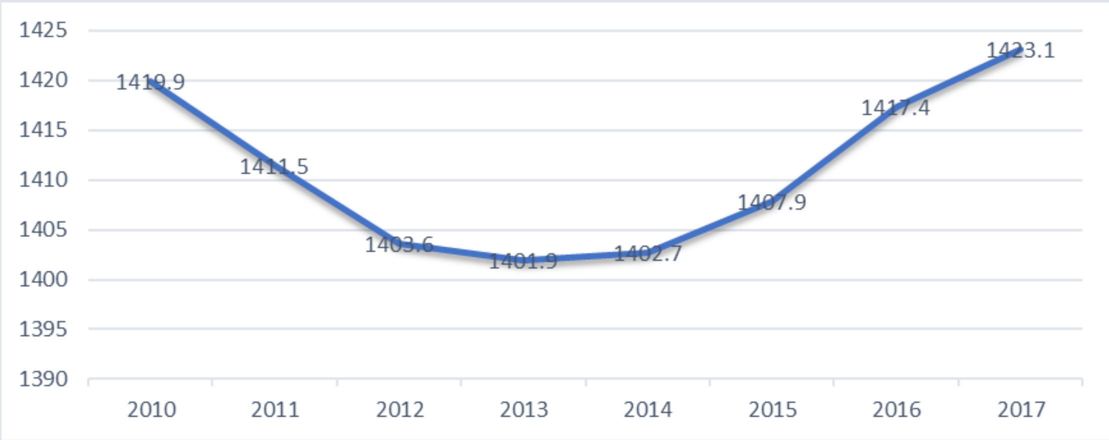


Figure 6.2: Population number in Minsk Region, thousand

Source: National Statistics Committee of the Republic of Belarus

Minsk Region consists of 22 Districts and one city of oblast subordination (Zhodino). The largest cities in the Region are: Borisov, Soligorsk, Molodechno, Slutsk, Zhodino.

The diverse the trends of population numbers in the above cities are shown below (Table 6.1).

Table 6.1: Population numbers in the largest cities of Minsk Region

Year	Borisov	Soligorsk	Molodechno	Slutsk	Zhodino
2011	146440	103089	93885	61446	62075
2012	145879	103961	93736	61436	62432
2013	145659	104745	93802	61847	62696
2014	145223	105376	94155	62046	63157
2015	144945	105998	94686	62192	63560
2016	143919	106503	94922	62226	63888
2017	143287	106839	95233	62147	64303

Source: National Statistics Committee of the Republic of Belarus

More than a half of the region's population lives in cities. By the start of year 2017 urban residents accounted for 56.6% of the total population number, whereas 43.4% lived in rural settlements. Overall proportion of urban and rural population in the Republic of Belarus is 77.9% to 22.1%, respectively. Thus even though urban population prevails in Minsk Region, the level of urbanization in this area is below the country's average. The share of rural population in the region has been growing over past 3 years (Table 6.2).

Table 6.2: Urban and rural population numbers in Minsk Region, as by start of year 2017

Year	Urban and rural population number, start of year							
	Urban population				Rural population			
	Total, '000 persons	Share in total population', %	Men, '000 persons	Women, '000 persons	Total, '000 persons	Share in total population', %	Men, '000 persons	Women, '000 persons
2010	787.5	55.5	369.2	418.3	632.4	44.5	298.4	334
2011	787.8	55.8	369.1	418.7	623.7	44.2	295.1	328.6
2012	789.1	56.2	369.6	419.5	614.5	43.8	291.4	323.1
2013	792.1	56.5	370.6	421.5	609.8	43.5	289.8	320
2014	795.6	56.7	372	423.6	607.1	43.3	289.5	317.6
2015	799.8	56.8	373.8	426	608.1	43.2	290.9	317.2
2016	802.7	56.6	375.4	427.3	614.7	43.4	295.3	319.4

Year	Urban and rural population number, start of year							
	Urban population				Rural population			
	Total, `000 persons	Share in total population', %	Men, `000 persons	Women, `000 persons	Total, `000 persons	Share in total population', %	Men, `000 persons	Women, `000 persons
2017	804.8	56.6	375.8	429	618.3	43.4	298.3	320

Source: National Statistics Committee of the Republic of Belarus

It should be noted that in general, the outflow of young people from rural settlements is taking place in the country, which contributes to the accelerated ageing of population and depopulation of rural settlements. On the other hand, relocation of young people from rural areas to cities results in contributes to the rejuvenation of urban population. Overall urbanization process in Belarus is described as "capital-bound vector", and 19.3% of the country's population live in Minsk. This value is significantly higher than in capitals of other former republics of the Soviet Union: 8.1% of Russia's population live in Moscow, and 6.1% of Ukrainians live in Kiev. Belarusian publication "Khartyja 97", with reference to studies by demographers Lilia Karachurina and Nikita Mkrtchyan, notes that actual share of Minsk in the total population of Belarus is even greater, and the total number of capital's residents, including temporary population, students and migrant labour, is estimated to be 2.2-2.3 million[49].

As of the beginning of 2017, women accounted for 52.6% of the total population number in the region, and the share of men was 47.4%. The gender ratio is 1: 1.11. Male population prevails over female in the age group from birth to the age of 39 years. Later on the ratio reverses towards significant predominance of women in the older age groups: 2 women per 1 man at the age of more than 70, 4 women per 1 man in the group over 80 years old.

The age distribution of population of Minsk Region is described as regressive type: the share of people older than 50 years is by more than 2 times greater than share of children at the age of 0-14 years (38% and 17.4% respectively). This means that the current birth rate does not support reproduction of population. The proportion of people who have reached the retirement age is steadily growing. For instance, in 1990 the share of this age group was 17.1%, and by 2016 it reached 26.4%, i.e. almost every fourth resident in the region is a retired person. At present the ratio of retirement age and working age population is 2.1 working age persons per one pensioner, whereas in 1990 this proportion was 3.47 to one.

The life expectancy trend is positive in the region and in Belarus in general, however Minsk Region has the lowest rank among the country's regions for this parameter: life expectancy in Minsk Region is 73.1 years, whereas the average level in the country is 74.1 years. On the other hand, life expectancy of rural residents (both male and female) in Minsk Region (71.9 years) is higher than average in the republic (70.8 years), and longer life expectancy is reported only in Brest Region (72.1 years). Life expectancy of urban residents in Minsk Region (74.2 years) is the lowest in the country and is by almost 2.5 years shorter than in Minsk City (76.5 years) (Table 6.3).

Table 6.3: Life expectancy in Minsk Region

Year	Region average			Country average		
	Whole population	Male	Female	Whole population	Male	Female
2010	68.9	62.9	75.6	70.4	64.6	76.5
2011	69.3	63.2	76	70.6	64.7	76.7
2012	71	65.3	76.9	72.2	66.6	77.6
2013	71.4	65.9	77.1	72.6	67.3	77.9
2014	72	66.4	77.7	73.2	67.8	78.4
2015	72.9	67.6	78.1	73.9	68.6	78.9

[49] *Ibid.*

Year	Region average			Country average		
	Whole population	Male	Female	Whole population	Male	Female
2016	73.1	67.7	78.5	74.1	68.9	79

Source: National Statistics Committee of the Republic of Belarus

The difference of life expectancy at birth between female and male is still significant, in 2016 it further increased to 10.1 years.

Overall population changes in Minsk Region are described as depopulation, however this trend has slightly slowed down. Natural decline of population reported in 2016 is 1325 persons (Table 6.4) which is by almost one and half times greater than in 2015 (958 persons).

Table 6.4: Natural population changes in Minsk Region

Year	Natural population development		
	Births	Deaths	Increase/decline
2010	16667	23154	-6487
2011	16752	22581	-5829
2012	17960	21113	-3153
2013	18629	20927	-2298
2014	18587	20115	-1528
2015	19076	20034	-958
2016	18541	19866	-1325

Source: National Statistics Committee of the Republic of Belarus

The population growth reported during past years is induced by the immigration flows which leveled the negative consequences of natural decline of population (Table 6.5). The migrants arrive both from other regions of Belarus and from other countries.

Table 6.5: Immigration balance in Minsk Region

Year	2010	2011	2012	2013	2014	2015	2016
Arrivals							
Total	38310	36096	36208	39989	46034	54279	47623
Internal migration in the region	16496	15492	14133	14673	17075	19108	16480
Inter-district migration	8759	8126	7653	8045	8888	9880	8508
Intra-district migration	7737	7366	6480	6628	8187	9228	7972
Inter-regional migration	19622	18358	19764	22823	25940	31491	28886
International migration	2192	2246	2311	2493	3019	3680	2257
including:							
CIS countries	1936	2014	1828	2089	2673	3357	2001
Other countries	256	232	483	404	346	323	256
Departures							
Total	40126	38304	34685	36851	39312	43913	40609
Internal migration in the region	16496	15492	14133	14673	17075	19108	16480
Inter-district migration	8759	8126	7653	8045	8888	9880	8508
Intra-district migration	7737	7366	6480	6628	8187	9228	7972
Inter-regional migration	22964	22078	19805	21617	21682	24014	22908
International migration	666	734	747	561	555	791	1221
including:							

Year	2010	2011	2012	2013	2014	2015	2016
CIS countries	537	565	592	389	413	571	964
Other countries	129	169	155	172	142	220	257
Migration growth/decline							
Total	-1816	-2208	1523	3138	6722	10366	7014
Inter-regional migration	-3342	-3720	-41	1206	4258	7477	5978
International migration	1526	1512	1564	1932	2464	2889	1036
CIS countries	1399	1449	1236	1700	2260	2786	1037
Other countries	127	63	328	232	204	103	-1

Source: National Statistics Committee of the Republic of Belarus

The positive migration balance which has been reported in Minsk Region since 2012 also slackens the rate of population decline. The total migration flow in 2016 involved 88 232 persons (including internal migration within the region). The number of immigrants was 47,623, i.e. by 12.3% less than in 2015 (54,279). The number of emigrants also decreased (by 7.5%) between 2015 and 2016 – 43,913 and 40,609 respectively. With the above migration processes, the migration growth of Minsk Region population in 2016 decreased by 32.3%: +7 014 persons vs. +10 366 persons in 2015. Increasing positive balance of migration exchange flows is reported in the region: +1 037 with other CIS countries, +1 036 globally, +5 978 with other regions of Belarus (Table 6.6).

Table 6.6: Migration exchange between Minsk Region and other regions of Belarus

Migration exchange between Minsk Region and other regions of Belarus							
Year	2010	2011	2012	2013	2014	2015	2016
Arrivals							
Total	19622	18358	19764	22823	25940	31491	2886
including from							
Brest Region	1872	1673	1642	1958	2024	2245	2191
Vitebsk Region	1767	1576	1534	1691	1766	1720	1741
Gomel Region	1379	1253	1155	1207	1339	1411	1300
Grodno Region	1645	1365	1438	1594	1936	1979	1815
Minsk City	11283	11154	12741	15199	17621	22727	20596
Mogilev Region	1676	1337	1254	1174	1254	1409	1243
Departures							
Total	22964	22078	19805	21617	21682	24014	22908
Including to							
Brest Region	1708	1503	1378	1571	1609	1626	1550
Vitebsk Region	1727	1449	1278	1243	1422	1433	1293
Gomel Region	1077	835	915	836	843	906	883
Grodno Region	1362	1318	1128	1186	1259	1315	1169
Minsk City	16061	15921	14038	15678	15482	17633	16919
Mogilev Region	1029	1052	1068	1103	1067	1101	1094

Source: National Statistics Committee of the Republic of Belarus

Directional analysis of internal migration flows indicates active exchange between the region and Minsk city, for education and employment. The positive migration balance with Minsk city is explained inter alia by intensive development of satellite towns around the capital. Affordable housing and developed transport infrastructure encourage people to change their permanent residence from the city to suburbs.

External migration flows are smaller. The greatest increase of external immigration was reported in 2015, due to the inflow of displaced persons from Ukraine (Table 6.7).

Table 6.7: International immigration flows in Minsk Region

Number of international immigrants							
Year	2010	2011	2012	2013	2014	2015	2016
Total	2192	2246	2311	2493	3019	3680	2257
From CIS countries	2192	2246	2311	2493	3019	3680	2257
Russia	1295	1388	1204	1370	1166	1063	752
Ukraine	305	217	221	251	948	1745	684
Kazakhstan	150	237	240	252	325	281	180
Uzbekistan	33	26	39	36	31	29	196
Azerbaijan	39	38	24	44	53	54	37
Armenia	41	31	33	49	41	39	22
Kyrgyzstan	19	12	15	16	15	12	13
Moldova	36	45	37	42	56	54	37
Tajikistan	14	14	13	19	19	17	33
Turkmenistan	4	6	2	10	19	63	47
Non-CIS countries	256	232	483	404	346	323	256

Source: National Statistics Committee of the Republic of Belarus

No active international emigration from Minsk Region has been reported. According to the available statistical reports, the greatest number of recorded emigrants moved to Russia (Table 6.8).

Table 6.8: International emigration flows in Minsk Region

	Number of international emigrants						
Year	2010	2011	2012	2013	2014	2015	2016
Total	666	734	747	561	555	791	1221
To CIS countries	537	565	592	389	413	571	964
Russia	460	476	518	316	365	435	610
Ukraine	57	62	61	48	31	55	283
Kazakhstan	11	16	6	6	9	8	39
Uzbekistan	1	1		3	1	1	3
Azerbaijan	1	2	3	6	6	4	10
Armenia	1	2	1	5		5	11
Moldova	1	5	3	1	1	6	5
Tajikistan	1					3	1
Turkmenistan	4	1		4		54	2
Non-CIS countries	129	169	155	172	142	220	257

Source: National Statistics Committee of the Republic of Belarus

6.2.2 Gender situation in Belarus/Minsk

6.2.2.1 General

Overall gender equality situation in Belarus is positive, based on the following indicators:

- Legal base,
- Political engagement, and
- Education.

In 2015 Belarus occupied 31st place among 155 countries for the Gender Inequality Index (GII=0.151). Gender equality is a matter of continuous monitoring at the national level. The National Centre for

Legislation and Legal Research provides expert review of legislation for conformity with the Convention on the Elimination of all Forms of Discrimination Against Women, and for any provisions which would discriminate women. The National Statistics Committee of the Republic of Belarus compiles and provides information on a significant number of gender equality indicators (gender statistics). Preparation of the National Human Development Report includes calculation of the country gender inequality index based on composite indicators of gender differences in terms of health, education, economic activity, political engagement. In 2017 the fifth programme document which defines the national gender policy was adopted – the National Gender Equality Action Plan of the Republic of Belarus 2017-2020. The Plan is intended to develop mechanisms for integration of gender approach into the process of development and implementation of state policy in various spheres of public activities.

6.2.2.2 Politics

After the elections of 2016 to the National Assembly of the Republic of Belarus, the share of women among deputies of the House of Representatives and members of the Council of the Republic increased to 33.7%. Active engagement of women in public life is demonstrated by the activities of over 30 women's organizations and unions operating in the country. Furthermore, women prevail (57%) in the total number of members of various non-government associations and organizations.

6.2.2.3 Education

Беларусь демонстрирует успехи в достижении гендерного равенства в образовательной сфере. На Belarus has well advanced in the sphere of gender equality in education. By the start of academic year 2015/2016 the net coverage factor of the first level of secondary education was 95.5% for women and 95.4% for men. Overall coverage factor of the second level of secondary education is 107% for women and 113.6% for men, and that of the third level is 103.8% and 80%, respectively[50].

6.2.2.4 Healthcare

From the perspective of health and longevity, a major disproportion is reported for the life span and health of men and women, which is explained by the high level of early mortality among men, including due to risky behavior habits.

6.2.2.5 Key problems

The problem of economic inequality of men and women is common for the country in general. The gender gap persists in wages (23-24%), differences in incomes and solvency, employment opportunities, career, access to finance. Despite the high human potential of women in Belarus, their personal fulfillment is still limited. The differences in wage levels of men and women are explained inter alia by the large proportion of women employed in unproductive sphere where wage level is in general lower than average in the country. For instance, women account for 82.3% of total number of personnel in education, 80.5% in retail, 85.9% in healthcare and social services.

One serious problem in Belarusian society is violence against women which may take various forms (sexual violence, human trafficking, domestic abuse). Despite the measures taken by government which significantly reduced the scale of human trafficking activity, the problem of domestic abuse still persists. A system of providing shelter for women and children affected by family violence is gradually developing in Belarus, on the basis of social service centres. Since 2011 the number of "crisis rooms" quadrupled. As of 1 January 2017 the number of such rooms all over the country was 124. "Crisis rooms" are available in all districts of Minsk Region. Domestic abuse is a direct consequence of alcohol addiction of male population.

Minsk city offers more favourable environment for economic equality, as gender gaps in income levels and access to economic resource are reduced as a result of better employment opportunities in the capital's labour market, as well as active involvement of women in small and medium business, and the available loan funding. Also the problem of violence is less acute in the capital city. The risks of violence in Minsk are mitigated by activities of non-government organizations, development of mechanisms to

[50] F. I. Khramtxova. National features of gender policy in the Republic of Belarus. Post-Soviet issues. 2017;4(3):256-264

counteract family violence, as well sounder economic situation of women (compared to other regions of Belarus).

6.2.3 Economy

The structure of gross regional product in Minsk Region demonstrates a clear trend toward reduction of share of production, and the same trend is also reported in Minsk City economy. The share of production dropped by 7.5% over the period 2010-2016, with the most dramatic fall experienced in 2015-2016 – from 63.4% to 59.7%. The role of production in the regional economy is shrinking, alongside with decline of agriculture, forestry and fishery. This sector accounted for 17% of Minsk GRP in 2010, however in 2016 its share was only 10.7%. Processing industry demonstrated both growth and reduction of its share in GRP over the period 2010-2016, but in general its proportion in GRP remains at roughly the same level as in 2010.

While the share of production sector is shrinking, services are acquiring more significance in the regional economy. The highest growth rates are reported for the following sectors:

- Transportation, storage, postal and courier services (growth by 2.16 times);
- IT and communications (growth by 2.6 times).

Table 6.9: Breakdown of gross regional product, %

	2010	2014	2015	2016
Gross regional product	**100**	**100**	**100**	**100**
Including				
Production	**67.2**	**64.7**	**63.4**	**59.7**
Including				
Agriculture, forestry and fishery	17.0	11.0	8.9	10.7
Extraction industry	0.3	0.3	0.2	0.3
Processing industry	36.8	38.9	42.5	35.8
Power, gas, steam, hot water, conditioned air supply	1.1	0.7	0.7	1.8
Water supply; collection, treatment and disposal of wastes, decontamination operations	0.9	0.8	0.7	0.8
Services	**31.5**	**35.1**	**36.1**	**39.4**
Including				
Wholesale and retail trade; repair of automobiles and motorcycles	10.1	12.8	11.5	11.6
Transportation, storage, postal and courier services	2.5	4.1	4.3	5.4
Temporary accommodation and catering services	0.5	0.7	0.7	0.8
Information and communications	0.4	0.9	1.1	1.3
Finance and insurance	2.6	1.8	2.0	2.3
Real estate operations	4.4	4.4	5.3	5.6
Professional, scientific and technical activities	1.3	1.4	1.6	1.9
Administrative and auxiliary services	0.9	0.9	0.9	0.9
Public administration	1.6	1.2	1.2	1.3
Education	3.8	3.2	3.5	3.7
Healthcare and social services	2.6	2.7	2.9	3.4
Art, sports, entertainment and leisure	0.4	0.6	0.6	0.7
Other services	0.4	0.4	0.5	0.5
All economic operations	**98.7**	**99.8**	**99.5**	**99.1**
Net tax on products	1.3	0.2	0.5	0.9

Source: National Statistics Committee of the Republic of Belarus, 2017

The following sectors form the basis of the region's processing industry (93.2% of the total industrial output):

- Production of food, beverages and tobacco (29.1%);
- Production of chemical products (18%);
- Production of rubber and plastic articles, other non-metal mineral products (8.2%);
- Production of machinery and equipment not included in other groups (7.9%).

Minsk Region makes a significant contribution to the total national output of a number of products which are listed below (with respective percentage values of their share in the total production in 2016 shown in brackets):

- Noodle products and other pasta (67.1%);
- Vinegar and its substitutes of acetic acid from food raw materials (71.3%);
- Parquet panels and tiles (79.3%);
- Roof tiles (100%);
- Potash fertilizers, chemical or mineral (as 100% K_2O) (100%);
- Pesticides and other agrochemical products (84.8%);
- Mine dump trucks (99.2%);
- Passenger cars (99.7%).

Despite the dominating position of the region in terms of production of mine dump trucks, it should be noted that the available capacity of this sector is utilized only by 34.6%.

"Agricultural organization" is the predominant form of entity in agricultural sector of Minsk Region. The share of agricultural organizations increased from 65.6% to79.1% over the period 2010-2016. The share of "household farms" decreased from 33.5% to 19.3% during the same period.

The agricultural products indexes are shown below (Table 6.10).

Table 6.10: Production indexes of agricultural products (per cent to previous year; comparable prices)

	2011	2012	2013	2014	2015	2016
Agricultural products – total	107.1	106.4	95.2	102.1	100.7	104.9
including						
crop products	111.5	107.2	90.2	106.9	93.2	107.3
livestock products	101.7	105.5	99.6	97.3	108.4	102.7

Source: National Statistics Committee of the Republic of Belarus, 2017

6.2.4 Poverty risk and vulnerable groups in Minsk Region

According to research studies of IPM Research Center[51], the impact of economic decline of 2015-2016 on household incomes in Minsk Region was less notable than in other regions of Belarus. Nevertheless, the poverty rate is reported to have increased and reached the country's average level. Herewith the increase of risk group was insignificant, and the level of inequality decreased as demonstrated by the Gini index in table below (Table 6.11).

Table 6.11: Poverty and inequality indexes in Minsk Region

	2014	2014	2015	2016
Absolute poverty	5.5	3.2	5.3	7.1
Depth of poverty	19.5	19.1	16.9	17.7
Distribution of population with incomes near the poverty line				
<67% poverty line	0.7	0.6	0.3	1.2
67–83%	2.8	0.9	2.4	1.8
83–100%	2.0	1.7	2.6	4.2
100–117%	2.1	2.7	2.0	3.4
Gini index	25.0	24.5	23.5	22.8
Relative poverty	10.9	7.9	8.8	9.5

[51] http://research.by/

Source: IPM Research Center, 2017

The reduction of inequality index is explained by faster rate of income reduction among more wealthy groups compared to those with lower income levels.

The poverty growth in Minsk Region was mainly caused by the wage cuts which affected people of working age employed at low pay jobs. The absolute poverty risk is highest in rural communities (Figure 6.3).

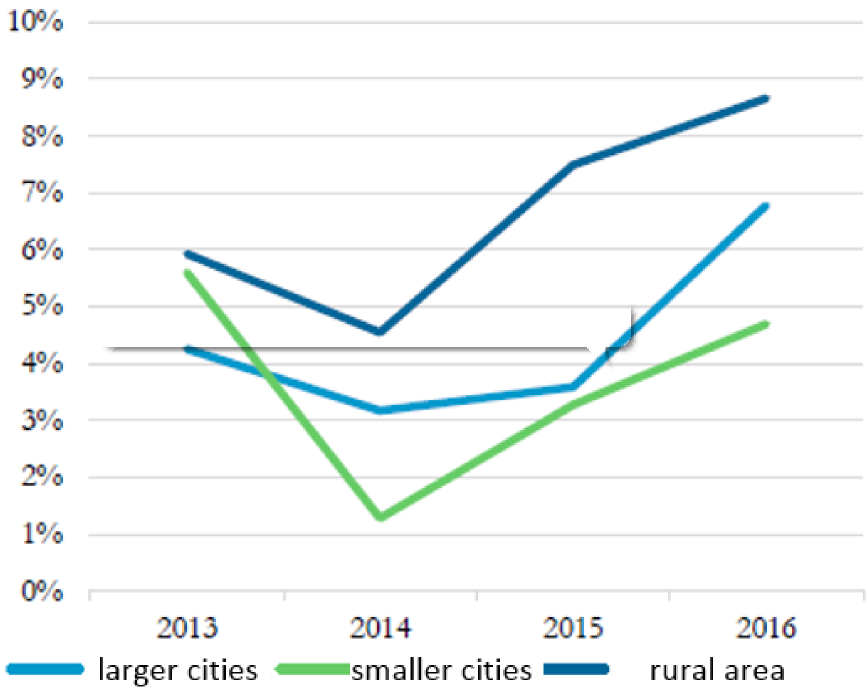


Figure 6.3: Risk of absolute poverty in Minsk Region, various types of communities

Source: IPM Research Center, 2017

The threefold increase of child poverty risk contributed much to the growth of poverty in Minsk Region (Figure 6.4).

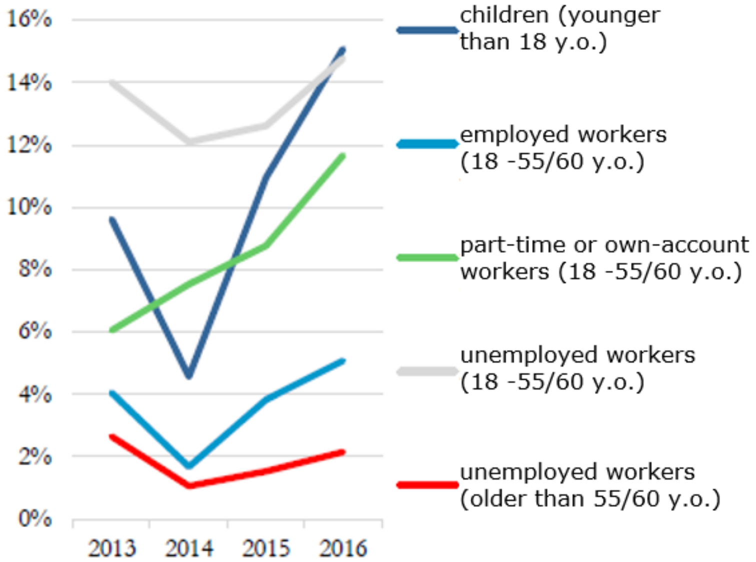


Figure 6.4 Risk of absolute poverty in Minsk Region, various types of communities

Source: IPM Research Center, 2017

Notably the increase of child poverty risk in the Republic of Belarus in general was smaller than in Minsk Region, which is partially explained by weaker effect of child allowances on poverty reduction in the region.

6.2.5 Health

Morbidity levels in Minsk Region are reported to increase in 2016 compared to the previous year, both for general morbidity (by 1.2%) and primary incidence (by 0.8%). No significant changes in the structure of primary incidence have been reported over past years. The most common diseases are:

1. Respiratory diseases – 50.6%;
2. Injury, poisoning and other consequences of external causes – 9.3%;
3. Musculoskeletal disorders – 5.6%.

Circulatory diseases are a serious problem among adult population in Minsk Region. Even though this group of disorders ranks the fourth among other diseases as its specific primary incidence is only 4.2%, it is the main mortality and disability factor for adult population (Table 6.12).

Table 6.12: Morbidity rates in Minsk Region

Morbidity rates in Minsk Region					
	2010	**2013**	**2014**	**2015**	**2016**
Primary disease incidence, number	1167684	1126911	1052528	1108520	1132526
Per 100,000 residents	82482.3	80362.7	74897.2	78473.8	79747.1
First in life incidence among children of 0-17 years, number	459156	446474	419697	455715	459183
Per 100,000 residents	175017.2	168939.8	155678	164856.1	162370.8
First incidence of malignant neoplasms	6652	6515	6645	7180	7137
Per 100,000 residents	469.9	464.6	472.9	508.3	502.6
Active tuberculosis	700	548	541	488	408
Per 100,000 residents	49.4	39.1	38.5	34.5	28.7
Mental and behavioral disorders	9446	10302	10081	9511	9893
Per 100,000 residents	667.2	734.7	717.4	673.3	696.6
Alcoholism and alkyl insanity	4678	3535	3228	3143	3008
Per 100,000 residents	330.4	252.1	229.7	222.5	211.8
Substance addiction	236	274	230	180	118
Per 100,000 residents	16.7	19.5	16.4	12.7	8.3
Persons with disabilities recognized for the first time at the age of 18 years or older, number	6614			8681	8265

Morbidity rates in Minsk Region					
	2010	2013	2014	2015	2016
Children with disabilities younger than 18 years, registered by employment and social protection agencies, total number as of end of year, number	3906	3755	4221	4512	4593
Per 10,000 children	149.7	140.9	154.8	161	160.9

Source: Information-analytical Bulletin of the Ministry of Health of the Republic of Belarus "Public Health and Environment. Minsk Region 2016"

As of 1 January 2017, 3265 HIV cases were reported in Minsk Region, or 14.7% of the total number of HIV cases in the Republic of Belarus. The number of registered PLHA is 2671of which 41.7% are women and 58.3% are men. The prevalence rate is 188.5 per 100,000 residents (181.7 per 100,000 at the whole country level). 450 persons with HIV infection were registered in Minsk Region in 2016 (367 persons in 2015). The increase compared to year 2015 is 22.6%, whereas overall country value is 3.7% (Table 6.13).

Table 6.13: HIV incidence in Minsk Region

HIV incidence in Minsk Region							
	2010	2011	2012	2013	2014	2015	2016
Number of new HIV cases	153	216	223	210	251	367	450
HIV incidence per 100,000 of residents	10.8	15.4	15.9	15	17.9	26.1	31.8

Source: Information-analytical Bulletin of the Ministry of Health of the Republic of Belarus "Public Health and Environment. Minsk Region 2016"

The prevailing way of HIV transmission is sexual transmission which accounted for 69.8% of newly diagnosed incidences in 2016.

6.3 Regional and Local Socio-economic Situation

6.3.1 Demography

Population number in Minsk is 1,974,819 as of 1 January 2017. Overall population number in the city increased by 7% over the period 2010-2017, as a result of natural and migration growth.

Total number of population in Zavodskoy District as of 1 January 2017 is 236,837 (Figure 6.5). Zavodskoy District is the third largest among the 9 administrative districts of Minsk.

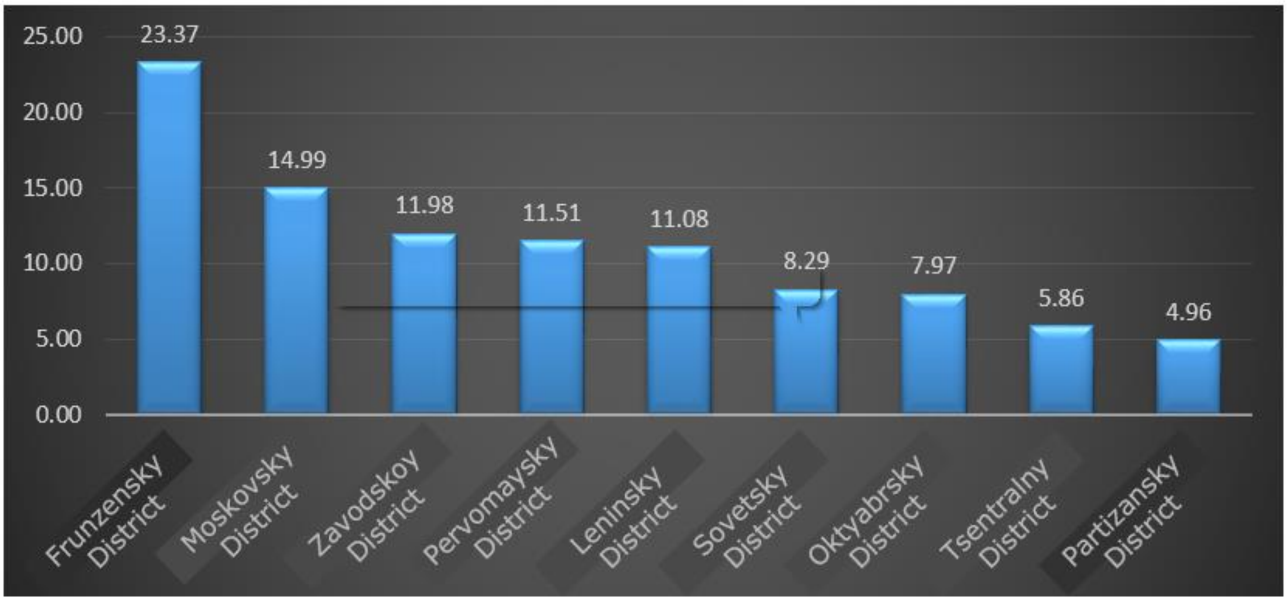


Figure 6.5: Population numbers in administrative districts of Minsk

Source: National Statistics Committee of the Republic of Belarus

While overall population in Minsk has been growing, the number of residents of Zavodskoy District reduced by 1.15% over the period 2010-2017 (Figure 6.6).

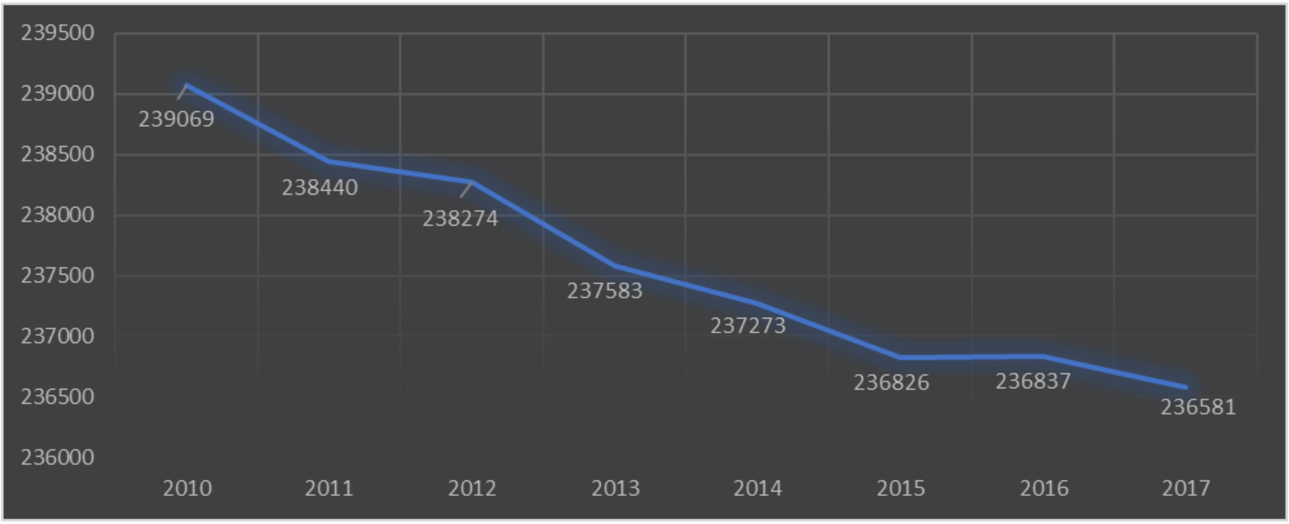


Figure 6.6: Population numbers in Zavodskoy District of Minsk

Source: National Statistics Committee of the Republic of Belarus

Population of Zavodskoy District decreased by more than 15 thousand over the past period of 20 years, from 253,671 persons in 1996 to 236,581 in 2017[52].

The demographic trend turned positive since 2012, as a result of natural growth induced by the increase of birth rate in 2012-2014 (overall birth rate per 1000 of residents of Zavodskoy District increased from 10.5 in 2011 to 11.9 in 2014). The raise was followed by a period of decline which affected the whole city and overall population development (Table 6.14).

[52] https://realt.onliner.by/2015/05/20/stat-12

Table 6.14: Natural population changes in Zavodskoy District of Minsk

Natural population changes in Zavodskoy District of Minsk						
	Births		Deaths		Increase/decrease	
	Total number	Per 1000 residents	Total number	Per 1000 residents	Total number	Per 1000 residents
2010	2647	11.1	2890	12.1	-243	-1.0
2011	2507	10.5	2811	11.8	-304	-1.3
2012	2674	11.2	2624	11	50	0.2
2013	2786	11.7	2610	11	176	0.7
2014	2816	11.9	2737	11.5	79	0.4
2015	2735	11.5	2589	10.9	146	0.6
2016	2612	11	2586	10.9	26	0.1

Source: National Statistics Committee of the Republic of Belarus

Migration balance in Minsk is positive, however the growth rate has been declining since 2012 (Table 6.15). Migration balance in Zavodskoy District is also positive, but the district demonstrates a steady trend toward prevalence of departures, taking into account the local movements (Table 6.16).

Table 6.15: Migration trends in Minsk

Migration in Minsk							
	2010	2011	2012	2013	2014	2015	2016
Arrivals, total	40 829	39 944	37 657	44 663	44 419	53 220	49 469
International	2 764	2 503	3 128	4 915	4 710	6 308	5 096
from CIS	2 244	2 017	1 834	3 034	2 931	3 967	3 072
from other countries	520	486	1 294	1 881	1 779	2 341	2 024
Inter-regional	38 065	37 441	34 529	39 748	39 709	46 912	44 373
Departures, total	23 443	21 765	26 829	29 331	33 713	37 247	39 665
International	1 633	1 812	2 095	2 300	3 457	2 386	2 626
to CIS	859	989	1 279	1 233	1 710	1 244	1 451
to other countries	774	823	816	1 067	1 747	1 142	1 175
Inter-regional	21 810	19 953	24 734	27 031	30 256	34 861	37 039
Migration growth (decline)	17 386	18 179	10 828	15 332	10 706	15 973	9 804
International migration	1131	691	1 033	2 615	1 253	3 922	2 470
with CIS	1 385	1 028	555	1 801	1 221	2 723	1 621
with other countries	-254	-337	478	814	32	1 199	849
Inter-regional	16 255	17 488	9 795	12 717	9 453	12 051	7 334

Table 6.16: Migration trends in Zavodskoy District of Minsk

Migration in Zavodskoy District of Minsk						
Year	Arrivals	Departures	Balance	Number of arrivals including local movements	Number of departures including local movements	Balance including local movements
2010	4477	2147	2330	7774	8160	-386
2011	4486	2088	2398	7597	7459	138
2012	3758	2106	1652	6057	6798	-741
2013	3968	3026	942	7585	8071	-486
2014	4518	3550	968	7621	8147	-526
2015	4747	3299	1448	7838	7973	-135
2016	4806	3914	892	8376	8658	-282

Source: National Statistics Committee of the Republic of Belarus

Life expectancy in Minsk is higher than the country average level, which is explained by better access to medical services and more cautious behavior[53] of residents of the capital city (Table 6.17).

Table 6.17: Life expectancy in Minsk

Year	Population in general	Male	Female
2010	73.5	68	78.4
2011	736	67.9	78.7
2012	74.9	69.6	79.4
2013	75.3	70.2	79.6
2014	75.5	70.3	79.9
2015	76.3	71.1	80.5
2016	76.5	71.6	80.5

Source: National Statistics Committee of the Republic of Belarus

Age distribution of population of Minsk is characterized by significant proportion of active age residents. Even though birth rate has slightly increased resulting in growth of age groups younger than employable age, the share of older age groups is still increasing.

[53] Cautious behaviour is individual's behaviour where the main construct is focussed on value of health, i.e. behaviour focussed on preservation of health, full-fledged life processes longevity.

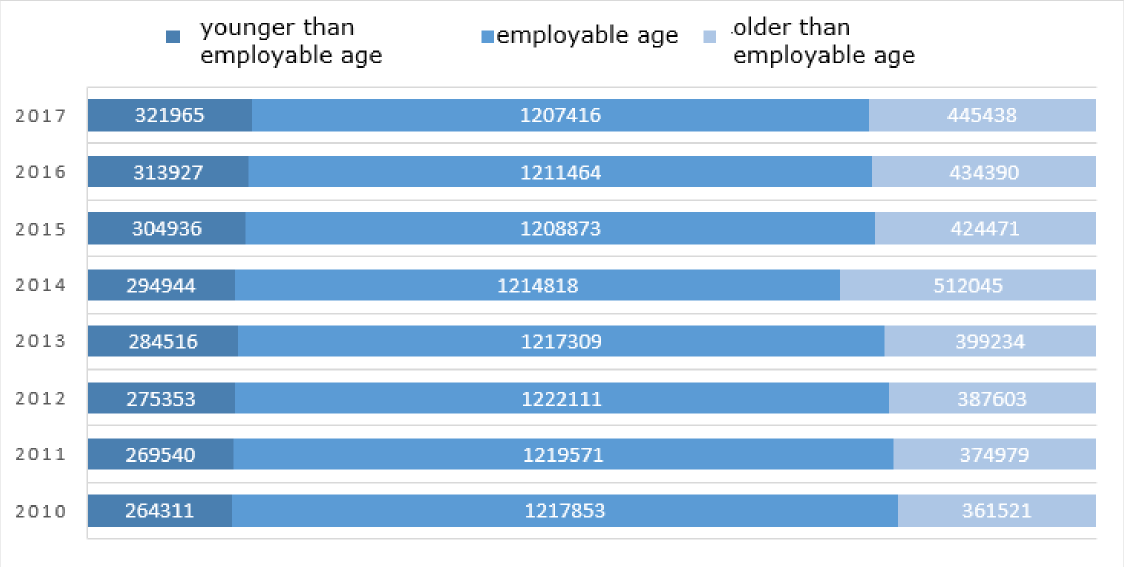


Figure 6.7: Age distribution of Minsk population

Source: National Statistics Committee of the Republic of Belarus

Population of Zavodskoy District is steadily ageing (Figure 6.8), which is clearly demonstrated by the fact that the share of older people is much greater than share of children (14.8% of children under the age of 16, 24.5% of people of retirement age). On the other hand, age distribution varies substantially between service areas within Zavodskoy District. In the area of Chizhovka and Partizansky prospect, the share of retired persons is 24%, and people younger than employable age account for 13% of total population. In Shabany area, on the contrary, proportion of older people and children is 15% and 18% respectively.

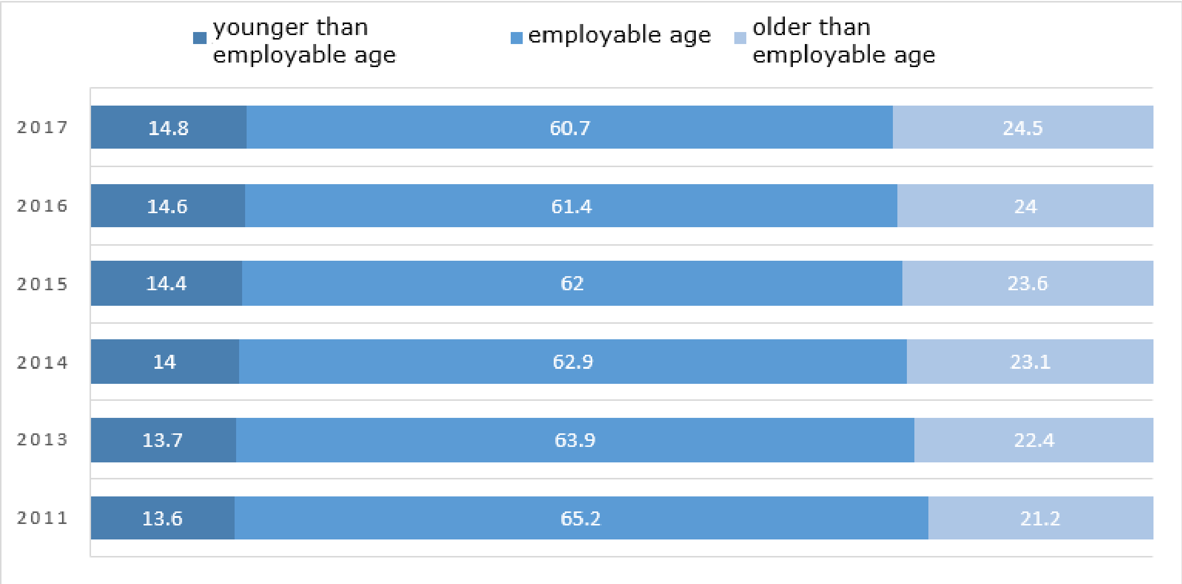


Figure 6.8: Age distribution of Minsk population

Source: National Statistics Committee of the Republic of Belarus

6.3.2 Morbidity and epidemiology

Respiratory diseases category is the most common group of diseases reported in 2016 (Figure 6.9).

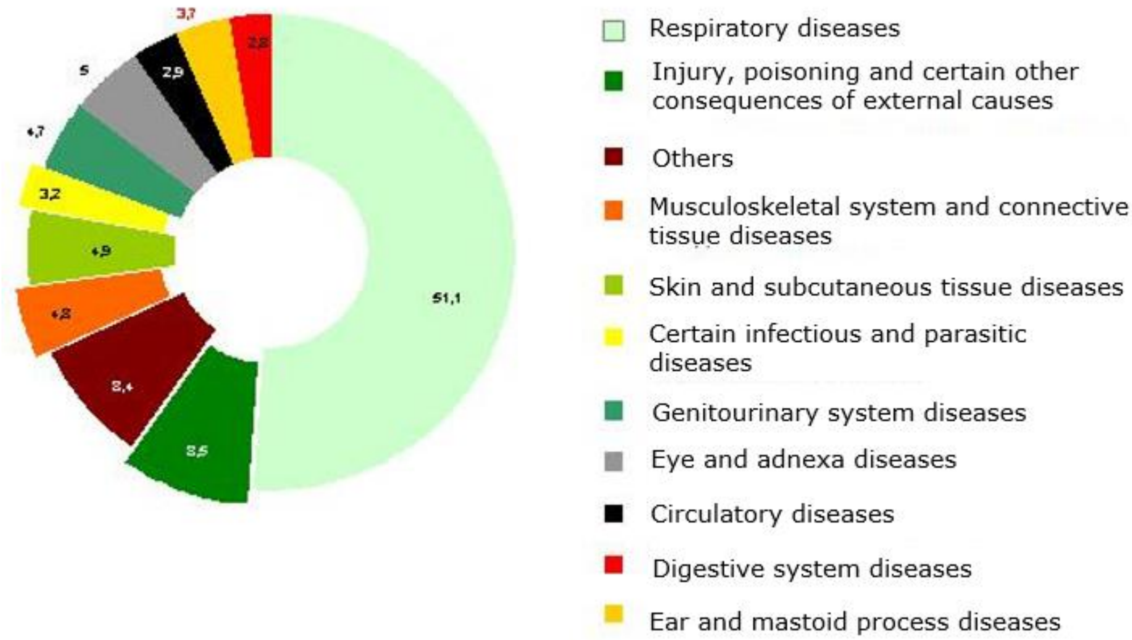


Figure 6.9: Incidence of various groups of diseases, 2016

Source: National Statistics Committee of the Republic of Belarus

The reported primary incidence rates in Minsk (Table 6.18) indicate overall growth of morbidity among adults and children.

Table 6.18: Primary incidence rates in Minsk

Year	2010	2013	2014	2015	2016
Primary disease incidence, number	2 132 389	2 216 144	2 132 949	2 234 188	2 322 807
Per 100,000 residents	115 022,5	115 941,5	110 513	114 631	118 071
First in life incidence among children of 0-17 years, number	798 203	859 762	874 571	930 064	980 312
Per 100,000 residents	255 715,5	262 856,6	260 595,3	269057,4	275034,8
Certain infectious and parasitic diseases, number	74 974	71 153	70 663	71 166	74 900
Per 100,000 residents	4 044,1	3 722,5	3 661,2	3 651,4	3 807,3
First incidence of neoplasms	26 993	30 810	31 190	31 069	33 913
including malignant				10 278	10 295
Per 100,000 residents				527,3	523,3
Mental and behavioral disorders	37 614	37 126	36 986	48 463	48 330
Per 100,000 residents	2 028,9	1 942,3	1 916,3	2 486,5	2 456,7
Alcohol and alcoholic psychosis	4 368	3 895	3 950	4 184	4 118
Per 100,000 residents	235,6	203,8	204,7	214,7	209,3
Substance addiction	954	527	423	282	242

Year	2010	2013	2014	2015	2016
Per 100,000 residents	51,5	27,6	21,9	14,5	12,3
Persons with disabilities recognized for the first time at the age of 18 years or older, number	43 994	55 973	53 602	56 635	54 454
Per 100,000 residents	56,8	72,6	69,6	73,7	71,1

Source: National Statistics Committee of the Republic of Belarus

Annual number of first diagnosed HIV cases in Minsk more than doubled over the period 2010-2016 (Table 6.19).

Table 6.19: Newly identified HIV cases

	2010	2013	2014	2015	2016
Number of new HIV cases, total	1 069	1 533	1 811	2 305	2 391
HIV incidence per 100,000 of residents	11.3	16.2	19.1	24.3	25.2

Source: National Statistics Committee of the Republic of Belarus

Zavodskoy District is reported to be among the most problematic areas of Minsk, for HIV incidence (Table 6.20).

Table 6.20: HIV incidence distribution in Minsk and incidence per 100 thousand residents in districts of Minsk

District	Total cases since 1987	Incidence by 01.12.2015 (exclusive of deaths)	Incidence by 01.01.2016 (exclusive of deaths)
Zavodskoy	701	248.0	250.9
Moskovsky	440	136.9	138.7
Leninsky	372	149.4	150.8
Oktiabrsky	248	139.6	141.5
Pervomajsky	355	140.2	142.5
Sovetsky	238	123.6	124.3
Partizansky	177	149.2	154.3
Tsentralny	202	157.5	159.3
Frunzensky	646	129.9	133.9
Minsk city	3379	151.6	154.1

Source: Municipal Polyclinic No.21, 2016

Municipal Centre for Hygiene and Epidemiology of Zavodskoy District of Minsk (MCHE ZD) reports the greatest number of HIV cases – 709 cases, or 300 cases per 100,000 residents, i.e. 20.7% of the total number of HIV cases recorded in the capital city of Belarus.

Moreover, according to MCHE ZD, HIV incidence in Zavodskoy District over the period 2005-2015 demonstrates a growth trend. 115 new HIV cases were recorded in Zavodskoy District of Minsk in year 2015, i.e. 48.7 cases per 100,000 residents. This value is two times greater than in year 2014 (57 cases, or 24 per 100,000 residents), and by 18.7% higher than average of all districts in Minsk.

In 2015, women accounted for 31.3% of HIV cases (36 cases), and men accounted for 68.7% (79 cases). Persons affected by HIV in 2015 are largely young people at the age of 30-34 (40% or 46 persons).

The leading cause of deaths in Minsk are circulatory diseases (Figure 6.10). The level of mortality caused by other diseases is significantly lower.

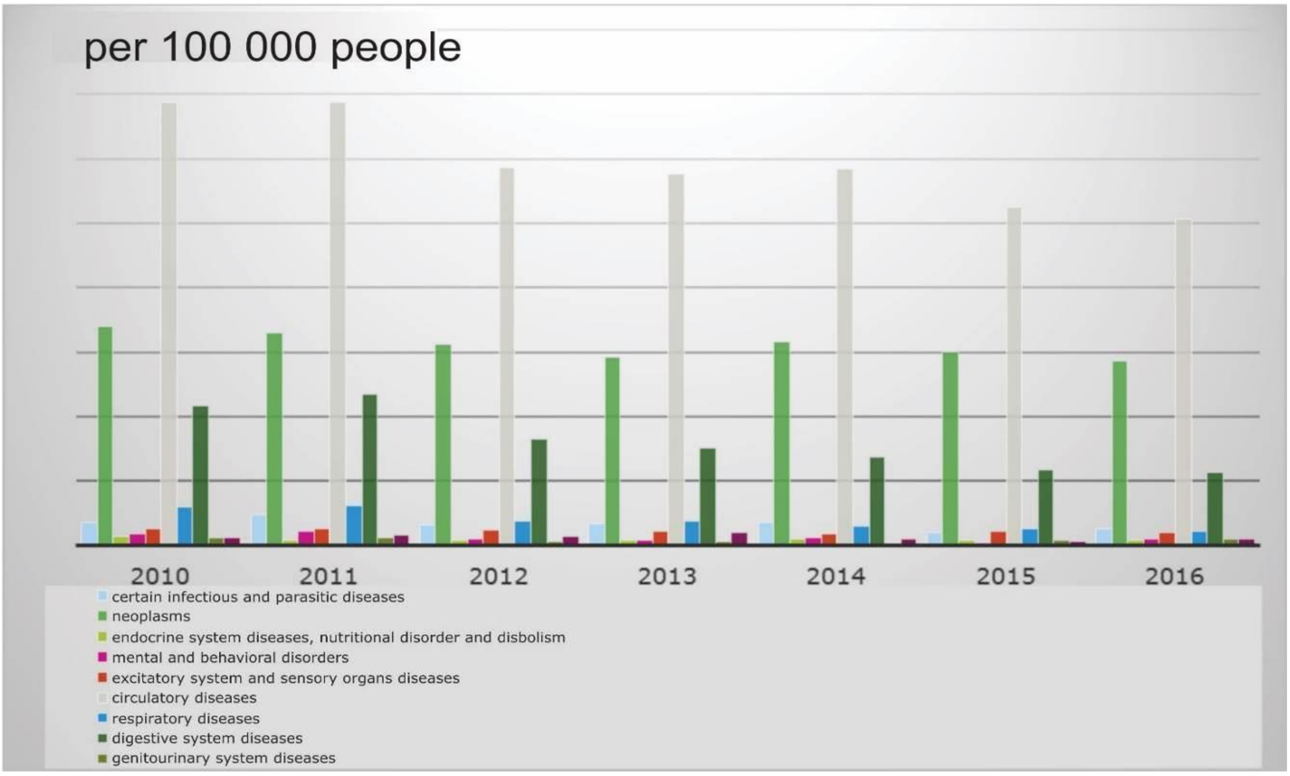


Figure 6.10 Death rate distribution by cause diseases

Source: National Statistics Committee of the Republic of Belarus

In relation to discussion of child morbidity rate in Zavodskoy District, it should be noted that at the country level the most common diseases among children are respiratory diseases which "account for 61% to 72% of all newly diagnosed cases in children"[54]. Researcher Porada mentions the following key causes of respiratory diseases: industrial pollution of the environment, inadequate social living conditions and poor quality of medical services.

Porada analyzed information about diseases of patients of Municipal Children's Polyclinic No.10 of Zavodskoy District in 2003-2012 and identified moderate growth of incidence of respiratory diseases in children. Besides the above morbidity factors, the growth of respiratory diseases may be partially caused by the changes in structure of child population of Minsk which are shown in the diagram below (Figure 6.11).

[54] N. E. Porada. Respiratory Diseases in Children. Zavodskoy District of Minsk. Ekologichesky Vestnik (Environmental, 2015, No. 2 (32)

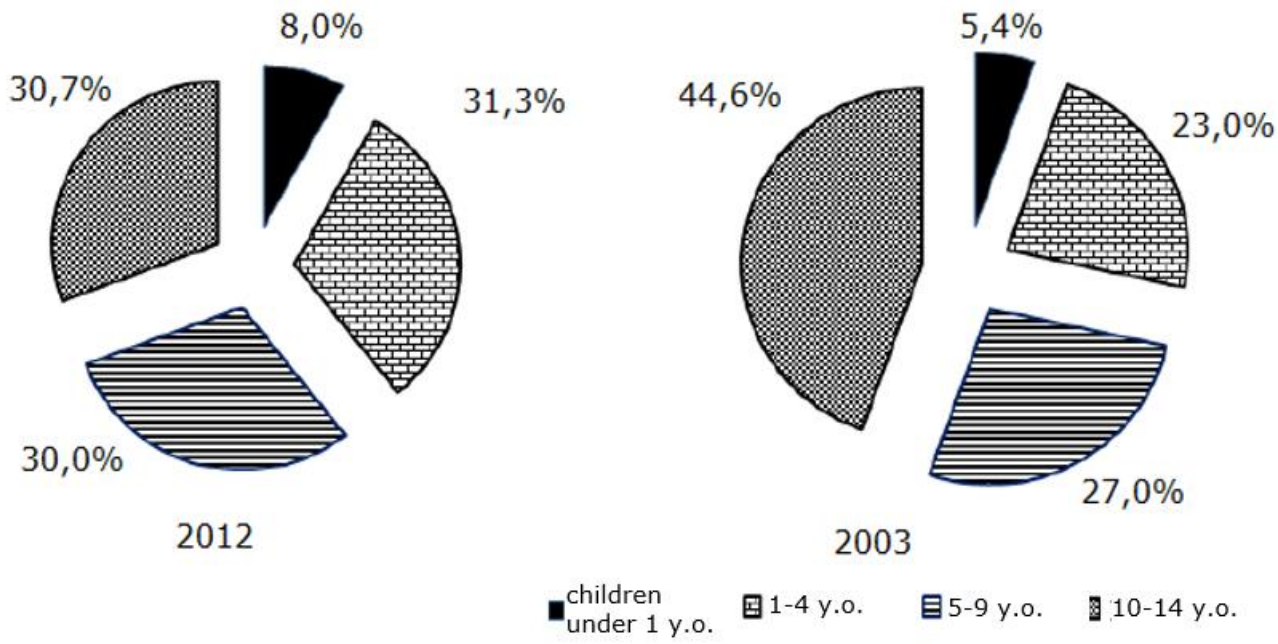


Figure 6.11: Age distribution of child population of Zavodskoy District, 2003 and 2012

Source: Porada, 2015

The above diagram demonstrates that proportion of children at the age of 10 to 14 years substantially decreased over the period 2003-2012, while the share of children at the age of 0 to 9 years increased by 13.9%. Conclusions from the analysis performed by Porada indicate significance of such changes in the age structure of child population which manifested in increased coefficients of general and primary incidence of diseases in young children. Nevertheless, the researcher pointed out the growth of respiratory morbidity in all age groups.

The structure of respiratory diseases of child patients of the Municipal Polyclinic No.10 in 2003 and 2012 shown in the table below (Table 6.21).

Table 6.21: General distribution of respiratory diseases in child population by clinical entity, 2003 and 2012, %

Types of diseases	2003	2012
Acute infection of upper respiratory tract	78.5	86.3
Influenza	11.8	0
Chronic amygdalopathy	5.8	2.1
Asthma	2.1	1.0
Pneumonia	0.5	0.6
Nasal allergy, chronic rhinitis, nasopharyngitis, pharyngitis, sinusitis, chronic and unspecified bronchitis, pulmonary emphysema, etc.	1.3	10.1

Source: Porada, 2015

6.3.3 Employment and economic situation in Minsk

Economic situation of Minsk in 21st century is predefined by its urban development in 20th century. In the first half of the past century industrial development of the city was limited, due to its position close by the national boarder. On the other hand Minsk was developing as a centre of culture and education at the time. A number of scientific and education institutions were established during that period, including Belarus State University (1921), Medical Institute (1930), Pedagogical Institute (1931), BSSR Academy of Science (1926).

Despite the devastating consequences of the World War II, Minsk managed to preserve its status as a centre of culture. Moreover, after the period of rehabilitation which ended by 1950s, the capital of Belarus SSR also assumed a role of industrial hub. Several major industries were established to serve both domestic market and countries of Council for Mutual Economic Assistance. Minsk Automobile Plant became operational in 1947 and Minsk Tractor Plant in 1950. A few other industries were commissioned in the second half of 20th century including watch, electrotechnical, automatic lines, motor, computer, refrigerator, optical mechanics manufacturing plants, Integral plant, as well as new television production line at the radio manufacturing plant. Besides the machinery manufacturers, consumer goods and food industries were also established including: bakeries, meat processing, wallpaper, porcelain, worsted, woollen plants, Milavitsa and Galanteya plants. The rapid industrial development induced population growth from 239 thousand in 1939 to 509 thousand in 1959, and to 907.1 thousand in 1970.

Transition to market economy resulted in significant reduction in output of machinery industries, and the proportion of population employed by Minsk industries declined too.

Nowadays Minsk bears the status of capital city and at the same time multifunctional hub with diverse economic activities and employment opportunities. The functional diversity implies that large proportion of the city residents are occupied in management, services and university education. IT companies play an important role in overall occupational pattern.

The general trend toward reduction of share of processing industry and increasing significance of information and communications sector in Minsk economy is clearly seen in the traced by the breakdown of gross regional product (Table 6.22).

Table 6.22: Gross regional product breakdown by economic sectors (current price level, per cent of total)

Year	2010	2011	2012	2013	2014	2015
Gross regional product	100	100	100	100	100	100
Gross value added	98.7	99.4	99.4	99.4	98.9	98.8
including:						
Agriculture, forestry and fishery	0.2	0.2	0.2	0.3	0.1	0.1
Extraction industry	0.0	0.0	0.0	0.0	0.0	0.0
Processing industry	23.0	24.7	21.9	19.2	16.9	16.1
Power, gas, steam, hot water, conditioned air supply	1.9	1.3	2.1	1.7	2.5	2.8
Water supply; collection, treatment and disposal of wastes, decontamination operations	0.4	0.3	0.4	0.6	0.6	0.6
Construction	7.4	5.1	6.3	9.1	11.3	7.5
Wholesale and retail trade; repair of automobiles and motorcycles	22.9	27.2	25.3	21.6	20.7	22.1
Transportation, storage, postal and courier services	7.5	8.7	9.3	8.2	7.5	7.8
Temporary accommodation and catering services	1.4	1.2	1.2	1.4	1.7	1.5
Information and communications	6.1	5.7	7.2	7.9	7.7	10.4
Finance and insurance	6.7	6.9	5.8	5.1	5.8	6.9
Real estate operations	5.1	4.8	4.9	7.7	7.5	6.1
Professional, scientific and technical activities	5.8	5.3	5.2	5.2	5.9	5.9
Administrative and auxiliary services	1.4	1.3	1.9	3.5	2.2	2.1
Public administration	1.3	0.9	0.8	0.9	1.0	1.0
Education	3.4	2.6	2.8	2.9	3.0	3.1
Healthcare and social services	2.2	1.6	2.1	2.1	2.3	2.5
Art, sports, entertainment and leisure	1.6	1.3	1.6	1.6	1.3	1.3
Other services	0.4	0.3	0.4	0.4	0.9	1.0
Net tax on products	1.3	0.6	0.6	0.6	1.1	1.2

Source: Main Statistics Department of Minsk City, 2017

The trends of sector indexes of gross regional product are shown below (Table 6.23). GRP indexes in Zavodskoy District clearly demonstrate steady reduction of share of processing industry.

Table 6.23: Sector indexes of gross regional product (comparable prices, per cent of previous year)

Year	2011	2012	2013	2014	2015
Gross regional product	115.0	96.0	101.8	100.3	95.5
Gross value added	115.0	96.0	101.8	100.3	95.5
including:					
Agriculture, forestry and fishery	101.3	86.2	101.9	94.3	88.3
Extraction industry	107.0	102.5	96.8	79.0	85.7
Processing industry	112.8	104.8	84.4	88.8	85.9
Power, gas, steam, hot water, conditioned air supply	98.7	117.8	94.6	110.5	94.8
Water supply; collection, treatment and disposal of wastes, decontamination operations	99.5	104.8	106.8	105.4	93.0
Construction	118.2	97.6	109.4	94.7	78.7
Wholesale and retail trade; repair of automobiles and motorcycles	133.6	77.0	114.7	108.9	101.4
Transportation, storage, postal and courier services	104.4	103.2	102.7	99.6	96.3
Temporary accommodation and catering services	96.0	112.6	115.0	106.3	98.3
Information and communications	123.0	110.2	99.2	111.5	106.4
Finance and insurance	114.2	105.5	101.7	106.7	103.8
Real estate operations	106.6	93.9	102.5	99.1	100.1
Professional, scientific and technical activities	93.9	96.2	100.8	94.7	98.8
Administrative and auxiliary services	100.3	96.6	112.9	95.8	93.6
Public administration	101.0	97.3	96.3	91.2	97.4
Education	98.8	98.1	96.8	98.8	98.7
Healthcare and social services	102.7	103.4	100.2	103.0	106.4
Art, sports, entertainment and leisure	114.5	119.1	108.0	107.2	92.2
Other services	93.5	90.8	103.9	98.0	110.0
Net tax on products	x	x	x	x	x

Source: Main Statistics Department of Minsk City, 2017

The reduction trend of the share of industrial output in Minsk GRP is clearly reflected by occupation patterns in the capital city – proportion of people employed by service sector has been steadily growing over past 7 years (Figure 6.12).

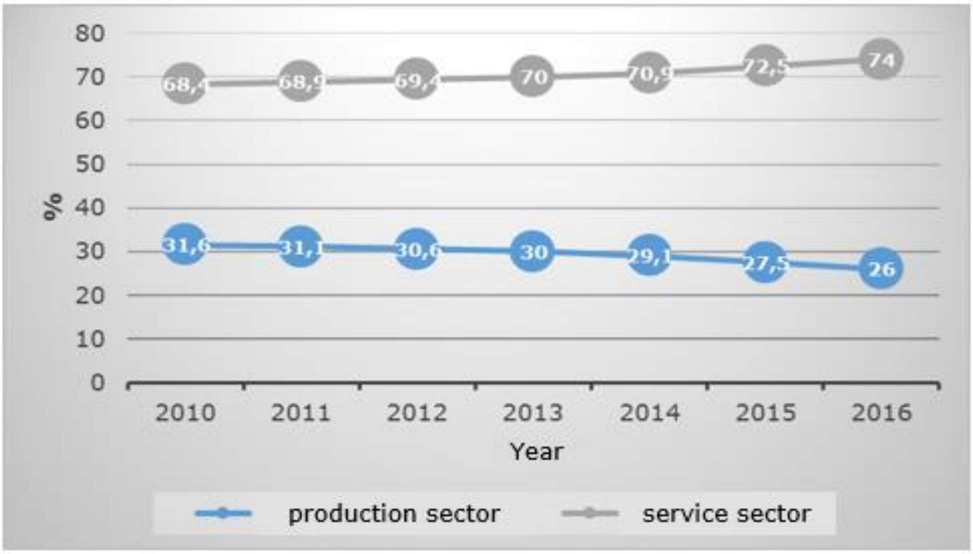


Figure 6.12: Employment structure by sectors (production and services), %

Source: Main Statistics Department of Minsk City, 2017

More detailed figures of employment of Minsk population in various sectors during the period 2010-2016 are provided below (Table 6.24).

Table 6.24: Employment by sectors of economy, %

Year	2010	2011	2012	2013	2014	2015	2016
Total employed in economy	100	100	100	100	100	100	100
Production sphere	31.6	31.1	30.6	30.0	29.1	27.5	26.0
Agriculture, forestry and fishery	0.3	0.3	0.2	0.2	0.2	0.2	0.1
Industry	21.9	21.5	21.4	20.4	19.4	18.3	17.7
Extraction industry	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Processing industry	20.4	20.0	19.9	19.0	18.0	16.9	16.3
Power, gas, steam, hot water, conditioned air supply	1.0	1.0	1.0	0.9	1.0	1.0	0.9
Water supply; collection, treatment and disposal of wastes, decontamination operations	0.5	0.5	0.5	0.5	0.4	0.4	0.5
Construction	9.4	9.3	9.0	9.4	9.5	9.0	8.2
Services	68.4	68.9	69.4	70.0	70.9	72.5	74.0
Wholesale and retail trade; repair of automobiles and motorcycles	18.7	18.5	18.6	18.8	19.1	19.1	18.8
Transportation, storage, postal and courier services	7.3	7.0	6.9	6.8	6.8	6.8	6.6
Temporary accommodation and catering services	2.4	2.5	2.5	2.6	2.8	2.8	3.0
Information and communications	3.8	4.1	4.3	4.6	4.9	5.3	5.8
Finance and insurance	2.7	2.8	2.9	3.0	3.1	3.2	3.2
Real estate operations	2.3	2.5	2.5	2.5	2.5	2.7	3.3
Professional, scientific and technical activities	6.6	6.5	6.5	6.8	6.8	6.8	7.1
Administrative and auxiliary services	2.9	3.1	3.1	3.3	3.6	3.6	2.9
Public administration	4.0	4.1	4.1	3.9	3.6	3.5	3.8
Education	8.8	9.0	9.0	8.8	8.9	9.1	9.2
Healthcare and social services	4.9	5.0	5.2	5.1	5.1	5.4	5.6
Art, sports, entertainment and leisure	2.0	2.0	2.0	2.1	2.1	2.3	2.5
Other services	2.0	1.8	1.7	1.7	1.6	1.8	2.1

Source: Main Statistics Department of Minsk City, 2017

Data in the table above clearly demonstrate the increasing significance of IT and communication sector in Minsk economy and employment, as the sector develops at a faster pace than any other sector in the city. The decrease of industrial employment and overall decline of industrial sector in the city's economy is an important factor for economic situation and development of Zavodskoy District and Shabany-1 and Shabany-2 areas where workers of various industries lived in 1970-1980-s. As shown in the figure below (Figure 6.13) the trend of industrial production index of Zavodskoy District has been negative over past six years.

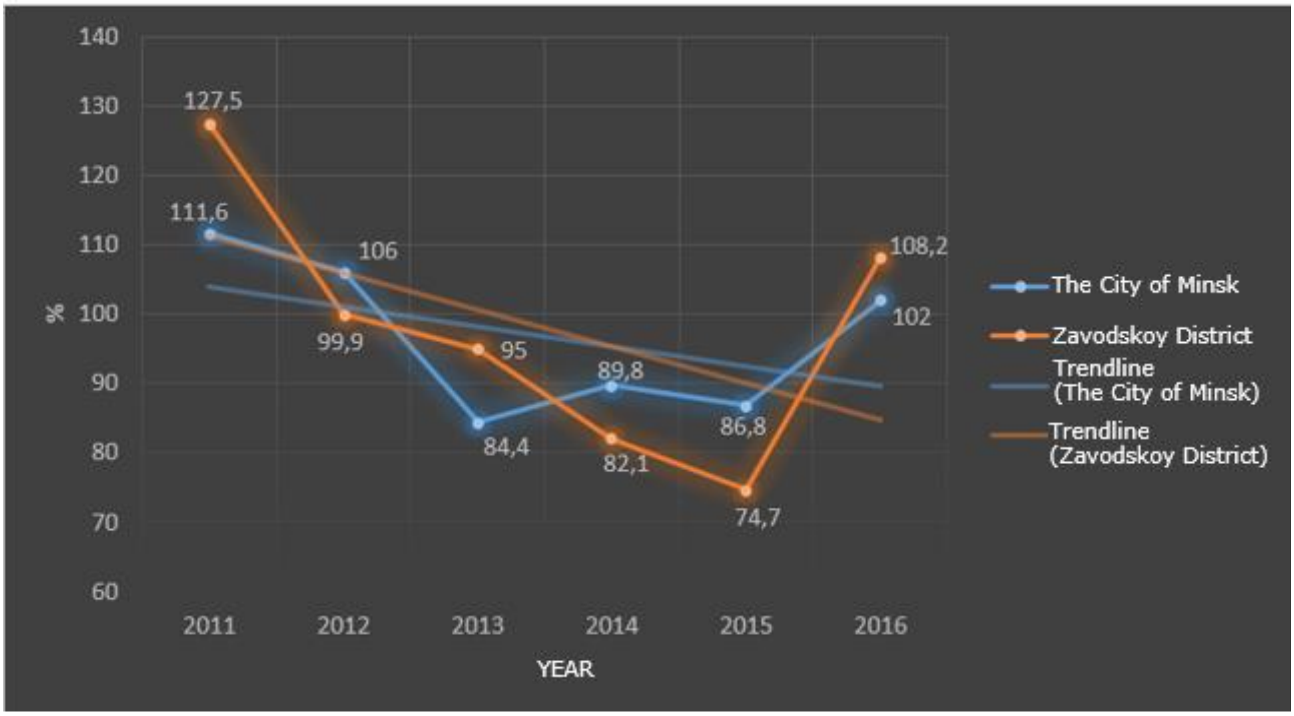


Figure 6.13 Industrial production indexes in Minsk City and Zavodskoy District

Source: Main Statistics Department of Minsk City, 2017

The above figure clearly shows that industrial production index in Zavodskoy District is falling more rapidly than the index at the whole city level.

Women clearly prevail over men in overall employment structure in Minsk city (by 13.4%). The most obvious gender gaps are demonstrated in the following significant sectors the capital's labour market:

- construction (78% men and 22% women);
- wholesale and retail trade; repair of automobiles and motorcycles (35.1% men and 64.9% women);
- transportation, storage, postal and courier services (62.4% men and 37.6% women);
- temporary accommodation and catering services (31.7% men and 68.3% women);
- finance and insurance (29.2% men and 70.8% women);
- public administration (30.8% men and 69.2% women);
- education (20.9% men and 79.1% women);
- healthcare and social services (13.4% men and 86.6% women).

In some of the above sectors, nominal monthly wages of women are below average level in the city. Development of ratios of wages in such sectors to average level of salaries in the city over the period 2010-2016 is shown below (Figure 6.14).

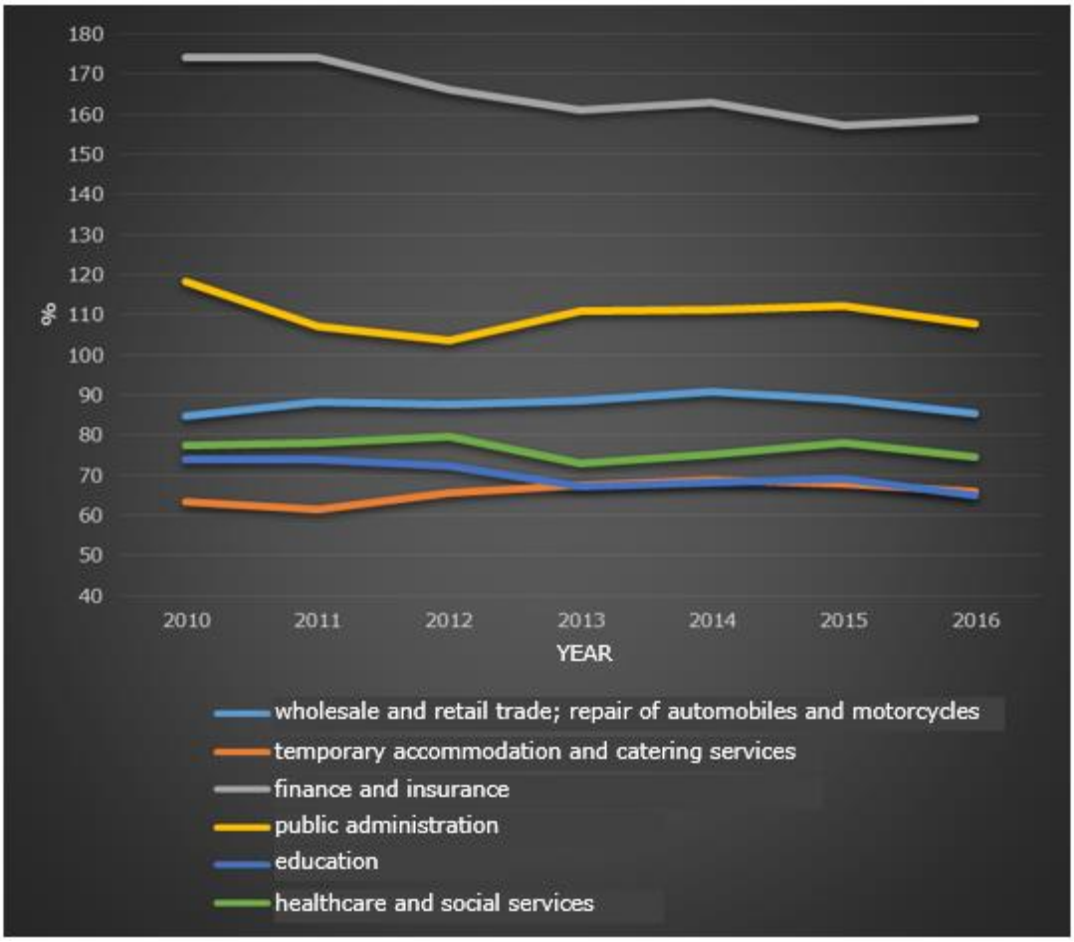


Figure 6.14: Ratio of nominal average monthly average wages paid in specific sectors of economy to average wage level in the city

Source: Main Statistics Department of Minsk City, 2017

City average nominal wage level is shown in the above figure as 100%. Two sectors with prevalence of female employees pay wages higher than average in the city (including finance and insurance sector where wages are significantly higher). However in four other sectors where female personnel prevail wage level is below the city average (including temporary accommodation, catering and education services where the gap is large).

Employment analysis of Zavodskoy District is closely related to local industrial situation. Significant number of residents are employed by processing industries (173.3 thousand persons or 16.3% of the total number employed in Minsk economy), however this value has been gradually declining (Figure 6.13). The gender gap in processing industry is less notable than in the spheres mentioned above (Figure 6.14). By 2016 processing industry of Minsk employed 24.5 thousand men and 15 thousand women, i.e. the proportion is 55.5% to 44.5%.

As mentioned above, in the second half of 20th century Minsk developed into an important industrial hub. A few industries dating back to the Soviet era are located in Zavodskoy District. At present the district plays a key role in industrial sector of the capital city and the Republic of Belarus in general. As reported at the official web site of Zavodskoy District, local economy is export-oriented, as "every third export dollar is earned in Zavodskoy District". The list of major industries in the district includes inter alia the following companies:

- Minsk Automobile Plant;
- Minsk Bearings Plant;
- Minsk Wheeled Tractor Plant;
- Automobile trailer and bodywork plant "MAZ-Kupava";

- OJSC "Minskzhelezobeton" (RC products);
- OJSC "Minskdrev" (woodworking);
- OJSC "Gormolzavod No.2" (dairy).

The Shabany special economic zone is established in the district (in the territory of the Shabany industrial hub). The major residents of the special economic zone are JV "Alutech Incorporated" (manufacturer of roller shutter components), CJSC "Gidrodinamika" (manufacturer of submersible dynamic pumps), JV "Bel-Izolit" (manufacturer of pre-insulated pipes), JV "Unibox" (tin lithography).

<u>Shabany area real estate market and socio-economic problems</u>

As reported by Belarus media, including those focused on analysis of real estate market, investment attractiveness of real estate in Shabany area is very low, e.g. price of square metre of dwelling in this area is reportedly lower than city average by 5% (Figure 6.15).

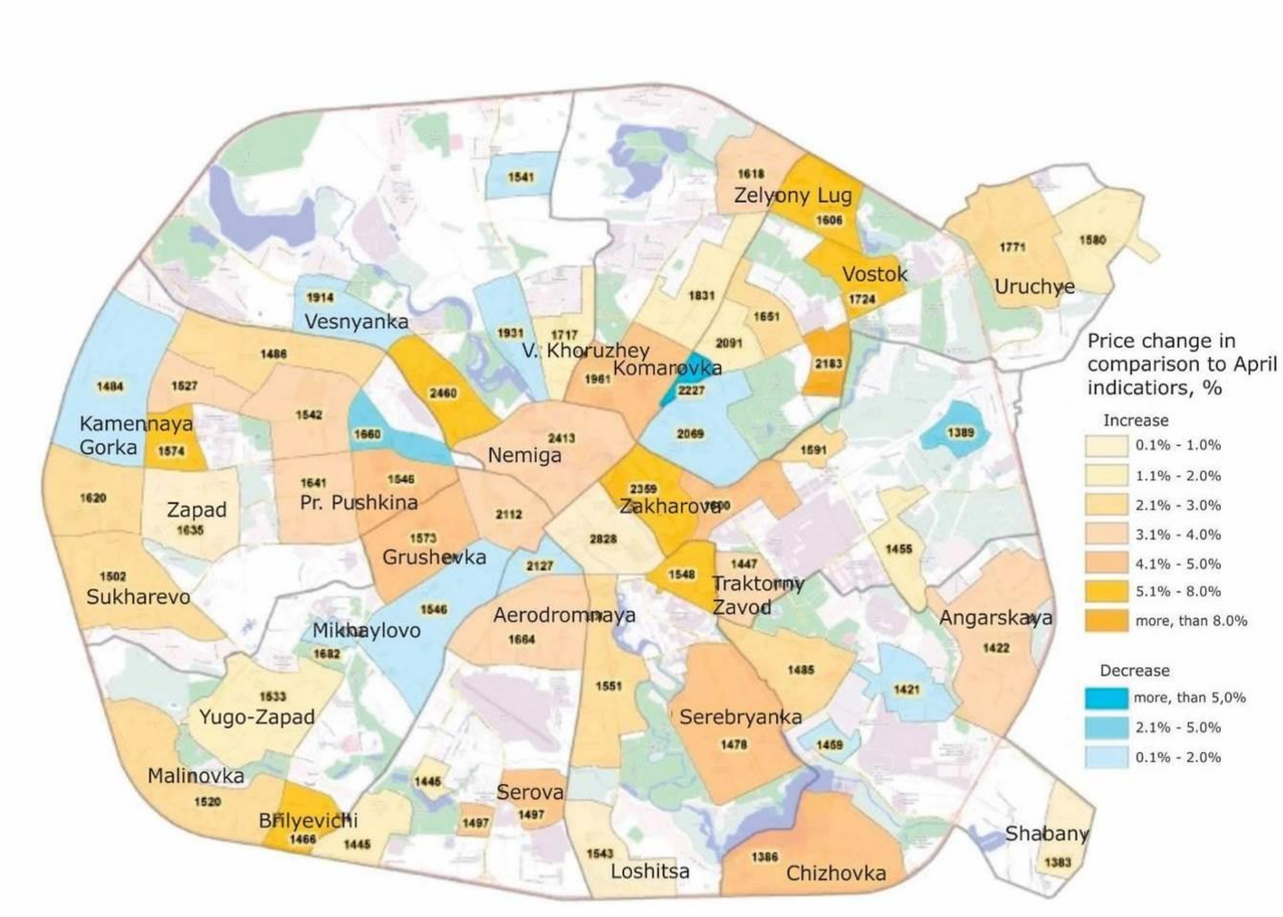


Figure 6.15 Average offered price for apartments in Minsk, May 2013

On the other hand, in some years before 2013 the gap was as large as 15-20%, which indicates some positive developments in Shabany by 2013. Nevertheless, the price per square metre of dwellings in Shabany area dropped to USD 1000-1050, as of October 2017 (Figure 6.16).

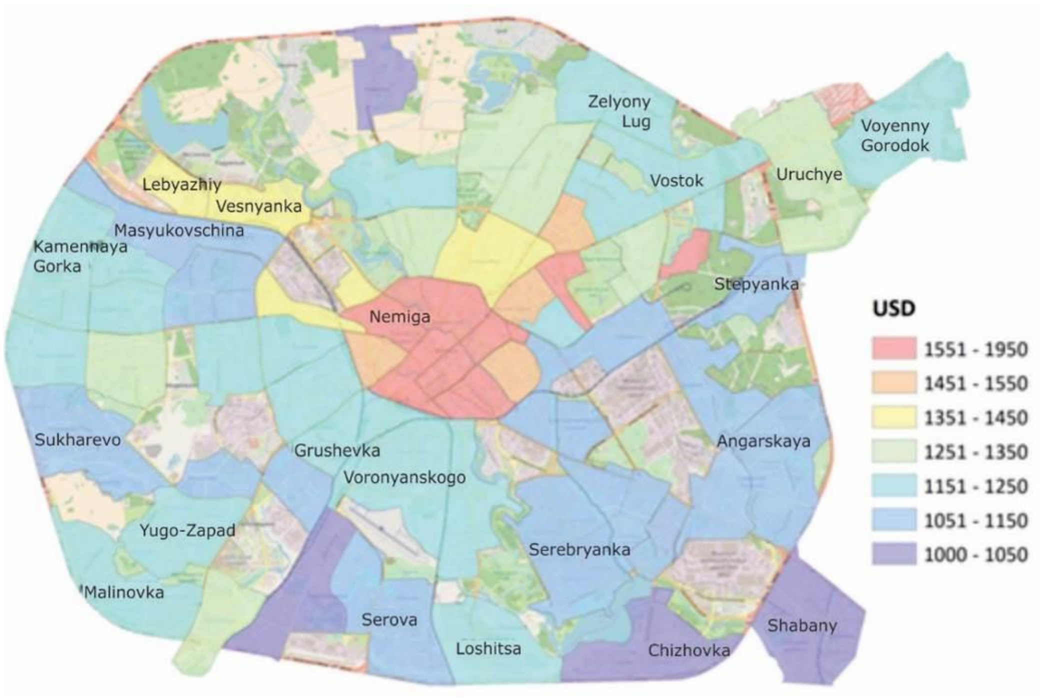


Figure 6.16 Dwellings prices per square metre in Minsk, October 2017

Source: Realt.by, 2017

According to Realt.by, the situation in the real estate market is defined by several socio-economic factors which are briefly discussed below.

Established perception of Shabany as a crime-prone area

According to information and comments in press and new media, residents of Minsk describe Shabany as a crime-prone and insecure area. This perception of Shabany established in 1990-s and is still true to an extent. On the other hand, certain positive changes which happened during the period 2000-2010 are also recognized, and the crime rate has decreased.

Using survey materials, journalists of Realt.by concluded that crime levels are higher in the areas with cheap properties and old houses, especially "Khruschevka" houses (prefabricated five-storey blocks of compact flats) and houses built in 1970-s – 1990-s. Shabany area matches this description of housing market for both factors.

Vicinity of major industries

Zavodskoy District, and in particular Shabany area accommodate the main industrial capacities of Minsk. According to the community opinions published in local media[55], industrial sites are the source of odours, especially those emitted by Minsk wastewater treatment plant and municipal wastes landfill. In 2012 former Head of Zavodskoy District Municipality commented that "people are reluctant to live in Zavodskoy District, as they believe that local ecology is bad… with the local wind rose, all emissions from industrial sites are carried to south-east"[56]. The problem of odour emissions was further recognized and characterized as "a problem for decades" at the meeting of new Head of Zavodskoy District Alexander Dorokhovich with community in 2016.[57]

Remote location and poor transport access

[55] https://news.rambler.ru/other/38540784-gorodskaya-sreda-minsk-aromatnyy-i-s-dushkom/

[56] http://www.bel-jurist.com/page/factory-district

[57] https://news.tut.by/society/502836.html

Shabany area is located outside the ring road of Minsk. Distance from the area border to the nearest metro station (Mogilevskaya) is 2.5. Local residents note the long time required to get to metro by surface public transport during rush hours in the morning.

