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POLYMETAL

KYZYL SESR

Date Issued: December 2016

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CONTENTS

TABLES

FIGURES

APPENDICES

CONTENTS

1 INTRODUCTION

1.1 Context

Wardell Armstrong International ("WAI") was commissioned by Polymetal JSC ("PM") to undertake an Environmental and Social Impact Assessment ("ESIA") of the Kyzyl Gold Project ("the Project") in Auezov, East Kazakhstan. The ESIA and accompanying Non-Technical Summary ("NTS") were publically disclosed in December 2015.

PM seeks financing from the European Bank for Reconstruction and Development ("EBRD") and this Supplementary Environmental & Social Report ("SESR") has been prepared following discussions with PM and EBRD to bring the ESIA, and other environmental and social documentation, and the Project in line with the environmental and social requirements of the EBRD. These requirements are the Performance Requirements (PRs), which for part of the EBRD's Environmental and Social Policy of May 2014.

In this context, the ESIA should be seen as the primary document with the SESR comprising supplementary information, with its chapters referring back to the ESIA when relevant. This report, together with the ESIA and its supporting documents, together form the ESIA disclosure package which is now disclosed for a minimum of 60 days in line with the EBRD's Public Information Policy (2014) before the Project is presented to the EBRD's Board of Directors for approval. A new Non-Technical Summary has also been compiled to succinctly communicate the key findings of the ESIA and the SESR.

1.2 Structure

This SESR report is structured to align with the ESIA, complementing the original report chapter by chapter. The chapter structure is as follows:

Chapter	Title
1	Introduction
2	Regulatory Framework
3	Project Description
4	Environmental and Social Baseline
5	Environmental and Social Impact Assessment
6	Alternatives Assessment & Safety Requirements
7	Consultation and Disclosure
8	Cumulative Impact Assessment
9	Environmental and Social Management Plans

This report supplements the ESIA to align the Project with the EBRD PRs, in particular by presenting additional baseline data on hydrology, air quality, noise, biodiversity and socioeconomic aspects to inform a more robust assessment of impacts associated with the Project on these aspects of the physical, biological and social environment. This report further includes additional information on the standards to be applied by the Project (with reference to EBRD PRs and EU standards); consultation and information disclosure commitments; information on the different alternatives considered in the design of the Project; design safety considerations and additional mitigation measures to avoid,

reduce, mitigate and/or compensate/offset impacts associated with the Project. These measures are captured in a set of updated framework Environment and Social Management Plans.

The EBRD's Performance Requirements apply not just during the development of the Project but during operation and closure as well. To ensure that the Project is aligned with the Bank's requirements, the ESIA disclosure package includes an Environmental and Social Action Plan (ESAP), which will form part of the financing agreements between PM, which includes a list of actions that require implementation by PM during the life of the Project, building on the E&S documentation already developed such as E&S management plans. The ESAP is disclosed as a draft to be finalised after the disclosure period has expired.

1.3 EBRD Disclosure Requirements

The EBRD's disclosure period for this project is a minimum of 60 days, whereby the ESIA disclosure package, including this SESR report, will be made available on the websites of the local Akimats, Polymetal and EBRD in English, Russian and Kazakh (not English on Akimat's website). In addition, the ESIA disclosure package will be available in various locations in the Project area including at PM and Akimat offices in Auezov and EBRD's office in Ust-Kamenogorsk. In order to communicate the findings of the ESIA and SESR a series of public hearings "Information Sessions") will be held in Auezov, Shalabay and Ust-Kamenogorsk during which the Project will present the Project and the ESIA documentation and respond to oral and written questions from meeting attendees and the public. The ESIA disclosure package will be available during these information sessions in both Russian and Kazakh. A number of copies of the NTS will be available in Russian and Kazakh for members of the public to take away with them. The full disclosure plan, together with future consultation and information disclosure commitments, can be found in the Stakeholder Engagement Plan ("SEP") included with the SESR.

CONTENTS

TABLES

2 REGULATORY FRAMEWORK

2.1 Introduction

The project will be subject to laws, regulations and standards of the Republic of Kazakhstan (RoK) as well as international best practice, notably the EBRD Performance Requirements (2014) and the International Finance Corporation's (IFC) Performance Standards of 2012. The Project will be required to meet the most stringent of these standards, whether they are international or Kazakh standards. Chapter 2 Regulatory Framework of the Kyzyl ESIA (2015) provides a description of the relevant legislative, regulatory and administrative framework, together with targets for environmental and regulatory compliance and a summary of the status of the project permitting at that time. Refer to Chapter 2 of the ESIA for full details of the regulatory framework.

Whilst Chapter 2 of the Kyzyl ESIA (2015) focused on how the project relates to the IFC performance Standards, this SESR extends this analysis to the European Bank for Reconstruction and Development's ("EBRD") Performance Requirements ("PRs") and other relevant policies and guidance, such as EU Directives that are applicable to the project, in accordance with lender requirements that were not considered in the ESIA. This chapter provides a broad comparison between EBRD PRs the and World Bank's International Financial Corporation ("IFC") Performance Standards ("PS") that were considered in the ESIA (see Table 2.1 and the following sections).

Table 2.1: Summary of the differences between components within IFC and EBRD standards for sustainability (Source: World Bank)

	Over-arching Policy Statement	**Operational Requirements for Borrowers/Clients**	**Environmental and Social Review Procedures**	**Access to Information Policy**	**Guidelines, Sourcebooks, Manuals for 'Good Practice' (selected examples)**
EBRD (2014)	Environmental and Social Policy	Performance Requirements (PRs)	Environmental and Social Procedures	Public Information Policy (2014)	Guidance for Clients
IFC (2012)	Sustainability Policy	Performance Standards (PSs)	Environmental and Social Review Procedures	Access to Information Policy (2012)	Guidance Notes; Environmental, Health and Safety Guidelines; Interpretation Notes; Good Practice Materials

2.2 Relevant International Standards

2.2.1 Thematic overview

IFC PSs and EBRD PRs are broadly consistent with respect to the broader themes they cover, namely:

- Environmental and Social Assessment and Management;
- Strategic Environmental Assessment;
- Protection of Natural Habitats;
- Pollution Prevention and Abatement;
- Cultural Heritage;
- Land Acquisition and Tenure and Involuntary Resettlement; and
- Indigenous Peoples.

More specifically, in terms of detailed coverage of environmental and social impacts and risks, IFC PSs and EBRD PRs both cover the following:

- Biodiversity, ecosystem services and natural resource management;
- Climate change;
- Community and worker health and safety;
- Disability and health;
- FPIC and/or reference to the UN General Assembly Resolution on the Rights of Indigenous Peoples;
- Human Rights;
- Gender;
- Sexual Orientation and Gender Identity (EBRD only);
- Vulnerability and Impoverishment;
- Labour and Working Conditions;
- Stakeholder Engagement; and
- Resource Efficiency.

2.2.2 Categorical Exceptions and Prohibitions

Both the EBRD PRs and IFC PSs comprise a number of categorical "exclusions" or similar, lists of "prohibited" projects, activities and products that they will not support either through direct investment and/or indirectly.

- **EBRD's** "Environmental and Social Exclusion List," Appendix I of the Environmental and Social Policy (ESP), states that "EBRD will not knowingly finance, directly or indirectly, projects involving the following…" In addition, EBRD has published on its website a list of other types of projects it does not finance, such as defence sector, tobacco, etc., although these are not cited in the Exclusion List accompanying the ESP.
- **IFC's** Policy on Environmental and Social Sustainability states that, "there are several types of activities that IFC does not support, either through its investments or advisory services. These

activities are set out in the IFC Exclusion List."[1] The IFC "Exclusion List" applies to all IFC financing with diverse supplemental exclusions applicable to the following three categories of indirect lending:

(i) all financial intermediaries;
(ii) microfinance activities; and
(iii) trade finance projects.

The Kyzyl Project does not hit any of these criteria.

2.3 EBRD Performance Requirements

The EBRD promotes environmentally and socially sound and sustainable development in the full range of its activities, whenever possible. EBRD seeks to ensure that the projects they finance are socially and environmentally sustainable, respect the rights of affected workers and communities and are designed and operated in compliance with applicable regulatory requirements and good international practices. To this end, the EBRD has defined ten PRs covering the key areas of environmental and social issues and impacts:

- PR 1: Assessment and Management of Environmental and Social Impacts and Issues
- PR 2: Labour and Working Conditions
- PR 3: Resource Efficiency and Pollution Prevention and Control
- PR 4: Health and Safety
- PR 5: Land Acquisition, Involuntary Resettlement and Economic Displacement
- PR 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
- PR 7: Indigenous Peoples
- PR 8: Cultural Heritage
- PR 9: Financial Intermediaries
- PR 10: Information Disclosure and Stakeholder Engagement

The PRs are meant to help clients improve the sustainability of their business operations, in particular in avoiding adverse impacts on workers, communities and the environment. If avoidance is not possible, negative impacts should be reduced, mitigated or compensate for, as appropriate. New facilities or business activities financed by the EBRD must be designed to meet the Performance Requirements from the outset, as outlined in the EBRD's Environmental and Social Policy.[2]

Direct investment projects must meet PRs 1 to 8 and 10; FI projects (provision of funds to a financial intermediary such as a local bank to be on-lent) must meet PRs 2, 9 and the occupational health and safety requirements of PR 4. Each PR defines, in its objectives, the desired outcomes, followed by specific requirements for projects to help clients achieve these outcomes. Compliance with relevant national law is an integral part of all PRs. With respect to the Project, the following PRs apply: PR 1, 2,

[1] IFC Policy on Environmental and Social Sustainability, para. 19
[2] EBRD:http://www.ebrd.com/who-we-are/our-values/environmental-and-social-policy/performance-requirements.html%20

3, 4, 5, 6, 8 and 10. PR 7 does not apply as there are no indigenous people, as per the definition in PR 7, have been identified. PR 9 does not apply as EBRD is considering providing direct financing to the Project.

The EBRD's Environmental and Social Policy makes provisions for the categorisation of Projects. A project is categorised A when it could result in potentially significant adverse future environmental and/or social impacts which, at the time of categorisation, cannot readily be identified or assessed, and which, therefore, require a formalised and participatory environmental and social impact assessment process. A list of indicative Category A projects is presented in Appendix 2 of the Policy. A project is categorised B when its potential adverse future environmental and/or social impacts are typically site-specific, and/or readily identified and addressed through mitigation measures. Environmental and social appraisal requirements may vary depending on the project and will be determined by the EBRD on a case-by-case basis.

The Project is included in the EBRD's list of indicative Category A projects: *Activity 14. Large-scale peat extraction, quarries and open-cast mining, and processing of metal ores or coal.* Category A projects are required to undergo a comprehensive ESIA including public disclosure thereof prior to consideration of the Project for financing by the EBRD's Board of Directors.

2.3.1 World Bank Group IFC Standards and Guidance

As a development institution with a mission to promote private sector growth and job creation in the developing world, the IFC helps clients understand the business case for social and environmental responsibility: lower costs, less political risk, better community relations, higher productivity, and brand enhancement.

In the context of the IFC's Sustainability Framework, the IFC Performance Standards ("PS") are used to identify, assess, manage and monitor risk for proposed development projects, with the most recent 2012 revision highlighting the importance of social and ecological aspects of project development assessments. The eight IFC PS are:

- PS1: Assessment and Management of Environmental and Social Risks and Impacts
- PS2: Labour and Working Conditions
- PS3: Resource Efficiency and Pollution Prevention
- PS4: Community Health, Safety, and Security
- PS5: Land Acquisition and Involuntary Resettlement
- PS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
- PS7: Indigenous Peoples
- PS8: Cultural Heritage

Performance Standard 1 establishes the importance of (i) integrated assessment to identify the environmental and social impacts, risks, and opportunities of projects; (ii) effective community engagement through disclosure of project-related information and consultation with local

communities on matters that directly affect them; and (iii) the client's management of environmental and social performance throughout the life of the project.

Performance Standards 2 through 8 establish objectives and requirements to avoid, minimize, and where residual impacts remain, to compensate/offset for risks and impacts to workers, Affected Communities, and the environment. While all relevant environmental and social risks and potential impacts should be considered as part of the assessment, Performance Standards 2 through 8 describe potential environmental and social risks and impacts that require particular attention. Where environmental or social risks and impacts are identified, the client is required to manage them through its Environmental and Social Management System (ESMS) consistent with Performance Standard 1.[3] The IFC has developed detailed Guidance Notes for each of the Performance Standards which provide additional information on the meaning of the PS and guidance on its practical application.

2.4 Requirements of EBRD PRs, relevant to the Project

The PRs are broadly consistent with the IFC Performance Standards but also include requirements, such as a project compliance with all relevant EU Directives, specifically with respect to environmental and social aspects. Table 2.2 provides a summary of the additional requirements that have been considered in the SESR, together with a brief outline of where the analysis is located, by chapter. For a summary of the requirements of project compliance with IFC PSs by general theme (refer to the ESIA). How the standards identified in the ESIA and SESR will be addressed during the project life, has been considered in the Environmental and Social Management Plan ("ESMP"), which has been updated in the SESR. Table 2.2 provides a summary of project compliance with EBRD PRs and relevant EU Directives, together with a reference to national Kazakh legislation. From this summary, the SESR requires that the Project adopt the most stringent (by comparison of national and EBRD / EU performance requirements as the Project Standard (see also Tables 2.3 to 2.11).

[3] IFC:http://www.ifc.org/wps/wcm/connect/115482804a0255db96fbffd1a5d13d27/PS_English_2012_Full-Document.pdf?MOD=AJPERES

Table 2.2 Summary of standards used to inform Project Compliance Standards			
General theme	**Local (Kazakhstan legislation)**	**EBRD/EU**	**Applied in the SESR**
Environmental and Social Assessment and Management	The Environmental Code, Aug 2011 and Dec 2014 Instruction of Environmental Impact Assessment Conduction of Proposed Economical. Other Activities during Development of Pre-planning, Planning, Pre-design and Design Documentation, approved by Order of Minister of Environmental Protection of RK No.204-p of 28.06.2007	PR1: Environmental and Social Appraisal and Management PR9: Financial Intermediaries PR10: Information Disclosure and Stakeholder Engagement	The ESIA provides the detailed analysis of the baseline condition (both environmental and social). The SESR provides additional information required to ensure conformance with the following: PR1: improving specific aspects of the baseline and impact assessment to align with PRs and EU Directives (see Chapters 4 & 5, plus updated framework management plans). PR9: Not applicable PR10: Specific requirements for the disclosure of the ESIA and SESR (see updated Stakeholder Engagement Plan (SEP) (SEP – MP10).
Strategic Environmental Assessment	The Environmental Code, Aug 2011 and Dec 2014	PR1: Environmental and Social Appraisal and Management	Not applicable in this case, as the Project is site specific
Protection of Natural Habitats	Law on Specially Protected Natural Territories (July 2006, amended Sep 2014) Law on 'About the Protection, Reproduction and Use of the Animal World' (2004) Forest Code of RoK 477-II (2003)	PR6: Biodiversity Conservation and Sustainable Management of Living Resources EU Habitat Directive (92/43/EC) EU Birds Directive (2009/147/EC) EU Ground water (2006/118/EC) Directives	The SESR includes additional information on: • Noise baseline, to accurately characterise the current environment for the people living in the local community • Biodiversity additional baseline data with respect to flora, invertebrates and raptors. Reassess surveys of aquatic ecology. The purposed of the additional surveys was to establish the presence, or confirm the absence, of priority species and critical habitat in accordance with EU Directives (see Chapter 4).

Table 2.2 Summary of standards used to inform Project Compliance Standards			
General theme	**Local (Kazakhstan legislation)**	**EBRD/EU**	**Applied in the SESR**
		EU Water Framework Directive (Directive 2000/60/EC	• Water resources undertake additional assessment of the design and control of surface and ground water, with reference to potential impacts (associated with the watercourse and its users) downstream, in accordance with EU Directives.
Pollution Prevention and Abatement	Separate legislation for Soils (GOST Natura Protection. Soils); Air; Surface and Underground Waters; Water	PR3: Resource Efficiency and Pollution Prevention and Control EU Mining Waste Directive (2006) EU Reference Note (BREF 25 BAT) for Management of Tailings and Waste Rock in Mining Activities - 2009 EU Landfill Directive EU Medium Combustion Plant Directive (2015/2193) EU Air Quality Directive (2008/50/EC) EU Industrial Emissions Directive (2010/75/EU)	The management of mining waste with reference to acid rock drainage has been addressed in the ESIA and not considered further in the SESR. The management of tailings and waste rock has been considered with reference to Alternatives (Chapter 6 and a Chapter 3 which considers safety aspects) The management of non mining wastes considered in the ESIA The SESR provides predictions of air quality resulting from the emission from coal fired boilers supplying heat to the mine and separately to the homes in Solnechniy and Auezov, in order to determine compliance with EU Directives on industrial emissions and air quality. The Directive that applies to coal fired boilers to be used at the Project come into force in 2018 and provides dates for compliance, for plant in use prior to that date.

Table 2.2 Summary of standards used to inform Project Compliance Standards			
General theme	**Local (Kazakhstan legislation)**	**EBRD/EU**	**Applied in the SESR**
		EU Urban Wastewater Directive (91/271/EEC)	Waste water treatment considered in the ESIA and this Directive does not directly apply to the Project.
Physical Cultural Resources	The Law of RoK 1488-X11 (July 1992, amended Jan 2014) on the Protection and Use of Objects of Historical and Cultural Heritage	PR8: Cultural Heritage	There is no additional information in the SESR – refer to ESIA
Land Acquisition and Tenure and Involuntary Resettlement	Land use and protection regulated by the Environmental Code and the RoK Land Code (2003, Nov 2015) as well as the Rules of Land Preservation (2003)	PR5: Land Acquisition, Involuntary Resettlement and Economic Displacement PR10: Information Disclosure and Stakeholder Engagement	The SESR has information on the following: • Further information on the procedures that were followed during the acquisition of properties
Labour and Working Conditions	RoK Labour Code No. 251-III (2007)	PR2: Labour and Working Conditions PR4: Health and Safety 'Workers Accommodation Processes and Standards: A guidance note by IFC and EBRD: August 2009'	There is no additional information in the SESR – refer to ESIA Health & Safety issues have been considered further in the design of the project, described in Chapter 3 of the ESIA. In this chapter, the SESR has considered the safety aspects of the design criteria adopted for the waste rock dump and the tailing pond dam. There is no additional information in the SESR – refer to ESIA

	Article 115 of Subsoil Law ("Ensuring Subsoil Use Conditions Safe for Population and Staff")	PR4: Health and Safety	The SESR provides further information on the management and control of arsenic that is present in the ore and can enter the environment from a number of sources including: • Dust emissions from mining operations and from the existing tailings pond; • Elevated concentrations in soil, from contamination and deposition of dust; and • Through process and refining of the ore, including offsite during smelting. The implications of the EU Directive 2008/50/EC compared to the Kazakh standard for arsenic in air have been considered in Chapter 4
Community Health, Safety and Security	Rules on Public Hearing Conduction, approved by Order of Minister of Environmental Protection of RK No.135-p of 07.05.2007	PR10: Information Disclosure and Stakeholder Engagement	The SESR documents the requirements of the 60-day disclosure required by EBRD, including availability in three languages – Kazakh, Russian and English. In addition, the requirements for public dissemination of the ESIA / SESR findings are detailed in the SEP.
	Rules on Access to Environmental Information Relevant to Environmental Impact Assessment (EIA) Procedure and Decision-Making Process on Proposed Economical and Other Activities, approved by Order of Minister of Environmental Protection of RK No.233-p of 25.07.2007		There is no additional information in the SESR – refer to ESIA
	Rules on Conduction of Public Hearing while Considering Application for Approval or Change of		There is no additional information in the SESR – refer to ESIA

Table 2.2 Summary of standards used to inform Project Compliance Standards			
General theme	**Local (Kazakhstan legislation)**	**EBRD/EU**	**Applied in the SESR**
	Tariffs (Prices, Rates) of Entities which are Natural Monopolies. Approved by Decree of RK Government No. 376 of 21.04.2003 Code of RoK 'On people's health and the healthcare system' (Sep 2009, amended Oct 2015)		There is no additional information in the SESR – refer to ESIA

2.5 Standards by Environmental Aspect

The following tables show a comparison of international standards by each environmental aspect, the project standards that will be applied to the design and management of the project have been highlighted in bold font and summarised in Table 2.12.

2.5.1 Water Quality

The project will adhere to the IFC Environmental, Health, and Safety Guideline values for water quality in Mining which are highlighted in bold text in the following table.

Table 2.3: Water Quality Guideline Values

Parameter	Kazakhstan Fisheries [1]	Kazakhstan Drinking Water [1]	WHO Drinking Water [2]	IFC [3]	EU Health [4]	Unit
Aluminium	-	-	**0.2**	**-**	**0.2**	mg/l
Ammonium ion	0.5	-	-	**-**	**0.5**	mg/l
Antimony	-	-	0.02	**-**	**0.005**	mg/l
Arsenic	0.05	0.05	**0.01**	0.1	**0.01**	mg/l
Barium	-	-	**0.7**	**-**	-	mg/l
Boron	0.017	**0.5**	**0.5**	**-**	1.0	mg/l
Cadmium	0.005	**0.001**	0.003	0.05	0.005	mg/l
Chloride	-	-	-	**-**	**250**	mg/l
Chromium	-	-	**0.05**	0.1	**0.05**	mg/l
Copper	0.001	1.0	2.0	**0.3**	2.0	mg/l
Cyanide	-	-	0.07	0.1	**0.05**	mg/l
Flouride	0.05	**1.5**	**1.5**	**-**	**1.5**	mg/l
Iron	0.1	-	-	2.0	**0.2**	mg/l
Lead	-	-	**0.01**	0.2	**0.01**	mg/l
Magnesium	40.0	-	-	**-**	-	mg/l
Manganese	0.01	-	0.4	**-**	**0.05**	mg/l
Mercury	0.00001	**0.0005**	0.006	0.002	0.001	mg/l
Molybdenum	-	-	**0.07**	**-**	-	mg/l
Nickel	0.01	-	0.07	0.5	**0.02**	mg/l
Nitrate ion	40.0	**45.0**	50	**-**	50	mg N/l
Nitrite ion	0.08	3.3	**0.2**	**-**	0.5	mg N/l
Selenium	-	-	**0.01**	**-**	**0.01**	mg/l
Sodium	-	-	-	**-**	**200**	mg/l
Sulphate ion	100.0	-	-	**-**	**250**	mg/l
Uranium	-	-	**0.015**	**-**	-	mg/l
Zinc	0.01	1.0	-	**0.5**	-	mg/l
Oil products	0.05	**0.3**	-	10	-	mg/l
Phenols	0.001	**0.001**	-	0.5	-	mg/l
BOD5	3	3	-	50	-	mg/l
COD	-	-	-	**150**	-	mg/l
Temperature	-	-	-	**<3^0 differential**	-	Degree
pH	-	-	-	**6 - 9**	≥ 6.5 and ≤	
Total Suspended Solids	-	-	-	**50**	-	mg/l

Table 2.3: Water Quality Guideline Values						
Parameter	**Kazakhstan Fisheries [1]**	**Kazakhstan Drinking Water [1]**	**WHO Drinking Water [2]**	**IFC [3]**	**EU Health [4]**	**Unit**

Source:

[1] *A. Jumagulov, A. Nikolayenko, I. Mirkhashimov. The Regional Environmental Center for Central Asia. Water quality standards and norms in the Republic of Kazakhstan. Almaty, 2009.*

[2] *WHO's Guidelines for Drinking-water Quality, Geneva, 1993*

[3] *International Finance Corporation: Environmental, Health, and Safety Guidelines-Mining. Dec 2007.*

[4] *European Union Drinking Water Standards. Council Directive 98/83/EC on the quality of water intended for human consumption. Nov 1998.*

2.5.2 Ambient air quality

Table 2.4: Ambient Air Quality Standards				
Parameter	**Averaging Period**	**IFC Guideline Values (WHO Guideline Value) µg/m³**	**EU Directive 2008/50/EC[3] µg/m³**	**Kazakh limit[4] µg/m³**
Particulate Matter - PM_{10}	1 hr	-	-	300
	24-hour	150[1]	**50**	-
	Annual	70[1]	**40**	-
Arsenic	One time	-		30
	24 hr	-		3
	Annual		**0.006**	
Nitrogen dioxide (NO_2)	1 hr	**200[1]**	**200**	-
	24 hr	-	-	-
	Annual	**40[1]**	**40**	**40**
Sulphur dioxide (SO_2)	1 hr			-
	24 hr	**125[2]**	**125**	**125**
	Annual	-	-	-
Carbon Monoxide	1 hr	**30,000[2]**	-	-
	24 hr		**10,000**	-
	Annual	-	-	-

[1] *World Health Organization (WHO). Air Quality Guidelines Global Update, 2005. PM 24-hour value is the 99th percentile. Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines.*

[2] *These standards are not included in the WHO Air Quality Guidelines Global Update 2005 but can be found in the WHO Air Quality Guidelines for Europe (WHO, 2000).*

[3] *EU Directive 2008/50/EC*

[4] *Based on new Kazakh Sanitary Norms and Rules #168, 25, January, 2012*

Arsenic

In ambient air, metals, metalloids and their compounds are mainly encountered as part of particulate matter. The emissions of Arsenic associated with industrial and mining operations generally include flue gas emissions, in which the arsenic normally occurs as compounds condensed on the surface of

particles and the vapour phase emissions constitute only a small extent of the emissions[1]. The Kazakhstan national standard for Arsenic relates to the concentrations of arsenic in total suspended particulates and refers to short term instantaneous emissions. The EU Standard refers to the arsenic concentrations in ambient air based on PM_{10} sampling and relates to long term annual period.

The EU's Position Paper - Ambient air pollution by AS, CD and NI compounds states that based on size distribution analysis, the TSP and PM_{10} based data are more or less comparable for arsenic as it is enriched in the fine modes. The Paper also states that the results based on TSP sampling thus overestimates PM_{10} based concentrations only by about 10 % or less at rural and urban background stations and about 20 % or less at industrial sites. This conclusion has been drawn by the assessment of arsenic concentrations measured near sites with point source of arsenic emissions (flue gas emissions).

For the Kyzyl project, there are no flue gas emissions of arsenic as there are no current or future plans to smelt ore at Kyzyl. The sources of arsenic emissions associated with the site primarily include wind-blown dusts from sources that contain elevated arsenic, from contaminated land, or from the mechanical processing (open pit, haulage, crushing, screening and tailings management (former tailings lagoon). In general, 95% of particles associated with windblown dusts arising from mineral workings have been found to be between 10 and 75μm, which indicates that the PM_{10} fraction constitutes less than 5% of the windblown dusts. Since the source of arsenic at the Kyzyl project includes only windblown dust, the results based on TSP sampling cannot be considered representative of PM_{10} sampling, taken in isolation.

The Kazakhstan standard provides a reference for the short term effects and includes arsenic in particulates >$PM_{10.}$ However, because the health effects from arsenic are associated with long term exposure to arsenic present in the environment, the EU standard is based on annual averages, therefore for future environmental monitoring for the Kyzyl project, the arsenic content of the PM_{10} fraction will be defined as the relevant quality standard (see also Chapter 5.2).

[1] Ambient air pollution by AS, CD and NI compounds - Position Paper – European Commission (October 2000)

Table 2.5: Emission Limit Values			
Parameter	**EU Medium Combustion Plants Directive (mg/Nm^3)[4]**	**EU Industrial Emissions Directive (mg/Nm^3)[5]**	**IFC's Emission Guidelines for Small Combustion Facilities Emissions (3MWth – 50MWth)[6]**
Sulphur oxides	**400**	**400**	0.5 percent Sulphur or lower percent Sulphur if commercially available without significant excess fuel cost
Nitrogen Oxides	**300**	**300**	N/A
Total suspended particulates	**20**	30	96 ppm (Electric generation) 150 ppm (Mechanical drive)

2.5.3 Noise and Vibration

Kazakh regulation 3.01.035-97 "Sanitary rules and norms for Maximum permissible noise levels in residential and public buildings and housing areas" provided by Polymetal sets out details of national regulatory limits as presented within Table 2.6.

Table 2.6: Kazakh Regulatory Limits		
Type of Premises or Area	**Time**	**Max. L_A dB**
Areas immediately adjacent to residential buildings, rest homes for elderly/disabled, kindergartens, schools and other educational institutions, libraries	7 am – 11pm 11pm – 7am	70 60
Recreation areas in the territory of building estates and residential building blocks, rest houses, rest homes for elderly/disabled; playgrounds of kindergartens, schools and other educational institutions	7 am – 11pm 11pm – 7am	75 65

It should be noted that the national regulatory limits provided in Table 2.6 are for maximum instantaneous noise impacts. Therefore should only be used to assess the noise impact from instantaneous noise, such as blasting.

The limits do not cover the LAeq average day and night-time noise levels and therefore, it is considered appropriate to assess the day and night-time noise impact to the IFC EHS Guidelines.

IFC Environmental Health and Safety Guidelines; General EHS Guidelines;

The International Finance Corporation (IFC) has produced General EHS Guidelines for noise, which are summarised in Table 2.7. They make reference to noise from facilities and stationary noise sources, and are commonly applied as design standards for industrial facilities. Whilst they offer general

[4] Directive (EU) 2015/2193 of the European Parliament and the Council of 25 November 2015 on the limitation of emissions of certain pollutants into the air from medium combustion plants

[5] Directive 2010/75/EU of the European Parliament and the Council on industrial emissions

[6] IFC's General EHS Guidelines: Environmental - Air emissions and ambient air quality

guidance on noise effects, the IFC has indicated that they are not directly applicable to transport or mobile noise sources.

Measurements are to be taken at noise receptors located outside the project property boundary.

Table 2.7: WHO Noise Level Guidelines		
Receptor	**Maximum Allowable Ambient Noise Levels, $L_{Aeq,1hr}$, dBA Free field**	
	Daytime 07:00 – 22:00	**Night-time 22:00 – 07:00**
Residential, institutional, educational	**55**	**45**

Therefore, the absolute noise levels of 55dB(A) and 45dB(A) will be adopted as compliance criteria by the Project for both day and night periods respectively.

Workplace Vibration

The Threshold limits as determined by ACGIH for hand arm vibration and the European Vibration Directive Exposure Limits (2002/44/EC) for whole body vibration in the workplace exposure are summarised in Table 2.8.

Table 2.8: Comparison of ACGIH Threshold Limit Values (TLVs) for Exposure of the Hand to Vibration in X, Y or Z Direction and Daily Exposure in EU Directive 2002/44/EC	
Total Daily Exposure Duration (hours) (ACGIH)	**Maximum value of frequency weighted acceleration (m/s^2) in any direction**
4 to less than 8 hours	**4**
2 to less than 4 hours	**6**
1 to less than 2 hours	**8**
Less than 1 hour	**12**
Daily exposure (EC Directive - 2002/44/EC)	**Maximum value of frequency weighted acceleration (m/s^2) in any direction**
Daily Exposure Limit Value 8hr (DELV)	**5**
Daily Exposure Action Value (DEAV)	**2.5**

There is no direct comparison between the two sets of guidelines, as the ACGIH has values dependent on duration of exposure and is based on any single axis exceeding 4m/s2. The EU DELV identifies 5m/s2 as the vector sum of the three axes and is based on an 8hr exposure time. There is no major difference in standard between the two; therefore, the Project will use the EU Daily exposure limits as it is multi directional compliance criteria.

Whole body vibration identified as ACGIH limits are identified by Z and XY vector graphs; however, ACGIH also refers to the EU Exposure Limit of 0.5m/s^2 action level. The EU Directive (2002/44/EC) uses limits on any of the three axes and the Project will use the EU exposure limits as compliance criteria (see Table 2.9).

Table 2.9: European Vibration Directive (2002/44/EC) Exposure Limits		
Type	**Daily Exposure Action Value (m/s^2)**	**Daily Exposure Limit (m/s^2)**
Whole body vibration	**0.5**	**1.15**

2.5.4 Soils

The EBRD Performance Requirements that relate to soils are set out in Table 2.10.

Table 2.10: Relevant IFC and EBRD Requirements that Relate to Soils			
	Performance Standard / Requirement		**Requirements**
EBRD	PR1	Environmental and Social Appraisal and Management	Consider in an integrated manner the potential environmental impacts, including that of soil, associated with the proposed project. Minimize, mitigate, or offset / compensate for adverse impacts and to identify, and where feasible adopt, opportunities to improve environmental performance.
	PR3	Pollution Prevention and Abatement	Technical characteristics of the installation, its geographical location and local / ambient environmental conditions shall be considered to apply pollution prevention and control technologies and practices (techniques) that are best suited to all polluting activities in all economic activities, and from effluents and emissions at the facility level, to a regional and global level where appropriate.
	PR6	Biodiversity Conservation and Sustainable Management of Living Natural Resources	The sustainable use and management of natural resources, in all types of habitats, irrespective of whether they have been disturbed or degraded previously, or whether or not they are protected or subject to management plans. This is to achieve no net loss / net gain of biodiversity in the affected habitat. Soils support these habitats and the ecosystem services they provide, and consequently are to be considered in the same way.

Reference Values for the Concentration of Potential Contaminants in Soils

To assess the content of potential contaminants the Kazakh MAC and background values were used. For comparative purposes, the concentrations were also compared to the United Kingdom General Assessment Criteria (GAC) guidelines. The GAC guidelines conform to EU directives and are continually updated. They provide values for specific groups of uses which vary in exposure pathways and therefore provide more informative assessment than comparison with the general Kazakh MACs.

The UK Environment Agency (EA) have published their recommended approach on undertaking human health risk assessments in the UK, their revised Contaminated Land Exposure Assessment technical guidance (CLEA model), in January 2009. In addition, the EA have released Science Reports SC050021/SR2 and SC050021/SR3 along with a new CLEA Model (Version 1.06) to calculate revised Soil Guidance Values (SGV). At the time of writing, SGVs for a number of potential contaminants have been published (i.e. benzene, ethylbenzene, toluene, xylene, phenol, mercury, selenium, arsenic, nickel, cadmium and dioxins).

The Chartered Institute of Environmental Health (CIEH) and Land Quality Management (LQM) produced a set of Generic Assessment Criteria (GAC) using the CLEA model in 2009. This report provided GAC (i.e. screening values or trigger concentrations) values for a number of potential contaminants including:

- Aliphatic and aromatic hydrocarbon fractions;
- Individual Polycyclic Aromatic Hydrocarbons (PAH);
- Selected volatile organic compounds and semi-volatile organic compounds; and
- Metals and non-metals - beryllium, boron, cadmium, chromium, copper, vanadium and zinc.

Additionally, members of the Environmental Industry Commission (EIC) undertook an initiative to produce a further set of GAC values in December 2009 to complement the SGVs published to-date by the EA and GACs published by CIEH/LQM. This report has provided GAC values for a number of potential contaminants including:

- Metals - antimony, barium and molybdenum;
- Phthalates;
- Halogenated organics;
- Selected hydrocarbons; and
- Selected phenols.

More recently, in January 2015, CIEH and LQM produced Suitable for Use Levels (S4ULs); a further set of assessment criteria to support generic quantitative risk assessment (GQRA) which are "intended to provide a complete and updated replacement for the 'old' LQM/CIEH GAC." These, most recent, values for residential areas with plant uptake (RPU) and allotments (ALLOT) were used in this assessment. These values are much lower than limits for commercial and industrial sites, but they were deemed appropriate due to largely undisturbed and uncontaminated character of the Project area.

Table 2.11: Reference Values for Potential Soil Contaminants

Analyte	Form	MAC	GAC	
			ALLOT[1]	RPU[2]
	Concentration mg/kg			
Copper (Cu)	Total	-	520	2400
	Labile	3	-	-
Lead (Pb)	Total	32	80	200
	Labile	6	-	-
Zinc (Zn)	Total	-	620	3700
	Labile	23	-	-
Arsenic (As)	Total	2	43	37
Manganese (Mn)	Total	1500	-	-
Cadmium (Cd)	Total	-	1.9	11

Table 2.11: Reference Values for Potential Soil Contaminants				
Analyte	**Form**	**MAC**	**GAC**	
			ALLOT[1]	**RPU[2]**
	Concentration mg/kg			
Vanadium (V)	Total	150	91	410
Mercury (Hg)	Total	2.1	21	1.2
Fluorine (F)	Labile	2.8	-	-
Nickel (Ni)	Total	-	53	130
	Labile	4	-	-
Boron (B)	Total	-	45	290
Beryllium (Be)	Total	-	35	1.7
Cobalt (Co)	Labile	5.0	-	-
Chromium	III (labile)	6.0	15300	627
	VI (total)	0.05	1.8	6
Iron (Fe)	Total	-	-	-
Molybdenum (Mo)	Total	-	-	670*
Antimony (Sb)	Total	4.5	-	550*
Selenium (Se)	Total	-	88	250
Cyanide (CN)	Total	-	-	-
Petroleum hydrocarbons	Total	-	1200**	1600**

1 – maximum values for use as allotments (gardens)
2 – maximum values for residential use with plant uptake
* – EIC values for residential use without plant uptake, ALLOT and RPU S4UL values were not available
** - S4UL values for Aliphatic + Aromatic EC >44-70 hydrocarbons
Note: Project standards for soil contamination will be based on the S4ULs, to take account of landuse at the time of reclamation and rehabilitation of the mine. These standards will be take account of the reference values quoted and articulated in the Mine Closure and Reclamation Plan to be finalised a minimum of two years prior to closure of Kyzyl mine.

A summary of the project standards defined in the ESIA and used to specific target criteria in the framework management plans have been summarised in Table 2.12.