<u>Free Economic Zone "Minsk"</u>

Free Economic Zone (FEZ) "Minsk" consists of 21 sites in Minsk Region and Minsk City with the total area of 2,652.48 ha, including 1047.79 ha in Minsk City (Figure 6.17). The FEZ is intended to facilitate construction and reconstruction of industries, modernization of production facilities.

At present FEZ "Minsk" includes an industrial park with newly built and reconstructed facilities comprising 39 operational plants, 14 industrial sites under construction, and 12 new facilities at the design development stage.

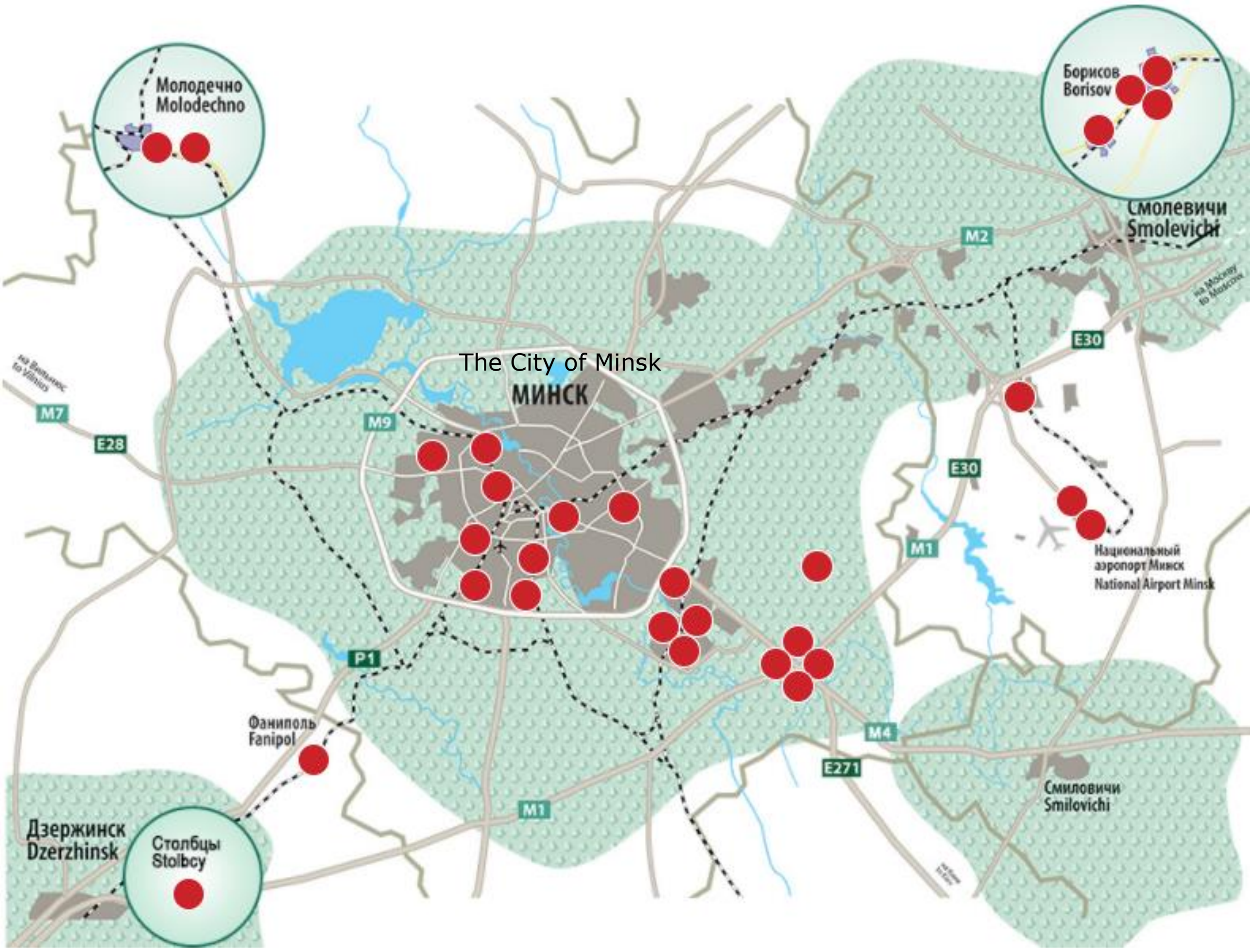


Figure 6.17: Location of FEZ "Minsk" sites

The Project area is located at Site 1 of FEZ "Minsk" which consists of four independent sectors. The facilities of UP "Minskvodokanal" occupy the area of 298 ha in sector 2. In the north sector 2 has a boundary with Minsk, in the east it boarders the site of the Transport National Unitary Enterprise "Minsk Section of Belorussian Railway". To the south is the land of Municipal Unitary Enterprise for Road Design, Maintenance and Construction "Minskobldorstroy" (motor road Novy Dvor – Matsevichi), and to the west are the lands of Novodvorsky Rural Municipality (Novy Dvor Village) of Minsk Region, of Municipal Unitary Agricultural Enterprise "Sovkhoz Agrofirma "Rassvet", and of Minsk City.

According to the information provided by representative of UP "Minskgrado" during consultations, the lands of Novodvorsky Rural Municipality (in particular those owned by Agrofirma "Rassvet") represent a value for further development of the industrial cluster which currently exists in the territory of FEZ "Minsk". Such intentions are supported by the document titled "Urban development design. Detailed area planning of FEZ "Minsk" (Site 1 MSA)" which envisages provision of certain urban development conditions to encourage rapid development of a part of industrial hub “Shabany”, including sector 2 of Site 1 of FEZ “Minsk”. The project objective is formulated as “creating multifunctional multisector production structure, transport infrastructure, public facilities”[58]. According to publication at the municipal information portal “Minsk News”[59], the area of industrial hub will significantly increase from 357.9 thousand m^2 to 1,276 thousand m^2 and will approach the agro-town of Novy Dvor. The total personnel number of local industrial facilities is expected to increase from 50 to 15,700.

The industrial hub development project within FEZ provides for[60] construction of the following facilities:

- Storage and operations support facilities;
- Production process site;
- Office and domestic facilities building including mechanical repair workshop;
- Concrete and RC wastes recycling facilities;
- Sludge incineration plant (project of UP Minskvodokanal);
- Metalworking plant near Novy Dvor agro-town, for manufacturing of steel and aluminium products for construction industry.

Implementation of the industrial hub development project may require demolition of four private houses.

6.3.4 Social infrastructure in Minsk

According to the research published by A. G. Leontovich[61], the available social infrastructure in Minsk is not always capable of meeting the demands of the rapidly increasing population. The researcher identified certain imbalance in spatial distribution of social infrastructure facilities and population density, which impedes access to some services. Results of the analysis which are illustrated in figure below demonstrate relatively low provision of secondary education, healthcare, retail trade, catering and sports facilities in Zavodskoy District. Insufficiency of healthcare institutions in the district is most noticeable (Figure 6.18).

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[58] https://minsknews.by/na-obshhestvennoe-obsuzhdenie-vyinositsya-gradostroitelnyiy-proekt-zastroyki-promzonyi-v-shabanah/

[59] *Ibid.*

[60] https://realty.tut.by/news/offtop-realty/551339.html

[61] A. G. Leontovich. Social infrastructure in Minsk and its role in metropolitan area functionality. Demographic risks of 21st century (publication for the World Population Day), Minsk, 2016

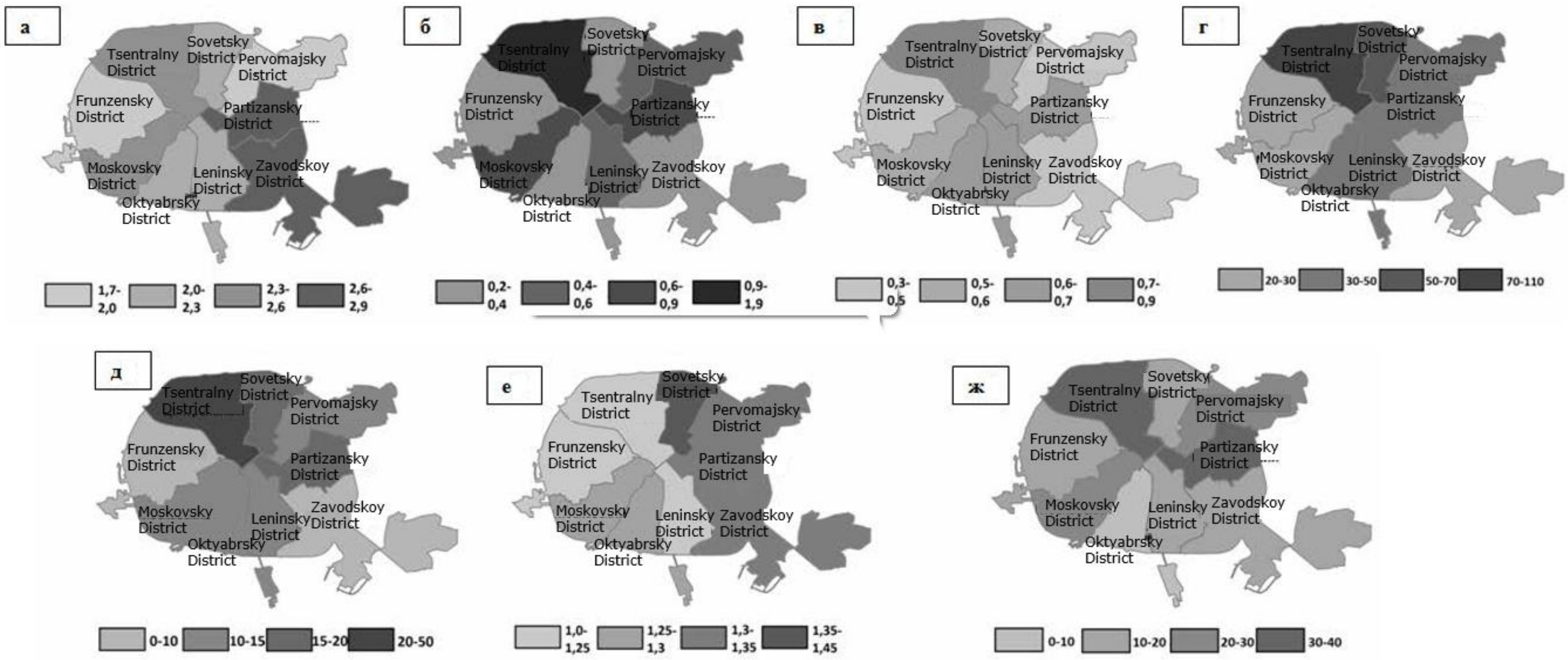

Figure 6.18 Availability of social infrastructure facilities by administrative districts of Minsk, provision per 10 000 capita, 2015. a) pre-school education; b) secondary education; c) healthcare; d) retail trade; e) catering; f) culture; g) sports.

Source: Leontovich, 2016

6.3.4.1 Healthcare infrastructure

According the reports of year 2016, healthcare infrastructure in Minsk includes 480 outpatient clinics and 51 hospitals. The number of specialist doctors is 15.9 thousand (58.7 per 10,000 residents), and the number of paramedical personnel is 26.1 thousand (132.1 per 10,000 residents).

8 outpatient clinics operate in Zavodskoy District, including 3 children's clinics and 1 dental care clinic. Other healthcare institutions in the district are 3 municipal hospitals, municipal psychoneurologic dispensary and municipal TB dispensary.

6.3.4.2 Education infrastructure

Education infrastructure of Zavodskoy District consists of 110 institutions including:

- 69 pre-school institutions;
- 2 primary schools;
- 3 gymnasiums;
- 27 secondary schools;
- 1 special school No.18 for children with serious articulation disorders;
- 4 out-of-school education facilities (Children's and Youth Sports Centre of Zavodskoy District (FSZ DiM), Children's and Youth Culture Centre "Zolak", Children's and Youth Culture Centre "Orion", Specialized Children and Youth Sports Schools of the Olympic Reserve No.4).

Four secondary schools are situated in Shabany area:

- Secondary school No. 210;
- Secondary school No. 186;
- Secondary school No. 200;
- Secondary school No. 142.

Furthermore, two institutions provide services for children with special needs:

- Auxiliary boarding school No. 10;
- Special education and rehabilitation centre (KROiR Centre).

Institutions for children without parental support:

- Children's home No. 6;
- Social pedagogical centre with orphan asylum of Zavodskoy District of Minsk.

6.3.5 Community safety and security in Minsk

A positive trend is reported in development of crime rate in Minsk. Crime rate in the capital city dropped by 46.8% over the period 2010-2016, and the number of crimes per 100,000 of residents reduced from 1925 in year 2010 to 969 in year 2016 (Table 6.25).

Table 6.25: Number of recorded offences in Minsk

Year	Total number of crimes	Number of crimes per 100,000 of residents
2010	35 681	1 925
2011	32 202	1 718
2012	25 251	1 334
2013	22 985	1 203
2014	20 776	1 076
2015	20 248	1 039
2016	19 014	967

Source: National Statistics Committee of the Republic of Belarus

According to crime statistics in Minsk over the period 2010-2017, the greatest number of offences was recorded in Zavodskoy District. Shabany area is characterized as the least secure territory62. Significant number of crimes is related to drug trafficking. As shown in the crime map of Minsk published at portal Realt.by (Figure 6.19) Shabany is regarded as one of the most crime-prone areas of the capital city, alongside with Chizhovka and Kharkovskaya.

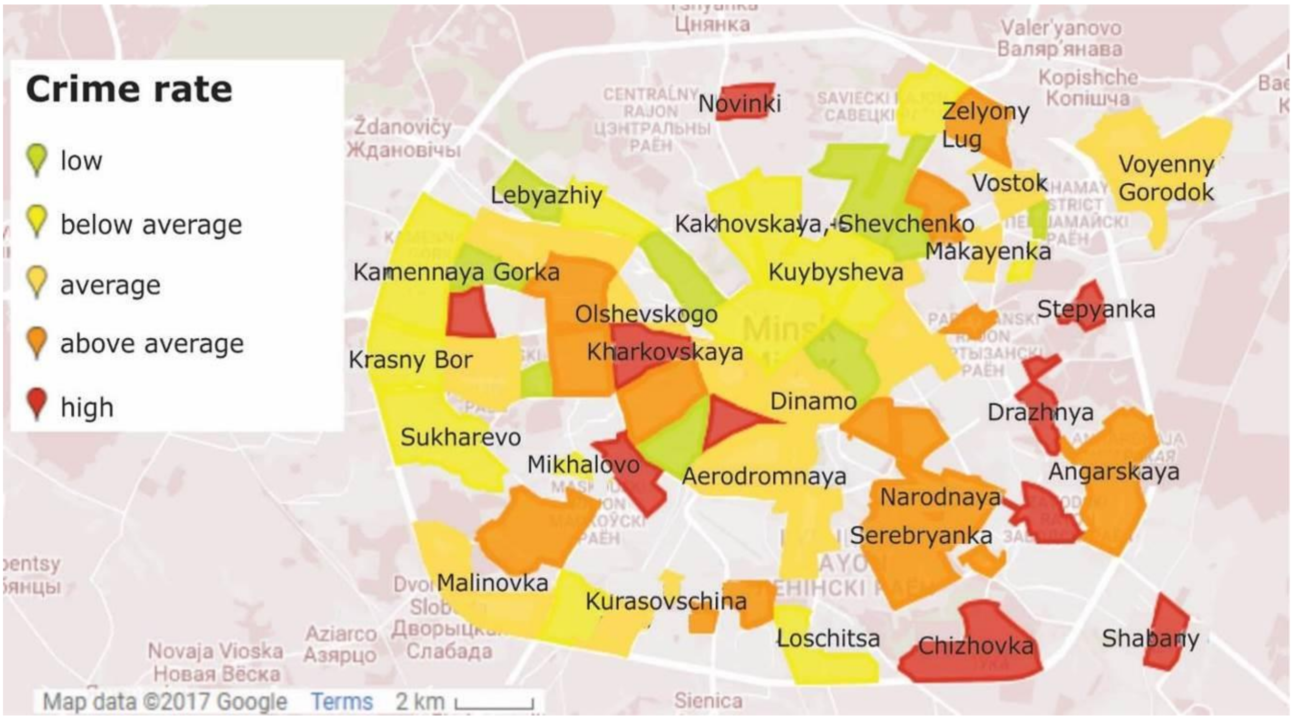

Figure 6.19 Crime map of Minsk, 2015

Source: Portal Realt.by, 2015

6.3.6 Summary information on Minsk District and Novodvorsky Rural Municipality

As mentioned earlier, the Project territory adjoins the land of Novodvorsky Rural Municipality of Minsk District. The nearest settlements to UP Minskvodokanal are Novy Dvor agro-town and Podlosje village (Figure 6.20).

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62 https://news.tut.by/society/352049.html

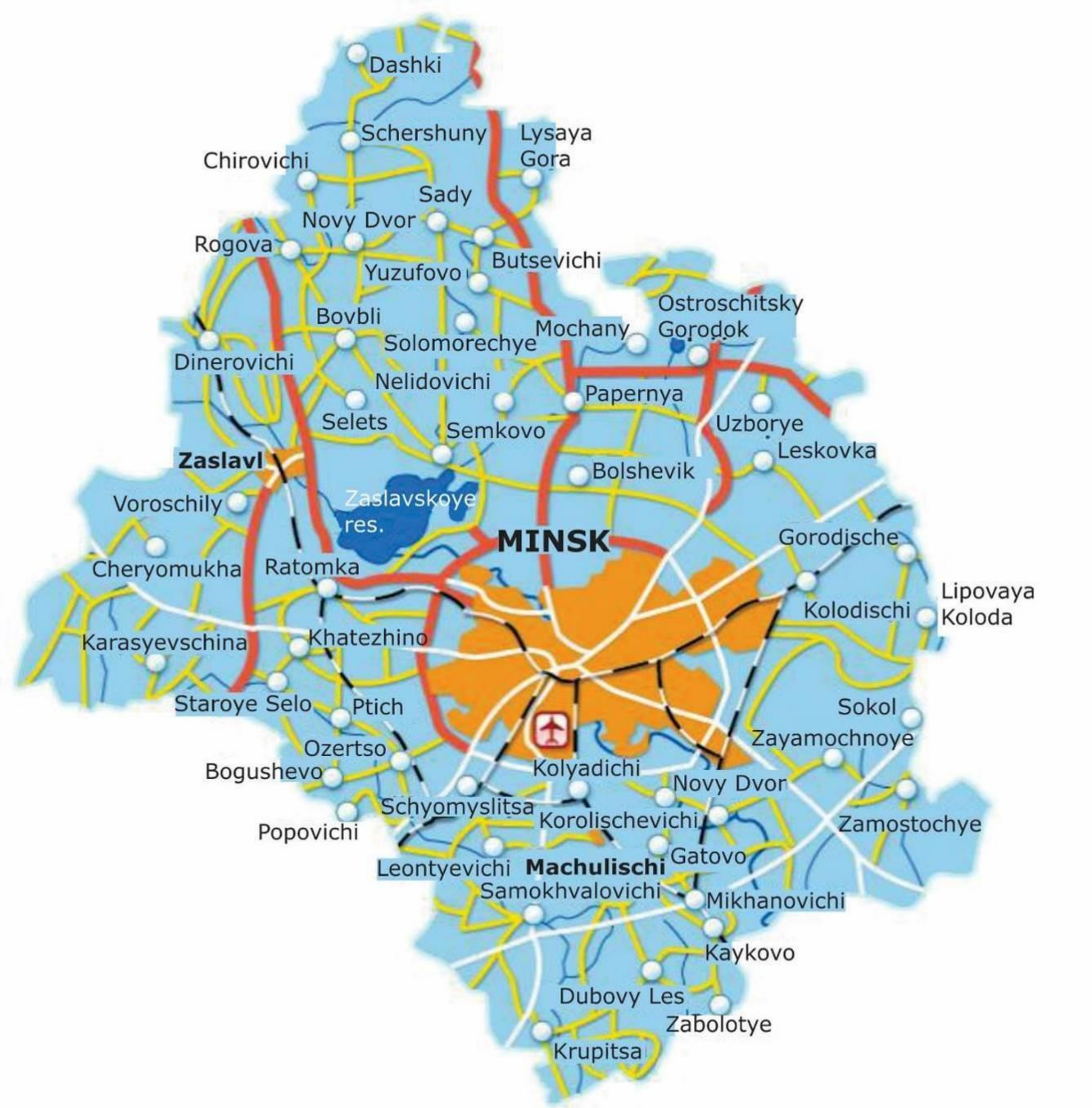

Figure 6.20 Map of Minsk District

Source: Community health and environment in Minsk District, 2016

As of 1 January 2017, Minsk Distinct is the largest district in Minsk Region in terms of population number (208787 residents). 14.7% of the total population of Minsk Region live in Minsk District, and its population number has been growing from year to year (Figure 6.21)the number increased by 14582 persons during year 2016 (10476 persons in year 2015). Residents of rural settlements prevail in the total population of Minsk District – 88.6% (184954 residents). Urban population of the district is 23833 persons, as of year 2016. In terms of age distribution, 58% of Minsk District population are people of employable age (men at the age of 16-59, women at the age of 16-54). Each of the age groups under and below employable age accounts for 21% of the total population number.

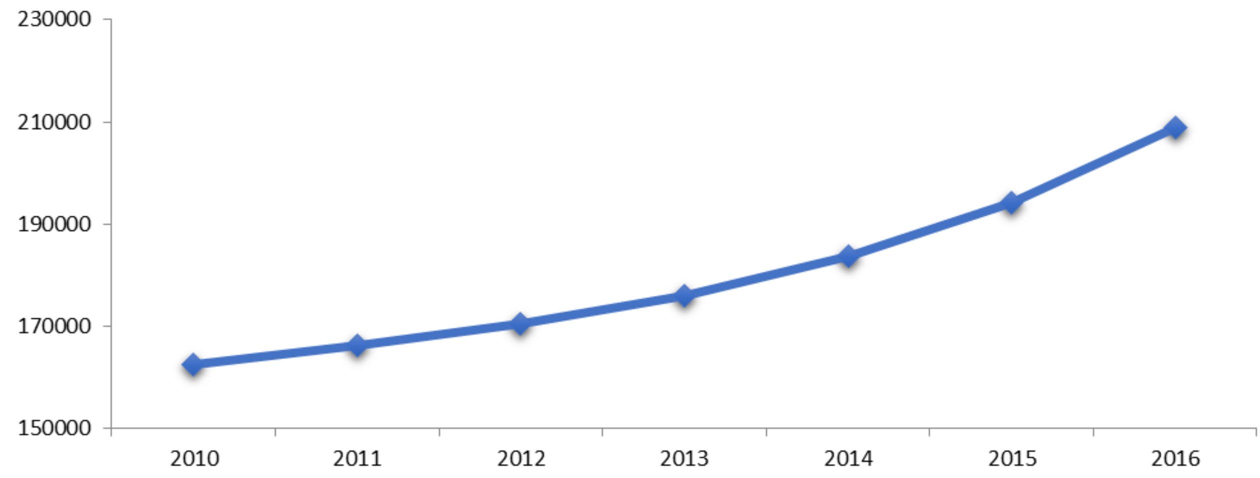

Figure 6.21 Minsk District Population

Over 18 thousand economic entities operate in Minsk District, including 7 thousand individual entrepreneurs. Total number of population employed in the district economy is 135 thousand.

The district's industry relies on the significant capacities originating from the developments in the second half of 20th century. At present 880 enterprises operate in Minsk District, including 64 major industries. The following sectors play the most important role in the district's industrial activities:

- Metallurgy and production of finished metal products (29.1%);
- Food industry (17 %);
- Manufacturing of rubber and plastic articles (10.2%).

It should be noted, that annual products output of industries of Minsk District is worth more than M 750 EUR, i.e. 14.3% of the total industrial output of Minsk Region. The largest industries are: Alutech Group (aluminium alloy structures and profiles), ICUP "Kosvik" (parquet flooring manufacturer), SOOO "Henkel Bautechnik" (construction mixes), OOO "Ilmax" (construction mixes, putties), IP "Inkraslav" (liquid soap, detergents, cleaning and disinfection agents), OOO "Zaslavsky Paint Plant" (paints), OOO "Master Flex" (printed packaging tape), CUP "Enisey" (glass articles), OOO "Effektivnyje Sistemy Upakovki" (PET-preform, polyamide casing), ZAO "Uniflex" (roll packaging and labels, photopolymer printing plates).

20 companies in the district are engaged in tourism services, of which 87% are health resorts including therapeutic facilities "Junost", "Krinitsa", "Belorusochka", "Praleska". In addition 176 farm-based holiday homes operate in Minsk District.

Minsk District plays an important role in the country's agricultural sector. Local enterprises produce milk, meat, eggs, grain, potatoes, sugar beet, and vegetables. The list of sustainably developing agricultural facilities includes the following enterprises: MRUP "Zhdanovichi Multi-Unit Agricultural Enterprise", OAO "Gastellovskoye", OAO "Ignatichi", OAO "Schomyslitsa", KSUP "Minsk Vegetable Farm". This list was recently extended to include OSP "Sovkhoz Minsky", OAO "DORORS", OAO "Raps" and OAO "Minsk Paultry Farm No.1".

Novodvorsky Rural Municipality is an administrative unit within Minsk District which immediately adjoins the territory of Minsk City. More specifically, the land of this municipality has a boundary with industrial hub "Shabany" being part of FEZ "Minsk". Total number of population registered in Novodvorsky Rural Municipality is 18058, as of 1 January 2017 (Table 6.26).

Table 6.26: Minsk District Population

			Including		
	Number of households	Number of population	Younger than employable age	Employable age	Older than employable age
Novodvorsky Rural Minicipality, total	6850	18058	5496	10517	2045
Novy Dvor	657	1546	565	824	157
Podlosje	37	64	0	24	40
Bloshoye Stiklevo	509	1614	479	942	193
Bolshoy Trostenets	1323	3203	897	1968	338
Gatovo	2692	8875	2624	5202	1049
Dubki	23	34	2	7	25
Dergai	34	17	1	3	13
Yelnitsa	460	901	270	568	63
Klimovichi	119	323	58	201	54
Korolischevichi	361	681	214	365	102
Matsevichi	57	145	26	55	64
Oseyevka	28	37	6	8	23
Pashkovichi	37	66	-	23	43
Tsesino	58	44	4	13	27

Source: Novodvorsky Municipal Administration

Population of the Rural Municipality has been growing as a result of natural growth and immigration processes. The total increase over the period 2014-2017 is 1.5%.

Medical services in Novodvorsky Rural Municipality are provided by 2 outpatient clinics in agrarian town Novy Dvor and village Bolshoy Trostenets, and a polyclinic in agrarian town Gatovo.

The outpatient clinic in Novy Dvor has a capacity of 90 patients per shift and serves 7 settlements with the total population of 3721 persons including:

- 1229 children; and
- 2492 adults.

The radius of service area of Novodvorsky outpatient clinic is 15 km. Residents of Novy Dvor agrarian town are served by both local clinic and medical institutions of Minsk.

As reported by the Ministry of Health, the number of HIV cases in Novodvorsky Rural Municipality over the period 1989-2017 is 38, including 4 cases registered in 2016.

3 secondary schools in the territory of the Rural Municipality:

- GUO Novy Dvor Secondary School, 500 pupils;
- GUO Gatovo Secondary School, 500 pupils;
- GOU Trostenets Secondary School, 200 pupils.

Pupils of Novy Dvor Secondary School live in Novy Dvor agrarian town and the nearest settlements. Few children from Novy Dvor study in Minsk. Parents arrange transport to the capital's educational establishments on their own.

3 pre-school institutions operate in the Rural Municipality – one in Novy Dvor agrarian town and two in Gatovo agrarian town.

According to information provided by Novodvorsky Rural Municipality, 3 houses are still populated in the resettled area of former Shabany village to the north-east of Novy Dvor agrarian town. The remaining residents represent native population of Shabany village which was officially resettled at the end of 1980-s. Dwellings in Minsk were provided to all resettled residents, however the land on which these specific houses are located has not been adequately reclaimed, and people opted to stay in their homes. No agreement has been reached with owner of one of the houses regarding resettlement and compensation for demolition of garage. As a result both the house and garage have not been demolished. According to specialists of Novodvorsky Rural Municipality, all people residing in the houses scheduled for demolition are registered in Minsk and have dwellings there which were provided to them during the resettlement process. However they still use the houses as summer cottages and for auxiliary purposes. The above buildings are located 100-150 m off the boundary of MOS-1 area.

50 business entities representing various sectors of economy operate in the territory of the Rural Municipality.

No agricultural farms are officially registered in the Rural Municipality, however some agricultural enterprises do have operations in its territory:

- MRUP "Zhdanovichi Multi-Unit Agricultural Enterprise";
- OOO "Agromashresurs";
- OAO "MinskSortSemOvosch";
- Municipal Agricultural Unitary Enterprise "Minsk Vegetable Farm";
- OOO "Grape Wine Plant "Pyat Kontinentov".

Agricultural fairs in Novy Dvor are arranged on annual basis, for residents of the town and nearby villages.

During the consultations representatives of Novodvorsky Rural Municipality reported significant demand for improvement of housing conditions – 1568 persons are registered as needing better dwellings.

6.3.7 Trostenets Memorial (Minsk City)

Memorial at the site of former extermination camp Trostenets where up to 206.5 thousand persons died during the Second World War[63] (Figure 6.22) is located at a distance of 1 km to the north-east of Minskvodokanal facilities. Trostenets was the largest extermination camp in the territory of former Soviet Union republics.

[63] https://minsknews.by/kak-vyiglyadit-memorialnyiy-kompleks-trostenets-za-neskolko-dney-do-otkryitiya/

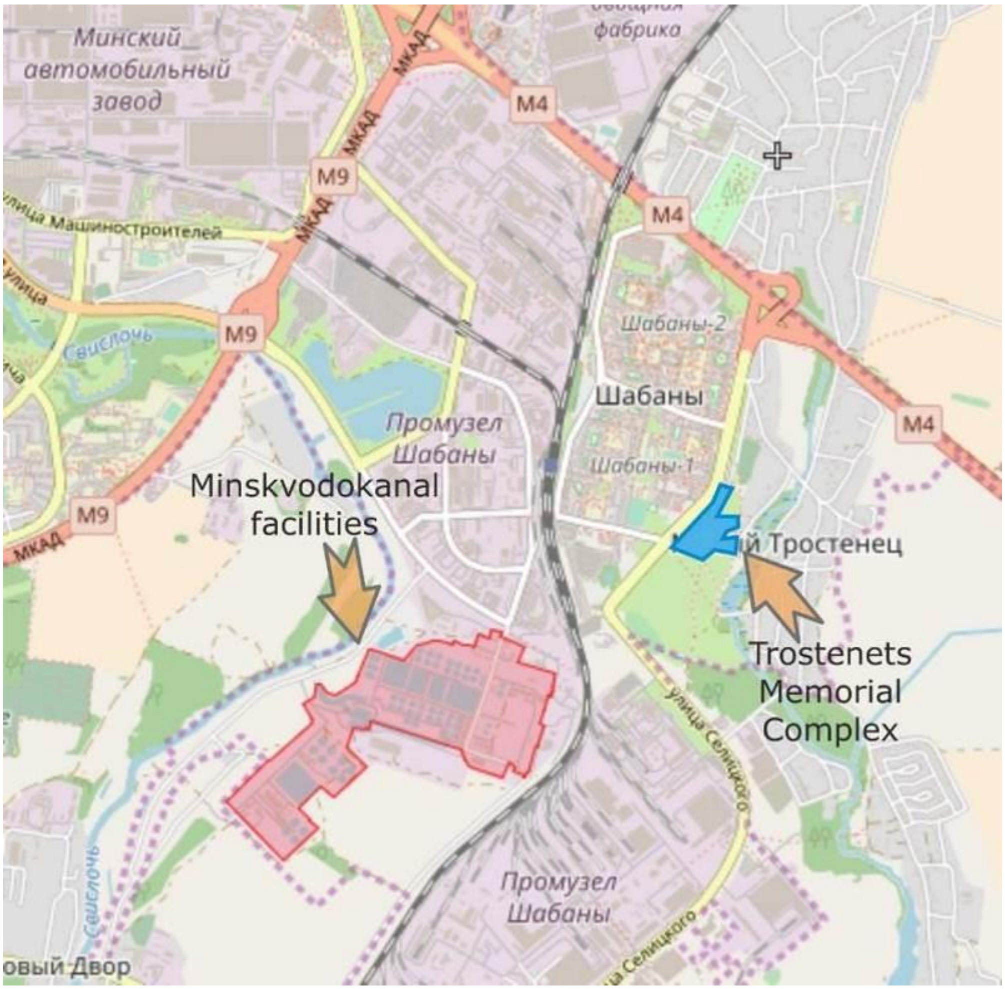

Figure 6.22: Location of Trostenets Memorial

The Memorial was established in 2015 and represents a system of alleys, remains of buildings of the "death camp" and new architectural forms (Figure 6.23) devoted to the tragic events of the Second World War.

Figure 6.23: Trostenets Memorial

Source: Holiday.by

7. STAKEHOLDER ENGAGEMENT AND INFORMATION DISCLOSURE

7.1 Introduction

This Chapter presents information on actions and practices related to engagement with the interested parties of the Project.

The Project's potential external stakeholders (e.g. local communities and authorities) are most likely to reside and be based in the following settlements:

- City of Minsk (particularly, Shabany neighbourhood of the City of Minsk)
- Novy Dvor agro-town (administrative center of Novodvorsky rural council)
- Podlosye village (part of of Novodvorsky rural council)
- Other settlements of Novodvorsky rural council

Stakeholder engagement process is required in order to ensure that the Project implementation is beneficial to local and regional stakeholders, and to discover and properly manage potential negative impacts of the Project. Initiating the engagement process at the early stage of the Project, together with the adoption of appropriate communication mechanisms, helps ensure the following:

- timely public access to all relevant information; and
- that all stakeholders are provided with an opportunity to input into the Project design, the identification and assessment of impacts and measures for impact mitigation and enhancement (in the case of beneficial effects).

This chapter covers the following key issues:

- Identification of the key stakeholders;
- Overview of the approach taken by the Company to stakeholder activities, including current roles and responsibilities related to stakeholder engagement, as well as retails on external and internal grievance mechanism;
- Overview of consultation and stakeholder engagement activities undertaken to date.

As part of the ESIA package, Ramboll has prepared the Stakeholder Engagement Plan (SEP), which includes details on the topics discussed in this chapter and provides provisions of future activities in the field of stakeholder engagement.

7.2 Key stakeholders

Identification of key stakeholders is a vital part of the ESIA process required to understand the groups that have been or will be affected by the Project. For the purposes of effective and Project-tailored engagement, the Project stakeholders have been categorised into the following key groups:

- Affected Parties

This category includes persons, groups and entities within the anticipated Project Area of influence that are directly affected, either actually or potentially, by the Project and/or have been identified as most susceptible to changes associated with the Project.

This group involves affected land users, rural communities of Novodvorsky rural council, communities living in Zavodskoy district of Minsk, Project contractors and subcontractors and Minskvodokanal workers.

- Interested Parties

Individuals/groups/entities that may not experience direct impacts from the Project but who consider or perceive their interests as being affected by the Project and/or who could influence the Project and the process of its implementation in an indirect way, are included into this category.

This category of stakeholders includes various city-, district- and region-level authorities and elected officials, businesses, civil society groups, mass media representatives, and educational institutions.

More details on stakeholder groups are provided below.

7.2.1 Affected Parties

7.2.1.1 Affected land and Svisloch River users

Land users, whose activities may be potentially affected by the Project, are viewed as stakeholders of the Project. The following land and Svisloch River users are considered as the parties potentially affected by the Project:

- Users of the four houses on the territory of the former Shabany village to the north-west of the Minskvodokanal site involved into subsistence farming activities;
- Agricultural businesses located in Novodvorsky rural council (in Novy Dvor agro-town)
- Recreational anglers involved into fishing activities at Svisloch River according to anecdotal information received by Ramboll during the site visit

7.2.1.2 Rural communities in the project area of influence

Within the territory of Minsky district, the following rural communities are expected to be potential direct recipients of the Project impacts:

- Communities residing in Novy Dvor agro-town
- Communities residing in Podlosye village

The authorities in charge of administration of these communities, as well as any elected officials (e.g. the elders (*starosta*)), shall also be considered as key stakeholders of the Project. It should be noted that the residents of Novodvorsky rural council expressed their worries and, at times, resentment towards the broader development of the Shabany industrial area, which proposed to include the Project. More details on the past consultations with local communities, which discovered such attitude to development activities in the area are discussed in section 7.4.2.

7.2.1.3 Communities, businesses and state authorities of the City of Minsk

It is understood that the Project may potentially have an impact on the major part of Minsk population since roughly 95% of the Belarusian capital’s residents are consumers of Minskvodokanal services. However, it is expected that a direct impact of the Project construction phase is likely to concentrate on the following stakeholders that are viewed as key to the Project:

- Residents of Shabany neighbourhood
- Businesses located on the territory of Shabany residential neighbourhood
- Businesses located on the territory of ‘Minsk’ Free Economic Zone

The authorities, agencies and elected officials of Zavodskoy district of Minsk shall be treated as key stakeholders of the Project.

7.2.1.4 Project contractors and sub-contractors

It is understood that Minskvodokanal shall invite contractors to perform the construction activities of the Project. All contractors and subcontractors shall be selected in accordance with the Belarusian legislation stipulating evaluation of qualification for construction contractors. The normative criteria for selection of contractors and for their evaluation include Presidential decree #26 and Resolution of the Cabinet of Ministers #252. Overall, the process of engagement with contractors is regulated by a Minskvodokanal internal document 'Engagement with contractors', which is part of the Company management system.

Currently, Construction Department of Minskvodokanal is in the process of defining the structure of contractors to be involved into the Project.

7.2.1.5 Minskvodokanal workers employed at the Project site

Project workers are key stakeholders in the Project. Currently, Minskvodokanal employs a total number of 3,158 workers of whom 265 are employed at the Minsk water treatment facility which is subject to Project activities. The details on the facility's workforce are provided in Chapter 9 Social Impact Assessment.

7.2.1.6 Trade union

The trade union of Minskvodokanal is viewed as one of the key stakeholders as it provides a variety of mechanisms of communication between the Minskvodokanal workers and management. Major mechanism of such communication is the practice of a Labour disputes commission which is indicated as a provider of one of the internal forms of grievance redress mechanisms.

7.2.2 Interested parties

7.2.2.1 Government authorities

The government authorities interested in the Project shall be of the following levels:

- Republican level
- Regional level

State authorities of local level shall be considered as directly affected parties (see Section 7.2.1).

7.2.2.2 Businesses of the city of Minsk and the Republic of Belarus in general

Minsk businesses are viewed as interested parties as they may potentially benefit from the Project as part of Minskvodokanal procurement activities. At present, there is no clarity on the actual list of businesses that are to be involved into the Project construction. However, local companies could play a role in the Project as sub-contractors to larger contractors. Potential for attraction of Belarusian companies is assessed as high and is substantiated by the Resolution #213 of the Minsk council of elected representatives.

7.2.2.3 Civil society organisations

During the meetings held in November 2017, the representatives of the Department of Labour Management and Personnel Motivation informed consultants of Ramboll that the Company representatives engaged with Belarusian Women Union ('*Belorussky soyuz zhenschin*') dedicated to discussion of discriminatory practices and related awareness-raising activities.

7.2.2.4 Press and mass media

Minskvodokanal engages with the media on a regular basis via a Media plan prepared quarterly. The following mass media are active in the Minsk, Minsky district and Shabany neighbourhood:

- Newspapers:
  - Vecherny Minsk
  - Minsky Curyer
  - Blizkiye Novosti
  - Narodnaya volya
  - Komsomolskaya Pravda (Belarusian edition)
  - Respublica
- Press agencies:
  - Minsk-Novosti
- Radio:
  - Radio-Minsk
  - Minskaya Volna
  - Russkoye radio Minsk
  - Stolitsa
  - Alfa-radio
  - Radio Mir
- TV channels:
  - Stolichnoye Televidenie (STV)
  - Minsk TV
- Websites:
  - City information site "Minsk-novosti" www.minsknews.by
  - The webpage http://blizko.by/regions/shabany presents news relevant to Shabany neighbourhood
  - Website of "Narodnaya volya" newspaper
  - News website TUT.by

7.2.2.5 Higher and secondary education institutions

The Company has cooperation agreements with higher and secondary education institutions:

- Belarusian national technical university;
- Belarusian state technological university;
- Minsk state college for architecture and construction.

Additionally, Minskvodokanal has cooperation agreements with three educational institutions providing vocational training.

Cooperation with six educational entities includes internships for students and employment of recent graduates.

7.3 Approach to stakeholder engagement and information disclosure

Minskvodokanal engages with the external parties interested in its activities and with customers via two major channels of communication:

1. Engagement by means of Minsk executive committee
2. Engagement by means of Minskvodokanal internal instruments

7.3.1 External engagement by means of Minsk executive committee

In case of distribution of information regarding activities of Minskvodokanal by Minsk executive committee, the ultimate parties responsible for such information exchange typically represent the relevant divisions of city districts' administrations. In case of Zavodskoy district, within the boundaries of which the Project is being developed, officially, such responsible division is the Department for treatment of requests by citizens and legal entities. It is understood that other divisions of the Administration of Zavodskoy district are involved into engagement activities on an as-needed basis.

The following means of communication are utilized by Minsk executive committee during stakeholder engagement on Minskvodokanal matters:

- Information distribution day;
- Live phone line sessions;
- Personal meetings held in accordance with a pre-defined schedule.

Minsk executive authority has a dedicated deputy chairperson who is in charge of coordinating the activities related to Minskvodokanal.

After the request related to Minskvodokanal matters is lodged to Minsk executive committee via any of the means of communication listed above, it is cascaded to a responsible person in Minskvodokanal for treatment. The Company's response to the request is provided in a written form.

7.3.2 External engagement by means of Minskvodokanal instruments

The engagement with external stakeholders by means of Minskvodokanal instruments is mainly arranged by the following structural divisions of the Company:

- Department for Organizational Affairs
- Operations Control Service
- Documentation Management Department

The following instruments are employed by Minskvodokanal to ensure timely engagement with consumers and other potential stakeholders:

- Personal meeting with the director of Minskvodokanal
- Personal meetings with heads of enterprises of Minskvodokanal (including Minsk water treatment plant)
- 'One window' service

Major functions of the divisions responsible for stakeholder engagement and consultations are provided in the figure 7.1 below.

Department for Organizational Affairs

- Information sharing with external stakeholders
- Engagement with media representatives in acordance with quarterly arranged media plan
- Operation of the website and social media pages of Minskvodokanal (namely, Youtube and Facebook pages)
- Marketing and publicity activities of Minskvodokanal
- Conceptual arrangement of community engagement principles
- Maintaining a wide variety of public relations activities including exhibitions, seminars, presentations, demonstrations, marches
- Control over employees' conformance with business ethics principles
- Introduction of the corporate directives and policies to the employees and organization of their observation
- Treatment of requests by citizens and legal entities
- Accumulation of data for 'information sharing days'
- Study of the workers' opinions and attitudes

Operations Control Service

- Hotline operation (24/7)
- Receipt of queries from citizens and distribution of them to the ultimate responsible party
- Management of the consumers' grievances requiring prompt resolution

Documentation Management Department

- Management of incoming correspondence
- Primary treatment of requests by citizens and legal entities
- Primary treatment of grievances (both internal and external)
- Operation of 'Contacts and quiries' website section including treatment of the queries and grievances received via e-mail

Figure 7.1 Departments of Minskvodokanal involved into stakeholder engagement

The human resources are distributed among the three divisions as follows:

- Department for Organizational Affairs – 4 specialists
- Operations Control Service – 19 specialists involved into operation control
- Documentation management department – 5 specialists

7.3.3 External grievance mechanism

In the practice of queries (grievances) treatment, Minskvodokanal adheres to the provisions of the Law of the Republic of Belarus 'On queries of citizens and legal entities' (July 18th, 2011) and Resolution of the Council of Ministers of the Republic of Belarus #1786 'On approval of the order of management of documents related to queries of citizens and legal entities to state agencies, other organizations and individual entrepreneurs' (December 30th, 2012). Based on these legal acts the Company has developed its 'Instruction on documentation management in relation to queries of citizens, individual entrepreneurs and legal entities to Minskvodokanal' approved on August 22nd 2014 and amended on January 25th 2016. The instruction indicates the overall order of treatment of all queries received by Minskvodokanal, which is depicted in Figure 7.2 in a simplified manner.

All queries received by Minskvodokanal (including electronic queries submitted via a special form on the corporate website) are registered by Minskvodokanal at the day of the submission and inserted into a digital control system (DCS) of document management. After registration, all queries are forwarded to

1. Incoming query of any type from all sources
2. Registration of the query by Documentation Management Department
3. Decision on review of the query ('resolution')
4. Transfer of the query to the responsible party
5. Preparation of the response and transfer of the response to the applicant
6. Grievance closure

Figure 7.2 External grievance mechanism of Minskvodokanal

the director, chief engineer and/or deputy directors and the decisions on the review of the queries are generated in a form of signed and dated 'resolutions'. Responsibilities, review period and final response dates are defined in resolutions. Once the resolution is signed, it is submitted to the register-control card within the DCS. Within a day afterwards, the queries are transferred to the responsible party defined in the resolution.

The query review period typically takes up to 15 days. This period may be prolonged depending on certain circumstances that are listed in the Instruction. If the query is not relevant to Minskvodokanal responsibilities, it is forwarded to the responsible agency within 5 days upon a receival or left without an answer with a necessary notification of a person lodged the query.

If the query is given an interim response, it is not marked as closed within the DCS until the final resolution is provided. The query is marked as closed if:

- All issues raised within the query are considered;
- Necessary measures are taken in order to resolve the issues raised;
- The persons who submitted the query are provided with written, oral or electronic responses.

The decision on closure of the query is taken by the director, chief engineer or deputy directors.

The principle of data confidentiality is directly described by the Law of the Republic of Belarus 'On queries of citizens and legal entities'. However, the Minskvodokanal mechanisms for queries and grievances treatment do not contain a clear statement that all personal data submitted by an applicant shall be treated in a confidential manner.

7.3.4 Internal grievance mechanism

Relationships and communication practices between the Minskvodokanal management and its employees (including former employees) are based upon the requirements of the Labour Code of the Republic of Belarus and the Law of the Republic of Belarus #433-3 'On administrative procedures' and the Order of the President of the Republic of Belarus #200 'On administrative procedures exercised by state and other agencies in response to citizens' queries'.

Based on the aforementioned legislative acts, Minskvodokanal issued an Order #157 'On the matter of exercising the administrative procedures'. This Order regulates the administrative procedures exercised by Minskvodokanal, as well as it establishes the Provisions of operations of the 'one window' submission principle and Instruction on documentation management in relation to queries related the administrative procedures. The norms of the Order #157 are relevant to the queries submitted by the Minskvodokanal employees (including the former employees).

The overall mechanism of redress of internal grievances is similar to the mechanism used for external queries treatment. The incoming queries (grievances) are registered in a specially maintained register within the DCS by the employees in charge of administrative procedures. All queries are registered and ascribed with a tracking number at the day of their submission. If the query is submitted orally, the relevant register entry is marked as 'oral submission'. The process of the query review and resolution is reflected within the register. The query is marked as 'closed' if all issues raised within the query are considered and the applicant is provided with a written, oral or electronic response.

Additionally, the following instruments for grievance submission are available for the workers of Minskvodokanal:

- Personal meeting with the enterprise's director;
- Labour disputes commission consisting of Minskvodokanal representatives and trade union representatives (in equal shares).

7.4 Past Project-related consultation and engagement activities

For disclosing Project-related information and engaging with relevant stakeholders, the following activities were employed:

- Statutory consultations conducted by MVK as part of the Belarusian EIA (OVOS);
- Public meetings held by Zavodskoy district administration jointly with Minskgrado;
- Disclosure of relevant information via media sources by the MVK;
- Engagement activities taken by Ramboll and MVK in November 2017;
- Relevant communications of MVK with stakeholders via established grievance mechanism.

7.4.1 National EIA consultations

In November 2015, Minskvodokanal initiated the public consultations on the national EIA of the planned reconstruction of Minsk water treatment plant (the Project). A special commission was created involving the representatives of Minskvodokanal, Minsk authorities and agencies. The consultations' notification was published in advance in 'Minsky kuryer' and 'Vecherny Minsk' newspapers (see Figure 7.3).

Additionally, the notification was posted online on the websites of Minsk executive committee and Minskvodokanal.

Уведомление об общественных обсуждениях

по объекту: «Реконструкция Минской очистной станции» (обоснование инвестиций)

Заказчик планируемой деятельности: КУПП «Минскводоканал», 220080, г. Минск, ул. Пулихова, 15, тел./факс +375 (17) 233-91-17, e-mail: info@minskvodokanal.by, сайт www.minskvodokanal.by.

Цели планируемой деятельности: реконструкция Минской очистной станции (МОС-1).

Обоснование планируемой деятельности: необходимость ремонта сооружений и замены технологического оборудования; совершенствование процесса очистки сточных вод для достижения требуемых показателей качества очищенных сточных вод; необходимость существенного снижения объемов хранения осадков сточных вод (отходов очистки); сокращение размеров санитарно-защитной зоны.

Описание планируемой деятельности:

- строительство нового здания решеток;
- замена существующих песколовок на новые;
- внедрение установки сепарации песка вместо песковых площадок;
- ремонт железобетонных конструкций первичных отстойников и аэротенков с заменой технологического оборудования;
- внедрение технологии глубокого удаления биогенных элементов;
- реконструкция с заменой технологического оборудования в следующих сооружениях: вторичных отстойниках, насосных станциях сырого осадка, фугата, илоуплотнителей и активного ила, воздуходувных станциях, цехах подготовки и обработки осадка, КНС (собственных нужд);
- внедрение системы обеззараживания сточных вод при помощи ультрафиолетового излучения;
- устройство перекрытия открытых сооружений механической очистки и удаление отходящих газов от всех зданий и сооружений механической очистки МОС-1 (приемная камера, здания решеток, песколовки, первичные отстойники, каналы транспортировки сточных вод между сооружениями механической очистки) на проектируемый комплекс по их очистке;
- строительство комплекса по утилизации осадков очистных сооружений г. Минска.

Место осуществления планируемой деятельности: *площадка канализационных очистных сооружений расположена в Заводском районе г. Минска, в промзоне «Шабаны», по адресу: ул. Инженерная, 1.*

Сроки осуществления планируемой деятельности: *2016–2022 годы.*

Орган, принимающий решение о разрешении строительства: *Минский городской исполнительный комитет, 220030, г. Минск, пр. Независимости, 8, e-mail: mgik@minsk.gov.by, сайт www.minsk.gov.by.*

Сроки проведения общественных обсуждений и представления замечаний: *30 (тридцать) календарных дней со дня опубликования уведомления об общественных обсуждениях в соответствии с п. 35-1 Положения о порядке проведения оценки воздействия на окружающую среду (далее — Положение).*

С отчетом об ОВОС можно ознакомиться:

— в администрации Заводского района г. Минска: 220026, г. Минск, ул. Жилуновича, 17, тел./факс +375 (17) 296-25-92; e-mail: zav.glav.priem@minsk.gov.by, сайт www.zav.minsk.gov.by. Контактное лицо Мартинкевич Дмитрий Станиславович, начальник отдела городского хозяйства.

— в КУПП «Минскводоканал»: 220088, г. Минск, ул. Пулихова, 15, e-mail: info@minskvodokanal.by, сайт www.minskvodokanal.by. Контактные лица: Ланько Ирина Петровна, начальник технического бюро (тел. +375 (17) 327-64-02, факс +375 (17) 233-91-17); Антонов Кирилл Викторович, начальник ПТО заместитель начальника производства «Минскочиствод» (тел. +375 (17) 327-88-36; факс +375 (17) 327-70-06).

Замечания и предложения по отчету об ОВОС можно направить *в администрацию Заводского района г. Минска по адресу: 220026, г. Минск, ул. Жилуновича, 17, или по e-mail: zav.glav.priem@minsk.gov.by.*

Заявление о необходимости проведения собрания по обсуждению отчета об ОВОС можно направить *в администрацию Заводского района г. Минска по адресу: 220026, г. Минск, ул. Жилуновича, 17, тел./факс +375 (17) 296-25-92, или на e-mail: zav.glav.priem@minsk.gov.by,* в течение 10 (десяти) рабочих дней со дня опубликования уведомления об общественных обсуждениях в соответствии с п. 37 Положения. В случае наличия заявления от общественности о необходимости проведения собрания по обсуждению отчета об ОВОС дата и место его проведения будут сообщены позднее.

Заявление о намерении проведения общественной экологической экспертизы можно направить *в администрацию Заводского района г. Минска по адресу: 220026, г. Минск, ул. Жилуновича, 17, или по e-mail: zav.glav.priem@minsk.gov.by, в течение 10 (десяти) рабочих дней со дня опубликования уведомления об общественных обсуждениях.*

Figure 7.3: Notification of public consultations in 'Minsky kuryer' newspaper

Source: Excerpt from 'Minsky kuryer' newspaper, October 14th, 2015

The notification included a short description of the planned activities. Clear instructions were provided on how the public may initiate or facilitate the following:

- Submission of queries and propositions (within a 30-day period after the notification is posted);
- Public assembly for discussion of the EIA report (within a 10-day period after the notification is posted);
- Request for carrying out a public ecological appraisal.

The EIA's non-technical summary was disclosed on the website of the city administration. The EIA report was made available at the premises of Zavodskoy district administration and Minskvodokanal.

The protocol of public consultations was prepared on November 20th, 2015, and reported the absence of requests for public assemblies for discussion of the Project submitted within the 10-day period after notification was posted. No queries or propositions were submitted within the 30-day period. Due to the absence of the aforementioned, the commission for public consultations stated that it does not object to further implementation of the Project.

7.4.2 Other consultations with communities via public meetings

In summer 2017, UP 'Minskgrado' and authorities of Zavodskoy district of Minsk initiated public consultations on the matter of proposed development of the 'Shabany' industrial area. The consultations started on July 24th and ended on August 17th. Minskvodokanal representatives did not take part in organization of the consultations. However, since the proposal for further spatial development of the area includes the Project implementation (though on the greenfield which is not relevant to the Project anymore), the results of the consultations provide valuable data on local communities' attitudes towards extension of Minsk waste water treatment plant on greenfield.

UP 'Minskgrado' was in charge of this engagement activity and announced the consultations on information boards in public places and in local media.

On July 26th, 2017, UP 'Minskgrado' and the authorities of Zavodskoy district held the presentation aimed at disclosing principle ideas of the proposed spatial development plan. The meeting was held at 'Zolak' cultural center and was attended by eight persons from Novy Dvor, including the local leader ('*starosta*'). Overall, during the consultation period 14 queries, including one collective query, were received.

Major concerns of local residents in relation to the overall plan for Shabany industrial area development were as follows:

- Unpleasant scent caused by Minskvodokanal activities and coming from local sewage pumping station;
- The issue of sediment incineration and related air pollution that may be potentially caused by the Project implementation, which is viewed especially significant by Novy Dvor residents as the settlement is 'surrounded' (as reported by local citizens during the consultations) by various industrial facilities;
- Concern on contamination of soils of lands used for subsistence farming resulted from the area development;
- EIA presented during consultations was prepared in 2012 with some statistical data dated 2007;
- The issue traffic load increased by the area development;
- Negative health impacts;
- Ash transportation;
- Scarce description of alternatives for incineration facility construction at the Minskvodokanal water treatment plant;
- Necessity for ensuring a green buffer zone between residential areas and the proposed development;
- Potential transformation of agricultural lands (between Novy Dvor and Minskvodokanal facilities) into industrial lands (this concern was signed by 91 residents of Novodvorsky rural council).

All queries were provided with written responses.

On September 1st, 2017, the Council for Architecture and Urban Planning of Minsk executive committee issued the protocol summarizing the aftermath of the public consultation process. The protocol reports that the grievances received during the consultation process do not present proof of law violation caused by the proposed development and shall not prevent the development plan from implementation.

7.4.3 Information disclosure via media

As mentioned in Figure 7.1, the Department for organizational affairs is in charge of communication with media sources. The series of activities related to disseminating information in respect to Minskvodokanal practices in general and Project in particular include the following:

1. Engagement with printed media, electronic media, TV and radio on a variety of topics including dissemination of up-to-date information on job opportunities and reconstruction of Minsk waste water treatment plant (selected media entries are re-posted on https://www.minskvodokanal.by/press/mass-media/).
2. Information disclosure via the corporate website (www.minskvodokanal.by/), which was substantially updated in June 2016 and is now well accessible from all types of gadgets including mobile phones. The website contains Minskvodokanal contact information, as well as grievance/queries' forms and information on time slots for personal meetings. Minskvodokanal also maintains its Facebook and YouTube pages.
3. Information disclosure via cash processing centers where the stands are placed in order to publish up-to-date data on Minskvodokanal activities.

During the past two years the following media entries were published detailing the implementation of the Project and the overall issues of Minsk water treatment plant:

- TV Channel 'Stolichnoye televidenie': 'Environmental and efficient' report published on July 10th, 2017 and available at https://www.minskvodokanal.by/press/mass-media/ctv-ekologichno-i-ekonomichno/;
- Newspaper 'Respublica': 'On treatment campaign' article published on July 21st, 2017 and available at https://www.sb.by/articles/ot-vsey-ochistnoy-kompanii.html ;
- Newspaper 'Minsky kuryer: 'At the limit of its capacity' article published on June 18th, 2017 and available at http://mk.by/2017/06/28/165206/;
- Website TUT.by: 'Reason for Minsk water treatment upgrade worth 150 million euro' article posted in June 28th, 2017 and available at https://news.tut.by/society/549189.html.

7.4.4 Consultation activities taken by Ramboll

In November 2017, Ramboll consultants together with MVK conducted the following stakeholder engagement activities:

- A meeting with the representatives of Minskgrado and administration of Zavodskoy district of the City of Minsk;
- A meeting with the Head of Novodvorsky rural council Nikolay Maksimchikov

During the first meeting, the following officials were interviewed:

- Natalya Gurkova-Maslova (Representative of the Committee of architecture and urban planning of Minsk executive committee)
- Marina Pivovarchik (Head of the Department of Architecture of the Directorate of Architecture and Construction of Zavodskoy district)
- Mikhail Drushchits (Representative of Minskgrado)

The topics raised and discussed:

- Spatial development of Shabany industrial urban area
- Major issues faced by the urban planners during the Shabany masterplan preparation
- Development of the Special Economic Zone 'Minsk'
- Public hearings and previous presentation of the project for extension of the Shabany industrial urban area towards the nearby rural areas and rural settlements
- Major grievances raised by local communities including Shabany-1 and Shabany-2 neighbourhoods and local rural settlements' residents
- Major concerns of local residents in relation to Minskvodokanal activities and other industrial practices in the area

During the meeting with the Head of Novodvorsky rural council, Ramboll consultant discussed a variety of topics on socio-economic development of local rural communities:

- Demographic structure of local communities;
- Social infrastructure capacity;
- Economic situation in Novodvorsky agro-town;
- Local residents' demand for upgraded housing;
- The issue of four houses/buildings located on the territory of former Shabany village that are, reportedly, used as summer houses.
  - In February and March 2017, Ramboll and Minskvodokanal conducted the first consultations with persons living in four households of former Shabany village. The results of the consultations are presented in section 9.3.3.

7.4.5 Relevant communication with stakeholders

Minskvodokanal receives periodic complaints (via established grievance mechanism) from the residents of Sinilo village regarding the unpleasant scent from the sludge lagoons operated by Minskvodokanal. The sludge is transported to these ponds from Minsk water treatment plant, which is subject to Project activities. The implementation of the Project shall cease further expansion of the sludge lagoons.

7.5 Conclusions

In general, the approach of the Company towards stakeholder engagement enables proper and timely reaction to the incoming queries. The grievance mechanism of the Company contains a universal action protocol, which has been in operation for three years by now and is deemed to be sufficiently sustainable in the event of new personnel appointments within the responsible departments of the Company.

Consultations that preceded preparation of this ESIA in line with EBRD requirements were of discontinous nature in respect to the international requirements, though in line with national requirements of the Republic of Belarus.

In 2015, on the one hand, Minskvodokanal conducted public consultations as part of national EIA process but no feedback was received from the interested parties. On the other hand, the consultations conducted by Minskgrado in 2017 demonstrated a high level of involvement of the residents of Zavodskoy district of Minsk and of Novodvorsky rural council. During the course of the Minskgrado-led consultations a wide range of local residents’ concerns were registered regarding “Shabany” industrial area development and, in particular, rehabilitation of Minsk WWTP facilities.

Taking into account the current situation, it is necessary to conduct additional consultations with the interested parties and ensure proper information disclosure based on results of Supplementary ESIA in compliance with international requirements, appropriate recording and handling of the stakeholders’ grievances.

As part of this ESIA preparation, the Stakeholder Engagement Plan (SEP) was developed containing a range of recommended measures to ensure the consultations and disclosure practice of MVK is aligned with the EBRD requirements.

8. ENVIRONMENTAL IMPACT ASSESSMENT

8.1 Air Pollution Impacts Assessment

8.1.1 Existing sources of pollution emissions

Information on sources of pollution emissions to air is provided in Section 5.1.1 Book 6 Volume 14.043-06[64] and Comprehensive Environmental Permit No.5 issued to UE Minskvodokanal by Minsk City Committee for Natural Resource and Environmental Protection on 30 November 2015 (revision of 31 August 2017).

The main sources of emissions at the sites of Minsk Waste Water Treatment Plant are the mechanical and biological treatment facilities at MWWTP-1 and MWWTP-2 and sludge treatment facilities at MWWTP-1, namely:

- Screening facilities;
- Primary sludge pumping stations;
- Grit removal basins (MWWTP-1 – 6 units, MWWTP-2 – 3 units);
- Primary sedimentation tanks (MWWTP-1 – 14 units, MWWTP-2 – 4 units);
- Grid drying beds;
- Activated sludge pumping stations;
- Aeration tanks (MWWTP-1 – 11 units, MWWTP-2 – 5 units);
- Secondary sedimentation tanks (MWWTP-1 – 2 units, MWWTP-2 – 8 units);
- Pumping stations of sludge thickeners;
- Sludge pre-treatment facilities and sludge treatment facilities.

The main air pollutants generated by operation of the mechanical and biological treatment facilities at MWWTP-1 and MWWTP-2 are:

- ammonia;
- hydrogen sulphide;
- methane.

Emission sources at the auxiliary and laboratory facilities of MWWTP are:

- exhaust hoods at the chemical-bacteriological laboratory;
- turning and blank preparation facilities at the mechanical maintenance workshops;
- welding stations;
- repair stations at the electrical maintenance workshop;
- painting section of the building maintenance workshop.

The building maintenance workshop (woodworking section) is equipped with an air treatment system to remove timber dust:

- cyclone OEKDM No.16 with purification efficiency of 80.9- 83.99% and
- cyclone D1600 with purification efficiency of 79.2-80.7%.

Pollution emissions from operation of auxiliary workshops and laboratory facilities are minor in terms of volumes and their impact on air quality at MWWTP sites and at the boundary of SPZ and the nearest residential area is minor.

[64] Reconstruction of Minsk Waste Water Treatment Plant. Feasibility Studies. Environmental Protection. Environmental Impact Assessment. – Minsk: Republican Unitary Design Enterprise "BELKOMMUNPROJECT", 2016

The total number of permanent emission sources in the Project area is 163, including 139 stationary sources and 24 fugitive sources. 11 gas treatment units are provided at the operational site of the nature user, with residual pollutants emitted to the indoor work areas[65].

Emissions from fugitive permanent sources account for 98.9% of the total mass flow of pollution emissions from the Company operations.

Ammonia, hydrogen sulphide and methane emissions at the Volma sludge disposal site originate from the sludge lagoons.

8.1.2 Current emission levels

In 2016 emissions from MWWTP operations totalled in 428 tons[66]. Three pollutants (methane, ammonia and hydrogen sulphide) make up about 99.8% of the total mass flow of emissions, with methane emissions contributing as much as 95%. Combined contribution of ammonia and hydrogen sulphide is about 4%.

Review of annual changes in pollution emissions from sources at MWWTP over the period 2013-2016 indicates a decrease of total mass flow of emissions from 532 tons in 2013 to 428 tons in 2016, i.e. annual emissions quantity has reduced by almost 20%, mainly due to the reduction of methane emissions (Table 8.1).

Table 8.1: Pollution emissions from sources at MWWTP, 2013-2016

Pollutants	t.p.a.			
	2013	2014	2015	2016
Nitrogen dioxide	0.097	0.097	0.097	0.017
Ammonia	10.405	10.651	9.830	8.150
Hydrochloride (hydrogen chloride, hydrochloric acid)	-	-	-	0.003
Xylene (mix of o-, m-, p- isomers)	0.104	0.104	0.111	0.015
Copper and its compounds (as Cu)	0.036	0.036	0.034	0.001
Methane	510.327	459.542	406.317	409.099
Nickel and its compounds (as Ni)	-	-	0	0
2-propanone (acetone)	0.005	0.005	0.005	0.008
Other substances of hazard class 2 (total)	0.007	0.007	0.007	0.017
Other substances of hazard class 3 (total)	0.231	0.231	0.230	0.133
Other substances of hazard class 4 (total)	0.019	0.019	0.019	0.006
Wood dust	0.862	0.862	0.860	0.357
Inorganic dust with silicic dioxide of less than 70% (fire clay, cement, etc.)	0.025	0.025	0.038	0.036
Hydrogen sulphide	11.539	9.519	10.645	9.918
Total solids	0.015	0.015	0.019	0.013
Acyclic hydrocarbons	0.076	0.076	0.086	0.021
Aromatic hydrocarbons	0.073	0.073	0.082	0.020
Unsaturated hydrocarbons of aliphatic series	0.097	0.097	0.110	0.018
Saturated hydrocarbons of aliphatic series C1 - C10	0.047	0.047	0.053	0.025

[65] Development of Sanitary Protection Zone Project for Minsk Waste Water Treatment Plant of UE Minskvodokanal at the site address: Minsk, 10 Inzhenernaya St. Report / Private Unitary Research and Production Enterprise "Environmental Centre "Pylegazoochistka". Minsk, 2018. 90 p.

[66] Statistical reporting Form 1-air 2016.

Pollutants	t.p.a.			
	2013	2014	2015	2016
Phenol (hydroxybenzene)			-	0.000
Gaseous fluoride compounds (as F) - hydrofluoride	0.001	0.001	0.001	0.000
Chromium (VI)		0.0	0.0	0.000
Butyl acetate (acetic acid butyl ether)	0.011	0.011	0.01	0.000
Saturated hydrocarbons of aliphatic series C11 - C19			-	0.001
Total:	**532.271**	**479.712**	**426.792**	**428.000**

Reported total quantity of pollution emissions from operation of the Volma sludge facilities in 2016 is 2102.7 tons including:

- Ammonia – 87.7 tons;
- Hydrogen sulphide – 0.2 tons;
- Methane – 2012.8 tons.

8.1.3 Design solution for control of pollution and odour emissions

Air quality is a major problem in the location area of Minsk WWTP. Operations of dozens of industrial sites and heavy traffic generate a wide range of pollutants which are emitted to air and dispersed over vast territories including residential areas in Minsk city and district. The conventional marker substances of MWWTP contribution are sulphur and nitrogen compounds which feature a distinct unpleasant odour, therefore local communities and visitors of the area tend to blame the treatment plant for contamination of air, despite the relatively small quantities of such emissions.

The excessive release of hydrogen sulphide, mercaptan, amines and other odorous substances (odorants) at MVK facilities (WWTP and Volma sludge facilities) is mainly caused by the large area of open surfaces for evaporation of waste water and sludge. Therefore, the reconstruction design provides for isolation of a large group of mechanical treatment facilities from free gas exchange with atmosphere – primary sedimentation tanks, channels and grit basins will be closed with special hoods. Gaseous phase from under the hoods will be pumped through a block of scrubbers (wet cleaning systems for gas-vapour mixtures) before emission to air at one central source.

Efficiency of such systems as way to reduce pollution emissions, in particular odorants from wastewater treatment plants is proven by operation in EU and the USA.

MWWTP reconstruction programme includes a range of measures to enhance wastewater treatment performance and achieve the required effluent quality at operation with the forecasted influent load (420 th.m^3/day for MWWTP-1):

- construction of new coarse screening chamber will improve removal of coarse particles (additional fine screens with bar spacing of 6 mm (3 operating and 1 backup) will be provided, as well as new coarse screens with bar spacing of 12 mm (3 operating and 1 backup));
- construction of new horizontal aerated grit removal basins with fat collection system (3 sections with two compartments, total length 60 m, width 6 m, water depth 4.5 m) instead of the existing ones which are too small to achieve the required treatment performance, will significantly enhance removal of insoluble mineral impurities (suspended solids) and fat;
- the new grit separation chamber which will be implemented instead of the existing grit beds will provide quick washing and drying of grit collected from the grit removal basins, thus the impact on air quality will be minimized, and grit transported to MSW landfill will be cleaner;

- rehabilitation of RC structures of the primary sedimentation tanks, replacement of sludge scrapers, provision of plastic central deflector bowls and saw-toothed weirs to equalize hydraulic load throughout the tanks area;
- reconstruction of concrete elements of aeration tanks to provide internal mixing zones and special partitions to guide the flow of mixed liquor; implementation of nitrification and denitrification technology for biological removal of phosphorus; provision of a set of aeration and mixing equipment, as well as instrumentation and control equipment to steer the biological treatment process;
- provision of plastic weirs, central inlet units, as well as sludge suction systems for removal of settled sludge from the secondary sedimentation tanks, to equalize hydraulic load throughout the tanks area and improve the treatment performance;
- implementation of effluent UV disinfection system using a gravity-flow unit based on trough-type module 88MLV-36A800-M-G (5 channels with EV disinfection modules, 4 operating sections and 1 standby section, 2 modules per section) will improve bacteriological quality of treated effluent to meet the regulatory requirements;
- reconstruction and technical renovation on the basis of fault detection reports for the following facilities: primary sludge pumping stations Nos. 2, 3, 4, blower stations Nos. 2 and 3, activated sludge pumping stations Nos. 1, 2 and 3, sludge thickener pumping stations Nos. 1 and 2, sludge preparation and dewatering units, centrate pumping station, waste water pumping station (for local site needs);
- provision of cover on open mechanical treatment facilities integrated with waste gas collection system serving all buildings and facilities at MWWTP-1 site (inlet chamber, screen chambers, grit removal basins, primary sedimentation tanks, waste water transportation channels between the facilities), and waste gas delivery to the new air treatment facilities, with the aim of reducing the negative impacts on atmospheric air.

All above measures will contribute to reduction of emissions of ammonia and hydrogen sulphide, however the most efficient component is the system for collection and treatment of emissions from the mechanical treatment facilities at MWWTP-1.

The air treatment facilities will be constructed at the site of the existing grit drying beds. The system of ducts will transport the collected air (500,000 m^3/h) to high-pressure feeding fans of the gas treatment facilities.

The air treatment process will consist of three stages (refer to Figure 4.2 in the Project Description Section):

- sulphuric acid (H_2SO_4) scrubbing;
- sodium hypochlorite (NaClO) scrubbing;
- sodium thiosulphate ($Na_2S_2O_3$) scrubbing.

The acid scrubber consists of three functional zones. The lowest zone serves as a liquid holding reservoir and is equipped with all necessary fittings for connection to recirculation pumps of the gas treatment unit, for blowing-down and level control. The air tube and sight window are provided immediately above this zone.

The medium zone of the scrubber contains the reactor line: a packed bed mounted on support grid which features minor flow resistance and fair mass-transfer performance. The scrubber upper zone contains the liquid spreader units followed by demister. The cleansing agent – sulphuric acid solution – is fed from tank by circulating pumps.

Contaminated air flows through the reactor in the opposite direction (against the washing fluid) to demister where residual liquid is removed. After that air is successively passed through the remaining treatment stages: with sodium hypochlorite and sodium thiosulphate.

The above process will remove 95% of impurities contained in air discharges of the waste water treatment facilities, and purified air will be extracted from the building by a system of fans.

Pollution levels in air from the mechanical waste water treatment facilities at MWWTP-1 at the inlet and outlet of the gas treatment facilities (removal performance 95%) are summarized in Table 8.2.

Table 8.2: Pollution emissions from mechanical treatment facilities at MWWTP-1, after reconstruction

Pollutant	Bulk emission			
	Before treatment		After treatment, removal rate 95%	
	g/s	t/a	g/s	t/a
Ammonia	0.19	2.69	0.01	0.13
Hydrogen sulphide	0.41	6.47	0.02	0.32
Methane	12,15	172,12	0,61*	8,60

As a result of the reconstruction project total pollution emissions from MWWTP will decrease by 1.9 times, through reduction of emissions of ammonia, hydrogen sulphide and methane. The design does not provide for reduction of emissions of other pollutants.

Some other elements of the proposed reconstruction are related to the new sources of emissions, including the sludge treatment complex and its system of sludge digestion, dewatering and drying facilities which will be provided with gas scrubbers too.

8.1.4 *Pollution dispersion analysis for SPZ project*

Ground-level concentrations of polluting substances in air were estimated in 2017 as part of development of new project for SPZ. Simulation was run using Ekolog software, assuming the maximum load on the process plant and simultaneous operation of all processes at the WWTP site.

Simulation of pollution dispersion from the existing sources at MWWTP showed that concentrations of all controlled pollutants (including hydrogen sulphide and ammonia) at the boundary of residential area and the designed SPZ are within the air quality limits, namely MPC for residential areas (Table 8.3).

Estimated content of hydrogen sulphide in ground-level air is 0.9 MPC at the boundary of residential area, 0.84 MPC at the boundary of designed SPZ. Concentrations of the summation group of ammonia and hydrogen sulphide at the boundary of residential zone and the designed SPZ are 0.96 MPC and 0.9 MPC, respectively (Figure 8.1).

Table 8.3: Pollution dispersion analysis for MWWTP before reconstruction

Pollutant	Maximum level, MPC fractions (current situation)			
	In residential area		At the boundary of designed SPZ of 500 m	
	With background	Without background	With background	Without background
Ammonia	0.19	0.07	0.19	0.07
Hydrogen sulphide	-	**0.96**	-	**0.84**
Summation group (ammonia + hydrogen sulphide)	-	**0.96**	-	**0.90**

Monitoring data from the boundary of residential area collected within the scope of the Environmental Monitoring Programme 2017 showed that actual hydrogen sulphide levels did not exceed the MPC standard (8 μg/m^3) and were below the limit of quantification (less than 3 μg/m^3) in 90% of samples. The maximum measured concentrations of hydrogen sulphide at the boundary of residential area are reportedly as follows:

- 0.89 MPC – in December 2017;

- 0.8 MPC – in August 2017;
- 0.7 MPC – in September 2017.

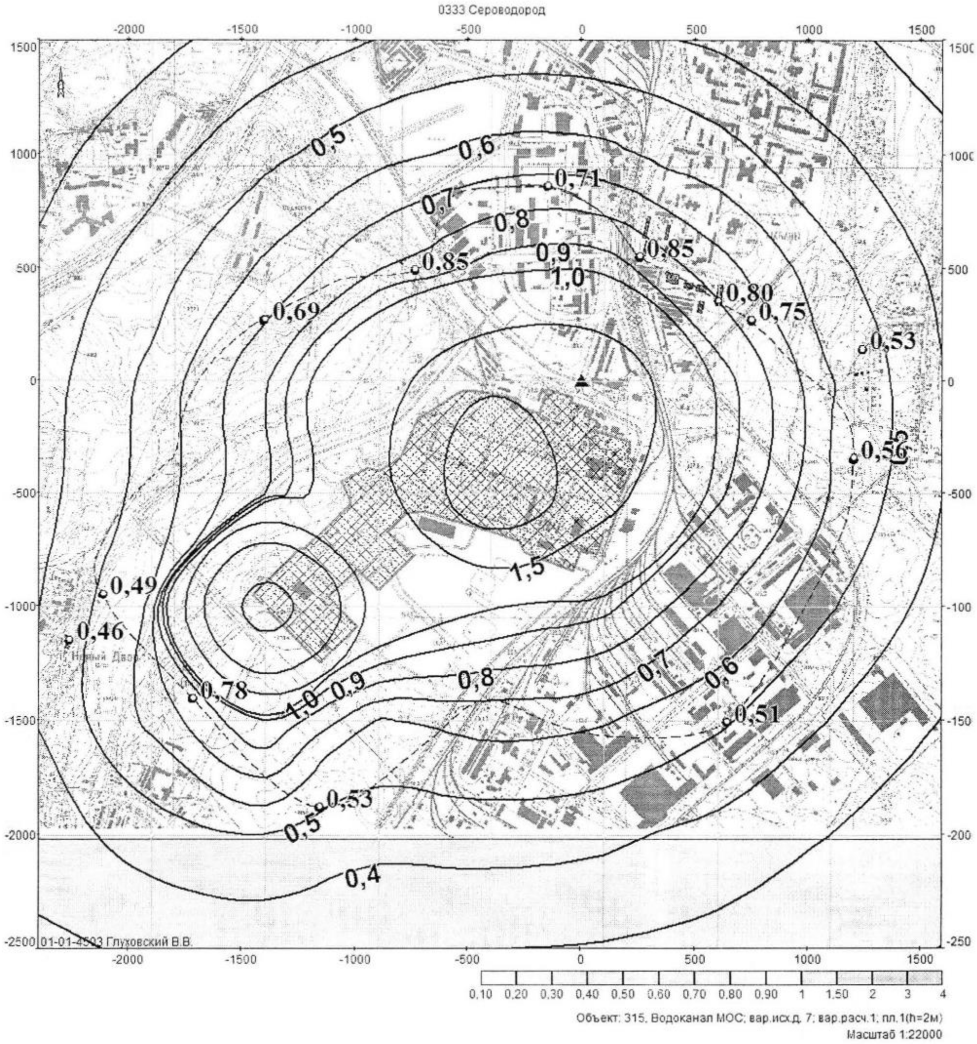

Figure 8.1: Hydrogen sulphide dispersion analysis, before MWWTP reconstruction

8.1.5 Pollution dispersion analysis for the baseline situation and after the Project implementation

In order to determine the effect of emissions on air quality and community health in the location area of MWWTP, the Consultant prepared pollution dispersion analysis using Ekolog software (to make the output compatible with results of other dispersion simulations) with the model MPP-2017 (updated version of model OND-86). The simulations were conducted for the existing situation ("zero alternative", or "No Project") and MWWTP-1 reconstruction Option 2 which would bring about the heaviest impact on atmospheric air.

Input data on the baseline situation was adopted from the emission sources inventory and the Project of the Sanitary Protection Zone which was developed by UE Environmental Centre "Pylegazoochistka" in 2017.[67]. Parameters of MWWTP-1 reconstruction were sourced from the basic EIA (UE Belkommunproject, 2016) after prior approval by the Technical Consultant (Sweco Danmark).

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[67] Development of Sanitary Protection Zone Project for Minsk Waste Water Treatment Plant of UE Minskvodokanal at the site address: Minsk, 10 Inzhenernaya St. Report / Private Unitary Research and Production Enterprise "Environmental Centre "Pylegazoochistka". Minsk, 2018. 90 p.

The polluting compounds content is limited in the Republic of Belarus by Maximum Permissible Concentrations measured at peak 20-30 min time and the maximum possible inputs from all sources are used for air modelling (worst-case scenario). Therefore these values are less dependent on the average characteristics and shall be takes at their maximum in g/s. Emissions from evaporation surfaces (tanks and other equipment) will depend on their open area. Emissions for sludge treatment process are considered at the full capacity. Table 8.4 demonstrates the maximum 20min emissions in g/s in respect to OVOS 2016г., but the annual air emissions are corrected using the new target capacity for MWWTP1 – decreased from 550 thous. (total 278 t/day of sludge dry solids) to 420 thous. m^3 (total - 150 t of sludge dry solids) per day.

The baseline dispersion analysis results are provided in Annex C 8.1-8.9. The results table uses special colour coding to highlight the sources which will stop functioning after the proposed reconstruction (red background) and sources at MWWTP-2 (yellow background) which will not be affected by the Project.

Annex C 8.10-8.18 provides pollution dispersion analysis for MWWTP-1 reconstruction Option 2. Green background in the table is used to highlight the new sources of emissions associated with the designed facilities: Nos. 156-161 – scrubbers and other air treatment systems, Nos. 162-164 – digesters, Nos. 165-169 – biogas fired power generator, Nos. 170-171 – biogas holding tanks, Nos. 172, 173 – sludge incinerator, No. 174 – flaring system.

Despite the fact that the selected option for reconstruction of MWWTP-1 provides for implementation of a sludge incinerator which will inevitably increase of the range of pollutants emitted to air and elevate concentrations of common combustion products of organic matter (carbon oxide, oxides of nitrogen and sulphur – refer to Table 8.4), the resultant pollution concentrations will still remain within the permissible limits in the area of existing sanitary protection zone, but also at a distance of 500 m from the boundary MWWTP site (Table 8.6). Thus, a new project for reduced SPZ can be developed in the future.

Table 8.4: Major pollutants in emissions from MWWTP, baseline and after reconstruction

Ref.	Pollutants		Baseline		Operation after implementation of the preferred reconstruction option		
	Code	Description	g/s	t/a	g/s	Feasibility study 2015	Project
1	410	Methane	12.932	444.941	20.6137	369,65	199.6
2	301	Nitrogen dioxide	0.04849	0.109	9.4286	281.4	152.0
3	337	Carbon oxide	0.4937	0.818	7.8221	192.4	103.9
4	303	Ammonia	0.2959	9.7842	0.2529	8.17	4.41
5	333	Hydrogen Sulfide	0.147	10.174	0.1277	7.769	4.195
6	140	Copper sulphate (as Cu)	0.002	0.008	0.0164	0.423	0.228
7	143	Manganese and its compounds	0.00311	0.0065	0.01751	0.421	0.227
8	203	Chromium (VI)	0.000066	0.000046	0.01447	0.415	0.224
9	123	Iron oxide	0.071	0.221	0.071	0.221	0.119
10	616	Dimethylbenzene (xylene)	0.075	0.18	0.075	0.180	0.10

Comparison of future and baseline situation in terms of emissions of major pollutants:

Increase of emissions
Reduction of emissions

Table 8.5: Main emissions from sludge digestion and biogas utilization, and sludge incineration

Source of pollutant emissions	Pollutants	Design pollutant emissions		
		g/s	t/a	
			Design capacity 550 ths. m³/day (278 t on a dry basis)	Adjusted design capacity 420 ths. m3/day (150 t on a dry basis)
Digestion and Biogas Utilization				
Methane tanks (№№162-164)	Methane	7.72	4.21	2.27
Power Generator (№№ 165-169)	NO_2	2.16	90.55	48.90
	CO	3.75	117.72	63.57
	Alkanes C_1-C_{10}	0.86	27.16	14.67
Gas holders (№№ 170-171)	Methane	2.81	0.94	0.51
Flaring system (№174)	NO_2	0.93	2.28	1.23
	CO	1.21	2.96	1.60
	Alkanes C_1-C_{10}	0.28	0.68	0.37
Sludge Incinerator				
Insenirator (№№ 172-173)	NO_2	5.76	165.82	89.54
	CO	1.44	41.46	22.39
	Алканы C_{12}-C_{19}	0.29	8.29	4.48
	SO_2	1.44	41.46	22.39
	Suspended Solids	0.29	8.29	4.48

Table 8.3: Projected maximum pollution levels in the reference points at the boundary of the nearest residential areas and reduced sanitary protection zone (SPZ) of 500 m

Ref;	Pollutants		Maximum ground level concentrations in reference points * (RP), fractions of MPC			
			Baseline		Operation of the Project	
	Code	Description	Residential area	SPZ	Residential area	SPZ
1	123	Iron oxide	0.01	0.01	0.01	0.01
2	140	Copper sulphate (as Cu)	0.01	0.02	0.04	0.04
3	143	Manganese and its compounds	0.02	0.01	0.02	0.02
4	203	Chromium (VI)	less than 0.001		0.05	0.05
5	301	Nitrogen dioxide	0.3	0.3	0.66	0.65
6	303	Ammonia	0.22	0.22	0.2	0.21
7	333	Hydrogen sulphide	0.98	0.86	0.62	0.71
8	337	Carbon oxide	0.14	0.14	0.16	0.16
9	410	Methane	0.02	0.02	0.01	0.01
10	616	Dimethylbenzene (xylene)	0.02	0.02	0.02	0.02

*The values represent the points with maximum concentrations of pollutants

Comparison of future and baseline situation:

Increase of pollutant concentration compared to baseline
Decrease of pollutant concentration compared to baseline

The findings are illustrated by a series of schematic maps with isometric lines of pollution concentrations before and after the reconstruction. The reduction of the isometric lines for 0.5 MPC and 1 MPC is highlighted for two key substances – ammonia and hydrogen sulphide (Annex C8.19).

A fragment of schematic map which is provided below in Figure 8.1a illustrates dispersion of hydrogen sulphide, the most problematic component of MWWTP emissions. The figure shows that after implementation of the selected option of reconstruction of MWWTP-1 the dispersion area of H_2S will shrink (red contour with hatched filling inside the contour with dotted filling that depicts the baseline area of dispersion) and split in two parts.