Table 2.12: Summary of Project Standards			
Water resources			
Parameter	**Project standard**		**Unit**
Aluminium	0.2		mg/l
Ammonium ion	0.5		mg/l
Antimony	0.005		mg/l
Arsenic	0.01		mg/l
Barium	0.7		mg/l
Boron	0.5		mg/l
Cadmium	0.001		mg/l
Chloride	250		mg/l
Chromium	0.05		mg/l
Copper	0.3		mg/l
Cyanide	0.05		mg/l
Flouride	1.5		mg/l
Iron	0.2		mg/l
Lead	0.01		mg/l
Magnesium	0.05		mg/l
Manganese	0.05		mg/l
Mercury	0.0005		mg/l
Molybdenum	0.07		mg/l
Nickel	0.02		mg/l
Nitrate ion	0.2		mg N/l
Nitrite ion	0.2		mg N/l
Selenium	0.01		mg/l
Sodium	200		mg/l
Sulphate ion	250		mg/l
Uranium	0.015		mg/l
Zinc	0.5		mg/l
Oil products	0.3		mg/l
Phenols	0.001		mg/l
BOD5	3		mg/l
COD	150		mg/l
Temperature	**<3^0 differential**		Degree Celsius
pH	**6 - 9**		mg/l
Total Suspended Solids	**50**		
Air quality			
Parameter		**Averaging Period**	
Particulate Matter - PM_{10}	50	24hr	µg/m^3
	40	Annual	µg/m^3
Arsenic	30 (TSP)	One time	µg/m^3
	3 (TSP)	24hr	µg/m^3
	0.006 (in air)	Annual	µg/m^3
Nitrogen dioxide (NO_2)	200	1hr	µg/m^3

Table 2.12: Summary of Project Standards			
Air quality			
Parameter		**Averaging Period**	
	40	Annual	µg/m^3
Sulphur dioxide (SO_2)	125	24hr	µg/m^3
Carbon Monoxide	30,000	1hr	µg/m^3
	10,000	24hr	µg/m^3
Emission limit values (Coal fired boilers)			
Parameter	**Current – Project Standard**	**Future (EU medium sized combustion plant directive) – Project Standard**	
Sulphur oxides	**0.5% sulphur or less in coal**	400	mg/Nm^3
Nitrogen Oxides	**n/a**	300	mg/Nm^3
Total suspended particulates	**150**	20	mg/Nm^3
Noise			
Parameter	**Project Standard**	**Time period**	
Daytime	55	07:00 – 22:00	$L_{Aeq,1hr}$, dBA Free field
Night-time	45 (temp operations 55)	22:00 – 07:00	$L_{Aeq,1hr}$, dBA Free field
Vibration – Occupational exposure (Hand and whole body)			
Parameter	**Project Standard**	**Exposure period**	
Total Daily Exposure Duration	4	4 to less than 8 hours	Maximum value of frequency weighted acceleration (m/s^2) in any direction
	6	2 to less than 4 hours	
	8	1 to less than 2 hours	
	12	Less than 1 hour	
Daily exposure			
Daily Exposure Limit Value	5	8hr (DELV)	Maximum value of frequency weighted acceleration (m/s^2) in any direction
Daily Exposure Action Value (DEAV)	2.5	8hr (DEAV)	
Whole body	0.5	Daily Exposure Action Value	(m/s^2)
	1.15	Daily Exposure Limit	(m/s^2)

CONTENTS

TABLES

3 PROJECT DESCRIPTION

The following text provides further detail in relation to the stability of a number of project design features, including the open pit, waste dump and tailings storage facility. This additional detail also provides further information in respect the seismic design of these features.

3.1 Introduction to Stability Assessment

Polymetal Engineering have undertaken the open pit mine design for the Kyzyl gold deposit on behalf of Polymetal Mining. The design considered the geological information available for the area to interpret a geological structure and thereby design the mine to optimise ore extraction whilst maintaining the stability of the open pit.

The deposit occurs along the Kyzyl Shear Zone within Carboniferous sedimentary rocks. These form part of the Kalbinsky synclinorium and the strata are generally inclined to the north. The Kyzyl Shear Zone is also inclined to the north at about 40 degrees. Mineralisation was predominantly controlled by the geological structure and took place in four phases, with the third phase being the most important for gold mineralisation.

The deposit is therefore structurally complex and the mineralisation and host rocks are heavily fractured. Stability is an issue for site safety for the mine operatives and economic feasibility regarding continuity of the operation of the mine. The geotechnical stability of the open pit and associated waste dumps have been assessed in detail as part of the mine design.

3.2 Open Pit Mine

3.2.1 General mine layout

There is an existing open pit in the mineral deposit and this will be extended by these proposals to a footprint that is 2,400m long by 860m wide, and 320m to 390m deep. The pit will be excavated with 30m benches and 10m berms, giving a pit wall slope angle of 41 to 48^{o} and bench angles of 50 to 80^{o}.

The geological structure involves the strata dipping to the north such that the southern slopes of the open pit lie close to the angle of dip. The northern slopes cut across the sequence of strata and are slightly steeper.

3.2.2 Assessment of Borehole Information

The proposed excavation has been designed having regard to the stability of the geological strata, based on a programme of sampling and testing. The open pit mine has been investigated by 460 boreholes, producing 10721 samples for various laboratory tests.

The physical and mechanical properties of the deposit rock have been assessed by the Russian National Scientific Research Institute of Hydrogeology and Geotechnical Engineering (VSEGINGEO) and the results of their study have been incorporated in to the stability assessment. Similarly, the physical and mechanical properties of the ore deposit have been studied by the Institute of Mining Academy of Science of Kazakh Soviet Socialist Republic (IGD An of KazSSR) and the results have also been utilised in the stability assessment.

The Rock Quality Designation (RQD value) has been assessed from the fracturing in the borehole cores within a 100m thick layer around the final profile of the open pit. The geology of the final pit profile and the RQD results have been used to divide the pit into 6 domains, three of which have been classified as comprising weakly fractured rock and three are moderately fractured rock, although the RQD values of the latter lie close to the limit of the weakly fractured classification.

3.2.3 Stability Analysis

These 6 geo-mechanical domains have been analysed using Rocscience's slope stability software Slide, which has been licenced in Russia and certified for use (Conformance Certificate No ROSS SA.SP15.H00678). The software has been developed in Canada by Rocscience and is one of the internationally recognised programs for slope stability assessment. The calculations have been undertaken in compliance with the factors of safety recommended in the "Regulations on ensuring slope safety at coal strip mines" published in 1998 by the Research Institute of Mining Geomechanics and Mine Surveying (VNIMI), Saint Petersburg. These regulations have been approved by the Gosgortechnadzor (State Mining Control) and recommend that a minimum safety factor of 1.5 is used for surface mine slopes, which are also applicable to open pit mines.

The results of the stability assessment produced factors of safety ranging from 1.51 to 2.83 for the six geo-mechanical domains. These comply with the regulatory requirements of the VNIMI, which requires the factors of safety to exceed 1.5.

In terms of good practice applied in the European context, recommended factors of safety for slope stability vary from 1.25 to 1.5, depending on the circumstances and the level of confidence in the available data. The Russian regulatory requirements are, therefore, comparable in terms of recommended factors of safety, and the stability analysis has been undertaken using internationally recognised software.

3.3 Waste Dump

3.3.1 Waste Dump Construction

The mining waste will be deposited in a waste dump located on topographically level or gently inclined ground to the north of the mine. The waste will be deposited on a sandstone substrate in two main lifts up to 50m high with a 2m wide bench in between.

The material will be a coarse rock waste and slope angles are reported to range from 26 to 29°, although cross section from the stability calculations appear to show steeper angles up to 34°. Stability is an issue for site safety in relation to the mine operatives during site operations, and potentially to any third parties in the immediate vicinity of the outer slopes during site operations and also during closure

3.3.2 Stability Analysis

The slopes have been analysed for representative parts of the waste dump using material properties determined by laboratory testing and the certified Rocscience Slide software referred to above. The

resulting factors of safety range from 1.260 to 1.736. These all exceed the regulatory requirements of the VNIMI, which requires a minimum factor of safety of 1.05.

In terms of good practice applied in the European context, recommended factors of safety vary from 1.1 to 1.3 depending on the circumstances and the level of confidence in the available data. The higher factors of safety would be required where third parties are likely to be affected e.g. where vulnerable structures or services are located near the base of the slope. Lower factors of safety are acceptable in more remote areas. The Russian regulatory requirements are therefore comparable in terms of recommended factors of safety, and the stability analysis has been undertaken using internationally recognised software.

3.3.3 Construction Method and Waste Composition

Constructing the dump in 50m high lifts is acceptable for coarse rock fill with a consistent waste stream. However, issues have been experienced in the European context where weaker rocks and clays occur whereby the material forms a weak layer parallel with the slope due to the method of construction. As coarse rock builds up over this weaker surface the effect can be to reduce the factor of safety and cause slope failure. As a result of this experience best practice recommends constructing waste dumps in smaller horizontal lifts of 2 to 5m height.

Construction in smaller lifts would be impractical in this situation, however, the operator should be alert to the potential risk and manage any weaker materials by depositing them in horizontal layers within the body of the waste dump rather than near the outer slopes.

3.4 Tailings Storage Facility

3.4.1 Tailing Embankment Construction

The Tailings Storage Facility (TSF) comprises an earthworks embankment that forms a dam across an existing valley feature. The tailings will be deposited in a lagoon behind the embankment by settlement of the solid particles, the tailings will therefore accumulate as mining proceeds. The dam has therefore been designed to be constructed in three stages as the tailing accumulate, reaching a maximum height of 35m.

A geotechnical investigation of the tailing embankment site was carried out by the East Kazakhstan Geological Investigation center" (VK CGI), in 2014 and reported upon in 2015.

The design of the TSF has taken account of local regulations and guidance, whereby the TSF was categorized as follows:

- Category of hydraulic engineering facility - II, in accordance with SNiP RoK 3.04-01-2013, Appendix 2 (Construction Norms and Rules of the Republic of Kazakhstan);
- Criticality rating of the facility - II – normal, in accordance with RDS RK 1.02-04-2013 (Criticality Rating of Construction and Urban Planning Projects);

- Service life category (for hydraulic structure depending on the dam height and base material) - III, approved in accordance with the Guidelines for Design and Construction of Slurry Reservoirs and Tailings Storage Facilities in the Metallurgical Industry" cl.3.25, Table 1;
- Seismic rating of the embankment construction site based on the ground conditions - 6;

3.4.2 Stability Analysis

Cross sections were presented to show proposed construction profiles and properties of the construction materials for stability analysis. The Safety Factor Ksaf was calculated in PLAXIS 2D, which is a two-dimensional finite-element software designed for calculation of deformation, stability and ground water filtration in geotechnical assessments.

Calculation in PLAXIS is based on the finite elements method. In this method the stress components on the slip plane are determined by the elastic solution for ground mass based on the deformation modulus and Poisson lateral expansion coefficient of the soil. This is the most suitable approach for an earthworks embankment retaining water and accumulated tailings.

PLAXIS was developed in the Technical University of Delft upon the initiative of the Dutch Ministry of Public Works (Rijkswaterstaat). PLAXIS is targeted at the complex geotechnical issues, which allows for modelling of soil behaviour and interaction between structures and soil, and is used worldwide in geotechnical engineering and design.

The stability of embankment 1 downstream slope was calculated for three design cases:

1) phase 1 and 2 with downstream slope ratio 1:2.0; phase 3 and 4 with downstream slope ratio 1:2.5 without geomembrane on the upstream face;
2) phase 1 and 2 with downstream slope ratio 1:2.0; phase 3 and 4 with downstream slope ratio 1:2.5 with geomembrane on the upstream face;
3) phase 1 and 2 with downstream slope ratio 1:2.5; phase 3 and 4 with downstream slope ratio 1:3.0 with geomembrane on the upstream face;

Each calculation was run in 17 phases to assess the stability at various stages of construction and operation. The software calculates the Safety Factor Ksaf and determines its minimum value for each of the three design cases:

3.4.3 Stability Results

The stability results from the design report are presented in the table below:

Table 3.1: Stability Results

Calculation stage:	Calculation 1	Calculation 2	Calculation 3
Phase 1 dam stability	1.407	1.437	1.985
Phase 1 dam stability with tailings;	1.250	1.267	1.646
Phase 2 dam stability	1.394	1.408	1.976
Phase 2 dam stability with tailings;	1.084	1.108	1.528
Phase 3 dam stability	1.543	1.643	1.959
Phase 3 dam stability with tailings;	1.208	1.219	1.617
Phase 4 dam stability	1.374	1.464	1.945
Phase 4 dam stability with tailings;	1.109	1.119	1.559

The standard Safety Factors Ksaf are determined with regards to the category of the facility in accordance with SNIP RK 3.04-01-2013 "Hydraulic engineering facilities. Main Design Regulations" and range from 1.10 to 1.25 for special load combination and from 1.2 to 1.4 for basic load combinations.

The slope is considered stable if the following condition is observed:

$$K_{min,} \geq \frac{K_н \cdot K_c}{K_м}$$

(Formula 8, SNIP RoK 3.04.02-2008)

where Kн - safety factor based on the criticality of the facility ($K_{Н_н}$=1,20 for class II,in accordance with SNiP RoK 3.04.02-2008 “Dams Made of Soil Materials” Table 9);

K_{c_c} - safety factor based on load combination (K_{c_c}=1,00 for basic load combination in accordance with SNiP RoK 3.04.02-2008 “Dams Made of Soil Materials” Table .10);

Kм =1,00 - service factor (Kм=1,00 for equilibrium condition calculations in accordance with SNiP RoK 3.04.02-2008 “Dams Made of Soil Material” Table 11).

$$K_{min} = \frac{1,2 \cdot 1,0}{1,0} = 1,2$$

The examples of calculation 1 and 2 show that the slope ratios 1:2 and 1:2.5 have the safety factor Ksaf lower than the above standard value for the class II facilities. The report therefore recommended that slope ratio should be 1:3, with berms every 10 m of height to ensure higher stability and for safety reasons.

The results of calculations indicate that, if no geomembrane is placed on the upstream slope, the downstream slope loses its stability due to groundwater seepage. The report therefore also recommended that the embankment design should exclude water seepage from the lagoon through the embankment.

According to the geological investigations, the clay on the mine site does not meet the specifications to be used for construction of impervious clay barrier, due to its swelling and heaving properties. Therefore, geomembrane materials that meet the tailings dam construction specifications should be used for the impervious barrier.

3.4.4 Embankment Foundation Conditions

The designs of soil embankments built on the non-rock foundation should, generally, include preparation and levelling of the base by stripping of vegetation and the layer penetrated by the roots of trees and bushes, or holes made by burrowing animals, as well as removal of soil containing more than 5% of organic inclusions by weight or the same amount of highly soluble salts. (SNiP RK 3.04-04-2006. Foundations of Hydraulic Engineering Facilities).

The report also recommends the design of embankment foundation areas should include the removal or replacement of soft materials (or materials softened during construction) and frozen superficial materials, where these could change their physical, mechanical and thermal characteristics when thawed. Removal should be from surface to a depth below which the soil characteristics (with potential improvement) satisfy the requirements of stability, base robustness and design filtration pattern. (SNiP RK 3.04-04-2006. Foundations of Hydraulic Engineering Facilities).

3.4.5 Summary of Recommendations

The above analysis uses internationally recognized software that is suitable to the type of structure being assessed. The analysis is comprehensive taking the various construction and operational stages into account. The factors of safety are comparable to those used in European settings and closely follow local regulations and standards, which in turn will be based on worldwide experience.
Based on the above analysis the report makes the following recommendations:

- The recommended slope ratio of the downstream face is 1:3 with berms every 10 m of height to ensure higher stability and for safety reasons;
- Placement of geomembrane on the upstream slope as an impervious barrier;
- Removal of top soil and its stockpiling for further use in TSF closure;
- Removal of highly swelling and medium-heaving clay in the dam base. The layer of clay should be removed to the freezing depth in the area of the downstream toe and replaced with the hard rock.

These recommendations have been included in the design of the Tailings Storage Facility. There were no recommendations relating to the operation of the facility.

3.5 Seismic Design

The report includes allowance for seismicity in the stability assessment. It is prudent to ensure that the detailed designs include a factor of safety to take into account seismic risk. The factors of safety for the designed slopes presented above were therefore derived from the stability assessments that incorporate an allowance for seismic acceleration.

The proposed mine is located in an area designated by the Global Seismic Hazard Assessment Program (GSHAP, 1999) as having low seismicity. This is defined as having a 10% chance of exceeding a seismic event that produces a peak horizontal ground acceleration of up to 0.4m/sec^2 (equivalent to 4% g) over a 50-year design life. This approach has been adopted by the European standard, Eurocode 8, for assessing seismic design standards for buildings.

CONTENTS

TABLES

FIGURES

APPENDICES

4 ENVIRONMENTAL & SOCIAL BASELINE

4.1 Introduction

In light of the EBRD's environmental and social requirements for ESIA, this chapter addresses gaps in the ESIA baseline for noise, dust, water, biodiversity and social aspects related to displacement of people and fishing activities in and around the Project area.

Table 4.1: Summary of Additional Baseline Work

Section	Aspect	Action	Main Conclusions	Relevant appendices
4.2	Noise	Strengthening noise baseline around the proposed mine site and in the Project area	The noise monitoring results indicate that the existing noise levels are within the prescribed standards.	• Noise monitoring locations (see Appendix 4.1) • Environmentally sensitive receptors
4.3	Dust	Strengthened dust baseline by referring to original baseline data in ESIA	Cross reference to dust baseline is provided. Additional analysis that relate to the occupational health and environmental impact of dust containing arsenic has been identified and cross referenced to Chapter 5.	• Air quality management has been updated to take account of the chapter 4 reference to the dust baseline.
4.4	Water	Addresses gaps in ESIA water baseline relating to aquatic flora and fauna and water quality information particularly along Akbastaubulak brook. Also information from a hydrological study of conditions downstream of the proposed waste dump diversion outlet on Holodniy Klyuch brook.	The waste rock dump stream diversion will almost double the flow within the receiving channel of Holodniy Klyuch brook but indications are that this will only cause localised out-of-bank flooding and scouring at the diversion outlet during the very highest flows in spring. Mine water discharges are likely to be an order of magnitude smaller than flows that currently occur within the Akbastaubulak brook during high flow snow melt conditions in spring. The Akbastaubulak brook and Holodniy Klyuch/Mayran brook contain five species of fish and two species of crayfish none of which are reported by the survey as being endangered or as being specific to this area. Previous mine water discharge has exceeded Kazakhstan Maximum Permissible Concentrations for	• Hydrology baseline photos 2016 • Excavations map • Polymetal Channel Stream Diversion Report Volume 1

Table 4.1: Summary of Additional Baseline Work				
Section	**Aspect**	**Action**	**Main Conclusions**	**Relevant appendices**
			arsenic, cadmium, selenium, and sulphate.	
4.5	Socio-economic	Local fisherman survey Clarification of resettlement process	No fishing takes place at Akbastaubulak brook Resettlement clarified to show that process was voluntary and in line with EBRD PR5 requirments	• Household resettlement details
4.6	Biodiversity	Additional baseline data around presence of flora, raptors and butterflies. Ecological report for the area around Akbastaubulak brook	No critical habitat or Priority Biodiversity Features in or around the Project Area No endangered or rare species found in Akbastaubulak brook Steppe eagle (IUCN Red Book – Endangered) spotted within the site though no nests found	• Ornithological report 2016 • Ecology report Ak Brook 2013 • Large Heath Butterfly Report 2016

4.2 Noise

Noise surveys were carried out in August, 2016 by LLP 'Laboratory – Atmosphere' to assess the acoustic environment in the vicinity of the development site, including noise from existing installations, to determine the potential impact at proposed receptors.

Noise measurements were taken at five monitoring locations; considered to be representative of ambient noise levels.The noise monitoring locations were identified based on the proximity to the proposed mine operations and other noise sources such as vehicular traffic and include the settlements of Auezov and Solnyechni. Receptors such as Auezov School, which is sensitive to increase in noise level was also considered. The details of the noise monitoring locations are presented in Table 4.2 and their locations are shown in Appendix 4.1.

Table 4.2: Noise Monitoring Locations			
Location	**Description**	**Latitude**	**Longitude**
NQ-1	Northern extent of Auezov settlement (residential)	49°42'50.62"N	81°34'31.03"E
NQ-2	Southern extent of Auezov settlement (residential)	49°42'23.07"N	81°34'50.55"E
NQ-3	Auezov school	49°42'21.90"N	81°34'9.36"E
NQ-4	Eastern extent of Auezov settlement (residential)	49°42'52.57"N	81°35'17.55"E
NQ-5	Solnyechni village (residential)	49°42'4.50"N	81°35'52.44"E

Attended day-time noise monitoring was carried out sequentially during 29th , 30th and 31st August, 2016.

The noise measurements were made using Class 1, integrating sound level meters, mounted vertically on tripods 1.5m above the ground and at a distance of more than 3.5 meters from any reflective surfaces.

All noise monitoring took place during dry and calm weather conditions. The sound level meters were calibrated both before and after the noise surveys. No drift in the calibration during the survey was noted.

For the purpose of this assessment and in accordance with WHO guidelines, daytime hours are taken to be 0700 to 2300 hours and night-time hours to be 2300 to 0700 hours.

The attended noise measurements were taken over 1 hour periods during the daytime and night time survey. A weighted[1], L_{eq}[2], L_{90}[3] and L_{10}[4] were recorded. The maximum and minimum sound pressure levels were also recorded to provide additional information. The summary of the noise monitoring results are presented in Table 4.3 and the locations are shown in Appendix 4.1.

Table 4.3: Noise Monitoring Results

Location	Daytime			Nightime		
	L_{eq} dB(A)	L_{90} dB(A)	L_{10} dB(A)	L_{eq} dB(A)	L_{90} dB(A)	L_{10} dB(A)
NQ-1	45	41	47	38	37	42
NQ-2	41	38	42	39	38	39
NQ-3	39	37	42	36	34	37
NQ-4	46	42	46	40	37	40
NQ-5	41	38	43	37	36	39
WHO Standards	**55**	-	-	**45**	-	-

The noise monitoring results indicate that the existing noise levels are within the prescribed standards.

4.3 Dust

A complete Particulate Matter (PM_{10} and $PM_{2.5}$) and Dust baseline can be found in Chapter 4.4 (Pages 123-132) of the ESIA. The impact of dust on the health and safety of workers and local populations, as well as on the environment, is directly relevant to EBRD PRs 2, 3, 4 and 6.

Fugitive dust emissions come from salvage activities at the Project site, from roads as well as from exposed surfaces around the mine site. A summary of dust particulate results (Table 4.4.7 on Page 132, of the ESIA) shows that the PM_{10} 24 hour average (µg/m^3) is 26.69 and the $PM_{2.5}$ 24 hour average (µg/m^3) is 2.27, both below WHO guidelines of 50 and 25 µg/m^3, respectively.

[1] A' Weighting An electronic filter in a sound level meter which mimics the human ear's response to sounds at different frequencies under defined conditions of sound energy as the time-varying sound pressure levels.
[2] Leq Equivalent continuous noise level; the steady sound pressure which contains an equivalent quantity
[3] L90 The noise level which is exceeded for 90% of the measurement period.
[4] L10 The noise level which is exceeded for 10% of the measurement period.

Arsenic concentrations in Total Suspended Particulate (TSP), were measured at 13 points along the Sanitary Protection Zone (SPZ) boundary as part of the baseline studies. These measurements were used to assess compliance with the national limits, based on a single set of measurements for 20-minutes interval at each of the 13 locations, as a representative sample for Quarter 1 to Quarter 3 – 2014 and subsequently Quarter 2 – 2015. The baseline study found that the daily mean arsenic concentrations in total suspended particulates along the boundary of the current SPZ range from 1.44 to 2.35µg/m^3 and are well within the Kazakh maximum permitted concentrations of 3µg/m^3 for one time concentrations.

Due to the limited data set obtained for each quarter, which is not sufficient for calculating the long term average coupled with the data relating to arsenic concentrations in total TSP rather than PM_{10}, it is not possible to compare this data with the EU standard of 0.006µg/m^3 for annual averages. Furthermore, the EU's 'Ambient air pollution by AS, CD and NI compounds - Position Paper' states that 'Data from shorter sampling intervals (for example daily or weekly means) can be higher by orders of magnitude. Consequently, the baseline data obtained to validate arsenic concentrations in air with national standards is not comparable with either the annual or half yearly means' that are required to assess long term environmental exposure to arsenic in air. In order to develop the baseline, further sampling of TSP and PM_{10} will be collected over a period of one week repeated during the summer months to calculate the annual mean and assess compliance with the EU standard of 0.006µg/m^3 for arsenic in air at the boundary of the SPZ.

The environmental baseline data will be supplemented with monitoring within the SPZ in work areas to confirm that arsenic in air concentrations do not exceed an occupational workplace exposure limit of 0.01mg/m^3 (typical European standard) (Refer Air Quality Management Plan).

The concentrations of Arsenic monitored in the ambient air can be attributed to increased geochemical background in the region. Measures for minimising dust emissions have been included in the Air Quality Management Plan.

To monitor potential health effects, workers biomonitoring will be carried out as part of routine worker health testing to monitor the Arsenic concentrations in urine using a internationally recognised arsenic in urine limit of 35-50µg/l (ACGIH). If exceedances are observed, additional measures for minimising arsenic (in dust) exposure will be identified and implemented and worker hygiene monitoring wil be continued on a regular basis. Polymetal will maintain a dialogue with local medical providers to monitor local health conditions. No health risks to workers or the local community as a result of previous mining activities, including potential arsenic in dust risks, have been identified to date (following consultation with local medical providers).

4.4 Water

This section addresses gaps in the Project's water baseline, specifically presenting further analysis of hydrological, topographic, aquatic flora and fauna data. This will facilitate an assessment of channel capacity and flow conditions downstream of the mine excess water discharge outlet on the Akbastaubulak brook and waste rock dump diversion channel outlet on the Holodniy Klyuch brook.

4.4.1 Proposed Design of Diversion Channel and Mine Discharge Outlet

Mine development Stage 1 will include development of the open pit, waste dumps and ore stockpile from 2016 to 2026 including a watercourse diversion to protect the waste dump and a discharge outlet to dispose of excess water from the mine site. Stage 2 is scheduled from 2026 to 2039 and includes development of underground facilities from the base of the open pit and the continued operation of the stream diversion and mine water outlet.

Waste Dump Diversion Channel

The Akbastaubulak brook and its tributary, the Kyzyltu brook, flow south through the footprint of the proposed waste rock dump. In order to protect the stability of the waste rock dump, a protection dike for each creek will be constructed. Protection dike No. 1 (containment dam No 1) will block the Kyzyltu brook valley resulting in the formation of a settling pond and protection dike No. 2 will block the Akbastaubulak brook valley also resulting in the formation of a settling pond. The water that collects in the settling ponds will be conveyed westwards to the Holodniy Klyuch brook via a stream diversion channel (Appendix 4.2. - Drawing Number 1). The channel has been designed to handle an estimated flow of 2.96m³/s with a 3% annual exceedance probability (see Appendix 4.2 - Drawing Number 3).

The waste rock dump diversion channel inlet will therefore divert all runoff from the upper catchment of the Akbastaubulak brook and its tributaries into the Holodniy Klyuch brook up to discharges equivalent to the diversion channel capacity. This will almost double the flow in the Holodniy Klyuch brook which studies show can be conveyed by the existing channel, and halve the flow in the lower reaches of the Akbastaubulak brook. A description of the changes in hydrology is provided in Section 4.11 and Chapter 5.

The outlet of the waste rock dump diversion channel will discharge into the upper reaches of the Holodniy Klyuch brook whereafter flow will continue southwards for a distance of approximately 4 km before entering the Kyzylsu river. The diverted flow within the Holodniy Klyuch brook will enter the Kyzylsu river a short distance downstream of its existing discharge point (Akbastaubulak brook) and thus the diversion will not have an appreciable impact on the Kyzylsu river flow.

The area at the diversion channel outlet is relatively flat with a gradient of less than one percent (see Table 4.1 in Appendix 4.5) and lies within a broad well vegetated flood plain (Figure 4.1 and photographs in Appendix 4.4) with two distinct channels (see Appendix 4.2 - Cross Section 1 on Drawing Number 4). In line with best practice the gradient of the diversion channel outlet will be closely matched to that of the receiving channel and be oriented at an acute angle to the receiving channel to minimise scouring of the stream bed and opposite bank.

Infrastructure within or adjacent to the Holodniy Klyuch brook downstream of the waste dump diversion channel outlet which could potentially be impacted by the diversion outflow includes:

- Road crossing 2km downstream of diversion channel outlet comprising a ford with no discernible man made structure.

- Small number of dwellings and cultivated areas on right bank of Holodniy Klyuch brook approximately 3 km downstream of diversion channel outlet. Closest dwelling is approximately 80 m from brook.
- Minor road crossing with culvert about 4 km downstream of diversion channel outlet and close to the confluence of the Holodniy Klyuch brook and Kysylsu river.

Figure 4.1: Area at Proposed Waste Dump Diversion Channel Outlet

Mine Water Discharge Outlet

During open pit mining, rain, snowmelt and groundwater ("open pit water") will flow into the mined out area of the open pit. The open pit water will be pumped via a pressure pipeline to the pit water-settling pond. The settling pond will be located within the existing abandoned open pit. After satisfying process water and firewater supply requirements excess water will be discharged to the Akbastaubulak brook (Appendix 4.3 - WAI Drawing 3.7 and Figure 4.2).

The Akbastaubulak brook in the vicinity of the discharge outlet has a well vegetated, relatively flat and wide floodplain (Figure 4.2) containing a number of braided channels. In line with best practice the pipe outlet will discharge onto a rock protection apron and be oriented at an acute angle to the receiving channel to minimise scouring of the stream bed and opposite bank.

The anticipated annual volume of intercepted open pit water during Stage 1 is 413,000 m^3/yr and the total estimated annual volume of water intercepted during Stage 2 is 2,094,000 m^3/yr (Appendix 4.3 - WAI Drawing 3.5 and 3.6). The mine water balance (Appendix 4.3 - WAI Drawing 3.5 and 3.6), which considers average annual flows, indicates that the mine water treatment plant will discharge to the Akbastaubulak brook 34,510 m^3/yr (0.001 m^3/s) in Stage 1 and in Stage 2 the mine water treatment plant will discharge to the Akbastaubulak brook 1,411,500 m^3/yr (0.045 m^3/s). Table 4.4 provides a seasonal breakdown of anticipated water pumping rates from the open pit and underground mine. This suggests that highest flows can be expected during the spring snowmelt and summer rain storms

when flow rates in receiving watercourses are likely to be greatest. The mine water discharge would be in the region of 0.05 to 0.07 m^3/s in Stage 1 and 0.12 to 0.18 m^3/s during Stage 2.

Table 4.4: Water Pumping Rates for Pit Dewatering					
	Heavy Rain	**Snowmelt**	**Summer**	**Winter**	
Eastern pit area: Open pit mining	1608	1152	504	not specificed	m^3/day
Western pit area: Open pit mining	4032	2904	1248	not specificed	m^3/day
Total Stage 1	5640	4056	1752	0	m^3/day
Total Stage 1	0.065	0.047	0.020	0	m^3/s
Eastern pit area: Underground mining	4104	2832	1584	1080	m^3/day
Western pit area: Underground mining	11736	7776	4680	3432	m^3/day
Total Stage 2	15840	10608	6264	4512	m^3/day
Total Stage 2	0.183	0.123	0.073	0.052	m^3/s
Source: Table 3.11 of the Project Description chapter					

Figure 4.2: Receiving Channel at Proposed Mine Water Discharge Outlet

Infrastructure within or adjacent to the Akbastaubulak brook downstream of the mine water discharge outlet includes:

- Minor road crossing comprising a culvert located approximately 200m downstream of the discharge outlet.
- 9 Ha of cultivation on left bank of Akbastaubulak brook approximately 1 km downstream of discharge outlet. Existing median flow rates within Akbastaubulak brook during the summer growing season are in the order of 1 l/s to 5 l/s (Table 30 Hydrometeorlogical Report, EK Geological Survey Center, 2014) and are unlikely to be sufficient to sustain a water supply to a cultivated area of 9 Ha. Furthermore, the absence of diversion channels and pumps suggest

that dryland farming is practised. Soil moisture conditions during the summer growing season will be maintained by incident rainfall and to a lesser extent seepage from the previous spring snowmelt runoff from the southern flanks of waste rock dumps which will flow into the Akbastaubulak brook channel will be insufficient in magnitude or duration to be benefit for irrigation.

- Cemetery on right bank approximately 2.5 km downstream of the discharge outlet.
- Minor road crossing comprising two culverts located close to the confluence of the Akbastaubulak brook and Kyzylsu river 4 km downstream of the discharge outlet.
- Wetland at confluence of Akbastaubulak brook and Kyzylsu river which appears to overlap the floodplain of both watercourses and thus its primary water source is indistinct.

Note that household/potable water is supplied to current mine infrastructure and Auezov settlement from the surface water intake at the Kyzylsu river water reservoir (located in a neighbouring catchment) and from the underground water well intake located in the Kyzyltu river valley (to north of mine site). A new pipeline from the Kyzylsu reservoir is proposed to augment current supplies. None of these intakes will be affected by the diversion channel or mine water discharge.

4.4.2 Hydrological Data

The monitoring network in watercourses surrounding the mine site is shown in Appendix 4.3 - WAI Drawing 4.8.1. Available data has been documented in the ESIA Water Resources baseline chapter Section 4.8.2 and additional relevant data is reproduced in Table 4.5: . Given the relatively short length and coarse temporal resolution of records at monitoring points within the survey area it is assumed that values of flow frequency were estimated from longer gauge records of nearby catchments and transposed to the survey area by a proportioning of catchment area.

Surface water monitoring points were installed by the Bakyrchik Mine as early as 2004. Reported data comprises monthly flow records of 10 Years (2004 to 2014) at gauges on the Akbastaubulak brook (GP25) and Kyzyltu (GP18) brooks upstream of the diversion inlet and mine water outlet.

An extensive network of 16 surface water monitoring points was set-up in 2015 to monitor stream stage and surface water quality in the vicinity of the mine site. Four monitoring points are located on the Akbastaubulak brook and Kyzyltu brooks upstream of the mine site and on several of its right-bank tributaries and provide weekly water level records between November 2014 and April 2015.

In addition to the above records a flow record of more than 30 years is available for the Kyzylsu river at Ostrikovka village. This gauge has a catchment several orders of magnitude greater than the catchment upstream of the mine.

On average, annual precipitation is 335 mm and annual potential evaporation is 910 mm. In general precipitation exceeds evaporation in July, August and September when soil moisture storage will be replenished. The contribution to annual flow in watercourses is typically:

- snow melt/surface runoff– 54%
- groundwater – 37%
- rainfall/surface runoff – 9%

Table 4.5: Hydrologic Characteristics of Water Courses in the Survey Area									
Gauge No.	**Description**	**Catchment area km²**	**Length, km**	**Average catchment altitude m**	**Cross-section elevation m**	**Long-term average annual water flow m³/s**	**[A] Flow rate of low-water period in a year with 95% probability m³/s**	**Maximum flow during spring and autumn in a year with 0.5% probability m³/s**	**Maximum flow during spring and autumn in a year with 3% probability m³/s**
1	Mairanbastau brook - mouth	4.02	2.77	420	385	0.002	0.0004drying, freezing	0.87	0.57
2	Holodniy Klyuch brook - mouth	21.4	4.38	410	348	0.011	0.002drying, freezing	3.17	2.06
3	Akbastaubulak brook. - upstream cross-section.	5.8	1.89	425	395	0.003	0.001drying, freezing	1.28	0.84
4	Kyzyltu brook. - mouth	7.14	3.46	440	395	0.004	0.001drying, freezing	1.85	1.20
5	Akbastaubulak brook - in front of the Auezov/ Chalobai road	15.7	5.7	420	360	0.008	0.002drying, freezing	2.84	1.84
6	Akbastaubulak brook. - mouth	32.6	11.4	410	350	0.017	0.003drying, freezing	4.54	2.96
13	Kyzylsu river - Chalobai.	1010	101	600	350	1.35	0.10	352	229
Notes: [A] Drying and freezing are possible in individual years									

4.4.3 Hydrological Analysis

Waste Dump Diversion Channel

The required capacity of the proposed waste dump diversion channel has been investigated (see 'Stream Diversion Design Report' Appendix 4.5). The diversion channel has been designed with a capacity to convey a spring flow event from the upstream catchment with an estimated 3% annual exceedance probability. The origin of reported design flow estimates for locations throughout the survey area is not provided. However, it is apparent that the diversion channel design discharge capacity of 2.96 m³/s corresponds to the reported 3 % annual exceedance probability flow at the confluence of the Akbastaubulak brook with the Kyzylsu river (see gauge no. 6 in Table 4.5:). The catchment of gauge no. 6 is five times greater than the catchment upstream of the diversion inlet which appears to be in the vicinity of gauge no. 3.

The Stream Diversion Design Report also includes an assessment of the channel capacity of the Holodniy Klyuch brook downstream of the diversion outet. This provides an estimate of water levels, flow velocity and discharge at six locations downstream of the diversion outlet (see Appendix 4.2 - Drawing no. 4) during a design flow event in spring corresponding to a 0.5 % annual exceedance probability. The results are summarised in Table 4.6: and show that flows in the receiving channel will typically double because of the diversion.

The stream diversion analysis appears to have derived design flow estimates for the receiving channel (Holodniy Klyuch brook) from data at gauge no.2. This gauge is located close to the confluence of the Holodniy Klyuch brook and Kyzylsu river and its catchment is approximately double that of the catchment upstream of the diversion inlet. Also, the analysis of downstream impacts on water levels during a 0.5% annual exceedance probability conservatively assumes that the diversion channel can convey flows in excess of the design capacity (2.96 m^3/s). In reality flow in excess of the channel capacity would pond at the diversion channel inlet or spill onto surrounding lands and less flow would reach the Holodniy Klyuch brook than has been considered in the analysis. The analysis demonstrates that Holodniy Klyuch brook will be able to convey the combined flow from the diversion and the exsting flow from the Holodniy Klyuch brook within its existing channel.

An inspection of average annual flows along Akbastaubulak brook (Table 4.7) suggests the waste dump diversion channel will reduce flow in the downstream reach of Akbastaubulak brook by about 0.008 m^3/s (annual average).This is about half the existing average annual flow at the outlet of the Akbastaubulak brook (0.017 m^3/s). It is assumed that this flow rate does not include any flow contribution from the existing waste water treatment plant in Auezov (anticpated contribution from waste water treatment plant during operation phases are 45m^3 per day in Stage 1 and 122m^3 in Stage 2). To place this into the context of the regional river system, the average annual flow in the Kyzylsu river near its confluence with the Akbastaubulak brook is 1.35 m^3/s. Thus flows in Akbastaubulak brook are several orders of magnitude smaller than the flow in the Kyzylsu river and the localised loss of flow along the Akbastaubulak brook due to the diversion is relatively small in a regional context.