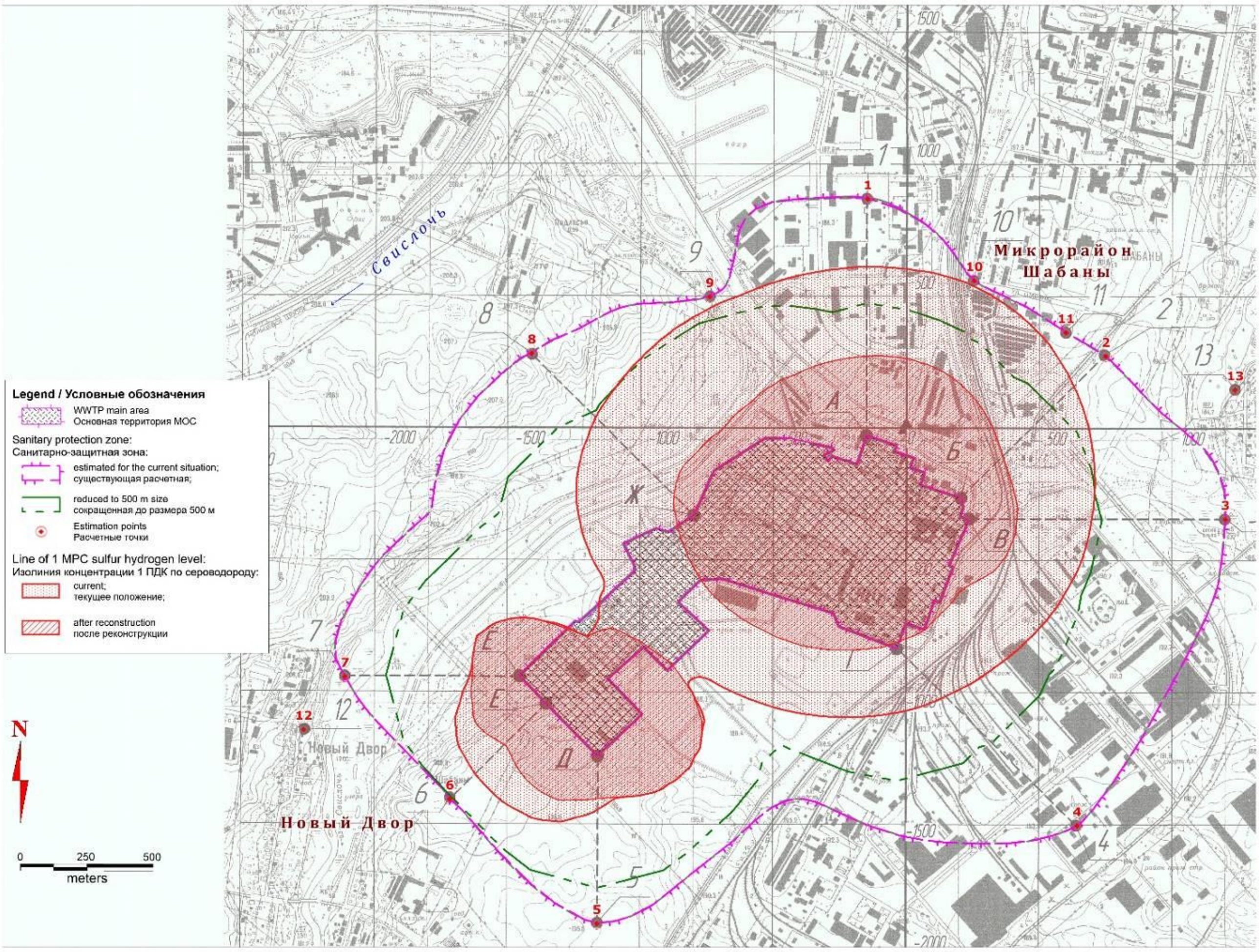

Figure 8.2: Reduction of pollution dispersion areas after MWWTP reconstruction (sample map for hydrogen sulphide)

As the available calculations demonstrate compliance with pollution concentration standards taking into account the background pollution level, the following conclusions can be drawn: 1) the health impact is admissible even for the 4 households in the former Shabany village; and 2) significant reduction of SPZ area is possible after the Project implementation.

8.1.6 Comparison of pollution emissions of various MWWTP reconstruction scenarios

Pollution emission parameters of various options of MWWTP reconstruction in terms of waste water sludge disposal (based on EIA 2016) are shown in Table 8.7[68].

[68] Pollution parameters of the sources which are not related to MWWTP reconstruction facilities or which are identical in all scenarios are left out the Table.

Table 8.4: Pollution emissions of various MWWTP reconstruction scenarios

Pollutant	Baseline	Option 1 Drying + incineration + generation of thermal and electric energy		Option 2 Digestion + drying + incineration + generation of thermal and electric energy		Option 3 Drying + incineration + production of alternative fuel		Option 4 Drying with natural gas + production of alternative fuel	
		Feasibility study 2015	Project	Feasibility study 2015	Project	Feasibility study 2015	Project	Feasibility study 2015	Project
	t/a	t/a		t/a		t/a		t/a	
Divanadium pentoxide	0	0.415	0.224	0.415	0.2241	0.280	0.151	0	0
Cadmium and its compounds	0	0.041	0.022	0.041	0.022	0.280	0.151	0	0
Cobalt	0	0.415	0.224	0.415	0.224	0.280	0.151	0	0
Copper and its compounds	0.036	0.451	0.244	0.451	0.244	0.036	0.019	0.036	0.019
Manganese and its compounds	0.007	0.421	0.227	0.421	0.227	0.287	0.155	0.007	0.004
Sodium hydroxide	0	0.000	0.000	0.000	0.000	0.280	0.151	0	0
Nickel oxide	0	0.415	0.224	0.415	0.224	0.280	0.151	0	0
Mercury and its compounds	0	0.041	0.022	0.042	0.023	0.028	0.015	0	0
Lead and its inorganic compounds (as Pb)	0	0.041	0.022	0.041	0.022	0.028	0.015	0	0
Thallium carbonate (as Tl)	0	0.04	0.02	0.04	0.02	0.03	0.016	0	0
Chromium (VI)	0.00002	0.41	0.22	0.41	0.22	0.03	0.016	0.00002	1.08E-05
Antimony	0	0.41	0.22	0.41	0.22	0.03	0.016	0	0
Nitrogen (IV) oxide	0.097	165.921	89.597	281.391	151.951	112.097	60.532	45.707	24.682
Ammonia	11.126	7.937	4.286	7.937	4.286	7.937	4.286	7.937	4.286
Hydrochloride	0.011	8.302	4.483	8.302	4.483	5.611	3.030	0.011	0.006
Arsenic	0	0.415	0.224	0.415	0.224	0.028	0.015	0	0
Sulphur dioxide	0	41.5	22.4	41.5	22.4	0.03	0.016	0	0

Pollutant	Baseline	Option 1 Drying + incineration + generation of thermal and electric energy		Option 2 Digestion + drying + incineration + generation of thermal and electric energy		Option 3 Drying + incineration + production of alternative fuel		Option 4 Drying with natural gas + production of alternative fuel	
		Feasibility study 2015	Project	Feasibility study 2015	Project	Feasibility study 2015	Project	Feasibility study 2015	Project
	t/a	t/a		t/a		t/a		t/a	
Hydrogen sulphide	12.6	6.2	3.3	6.2	3.3	6.2	3.3	6.2	3.3
Carbon oxide	0.3	41.7	22.5	191.8	103.6	28.3	15.3	28.2	15.2
Gaseous fluoric compounds	0.001	0.830	0.45	0.830	0.45	0.561	0.303	0.001	0.0005
Saturated hydrocarbons C1-C10	0.047	0.047	0.025	34.688	18.732	0.246	0.133	0.246	0.133
Methane	516.6	268.6	145.0	273.8	147.9	268.6	145.0	268.6	145.0
Unsaturated hydrocarbons	0.097	0.097	0.052	0.097	0.052	0.296	0.160	0.296	0.160
Acyclic hydrocarbons	0.076	0.076	0.041	0.076	0.041	0.307	0.166	0.307	0.166
Banz(a)pyrene								0.000006	3.24E-06
n-butanol	0.03	0.03	0.016	0.03	0.016	0.17	0.09	0.17	0.09
2-ethoxy ethanol	0.01	0.01	0.005	0.01	0.005	0.06	0.03	0.06	0.03
2-propanone	0.01	0.01	0.005	0.01	0.005	0.10	0.05	0.10	0.05
Saturated hydrocarbons C11-C19	0.00	8.29	4.48	8.29	4.48	5.60	3.02	0.00	0.00
Particulate matter	0.02	8.31	4.49	8.31	4.49	5.62	3.03	0.02	0.01
Dioxins	0	8.2E-08	4.43E-08	8.2E-08	4.43E-08	5.6E-08	3.02E-08	0	0
Total:	**542.5**	**562.8**	303.9	**868.2**	468.8	**475.4**	256.7	**368.6**	199.0

The maximum bulk emissions (468.8 t/a) are expected in case of implementation of Option 2. The priority pollutants for this option are nitrogen dioxide (32.4%), methane (31.5%), carbon oxide (22.1%), sulphur dioxide (4.8%) and saturated hydrocarbons (C1-C10 – 4%).

In terms of bulk emissions (199.0 t/a), reconstruction Option 4 (drying with natural gas and production of alternative fuel) only slightly differs from reconstruction scenario without construction of sludge disposal facilities. Emissions of methane, ammonia and hydrogen sulphide would be supplemented by nitrogen dioxide and carbon oxide. Option 4 significantly differs from other options by presence of benz(a)pyrene, however quantity of this pollutant would be small – 0.000003 t/a.

Pollution emissions of Options 1 and 3 would amount 303.9 t/a and 256.7 t/a, respectively. While methane emissions levels of the two scenarios are similar, Option 1 differs from Option 3 by significantly higher emissions of nitrogen dioxide, roughly double emissions of carbon oxide, and forty times higher emissions of sulphur dioxide. In addition, heavy metals emissions (cadmium, cobalt, nickel, etc.) of reconstruction Option 1 would be almost two times higher than if Option 3 would be implemented.

The principal difference between emission parameters of Options 1, 2 and 3 lays in their dioxins content. Flue gas from waste incineration units under Options 1 and 2 would contain $0.082*10^{-6}$ t/a of dioxins (converted to 2,3,7,8, tetrachloro dibenzo- 1,4-dioxin), while in case of Option 3 flue gas dioxins content would be $0.044*10^{-6}$ t/a.

Pollution standards for gas turbine units fired with wastes and biogas are established by the law of the Republic of Belarus[69]. Final design of the sludge disposal facilities should comply with the following requirements:

- Sources of emissions which contain particulate matter shall be equipped with gas treatment systems with a minimum removal performance of 95 per cent of solid particles, to ensure residual concentration of 50 mg/m^3, maximum, in normalized dry flue gas;
- Gas turbine units with capacity of 0.1 to 5 MW operating on gaseous fuel shall meet the following emission standards (Annex E.15 EcoNiP 17.01.06-001-2017):
    - Nitrogen dioxide – 150 mg/m^3;
    - Emissions of carbon oxide, total organic carbon and particulate matter are not regulated;
- Emission from waste incineration processes shall comply with the standard requirements listed in Table 8.8.

[69] EcoNiP 17.01.06-001-2017 Environmental Protection and Nature Management. Ecological Safety Requirements

Table 8.5: Pollution emission standards for waste incinerators (Annex E.24 EcoNiP 17.01.06-001-2017)

Загрязняющее вещество	Норма выбросов
Particulate matter	10 mg/m^3
Nitrogen oxides (as nitrogen dioxide)	200 mg/m^3
Sulphur dioxide	100 mg/m^3
Carbon oxide	300 mg/m^3
Polychlorinated dibenzodioxins and polychlorinated dibenzofurans (as 2,3,7,8-tetrachloro dibenzo-1,4-dioxin)	0.1 ng/m^3
Total organic carbon	50 mg/m^3
Heavy metals and their compounds, total: antimony, arsenic, lead, chromium, cobalt, copper, manganese, nickel, vanadium, cadmium, thallium	0.5 mg/m^3
Mercury	0.05 mg/m^3
Polycyclic aromatic hydrocarbons, total	0.1 mg/m^3
The values are shown for flue gas in normal conditions (temperature 273 K, pressure 101.3 kPa), converted to dry flue gas with oxygen content of 11 %	

Pollution control systems for removal of particulate matter and substances are included in the MWWTP reconstruction design (Table 8.9), however IEA 2016 does not provide specific details on the air treatment methods and performance.

Table 8.6: Air treatment equipment for various MWWTP reconstruction scenarios

<table>
<tr><th rowspan="2">Process section</th><th colspan="4">MWWTP reconstruction options</th></tr>
<tr><th>Option 1</th><th>Option 2</th><th>Option 3</th><th>Option 4</th></tr>
<tr><td>Mechanical treatment facilities</td><td>Scrubbing system with removal performance of 95% of ammonia, hydrogen sulphide and methane</td><td>Scrubbing system with removal performance of 95% of ammonia, hydrogen sulphide and methane</td><td>Scrubbing system with removal performance of 95% of ammonia, hydrogen sulphide and methane</td><td>Scrubbing system with removal performance of 95% of ammonia, hydrogen sulphide and methane</td></tr>
<tr><td>Drying and incineration facilities</td><td>Electrostatic precipitator, 2-step scrubbing, absorber</td><td>Electrostatic precipitator, 2-step scrubbing, absorber</td><td></td><td></td></tr>
<tr><td>Drying facilities</td><td></td><td></td><td>Cyclone, odour control unit</td><td>Cyclone, odour control unit</td></tr>
<tr><td>Incineration facilities</td><td></td><td></td><td>Cyclone, reactor tower, bag filter</td><td></td></tr>
</table>

Final design of the sludge treatment and disposal facilities should fully meet the requirements of EcoNiP 17.01.06-001-2017 - Environmental Protection and Nature Management. Ecological Safety Requirements to gas treatment equipment.

For instance, biogas facilities with biogas generation units shall be planned, designed and operated with a system of gas treatment equipment including gas filter, desulphurizer and demister (p. 3.5. EcoNiP 17.01.06-001-2017).

8.1.7 *Pollution dispersion analysis for the Project alternatives*

EIA package at the phase of feasibility studies (2016) included estimation of pollution dispersion from all options of the treatment plant reconstruction. This information can be used for comparative analysis of the alternatives. The difference between the simulations prepared by the Consultant and the developer of EIA 2016 is most probably caused by adjustment of the input data on pollution sources after the inventory verification in 2017.

Results of the priority pollutants dispersion analysis (nitrogen dioxide, carbon oxide, sulphur dioxide, heavy metals of hazard class 1, dioxins, PAC) demonstrated the ground level concentrations at SPZ boundary (500 m) within the MPC limits for residential areas (Table 8.10), except for hydrogen sulphide.

Table 8.7: Maximum pollution levels at the boundary of SPZ (500 m), fractions of MPC

Pollutant	Option 1		Option 2		Option 3		Option 4	
	with background	without background	with b/ground	without b/ground	with b/ground	without b/ground	with b/ground	without b/ground
Cadmium and its compounds	Not applicable				0.01	0.01	-	-
Copper and its compounds	0.96	0.96	0.96	0.96	1.00	1.00	0.91	0.91
Manganese and its compounds	0.13	0.13	0.13	0.13	0.14	0.14	0.12	0.12
Mercury (metallic)	0.02	0.02	0.02	0.02	0.04	0.04	расчет н/ц	
Lead and its compounds	0.15	0.02	0.15	0.02	0.17	0.04	0.13	0.00
Nitrogen dioxide	0.43	0.18	0.67	0.43	0.66	0.41	0.57	0.32
Ammonia	0.22	0.14	0.22	0.14	0.22	0.14	0.22	0.14
Arsenic and its compounds	0.01	0.01	0.01	0.01	0.03	0.03	-	-
Sulphur dioxide	0.07	0.03	0.07	0.03	0.10	0.06	0.04	0.00
Hydrogen sulphide	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73
Carbon oxide	0.12	0.01	0.14	0.03	0.12	0.01	0.12	0.01
Fluoride gas	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.02
Methane	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Xylene (mixed isomers)	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Toluene	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00
Ethylbenzene	-		-		0.06	0.06	0.06	0.06
Aromatic hydrocarbons	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Benz(a)pyrene	-		-		-		0.04	0.00

Pollutant	Option 1		Option 2		Option 3		Option 4	
	with background	without background	with b/ground	without b/ground	with b/ground	without b/ground	with b/ground	without b/ground
Phenol	0.13	0.00	0.13	0.00	0.13	0.00	0.13	0.00
Particulate matter	0.23	0.01	0.23	0.01	0.24	0.02	0.22	0.00
Inorganic dust, SiO_2 content less than 20-70%	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Summation group 303 333	2.87	2.84	2.87	2.84	2.87	2.84	2.87	2.84
Summation group 301 330 337 1071	0.73	0.21	0.99	0.47	0.99	0.47	0.86	0.34
Summation group 184 330	0.20	0.02	0.20	0.02	0.24	0.07	0.18	0.01
Summation group 330 342	0.08	0.04	0.08	0.04	0.12	0.08	0.05	0.01
Summation group 301 303 330	0.64	0.27	0.88	0.53	0.91	0.54	0.78	0.41
Summation group 302 316 322	0.01	0.01	0.01	0.01	0.03	0.03	0.00	0.00
Summation group 329 2902 2908 2937	0.25	0.05	0.25	0.05	0.25	0.05	0.25	0.05

The new dispersion analysis for hydrogen sulphide and results of air quality monitoring in 2017 demonstrated hydrogen sulphide concentrations at the boundary of residential area below the MPC level. Thus ground level concentrations of this pollutant at the boundary of SPZ and residential area after reconstruction of MWWTP and implementation of any of the sludge disposal options will most probably stay below the MPC limit.

8.1.8 Sanitary Protection Zone

MWWTP of UE Minskvodokanal is located in the south-eastern part of Minsk, at the site address 220075 Minsk, 1 Inzhenernaya St.

The operational site adjoins various territories and facilities including:

- on the northern side: traffic way in Svislochskaya St. with associated sidewalks and pedestrian passages, territory of Shabany industrial area, railway track, and residential buildings in Shabany St.;
- on the north-eastern side: traffic way in Svislochskaya St., Inzhenernaya St. with associated sidewalks and pedestrian passages, territory of operational site of Belinterklimat LLC, railway

track, garage association in Rotmistrova St., traffic way in Selitsky St. with associated sidewalks and pedestrian passages, residential buildings in Shabany St., and unbuilt territories: arable land, Trostenets memorial park;
- on the eastern side: railway track, territory of Shabany industrial area in Selitsky St., territory of operational site of Mapid OJSC – KPD-3 Plant, traffic way of Selitsky St. with associated sidewalks and pedestrian passages, and unbuilt territories: arable land, Trostenets memorial park;
- on the south-eastern side: railway track, territory of Shabany industrial area in Selitsky St., territory of Belorusneft petrol filling station No.14, operational site of the Machinery Department of UE Minskmetrostroy, industrial development territory, motor road H9050;
- on the southern side: railway track, territory of Shabany industrial area in Selitsky St., territory of operational site of DUP Belgidravlika UPP Niva, industrial development territory, unbuilt territory with arable land, residential area of Novy Dvor village of Minsk District built with individual houses, motor road H9050;
- on the south-western side: unbuilt territory – arable land, residential area of Novy Dvor village of Minsk District built with individual houses, surface water body – River Svisloch, motor roads H9050, H9034, H9035;
- on the western side: unbuilt territory – forest (former Shabany village), surface water body – River Svisloch, unbuilt territory – arable land;
- on the north-western side: surface water body – River Svisloch, unbuilt territory – arable land, residential area of Podlosje village of Minsk District built with individual houses.

According to the sanitary standard "Requirements to sanitary protection zones of industrial plants, structures and other facilities which produce impacts on health and environment", the basic size of sanitary protection zone (SPZ) is 500 m (Chapter 12 "Waste Water Treatment Plants", p.440, Annex 3 for waste water treatment facilities – "Mechanical and biological treatment facilities with digested sludge disposal areas, and the sludge disposal areas", design capacity 50.0 – 280.0 th.m^3 /day).

The above Annex 3 does not specify size of SPZ for waste water treatment facilities with design capacity over 280 th.m^3 /day. The current approved size of SPZ for the Company's facilities is defined by calculation (Act of State Sanitary-Hygienic Expert Examination of 13 April 2013 No.35 - 19/bObpr).

Locations of the nearest residential areas and other facilities prohibited in SPZ are defined as follows:

- distance from the border of household plot of individual house at 23 Podlosje St., Podlosje vil. of Minsk District, to the boundary of Company's operational site is 701 m to the north-west;
- distance from windows of residential house at 2 Rotmistrova St., Minsk, to the boundary of Company's operational site is 577 m to the north-east;
- distance from windows of residential house at 16 Shabany St., Minsk, to the boundary of Company's operational site is 740 m to the north-east;
- distance from the border of household plot of individual house at 1a Novy Dvor St., Novy Dvor vil. of Minsk District, to the boundary of Company's operational site is 782 m to the west;
- distance from the border of household plot of individual house at 4 Zarechnaya St., Maly Trostenets vil. of Minsk District, to the boundary of Company's operational site is 1105 m to the east.

The design of sanitary protection zone which was developed in 2017 proposes to set dimensions of the design SPZ taking into account the existing development of the territory.

The following conclusions have been drawn as a result of survey of the Company's operating site and surrounding territory, results of pollution dispersion analysis in ground level air, at the reference points of the designed sanitary protection zone and in the territory adjacent to the residential area:

- no prohibited facilities are present in SPZ; the Company's operational site is surrounded by other industrial sites;

- concentrations of substances emitted by fixed sources at the Company's facilities are found to be compliant with the standard limits;
- no excessive levels of noise emissions from permanent and intermittent sources of point, linear and volumetric type at the Company's facilities have been identified;
- starting points for measuring the size of sanitary protection zone are located at the border of the Company's operation site, as pollution emissions from permanent fugitive sources account for 98.9% of the total emissions mass from the Company's operations.

The SPZ design 2017 proposes to establish the following boundaries of the sanitary protection zone (measured from the borders of MWWTP site):

- to the north: 900 metres;
- to the north-east: 780 metres;
- to the east: 960 metres;
- to the south-east: 1000 metres;
- to the south: 660 metres;
- to the south-west; 500 metres;
- to the west; 660 metres;
- to the north-west: 860 metres.

SPZ boundaries in accordance with the design of 2017 are shown in Figure 8.2.

Figure 8.3: Boundaries of the sanitary protection zone of MWWTP (SPZ Design 2017)

In accordance with EcoNiP 17.01.06-001-2017 – Environmental Protection and Nature Management. Ecological Safety Requirements - SPZ with the size of 501-1000 m shall have the minimum vegetation coverage of 40%.

The notion of "vegetation coverage" in EcoNiP 17.01.06-001-2017 is defined as the ratio of territory covered with vegetation (trees, shrubs, flower beds, lawns, and other herb cover) to the total area size of the given territory.

The SPZ design approved in December 2017 established the following:

- Vegetation coverage of SPZ area of the designed facilities shall be at least 30% of its total area;
- Total area of the designed sanitary protection zone (including the operational site of 84.9615 ha) is 819.7302 ha;

Existing objects in the basic sanitary protection zone:

- transport infrastructure including roads, sidewalks and pedestrian passages: 208.0922 ha;
- unbuilt territories: 358.138 ha, including 46.738 ha of green areas – lawns, shrubs and trees plantations;

- industrial operations sites: 174.455 ha.

Based on the above data, it is concluded in SPZ design 2017 that existing vegetation coverage of the proposed design sanitary protection zone is 48.35%.

The unbuilt territories in SPZ are actually agricultural lands, including ploughed land which can be positively detected in the satellite images of SPZ territory. The arable lands are currently used for growing of technical crops. The requirement of 40% vegetation coverage may not be fully met with the present level vegetal cover. SPZ design should include the necessary measures to ensure compliance with the vegetation coverage requirement.

8.1.9 Mitigations

In accordance with the RB Law "On protection of atmospheric air", entities that have sources of pollution emissions are required to develop and implement air protection measures. The air protection measures include planning, process and special measures directed towards reduction of the emission volumes and ground level concentrations of pollutants.

In order to minimize negative impacts of the reconstructed facilities on atmospheric air quality, the following measures are included in the design:

- provision of gas treatment systems for the facilities and process units with the most extensive emissions:
  - air removed from the mechanical waste water treatment facilities will be treated by three-stage scrubbing system to achieve 95% reduction of ammonium, hydrogen sulphide and methane;
  - treatment of flue gas from sludge incineration facilities (Options 1, 2, 3);
  - treatment of gas from sludge drying and pelletizing facilities (Options 3 and 4);
- technical and hygienic testing of ventilation systems and performance testing of gas treatment equipment;
- renewal of vehicle fleet, procurement of new vehicles with engines to environmental standard Euro-3, Euro-4;
- regular environmental monitoring and testing of atmospheric air quality;
- updating of documentation on air protection.

With the above measures implemented, residual impact on air at the operation stage can be assessed as **moderate**.

Development of specific measures to reduce pollution emissions in adverse weather conditions is beyond the scope of this project, however the best practice in adverse weather conditions includes the following:

- enhanced control of strict compliance with the operational process regulations;
- prohibition of plant operation in high-power mode;
- closer monitoring of the measuring and control instruments and automatic process control systems;
- prohibition of blowing-down and cleaning of equipment, gas ducts, tanks containing polluting substances, prohibition of maintenance operations associated with emission of harmful substances;
- stopping the equipment testing processes related to changing process operation modes and resultant increase of pollution emissions.

At the construction phase the recommended measures include prevention of dust release, protection of fertile soil cover, prevention of erosion, making sure that ground is not transported off the site on vehicle tyres, prohibition of idle running of construction machinery, etc.

After the above mitigations, the residual impact of Project facilities construction on atmospheric air will be reduced to **minor**.

Summary of the pollution emissions and mitigations is provided in Table 8.11.

8.1.10 Emissions monitoring

The project will include arrangements and implementation of continuous monitoring of emissions in the influence area of MWWTP, within the framework of the operational monitoring programme.

The air monitoring system is to be developed in line with the requirements to atmospheric air quality monitoring arrangements as per the Sanitary Norms and Rules "Requirements to atmospheric air in settlements and in mass recreation areas", and TKP 17.13-15-2014 "Sampling of air, atmospheric precipitation and snow cover for testing of pollution concentrations and weather monitoring".

As reported by UE Minskvodokanal, the existing air sampling network consists of two clusters:

- 12 monitoring points in the influence area of emissions from MWWTP facilities;
- 5 monitoring points in the influence area of emissions from the Volma sludge disposal facilities.

Summary of the air impacts monitoring, applicable parameters and intervals is provided in Table 8.12.

8.1.11 Conclusions and recommendations

The most significant impact on atmospheric air is caused by emissions of methane, hydrogen sulphide, ammonia and summation groups which include the above substances.

Review of the dispersion analysis results demonstrated that after implementation of the Project (i.e. reconstruction of MWWTP and construction of sludge incinerator) the ground level concentrations of pollutants will not exceed the maximum permissible concentrations (MPC) applicable in the regulated territories.

The project is designed to achieve significant reduction of odour nuisances caused by operation of MWWTP and thus improve the quality of life in the nearest settlements. Other operations in the industrial cluster may also contribute to the odour nuisance (refer to Chapter 11).

Results of the dispersion analysis demonstrate obvious improvement of air quality after reconstruction of Minsk WWTP. Emissions from the new sludge incineration facilities will not contribute much to the baseline impacts on air, however reduction of sludge volumes and cessation of use of the sludge lagoons will improve air quality not only in the area of the treatment plant, but also in the settlements of Lugovoslobodsky rural council. The air treatment performance will be continuously monitored, and the technical solutions implemented at MWWTP-1 can be subsequently extended to improve air protection schemes at MWWTP-2.

For a more accurate assessment of air impacts at the stage of design development, it is recommended to:

- check specifications of the designed facilities and amend the design pollution emissions parameters;
- make a detailed inventory list of emission sources taking into account the design solutions and selected sludge disposal scheme;
- define annual emissions quantity taking into account the adopted design solutions;
- consider establishing a network of permanent air pollution monitoring stations to facilitate representative evaluation, monitoring and forecasting of air pollution levels, and assessment of environmental impacts of Project construction and operation.

Table 8.8: Summary of air impacts and mitigations

Impact	Receptor	Project phase	Impact significance	Design solutions and mitigations	Additional recommendations by Ramboll	Residual impact
Air pollution	Workforce Local communities Natural environment	**O**	**M**	• Provision of gas treatment systems for the facilities and process units with the most extensive emissions: ○ air from the mechanical waste water treatment facilities to be treated by three-stage scrubbing system to achieve 95% reduction of ammonium, hydrogen sulphide and methane; ○ treatment of flue gas from sludge incineration facilities (Options 1, 2, 3); ○ treatment of gas from sludge drying and pelletizing facilities (Options 3 and 4); • Technical and hygienic testing of ventilation systems and performance testing of gas treatment equipment; • Renewal of vehicle fleet, procurement of new vehicles with engines to environmental standard Euro-3, Euro-4; • Regular environmental monitoring and testing of atmospheric air quality; • Up-to date air protection documentation.	*General practices in adverse weather conditions:* • enhanced control of strict compliance with the operational process regulations; • prohibition of plant operation in high-power mode; • monitoring of the measuring and control instruments and automatic process control systems; • stopping the equipment testing processes related to changing process operation modes and resultant increase of pollution emissions. *Reduction of SPZ:* • Develop SPZ design and get it approved by supervising authorities	**L**
Air pollution	Workforce Local communities Natural environment	**C**	**M**	-	Dust suppression. Protection of fertile soil layer. Prevention of erosion and making sure that ground is not transported off the site with vehicles' tyres/ Prohibition of idle running of construction	**L**

Impact	Receptor	Project phase	Impact significance	Design solutions and mitigations	Additional recommendations by Ramboll	Residual impact
					machinery. Stabilization of spoil piles in case of storage period longer than 2-3 months.	

Parameter	Designation	Meaning	Parameter	Designation	Meaning
Stage / Этап	C	Construction / строительство	Significance of impact / Значимость воздействия	Mj	Major / высокая
	O	Operation / эксплуатация		M	Moderate / умеренное
	Cm / DCm	Commissioning or decommissioning / Ввод и вывод из эксплуатации		L	Low /малое
Recipient Sensitivity / Восприимчивость реципиента	H	High / высокая			
	M	Moderate / средняя		N	Negligible / пренебрежимо малое
	L	Low / низкая			
	N	Negligible / пренебрежимо малая			

Table 8.9: Summary of air impacts monitoring requirements

Aspect	Phase	Place	Parameters	Intervals
Air quality	C, O	Boundary of MWWTP SPZ Adjacent residential area	Pollution concentrations: • Ammonia; • Methane; • Hydrogen sulphide; • Phenol: • Formaldehyde; • Summation group of phosphoric anhydride and phosphoric acid	Quarterly Monthly
Air quality	C, O	Boundary of MWWTP sludge facilities SPZ and adjacent residential area	Pollution concentrations: • Ammonia; • Methane; • Hydrogen sulphide; • Phenol: • Formaldehyde; • Summation group of phosphoric anhydride and phosphoric acid	Monthly at daily mean temperature below 20°C Weekly at daily mean temperature higher than 20°C
Emissions from waste incineration facilities	O	Waste processing units with capacity greater than 3 t/hour	Particulate matter, nitrogen oxides (as nitrogen dioxide), carbon dioxide, oxygen, sulphur dioxide	Continuous measurements as per EcoNiP 17.01.06-001-2017

8.2 Physical Impacts

8.2.1 Noise

In 2017, the private company Environmental Centre PYLEGAZOOCHISTKA, against the order of UE Minskvodokanal, made assessment of adverse physical impacts of MWWTP on the adjoining area for estimating minimal size of the sanitary protection zone and assessing a possibility of its reduction from 700 to 500 m.

Baseline data were actual noise characteristics, coordinates of the MWWTP noise sources and the aforesaid hygienic noise limits for residential areas. Continuous noise was rated by sound pressure levels (dB) in octave bandwidths at geometric mean frequencies 31.5, 63, 125, 250, 500, 1000, 2000, 4000, and 8000 Hz and non-continuous noise – by equivalent and maximal acoustic levels (dBA).

To evaluate acoustic impacts all MWWTP noise sources were identified and split in three groups:

- single-point: fans of operating ventilation systems installed in the open on the roof, walls and in other places outdoors (roof, axial, centrifugal, and radial fans);
- linear: motor roads and railroads;
- thickness: process equipment, industrial processes, buildings and structures.

Noise from fans was regarded as continuous and in conformity with product data sheets and catalogue specifications. Road noise was interpreted as singular acoustic events associated with traffic of single vehicles.

The engine rooms of blowing houses, woodworking department, pump stations, sludge pretreatment and treatment workshops, bar screen building and sand treatment building were categorized as thickness noise sources. Field measurements of acoustic impact were taken for a number of sources. Additionally, instrumental measurements of noise levels were made at reference points located at the boundary of the approved SPZ (Figure 8.4).

Both evaluations and measurements have shown that the MWWTP acoustic impact parameters cannot surpass regulatory limits.

Also, Ramboll experts in the course of the onsite visit did not identify sections with the excessively high or substantial acoustic load within its boundaries. An exception is indoor space of buildings and structures where pumping or some other noise generating equipment is installed.

In the context of the projected reconstruction, it is possible to expect a short-term (during construction) increase of acoustic loads near the areas where dismounting, groundbreaking, material and waste handling works will be conducted as well as along the access roads.

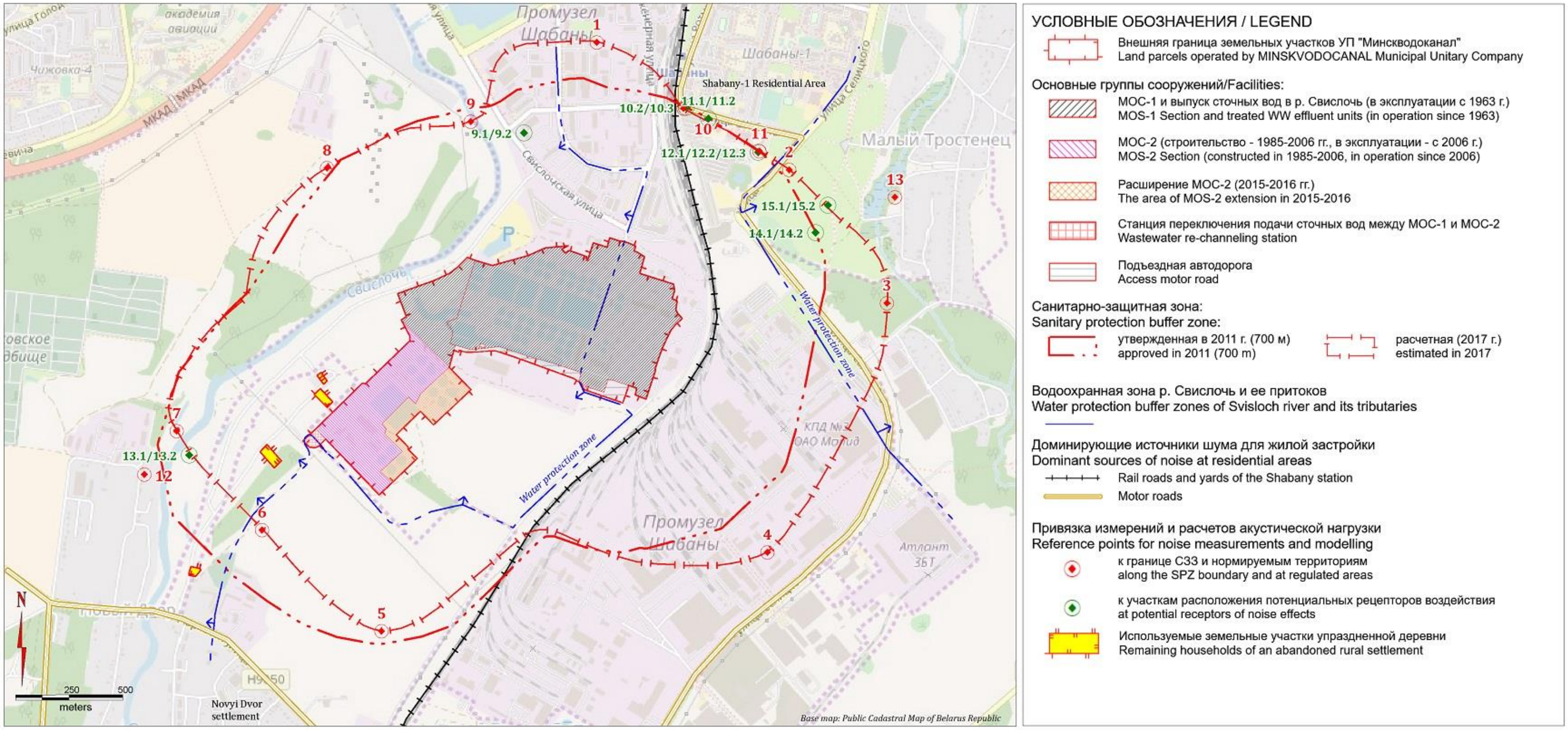

Figure 8.4: Conditions for the evaluation of acoustic loads in the sanitary protection zone of the Minsk Waste Water Treatment Plant

The nearest residential areas in the Zavodskoy district of Minsk (block Shabany-1) and Novodvorsky rural community (Novyi Dvor, Podlosie and Elnitsa) are situated at a distance of 700-1000 m and are separated from the MWWTP noise sources by motorways and railroads, as well as by other industrial facilities and organizations whose activities are also associated with noise. The visit to these residential areas in October 2017 allowed a conclusion that dominating external noise exposure here was largely related to railroad and automobile traffic; somewhat less essential for them is acoustic impact from local construction and repair works, transformers, ventilation, playback devices and others.

In Ramboll's opinion, noise impact cannot be considered as a significant factor for determining the boundaries of the MWWTP impact zone in accident-free operation conditions. It will be possible upon the Project completion to undertake noise propagation modeling for the selected MWWTP reconstruction option on the basis of data on acoustic impact of equipment planned for installation to be provided by the engineer consultant. Acoustic impact modeling for the reconstruction period should be performed at the projecting phase and should take in account data of the site master plan and layout of operations, primarily dismounting, excavation, material handling, and piling. Modeling of the above works should use actual data on the acoustic situation in the proximal territories under regulation.

8.2.2 Vibration

Main sources of vibration are process equipment units such as pumps and fans. The generated oscillations are assessed as negligible and will be even lower after re-equipment of the plant. The MWWTP reconstruction project does not provide for the use of shock equipment and heavy power plants with high vibrational characteristics. Otherwise, both upgraded and new equipment will be fitted with modern vibration dampers.

8.2.3 Infrasound and ultrasound

The emergence of infrasound waves in the Project area is low probable for the following reasons:

- rotation speed parameter (directly related to the electric motor) of basic process equipment to be installed varies over a range from 1200 to 3000 rpm (20-50 rps), therefore no infrasound emission during operation may occur;
- speed limit is established for motor traffic in the Project area (5-10 km/h, maximum), which also precludes the infrasound generation.

The installation and operation of ultrasound-emitting process equipment are not envisaged at the reconstructed plant.

Basing on the above, environmental impact of the Project in terms of the ultrasound factor is low probable and assessed as insignificant and weak; as regards ultrasound, no impact is foreseen.

8.2.4 Electromagnetic radiation

Electromagnetic radiation sources at the operational sites include all electric consumers, package transformer substations, and power mains.

The following measures will be taken to prevent their harmful impact on the MWWTP personnel:

- placing of conductive parts of process units inside metal bodies with isolation from metal structures;
- earthing of metal bodies of package equipment and their functioning as natural fixed shields from electromagnetic fields;
- safety earthing and zero grounding, equipotential bonding, protective cutout devices;
- earthing of power and lighting equipment with zero protective earth (PE) conductors;
- lightning protection system.

Basing on the above, environmental impact of electromagnetic radiation from the Project can be assessed as insignificant and weak.

8.2.5 Ionizing radiation

The MWWTP reconstruction does not include the installation and operation of artificial ionizing radiation sources, therefore no environmental impact of ionizing radiation from the planned processes is anticipated.

8.2.6 Thermal impact

Operation of process equipment and traffic at the MWWTP site results in hot gas emissions to air and hence inevitable local thermal contamination of the environment. The assumption on Project-related heat losses given in the EIA was made with account for annual fuel consumption and efficiency of equipment and engines.

Basing on the estimate done and comparison of its results with average solar radiation for the latitude of Minsk, a conclusion was made that the input of MWWTP facilities before and after the reconstruction to the overall thermal emission in air of the Project area would be insignificant. Ramboll however believes that the EIA developers' predication about the absence of thermal impact on surface water bodies is arguable because one of the reconstruction objectives is to increase productivity of the plant from current 400-500 up to 550 thou. m^3 per day. Subject to actual growth of water discharge volumes it will inevitably result in the plant's thermal effect extension to fresh water ecosystems of the Svisloch and such impact needs assessment.

8.3 Surface Water Impacts

8.3.1 Introduction

Surface water flows in the location area of MWWTP include the largest water body in Minsk – River Svisloch of fishery category 2. There are no lakes and marshlands in the Project area.

The main impacts on water bodies at MWWTP operation will be related to discharge of significant amounts of treated effluents to River Svisloch. Negative impacts may be also caused by potential disorders in WWTP processes resulting in discharge of inadequately treated waste water to the river.

8.3.2 Overall characteristic of MWWTP

Minsk Waste Water Treatment plant treats about 95% of domestic and industrial waste water from industrial sites, residential areas and suburban settlements of Minsk. Estimated daily flow of 500 th. m^3 at the inlet of MWWTP by 30% consists of pre-treated industrial waste water. Average duration of treatment processes cycle at the plant is 12 hours.

The treatment plant comprises two sites – MWWTP-1 and MWWTP-2. According to the design of sanitary protection zone of the Company's operational site, the actual treatment capacity of the plant is 480 th.m^3/day (2014-2016) including:

- MWWTP-1: 379 th.m3/day;
- MWWTP-2: 101 th.m3/day.

Facilities at the first operational site originally designed for 670 th. m^3/day (current capacity is 470 th. m^3/day) were commissioned in 1963 and rely on the treatment train of conventional mechanical and biological processes:

- a series of inlet chambers, mechanical step screens, grit removal basins and primary sedimentation tanks is intended to remove debris, mineral and organic particles and floating matter;
- the next treatment stage consists of a system of aeration tanks where activated sludge is added to clarified waste water flow to enable biological treatment, followed by secondary sedimentation tanks and then the collection channel with aeration bowl.

A mini-HPP operated by a third party is arranged at the effluent discharge point of MWWTP-1.

Facilities at the second operational site

Construction of MWWTP-2 facilities with similar treatment processes was started in 1985, and the treatment plant with the design capacity of 200 th. m^3/day was commissioned in several stages during the period 2006-2016. Treated effluent from MWWTP-2 is discharged to the common collection channel with effluents of MWWTP-1.

The collection channel discharges to River Svisloch where treated effluent make up 45% of the river flow immediately downstream of the discharge point, and 18% of the flow in the river section between the settlement of Novy Dvor and Osipovichi reservoir.

Technical assessment of MWWTP (please refer for details to Chapter 4) identified the driver problems of the treatment plant reconstruction, including:

- inadequate waste water treatment performance and lack of effluent disinfection stage in the treatment train;
- poor status of surface water in River Svisloch downstream of treated effluent discharge point, due to the low self-purification capacity of the water course and the significant accumulated environmental damage;
- environmental and economic problems of further use of sludge lagoons at the Volma sludge disposal facilities.

The Project preparation phase included analysis of various potential solutions to enhance waste treatment performance. Further development of MWWTP reconstruction approach took into account the need for extension of treatment capacity, to serve the urban areas and settlements newly connected to sewerage systems. The following targets were set in 2015 in the Terms of Reference for the design development:

- average design waste water flow – 550 th.m3/day = 22,917 m^3/h = 6,366 l/s;
- maximum design waste water flow – 28,302 m^3/h = 7,862 l/s[70].

More details of the design solutions are provided in Chapter 4.

After reconstruction, the maximum contribution of effluent discharge will be more than 50% of the flow of River Svisloch downstream the discharge point and about 22% of the flow in the section between Novy Dvor settlement and Osipovichin reservoir. However the Technical Consultant predicts a lower load on the treatment plant, based on the recent decline of wastewater flows growth rate.

8.3.3 Assessment of quality of effluents discharged to River Svisloch

Influent chemical parameters and effluent quality before discharge to River Svisloch is controlled by the chemical and bacteriological laboratory (CBL) of Minsk WWTP which is accredited within the System of Calibration and Testing Laboratories of the Republic of Belarus.

Waste water is tested by 25 parameters (Table 8.12) including integral parameters e.g. biological and chemical oxygen demand (BOD, COD), content of suspended matter and surfactant, mineral content.

Comparison of annual mean pollution levels in River Svisloch upstream of MWWTP effluent discharge point (near the village of Podlosje), downstream the effluent discharge point (at Korolischevichi) and the mouth of River Svisloch (Svisloch village) demonstrated the following:

1. Annual mean pollution concentrations at the section near Korolischevichi village are higher than those upstream of WWTP effluent discharge point for almost all monitored parameters, which indicates a major contribution of MWWTP effluent to pollution of River Svisloch;
2. Changes of the priority parameters of biological treatment systems (nitrate, phosphate and ammonium ion indicate that river quality downstream of MWWTP effluent discharge point improved over the past 5 years, however in 2011, 2014 and 2015 pollution levels downstream of the discharge point exceeded the upstream levels for the following parameters (Figures 8.5, 8.6 and 8.7):

[70] Reconstruction of Minsk Waste Water Treatment Plant. Feasibility Study. General Explanatory Note. - Minsk: UE 'BELCOMMUNPROJECT', 2015

- Phosphate ion – by 29, 15 and 19 times;
- Nitrite ion - by 7, 5 and 4.5 times;
- Ammonium ion - by 8, 6 and 8 times, respectively.

3. In the river section upstream of MWWTP effluent discharge actual levels of polluting substances stayed within MPC limits for almost all parameters. Measurements downstream of the discharge point during the past 5 years demonstrated that phosphate ion and ammonium ion levels exceed the MPC limit by 1.2-6.7 times. At the same time concentrations of BOD_5 were below the MPC limit, and nitrite ion levels were equal to MPC;
4. Pollution levels at the mouth of River Svisloch are lower than immediately downstream of MWWTP effluent discharge point but still higher than upstream of the discharge. This means that despite the self-purification and dilution processes, effluent discharges from MWWTP significantly affect hydrochemical parameters of all river sections between the effluent discharge point and Osipovichi reservoir.

Figure 8.5: Phosphate ion levels at Podlosje, Koroloschevichi and Svisloch settlements, 2000-2015

Figure 8.6: Nitrite ion levels at Podlosje, Korolischevichi and Svisloch settlements, 2000-2015

Figure 8.7: Ammonium ion levels at Podlosje, Korolischevichi and Svisloch settlements, 2000-2015

8.3.4 Standards of pollution discharge to River Svisloch

The Project will have a positive effect on pollution discharge levels based on three parameters regulated in the comprehensive environmental permit No.5 issued to UE Minskvodokanal (Figure 8.8). After reconstruction of the treatment plant discharge of total phosphorus, total nitrogen and ammonium ion will significantly decrease. More specifically, phosphorus discharge will be reduced by almost two times – from 728 t/a to 383 t/a. Total nitrogen discharge was reported in 2016 as 4119 t/a and is expected to decrease to 2873 t/a by 2023. Ammonium ion discharge will be reduced from 2107 t/a to 1724 t/a by year 2023.

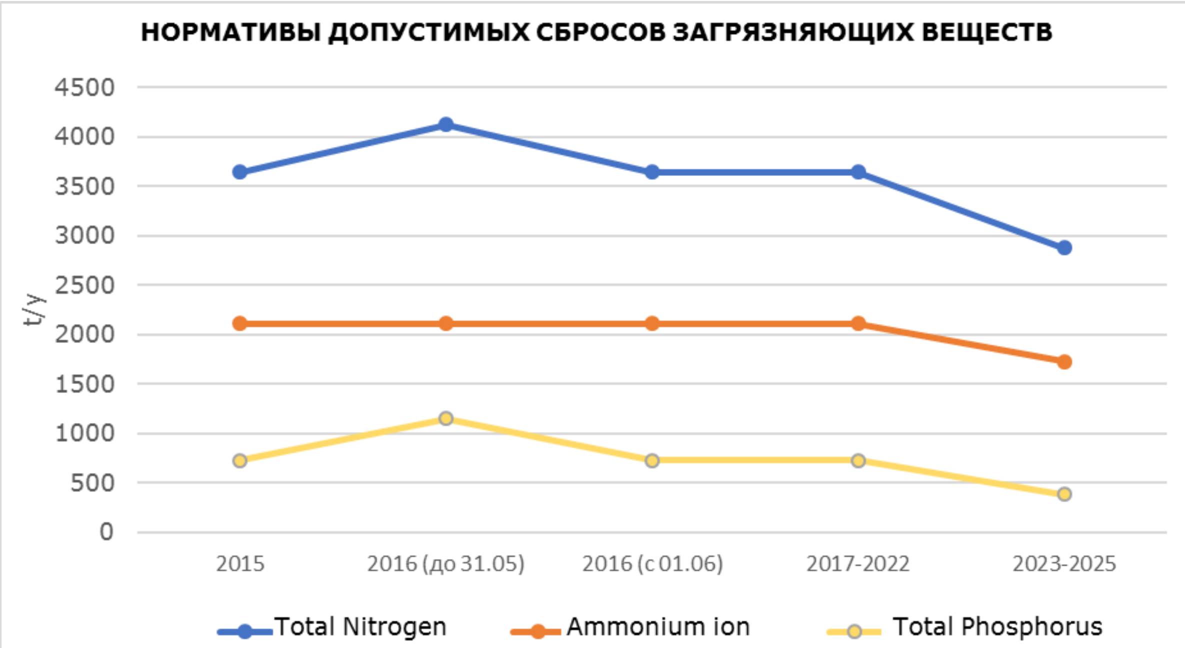

Figure 8.8: Changes of permitted maximum levels of pollutants discharge to River Svisloch

The data in Table 8.13 below indicate enhanced treatment of waste water at MWWTP and high performance of the treatment facilities especially in terms of removal of BOD, COD, suspended solids, total chromium, total iron and copper, with the rate of removal of the above pollutants as high as 90-95 %.

Treated effluent quality will meet the requirements set in the comprehensive environmental permit[71] for the period until 2015 (Table 8.13). The treatment plant has a good "factor of safety" for removal of the majority of the controlled parameters, i.e. actual effluent concentrations are by far lower than the limits, e.g. for heavy metals (total chromium, nickel, copper, cadmium, lead, manganese). Furthermore, all analyzed parameters meet the waste water treatment standards applicable to the given type of treatment plant in the Republic of Belarus.[72]

However it should be noted that the permissible discharge limits for MWWTP are higher than quality standards for surface water bodies[73] for almost all parameters, including petroleum products – by 4.6 times, nitrogen ammonia and nitrogen nitrite – by 29 times, phosphate – by 30 times, copper, zinc and lead – by 7-8 times, manganese – by 10 times (Table 8.13).

The parameters largely meet the waste water quality standards established by EU Directive; the only exception is total phosphorus with actual concentrations reported in 2015-2016 in excess of the EU standard by 1.5 times (Table 8.13).

Due to the lack of denitrification and phosphorus removal systems at the biological treatment facilities of MWWTP-1, temporary limits were established for content of total nitrogen and total phosphorus in treated effluent discharged to River Svisloch for the period until January 2023. After reconstruction of MWWTP total nitrogen and total phosphorus levels should meet the effluent quality standards of the Republic of Belarus.

EU standards apply less stringent requirements to discharges of certain pollutants, however sensitive water bodies are protected through application of more stringent requirements to content of total nitrogen and total phosphorus (refer to Table 8.13a for more details).

EC Directive 91/271/EEC (Directive on urban waste water treatment) defines permissible levels of total nitrogen and total phosphorus in treated waste water and requires EU members to identify the sensitive recipient waters including:

- Fresh water bodies, river outlets and coastal waters which are or *may be exposed to eutrophication* in absence of protective measures;
- Surface fresh water bodies used for abstraction of water for potable water supply, where nitrate level exceeds or may exceed 50 mg/l;
- Sections where enhanced treatment is required to achieve compliance with other Directives of the European Council, e.g. Directive on bathing water quality.

The considered section of River Svisloch does not immediately qualify as a sensitive water body based on the above criterial. However the environmental impact on the river is long-term, and if persists without any positive changes, it may cause eutrophication. This opinion is supported by several mass fish mortality incidents reported in 2015-2016. Even though no evidence is available to prove that the incidents were related to impacts of MWWTP, such events indicate potential eutrophication of the river.

Table 8.13a: Waste water quality at the inlet and outlet of WWTP-1 and effluent quality standards

Parameter	Influent	Effluent	Discharge limits		
			Permit	National standard	EU Directive
BOD_5	250 mg/l	10 mg/l	15 mg/l	15 mg/l	25 mg/l

[71] Comprehensive environmental permit No. 5 of 31.08.2017. Minsk City Committee for Natural Resource and Environmental Protection. 77 p.

[72] Resolution of the Ministry of Natural Resource and Environmental Protection of the Republic of Belarus of 26 May 2017 No. 16 "On certain issues of regulation of discharges of chemicals and other substances contained in waste water".

[73] Resolution of the Ministry of Natural Resource and Environmental Protection of the Republic of Belarus of 30 March 2015 No.13 "On approval of water quality standards for surface water bodies".

Parameter	Influent	Effluent	Discharge limits		
			Permit	National standard	EU Directive
COD	600 mg/l	40 mg/l	70 mg/l	70 mg/l	125 mg/l
Suspended solids	430 mg/l	20 mg/l	20 mg/l	20 mg/l	35 mg/l
Ammonia	41 mg/l	7 mg/l	9 mg/l	10 mg/l	Н/П
N_{tot}	50 mg/l	17 mg/l	15 mg/l	20 mg/l	10 mg/l*
P_{tot}	8 mg/l	2 mg/l	2 mg/l	2 mg/l	1 mg/l*

Source: Gap analysis as part of the technical feasibility studies for the Minsk Vodokanal Project, SWECO Danmark, December 2017

* for sensitive sections, in accordance with EC Directive 91/271/EEC.

The Project will improve the quality of waste water treatment, however at the time of feasibility studies in 2015-2016 its objectives did not include compliance with stringent European standards for removal of nutrients (applicable to sensitive water bodies). Given the existing potential of MWWTP, the Technical Consultant asses additional cost of achieving compliance with EC standards as small compared to the cost required to achieve only national compliance. Thus the Consultant recommends MVK to focus on meeting the above EC standards for removal of nutrients.

Table 13b. Summary of pollution loads for MWWTP1

Patameter	2017		2030	
	Concentration	Load (kg/d)	Concentration	Load (kg/d)
Flowrate, Q (м^3/day)	380 000		418 000	
BOD_5 (mg/L)	250	95 000	250	104 500
COD (mg/L)	600	228 000	600	250 800
SS (mg/L)	430	163 400	430	179 740
Total-N (mg/L)	50	19 000	50	20 900
Total-P (mg/L)	8	3040	8	3344

Table 8.10: Influent and effluent waste water quality reported by UE Minskvodokanal

Ref.	Parameter	Units	Influent waste water quality, 2015		Effluent quality at the discharge to Svisloch River			Limit concentration as per the special water use permit[74]					Surface water quality standard, mg/dm3[75]	Waste water quality standard, mg/dm3[76]	EC Directive[77]
			MWWT P-1	MWWT P-2	2015	01.01 - 31.05.2016	after 01.06.2016	2015	01.01 - 31.05.2016	after 01.06.2016	2017-2022	2023-2025			
1	pH	pH units	7.6	7.7	7.7	7.7	7.7	6.5÷8.5	6.5÷8.5	6.5÷8.5	6.5÷8.5	6.5÷8.5	6,5-8,5		
2	**BOD_5**	mgO_2/l	246.1	227.2	**10.5**	**9.9**	**8.7**	15	16	15	15	15	6	15	25
3	Suspended solids	mg/l	427.6	669.1	18.4	19`.1	18.2	20	30	20	20	20	25 background +5	20	35
4	Dry residue	mg/l	640.6	691.6	566.2	582	554.6	1000	1000	1000			1000		
5	Petroleum products	mg/l	2.91	1.01	**0.17**	**0.16**	**0.15**	0.23	0.28	0.23	0.23	0.23	0.05		
6	COD	mgO_2/l	606.8	521.3	**34.7**	**30.9**	**30.3**	70	70	70	70	70	30	70	125
7	Nitrogen ammonia	mg/l	38.1	42.5	**6.9**	**7.2**	**7.8**	11	11	11	11	9	0.39	10	
8	**Nitrogen nitrite**	mg/l	0.12	0.1	**0.18**	**0.19**	**0.21**	0.7					0.024		
9	**Nitrogen nitrate**	mg/l	0.33	0.22	7.7	9.0	6.7	9					9.03		
10	Total nitrogen	mg/l	52.86	59.33	**17.11**	**18.91**	**16.68**	19	21.5	19	19	15	5	20	10
11	**Phosphate (as P)**	mg/l	5.37	3.41	**1.1**	**1.01**	**1.04**	2					0.066		
12	Total phosphorus	mg/l	7.93	6.02	**1.49**	**1.53**	**1.58**	3.8	3.8	3.8	3.8	2	0.2	2.0	1
13	Chloride	mg/l	78.6	120.8	90.3	89.8	97.4	350	350	350	350	350	300		
14	Sulphate	mg/l	64.3	68.8	60.6	54.6	59.3	500	500	500	500	500	100		
15	Synthetic anionic	mg/l	1.6	1.89	0.073	0.065	0.066	0.131	0.131	0.131	0.131	0.131	0.1		

74 Comprehensive environmental permit No. 5 of 31.08.2017. Minsk City Committee for Natural Resource and Environmental Protection. 77 p.
75 Resolution of the Ministry of Natural Resource and Environmental Protection of the Republic of Belarus of 30 March 2015 No.13 "On approval of water quality standards for surface water bodies"
76 Resolution of the Ministry of Natural Resource and Environmental Protection of the Republic of Belarus of 26 May 2017 No. 16 "On certain issues of regulation of discharges of chemicals and other substances contained in waste water"
77 EU Council Directive of 21.05.1991 On treatment of urban waste water (91/271/EEC)

Ref.	Parameter	Units	Influent waste water quality, 2015		Effluent quality at the discharge to Svisloch River			Limit concentration as per the special water use permit[74]					Surface water quality standard, mg/dm^3[75]	Waste water quality standard, mg/dm^3[76]	EC Directive[77]
			MWWT P-1	**MWWT P-2**	**2015**	**01.01 - 31.05.2016**	**after 01.06.2016**	**2015**	**01.01 - 31.05.2016**	**after 01.06.2016**	**2017-2022**	**2023-2025**			
	surfactants														
16	**Total chromium**	mg/l	0.129	0.337	**0.007**	**0.008**	0.004	0.02	0.02	0.02	0.02	0.02	0.005		
17	Nickel	mg/l	0.015	0.01	<0.005	0.007	0.006	0.034	0.034	0.034	0.034	0.034	0.034		
18	Total iron	mg/l	3.61	3.83	**0.28**	**0.28**	**0.33**	0.44	0.44	0.44	0.44	0.44	0.27		
19	Copper	mg/l	0.115	0.077	**0.007**	**0.01**	**0.006**	0.019	0.019	0.019	0.019	0.019	0.0045		
20	**Zinc**	mg/l	0.31	0.355	**0.055**	**0.081**	**0.074**	0.117	0.117	0.117	0.117	0.117	0.016		
21	Cobalt	mg/l	<0.005	< 0.005	<0.005	<0.005	<0.005	0.01	0.01	0.01	0.01	0.01	0.01		
22	Cadmium	mg/l	<0.0005	0.0005	<0.0005	<0.0005	<0.0005	0.002	0.002	0.002	0.002	0.002	0.005		
23	Lead	mg/l	0.012	0.046	<0.005	<0.005	<0.005	0.014	0.014	0.014	0.014	0.014	0.014		
24	**Manganese**	mg/l	0.243	0.352	**0.086**	**0.079**	**0.117**	0.259	0.259	0.259	0.259	0.259	0.038		
25	Dissolved oxygen	mg/l	–	–	7.38			minimum 4.0					Minimum 4 during ice cover period Minimum 6 during open water period		

8.3.5 Water supply and sewerage systems at MWWTP

Water supply

Water supply for MWWTP site is provided by the existing municipal network, from the existing water intake facilities. Water supply system of Zavodskoy District of Minsk is fed by 2 ground water intakes – Water Works No.4 "Drazhnya" and Water Works No.6 "Ostrovy". The additional source of water is the "Sosny" Water works (artesian wells Nos. 1, 2, 3, 4, 5, 6, 66, 7) which is situated in Zavodskoy District.

Potable water is used at the WWTP site for drinking-household needs and for showers, washing of floors, watering of territories and plants. Standards for water used for household and drinking needs are set in SanPiN 10-124 РБ – Potable Water.

Water from the municipal water network is supplied to the looped plant-wide network of household-drinking/fire-fighting water, and then to the local site networks of household-drinking/fire-fighting water supply of the sludge disposal and gas treatment facilities, and to consumers.

Information about water consumption at MWWTP is provided in Table 8.14.

Table 8.11: Water consumption of MWWTP, 2013-2016

Parameter	Value, th. m^3			
	2013	2014	2015	2016
Volume of abstracted and supplied water, total	658.897	687.812	762.462	843.633
including:				
from ground water sources	288.6	300.563	318.188	210.587
Water consumed for:				
household-drinking needs	248.788	184.533	246.729	412.562
process needs	410.109	503.279	500.710	407.935
other uses *Dilution of liquid wastes*	-	-	15.023	19.732
Water recycling	831.5	17.7	9.4	4.18

Waste water disposal

All waste waters generated at the Company sites are collected at the local WWPS and pumped to the inlet chamber of the waste water treatment plant.

In accordance with the basic design of MWWTP reconstruction, domestic and industrial waste water from the sludge disposal and gas treatment facilities will be discharged to the designed local sewerage network and pumped by the designed WWPSs (No.1 and No.2) to the existing site sewerage network from where it will be directed to the inlet chamber of the waste water treatment plant.

Water meters will be provided at the water supply connections of the designed buildings. Flowmeters will be installed in the channels feeding waste water to grit removal basins, and also on the effluent pipeline before discharge to River Svisloch.

Detailed information about waste water disposal at the Company's operational sites is provided in Table 8.15.

Table 8.12: Waste water disposal at MWWTP, 2013-2016

Parameter	Design value		Value, th. M3			
	m^3/day	th. m^3/a	2013	2014	2015	2016
Waste water disposal volume, total	870,000	317,550	176,084	177,008.5	173,267.9	170,517.8
Disposed to water bodies	-	-	176,084	177,008.5	173,267.9	170,517.8

Storm water runoff from the sludge disposal facilities will be collected to the designed closed drainage sewer and pumped by DWPS (three submersible pumps capacity 150 m^3/h) to the designed RC holding tanks with effective volume 156 m^3 (2 units). After 12 hour retention time drainage water will be pumped to the site sewerage system and further to the inlet chamber of the waste water treatment plant.

The future drainage system will collect storm water runoff from the designed territories with the following parameters:

- Annual drainage flow - 3,343.96 m^3/a;
- Daily volume of storm water - 156 m^3/day

Design outlet drainage water flow from the site is 123.49 l/s.

Initial concentrations of storm water runoff are adopted from Table 10.1 of TKP 45-4.01-57-2012 and shown in Table 8.16 below. Storm water pollution levels after treatment are defined in accordance with TKP 17.06-08-2012.

Table 8.13: Treatment effect of storm water settling

Treatment stage	Suspended solids content		Petroleum products content	
Holding tank (for one-day retention)	Before treatment, mg/l	After treatment, mg/l	Before treatment, mg/l	After treatment, mg/l
	500	20	10.0	0.3

8.3.6 Monitoring

In accordance with the Operational Environmental Monitoring Guidelines, monitoring activities at the operational sites of MVK should cover the following objects:

- Effluent to River Svisloch;
- Surface water of recipient water body (River Svisloch) in points located 500 m upstream and downstream of the effluent discharge point;
- Ground water (monitoring wells) in the area of MWWTP sludge disposal facilities.

The local monitoring schedule is defined in the Laboratory Monitoring Programme approved by the Chief Engineer of MVK (see table below).

Effluent samples at the discharge to River Svisloch, as well as samples of surface water (River Svisloch) in the points 500 m upstream and downstream of the effluent discharge point are taken 4 times per month, in accordance with the Laboratory Monitoring Programme.

Laboratory monitoring of ground water is provided on a monthly basis in the monitoring wells in the area of MWWTP sludge disposal facilities, based on the list of monitored parameters established in Annex 12 to the Guideline document on local monitoring.

The Heal of the Chemical and Bacteriological Laboratory of MWWTP reports the local monitoring data to Minsk City Committee for Natural Resource and Environmental Protection within 15 calendar days from sampling.

Summary of the air monitoring requirements, monitored parameters and intervals is provided in Table 8.18.

8.3.7 Conclusions

Effluent discharge to River Svisloch makes up about 45% of the river flow immediately downstream of the discharge point and about 18% of the river flow in the section between the settlement of Novy Dvor and Osipovichi reservoir. Thus discharges of treated waste water from MWWTP significantly affect flow conditions in River Svisloch.

Review of treatment efficiency of MWWTP-1 and MWWTP-2 demonstrated relatively good performance of the treatment processes.

Due to the fact that treated effluents may contribute up to 50% to the total flow of River Svisloch, river water quality downstream of the waste water discharge point does not meet the requirements applicable to fishery water bodies, despite the high rate of removal of specific pollutants at the treatment facilities (MWWTP-1 and MWWTP-2).

Permissible levels of total nitrogen and total phosphorus at the outlet of MWWTP can be achieved only after reconstruction of MWWTP-1 including implementation of enhanced nitrogen and phosphorus removal processes. It is expected that after the Project implementation effluent quality will meet all standards applicable to water treatment plants of the given type in the Republic of Belarus and EU.

The main impacts on water bodies at the operational phase are caused by effluent discharges to surface waters and disturbance of river flow conditions. The operational phase impacts in terms of quality are assessed **moderate**. The Project will have a positive effect and the impact will decrease compared to the baseline situation.

The main construction impacts during the period of MWWTP reconstruction will be associated with the risk of suspended solids and pollutants transport with surface runoff, and also with the construction activities in the water protection area of the river. The construction phase impacts are assessed as **minor** to **moderate**.

Overall impact on surface water after implementation of the proposed technical and environmental measures is assessed as **regional** and **moderate**. The negative impacts of the Project on surface water at the construction and operation phases can be prevented or reduced by implementation of a range of proposed environmental measures (Table 8.17).

The impact of the Minsk WWTP activities on the Svisloch River, the most important waterway of the region, is mainly represented by three waste streams. The biggest one is the effluent outlet pipe from the MWWTP discharging a flow comparable with the river flow rate measured at the effluent outlet location. Less significant waste streams polluting the river include surface runoff discharge and groundwater seepage into the riverbed. The groundwater catchment area includes the MWWTP site.

Despite the fact that the rehabilitation project is aimed at reducing the burst rate at the wastewater treatment facilities and improving the quality of effluent, the discharge of pollutants into the river may increase for a short period, due to the risk of emergencies during implementation of excavation, demolition and other civil work at the MWWTP site, which may increase the volume of the three waste streams mentioned above. In particular, excavation may lead to the mobilization of pollutants previously accumulated locally in the geological environment, causing their infiltration to the groundwater and then to the surface water course. Disturbance of soil and vegetation during demolition and new construction will lead to erosion of exposed soils and pollution of surface runoff with solid particles and associated sorbed contaminants. Finally, any work in the area of utility lines may result in emergency discharge of wastewater into the environment and further mixing of pollutants with surface runoff/infiltration into groundwater, followed by discharge into the river Svisloch.

Table 8.14: Summary of the impacts on water resources and mitigation measures

Impacts	Recipient	Project Phase	Significance of impact	Solutions and mitigation measures	Additional measures recommended by Ramboll	Residual impact
Impacts from work carried out near water bodies	Water protection zones	Construction	Minor	• No car/other vehicle washing outside the waterproofed designated areas • No storage of snow containing sand, salt and de-icing chemicals • No wood cutting, removal and transplantation of flora objects without the respective forest management/design documents • Ensuring compliance with the boundaries of the construction site • Carrying out civil work by methods preventing the degradation of soil due to its uncontrolled erosion with surface runoff/groundwater, freezing and/or damage caused by vehicle movement • Area planning to avoid accumulation of storm water /snowmelt	• No vehicle movement outside of temporary and permanent access roads • No storage of fuel and lubricants on site • Carry out excavation work taking into account the season, the water level in the river and the condition of soil • Bunding and waterproofing of technical areas/platforms • Cleaning of debris and redundant materials after completion of construction; cleaning of the adjacent catchment area	Negligible
Chemical and biological pollution of surface water bodies	Surface water bodies		Moderate	• Bringing a number of facilities, in particular, process lines and civil structures to compliance with regulatory requirements • Construction of a new grit separation unit to replace the existing grit basins • Ensuring compliance with the boundaries of the construction site • Carrying out civil work by methods preventing the degradation of soil due to its uncontrolled erosion with surface runoff/groundwater, freezing and/or damage caused by vehicle movement • Area planning to avoid accumulation of storm water /snowmelt • Introduction of biogas system at the MWWTP within the framework of the rehabilitation project	• Accumulation of domestic and industrial wastewater in storage tanks and timely removal for treatment by third parties • Carrying out civil work in the water protection zone of the River Svisloch as quickly as possible, during the period of minimum runoff • Providing workplaces with inventory containers for domestic waste and debris • Ensuring compliance with the boundaries of the construction site • Refuelling the caterpillar vehicles at designated areas, from a tanker equipped with a hose, outlet valves and a dripping pan to avoid fuel spills • Refuelling vehicles and pneumatic wheeled construction equipment at the nearest filling station.	Minor

Impacts	Recipient	Project Phase	Significance of impact	Solutions and mitigation measures	Additional measures recommended by Ramboll	Residual impact
Depletion of natural resources	Surface water bodies		Minor	The use of surface water resources during construction work is minimized by design solutions.		Negligible
Chemical and biological pollution of surface water bodies	Surface water bodies	Operation	Significant	• Application of technology ensuring the required effluent treatment quality before discharge to the water body • Sludge utilization at new Project facilities • The use of biologically treated wastewater after the secondary sedimentation tank, in order to save water resources (the cost estimate of the water recycling system will be specified at a late designing stage); • Conducting monitoring in accordance with the production control and monitoring program	• On-going quality monitoring over the work of the WWTP • Regular cleaning of the site • Timely repair of road surfaces • Curbing of green spaces to prevent erosion of soil to road surfaces during heavy rains • Measures to prevent filtration and accidental spills of waste water	Moderate
	Water protection zones		Minor	• No unsanctioned storage of production and consumer waste; no use of fertilizers/ameliorants for reclamation of disturbed lands; no discharge of untreated wastewater • No vehicle washing outside the designated waterproofed areas		Negligible
Disruption of natural runoff	Natural runoff lines		Minor	• Landscaping and planting	• Inspection and maintenance of storm water systems according to a maintenance plan • Design of the site area with a balance of solid and permeable surfaces	Negligible

Impacts	Recipient	Project Phase	Significance of impact	Solutions and mitigation measures	Additional measures recommended by Ramboll	Residual impact
Pollution of surface water courses by wastewater/oil leakage/spill	Surface water bodies	Emergency wastewater leakage	Moderate	Implementation of measures to prevent accidental leakage/spill of wastewater, fuel and lubricants: • External and internal waterproofing of walls and manhole bottoms • Painting all steel elements with corrosion-proof paint • Use of PE pipes less prone to corrosion • Laying the pipelines over a prepared bed, in accordance with the applicable regulations • Installation of valves for smooth and flexible operation of the system	• Thermal insulation of pipelines and heating of wastewater tanks, in order to prevent freezing of the wastewater transportation system • Bunding of the areas designated for storage of fuel and lubricants and construction of drainage system to divert contaminated wastewater into the industrial wastewater system for treatment • Collection and of contaminated storm water and disposal for treatment • Equipment of vehicles intended for the transportation of explosive and inflammable cargos with spark arresters, casings and fire extinguishing means	Minor

Table 8.15: Recommendations for monitoring the impacts on water resources

Aspect	Phase	Task	Parameters	Interval
Waste water discharged into the river Svisloch	Construction /Operation	Quality control of the wastewater treatment and the efficiency of the WWTP operation	The amount of generated effluent is carried out by means of flowmeters. Monitoring of effluent composition for compliance with the respective standards is performed by the MVK' laboratory. The following parameters are analysed: • Temperature • pH • Dissolved oxygen • Nitrogen ammonia • Phosphate (as P) • Nitrogen nitrate • Nitrogen nitrite; • Suspended solids • BOD_5	At least once a month Daily
The quality of water in the water	Construction /Operation	The quality of effluent at the outlet to the Svisloch River and the quality of	• Kjeldahl nitrogen • Total phosphorus	Once a week

Aspect	Phase	Task	Parameters	Interval
body (the wastewater recipient)		water in the Svisloch River upstream and downstream the effluent discharge. The monitoring point is established at the boundary of the monitoring zone (over 500 m downstream from the outlet pipe and at the background monitoring point located at least 500 m upstream from the outlet pipe).	• Total volumetric activity of radionuclides; causative agents of intestinal infections	Once a month
			• Total microbial count • Total coliforms • TCB • Helminth eggs • Coliphages	4 times a month
			• Temperature • pH • Suspended solids • BOD5 • COD • Dissolved oxygen • Dry residue (mineralization) • Ammonium ion (as N) • Nitrite ion (as N) • Nitrate ion (as N) • Total nitrogen • Kjeldahl nitrogen • Total phosphorus • Phosphate ion (as P) • Chloride ion • Sulphate ion • Total iron • Cadmium • Cobalt • Manganese ion • Copper • Nickel • Lead • Total chrome • Zinc • SSAS (anionic) • Petroleum products	4 times a month

Aspect	Phase	Task	Parameters	Interval
Condition of groundwater	Construction /Operation	Monitoring of groundwater quality through the monitoring wells at the sludge lagoons	• Temperature • pH • Dry residue (mineralization); • Ammonium ion (as N) • Nitrite ion (as N) • Nitrate ion (as N) • Phosphate ion (as P) • Chloride ion • Sulphate ion • Aluminium • Total iron • Cadmium • Manganese ion • Copper • Nickel • Lead • Total chrome • Zinc • Anionic surfactants (anionic); • Petroleum products • Phenols • Mercury	Once a month

8.4 Impacts on Land Resource and Natural Land Use Conditions

The Project will affect the land use conditions in a vast area the larger part of which belongs to major industrial hub of Shabany. In November 2017 specialists of UE Minskgrado, designer of the Free Economic Zone "Minsk" (including Shabany industrial area), participated in consultations with UE Minskvodokanal and Ramboll. UE Minskgrado prepared a layout scheme of the industrial hub (Figure 5.54) in which Minsk Waste Water Treatment Plant including the sites of MWWTP-1 and MWWTP-2 occupies about 40% of the territory, with potential extension to 50% through acquisition of land plots to the south-east of MWWTP-2.

With its current scope, the Project activities will affect only MWWTP-1. Thus impacts of future reconstruction of MWWTP-2 and potential extension of the treatment plant area are a question of long-term future which is beyond the scope of this assessment.

Immediate impacts of the proposed Project will affect the land plot with cadastral number 500000000002008622 which occupies the area of 50.6139 ha (yellow contour line in Figure 5.53). The titleholder of this land plot is Municipal Unitary Production Enterprise "Minskvodokanal" (Certificate No. 500/1719-1479 dated 19.05.2017). Reconstruction and construction of MWWTP-1 will be implemented at this site, with no need for permanent or temporary acquisition of any further land plots.

Thus the Project will be implemented in the land specifically allocated for operation and maintenance of waste water treatment facilities. After removal of unused buildings and structures, provision of new utilities instead of the old ones, construction of new modern buildings and facilities, landscaping and re-vegetation of disturbed land, the land use conditions in the territory of MWWTP will be more suitable and safe than at present.

It is anticipated that sanitary protection zone of MWWTP after reconstruction will be reduced from 700-1000 metres to 500 metres (Figure 5.52). Such reduction will significantly ease restrictions on land use and enhance opportunities for further development of the territory as part of Shabany industrial area of Free Economic Zone "Minsk".

The Project implementation will help to reduce indirect impacts of MWWTP in the adjacent territories which belong to different categories in terms of ownership and land use, including residential areas in Shabany neighbourhood of Minsk City and several settlements of Minsk Districts. The following reduction of indirect impacts is anticipated as a result of the Project:

- decrease of pollution emissions which will improve ambient air quality will also provide grounds for reduction of the sanitary protection zone of Minsk WWTP;
- water quality in River Svisloch will ameliorate as a result of decrease of pollution discharges with treated waste water, and hence water use conditions downstream of MWWTP will also improve;
- cessation of sludge disposal practice at the Volma site will result in a decrease, though minor, of load on Minsk District road network and associated traffic impacts on receptors along the roads[78].

Alongside with the above positive effects, the Project may also have negative consequences, mostly during the construction phase:

- short-time increase of load on air during demolition, reconstruction and construction of MWWTP facilities: pollution emissions, vibration and noise from the activities at MWWTP site, and also from the vehicles using the public roads beyond the site territory;

[78] The issues of potential reduction of impacts associated with "breathing" of the air pollutant accumulators, as well as risk of contamination of geological environment and surface water as a result of potential leaks from the holding reservoirs or the underground pipeline for transportation of drainage water from the sludge facilities to MWWTP are beyond the scope of this Project and can be discussed in the context of future operation (without further disposal of sludge) and reclamation of the sludge lagoons.

- short-time increase of surface runoff pollution at the site of MWWTP caused by construction works and associated activities, with consequential risk of contamination of ground water and River Svisloch as a result of discharge of polluted drainage water.

After completion of the construction activities, negative impacts of the Project may be associated with disposal of residual wastes from sludge incineration processes. Such impacts will affect off-site facilities (waste disposal landfill) and public roads used for transportation of wastes from MWWTP site. The least beneficial scenario from the perspective of land resource quality is so called "zero alternative", i.e. continuation of the current practices which would require extension of the sludge lagoons and acquisition of additional land plots for the purpose.

The only encumbrance on permanent right of use of the above land plot is due to the fact that a part of it (31.3012 ha) is situated in water protection area of River Svisloch and a tributary. Configuration of the water protection area is shown in Figure 5.52. In accordance with Article 52 of the Water Code of the Republic of Belarus (WCRB), MVK bears responsibility for adequate maintenance of the part of the water protection area within the boundaries of MWWTP site, and for compliance with the regulations on permitted business operations in such area. The proposed Project activities are not prohibited by WCRB, however they should be conducted in compliance with the general requirement about prevention of pollution and contamination of surface waters through provision of adequate storm water sewerage systems, area improvement, as well as water protection measures (if needed).

The above Project impacts on the land resource and land use conditions are summarized in Table 8.19. As significance of the anticipated negative impacts on land resource is minor, it is deemed irrelevant to recommend any specific mitigations to supplement the measures for prevention, minimization and remediation of more significant negative environmental and social impacts of the Project which are provided for in the design documentation and covered in this Report.

8.5 Impacts on Soil, Terrain and Geology

As the Project impact on soil, terrain and geology is deemed to be insignificant, this topic was left out of EIA studies of 2016. However it would be reasonable to supplement the earlier studies with estimation of potential impacts of the most probable scenarios of MWWTP reconstruction on the identified components of landscape, and with a list of prevention, minimization and remediation measures.

As discussed in Chapter 7, natural topsoil within the area of proposed reconstruction is non-extent and has been replaced with a combination of disturbed sod-podzolic and associated soils, technogenic soils with topsoil formation signs in surficial layers, and hard-paved and built-over areas where no top soil is present. As reported in EIA 2016, in the MWWTP area, fertile properties are inherent in the surficial soil and soil-ground horizon to the depth of 10-20 cm. It is supposed that the top soil throughout the site territory is contaminated with technogenic pollutants that precipitate from atmosphere and are transported by waste water, as well as pollutants from local sources (historical storage of wastes) and petroleum products (unknown origin).

Geomorphological, geological and hydrogeological conditions at MWWTP site are stable and fair. They are not exposed to any negative impacts except for some local areas, e.g. buildup of petroleum contaminants, areas of historical bursts and repairs of underground water utility lines, etc.

Current impacts of MWWTP operations on soil are associated with precipitation of pollutants emitted by stationary and mobile sources in the treatment plant area (mainly in the form of solid and liquid aerosols). This impact is most significant near the sources and is also present in the sanitary protection zone where pollution levels in air contacting the soil cover may exceed the safety standards for residential areas which are applicable in the Republic of Belarus. The existing and future reduced SPZ mainly consist of land intended for industrial and transport operations (industrial zone, motor and rail roads to the north and east of MWWTP), agricultural land (Zhdanovichi Agricultural Enterprise to the south of MWWTP, and farm land on the right bank of River Svisloch). Other types of land use including individual houses with auxiliary plots (gardens) are located outside the SPZ however near its current boundaries, which means that top soil in the gardens is potentially exposed to pollution impacts of MWWTP in case of deviation from design operation parameters. In general this type of impact on soil resources of Minsk District is deemed to be minor, both in the baseline situation and if any of the reconstruction options is to be implemented.

The most significant impact on soil cover, terrain and geology will be caused by a combination of physical factors and associated impacts during removal, reconstruction and construction of WWTP facilities (however this impact will hardly affect any territories outside the boundary of MWWTP site):

- immediate mechanical disturbance of soil and ground caused by preparatory activities, excavations, piling and auxiliary operations, as well as movements of construction machinery;
- littering of soil surface with solid wastes;
- local contamination of top soil and geological environment with substances that degrade their biological, physical and chemical properties – waste water, fuel and lubricants, paints.

The above direct impacts may cause the following consequential impacts:

- wind and water erosion in disturbed areas with loss of fertile soil material;
- local changes of top soil formation (watering) conditions in soil and ground, heat transfer and other physical properties in the areas adjacent to the construction area;
- secondary migration of pollutants which were already present in the top soil and geological strata induced by construction operations, or caused by dispersed (with atmospheric precipitation) or lumped (spills, leaks, etc.) ingress of such pollutants during the preparatory, construction, installation and auxiliary works.

Based on the available information on the nature of proposed construction and operation activities, it is anticipated that changes in chemical composition of soil and geology in the Project area of influence will remain at the level of trends, without exceeding the threshold levels after which the natural status of local soil and ground water would change. The Project construction activities are not expected to produce any notable additional impact on nearby soil and land (e.g. increase of phytotoxicity, pollution discharges to ground water, etc.). To minimize the respective environmental risks, the method statement should provide for adequate monitoring of compliance with construction standards and regulations, hazardous materials and wastes storage rules, as well as response measures in case of pollution accidents or encountered historical contamination.

EIA 2016 includes a requirement that fertile top soil in the areas construction activities shall be stripped and subsequently reused for landscaping of the territory disturbed by construction. Based on the results of reconnaissance survey of MWWTP territory and materials of earlier geological surveys, the Consultant assumes that soil in the Project area may consist of thin sand and gravel-rubble soil, as well as soil with humus content of less than 1% and fertile layer thinner than 10 cm. In accordance with p.4.3 of EcoNiP 17.01.06-001-2017, this kind of soil is not subject to stripping, and post-construction landscaping may require addition of peat-sand mixes or humic mineral soil to produce artificial topsoil.

In addition to the above, the Consultant recommends the following measures:

- prior to commencement of the works, mark out the boundaries of known areas contaminated with petroleum products;
- as soon as design location of the new buildings and facilities is known, extend the programme of detailed investigations to include well-based soil vapour and hydrogeological surveys, sampling and analysis of soil and ground samples to the depth of designed excavations for determination of their status in terms chemical, biological and radiation pollution and subsequent assessment of the

material suitability for local land reclamation and landscaping, or for handing over for disposal to third parties (MSW landfills, road construction companies, etc.);

- the works method station should include a procedure in case of unexpected historical contamination of soil and geology (with petroleum products and solid wastes) at the construction and demolition sites, taking into account the potential presence of gas generating or other types of ground with adverse physical and chemical properties;
- the works method station should include a procedure in case of extensive discharge of ground water (including water with signs of chemical contamination) in excavations, trenches and pits in the construction area;
- mark out the boundary of water protection zone in the construction work sites and avoid construction of any temporary facilities in the water protection area without appropriate site preparation (hard waterproof paving, storm water drainage systems);
- extend the programme of local environmental monitoring at MWWTP sites to include monitoring of top soil quality: at least 15 testing grounds should be provided taking into account locations of the dominating sources of pollution emissions (e.g. flue gas stack of the waste water sludge incineration facilities) in the areas with disturbed soil cover within the boundaries of MWWTP sites and SPZ; the profiles should be selected to take into account the repeatability of wind directions and positions of vulnerable and regulated territories (residential areas, household plots, farming land); the monitoring intervals, methods and monitored parameters of soil should be defined in accordance with EcoNiP 17.01.06-001-2017 and validated using the data from preliminary studies of soil cover of the land plot[79];
- extend the programme of local environmental monitoring at MWWTP sites to include the route surveys of soil cover in the water protection zone, both at the WWTP site and outside its boundaries – on the left bank of River Svisloch between the upstream section of MWWTP and the section at Novodvorskoye cemetery, to identify and record any signs of physical disturbance and chemical contamination of soil cover, places of natural discharge of the phreatic aquifer in River Svisloch valley, and potential disturbance of conditions in the water protection zone,
- consider extending the local environmental monitoring programme with observations of quality of the ground water used for potable water supply in the former village of Shabany (wells) within the sanitary protection zone of MWWTP.

The above impacts, their assessed significance and mitigation measures are summarized in Table 8.19 below.

[79] The requirement for preliminary soil, landscape and geochemical studies of the land plot is established in EcoNiP 17.01.06-001-2017 (p. 12.6.4) and Instruction “On local environmental monitoring procedures for entities which conduct operations with harmful environmental impacts, including ecologically hazardous operations” (as amended by RB MEP Resolutions of 29.03.2008 No.42, of 27.07.2011 No.26 and of 15.12.2011 No.49).