Table 4.6: Flow Characteristics Downstream of Diversion Channel Outlet						
Location	**Brook**	**3% AEP Flow (m^3/s)**	**0.5% AEP Flow (m^3/s)**	**0.5% AEP Water Level (m)**	**0.5% AEP Flow Velocity (m/s)**	**0.5% AEP Over bank Water Width (m)**
Upstream of diversion outtlet	Holodniy Klyuch	2.06	3.17	N/A [C]	N/A [C]	N/A [C]
At diversion inlet	Kyzyltu and Akbastau	2.96	4.54 [B]	N/A [C]	N/A [C]	N/A [C]
Downstream of diversion outlet	Holodniy Klyuch	5.02	7.71	N/A [C]	N/A [C]	N/A [C]
[A] Cross Section 1	Holodniy Klyuch	5.02	7.71	375.38	1.44	103.69
[A] Cross Section 2	Holodniy Klyuch	5.02	7.71	373.40	1.33	0
[A] Cross Section 3	Holodniy Klyuch	5.02	7.71	371.55	1.25	0
[A] Cross Section 4	Holodniy Klyuch	5.02	7.71	354.15	1.18	0
[A] Cross Section 5	Holodniy Klyuch	5.02	7.71	351.62	1.33	0
[A] Cross Section 6	Holodniy Klyuch	5.02	7.71	349.48	1.41	0
Notes: [A] see WAI Drawing No. 34 01 03 020 19 for locations. [B] this flow exceeds design capacity of diversion. [C] N/A information is not available from the Stream Diversion Design Report and cannot be estimated due to lack of cross section data						

Mine Water Discharge Outlet

An analysis of impacts on the Akbastaubulak brook receiving channel downstream of the mine waste water discharge outlet has not been previously carried out. The analysis of impacts on water levels and flow velocity is prevented by an absence of topographic data with which to define the receiving channel profile. However, it has been possible to show that the proposed rate of mine water discharge will not exceed the existing flow capacity of the receiving channel as presented below. The potential impacts are assessed in Chapter 5 Section 5.4.3.

Mine affected water will be treated to IFC guideline standards prior to discharge to the Akbastaubulak brook (Chapter 2 Table 2.3) and is therefore not expected to adversely affect water quality or aquatic ecosystems. Descriptions of the aquatic ecology and water quality of Akbastaubulak brook are presented in Sections 4.4.4 and 4.4.5, respectively, and the potential impacts of the diversion and mine discharge are assessed in Chapter 5 Section 5.4.3.

Flow conditions in Akbastaubulak brook in the vicinity of the mine water discharge outlet will be reduced by the construction of the waste dump diversion channel which is situated upstream of the proposed mine dumps and discharge outlet. The diversion channel will divert runoff from an area that is about 40 percent of the catchment upstream of the mine into the neighbouring catchment of the Holodniy Klyuch brook. Indications are that this reduction is likely to average 0.008 m^3/s (annual average).

Groundwater contributes to flow within the Akbastaubulak brook downsteam of the proposed diversion but previous groundwater modelling has shown that mine dewatering at the pit is likely to capture most of this contribution in the vicinity of the mine.

Therefore, excepting for a relatively small amount of runoff from the southern flanks of the waste rock dumps the Akbastaubulak brook channel adjacent to the mine discharge outlet will have very little natural flow. The natural flow will increase as the area contributing runoff to the Akbastaubulak brook channel increases in a downstream direction. Natural flows within Akbastaubulak brook are expected to gradually increase to an average annual flow of about 0.01 m3/s at its confluence with the Kyzylu river. This excludes any contribution from mine water discharge.

Mine water discharges will be greatest during development Stage 2. Due to the year-round need for underground mine dewatering, mine water discharges will occur during both high flow snow melt conditions in spring and low flow or freezing conditions in winter. From Table 4.4 it is estimated that mine water discharge during spring snowmelt conditions is likely to be 0.12 m^3/s whilst during winter months it would be 0.05 m^3/s. The average annual mine water discharge will be 0.045 m^3/s.

The results of the hydrological analysis involving a comparison of relative flow rates from the mine discharge outlet with existing flows in the receiving Akbastaubulak brook are summarised in Table 4.7 and illustrate their relative magnitude by season. The flow data shows that:

- Average annual mine water discharges (0.045 m^3/s) are likely to be an order of magnitude greater than existing flows within the receiving channel of Akbastaubulak brook (0.008 m^3/s). Following construction of the waste dump diversion channel, flows within Akbastaubulak brook will reduce to near zero at the mine discharge outlet.
- During low flow conditions in winter mine water discharges (0.052 m^s/s) are likely to be an order of magnitude greater than existing flows within the receiving channel of Akbastaubulak brook (0.002 m^3/s). Weather conditions in winter months are likely to cause a freezing of the receiving channel whilst the water from the underground mine will be relatively warm and thus free flowing for some distance downsteam of the discharge outlet until influenced by temperature conditions at the surface.
- During high flow snow melt conditions in spring mine water discharges (0.12 m^3/s) are likely to be an order of magnitude smaller than existing flows that within the Akbastaubulak brook (1.84 m^3/s). This suggests that the mine water discharge would not exceed the downstream channel capacity of the Abastau Brook that coincides with its existing natural flow condition.

Table 4.7: Flow Characteristics Downstream of Mine Discharge Outlet					
Location	**Brook**	**95% AEP Winter Low Flow (m^3/s)**	**3% AEP Spring High Flow (m^3/s)**	**0.5% AEP Spring High Flow (m^3/s)**	**average annual flow (m^3/s) [B]**
Upstream of discharge outlet (no upstream diversion) [A]	Akbastaubulak brook	0.002	1.84	2.84	0.008
Upstream of discharge outlet (with upstream diversion)	Akbastaubulak brook	0	0	0	0
From mine water discharge outlet (Stage 2)	pipeline	0.052	0.12	0.12	0.045
Downstream of discharge outlet near gauge 5 (no upstream diversion)	Akbastaubulak brook	0.054	1.96	2.96	0.053
Downstream of discharge outlet near gauge 5 (with upstream diversion)	Akbastaubulak brook	0.052	0.12	0.12	0.045
Notes: [A] this assumes catchment runoff upstream of the mine water outlet is similar to the estimated flow at the location of gauge no. 5 located further downstream. [B] Appendix 4.3 - WAI Drawing 3.5 and 3.6.					

4.4.4 Aquatic Flora and Fauna

In July 2013, a survey and water sampling exercise was carried out at ten locations in and around the mine site to identify aquatic flora and fauna (Figure 1 in Appendix 4.6). This included a survey site at Dalniy quarry on the Mayran brook about 1 km upstream of the stream diversion outlet (description Section 2.1 Appendix 4.6). The survey site at Zagadka (Sorokovaya) quarry is in an area that is close to the confluence of the Akbastaubulak brook and Kyzylsu river but does not appear to be on the Akbastaubulak brook channel (Figure 4 Appendix 4.6). No survey was carried at Quarry No. 5-6 and in any case its coordinates suggest it is located to the west of the Akbastaubulak brook. Despite this apparent shortfall the report makes observations about the reaches of the Akbastaubulak brook upstream of the mine site.

A summary of the survey report's findings as they relate to the Holodniy Klyuch/Mayran brook (receiving watercourse of stream diversion channel) and Akbastaubulak brook (receiving watercourse of mine water discharge) are as follows.

Holodniy Klyuch/Mayran brook at Dalniy quarry upstream of the stream diversion outlet contains five species of fish and two crayfish, none of which are unique to this area or on the IUCN Red List as Endangered:

- The study area is lacking in higher order crustaceans with only two species of crayfish (Amphipoda *Gammarus lacustris Sars*) and Decapoda (*Astacus leptodactylus Eschscholtz*) being found in streams and water storage basins.
- Prussian Carp (*Carassius gibelio*).
- Roach (*Rutilus rutilus*) are the most numerous species of fish in the survey area.

- Common Minnow (fresh-water) (*Phoxinus phoxinus*) is most prevalent in unspecified stream.
- Gudgeon (*Gobio gobio*).
- River Perch (*Perca fluviatilis*).

Akbastaubulak brook contains five species of fish and one crayfish none of which are reported as being endangered or specific to this area:

- Crayfish (Amphipoda *Gammarus lacustris Sars*) are present throughout the survey area.
- Prussian Carp (*Carassius gibelio*) are present in the upper reaches of the Akbastaubulak brook and in the Dalniy quarry.
- Common Minnow (fresh-water) (*Phoxinus phoxinus*) is prevalent in unspecified streams.
- Tench (Tinca tinca).
- Gudgeon (*Gobio gobio*).
- Bearded Stone Loach (*Barbatula toni*).

The algal flora of water bodies is mainly represented by diatom and green algae. The largest biomass is a characteristic of slow flowing water in natural water bodies which have a strong organic matter supply, such as the Kyzylsu rervoir and Alaiagyr dam. The smallest biomass is typical found in quarries.

The higher order water flora consists of hygrophilous and hydrophilic forms. Most common are plants such as southern reed, narrow-leaved cattail, sedges and various species of pond weed.

Plankton in the examined water bodies includes 35 species. Water bodies are dominated by rotifers and occasionally by cladocerans. The nature of nutrient status depends on the supply of organic matter and in water bodies it varies from β-mesotrophic to ultra-oligotrophic.

The survey report recommends that in order to monitor the health of the ecosystem the distribution of species such as: caddis flies and worms, Common Minnow, Gudgeon, Siberian Loach and larvae of Diptera and Tench should be monitored. It is further recommended that the occurrence of any deformities in fish should be documented as an indicator of pollution in receiving waters.

4.4.5 Surface Water Quality

The close proximity and similarity in land use and geology of the Holodniy Klyuch and Akbastaubulak brooks means their water quality of the two watercourses will be similar. Therefore, the diversion of water from the Akbastaubulak brook is unlikely to cause changes in the water quality of the Holodniy Klyuch Brook.

During the previous continuous operation of the mine, mine drainage water was normally pumped into the tailing dam via a pipeline. Following the cessation of operations it has been reported that mine drainage water was allowed to enter the Akbastaubulak brook.

The numerous waste dumps and non-economic ore stockpiles together with the open or backfilled open pits contribute to groundwater recharge and subsequently to groundwater inflows to the mine. Also, the original ESIA has reported that the pit groundwater interacts with the rocks of the ore-body causing the quality of dewatering to differ from fresher water abstracted in the Kyzylsu wellfield.

The original ESIA (ESIA Appendix 4.8.2) reported available water quality data for mine drainage in 2012 and 2013 and data for the Akbastaubulak brook in 2015 (reproduced in Table 4.8). These data shows that the mine water discharge exceeded Maximum Permissible Concentrations in drinking water for arsenic, cadmium and sulphate. Also, it has been reported that groundwater concentrations were above the Maximum Permissible Concentrations in drinking water for a similar set of parameters (arsenic, cadmium, sulphate, manganese, and nitrate) in a number of boreholes. This tends to confirm the interaction of deeper groundwater with the ore body.

In 2015, when it is presumed there was no mine water discharge, the receiving channel exceeded Maximum Permissible Concentrations for drinking water for cadmium, only. This tends to confirm the freshness of the shallow superficial alluvial aquifer which groundwater piezometry suggests feeds surface water features, at least in part.

There are no surface water abstractions for potable use on the Akbastaubulak brook but the stream sustains fish species common to the local area. The IFC Environmental, Health, and Safety Guidelines for water quality in Mining are the most appropriate international standard (Table 2.5.1 in Chapter 2) and will augment the existing monitoring suite. However, water quality monitoring should account for the aquatic habitat through the application of a biocriteria based monitoring programme where selected fish species are recorded during stream surveys. The fish surveys are recommended on an annual basis to complement the water quality sampling. Additional fish surveys will be undertaken in 2017 following the compeletion of the water diversion channel.

Table 4.8: Surface Water Quality Records

	Mine Drainage Water		Akbastaubulak brook downstream of mine site	
Parameters	**2012 Concentration (mg/l)**	**2013 Concentration (mg/l)**	**PES5 Concentration (mg/l)**	**PES6 Concentration (mg/l)**
Ammonium Salt	0.185	0.11	0.15	0.16
Arsenic	0.176	0.185	0.0256	0.0136
Cadmium	0.0071	0.0058	0.0012	0.0062
Chloride	56.62	65.77	12.02	4.01
Copper	0.008	0.0016	0.0013	0.0028
Fluorine	0.4	0.37	0.80	0.74
Iron	0.034	0.037	0.061	0.042
Lead	0.0007	<0.01	0.0003	0.0004
Manganese	0.018	0.031	0.091	0.004
Nitrates	5.06	3.3	0.40	3.90

Table 4.8: Surface Water Quality Records				
Mine Drainage Water			Akbastaubulak brook downstream of mine site	
Parameters	2012 Concentration (mg/l)	2013 Concentration (mg/l)	PES5 Concentration (mg/l)	PES6 Concentration (mg/l)
Nitrite	0.027	0.0515	0.019	0.025
Oil	0.04	0.1	<0.02	<0.02
Selenium	0.0094	0.024	0.006	0.005
Sodium	99.9	97.05	99.0	95.5
Strontium	2.3746	0.76	2.173	1.703
Sulphate	556.2	566.25	60.1	44.9
Zinc	0.0052	0.013	0.0016	0.0022

4.5 Socioeconomic Items

This section addresses gaps relating to the Project's social baseline, specifically presenting results from a survey of local fishermen and addressing issues within the ESIA's land acquisition section.

4.5.1 Local Fishermen Survey

Polymetal carried out an interview-based survey of local fishermen in August 2016 in order to verify whether any fishing takes place around Akbastaubulak brook, both upstream and downstream of the planned diversion. In total, 6 fishermen were interviewed. All the interviewed fishermen were male residents of Auezov, with an average age of 47.

The interviewees reported fishing at the Kyzyl-Su River (all) as well as at Ala-Aygyr water reservoir (1) and Kyzylsu water reservoir (1). They reported fishing up to 2 or 3 times per month, taking fish exclusively for their own consumption (not selling it on). They reported catching carp (family Cyprinidae), perch (genus Perca), pike (family Esocidae) and Siberian roach (*Rutilus rutilus lacustris*).

All 6 fishermen reported that they never fish at Akbastaubulak brook.

4.5.2 Land Acquisition and Voluntary Resettlement

This section provides a more detailed understanding of the Project's land acquisition process.

Overview

Official documents indicate that Polymetal has resettled residents from 27 properties on Sotsialisticheskaya Street. The land acquisition negotiation process has been completed and all agreements have been finalised. Since the official deadline for residents to vacate their properties was 1 May 2016, all households have physically relocated, all compensations have been executed and all properties have been subsequently demolished. WAI has been supplied with the official documentation confirming the demolition of all properties and documents supporting Polymetal's account of the resettlement process (see Appendix 4.7) for a List of Households, Household History and Timeline for Demolition).

Voluntary Resettlement

According to EBRD PR 5 on Land Acquisition, Involuntary Resettlement and Economic Displacement, resettlement is considered involuntary when affected individuals or communities do not have the right to refuse land acquisition, or restrictions on land use, that result in displacement.

In the early stages of the project, before open pit optimisation, the SPZ included three houses on Sotsialisticheskaya Street. At that point, BMV initiated relocation proceedings for all 27 households on the street, given their proximity to the SPZ boundary. As the Project developed, the open pit boundary was moved away from the village and the SPZ was moved accordingly, meaning that all 27 households were outside the SPZ. In this context, the process carried out at Kyzyl is considered to have resulted in voluntary resettlement of affected residents because affected residents, all living outside the SPZ, chose to sell their properties when Polymetal approached them and because Polymetal showed intention during meetings to adapt the mine plan in order to eliminate the need for resettlement. Informed consent was obtained from all 27 households displaced as a result of the Project.

Summary of Resettlement Process

Polymetal held the first meetings with small groups of the potentially affected households in October 2014. The initial meeting was to explain the mine plan concept and potential land acquisition requirements. Polymetal was undecided whether to acquire the land and properties of Potentially Affected Parties at this point and were considering making changes to the mine plan, in order to accommodate the response from residents who would be affected. The outcome of these meetings was that all residents wanted to sell their properties through negotiated transactions.

In further discussions with affected residents Polymetal offered them two options: a) physical resettlement (alternative accommodation provided by Polymetal), and b) negotiated sale of their property. All the affected households selected the second option (b) of directly selling their property to Polymetal.

A second meeting was then held during December 2014 with individual affected households to review the conditions of housing and the land attached to the property, including outbuildings and other structures, in order to produce a price estimate. Fruiting trees and cropping plants were not included within the evaluation. The third meeting was held with the household members during January 2015 in order to negotiate price and terms of the transfer. All meetings were documented and the outcomes were reviewed and agreed with the meeting participants.

Polymetal developed a Resettlement Procedure to provide a framework for implementation of the land acquisition and voluntary resettlement process. The Resettlement Procedure outlines broader principles, approaches and processes to take forward land acquisition in a consistent and uniform manner.

The land acquisition process was implemented from October 2014 to August 2016, when the properties were demolished, and all transaction agreements have been completed. All residents of Sotsialisticheskaya Street were given a deadline (1 May 2016) to move out of the properties, a date

which was listed in the contract documentation. Some residents stayed in their homes until just before May 2016 because they needed more time and/or required help from friends and family to plan and carry out their move.

All legal transaction agreements have been completed and no further land acquisition is required for the project. All of the properties which have been acquired were demolished with the aim of cultivating the land by June 2016.

4.6 Biodiversity

This complementary baseline focuses on understanding the differences in sourcing of baseline information for the ESIA, in particular to distinguish between primary and secondary data. Further, this work aims to address gaps in biodiversity information around the site, relating them to EBRD's Performance Requirements (PR6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources), and to strengthen baseline data around the large heath butterfly and migratory raptors. Also, this chapter aims to provide complementary baseline information and biodiversity impact assessment analysis and mitigation measures focusing on the biodiversity of Akbastaubulak brook brook and downstream to the confluence with the Kyzylsu River.

In accordance with EBRD's PR6, none of the areas affected by the project may be considered "priority biodiversity features" which are defined as including:

(i) threatened habitats;
(ii) vulnerable species;
(iii) significant biodiversity features identified by a broad set of stakeholders or governments (such as Key Biodiversity Areas or Important Bird Areas); and
(iv) ecological structure and functions needed to maintain the viability of priority biodiversity features.

Priority Biodiversity Features, as defined by EBRD, are a subset of biodiversity that is particularly irrepleable or vulnerable, but at a lower priority level than critical habitats

4.6.1 Sourcing of Baseline Information for the ESIA

The biodiversity baseline provided in the ESIA sources information from primary (obtained on-site by WAI or other consultants) and secondary (desk-based studies) data.

A number of field studies have been undertaken at the Project site (summarised in Table 4.9.2 below) under differential field survey areas and sampling strategies according to the taxonomic group being studied. A brief explanation of the methodologies employed is provided in Section 4.9 of the ESIA, which describes the baseline for each taxonomic group. Surveys were carried out for the Project study area, which includes the Project's footprint and also areas that might be exposed to disturbance, pollution or other effects on the Project.

Table 4.9: Summary of Ecological Surveys Undertaken	
Date	**Survey**
Autumn 2010	Review of literature
	Preliminary study - Mammals
	Preliminary study - Birds
	Preliminary study - Reptiles
	Preliminary study - Amphibians
	Geobotanical field surveys
June 2011	Review of literature
	Breeding Bird survey
	Walk through route survey - Mammals
	Walk through route survey – Reptiles
	Walk through route survey - Amphibians
	Walk through route survey - Invertebrates
	Survey of fishermen - Fish
September to October 2011	Additional ornithological survey – autumn migration.
July 2013	Field survey - Aquatic Ecology
July 2013	Field Survey – Sand lizard populations
July 2013	Review of literature and field survey - Invertebrates

The field studies show that whilst the golden eagle (*Aquila chrysaetos*) and large heath butterfly (*Coenonympha tullia*) have been spotted in the region, neither were observed on site during the survey periods.

4.6.2 Strengthening of Baseline Data on Large Heath Butterfly and Migratory Raptors

Migratory Raptors

Between 2010 and 2016, a number of bird surveys were carried out in and around the Project site (Table 4.2.2).

Table 4.10: Summary of Bird Surveys	
Date	**Survey**
Autumn 2010	Review of literature and preliminary study
June 2011 (including breeding bird survey)	Including breeding bird survey
Sep - Oct 2011	Ornithological field survey
August 2016	Ornithological field survey - eagles

A single individual golden eagle (*Aquila chrysaetos*) was observed circling at very high altitude over the area planned for the new tailings facility on 1 October 2011. This species is listed in the Red Book of Kazakhstan as rare (Category III) but is considered a species of 'Least Concern' in the IUCN Red List. The golden eagle does not breed on the Project site, therefore nesting birds of the species are not likely to be influenced by land take or the area of influence of the mine.

In August 2016, an ornithological field survey of the open pit area, involving 22 transects and 12 observation points at the Project's sanitary protection zone and buffer zone found steppe eagle

(*Aquila nipalensis*) active within the SPZ area and the village of Auezov. The species is listed in the Red Book of Kazakhstan and on the IUCN Red List (as Endangered). Remains of dead rooks and what was presumed to be a raptor were found in the area along the transmission line within the SPZ area.

No prey bird nests or likely nesting areas, were found within the SPZ area, following an assessment by experienced external experts (who was also informed by discussions with local community, during social surveys on the prescence of raptors in the area). In accordance with EBRD PR6, it can be confirmed that the land within the Project footprint has no Critical Habitat. Surveys have identified that the habitat influence by the Project is not characterised by any of the EBRD's key defining features, which are:

(i) Highly threatened or unique ecosystems (the baseline surveys, confirmed by an additional survey in August 2016, confirmed that no threatened or unique ecosystems were present within the Project footprint);
(ii) Habitats of significant importance to endangered or critically endangered species (baseline surveys confirmed that there were no habitats that were of specific importance to any endanged or critically endangered species);
(iii) Habitats of significant importance to endemic or geographically restricted species (baseline surveys confirmed that no habitats, significantly important endemic or geographically restricted species were identified within the project footprint);
(iv) Habitats supporting globally significant migratory or congregatory species (baseline surveys confirmed that no significant migratory or congregatory species were present with the SPZ, or surrounding area);
(v) Areas associated with key evolutionary processes (none were identified as present in the baseline surveys); or
(vi) Ecological functions that are vital to maintaining the viability of biodiversity features necessary (none identified as present in the baseline surveys).

Large Heath Butterfly

Complementary detail was provided regarding the July 2013 invertebrate survey, in particular relating to the presence of the large heath butterfly (*Coenonympha tullia*). During the survey, the large heath was not found within the area of the Project. It was observed in the buffer zone (more than 5 km from the site facilities) and depressions of the SPZ 2km from the industrial area. The species was not recorded in the preliminary survey of 2011. In a survey carried out in August 2016 (see Appendix 4.6), the large heath butterfly was identified within the Project area but amounted to an insignificant proportion of the sample. The large heath butterfly has not yet been assessed for the IUCN Red List but it is listed as a Category III (rare) species in the Red Book of Kazakhstan and 'Vulnerable' in the Red Book of European butterfly species. Taken together, the two surveys indicate that, although the site is suitable for such a species, it does not contain any evidence of large heath butterfly and is therefore not a Critical Habitat as defined in EBRD's PR6, nor does the Project area comprise Priority Biodiversity Features (defined in PR6). Both the survey in Appendix 4.6 and those presented in the baseline studies for the ESIA confirm that similar habitat extends accross the steppe grasslands that surround the footprint of the Project. In addition, the baseline studies presented in the ESIA identified evidence of

populations of large heath butterfly in adjacent areas of habitat that will not be affected as a consequence of mining operations described in Chapter 3 of the ESIA.

The August 2016 baseline survey (Appendix 4.6) identified that a small number of individual species of false ringlet butterfly (*Coenonympha oedippus*) are present within the Project footprint. This species is listed as Near Threatened on the IUCN Red List. Baseline study report in the ESIA (see Chapter 4), identified that this species is also present within the habitat of the wider area.

The Project area is not considered to contain Priority Biodiversity Features for either the false ringlet and the large heath butterflies, as described by EBRD's PR6. False ringlet butterflies were found in very low concentrations and previous surveys showed that the species is also present across the wider region, meaning the Project area does not comprise critical habitat for this species. The large heath butterfly was also found in the region adjacent to the project area and the Project area is not thought to comprise any of the Priority Biodiversity Features, as defined by the EBRD earlier in this chapter.

4.6.3 Complementary Biodiversity Baseline Around Akbastaubulak brook

A baseline ecological study around Akbastaubulak brook was carried out by "The Wild Life Laboratory" ecological surveyors in 2013 and has now been made available to WAI (see Appendix 4.6). Some species were noted in the brook, namely leech (*Erpobdella octoculata*) which is the only species of leeches and some aquatic insects, including backswimmers (*Notonecta glauca*) and water boatmen (*Corixia linnaei*). The survey noted that in 1995, young species of Tench (*Tinca tinca*) were caught at the outlet of one of the dams in the Akbastaubulak brook, however, the study shows that no endangered or rare species are present at and around Akbastaubulak brook.

4.6.4 Conclusions

WAI developed this biodiversity baseline through site surveys supported by consultation with stakeholders and external experts. External experts were deployed in order to minimise the risk of vulnerable species or critical habitats being overlooked. Conclusions and further actions are summarised in Table 4.10 below.

In accordance with PR6 (EBRD), the most sensitive biodiversity features are defined as Critical Habitat, which comprise one of the following:

(i) Highly threatened or unique ecosystems;
(ii) Habitats of significant importance to endangered or critically endangered species;
(iii) Habitats of significant importance to endemic or geographically restricted species;
(iv) Habitats supporting globally significant migratory or congregatory species;
(v) Areas associated with key evolutionary processes; or
(vi) Ecological functions that are vital to maintaining the viability of biodiversity features described in i-v above.

In this context, the Project area does not comprise any habitat that can be defined within this framework and, although the large heath butterfly and steppe eagle were spotted within the Project area, the same habitat extends far beyond the Project boundary and into the adjacent region.

Further, none of the habitats were considered of significant importance or supporting globally significant concentrations of migratory species. The site does not support highly threatened and/or unique ecosystems or those of significant social, economic or cultural importance to local communities or areas associated with key evolutionary processes. As a result, Critical Habitat (as defined in PR6) does not apply to the assemblage of flora and fauna within the project footprint. Further, the additional ornithological survey undertaken in August 2016 identified that the habitat, within the project footprint was of medium importance to birds on the basis of assemblage of species present (see Appendix 4.6 and Chapter 4 of the ESIA). Consequently, the area within the project footprint has not been assessed as a Priority Biodiversity Feature (PBF), in the context of definition in PR6.

Similarly, additional lepidopterofauna surveys undertaken in August 2016 identified limited suitable habitat which was not equally represented outside of the project area, and although a few individual spcecies of false ringlet butterfly (*Coenonympha oedippus*) were observed, these are not considered a vulnerable specieces and therefore would not fall under the definition of a PBF. Furthermore, the abundance of similar habitat that surrounds the project footprint is known to provide suitable habitat for both large heath and the false ringlet butterfly (see Chapter 4 of the ESIA). These populations that have been observed outside the Project footprint would not be adversely affected by mining and ancillary operations (see Chapter 5 of the ESIA).

The relevant aspects of biodiversity features at Kyzyl in comparison with the requirements of PR6, has been summarised in Table 4.11 confirming that no further actions are required with respect to critical habitat and priority biodiversity features.

Table 4.11 Relevant aspects of biodiversity features at Kyzyl in line with EBRD's Performance Requirement 6 definitions of Critical Habitats and Priority Biodiversity Features				
Critical habitat as per EBRD PR6 (2014) para 14[5]	**Definition/examples**	**Priority biodiversity features as per EBRD PR6 (2014), paragraph 12**	**Biodiversity baseline surveys and relevant aspects at Kyzyl**	**Action needed**
(i) Highly threatened or unique ecosystems	Ecosystems that are at risk of significantly decreasing in area or quality; have a small spatial extent; and/or contain concentrations of biome-restricted species. For example: - Ecosystems listed as, or meeting criteria for, Endangered or Critically Endangered by the IUCN Red List of Ecosystems - Areas recognised as priorities in official regional or national plans, such as National Biodiversity Strategy and Action Plans - Areas determined to be of high priority/significance based on systematic conservation planning carried out by government bodies, recognised academic institutions and/or other relevant qualified organisations (including internationally-recognised NGOs).	(i) Threatened habitats	- Baseline survey showed that there are no highly threatened or unique ecosystems present within the natural habitats that will be disturbed, within the Project area. - The Project area contains a 'brownfield' land with a history of industrial use; further to the current project, it has historically not been determined to be of high priority/significance to conservation of biodiversity in Kazakhstan.	No further action required

[5] Modified from EBRD Guidance Note | Biodiversity Conservation and Sustainable Management of Living Natural Resources

Table 4.11 Relevant aspects of biodiversity features at Kyzyl in line with EBRD's Performance Requirement 6 definitions of Critical Habitats and Priority Biodiversity Features				
Critical habitat as per EBRD PR6 (2014) para 14[5]	**Definition/examples**	**Priority biodiversity features as per EBRD PR6 (2014), paragraph 12**	**Biodiversity baseline surveys and relevant aspects at Kyzyl**	**Action needed**
ii) Habitats of significant importance to endangered or critically endangered species	Areas supporting species at high risk of extinction (Critically Endangered or Endangered) on the IUCN Red List of Threatened species (or equivalent national/regional systems). For example: • Alliance for Zero Extinction sites • Animal and plant species of community interest in need of strict protection as listed in EU Habitats Directive (Annex IV).	(ii) Vulnerable species	Desk studies data identified potentially eight plant species that are listed within the Red Book of Kazakhstan, including: Steppe peony; Spring asphodel, *Hyssopus macranthus Boriss,* Prairie Crocus (*Pulsatilla patens),* Bent tulip, Wild Rosemary (*Rhododendron tomentosum)*, *Euphorbia macrorrhiza, and* Ludwig's iris *(Iris ludwigii)* (see Appendix 4.9.5 and Appendix 4.9.6 of the ESIA). Of these, field surveys within the Project affected area (completed in 2010), identified that Wild Rosemary (*R. tomentosum*) was present on land near the existing mine footprint. The conservation status is identified as least concern, due to it widespread geographical presence in the habitats of the Russian Altai. In Kazakhstan, the species is recorded as rare, therefore mitigation has been identified to either conserve (from disturbance), where present or translocate in advance of disturbing top soil. None of the species fall within the category of Priority Biodiversity Feature, with respect to the extent of the project affected area.	No further action required

Table 4.11 Relevant aspects of biodiversity features at Kyzyl in line with EBRD's Performance Requirement 6 definitions of Critical Habitats and Priority Biodiversity Features				
Critical habitat as per EBRD PR6 (2014) para 14[5]	**Definition/examples**	**Priority biodiversity features as per EBRD PR6 (2014), paragraph 12**	**Biodiversity baseline surveys and relevant aspects at Kyzyl**	**Action needed**
(iii) Habitats of significant importance to endemic or geographically restricted species	Areas holding a significant proportion of the global range or population of species qualifying as restricted-range under Birdlife or IUCN criteria. For example: • Alliance for Zero Extinction sites • Global-level Key Biodiversity Areas and Important Bird and Biodiversity Areas identified for restricted-range species	iii) Significant biodiversity features identified by a broad set of stakeholders or governments (such as Key Biodiversity Areas or Important Bird Areas)	No endemic or geographically restricted species were found by baseline surveys both within and adjacent to the Project footprint.	No further action required
iv) Habitats supporting globally significant (concentrations of) migratory or congregatory species	Areas that support a significant proportion of a species' population, where that species cyclically and predictably moves from one geographical area to another (including within the same ecosystem), or areas that support large groups of a species' population that gather on a cyclical or otherwise regular and/or predictable basis. For example: • Global-level Key Biodiversity Areas and Important Bird and Biodiversity Areas identified for congregatory species • Wetlands of International Importance designated under criteria 5 or 6 of the Ramsar Convention.		• See ii) above, with comments regarding steppe eagle, a migratory raptor • No other globally significant concentration of migratory species was found in this survey	No further action required

Table 4.11 Relevant aspects of biodiversity features at Kyzyl in line with EBRD's Performance Requirement 6 definitions of Critical Habitats and Priority Biodiversity Features				
Critical habitat as per EBRD PR6 (2014) para 14[5]	**Definition/examples**	**Priority biodiversity features as per EBRD PR6 (2014), paragraph 12**	**Biodiversity baseline surveys and relevant aspects at Kyzyl**	**Action needed**
(v) Areas associated with key evolutionary processes	Areas with landscape features that might be associated with particular evolutionary processes or populations of species that are especially distinct and may be of special conservation concern given their distinct evolutionary history. For example: • Isolated lakes or mountaintops • Populations of species listed as priorities by the Edge of Existence programme.		No areas associated with key evolutionary processes were identified by surveys on the Project site. Its historical legacy as a mining area make it highly unlikely that key evolutionary processes exist within the Project's SPZ area.	No further action required
(vi) Ecological functions that are vital to maintaining the viability of biodiversity features described (as critical habitat features)	Ecological functions without which critical biodiversity features could not persist. For example: • Where essential for critical biodiversity features, riparian zones and rivers, dispersal or migration corridors, hydrological regimes, seasonal refuges or food sources, keystone or habitat-forming species.	(iv) Ecological structure and functions needed to maintain the viability of priority biodiversity features	No areas associated with vital ecological functions were identified by surveys on the Project site. Its historical legacy as a mining area make it highly unlikely that such functions exist within the Project's SPZ area.	No further action required

CONTENTS

TABLES

FIGURES

APPENDICES

Appendix 5.1 Air Quality Assessment

5 ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT

5.1 Introduction

This impact assessment chapter complements the ESIA in the areas of air quality (5.2), noise (5.3) and water including aquatic ecology (5.4). The detailed assessment of other environmental and social aspects can be found in the original ESIA.

5.2 Air Quality Assessment

5.2.1 Arsenic in Dust

The impact assessment for fugitive dust emissions including respirable particulate matter and Arsenic have been discussed in detail in Section 5.6 of the original ESIA report. This section provides additional assessment for the Arsenic emissions associated with the existing and proposed operations.

5.2.2 Emission Sources

The existing and proposed sources of Arsenic emissions associated with the Project are listed below:

Existing Sources

The Bakyrchik mining site has been operational since 1956, and mining activity has continued on site intermittently to the present day. Due to historical mining activities there are several existing waste dumps and a number of existing open pits within the project area, some of which have high concentrations of arsenic.

The site comprises land contaminated with arsenic which when subject to wind erosion can result in the release of arsenic into the air together with dust. This may include areas around a now decommissioned roaster. A tailings storage facility was also required as part of the historical operations which has dried up over the years, and as a result has high arsenic concentrations. The tailings storage facility has not been closed and is exposed to wind which may contribute to the high concentrations of arsenic observed in the baseline monitoring results (Refer Section 4.4.5 of the original ESIA report). Following further study as to determine the composition of the historic tailings, measures for creating a temporary barrier through use of High Density Polyethylene (HDPE) liner or geotextile membrane could be a reasonable option to ensure the contents of the tailing storage facility are contained and are not exposed to winds. With such containment in place windblown arsenic from the facility is anticipated to be negligible.

The arsenic waste landfill site, to the east of the Project area was previously used to dispose arsenic waste material generated from the processing of ore. The arsenic waste material was stored in sealed bags in the facility. The landfill is no longer in use, and will not be used for the Project. It has been rehabilitated by capping with a 0.5mm plastic geotextile and a 0.5m layer of sandy loam material, and is therefore not considered to be either an existing or ongoing source of fugitive dust emissions containing arsenic.

Sources associated with Proposed Operations

The proposed operations will involve ore preparation facility which includes crushing of ore and transfer, by the conveyor, to ore processing facility which comprises a mills and flotation circuit. The

ore preparation operations may generate fugitive emissions of arsenic dust, however the ore processing entails wet processes only and therefore any emissions of arsenic dust will be limited. The ore processing does not involve any thermal treatment and is therefore not likely to result in vapour phase emissions of arsenic. The emissions associated with the processing of ore to concentrate are, therefore, anticipated to be negligible.

5.2.3 Potential Impacts to Air Quality

Local Weather Conditions

In order to provide information on how air emissions and dust deposition might be affected by local weather conditions, wind speed and wind direction data were obtained from the Shalabay weather station[1] for the period 1938-2013 (wind data for 1986 to 2009). An analysis of the wind data is presented in Section 5.6.4 of the ESIA report and suggests that calm or very low wind speeds (i.e. 1m/s or less) occur for 50% of the time (Refer Table 4.2.4 of the ESIA report) and the majority of wind speeds recorded (i.e. 98%) are below 10m/s.

The proportion of time when the dust sensitive receptors may be located downwind of the Kyzyl project based on the analysis of wind direction data from the Shalabay weather station is estimated to be 2609-4241 hours (Refer Table 5.6.7 and Table 5.6.8 of the ESIA report). Further, all dust sensitive receptors (Refer Section 5.6.3 of the ESIA report) are located more than 250m from the closest areas of working and it is therefore, predicted that larger dust particles, and a large proportion of medium size particles, will be deposited before reaching the sensitive receptors.

A wind speed of 5.5-6.0m/s is required to raise some dust, but higher wind speeds would be required to raise significant volumes. The wind data in Chapter 4.2 of the original ESIA report, identifies that approximately 88% of winds would be expected to be 5m/s or below in an average year. As a result, the number of working hours in which wind blows over the site towards the receptors in an average year is considered to be an overestimate, as it includes lower wind speed data that cannot be isolated in this analysis.

Although precipitation levels in the local area are not considered to be high, due to the continental type climate, there is an average annual precipitation rate of 335mm. This includes the approximately 150 days per year when mean temperatures are below 0°C, and therefore precipitation will occur as sleet and/or snow. During these conditions, the potential for dust dispersion is low. In addition, during the period of snow cover, dust emissions are also considered to be low.

Taking into account the distances involved and the local weather conditions, the effect magnitude is considered to be negligible. Applying medium receptor sensitivity and negligible magnitude identifies the effect is likely to be negligible, and so the impact of arsenic dust on the community health will not be significant.