Table 8.16: Assessment of forecasted significance of residual impacts of construction and operation of the Project facilities on geological environment

Impact	Negative/positive	Receptors	Project phase	Impact significance	Design solutions and mitigations	Additional measures recommended by Ramboll	Residual impact
Impact on land resource and land use conditions							
Land acquisition	N	Land resource in Minsk City and Minsk District	C, O	Negligible	None provided, as the Project will be implemented within the existing MWWTP site. No known mineral deposits or producing aquifers are present at the site and its surroundings.	Not required	Nil
Deterioration of subsoil use conditions	N	Minerals and ground water deposits at MWWTP site	C, O	Minor		Implementation of measures described in other items of the Table.	Negative cumulative impact, due to the increase of share of built territory and higher risk of contamination to geological environment
Transformation of land plots use conditions	N	MWWTP site	C	Significant in terms of short-time limitations during demolition, reconstruction and construction of MWWTP facilities	Compliance with occupational health and safety requirements during the works	Not required	None expected
	P		O	Significant due to technical development, renewal and development of infrastructure, improved working conditions	Not required	Not required	Positive cumulative impact (refer to description in the “Significance” column)
	N	Territories around MWWTP site	C	Minor to moderate, due to short-term increase of Project impacts to atmosphere and contacting media during the demolition, reconstruction and construction of MWWTP facilities	Modelling of impacts to the nearest regulated territories	Not required	None expected
	P		O	Significant, due to reduction of SPZ and decrease of MWWTP impacts to air as a result of Project implementation	Not required	Not required	Positive cumulative impact (refer to description in the “Significance” column)
	P	Territories adjoining the remote facilities of MVK (Volma sludge facilities and utility lines connecting it	O	Minor to moderate, due to cessation of sludge disposal in sludge lagoons, and moderate to high after their reclamation (beyond the scope of the Project)	Not required	Not required	Positive cumulative impact (refer to description in the “Significance” column)

Impact	Negative/positive	Receptors	Project phase	Impact significance	Design solutions and mitigations	Additional measures recommended by Ramboll	Residual impact
		with MWWTP)					
Physical impacts of soil cover and geology							
Transformation of soil cover in general, as a result of excavations and other associated works (including stripping of fertile soil, ground excavation and displacement, technical reclamation)	N	Soil cover and geological environment at MWWTP site	C	Moderate – for soil cover and geological top layers (to the depth of excavations); low – for deeper ground layers and ground water	Stripping of fertile soil prior to start of construction works, and subsequent utilization for reclamation and landscaping	Monitoring of soil cover and ground to layers in the areas without top soil	Negative cumulative impact, due to the loss of fertile soil material, reduction of unbuilt territories
Vertical transformation of soil cover as a result of drilling and piling works	N		C	Negligible – for the location area of MWWTP facilities in general; low – for wells and pile fields (localization within the design battery limits)			Negative cumulative impact, due to increased loads and re-distribution of strain in geological environment
Static loads on soil cover	N		C, O	Minor – for buildings and facilities footprint (localization within the design battery limits)			
Dynamic loads on soil cover	N		C, O	Minor (O) to moderate (C) – sections of access roads (localization within the design battery limits)			
Development of dangerous exogenous geological processes (EGP)							
Erosion accumulation processes	N	Terrain, soil cover and top geological horizons at MWWTP site and adjacent territories	C	Minor – for the MWWTP facilities location area in general; moderate – for the development areas of erosion and accumulation terrain (local extent with potential development to reach beyond the boundaries of allocated plots)	Area grading, prevention of storm and melt water accumulation. Application of construction methods which prevent degradation of base ground properties caused by washout by surface and ground water, freezing, mechanical damage by machinery and vehicles	Monitoring of existing and potential EGP areas	None expected
Gravitational processes	N		C	Minor to moderate – in the areas with technogenic terrain and adjacent territories (local			

Impact	Negative/positive	Receptors	Project phase	Impact significance	Design solutions and mitigations	Additional measures recommended by Ramboll	Residual impact
				extent with potential development to reach beyond the boundaries of allocated plots)			
Flooding and water logging	N		C, O	Minor – for the location area of MWWTP facilities in general; moderate – in depressions, along the back joints of terraces above flood plain; significant – along artificial embankments and underground structures (local extent)			Negative cumulative impact, due to the increase of share of built and hard-paved territories, construction and operation of new underground facilities, permanent transformation of hydro-thermal conditions of the earth cover
Modification of seasonal freezing and thawing conditions	N		C	Minor, as no permafrost ground is present. Local heaving phenomena are possible			
Other EGP	N		C, O	Minor (local extent)			
Chemical and biological contamination of soil cover and geological environment							
Contamination of soil cover, top ground horizons in the aerated zone which contact the soil cover or have no soil cover, resulting in formation of secondary foci and/or infiltration bodies	N	Soil cover and top horizons of the geological environment at MWWTP site	C	Moderate – during the construction phase, due to high concentration of construction machinery, vehicles, mobile buildings and structures, plant, industrial and domestic wastes, at the time of extensive activities related to destruction or disturbance of soil cover	Provision of containers (waste collection sites) for segregate collection of construction wastes at the construction site, and timely removal of wastes for disposal; compliance with operating wastes management regulations	Monitoring of soil cover and top ground horizons in the areas without vegetation cover	Negative cumulative impact, due to ingress of pollutants, and accumulation of some pollutants in the soil cover and geological environment
			O	Minor			
Secondary mobilization and spread of pollution in soil cover and geological environment	N	Soil cover, geological environment (ground, aeration zones, ground water) at the site of	C	Умеренная, локально - существенная	None planned	Prior to start of the works – verify and mark out the boundaries of known areas of ground and geological environment contamination with	The impact is unavoidable in the areas of earth works, piling works and other activities associated with mechanical
			O	Minor			

Impact	Negative/positive	Receptors	Project phase	Impact significance	Design solutions and mitigations	Additional measures recommended by Ramboll	Residual impact
		MWWTP and adjacent territories				petroleum products. Supplement the works method statement with a procedure in case of unexpected historical contamination of soil and geology (with petroleum products and solid wastes) at the construction and demolition sites, taking into account the potential presence of gas generating or other types of ground with adverse physical and chemical properties	disturbance of soil cover and geological environment, as well as areas of surface runoff infiltration; however its anticipated significance is minor.
Ground water pollution	N	Perched (temporary) water table, phreatic aquifer (sporadic)	C, O	Moderate (O) to high (C) – in the situation where water resources are poorly protected. There is a risk of undesirable spread of pollution with ground water from a local focus (source) to lower horizons and/or discharge to surface water bodies	Surface grading to prevent accumulation of storm and melt water. Provision of closed drainage system at the sludge disposal facilities; drainage water pre-treatment before discharge to the existing industrial and domestic sewerage system.	The local environmental monitoring programme at MWWTP sites should include the route surveys of soil cover in the water protection zone, both at the WWTP site and outside its boundaries – on the left bank of River Svisloch between the upstream section of MWWTP and the section at Novodvorskoye cemetery, to identify and record any signs of physical disturbance and chemical contamination of soil cover, places of natural	Negative cumulative impact, due to downward migration of pollutants in the aeration zone and their ingress into the poorly protected ground water
		Second from surface aquifer (continuously distributed)		Minor (O) to moderate (C) in situation where water resources are poorly protected			
		Producing aquifers		Minor, as no producing aquifers are exposed to the impact			

Impact	Negative/positive	Receptors	Project phase	Impact significance	Design solutions and mitigations	Additional measures recommended by Ramboll	Residual impact
						discharge of the phreatic aquifer in River Svisloch valley, and potential disturbance of conditions in the water protection zone. Arrangement of quality monitoring at de-centralized sources of water (wells) in the former Shabany village in MWWTP SPZ.	

8.6 Waste Handling

8.6.1 Background

It is expected that during the Project implementation a significant amount of waste will be generated, resulting in a negative impact on the environment. Therefore, it is necessary to define the appropriate measures for waste management and waste disposal/recycling.

During the construction/rehabilitation phase and operation of the Project's facilities, several waste streams will be generated, including solid, liquid, hazardous, non-hazardous and inert waste. The generation of waste in relation to the Project may cause the following main types of environmental impact:

- Pollution of the environment, in particular, atmospheric air, surface water bodies, groundwater and soils by waste spills caused by improper waste handling or storage
- Fugitive emissions of dust and contaminants during transportation and storage of certain types of waste
- Overfilling of the capacity of the landfills having limited service life
- Health and safety impacts on employees and local communities
- Fire and explosion hazards, due to the presence of reactive, inflammable and explosive materials
- Visual impact associated with improper conditions of waste storage, and
- Increase of traffic movement due to transportation of waste from the Project sites to the place of final disposal

In accordance with the Law of the Republic of Belarus on Waste Management dated 20 July 2007, No 271-3, Article 15, all the waste is classified as extremely hazardous (1st class of danger), highly hazardous (2nd class of danger), moderately hazardous (3rd class of danger), low-risk (4th class of danger) and non-hazardous. The handling of hazardous wastes requires special attention, especially when choosing the ways of temporary storage, final processing, disposal or recycling.

Wastes generated by the Company are divided by types and stored in accordance with the requirements of the legislation of the Republic of Belarus.

Disposal of industrial wastes at external facilities (landfills) is carried out on the basis of a permit obtained from the local authority regulating the use of natural resources and protection of the environment.

The quantity of each type of waste (the waste generation and disposal limit) is defined as the difference between the expected volumes of waste generation and the expected volumes of reuse, based on the norms for consumption of raw materials and other materials, the norms for generation and use of waste, the amount of production and the capacity of the disposal facility, taking into account the impact of the waste on the environment.

Application for the waste generation and disposal limit is mandatory in the following cases:

- The waste is disposed to waste disposal sites
- The amount/period of storage of industrial waste at waste disposal facilities prior to use or neutralization exceeds one cargo transport unit/15 calendar days

The waste storage period, the maximum amount of waste stored, the amount of industrial waste stored before transportation by one cargo transport unit shall be established annually.

If any new types of waste are identified as a result of inventory, additional waste generation and disposal limits shall be obtained in the order established by the legislation.

This chapter is focused on the proposed methods of handling/storage and disposal of waste streams that can be generated during the construction and operation phases of the Project, as well as on the potential environmental impact of waste management and the respective mitigation measures. The issues related to the environmental impact of the waste generation and disposal during the decommissioning phase of the Project are discussed in Chapter 10 of this report.

8.6.2 Waste Management during the Construction Phase

This section describes the characteristics of waste streams that can be generated during the construction of the Project facilities, taking into account the consumed raw materials.

The materials consumed during the construction phase include those required for preparatory work on site and construction of buildings and structures, such as steel elements, reinforcement, blocks and piles, sand, cement and other finishing materials, auxiliary structures, construction site elements and other materials, as well as the process equipment for the Project facilities.

During the construction phase, the hazardous waste formed on site may include spent oils and solvents, contaminated polyethylene and polypropylene containers, wiping material, sweepings, hydraulic fluids, lubricants, paint and varnish waste, contaminated soil (due to possible leaks or spills), spent batteries, etc. The handling of such hazardous waste requires special attention, in particular with regard to temporary storage, final processing, disposal or recycling methods.

Information on waste streams that are expected to form during the construction phase of the Project, as well as their potential impact, handling/storage and disposal methods is provided in Annex C hereto. The types and amount of generated waste shall be specified at the stage of development of design documents.

During the construction phase, special facilities for the collection and storage of waste will be arranged at the Project site, some of which can later be used also during the operation phase. These facilities will be used for temporary accumulation of materials before transportation to final disposal sites.

The environmental impact of the waste generated during the construction/rehabilitation phase will mainly be related to the formation of a large volume of debris after demolition of buildings and structures and its subsequent removal (transportation) and disposal, as well as to the fugitive emissions (mainly dust) to the atmosphere, the risk of contamination of soil and underground water/surface water bodies and local visual impact (significant for large-sized and household waste). Furthermore, the increased traffic intensity associated with the removal of large volumes of waste may result in the increased public concern and the risk of road accidents.

These potential impacts can be prevented and minimized by appropriate measures, therefore it is recommended to develop a waste management plan for the construction phase, which should be further developed by the construction contractor and monitored by the Client.

The impacts described above will be short-term and, in general, reversible. The overall impact on the environment from waste management activities during the construction phase is estimated as ***moderate***. If the respective recommendations for mitigation of the impacts are observed, the residual impact from waste management during the construction phase of the Project is assessed as ***minor***.

8.6.3 Waste Management during the Operation Phase

At present, the facilities of Minskvodokanal generate 50 different types of solid and liquid waste of various hazard classes, from Class 1 to non-hazardous. According to the state statistical report for 2016, the largest waste streams are attributed to the following types of waste:

- Industrial waste similar to household waste (non-hazardous, code 9120400), in the amount of 714.6 t/a
- Screenings (Hazard Class 3, code 8430100) – 1,435.763 t/a
- Grit from sand basins (mineral sediment) (Hazard Class 4, code 8430500) – 8,744.39 t/a, and

- Sludge from biological treatment facilities for domestic wastewater (Hazard Class 3, code 8430200) – 244,138.0 t/a (20% DS)

According to the current waste management regulations of Minskvodokanal dated 20 September 2017, the grit from the sand basins is transported to the sludge lagoons and used as a basis for mulching. The screenings from the grids and different types of non-hazardous waste are transported to the MSW landfills. The sludge from biological treatment facilities is taken to the sludge lagoons operated by Minskvodokanal. The Complex Environmental Permit No 5 issued on 31 August 2017 specifies the storage and disposal facilities for the waste of Minskvodokanal. At present, the 3rd and 4th hazard class waste formed at the facilities of the Minsk WWTP is disposed to the Trostenetsky landfill (operated by Ekores UP), in amounts corresponding to the limits specified by the Complex Environmental Permit. Other landfills (MSW landfill in Zaslavl, MSW landfill in Molodechno District, MSW landfill in Vileika, MSW landfill in Smolevichi, MSW landfill in Dzerzhinsk, MSW landfill in Druzhny, MSW landfill in Cherven) receive waste from Minskvodokanal's branches.

The sludge grounds of the Minsk Wastewater Treatment Plant are designed for storage of biological sludge from domestic sewage (code 8430200) and include sludge lagoons and a pumping station. The lagoons are arranged in old sand quarries formerly operated by Volma and located in the villages of Sinelo, Mihanovichi and Veselki. The total area occupied by the lagoons and related facilities exceeds 150 hectares, and the total volume of buried sludge is approximately 5 million cubic meters.

There is no remaining capacity of the Volma sludge lagoons, which is why it was decided to carry out the rehabilitation of WWTP-1, including the introduction of modern methods of sludge utilization. One of the immediate objectives of the implemented Project is to reduce the negative impact from the waste generated during the operation of the Minskvodokanal's wastewater treatment facilities.

Based on the results of the preliminary feasibility study, it was recommended to implement a rehabilitation project that includes digestion, dewatering and incineration of the sludge, as well as generation of electricity and heat for internal use and/or sale. The proposed process includes mechanical treatment, followed by digestion of raw sludge in methane tanks (thermophilic process), to produce biogas for subsequent combustion in gas piston plants and generation of electric and thermal energy. The digested sludge is mixed with biological sludge and transported for dewatering in a drum-type dryer. After dewatering, the sludge is incinerated. If the proposed option is implemented, the main waste stream will be ash.

The proposed solution will make it possible to use the biogas obtained during fermentation of raw sludge for the production of power and heat. The Volma sludge lagoons will be decommissioned and remediated (if necessary), since there will be no need to dispose large amounts of sludge. Most of the waste will be disposed of by burning at the MWWTP site.

When the Project is implemented, the main types of waste generated during the operation phase will be as follows:

- Industrial waste similar to household waste (non-hazardous, code 9120400), in the amount of 23.4 t/a – to be disposed at a MSW landfill
- Screenings (Hazard Class 3, code 8430100) – 17,629.5 t/a – to be disposed at a MSW landfill
- Grit from sand basins (mineral sediment) (Hazard Class 4, code 8430500) – 18,834.0 t/a (80% DS) – to be disposed at a MSW landfill
- Sludge from biological treatment facilities for domestic wastewater (Hazard Class 3, code 8430200) – 273,000.0 t/a – dewatered to 20% DS and incinerated
- Absorbing coal (a mix of activated carbon from the absorber), contaminated with mercury (Hazard Class 1, code 3141704) – around 30 t/a (unloaded once every 12-36 months) – incinerated together with sludge or transported to industrial landfill for disposal

- Ash from incineration of briquettes produced from a mixture of dewatered sewage mix containing iron, zinc, copper, nickel, manganese, lead, chromium, phenol, formaldehyde, benzo(a)pyrene, phenanthrene, etc. (Hazard Class 3, code 3130806) – 10,000.0 t/a – to be disposed at a Trostenetsky landfill
- Sludge from boiler cleaning (Hazard Class 3, code 3164200) – 6 640,0 t/a – to be disposed at a MSW landfill
- Scrubber cleaning mud (cake from cleaning scrubbing water) (no hazard class specified, code 3165900) - 30,4 t/a – to be disposed at an industrial waste landfill
- Spent synthetic and mineral oil (Hazard Class 3, code 5410201) - 16,35 t/a – transported to a specialized company for regeneration
- Screenings from DNS screens (Hazard Class 3, code 8430100) – 0.12 t/a – to be disposed at a MSW landfill
- Suspended solids from storm water treatment (Hazard Class 4, code 8440100,) - 1,05 t/a – to be disposed at a MSW landfill or used in the road construction, and
- Oil sludge from mechanical wastewater treatment (Hazard Class 3, code 5472000) - 0,08 t/a – collected in a separate container and transported to a specialized company for regeneration

There will also be other waste streams generated at the operational stage, associated with the maintenance of WWTP-1 facilities. These will include spent batteries, contaminated package, hydraulic fluids, lubricants, paint and varnish waste, oil-contaminated wiping material and soil, sweepings from the site area, etc. These wastes will be taken away by specialized organizations, for further neutralization, processing and disposal at a landfill that accepts hazardous industrial waste.

Thus, the proposed technology of digestion, dewatering and incineration of sewage sludge will reduce the amount of waste transported outside the MWWTP from current 244,000 t/a of sludge (DS=20%) to 10,000 t/a of ash (i.e. by more than 24 times). In order to minimize the impact on the environment, it is recommended to use the ash from sludge incineration for production of goods, e.g. building materials. However, this will require investigation of the actual composition of the generated ash.

The EIA of 2016 considers two options for the potential use of ash under the Project, namely:

1. Production of Ceramic Bricks

It has been found that ash has a lower melting point (970°C), an increased specific surface area (4 699 cm^2/g) and a content of water-soluble salts (62.7 mg equiv.). The main feature of ash is the presence of a large number of chemically active trace elements in its composition. In the Russian Federation, TU 5718-001-03323809-98 (Ash from Incineration of Sewage Sludge) and TK 05173538-01-00 for manufacturing ceramic bricks under GOST 530-95 have been developed. The technology of using ash from sludge incineration is implemented by NPO Keramika ZAO (St. Petersburg). Industrial development of the technology of production of ceramic bricks with ash content has shown that the addition of ash reduces the defects of drying and firing. The strength of bricks increases from Brand 100 -125 to Brand 125–150; and frost resistance increases from MRZ 25 to MRZ 50 and better. The fuel consumption for firing is reduced by 5% to 6%. It was found that ceramic bricks containing ash from incineration of sewage sludge are regarded as low-radioactive objects and correspond to the first class of radiation safety, suitable for construction of all types of buildings. Heavy metals contained in the ash are bound as glass phase or converted into hardly soluble silicate and aluminosilicate compounds. They are extracted only by enhanced acid treatment. Under normal use, the bricks are not subjected to such a strong impact, so the washing out of heavy metals is not possible. Given the results of ash analysis, the content of heavy metals in the bricks will be below the limits established by the sanitary requirements for the production of building materials.

2. Production of Cement, Concrete and Mortar

At present, ash from the combustion of hard coal at CHP is used as raw material in the production of dry mix mortars. The use of ash from sludge incineration requires deeper study of ash properties after the plant is put into operation.

The options for the use of ash from incineration of sludge will be considered taking into account the existing producers of construction materials in Belarus and other countries, the potential consumers of this waste as a source of raw materials and prospective markets identified.

It should be borne in mind that sewage sludge contains a large number of pollutants, in particular heavy metals, since the contaminated wastewater from industrial subscribers is collected for treatment at the Minsk Wastewater Treatment Plant. In the event of violation by the subscribers of the limits for the content of pollutants in the wastewater transferred to treatment, the concentrations of pollutants in the sludge and, accordingly, in the ash may increase and exceed the permissible levels established by sanitary requirements. Considering this, the possibility of using ash for production of ceramic bricks or cement, concrete and mortar will be questionable.

8.6.3.1 Approach to Ash Management

If the chemical composition of the ash does not meet the requirements for raw materials, this type of waste will need to be transported to landfill. The hazard classes of ash from incineration of sludge, as well as its other properties, allow its disposal at the properly engineered SMW (solid municipal waste) landfill. An analysis was made of the availability and suitability of landfills for ash disposal in the locations nearest to the MWWTP site (see section 5.6.2 for details).

Taking into account the decommissioning of the Northern Landfill and the future closure of the Prudishche Landfill, the only municipal MSW landfill still available and having the capacity sufficient to receive ash from sludge incineration is Trostenetsky Landfill, which is confirmed by the letter of the waste management enterprise Ekores. Trostenetsky Landfill also contains an operational line for processing of secondary raw materials. In the next few years two more landfills will be designed and constructed, to serve the city of Minsk.

Landfill must comply with the Belarusian and European legislative requirements in relation to landfills of municipal solid waste including ash. Table 8.19 contains a comparative analysis of the Belarusian national legislation with the following legislative documents and guidelines of best practices:

- COUNCIL DIRECTIVE 1999/31/EC (Luxembourg,1999);
- Basel Convention. Technical Guidelines on Specially Engineered Landfill (D5) (Geneva, 1995);
- Environmental, Health, and Safety Guidelines of IFC for Waste Management Facilities (2007).

The comparison showed almost complete similarity of requirements for the landfill, therefore the current design decision is to use landfill Trostenetsky. Its operating company UE “Ecores” confirmed the capacity of the landfill to accept ~20,000 t of ash per annum (which is twice more than the value, estimated by the technical consultants).

If it will be impossible to use the existing landfill of municipal solid waste, the project considered the construction of its own waste facility (landfill) near Minsk Waste Water Treatment Plant. However, the following approach seems to be more appropriate now:

- Confirmation of the real composition of the produced ash and the confirmation of its hazard class to obtain the necessary permits for placement of waste;
- Analysis of the compliance of the landfill with the requirements in table 8.19a before conclusion of the contract for the placement of ash during the period after commissioning of the sludge incinerator;
- Research of possible alternatives for the use of recycled ash in the construction industry (cement industry, road building, etc.).

Table 8.19a. Comparison of the legislative requirements of the Republic of Belarus regarding ash landfills with European and international legislative requirements

Aspect	European legislative requirements	International legislative requirements		legislative requirements of the Republic of Belarus (TKP 17.11-0.2-2009, SANPIN 2.1.7.12-9-2006)	The degree of compliance
	Requirements of COUNCIL DIRECTIVE 1999/31/EC on the landfill of waste (Luxembourg,1999)	Basel Convention. Technical Guidelines on Specially Engineered Landfill (D5) (Geneva, 1995)	Environmental, Health, and Safety Guidelines of IFC for Waste Management Facilities (2007)		
Placement of a landfill taking into natural conditions, the existence of cultural, historical patrimony, etc.	The location of a landfill must take into consideration requirements relating to: • The existence of groundwater, coastal water or nature protection zones; • The geological and hydrogeological conditions; • The risk of flooding, subsidence, landslides or avalanches; • The protection of the nature or cultural patrimony.	• The selection of natural clay liner or clay available for liner, and final cover material available; • Avoid unique habitat area (important to propagation of rare and endangered species) and wetlands, floodplain with high level of groundwater; • Avoid areas of unique archaeological, historical and paleontological interest; • Avoid areas with earthquakes, slides, faults, underlying mines, sinkholes, and solution cavities.	Site geology and hydrogeology: • Landfills should be located in gently sloped topography, amenable to development using the cell (bund) method; • Groundwater's seasonally high table level should be at least 1.5 meters below the proposed base of any excavation or site preparation to enable landfill cell development; • Suitable soil cover material should be available on-site; • Landfills should be sited outside of a floodplain and areas with seismic activity; • No fault lines or significantly fractured geologic • structure should be present within 500 meters of the perimeter of the proposed landfill cell development which would allow unpredictable movement of gas or leachate; • There should be no underlying limestone, carbonate, fissured or other porous rock formations.	The landfill should be placed outside the floodplain with low level of groundwater (at least 1 m below the bottom liner of landfill). Soils should be relatively impermeable. It is necessary to avoid faults, sinkholes, slides, wetlands, areas with water bodies, forest, nature, cultural, historical patrimony.	**Almost full compliance.**
Placement of a landfill outside of residential and recreation areas, waterways, water bodies, water supply.	The location of a landfill must take into consideration requirements relating to the distances from the boundary of the site to residential and recreation areas, waterways, water bodies and other agricultural or urban sites.	Suitable buffer zone (with planting trees) should be provided around the perimeter of the site, no development should occur near the landfill (apart from buildings on the site). The width of the buffer zone varies according to adjacent land use. The distance from landfill to water supply is minimum 500 feet (150 meters).	The proposed landfill should be typically further than 250 meters from residential development and further than 500 meters from supply wells. The minimum distance to airports is 1,6-3 kilometers.	For landfill with municipal solid waste the width of sanitary protection zone (spz) is 500 meters. At least 40% of territory around the perimeter of spz should include green spaces. Landfill should be located on the downwind side of the prevailing wind direction in relation to residential development.	**Full Compliance.** The legislative requirements of the Republic of Belarus include a number of limitations on activity near landfill. The width of the buffer zone is even more than in the requirements of IFC guideline.
Sealing system and protective barriers.	• The combination of a geological barrier and a bottom liner during the operational/active phase and combination of a geological barrier and a bottom liner during the operational/active phase and the combination of a geological barrier and a top liner during the passive phase/post closure; • The landfill base and sides shall consist of a mineral layer which satisfies permeability (k) and thickness requirements with a combined effect in terms of protection of soil, groundwater and surface water. In case of storing hazardous waste: **K ≤1x10^{-9} m/s, thickness ≥ 5 m**. Where the geological barrier does not naturally meet these conditions it can be completed artificially and reinforced by other means giving equivalent protection. An artificially established geological barrier should be no less than **0,5 m** thick; • The drainage layer with thickness more than **50 cm** is also planned; • A surface sealing may be prescribed by competent authority in cases of insufficient protection.	• Increasingly, double and sometimes even triple liner systems are selected: • A mineral sealing layer (for example, compacted clay) typically **2 m** thick with a permeability of about **10 m/s**; • A plastic liner typically **2,5 mm** thick; • A drainage layer of about **30 cm** thickness. It should be constructed of coarse material, so that over time its permeability will be reduced by clogging.	Liner systems for landfills can consist of a combination of geological barrier with an overlying bottom liner and leachate drainage layer. Permeability and thickness requirements may range from a hydraulic conductivity of **1 x 10^{-7} cm/s (1×10^{-9} m/s)** for a **0,6-meter layer** of compacted soil overlaid by a 30-mil flexible membrane liner (60-mil if made from high density polyethylene (HDPE)) to a **1 m** thickness and hydraulic conductivity of **1 x 10^{-9} m/s** for the combined geological barrier and liner system with a **0.5 m** drainage layer. After landfill site closure the surface sealing is provided.	The overlying bottom liner of landfill should be located above compacted layer of soil at least **0,5 m** thick with a permeability of about no more than **10^{-5} cm/s (10^{-7} m/s).** In this case special measures for construction of additional barrier is not required (sometimes the drainage layer is required). In areas with more permeable soils the sealing of landfill base and sides is necessary. There are several types of barriers: single-layer clay, bituminous and cement, made of polyethylene membrane, with latex emulsion. The choice of certain type depends on results of technical and economic calculations.	**Full Compliance.** According to the Belarusian, European and international legislative requirements, a sealing system and a combination of barriers are necessary at landfill. Belarusian requirements in relation to permeability and thickness of natural geological barrier are less stringent, but are provided in the case of the Project. The use of additional artificial barriers (bitumen, cement, latex, etc) can provide a sufficient protection in a certain case. For example, bentonite was used as an artificial barrier at the landfill "Trostenetsky" (Eroshina et al., 2010). The permeability of bentonite varies **from 10^{-9} to 10^{-11} m/s**, that complies with the requirements of COUNCIL DIRECTIVE 1999/31/EC.
Monitoring of level and composition of surface, underground water at landfill	• Quarterly monitoring of level and composition of surface water. It shall be carried out at not less than two points,	Requirements as in COUNCIL DIRECTIVE 1999/31/EC.	Monitoring of surface and underground water near landfill. Sampling sites as in COUNCIL DIRECTIVE 1999/31/EC.	For landfills with large and medium amount of waste the special project of local environmental monitoring should be	**Full Compliance.**

Aspect	European legislative requirements	International legislative requirements		legislative requirements of the Republic of Belarus (TKP 17.11-0.2-2009, SANPIN 2.1.7.12-9-2006)	The degree of compliance
	Requirements of COUNCIL DIRECTIVE 1999/31/EC on the landfill of waste (Luxembourg,1999)	Basel Convention. Technical Guidelines on Specially Engineered Landfill (D5) (Geneva, 1995)	Environmental, Health, and Safety Guidelines of IFC for Waste Management Facilities (2007)		
or near it.	one upstream from the landfill and one downstream; • Monitoring of level (every six months) and composition (site-specific frequency) of underground water with at least one measuring point in the groundwater inflow region and two in the outflow region.			developed. It includes the control of physical, chemical, bacteriological parameters and the level of surface and underground water. To assess the impact of landfill on groundwater quality at least 3 samples are collected (one sample in the groundwater inflow region and two samples in the outflow region). The certain list of controlled parameters and the frequency of sampling are approved by the supervisory authority.	
Control water entering into the landfill body. Leachate monitoring.	• Control water from precipitations entering into the landfill body; • Prevent surface water and/or groundwater from entering into the landfilled waste; • Measuring (volume and composition) of leachate must be performed separately at each point at which leachate is discharged from the site. Measuring of volume and composition is conducted monthly and quarterly respectively. If an assessment based on consideration of the location of the landfill and the waste to be accepted shows that the landfill poses no potential hazard to the environment, the competent authority may decide that this provision does not apply.	Monitoring of leachate composition. Determination of major ions, heavy metals, organic compounds and micro-organisms.	Determination of leachate quantity or quality. Changes in leachate quantity or quality not attributable to weather or other factors may indicate changes in the liner, leachate collection, or landfill cover systems.	For monitoring of leachate quantity at landfill with amount of waste more than 30000 m^3/year the control well is installed.	**Partial compliance.** There is no Belarusian legislative requirements in relation to leachate composition monitoring. It is necessary to provide a control water entering into the landfill body.
Leachate collection system (LCS).	leachate collection system must be installed so as to ensure that leachate accumulation at the base of the landfill is kept to a minimum.	Requirements as in COUNCIL DIRECTIVE 1999/31/EC.	Install a leachate collection and removal system immediately above the upper liner to collect and remove leachate from the landfill so that leachate depth over the liner does not exceed **30 cm**. The leachate collection and removal system should be: • Constructed of materials that are chemically resistant to the waste managed in the landfill and the leachate expected to be generated and of sufficient strength and thickness to prevent collapse under the pressures exerted by overlying wastes, waste cover materials, and by any equipment used at the landfill; • Designed and operated to function without clogging through the scheduled closure of the landfill	In areas with high level of groundwater for landfill with amount of waste more than 30000 m^3/year the leachate collection system is necessary. The leachate depth over the bottom liner or barrier does not exceed **20 cm**.	**Full Compliance.** But the leachate collection system, according to the Belarusian requirements, is not installed in all cases. The ash will be delivered to Trostenetsky landfill
Treatment of contaminated water and leachate collected from the landfill.	Treatment of contaminated water and leachate to the appropriate standard.	Requirements as in COUNCIL DIRECTIVE 1999/31/EC.	Treatment of leachate onsite and/or discharge to municipal wastewater system. Potential treatment methods include aerated lagoons, activated sludge, anaerobic digestion, artificial wetlands, re-circulation, membrane filtration, ozone treatment, peat beds, sand filters, and methane stripping.	No information.	**Potential noncompliance.** There is no Belarusian legislative requirements in relation to treatment of water and leachate collected from the landfill. It is necessary to verify a compliance with this requirement after clarification of the landfill.
Collection of meteorological data.	In operation phase it is recommended to collect meteorological data from monitoring at the landfill or from the nearest meteorological station. The collected data are the following: • Volume of precipitation; • Temperature (min., max., 14.00 h CET); • Direction and force of prevailing wind; • Evaporation;	Requirements as in COUNCIL DIRECTIVE 1999/31/EC.	No information.	No information.	**Complete Compliance.** It is necessary to provide a collection of meteorological data from monitoring at the landfill or from the nearest meteorological station. There is a meteorological station near the landfill "Trostenetsky".

Aspect	European legislative requirements	International legislative requirements		legislative requirements of the Republic of Belarus (TKP 17.11-0.2-2009, SANPIN 2.1.7.12-9-2006)	The degree of compliance
	Requirements of COUNCIL DIRECTIVE 1999/31/EC on the landfill of waste (Luxembourg,1999)	Basel Convention. Technical Guidelines on Specially Engineered Landfill (D5) (Geneva, 1995)	Environmental, Health, and Safety Guidelines of IFC for Waste Management Facilities (2007)		
	• Atmospheric humidity (14.00 h CET).				
Gas monitoring.	• Gas monitoring must be conducted monthly for each section of the landfill; • The objects of monitoring are: methane, carbon dioxide, oxygen, hydrogen sulphide, hydrogen, etc. Measuring of other gases depends on composition of the waste deposited.	Determination and monitoring of gas composition (objects of monitoring and frequency of measuring as in COUNCIL DIRECTIVE 1999/31/EC). Installation of explosion-proof methane detectors. Gas migration control systems should include the monitoring of peripheral boreholes for landfill gas concentration.	Collection of gas samples from wells near landfill.	The system of industrial environmental control includes devices and facilities for control of atmospheric air quality. The objects of monitoring are: methane, hydrogen sulphide, carbon monoxide, ammonia, benzene, phenol, etc.	**Partial compliance.** Compliance with the requirements of COUNCIL DIRECTIVE 1999/31/EC. Sampling of gas from wells is necessary to achieve the compliance with the Basel Convention and IFC requirements. It is necessary to verify a compliance with this requirement after clarification of the landfill.
Landfill gas collection, treatment, use system.	• Landfill gas shall be collected from all landfills receiving biodegradable waste and the landfill gas must be treated and used. If the gas cannot be used to produce energy, it must be flared; • The collection, treatment and use of landfill gas should be carried on in a manner which minimizes damage to environment and risk to human health.	Installation of gas collection system and whenever possible to recover the gas for use as an energy source. In other cases treatment of gases using incineration (if the gas has high content of methane and/or volatile hydrocarbons), wet scrubbing (if the gas has significant hydrogen sulphide content and relatively small amounts of volatile hydrocarbons).	• Installation of gas collection system; • Whenever possible to recover the gas for use as an energy source; • Treatment before emission using enclosed flare or thermal oxidation, if methane content is less than about 3 percent by volume. Highly efficient combustion of landfill gas ranges from 0,6-1,0 seconds at 850 degrees Celsius to 0,3 seconds at 1000 degrees Celsius in enclosed flares; • Use gas blowers (boosters) of sufficient capacity for the predicted gas yield.	Installation of gas collection system for landfill with amount of waste more than 30000 m^3/year and height more than 10 meters. In most cases gas should be used as an energy source.	**Full Compliance**. But the landfill gas collection, treatment, use system, according to the Belarusian requirements, is not installed in all cases. It is necessary to clarify the specific landfill at which ash will be delivered. On the other hand, ash is mainly non-biodegradable mineral substrate. Therefore, the formation of a large amount of landfill gas is not expected.
Measures aimed at prevention, minimization of nuisances and hazards at landfill.	Measures shall be taken to minimize nuisances and hazards arising from the landfill through: • emissions of odours and dust,; • wind-blown materials; • noise and traffic; • birds, vermin and insects; • formation and aerosols; • fires.	An emergency procedures plan should be prepared and updated on a regular basis. Examples of incidents include fires, explosions, emission of toxic gases, accidental spills of contaminants and of unanticipated contaminated run-off and/or leachate.	Measures aimed at prevention, minimization of nuisances and hazards at landfill: • Minimize open tipping face area; • Pin waste by use of dozers and landfill compactors immediately after discharge from the vehicles delivering the waste; • Use soil or artificial cover materials so that deposited waste is held in place; • Provide perimeter planting, landscaping, or fences to reduce wind; • Use scaring techniques or natural predators to control scavenging birds; • Construct temporary banks and bunds immediately adjacent to the tipping area, install strategically placed mobile catch fences close to the tipping area or on the nearest downwind crest, and/or fully enclose of the tipping area within a mobile litter net system; • Install wind fencing upwind of the tipping area to reduce the wind strength as it crosses the facility; • Temporarily close the facility to specific or all waste or vehicle types when weather conditions are particularly adverse.	Measures aimed at prevention, minimization of nuisances and hazards at landfill: • Pin waste by use of dozers and landfill compactors; • Use soil or artificial cover materials; • Construct mobile litter net systems (barriers) typically 4-4.5 m in height and 1-1,5 m in width adjacent to the tipping area and taking into account the prevailing wind direction; • Provide perimeter planting, landscaping, or fences to reduce wind; • Conduct moisture of wastes in summer and fire risk periods; • Preparation of the emergency procedures plan and fire safety regulations, installation of fire water storage tanks, firefighting equipment.	**Almost full compliance.**
Security management.	The landfill shall be secured to prevent free access to the site. The gates shall be locked outside operating hours. The system of control and access to each facility should contain a program of measures to detect and discourage illegal dumping in the facility.	Access to the site should be strictly controlled. The security of the site should be maintained by a perimeter fence to keep out unauthorized people as well as itinerant wildlife.	Fully enclose the waste management site with fencing. Provide daily cover of wastes to minimize the attraction to birds, which can become infected with avian influenza and other bird diseases that can then be carried off-site.	Fully enclose the waste management site with fencing. The fence can be replaced by a drainage ditch with more than 2 m in depth or a bund with no more than 2 m in height.	**Complete Compliance.**

Source: Ramboll

8.6.4 General Waste Management Procedure

Waste streams generated during operation shall be stored, used, decontaminated or disposed of in accordance with special procedures that minimize the negative impact on the environment and meet the requirements of national and international standards.

According to the requirements of the IFC's General EHS Guidelines, all generated waste (irrespective of the project phase) shall be classified as non-hazardous and hazardous and collected respectively, taking into account their possible further re-use, processing or disposal. In accordance with the legislation of the Republic of Belarus, waste is divided into classes and types that shall be handled separately, starting from the collection and temporary storage. Joint handling of different waste streams is allowed if they can be later handled and disposed together.

During the Project implementation, the following requirements of the IFC's General EHS Guidelines for waste management shall be considered:

Non-hazardous waste:

- Waste management planning: identify and define the sources of all waste streams under the Project and develop proposals for their final disposal
- Prevent waste generation where possible: in the first place, identify the opportunities for eliminating waste generation
- Recycling and reuse: identify opportunities for re-use and recycling by own forces or by involvement of licensed companies
- Treatment and disposal: if processing/reuse is not possible or feasible, determine appropriate treatment and/or disposal methods for all waste streams

Hazardous waste:

- Storage/accumulation of waste: the system of temporary storage/accumulation of waste shall be fully developed; the system design shall comply with the best industry practice
- Transportation: all containers intended for the removal of waste from the site shall be sealed and labeled accordingly; filling of containers shall be supervised by the competent staff of Minskvodokanal, who have received appropriate training
- Treatment and disposal: if processing or reuse is not possible or feasible, the appropriate treatment /disposal methods for all waste streams, including hazardous wastes, shall be defined

Within the framework of the Project, the existing Minskvodokanal’s system will be utilized for tracking the movement of waste from the point of generation to the point of final processing/disposal. All types of waste require separate collection/temporary storage on site in accordance with the requirements of the Federal Classification Catalog of Waste. Transportation, processing and final disposal of waste shall be carried out by contractors having appropriate licenses.

The existing industrial waste management regulations of Minskvodokanal, dated 20 September 2017, require keeping records of waste, in order to prevent damage to the environment, human life, public health and personal property. Waste recording allows determining the amounts and types of waste and secondary raw materials for further reuse. Furthermore, it enables to document the waste management actions in timely and reliable manner.

The collection of waste is carried out by type, hazard class and other characteristics, which ensures further use of waste as secondary raw material, decontamination and environmentally safe disposal. It is forbidden to mix waste of different hazard classes in the same container. It is also unacceptable to put the waste that is subject to decontamination, into waste containers intended for landfill disposal.

Storage of waste on site is allowed only in designated areas, namely, at the waste storage facilities specified in the complex environmental permit or at other locations specified in the Instruction for Temporary Storage of Industrial Waste, until the accumulated amount is transported to a relevant disposal/decontamination / recycling location. Waste shall be accumulated to a volume not exceeding one cargo transport unit. The maximum capacity of the cargo transport unit is defined separately for each type of waste.

Temporary storage of industrial waste on site is allowed in the following cases:

- if the waste is used in the subsequent process stages
- in the absence of landfills for final disposal, and
- if the accumulated volume is less than one cargo transport unit

Depending on the hazard class and the physical-chemical characteristics of the waste, temporary storage can be arranged in the following locations:

- At production facilities (e.g. workshop, process building, etc.) or auxiliary premises (e.g. warehouse, storage room, etc.)
- In a temporary warehouse, and
- Outdoors in an open area

The method of temporary storage is determined by the hazard class of waste:

- Waste of Hazard Class 1&2 shall be stored in sealed containers
- Waste of Hazard Class 3 shall be stored in closed containers/barrels/cisterns/tanks/PE bags or plastic/textile/paper bags, boxes and other containers, and
- Waste of Hazard Class 4 shall be stored in closed/open containers or in bulk, in heaps, in ridges/ dumps, in bales/rolls/parcels, on pallets/stands

Waste collection and storage sites arranged in the Project area during the construction phase shall be equipped in accordance with the following requirements:

- Separate sites shall be arranged for storage of hazardous and non-hazardous waste
- Separate containers for each waste stream shall be arranged to ensure separate collection and maximum opportunity for reuse and recycling
- All containers shall have appropriate covers (to prevent precipitation into the container or blowing of light materials by wind)
- Liquid waste shall be stored in tanks or barrels in a bunded area capable of holding 110% of the volume of the biggest tank
- Storage areas for liquid waste shall be equipped with spill collection kits
- Hazardous waste storage sites shall be located at a distance from the existing sensitive recipients, e.g. industries
- The risks of theft or vandalism shall be eliminated
- Simplicity and security of access, and
- Appropriate ventilation

Burning of combustible waste and debris on site within the city limits is not allowed. Debris shall not be buried on site.

Temporary storage of waste in non-stationary warehouses, in the open, without containers or in a leaky container, shall be arranged on hard paved surfaces. Containers for waste storage shall be marked with indication of waste type and hazard class. For each shipment of exported waste, an accompanying waste certificate shall be issued, in the form approved by the Decree No 112 of the Ministry of Natural Resources of the Republic of Belarus, dated 9 December 2008.

The points of generation and temporary storage of waste during the operational phase shall be clearly defined and plotted on the waste disposal maps attached to the Minskvodokanal Waste Management Regulations approved by the Minsk City Committee for Natural Resources and Protection of the Environment.

The ash from sludge incineration shall be disposed only to landfills intended for this purpose and equipped with dust suppression systems (sprinklers for periodic wetting of dust waste with water), taking into account the requirements described in Sub-Section 8.6.3.1.

If the Project includes the construction of the MVK's own MSW landfill, it shall comply with the following requirements of SanPiN 2.1.7.12-9-2006 (Hygienic Requirements for the Construction and Maintenance of Landfills for Solid Municipal Waste):

- The site for the landfill facility shall be selected considering the climatic, geographical, soil, geological and hydrological conditions. Hydrological investigations are required at the site proposed for construction of the landfill. The preferable locations shall be those where clays or heavy loams are found, and the groundwater levels are at the depth below 2 m. The landfill site shall be arranged on flat ground, to prevent the movement of some waste by atmospheric precipitation and contamination of adjacent lands and surface water courses.
- The waste shall be accepted at the MSW landfill under the supervision of the landfill operator it in accordance with the relevant procedures. The condition of underground water and surface water bodies, atmospheric air and soil, as well as the noise levels, in the zone of possible negative impact of the landfill shall be monitored by an industrial laboratory according to an established program.
- The operations performed in the process of MSW disposal shall prevent the pollution of ground water and surface water bodies, air and soil by concentrations above the Maximum Allowable Concentrations/Approximate Safe Exposure Levels established in the relevant hygienic standards.
- Taking into account that the landfill will mainly accept the ash from sludge incineration, it is necessary to provide dust suppression measures when operating the landfill.
- The industrial quality control system shall include the devices and systems to monitor the state of underground and surface water, air, soil and noise levels in the area of potential impact of the landfill.
- The landfill shall be taken out of operation after filling up to the design height.

8.6.5 Impact Assessment and Recommendations

The environmental impacts of the waste generated during the operation phase, in case of implementation of digestion, dewatering and incineration of the sludge, will be related to the disposal of ash from sludge incineration and decontamination of coal absorber containing mercury. The considered impacts are estimated as medium-term. Considering the significant volumes of the waste and its hazard classes (I and III), as well as strong impact of the incineration process on atmospheric air, the overall impact on the environment from waste management activities during the operation phase is estimated as <u>high</u>. Subject to implementation of the proposed solutions and waste management procedures and taking into account the general requirements for collection, temporary storage, transportation and disposal of waste, the residual impact is assessed as <u>moderate to low</u> and as localized.

Subject to implementation of the set of measures for recycling of ash in production of materials for construction industry and the incineration of coal-absorber, the impact can be mitigated to <u>minor</u>.

Monitoring of the impacts caused by waste handling shall be carried out on a regular basis, including regular internal audits to monitor waste management practices and regulatory compliance throughout the life cycle of the Project, as well as assessment of compliance with environmental, sanitary, epidemiological and fire safety requirements with regard to the collection, accumulation and storage of waste.

Recommendations on improvement of waste management practices under the Project shall be included in the routine reporting procedures. Furthermore, procedures should be developed to monitor the movement of waste streams. It is necessary to keep records of the waste stream amounts by types and hazard classes, both at the accumulation and temporary storage facilities and outside these facilities.

With regard to the Volma sludge lagoons, a recommended strategy would be the development of a decommissioning plan, including, but not limited to, the following activities:

- Ensuring safety of the local people (by restricting access to the site)
- Monitoring the composition of surface water bodies and the conditions of the geological environment and groundwater in the affected area
- Collection and treatment of surface runoff, as required until closing-down or reclamation of the site, and
- Development of measures for closing-down or remediation of the site

Table 8.17: Summary of the waste impacts, the impact significance and mitigation measures

Impacts	Phase	Recipient	Severety of impact	Sensitivity	Significance	Design solutions and mitigation measures	Residual impact
Exhaustion of capacity/filling-up of waste management facilities	C	Waste management facilities	Low	Low	Low	The use of landfills with an exhaustible capacity is allowed only if there are no other ways of waste disposal Minimization of waste volumes (including recycling, processing, compaction, etc.) Monitoring of hazardous waste generation amounts Separation of hazardous waste by types Regular collection of waste by licensed contractors or by the company itself, subject to a license Recycling/processing of most of the waste at specialized licensed facilities Disposal of waste to waste management facilities included in the Register of Waste Storage and Waste Facilities of the Republic of Belarus	Insignificant
	O		High	Low	Moderate	The use of landfills with an exhaustible capacity is allowed only if there are no other ways of waste disposal Minimization of waste volumes (including recycling, processing, compaction, etc.) Monitoring of hazardous waste generation amounts Separation of hazardous waste by types Regular transportation of the waste off the site by licensed contractors or by the company itself, subject to a license Recycling/processing of most of the waste at specialized licensed facilities Minimization of sludge volumes by burning the sludge in gas piston plants and generation of ash Closing-down and remediation of the existing Volma sludge lagoons	Low (in case of secondary use of ash – insignificant)

						Recycling of waste (ash) from sludge incineration in production of materials for construction industry. If recycling/ reuse is impossible, disposal of ash to a licensed landfill Incineration of mercury-contaminated coal absorber (Hazard Class 1) together with the sludge or transportation to an industrial waste landfill for disposal If it is not possible to arrange ash removal to landfills owned by third parties, taking into account the relevant requirements for environmental protection (hazard class, dust suppression measures, etc.), construct a separate waste disposal facility in compliance with the applicable requirements of the Republic of Belarus and the EU Disposal of waste to waste management facilities included in the Register of Waste Storage and Waste Facilities of the Republic of Belarus	
Impact on human health and safety, visual impact	C O	Personnel, construction workers Population	Moderate	Moderate	Moderate	Arrangements for safe temporary waste accumulation, strictly within the borders of specially designated areas Separation of hazardous waste by types. Arrangement of temporary storage according to the hazard class (storage of waste of Hazard Class 1&2 in sealed containers; storage of waste of Hazard Class 3 in closed containers/barrels/cisterns/tanks/PE bags or plastic/textile/paper bags, boxes and other containers; storage of waste of Hazard Class 4 in closed/open containers or in bulk, in heaps, etc.) Hazardous waste storage sites shall be located at a distance from existing sensitive recipients, e.g. existing industries Elimination of the risk of unauthorized access, theft or vandalism Containers for collection of waste shall be equipped with a tight-fitting lid; all storage tanks shall be closed at all times Containers and platforms shall be washed and treated	Low

						with disinfectants at least once every 10 days (except during the winter) Regular collection of waste by licensed contractors or by the company itself, subject to a license Removal of waste by type, to designated landfills During transportation, only the staff members accompanying the cargo shall be present. The presence of unauthorized persons is not allowed Training of personnel in waste management practices Elimination of rodents at waste disposal facilities, by timely disposal of waste as a source of food If necessary, implementation of rat prevention measures (e.g. rat traps) around kitchens and canteens Arrangement of temporary bio toilets, if necessary, and waste disposal by a licensed contractor	
Impacts on surface water bodies, soil and groundwater (e.g. spills, infiltration and migration as a result of improper storage)	C O	Surface water bodies Aquatic organisms Groundwater Soils Local communities (water quality and condition of soils)	Low	Low	Low	The containers for temporary storage of waste shall be labelled and equipped with lids, special bags for preventing leakage, etc. Storage areas for liquid waste shall be equipped with spill collection kits The platform for containers shall have asphalt or concrete surface and a barrier 1.0-1.2 m high, on three sides, to prevent littering the surrounding area Liquid waste shall be stored in tanks or barrels in a bunded area capable of holding 110% of the volume of the biggest tank Equipment of driveways and passages to each area of temporary waste storage. Covering roads with solid, oil-resistant materials Arrangements for emergency collection of liquid waste spills during transportation Prior to transportation, the packaging of waste shall be checked, in order to avoid dust, spills and other waste	Insignificant

						loss along the way.	
Impact on atmospheric air	C	Employees Local communities	Moderate	Low	Low	Selection of waste disposal facilities located as close as possible to the Project site, to reduce the haul distance Burning of combustible waste and debris on site is not allowed Transportation of waste shall be carried out by Minskvodokanal's special vehicles or by the landfill operator, subject to an appropriate license Transportation of waste shall be carried out in dump trucks with a closed canvas top; in summer the waste shall be sprinkled with water to prevent formation of dust Prior to transportation, the packaging of waste shall be checked, in order to avoid dust, spills and other waste loss along the way.	Insignificant
	O		High	Moderate	High	Selection of waste disposal facilities located as close as possible to the Project site, to reduce the haul distance Transportation of waste shall be carried out by Minskvodokanal's special vehicles or by the landfill operator, subject to an appropriate license Installations for thermal disposal of waste (by incineration) shall be equipped with dust removal and gas cleaning equipment, to ensure compliance of emissions with the relevant regulatory requirements The facilities for loading/ unloading of ash to/from vehicles shall be equipped with dust suppression systems (e.g. sprinklers) During windy weather causing excessive dust generation, the ash loading/unloading works shall be limited or completely stopped Transportation of waste shall be carried out in dump trucks with a closed canvas top; in summer the waste shall be sprinkled with water to prevent formation of dust	Low

						Storage of ash shall be provided with dust suppression systems (e.g. sprinkling, water curtain, etc.)	
Impact on biodiversity (littering and pollution of habitats, increase of the rodent population, household waste as a feeding base for birds)	C O	Terrestrial fauna, soil fauna	Minor	Low	Minor	Arrangements for safe temporary waste storage, strictly within the borders of specially designated areas Waste disposal only to licensed landfills Transportation of waste shall be carried out in dump trucks with a closed canvas top, in order to avoid dusting, spills and losses on the route, as well as pollution of habitats with waste Elimination of food base for rodents and birds by safely storing food waste in closed containers within designated areas; regular collection and removal of domestic waste by licensed contractors or by the Company, subject to a relevant license and appropriate vehicles Liquid domestic waste shall be collected in special containers and disposed of in a timely manner by specialized vehicles	Insignificant
Impact on the environment (general management, ensuring compliance with legislative requirements)	C O	All environment s	Moderate	Low	From moderate to low	Appointment of officials responsible for waste management at each individual Project site Timely training of the relevant officials in waste management Development of a waste management procedure and relevant instructions within the Project documents during the construction phase and operation phase of the Project Regular internal audits to monitor waste management practices and regulatory compliance throughout the life cycle of the Project, followed by recommendations to be included in the routine reporting procedures Implementation of documented monitoring of temporary storage, separate collection and removal of all types of waste Conclusion of contracts for processing and disposal of waste with licensed companies, in a timely manner, as	Insignificant

						well as contracts for disposal of waste at the waste management facilities included in the Register of Waste Storage and Waste Facilities of the Republic of Belarus Hazardous waste shall be transported by appropriate vehicles bearing special signs and travelling in compliance with the relevant safety requirements for transportation of dangerous cargos. Each consignment shall be accompanied by a hazardous waste certificate	

Table 8.18: General requirements for monitoring the impact caused by waste generation

Aspect	Phase	Location	Parameters	Interval
Production and consumer waste	Throughout the Project implementation period	Places of temporary storage/accumulation of waste	Monitoring of compliance of waste collection, accumulation and storage practices with environmental, sanitary, epidemic and fire safety requirements Recording the amounts/volumes of waste by type and hazard class: • at the locations designated for accumulation/temporary storage of waste, and • outside the locations designated for accumulation/temporary storage of waste	As the relevant waste volume is generated and accumulated, but at least once a month

8.7 Biodiversity Impact Assessment

This section describes assessment of the impact of Minsk Waste Water Treatment Plant Reconstruction Project on biodiversity, evaluation of its significance, proposed mitigations and methods to improve status of ecosystems at all stages of the Project. Assessment methodology, including assessment of significance of residual impacts, is also described below.

The biodiversity impact assessment is based on the baseline characteristic of flora and fauna which is provided in Section 5. The assessment covers plant and animal species, including rare and protected species, their genetic diversity, abundance, habitats, natural and transformed ecosystems, and high significance biodiversity territories.

8.7.1 Assessment methodology

Description of the main assessment methodologies used for preparation of the EIA report is provided herein in the beginning of the document. Biodiversity impact methodology also consists of four elements:

- Identification of key negative impacts on biodiversity and their effects for plants and animal life and natural ecosystems in general;
- Assessment of impacts nature and significance;
- Development of mitigation measures aiming to prevent, reduce damage, and to rehabilitate disturbed ecosystems, as well as biodiversity compensation measures;
- Assessment of anticipated residual impacts after implementation of the hierarchy of mitigation measures, and development of proposals for further measures to enhance biodiversity.

Assessment of biodiversity impacts significance is based on the same criteria as for impacts on other important environmental and social components, in accordance with the common methodology applied by Ramboll.

8.7.2 Background biodiversity assessment and Project area of influence

According to the landscape classification, the Project area is located at the boundary of two landscape provinces: Minsk District of moraine-erosion landscapes with broad-lived/spruce and pine woods of the Highland Province, and Verkhneptichsky District of secondary fluvio-glacial landscapes with pine and broad-lived/spruce woods of Predpolesye Province, however in the Project area the natural landscapes have been substantially transformed.

The whole territory occupied by the infrastructure facilities consists of transformed landscapes which are affected by further anthropogenic impacts of the industrial development in Shabany industrial area, the waste water treatment plant, as well as former sludge disposal facilities in undeveloped area to the south-east of the site of the reconstruction Project, which have been decommissioned and reclaimed. The right bank of River Svisloch in front of Minsk WWTP is occupied by cultivated land.

According to the vegetation count studies, about 50% of the Company sites are occupied by lawns and flower beds. Trees and shrubs cover less than 0.1% of the territory and mainly consist of ruderal and synanthropic species which are characteristic for disturbed habitats. No rare or protected species have been identified by the geo-botanical studies.

Animal diversity in the treatment plant area is extremely scarce. Insects, amphibians, reptiles, birds and mammals are represented by typical fauna composition. Few migrating birds are encountered here on transit in spring. The autumn migration is less pronounced, without large gatherings of birds. No Red Listed animals are present in the area.

No habitats of rare and protected species or other biodiversity values in the context of the standard of International Union for Conservation of Nature have been identified in the vicinity of the infrastructure facilities. The nearest designated natural areas – Republican level biological reserve "Stiklevo" and local biological reserve "Sokoliny" – are located 4800 m to the north-east and 5900 m to the south-west of the

Project site, respectively. The Krasnaya Sloboda municipal park is located in residential area at a significant distance – 1600 m to the north-west of the Project site.

The natural ecosystems include aquatic ecosystems of River Svisloch which flows 100 m to the north-west of the Project site, and the right-bank biocoenosis, however the latter are degraded due to the accumulated ecological damage caused to the water body by the historical operations. For instance, implementation of Zaslavl reservoir also known as "the Sea of Minsk" caused significant changes to hydrological conditions of River Svisloch which manifested in reduction of maximum water flows during spring high water period, decline of storm floods, and increase of low-water flow. River Svisloch is a 2nd category fishery water course with breeding perch, roach, pike, crucian, tench, however downstream of Minsk it is one of the worst polluted streams in the Republic of Belarus (its status is described as "dirty"), thus aquatic fauna occurrence and concentration is lower.

In view of the above, potential area of biodiversity impacts of the Project is described as follows:

- Mechanical damage of soil and plants, and nuisance to animal life – MWWTP construction site and associated infrastructure facilities and adjacent territories;
- Noise impact on animals – depending on type of works and taking into account air attenuation to 60 dB relative to 20 µPa is about 400-500 m;
- Impacts of pollution emissions on ground surface ecosystems – in accordance with protective sanitary zone estimation;
- Impacts of treated effluent discharges on aquatic ecosystems – all sections of River Svisloch downstream of Osipovichi reservoir (taking into account the cumulative impacts of other water users).

8.7.3 Impacts at the Construction Stage

The main impacts at this stage will be associated with reconstruction of the existing and construction of new infrastructure facilities, in particular:

- Cutting of fertile soil cover and clearance of vegetation in the territories intended for construction of infrastructure facilities, access roads and laydown areas;
- Cutting of trees and shrubs which hamper construction of infrastructure facilities, access roads and laydown areas;
- Disturbance of plants vegetative functions and increasing stress factors as a result of construction dust settlement on photosynthesizing surfaces;
- Noise impacts of construction of animal life;
- Disorientation and disturbance of circadian rhythm of animals, primarily birds, amphibians and reptiles, due to enhanced light background during construction activities at night time;
- Death of animals, mainly amphibians and reptiles, under wheels of vehicles, due to increased construction traffic;
- Disturbance of ecosystems by new construction and domestic wastes storage sites;
- Soil and vegetation contamination by spills of oil, paint and other hazardous liquids.

Overall biodiversity impact at the construction stage is assessed as **negative**, however **temporary, short-time** and **local** by nature, as it will be present only at the work sites and immediately adjacent areas, and will not result in permanent loss of natural ecosystems and habitats of rare and protected species. In view of the **medium** scale of aggregate impact (based on the scope and types of the works and the vast range of biodiversity impacts", recipients' sensitivity is assessed as **high**, however the impact significance before mitigation is **medium**.

8.7.4 Impact level and significance: Operation Stage

The main impacts at the operation stage will be related to capacity increase of the treatment plant and auxiliary infrastructure:

- Impact on River Svisloch flow patterns and values, due to increased treated effluent discharges to the water course;
- Impact on aquatic fauna and ecosystems of River Svisloch, due to increased treated effluent discharges to the water course;
- Impact on temperature conditions in River Svisloch, due to increased treated effluent discharges to the water course;
- Impact on nearby ecosystems, due to increased emissions from various sources at the reconstructed WWTP.

At the operation stage, the impact on ground-surface ecosystems and designated natural territories is expected to be **minor**, however, since the reconstruction Project provides for increasing effluent discharge volume by a third, anticipated impact on flow patterns and ecosystems of River Svisloch is assessed as **permanent** and **long-term**, however **local** by nature. There is a high chance that **beneficial** environmental effect will be produced by reduction of discharges of inadequately treated waste water from residential areas and industries in Minsk. In view of the medium level of impact on ecosystems of River Svisloch and the uncertainty about forecasts, development trends and receptors' sensitivity, the impact significance at the operation phase, before mitigation, is assessed as **medium**.

8.7.5 Impact level and significance: Decommissioning Stage

This stage involves taking infrastructure out of operation and its disposal. The anticipated impact types are the same as for the construction stage.

Biodiversity impact at the decommissioning stage is assessed as **negative**, **temporary**, **short-time** and **local**, with **medium** level and **high** sensitivity of receptors; thus the impact significance before mitigation is assessed as **medium**.

8.7.6 Mitigations, residual effects and ecosystem enhancement recommendations

Construction of the treatment facilities is intended to bring environmental benefits, especially for aquatic ecosystems which are exposed to current impacts of inadequately treated effluent discharges that degrade water quality and change flow patterns. With the current level of growth and development of Minsk industrial potential, the baseline situation or "zero alternative" (i.e. without modernization of MWWTP) would result in further environmental deterioration, in particular aquatic ecosystems of River Svisloch. Thus the Project implementation will bring benefits to the river and flood valley ecosystems, and these benefits can be further enhanced by developing and implementing additional environmental measures.

The Project provides for reconstruction of existing facilities rather than construction of new facilities. Besides that, biodiversity in at the Project site and its area of influence does not include any natural ecosystems and consists of transformed landscapes used for various business operation, with ruderal and synanthropic species.

In view of the above, the mitigations and proposed remediation for loss of biodiversity have been developed with due account for the value of the affected ecosystems, at the species, abundance and genetic levels.

8.7.6.1 Construction Stage

Based on the main types of biodiversity impacts at the construction stage, and the limited potential for prevention of the negative impacts, the following system of measures is recommended for implementation during the construction activities.

Mitigation of impacts

- Arrange special storage areas for the cut fertile soil intended for subsequent recultivation of the sites and temporary roads. Discuss with the relevant authorities possibility of using the cut fertile soil which is not needed at the site for plantations in other urban territories.

- Avoid cutting of trees and shrubs in excess of the minimum required for construction of permanent facilities. Make sure that temporary infrastructure, access roads and laydown areas are optimally planned. Replant plants from the area of direct impacts, where technically possible and reasonable.
- Provide for dust suppression – water sprinkling in dry weather, stabilization of soil burrows.
- Provide for site shielding to prevent propagation of industrial noise.
- Minimize night-time operations, avoid noisy works.
- Provide tube or tunnel crossings at the access roads, to ensure free flow of surface runoff and safe daily movements of amphibians, reptiles and small mammals.
- Implement a waste management plan providing for dedicated storage sites for various types of wastes and prevention of illegal dumping of construction and domestic wastes.
- Provide for special places (isolated from soil) for storage of hazardous liquids and refueling of machinery and vehicles.
- Minimize construction site illumination at dark time of the day, select positions of lighting equipment in a way that illuminated area would be limited by the boundaries of the construction site.

Measures to restore disturbed ecosystems

- Upon completion of construction activities, provide mechanical and biological remediation of all temporary sites and access roads, including restoration of fertile soil and vegetation.
- Plant trees and shrubs.

As a further remediation measure it is recommended to consider remediation of disturbed land using natural seed materials, plants and shrubs that are typical for the natural ecosystems. Even small refugia of zonal biotopes are able to attract animal and bird species which are characteristic to them, rather than synanthropic species.

As the construction stage will not result in loss or fragmentation of natural ecosystems, the above system of measures will support ecosystem resilience and help to reduce the residual impacts significance to **low** level, where no special remediation measures are required in natural terms.

8.7.6.2 Operation Stage

Results of the assessment indicate that the main negative impacts on biodiversity at the operation stage will be associated with pollution emissions from the sludge incinerator, and with treated effluent discharges. The following mitigations should be considered:

- Develop a system for pollution emissions monitoring and operating performance control, which would prevent potential failure to comply with the approved limits;
- Provide a monitoring and control system intended to prevent untreated or inadequately treated effluent discharges to water body;
- Implement a system to monitor treated effluent parameters, in order to maintain the established water and temperature patterns in River Svisloch.

Taking into account the gaps in the available information and the lack of reliable forecasts in terms of hydrological patterns and ecosystem status of the water body, it is recommended to further develop a River Svisloch Monitoring Programme to cover the area of immediate influence of Minsk WWTP. The Programme objectives, tasks and key directions should be, as far as possible, defined in cooperation with other stakeholders, including research and environmental institutions. A reporting and disclosure mechanism shall be provided. It is also recommended to conduct baseline studies for the Programme before commissioning of the reconstructed facilities, and subsequently conduct monitoring activities on an annual basis during three years after commissioning. Further monitoring intervals should be defined on the basis of the collected information.

If the monitoring results indicate notable degradation of ecosystems, further remediation measures to enhance the net gain for biodiversity may include the following:

- Sediment control and sanitization of stream banks in the area of immediate influence of MWWTP, in order to improve the status of aquatic ecosystems;
- Bank reinforcement in the area of immediate influence of MWWTP, to prevent erosion;
- Planting of zonal bank vegetation species in the area of immediate influence of MWWTP, to support the rare biotopes of the Republic of Belarus;
- Release of fish fry into River Svisloch, to support species and population biodiversity.

Implementation of reliable monitoring systems to ensure the statutory functioning of the treatment plant and efficient control of emissions and discharges will help to reduce the negative effects to **minor** level, and enhanced quality of treated effluents at the discharge to River Svisloch will bring **positive** environmental effect, especially if supported by the additional environmental measures to maximize the net gain for biodiversity.

8.7.7 Decommissioning Stage

At the stage of taking the facilities out of operation and their demolition and disposal, it is recommended to consult the same list of environmental measures as for the constructions stage, which would help to reduce the residual impacts to the **low** level.

8.7.8 Conclusion

In view of the above, alternatives provided for more enhanced treatment of waste water compared to other proposed options, should be preferred from the perspective of biodiversity impacts, which is also in line with the Project tasks and objectives.

Table 8.19: Summary of the impacts on biodiversity and mitigation measures

Impact	Recipient	Project Stage	Impact Significance	Measures, recommended to Ramboll	Residual Impact
Soil and vegetation damage during clearence of the territory intended for construction of infrastructure facilities	Soil and vegetation, tree and shrub vegetation	C	M	Arrange special storage areas for the cut fertile soil intended for subsequent recultivation. Make sure that temporary infrastructure, access roads and laydown areas are optimally planned. Replant plants from the area of direct impacts, where technically possible and reasonable. Upon completion of construction activities, provide mechanical and biological remediation. It is recommended to consider recultivation of disturbed land using natural seed materials, plants and shrubs that are typical for the natural ecosystems.	I (to No Net Loss)
Dust settlement on vegetation	Vegetation and support ecosystem services	C, DCm	L	Provide for dust suppression measures.	I
Noise and light nuisance during the construction	Wild animals	C, DCm	M	Provide for site shielding to prevent propagation of industrial noise. Minimize night-time operations, avoid noisy works. Select positions of lighting equipment in a way that illuminated area would be limited by the boundaries of the construction site.	I
Habitat contamination by new construction and domestic wastes storage sites	Ground surface ecosystems, including wild animals, vegetation and soil	C,DCm	H	Implement a waste management plan providing for dedicated storage sites for various types of wastes and prevention of illegal dumping of construction and domestic wastes	L
Soil and vegetation contamination by spills of hazardous liquids	Ground surface ecosystems, including wild animals, vegetation	C, DCm	H	Provide for special places (isolated from soil) for storage of hazardous liquids and refueling of machinery and vehicles.	L

Impact	Recipient	Project Stage	Impact Significance	Measures, recommended to Ramboll	Residual Impact
	and soil				
Increased effluent discharges to the water course	Aquatic fauna and ecosystems	O	M (not enough data)	Provide a monitoring and control system intended to prevent untreated or inadequately treated effluent discharges to water body. Implement a system to monitor treated effluent parameters, in order to maintain the established water and temperature patterns in River Svisloch. Develop a River Svisloch Monitoring Programme to cover the area of immediate influence of Minsk WWTP. If the monitoring results indicate notable degradation of ecosystems, further remediation may include following countervailing measures: П: • Sediment control and sanitization of stream banks in the area of immediate influence of MWWTP, in order to improve the status of aquatic ecosystems; • Bank reinforcement in the area of immediate influence of MWWTP, to prevent erosion; • Planting of zonal bank vegetation species in the area of immediate influence of MWWTP, to support the rare biotopes of the Republic of Belarus; • Release of fish fry into River Svisloch, to support species and population biodiversity.	Possitive L (Net Gain)
Increased emissions	Ground surface ecosystems, including wild animals, vegetation and specially protected territories	O	I	Develop a system for pollution emissions monitoring and operating performance control, which would prevent potential failure to comply with the approved limits	I

8.8 Visual Impact

8.8.1 Main landscape features

The site is located in the Zavodskoy district of Minsk on the left bank of the Svisloch River. The area is part of the Free Economic Zone (FEZ) "Minsk" that comprises 142 industrial enterprises, including the MWWTP-1 site suggested for upgrade and construction of the wastewater treatment plant under the Project (Appendix B, Photograph 1).

According to landscape zoning, the Project area sits on the boundary of two landscape provinces: the Minsk region characteristic of undulating moraine erosion landscapes with mixed broad-leaved and spruce and pine forests in the Belorussian upland province and Verkhneptichskiy region of secondary fluvioglacial landscapes with pine and mixed broad-leaved and spruce forests in the Predpolesskaya province.

Currently, natural landscapes in the Project area have been dramatically transformed. The landscape is under anthropogenic impact produced by industrial development of the Shabany industrial zone (Figure 3), sewage treatment facilities and undeveloped territory adjacent to the Project site from south-east which was used as sludge drying beds in the past (decommissioned and remediated).

Key specific features of the landscape of the Project site location are:

- the site is located in the Svisloch valley complex;
- natural landscape of the Project area situated inside the Shabany industrial zone has been considerably modified and converted to technogenic;
- the Project will be implemented in the area of MWWTP-1 and does not extend beyond its boundary;
- there are secondary motor roads at a short distance from the site and the highway MRMR (Minsk Ring Motor Road) is 1.26 km north-west;
- the railroad passes along the eastern boundary of the Project area and is designed to carry freight and passengers (Appendix B, Photograph 21);
- high-rise residential buildings are located 1.3 km north-east and there are sparse single storey private houses in the proximity of MWWTP-1 (Appendix B, Photograph 17).

8.8.2 Populated localities and land use

The following populated localities are situated around MWWTP:

- residential estates Shabany-1 and Shabany-2 (multi-storey buildings);
- low-rise houses in the resettled village Shabany;
- agro-town Noviy Dvor (on the right and left banks of the Svisloch);
- village Podlosie (on the right bank of the Svisloch).

All these settlements are located not more than 1 km from MWWTP, except for low-rise houses in the resettled village Shabany.

Landscapes southward from MWWTP are categorized as arable-anthropogenic formed by land plowing (Appendix B, Photograph 18). Detailed information about past agricultural activity on these lands is unavailable.

The Table below summarizes data on main recipients, their location and sensitivity. The recipients were identified from outcomes of field surveys and review of map data and satellite images.

Table 8.20: Classification of the recipients

Recipients	Visual perception	Recipients' location	Recipients' sensitivity
Residents of populated localities			
Residents and visitors of populated localities	Visual focus is mainly on the populated locality and surrounding landscape	Shabany-1 and 2; resettled village Shabany; agro-town Noviy Dvor; village Podlosie	Medium
Railroad and moto roads users			
Train and car drivers and passengers who use moto roads and the railroad in the vicinity of the MWWTP site	Landscape is of high importance though recipients focus, to a great extent, on the view along the route which is perceived in the context of surrounding urbanistic landscape	Railroad, MRMR, secondary motor roads in the vicinity of the site	Low
Workers of agricultural and public utilities sectors			
Workers of public utilities and agricultural enterprises	Focus on their occupational activity which is why they are low susceptible to landscape modifications	Agricultural lands on the right bank of the Svisloch and fields southward from MWWTP	Low
Tourists and holiday-makers			
Tourists and holiday-makers who use landscape for recreation	General view of the landscape is of major importance. In terms of the industrial zone and Project siting at MWWTP-1, the sensitivity of such recipients is not high	Valley of the Svisloch (Appendix B, Photograph 16)	Medium

8.8.3 Impact at the construction phase

The Project will be implemented in the area of the current site of MWWTP-1 located within the existing industrial zone "Shabany" characterized by technogenic landscape. Given the existing structures, similar to those designed, and continuous fencing, no meaningful changes in the visual perception of landscape are foreseen during the construction period.

At the construction phase, impact will mainly show itself in the following processes that affect the visual perception of landscape:

- road traffic;
- operation of heavy construction machinery, cranes;
- earthworks;
- dusting from moving vehicles, earthworks and demolition of buildings and structures;
- evening and night-time lighting.

The existing continuous enclosure of the site will contribute to minimization of impact of these processes on the visual landscape perception.

Given the low sensitivity of a majority of the recipients, this impact is assessed as **local, medium-term and medium intensive**. Impact may be mitigated down to **local, medium-term and low intensive** through implementing design solutions such as dusting control (watering of site and road surfaces, stored soil, etc. in dry weather) and setting a special lighting mode.

8.8.4 Impact at the operation phase

All Project facilities will be sited within the land plot of MWWPT-1 where similar structures currently exist. The reconstruction of MWWPT-1 will not entail considerable changes in the existing technogenic landscape of the industrial zone Shabany. Visual impact of the sludge neutralization plant should be reassessed after determining the plant chimney height by the developer.

Project infrastructure will be chiefly sited near the southern boundary of the industrial zone, continuously fenced and will be poorly visible from neighboring settlements such as agro-town Noviy Dvor, village Podlosie and residential blocks Shabany-1 and Shabany-2. The railroad and large motorways are also located rather far from the site and partly block the view in its direction.

One of the potential impact factors will be additional lighting at night-time; however, this impact can be compensated by adjusting the lighting equipment direction and lighting intensity depending on the time of day. Hence, given the low sensitivity of most of potential recipients, impact at the operation phase can be assessed as **local, long-term and low intensive.**

8.8.5 Impact at the decommissioning phase

Impact at the decommissioning phase will be similar in its nature to that at the construction phase. Detailed information on the works planned for the decommissioning phase is unavailable.

8.9 Climate Change

The changing global climate and its documented manifestation in the Republic of Belarus may, through extreme weather events and chronic long-term changes of climate[80], present risks and opportunities that need to be identified and managed appropriately to avoid loss and damage to infrastructure, prevent potential disruptions of water and wastewater services and potential disturbance or even harm for the Project workforce and local community. Therefore investment in reconstruction of the treatment plant and construction of sludge treatment facilities, i.e. the Project, needs to consider both the changing nature of extreme events and long-term climate resilience issues to ensure that investment risk is minimised, and appropriate planning for design, construction and management applied during the project's lifetime.

This section identifies the relevant existing variations to climate conditions that should be accounted for as risks and the corresponding resilience and adaptation responses. A climate baseline and trends have been considered for key climate variables in the region.

As a baseline, the observational climate records from international and Russian data bases were considered for the medium term period of 2005-2017 (weather monitoring station "Minsk 26850")[81] and 2000-2017 (weather monitoring station "Minsk 261148")[82].

The following limitations must be taken into account when using the results of this review:

- **Baseline and Current Data**: Observational data was provided for air temperature (average, annual mean as well as extreme), precipitation, thunderstorms, wind speed which enable the analysis and establishment of annual trends. Monthly data was provided for part of these data sets and, where possible, was used for identification of extreme temperature trends.

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80 Belarus climate change trends and forecasts. Radiobiology Institute, NAS RB. http://www.irb.basnet.by/ru/trendy-i-prognozy-izmeneniya-klimata-v-respublike-belarus/

81 Minsk weather archive, WMO ID 26850 // Electronic publication at the website of Raspisanije Pogody LLC at https://rp5.ru/Архив_погоды_в_Минске

82 Climate Minsk, climate data: 2000-2017 The weather station 261148 (UMMS) // Electronic publication at the website of Tutiempo Network at https://en.tutiempo.net/climate/ws-261148.html

- **Future projections** were not studied at this stage.
- **Climate change risks minimization:** Taking into account the high uncertainty of the climate projections, the likely global climate change trends had been considered by the technical experts during the PIP development where applicable and appropriate. Accordingly, any further research, analysis or decision-making should take account of the nature of the climate projections and should consider the available up-to-date observations data, the range of literature, additional studies and research materials.

Climatic change overview

The climate characteristics of the city of Minsk are described in Section 5.1. Minsk city and district feature moderate continental climate which is distinguished by warm summers and mild wet winters supported by western disturbances of air mass.

In terms of precipitation volumes the area belongs to the sufficient moistening zone. Precipitation is largely associated with cyclonic activity. The longest precipitation events are recorded in winter; summer precipitation events are shorter, however their frequency is higher by more than two times. In autumn precipitation events acquire steady nature.

Local weather conditions are defined by the Project location in the flat terrain. The MWWTP sites are located in the valley of River Svisloch, in the territory of industrial area with transformed technogenic landscape.

The key climate variables considered for the Project are temperature, precipitation amounts and patterns, and frequency of extreme events. A climate baseline has been reviewed based on observational data for these key climate variables in the Area of Influence and other freely available information.

The analysis of the observational data for the city of Minsk demonstrates that the climate is undergoing changes.

8.9.1 Temperature

According to the observational data for the period 2005-2017, annual average temperature in Minsk city varied within the range from 6.4°C (2013) to 8.7°C (2015) and deviated from the climate normal values for the period 1981-2010 by **+0.1-1.8°C**. The maximum extreme temperatures observed in the same period varied from 30°C in 2011 to 35.8°C in 2015. The minimum extreme temperatures were from -28.6°C in 2006 to -16.3°C in 2008.

According to information from the international data base for the period 2000-2017, the annual average maximum temperatures varied within the range from 9.8°C (2004) to 12.5 °C (2015). The annual average minimum temperatures in Minsk over the same period varied within the range from 0.9°C in 2003 to 2.7°C in 2017. 2015 was the warmest year in the period of observations since 1945.[83]

[83] Climate characteristics of year 2017. Belhydromet, 2018

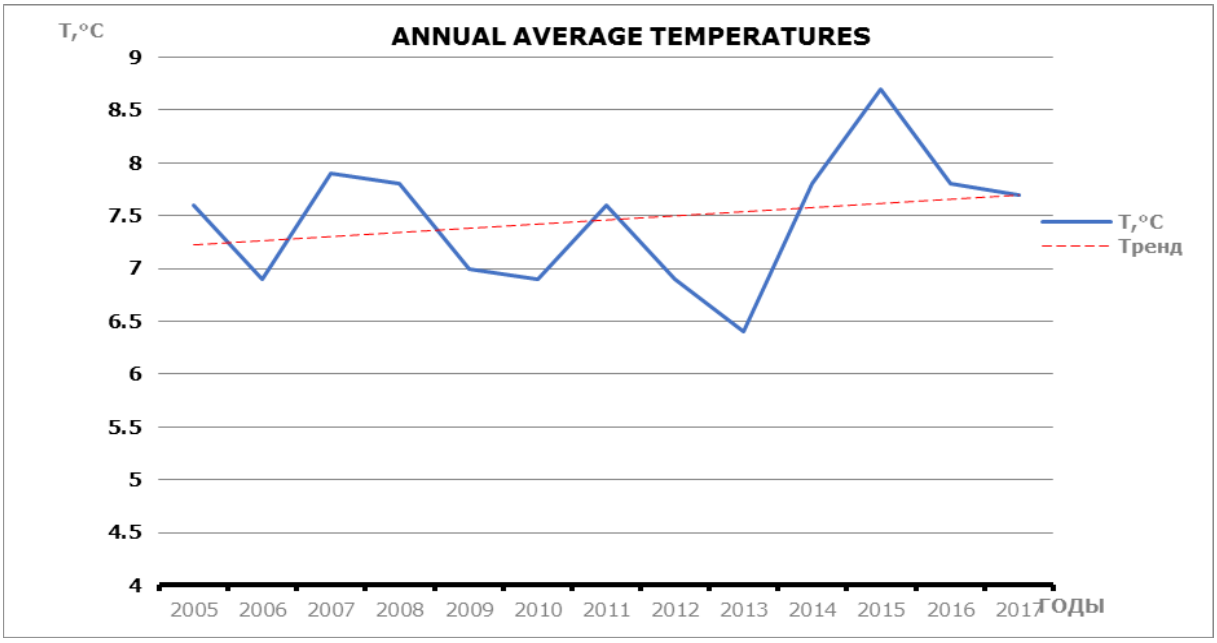

Figure 8.9: Annual average temperatures at weather monitoring station "Minsk 26850" over the period 2005-2017, °C

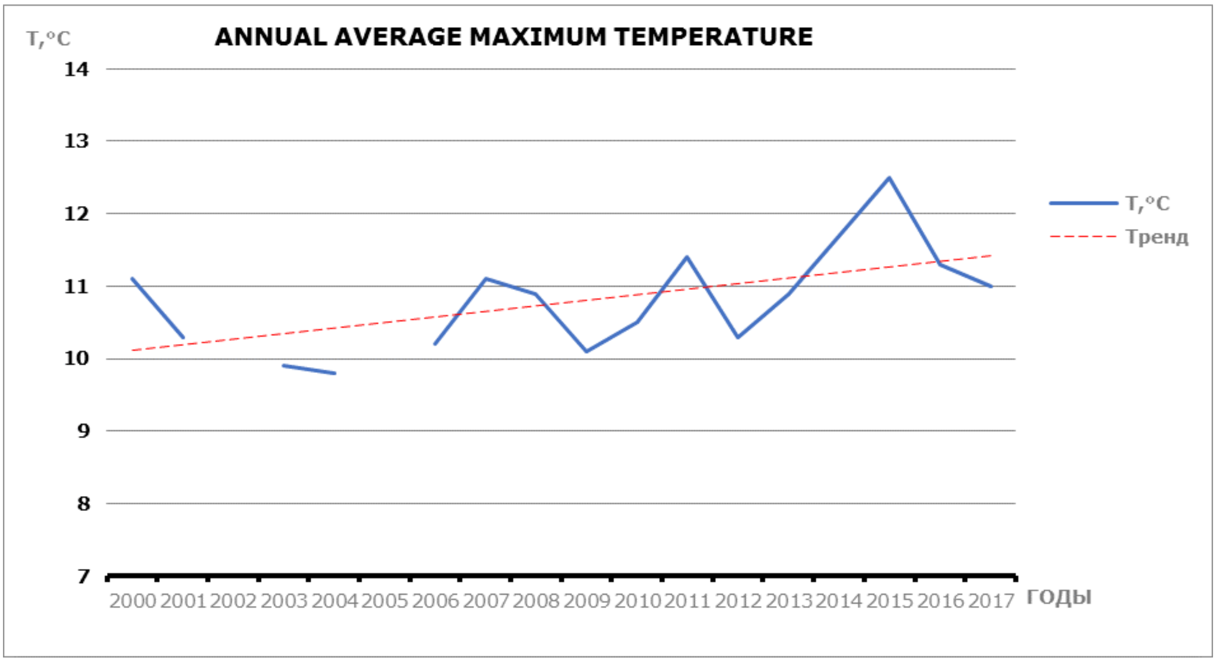

Figure 8.10: Annual average maximum temperature at weather monitoring station "Minsk 261148" over the period 2000-2017, °C

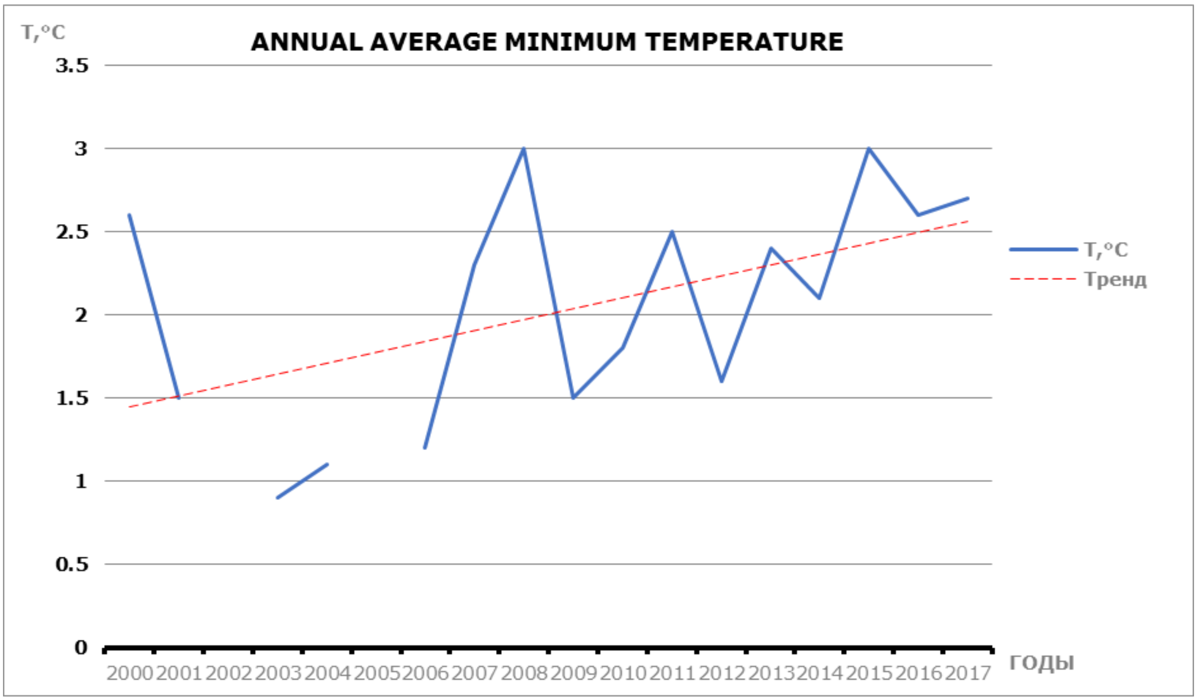

Figure 8.11: Annual average minimum temperature at weather monitoring station "Minsk 261148" over the period 2000-2017, °C

Observations over the past 20 years indicate a delay of the permanent change over to air temperatures above +5°C (start of vegetation period) and change over to daily mean air temperature above +10°C (start of active vegetation) by one or two weeks in larger part of the territory of the Republic. Similar trend is also identified for the reverse transition of daily mean air temperature over the 10°C threshold in autumn (end of active vegetation period). Analysis of seasonal trends of air temperature variations in the Republic of Belarus over the period 1981-2012 indicates that the winter-spring warming which started in 1980-s gave way to summer-autumn warming during past 10-12 years.