[1] Bakyrchik Mining Venture LLC, The Bakyrchik Gold Deposit, MINE AND PROCESS PLANT CONSTRUCTION, 34.01.06.001.00 PZ3, St Petersburg, 2015

As described in Section 5.2.1, measures for creating a temporary barrier through use of High Density Polyethylene (HDPE) liner or geotextile membrane is proposed to ensure the contents of the tailing storage facility are contained and are not exposed to winds. This will be informed by further study into the composition of the historic tailings to determine whether there is an legacy arsenic risk or not. The Project will carry out additional monitoring of Arsenic in air to assess compliance with the EU ambient air quality standard of 0.006µg/m^3 (annual mean for arsenic) outside the SPZ and to identify additional mitigation measures if required. This will be completed with workplace air quality monitoring against a limit of 0.01 mg/m^3 arsenic in air.

Considering the legacy issues associated with the site, with respect to arsenic, to the Project will carry out workers biomonitoring as part of routine worker health testing to monitor the arsenic concentrations in urine using an internationally recognised arsenic in urine limit of 50ug/l (ACGIH). If exceedances are observed, additional measures for minimising arsenic (in dust) exposure will be identified and implemented and worker hygiene monitoring will be continued on a regular basis. Polymetal will maintain a dialogue with local medical providers to monitor local health conditions. No health risks to workers or the local community as a result of previous mining activities, including potential arsenic in dust risks, have been identified to date (following consultation with local medical providers.

5.3 Combustion Sources

This section provides detailed air quality assessment for the point source of emissions associated with the operation phase of the project. During Phase 1 of the project, two new boiler houses (village boiler house and mine boiler house) will be constructed and the existing Auezov boiler house will be decommissioned. The village and mine boiler house will have a total installed capacity of 7.5MW (3 boilers (1 as backup) of 2.5MW each) and 12.5MW (5 boilers (1 as backup) of 2.5MW each) respectively. The boilers will be coal fired and will provide heat for the settlement, mining and processing facilities' needs. The mine boiler house will also include one 1.6MW diesel fired boiler. The fuel combustion associated with the boilers will result in emissions of nitrogen oxides (NOx), sulphur oxides (SOx), total suspended particulates (TSP or dust) and carbon monoxide (CO).

In summary, the following emission sources have been considered for the air quality assessment:

- Mine – Boiler House
  - 4 boilers in operation and 1 standby with coal combustion of 635kg/hr for each boiler – operational for 206 days in a year
  - 1 oil fired boiler 1.6MW which will be operational for 145 days in a year
- Auezov Boiler House
  - 2 boilers in operation and 1 standby with coal combustion of 635kg/hr for each boiler – operational 365 days a year

5.3.1 Assessment Methodology

Air Dispersion Modelling

The emissions associated with the operation of these boilers have been estimated using a steady state air dispersion model, AERMOD (Lakes Environmental model version 9.1). The assessment has been carried out based on a worst-case approach and therefore all boilers have been assumed to be operational for the entire year and seasonal variations have not been accounted. Meteorological data comprising of a complete series of hourly values of surface observations and upper soundings prepared with the MM5 prognostic model has been used.

The model produces computed concentrations that are the Process Contribution (PC). These process contributions have then been added to the ambient background concentrations to give a total Predicted Environmental Concentration (PEC) at pre-identified environmental sensitive receptor (ESR) locations assessed (i.e. ESR 1-5) (Refer Figure 5.1 below).

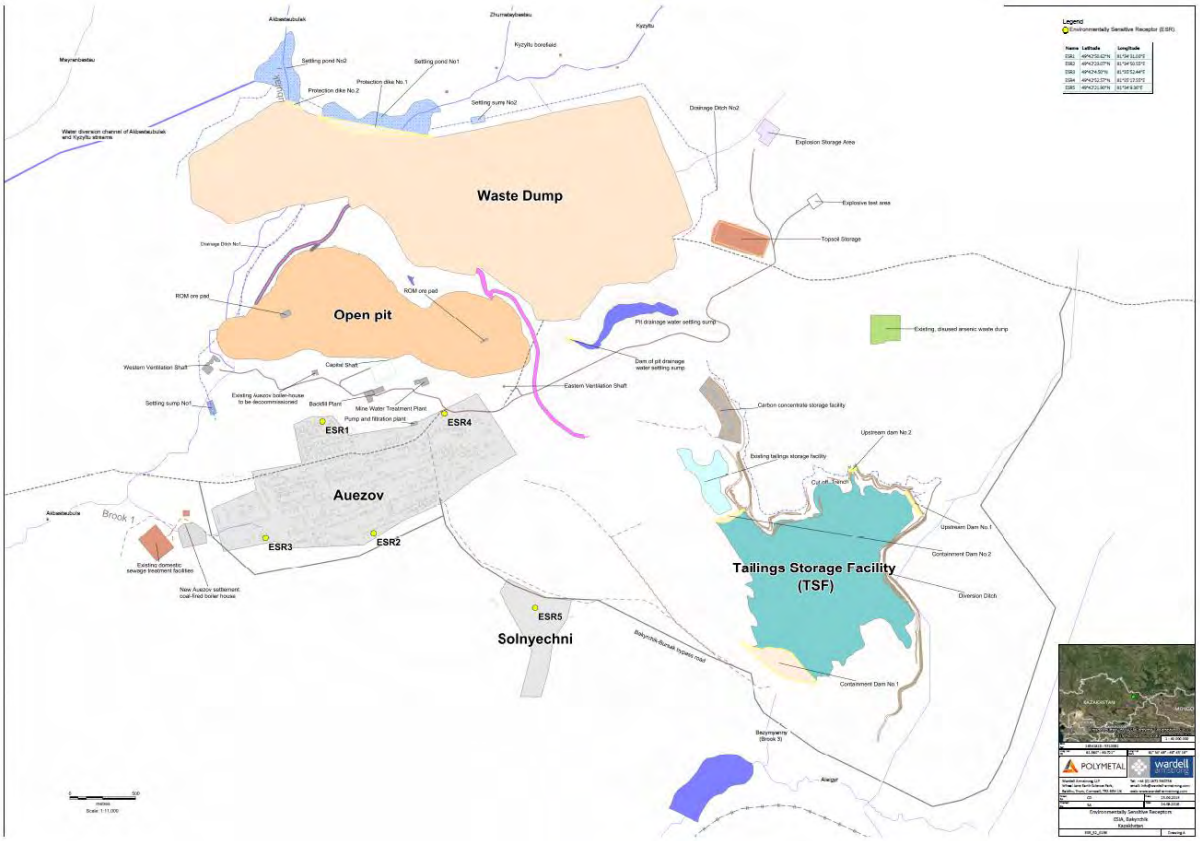

Figure 5.1: Receptors considered for Air Quality Assessment

More details are presented in Appendix 5.1 Air Quality Assessment.

Impact Significance

The significance of any environmental effect is determined by the interaction of magnitude and sensitivity. The impact significance matrix used for assessing air quality related impacts is the same as the default matrix defined in Section 5.1 (Table 5.1.3) of the ESIA report.

The methodology for determining sensitivity of receptor is presented in Table 5.1.6 of the ESIA report and the same methodology has been used. For the significance of the impact, new guidance has become available since the publication of the ESIA report (Refer Table 5.1 and Table 5.2) and has been used.

Table 5.1: Methodology for Determining Sensitivity	
Sensitivity	**Methodology**
Minor	The location is tolerant of change without detriment to its character, and is of low or local importance, for example industrial and agricultural activities, that are at a low risk from being affected by changes in air quality.
Medium	The location has moderate capacity to absorb change without significantly altering its present character, or is of high importance. For example, residential dwellings and communities.
High	The location has little ability to absorb change without fundamentally altering its present character, or is of national importance. For example, hospitals, and commercial / industrial premises, which have a requirement for clean air to maintain operations; and vegetation that is sensitive to changes in air quality and / or the deposition of particulates in terms of species composition and habitat quality.
Very High	The location is of the highest sensitivity to changes in air quality, or is of international importance. For example, highly sensitive high-tech operations that require clean air and operate air filtration units; and specific habitats that are of international importance and sensitive to changes in air quality and / or particulate deposition.

Table 5.2: Methodology for Determining Significance				
Long-term average concentration at receptor in assessment year	**% Change in concentration relative to Ambient Air Quality Limit (AQL)**			
	1	**2-5**	**6-10**	**>10**
75% or less of AQL	Negligible	Negligible	Minor	Medium
76-94% of AQL	Negligible	Minor	Medium	Medium
95-102% of AQL	Minor	Medium	Medium	High
103-109% of AQL	Medium	Medium	High	High
110% of AQL	Medium	High	High	High

5.3.2 Air Dispersion Modelling

Emission Sources

The flues associated with each boiler within the village/mine boiler house will be accommodated within a single shared stack. Each stack has been included as a point source within the model and the parameters included in the model are shown in Table 5.3.

Table 5.3: Model Parameters for Stack Emissions			
Parameter	**Mine Boiler House**	**1.6MW Oil Fired Boiler**	**Village Boiler House**
Total Installed Capacity	12.5MW	1.6MW	7.5MW
Boiler Configuration	5 boilers (4 operational, 1 standby)	1 boiler	3 boilers (2 operational, 1 standby)
Number of stacks	1	1	1
Stack Location	111142, 5520396	111129, 5520430	107937, 5520237
Stack Diameter	1.0	0.3	0.8
Stack gas flow (Am^3/s)	12.9	1.2	8.3
Temperature of exhaust gases (^oC)	75	60	70
Stack efflux velocity (m/s)	16.47	16.47	16.47
Stack height (m)	31.8m	6m	31.8m

Emission Limits

The EBRD refers to the EU emission standards for the projects it finances. The EU's Industrial Emissions Directive is one of the main EU instrument regulating pollutant emissions from industrial installations. The Industrial Emissions Directive (IED) was adopted on 24 November, 2010. The IED applies to all combustion plants with a total rated thermal input of or greater than 50 MW.

While smaller and bigger plants were covered by respective EU directives, the emissions from medium combustion plants were not regulated at EU level at the time of preparation of the ESIA report. On November 10, 2015, the European Council adopted the Medium Combustion Plant Directive, to limit the emissions from combustion plants of medium size (e.g. 1 MW to 50 MW capacity).

The EU's Medium Combustion Plant Directive, regulates emissions of SO_2, NOx and dust into the air with the aim of reducing those emissions and the risks to human health and the environment they may cause. The Directive regulates pollutant emissions from the combustion of fuels in plants with a rated thermal input equal to or greater than 1 megawatt (MWth) and less than 50 MWth.

The emission limits prescribed in the Directive are presented in Table 5.4.

Table 5.4: Emission Limit Values			
Parameter	**EU Medium Combustion Plants Directive (mg/Nm^3)[2]**	**EU Industrial Emissions Directive (mg/Nm^3)[3]**	**IFC's Emission Guidelines for Small Combustion Facilities Emissions (3MWth – 50MWth)[4]**
Sulphur Oxides	400	400	0.5 percent Sulphur or lower percent Sulphur if commercially available without significant excess fuel cost
Nitrogen Oxides	300	300	N/A
Total suspended particulates	20	30	96 ppm (Electric generation) 150 ppm (Mechanical drive)

The European Council has agreed the following timeframes for the adoption of the emission limits prescribed in the Medium Combustion Directive:

- for bigger existing plants (5-50 MW): from 2025
- for smaller existing ones (1-5 MW): from 2030
- for new plants: after a transposition period of two years following entry into force (20 December, 2018 onwards)

The Directive will be applicable to new plants after a transposition period of two years of coming into force and therefore any plant installed before 20 December, 2018 will be exempt. In this instance, the project boilers will comply with IFC's emission guidelines for small combustion facilities if installed before 20th December, 2018. In case the boilers are installed after this date, they will comply with the EU Medium Combustion Plant Directive. Further, since each proposed boiler is below the 5MW threshold, the 2030 timeframe for adoption would apply.

Emission Factors

The emission rates included in the AERMOD model are presented in Table 5.5.5. To assess the impacts of NOx, the total emissions for NO_2 have been calculated as the total of emission factor provided for NO_2 and equivalent NO_2 emission factor for NO. Similarly, for SOx, all emissions have been considered as SO_2 in the model and then compared with the ambient air quality standards for SO_2.

Table 5.5 : Emission Rates						
Parameter	**Emission Factors**					
	Mine Boiler House		**1.6MW oil fired boiler**		**Village Boiler House**	
	mg/m^3	**g/s**	**mg/m^3**	**g/s**	**mg/m^3**	**g/s**
Total Suspended Particulates	70.7	0.728	-	-	70.7	0.472
Sulphur Dioxide (SO_2)	598.3	6.2	651.7	0.6	598.3	4.0

[2] Directive (EU) 2015/2193 of the European Parliament and the Council of 25 November 2015 on the limitation of emissions of certain pollutants into the air from medium combustion plants

[3] Directive 2010/75/EU of the European Parliament and the Council on industrial emissions

[4] IFC's General EHS Guidelines: Environmental - Air emissions and ambient air quality

Table 5.5 : Emission Rates						
Parameter	Emission Factors					
	Mine Boiler House		1.6MW oil fired boiler		Village Boiler House	
	mg/m³	g/s	mg/m³	g/s	mg/m³	g/s
Nitrogen Dioxide (NO_2)	140.3	1.4	274.2	0.26	140	0.94
Carbon Monoxide (CO)	379.0	3.9	2160.0	2.1	379.0	2.5

5.3.3 Assessment of Impacts

The modelling results for the study area are provided in Table 5.6 and indicate that the maximum predicted environmental concentrations will be below the limits specified by both national limits and international guidelines considering a worst case with all boilers in operation throughout the year (Refer Appendix 5.1 for detailed results at each receptor location).

Table 5.6: Estimated Ground Level Concentrations						
Pollutant	Averaging Period	Maximum Predicted Process Contribution at ESRs (µg/m³)	Background Concentration (µg/m³)	Predicted Environmental Concentration (µg/m³)	Ambient Air Quality Limits (AQL) (µg/m³)	
					EU/IFC Limit	National Limits
Total Suspended Particulates (TSP)	1-hour	14.5	-	-	-	300
	24 – hour	1.3	39.5	40.8	150/50	-
	Annual	0.08			70/40	-
Sulphur Dioxide (SO_2)	1-hour	122.9	-	-	-	-
	24 – hour	10.8	8.5	19.3	125	125
	Annual	0.9	-	-	-	-
Nitrogen Dioxide (NO_2)	1-hour	28.9	-	-	200	-
	24 – hour	2.6	20.5	23.1	-	-
	Annual	0.3	-	-	40	40
Carbon Monoxide (CO)	1-hour	77.0	-	-	30,000	-
	24 – hour	12.9	-	-	10,000	-
	Annual	1.2	-	-	-	-

The results indicate that the predicted environmental concentrations are within the prescribed ambient air quality limits for all pollutants and the contribution from the boilers associated with the project is minor except for sulphur dioxide for which the emissions are considered to be moderate. Since, the Medium Combustion Plant Directive will be applicable to new plants after a transposition period of two years of coming into force, any plant installed before 20 December, 2018 will be exempt. In this instance, the project boilers will comply with IFC's emission guidelines for small combustion facilities if installed before 20th December, 2018. In case the boilers are installed after this date, they will comply with the EU Medium Combustion Plant Directive. The following mitigation measures have been recommended to ensure compliance with the IFC's emission guidelines for small combustion plant:

- Use of low sulphur fuel (less than 0.5%) and/or use of a flue gas desulphurisation unit
- Use of higher efficiency dust removal equipment such as high efficiency cyclones or Electro-static Precipitators.

Furthermore, the plants will have to comply with the Medium Combustion Plant Directive by 2030.

5.4 Noise

Detailed noise modelling exercise for the construction and the operation phases of the project was carried out and presented in Section 5.7 of the ESIA report. Subsequent to completion of the ESIA report, additional noise surveys have been carried out and this section presents an update to the operational phase noise assessment with consideration to the background concentrations available as a result of these surveys.

5.4.1 Operation Phase – Noise Assessment

The potential noise impact at existing receptors considered have been assessed by comparing the noise levels predicted for the operational phase of the project with the ambient noise level limits prescribed by WHO guidelines, which should not be exceeded during daytime (07:00-23:00) and night-time (23:00-07:00) periods. The predicted daytime noise values in the nearby communities during the 2016 (opening year), 2019 and 2027 operational phases are compared to these values in Table 5.7, Table 5.8 and Table 5.9 respectively.

Table 5.7: 2016 (Opening Year) Operational Phase Assessment Daytime Noise Impact

Receptor	Background Noise Levels (dB)	Predicted Site Noise Level, L_{Aeq} (dB)	Resultant Noise Level, L_{Aeq}, dB(A)	Daytime Noise Criteria, L_{Aeq} (dB)	Difference
ESR 1 – Solnechnoye	41	40	43	55	-12
ESR 2 – North West Auezov	45	54	55	55	0
ESR 3 – North East Auezov	46	51	52	55	-3
ESR 4 – East Auezov	46	52	53	55	-2
ESR 5 – North East Auezov	46	52	53	55	-2

Table 5.8: 2019 Operational Phase Assessment Daytime Noise Impact

Receptor	Background Noise Levels (dB)	Predicted Site Noise Level, L_{Aeq} (dB)	Resultant Noise Level, L_{Aeq}, dB(A)	Daytime Noise Criteria, L_{Aeq} (dB)	Difference
ESR 1 – Solnechnoye	41	40	43	55	-12
ESR 2 – North West Auezov	45	49	51	55	-4

Table 5.8: 2019 Operational Phase Assessment Daytime Noise Impact					
Receptor	**Background Noise Levels (dB)**	**Predicted Site Noise Level, L_{Aeq} (dB)**	**Resultant Noise Level, L_{Aeq}, dB(A)**	**Daytime Noise Criteria, L_{Aeq} (dB)**	**Difference**
ESR 3 – North East Auezov	46	48	50	55	-5
ESR 4 – East Auezov	46	47	50	55	-5
ESR 5 – North East Auezov	46	49	51	55	-4

Table 5.9: 2027 Operational Phase Assessment Daytime Noise Impact					
Receptor	**Background Noise Levels (dB)**	**Predicted Site Noise Level, L_{Aeq} (dB)**	**Resultant Noise Level, L_{Aeq}, dB(A)**	**Daytime Noise Criteria, L_{Aeq} (dB)**	**Difference**
ESR 1 – Solnechnoye	41	38	43	55	-12
ESR 2 – North West Auezov	45	43	47	55	-8
ESR 3 – North East Auezov	46	46	49	55	-6
ESR 4 – East Auezov	46	45	49	55	-6
ESR 5 – North East Auezov	46	48	50	55	-5

It can be seen that the daytime noise levels during the operational phases of 2016, 2019 and 2027 will be below the WHO Guidelines at all receptor locations. It should be noted that these predictions represent a "worst-case" scenario and that for the majority of the operational phases the noise impact at sensitive receptors would be less.

The output from the noise prediction model, showing noise emission from Project operational phase during the daytime are presented in Drawings 5.7.1, 5.7.2 and 5.7.3 for 2016, 2019 and 2027 of the original 2015 ESIA report. It should be noted that the unshaded parts of the contour plots represent areas where the predicted site noise level is less than L_{Aeq}55dB (in compliance with WHO daytime noise levels).

The significance of this impact in **None- Small**, when compared to the sensitivity of the receptor in accordance with the impact assessment criteria set out in Table 5.7.2 of the ESIA report.

The night-time noise levels arising from the operational phases of 2016, 2019 and 2027 have been assessed in Table 5.10, Table 5.11 and Table 5.12.