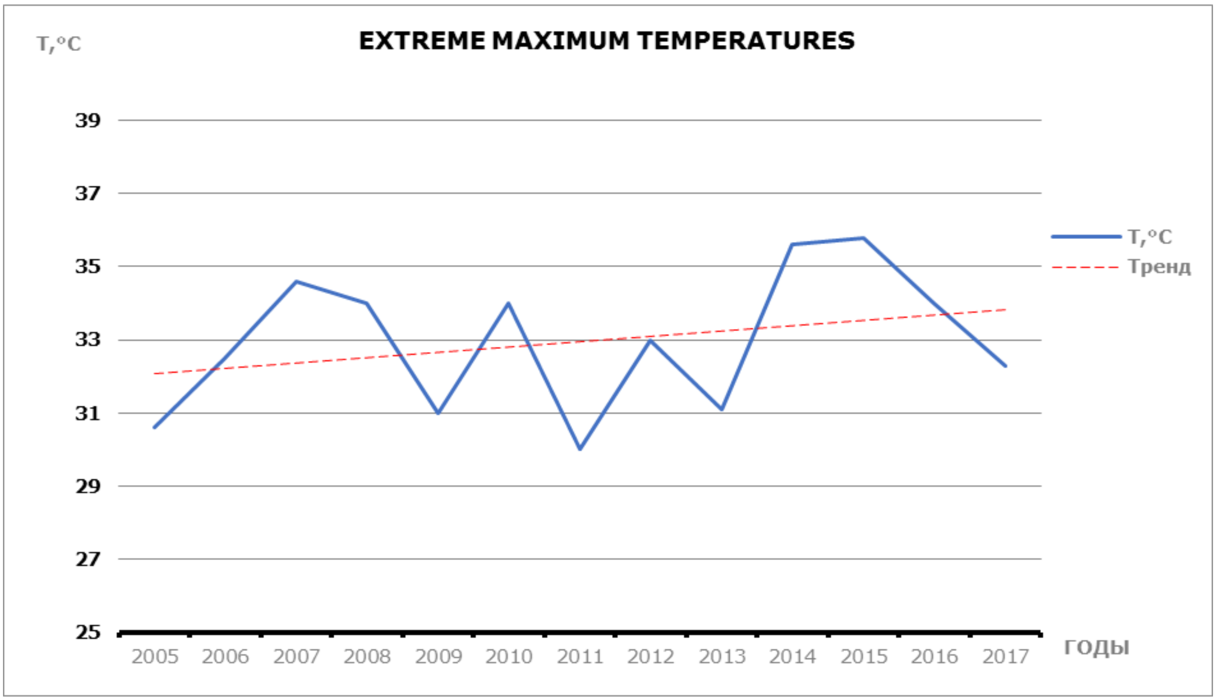

Figure 8.12: Extreme maximum temperatures at weather monitoring station "Minsk 26850" over the period 2005-2017, °C

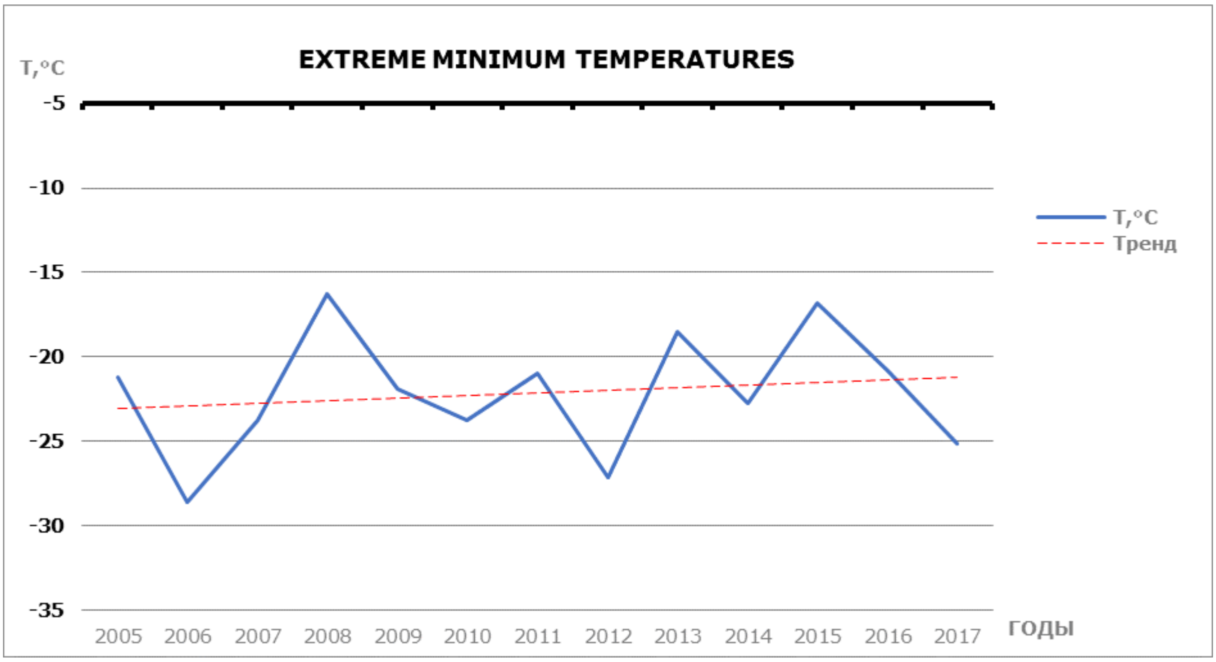

Figure 8.13: Extreme minimum temperatures at weather monitoring station "Minsk 26850" over the period 2005-2017, °C

The recent observations (1980-2017) demonstrate a general trend of significant increase of annual average maximum and minimum temperatures (by more than 2°C in both cases) and extreme maximum and minimum air temperatures, as well as steady growth of annual average temperatures since 1988 (~2°C). The prominent increase of annual average temperature correlates well with general trend in neighboring Russia however it exceeds the global trend by *2-2.5 times*[84]*.*

8.9.2 Precipitation and wind speed

The average annual precipitation depth over long-term period is 696 mm, whereas the climatic normal value for the Republic of Belarus is 649 mm over the period 1981-2010. Observations data for the period 2005-2017 demonstrate precipitation between 551 mm (2015) and the maximum level of 898 mm (in 2009). Precipitation distribution during the year has higher and lower maximums. Annual precipitation depth varies between years, and small precipitation quantity is recorded in one of the "dry" months once in several years. In general precipitation period tends to shift toward autumn leaving August as distinctly dry month.

Precipitation quantity over the period of observations is similar to the many-years average value, with only a slight decline trend. A minor reduction of the number of days with snow was recorded over the period passed since 2005, and the number of days with rains increased more significantly (by 11% and by 20%, respectively). The number of days with thunderstorms substantially increased (by more than 15%).

[84] Report on climate conditions in the territory of the Russian Federation in 2016. Roshydromet, Moscow 2017

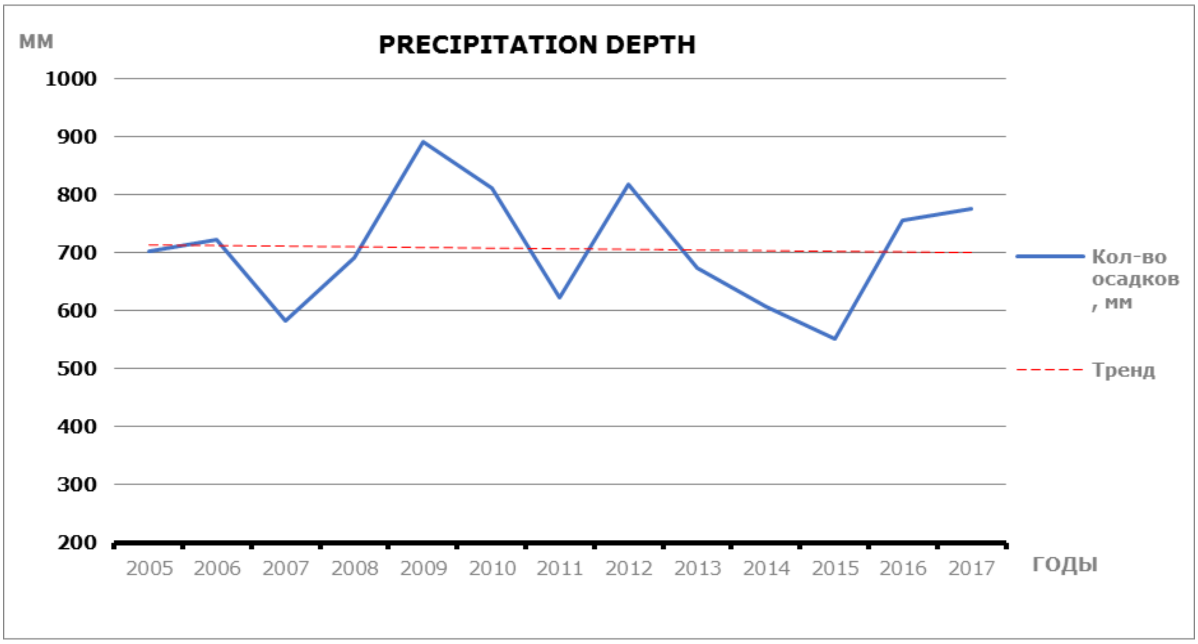

Figure 8.14: Precipitation depth in the period 2005-2017, mm

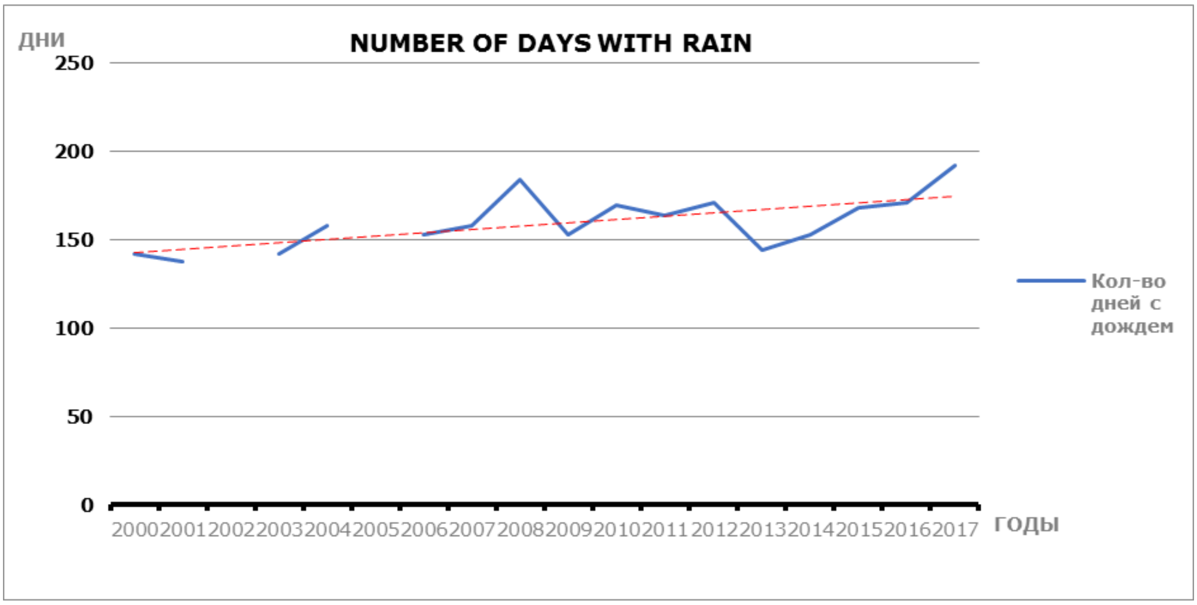

Figure 8.15: Number of days with rain at Minsk weather monitoring station in the period 2005-2017

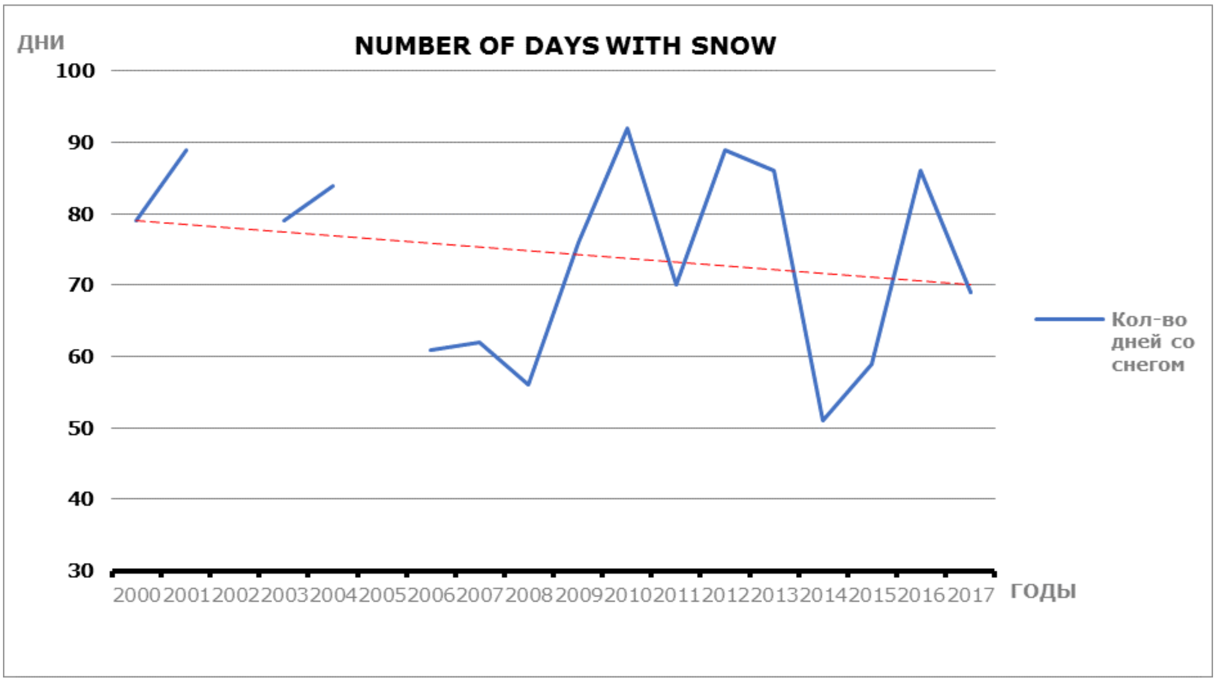

Figure 8.16: Number of days with SNOW at Minsk weather monitoring station in the period 2005-2017

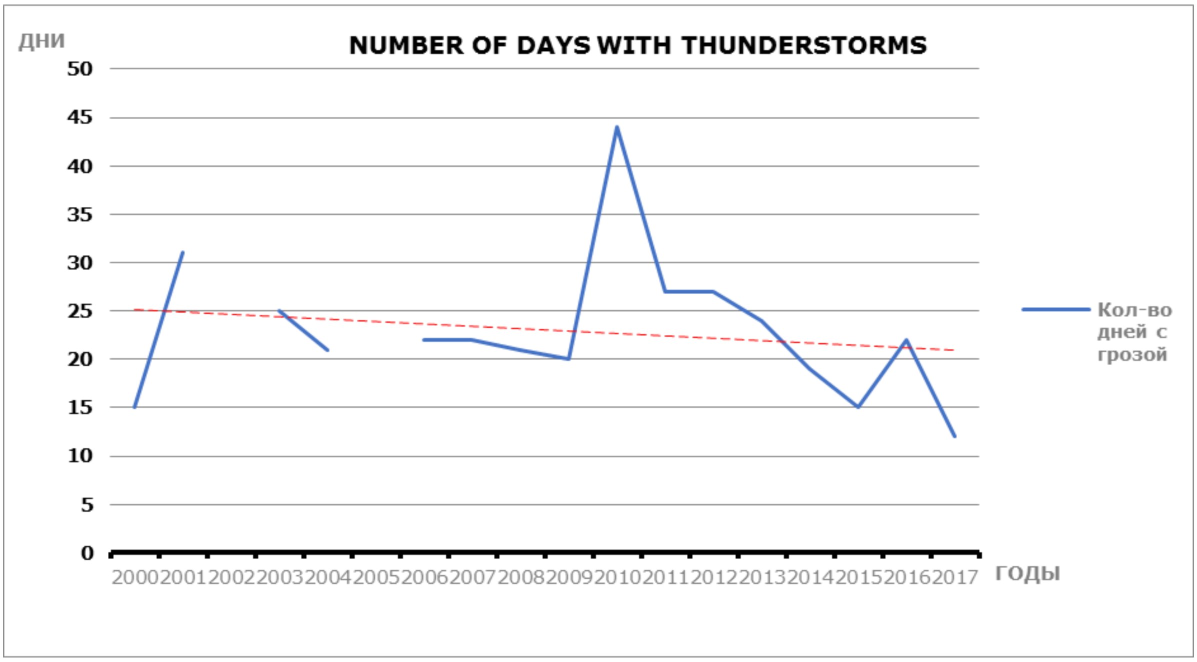

Figure 8.17: Number of days with thunderstorms at Minsk weather monitoring station in the period 2005-2017

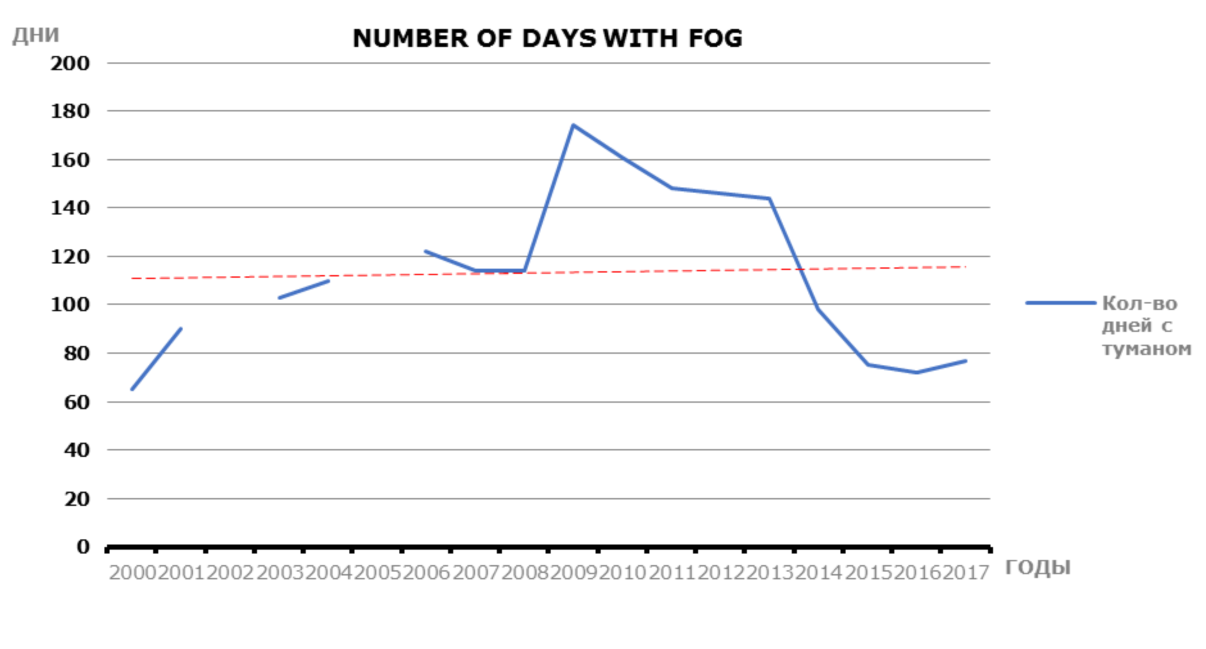

Figure 8.18: Number of days with fog at Minsk weather monitoring station in the period 2005-2017

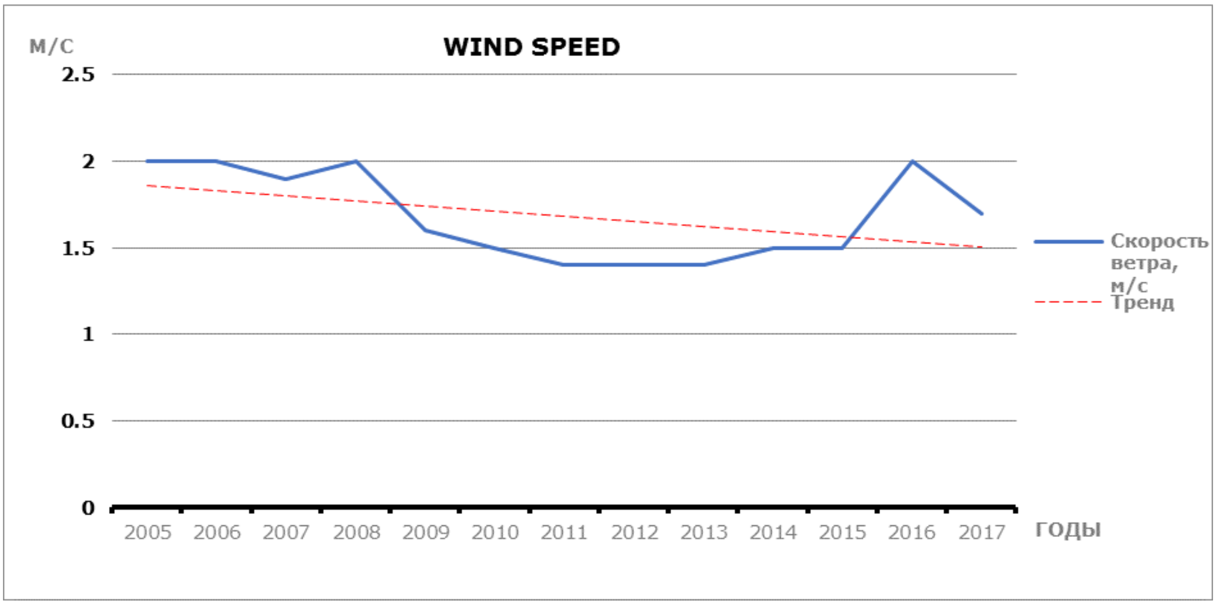

Figure 8.19: Average annual wind speed at Minsk weather monitoring station

The slight increase of the number of days with fog and reduction of monthly average wind speed also correlate well and, despite their potential impact on pollution dispersion, are also strongly related with such factors as local climate, terrain and landscape. The Project site is located in the valley of River Svisloch with flat terrain and sparse low-rise industrial development and very sparse trees. Such conditions do not support fogs and still air, thus the risk of deterioration of dispersion conditions due to changes of local climate is assessed as minor.

8.9.3 *Extreme weather events*

Frequent adverse weather events in the studied area may disrupt operations of the Company.

The average annual number of days with thunderstorms in the country is 28, mainly in June and July. Snow storms are observed 20-25 days per year, and hail events are reported 5-6 days per year. Annual repeatability of ground frosts in May is 60-70%, repeatability of wind gales (minimum 25 m/s) and gusts is 10% or less. Average number of days with glaze ice is 24 days per year, with hoarfrost – 21 days per year (refer to section 5.1). Slush build-up is also possible.

Frequent and dramatic temperature variations with crossing of zero (such events are more probable in the urban environment, due to the thermal effects of development) increase the risk of traffic accidents, deteriorate road paving and buildings, and thus should be specifically addressed at the construction phase.

The climate changes are attended by increasing number of days with high daily air temperatures and longer periods with extreme high temperatures (heat waves). High temperatures accompanied by high humidity become more frequent. Draught events have become more common too, especially in late summer (August).

Such events may damage water infrastructure, deteriorate its reliability and increase the operational safety risks at the Company's sites. There is also a risk of deterioration of water quality in the surface source (River Svisloch).

In 2015 a wind storm broke a power transmission line and disrupted MVK operations (water supply in the city). To prevent recurrence, a backup power supply system has been provided as a preventive measure and adverse weather alerting procedure has been adjusted.

8.9.4 Risks and adaptation measures

The analysis of the observational data and climate change projections for the region demonstrates that the climate is undergoing changes. The anticipated growth of maximum and average temperatures, more frequent of adverse weather events (strong wind blasts, draughts, icing) are likely to perform the climate change risks relevant to the Project. These factors might induce shortage of the water supply as well as decrease the water quality. The climate risks to the Project have been categorised as construction, maintenance and operational management issues associated with:

- **Construction, maintenance and operation management** – Changes in thunderstorms frequency of adverse weather events (AWE) increase the risk of incidents, may cause disruption of operations and impact overall work schedule (impact on construction and operation)**.**
- **Main assets and infrastructure protection and maintenance:**
  - Increased extreme summer temperatures and annual average temperatures, frequent zero crossings in winter may lead to increased pipelines deterioration and structural materials expansion, buckling and stress loads, and may invoke the need to take additional measures to provide adequate conditions for operation of equipment and personnel (impact on construction and operation);
  - More frequent and extensive adverse weather events may affect technical state of the facilities (impact on construction and operation).
- **Workforce health and safety** – high risk of working in adverse weather conditions (impact on construction and operation).
- **Increased water demand** – the future slight increase of average and extreme temperatures may result in gradual increase of demand for potable water, and demand peaks at extreme maximum temperature.
- **Deterioration of water quality** – risk of river water quality deterioration during potential draught periods. Direct impact on water abstraction and water supply, potential problems at the stage of water abstraction and treatment. Potential deterioration of background water quality in

the recipient section of the river will be offset by external flow control in River Svisloch (impact on operation).

- **Increased electricity and water consumption for the Company's needs** – higher average and extreme summer temperatures may result in increased consumption of electric energy and water for own needs – for cooling of premises and equipment in summer (impact on operation).

Table 8.24 below provides summary of the recommended Project adaptation measures.

Table 8.21: Adaptation measures to be accounted for at the Project implementation

Climate change risk	Project risk related to climate change	Risk / Phase	Required adaptation measures
Increased annual average and extreme maximum temperatures More frequent and extensive adverse weather events	Incidents, disruptions, structural damage	M / C	Working conditions and operational environment may deteriorate due to extreme temperatures and other adverse weather events. This risk should be accounted for and managed through HSMS and OHS procedures. AWE response procedure should be developed, and its provisions should be also applied to the Main Contractor
	Occupational health and safety	H / C M / O	
	Deterioration of the main assets, infrastructure and other facilities	M / O	Equipment shall be designed for reliable operation, with allowance for the risk of slightly higher extreme maximum temperatures in summer, and for AWE
	Potential slight increase of water demand	L / O	The risk can be reduced to minor through implementation of automated control of water and wastewater systems and making an allowance for capacity safety margin in the design. Implementation of technical solutions for the process adjustments.
	Potential increase electricity and water consumption for the Company's needs	L / O	

8.10 Greenhouse Gas Emissions

Historical and national Context

The Republic of Belarus occupies a position in the middle of the global list of countries ranked by the volume of gaseous emissions causing greenhouse effect (*"greenhouse gas" or "GHG"*), with annual contribution of about 110,000 Gg[85] of CO_2-e (2012) and historical variations range between the maximum of 185,000 Gg in 1990 and minimum of 83,000 in 2000[86].

The first National Communication submitted by the Republic of Belarus in 2003 under the UN Framework Convention on Climate Change[87] contains information on the long-term ratios of specific substances and economic sectors in the bulk GHG emissions.

[85] The conventional measurement unit in this context in gigagram (Gg).

[86] Emissions Database for Global Atmospheric Research. - EDGAR Joint Research Centre. Available at http://edgar.jrc.ec.europa.eu/

[87] First National Communication of the Republic of Belarus under the UN Framework Convention on Climate Change. Minsk. Ministry of Natural Resource and Environmental Protection of the Republic of Belarus, 2003

In particular, the greatest influence is attributed to emissions of carbon dioxide (CO_2) of about 73,000 Gg in 2000 or 60% of the baseline year 1990; and in the years of the greatest emissions reduction increased to 90%. The largest contributor of carbon dioxide emissions is energy sector – about 50,000 Gg or 70%, followed by agriculture and forestry.

Emissions of methane (CH_4) in the same year (2000) amounted 13,000 Gg CO_2-e[88] or 25 % of the bulk GHG emissions. The main source sectors of CH_4 are energy (20 %), agriculture (35 %) and waste management (20 %). It was specifically noted that the aerobic biological process which is used for treatment of municipal waste water in the Republic of Belarus minimizes emissions of CH_4, while the sludge from waste water treatment processes which is disposed at lagoons and landfills is a major source of methane emissions.

Quantities of emissions of the third important greenhouse gas - dinitrogen monoxide (N_2O) – from the territory of the Republic of Belarus are reported to be significantly smaller: about 7000 Gg CO_2-e in 2000, i.e. 13% of the bulk GHG emissions.

According to the second biennial report of the Republic of Belarus under the UN Framework Convention on Climate Change[89], proportions of the main types of GHG in the country's bulk emissions recently changed: dinitrogen monoxide with the share of 18.4 % outran methane (17.2 %) and moved to the second position, while carbon dioxide still accounts for the largest share of greenhouse emissions (64.4 %).

In relation to implementation of the Paris Agreement to the UN Framework Convention on Climate Change the Republic of Belarus has adopted an Action Plan (Decree of RB President of 20.09.2016 No. 345) and started preparation of new strategic documents with the intention to adapt the national practices to the new parameters on the global climate agenda. One important issue to be addressed by the strategies is waste landfills (including wastewater sludge disposal sites) being a major source of biogas emissions. In this context further use of such sludge disposal facilities will be complicated due to their nonconformity to the new international and national waste management practices. Clearly the current sludge disposal practices must be rethought.

GHG emissions from MWWTP-1: Baseline situation and reconstructed facilities[90]

For the most common configuration of municipal waste water treatment plant in a major city, the main sources of GHG emissions are waste water treatment processes, sludge digestion, consumption of energy, auxiliary chemicals consumption, and disposal of sludge (Table 8.25). Contributions of the listed sources vary in magnitude, and the greatest share in the bulk GHG emissions is attributed to the following sources (listed in the descending order of significance):

1) waste water treatment (including operation of mechanical and biological treatment facilities);

2) anaerobic digestion of sludge (including operation of digesters);

3) off-site disposal of sludge (any method – landfilling, incineration, utilization in agriculture or forestry, etc.).

Table 8.22: Common proportions of the main groups of waste water treatment processes, based on their contribution to GHG emissions

Processes	GHG emissions, kg CO2-e per 1 m³ of treated waste water	
	Basic WWTP without specific systems to control the levels of free oxygen, nitrates and ammonium in aerators	Versions with systems allowing to control and maintain desired levels of free oxygen, nitrates and ammonium in aerators
Waste water treatment	0.616	0.544-0.599

[88] Henceforward CO2 equivalents for methane and dinitrogen monoxide are defined for 20-year period respectively as 72 and 289 units.

[89] Second Biennial Report of the Republic of Belarus under the UN Framework Convention on Climate Change. Minsk. Ministry of Natural Resource and Environmental Protection of the Republic of Belarus, 2015

[90] This section has been prepared in compliance the EBRD Methodology for Assessment of Greenhouse Gas Emissions (Version 7, July 6th 2010).

Processes	GHG emissions, kg CO2-e per 1 m³ of treated waste water	
	Basic WWTP without specific systems to control the levels of free oxygen, nitrates and ammonium in aerators	Versions with systems allowing to control and maintain desired levels of free oxygen, nitrates and ammonium in aerators
Sludge processing, including	0.231	0.228
Emissions of CO_2	0.079	0.078
Emissions of CH_4	0.152	0.150
Total net power GHG emissions	0.001	–0.030
Embedded GHG emissions from chemicals use	0.099	0.099
Total sludge disposal and reuse GHG emissions	0.194	0.191
Total GHG emissions	1.142	1.032-1.100

Using the daily influent flow forecasted by the Project Technical Consultant Sweco Danmark A/S (Denmark) and CJSC DiArKlass (Republic of Belarus) of 420000 m^3 and the ratios listed in the above table, annual GHG emissions will total in **170,000 t CO_2-e per year** (i.e. about 0.15% of the national GHG emissions), including 30,000 tons (or 15-20%) in relation to sludge disposal or utilization activities. This is an average estimate which does not allow for extensive sludge management operations.

Current practices of UP Minskvodokanal include transportation of 650-700 tons of dewatered sludge per day (or 240-250 thousand tons per year) by road to a remote disposal site – Volma sludge facilities comprising 18 barrow pits of former sand quarries. Some quarries have been recultivated with planting of trees while other quarries are water logged. The sludge lagoons and auxiliary facilities occupy more than 150 ha and estimated total volume of disposed sludge is 5 Mm^3. Thus the total "breathing" area of the sludge lagoons is larger than the whole territory of MWWTP-1 by almost two times. If only emission sources at MWWTP are taken for comparison (i.e. sedimentation tanks, aeration tanks, sludge thickeners, channels, lagoons, etc.) the ratio would be as high as 6 or 7. In view of the above, the contribution of sludge disposal facilities to the total amount of GHG emissions (especially carbon dioxide and methane) from the sites of UP Minskvodokanal appears to be comparable with contribution of the waste water treatment plant.

Thus one obvious benefit of the Project is related to cessation of the practice of sludge disposal at Volma facilities which can be decommissioned and subsequently recultivated. In the context of MWWTP, this scheme will redistribute the greenhouse-warming potential of sludge between various options of its disposal (e.g. incineration) and will not stop "breathing" of the filled sludge lagoons. However it should be noted that firstly, the sludge generation rates will substantially decrease - to 67 tons per day (i.e. by about 10 times), and secondly, emissions relating to sludge recycling will be redistributed in favour of gases with smaller greenhouse-warming potential, primarily CO_2.

GHG emissions from the waste water treatment process will also change after reconstruction. In accordance with IPCC Guidelines[91], the maximum methane generation capacity of municipal waste water treatment process is bound to the organic content of influent waste water and estimated as 0.6 kg per 1 kg of BOD or 0.25 kg per 1 kg of COD. In the given situation (Table 8.26) this means that projected daily emissions of methane from MWWTP-1 will increase from 57 to 62-63 tons per day (to 4500 tons CO_2-e), or by 10% compared to the baseline.

Table 8.23: Change of load on MWWTP-1 as a result of the proposed reconstruction, in terms of BOD5, COD, suspended solids and total nitrogen

Parameter	2017		2030	
	Concentration	Load	Concentration	Load
Waste water flow to treatment	380000 m3/day		420000 m3/day	

[91] 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Parameter	2017		2030	
	Concentration	Load	Concentration	Load
BOD5	250 mg/l	95000 kg/day	250 mg/l	104500 kg/day
COD	600 mg/l	228000 kg/day	600 mg/l	250800 kg/day
Suspended solids	430 mg/l	163400 kg/day	430 mg/l	179740 kg/day
Total nitrogen	8 mg/l	19000 kg/day	8 mg/l	20900 kg/day

Notably the increase will be solely caused by the anticipated increase of waste water flows rather than changes in their quality. Due to substandard and variable quality of influent waste water at MWWTP-1, the Technical Consultant advises UP Minskvodokanal to closely engage with the customers who discharge the worst contaminated effluents and incentivise them to pre-treat waste water, in order to reduce the load on sewerage system and the waste water treatment plant. In the context of MWWTP, actual amount of GHG emissions will depend on composition of influent waste water, whereas the proposed reconstruction will only redistribute the flows of pollutants and energy.

Quantitative assessment of GHG emissions from MWWTP can be prepared on the basis of contributions of the existing sources – for the baseline, and using estimated contributions of the proposed sources – for the future situation. Dispersion analysis, emissions inventory records of MWWTP and sanitary protection zone project mention only one of the three substances which have a direct greenhouse effect and are regulated by air quality standards for residential areas - methane[92]. According to the forecasts prepared for MWWTP-1 reconstruction project, the instantaneous emission value used for dispersion analysis will increase from the baseline level of 13 g/s to 21 g/s, as several new sources of methane will be constructed – sludge digesters, scrubbers, etc. (refer for details to Section 8.1). At the same time annual emission of methane (which is more important for estimation of greenhouse effects) will significantly decrease from 445 tons to 370 tons (i.e. from 32,000 tons to 27,000 tons CO_2-e), as the sources of its increase will not be permanent in will stop functioning after a short time, and some of the existing permanent sources will be eliminated (refer to Annex C9-18).

The quantitative assessment of contribution of the future incinerator which will be built at the site of MWWTP using the average parameters adopted from EMEP/EEA Air Pollutant Emission Inventory Guidebook links GHG emissions to the mass of incinerated dewatered sludge. According to the reports prepared by the Technical Consultant, implementation of digestion and other treatment processes will reduce the sludge flow to 67 tons of dry matter per day. In this case the incinerator will contribute a maximum of 1 ton of CO_2 per ton of dried sludge[93], i.e. 67 tons of carbon dioxide per day (24,500 tons per year), and also about 100 mg of N_2O per 1 m^3 of treated waste water, i.e. 15 tons of N_2O or 4430 tons as CO_2-e annually. Tentative emissions of methane and dinitrogen monoxide from the facilities associated with the future power plant and incinerator reported by Sweco Danmark A/S and CJSC DiArKlass are significantly smaller than industry average values – respectively 78 and 0.4 tons per year, or 5600 and 116 tons as CO_2-e.

Power consumption from grid is expected to decrease from the baseline 45,088,766 kWh/a (reported in 2017) to 28,804,329 (2024 forecast). Specific power consumption per 1 m^3 of influent waste water will decrease from 0.34 to 0.20 kWh. This means that associated emissions of carbon dioxide will be reduced from 5140 to 3283 tons per year (estimated using IFC Carbon Emissions Tool and average value of CO_2 emissions per unit of power consumed in the Republic of Belarus – 0.114 kg CO_2/kWh).

Conclusions

[92] No data is available of carbon dioxide and dinitrogen monoxide emissions from MWWTP, and these two substances are not monitored in air. Quantitative assessment of contribution of the sludge lagoons is not possible either, due to the lack of monitoring. This means high level of uncertainty of the proposed assessment.

[93] EMEP/EEA Air Pollutant Emission Inventory Guidebook. NFR 5.C.1.b.i,5.C.1.b.ii, 5.C.1.b.iv - Industrial waste incineration including hazardous waste and sewage sludge. - European Environment Agency, 2016

In the context of life cycle of Minsk WWTP, the main factor that determines its GHG emissions is influent waste water quality. The proposed reconstruction Project will not result in significant reduction of emissions, but will rather redistribute the flows of pollutants (including GHG) and their composition: the share of gas with smaller greenhouse-warming potential (especially CO_2) will increase, with overall beneficial effect.

Decommissioning of sludge lagoons will be a key benefit of the proposed reconstruction, also in terms of GHG emissions. On the opinion of Ramboll, unaccounted "breath" of these facilities is comparable to the contribution of WWTP to methane and carbon dioxide emissions or is even greater.

Within the boundaries of MWWTP-1 site, the Project will create new sources of GHG: scrubbers, incinerator, power plant, however their contribution will not increase emissions significantly. Instead annual emissions of methane will decrease from the baseline of 32,000 tons to 27,000 tons CO_2-e, i.e. roughly by 35% (this decrease will be partially compensated by increased emissions of CO_2).

The contribution of MWWTP to bulk GHG emissions in the Republic of Belarus is estimated to be 0.15%, i.e. contribution of the proposed Project at the national level is minor and thus may not affect the country's ability to fulfil the obligations under the Paris Agreement and other documents on the global climate agenda, even if emissions of methane, carbon dioxide and other GHG slightly increase due to the increased waste water flows to treatment.

8.11 Transboundary Impacts

The zone of potential Project's influence does not extend to territories of other states because:

- Basing on the intended activity scope described in Chapter 4, the region of the Project location and its zone of influence, it is possible to conclude that the overall activity is performed within the territory of the Republic of Belarus and major impacts will not be of transboundary nature;
- Technologies to be used allow low SO_2 emissions during operation of the integrated plant for wastewater sludge treatment (drying and incineration). It is anticipated that the Project's input to background sulfur dioxide concentrations will have insignificant region-scale and vanishingly small, in terms of transboundary transfer, implications;
- Assessment of emissions of nitrogen compounds in the course of wastewater sludge drying and incineration under the Project is provided in Section 8.1. However, due to the Project location, no noticeable contribution of Project emissions that would transfer across the State Border is expected.
- Project waste will be landfilled (see also Section 8.6). All Project infrastructure is located in the territory of the Republic of Belarus (licensed contractors will be only employed).

Therefore, no significant transboundary impacts from the Project implementation are envisaged. However, of note is that greenhouse gas emissions during the Project lifecycle will make a negative contribution to global climate change. This issue is also addressed in Section 8.9.

9. SOCIAL IMPACT ASSESSMENT

9.1 Identification of social impacts area of influence

The social impacts are assessed within the Project's Social Area of Influence (PSAoI). The PSAoI is identified for the territories and communities which will be subjected to significant social impacts at various stages of the Project, and subdivided into two types:

- Area of immediate (direct) influence;
- Area of consequential (indirect) influence.

The following territories and communities have been included into PSAOI, based on the Project description, in particular location and boundaries of the Project facilities, as well as on information on potential impacts of various components of the Project:

- Area of immediate (direct) influence:
  - Former Shabany village territory (potential recipients are local land users, temporary and/or permanent residents);
  - Novy Dvor agro-town (recipients – local residents);
  - Podlosye village (recipients – local residents);
  - Svislochskaya street, Inzhenernaya street, Partizansky avenue and Minsk Beltway (recipients – road network users);
  - Shabany neighbourhood (recipients – local residents and businesses);
  - Trostenets memorial site (recipients – visitors of the memorial site);
  - Areas directly adjacent to the Svisloch River (recipients – local amateurs and hobby fishers);
  - Territories used by Project personnel;
- Area of consequential (indirect) influence:
  - Minsk population in general (recipients – consumers of Minskvodokanal, job seekers, business owners);
  - 'Minsk' Free Economic Zone (recipients – businesses operating in the zone);
  - Other settlements of Novodvorsky rural council;
  - Project personnel.

Table 9.1: Territories and communities included into the SAoI

Area	Potential recipients	Sensitivity	Direct/ Indirect impact	Presence of vulnerable groups	Administrative attribution
The territory of former Shabany village located to the north from Minskvodokanal facilities	Local land users, temporary and/or permanent residents	High	Direct	Yes	Novodvorsky rural council of Minsky district

Area	Potential recipients	Sensitivity	Direct/ Indirect impact	Presence of vulnerable groups	Administrative attribution
Novy Dvor agro-town	Local residents Local agricultural businesses	High	Direct	May be present	Novodvorsky rural council of Minsky district
Podlosye village	Local residents Local agricultural businesses	High	Direct	May be present	Novodvorsky rural council of Minsky district
Adjacent roads network	Road users	Medium to high	Direct	No	Zavodskoy district of Minsk
Shabany neighbourhood	Local residents Local businesses		Direct/ Indirect		Zavodskoy district of Minsk
'Minsk' Free Economic Zone	Businesses operating within the economic zone				Zavodskoy district of Minsk
Trostenets memorial site	Visitors of the memorial site	Medium to high	Direct	No	Zavodskoy district of Minsk
Areas directly adjacent to the Svisloch River	Local fishers (amateur and hobby fishing)	Medium to high	Direct	No	Novodvorsky rural council of Minsky district
Minsk in general	Users and consumers of Minskvodokanal Job seekers and business owners	Medium to high	Indirect	Yes	Minsk municipality
Project site	Project personnel (Minskvodokanal, contractors/ subcontractors)	Medium to High	Direct/ indirect	May be present	Zavodskoy district of Minsk
Other settlements of Novodvorsky rural council	Local residents Local businesses		Indirect	May be present	Novodvorsky rural council of Minsky district

Social baseline studies and conducted consultations identified various issues of socioeconomic conditions of some of the affected communities. The following aspects of the socio-economic baseline and consultations results are deemed relevant for the process of social impact assessment:

- Demographic characteristics:
  - Growth of Minsk metropolitan area population
  - Increasing dependent population share in Zavodskoy district of Minsk
  - Ageing population of Zavodskoy district of Minsk, although in Shabany neighbourhood the population is younger than in Zavodskoy district overall
  - Outmigration and population decrease in Zavodskoy district of Minsk

  - Significant share of country’s population residing (19.3% based on official data) and working (including daytime workers) in Minsk
- Economic and infrastructure issues:
  - Intensive housing development of the satellite towns and Minsk suburbs
  - Traffic congestion problems in Shabany district
  - Transitional economy of Zavodskoy district as industrial output, which was a cornerstone of the economic development pattern of this urban district for decades, slows down
  - Decline of significance of agricultural production at a regional level
- Social sphere, health profile and vulnerable communities:
  - Increasing numbers of newly registered people living with HIV at regional level and at Zavodskoy district level. Overall, Zavodskoy district is reported as one of the most problematic districts in terms of HIV incidence with over 20% of newly registered HIV cases of Minsk
  - Respiratory diseases form a leading group of diseases in Minsk and Zavodskoy district. Particularly, Zavodskoy district children’s susceptibility to respiratory diseases demonstrate steady growth, which, among other reasons, may be caused by air pollution as indicated by some researches
- Land issues and disputes:
  - Four unregistered houses populated by 7 residents are located in close proximity to the Minskvodokanal waste water treatment plant facilities. The houses are used on a permanent basis. Three out of four houses are adjoined by land parcels used for small-scale supplementary agricultural activities
- Cultural heritage:
  - Close proximity of the Project site to Trostenets memorial
- Local communities’ engagement (see Chapter 7 and Stakeholder Engagement Plan for details):
  - Statutory national EIA consultations (2015) were taken in a form of information disclosure and did not manage to attract public attention and did not result in public meeting to collect opinions of local residents towards the planned activity
  - Presentation of the wider spatial development plan designed for the ‘Shabany’ industrial area drew significant public attention and various concerns were expressed by local communities from Shabany neighbourhood and Novodvorsky rural council

9.2 Review of positive social impacts

Positive impacts concern the economic and social benefits of the Project for communities in PSAOI, because it is aimed at improving the efficiency of operating infrastructure facilities ensuring high standard of living. The Project will yield benefits for local communities by providing new employment opportunities at construction phase and, to a lesser extent, at operation phase, new opportunities for local businesses through the Project procurement system, and the upgrade of the waste water treatment system which implies reduction of unpleasant odours emitted by the Minskvodokanal facility. The significance of these positive impacts can be enhanced through specific corrective actions described further in this chapter.

Summary list of the Project's anticipated key positive effects (provided that the mitigations measures are implemented) is provided below.

- significant reconstruction of Minsk Waste Water Treatment Plant improving the efficiency of wastewater treatment process and reducing unpleasant odours of its current operations;
- stimuli for development of local small and medium businesses, e.g. through contracting local companies during the Project construction phase;
- potentially – additional incentive for real estate popularity raise in Novy Dvor agro-town and Shabany neighborhood due to decrease of air emissions and odours from Waste Water Treatment Plant;
- local procurement opportunities, in turn, will yield benefits for local businesses and indirectly support creation of new jobs;
- increased employment level of local residents engaged into construction activities;
- elimination of use of heavy load vehicles for transportation of WWTP-produced sludge to the lagoons;
- slightly increased demand for skilled professionals during operation phase.

Sensitivity of all recipients of the positive impacts is assessed as *medium* to *high* (for the vulnerable groups and recipients of high intensity impacts), and as a rule the positive changes produce *long-term* effect. The spatial scale of the positive impacts will vary from *local* (at the level of Novodvorsky rural council and Shabany neighbourhood) to *regional* (at the level of Minsk and Minsk region). The overall significance of the positive impacts of the Project is assessed as **medium** to **high**.

The selected positive impacts, as well as potential negative impacts, are discussed in more details in the further sections of this chapter.

9.3 Assessment of selected positive and negative social impacts

9.3.1 Employment opportunities

Impact description

Based on the assessment provided by the Project's technical consultant, WWTP personnel numbers are relatively high for a facility of such type. This may be explained by the practice of undertaking all services "in-house". The detailed figures on personnel of WWTP is provided in Table 9.2.

Table 9.2 Composition of Minsk waste water treatment plant workforce, 2017

	Male	Female	Total
Blue-collar professionals	224	101	235
Specialists	6	8	14
Management	12	3	15

Minskvodokanal will attract local contractors at a construction stage. This enables the possibility for local-level job generation. The Company shall only use certified contractors, which is to ensure a certain level of labour and working conditions in line with the conditions of the Resolution #252 of the Council of Ministers of the Republic of Belarus.

As the Project is seeking for funding from European Bank for Reconstruction and Development, Minskvodokanal shall also ensure that the specific provisions of EBRD Performance Requirement 2 of the Environmental and Social Policy (2014) are followed. These provisions include but are not limited to the following:

- Compliance of the activities of all parties involved into the Project with the national social security, health and safety and labour requirements;
- Fundamental standards and principles of International Labour Organization in regard to forced labour, freedom of association, discrimination at a workplace, minimum age, and child labour;
- Accommodation facilities standards;
- Details on internal grievance redress mechanism;
- Contractors personnel management and control.

It is understood that Minskvodokanal has a well-developed system allowing proper management of its human resources to the extent that is viewed sufficient to comply with the EBRD PR 2. The most crucial task for Minskvodokanal shall be to ensure that all Project's contractors' and subcontractors' workers are managed in a manner compliant with the same requirements. It is assessed that Minskvodokanal's approach to and experience in regulating labour issues is sufficient to ensure proper contractors' management.

Project's expected compliance with the aforementioned requirements enhances the significance of this positive impact as it will be ensured that employment opportunities are provided coupled with sufficient labour conditions.

At the moment, there is a high level of uncertainty on the approximate numbers of construction workers that are to be retained for the Project. Hence, it is difficult to indicate the probability of potential creation of new positions for the needs of Project construction. Although job generation via contractors is viewed as possible, it is also presumed that the contractor may have sufficient personnel capacities with no actual need for creation of new positions specifically for WWTP assignment. It is understood that the preference will be given to Belarusian contractors and no migrant workers shall be attracted.

At the operation stage, Minskvodokanal expects the Project to create 28 positions for skilled personnel. Although the current organizational structure of WWTP is defined by the technical consultant as overstaffed, the Company has no intention to conduct any mass reductions. However, to ensure better organizational efficiency, it is assumed that MVK may use internal Human Resources to fill the new Project-related positions at least partially via re-qualification and training courses.

During operations, it is expected that the positive impact of the employment generation will mainly conclude in the opportunity provided to Minskvodokanal employees to enhance their professional capabilities. Some additional skilled specialists from the city of Minsk may be attracted at the operation stage, too.

During operation phase, the probability of new jobs generation is assessed as *medium*, and the level of its spatial coverage is *local* to *regional*. It is expected that the impact will be *long-term*. The recipient's sensitivity is assessed as *high* as according to the baseline data large proportions of country's population seek job opportunities in the city of Minsk. At the operation stage, the expected number of new workers attracted will be low; however, the positions created by the Company will generate opportunities for highly skilled personnel and, therefore, the overall significance of the impact at the operation stage is assessed as **medium**.

During construction phase, the Project is expected to attract significant number of unskilled, semi-skilled and skilled construction workers via the contractors. The probability of the impact is assessed as *high*. The spatial extent of the impact will be of *local to regional* nature. As the construction stage will last up to three years, the impact's duration will be *medium-term*. The sensitivity of the recipient (potential construction workers) is assessed as *high* as it is understood that project-based construction work is a major source of their incomes. The overall significance of the impact is assessed as **high**.

<u>Measures to enhance significance of the positive impact</u>

Although as the aforementioned factors explain uncertainly in regard to use construction workforce and the peculiarities of attraction of new workers during the Project's operation, a set of measures is still recommended for the Company. This set will be utilized as applicable by the responsible parties within Minskvodokanal and the contractors. The measures aim at maintaining this positive impact and include activities that will support proportion of local residents among the professionals employed by the Company and its contractors at either construction or operation phase:

- Minskvodokanal shall ensure that the Project's contractors' and subcontractors' personnel rights are not infringed and that the requirements of EBRD PR 2 and relevant national labour legislation are applicable to all Project workers, including attracted construction workforce;
- contractors' and subcontractors' workers are provided with an opportunity to use internal grievance mechanism as indicated in SEP;
- development of the accommodation camp management plan in line with EBRD/IFC Guidance Note "Workers' accommodation: processes and standards" (if camps are used for accommodation of construction workforce);
- job fairs and exhibitions in Minsk;
- where possible, cooperation with local employment centres and recruitment agencies for more detailed analysis of labour market and diversification of employment channels for potential employees;
- disclosure of the Company's HR policy;
- at recruitment, it is recommended to employ representatives of vulnerable groups, provided that all other characteristics of the job seekers are equal;
- cooperation with educational entities of Minsk and Minsk region, including:

  - internships for students;
  - site tours to the Project facilities for students;
  - participation of the Company's specialists in the training process as guest lecturers or mentors.

As a corrective measure, a Local Recruitment Policy may be considered for development and implementation. It is assumed that the Local Recruitment Policy may be applied during construction phase by the Company and its contractors/subcontractors. The Policy will aim at enhancing the number of the residents of Zavodskoy district, Shabany neighbourhood and Novodvorsky rural council, and will provide an accurate definition of "local employee". The Local Employee is expected to be defined as a person registered in Zavodskoy district, Shabany neighbourhood and Novodvorsky rural council. It is proposed that the Policy will assist in increasing the share of local residents among the Project workforce mainly during the construction phase. Minskvodokanal shall ensure that the contractors implement such policy and attract local employees to perform unskilled[94] labour, semiskilled labour and skilled labour. This measure will help enhance the level of involvement of local residents into the Project and the support of local communities to the Project (social license to operate).

The Policy will further define the recruitment and employment procedures. The recommended practice provides for preparation of a database well in advance with information about the local workers using the information available at employment agencies, and recruiters (within the Company and its contractors/subcontractors) must be obliged to use the data base for selection of personnel of the respective categories in accordance with the definition above. The Policy will clearly set the priority of candidates qualification for recruitment, so that preference will be granted to local residents only when they meet the qualification criteria.

Assessment of residual impact

Taking into account the explained uncertainties concerning future employment practices, the impact level after implementation of the above recommendations is still anticipated to be **medium** for operation stage and **high** for construction stage.

9.3.2 Economic benefits of engaging local contractors for the Project

Impact description

As discussed above, the Project may generate a positive impact on development of local (Minsk-level) and regional (Minsk region) economy. Contracting of local businesses for the Project implementation is expected to be one of the main components of this impact. The contractors will be engaged via the Resolution #252 of the Council of Ministers of the Republic of Belarus that would ensure that the invited companies comply with certain requirements including the labour and H&S standards of the Republic of Belarus. Minskvodokanal shall also ensure the compliance with relevant labour requirements of EBRD PR 2 (see also Section 9.3.1 for details).

Probability of the impact to eventuate is assessed as *high*. The impact scale is assessed as *regional* (business community of Minsk and Minsk region). Recipient's sensitivity is *medium*. The impact duration is assessed as *medium-term* as it is expected that major attraction of contractors will occur during construction of the Project. The impact significance is assessed as **high**.

Measures to enhance significance of the positive impact

In order to maintain the high level of significance of the impact, it is proposed to the extent possible to develop and implement a Local Procurement Policy. The Policy will focus the businesses located in Zavodskoy district and Novodvorsky rural council. It is understood that the Policy will mainly aim at

[94] These categories must be clearly defined in the Policy, in compliance with the categories recognized by the Labour Code of the Republic of Belarus, or adopted by the Belarusian urban infrastructure and construction industry.

inviting local enterprises active in supporting services (e.g. catering services). Local businesses will be only preferred provided that adequate quality of products and services is ensured. The Policy will further describe reasonable exceptions for certain services as appropriate. Upon implementation the Policy will be applicable to all contractors and subcontractors engaged at the Project sites. The Policy will clearly state the priority of quality in selection of contractors, thus local businesses will enjoy preferential treatment only when they comply with qualification criteria.

Assessment of residual impact

The impact level after implementation of the above recommendations will be still **high**.

9.3.3 Assessment and scoping out of the potential resettlement impact

Impact description

As discussed in section 5.8, and the south-western and western boundary of WWTP-2adjoins the territory of former Shabany village that previously part of Novodvorsky rural council. On the territory of this former village, four houses are indicated that are used for permanent residence all year round (fig.5.55). Subsidiary farming and gardening is practiced on the land parcels adjacent to three out of four houses. Three houses fall within the existingsanitary protection zone (SPZ). Description of SPZ and scattering of emission from WWTP are presented in section 8.1. The house located closely to the cemetery and to the border with Novy Dvor agro-town is not within the current SPZ.

1) During the preliminary appraisal of potential for resettlement of the identified houses it was concluded that additional consultations with the residents are required. The consultations were made in two stages: Early February 2018 – a visit to the identified houses made by Minskvodokanal representative accompanied by the head of Novodvorsky rural council:
2) 1st of March 2018 – interviewing of the residents of the identified houses and representatives of Novodvorsky rural council conducted by Ramboll consultant on social issues who was accompanied by representatives of Minskvodokanal.

The Minskvodokanal representatives escorted by the head of Novodvorsky rural council visited the dwellings and made their first contacts with the residents in early February 2018. During the meetings the houses' inhabitants were moderately precautious of contacts with the officials and expressed some level of mistrust towards the Minskvodokanal representatives and the head of Novodvorsky rural council. No information on the households' activities and composition were provided and no clarity was derived from the meetings on the residents' resistance either towards Minskvodokanal operations or Project construction activities

1) The second stage of consultations was led by Ramboll consultant on social issues who conducted the semi-structured interviews with the representatives of three out of four houses. The interviews were conducted in line with the pre-developed questionnaire. The following blocks of questions were discussed: Households' history;
2) Household residents' characteristics;
3) Utilities and engineering networks available to the residents;
4) Relationships with Minskvodokanal, representatives of Novodvorsky rural council and other social institutes.

The interviews revealed that two out of four households are kept by the persons who have direct relation to former Shabany village: the residents of one household lived on this territory for their whole life and the second household for decades belonged to the parents and other relatives of the current occupant. The third and the fourth houses is occupied by its current inhabitants for the past 15 years. The information on the fourth house was shared by its neighbours as Ramboll did not have a chance to have an interview with a person living there. 7 persons in total live in these houses.

Overall, the second stage of consultations indicated that the residents of the unregistered households have their everyday practices rather well organized. They are connected to the local power grid and are its official users. The water is extracted from wells located near the houses or brought from the street standpipe located in Novy Dvor agro-town. Botted gas is used for cooking and the heating is arranged via the oven.

Two of the area inhabitants have health issues, namely diabetes and oncological disease. The other four residents whose representatives were interviewed did not report any diseases. No children live in the households.

All residents interviewed were univocal in their view that the MWTP operations do not have negative impacts on their lives. All respondents reacted negatively when asked on whether unpleasant odours are felt due to WWTP activities.

The residents of the houses use social and trade infrastructure of Novy Dvor agro-town. The only approach road actively used by the residents starts in Novy Dvor. The representatives of Novodvorsky rural council claim they help the community of former Shabany village by grading the road. It is also understood that some of the residents arrange road maintenance activities at own expenses.

Two stages of consultations conducted by by Minskvodokanal and Ramboll, revealed that at least three of the houses are in good condition and have the subsidiary economic practices well-managed. All respondents were informed of the planned Project at construction site of MWTP-1 and their reaction was mild or indifferent. The interviews demonstrated that two households opted to stay in the village to moving out despite massive construction activities of MWTP-2 construction. For two of the households, the Shabany village area was a place of residence for a large part of their lives or for their entire lives. The activities of Minskvodokanal are not associated by the residents with negative emotions and no complaints were mentioned when directly asked if the residents had any. The construction site of WWTP-1 will be located in circa 500 m from the houses. The houses are typically approached by the road starting in Novy Dvor and the road near Minskvodokanal facility is almost never used. These factors allow to conclude that there is an understanding that the residents do not have the will to relocate their lifestyle and economic practices to another place despite the planned Project activities.

The air modelling conducted by Ramboll and presented in Section 8.1 allows to conclude that during operations the air quality will be enhanced as a result of the WWTP-1 rehabilitation.

Accounting for all the aspects listed, it is understood that **no resettlement action** **will be required** due to Project implementation under condition of application of a set of mitigation measures recommended in this chapter and Chapter 13 for the construction phase operation and implementation of provisions of SEP.

Based on the conclusions made above, the resettlementimpact is **scoped out**.

9.3.4 Public health impacts

9.3.4.1 Assumptions and limitations for assessment of potential public health impacts

It shall be taken into account that this assessment is based on a limited set of high-level data on the epidemiological situation of Minsk, Minsk district and on some fragmented information on the health conditions of some groups residing in Zavodskoy district. Detailed Shabany community health profile data was requested from Minsk executive committee at least four months prior to the ESIA package disclosure date (mid-November, 2017-mid-March, 2018). No detailed data on the health profile of Shabany community was provided.

Overall, it is understood that the health-related effects associated with the Project implementation are two-fold, because there are positive and negative factors. . The ESIA is conducted to identify measures increasing the influence of positive factors and preventing or mitigating the adverse impacts.

9.3.4.2 Influence of negative factors on community physical health

Impact description

The potential risks to physical health assessed in this section concern the communities residing in Shabany urban neighbourhood, former Shabany village, Novy Dvor agro-town and Podlosye village. The following factors are considered within the assessment:

- air emission at the Project operation phase (due to the operation of sludge incinerator and reduction of emissions from the reconstructed part of MWTP-1);
- dust emissions from the Project construction activities;
- contacts between Project construction personnel and local communities.

Impacts of these factors are considered below (separately for each factor).

Emissions of polluting substances at the operation stage (due to the operations of sludge incinerator)

Analysis and assessment of Project impacts on air quality is provided in section 8.1. The main potential recipients considered during the assessment include:

- Residents the houses located on the territory of the former Shabany village (the residence located closest to the future construction area are at a distance of roughly 500 m);
- Residents of Novy Dvor agro-town;
- Residents of Podlosye village;
- Residents of Shabany urban neighbourhood.

Baseline studies demonstrated that there is a large share of respiratory diseases in the morbidity profile of Zavodskoy district population (including vulnerable child population), and it is understood that potential sensitivity of the recipients is *high*. However, the consultation process indicated that there are no vulnerable groups of children residing in former Shabany village legacy houses that is the closest area to the Project construction site. The analysis of air emissions provided in Section 8.1 demonstrated that the potential recipients from in Novy Dvor, Podlosye and Shabany urban neighbourhood reside outside the sanitary protection zone that is pre-evaluated by Ramboll accounting for emissions' levels of various substances.

The analysis provided in Section 8.1 demonstrates that no increase of pollutant emissions will be triggered by the Project activities, including the operation of sludge incinerator located within the boundaries of WWTP-1 of Minskvodokanal. On the contrary, the overall impact from Project implementation associated with air emissions is expected to be positive due to overall decrease in emissions of pollutants, including the impact on four houses of former Shabany village.

Therefore, it is assessed that despite the potentially high sensitivity of the recipient, the residual negative health impact resulted from decline of air emissions associated with the Project implementation will be *low* intensity and of *highly localized* nature. The risk of the negative impact is assessed as *low*. The impact significance is assessed as **low**.

Mitigation measures

The following mitigation measures are recommended:

- Minskvodokanal shall ensure that the information regarding the Project's level of impacts on air is delivered to local stakeholders, including the communities of Shabany neighborhood and Novodvorsky rural council. The Company shall emphasize the positive outcomes for public health that the Project is expected to entail as described in the Section 9.2. The Company is recommended to use various methods for relevant information disclosure, including exhibitions, information repositories, Q&A sessions and procedures as defined by Stakeholder Engagement Plan;
- Implement the measures covering the impacts on ambient air and described in Section 8.1;

Conducting the mitigation activities proposed above shall ensure the Company to prevent or minimize the potential public health impacts. Residual level of the impact is assessed as **negligible**.

Dust emissions from Project construction activities

Dust emissions at the Project construction phase will be associated with earth works on the site and movement of heavy machinery (e.g. transportation of loads and personnel). It is anticipated that the main recipient of the impact will be residents of the houses located on the territory of former Shabany village due to the absence of other houses near MWTP-1. The recipient' sensitivity is assessed as *low to medium* as during the consultations Ramboll was informed by the area residents that there is no nuisance from WWTP activities. The risk of dust emissions from the above operations affecting the residents is mitigated by the distance from the Project site to the nearest residences (roughly 500 m) and by the trees surrounding the houses. Besides, the former village territory is practically not available from the side of WWTP and no Project traffic shall be expected crossing the village (although subject to the mitigation measure as indicated below). Therefore, the risk of the impact is assessed as *low*. In absence of mitigation the impact will be *mid-term* (at least up to three years based on typical duration of construction of the projects of such type)*, reversible* and *highly localized*. However, due to the remoteness of the recipients from the construction site and the absence of roads near the houses (suitable for the transportation of materials and equipment), the impact significance is assessed as **medium**.

<u>Mitigation measures</u>

Measures to mitigate the impact include:

- Activities to prevent dust emissions as described in Chapter8;
- Ensuring that the former Shabany village approach roads are not used by the construction contractors.

Residual level of the impact is assessed as **negligible)**.

Contacts between Project personnel and local communities

The risk of contacts between Project personnel (at the construction phase) and local residents is associated with:

1) Communicable diseases, including sexually transmitted diseases. HIV/AIDS morbidity in Zavodskoy district of Minsk is a matter of special concern

2) Potential for disputes and conflicts between local residents and Project personnel, with mutual physical impacts. The following communities are viewed as potentially subject to conflicting situations with the Project construction workforce:

- residents of former Shabany village legacy housing units (considered as a vulnerable group due to absence of formal land rights; high level of sensitivity)
- residents of Novy Dvor agro-town (medium level of sensitivity)
- residents of Shabany neighborhood (medium level of sensitivity)
- employees of the enterprises located in close proximity to the Project area (low level of sensitivity)
- visitors of Trostenets memorial (medium level of sensitivity)

The potential for eventuation of both effects leading to diseases and conflicts is mitigated by the 'urban factor' of the Project implementation. The Project is to be located in the well-developed industrial area and the communities residing in vicinity to the Project site are expected to be adjusted to new development activities, including construction activities. The Project site is spatially separated from potential venues of contact between local residents and construction workers, including:

- The road used to approach the former Shabany village territory starts in Novy Dvor agro-town; the former village may be hypothetically approached from the side of Minskvodokanal, however, as reported by local residents, the part of the road starting point that located closer to WWTP-1 is in very poor condition and is not used by traffic;
- Shabany neighbourhood is separated by a range of other industrial sites;
- Novy Dvor agro-town is separated by the agricultural fields used for cultivation of technical crops;
- Trostenets memorial is separated by the railroad line.

The highest risk of the impact, especially in regard to potential conflicts, may be associated with the residents of former Shabany village. The risk of contacts of construction workers with local communities may arise at the construction phase of the Project.

The risk of the impact to occur is assessed as *medium*. Recipient's sensitivity is *medium* (in case of vulnerable stakeholders affected). If the corrective measures are not implemented, the impact will be *mid-term*, *reversible* and *local* (the area of Novodvorsky rural council and Shabany neighbourhood). Thus, the impact significance is assessed as **medium**.

Mitigation measures

Significance of impact of contacts between Project personnel and local communities on physical health of the affected communities may be reduced by the following measures:

- introduction of a Code of Conduct for Project personnel to be followed by contractors and subcontractors. The Code will tentatively include the following:
    - demonstration of respect for culture, activities (fishery and subsistence farming) and standards of behavior generally accepted by local communities;
    - prohibition of fishing for all personnel;
    - refraining from any activities which may have adverse consequences for local communities, and any types of behavior which may be destructive for the established norms of conduct;
    - demonstration neutral position and "non-involvement", and prevention of disputes in case of potential conflicts;
    - disciplinary sanctions applicable in case of failure to follow provisions of the Code, depending on severity of violation.
- informing Project personnel about the risk of sexually transmitted diseases, in particular HIV/AIDS;
- ensure presence of qualified medical personnel available for construction workforce at the Project site;
- regular activities for promotion of healthy lifestyle and sports (e.g. competitions between groups of Project personnel);
- if it is decided upon the use of construction workforce accommodation facilities at the construction phase of the Project, Accommodation Policy and Accommodation Management Plan will be developed;
- arrangement a dining area for construction workforce;
- arrangement of recreational activities and/or resting areas to diminish the potential for work-related stress that may lead to heightened risk of conflicts;
- **Sufficient control over the contractors in regard of the above-mentioned measures is deemed critical**.

The mitigation measure will decrease the impact level to **low**.

9.3.4.3 Positive community physical health impacts

Impact description

The Project will enhance the environmental tiers of WWTP practices due to the following:

- Decrease of emissions of pollutants;
- Enhancement of quality of water discharged into the Svisloch river, which is used for fishing by the communities located downstream;
- Elimination of regular (up to 80 trips per day) use of heavy-load vehicles for sludge disposal to the lagoons;
- Elimination of use of the sludge lagoons and their gradual rehabilitation.

The probability of this *positive* impact is assessed as *high*. Recipient's sensitivity is *high* due to air emissions and health concerns of local communities. The impact will be *long-term*, *irreversible* and *local* (the area of Novodvorsky rural council and Shabany neighbourhood). Thus, the impact significance is assessed as **high**.

The Company is recommended to communicate the essence of this positive impact to local communities and arrange proper stakeholder engagement practices to ensure that no false and untrustworthy information is circulated among local communities about the health implications of the Project. The Company shall use a series of mechanisms for proper and well-managed Project information disclosure, including exhibitions, information repositories, Q&A sessions and procedures as defined by Stakeholder Engagement Plan.

9.3.4.4 Public psychological well-being risks

Impact description

Risks to psychological well-being of local communities may be caused by potential conflicts/social tension due to contacts between local community (including the households on the territory of former Shabany village) and Project personnel and local residents' concerns about the potential air emissions and traffic impacts of the Project.

During construction, it may be expected that the Project will attract significant numbers of contractors' workers, although their exact number is currently unknown. In case of conflicts with the Project personnel, the main recipients of the impact may be the inhabitants of the houses situated in former Shabany village. The nearest house is located at a distance of roughly 500 m to the Project area and there is low potential that the approach road to their houses is to be affected by the Project, which may potentially become one of the reasons for conflicts. But it's unlikely.

The impact on psychological health may be triggered by the negative attitude that the residents of Novodvorsky rural council and Shabany neighbourhood express towards the Project and general development of the Shabany industrial area (related to the previous plans for the Project location on the new territory) and low level of awareness regarding the Project's details and scope. Representatives of local communities expressed their concerns regarding potential negative impacts of the Project during the consultations held by Minskgrado in 2017. The rumours circulating among local population due to these concerns may possibly not reflect on the actual Project's positive impacts, exaggerating the negative effects. Such situation can result in stress felt by local residents who may perceive that the upcoming development would affect their health and lifestyle.

Impact on psychological well-being may be potentially lessened by the public grievance mechanism introduced by the Company. The mechanism ensures the ability for local communities to express their views and opinions on the Project development process.

Recipient's sensitivity is assessed as *high*. The impact will be *medium-term* in time and manifested at the *local* level. The impact is expected to be *reversible*. In view of the above, before mitigations taken the impact significance is assessed as **medium**.

Mitigation measures

It is understood that the significance of the impact on psychological well-being of the affected communities can be effectively reduced by the following measures:

- Ensure that the grievance mechanism of the Company is specifically introduced to the affected communities, and that they understand its principles and processes;
- Dissemination of proper Project-related information among local communities as indicated in the Stakeholder Engagement Plan;
- Minskvodokanal shall ensure that the information regarding the Project's health impacts is delivered to local stakeholders, including the communities of Shabany neighborhood and Novodvorsky rural council. The Company shall emphasize the positive outcomes for public health that the Project is expected to entail. The Company is recommended to use various methods for relevant information disclosure, including exhibitions, information repositories, Q&A sessions and procedures as defined by Stakeholder Engagement Plan;
- employment of local residents for the construction works as far as possible;
- introduction of check-in-check-out system at all Project sites;
- introduction of a Code of Conduct to be followed by all Project personnel, including contractors and subcontractors;
- measures listed in Section 8.1, covering the impacts of pollution (odorous) emissions and distribution of noise;
- strict control over contractors' and subcontractors compliance with the mitigation measures listed.

Assessment of residual impact

The above measures are expected to support people's satisfaction about Project development, ease tensions between various Project personnel groups and local communities, and in general reduce significance of the negative impact on psychological well-being.

The mitigation measures will help to reduce the impact level to **low**.

9.3.5 Potential increase of tariffs

Impact description

As of the end of 2017, the tariffs for water supply and sewage are assessed as relatively low and constitute 0.33 EUR per m^3 and 0.22 EUR per m^3, respectively. In January 2018 the tariffs increased by 40%, which, according to the evidence provided by Minskvodokanal, was necessary to reach the break-even point and receive some profit, but still does not include the investment component. These changes of the tariffs policy do not correlate to the Project implementation as the Company asserts. For the next several years, no tariffs increase is planned.

In distant future, it may be expected that the cost of production will increase due to a raising operation expenditures. Currently, there are no calculations for such increase as it is not planned for the nearest future. One of the factors that will help mitigate potential raise of tariffs in distant future, is the existing subsidy system assisting a range of vulnerable groups, including war veterans, Heroes of Belarus, Labour Heroes, some groups of people with disabilities and other. Depending on the specific group, from 50 to 100 percent of water supply and sewage fees may be waived.

Overall, the Project will have **no direct impact** on the tariff policy of Minskvodokanal. However, during operations indirect impacts on water supply and sewage pricing may be caused by the Project. The risk of such impact may not be defined at the moment due to high level of uncertainty. The recipients (Minskvodokanal consumers) sensitivity should be currently treated as *high* due to the significant increase in pricing of the services happened in early 2018. The overall significance of the impact is now assessed as **high** due to the identified level of recipients' sensitivity and the *regional* spatial scale of the impact as the Company's operation covers up to 95% of Minsk and some areas of Minsk region. However, it should be accounted for a possibility of significance's decrease if, as planned, no further tariff raise is initiated by Minskvodokanal in the coming years.

9.3.6 Positive impact on infrastructure of Minsk and Novodvorsky rural council

Impact description

At the operation stage, the Project will have a positive effect on the following elements of infrastructure of Minsk:

- waste water treatment facility as the enhancement of the Minsk WWTP functions and efficiency of operations is the essential objective of the Project
- transportation infrastructure as the heavy load vehicles currently used for transportation of waste water sludge (approximately 80 trips daily as of November 2017) will not be in use after the Project commissioning.

Heavy traffic was mentioned by local residents as one of the pressing issues for Shabany neighbourhood. This perception of the traffic problem is confirmed by the media entries reviewed in the process of ESIA preparation. Additionally, the Project will reduce the air emissions to the extent that will allow reduction of unpleasant odours in Novodvorsky rural council and Shabany neighbourhood, which is proved to be a serious concerns for local communities as revealed by consultations taken by Minskgrado in 2017. Therefore, the sensitivity of the recipient to the positive traffic effects is assessed as *high*.

The probability of this positive impact is assessed as *high*. The impact will be *long-term* and *local* (the area of Novodvorsky rural council and Shabany neighbourhood). The impact significance is assessed as **high**.

Mitigation measures

The impact enhancement measure is similar to the one proposed for the positive health impact. Namely, the Company is recommended to communicate the essence of this positive impact to local communities and arrange proper stakeholder engagement practices to ensure that untrustworthy information is circulated among local communities.

After implementation of the enhancement measures, the significance of the positive impact will remain **high**.

9.3.7 Negative impact on infrastructure of Minsk and Novodvorsky rural council

Impact description

The project may affect certain elements of road network in Minsk which will be exposed to increased load during construction period, namely the road and highway system of Shabany neighborhood of Zavodskoy district.

At the moment it is not yet decided upon the potential routes that the Project construction contractor will include into their construction delivery planning. However, it is expected that the following roads may be potentially affected by these activities:

- Svislochskaya street;
- Inzhenernaya street;
- Partizansky avenue
- Minsk Beltway.

It is expected that the listed roads will be utilized for the following:

- delivery of goods and equipment by heavy-load vehicles to (e.g. building materials) and from (e.g. wastes) the construction site;
- transportation of the construction workers by coaches.

The territory of the WWTP is adjacent to the railroad line. However, there is currently no information on whether this line shall be used for delivery of goods and/or equipment for the construction stage.

The use of road network of Novodvorsky rural council for Project construction is not expected. However, it should be noted that one of the approach roads to former Shabany village is in close proximity to the WWTP facilities. This may potentially cause a risk of informal use of this unpaved approach road by the construction workers for various purposes.

Probability of the impact is assessed as *high*. The impact will be present during the construction phase, i.e. its duration will be medium-*term*. Recipient's sensitivity is *medium* (*high* if the groups of the residents of former Shabany village are affected). The impact scale is *local*, and its overall level is assessed as **high**.

<u>Mitigation measures</u>

The impact can be mitigated by the following measures:

- the construction workers shall be prohibited to use the unpaved road approaching the former Shabany village
- prior to construction, conduct an analysis of transport infrastructure of Zavodskoy district and Shabany neighbourhood (by a traffic specialist) including:
    - identification of transport routes and modes required for the Project;
    - identification of rush hours and seasons when roads are most busy;
    - key routes of public motor transport (including routes used by local communities for trips to Trostenets memorial and the places of work including the enterprises located within the Shabany industrial area);
    - assessment of pavement quality and maintenance schedule;
    - study of the additional traffic which will be generated by the Project;
    - analysis of distribution of the Project traffic by routes and modes of transport;
    - analysis of alternative routes and modes of loads transportation;
    - assessment of traffic generated by other projects planned for implementation in Minsk Free Economic Zone for the same period as the Project's construction phase. This information can be obtained through liaison with local business community and representatives of the companies;
- in case if the accommodation facilities are deemed necessary at the construction phase, provide worker's accommodation at the facilities which are reasonably located in relation to the Project construction site to minimize use of additional transport for transfers;
- manage the Project transportation activities in a manner ensuring use of municipal roads at low traffic hours to the extent possible;
- ensure observance of traffic safety rules, including speed limits;
- regular inspection of vehicle fleet to avoid breakdowns during trips and prevent consequential traffic congestion on the municipal roads.

Assessment of residual impact

The proposed measures will help reduce the significance of the impact to the **medium** level.

9.3.8 Negative impact on social infrastructure of Zavodskoy district

Impact description

As mentioned above, at the construction phase the Project will engage contractors' personnel most likely coming from Minsk, Minsk region and local communities.

As the number of personnel at the Project construction sites will grow, the load on local healthcare infrastructure may also increase. Additional load on local hospitals may be created as a result of traffic accidents, as well as other accidents or emergency situations (e.g. mass food poisoning) in the Project area. Another risk is associated with communicable diseases which might spread among the Project personnel as a result of contracts with local communities.

However, probability of this impact is significantly reduced by action of several factors. Firstly, current practice adopted by Minskvodokanal ensures attraction of the contractors licensed to perform their duties and compliant with specific health and safety norms. On the other hand, there is currently no clarity on what companies will act as the contractors for the Project and on their social management systems. Besides, there is currently no information on potential use of medical and sanitary facilities within the Project including portable cabins, canteens, which is regularly inspected for compliance with sanitary norms, medical station with the required medicines and skilled doctors.

At the operation phase, no impact on local social infrastructure is expected.

Probability of the impact is assessed as *low*, its scale is *local*, and duration is *short-term*. At this stage the recipient's sensitivity is considered to be *medium*, however this issue must be further studied via a set of measures proposed in Section "Public health impacts". The impact level is assessed as **low**.

Mitigation measures

The impact can be mitigated by the following corrective measures:

- ensure that the accommodation facilities (if necessary) are compliant with EBRD/IFC Guidance "Workers' Accommodation: Processes and Standards";
- ensure that the canteens (in case of their use) are regularly inspected for compliance with sanitary norms;
- ensure presence of a well-equipped on-site medical facility and an experienced paramedic;
- provide a clear medical emergency response action plan;
- implementation of measures in the sphere of traffic safety (Section 9.3.12), public health (Section 9.3.4) and occupational health and safety.

Assessment of residual impact

After implementation of the above corrective measures the negative impact will be **negligible**.

9.3.9 Potential negative impacts in the field of employment and labour and working conditions

Impact description

Potential negative impact in the sphere of employment relations may be caused in case of Company's and contractors' failure to comply with specific requirements of international labour standards, with the following potential consequences:

- violation of employee rights (e.g. with respect to overtime work, provision of facilities and time for rest and holidays, salary payment, workers' unions, confidential treatment of personal data of employee);
- any type of discrimination of employees;

- tensions between various groups of personnel and the contractors' management;
- failure to provide healthy working conditions for Project personnel;
- retrenchments associated with the Project.

Although the above consequences are not totally improbable, the desk and field studies have identified that the Company's practice in the sphere of employment and human resources management is in general compliant with the international labour requirements (namely, the EBRD Performance Requirement 2). The Company implements a set of activities as part of various corporate policies and the Collective Agreement which are intended to prevent the negative consequences mentioned above. No retrenchment is planned by Minskvodokanal either as part of the Project or as part of other corporate activities.

However, the potential impacts may be caused by labour relations offences committed by contractors. Experience of projects of similar scale indicates that contractors and subcontractors may attract personnel who may not fully understand their rights and duties. Hence, it is understood that contractors' management shall be a pressing issue for the Company. On the other hand, as mentioned in Section "Employment opportunities", Minskvodokanal shall only use certified contractors which shall ensure a certain level of labour and working conditions. It is also understood that the Company must ensure compliance of all Project contractors with EBRD PR 2 (see the mitigations proposed below). It shall reduce the probability and significance of the impact.

Taking into account the Company's activities, practices and capabilities (including a policy to attract certified companies as contractors) in the sphere of management of employment and labour relations, the impact (if any) will be *short-term* and *local*. In view of engagement of contractors' and subcontractors' personnel, its probability is assessed as *medium*. The recipient's sensitivity is assessed as *medium*. Overall level of the impact is assessed as **medium**.

<u>Mitigation measures</u>

Description of proposed measures to reduce probability of potential negative impacts in the sphere of employment relations is provided below.

It is recommended that Minskvodokanal shall require the Project contractors and subcontractors to comply with the labour requirements of EBRD PR2 as a special clause in the service and supply contracts. This action will help ensure that the Project's contractors' and subcontractors' personnel rights are not infringed.

The Company will monitor contractors and subcontractors at the Project sites for compliance with requirements through a system of inspections and/or audits that would reflect on at least the following topics:

- Prohibition of child and forced labour;
- Non-discrimination;
- Freedom of association;
- Timely and fair remuneration;
- Provision of safe and healthy working conditions;
- Provision of sufficient living conditions (in case of use of accommodation facilities for construction workers);
- Access to grievance mechanism.

This list of the topics may be extended and supplemented by a structural division in charge of the audits and/or inspections.

Minskvodokanal should make sure that the internal grievance mechanism is accessible for contractors and subcontractors. Contractors and subcontractors should be aware of the need to allow for confidential submission of grievances from their personnel.

The Company should further introduce a Code of Conduct for the Project personnel which will also cover contractors and subcontractors.

As mentioned above, the retrenchment is not expected to be triggered by the Project. However, in case of unlikely process of retrenchment of 20 or more employees of the WWTP, the Company is advised to develop a Framework Retrenchment Plan.

Assessment of residual impact

It is expected that the above corrective measures will reduce the impact level to **low**.

9.3.10 Tensions and potential conflicts between groups of workers at the Project construction site

Impact description

Experience of implementing major projects all over the world indicates the possibility of conflicts between shift workers. Conflicts and tensions can be caused by various factors of which the most important are:

- alcohol and drug consumption;
- congested accommodation camps (in case of their use);
- poor living conditions in accommodation camps (in case of their use);
- dissatisfaction with working arrangements (e.g. in case of regular overtime work);
- fatigue caused by detachment from family and friends (in case of attraction of non-local workforce);
- lack of facilities for rest and leisure (in case of long shifts).

Currently there is uncertainty in regard of specific arrangements the Company shall take to attract construction workforce. There is an expectation that construction activities are to be delegated to the approved contractors most likely attracting local employees, and no accommodation camp is yet planned within the Project area. During the interview, the head of Construction Department confirmed that Minskvodokanal had not practiced the use of accommodation camps previously. This factor allows mitigate the risk of tensions and conflicts among the construction workforce as the workers shall not be detached from their customary living environment and families. Hence, no significant risk of fatigue and alcohol or drug consumption at the Project site is expected.

Overall, it is expected that the scale of impact is to be *local* and the duration shall be *short-term*. The impact shall be *reversible* and of *medium* risk. Recipient's sensitivity is *medium*. Hence overall impact level is assessed as **medium**.

Mitigation measures

In order to reduce the level of impact to low, it is recommended to:

- develop and implement a Construction Accommodation Management Plan and Policy (in case of use of accommodation facilities;
- ensure proper arrangements for rest; and
- develop and implement the Code of Conduct emphasizing the need for respect demonstrated towards all workers involved into Project construction.

Assessment of residual impact

Implementation of the mitigation measures will mitigate the impact to **low** level.

9.3.11 Project sites security risks

Impact description

Currently there is no clarity on whether a private security contractor will be retained by Minskvodokanal for the Project. In general, use of security forces may potentially affect safety of local communities in the following situations:

- exceeding of the guard's authority (e.g. use of arms in conflicts with local residents (former Shabany village) and fishers at Svisloch River);
- use of arms by guards in case of wrongful acts of local residents (e.g. theft of Project equipment, machinery);
- inadequate performance of duties of the Project security personnel and lack of facilities to prevent unauthorized access to construction site, which may result in presence of unauthorized persons at the Project sites who will be exposed to hazards with potential injury or lethal outcome.

Impact assessment

Although recipient of the impact (local communities in the direct vicinity of the Project sites) have *high* sensitivity, probability of the impact (i.e. use of force, arms and non-lethal weapons) is assessed as *low*. The impact will be *local* and *short-term*. Its level is assessed as low.

Mitigation measures

The security impact can be further mitigated by the following measures:

- provision of additional training for the Project security guards for familiarization with the ideas described in the following internationally recognized documents:
    - International Finance Corporation Document «Good Practice Handbook: Use of Security Forces: Assessing and Managing Risks and Impacts Guidance for the Private Sector in Emerging Markets» (2017);
    - the Voluntary Principles on Security and Human Rights;
- the preferred method to protect the Project property shall be prevention (provision of safe cabinets, locks, fences, etc.);
- keeping munition at the fixed guard posts;
- provision of means to prevent unauthorized access to the Project sites (fences, checkpoints, etc.);
- development of a Code of conduct and familiarization of security personnel with its provisions at the time of recruitment (against signature), and provision of additional training (if required) on Project-related concerns of the local communities.

Assessment of residual impact

After implementation of the proposed mitigations the impact on security of local communities will remain **low**.

9.3.12 Community safety risks

Impact description

Safety risks for local communities may be caused by the following:

- transport operations at the Project construction and operation phases;
- potential accidents and emergency situations at the Project sites during construction and operation (the section on occupational health and safety considers these issues in details);

- exceeding authority of the guards at the Project sites, and unauthorized access to construction and operation sites (see Section 9.3.11 for more details).

It is understood the Project may use passenger vehicles and heavy-load vehicles for transportation of personnel and cargoes. Transportation of large machinery is also possible. These factors may increase the risk of traffic accidents on the streets that may be potentially used by the Project, namely:

- Svislochskaya street;
- Inzhenernaya street;
- Partizansky avenue
- Minsk Beltway.

The impacts severity is mitigated by the nature of the neighbourhood surrounding the Project site as the area around WWTP is industrial and no significant numbers of pedestrians are present.

Probability of the Project transport operations impact is assessed as *high*. The impact will be *local* and potentially *long-term*. Recipient's sensitivity is assessed as *high*, thus the impact level is **high**.

Mitigation measures

The impact can be mitigated by the following measures:

- implementation of mitigations described in Section 9.3.11;
- provision of appropriate training to workers on driver and vehicle safety;
- if deemed necessary based on the results of a local traffic study proposed in Section 9.3.7, road safety impact assessment may be developed; Directive 2008/96/EC of the European Parliament and of the Council on road infrastructure safety and management may be used as a benchmark;
- encouragement of joint trips (car-share) by the Project personnel, in order to minimize the number of passenger vehicles, and use of large-capacity cars;
- strict control of compliance with traffic safety rules, including speed limits;
- regular technical inspection of the Project vehicles and elimination of identified faults;
- mitigations listed in Section 9.3.7.

Assessment of residual impact

The remaining impact on safety of local community after the proposed mitigation measures is assessed as medium.

9.3.13 Land use and natural resource (impacts on fishing practices)

Impact description

The following land use practices may be potentially disturbed by the Project and the related activities:

- Angling at the Svisloch River;
- Agricultural activities on the territory of the former Shabany village.

During Project construction, the practices of fishers practicing angling activities at the Svisloch River may be affected due to improper conduct of construction workers who may potentially interfere into fishers' practices if no sufficient mitigation is taken. During operations, on the other hand, it is expected that the Project will be able to enhance natural conditions for fish habitats due to higher level of treatment of the water discharged into the river.

The agricultural activities of the residents of four houses located in the officially abandoned village of Shabany may be also affected by improper conduct of the construction workers

No impact is expected on agricultural activities practices in Novy Dvor agro-town.

Probability of the impact is tentatively assessed as *medium*. The potential period when impact may be present is the construction phase of the Project, i.e. the impact duration will be *medium-term*. Recipient's sensitivity is *high*, and the impact scale is *local*. Overall impact significance is assessed as **medium**.

Mitigation measures

Recommended measures to mitigate the impact:

- arrange regular consultations with the residents of the former Shabany village to ensure their feedback on Project activities;
- introduction of a Code of Conduct for the Project personnel including contractors, with explicit prohibition of fishing by the Project personnel;
- ensure that the Project transport does no use the gravel road approaching the former Shabany village.

Assessment of residual impact

The proposed mitigations will reduce the impact level to **low**.

9.3.14 Cultural heritage

Impact description

As the Project construction is planned within the boundaries of the area that have been subject of extensive development for several decades, there is an understanding that no assets of archaeological value are located within the construction site boundaries. For the same reason, the potential for chance finds is assessed as low.

As indicated in Chapter 6, Trostenets memorial is located in 1 km away from the WWTP facilities. The memorial is separated from the Project area by blocks of industrial buildings and a railway line. The Project-related traffic is not expected to interfere with the roads approaching the memorial. Hence, the risk of any disruption of memorial operations due to Project activities, including transportation of goods, is assessed to be *low*. The recipient's sensitivity is presumed to be *high* as the topic of WWII and genocide of Jewish groups is viewed as a highly sensible area of the Belarusian history. If the impact eventuates, its duration will be *short-term*, and its spatial shall be *local*. The significance of the impact is assessed as **low**.

Mitigation measures

The Company is recommended to ensure that the routes taken by the Project vehicles do not interfere with the roads approaching Trostenets memorial.

Assessment of residual impact

The above mitigations will reduce the impact level to **negligible**.

9.4 Labour Relations

Relationships between the Company and its personnel are regulated by a range of documents including the Collective Agreement, individual employment agreement, contract, internal labour regulations.

The Collective Agreement is intended to define and ensure implementation of specific measures and mutual commitments relating to protection of socio-economic, occupational and professional interests of MVK employees. It helps to create adequate conditions to achieve economic and financial sustainability of the Company operations, guarantee fair remuneration, healthy and safe working conditions, to make sure that worker's rights are respected at the level of employment relations and in other associated spheres, etc. The Collective Agreement describes specific duties of the parties as required to ensure sustainable functioning of all personnel of MVK, and to materialize the guarantees envisaged by the law of the Republic of Belarus and the Collective Agreement. Any amendments to the Collective Agreement can be introduced only after consultation with employees in the format of meetings or conferences.

Employment agreements and contracts are standard agreements between employee and employer which are made in the form defined by the Labour Law of the Republic of Belarus. Employment agreements are made for indefinite term while contracts have fixed terms. Both agreements and contracts guarantee the right to work, workplace health and safety, protection of economic and social rights and interests, participation in meetings and organization management, timely payment of remuneration, rest, social insurance, pension provision and respect of dignity. Salary levels are defined on the basis of the Unified Wage Rates Schedule of workers in the Republic of Belarus. The Trade Union Committee monitors the forms and system of remuneration, accounting and payment of wages and salaries. In addition to payment of salaries, the Company also runs an incentive rewards system. The minimum incentive reward is 72% of monthly salary, in average.

In accordance with the Labour Law, the Company has developed Internal Labour Regulations which are based on the constitutional right to work, and to safe and healthy working conditions.

The Regulations define the following:

- recruitment and dismissal procedures;
- duties of employees;
- duties of employer;
- working hours and their use;
- incentives for good work;
- responsibility for violation of workplace discipline.

The maximum allowed duration of work time at the Company is 40 hours per week.

9.5 Occupational Health and Safety

9.5.1 Occupational Health and Safety Management System (HSMS)

The Company has developed and introduced a Health and Safety Management System (HSMS) in accordance with international requirements (OHSAS 18001:2007) and local legislation (refer to Chapter 12). The documented Policy covers all appropriate principles of management systems including legal and other compliance and maintaining priority of personnel life and health. The Policy is communicated to all personnel of MVK.

The OHS targets of MVK at the corporate level are defined in the Occupational Health and Safety Policy. Progress against the targets is assessed annually as part of the management review of HSMS.

Individual OHS targets of the Company units are focused on reduction of unacceptable risks and enhancing workplace safety in general. Unit managers are responsible for attainment of the set targets.

Hazards identification and risk assessment procedures are carried out on annual basis in all divisions covered by the corporate HSMS, with due regard of specific activities and operations, human factors, external sources of hazards, infrastructure, equipment and materials, organizational changes and other factors.

Divisional manager prepares a hazards register for the division, using results of the above analysis. After assessment of risks the register is approved by the Chief Engineer of UE Minskvodokanal – the top management representative responsible for HSMS.

All identified hazards are assessed in order to identify the most severe risks to be managed. The assessment is based on product of consequences severity factor and impact probability factor.

To reduce the chance of unacceptable risks, all risks are analysed and mitigation measures are developed. All appropriate information in recorded in the register of unacceptable risks.

Identification of the required management measures and consideration of changes in the existing management measures are based on the following hierarchy of risk mitigation:

- removal;
- replacement;
- technical measures;
- prevention and/or administrative measures;
- personal protection equipment.

Internal HSMS audits are conducted by MVK personnel – HSMS auditors. At the beginning of each year the OHS Unit Manager prepares a programme of internal audits to be conducted in the Company divisions during the year.

Accidents, occupational diseases and incidents are investigated and registered in order to identify the root causes and prevent recurrence. The above activities are conducted in compliance with the "Rules for investigation and registration of workplace accidents and occupational diseases" approved by the Council of Ministers of the Republic of Belarus, Resolution No. 30 of 15.01.2004, and "Regulation on technical investigation of causes of accidents and incidents at hazardous operational facilities" approved by RB MES, Resolution No.9 of 28.06.2000.

The reported numbers of accidents during the past five years are shown in the occupational accidents report (Table 9.3). The maximum number of accidents was recorded in 2014. A lethal accident was reported in 2012. No accidents due to the fault of insurant happened since the time of implementation of the certified HSMS (2015).

Table 9.3: Workplace accidents 2012-2016

No.	Year	Total accidents	Lethal accidents	Severe accidents	Note
1	2012	2	1	1	
2	2013	2			
3	2014	5		2	3 accidents with no fault of insurant
4	2015	2			2 accidents with no fault of insurant
5	2016	0	-	-	

Contractors' activities at the Company sites may represent hazard to MVK personnel. To reduce (eliminate) the risks introduced by MVK contractors, the Company has developed a special procedure for interaction with contractors.

The Company cooperates with certified contractors for health and safety arrangements at construction and operation of buildings and facilities. The certified contractors develop OHS systems, check OHS knowledge level of the manager, his deputies and staff members responsible for occupational health and safety in accordance with the procedures defined by the applicable law.

At the stage of contract negotiations contractor provides the following documents and records:

- Copy of Order on appointment of commission for OHS knowledge testing in contractor's organization;
- Copies of documentary evidence of the tests passed by members of the above commission;
- Copy (copies) of certificates or extracts from the protocol of OHS knowledge testing of the contractor's organization top manager or his deputy responsible for OHS;
- List of personnel involved in the contract works on the site, including their names, professions and posts, and copies of knowledge testing protocols;
- List of the contractor's works at the Company sites;
- In case of hot works, contractor shall provide copies of fire safety training certification slips;
- In case of works with electrical plant, contractor shall provide copies of certificates of the appropriate level of electrical safety training.

Contractors working on MVK sites are obliged to ensure safe performance of hazardous works with reference to the Company's list of hazardous operations.

The following parties in MVK organization check contractors' compliance with OHS requirements:

- Director;
- Chief Engineer;
- OHS Unit Manager;
- Construction Unit Manager;
- OHS personnel;
- Managers of relevant divisions;
- Manager of division in which the works are conducted,

Compliance checks can be also arranged by OHS commissions in the Company divisions, internal HSMS auditors of the Company units. In addition, each employee of MVK may check contractor's compliance with OHS requirements.

Risks related to contractors' operations are identified depending on specific types of the operations and assessed using the contractor-related risks register.

9.5.2 OHS training and testing

OHS training, practice, briefings are provided in compliance with Resolution of the Ministry of Labour and Social Protection of the Republic of Belarus No.175 and Resolution of the Ministry of Housing and Municipal Services of the Republic of Belarus, Ministry of Labour and Social Protection of the Republic of Belarus No.11/55.

Practice is an important stage of training before worker can be allowed to work unsupervised. The minimum duration of practice for elevated hazard professions is defined by the Order as 5 days.

The induction OHS briefing is provided on recruitment for permanent or temporary work. Personnel of OHS Unit conduct the induction briefing sessions in accordance with the induction briefing programme approved by the Chief Engineer of MVK. Toolbox talks are arranged at the workplaces as defined in OHS instructions for specific professions and operations. Refresher briefings are provided with three-month intervals. Target safety training is provided in case of excursions, site visits of delegations, students and other groups.

Personnel involved in hazardous operations or working at specially supervised facilities pass regular knowledge testing with intervals stated in the applicable legal acts and internal regulations, but at least once a year.

Managers and professionals pass knowledge testing within one month from the date of appointment to the specific post and thereafter regularly as required by the applicable regulations but at least once in three years. The maximum number of personnel who upgraded their OHS qualifications was reported in 2016 (refer to Figure 9.1).

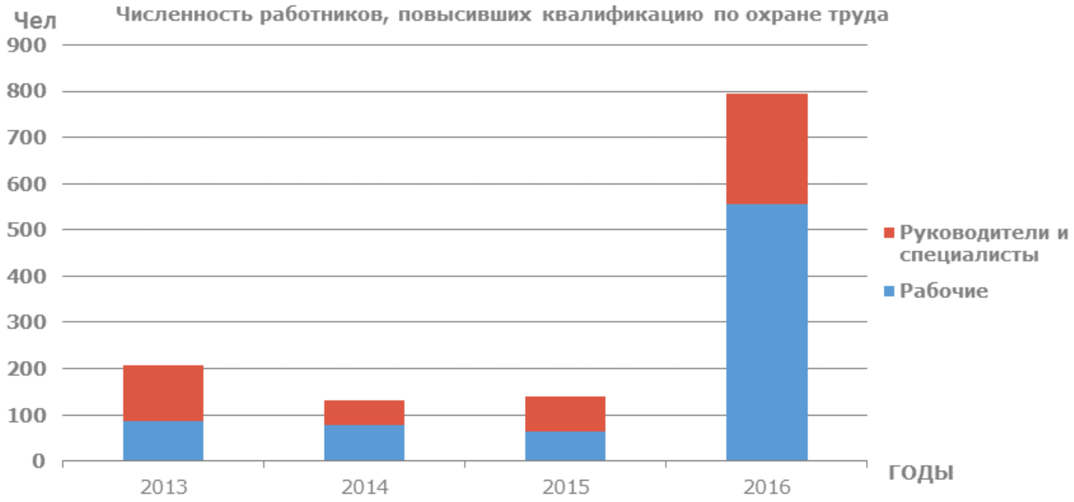

Figure 9.1: Upgrading OHS qualification, number of personnel

9.5.3 Use of personal protection equipment (PPE)

In accordance with Resolution No.209 of the Ministry of Labour and Social Protection of the Republic of Belarus and the internal labour regulations, the employer shall provide to employees the working clothes, protective footwear and other personal protection equipment (PPE), and arrange for adequate storage and maintenance of such equipment. The list of professions and positions subject to free provision of PPE, washing and neutralization agents is included in the Collective Agreement.

9.5.4 Measures to improve working conditions, technical renovation and upgrading of operating facilities

During the period 2013-2017 annual allocations of funding to finance the measures intended to improve working conditions, reduce harmful and/or hazardous industrial factors amounted 240 thousand USD, in average. The trend analysis shows that the funding levels were growing over the period 2013-2015 and slightly decreased in 2016 (Figure 9.2). In 2017 no financial investments were planned. The actual use of funding declined in 2013 and 2014 and increased over the period 2014-2016. No finance was provided for improvement of working conditions and reduction of hazardous factors in 2017.

Average level of allocations for technical renovation and upgrading over the period 2013-2017 was 2390 thousand USD, of which about 600 thousand USD was actually used every year, in average (i.e. 25% of the planned amount). This may indicate inefficiency of the Company's approach. The maximum amounts of allocated and implemented investments for technical renovation and upgrading of MVK operational facilities were reported in 2016 (Figure 9.3).

Figure 9.2: Planned and implemented investments for improvement of working conditions, reduction of harmful/hazardous workplace factors

Figure 9.3: Planned and implemented investments for technical renovation and upgrading

The Company regularly arranges the "OHS Day" events which are intended inter alia to support functioning and continuous improvement of HSMS, communication and monitoring of OHS targets, programmes and actions, working with stakeholder grievances and queries, timely and adequate OHS training, briefing and testing, etc.

9.5.5 Workplace assessment and operational monitoring

Workplace assessment for working conditions is provided in accordance with Resolution No.253 of the Council of Ministers of the Republic of Belarus. Assessments are conducted with a maximum interval of 5 years, and as required in the course of implementation of the action plan for improvement of working conditions and upgrading of operational equipment.

During the period 2013-2017 the average number of workplaces with harmful and/or hazardous working conditions was 734 (30%), and the number of personnel (headcount) occupied at such workplaces was 1046 (34%).

The hazards occurrence rate at the Company facilities is declining (Figure 9.4). This may indicate better performance of the OHS service and compliance with the requirements of OHSAS 18001:2007 since 2015. The positive changes in 2015-2016 could be also supported by the increase of funding for improvement of working conditions and occupational health and safety.

The Collective Agreement includes the list of worker professions eligible for extra compensation is paid for the harmful and/or hazardous working conditions, free provision of milk and extra holiday entitlement.

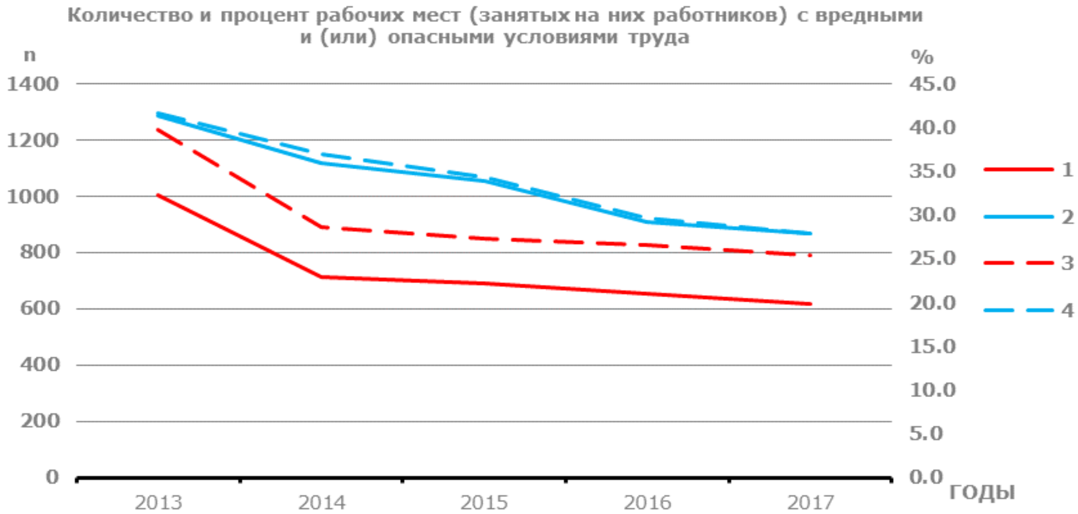

Figure 9.4: Number and percentage of workplaces (occupied personnel) with harmful and/or hazardous working conditions

1- Number of workplaces with harmful and/or hazardous working conditions

2- Number of personnel (headcount) occupied at workplaces with harmful and/or hazardous working conditions

3- Percentage of workplaces with harmful and/or hazardous working conditions

4- Percentage of personnel (based on headcount numbers) occupied at workplaces with harmful and/or hazardous working conditions

Operational monitoring is conducted in accordance with the workplace environment monitoring programme.

9.5.6 Medical examinations and personnel health

Medical examinations are arranged on the basis of Resolution No.47 of the Ministry of Health. The Company maintains a system of mandatory medical examinations including pre-employment regular (during employment) and unscheduled examinations of personnel at recruitment and during the period of their work, including working in harmful and/or hazardous conditions or jobs that require health screening of personnel. A list of professions (positions) subject to regular medical examinations is prepared on annual basis.

9.6 Assessment of Potential Occupational Health Impact

The main risks to health of personnel are anticipated at the stage of construction and those will be standard risks of construction operations. The workplace hazards at this stage may include hazardous substances, air pollution with dust and contaminants, noise, vibrations, electromagnetic radiation. The most probable injuries may be caused by vehicular, machinery and plant traffic, contact with cold, hot, sharp parts of equipment, falls of objects, weight lifting, falls from height, electric shocks, explosions and fires. Almost all construction activities are related to physical and psychological strain.

Impact significance and magnitude of risks vary within a vast range – from minor to high. The high risks are caused by the high probability of irreversible health consequences, e.g. physical impacts or falls during civil and installation works.

OHS risks at the construction stage will be mitigated by including legal and regulatory OHS compliance into the bidding process and contractor agreements, construction supervision and regular inspections to check the contractors' practices. Only certified contractors will be involved for the Project implementation.

Adverse impacts at the Project operation phase will be largely reduced through the mechanisms of the existing HSMS, personnel training and knowledge testing, provision of PPE, workplace assessments, operational monitoring and medical examinations. At the operation stage the emissions of ammonia, hydrogen sulphide and methane from the mechanical treatment facilities will decrease, and impact of the above substances on human health will decrease accordingly.

Recommended impact specific mitigations for the construction phase are listed in Table 9.4 The recommendations are based on provisions of the law of the Republic of Belarus and OHS best practices applied in Benelux.

Table 9.4: Occupational health impacts and mitigations summary

Impact	Source, activity	Receptor	Phase	Magnitude	Risk	Recommended mitigations	Residual impact
Injuries by moving objects and parts Diseases caused by air contamination with gas and dust	Operation of construction machinery and plant, building works	Workers	C	H, M	M, Mr	Use of certified contractors. Compliance with OHS regulations. Site traffic arrangements with due account of OHS requirements. Appointment of officers responsible for reliable and safe operation of vehicles. Appointment of responsible person for instrumental testing of drivers for alcohol, drugs, psychotropic, toxic and other stupefying substances	M L
Diseases caused by excessive noise and vibration	Operation of construction machinery and plant, building works	Workers	C	M	M	Compliance with OHS law. Noise monitoring	Mr
Diseases caused by toxic substances, welding aerosols Injuries and diseases caused by explosions and fires	Building works, hot works Operation of air compressors, electrical equipment, working in confined space	Workers	C	H, M	M, Mr	Compliance with OHS rules. Issuing work permits for hot works. Provision of primary fire suppression means at the places of temporary hot works. Selection of materials, paint with minimum toxic content. Regular testing of compressors for pressure tightness, draining of accumulated water and oil. Compressors shall be equipped with pressure gauges and spring-loaded safety valves. Development of procedures for working in confined spaces. Appointment of responsible person to supervise works in confined space. Use of communication means. Monitoring of combustible and toxic gas concentrations. Use of explosion-proof electrical equipment and luminaires	L

Impact	Source, activity	Receptor	Phase	Magnitude	Risk	Recommended mitigations	Residual impact
Physical and psychological strain Injuries caused by contact with cold, hot, sharp parts of equipment and materials Injuries caused by falls of objects and tools	Operation of construction machinery and plant, building works, hot works, working at height, working in confined space	Workers	C	H, M	M, Mr	Compliance with OHS law, procedures for working in confined spaces. Appointment of responsible person to supervise load-handling operations. Use of load-lifting equipment	L
Electric shocks, impacts of electromagnetic radiation	Building works, working with electrical equipment	Workers	C O	H, M	Mr	Compliance with electrical plant operation regulations, earthing of electrical equipment bodies, prevention of overloading of electrical distribution sockets, damages of plugs and cables, provision of Lock-Out/Tag-Out systems and development of a documented programme for their application, appointment of competent person for personnel training (including contractors) on prohibition of disabling the lock-out system and starting of de-energized equipment	M
Injuries caused by falls from height	Working at height	Workers	C	H, M	M, Mr	OHS compliance when working at height. Issuing work permits. Order of appointment of person responsible for regular pre-operation testing of stairs and ladders with static load, with testing records in the stairs accounting and testing log. Order of appointment of person responsible for visual inspection of stairs and ladders	M

9.7 Impacts summary

Table 9.5 below provides summary of identification and assessment of social impacts, based on the preliminary assessment and subsequent socio-economic studies. Description of measures to manage the impacts is provided in Section 9.3.

Table 9.5: Social Impact Assessment

Impact	Recipient	Project stage	Impact significance	In-built mitigations/enhancement measures	Additional mitigation measures as recommended by Ramboll	Residual impact
Employment opportunities	Job seekers of Minsk, Shabany neighbourhood and Novodvorsky rural council	C/O	M/H	Minskvodokanal has the communication channels with relevant Minsk educational entities	Job fairs and exhibitions in Minsk; Where possible, cooperation with local employment centres and recruitment agencies for more detailed analysis of labour market and diversification of employment channels for potential employees Disclosure of the Company's HR policy; Employment of representatives of vulnerable groups, provided that all other characteristics of the job seekers are equal Cooperation with educational entities of Minsk and Minsk region (internships for students, site tours to the Project facilities for students, participation of the Company's specialists in the training process as guest lecturers or mentors)	M/H
Economic benefits of engaging local contractors for the Project	Local business owners, Businesses operating within the free economic	C	H	Minskvodokanal shall only contract certified organizations ensuring a certain level of labour and working conditions in line with the conditions of the Resolution #252	Introduction of a Local Procurement Policy	H

Impact	Recipient	Project stage	Impact significance	In-built mitigations/enhancement measures	Additional mitigation measures as recommended by Ramboll	Residual impact
	zone			of the Council of Ministers of the Republic of Belarus		
Potential resettlement	Former Shabany village land users and residents	N/A	None (scoped out)	N/A	None (scoped out)	None (scoped out)
Negative community physical health impacts (Emissions of polluting substances at the operation stage (due to the operations of incinerator))	Residents of former Shabany village, Novy Dvor agro-town, Podlosye village and Shabany neighbourhood	O	L	N/A	Communicate with relevant authorities on potential provision of HIA Ensure proper communication of the information on potential public health impacts to local stakeholders via use of various methods for relevant information disclosure, including exhibitions, information repositories, Q&A sessions and procedures as defined by Stakeholder Engagement Plan Identification of the extent of negative impacts on health of vulnerable groups (e.g. elderly, children, asthma patients, persons with disabilities and/or disorders)	N
Negative community physical health impacts (Dust emissions from	Residents of former Shabany village, Novy Dvor agro-town, Podlosye village	C	L	N/A	Ensure that the former Shabany village approach roads are not used by the construction contractors	L to N

Impact	Recipient	Project stage	Impact significance	In-built mitigations/enhancement measures	Additional mitigation measures as recommended by Ramboll	Residual impact
Project construction activities)	and Shabany neighbourhood					
Negative community physical health impacts (Contacts between Project personnel and local communities)	Residents of former Shabany village, Novy Dvor agro-town, Shabany neighbourhood, visitors of Trostenets memorial	C/ consequences may be felt during O	M	Shabany neighbourhood is separated by a range of other industrial sites; Novy Dvor agro-town is separated by the agricultural fields used for cultivation of technical crops; Trostenets memorial is separated by the railroad line	Introduction of a Code of Conduct for Project personnel Informing Project personnel about the risk of sexually transmitted diseases Ensure presence of qualified medical personnel available for construction workforce If it is decided upon the use of construction workforce accommodation facilities at the construction phase of the Project, Accommodation Policy and Accommodation Management Plan will be developed Arrangement a dining area for construction workforce Arrangement of recreational activities and/or resting areas to diminish te potential for work-related stress that may lead to heightened risk of conflicts	L
Positive community physical health	Residents of former Shabany village, Novy	O	H	Decrease of air emissions Enhancement of quality of water	Communication of the essence of this positive impact to local communities and arrange	H

Impact	Recipient	Project stage	Impact significance	In-built mitigations/enhancement measures	Additional mitigation measures as recommended by Ramboll	Residual impact
impacts	Dvor agro-town, Podlosye village and Shabany neighbourhood			discharged into the Svisloch river, which is used for fishing by the communities located downstream; Elimination of regular (up to 80 trips per day) use of heavy-load vehicles for sludge disposal to the lagoons; Elimination of use of the sludge lagoons and their gradual rehabilitation	proper stakeholder engagement practices to ensure that no false and untrustworthy information is circulated among local communities about the health implications of the Project	
Public psychological well-being risks	Residents of former Shabany village, Novy Dvor agro-town, and Shabany neighbourhood	C	M	Public grievance mechanism introduced by the Company	Measures associated with potential resettlement described in Section "Potential resettlement" Ensure that the grievance mechanism of the Company is specifically introduced to the affected communities, and that they understand its principles and processes; Ensure that the information regarding the Project's health impacts is delivered to local stakeholders, including the communities of Shabany neighborhood and Novodvorsky rural counci Employment of local residents for the construction works as far as possible	L

Impact	Recipient	Project stage	Impact significance	In-built mitigations/enhancement measures	Additional mitigation measures as recommended by Ramboll	Residual impact
					Introduction of check-in-check-out system at all Project sites Introduction of a Code of Conduct to be followed by all Project personnel, including contractors and subcontractors Measures ensuring decrease of pollution (odorous) emissions and noise	
Potential increase of tariffs	Residents of Minsk and some areas of Minsk region	O	H	No raise of tariffs is expected within the next years	N/A	M
Positive impact on infrastructure of Minsk and Novodvorsky rural council	Road network users, residents of Shabany neighbourhood, Novy Dvor rural council and former Shabany village	O	H	Reduction of the air emissions	Communication of the essence of the positive impacts on infrastructure and public health to local communities Arrangement of stakeholder engagement practices ensuring no false and untrustworthy information circulation	H
Negative impact on infrastructure of Minsk and Novodvorsky rural council	Road network users, Shabany neighbourhood residents, former Shabany village residents	C	H	N/A	Prohibition of use of the unpaved road approaching the former Shabany village Analysis of impact on transport infrastructure of Zavodskoy district and Shabany neighbourhood by a traffic specialist	M

Impact	Recipient	Project stage	Impact significance	In-built mitigations/enhancement measures	Additional mitigation measures as recommended by Ramboll	Residual impact
					Use of local road networks out of rush hours, regular fleet inspections and respect of traffic rules Minimize number of trips for personnel transfers	
Negative impact on social infrastructure of Zavodskoy district	Zavodskoy district residents	C	L	N/A	Accommodation facilities (if necessary) management is compliant with relevant international standards Regular canteen inspections for compliance with sanitary norms Presence of a well-equipped on-site medical facility and an experienced paramedic Provision of a clear medical emergency response action plan implementation of measures in the sphere of traffic safety, public health and OHS	N
Potential negative impacts in the field of employment and labour and working conditions	Project personnel	C/O	M/M	Minskvodokanal shall only contract certified organizations ensuring a certain level of labour and working conditions in line with the conditions of the Resolution #252 of the Council of Ministers of the Republic of Belarus	Minskvodokanal shall require the Project contractors and subcontractors to comply with the labour requirements of EBRD PR2 as a special clause in the service and supply contracts Minskvodokanal shall enable	L/L

Impact	Recipient	Project stage	Impact significance	In-built mitigations/enhancement measures	Additional mitigation measures as recommended by Ramboll	Residual impact
					the use of internal grievance mechanism by contractors' and subcontractors' personnel Introduction of a Code of Conduct for the Project personnel including contractors In case of 20 or more employees retrenchments, the Company is advised to develop a Framework Retrenchment Plan	
Tensions and potential conflicts between groups of workers at the Project construction site	Project construction personnel	C	M	So far there is no plan to use the any accommodation facilities for construction workers	Introduction of Construction Accommodation Management Plan and Policy (<u>in case of use of accommodation facilities</u>) Ensure proper arrangements for rest Code of Conduct emphasizing the need for respect demonstrated towards all workers involved into Project construction	L
Project site security risks	Residents of former Shabany village	C	L	N/A	Additional training for the Project security guards for familiarization with the ideas described in the internationally recognized documents Prefer preventive measures for Project property protection (provision of safe cabinets,	L

Impact	Recipient	Project stage	Impact significance	In-built mitigations/enhancement measures	Additional mitigation measures as recommended by Ramboll	Residual impact
					locks, fences, etc.) Munition is kept at the fixed guard posts Prevention of an unauthorized access to the Project sites (fences, checkpoints, etc.) Development of a Code of conduct and familiarization of security personnel with its provisions	
Community safety risks	Residents of Shabany neighbourhood	C	H	The impact's severity is mitigated by the nature of the neighbourhood surrounding the Project site as the area around WWTP is industrial and no significant numbers of pedestrians are present.	As provided in mitigations for impacts on infrastructure and related to security personnel risks Provision of appropriate training to workers on driver and vehicle safety Provision of a road safety impact assessment Encouragement of car-sharing practice Control of compliance with traffic safety rules Project vehicles inspections	M
Land use and natural resource (impacts on fishing practices)	Local fishers (amateur and hobby fishing) and former	C	M	N/A	Regular consultations with the residents of the former Shabany village to ensure their feedback on Project activities;	L

Impact	Recipient	Project stage	Impact significance	In-built mitigations/enhancement measures	Additional mitigation measures as recommended by Ramboll	Residual impact
	Shabany village residents				Introduction of a Code of Conduct for the Project personnel including contractors, with explicit prohibition of fishing by the Project personnel; Ensure the Project transport does not use the gravel road approaching the former Shabany village	
Cultural heritage	Residents of Minsk and Minsky region	C	L	N/A	Ensure that the routes taken by the Project vehicles do not interfere with the roads approaching Trostenets memorial	N

10. DECOMMISSIONING AND CLOSURE

The lifecycle of the project facilities shall be determined by a set of external and internal factors, such as industrial and associated development of the district hosting the treatment plant, the economic status, socioeconomic and environmental conditions, etc.

It is anticipated that the main Project facilities and equipment of the sludge incinerator will be operated for 15-20 years, and service life of the rest of facilities will be 15-30 years. More accurate assessment of decommissioning times for specific Project facilities will be available after the design development stage. Assessment of the need for renovation or decommissioning should be assessed closer to that time (or at an earlier time, if needed). At the time of this Report, the lease period of the Project site allows for its use during a longer period.

The law of the Republic of Belarus does not require preparation of a design for conservation or for demolition (dismantling) of capital facilities at the time of the original project design development. As Minsk Waste Water Treatment Plant is a vital element of municipal infrastructure, decommissioning of any part of it would be associated with MWWTP renovation or simultaneous construction of new facilities of adequate profile. A separate design should be developed for such activities in the future, including appropriate preliminary engineering surveys, and the closure design is subject to governmental expert review. One of the information sources for the engineering environmental survey for this phase of the Project will be the results of the operational environmental monitoring conducted throughout the entire operation phase of the Project. The environmental survey program for the Project closure phase should include, amongst other requirements, an assessment of changes in the natural and technogenic environment during the operation phase of the Project (including changes caused by the Project impact), an assessment of the consequences of environmental deterioration and their effect on the public health, an assessment of the contamination parameters of used or removed soil, recommendations relating to the dismantling (demolition) methods, as well as proposals for rehabilitation of the natural environment.

Considering the duration of Project construction period and due to differences in the lifecycle of various project facilities, their decommissioning and closure will also take several years. At present, the requirements to the design development for the treatment plant decommissioning cannot be fully appreciated for the following reasons:

- Changes in the applicable regulatory and legal framework by the time of the decommissioning and closure of the Project facilities and/or replacement with other similar facilities;
- Changes in the Project during its planned lifecycle and its condition by the time of the closure; and
- Development of new technologies and methods for conservation and closure of facilities, development of waste water treatment technologies which would be available at the time of the closure, including also the experience gained from similar facilities elsewhere.

The actual conservation and closure procedures can be designed and implemented through the development of a Decommissioning and Conservation (Closure) Plan for the Project facilities, which will reflect regulations of the Republic of Belarus and the best international industry practices. The latter is currently represented by the IFC's Performance Standards which in general require that the decommissioning and closure (conservation) process should comprise the following stages:

- Safe changing over between the facilities scheduled for demolition and the new facilities on a step-by-step basis;
- Removal of liquid and solid products/wastes for their treatment and disposal; in case of pipelines, reservoirs and process vessels, they should be washed and cleaned to remove residual liquids and wastes;
- Assessment of potential use of the empty and cleaned vessels, structures and equipment to take the best decisions from the environmental, social and economic perspective, in conformity with the good international industry practices;

- Dismantling and removal of decommissioned aboveground and underground vessels and process piping;
- Additional research is to be conducted to assess the extent of the environment pollution caused by the Project operations, and development of a reclamation plan in conformity with the good international industry practices.

MVK will as far as possible adopt the above approaches in the process of design, and review the waste management systems on a regular basis, to identify more environmentally sound methods compliant to the requirements of national and international law, as well as international best practice. Like the materials/demolition wastes which can be considered for reuse, certain Project facilities and buildings, parts of its infrastructure can be reconstructed for further use for industrial purposes or as part of infrastructure systems. Materials can be also transferred for recycling, where possible. Due to the anticipated potential amount of structures for decommissioning and necessary compliance with applicable international and local requirements in the sphere of waste management, a structured approach based on best practices can be defined in a Waste Management Plant for Decommissioning Phase.

According to current legislation of the Republic of Belarus, the main part of the work associated with demolition (dismantling) of buildings and structures with subsequent technical reclamation of the affected area is classified as construction activities and in this context it is not different from any other construction operation with regard to the environmental protection measures to be taken. The general regulatory requirements to the design development for demolition (dismantling) of capital facilities are presented in TKP 45-1.02-295-2014 (02250) and TKP 45-1.03-161. The design document for demolition or dismantling of capital facilities should as a minimum include the following information:

- Basis for development of a design for organization of work for demolition or dismantling of capital buildings, structures and facilities;
- List of capital buildings, structures and facilities subject to demolition (dismantling);
- List of measures aimed at decommissioning of capital buildings, structures and facilities;
- List of measures preventing access of people and animals to the capital buildings, structures and facilities subject to demolition (dismantling) and protecting the existing vegetation;
- Description and justification of the adopted demolition (dismantling) methods;
- Description and justification of solutions proposed for safe execution of demolition (dismantling) operations;
- Calculation and justification of the dimensions of the zone affected by demolition and hazardous zones depending on the adopted demolition (dismantling) method;
- Assessment of the probability of damage inflicted to engineering infrastructure facilities, including operating underground utilities, in the process of demolition (dismantling);
- List of measures aimed at ensuring the safety of the local communities (if required);
- Description of solutions relating to waste removal and disposal;
- List of measures aimed at land remediation and site improvement (if required);
- Information relating to networks, structures and facilities remaining after demolition (dismantling) underground and in water bodies;
- Information relating to approvals and permits issued by the relevant supervisory agencies (if applicable).

In addition, the graphical part of the project design documentation for demolition (dismantling) of capital facilities should be prepared including:

- Schematic layout of the site and adjacent areas with indication of the facility to be demolished, associated engineering network, hazardous zones in the process of demolition, areas to be used for short-term storage of dismantled materials, structures, parts and equipment;
- Drawings of protective devices of the engineering infrastructure facilities and underground networks; and

- Process flow diagrams indicating the sequence of operations for demolition (dismantling) of building structures and equipment.

It is too early to determine potential environmental and social impacts associated with the decommissioning and closure at this stage of the Project, however it can be assumed that some impacts will be equivalent to those at the construction phase. Furthermore, the impacts can be mitigated and reduced to the acceptable levels through the use of the good international industry practices.

11. CUMULATIVE IMPACTS

11.1 Introduction

This Chapter provides environmental and social assessment of the cumulative impacts (ACI) associated with the current and future operations in the area of the studies, taking into account other operations in the same area or adjacent territories.

11.2 Results of Scoping Stage I – TEC, spatial and temporal scope

Once the scope of assessment was defined, the following TECs were identified for further ACI analysis (based on significance of residual Project impact on TEC, probability of cumulative effects, and findings of stakeholder consultations):

- Atmospheric air;
- Ground water;
- Surface water;
- Aquatic habitats and aquatic life;
- Community health and safety;
- Local infrastructure (roads).

11.3 Results of Scoping Stage II – Other operations and significant environmental factors

This section identifies historical, current and planned operations, as well as clearly defined projects located close by the Project area. Possible temporal and/or spatial interaction of the Project with the above operations has a potential to produce cumulative impacts.

ACI included analysis of the following programme documents associated to development of the studied area:

- Socio-economic Development Programme of the Republic of Belarus for the period 2016 -2020, approved by the Presidential Order of the Republic of Belarus of 15.12.2016 No.466;
- Industrial Development Programme of the Republic of Belarus for the period until 2020, approved by the Council of Ministers of the Republic of Belarus, Resolution of 05.07.2012 No.622;
- Socio-economic Development Programme of Minsk Region for the period until 2020, approved by Minsk Region Council of Deputies, Resolution of 13.04.2017 No.206;
- Socio-economic Development Programme of Minsk City for the period 2016-2020, approved by Minsk City Council of Deputies, Resolution of 28.02.2017 No.275;
- National Programme for Transport Sector Development in the Republic of Belarus for the period 2016-2020, approved by the Council of Ministers of the Republic of Belarus, Resolution of 28.04.2016 No. 345;
- Minsk City Master Plan (amended), approved by the Presidential Order of the Republic of Belarus of 23.04.2003 No.165 (amended by the Presidential Order of the Republic of Belarus of 15.09.2016 No.344);
- National Programme "Environmental Protection and Sustainable Nature Management" for the period 2016-2020, approved the Council of Ministers of the Republic of Belarus, Resolution of 17.03.2016 No.205;
- National Energy Saving Programme for the period 2016-2020 approved by the Council of Ministers of the Republic of Belarus, Resolution of28.03.2016 No.248;
- National Scheme for Comprehensive Territorial Management in the Republic of Belarus, approved by the Presidential Order of the Republic of Belarus of 12.01.2007 No.19;
- Presidential Order of the Republic of Belarus of 18.01.2016 No.13 "On approval of schemes for comprehensive territorial management of regions and master plans of satellite towns";

- Presidential Order of the Republic of Belarus of 02.03.1998 No. 93 "On establishing the free economic zones of "Minsk" and "Gomel-Raton";
- Action Plan for sustainable use of natural resource and environmental protection in Minsk for the period 2016-2020, approved by Minsk City Council of Deputies, Resolution of 29.06.2016 No.211;
- Water Strategy of the Republic of Belarus for the period until 2020, approved by the Board of the RB Ministry of Natural Resource and Environmental Protection, No.72-R of 11.08.2011;
- Gradual Rehabilitation Plan for water system of River Svisloch – Osipovichi reservoir for the period 2014-2020, adopted in 2013.

11.3.1 Historical and current operations

As mentioned before, the Project area is located in Zavodskoy District in the south-east of Minsk city, in Shabany industrial area which is a part of Area 1 (Sector 3) of FEZ "Minsk". This area has a long history of extensive industrial operations.

Industrial development of south-eastern suburbs of Minsk (which until 1923 bore the names of Arkhiyerejskaya Roscha and Krasnoye Urochische) started in early 20th century: the city expended to this area with industrial facilities which in their turn invoked development of residential quarters. More extensive development of Zavodskoy District (until 1961 Stalinsky District) started in 1944/ After the Second World War it was decided to develop this area as industrial centre of the capital city. The city's restoration efforts were focused on establishing new industrial operations rather than mere rehabilitation of the pre-war industries. The new industrial sectors played important role in the economy of the Republic of Belarus, but also at the level of the Soviet Union.

The first car-making giant of the USSR – Minsk Automobile Plant (MAZ) – became the centre of Stalinsky District at the end of 1940-s.

Unlike many other areas of Minsk, Zavodskoy District developed by converting small villages and settlements into urban residential areas. The area of Shabany is located in the former land of Rassvet State Farm.

At present Zavodskoy District is one of the largest industrial districts of the city with 45 major industries operating in its territory, including Minsk Automobile Plant (Belavtomaz Holding), Minsk Bearings Plant, Minsk Whelled Tractor Plant, Automobile trailer and bodywork plant MAZ-Kupava, OJSC "Minskzhelezobeton" (RC products), OJSC "Minskdrev" (woodworking), JV CJSC Beltelecabel (cable products), NP CUP Adani, LeanGroup LLC, Zapagromash LLC, etc. Automobile and machinery products account for over 60% of the total industrial output of the district.

Free Economic Zone "Minsk" was established in 1998 (Presidential Order of the Republic of Belarus "On establishing the free economic zones of "Minsk" and "Gomel-Raton") with the purpose of attracting local and international investments, establishing and development of industrial operations based on new and high technologies, as improving economic development conditions in Minsk city and Minsk region. FEZ "Minsk" hosts over 110 industries. From the time of its establishment the resident companies have constructed 42 modern plants. Construction and reconstruction activities are in progress at 9 industrial sites, and 15 projects are at the design stage.

The Project area is located in Area 1 of FEZ "Minsk" with the total territory of 1011.07 ha which comprises four sectors, including Shabany industrial area, industrial area "11km of Mogilev highway", and an area near Yelnitsa village. Other parts of FEZ "Minsk" are located in south-east of Minsk (Zavodskoy, Oktyabrsky, Leninsky Districts), and in the territory of Minsk District of Minsk Region: Area 2 (257.33 ha, Prilesje, Privolny, Obchak villages), Area 3 (41.42 ha – Sosny village of Zavodskoy district), area 13 p(18.6 ha – territory of OJSC Kamvol), area 19 (27.59 ha, territory of OJSC MOTOVELLO), area 21 (10.1055 ha – territory of Belcommunmach OJSC), area 20 (3.0448 ha – territory of Belryba OJSC) (refer to Section 5.8).

In the west, south and east Zavodskoy district adjoins the territory of Novodvorsky rural municipality of Minsk District, Minsk Region. It includes territories of 14 settlements: Novy Dvor agrotown (administrative centre), Bolshoy Trostenets village, Gatovo agrotown, villages of Elnitsy, Podlosje, Korolischevichi, Matsevichi, Bolshoye Stiklevo, etc. Two state farms operate in the territory of Novodvorsky rural municipality: Rassvet and Minsk Vegetable Plant specialized in growing vegetables.

Construction of high-rise apartment blocks in Gatovo village started in 1968, in relation to commissioning of Minsk Plant VTORCHERMET. The second peak of construction was induced by the tannery which started its operations near the village in 1988.

Historically, the territory of current MWWTP site was used for absorption fields. After commissioning of Minsk WWTP in 1960s, waste water discharges to the adsorption fields gradually ceased, and further land acquisitions downstream the river were only needed for arrangement of sludge lagoons. The eastern part of the former sand and gravel quarry Koroloschevichi has been used for the purpose since 1978. The quarry with the total area of about 32 ha is located 1 km to the south-south-east of MWWTP site (it adjoins the southern part of Shabany industrial area – Sector 3 Area 1 of FEZ "Minsk"). In 1978, eastern part of the quarry (about 18 ha) was, by the decision of local authorities, divided between MWWTP-1 (for disposal of waste water sludge) and RUP Minsk Tractor Plant (MTZ) (for landfilling of industrial wastes of hazard class 3 and 4. In 1991 the northern part (3.5 ha) was allocated to MPKO OJSC, for landfilling of tannery wastes.

A reclamation design was developed for larger part of the landfill, which provided for use of MTZ wastes of hazard class 4 or lower (mainly mineral matter) as cover material. No information about reclamation activities is available. Potential environmental risks, especially risks to surface and ground water are associated with soluble compounds and active forms of microelements contained in the buried wastes. Results of a series of analysis which were conducted in 2008 indicate that levels of four microelements (Mn, Cu, Ni, Cr) exceeded soil quality MPC by more than 2 times. The priority pollutants in sludge (in quantitative terms) were copper, zinc, and then chromium and lead. Among polluting substances contained in the landfill sludge blend, phenol and naphthalene were found in the greatest quantities. The highest organic contamination (predominantly petroleum products) is reported in the adsorption fields sludge.[95].

Current activities around the Project area are mostly related to operation of multiple industries. Major industrial areas with industries which may produce impacts in the PAI are listed Table 11.1.

Table 11.1: Major industrial areas om the Project area of influence

Industrial areas	Location	Main industries
Shabany industrial area (including FEZ "Minsk", Sector 3, Area 1)	100-200 m across the railroad, to the east and north-east of the Project Area	JV Alutech Incorporated (components for roll-up barriers components); MACRODOR OJSC (hot asphalt concrete mixtures); domestic appliances plant "Atlant"; Beltelecabel CJSC (cable products); UE Ecores (municipal unitary waste management enterprise); Mapid OJSC; Shabany district heating boiler house; "Strunnyje Tehnologii" CJSC operations base; "Minskzhelezobeton" OJSC; "Komplekt" OJSC operations base; "Spetsmontazhstroj" OJSC; Asphalt Concrete Plant; PromStrojIndustria plant; "FlexoForce" CJSC (rolled packaging materials with flexographic printing); "Unibox" JV; "Getz Group" LLC; UE "ADANI; "StalColor" LLC (application of protective and decorative coatings on steel, manufacturing of steel tape and articles from it); "Mashinostroitelnyj Alliance" LLC (assembly of crawler road-construction machines); "NanoKompozit" LLC (production of polymer products using nanoparticles), "Grand Right Service" Private Company (construction of glued laminated timber plant); "PROFTEKHSINTEZ" LLC (construction of production and storage facilities for manufacturing of filling machinery for technical

[95] N.A.Lysukho, D.M.Yeroshina. Industrial and domestic wastes, their environmental impacts. Monography. Minsk. MGEU n.a. A.D.Sakharov, 2011 – 210 p.

Industrial areas	Location	Main industries
		and food fluids); "Niva-Motor" LLC (manufacturer of asynchronous propulsion engine DTAN; "Tekhno-Express" JV LLC (construction of plant for manufacturing of electrical equipment for railway passenger cars); DUP "BELGIDRAVLIKA" UPP "NIVA" Romanovich S.G. (development of manufacturing facilities for high-pressure hoses, mining shaft control equipment, high pressure pumping stations and specialist hydro-mechanical products); Insulating Glazing Units and Architectural Glass Plant, JV LLC; UE "Zavod Effektivnykh Promyshlennykh Konstruktsij".
Shabany industrial hub (11 km of Mogilev highway) (including FEZ "Minsk", Sector 1, Area 1)	Across Svislochskaya St., 100 m to the north of the Project Area	Belmetall OAO; Alutech Gate Systems OOO (production of gate systems, as well as accessories for sectional doors); BelBakaleja OAO; BelElectromontazh OAO; Mostostroy OAO; Trest Promstroy ZAO; Minsktermoizolyatsiya ZAO; Gormolzavod №2 OAO, etc.
The Free Economic Zone Minsk, Sector 4, Area 1 (near the village Yelnitsa)	About 1 km to the east of the Project Area	ZAO Adani Technologies (production of high-tech X-ray equipment for industrial and special applications, based on the use of X-rays with an energy range up to 100 MeV); Zorka Jewelry Factory SOOO; Thin-Film Coating Plant.
Korolischevichi Waste Disposal Complex	About 1 km to the south-south-east of the Project Area	MOC Industrial Waste LAndfills of the MTZ and MPKO, the former filtration fields of Minsk WWTP
Industrial zone of MAZ	2.2 km to the north-west of the Project Area	Minsk Automobile Plant OAO, Minsk Wheeled Tractor Plant OAO, MAZ-KUPAVA OOO (Automobile trailers and bodywork factory), etc.
Gatovskaya industrial zone (the village of Gatovo, Novodvorsk Rural Council)	2,8 km to the south and south-west of the Project Area	Belvtorchermet OAO; Minsk Production Tannery OAO; Beltsvetmet OAO; Housing and Communal Services of Minsk Region KUP; Kiilto-Glue IOOO; Isakidis-Granitis; Alvesta Confectionery Factory; Uniflex ZAO
Industrial hub of Kolyadichi	5 km to the west of the Minsk WWTP site	Industrial hub of Kolyadichi (an area of about 200 hectares) and other industrial enterprises of the Oktyabrsky District, including those belonging to the Minsk FEZ, such as Integral OAO and Keramin OAO (production of building materials), Krion OAO (production of gases and gas mixtures), Minsk Grape Wine Plant ZAO, SolarLS ZAO (production of high-tech equipment and lasers), Olmiservis OOO (precision machining of metal and plastic parts, production of measuring instruments), RECIF Technologies Bel. OOO
Agricultural enterprises and agro-land of the Novodvossky Village		State farms of Agrofirm Rassvet OAO and the Minsk Vegetable Factory

Industrial areas	Location	Main industries
Council		
Free Economic Zone Minsk, Area 3	7,5 km to the north-east of the Minsk WWTP site	Radian Plant Joint Institute for Energy and Nuclear Research and the Sosny Repository for Radioactive Waste
Public utilities Ecores	2-3 km to the north-east of the Project area Prudische Landfill 4.4 km to the west of the Minsk WWTP site	Trostenets SMW Landfill (closed); Trostenetsky SMW Landfill; Waste Processing Plant; Prudishche Industrial Waste landfill.

11.4 Planned Economic Activity

The Program for the Development of the Industrial Complex of the Republic of Belarus for the Period up to 2020 is aimed at creation of a number of specialized industrial clusters in Belarus, in particular, in Minsk this will include an automobile and tractor cluster (Minsk Tractor Plant, Minsk Automobile Plant, Minsk Motor Company Plant), a cluster for the production of motorcycle, bicycles, quadrocycles and scooters (the key company is Motovelo OAL); in the Minsk Province this will include a potash production cluster (Pukhovichi District, near TPP-5), under the support of Belaruskaliy.

The regional clusters will be mainly arranged as industrial parks (including those of FEZ) aimed at attracting foreign investors and establishing cooperation between the Belarusian producers and international companies. Projects implemented within the industrial parks will be linked together by a single concept; and the new companies will be mutually complementary.

The important strategic directions for the development of production areas in Minsk until 2030, according to the Master Plan, will include:

- The extension of an industrial hub in the existing production areas of the Eastern Sector (Shabany-FEZ Minsk), the Southeastern Sector (Kolyadichi) and the Western Sector (CHP-4)
- Formation of industrial parks in the production areas of the middle belt of Minsk in the eastern and southern planning sectors
- Transfer of subsidiary and auxiliary industrial facilities (industrial areas and warehouses, motor transport enterprises, etc.) outside the central and middle zones of the city. Those include the enterprises of regional and republican subordination, whose activities are not related to provision of services to the population of Minsk and economic entities located directly in Minsk
- Extension of the industrial area around the Trostenetsky SMW Landfill, from 108 ha to 235 ha, and around Kolodishchi, from 20 ha to 124 ha, for the construction of new municipal facilities (a waste processing plant, the Minsk Freight Depot, etc.)
- Completion of technological modernization of the FEZ resident enterprises, including: Electronika OAO located at Kizhevatogo Street, Motovelo OAO located at Partizansky Avenue, Sukno OAO located at Matusevich Street, Horizont OAO located at S. Kovalevskaya Street, Kamvol OAO located at Mayakovsky Street and other production facilities located in the Shabany industrial park (11th km Sector)
- Phased relocation of the Agrokombinat UP Zhdanovichi greenhouse complex enterprises located at Briket Street and the Minsk Greenhouse Complex located at Parnikovaya Street, to move them outside the city boundaries.

The strategy of the engineering infrastructure development in Minsk is focused on the following main activities:

- Transfer of the city's water management complex to drinking water supply from underground sources until 2030
- Provide storm water drainage system for all the existing and future areas in Minsk
- Provide reliable gas supply to the city of Minsk via a district gas pipeline Ø720-820 mm along the Minsk Ring Road. Taking into account a significant ware of the existing high pressure gas pipelines and the increased gas demand in Minsk, there are plans to replace the looped sections and rehabilitate the sections of the gas pipelines from Eastern Gas Distribution Station to the Minsk Ring Road (Ø720 mm) and from Western Gas Distribution Station to GRP-3 (MKAD) (Ø820 mm) from the existing, reconstructed gas distribution stations
- Improve sanitary and environmental condition of the river Svisloch and Slepianskaya Water System by increasing the flow transfer through the Vileika-Minsk Water System to at least 2 m^3/s (= the volume of the river Svisloch), and to 1.2 m^3/s for the Slepianskaya Water System. Continuation of the work on dredging the riverbed of the rivers Svisloch and Loshitsa

- Construct three plants for complex processing of SMW, to produce secondary raw materials and power
- Close and reclaim the industrial waste landfills in the Minsk WWTP area, and the Minsk WWTP filtration fields
- Establish new and related industries on the basis of the existing Ekores KUP and construction of integrated waste processing plants for efficient processing of individual components. Implement the technologies of landfill gas and biogas utilization, for generating electricity and heat
- Introduce the landfill gas collection technologies at the landfills of Severny and Trostenets and use the collected gas as a fuel for the production of thermal and electric energy
- Rehabilitation of a radioactive waste disposal facility in Sosny village

In accordance with the Scheme of the Complex Territorial Arrangement of the Minsk Region, developed by the Bel NIIP town-planning design institute for the period up to 2015 and up to 2030, the following main activities are planned:

- Improvement of the road network, including the construction of the second ring road around Minsk (MKAD-2). The radial elements of the planning framework of the Minsk suburban zone are supposed to be supplemented with road network directions of national importance: Minsk - Gatovo - Mikhanovitchi bypass route of Corridor N 9B (independent highway from Minsk towards Gomel), Minsk - Minsk National Airport (direct vehicular connection of the city with the airport). The second direction in future can be supplemented by high-speed rail transport (e.g.tram)
- Railway transport – Power supply to the 2nd line of Shabany-Kolodishchi and Gatovo-Mikhanovichi
- By 2030 it is planned to build a railway station in the Shabany district, for the high-speed Minsk-Moscow railway line and to build a metro station on the Avtozavodskaya Line
- Construction of a backup automobile entrance to Minsk from Mogilev highway, from the settlement of Prilesye to the Shabany industrial park, with access to Mashinostroiteley street, so that to reduce the increasing load on the highway in the direction of Mogilev, Gomel, and Rudensk
- Construction and rehabilitation of the main radial highways, providing additional transport links between the city center and peripheral districts, including the extension of Svisloch Street to Selitsky Street across the Kolodischi-Shabany railroad line (the length of extended section is 0.5 km)
- It is planned to implement major investment projects for the construction of the Prilesye Transport and Logistics Center and the Trade and Logistics Center InterStroyPortalPlus OOO (currently under construction)
- Further development of the Minsk National Airport - construction of the second runway. The construction began in October 2016, the project will be completed by November 2018
- Due to closing of the old airport Minsk-1, the existing aircraft repair plant (OAO Minsk Aviation Plant No. 407) is being transferred from the city center to the National Airport. In fact, an entirely new enterprise is being built on the airport site, capable of dealing not only with Soviet aircraft, but also with modern aircraft of western production (i.e. Airbus, Boeing, Bombardier, etc.). At the moment, a new aircraft repair plant is being constructed on the territory adjacent to the Minsk National Airport.
- One of the most important directions for the development of the innovation infrastructure is the formation of new technological clusters. Together with China CAMC Engineering Co., Ltd. it is planned to create a Chinese-Belarusian technological cluster in Smolevichy Region. The cluster is a territorial formation of 91.5 km2 with a special legal regime ensuring comfortable conditions for doing business. The cluster is located 25 km from Minsk. The cluster will include industrial and residential areas, office, shopping and entertainment complexes, financial and research centers. In fact, it will become a modern international eco-city with an emphasis on high-tech and

competitive innovative facilities with a high export potential. The project is being developed within the framework of interstate Chinese-Belarusian cooperation and relevant intergovernmental agreements. The construction period is 30 years, the number of employees is 120 thousand people. Priority areas for the cluster are electronics, biomedicine, fine chemicals, engineering and new materials.

- In the Smolevichi Region, work is also underway to build the Minsk Regional Technological Cluster. The main specialization is engineering, metalworking and electrical engineering. The cluster will include the production of electrical equipment, gas piston plants of a small capacity of up to 0.6 MW and a plant for processing worn-out tires in the environmentally friendly way
- Formation of an industrial cluster for potash production. Several plants will be built near Minsk – two of them will specialize in the production of potassium sulphate. One of the plants will be able to produce 100,000 t/a of potassium sulfate. The second one, located in the neighborhood, will produce 500,000 t/a. The cluster will also include the production of mixed fertilizers and organic-mineral products. In addition, the cluster will house a modern laboratory for testing the quality of fertilizers

As for residential development, according to the Master Plan of Minsk until 2030, in the south-east of the area adjacent the Project Area, it is planned to build up new residential districts of Nottingham and Zeleny Bor. Construction will start no earlier than 2017.

As already mentioned in Section 5.8, in 2017 a detailed planning design was developed for one of the developing sections of Minsk FEZ (Sector 2 of Area 1, which appears as Section 1 of the MSA in the town planning documents). According to this design document, the rehabilitation of the Minsk Wastewater Treatment Plant could take place within the framework of the integrated development of the entire area of the site. Currently the MVK does not plan to occupy this area.

According to the design document, the industrial and public facilities with developed infrastructure will appear in the zone. The first phase will include the development of a site near the railway. Then the development will continue in the direction of the Novy Dvor agro-town. In particular, this will include 5 new and reconstructed facilities, including a factory for the production of steel and aluminum products (Funktsionalnyye Produkty OOO). The Effective Industrial Structures Plant will ensure the work of the facility for processing concrete and reinforced concrete waste products of products. The area will also include the facilities of Gordormaterialy RPKUP and Zhilkomplekt PKUP.

If all planning proposals are implemented, the industrial development of the area under consideration will increase from the current 357,900 km^2 to 1,276,000 km^2. The number of employees at production facilities will increase from 500 to 15,700 people. The project will require the creation of about 3000 parking spaces.

Table 11.2 shows the main investment projects planned until 2020 in the city of Minsk and the Minsk Province, to be implemented in the Project Area or in the adjacent territories in accordance with the Socio-Economic Development Programs of Minsk and the Minsk Province until 2016-2020.

Table 11.2: The main investment projects planned for implementation in the South-East of Minsk and in Minsk Province (Minsk Region and adjacent areas) until 2020

Description of Investment Project	Implementation Period	Number of Workplaces
Minsk		
ADANI UP – Formation of innovation and industry cluster of high technologies in the field of complex medical equipment and security systems	2013-2020	300
Minsk Civil Aviation Plant No. 407 OAO – Construction of an aircraft repair plant at the Minsk National Airport	2013-2018	400

Description of Investment Project	Implementation Period	Number of Workplaces
Minsk National Airport– Construction of a second artificial runway with auxiliary facilities for the aircraft of A-380 type and a precision approach radar system of the 3rd category at the Minsk National Airport	2011-2019	200
Minsk Gear Factory OAO – Plan of modernization and technical re-equipment of the factory until 2016-2025	2016-2025	-
OAO Managing Company of Minsk Motor Plant Holding – Development of production of small-displacement diesel engines up to 75 hp	2017-2025	4
OAO Managing Company of Minsk Motor Plant Holding – Development of the production of engines meeting the requirements of modern environmental standards for cars, wheeled tractors and off-road vehicles	2017-2030	4
OAO Managing Company of Minsk Motor Plant Holding – Construction of production line for engines up to 1500 horsepower	2018-2025	1
OAO Managing Company of Minsk Motor Plant Holding – The facility for melting of high-strength cast iron (1st stage)	2019	
MTZ (Minsk Tractor Factory) – the release of new products – an annual increase in the output of tractors with an electro-mechanical transmission of 300-350 horsepower	2017-2019	
Zoomex Investment OOO – Project for development of public and residential complex at Nezavisimosti Avenue, along the border of landscape and recreational zone 85LR1 – Skoryna Street – extension of Kalinovsky Street (Minsk Mayak)	2011-2019	60
Minskcommunteploset UP – Rehabilitation of heat networks using pre-insulated pipes	2016-2020	2
Tabak Invest OOO –Design, construction and commissioning of a shopping and entertainment center with multi-level parking at Independence Avenue /Minsk Ring Road	2011-2019	1400
Construction Project – Rehabilitation of the radioactive waste disposal facility in the village of Sosny, Minsk. Phase 4.	2016-2019	
State Enterprise Minskstroy ZEPK KUP– Construction of a facility for processing of concrete and reinforced concrete products in the Shabany Industrial Park	2016-2017 (design completed)	
Oboronnyye initsiativy OOO – Construction of an engineering center at FEZ Minsk		48
OOO Greenbiovet – a factory for the production of veterinary disinfectants and antiseptics drugs in compliance with GMP standard.	2021	19
First Abrasive Company OOO – investment project for the construction of a production and warehouse complex for production of abrasive tools	2018–2025	7

Description of Investment Project	Implementation Period	Number of Workplaces
SMU-25 Construction Service OOO – project for the construction of a steel structures factory for industrial housing, production facilities, warehouses and trade infrastructure facilities		45
Minsk Province		
VOLMA Corporation OOO – Modernization of the existing plant of BELGIPS OAO and construction of a plant for the production of construction materials based on gypsum in the village of Gatovo, Minsk Region	2014-2018	210
OOO Functional Products – Metalworking production facility for the construction industry	2013-2020	27
String Technologies ZAO – Construction of a production facility for the creation of an eco-technical park for communication systems and the development of business tourism at the site of an asphalt-concrete factory owned by Minskboldorstroy (a municipal unitary enterprise for design, repair and construction of roads)	2015-2018	105
Univak OOO – Development of the production of food plastic packaging on the basis of the construction of the Univak plant in the Minsk FEZ	2014-2020	16
The managing company of AMKODOR OAO holding – Construction of a factory for the production of special vehicles, including rehabilitation of the current production facilities	2016-2021	990
Slavkaliy OOO – Construction of a mining and processing complex with a capacity of 1.1 to 2 million tons of potassium chloride per year, located at the Nezhinsky raw materials site (eastern part) of the Starobinsky potassium salt deposit, the Luban District	2012-2020	2000
Belarusian-British joint venture of UNISON ZAO – Rehabilitation of the plant for the production of cars and implementation of projects for expansion of production facilities (construction of shops for welding and painting of car bodies) and modernization of car assembly line	until 2026	n/a
AluminTechno OOO joint venture – The commissioning of a new extrusion-pressing line and the construction of an automated storage warehouse for finished products	2018-2019	n/a
Beltsvetmet OAO – Construction of facility for the processing of heavy plastic formed by processing of used batteries	2019-2020	n/a
Darida private production unitary enterprise – Construction of a production workshop	2018-2020	
Profistil OOO – Construction of a roadside service facility with an administrative and production complex (wallpaper factory)	until 2018	
AluKoil OOO – Construction of a plant for the production of aluminum rolled products, equipped with a freight railway terminal and a warehouse complex,	until 2024	

Description of Investment Project	Implementation Period	Number of Workplaces
in Minsk FEZ		
Logistic Center Prilesye OOO – The completion of transport and logistics complex Prilesye" in Minsk FEZ	until 2017	
Zelenaya Gavan OOO – The construction of a residential village, a golf academy, a club house, social, engineering and transport infrastructure as part of a golf complex for sports and tourism	2017-2030	
Minsk District Unitary Enterprise Multi-Unit Agricultural Enterprise Zhdanovichi – Construction of the second phase of the pig complex for 24 thousand heads in the village of Plashevo	until 2020	
Fortiva Med OOO – pharmaceutical plant, Minsk Region, the town of Machulishchi	2018	80
Sobir Group OOO –corrugated board production	2018	15
Belarusian National Biotechnology Corporation ZAO – Implementation of the investment project for full cycle high-tech agro-industrial production in 2016-2032, including a plant for the production of lysine, a plant for the production of threonine and tryptophan, a plant for the production of mixed fodders, a plant for processing oilseeds, a complex of grain storage facilities, an auto plant in the town of Rudensk, Pukhovichsky District of the Minsk Province	until 2032	
Infida OOO – Implementation of the investment project for construction of an elevator with storage facilities and access roads in the vicinity of Kopeynoye village	2018	40
Puhovichimyasoprodukt OOO – Implementation of the investment project for construction of the slaughtering workshop with capacity of 300 heads per shift	2017	40
BelSvissInvest (a foreign production and construction unitary enterprise) – Construction of Village of Hypermarkets – a multifunctional shopping complex in the village of Senitsa	2017-2020	
Annual construction of three apartment blocks (each for 100 flats) and related engineering networks under state order (if financing is available) in the village of Druzhny	until 2020	
Construction of the Great Stone China-Belarus Industrial Park and implementation of investment projects of the residents of the park– Smolevichi District	until 2020	Phase I – 25,000 jobs Phase II – 130,000 jobs. Some of the workers will live in the industrial park.
• China Merchants CHNBLR Commercial and Logistic Company ZAO – Construction of a logistics sub-park	until 2017	
• Chengdu Sinju Silk Road Development – production of supercapacitors, equipment and materials for railway transport	until 2020	
• ZUMLION BEL-RUS OOO – production of specialized equipment	until 2020	

Description of Investment Project	Implementation Period	Number of Workplaces
• Telecommunications Equipment Plant OOO – Construction of a plant for the production of process equipment and components of transport systems, small power plants and communication facilities	until 2020	
• Bel Huawei Technologies OOO – the establishment of a research and development center for Huawei	2017-2020	
• NanoPektin OOO – construction of a pectin production plant using a new technology	2017-2020	

In Minsk, a number of measures are planned for rational (sustainable) use of natural resources and environmental protection for 2016-2020. Among the main activities that may have an impact on air quality in Zavodskoy district by reducing emissions of pollutants into the atmospheric air from stationary sources, there are projects on re-equipment of large industrial enterprises with modern efficient gas cleaning systems, including the following:

- Full-scale upgrading of Minsk Tractor Plant OAO
- Modernization of the melting process for bronze casting at MAZ OAO, including the installation of an induction furnace and a gas cleaning system
- Rehabilitation of Minsk CHPP-3 and replacement of old capacities of Phase 14 Mpa
- Rehabilitation of the paint production of Minsk Wheeled Tractor Plant OAO
- Elimination of galvanic production at ATLANT ZAO
- Installation of the Benenghoven ECO 3000 asphalt mixing plant at Shabany ABZ located at Selitskogo St., 19b in Minsk, to replace the existing asphalt mixing plant DS 168. The sanitary protection zone of Shabany ABZ will be reduced from 500 m to 300 m
- Measures to reduce air emissions from mobile sources, including the transfer of the rolling stock of Minsktrans KTUP to gaseous fuels and the use of hybrid buses as passenger transport

Measures on the rational use and protection of water resources include the reduction of the pollution of surface and ground water through the construction/rehabilitation of treatment facilities, reduction of the discharge of pollutants into water bodies, increase of the volumes of recycled water and re-consecutive water supply, water quality improvement in the river Svisloch within the city of Minsk, extension of groundwater abstraction for public drinking water supply and improvement of the quality of drinking water.

11.4.1 Other Anthropogenic Impacts

Other major anthropogenic impacts that may be relevant to the TEC defined within the ACI scoping for further analysis may include the following:

- In recent decades, there has been a steady increase in the population of Minsk and the Minsk Region, based on demographic and migration processes, which leads, *inter alia*, to increasing loads on surface water bodies and groundwater.
- Long-term intensive extraction of groundwater from the inter-moraine Dnieper-Sozh water-bearing complex for water supply of the city of Minsk has led to the formation of an extensive depression funnel having a diameter of 40 km and caused a decrease in groundwater levels by 25-30 m in the central part of the funnel. Until 2020, it is planned to transfer the entire city to underground water supply.
- Most of the water bodies in Belarus, including the river Svisloch, are at risk of pollution of water bodies with nutrients from agricultural industry, taking into account the current level of

agricultural development in the country. Moreover, all the rivers in the Upper Dnieper basin are exposed to high conversion of water bodies, due to drainage reclamation of lands.
- Pollution of the environment with industrial, construction and household waste. The land adjacent to motor roads, utility systems and residential areas is littered to a greater extent. There are unauthorized SMW dumps around settlements located within the catchment area of the river Svisloch, which also has a negative impact on the quality of water in the river.

Climate change is an external anthropogenic factor that may have a negative impact on the whole Belarus. According to estimates, the average air temperature in Belarus in the Upper Dnieper river basin will increase between 1.5 and 2.0ºC in winter and 1.0 to 1.5ºC in summer until 2035, depending on climate change scenarios. The climate change will also affect the amount of precipitation – in autumn and winter the precipitation will slightly increase (up to 10%); and in spring and summer it may decrease (up to 10%). At the same time, the average annual runoff in the Dnieper basin may decrease in 2016 - 2035 (by 10% on average), which will significantly increase both the likelihood and the scale of negative consequences of low-water periods. Thus, the drop of river flow rate in Svisloch will probably exacerbate, due to the adverse effects of climate change[96].

However, the magnitude and nature of such changes caused by external factors throughout the life cycle of the Project are highly uncertain. Thus, the impact of climate change is exposed in this ACI only by a qualitative high-level assessment.

11.4.2 Review of the Project's Contribution to Cumulative Impacts

To assess the potential contribution of the Project to the cumulative impact, an analysis of existing impacts and planned projects was carried out. Table 13.3 provides the results of the analysis and the projects included/not included in the ACI scoping (the construction projects not included in the evaluation are considered incapable of causing significant cumulative impacts if implemented in parallel with the Project). The Table also shows the projects having a high uncertainty factor or not clearly described, which makes a proper assessment of their potential cumulative impacts impossible.

Based on the analysis in Table 13.3, ACI includes the following projects/activities:

Past and current activities:

- Past activities of the MVK /former aeration fields in the Project Area
- Past and current activities of enterprises in the Shabany industrial park
- Korolischevichi Waste Disposal Complex
- Past and current activities of enterprises in the Gatovskaya industrial park
- Kolyadichi industrial area and Prudishche industrial waste landfill
- Large enterprises of other industrial parks in Minsk, including the Minsk Tractor Plant, MAZ, etc .
- Agricultural activities within the catchment area of the river Svisloch
- The activities of industrial enterprises within the boundaries of the Svisloch catchment area downstream of the Minsk WWTP to the Osipovichi Reservoir, including Volma and Svisloch fish farms, Rudensk OAO, Minskenergo RUP (CHP-5), OAO Belkarton, the Managing Company of Belarusian Wallpaper Holding, etc .
- Ecores communal enterprises (Trostenets SMW landfill (closed), Trostenetsky SMW landfill and a waste processing plant)

Planned Development:

- On-going and future construction projects within the Shabany industrial park (Minsk FEZ), including the formation of an innovation and industrial cluster of high technologies in the field of complex medical equipment, security systems, processing of concrete and reinforced concrete products; metalworking for the construction industry, the construction of an industrial facility to

[96] Upper Dnieper River Basin Management Plan for Belarus, 2015

create an eco-technical park for communication systems and the development of business tourism at the site of an asphalt-concrete factory owned by a municipal unitary enterprise for design, repair and construction of roads; development of production of food plastic packaging; investment project for the construction of a production-warehouse complex and production of abrasive tools; introduction of a new extrusion-pressing line and construction of an automated storage warehouse for finished products; the construction of a plant for the production of aluminum rolled products, equipped with a freight rail terminal and warehouse complex, etc.)

- On-going and future construction projects within the Gatovskaya industrial park (modernization of the existing production of BELGIPS OAO and construction of a plant for the production of building materials based on gypsum, organization of a site for processing heavy plastic formed by processing of used batteries)
- Implementation of the investment project for full cycle high-tech agro-industrial production in 2016-2032, including a plant for the production of lysine, a plant for the production of threonine and tryptophan, a plant for the production of mixed fodders, a plant for processing oilseeds, a complex of grain storage facilities, an auto plant in the town of Rudensk, Pukhovichsky District of the Minsk Province.

Table 11.3: Types of activities/projects that can induce cumulative impacts together with the Project

Activity / Potential Development	Interaction with the Project	Included in the ACI (Yes/No)
Further development of Minsk WWTP after 2030 (replacement of mechanical and electrical equipment for WWTP -1 and WWTP-2, a new wastewater treatment line for another 200,000 PE, an extension of the sewerage network for an additional 200,000 PE within the city of Minsk)	It's beyond the ACI timeframe.	No
Plans for the development of transport infrastructure (until 2030) in Shabany District, including: • Extension of Svisloch Street to Selitsky Street across the Kolodischi-Shabany railroad line (the length of extended section is 0.5 km) • 2nd line of cargo railway section Shabany-Kolodishchi and Gatovo-Mikhanovichi • Construction of the station for the high-speed railway line Minsk-Moscow • Construction of the Shabany metro station on the Avtozavodskaya line	The interaction with the Minsk WWTP Rehabilitation Project is likely to occur if the construction periods coincide.	No (no data is available on the period of construction)
Past activities of MVK/former aeration fields in the Project Area	Local contamination of soils and land at the Minsk WWTP site was revealed. The cumulative effect is likely to occur.	Yes
Past and current activities of the enterprises in the Shabany industrial park	The industrial park adjoins the MWWTP site. The cumulative effect is likely to occur.	Yes
Korolischevichi Waste Disposal Complex	Waste landfills are not closed or reclaimed, they are located within the boundaries of the catchment basin of the river Svisloch. The cumulative effect is likely to occur.	Yes
Past and current activities of enterprises in the Gatovskaya industrial park	Cumulative impact is possible when the same VECs are affected.	Yes
Kolyadichi industrial park and Prudishche industrial waste landfill	Cumulative impact is possible when the same VECs are affected.	Yes

Activity / Potential Development	Interaction with the Project	Included in the ACI (Yes/No)
Large enterprises of other industrial parks in Minsk, including the Minsk Tractor Plant, MAZ, etc.	Cumulative impact is possible when the same VECs are affected.	Yes
Agricultural activities within the catchment area of the river Svisloch	Cumulative impact is possible when the same VECs are affected.	Yes
The activities of industrial enterprises within the boundaries of the Svisloch catchment area downstream of the Minsk WWTP to the Osipovichi Reservoir, including Volma and Svisloch fish farms, Rudensk OAO, Minskenergo RUP (CHP-5), OAO Belkarton, the Managing Company of Belarusian Wallpaper Holding, etc .	Cumulative impact is possible when the same VECs are affected.	Yes
Ecores communal enterprises (Trostenets SMW landfill (closed), Trostenetsky SMW landfill and a waste processing plant)	The facilities are located at a considerable distance from the MWWTP site. Nevertheless, the facilities are located within the boundaries of the catchment basin of the river Svisloch (in Trostinka, the inflow of the river Svisloch). Cumulative impact is possible when the same VECs are affected.	Yes
VOLMA Corporation OOO – Modernization of the existing plant of BELGIPS OAO and construction of a plant for the production of construction materials based on gypsum in the village of Gatovo, Minsk Region	Cumulative impact is possible when the same VECs are affected.	Yes
Slavkaliy OOO – Construction of a mining and processing complex with a capacity of 1.1 to 2 million tons of potassium chloride per year, located at the Nezhinsky raw materials site (eastern part) of the Starobinsky potassium salt deposit, the Luban District	It is located at a considerable distance from the Project Area. Cumulative effects are unlikely to occur.	No
ADANI UP – Formation of innovation and industry cluster of high technologies in the field of complex medical equipment and security systems	The project implementation area is adjacent to the Shabany industrial area, SEZ Area 1, Sector 2. The cumulative impact is likely to occur.	Yes
Minsk Civil Aviation Plant No. 407 OAO – Construction of an aircraft repair plant at the Minsk National Airport	This project is located at a considerable distance from the MWWTP site. This project is planned to be implemented until 2018, therefore, it will not coincide with the rehabilitation project of the MWWTP. The cumulative	No

Activity / Potential Development	Interaction with the Project	Included in the ACI (Yes/No)
	effect is unlikely to occur.	
Minsk National Airport– Construction of a second artificial runway with auxiliary facilities for the aircraft of A-380 type and a precision approach radar system of the 3rd category at the Minsk National Airport	This project is located at a considerable distance from the MWWTP site. Cumulative effects are unlikely to occur.	No
Minsk Gear Factory OAO – Plan of modernization and technical re-equipment of the factory until 2016-2025	Cumulative impact is possible when the same VECs are affected.	There is no information on the potential development of the plant and the scale of environmental impact, as compared to the present moment
Development projects of the Minsk Motor Plant • Development of production of small-displacement diesel engines up to 75 hp • Development of the production of engines meeting the requirements of modern environmental standards for cars, wheeled tractors and off-road vehicles • Construction of production line for engines up to 1500 horsepower • The facility for melting of high-strength cast iron (Phase I)	Cumulative impact is possible when the same VECs are affected.	There is no information on the potential development of the plant and the scale of environmental impact, as compared to the present moment
MTZ (Minsk Tractor Factory) – the release of new products – an annual increase in the output of tractors with an electro-mechanical transmission of 300-350 horsepower	Cumulative impact is possible when the same VECs are affected.	There is no information on the potential development of the plant and the scale of environmental impact, as compared to the present moment

Activity / Potential Development	Interaction with the Project	Included in the ACI (Yes/No)
Zoomex Investment OOO – Project for development of public and residential complex at Nezavisimosti Avenue, along the border of landscape and recreational zone 85LR1 – Skoryna Street – extension of Kalinovsky Street (Minsk Mayak)	This project is located at a considerable distance from the MWWTP site.	No
Minskcommunteploset UP – Rehabilitation of heat networks using pre-insulated pipes	No information. Cumulative effects are unlikely to occur.	No
Tabak Invest OOO –Design, construction and commissioning of a shopping and entertainment center with multi-level parking at Independence Avenue /Minsk Ring Road	This project is located at a considerable distance from the MWWTP site. Cumulative effects are unlikely to occur.	No
Construction Project – Rehabilitation of the radioactive waste disposal facility in the village of Sosny, Minsk. Phase 4.	No data. Cumulative effects are unlikely to occur.	No
State Enterprise Minskstroy ZEPK KUP– Construction of a facility for processing of concrete and reinforced concrete products in the Shabany Industrial Park	The project area is located on the same industrial site (Area 1 Sector 2) and adjoins the Minsk WWTP from the northeast. The cumulative impact is likely to occur, provided that the project will be implemented (currently the design documentation is being developed)	Yes
Functional Products OOO – Metalworking production facility for the construction industry	The project area is located on the same industrial site (Area 1 Sector 2) and adjoins the Minsk WWTP from the east. The cumulative effect is likely to occur.	Yes
String Technologies ZAO – Construction of a production facility for the creation of an eco-technical park for communication systems and the development of business tourism at the site of an asphalt-concrete factory owned by Minskboldorstroy (a municipal unitary enterprise for design, repair and construction of roads)	The project area is planned in the Minsk FEZ, in the Shabany industrial complex. Cumulative impact is possible.	Yes
Univak OOO – Development of the production of food plastic packaging on the basis of the construction of the Univak plant in the Minsk FEZ	The project area is planned in the Minsk FEZ, in the Shabany industrial complex. Cumulative impact is possible.	Yes

Activity / Potential Development	Interaction with the Project	Included in the ACI (Yes/No)
First Abrasive Company OOO – investment project for the construction of a production and warehouse complex for production of abrasive tools	The project area is planned in the Minsk FEZ, in the Shabany industrial complex. Cumulative impact is possible.	Yes
AMKODOR OAO – Construction of a factory for the production of special vehicles, including rehabilitation of the current production facilities construction of a production-warehouse complex and production of abrasive tools	The project is located in the agro-town of Kolodishche, at a considerable distance from the Minsk WWTP site.	No
UNISON ZAO – Rehabilitation of the plant for the production of cars and implementation of projects for expansion of production facilities (construction of shops for welding and painting of car bodies) and modernization of car assembly line	The project is located on Area 2 of the Minsk FEZ, at a considerable distance from the MWWTP site. Temporary interaction with the Project will not cause an adverse cumulative impact.	No
AluminTechno OOO joint venture – The commissioning of a new extrusion-pressing line and the construction of an automated storage warehouse for finished products	The project is planned in the Minsk FEZ, in the Shabany industrial park. Cumulative impact is possible.	Yes
Beltsvetmet OAO – Construction of facility for the processing of heavy plastic formed by processing of used batteries	The project will be implemented within the Gatovskaya industrial park. Cumulative impact is possible if the same VECs are affected.	Yes
Darida private production unitary enterprise – Construction of a production workshop	The project is located in the city of Zhdanovichi in the north-west of Minsk at a considerable distance from the MWWTP site within the catchment area of the river Svisloch, but before the cascade of reservoirs. The cumulative effect is unlikely to occur.	No
Profistil OOO – Construction of a roadside service facility with an administrative and production complex (wallpaper factory)	The project is located at a considerable distance from the MWWTP site.	No
AluKoil OOO – Construction of a plant for the production of aluminum rolled products, equipped with a freight railway terminal and a warehouse complex, in Minsk FEZ	The project is planned in the Minsk FEZ, in the Shabany industrial park. Cumulative impact is possible.	Yes

Activity / Potential Development	Interaction with the Project	Included in the ACI (Yes/No)
Logistic Center Prilesye OOO – The completion of transport and logistics complex Prilesye" in Minsk FEZ	The project is located on Area 2 of the Minsk FEZ, at a considerable distance from the MWWTP site. Temporary interaction with the Project will not cause an adverse cumulative impact.	No
Zelenaya Gavan OOO – The construction of a residential village, a golf academy, a club house, social, engineering and transport infrastructure as part of a golf complex for sports and tourism	The project is located at a considerable distance from the MWWTP site.	No
Minsk District Unitary Enterprise Multi-Unit Agricultural Enterprise Zhdanovichi – Construction of the second phase of the pig complex for 24 thousand heads in the village of Plashevo	The project is located at a considerable distance from the MWWTP site.	No
Fortiva Med OOO – pharmaceutical plant, Minsk Region, the town of Machulishchi	The project is located in the village of Machulishchi at a considerable distance from the MWWTP site.	No
Belarusian National Biotechnology Corporation ZAO – Implementation of the investment project for full cycle high-tech agro-industrial production in 2016-2032, including a plant for the production of lysine, a plant for the production of threonine and tryptophan, a plant for the production of mixed fodders, a plant for processing oilseeds, a complex of grain storage facilities, an auto plant in the town of Rudensk, Pukhovichsky District of the Minsk Province	The project is located at a considerable distance from the MWWTP site within the catchment area of the river Svisloch in the zone of influence of Minsk WWTP. Cumulative impact is possible.	Yes
Infida OOO – Implementation of the investment project for construction of an elevator with storage facilities and access roads in the vicinity of Kopeynoye village	The project is located at a considerable distance from the MWWTP site within the catchment area of the river Svisloch. A significant negative cumulative effect is unlikely to occur.	No
Puhovichimyasoprodukt OOO – Implementation of the investment project for construction of the slaughtering workshop with capacity of 300 heads per shift	The project is located at a considerable distance from the MWWTP site within the catchment area of the river Svisloch (Titovka tributary). The cumulative effect is unlikely to occur.	No

Activity / Potential Development	Interaction with the Project	Included in the ACI (Yes/No)
BelSvissInvest (a foreign production and construction unitary enterprise) – Construction of Village of Hypermarkets – a multifunctional shopping complex in the village of Senitsa	The project is located at a considerable distance from the MWWTP site within the catchment area of the river Svisloch (Senitsa tributary). The cumulative effect is unlikely to occur.	No
Annual construction of three apartment blocks (each for 100 flats) and related engineering networks under state order (if financing is available) in the village of Druzhny	The project is located at a considerable distance from the MWWTP site within the catchment area of the river Svisloch. A significant negative cumulative effect is unlikely to occur.	No
Construction of the Great Stone China-Belarus Industrial Park and implementation of investment projects of the residents of the park– Smolevichi District	This project is located at a considerable distance from the MWWTP site. Cumulative effects are unlikely to occur.	

Source: Ramboll

11.5 Assessment of Cumulative Impacts

This section is focused on the risk of occurrence of any cumulative impacts on socio-ecological components. Table 11.4 summarizes the results of this review and indicates which activities/ projects planned for implementation were taken into account when conducting ACI with regard to important environmental and social factors.

Table 11.4: Activities/projects included in the ACI in relation to each TEC

Type of Activities/Planned Development	TEC					
	Atmospheric Air	Groundwater	Surface Water Bodies	Aquatic Bioresources	Public Health	Local Infrastructure
Past and current activities[97]						
Past activities of Minsk Vodokanal/former aeration fields in the Project Area		v	v	v		
Past and current activities of enterprises in the Shabany industrial park	v	v	v	v	v	v
Korolischevichi Waste Disposal Complex		v	v	v	v	
Past and current activities of enterprises of the Gatovskaya industrial park	v		v	v	v	v
Kolyadichi industrial park and Prudishche industrial waste landfill			v	v	v	
Large enterprises of other industrial parks in Minsk, including the Minsk Tractor Plant, MAZ, etc.	v		v	v	v	
Agricultural activities within the catchment area of the River Svisloch			v	v		
The activities of industrial enterprises within the boundaries of the Svisloch catchment area downstream of the Minsk WWTP to the Osipovichi Reservoir, including Volma and Svisloch fish farms, Rudensk OAO, Minskenergo RUP (CHP-5), OAO Belkarton, the Managing Company of Belarusian Wallpaper Holding, etc .			v			
Ecores communal enterprises (Trostenets SMW landfill (closed), Trostenetsky SMW landfill and a waste processing plant)	v		v		v	v
Future development						
Past and current activities of the enterprises in the Shabany industrial park (Minsk FEZ)	v	v	v	v	v	v

[97] While carrying out this ESIA, the Consultant considered the background condition of the environmental components in view of the past and ongoing activities of all enterprises operating in the Project Area (the Shabany industrial complex and other industrial parks in the Zavodsky District, as well as the Gatovskaya industrial area, the Ekores Utilities, etc.). The respective activities are included in the CIA, since there is a possibility of secondary pollution (contamination of soils, land, groundwater and bottom sediments of surface watercourses).

Type of Activities/Planned Development	TEC					
	Atmospheric Air	Groundwater	Surface Water Bodies	Aquatic Bioresources	Public Health	Local Infrastructure
• ADANI UP – Formation of innovation and industry cluster of high technologies in the field of complex medical equipment and security systems	v	v	v	v	v	v
• State Enterprise Minskstroy ZEPK KUP– Construction of a facility for processing of concrete and reinforced concrete products in the Shabany Industrial Park	v	v	v	v	v	v
• Functional Products OOO – Metalworking production facility for the construction industry	v	v	v	v	v	v
• String Technologies ZAO – Construction of a production facility for the creation of an eco-technical park for communication systems and the development of business tourism at the site of an asphalt-concrete factory owned by Minskboldorstroy (a municipal unitary enterprise for design, repair and construction of roads)	v	v	v	v	v	v
• Univak OOO – Development of the production of food plastic packaging on the basis of the construction of the Univak plant in the Minsk FEZ	v	v	v	v	v	v
• First Abrasive Company OOO – investment project for the construction of a production and warehouse complex for production of abrasive tools	v	v	v	v	v	v
• AluminTechno OOO joint venture – The commissioning of a new extrusion-pressing line and the construction of an automated storage warehouse for finished products	v	v	v	v	v	v
• AluKoil OOO – Construction of a plant for the production of aluminum rolled products, equipped with a freight railway terminal and a warehouse complex, in Minsk FEZ	v	v	v	v	v	v
On-going and planned projects within the Gatovskaya industrial park						
• VOLMA Corporation OOO – Modernization of the existing plant of BELGIPS OAO and construction of a plant for the production of construction materials based on gypsum in the village of Gatovo, Minsk Region			v	v	v	
• Beltsvetmet OAO – Construction of facility for the processing of heavy plastic formed by processing of			v	v	v	

Type of Activities/Planned Development	TEC					
	Atmospheric Air	Groundwater	Surface Water Bodies	Aquatic Bioresources	Public Health	Local Infrastructure
used batteries						
Belarusian National Biotechnology Corporation ZAO – Implementation of the investment project for full cycle high-tech agro-industrial production in 2016-2032, including a plant for the production of lysine, a plant for the production of threonine and tryptophan, a plant for the production of mixed fodders, a plant for processing oilseeds, a complex of grain storage facilities, an auto plant in the town of Rudensk, Pukhovichsky District of the Minsk Province			v	v		

*v activities / projects included in the assessment

11.5.1 Atmospheric Air

At present, the complaints and concerns of the local population (Shabany-1 and Novy Dvor agro-towns) are mostly related to smell and deterioration of air quality, as a result of the activities of Minsk WWTP-1, Minsk WWTP-2 and other industrial enterprises, including SMW facilities and Minsk Production Tannery OAO.

Rehabilitation of Minsk WWTP (mechanical and biological treatment) will lead to a significant reduction in emissions of hydrogen sulphide, ammonia and their summation groups compared with the current emissions from Minsk WWTP. According to the latest calculations of the dispersion of hydrogen sulfide emissions and the results of atmospheric air quality monitoring carried out in 2017 by MVK, as well as Ramboll in 2018, the concentration of hydrogen sulfide at the boundary of the residential zone will not exceed the MAC values. When operating a complex for the disposal of sewage sludge, the main air emissions will include nitrogen dioxide, carbon monoxide, sulfur dioxide, heavy metals of hazard class 1, dioxins and PAHs. The highest concentrations at the boundary of the SPZ (about 0.6 MAC, taking into account the background and the worst case scenario) will be nitric oxide concentrations. The residual impact of the Project as a whole, both at the construction stage and at the operational stage, is assessed as low level impact.

The main potential sources of anthropogenic impact on the composition of the surface layer of the atmosphere, which can exacerbate the negative impact on atmospheric air during the construction and operation of the Project facilities, are the on-going and planned FEZ facilities in the Shabany industrial park, if the construction period coincides with the Minsk WWTP Rehabilitation Project. In this case, the cumulative effect of air pollution is possible, both during the construction phase (especially with regard to nitrogen dioxide, carbon monoxide and suspended particles), and during the operation of MWWTP facilities. Increased emissions of hydrogen sulphide in the region are not expected.

Taking into account the location and sensitivity of the nearest recipients (residents of the former village of Shabany, Shabany microdistrict, Agro-town of Novy Dvor and Podlosiye village), the prevailing southwestern and western winds, as well as the numerous ongoing and planned development projects in the immediate vicinity of the WWTP site, the cumulative impact will most likely be **long-term, moderate.**

11.5.2 Groundwater

Low residual impact on the upper horizons of groundwater is expected, mainly during the construction period due to the extensive movement of construction equipment, transport, waste during the dismantling, rehabilitation and new construction of WWTP facilities, as well as due to a significant amount of work related to the destruction or movement of soil cover, in conditions of low water security. There is the possibility of spreading the pollution from a local source by groundwater to the underlying geological strata and/or discharging the pollution into surface water bodies.

Secondary migration of contaminants already present in the soil cover and the geological environment may also occur, induced by both the civil work and the supply of dispersed (atmospheric precipitation) or concentrated (spills, leakage, etc.) pollutants during the preparatory phase, civil work and related activities.

Based on the available information on the nature of the planned industrial activities in the immediate vicinity of the Minsk WWTP site, it can be assumed that no significant cumulative impact on the soil cover and groundwater is expected. Given the low likelihood of simultaneous occurrence of potential impacts, but, at the same time, the presence of highly sensitive recipients (such as residential buildings within the SPZ and homestead residential development in the agro-town of Novy Dvor), the impact on the upper strata of groundwater is estimated as **medium-term, moderate**.

11.5.3 Surface Water

Despite the fact that the rehabilitation of the Minsk WWTP facilities will have a significant positive effect on the water quality in the river Svisloch, the residual effect (chemical and biological pollution) on the river Svisloch is estimated as moderate, taking into account the increase in wastewater volumes. Discharge of effluent from Minsk WWTP will again significantly affect the flow pattern of Svisloch and the river flow rate.

When assessing the cumulative impact, it should be noted that river Svisloch is considered the most polluted watercourse in Belarus; and the pollution is of a long-term nature. The main sources of pollution of surface water bodies are untreated (insufficiently purified) effluents, storm water from industrial and residential areas and meltwater from roads and agricultural lands that occupy most of the catchment area of the water body (the average specific load in the catchment area is 67 kg of nitrogen per 1 ha[98]).

The most dangerous pollutants discharged to the river Svisloch are metals (copper, zinc, nickel, and chromium), ammonium nitrogen, phosphates, nitrite nitrogen, organic substances (BOD_5), iron and manganese compounds, suspended solids and petroleum products.

The pollutants accumulating in the bottom sediments of the river bed contribute to the secondary pollution of the river water. A substantial increase in the content of heavy metals, such as chromium, lead, zinc, nickel and vanadium, in the bottom silts is already observed at the industrial park and the municipal WWTP and stretches downstream to the river mouth. In addition to industrial enterprises in Minsk and the Minsk WWTP facilities, there is a significant impact on the river Svisloch in the Project Impact Area caused by enterprises of the Gatovskaya industrial park, in particular, the discharges of the tannery industry characterized by high chromium content.

The environmental protection measures implemented since 2003 (rehabilitation of the riverbeds of Svisloch and Slepianskaya Water System and improvement of the adjacent territories) contributed to reduction of anthropogenic load. As a result, in 2012-2013 the concentrations of ammonium, nitrate nitrogen, phosphorus of phosphate and easily oxidized organic substances (BOD_5) decreased to the values below the norms, with the exception of the village of Korolischevichi. At the same time, the concentration of oil products in winter 2012 reached 2.4-3.2 of MAC5.

The Master Plan of Minsk until 2030, the Action Plan for the Rational (Sustainable) Use of Natural Resources and Environmental Protection in Minsk for 2016-2020 and the Plan for the Gradual

[98] Upper Dnieper River Basin Management Plan for Belarus, 2015

Improvement of the Svisloch/Osipovichi Reservoir Water System until 2020 provide for a number of activities aimed at reducing the discharge of pollutants into water bodies, thus improving the water quality in the river Svisloch, including:

- Transfer of the city's water management complex to drinking water supply from underground sources until 2030
- Provide storm water drainage system for all the existing and future areas in Minsk
- Improve sanitary and environmental condition of the river Svisloch and Slepianskaya Water System by increasing the flow transfer through the Vileika-Minsk Water System
- Continuation of the work on dredging the riverbed of the rivers Svisloch and Loshitsa
- Close and reclaim the industrial waste landfills in the Minsk WWTP area, and the Minsk WWTP filtration fields
- Rehabilitation of industrial wastewater treatment facilities of Keramin OAO, etc.

Within the framework of the pilot project (2015) on the development of a river basin management plan for the upper Dnieper in Belarus, a set of measures was developed to maintain a good class of ecological status of the water bodies of the Upper Dnieper basin, including additional measures for the river Svisloch. However, even with the implementation of additional activities, a good environmental status for the river Svisloch (downstream of Minsk) may not be reached until 2022 or even 2028, due to a significant number of discharge points within the growing Minsk urban agglomeration, including industry, and along with limited wastewater treatment capacities of Minsk WWTP. The possible improvement of water quality in the Svisloch River by additional dilution due to flooding of the river from the Vileika-Minsk Water System may not completely solve this problem due to limited water availability of this system and insufficient technical and financial possibilities of flow regulation, even despite the decrease in water consumption in Minsk from the Vileika-Minsk Water System and the transition to underground sources of water supply to the city. Measures to increase the capacity and improve treatment at the Minsk WWTP, as well as modernization of the storm water sewerage system, can improve the water quality in the Svisloch River, but will not make it possible to achieve a good environmental status in view of the required criteria.

Thus, any additional activities planned in industry and agriculture within the considered section of the catchment basin of the river Svisloch, taking into account its poor capacity for self-cleaning, will inevitably lead to deterioration of water quality due to the discharge of untreated sewage and storm water from industrial sites and adjacent areas. The cumulative impact on the river Svisloch will probably stretch up to the Osipovichi reservoir. Despite the planned improvement of water quality in the river Svisloch, the cumulative impact on surface waters is estimated as **long-term, high**. The contribution of the WWTP facilities to the cumulative impact is significant, however the Project will aim to reduce this impact.

11.5.4 Water Habitats and Aquatic Organisms

Improvement of wastewater treatment before discharge to the Svisloch River will have a positive ecological effect, the residual impact on aquatic ecosystems is estimated as moderate.

Wastewater from the MWWTP contains a large number of biogenic components (e.g. organic substances, nitrogen and phosphorus compounds, etc.), which, in turn, leads to the decrease in the content of dissolved oxygen (vital for hydrobionts) in the river Svisloch downstream the discharge point. Pollution of the system with heavy metals and, especially, oil products leads to disruption of photosynthetic processes in the aquatic ecosystem and, as a consequence, to a decrease in dissolved oxygen and bio-productivity of the water body.

Wastewater from the MWWTP also has a significant thermal impact (the effluent temperature is about 15°C), which increases biological pollution by decreasing dissolved oxygen content in the water, but this effect has existed for a long time and largely determines the state of the river ecosystem.

Thus, the combination of these impacts creates a final negative impact on the quality of aquatic ecosystems and the deterioration of the habitat of aquatic organisms. However, with the implementation of the Project, this impact will be significantly reduced.

Considering further decrease in river water availability due to the adverse effects of climate change, additional industrial and agricultural activities within the considered section of the Svisloch catchment basin may lead to the increase of the total load on freshwater ecosystems in Svisloch up to the Osipovichi Reservoir. The cumulative impact is estimated as **moderate**. The contribution of MWWTP to the cumulative impact is significant; however the Project's implementation will reduce the total impact.

11.5.5 Public Health and Safety

The Project can have a negative impact on the health and safety of the local population due to the following factors (the residual impact is estimated as moderate):

- The risk to the physical and psychological health of the population (mostly the residents of the former village of Shabany, the agro-town Novy Dvor, Shabany microdistrict and Podlosye village), which is also associated with growing concern about the large number of industrial enterprises. Considering further development of industrial clusters, the public concern will increase
- The public safety risk associated with the movement of heavy machinery, cars and passenger transport on local public roads is related to the increase in the traffic intensity during the construction phase, which will lead to the reduction of road safety and increase the risk of accidents. It should be noted that following the results of the Project implementation the transport load will reduce, because sludge transportation will stop.

The possible cumulative effect on atmospheric air from current and planned activities, discussed above (see *Atmospheric Air*), can potentially lead to the increase of respiratory diseases.

The environmental situation in the city area, worsened by industrial parks in the neighborhood and by communal infrastructure enterprises (Minsk WWTP, waste landfills, incineration plant, etc.), raises concerns of local residents and, without proper information and consultations campaigns, contributes to a negative attitude to any new development projects in the region.

In general, the cumulative impact on public health and safety, taking into account the implementation of other large on-going and planned projects in the region, can be estimated as **moderate.**

11.5.6 Local Infrastructure (Transport)

Construction works under all the planned projects will lead to an increase in the traffic intensity of heavy equipment and personal transport (only 3 parking lots are planned to be built at the Minsk FEZ) on public roads, which can significantly afect local people who use personal cars and public transport. Given the generally poor capacity of the road network in the area (in particular, due to the lack of underground transport), if the city fails to implement the measures on improvement of the transport infrastructure (e.g. it is planned to build additional roads and entrances, electrify the second branch of the freight railway (Shabany-Kolodishchi, Gatovo-Mikhanovichi) and construct a new metro station in the Shabany micro-district), and if there will be no measures envisaged at the level of individual projects, the overall cumulative impact on the local infrastructure can be assessed as **moderate**, especially during the construction phase.

At the operational stage, the Project's contribution to the cumulative impact on public roads will be significantly reduced due to the absence of the need to transport the sewage sludge to the Wolma Sludge Landfill located far away from the MWWTP site.

11.6 Cumulative Impact Management and Key Findings

MVK takes an active position in managing the cumulative impacts through strict implementation of mitigation measures within the framework of the Project (sey Chapters 8 and 9 for more detail). This includes ongoing interaction and consultations with the local community (see Chapters 7 and 9 for more detail).

The conducted ACI did not reveal any additional significant cumulative environmental and social impacts, which would require special mitigation or monitoring measures, in addition to those already developed for the Project (see Chapters 8 and 9 for more detail). However, the assessment provides a set of mitigation recommendations, as follows:

- If the construction phase coincides with other development projects in the Project Area, it is recommended to develop coordinated road traffic management plans.
- During the operation phase, it is recommended to interact with other development projects within the Minsk FEZ (Section 1) in order to arrange a single SPZ for the industrial park facilities
- The quality of waste water received from subscribers shall be strictly monitored; and MVK should encourage the clients to introduce their own systems for preliminary treatment of effluents.
- MVK should get involved in the consultation process with the local community during the development of any new large investment projects that may appear in the vicinity of the Project Area and its zone of influence.

12. ENVIRONMENTAL AND SOCIAL MANAGEMENT

12.1 Environmental, Social, Health and Safety Management in MVK

The Company has developed and introduced elaborate systems for quality management (QMS), environmental management (EMS), health and safety management (HSMS). The systems cover the whole range of the main activities and operations of MVK: continuous supply of potable and technical water; collection, transportation and treatment of waste water; main contractor functions[99] and civil works[100]. In 2009 the Company's Quality Management System was certified for compliance with STB-ISO 9001-2009; in 2015 the Environmental Management System was certified for compliance with STB-ISO 14001-2005, and Health and Safety Management System was certified for compliance with OHSAS 18001:2007.

Parties responsible for efficient functioning of EMS and HSMS is the Chief Engineer who directly reports to the General Director. Stakeholder engagement and HR management functions are subordinated to Deputy Director for Economy and Finance whose sphere of responsibility includes inter alia supervision of Personnel Department and Labour Management and Personnel Motivation Unit.

Roles, responsibilities and powers of various members of personnel in relation to the management systems are defined in the job descriptions, regulations on various units and services, in Manuals, Procedures and other internal documents of the Company. MVK organization chart is shown in Figure 1.2. Head count of the Environment and Development Unit is 5 persons, Occupational Health and Safety Unit – 8 человек, Labour Management Unit – 9 persons, communications department (including personnel responsible for maintenance of automatic control systems) – 21 persons.

12.2 Occupational Health and Safety Management System

The Company has implemented its Environmental Policy and Health and Safety Policy and all key procedures of the management systems. The above Policies serve as a basis for planning and implementation of all operations. They are incorporated in the goals and targets setting process, and are applied to all divisions of the Company.

The Company has set itself a strategic goal of minimizing the negative environmental impacts through reasonable environmental management and efficient use of natural resource. To attain the goal, the Company conducts the following activities:

- Priority is given to systematic environmental management guided by STB ISO 14001;
- Compliance with environmental law at the operational level;
- Increasing personnel environmental awareness through adequate training and motivation;
- Actions are taken to reduce the risk of environmental pollution and potential emergency situations which may affect the natural environment;
- Application of energy saving technologies.

MVK takes a responsible approach to occupational health and safety, applies efforts to improve workplace safety and quality, and is, inter alia, committed to:

- Prioritize personnel life and health over operational performance, regularly identify and analyze OHS risks, prevent workplace accidents, injuries and occupational diseases, take measures and allocate adequate resource for minimization and control of hazardous and harmful impacts at the work places;
- Continuously improve technological processes through implementation of safer technologies and modern equipment, and upgrading the existing equipment;

[99] Quality Management System

[100] Health and Safety Management System

- Comply with legal and other requirements in the Republic of Belarus which are applicable to the Company's operations;
- Raise awareness and competence, make each member of staff personally accountable for his/her safety through engagement of personnel into the health and safety management process, and implementation of all provisions of the Collective Agreement.

MVK conducts regular reviews of the legal requirements to identify those applicable to the Company's operations. The applicable requirements are subsequently included in the process of assessment of significance of environmental aspects and OHS risks, target setting, and development of EHS measures. The register of legal acts which are applicable to the identified environmental aspects is regularly prepared in accordance with the Procedure DP D EMS 02-07 Environmental Aspects, Legal and Other Requirements. Requirements of international lending agencies to the financed projects are not included in the above registers.

The main documents which describe the principles, sphere of application and interaction between elements of EMS and HSMS are the Health and Safety Management System Manual (RK HSMS – 2015) and Environmental Management System Manual (R EMS Rev.3).

Other key corporate documents for the Environmental Management System are:

- DP D EMS 02-07 Environmental Management System. Documented Procedure. Environmental aspects. Legal and other requirements. Environmental targets and planned indicators and Environmental Management Programme.
- DP D EMS 01-08 Environmental Management System. Documented Procedure. Documentation. Documents management.
- DP D SU 01-07 Management System. Documented Procedure. Records management.
- DP D EMS 04-08 Environmental Management System. Documented Procedure. Operations management.
- DP D EMS 04-07 Environmental Management System. Documented Procedure. Emergency preparedness and response.
- DP D EMS 04-06 Environmental Management System. Documented Procedure. Monitoring and measurements.
- DP D SU 02-06 Management System. Documented Procedure. Corrective and preventive actions.
- DP D EMS 02-08 Environmental Management System. Documented Procedure. Management Review.
- DP D SU 01-01 Documented procedures management.
- DP D SU 02-04 Management system. Documented Procedure. Internal audits.
- DP P SU 03-02 Documented Procedure. Process. Water provision.
- DP P SU 03-03 Documented Procedure. Process. Water supply.
- Operational Waste Management Instruction of UE Minskvodokanal.
- Instruction of UE Minskvodokanal on Operational Environmental Monitoring and Efficient Use of Natural Resource.
- P SU 05 Management System Regulation on Responsible Officer for the Environmental Management System.
- P SU 06 Management System Regulation on Responsible Officer for Operational Environmental Monitoring.

Other key documents of the Company's Health and Safety Management System are:

- DP D SMK 04-02.01 Equipment management;

- DP D SMK 04-05 Management of monitoring and measuring devices;
- DP D SMK 04-02.02 Transport management;
- DP D SU 01-01 Management of documented procedures;
- DP D SMK 01-04 Document support of management;
- DP D SU 01-05 Management of divisional regulations, job descriptions and work instructions;
- DP D SUOT 04-11 Internal audit of Health and Safety Management System;
- DP D SUOT 02-09-2015 Hazards identification, risks assessment and definition of control measures. Health and safety targets. Health and Safety Management Programme;
- DP D SUOT 04-09 Liaison with contractors;
- DP D SUOT 04-10 Work permits issuing process;
- DP D SU 01-03 Management of technical regulations;
- Instruction on operating personnel actions in case of emergency situation at the chlorination facilities (chlorination station with 50 tons chlorine store; and store for 30 tons of chlorine) approved by the Chief Engineer of the State Production Amalgamation "Minsk City Utilities" on 03.03.2009;
- UE Minskvodokanal Order No.124 of 31.05.2013 "On managing buildings and structures";
- Industrial Safety Declaration of water treatment plant operated by the Water Supply Operations Division of UE Minskvodokanal, approved by the Chief Engineer of the State Production Amalgamation "Minsk City Utilities" on 03.03.2009;
- Regulation of operational monitoring of H&S compliance at hazardous operational facilities of UE Minskvodokanal, approved by the Company Director on 02.01.2012.

MVK defines EHS targets and objectives which are documented in the Environmental Management Programme and Health and Safety Management Programme. Attainment of the set targets and overall functioning of EMS and HSMS is subject to annual Management Review by the Company management. Results of such reviews are incorporated into Management Programmes for the next periods, in order to ensure continuous improvement of EMS and HSMS functioning.

Hazards identification, risks assessment and development of adequate control measures is provided in accordance with procedure DP D SUOT 02-09-2015 - Hazards identification, risks assessment and definition of control measures. Health and safety targets. Health and Safety Management Programme. The Procedure applies to the occupational health and personnel safety risks related to current operations and does not consider environmental and social risks.

12.2.1 Environmental, health and safety requirements to contractors

In accordance with DP D SUOT 04-09 – Liaison with contractors, responsibility for H&S compliance rests with (sub)contractor. This procedure regulates occupational health and safety and hardly mentions environmental and social issues. The Company has not implemented a similar procedure to regulate liaison with Contractors on E&S issues by now.

The "Liaison with contractors" Procedure defines the process of interaction between MVK services and responsible personnel and the Company's contractors. The Procedure applies to contract agreements for the following works:

- Civil works;
- Equipment installation and dismantling;
- Startup and commissioning;
- Repair of the main process equipment, including energy units;

- Warranty and other contractual works.

In accordance with this Procedure, contractor is required to ensure the works safety, including safe implementation of dangerous operations. However the contractors and suppliers screening procedure does not apply any criteria for EHS assessment of potential contractors.

The “Liaison with contractors” Procedure defines the mandatory items to be included in contract agreements. During the process of contract approval, contractors provide the following documents and records to the OHS Unit:

- Copy of Order on appointment of commission for OHS knowledge testing in contractor’s organization;
- Copies of documentary evidence of the tests conducted by members of the above commission;
- Copy (copies) of certificates or extracts from the protocol of OHS knowledge testing of the contractor’s organization top manager or his deputy responsible for OHS;
- List of personnel involved in the contract works on the site, including their names, professions and posts, and copies of knowledge testing protocols;
- List of the contractor’s works at the Company sites;
- In case of hot works, contractor shall provide copies of fire safety training certification slips;
- In case of works with electrical plant, contractor shall provide copies of certificates of the appropriate level of electrical safety training.

Risks related to contractor’s operations at MVK sites are identified by type of activities and assessed using a Contractors’ Risk Register which is prepared in accordance with Procedure DP D SUOT 02-09-2015 “Hazards identification, risks assessment and definition of control measures. Health and safety targets. Health and Safety Management Programme”. The contractors’ risk assessment is conducted at the beginning of each year, based on information provided by project owner divisions (departments, services). Amendments and changes can be made using information from project owner divisions (departments, services). Parties responsible for preparation of Contractors’ Risks Register are the Manager of OHS Unit and Managers of divisions (departments, services) who act (or will act) as clients ordering the works.

The following parties in MVK organization can check contractors’ compliance with OHS requirements:

- Director;
- Chief Engineer;
- OHS Unit Manager;
- Construction Unit Manager;
- OHS personnel;
- Managers of relevant divisions;
- Manager of division in which the works are conducted,

and OHS commissions in the Company divisions, internal HSMS auditors of the Company units. In addition, each employee of MVK may check contractor’s compliance with OHS, fire safety, industrial safety, electrical safety requirements; contractor’s failure to comply with the above shall be reported to line manager (or unit, facility manager) for action.

If any persons are identified on site who violate OHS, fire, electrical safety requirements, local rules of conduct applicable at the Company sites, its operational premises, auxiliary and domestic facilities, responsible officers of MVK shall:

- Remove such persons from the work sites and from the facility (division) territory;
- Report the incident to responsible officer of the contractor;

- Report the incident to the Operations Division Manager, Construction Unit Manager (for civil works contracts), OHS Unit Manager;
- Stop the works and issue a written notification of the cause of suspension of the contractor's works, with the list of identified violations and requirements to corrective measures. The letter shall be signed by the Company Director or Chief Engineer.

However the Procedure (and other documents provided by the Company) does not establish explicit requirement for contractor to have an own EHS service, with detailed provisions regarding scope of EHS organization depending on the contractors headcount, permanent presence of contractor's EHS personnel on the Project site throughout the works period. The procedure and frequency of audits of contractors' EHS practices against the Company's requirements is not specified either.

12.2.2 Operational monitoring and control

MVK develops and implements an Operational Environmental Monitoring Programme which is intended to monitor environmental status in the Company's area of operations. The following components are addressed by the monitoring activities:

- Effluent discharges to surface and ground water;
- Pollution emissions and atmospheric air quality;
- Waste generation, their temporary storage and disposal sites.

Results of chemical analysis of various components of the environment (air, water, soil) indicate that overall parameters of the Company's area of operations correlate well with background levels and normal values reported in the region, taking into account the local natural and geographic conditions. Recommendations for improvement of the Monitoring Programme are given in Chapter 8.

Details of contractors' monitoring and supervision approach are provided in Subsection 12.2.1.

12.3 Social Management System

HR management in MVK is supervised by Deputy Director for Economy and Finance whose sphere of authority includes inter alia the following divisions:

- Labour Management and Personnel Motivation unit;
- Personnel Department.

OHS Unit which reports to the Chief Engineer is in charge of occupational safety at the Company facilities.

Personnel Department functions in accordance with annual plans which define the main directions of its activities including: HR development, working with succession pool, young professionals, liaison with educational institutions to attract qualified workforce and professionals (it is planned that 30 graduate professionals will be employed in 2017), training, retraining, refresher courses for personnel (according to the current annual plan this activity will cover 46% of the total number of personnel), performance appraisals of personnel, corporate identity activities.

The Company offers benefits and privileges, practices the collective labour agreements and personnel grievance mechanism, and pays compensation for working overtime. Employment relations and provision of adequate working conditions are regulated in line with the law of the Republic of Belarus.

Coordination of external stakeholder engagement activities is provided by the departments reporting to Deputy Director for HR and Ideology: the Document Control Unit and Communication Unit. Depending on subject, the incoming grievances are communicated to Director, Chief Engineer, or to Deputy Directors who supervise specific directions of the Company activities.

MVK uses an effective mechanism for reception and processing of public grievances related to the Company operations and services. However the review identified that current approach to public discussions does not match the best practice and requirements of international financiers. Refer to Chapter 7 for more details on this issue and Consultant's recommendations.

12.4 Project ESHS Management

Existing corporate procedures provide adequate control of environmental, social, health and safety impacts and risks associated with current operations, however Project management and monitoring procedures should be developed taking into account the findings of ESIA studies in the area, as well as existing site-specific construction and operational practices.

During the Project implementation all existing procedures and documents of the corporate management systems will be also applied to the Project activities, however additional (or updated) procedures may be required to meet specific demands of the future activities and applicable requirements.

The Company will coordinate and monitor the Project throughout its life cycle – from design development to decommissioning. Specific mechanisms will be provided at each phase to ensure prevention, minimization, mitigation of potential negative impacts, as well as measures to enhance the positive effects including:

- Environmental and social impact assessment in compliance with international requirements, including concerns expressed by stakeholders during public discussions;
- Preparation of assignments for design development in line with the best industry practices and internal expert review of design solutions;
- Appointment of qualified contractors who are capable of ensuring compliance with the Project requirements, and monitoring contractor's practices for compliance with such requirements throughout the contract period;
- Procurement of modern equipment and materials which meet up-to-date environmental and safety standards;
- Ongoing supervision and monitoring of construction activities on the site, and use of modern construction technologies;
- ESHS training of the Company and contractor's personnel;
- Day-to-day and long-term management of environmental, occupational health and safety, community safety impacts and risks within the scope of the corporate management systems.

To ensure compliance with the applicable requirements and commitments taken by all participants during the Project implementation, the Company will further improve its EHSH management systems and inter alia develop and introduce specific documents with definition of measures and actions intended to enhance environmental and social performance, and to mitigate potential environmental and social risks and impacts identified through the ESIA process. Such documents will include procedures, rules and plans aimed at systematic and comprehensive management of all environmental and social aspects of the Project implementation. The above programmes shall cover the whole range of Project activities conducted by MVK and its contractors.

In particular, MVK will develop the following basic documents for supervision and monitoring:

- Construction Environmental and Social Management Plan (to be developed with due account of the design solutions, refer to Subsection 12.4.1);
- Environmental and Social Action Plan (developed as a separate document, description is provided in Subsection 12.4.2).

12.4.1 Environmental and Social Management Plan (ESMP)

Construction ESMP is a framework document with description of environmental and social management and monitoring procedures. The document will be supplemented as required by a set of environmental and social management plans and procedures for specific Project activities which are of special significance and require special attention. ESMP will identify the Project environmental and social requirements, as well as methods and approaches to ensure that such requirements are met throughout the Project development and implementation. In particular, ESMP will describe the following:

- Approach to environmental and social management, including definition and distribution of functions and responsibilities;
- Applicable environmental and social standards;
- Specific measures to be implemented for control, mitigation and monitoring of environmental and social impacts.

In view of the dynamic nature of Project development, the Environmental and Social Management Plan will allow for prompt response to changing circumstances and unforeseen events, and for revision of action plans based on monitoring and analysis of the Project activities.

In view of the natural, industrial and socio-economic baseline which was described in the previous chapters, the potential environmental and social impacts and proposed measures for their prevention and mitigation, the list of management plans and procedures to be developed for the Project includes but is not limited to the following:

- Project Stakeholder Engagement Plan (refer to details in Chapter 7, developed as a separate document) including comprehensive measures for meaningful disclosure of Project information to local communities and stakeholders, a consultations programme to cover various topics, provision of internal and external grievance mechanism;
- Construction Environmental and Social Management and Monitoring Plan (for "umbrella" main contractors engaging several subcontractors);
- Waste Management Plan for the construction and operation phase;
- Construction Workforce Accommodation Management Plan (if needed);
- Site Personnel Code of Conduct (also applicable to contractors' personnel);
- Zero Workplace Discrimination Policy (or integration of non-discrimination principle into other corporate regulations of the Company).

12.4.2 Environmental and Social Action Plan (ESAP)

During the ESIA process the Consultant identified potential compliance gaps against the requirements of international lenders and described recommended measures to achieve compliance which are listed in Chapters 8, 9 and 13. The above measures which shall be implemented to secure allocation of the loan funding formed the basis for preparation of the Environmental and Social Action Plan. ESAP is issued as a separate document.

13. CONCLUSIONS

13.1 Introduction

UP Minskvodokanal provides household-drinking and technical water supply services, as well as waste water pumping and treatment in the city of Minsk with the population number of almost 2 million. It is a major modern water company which uses revamped energy saving equipment, process automation and centralized operations control systems, however some of its main and auxiliary assets are outdated and upgrading is needed.

Furthermore, operational sites of the Company's waste water treatment plant are situated in industrial area relatively close by settlements. This situation imposes certain limitations on the operations, both in terms of generally high anthropogenic load in the territory, and also due to the need to provide adequate living environment for local communities. The above is another important driving force for reconstruction of the waste water treatment facilities.

The Resolution of Minsk City and the sector-specific wastewater disposal scheme of Minsk for the period until 2030 developed by UP "MinskEngProject" also provide for construction of wastewater sludge treatment facilities. This intention is dictated by the need to reduce the amount of wastewater treatment sludge storage and landfilling. Remaining capacity of the existing on-site storage capacity is only sufficient for next 4-5 years and its further extension is not possible.

The European Bank for Reconstruction and Development (EBRD) and the European Investment Bank (EIB) are considering co-financing of MVK project for reconstruction and optimisation of Minsk Waste Water Treatment Plant which is supported by the Government of the Republic of Belarus and Minsk City. The project is intended to reconstruct the plant to enhance waste water treatment efficiency and quality, and also provides for construction of sludge disposal facilities at the site of existing waste water treatment plant in Zavodskoy District of Minsk. Due to the anticipated participation of international financial institutions the design solutions will be developed taking into account the requirements of EU in the sphere of sludge incineration.

The waste water treatment plant plays important role in protection of the environment against man-caused impacts. All design solutions for the Project are focused to protect surface and ground water, as well as land resources of Minsk city and district. The EBRD has assigned a Category A to the Project, in line with the 2014 Environmental and Social Policy, which means that the Project requires a comprehensive Environmental and Social Impact Assessment (this Report) and the development of associated disclosure package, followed by their public disclosure for a minimum period of 120 days.

More details of the Project background, alternatives and proposed solutions are provided in Chapter 4.

13.2 Assessment of Impacts of the Main Alternatives

The Consultant prepared comparative analysis of the Project alternatives which are listed below on the basis of description of the Project alternatives (Chapter 4), baseline situation review (Chapters 5 and 6), and assessment of potential impacts (Chapters 8 and 9). The following alternatives have been reviewed:

- "Zero alternative" – i.e. no project;
- Option 1 – sludge drying and incineration, with utilization and/or sale of thermal and electric energy;
- Option 2 – sludge digestion, drying and incineration, with utilization and/or sale of thermal and electric energy;
- Option 3 – sludge drying and pelletizing for subsequent disposal at landfill or sale as alternative fuel for cement industry (the market is not developed at the moment, a part of pellets are burnt to produce thermal energy for the drying process);
- Option 4 – sludge drying with natural gas, pelletizing and potential sale as alternative fuel for cement industry (the market is not developed at the moment).

For detailed description of the alternatives refer to Section 4.7.4.

Impacts associated with various options have been analyzed and compared with each other using the impacts matrix – a proven method used for multicriterial analysis of positive and negative effects of proposed projects in complicated circumstances.

The comparison clearly demonstrated that reconstruction of MWWTP is needed to solve a number of pressing problems including the need to ensure efficient and reliable waste water treatment processes, to reduce odour emissions from the site of the treatment plant to improve life quality of local communities, and to solve the problem of sludge disposal.

Results of the multicriterial analysis confirmed selection of Option 2 which was earlier identified by MVK and the Project Technical Consultant as the preferred option for implementation. Option 2 would yield the best effect in terms of minimization of wastes and utilization of energy potential of waste water treatment sludge. Its implementation would reduce the traffic impacts and enhance sustainability of MVK waste water treatment operations. Options 3 and 4 will become more attractive if market develops for sale of pellets as alternative fuel or construction material (road pavement). In such circumstances option 4 would be the most attractive alternative, also in terms of reduction of environmental load in the industrial area which hosts MWWTP facilities. However in the actual situation, the best combination of positive effects and various impacts can be achieved through implementation of Option 2.

The main impacts of this option are discussed in Section 13.2 which also describes recommended prevention, mitigation and remediation measures associated with the main impacts, as well as recommendations for environmental and social management and development of a programme to monitor environmental and social performance of the Project.

Table 13.1: Assessment of the Main Alternatives

Impact	Zero alternative	Option 1	Option 2	Option 3	Option 4	Comment
Air	0	+	+	+	+	All options (except for "zero alternative") are beneficial, as emissions of pollutants and odours (ammonia and hydrogen sulphide) from reconstructed MWWTP facilities would decrease. Option which provides for removal of sludge pellets from the site (transportation, without incineration) would have a somewhat stronger beneficial effect on ambient air quality around the WWTP site, compared to other Project options.
Physical impacts	0	+	+	+	+	All new equipment of the sludge treatment and disposal facilities under Options 1-4 will be provided with noise-protective housings, so that is isolated from potential receptors to a maximum extent. Noise emissions from new equipment to be installed as part of reconstruction of the existing facilities will also be lower. At the operation phase, beneficial effect in terms of physical impacts will be achieved through reduction of vehicle trips associated transportation of sludge to disposal site.
Surface water	0	+	+	+	+	All options which provide for reconstruction of MWWTP facilities will have positive effect on surface water quality.
Ground water	0	+	+	+	+	All options except "zero alternative" are expected to reduce impacts on ground water, as a result of cessation of sludge disposal to ground and reconstruction of MWWTP facilities. A moderate impact on ground water is anticipated at the site of MWWTP-1 at the construction phase.
Land acquisition	0	+	+	+	+	The least beneficial scenario in terms of quality of land resources is "zero alternative", i.e. continuation of the current practice with consequential need to allocate further land plots for extension of sludge lagoons (this option appears to be hardly practicable).
Soil, terrain and geology	0	+	+	+	+	Implementation of all options except for "zero alternative" would reduce impacts on geology and soil, as a result of cessation of sludge disposal to ground and reconstruction of MWWTP facilities. Option 1 will cause the highest (compared to Options 2-4) secondary pollution effect, due to generation of large quantities of ash which has to be disposed at a waste landfill. All options will have moderate impacts at the construction phase.
Waste management	0	+	+	+	+	Implementation of all options except for "zero alternative" will solve the problem of disposal of large quantities of sludge. For Options 1-3 an appropriate route should be identified for disposal of ash (Option 1 will produce the greatest quantity of ash). The ash shall be managed as a hazardous solid waste. In absence of adequate sales market, implementation of Options 3 and 4 would mean that fuel pellets will be buried at MSW landfill. However if the market for fuel pellets develops, the two options will be preferred ones for this criterion.
Biodiversity and ecosystem services	0	+	+	+	+	Improved effluent quality at the discharge to River Svisloch will have a positive effect on aquatic ecosystems and ecosystem services.
Visual impacts	0	-	-	-	-	Whichever Project option is implemented, it will produce a minor incremental negative visual impact during the period of construction.
Climate	0	+	+	+	+	Direct emissions of greenhouse gas will be significantly reduced by generation and incineration of methane at the sludge treatment and disposal facilities (compared to the "zero alternative" with uncontrolled methane emissions from the sludge disposal facilities and treatment processes). Implementation of Option 2 will probably have the least impact on climate, as

Impact	Zero alternative	Option 1	Option 2	Option 3	Option 4	Comment
						this option provides for generation of thermal and electric energy to substitute 40% of energy imported by MWWTP for own needs. The decrease of power consumption will further result in indirect reduction of GG emissions.
Resource efficiency: - Gas consumption	0	-	-	-	-	All sludge disposal options would consume more natural gas than the "zero alternative". Option 4 will have the highest gas demand (33280 th.m3/a).
- Consumption of thermal and electric energy	0	+	+	+	+	As part of MWWTP reconstruction outdated equipment will be replaced with new energy-saving units; thus power consumption will decrease. Options 1 and 2 provide for utilization of thermal and electric energy for local site needs. Option 2 will produce the maximum effect.
- Utilization of sludge energy content	0	+	+	0	0	The most effective utilization of sludge energy content can be achieved by implementation of Option 2 where electric energy has a larger share in total energy output. The effect of Option 1 would be smaller, as this option is more oriented for generation of heat. Options 3 and 4 are intended to produce fuel pellets which at present do not have a sales market in the Republic of Belarus.
Community health and safety	0	+	+	+	+	Risks to physical and psychological health of local residents will be reduced by providing better quality of ambient air after the Project implementation. Option 4 would have the best effect in terms of air impacts around the Project site.
Quality of life	0	+	+	+	+	The quality of life of local residents will improve as odour emissions from MWWTP site will be reduced (or completely prevented), and air quality will improve. In case of implementation of Options 3 and 4 air quality improvement near the site would be greater, however integral improvement at the city level would be less significant (if pellets are used as alternative fuel).
Socio-economic benefits for local communities	0	+	+	+	+	New job opportunities will be created by all options except "zero alternative".
Are development potential	0	+	+	+	+	Reduction of pollution emissions after the Project implementation will improve air quality and abate the odour nuisances, and SPZ will be reduced. This will make the area more attractive and potentially remove constraints for its future development.
Potential relocation and economic displacement	0	0	0	0	0	The Project (all options) can be implemented without relocation and economic displacement of local residents.
Social tensions	0	+	+	+	+	In case of appropriate disclosure and public communication, reconstruction of MWWTP should release social tensions. The main causes of discomfort in relation to MVK operations, e.g. odour nuisances and pollution emissions, poisoning of fish, will completely disappear of substantially decrease. On-site incineration would not be required if Option 4 is selected for implementation.
Transport infrastructure	0	+	+	+	+	Cessation of sludge disposal practice at the Volma site will slightly decrease the load on the road network of Minsk District, as well as associated impacts of the traffic on the areas along the motor roads. Implementation of Option 2

Impact	Zero alternative	Option 1	Option 2	Option 3	Option 4	Comment
						implies the need for transportation of pellets.
Tariffs	**0**	**-**	**-**	**-**	**-**	No tariff increases are anticipated over the next few years. However tariff increases may be expected in the more remote future, as the cost of services will rise due to the growing operating costs. However no estimations are available so far to support such projections.
Economic performance	**x**	**-**	**-**	**-**	**-**	4-5 years from now, when the capacity of the existing sludge disposal site will be used up, "zero alternative" will become impractical due to the lack of territory for extension of sludge disposal facilities. Operating costs are relatively high due to poor performance of the existing equipment. It is also probable that supervising authorities will apply penal sanctions for failure to meet treated effluent and air quality standards, and also for inadequate composition of facilities at MWWTP and Volma site. Option 2 takes the first place among other options in terms of technical complexity and costs (€258.3), it is followed by Option 1 (€226.8), Option 3 (€197.7) and Option 4 (€165.5). The weak side of Options 3 and 4 is the lack of sales market for fuel pellets, which undermines their economic effect. Another disadvantage of Option 4 is that large volumes of imported natural gas would be consumed for production of alternative fuel with limited potential use.
Summary of Project options pros and contras	**Advantages:** zero negative impact of the construction stage ; zero capital cost of reconstruction. **Disadvantages**: poor quality of waste water treatment; multiple public grievances about odour nuisances; high operating costs – major part of the existing buildings and facilities at the site of MWWTP-1 are in need for reconstruction or capital repair; penal sanctions may be applied by supervising authorities for failure to comply with effluent and air quality standards, and for inadequate sludge storage facilities; wastage of valuable energy content of sludge; lack of capacity at the Volma sludge disposal facilities; provision of new sludge disposal facilities would be unfeasible (no suitable sites are available in the vicinity of MWWTP, high ecological risks, social consequences).	**Advantages:** smaller quantity of wastes (ash instead of sludge), utilization of sludge energy content, more straightforward sludge treatment process than in Option 2; reduction of pollution emissions from treatment facilities, enhanced treatment performance, release of social tension. **Disadvantages:** mainly thermal energy would be generated (the share of electric energy would be smaller), emissions at the sludge incineration stage.	**Advantages:** the smallest quantity of wastes (ash instead of sludge), more thorough utilization of sludge energy content; larger share of electricity in the total energy output; reduction of pollution emissions from treatment facilities, enhanced treatment performance, release of social tension. **Disadvantages:** this option is technically more complicated than Option 1; emissions at the sludge incineration stage, quota system for sale of generated electricity to the national grid of the Republic of Belarus.	**Advantages:** if sales market for the alternative fuel is available: smaller quantity of wastes and utilization of sludge energy content. **Disadvantages:** this option is technically more complicated than Option 1; emissions at the sludge incineration stage, sales market for fuel pellets is currently nonexistent (which means that the product will be wasted unless a commercial utilization route is identified) Pollution emissions in case of incineration at other sites.	**Advantages:** if sales market for the alternative fuel is available: smaller quantity of wastes and utilization of sludge energy content, the least emissions at MVK site. **Disadvantages:** this option features the highest energy demand (consumption of large quantities of natural gas), and is technically more complicated than Option 1, sales market for fuel pellets is currently nonexistent (which means that the product will be wasted unless a commercial utilization route is identified). Pollution emissions in case of incineration at other sites.	Thus, taking into account the absence of realistic options to extend the existing sludge disposal facilities, the "zero alternative" is unfeasible, let alone its poor environmental and social performance. The most attractive option from environmental perspective (the least impact on air quality) would be Option 4, however its operation implies consumption of large volumes of natural gas for production of sludge pellets which would have to be disposed as a waste, as there is no demand for this product in the Republic of Belarus. The optimum option, based on combination of parameters, is Option 2. Even though the capital cost of construction and reconstruction for this option would be the highest, its operating costs and anticipated environmental effects are the best among the considered Project alternatives.

Source: Ramboll

Description:

0 – the current situation, the baseline in comparison of alternatives;

«-» - negative effect in comparison with the current situation, 3 grades of significance;

«+» - positive effect in comparison with the current situation, 3 grades of significance;

«x» - absence of implementation possibility.

13.3 Project Impacts Overview

13.3.1 The Estimated Project Outcomes

The main outcomes of the Project which are listed in Table 1 indicate that the Project would be beneficial from the environmental and social perspective. The Project is compared to the baseline situation.

Table 13.2: Main problems to be solved by the Project (information on impacts is provided in section 4)

Reconstruction needs	State and results	
	Baseline	Project
MWWTP-1 treatment capacity	380 thousand m^3 / day	420 thousand m^3 / day
	1 583 000 population equivalent (p.e.)*	1 742 000 p.e.
Total MWWTP treatment capacity	490 thousand m^3 / day	540 thousand m^3 / day.
	1 995 000 p.e.	2 200 000 p.e.
Condition of buildings and structures	Significant proportion of outdated and decommissioned structures and equipment	Demolition of unused facilities, upgrading of facilities and equipment
Waste water treatment quality	During normal operation – compliance with national requirements, however organic removal performance is not high enough (17,2 mg/l N total and 1,1 mg/l P total). Lack of disinfection	Compliance with national and EU requirements (10 mg/l N total and 1,0 mg/l P total) More reliable operation Introduction of UV disinfection of treated wastewater
Impact of River Svisloch	Unsatisfactory condition, due to low water flow rate in the river and historical environmental damage, weak self-purification capacity of the water body	Reduced impact on river ecosystems will support its restoration
Air quality at the boundary of approved SPZ and in surrounding areas	Compliance with local requirements Multiple complaints about odour nuisances	Compliance with national and EU requirements Reduced impact on residential areas Significant reduction of odour emissions
Sludge handling approach and quantity of the main type of waste	Disposal of 650-700 t of sludge per day at the sludge fields Volma, hazard class 3	All sludge is treated on the new complex. Disposal of 27 t of ash per day at the Trostenets landfill, hazard class 3 (volume reduced by 25 times)
Transportation of the main type of wastes to disposal	Transportation distance to take sludge to the disposal facilities is 23 km. Significant load on public roads	Ash transportation distance to Trostenets landfill is 15 km. Load on public roads would be 38 times lower, and the risks on the roads would also decrease
Long-term solution for disposal of the main type of wastes	Lack of sludge disposal capacities in 4-5 years' time	Availability of proven capacity for ash disposal in short and medium term. Ash utilization potential in long term
Land use conditions	Treatment facilities operation at MWWTP sites Degradation of living conditions due to odour emissions	Project would be implemented at the same sites SPZ would be reduced to 500 m, minimum Improvement of living conditions nearby

* 1 p.e. (population equivalent)" means the organic biodegradable load having a five-day biochemical oxygen demand (BOD5) of 60 g of oxygen per day. Source: Council Directive 91/271/EEC of 21 May 1991 concerning urban waste water treatment.

13.3.2 Key Project Impacts

The review and appraisal of the proposed investment project have identified a number of potential environment and social impacts. The ESIA and ESAP propose mitigation measures for any of the aforementioned impacts. Special attention shall be paid to stakeholder engagement, managing construction activities, as well as supervision of design and construction works. Recommendations for enhancement of the Project benefits have been developed where possible. Conclusions on specific groups of impacts are summarised below.

More detailed information is available in chapters 8 and 9.

Air quality

The odour releases from MWWTP are mainly caused by the large area of open surfaces for evaporation of hydrogen sulphide, mercaptan, amines and other odorous substances. Therefore the reconstruction design provides for isolation of a large group of mechanical treatment facilities from free gas exchange with atmosphere with special hoods. Gaseous phase from under the hoods will be pumped through a block of scrubbers before emission to air at one central source.

Other elements of the Project will act as new sources of emissions: construction of preliminary digestion system which will be also equipped with biogas collection and removal system, as well as sludge incineration complex. Composition of emissions will change after reconstruction: reduced methane, ammonia and hydrogen sulphide content and increase in carbon oxide, nitrogen oxides and other combustion products of sludge. In order to determine the effect on air quality and community health, Ramboll prepared pollution dispersion model using Ekolog software. The software and model selection was dictated by the need to obtain results which would be comparable with outputs from previous dispersion analyses. The simulations were conducted for the existing situation ("No Project") and the selected reconstruction option. Changes in pollution emissions as a result of Project implementation are shown in Table 8.4.

Conclusions for the air dispersion modelling results indicate that despite the inevitable increase of pollution emissions to air from the proposed sludge incineration and biogas facilities and elevated concentrations of common combustion products of organic matter (carbon oxide, oxides of nitrogen and sulphur), the resultant estimated pollution concentrations will still remain within the permissible limits in the area of existing SPZ, but also at a distance of 500 m from the boundary MWWTP site, thus SPZ can be reduced to 500 m, i.e. by almost two times.

The findings are illustrated by a series of schematic maps with isometric lines of pollution concentrations before and after the reconstruction which are included in the supplementary ESIA package. A fragment of schematic map which is provided below in Figure 81a illustrates dispersion of hydrogen sulphide, the most problematic component of emissions at MWWTP-1. The figure shows that after implementation of the selected option of reconstruction of MWWTP-1 the dispersion area of hydrogen sulphide will shrink (red contour with hatched filling inside the contour with dotted filling that depicts the baseline area of dispersion) and split in two parts.

Thus, the Project will significantly reduce impacts on health of residents of the nearby settlements. Emissions from the new sludge treatment complex will not contribute much to the baseline impacts on air, however reduction of sludge volumes and cessation of use of the sludge lagoons (and sludge transportation) will improve air quality not only in the area of the treatment plant, but also in the settlements of Lugovoslobodsky rural council.

The air treatment performance will be regularly monitored. Monitoring results will be integral part of environmental and social reporting to EBRD.

Reduction of Greenhouse Gas Emissions and increase in energy efficiency

The main input of MWWTP-1 to the greenhouse gas (GHG) emissions is defined by the composition of wastewater (significant methane emission) for the baseline situation The Project implementation will lead to a major reduction of methane emissions due to coverage of evaporation surfaces on primary treatment equipment and constructions but also to an increase in the actual CO_2 emissions as the sludge and biogas combustion product, as well as an overall decrease of external electricity consumption (decrease of indirect emission).

External electricity consumption of MWWTP will drop from the current 45,088,766 kWh /a (2017 data) to 28,804,329 kWh/a (a forecast for 2024 after the Project implementation). The specific energy consumption per 1 m^3 of wastewater treatment decreases from 0.34 to 0.20 kWh. In total, the current GHG emissions will change from 5,140 to 3,283 t/a (calculated based on IFC Carbon Emissions Tool average emission factor for the Republic of Belarus for CO_2 is 0.114 кг CO_2/kWh).

After the Project implementation, the MWWTP emissions will change significantly including the GHG emissions with lower GHG potential value (first of all, CO_2), that will lead to significant improvement in MWWTP carbon footprint.

Noise and vibration

In 2017 UE "Minskvodokanal" commissioned the private company Environmental Centre PYLEGAZOOCHISTKA to assess adverse physical impacts of MWWTP on the adjoining area, for estimation of the minimum size of the SPZ and assessment of possibility of its reduction from 700 to 500 m. The assessment was based on the noise sources data and results of field measurements of acoustic impacts. Both calculations and measurements demonstrated that acoustic impacts of MWWTP are well within the permissible limits.

Site studies conducted by Ramboll did not identify any areas with substantial acoustic load. An exception is indoor space of buildings and structures where pumps or other noisy equipment are installed.

The nearest residential areas in the Zavodskoy district of Minsk (Shabany-1) and Novodvorsky rural council (Novy Dvor, Podlosje and Yelnitsa) are situated at a distance of 700-1000 m and are separated from the MWWTP noise sources by motorways and railroads, as well as by other industrial sites with local sources of operational noise. The dominating external noise exposure in residential areas is largely related to railroad and automobile traffic; whereas acoustic impact from local construction and repair works, transformers, ventilation systems and other equipment is less essential.

In the context of the proposed reconstruction, a short-term increase of level of noise may be expected during construction phase near the areas where demolition, foundation construction, materials and waste handling activities will be conducted, as well as along the access roads. It is also expected that the Project will decrease the acoustic impacts at the operation phase, as the reconstruction programme provides for replacement of old equipment with new units (with better noise performance) and provision of enclosures and emissions prevention facilities which will also contribute to reduction of noise levels.

Surface water. Water resources of River Svisloch catchment area

MWWTP operations affect River Svisloch mainly through the controlled discharge of treated effluents with the flow comparable to the natural river flow at the place of discharge. The second less significant source of impact is uncontrolled discharge of drainage water and ground water from the site.

The Project in general is intended to improve treated effluent quality to meet the requirements of the Republic of Belarus and the European Union, and to decrease the failure rate of the treatment facilities. Thus, the Project is expected to produce benefits for aquatic ecosystem of River Svisloch.

Earth works and other activities at the construction phase may potentially cause short-time increases of pollution flows to River Svisloch with drainage water and ground water. Disturbance of soil and vegetation cover in the areas of demolition and construction may result entrainment of ground particles by surface runoff.

However, if the activities are implemented in strict compliance with the applicable requirements, the risk of river contamination is negligible. Implementation of the proposed water protection measures will ensure the appropriate level of safety of River Svisloch water resource. Sufficiency and efficiency of the adopted measures will be assessed through the existing hydrochemical monitoring system of UE "Minskvodokanal" which will be extended to include a range of monitoring activities in the water protection zone.

Waste management practice

Positive effect of the Project is manifested in implementation of efficient sludge management system which helps to reduce the amount of the main type of waste of hazard class 3 by 25 times, from 650-700 t/day of sludge to 27 t/day of ash. The negative environmental impacts will be related to the disposal of ash from sludge incineration and decontamination of coal absorber containing mercury. Considering the significant volumes of the waste and its hazard classes (III and I), the overall impact of WWTP on the environment from waste management activities during the operation phase is initially estimated as high. Subject to implementation of the proposed solutions and waste management procedures and taking into account the general requirements for collection, temporary storage, transportation and disposal of waste, the residual impact is assessed as moderate to low and as localized. Subject to implementation of the set of measures for recycling of ash in production of materials for construction industry, the impact can be mitigated to minor.

Sludge and ash management plans should be developed, as well as procedures to monitor the movement of waste streams and records of the waste streams by types and hazard classes should be kept, both at the accumulation and temporary storage facilities and outside these facilities. Impacts of wastes generation will be controlled through regular monitoring of atmospheric air quality (locally – dispersed ash).

With regard to the Volma sludge lagoons, a recommended strategy would be the development of a decommissioning plan, including the following activities:

- Ensuring safety of the local people (by restricting access to the site)
- Monitoring the composition of surface water bodies and the conditions of the geological environment and groundwater in the affected area
- Collection and treatment of surface runoff, as required until closing-down or reclamation of the site, and
- Development of measures for closing-down or reclamation of the site.

Land resource and land use conditions

Alongside the positive effect on land use conditions in the location area of MWWTP-1, the Project will also have negative consequences during the construction phase:

- short-time increase of load in the area during demolition, reconstruction and construction of MWWTP-1 facilities: pollution emissions, vibration and noise from the activities at MWWTP-1, and also from the vehicles using the public roads beyond the site territory;
- short-time increase of surface runoff pollution at the site of MWWTP caused by construction works and associated activities, with consequential risk of contamination of ground water and River Svisloch.

After completion of the construction activities, negative impacts of the Project may be associated with disposal of residual wastes from sludge incineration processes. This refers to the waste disposal landfill and public roads used for transportation of wastes from MWWTP site. The least beneficial scenario from the perspective of land resource quality is continuation of the current practices which would require extension of the sludge lagoons and acquisition of additional land plots for the purpose.

Soil and geology

Geomorphological, geological and hydrogeological conditions at MWWTP site are stable and fair and are not exposed to any negative impacts except for some local areas affected by historical operations.

Current impacts of MWWTP operations on soil are associated with precipitation of pollutants emitted by existing sources in the treatment plant area. This impact is mostly present in the SPZ where pollution levels in air contacting the soil cover may exceed the safety standards for residential areas which are applicable in the Republic of Belarus. However, dispersion analysis has demonstrated that MPC levels in air will not be exceeded in case of Project implementation, i.e. the impact will notably decrease.

The existing and future reduced SPZ mainly consist of land intended for industrial and transport operations (industrial zone, motor and rail roads to the north and east of MWWTP), agricultural land

(Zhdanovichi Agricultural Enterprise to the south of MWWTP, and farm land on the right bank of River Svisloch). Other types of land use including individual houses with auxiliary plots (gardens) are located outside the SPZ however close by it. In general impact on soil outside SPZ is deemed to be minor for any of the reconstruction options.

A more significant impact on soil cover, terrain and geology will be caused by the construction activities, however this impact will hardly affect any territories outside the boundary of MWWTP site:

- immediate mechanical disturbance of soil and ground caused by preparatory activities, excavations, piling and auxiliary operations, as well as movements of construction machinery;
- littering of soil surface with solid wastes;
- local contamination of top soil and geological environment with substances that degrade their biological, physical and chemical properties – waste water, fuel and lubricants, paints.

Based on the available information on the nature of proposed construction and operation activities, it is anticipated that changes in soil and geology will remain within the acceptable limits where they do not affect the status of local soil and ground water. The Project construction activities are not expected to produce any notable additional impact on nearby soil and land. To minimize the respective environmental risks, the method statement should provide for adequate monitoring of compliance with construction standards and regulations, hazardous materials and wastes storage rules, as well as response measures in case of pollution accidents or encountered historical contamination.

Ecosystems and biodiversity

Potential area of the negative biodiversity impacts of the Project is described as follows:

- Mechanical damage of soil and plants, and nuisance to animal life in the adjacent areas during the construction activities;
- Noise and light impact on neighbor animals (at night);
- Impacts of pollution emissions on ground surface ecosystems
- Impacts of treated effluent discharges on aquatic ecosystems (taking into account the cumulative impacts of other water users) – at the operation phase.

The construction phase biodiversity impact in the location area of MWWTP is assessed as negative, however temporary, short-time and local by nature, as it will be present only at the work sites and immediately adjacent areas, and will not result in loss of natural ecosystems and habitats of rare and protected species.

In view of the potential slight increase of waste water discharges - by 10% by 2030, and the improvement of treatment quality, the anticipated impact of WWTP on flow patterns and ecosystems of River Svisloch is assessed as permanent and long-term, however local by nature. There is a high chance that beneficial environmental effect will be produced by reduction of pollution discharges to the river. However, due to low flows in River Svisloch, significant historical contamination and poor self-purification capacity of the water body, the impact significance at the operation phase is assessed as medium. It is recommended to monitor status of the river.

In view of the above, the mitigations for loss of biodiversity may, if needed, include further compensation measures, e.g. reclamation of disturbed land using natural seed materials, trees and shrubs that are typical for the natural ecosystems. As the construction stage will not result in loss or fragmentation of natural ecosystems, the above system of measures will support resilience of the existing ecosystems and help to reduce significance of the residual impacts.

Local socio-economic conditions

The Project in general is designed to improve reliability of sewerage services and waste water treatment quality, to reduce the impact on air, soil and ground water, on River Svisloch and its ecosystems, and to minimize odour emissions. The above translates to improved quality of life for local communities in the Project area and near the associated facilities (Volma sludge facilities).

Probability of impact on social infrastructure at the construction phase is assessed as minor, provided that adequate mitigations are implemented including provision of accommodation for Project workforce (if temporary accommodation is to be provided) in compliance with EBRD/IFC Guidance "Workers' Accommodation: Processes and Standards", provision of equipped on-site medical facility and experienced paramedic, implementation of measures in the sphere of traffic safety, etc.

The potential impacts may affect utilities and social infrastructure of Novodvorsky rural council and Zavodskoy district. To prevent the negative effects on transport infrastructure, UE "Minskvodokanal" will implement specific mitigations including adequate planning of construction traffic routes, compliance with the applicable transportation requirements.

The Project has a potential to increase of employment of local residents for the Project construction activities, local procurement opportunities, elimination of use of heavy load vehicles for transportation of WWTP-produced sludge to the lagoons, and a slightly increased demand for skilled professionals during the operation phase.

The Project may potentially affect recreation anglers who regularly visit the bank of River Svisloch, and auxiliary farming activities of the residents of the former Shabany village. The mitigation measures to be implemented by the Project include regular consultations with residents of the former Shabany village to ensure their feedback on current Project activities, development of a project-specific Code of Conduct for the Project personnel, prohibition of fishing by the Project personnel, and prevention of use of the gravel road approaching the former Shabany village by the Project vehicles.

Potential economic displacement

The assessment of social impacts of the Project considered potential relocation of occupants of the four houses located near UE "Minskvodokanal" facilities. Consultations with stakeholders demonstrated that such relocation will not be needed, provided that the proposed corrective measures are implemented. Such conclusion takes into account the overall beneficial effect of the Project on air quality in the former Shabany village at the operation phase, and the established practices of the four households. At the construction phase UE "Minskvodokanal" should apply their best efforts to implement the proposed mitigations and minimize disturbance and impacts on communities in the above houses.

Labour relations and occupational health and safety

To mitigate potential impact on labour relations and associated risks, a range of measures has been agreed for ensuring compliance with the law of the Republic of Belarus and requirements of EBRD by all parties of the Project including contractors and subcontractors.

Community health and safety

The Project will help to reduce negative impacts on air and improve life quality in the adjacent residential areas compared to the current level. This in turn will have a positive effect on health and wellbeing of local communities in the Project's area of influence.

Reduction of road transportation of sludge will support minimization of community health impacts on the roads.

Other potential impacts on community safety may include emergency and unplanned events in the Project area, and security arrangements at the Project sites, potential conflicts between various groups engaged in the Project and with local communities. The Company will implement the necessary measures to prevent such impacts, including emergency response planning, provision of MWWTP sites security and other actions.

Cultural heritage

Trostenets Memorial which commemorates the former extermination camp is the only object of cultural heritage located relatively close by the Project site. The memorial is separated from the Project area by blocks of industrial buildings and a railway line. The Company will make sure that Project traffic will not affect the access road to the memorial.

All potential negative impacts of the Project in the environmental and social sphere are in general controllable and can well be prevented or reduced as required by the proposed mitigations and through implementation of the Environmental and Social Action Plan and Stakeholder Engagement Plan.

14. REFERENCES

No.	Document title Название документа	Original title (in Russian) Оригинальное название на русском
1	**Maps and site plans / Карты и планы площадки**	
1.1	Dnieper Basin	Бассейн Днепра (схема)
1.2	General plan of Minsk	Генеральный план г. Минск (схема)
1.3	General plan of "Minskvodokanal"	Общий план УП "Минскводоканал"
1.4	Scheme of gauging stations in the Republic of Belarus	Схема гидропостов Республики Беларусь
1.5	Scheme of gauging stations on the river Dnieper	Схема гидропостов р. Днепр
1.6	Schematic map of emission sources on the nature user's production site Scale 1:2000; date 9/28/2016	Карта-схема расположения источников выброса на производственной площадке природопользователя, УП "Минскводоканал" Масштаб 1:2000, дата 28.09.2016
1.7	Technological scheme "Site of Wastewater Treatment Station MWTP-1"	Технологическая схема "Площадка станции очистки сточных вод МОС-1", УП "Минскводоканал" № 14.043-1-С2-ТК
1.8	Map "Sludge storage pond" Scale 1:500, date 6/13/2017	Карта "Иловый пруд-накопитель", РУП "Минское областной агентство по государственной регистрации и земельному кадастру", составлено 13.06.2017 Масштаб 1:500
1.9	Map "Pipe system of sludge water of storage pond" Scale 1:500, date 6/9/2017	Карта "Трубопроводы иловой воды пруда-накопителя", РУП "Минское областной агентство по государственной регистрации и земельному кадастру", составлено 09.06.2017
1.10	Schematic map: atmospheric air monitoring stations in the city of Minsk Ministry of natural resources and environmental protection of the Republic of Belarus The Republican Center for Hydrometeorology, Radiation Control and Environmental Monitoring	Схема размещения пунктов мониторинга атмосферного воздуха в г. Минске, Государственное учреждение «Республиканский центр по гидрометеорологии, контролю радиоактивного загрязнения и мониторингу окружающей среды» Минприроды Республики Беларусь
1.11	Scheme of soil monitoring stations	Схема размещения пунктов мониторинга почв
1.12	Aerophotograph of Shabany industrial hub (MVK)	Аэрофотоснимок Промузел Шабаны (МВК)
1.13	Map of Shabany industrial hub	Карта Промузел Шабаны (МВК)
1.14	Schematic map of industrial objects Minskochistvod	Карта-схема объектов производства Минскочиствод
1.15	Parking space layout for vehicles of Minskvodokanal UE employees and contractors onsite Minsk Wastewater Treatment Plant	Схема расположения парковочных мест личного легкового автотранспорта сотрудников подразделений УП «Минскводоканал» и подрядных организаций на территории ЦОС МОС
1.16	General plan of MWTTP, including utilizable land properties of abolished settlement Shabany	Общий план МОС, включая используемые землевладения упразднённого сельского населённого пункта Шабаны
2	**Land allocation / Использование земель**	
2.1	Information on land plots provided to the subject of Unified Register of State Property on the right of permanent use (date 3/1/2016) USR 100236027	Сведения на 01.03.2016 г. о земельных участках, предоставленных субъекту Единого реестра государственного имущества на праве постоянного пользования ЕГР (УНП) 100236027
2.2	General objects affiliation to land plots accessory	Принадлежность основных объектов к земельным участкам
2.3	General objects affiliation to land plots	Принадлежность объектов основных средств

No.	Document title Название документа	Original title (in Russian) Оригинальное название на русском
	of WTTP Electroshop accessory	к земельным участкам Электроцех МОС
2.4	General objects affiliation to land plots of waste treatment centre	Принадлежность объектов основных средств к земельным участкам ЦОО МОС
2.5	Universal State Registry of real estate of the Republic of Belarus (data of Minskvodocanal of 06/08/2017)	Единый государственный реестр недвижимого имущества Республики Беларусь (данные по Минскводоканалу от 8.06.2017)
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4	**Registry title deeds: buildings / Регистрация прав собственности: здания и сооружения**	
4.1	Registry title deed No. 600/1424-2895 of 08/11/2017 for the building with cadastral number 600/C-158000	Свидетельство №600/1424-2895 от 11.08.2017 о государственной регистрации для капитального строения с кадастровым номером 600/С-158000
5	**General organizational information and policies / Общая информация об организации и организационные политики**	
5.1	Organization structure of Minsk WWTP	Организационная структура УП "Минскводоканал"
5.2	Anti-corruption policy of Minsk WWTP of 05/16/2017	Антикоррупционная политика УП "Минскводоканал" от 16.05.2017
5.3	Taxes report for 2016	Справка о суммах исчисленных налогов за 2016 год
5.4	Quality policy of 12/11/2015	Политика предприятия в области качества от 11.12.2015
5.5	QMS for Minsk WWTP - Guidance for quality РК СМК 03-2015 date 12/11/2015	Система менеджмента качества УП "Минскводоканал" - Руководство по качеству РК СМК 03-2015 от 11.12.2015
6	**Environmental management / Управление природопользованием**	
6.1	ISO 14001-2005 certificate No. BY/112 06.01.021 00235 valid until 12/29/2019	Сертификат соответствия СТБ ИСО 14001-2005 (№BY|112 06.01.021 00235, действителен до 29.12.2019)
6.2	ISO 9001-2009 certificate No. BY/112 05.01/077 1701 valid until 03/31/2018	Сертификат соответствия СТБ ISO 9001-2009 (№BY/112 05.01/077 01701, действителен до 31.03.2018)
6.3	Guidance for Environmental Management System for Minsk WWTP of 04/02/2015	Руководство по системе управления окружающей средой УП "Минскводоканал" Р СУОС от 02.04.2015 г.
6.4	EMS program for 2017-2019	Программа УОС на 2017-2019 годы
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6.6	Functional report on EMS for 2014 of 02/17/2015	Отчёт УП "Минскводоканал" о функционировании системы управления окружающей средой за 2014 год от 17.02.2015 г.
6.7	Functional report on EMS for 2015	Отчёт УП "Минскводоканал" о функционировании системы управления окружающей средой за 2015 год
6.8	Functional report on EMS for 2016 of 01/25/2017	Отчёт УП "Минскводоканал" о функционировании системы управления окружающей средой за 2016 год от 25.01.2017 г.
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No.	Document title Название документа	Original title (in Russian) Оригинальное название на русском
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7	**Air Emissions / Выбросы в атмосферный воздух**	
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7.4	State statistical reporting: Air emissions of pollutants and carbon dioxide from stationary sources report for 2015	Государственная статистическая отчётность: Отчёт о выбросах загрязнающих веществ и диоксида углерода в атмосферный воздух от стационарных источников выбросов за 2015 год. - Минск: Национальный статистический комитет Республики Беларусь, 2016. - 5 с.
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7.8	Draft standards of permissible pollutant emissions into the atmosphere of	Проект нормативов допустисых выбросов загрязняющих веществ в атмосферный

No.	Document title Название документа	Original title (in Russian) Оригинальное название на русском
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7.9	Results of atmospheric air research at control points at the boundary of the SPZ of Minsk Wastewater Treatment Plant for the 4th quarter of 2017	Результаты по исследованию атмосферного воздуха в контрольных точках на границе СЗЗ Минской очистной станции за 4 квартал 2017
7.10	Inventory of air impact sources on Minskvodokanal UE Private Research and Production Unitary Enterprise "Environmental Center “Pylegazoochistka”	Акт инвентаризации источников воздействия УП "Минскводоканал" на атмосферный воздух Экологический центр "Пылегазоочистка"
7.11	Results of Minskvodokanal UE air pollutants inventory Private Research and Production Unitary Enterprise "Environmental Center “Pylegazoochistka”	Результаты инвентаризации выбросов загрязняющих веществ УП "Минскводоканал" в атмосферный воздух Экологический центр "Пылегазоочистка"
7.12	Applications: background concentrations and calculated meteorological characteristics	Приложения: фоновые концентрации и расчётные метеохарактеристики
7.13	Graphical applications: determination of pollutant emissions	Графические приложения: определение выбросов загрязняющих веществ
8	**Water use and quality / Использование и качество воды**	
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8.6	Hydrology, hydrochemistry, hydroecology: materials of the 4th all-Ukrainian scientific conference of 29 sept - 2 oct 2009; Dubman A.V. Environmental assessment of hydrobiological condition of Svisloch river	Дубман А.В. Экологическая оценка состояния р. Свислочь по гидробиологическим показателям / А.В. Дубман // Гидрология, геохимия, гидроэкология: материалы четвёртой всеукраинской научной конференции - Луганск, 2009. С. 57-58.
8.7	Laboratory control plan of Minsk Wastewater Treatment Plant operation	План-график лабораторного контроля работы очистных сооружений Минской очистной станции (МОС-1). - 4 с.
8.8	Development of water management plan (Pilot basin of the Upper Dnieper, Belarus) – Minsk, Central Research Institute for Water Use, 2014	Разработка проекта плана управления водными ресурсами (Пилотный бассейн Верхнего Днепра, Беларусь). - Минск: РУП "ЦНИИКИВР", 2014
8.9	River Basin Management Plan for the	План управления речным бассейном

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	Upper Dnieper on the territory of Belarus, 2015	верхнего Днепра на территории Белоруссии, 2015
8.10	Plan for phased improvement of the water system of the river Svisloch – Osipivochi reservoir for years 2014-2020	План поэтапного оздоровления водной системы р. Свислочь – Осиповичское водохранилище на 2014-2020 годы
9	**Waste management / Обращение с отходами**	
9.1	Waste management instruction for Minskvodocanal UE (for the facilities located in the city of Minsk). Minsk: Minskvodokanal UE, 2017. – 200 pp.	Инструкция по обращению с отходами производства УП "Минскводоканал" (для объектов, расположенных в г. Минске). Минск: УП "Минскводоканал", 2017. - 200 с.
9.2	State statistical reporting: Waste management report for 2013	Государственная статистическая отчётность: Отчёт об обращении с отходами производства за 2013 год. - Минск: Национальный статистический комитет Республики Беларусь, 2014. - 7 с.
9.3	State statistical reporting: Waste management report for 2014	Государственная статистическая отчётность: Отчёт об обращении с отходами производства за 2014 год. - Минск: Национальный статистический комитет Республики Беларусь, 2015. - 11 с.
9.4	State statistical reporting: Waste management report for 2015	Государственная статистическая отчётность: Отчёт об обращении с отходами производства за 2015 год. - Минск: Национальный статистический комитет Республики Беларусь, 2016. - 6 с.
9.5	State statistical reporting: Waste management report for 2016	Государственная статистическая отчётность: Отчёт об обращении с отходами производства за 2016 год. - Минск: Национальный статистический комитет Республики Беларусь, 2017.
9.6	Inventory of production waste of 09/29/2016, Minskvodokanal UE	Акт инвентаризации отходов производства от 29.09.2016 УП "Минскводоканал"
9.7	Letters on the placement of ash after sludge burning: Letter No. 02/956 of 04/23/2015 On Waste Acceptance Letter No. 568 of 03/28/2011 On the location of waste Letter No. 25-7 / 475 of 04/16/2015 On the preliminary approval	Письма о размещении золы после сжигания иловых осадков: Письмо №02/956 от 23.04.2015 О приёме отходов Письмо №568 от 28.03.11 О размещении отхода Письмо №25-7/475 от 16.04.2015 О предварительном согласовании
10	**PCB containing equipment / ПХБ-содержащее оборудование**	
10.1	Information on PCB containing equipment	Сведения о ПХБ-содержащем электрооборудовании
10.2	PCB inventory report of 12/20/2016	Акт инвентаризации ПХБ. Минск: УП "Минскводоканал", 2016. - 4с.
11	**Energy efficiency / Энергоэффективность**	
11.1	Actions for implementation of general energy efficiency lines for 2017: measures for fuel and power resources economy (including the table of electric power consumption for water pumping and purification for 2012-2017)	Мероприятия по реализации основных направлений энергосбережения на 2017 г по производству "Минскочиствод": мероприятия по экономии ТЭР (включая таблицу потребления электроэнергии на перекачку и очистку сточных вод за 2012-2017 годы)
12	**OHS / Охрана труда и промышленная безопасность**	
12.1	Certificate of registration OHSAS 18001:2007 No HSM40629	Сертификат соответствия требованиям OHSAS 18001:2007 No HSM40629
12.2	Occupational health and safety management system: documented procedure, hazard identification, risk	Система управления охраной труда: документированная процедура, идентификация опасностей, оценка рисков и

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	evaluation, management measures determination, OHS objectives, OHS control ДП Д СУОТ 02-09-2015	определение мер управления, цели в области охраны труда, программа управления охраной труда ДП Д СУОТ 02-09-2015, Минск, 2015. - 25 с.
12.3	Guidance for Health and Safety Management system РК СУОТ - 2015	Руководство по системе управления охраной труда РК СУОТ - 2015, Минск, 2015 г. - 78 с.
12.4	OHS System: documented procedure, work permits execution ДП Д СУОТ 04-10-2016	Система управления охраной труда: документированная процедура, оформление нарядов-допусков ДП Д СУоТ 04-10-2016, Минск, 2016 г. - 43 с.
12.5	Corrective No. 1 for ДП Д СУОТ 04-10-2016 Work permits execution	Изменение № 1 к ДП Д СУ ОТ 04-10-2016 Оформление нарядов-допусков Дата введения: 05.10.2017
12.6	Occupational health and safety management system: documented procedure, inner auditing ДП Д СУОТ 04-11-2015	Системы управления охраной труда: Документированная процедура, внутренний аудит ДП Д СУОТ 04-11-2015, Минск, 2015 г.
12.7	OHS Policy of 11/01/2016	Политика в области охраны труда УП "Минскводоканал" от 01.11.2016 ПРУП "Белкоммунпроект", Минск, 2015 г.
12.8	OHS Day procedure statement	Положение о порядке проведения "Дня охраны труда" УП "Минскводоканал"
12.9	Form of the protocol for OHS Day	Форма протокола проведения "Дня охраны труда"
12.10	State statistical reporting: Conditions of work and Occupational Health and Safety report for january-march 2017	Государственная статистическая отчётность: Отчёт по условиям и охране труда за январь-март 2017 года
12.11	State statistical reporting: Quantity of casualties of work accidents for 2016	Государственная статистическая отчётность: Отчёт о численности потерпевших при несчастных случаях на производстве за 2016 год
12.12	Factors of working environment at workplaces control plan for 2017 of 12/21/2016	План-график контроля факторов производственной среды на рабочих местах УП "Минскводоканал" на 2017 год от 21.12.2016
12.13	Knowledge check on OHS questions in the committees of the Company and its units of 11/16/2016	Положение о проверке знаний по вопросам охраны труда работников в комиссии организации и комиссиях структурных подразделений УП "Минскводоканал" от 16.11.2016
12.14	Internal labour regulations	Правила внутреннего трудового распорядка
12.15	Approval process of employment, assignment to a position, transfer, contract extension, granting vacation and resignation	Порядок согласования приёма на работу, назначения на должность, перевода, продления срока действия (заключения) контракта, представления отпусков и увольнения сотрудников УП "Минскводоканал"
12.16	Labour contract (template)	Трудовой договор (образец)
12.17	Labour contract between employer and employee (template)	Контракт нанимателя с работником (образец)
12.18	Guidance No.1 for private assurance of medical expenses	Правила №1 добровольного страхования медицинских расходов
12.19	Casualties of work accidents report for 2012-2016	Справка по несчастным случаям на производстве за 2012-2016 гг.
12.20	Documented procedure Hazard identification, risk assessment and management measures identification. Goals in the field of labor protection. Occupational Health and Safety	Документированная процедура Идентификация опасностей, оценка рисков и определение мер управления. Цели в области охраны труда. Программа управления охраной труда ДП Д СУОТ 02-09-2015

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	Management Program ДП Д СУОТ 02-09-2015	
12.21	Order No.130 of 11/04/2017 of Minskvodokanal UE Conduct of the specific briefings	Распоряжение КУПП "Минскводоканал" №130 от 04.11.2017 О проведении целевого инструктажа
13	**Technical information / Техническая информация**	
13.1	Sludge storage pond in the region of Sinilo village. Inventory number 600/C-158000. Datasheet. status at 06/09/2017	Технический паспорт на сооружение (иловый пруд-накопитель район д. Синило; инвентарный номер 600/С-158000) по состоянию на 09.06.2017
13.2	Pipeline of sludge water in storage pond. Datasheet. Status at 06/09/2017	Ведомость технических характеристик на сооружения (трубопроводы иловой воды пруда-накопителя) по состоянию на 09.06.2017
13.3	List of possible emergency situations	Перечень возможных аварийных ситуаций
13.4	Registry of technical inspection for buildings, according to ТКП 45-01--1.04-305-2016	Реестр Актов осмотра технического состояния зданий, сооружений, согласно ТКП 45-01--1.04-305-2016
13.5	Technical capability of gas-supply for the object "Minsk Wastewater Treatment Plant reconstruction" No. 02-21/1989 of 04/27/2015	Техническая возможность газоснабжения объекта "Реконструкция Минской очистной станции" №02-21/1989 от 27.04.2015. - Минск: Производственное республиканское унитарное предприятие "Мингаз", 2015. - 1 с.
13.6	Sewage Treatment Facilities (extension), phase 1. Re-adjustment. Start-up complex for capacity increasing up to 200 thousand m^3 per day. Ecological passport of the project 87.170.П2 - ЭПП ИНВ № 7-831 Minskvodokanal UE, Minsk, 2006. – 12 pp.	Канализационные очистные сооружения (расширение) 1 очередь. Повторная корректировка. Пусковой комплекс по доведению производительности до 200 тыс м3/сут Экологический паспорт проекта 87.170.П2 - ЭПП ИНВ № 7-831 КПИУП "Минскинжпроект", Минск, 2006. - 12 с.
13.7	Ecological passport of Minskvodokanal UE Sewage disposal and wastewater treatment systems production in the city of Minsk Minskochistvod plant, Minsk, 2017. – 23 pp.	Экологический паспорт предприятия КУПП "Минскводоканал" Производство по эксплуатации систем водоотведения и очистки сточных вод г. Минска Производство "Минскочиствод", Минск, 2017. - 23 с.
13.8	List of vehicles of MWTTP	Перечень автотехники МОС
14	**Sanitary protection zone / Санитарно-защитная зона**	
14.1	SPZ project for Minsk Wastewater Treatment Plant of 04/16/2011	Проект СЗЗ Минской очистной станции УП "Минскводоканал" от 16.04.2011 ООО "Семигор-Экология", Минск, 2011. - 79 с.
14.2	Report on the development of the SPZ project for Minsk Wastewater Treatment Plant of 10/10/2017 Private Research and Production Unitary Enterprise "Environmental Center “Pylegazoochistka”	Отчёт по теме: Разработка проекта СЗЗ для Минской очистной станции УП "Минскводоканал" от 10.10.2017 Частное научно-производственное унитарное предприятие "Экологический центр "Пылегазоочистка", Минск, 2017. - 90 с.
14.3	SPZ project of 12/11/2017 Minskvodokanal UE Private Research and Production Unitary Enterprise "Environmental Center “Pylegazoochistka”, Minsk, 2017. – 292 pp.	Проект СЗЗ от 11.12.2017 Коммунальное производственное предприятие "Минскводоканал" Частное научно-производственное унитарное предприятие "Экологический центр "Пылегазоочиистка", Минск, 2017. - 292 с.
14.4	Act of State Sanitary and Hygienic	Акт государственной санитарно-

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	Examination №35-19/606пр of 04/13/2011 Minsk City Centre for Hygiene and Epidemiology	гигиенической экспертизы №35-19/606пр от 13.04.2011 ГУ "Минский городской центр гигиены и эпидемиологии"
15	**Environmental impact assessments / Оценка воздействия на окружающую среду**	
15.1	Reconstruction of Minsk Wastewater Treatment Plant. JoI, EIA. Code 14.043, Vol. 14.-043-06. Environmental Protection. Book 6. - Minsk: Ministry of Municipal Housing Economy of the Republic of Belarus. Project-oriented republican unitary enterprise "Belcommunproject", 2016	Реконструкция Минской очистной станции. Обоснование инвестиций. Охрана окружающей среды. Отчет об оценке воздействия на окружающую среду. - Минск: Проектное республиканское унитарное предприятие "БЕЛКОММУНПРОЕКТ", 2016. - 355 с.
15.2	Environmental impact assessment of proposed economic activity for the object "Construction of sludge incineration plant at 1, Inzhenernaya str". – Minsk: Engineering and constructing company "ENEKA", 2012	Отчет об оценке воздействия на окружающую среду планируемой хозяйственной деятельности по объекту: «Строительство завода по сжиганию иловых осадков по ул. Инженерная, 1». - Минск: ОДО "ЭНЭКА", 2012.
15.3	Research report "Environmental impact assessment of proposed economic activity for the construction of the Second Ring Road around Minsk on the segment from M-3 Minsk-Vitebsk highway to M-6/E 28 Minsk-Grodno-Boundary of the Republic of Poland highway (I stage of construction)". – Minsk, RUE "Bel Research Facility "Ecology", 2010	Отчет НИР «Оценка воздействия на окружающую среду планируемой хозяйственной деятельности по строительству Второй кольцевой дороги вокруг г. Минска на участке от автомобильной дороги М-3 "Минск-Витебск" до автомобильной дороги М-6/Е 28 "Минск-Гродно-граница Республики Польша" (I этап строительства)». - Минск: РУП «Бел НИЦ «Экология», 2010
16	**Public sources / Открытые источники**	
16.1	Water registry of the Republic of Belarus	РУП "Центральный Научно-исследовательский институт комплексного использования водных ресурсов" Министерства природных ресурсов и охраны окружающей среды Республики Беларусь: Водный кадастр Республики Беларусь
16.2	Chemical analysis, wastewater and natural water purification of heavy-metal ions, Course work, Minsk, 2009	Химический анализ и очистка сточных и природных вод от ионов тяжелых металлов, Курсовая работа. Минск, 2009. - 40 с.
16.3	State of Environment of the Republic of Belarus: National Report / Ministry of Narural Resources and Environmental Protection, Minsk, 2015, 102 pages	Состояние окружающей среды Республики Беларусь: Нац. доклад / Министерство природных ресурсов и охраны окружающей среды Республики Беларусь, РУП «Бел НИЦ «Экология». – Минск:Бел НИЦ «Экология», 2015.–102 с.
16.4	National statistical Committee of the Republic of Belarus. Environmental protection in the Republic of Belarus. Statistical data book. - Minsk, 2016. 248 pages	Национальный статистический комитет Республики Беларусь. Охрана окружающей среды в Республике Беларусь. Статистический сборник. – Минск, 2016. 248 с.
16.5	National statistical Committee of the Republic of Belarus. Environmental protection in the Republic of Belarus. Statistical data book. - Minsk, 2017. 23 pages	Национальный статистический комитет Республики Беларусь. Охрана окружающей среды в Республике Беларусь. Статистический сборник. – Минск, 2017. 235 с.
16.6	Environmental Performance Reviews. Belarus. Third Review. United Nations, New York and Geneva, 2016, 490 pages	Обзоры результативности экологической деятельности. Беларусь. Третий обзор. ООН, ЕЭК. – Нью-Йорк, Женева, 2016. 490 с.
16.7	State of Environment of the Republic of Belarus: Ecological Bulletin for 2015,	Состояние природной среды Беларуси: экол. бюл. 2015 г. – Минск, 2016. – 323 с.

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	Minsk, 323 pages	
16.8	Water bories of the Republic of Belarus. Reference book. Chapter 1: Rivers. Central Research Institute for Complex Use of Water Resources, 2010.	Водные объекты Республики Беларусь. Справочник. Раздел 1. Реки. РУП "ЦНИИКИВР", 2010
16.9	International ecological bulletin of the ecological information centre “Eco-Info” of Kolas Central National Library of the National Academy of Sciences of Belarus No.1 (107), January, 2013, Minsk, Belarus	Международный экологический бюллетень экологического информационного центра "Эко-инфо" ЦНБ им. Я. Коласа НАН Беларуси №1 (107), Январь, 2013, Минск, Беларусь
16.10	Mihkailov V.N., Dobrovolsky A.D. General Hydrology, Moscow, “Higher School”, 1991. – 368 pp.	Михайлов В. Н., Добровольский А.Д. Общая гидрология, Москва, "Высшая школа", 1991. - 368 с.
16.11	Romanovsky V.I., Gurinovich A.D., Bakhmat A.B. The choice of sewage sludge use area in Minsk // Actual issues of construction economics and urban economy: reports of the International Scientific and Practical Conference, May 13-14, 2014, Minsk, BNTU / Belorussian National Technical University, Construction Faculty. – Minsk: BNTU, 2015. Pp 156-162	Романовский В.И., Гуринович А.Д., Бахмат А.Б. Выбор направления использования осадков сточных вод г. Минска // Актуальные вопросы экономики строительства и городского хозяйства: доклады Международной научно-практической конференции, 13-14 мая 2014 года, Минск, БНТУ / Белорусский национальный технический университет, Строительный факультет. - Минск: БНТУ, 2015. С. 156-162
16.12	Gubin V.N. Geoecology of Minsk region. – Minsk: UNIPAK, 2005. 116 pp.	Губин В.Н. и др. Геоэкология Минского региона. - Минск: ЮНИПАК, 2005. 116 с.
16.13	The branch development scheme for water disposal system in Minsk until 2030, developed by Minskinzhproject UE and approved by the decision of the Minsk City Executive Committee No. 2424 of 10/25/2007	Отраслевая схема развития системы водоотведения г. Минска до 2030 года, разработанной УП «Минскинжпроект» и утвержденной решением Мингорисполкома от 25.10.2007 г. №2424
16.14	Research report “Investigation of raw sludge and excess active sludge mixture formed at the Minsk Wastewater Treatment Plant, the yield, composition and energy value of anaerobic digestion” (intermediate) Minsk, 2008.	Отчёт о научно-исследовательской работе "Исследование химического состава смеси сырого осадка и избыточного активного ила, образующихся на Минской очистной станции; выхода, состава и энергетической ценности продуктов их анаэробного сбраживания" (промежуточный) Минск, 2008
16.15	State of Environment of the Republic of Belarus: Ecological Bulletin for 2014, Minsk, 344 pp.: tab.109, fig. 79.	Состояние природной среды Беларуси: экол. бюл. 2014 г. /Под ред. В.Ф. Логинова. – Минск, 2015. –344 с.: табл. 109, рис. 79.
16.16	N.A. Lysykho, D.M. Yeroshina. Wastes of production and consumption, their impact on the environment: a monograph. Minsk: ISEI BSU, 2011 – 210 pp.	Н.А. Лысухо, Д.М. Ерошина. Отходы производства и потребления, их влияние на природную среду: монография. Минск: МГЭУ им. А.Д. Сахарова, 2011. – 210 с.
16.17	“Greening of Belarussian cities”, Ministry of Natural Resources and Environmental Protection, Minsk, 2008	«Озеленение городов Беларуси», Министерство природных ресурсов и охраны окружающей среды, Минск, 2008г.
16.18	“Landscape and recreational areas of Minsk: development perspectives”, E.E. Natievskaya, a collection of scientific works, Issue 6, 2013	«Ландшафтно-рекреационные территории г. Минска: перспективы развития», Е.Е. Натиевская, сборник научных трудов, Выпуск 6., 2013г.
16.19	Environmental state and Nature Management of the City of Minsk”, Minsk City Committee of Natural Resources and Environmental Protection, RUE “Bel Research Facility “Ecology” [compiled by A.A.	«Состояние окружающей среды и природопользование города Минска», Минский городской комитет природных ресурсов и охраны окружающей среды, Республиканское научно-исследовательское унитарное предприятие "Бел НИЦ

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	Savastenko, A.A. Yakovenko]; Minsk, 2011	"Экология"; [сост.: А. А. Савастенко, А. В. Яковенко]; Минск, 2011г.
17	**Online sources / Источники в сети Интернет**	
17.1	Website of Municipal unitary enterprise "Minskvodokanal"	Сайт коммунального унитарное производственное предприятие "Минскводоканал"
17.2	Website of Minsk Regional Executive Committee	Сайт Минского областного исполнительного комитета
17.3	Website of District authority of Zavodskoy district of Minsk	Сайт администрации Заводского района г. Минска
17.4	Website of District authority of Moscow district of Minsk	Сайт администрации Московского района г. Минска
17.5	Website of Ministry of Natural Resources and Environmental Protection of the Republic of Belarus	Сайт Министерства природных ресурсов и охраны окружающей среды Республики Беларусь
17.6	Website of Minsk Regional Committee of Natural Resources	Сайт Минского областного комитета природных ресурсов
17.7	Website of Minsk Municipal Committee of Natural Resources	Сайт Минского городского комитета природных ресурсов и охраны окружающей среды
17.8	Website of Government agency "The Republican Center for Hydrometeorology, Radiation Control and Environmental Monitoring"	Сайт государственного учреждения «Республиканский центр по гидрометеорологии, контролю радиоактивного загрязнения и мониторингу окружающей среды» Минприроды Республики Беларусь
17.9	Informational resource "POGODA.BY"	Информационный ресурс "POGODA.BY"
17.10	Website of the Central statisticak administration of Minsk region	Сайт Главного статистического управления Минской области
17.11	Physico-geographical characteristics of the river Svisloch catchment area	Физико-географическая характеристика водосбора р. Свислочь
17.12	Red List of the Republic of Belarus	Красная книга Республики Беларусь
18	**Stakeholder Engagement / Взаимодействие с заинтересованными сторонами**	
18.1	Protocol of public debate of EIA report on the Minsk Wastewater Treatment Plant reconstruction of 11/20/2015	Протокол общественного обсуждения отчёта об ОВОС по объекту "Реконструкция Минской очистной станции" (Шифр инв. № 14.043) от 20.11.2015 Утверждено зам. главы администрации Заводского района г. Минска Л.А. Балаболовым
18.2	Material of EIA report on the "Reconstruction of the Minsk Wastewater Treatment Station" facility public debate	Материалы общественных обсуждений отчёта об ОВОС по объекту "Реконструкция Минской очистной станции" (шифр инв. № 14.043), 2015
18.3	Interaction with contractor organisations ДП Д СУОТ 04-09-2016	Взаимодействие с подрядными организациями ДП Д СУОТ 04-09-2016, редакция 2. - Минск: УП "Минскводоканал", 2016. - 28 с.
18.4	Record of hearings of Repiblican Problem Engineering center for water supply and disposal of 11/10/2015	Протокол заседания республиканского проблемного инженерного центра водоснабжения и водоотведения, г. Минск, 10.11.2015
18.5	Social inspector for labour protection statement	Положение об общественном инспекторе по охране труда; Утверждено Постановлением № 180 Президиума Совета Федерации профсоюзов Беларуси 25.08.2010
18.6	Message from MVK to EBRD of 01/08/2018	Письмо МВК в ЕБРР от 08.01.2018
19	**State Authorities / Взаимодействие с органами государственной власти**	
19.1	Environmental assessment conclusion No. 9-2015, justification of investments	Заключение №9-2016 государственной экологической экспертизы проектов

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	for reconstrucrion of Minsk Wastewater Treatment Plant Minsk municipal committee of Natural Resources and Envoronmental Protection	Минского городского комитета природных ресурсов и охраны окружающей среды по обоснованию инвестиций по объекту "Реконструкция Минской очистной станции". - Минск: Минский городской комитет природных ресурсов и охраны окружающей среды, 2016. - 26 с.
19.2	Conclusion on investment project, based on local expertise (business-plan of Minsk Wastewater Treatment Plant reconstruction)	Заключение по инвестиционному проету, подготавливаемое по результатам проведения локальной экспертизы инвестиционного проекта (бизнес-план проекта реконструкции очистных сооружений г. Минска). ЧУП "Консалтинговый центр "БКЦ", Минск, 2017. - 8 с.
19.3	Order No. 38 on violation elimination, discovered by the check of 06/05/2017	Предписание №38 об устранении нарушений, установленных в ходе проведения проверки от 5.06.2017 / Алейникова Н.Г., Минский городской комитет природных ресурсов и охраны окружающей среды, 2017. - 3 с.
19.4	Act of planned inspection on environmental protection and rational use of natural resources law compliance, No.38 of 04/06/2017	Акт плановой проверки соблюдения законодательства об охране окружающей среды и рационального использования природных ресурсов №38 от 6.04.2017. Минск: Министерство природных ресурсов и охраны окружающей среды Республики Беларусь, 2017. - 8 с.
19.5	Decision of the Minsk City Executive Committee No. 55 of 01/23/2003	Решение Минского Городского Исполнительного Комитета от 23.01.2003 № 55
19.6	Letter of Zavodskoy district Administration	Письмо Администрации Заводского р-на г. Минска №02-13/4739 от 31.01.2018 об итогах социально-экономического развития Заводского р-на за январь-декабрь 2016 года
20	**Ramboll materials / Материалы Ramboll**	
20.1	Answers for Questionnaire	Ответы УП "Минскводоканал" на вопросник
20.2	Answers for the bank on the Minsk Wastewater Treatment Plant	Ответы Банку по МОС (with EBRD questions)
20.3	From personnel administration	От отдела кадровой работы
20.4	From OHS Department	От отдела охраны труда
20.5	From Ecology and Development Department	От отдела экологии и развития
20.6	From Legal Department	От юрслужбы
20.7	Appendix of OHS Department	Приложение ООТ
20.8	Minskvodokanal Project Summary based on MVK FS	
20.9	Addititonal request and the ansver from Minskvodocanal UE	Дополнительный запрос информации + ответ от Минскводоканала
21	**Permit documentation / Разрешительная документация**	
21.1	Integrated permit №5 of 08/31/2017 Minsk City Committee of Natural Resources and Environmental Protection, 77 pp.	Env Permit КПР № 5 от 31.08.2017 Минский городской комитет природных ресурсов и охраны окружающей среды, 77 с.
22	**Legislation / Нормативно-правовые акты**	
22.1	Construction standards and regulations “Requirements for SPZ of organisations, facilities and other objects that have an impact on human health and environment”	СНИП "Требования к санитарно-защитным зонам организаций, сооружений и иных объектов, оказывающих воздействие на здоровье человека и окружающую среду"
22.2	Hygienic requirements for the SPZ	Гигиенические требования к составу

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	project composition of 12/24/2010, Usage instruction State Institution "Republican Scientific and Practical Center for Hygiene" of the Ministry of Health of the Republic of Belarus, Minsk, 2010	проекта СЗЗ от 24.12.2010, Инструкция по применению Государственное учреждение "Республиканский научно-практический центр гигиены" Министерства здравоохранения Республики Беларусь, Минск, 2010
22.3	Decree of the President of the Republic of Belarus No. 165 of 04/23/2003 "Approval of Minsk city with adjacent areas General plan with some issues of its implementation"	Указ Президента Республики Беларусь от 23.04.2003 №165 "Об утверждении генерального плана г. Минска с прилегающими территориями и некоторых вопросах его реализации"
22.4	Ministry of Health of the Republic of Belarus Resolution No. 17 of 02/12/2012 "Approval of MPD of petroleum products in lands (including soils) for various categories of land	Постановление Министерства здравоохранения Республики Беларусь 12.02.2012 г. № 17/1 Об утверждении предельно допустимых концентраций нефтепродуктов в землях (включая почвы) для различных категорий земель
22.5	Water Code of the Republic of Belarus No. 149-3 of 04/30/2014 (with amendment and addendum, Law of the Republic of Belarus of July 18, 2017 No. 399-3; Law of the Republic of Belarus of July 17, 2017 No. 51-3)	Водный кодекс Республики Беларусь" от 30.04.2014 № 149-З (с изм. и доп., Закон РБ от 18.07.2017 г. № 399-З; Закон РБ от 17.07.2017 г. № 51-З)
22.6	The registry of legal acts, technical legal acts and other requirements applicable to Minskvodokanal UE, which are applicable to identified environmental aspects	Реестр нормативных правовых актов, технических нормативных правовых актов и других требований, распространяющихся на УП "Минскводоканал", которые применимы к идентифицированным экологическим аспектам
22.7	Program for socio-economic development of the Republic of Belarus for 2016-2020, approved by Decree of the President of the Republic of Belarus No 466 of 12/15/2016	Программа социально-экономического развития Республики Беларусь на 2016–2020 годы, утв. Указом Президента Республики Беларусь от 15.12.2016 г. № 466;
22.8	Program for the development of the industrial complex of the Republic of Belarus for the period up to 2020, approved by Decree of the Council of Ministers of the Republic of Belarus No 622 of 07/05/2012	Программа развития промышленного комплекса Республики Беларусь на период до 2020 года, утв. Постановлением Совета Министров Республики Беларусь от 05.07.2012 № 622
22.9	Program for socio-economic development of the Minsk region for the period up to 2020, approved by the decision of the Minsk Regional Council of Deputies No 206 of 04/13/2017	Программа социально-экономического развития Минской области на период до 2020 года, утв. Решением Минского областного Совета депутатов от 13.04.2017 г. № 206
22.10	Program for socio-economic development of Minsk for 2016-2020, approved by the decision of the Minsk Regional Council of Deputies No 275 of 02/28/2017	Программа социально-экономического развития города Минска на 2016-2020 годы, утв. Решением Минского городского Совета депутатов от 28.02.2017 г. № 275
22.11	The State Program for the Development of the Transport Complex of the Republic of Belarus for 2016-2020, Decree of the Council of Ministers of the Republic of Belarus No 345 of 04/28/2016	Государственная программа развития транспортного комплекса Республики Беларусь на 2016—2020 годы, утв. Постановлением Совета Министров Республики Беларусь от 28.04.2016 № 345
22.12	General plan of Minsk city (adjustment), approved by the Decree of the President of the Republic of Belarus No 165 of 04/23/2003 (as amended by Decree of the President of the Republic of Belarus	Генеральный план города Минска (корректировка), утв. Указом Президента Республики Беларусь 23.04.2003 № 165 (в редакции Указа Президента Республики Беларусь 15.09.2016 №344)

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	No 344 of 09/15/2016)	
22.13	State program "Energy Conservation" for 2016-2020, approved by the Decision of the Council of Ministers of the Republic of Belarus No 248 of 03/28/2016	Государственная программа «Энергосбережение» на 2016–2020 годы, утв. постановлением Совета Министров Республики Беларусь от 28.03.2016 г. № 248
22.14	State scheme of complex territorial organization of the Republic of Belarus, approved by Decree of the President of the Republic of Belarus No 19 of 01/12/2007	Государственная схема комплексной территориальной организации Республики Беларусь, утв. Указом Президента Республики Беларусь 12.01.2007 №19
22.15	Decree of the President of the Republic of Belarus no 13 of 01/18/2016 "On the approval of schemes for the integrated territorial organization of districts and general plans for the satellite-cities"	Указ Президента Республики Беларусь от 18.01.2016 № 13 «Об утверждении схем комплексной территориальной организации областей и генеральных планов городов-спутников»
22.16	Decree of the President of the Republic of Belarus no 13 of 03/02/1998 "On the creation of free economic zones "Minsk" and "Gomel-Raton"	Указ Президента Республики Беларусь от 02.03.1998 №93 «О создании свободных экономических зон «Минск» и «Гомель-Ратон»
22.17	State program "Environmental protection and sustainable use of natural resources" for 2016-2020, approved by the Decision of the Council of Ministers of the Republic of Belarus No 205 of 03/17/2016	Государственная программа «Охрана окружающей среды и устойчивое использование природных ресурсов» на 2016 – 2020 годы утв. постановлением Совета Министров Республики Беларусь от 17.03.2016 № 205
22.18	Action plan for rational (sustainable) use of natural resources and environmental protection of the city of Minsk for 2016-2020, approved by the Minsk Regional Council of Deputies No 211 of 06/29/2016	План мероприятий по рациональному (устойчивому) использованию природных ресурсов и охране окружающей среды по г. Минску на 2016-2020 годы, утв. Решением Минского городского Совета депутатов от 29.06.2016 № 211
22.19	Water strategy of the Republic of Belarus for the period up to 2020, approved by Decision of the Board of the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus No 72-P of 08/22/2011	Водная стратегия Республики Беларусь на период до 2020 года, утв. решением коллегии Министерства природных ресурсов и охраны окружающей среды Республики Беларусь 11.08.2011 № 72-Р
23	**In-Process monitoring / Производственный контроль**	
23.1	Characteristics of wastewater (2014-2016)	Характеристика сточных вод (2014-2016)
23.2	Measured values and MPD for discharge to Svisloch river for 2012-2016	Фактические значения и установленные показатели на сброс СВ в р. Свислочь за 2012-2016 гг.
23.3	Table of water quality of the intake No. 6 for 2013-2017	Таблица с результатами анализа качества воды водозабора №6 за 2013-2017 годы
23.4	Water quality table (for 6 spots)	Таблица качества поверхностных вод г. Минск (на 6 точках отбора проб)
23.5	Qualitative description report for the wasterwater of Minsk Wastewater Treatment Plant for 2012-2016	Справка качественной характеристики сточных вод МОС за 2012-2016 годы
23.6	Calculation of standards for the permissible pollutant discharges in the composition of clarified wastewater discharged into the river Svisloch. Minsk, Minskvodokanal UE, 2015. – 16 pp.	Расчёт нормативов допустимого сброса загрязняющих веществ в составе очищенных сточных вод, отводимых в р. Свислочь. Минск, УП, "Минскводоканал", 2015. - 16 с.
23.7	Annual information of probes on water intake No. 6 "Ostrovy"	Годовые сведения об отборах воды на водозаборе №6 "Острова"
23.8	Analysis results on obresvational boreholes network "Volma" of sludge	Результаты анализов сети наблюдательных скважин "Волма" на иловых прудах Волма за

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	ponds Volma for 2017 (including allocation scheme of boreholes)	2017 год (со схемой размещения наблюдательных скважин)
23.9	Qualitative description data on income and outcome waters on Minsk Wastewater Treatment Plant for 2015	Данные о качественных характеристиках поступающих и очищенных сточных вод на Минской очистной станции (МОС) за 2015 г.
23.10	Sources of Minsk WWTP industrial waste	Источники образования отходов производства "Минскводоканал"
23.11	Industrial waste inventory record	Сведения о количестве образующихся отходов производства в сроки проведения инвентаризации УП "Минскводоканал"
23.12	Appendix for industrial waste inventory record for 2016	Приложение к акту инвентаризации отходов производства 2016
23.13	Referrence to the waste composition of sediments on Minsk Wastewater Treatment Plant for 2016 - october 2017	Справка о составе осадка (кек), образовавшегося на МОС в период 2016 - октябрь 2017 г.
23.14	Instruction No.170 of 06/09/2017 for the industrial control implementation in the field of environmental protection, rational use of natural resources in Minskvodokanal UE, Minsk, 2017. 37 pp.	Инструкция по осуществлению производственного контроля в области охраны окружающей среды, рационального использования природных ресурсов в УП "Минскводоканал" №170 от 09.06.2017 УП "Минскводоканал", Минск, 2017. - 37 с.
23.15	Program for in-process monitoring of the atmospheric air on SPZ boundary of the sludge facilities of Minsk Wastewater Treatment Plant and of the adjacent residential area of the Minsk region for 2017 of 03/19/2017	Программа производственного лабораторного контроля атмосферного воздуха на границе санитарно-защитной зоны илового хозяйства Минской очистной станции УП "Минскводоканал" и на территории прилегающей жилой застройки Минского р-на на 2017 год от 19.03.2017
23.16	Program for in-process monitoring of the atmospheric air on habitable territory in the area of Minsk Wastewater Treatment Plant discharge impact for 2017 of 03/15/2017	Программа производственного лабораторного контроля атмосферного воздуха селитебной территории в зоне влияния выбросов Минской очистной станции УП "Минскводоканал" на 2017 год от 15.03.2017
23.17	Sludge composition of Minsk Wastewater Treatment Plant by years 2012-2017	Справка о составе осадка, образовавшегося на МОС по годам 2012 - 2017
24	**Biodiversity / Биоразнообразие**	
24.1	Working diary of flora objects located on the lands of certain categories within the boundaries of the settlement accounting, Minskvodokanal UE	Рабочий дневник учёта объектов растительного мира, расположенных на землях отдельных категорий в границах населённого пункта, УП "Минскводоканал"
24.2	“Flora monitoring”, Ministry of Natural Resources and Environmental Protection, Minsk, 2016	«Мониторинг растительного мира», Министерство природных ресурсов и охраны окружающей среды, Минск, 2016г.
24.3	“Animal resources of the Republic of Belarus”, Khandogiu A.V., Prischepchik O.V., Course of lectures, Educational Institution “International State Environmental university named by A.D. Sakharov, Minsk, 2013	«Животные ресурсы Республики Беларусь», Хандогий А.В., Прищепчик О.В., Курс лекций, Учреждение образования «Международный государственный экологический университет имени А.Д. Сахарова», Минск, 2013г.
24.4	“Birds of the Central Botanical Garden of NAS of the Republic of Belarus, actively populating the city of Minsk”	«Птицы центрального ботанического сада НАН Беларуси, активно заселяющие город Минск»
25	**Geology, landscapes and soils / Геология, ландшафты и почвы**	
25.1	Geology of Belarus. – Minsk: Institute of geological science, NANB, 2001. 816 pp.	Геология Беларуси. - Минск: Институт геологических наук НАНБ, 2001. 816 с.
25.2	Nomenclature list of soils of Belarus / Smeyan N.I. and others, Minsk, 2003. 43 pp.	Номенклатурный список почв Беларуси / Н.И. Смеян и др. Минск: 2003. 43 с.
25.3	Smeyan N.I. Classification, diagnostics and systematic list of soils of Belarus /	Смеян Н.И. Классификация, диагностика и систематический список почв Беларуси /

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	N.I. Smeyan, G.S. Cytron: Institute of Soul Science and Argochemistry. – Minsk, 2007. 220 pp.	Н.И. Смеян, Г.С. Цытрон; Институт почвоведения и агрохимии. – Минск, 2007. 220 с.
25.4	Research report "Assessment of the state and trends of changes in the geological environment and the natural complex for the purpose of justifying environmental protective measures within the "Environmental scheme of Minsk and Minsk Region", Institute for nature management, Minsk, 2007	Отчет НИР «Оценка состояния и тенденций изменения геологической среды и природного комплекса для целей обоснования природоохранных мероприятий в составе «Схемы окружающей среды г. Минска и Минского района», ГНУ «Институт природопользования», Минск, 2007г.
26	**Feasibility study / Технико-экономическое обоснование**	
26.1	Reconstruction of the Minsk Wastewatwer treatment plant. Justification of investments. General Explanatory note. – Minsk, Belcommunproject PRUE, 2015. – 120 pp.	Реконструкция Минской очистной станции. Обоснование инвестиций. Общая пояснительная записка. - Минск: Проектное республиканское унитарное предприятие "БЕЛКОММУНПРОЕКТ", 2015. - 120 с.
26.2	Feasibility study by UE 'BELCOMMUNPROJECT', 2015; last updated in March 2017	Предварительное технико-экономическое обоснование проекта, 2015 Обновлено в марте 2017 г.
26.3	Minsk Vodokanal Technical Feasibility study Gap Analysis Inception report EBRD Contract No. C37622/499/1720/FC741/IPPF-2015-08-05F Sweko Danmark A/S December 2017	Минскводоканал. Технико-экономическое обоснование. Анализ пробелов. Первоначальный отчёт. Контракт ЕБРР №C37622/499/1720/FC741/IPPF-2015-08-05F Sweko Danmark A/S Декабрь 2017
26.4	Minsk Vodokanal Technical Feasibility study Gap Analysis Final Technical Report - Draft Report EBRD Contract No. C37622/499/1720/FC741/IPPF-2015-08-05F Sweko Danmark A/S January 2018	Минскводоканал. Технико-экономическое обоснование. Анализ пробелов. Окончательный технический отчёт – проект отчёта. Контракт ЕБРР №C37622/499/1720/FC741/IPPF-2015-08-05F Sweko Danmark A/S Январь 2018
26.5	Feasibility study review "Organisation of alternative fuel production from the sewage sludge of wastewater treatment plant in Minsk and its use for cement production on Belorussian Cement Plant JSC" (Developer: BNTU)	Отзыв на ТЭО "Организация производства альтернативного топлива из осадков сточных вод очистных сооружений г. Минска и использование его в производстве цементного клинкера на ОАО "Белорусский цементный завод" (Разработчик БНТУ)
26.6	Minsk municipal project for the treatment of sewage sludge Theoretical research and subsequent feasibility study Final report Project No. 1989 516 000 Sweco International AB March, 2010	Минский муниципальный проект по обработке осадков сточных вод Теоретическое исследование и последующее технико-экономическое обоснование Заключительный отчёт Проект № 1989 516 000 Sweco International AB Март 2010
26.7	Letter from Minskvodokanal UE No. 1-27/52 of 02/22/2018, comments on gap analysis report	Письмо УП «Минскводоканал» о рассмотрении отчёта об анализе пробелов №1-27/52 от 22.02.2018
26.8	Letter from Minskvodokanal UE No. 25-1-14/93 of 02/21/2018, comments on technical gap analysis report	Письмо УП «Минскводоканал» о рассмотрении отчёта ТЭО №25-1-14/93 от 21.02.2018

No.	Document title Название документа	Original title (in Russian) Оригинальное название на русском
26.9	Letter from Minskvodokanal UE No. 1-27/52-2 of 02/23/2018, comments on technical gap analysis report	Письмо УП «Минскводоканал» о рассмотрении отчёта ТЭО №1-27/52-2 от 23.02.2018

APPENDIX A
LIST OF THE APPLICABLE LAWS AND REGULATIONS OF THE REPUBLIC OF BELARUS

General requirements for design documentation development

- Law on Architectural, Urban planning and Construction Activity in Belarus, No. 300-Z of 05.07.2004
- GOST 21.001-2013. System of design documentation for construction. General provisions.
- TKP 45-1.02-295-2014 (02250). Construction. Design documentation. Scope and content.
- TKP 45-1.02-298-2014 (02250). Construction. Pre-project (pre-investment) documentation. Scope, development and approval procedures.
- Explanatory notes PZ-02 to construction standards SNB 1.03.02-96. Scope and procedure for the development of the Environmental Protection section of the design/project documentation.
- Resolution of the Council of Ministers of Belarus 'On the approval of the Regulations for the procedure of the State expert review of urban planning projects, architectural and construction projects, stages of such projects, start-up complexes and cost estimate documentation and of the Regulations on the procedure for development and approval of town-planning projects and design documentation', No. 1476 of 08.10.2008.

Requirements for state environmental expert review, environmental and social impact assessment, and project information disclosure

- Law 'On the State environmental review, strategic environmental assessment and environmental impact assessment', No. 399-Z of 18.07.2016.
- Resolution of the Council of Ministers of Belarus 'On the approval of the Regulations for the procedure for public consultations on decisions of environmental significance, environmental impact assessment reports, consideration of adopted decisions of environmental significance, and on amendments and supplements to some resolutions of the Council of Ministers', No. 458 of 14.06.2016.
- Resolution of the Council of Ministers of Belarus No. 24 of 13.01.2017 'On amendments to resolutions of the Council of Ministers No. 687 of 1.07.2011 and No. 458 of 14.07.2016'
- Resolution of the Council of Ministers of Belarus No. 47 of 19.01.2017 "On particular measures for implementation of the Law 'On the State environmental review, strategic environmental assessment and environmental impact assessment', No. 399-Z of 18.07.2016"
- TKP 17.02-08-2012 (02120) 'Procedure for Environmental Impact Assessment (EIA/*OVOS*) and reporting'

General environmental protection requirements

- Law 'On Environmental Protection', No. 1982-XII of 26.11.1992.
- Decree of the President of the Republic of Belarus 'On the criteria for identification of environmentally hazardous economic and other activities', No. 349 of 24.06.2008.
- Resolution of the Council of Ministers of Belarus 'On the approval of the State Programme for Environmental Protection and Sustainable Management of Natural Resources for 2016–2020', No. 205 of 17.03.2016.
- Resolution of the Ministry of Natural Resources and Environmental Protection 'On the approval of the Instruction on the procedure of development and approval of instruction on conducting production control in the field of environmental protection and rational use of natural resources', No. 52 of 08.11.2007
- Resolution of the Ministry of Natural Resources and Environmental Protection 'On particular aspects of accounting for natural resources used, emissions and discharges of pollutants into natural environment, waste management, and other types of adverse environmental impacts', N. 27 of 20.06.2014

- Resolution of the Ministry of Natural Resources and Environmental Protection 'On the approval of the Instruction on the procedure of maintenance of an Ecological (Environmental) Passport of the enterprise', No. 25 of 07.06.2013
- Resolution of the Ministry of Natural Resources and Environmental Protection 'On certain aspects of control in the field of environmental protection and rational use of natural resources', No. 56 of 29.12.2011
- Resolution of the Ministry of Natural Resources and Environmental Protection 'On the approval and entry into force of the technical regulation', No. 1-T of 05.01.2012
- TKP 17.13-14-2014 (02120) Environmental Protection and Management of Natural Resources. Analytical control and monitoring. General principles.

Air Protection Requirements

- Law 'On Air Protection', No. 2-Z of 16.12.2008.
- Resolution of the Council of Ministers of Belarus 'On the approval of the Regulations on the procedure for issuing of permits for pollutant air emissions, introduction of changes and/or supplements to these permits, suspension, renewal and extension of the effective period of the permits, and cancellation of permits', No. 664 of 21.05.2009.
- State Standard STB 17.08.02-01-2009. Environmental Protection and Management of Natural Resources. Atmospheric Air. Air pollutants. Codes and list.
- Resolution of the Ministry of Natural Resources and Environmental Protection 'On the approval of the list of pollutants, categories of air impact sources (facilities) subject to the establishing of permissible air emission limits, and of the list of air impact sources (facilities) which do not require establishing of permissible air emission limits, and on the annulment of the Resolution of the Ministry of Natural Resources and Environmental Protection dated 28.02.2005', No. 31 of 29.05.2009.
- Resolution of the Ministry of Natural Resources and Environmental Protection 'On the approval of the Instruction on the procedure for inventory of air pollution emissions', No. 42 of 23.06.2009
- Resolution of the Ministry of Natural Resources and Environmental Protection 'On the approval of the Instruction on the procedure for establishing the permissible air emission limits and on the annulment of the certain resolutions of the Ministry of Natural Resources and Environmental Protection', No. 43 of 23.06.2009
- Resolution of the Ministry of Healthcare of the Republic of Belarus 'On the approval and entry into force of the limit values for the maximum permissible concentrations of air pollutants and approximate permissible/safe levels of exposure to polluting substances in the ambient air of settlements and public recreational areas and on the annulment of the certain resolutions of the Ministry of Healthcare of the Republic of Belarus', No. 113 of 08.11.2016.
- Resolution of the of the Ministry of Healthcare of the Republic of Belarus 'On the establishment of the hazard classification for air pollutants and on the assignment of air pollutants to specific hazard classes' No.174 of 21.12.2010.
- Resolution of the of the Ministry of Healthcare of the Republic of Belarus 'On approval of the requirements to sanitary protection zones of organisations, facilities and other objects that have impact on human health and environment' No. 91 of 11.10.2017.

Soil and Subsurface

- Land Code of the Republic of Belarus, Law No. 425-Z of 23.07.2008.
- Subsurface Code of the Republic of Belarus, Law No. 406-Z of 14.07.2008.
- Resolution of the Council of Ministers of Belarus 'On certain issues in relation to prevention of land degradation (including soils)', No. 361 of 29.04.2015

- GOST 17.4.3.04-85. Environmental Protection. Soil. General requirements for control and protection from pollution.
- GOST 17.4.3.02-85. Environmental Protection. Soil. Requirements for conservation of fertile topsoil during execution of earth-moving work.
- GOST 17.5.3.04-83. Environmental Protection. Land. General reclamation and rehabilitation requirements.
- Resolution of the Chief Sanitary Inspector of the Republic of Belarus 'On the approval of health (hygiene) standards 2.1.7.12-1-2004: Maximum permissible concentrations (MPC) and approximate permissible concentrations (APC) of chemical substances in soil', No. 28 of 25.02.2004.
- Resolution of the Ministry of Healthcare 'On the approval of the health standard for 'Approximate permissible concentration of ammonium nitrogen in soil for all land categories', No. 1 of 04.01.2014.
- Resolution of the Ministry of Healthcare 'On the approval of the limit values for the maximum permissible levels of total mercury and arsenic in soil of different functional areas within settlements', No. 107 of 04.08.2010.
- Resolution of the Ministry of Healthcare 'On the approval of the limit values for the maximum permissible levels of active forms of nickel, copper and total lead in soil of different functional areas within settlements', No. 125 of 19.11.2009.
- Resolution of the Ministry of Healthcare 'On the approval of the health standards for maximum permissible levels of active forms of zinc, chromium, and cadmium in soil of different functional areas within settlements, in land areas designated for use by industry, transport, communication, energy, defense or other purposes', No. 187 of 06.11.2008.
- Resolution of the Ministry of Healthcare the Republic of Belarus «On the approval of maximum permissible levels of petroleum products in in soil for different land categories' No. 44 of 29.04.2009.
- Health standards. 12.03.2012 No. 17/1. Maximum permissible levels of petroleum products in soil for different land categories.
- Order of the State Committee on Land Resources, Geodesy and Cartography 'On the approval of the Regulations on the procedure for the handover of rehabilitated land plots to land owners and land users by economic entities engaged in extraction of minerals and peat or in geological exploration, survey and other works associated with disturbance of soil cover', No. 22 of 25.04.1997.
- Order of the State Committee on Land Resources, Geodesy and Cartography 'On the approval of Regulations on removal, use, and conservation of fertile topsoil during execution of works associated with disturbance of soil' No. 01-4/78 of 24.05.1999

Surface Water and Groundwater

- Water Code of the Republic of Belarus, Law No. 149-Z of 30.04.2014.
- STB 17.06.03-01-2008. Environmental Protection and Management of Natural Resources. Hydrosphere. Protection of Surface Waters from Pollution. General Requirements.
- STB 17.1.3.06-2006. Environmental Protection. Hydrosphere. Protection of Groundwater from Pollution. General Requirements.
- SanPiN 2.1.2.12-33-2005. Health requirements for protection of surface water from pollution.
- Resolution of the Ministry of Natural Resources and Environmental Protection 'On the introduction of water quality standards for surface water bodies', No. 13 of 30.03.2015.
- Resolution of the Ministry of Healthcare of the Republic of Belarus of 05.12.2016 № 122 'On approval of sanitary norms and rules 'Requirements to the keeping of the surface water bodies in

terms of their recreational use', hygienic standard 'valid values for the safety indicators of water from surface water bodies for recreational use', and a recognition of becoming invalid for the resolution of the Ministry of Healthcare of the Republic of Belarus of December 30, 2008 No. 238.

- Health (hygiene) standards GN 2.1.5.10-20-2003. Approximate permissible levels (APL) of chemical substances in the water of water bodies used for domestic and drinking water supply and recreational purposes.
- Health (hygiene) standards GN 2.1.5.10-21-2003. Maximum permissible concentrations (MPC) of chemical substances in the water of water bodies used for domestic and drinking water supply and recreational purposes.
- Health (hygiene) standards GN 2.1.5.10-29-2003. Maximum permissible concentrations (MPC) and Approximate permissible levels (APL) of chemical substances in the water of water bodies used for domestic and drinking water supply and recreational purposes.
- Resolution of the Ministry of Healthcare of the Republic of Belarus of 16.12.2016 No. 125 'On approval of sanitary norms and rules 'Health (sanitary and epidemiological) Requirements for protection of groundwater bodies used for drinking water supply from pollution'.
- Resolution of the Ministry of health of the Republic of Belarus of 'On approval of sanitary norms and rules 'Sanitary norms and rules 'Requirements for organization of sanitary protection zones for sources and centralized systems of drinking water supply' and on the annulment of Resolution No. 1 of the Chief Sanitary Inspector of the Republic of Belarus of 06.01.1999', No. 142 of 30.12.2016.

Flora and fauna, specially protected animal and plant species

- Law 'On Fauna', No. 257-Z of 10.07.2007.
- Law 'On Flora, No. 205-Z of 14.06.2003.
- Resolution of the Council of Ministers of Belarus 'On certain aspects of management of wild animals and plants', No. 638 of 18.05.2009.
- Resolution of the Ministry of Natural Resources and Environmental Protection 'On the approval of the lists of rare and endangered species of wild animals and plants that will be included into the Red Book of the Republic of Belarus', No. 26 of 09.06.2014.
- Resolution of the Council of Ministers of Belarus 'On certain aspects of management of wild plants', No. 1426 of 25.10.2011.
- Resolution of the Council of Ministers of Belarus 'On the approval of the Regulations on the procedure for the estimation and payment of compensations', No. 168 of 07.02.2008.
- TKP 17.05-01-2014 (02120). Environmental Protection and Management of Natural Resources. Flora. Regulations for the protection of wild plant species listed in the Red Book of the Republic of Belarus, including habitats of these plants.
- TKP 17.07-01-2014 (02120). Environmental Protection and Management of Natural Resources. Fauna. Regulations for the protection of wildlife species listed in the Red Book of the Republic of Belarus, including habitats of these animals.

Specially Protected Natural Areas

- Law 'On Specially Protected Natural Areas', No. 3335-XII of 20.10.1994.
- Resolution of the Council of Ministers of Belarus 'On the approval of the Regulation on the procedure of conduction of integrated monitoring of natural ecological systems within specially protected natural areas, on amendments and supplements to resolutions of the Council of Ministers of Belarus, and the annulment of the Resolution of the Council of Ministers of Belarus No. 1657 of 04.11.2008'.
- Resolution of the Council of Ministers of Belarus 'On the expansion of the system of specially protected natural areas', No. 649 of 02.07.2014.

- Resolution of the Ministry of Natural Resources and Environmental Protection 'On the approval of the guidelines for the assessment and introduction of limit values for permissible load on specially protected natural areas', No. 129 of 30.12.2008.
- Resolution of the Ministry of Natural Resources and Environmental Protection 'On the declaration of fine wood forest areas natural monuments of national importance', No. 41 of 05.05.2007.
- Resolution of the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus 'On certain aspects of specially protected natural areas' No 94 of 29.11.2008.
- Decree of the President of the Republic of Belarus 'On certain aspects of development of specially protected natural areas' No. 59 of 09.02.2012
- Resolution of the Council of Ministers of Belarus 'On the approval of the Regulations on the procedure for maintenance of the register of specially protected natural areas of the Republic of Belarus and for provision of information services regarding its content', No. 826 of 05.10.2015

Radiation safety and noise impacts

- Law 'On the Legal Status of Areas Affected by Radioactive Contamination from the Chernobyl Disaster', No. 385-Z of 26.05.2012.
- Law 'On Radiation Safety of Population', No. 122-Z of 05.01.1998.
- Resolution of the Council of Ministers of Belarus 'On the approval of the list of settlements and assets located within areas of radioactive contamination and on the annulment of some previous resolutions of the Council of Ministers', No. 9 of 11.01.2016.
- Resolution of the Ministry of Healthcare 'On the approval of SanPiN 'Radiation safety requirements for the execution of work within areas of radioactive contamination' and on the amendments to Resolution of the Ministry of Healthcare No. 211 of 28.12.2012', No. 89 of 02.07.2015.
- Resolution of the Ministry of Healthcare on the approval of SanPiN 'Radiation safety requirements' and GN 'Criteria for the assessment of radiation impact', No. 213 of 28.12.2012
- TKP 45-2.03-134-2009 (02250). Procedure for examination and criteria for the assessment of radiation safety of construction sites, buildings and structures
- Resolution of the Ministry of Healthcare on the approval of the sanitary standards, regulations, and health standards 'Noise at workplaces, in vehicles, inside residential and public buildings, and in residential areas' and on the annulment of certain resolutions of the Chief Sanitary Inspector of the Republic of Belarus', No. 115 of 16.11.2011.
- TKP 45-2.04-154-2009 (02250). Noise protection. Construction design standards

Waste management regulations

- Law 'On Waste Management', No. 271-Z of 20.07.2007
- Resolution of the Council of Ministers of Belarus 'On certain waste management issues', No. 1104 of 23.07.2010
- Resolution of the Ministry of Natural Resources and Environmental Protection 'On the approval of the classification catalogue of waste generated in the Republic of Belarus', No. 85 of 08.11.2007
- Resolution of the Ministry of Healthcare of the Republic of Belarus of 'On approval of sanitary norms and rules 'Requirements for the management of industrial and consumer waste', and on the annulment of certain resolutions of the Chief Sanitary Inspector of the Republic of Belarus', No. 143 of 30.12.2016.
- Resolution of the Ministry of Natural Resources and Environmental Protection 'On the approval of the Instruction on the procedure of development and approval of instruction on industrial waste management', No. 45 of 22.10.2010
- Decree of the President of the Republic of Belarus 'On certain aspects of consumer waste management' No. 313 of 11.07.2012

- Resolution of the Ministry of Natural Resources and Environmental Protection, the Ministry of Healthcare, and the Ministry of Emergency Situations the Republic of Belarus 'On the approval of the Instruction on the procedure of establishing the level of hazard of industrial waste and the hazard class of the hazardous industrial waste', No. 3/13/2 of 17.01.2008
- Resolution of the Ministry of Housing and Communal Services of the Republic of Belarus 'On the approval of the instruction on the organization of separate collection, storage, and transportation of municipal waste', No. 26 of 30.06.2003.

General health and safety requirements

- Law 'On the Sanitary and Epidemiological Well-being of Population', No. 340-Z of 07.01.2012.
- Law 'On Industrial Safety', No. 345-Z of 05.01.2016.
- TKP 45-1.03-40-2006 (02250). Safety of labour in construction. General requirements.
- Labour Code of the Republic of Belarus, Law No. 296-Z of 26.07.1999.
- Law 'On Labour protection', No. 356-Z of 23.06.2008.
- STB 18001-2009 'Labor Protection Management Systems. Requirements'

Land use regulations

- Land Code of the Republic of Belarus, Law No. 425-Z of 23.07.2008.
- Decree of the President of the Republic of Belarus 'On withdrawal and allocation of land plots', No. 667 of 27.12.2007.
- Decree of the President of the Republic of Belarus 'On certain measures for improvement of practices in relation to withdrawal, allocation and use of land plots', No. 431 of 23.09.2011.
- Resolution of the Council of the Republic of the National Assembly of the Republic of Belarus on the Decree of the President of the Republic of Belarus No. 10 of 06.08.2009 'On creating additional conditions for investment activity in the Republic of Belarus', No 141-SR4/III of 22.10.2009.

Forest protection

- Forest Code of the Republic of Belarus, Law No. 332-Z of 24.12.2015.
- Resolution of the Ministry of Forestry of the Republic of Belarus 'On the approval of regulations on the management of forests within the territories affected by Radioactive Contamination from the Chernobyl Disaster and on the annulment of certain resolutions of the Ministry of Forestry of the Republic of Belarus', No.86 of 27.12.2016.
- Resolution of the Ministry of Forestry of the Republic of Belarus 'On the approval of Sanitary rules for the forests in Republic of Belarus', No.79 of 19.12.2016.
- TKP 143-2008 (02080). Tree cutting regulations.
- TKP 026-2006 (02080). Sustainable forest management and use. Sanitary regulations for forests.
- TKP 047-2009 (02080). Sustainable forest management and use. Guidelines for restoration and cultivation of forests in the Republic of Belarus.

Cultural heritage

- Culture Code of the Republic of Belarus, Law No. 413-Z of 20.07.2016 (will come into effect from 02.01.2017).
- Resolution of the Council of Ministers of the Republic of Belarus 'On the status of historical and cultural values', No. 578 of 14.05.007.
- Resolution of the Council of Ministers of Belarus "On conducting particular administrative procedures in the field of culture', No. 21 of 12.01.2017.
- Resolution of the Ministry of Defense of the Republic of Belarus 'On the approval of the Instruction on the procedure of accounting for and relocation of the military burial sites and burial sites of the

victims of war, registering of the burial sites of the foreign military personnel within the territory of the Republic of Belarus, and maintenance of computerized data banks', No.17 of 09.08.2016.

- Resolution of the Ministry of Culture of the Republic of Belarus 'On the approval of the designed areas designated for the protection of historical and cultural values', No. 30 of 21.06.2007

Design of municipal water supply and drainage facilities, including sewage sludge disposal

- Resolution of the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus 'On certain aspects of regulation of discharges of waste water containing chemical and other substances', No. 16 of 26.05.2017.
- TKP 45-4.01-53-2012 (02250). 'Community sewage systems. Key provisions and general requirements. Construction design standards'.
- TKP 45-4.01-57-2012 (02250) 'Storm water drainage systems. Construction design standards'.
- TKP 45-4.01-51-2007 'Water supply and sewage systems of homestead type residential houses. Design standards'.
- TKP 17.06-08-2012 (02120) 'Environmental protection and management of natural resources. Hydrosphere. Procedure of establishing the limit values for permissible discharges of wastewater containing chemical and other substances'.
- Resolution of the Ministry of Healthcare of the Republic of Belarus 'On the approval of Sanitary norms and rules 'Requirements to community sewage/drainage systems' and on the annulment of Resolution No. 227 of the Chief Sanitary Inspector of the Republic of Belarus of 05.12.2005', No.48 of 15.05.2012.

APPENDIX B
PHOTOLOG OF THE PROJECT AND ADJOING AREAS

APPENDIX C
TECHNICAL APPENDICES

Table C.5.1 Average pollution levels at hydrochemical monitoring station in Podlosje

Parameter	2011	2012	2013	2014	2015	MPC
Suspended solids, mg/dm^3	12.1	12.06	7.55	8.51	9.25	25
Dissolved oxygen, mg/dm^3	11.2	8.02	7.64	8.16	9.41	4
Bichromate oxidability, mgO_2/dm^3	29.9	13	13.66	20.3	20.23	30
BOD_5, mgO_2/dm^3	3.31	2	2.53	2.42	2.17	6
Ammonium ion, mg/dm^3	0.33	0.21	0.24	0.26	0.26	0.39
Nitrite ion, mg/dm^3	0.03	0.02	0.02	0.02	0.02	0.08
Phosphate ion, mgP/dm^3	0.02	0.03	0.03	0.02	0.02	0.066
Total iron, mg/dm^3	0.35	0.47	0.39	0.4	0.37	0.270
Copper, mg/dm^3	0	0.008	0.008	0.011	0.011	0.0045
Zinc, mg/dm^3	0.02	0.015	0.012	0.014	0.025	0.016
Nickel, mg/dm^3	0	<d.l.	<d.l.	<d.l.	<d.l.	0.034
Petroleum products, mg/dm^3	0.05	0.044	0.038	0.047	0.034	0.05
Synthetic surfactants, mg/dm^3	0.03	0.06	0.06	0.058	0.057	0.1
Water pollution index	1	0.7	0.7	-	-	
Hydrochemical status	-	-	-	good	good	

Source: National Water Cadastre of the Republic of Belarus

Table C.5.2. Maximum pollution levels in River Svisloch (hydrochemical monitoring station in Podlosje)

Parameter	2011	2012	2013	2014	2015	MPC
Suspended solids (maximum), mg/dm^3	34.9	27	9.7	10.8	9.9	25
Dissolved oxygen (maximum), mg/dm^3	14.93	9.7	8.2	9.6	11.6	4
Bichromate oxidability (maximum), mgO_2/dm^3	48.88	17.7	19.1	29.3	22.5	30
BOD_5 (maximum), mgO_2/dm^3	4.99	2.53	2.84	2.85	2.37	6
Ammonium ion, mg/dm^3	0.81	0.47	0.31	0.31	0.41	0.39
Nitrite ion, mg/dm^3	0.052	0.021	0.027	0.026	0.024	0.08
Phosphate ion, mgP/dm^3	0.041	0.046	0.039	0.033	0.029	0.066

Parameter	2011	2012	2013	2014	2015	MPC
Total iron (maximum), mg/dm^3	0.53	0.93	0.401	0.471	0.447	0.270
Copper (maximum), mg/dm^3	0.007	0.016	0.012	0.015	0.019	0.0045
Zinc (maximum), mg/dm^3	0.021	0.025	0.014	0.019	0.029	0.016
Nickel (maximum), mg/dm^3	0.003	0	0	0	0	0.034
Petroleum products (maximum), mg/dm^3	0.095	0.08	0.05	0.08	0.05	0.05
Synthetic surfactants (maximum), mg/dm^3	0.049	0.06	0.08	0.069	0.065	0.1

Source: National Water Cadastre of the Republic of Belarus

Table C.5.3: Average pollution levels at hydrochemical monitoring station in Korolischevichi

Parameter	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	MPC
Suspended solids, mg/dm^3	15.4	17.81	15.3	16.3	19.3	12.7	15.5	14.5	14.65	13.36	19.24	17.62	11.3	9.43	10.87	12.48	25
Dissolved oxygen, mg/dm^3	6.66	6.51	7.42	7.76	8.29	8.32	8.11	8.17	7.81	8.63	8.11	7.5	8.45	7.33	7.84	6.7	4
Bichromate oxidability, mgO_2/dm^3	33.5	40.49	39.8	43.4	31.9	31.3	29.8	31.3	39.6	50.42	32.73	32.41	16.3	14.31	21.2	29.28	30
BOD_5, mgO_2/dm^3	5.7	6.09	6.42	7.75	5.96	6.63	5.47	4.57	5.05	5.68	7.31	7.02	3.85	3.94	4.41	3.79	6
Ammonium ion, mg/dm^3	1.88	5.07	5.48	5.95	4.79	3.82	4.26	4.08	3.06	2.38	2.55	2.63	0.61	0.49	1.55	2.07	0.39
Nitrite ion, mg/dm^3	0.087	0.15	0.185	0.223	0.251	0.375	0.384	0.211	0.179	0.13	0.13	0.21	0.03	0.04	0.1	0.09	0.08
Phosphate ion, mgP/dm^3	0.427	0.5	0.564	0.58	0.272	0.213	0.348	0.578	0.417	0.72	0.53	0.57	0.12	0.03	0.29	0.37	0.066
Total iron, mg/dm^3	0.23	0.27	0.25	0.4	0.37	0.29	0.32	0.41	0.18	0.51	0.46	0.38	0.51	0.4	0.41	0.42	0.27
Copper, mg/dm^3	0.011	0.007	0.009	0.008	0.009	0.008	0.008	0.005	0.004	0.009	0.007	0.005	0.007	0.01	0.015	0.015	0.005
Zinc, mg/dm^3	0.042	0.024	0.036	0.053	0.046	0.049	0.034	0.025	0.025	0.038	0.044	0.036	0.015	0.014	0.017	0.034	0.016
Nickel, mg/dm^3	0.01	0.009	0.014	0.016	0.015	0.013	0.008	0.009	0.006	0.005	0.004	0.003	<d.l.	<d.l.	<d.l.	<d.l.	0.034
Petroleum products mg/dm^3	0.06	0.051	0.09	0.12	0.12	0.12	0.08	0.06	0.07	0.07	0.081	0.09	0.061	0.046	0.072	0.06	0.05
Synthetic surfactants, mg/dm^3	0.062	0.106	0.091	0.072	0.069	0.075	0.066	0.065	0.053	0.036	0.033	0.036	0.076	0.062	0.07	0.076	0.1
Water pollution index	3.3	5.3	6	6.7	5.5	5.8	6.2	5.4	4.4	4.6	4.3	5	1.5	1.2	-	-	
Hydrochemical status	-	-	-	-	-	-	-	-	-	-	-	-	-	-	satisf.	satisf.	

Source: National Water Cadastre of the Republic of Belarus[101]

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101 http://www.cricuwr.by/gvk/default.aspx

Table C.5.4: Maximum pollution levels at hydrochemical monitoring station in Korolischevichi

Parameter	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	MPC
Suspended solids, mg/dm^3	22.4	42.8	47.3	30	98.5	34.2	30.4	27.9	36.9	27.2	32	48.4	13.2	12.8	16.2	15.2	25
Dissolved oxygen, mg/dm^3	9.53	9.22	9.98	9.86	10.5	11.5	10.31	12.22	10.86	12.1	11.35	10.66	12.99	8.7	9.8	9.86	4
Bichromate oxidability, mgO_2/dm^3	52.4	65.4	63.4	90.6	47.1	43.9	57.9	63.6	59.8	80.9	71.8	38.5	23.2	19.8	29.2	30.8	30
BOD_5, mgO_2/dm^3	7.18	7.32	8.4	14.5	10.1	15.46	9.7	7.33	13.65	9.92	8.61	10.99	5.71	4.41	5.04	4.12	6
Ammonium ion, mg/dm^3	4.08	8.72	12.44	14.65	19.6	7.65	11.65	5.3	5.8	5.63	4.57	3.58	0.94	0.87	2.03	2.66	0.39
Nitrite ion, mg/dm^3	0.206	0.34	0.47	0.61	0.63	0.65	0.69	0.415	0.294	0.285	0.23	0.373	0.08	0.149	0.284	0.181	0.08
Phosphate ion, mgP/dm^3	0.65	0.76	1.17	1.45	0.955	0.92	1.86	1.36	1.643	1.693	1.71	1.07	0.295	0.046	0.516	0.516	0.066
Total iron, mg/dm^3	0.42	0.49	0.51	1.47	1.24	0.71	0.85	3.38	0.61	0.8	1.08	0.8	0.82	0.422	0.455	0.511	0.27
Copper, mg/dm^3	0.018	0.013	0.02	0.02	0.027	0.018	0.022	0.011	0.006	0.014	0.015	0.014	0.014	0.014	0.02	0.025	0.005
Zinc, mg/dm^3	0.084	0.04	0.062	0.176	0.11	0.157	0.07	0.057	0.038	0.062	0.087	0.069	0.028	0.016	0.024	0.043	0.016
Nickel, mg/dm^3	0.019	0.018	0.022	0.033	0.038	0.028	0.019	0.021	0.015	0.013	0.007	0.005	0	0	0	0	0.034
Petroleum products mg/dm^3	0.12	0.11	0.17	0.48	0.31	0.24	0.21	0.13	0.11	0.16	0.19	0.188	0.103	0.07	0.09	0.104	0.05
Synthetic surfactants, mg/dm^3	0.15	0.285	0.18	0.17	0.3	0.24	0.11	0.117	0.078	0.058	0.052	0.053	0.108	0.07	0.08	0.086	0.1

Source: National Water Cadastre of the Republic of Belarus

Table C.5.5: Average pollution levels at hydrochemical monitoring station in Svisloch settlement.

Parameter	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	MPC
Suspended solids, mg/dm^3	7.3	7.95	6.9	14.3	9.8	7.9	8.6	8.6	9.5	8.04	7.53	8.57	9.4	7.73	6.78	6.15	25
Dissolved oxygen, mg/dm^3	8.95	8.17	8.23	9.46	7.7	7.33	7.09	7.77	7.01	6.82	7.41	7.98	8.09	7.49	7.51	8.36	4
Bichromate oxidability, mgO_2/dm^3	38.8	39.98	36.8	24.1	24.8	35	24	22.1	28.93	24.57	42.03	33.53	26.3	31.47	29.46	32.93	30
BOD_5, mgO_2/dm^3	3.66	2.99	4.13	4.16	2.65	2.37	2.42	2.87	2.61	2.45	2.27	2.13	2.74	3.1	3.06	3.27	6
Ammonium ion, mg/dm^3	0.82	0.98	1.01	0.88	1.11	0.94	1.29	0.67	0.52	0.57	0.83	0.48	0.57	0.66	0.69	0.61	0.39
Nitrite ion, mg/dm^3	0.028	0.11	0.085	0.094	0.054	0.057	0.054	0.067	0.052	0.06	0.03	0.02	0.1	0.04	0.06	0.08	0.08
Phosphate ion, mgP/dm^3	0.19	0.1	0.114	0.473	0.205	0.193	0.22	0.198	0.155	0.19	0.14	0.12	0.14	0.13	0.14	0.2	0.066
Total iron, mg/dm^3	0.29	0.34	0.46	0.44	0.34	0.32	0.18	0.22	0.36	0.56	0.66	0.35	0.62	0.38	0.45	0.33	0.27
Copper, mg/dm^3	0.009	0.01	0.006	0.009	0.007	0.006	0.005	0.005	0.004	0.008	0.006	0.015	0.002	0.002	0.005	0.002	0.005
Zinc, mg/dm^3	0.036	0.029	0.026	0.026	0.016	0.021	0.018	0.016	0.007	0.008	0.011	0.017	0.014	0.012	0.018	0.026	0.016
Nickel, mg/dm^3	0.009	0.008	0.008	0.01	0.01	0.013	0.008	0.006	0.005	0.004	0.006	0.004	<d.l.	<d.l.	<d.l.	<d.l.	0.034
Petroleum products, mg/dm^3	0.03	0.029	0.08	0.03	0.04	0.03	0.05	0.02	0.04	0.03	0.026	0.009	0.062	0.036	0.047	0.022	0.05
Synthetic surfactants, mg/dm^3	0.04	0.046	0.039	0.037	0.028	0.058	0.029	0.019	0.032	0.078	0.035	0.044	<d.l.	0.016	0.026	0.024	0.1
Water pollution index	1.6	1.9	2	2.8	1.8	1.6	1.9	1.6	1.4	1.5	1.3	0.9	1.8	1.4	-	-	
Hydrochemical status	-	-	-	-	-	-	-	-	-	-	-	-	-	-	satisf.	satisf.	

Source: National Water Cadastre of the Republic of Belarus

Table C.5.6: Maximum pollution levels at hydrochemical monitoring station in Svisloch settlement

Parameter	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	MPC
Suspended solids, mg/dm^3	13.9	19.4	15.5	32.4	24.6	15.3	21.9	27	13.9	12.4	13.6	15.4	27	12.5	9	9.6	25
Dissolved oxygen, mg/dm^3	12.62	11.01	13.03	12.37	11.42	9.49	9.16	10.53	8.32	8.74	9.4	9.59	9.87	9.46	11	12.3	4
Bichromate oxidability, mgO_2/dm^3	58.5	60	74.7	37.3	50.5	79.1	31.8	28.2	69.2	79.3	71.4	48.4	34.4	39.6	38.9	46.6	30
BOD_5, mgO_2/dm^3	4.87	5.49	6.44	7.13	5.09	3.92	3.71	4.16	3.13	3.3	3.56	2.94	3.48	3.61	4.27	4.66	6
Ammonium ion, mg/dm^3	3.31	2.9	4.86	2.24	3.04	2.56	3.72	1.41	1.31	1.31	1.9	1.36	1.5	1.15	1.19	1.99	0.39
Nitrite ion, mg/dm^3	0.054	0.28	0.38	0.18	0.149	0.118	0.127	0.263	0.068	0.115	0.078	0.051	0.198	0.069	0.163	0.182	0.08
Phosphate ion, mgP/dm^3	0.332	0.223	0.37	1.28	0.389	0.273	0.308	0.274	0.244	0.373	0.265	0.249	0.255	0.208	0.267	0.258	0.066
Total iron, mg/dm^3	0.52	0.63	1.01	0.9	0.688	1.23	0.3	0.52	0.71	1.13	1.35	0.52	0.89	0.64	0.594	0.491	0.27
Copper, mg/dm^3	0.012	0.021	0.018	0.013	0.019	0.01	0.008	0.012	0.01	0.022	0.013	0.053	0.004	0.003	0.014	0.004	0.005
Zinc, mg/dm^3	0.042	0.055	0.046	0.086	0.103	0.051	0.061	0.044	0.013	0.019	0.03	0.032	0.025	0.025	0.034	0.046	0.016
Nickel, mg/dm^3	0.01	0.01	0.013	0.013	0.015	0.022	0.014	0.015	0.009	0.013	0.017	0.019	0	0	0	0	0.034
Petroleum products mg/dm^3	0.06	0.07	0.35	0.13	0.25	0.08	0.15	0.04	0.15	0.04	0.11	0.04	0.16	0.05	0.236	0.049	0.05
Synthetic surfactants, mg/dm^3	0.104	0.112	0.109	0.095	0.049	0.297	0.079	0.032	0.044	0.268	0.092	0.071	0	0.031	0.044	0.061	0.1

Source: National Water Cadastre of the Republic of Belarus

Table C.5.7: Wastes on the construction stage

Waste type	Potential impact	Impact mitigation measures
Non-hazardous and low-hazard construction waste		
Ground excavations not contaminated with hazardous substances (code 3141101)	Environmental pollution during the washout with surface runoff and water ingress to surface water bodies Fugitive dust emissions. Land plot occupation for dump ground and excavated materials placement. Visual impact cawaste by inappropriate waste storage	Temporary storage on the area for further use or removal. Surplus of wastes are to be placed at the ground placements areas or waste for site leveling. Equipped platforms for dumping ground storage, slopes and dumps stabilization.
Cement waste in lump form (code 3143601)	Fugitive dust emissions. Placement on a landfill where it is impossible to use or restore materials. Visual impact cawaste by inappropriate waste storage Mileage increase when transporting waste from the Project site.	Usage on other work areas or return of unused cement to the supplier will minimize the amount of waste. Cement mortar must be dried. Dehydrated waste can be crushed and waste in road construction or as a filler, or buried at a city landfill. Soils contaminated with cement can also be waste as a covering material on landfills. Excessive amounts of generated such waste will be handled to the contractor for recycling or final disposal.
Other solutions and Flush waters (code 5274900)	Environmental pollution when ingress soils and water	Flush waters from the cement, if it's possible, must be waste on the site. The process of on-site concrete preparation must provide for the recirculation of the Flush water. Surplus Flush waters must be stored and evaporated. Flush water that can not be waste directly will be stored in an open trench with lining or in open tanks to ensure precipitation or other desired treatment on the site. The remaining flush water must be properly cleared (removal of particulate matter by filtration or sedimentation and pH-correction in range 6-9) before discharge into surface water bodies, if the appropriate permit is approved.
Scrap metal	Fugitive dust emissions.	Transporting to Minsk workshop of UE "Minskavtormet" for recycling.

Waste type	Potential impact	Impact mitigation measures
(code 3510900)	Placement on a landfill where it is impossible to use or restore materials. Mileage increase when transporting waste from the Project site.	
Scrap silica brick (code3144206) Broken ceramic tiles(code 3140702)	Large volumes of waste production Visual impact Placement on a landfill where the wastes cannot be separated and waste. Mileage increase when transporting waste from the Project site.	Transporting to the crushing and sorting complex of JV "Ecoshcheben" (Minsk region, village Kopishche) for recycling.
Plastic package (code 57111800)	Placement on a landfill where the wastes cannot be separated and waste. Visual impact cawaste by inappropriate waste storage Mileage increase when transporting waste from the Project site.	Transporting to the contractor for recycling.
Wooden containers and unpolluted wooden waste (code 1720100)	Placement on a landfill where the wastes cannot be separated and waste. Mileage increase when transporting waste from the Project site.	Transporting to the contractor for restoration or recycling.
Other glass scrap (code 3140899)	Placement on a landfill where the wastes cannot be separated and waste. Mileage increase when transporting waste from the Project site	Transporting to the contractor for recycling.
Paper and cardboard waste	Placement on a landfill where the wastes cannot be separated and waste. Mileage increase when transporting waste from the Project site	Transporting to the contractor for recycling.
Wooden construction waste (code	Placement on a landfill where the wastes cannot	Transporting for recycling to ODO “Ekologiya Goroda”, 13-24, Serafimovich

Waste type	Potential impact	Impact mitigation measures
1720200)	be separated and waste. Mileage increase when transporting waste from the Project site	str., Minsk; unsuitable – to "Trostenetsky" landfill.
Concrete (code 3142707) and reinforced concrete (code 3142708) rubble	Fugitive dust emissions. Placement on a landfill where it is impossible to use or restore materials. Mileage increase when transporting waste from the Project site	Transporting to the waste recycling site UE "Ekores" of "Trostenetsky" landfill
Mixed construction and buildings demolition wastes (code 3991300)	Visual impact Fugitive dust emissions. Placement on a landfill where it is impossible to use or restore materials. Mileage increase when transporting waste from the Project site	Removal to "Trostenetsky" landfill.
Asphalt-concrete from asphalt from asphalt coatings disassembly (code 3141004)	Visual impact Fugitive dust emissions. Placement on a landfill where it is impossible to use or restore materials. Mileage increase when transporting waste from the Project site	Removal to the secondary asphalt-concrete rubble recycling site UE "UDMSiB Minskgorispolkoma", 7, Promyshlennaya str., Minsk.
Dangerous hazards		
Waste mercury lamps (3532603)	Environmental pollution with hazardous substances. Placement on a landfill where the wastes cannot be separated and disposed in a proper way.	Transporting for neutralization to the contractor if there is a license (Hazard Class 1)
Intact lead accumulators with electrolyte fluid (code 3532201)	Environmental pollution with hazardous substances.	It is necessary to consider in detail the possibilities of recovery and reuse. Removal and utilization or processing by the contractor. If it is not possible

Waste type	Potential impact	Impact mitigation measures
Unsorted lead accumulators without electrolyte fluid (code 3532202)	Placement on a landfill where the wastes cannot be separated and waste.	to reuse, the transfer for disposal with a license.
Petroleum refinery wastes	Environmental pollution with hazardous substances. Placement on a landfill where the wastes cannot be separated and waste.	Wastes are subject to separate collection and temporary storage at the temporary storage sites for liquid wastes disposed in tanks with appropriate marking. Explore the possibilities of recovery and reuse. If it is not possible to recover and reuse, wastes are transferred to the licensed contractor for neutralization and placement.
Oily rags (oil content less than 15%) (code 5820601) Oily rags (oil content 15% and more) (code 5820602)	Environmental pollution with hazardous substances. Placement on a landfill where the wastes cannot be separated and waste.	Transporting to the licensed contractor for neutralization
Paint-and-lacquer materials waste	Environmental pollution with hazardous substances. Placement on a landfill where the wastes cannot be separated and waste.	Explore the possibilities of recovery and reuse. If it is not possible to recover and reuse, wastes are transported to the licensed contractor for neutralization and placement.
Waste of organic solvents, paints, varnishes, adhesives, mastics and resins	Environmental pollution with hazardous substances.	Proper temporary storage in marked containers on a sloping site for temporary storage of liquid waste. Secondary use, if it is possible, or return to the supplier. All remaining solvents must be burned on thermal neutralization complexes.
Waste tires with textile cord (code 5750147) Waste tires with metal cord (code 5750148)	Placement on a landfill where the wastes cannot be separated and waste. Visual impact cawaste by inappropriate waste storage Mileage increase when transporting waste from the Project site.	Transporting for neutralization to the contractor
Other non-hazardous wastes		
Human livelyhood waste and	Увеличение пробега при транспортировке	Storage in closed containers and removal to the placement on the licensed

Waste type	Potential impact	Impact mitigation measures
similar industrial waste	отходов с площадки Проекта.	landfill
Barrels, storages and containers from hazardous materials	Placement on a landfill where the wastes cannot be separated and waste. Visual impact cawaste by inappropriate waste storage Mileage increase when transporting waste from the Project site	Separate collection according to the requirements of FCWC and proper temporary storage on the site for temporary waste storage. Removal for neutralization to the contractor
Scrapped iron in lump form (code 3511103)	Placement on a landfill where the wastes cannot be separated and waste.. Visual impact cawaste by inappropriate waste storage. Mileage increase when transporting waste from the Project site	Transporting to Minsk workshop of UE “Minskavtormet” for recycling.

Table C.5.8: List of wastes produced at the facilities of UE "Minskvododcanal"

Waste type	Waste production, t (2016)	Source (process)	Potential environmental impact	Impact mitigation method
Intact lead accumulators with electrolyte fluid (code 3532201)	4,844	Vehicles maintenance	Highly hazardous waste Contain lead and and sulphuric acid in electrolyte fluid Toxicological effect	Placement of the accumulators in rooms or on sites with a solid (concrete) coating, equipped with a canopy to prevent atmospheric precipitation; storage in a sealed container, inert to the electrolyte, or stacks on pallets with a strap of polyethylene film, which does not allow stacking or falling of used accumulators; accumulators are supposed to have hermetically sealed plugs.

Waste type	Waste production, t (2016)	Source (process)	Potential environmental impact	Impact mitigation method
Waste fluorescent tubes (code 3532604)	1814 units	Retubing	Highly hazardous waste Tubes may content mercury (Toxicological effect)	Collection at the place of education and transfer to temporary storage (to the central warehouse) within 2 working days.
Waste mercury lamps (code 3532603)	102 units	Retubing	Highly hazardous waste Lampls may content mercury (Toxicological effect)	Separate collection and proper temporary storage in metal containers in a room not accessible to unauthorized persons. Removal for the neutralization to the contractor having a proper license (Hazard Class 1).
Waste compact fluorescent lamps (energy-saving) (code 3532607)	102 units	Retubing	Highly hazardous waste Lampls may content mercury (Toxicological effect) Toxicological effect	Separate collection and proper temporary storage in metal containers in a room not accessible to unauthorized persons. Removal for the neutralization to the licensed contractor (Hazard Class 1).
ABS plastic (code 5710812)	5,981	Metering instruments repair, wear of protective gear	Moderately hazardous waste Impact on soils, waters and fauna	Collecting in a special box on a solid basis, transferring to third-party processing organizations for recycling.
Oily rags (oil content less than 15%) (code 5820601)	0,846	Vehicles and equipment maintenance	Moderately hazardous waste Complex impact on soils, surface waters, flora and fauna May be fire hazardous and/or toxic	Storage in a special metal container. Disposal to the landfill according to the comprehensive environmental permit.
Synthetic leather waste "Kirza" (code 5711617)	3,258	Wear of the protective gear	Moderately hazardous waste Visual impact Possibility of recycling	

Waste type	Waste production, t (2016)	Source (process)	Potential environmental impact	Impact mitigation method
Screenings from DNS screens **(code 8430100)**	1435,763	Mechanical wastewater treatment	Moderately hazardous waste Toxicological effect	Storage in a special metal container. Disposal to the landfill according to the comprehensive environmental permit
Biological sludge from domestic sewage **(code 8430200)**	244 138,0	Water disposal network maintenance	Moderately hazardous waste Toxicological effect	Disposal to sludge lagoons according to the comprehensive environmental permit.
Ash from peat briquettes incineration (code 3130400)	5,576	Heating of special equipment and buildings	Moderately hazardous waste Mechanical landscapes pollution Possibility of recycling	Storage in special containers with close-fitting lids, installed on the solid surface.
Waste oil filters (code 5492800)	0,003	Vehicles maintenance	Moderately hazardous waste May be fire hazardous, toxicological effect	Storage in a box for filters with further removal to the landfill in accordance to the comprehensive environmental permit.
Polyethylene (film, trimming) (code 5712106)	0,310	Raw materials unpacking	Moderately hazardous waste Release of toxic substances during combustion; mechanical landscapes pollution	Collection in containers in a specially designated place for temporary storage with further transporting to specialized organizations for use.
Low-pressure polyethylene, (code 5712105)	4,010	Polyethylene scrap	Moderately hazardous waste Release of toxic substances during combustion; mechanical landscapes pollution	Collection in containers in a specially designated place for temporary storage with further transfer to specialized organizations for use.
Worn out tires with metal cord (code 5750201)	16,600	Vehicles maintenance	Moderately hazardous waste Toxicological effect on atmosphere and surface waters	Storage on a temporary site (with an entrance for vehicles), excluding direct proximity to combustible, lubricating and chemical

Waste type	Waste production, t (2016)	Source (process)	Potential environmental impact	Impact mitigation method
				substances. Transporting for processing to specialized organizations in accordance with concluded contracts.
Ash from fast-growing wood and firewood burning (code 3130601)	0,884	Buildings heating	Moderately hazardous waste Mechanical landscapes pollution Possibility of recycling	Storage in special containers with close-fitting lids, installed on the solid surface.
Waste synthetic and mineral oils (code 5410201)	5,643	Equipment maintenance	Moderately hazardous waste Complex impact on soils, surface waters, flora and fauna May be fire hazardous and/or toxic	Collection in a specially marked metal container with a lid. Use of equipment and inventory to facilitate and speed up operations. Exclusion of foreign matter. Transporting to specialized enterprises in accordance with concluded contracts.
Waste motor oils (code 5410202)	3,568	Vehicles maintenance	Moderately hazardous waste Complex impact on soils, surface waters, flora and fauna May be fire hazardous and/or toxic	Collection in a specially marked metal container with a lid. Use of equipment and inventory to facilitate and speed up operations. Exclusion of foreign matter. Transfer to specialized enterprises in accordance with concluded contracts.
Waste (pieces, trimmings) of rough furniture billet, plywood, particle board, veneer, etc. (code 1711700)	1,000	Furniture production	Moderately hazardous waste Mechanical landscapes pollution; fire hazard Possibility of recycling	Separate collection and storage on the site of temporary storage on the area of the enterprise with further transfer to recycling or disposal on the landfill.
PET bottles	0,033	Livelihoods of employees	Moderately hazardous waste Mechanical landscapes pollution;	Storage in a special container, transportation to specialized

Waste type	Waste production, t (2016)	Source (process)	Potential environmental impact	Impact mitigation method
(code 5711400)			impact on soils, waters and fauna; Release of toxic substances during combustion Possibility of recycling.	organizations for use.
Paper and and cardboard filters with harmful contaminants (mainly organic) (code 1871000)	0,400	Operation of air blowing units	Moderately hazardous waste	Separate collection in specially designated places. Disposal to the landfill in accordance with the comprehensive environmental permit.
Rubber-fabric waste (code 5750122)	0,013	Unfinished operational life of wear	Moderately hazardous waste	Collecting in storage tanks on the territory of structural units and a central warehouse, handing over to specialized organizations as they accumulate.
Grit from sand basins (code 8430500)	7844,39	Mechanical wastewater treatment	Low-hazardous waste	Disposal to sludge lagoons as a basis for mulching.
Sawdust from natural pure wood (code 1710200)	3,19	Production activities of carpenter's workshop, sawmills	Low-hazardous waste Mechanical landscapes pollution; fire hazard Possibility of recycling	Use for own needs
Oiled wooden sawdust (oil content less than 15%) (code 1721101)	0,20	Removal of oil stains	Low-hazardous waste Mechanical landscapes pollution; fire hazard	Storage in a metal container with lid and disposal to the landfill according to the comprehensive environmental permit.
Mixed construction and buildings demolition wastes (code 3991300)	882,10	General construction works, trenchless laying of sewage networks with the replacement of damaged	Low-hazardous waste Fugitive dust emissions;	Storage in a specially equipped area in bulk until a transport unit is accumulated / collection at the place of production and transfer for

Waste type	Waste production, t (2016)	Source (process)	Potential environmental impact	Impact mitigation method
		wells, the work on the localization of damages on the networks	Mechanical pollution	use within 2 working days.
Waste (sweepings) from cleaning of territory of industrial enterprises and organizations (code 9120800)	13,59	Cleaning of administrative and industrial premises	Low-hazardous waste	Storage in a special metal containers with close-fitting lids and proper marking on the sites with solid basis. Disposal to the landfill according to the comprehensive environmental permit.
Lump waste of natural clean wood (code 1710700)	9,15	Production activities of carpenter's workshop, sawmills	Low-hazardous waste Mechanical landscapes pollution; fire hazard Possibility of recycling	Storage in a metal container and handing over to the temporary waste accumulation site for further disposal by a licensed contractor.
Uncontaminated packaging cardboard waste (code 1870605)	0,80	Equipment unpacking	Low-hazardous waste	Collection at the place of production and removal for storage in densely bound bales to the places of temporary storage, according to the cartographic scheme. Transfer to use by specialized organizations as they accumulate.
Paper and cardboard waste from the office work (code 1870601)	2,93	Office work	Low-hazardous waste Mechanical landscapes pollution; fire hazard Possibility of recycling	Collection at the place of production (at the sites), transfer as it accumulates, centralized transfer for use of handing over for use by the structural unit.
Worn out cotton and other overalls (code 5820903)	1,723	Unfinished operational life of wear	Low-hazardous waste	Collection in a container in a specially designated place (place of production and in the central warehouse) and removal to the landfill.

Waste type	Waste production, t (2016)	Source (process)	Potential environmental impact	Impact mitigation method
"Triplex" glass waste (code 3140825)	0,90	Vehicles repair	Low-hazardous waste	Collection and storage in a special box (container) with an appropriate inscription, installed in a specially designated place on a solid basis. Removal to the landfill.
Waste of abrasive materials in the form of dust and powder (code 3144402)	0,00	Milling, metal processing, grinding, polishing and fitting workpieces	Low-hazardous waste	Sweeping the waste to a metal container at the place of work, transfer into used polyethylene or polypropylene bags, which a tightly tied to prevent the waste spillage.
Wooden construction waste (code 1720200)	0,80	Construction works	Low-hazardous waste Mechanical landscapes pollution; fire hazard Possibility of recycling	Collection and storage on the equipped site of the repair-building shop.
Contaminated glass waste (code 3140816)	0,18	Repair works	Low-hazardous waste Mechanical landscapes pollution Possibility of recycling.	Collection and storage in a special container on a solid basis. Transfer for usage.
Ruberoid waste (code 1870500)	4,10	Buildings repair	Low-hazardous waste	Storage on the equipped platforms until the transport unit is accumulated. Transfer for usage.
Paper bags from raw materials (cement)(code 1871707)	0,11	Cement unpacking	Low-hazardous waste Mechanical landscapes pollution; fire hazard	Collection and storage in a special container in the places of production. Removal to the landfill.
Metal containers polluted with PWM (code 3510602)	0,35	Тара из-под сырья, покраска автотранспорта	Low-hazardous waste Mechanical landscapes pollution;	Collection in special containers, preventing the PWM ingress into the environment, transfer to specialized enterprises for use.

Waste type	Waste production, t (2016)	Source (process)	Potential environmental impact	Impact mitigation method
Bark and sawdust from the cutting of logs in sawmill woodworking equipment (code 1710102)	1,45	Production activities of carpenter's workshop, sawmills	Low-hazardous waste Mechanical landscapes pollution; fire hazard Possibility of recycling	Collection in a metal container at the place of production.
Waste of dry cleaning of garages, car parks, parking places of transport (code 3142413)	2,00	Territory cleaning	Low-hazardous waste Mechanical landscapes pollution	Collection in metal containers on the sites with solid basis. Removal to the landfill in accordance with the comprehensive environmental permit.
Waste from protective grilles at water intake (code 8440400)	1,50	Mechanical wastewater treatment	Non-hazardous waste	Collection in a metal container for temporary storage at the place of production. Removal to the landfill in accordance with the comprehensive environmental permit.
Industrial waste similar to household waste (code 9120400)	714,56	Production activity	Non-hazardous waste	Collection (Hazard Classes 1 and 2 separately) in containers on the sites with solid waterproof basis. The sites should be equipped with litter bins with tightly closing lids and the appropriate marking. Removal to the landfill in accordance with the comprehensive environmental permit.
Ground excavations not contaminated with hazardous substances (code 3141101)	373,50	Excavation	Non-hazardous waste.	Collection at the place of production and transfer for usage.
Plant waste from water	380,68	Cleaning of structures,	Non-hazardous waste	Loading into a vehicle cargo area at

Waste type	Waste production, t (2016)	Source (process)	Potential environmental impact	Impact mitigation method
treatment (code 9121200)		water areas		the place of generation. Temporary storage in a container with a metal lattice. Transfer for usage within 2 working days.
Street and yard sweeping (code 9120500)	25,94	Territory cleaning	Non-hazardous waste	Collection in metal containers with tightly closing lids and appropriate marking on the sites with solid basis. Removal to the landfill in accordance with the comprehensive environmental permit.
Reinforced concrete rubble (code 3142708)	727,80	Repair-restoration (construction) works, elimination of networks damage	Non-hazardous waste	Storage on a specially equipped platform in bulk until the accumulation of a transport unit. Transporting for usage.
Asphalt-concrete from asphalt from asphalt coatings disassembly (code 3141004)	66,10	Construction, repair and excavation works	Non-hazardous waste	Collection at the place of production and transfer to the places of temporary storage on the specially equipped platform in a bulk, or for usage to special organizations.
Plant waste from the cleaning of gardens, parks, squares, cemeteries and other green areas (code 9121100)	24,1	Territory cleaning	Non-hazardous waste	Collection at the place of production and transfer for usage within 2 working days.
Boughs, branches, nodes (code 1730200)	65,95	Territory cleaning, seasonal pruning of trees and shrubs	Non-hazardous waste	Collection at the place of production and transfer for usage within 2 working days.
Waste grid cloth (code 3144411)	0,008	Parts polishing	Non-hazardous waste	Collection in a specially designated place, transfer to facilities for usage.

Waste type	Waste production, t (2016)	Source (process)	Potential environmental impact	Impact mitigation method
Gypsum products breakage (code 3143805)	1,80	Repair work	Non-hazardous waste	Collection into a box on a solid basis as waste is generated; transfer to use by third-party developers.

Appendix C.8.1-8.9
Air Modelling Results (current situation)

Appendix C.8.10-8.18
Air Modelling Results (Project)

Appendix C.8.19
Air Dispersion Modelling Results (Maps)