Table 5.10: 2016 (Opening Year) Operational Phase Assessment Night-time Noise Impact					
Receptor	**Background Noise Levels (dB)**	**Predicted Site Noise Level, L_{Aeq} (dB)**	**Resultant Noise Level, L_{Aeq}, dB(A)**	**Night-time Noise Criteria, L_{Aeq} (dB)**	**Difference**
ESR 1 – Solnechnoye	37	40	42	45	-3
ESR 2 – North West Auezov	38	54	54	45	9
ESR 3 – North East Auezov	40	51	51	45	6
ESR 4 – East Auezov	40	52	52	45	7
ESR 5 – North East Auezov	40	52	52	45	7

Table 5.11: 2019 Operational Phase Assessment Night-time Noise Impact					
Receptor	**Background Noise Levels (dB)**	**Predicted Site Noise Level, L_{Aeq} (dB)**	**Resultant Noise Level, L_{Aeq}, dB(A)**	**Night-time Noise Criteria, L_{Aeq} (dB)**	**Difference**
ESR 1 – Solnechnoye	37	40	42	45	-3
ESR 2 – North West Auezov	38	49	49	45	4
ESR 3 – North East Auezov	40	48	49	45	4
ESR 4 – East Auezov	40	47	48	45	3
ESR 5 – North East Auezov	40	49	50	45	5

Table 5.12: 2027 Operational Phase Assessment Night-time Noise Impact					
Receptor	**Background Noise Levels (dB)**	**Predicted Site Noise Level, L_{Aeq} (dB)**	**Resultant Noise Level, L_{Aeq}, dB(A)**	**Night-time Noise Criteria, L_{Aeq} (dB)**	**Difference**
ESR 1 – Solnechnoye	37	38	40	45	-5
ESR 2 – North West Auezov	38	43	44	45	-1
ESR 3 – North East Auezov	40	46	47	45	2
ESR 4 – East Auezov	40	45	46	45	1
ESR 5 – North East Auezov	40	48	49	45	4

It can be seen that the night-time operational phases occurring in 2016 and 2019 will be above the WHO Guidelines at all receptor locations within Auezov. Marginal exceedances are expected at three

receptors in Auezov during the night-time periods of 2027. The receptor location at Solnechnoye will be below the WHO Guidelines during the operational phases of 2016, 2019 and 2027.

It should be noted that the noise model predictions assume down wind conditions for all sensitive receptor locations. It has been found, based on average wind rose data from the Shalabay weather station[5], located approximately 5km south-west of the Kyzyl Project, for approximately 50% of the year sensitive receptors will be located up-wind from the mining operations. Therefore, the predictions represent a "worst-case" scenario and the noise impact at sensitive receptors would be less.

Additional calculations have been undertaken to quantify the likely noise impact as sensitive receptors when considering the average meteorological conditions throughout the whole year. The results predict a reduced impact to those presented within this report at all receptor locations of between 2 to 3 dB(A).

When comparing the predicted specific noise levels, at ESR 1 (Solnechnoye), from the operation phases of 2016, 2019 and 2027, with the WHO Guidelines, the magnitude of the noise impact of the operational phase is considered to be Negligible. The significance of this impact is **None** when compared to the sensitivity of the receptor using Table 5.3 of the ESIA report.

When comparing the predicted specific noise levels, at ESR's 2 to 5 (Auezov), from the operation phases of 2016, 2019 and 2027, with the WHO Guidelines, the magnitude of the noise impact of operational phase is considered to be Medium to Large at receptor locations in Auezov. The significance of this impact is **Substantial** in the short term and **Moderate** in the long term, when compared to the sensitivity of the receptor. The following measures have been proposed to mitigate the noise impacts:

- Installation of noise barrier such as greenbelt development or acoustic fence along the boundary of the site adjoining Auezov settlement;
- Scheduling of operations to minimise noise generating activities such as drilling during night time;
- Use of increased temporary noise limits for night time of up to 55dB(A) LAeq for periods of up to eight weeks in a year at specified noise sensitive properties;
- Regular monitoring of noise levels at Auezov to ensure compliance with the proposed increased temporary noise limits.

These measures will be informed by ongoing noise monitoring.

[5] Bakyrchik Mining Venture LLC, The Bakyrchik Gold Deposit, MINE AND PROCESS PLANT CONSTRUCTION, 34.01.06.001.00 PZ3, St. Petersburg, 2015

5.5 Water Assessment

This section provides an assessment of activities which may potentially cause impacts to the water environment during the operation phase of the project.

Groundwater modelling by SRK (2015) demonstrated that Akbastaubulak brook is likely to receive base flow contribution from a minor, shallow alluvial aquifer between the months of August and April. Monitoring has shown this water to be relatively fresh. A deeper, major aquifer occurs in the Lower Carboniferous fractured bedrock. Where the bedrock is not confined by the Pavlodar clay aquitard there is a high degree of connectivity with the shallow, alluvial aquifer near the surface.

During Phase 1 of the project, open pit mining activities will include dewatering of the pit and prior to 2018 will involve discharge of excess water to Akbastaubulak brook. Also, operation of the waste dump will require modification of surface water catchments and channels leading to the re-direction of flow from the Kyzyltu and Akbastaubulak brooks into the Holodniy Klyuch brook. Drainage from waste dump slopes will be discharged via settling ponds into nearby watercourses, including Akbastaubulak brook. After 2018, all water from pit dewatering will be recycled to help supply the water demands of the processing plant.

Dewatering of the open pit will create a cone of depression. Groundwater modelling by SRK shows that this will extend away from the open pit about 4 km to the south, and 2.8 km to the west and east. Therefore, a large proportion of the groundwater inflow to the open pit will originate from nearby streams (Akbastau, Kholodnyi Klyuch and Benzymiannyi brooks). The modelling indicates that base flow in the Akbastaubulak brook could be reduced by 60 and 70 percent in the 5th and 10th year of mining, respectively.

During Phase 2, underground mining activities will involve further dewatering activities. The existence of the waste dump will maintain the requirement for re-direction of flow from the Kyzyltu and Akbastaubulak brooks into the Holodniy Klyuch brook. The impacts of Phase 2 on groundwater flow have not been modelled at this stage but will be done so prior to Phase 2.

Due to the interaction of groundwater with the ore-body mineralisation of groundwater will occur. Maximum permissible concentrations were found to have been exceeded in 2015 for the following parameters: arsenic, cadmium, selenium, manganese, total iron, lead and strontium.

During mine operations potentially contaminated water reaching the aquifer water table will be contained by pit dewatering and the associated cone of depression. Potentially contaminated groundwater will therefore tend to flow towards the pit rather than away from the mine area.

Mine closure will curtail dewatering operations in the open pit and underground mine and discharge of mine water to Akbastaubulak brook will cease and as a result flow will decrease significantly on closure. The maintenance of waste dump integrity will require the continued diversion of flow from the Kyzyltu and Akbastaubulak brooks into the Holodniy Klyuch brook. Flow within the Akbastaubulak brook at the mine discharge outlet will continue to be significantly reduced receiving base flow

contributions from groundwater, the Auezov wastewater treatment plant and a small amount of surface runoff from the southern side of the waste rock dump.

During closure dewatering operations will cease and any contaminated groundwater will have the potential to move away from the mine area under recurrent natural hydraulic gradients.

5.5.1 Assessment Methodology

Hydrological Analyses

Estimates of flow within the receiving channels downstream of the diversion channel outlet (Holodniy Klyuch brook) and mine water discharge outlet (Akbastaubulak brook) have been derived from a frequency analysis of flow records from nearby catchments and transposed to the survey area by means of proportioning catchment areas.

Water levels and flow velocity along the Holodniy Klyuch brook downstream of the waste dump diversion channel have been estimated using the Chezy open channel flow equation and surveyed profiles of the channel. A similar analysis for the Akbastaubulak brook downstream of the mine water discharge outlet was not possible due to the lack of channel profile survey data.

The stream diversion could almost double the flow within the Holodniy Klyuch brook during a 1 in 200-year rainfall event, but calculations indicate that this will only cause localised out-of-bank flooding and scouring at the diversion outlet.

Mine water discharge will be an order of magnitude smaller than reported estimates of existing flows within Akbastaubulak brook during the high flow period of spring snowmelt. Therefore, water levels and flow velocities downstream of the discharge are unlikely to exceed the existing conveyance capacity of the Akbastaubulak brook and therefore will not contribute to flooding or erosion.

A description of aquatic flora and fauna that can be expected along the receiving watercourses downstream of the diversion channel outlet and mine water discharge outlet has been obtained from observations made during an aquatic flora and fauna survey and sampling study.

Impact Significance

The significance of any environmental effect is determined by the interaction of magnitude and sensitivity. These attributes have been determined from the same matrices used in the original ESIA and have been reproduced here in Table 5.13, Table 5.14 and Table 5.15.

Table 5.13: Magnitude of Effects with Respect to the Water Environment	
Impact Magnitude	**Guideline Criteria**
Negligible	Minimal or few detectable changes in baseline resource, which are either of short duration or infrequent periodicity, such direct control or management is not required.
Low	Detectable change to the baseline resource, such that preconstruction and during operations there would be ongoing deterioration in underlying characteristics or quality of the baseline situation in the absence of standard good industry practice to protect the water environment.
Moderate	Loss of, or alteration to the baseline resource such that post development characteristics or quality would be partially changed during construction and operational phase. Sustained mitigation strategy required through to post closure phase.
High	Total loss of, or alteration to, the baseline resource such that post development characteristics or quality would be fundamentally and irreversibly changed. Detailed mitigation strategy combined with offsite compensation is required to reduce the magnitude of the effect.

Table 5.14: Water Receptor Sensitivity Value		
Sensitivity (value)	**Typical Descriptors**	**Hydrogeology / Hydrology Descriptors**
Minor	Low importance receptor; Abundant; Local importance or scale; Resilient to change; Potential for substitution within the local area.	• A water body or aquifer of local importance (villages or hamlets) for water supply, food production, income or amenity value; • A water body of moderate amenity value; • A water body of low amenity value with casual access, e.g. along roads; • An area of aquatic ecosystem of low sensitivity.
Medium	Low to medium importance receptor; Relatively abundant; Regional important or scale; Reasonably resilient to change; Potential for substitution.	• A water body of regional importance (towns, cities or nomadic communities) for water supply, food production, income or amenity value; • An aquatic ecosystem of regional importance; • A regionally important aquifer for water supply, surface water support, food production or amenity value; • An area of aquatic ecosystem of regional importance or moderate sensitivity.
High	Medium to high importance receptor; Relatively rare; National importance or scale; Fragile and susceptible to change; Limited potential for substitution.	• A water body of national importance in an area used for national water supply, national food production, national income or national amenity value; • An aquatic ecosystem of national importance or high sensitivity; • A nationally important aquifer in an area used for national water supply, national surface water support or national food production.

Table 5.14: Water Receptor Sensitivity Value		
Sensitivity (value)	**Typical Descriptors**	**Hydrogeology / Hydrology Descriptors**
Very High	Very high importance receptor; Extremely rare; International importance or scale; Very fragile; Highly susceptible to change; Very limited potential for substitution.	• Any water body which forms a boundary between, or flows through, two or more countries; • Any water body that is bounded by two or more countries or within one country but provides a necessary channel between the open sea and other country; • A highly sensitive aquatic ecosystems of international importance; • A water dependent world heritage site or other water dependent site of international significance.

Table 5.15: Water Impact Significance Matrix				
Magnitude	**Sensitivity**			
	Very High	**High**	**Medium**	**Minor**
High	Major	Major	Moderate	Moderate
Moderate	Major	Major	Moderate	Minor
Low	Moderate	Moderate	Minor	Negligible
Negligible	Minor	Minor	Negligible	Negligible

5.5.2 Potential Receptors

The Holodniy Klyuch brook downstream of the waste dump diversion outlet contains the following infrastructure that could be impacted by the water environment:

- Road crossing 2km downstream of diversion channel outlet comprising a ford with no discernible man made structure. The road appears to be of local importance.
- Small number of dwellings and cultivated areas on right bank of Holodniy Klyuch brook approximately 3 km downstream of diversion channel outlet. The closest dwelling is approximately 80 m from the brook and dwellings are assumed to be occupied.
- Minor road crossing with culvert about 4 km downstream of diversion channel outlet and located close to the confluence of the Holodniy Klyuch brook and Kyzylsu river.

The upper reaches of the Holodniy Klyuch/Mayran brook contains five species of fish (Prussian Carp, Roach, Common Minnow, Gudgeon and River Perch) and two species of crayfish (Amphipoda and Decapoda) none of which are unique to this area or reported on the IUCN Red List as Endangered or important to the local economy.

The Akbastaubulak brook downstream of the mine water discharge outlet contains the following infrastructure that could be impacted by the water environment include:

- Road crossing comprising a culvert located approximately 200m downstream of the discharge outlet. The road appears to be of local importance.

- 9 Ha of cultivated land on left bank of Akbastaubulak brook approximately 1 km downstream of discharge outlet. It is not known whether farmers use Akbastaubulak brook for irrigation water. Existing median flow rates within Akbastaubulak brook during the summer growing season are in the order of 1 l/s to 5 l/s (Table 30 Hydrometeorlogical Report, EK Geological Survey Center, 2014) and are unlikely to be sufficient to sustain a water supply to a cultivated area of 9 Ha. Furthermore, the absence of diversion channels and pumps suggest that dryland farming is practised. Soil moisture conditions during the summer growing season will be maintained by incident rainfall and to a lesser extent seepage from the previous spring snowmelt and the Akbastaubulak brook channel.
- Cemetery on right bank approximately 2.5 km downstream of the discharge outlet.
- Road crossing comprising possibly of two culverts located close to the confluence of the Akbastaubulak brook and Kyzylsu river 4 km downstream of the discharge outlet. The road appears to be of minor importance.
- Wetland at confluence of Akbastaubulak brook and Kyzylsu river which overlaps the floodplain of both watercourses and its primary water source is therefore indistinct.

The upper reaches of Akbastaubulak brook contains five species of fish (Prussian Carp, Common Minnow, Tench, Gudgeon, Bearded Stone Loach) and one species of crayfish (Amphipoda) none of which are reported by the survey to be endangered or as being specific to this area.

After consideration of the above listed locations the original ESIA classification of receptors has been retained, i.e. “The brooks located in the project area are generally small streams, which flow broadly in a northeast to southwest direction”. Collection of flow data has been sporadic, but it was observed that the flow within the brooks is ephemeral between the months of August and March. The local abundance of fish species and the ephemeral nature the Akbastaubulak and Holodniy Klyuch means that the brooks are considered to have ***Minor*** **sensitivity**.”

The location of cultivated land adjacent to the Akbastaubulak brook suggest that it is a potential receptor. However, the absence of water abstraction infrastructure and the small magnitude of summer flow together with the small dimensions of the channel (less than 0.5m deep and up to 1.2m wide) make it unlikely that the sustenance of agriculture is reliant on flows within Akbastaubulak brook.

Polymetal carried out an interview-based survey of local fishermen in August 2016 interviewing 6 fishermen who are residents of Auezov. The interviewees reported that they did not fish from the Akbastaubulak brook and it is therefore assumed there is no fishing in the Akbastaubulak brook along the reach downstream of the mine.

It is uncertain to what extent the wetland at the mouth of the Akbastaubulak brook depends on flow from the Akbastaubulak brook as the wetland appears to overlap with the floodplain of the Kyzylsu river. The much greater and more sustained flow regime of the Kyzylsu river is more likely to dominate the health of the wetland relative to the contribution from the Akbastaubulak brook.

Therefore, whilst the presence of cultivated land and wetland along Akbastaubulak brook represent potential receptors, the absence of a dependence on flow from Akbastaubulak brook conforms to the overall Minor sensitivity rating for receptors.

5.5.3 Potential Impact

The following assessment of potential impacts to water resources is divided into four sections, and only includes any additions or changes to those reported Section 5.9.4 of the original ESIA Water Impact Assessment for the three phases of the project:

1. Surface water quantity;
2. Surface water quality;
3. Groundwater quantity; and
4. Groundwater quality.

1 Surface Water Quantity – Construction Phase
No additions to original ESIA.

1 Surface Water Quantity – Operational Phase
Waste dump diversion - Akbastaubulak brook downstream of inlet.

As a result of the diversion of flow from Akbastau and Kyzyltu brooks into Holodniy Klyuch brook and pit dewatering activities, the flow in Akbastaubulak brook downstream of the WRD will be reduced. There are no known surface water abstractions that could be affected by the reduced flows along the watercourse between the diversion inlet and the confluence of Akbastaubulak brook and Kyzylsu river. The reduction in flow (due to the removal of runoff from the upper catchment and groundwater drawdown) is likely to result in a **High magnitude** of change to the stream receptor and its aquatic flora and fauna. The receptor has **Minor sensitivity** due to the absence of unique flora and fauna and the location of sensitive infrastructure outside of flow paths. Impacts will therefore be of **Moderate significance**.

The potential for a moderate magnitude of impact on aquatic flora and fauna is supported by the continued presence of species in the unaffected reach upstream of the stream diversion and in other watercourses throughout the region.

The potential for a moderate magnitude of impact on surface quantity (stream flows and level) is reduced by the positive effect of mine water discharge and surface runoff from the southern sides of waste dumps which will discharge into Akbastaubulak brook. The potential impact should also be viewed in the context of the size of the Akbastaubulak brook downstream of the inlet relative to the overall catchment of the Kyzylsu river. The Kyzylsu river will see no overall reduction in flows as a result of the diversion because both the Akbastaubulak brook and the Holodniy Klyuch brook drain to it.

Waste dump diversion - Holodniy Klyuch brook downstream of outlet

As a result of the diversion of flow from the Akbastau and Kyzyltu brooks into the Holodniy Klyuch brook to the west, the flow in the Holodniy Klyuch brook downstream of the diversion outlet will be increased.

A hydrological analysis has shown that the diversion of flow from the Kyzyltu and Akbastaubulak brooks, upstream of the waste dumps, into the Holodniy Klyuch brook could more than double the flow of extreme events (0.5% annual exceedance probability) along the Holodniy Klyuch brook. This would cause out-of-bank flooding within 200 m of the diversion outlet but thereafter flows are likely to be contained by the existing channel along much of the remaining reach to its confluence with the Kyzylsu river. Flows during more frequent less extreme events are unlikely to cause flooding at the diversion outlet.

The velocities of diverted flows during the 0.5% annual exceedance event in the vicinity of the ford road crossing downstream of the diversion outlet are relatively slow and unlikely to cause scouring of the crossing point. Flow during more frequent less severe events is unlikely cause any scouring.

The containment of diverted flows within the existing channel of the Holodniy Klyuch brook would therefore not impact the dwellings and cultivated areas on the right bank of the lower reaches of Holodniy Klyuch brook.

The hydrological analysis suggests that flows within the Holodniy Klyuch brook will be doubled by the diversion during a 0.5% annual exceedance event. There is potential for such an extreme event to exceed the capacity of the road culvert close to the confluence with the Kyzylsu river. However, the floodplain is broad in this area providing significant additional storage and any flooding associated with the culverts lack of capacity would be localised and temporary.

The increase in flow and velocity is not expected to adversely affect aquatic flora and fauna within the existing natural channel.

The increase in flow downstream of the diversion outlet is likely to result in a **Low magnitude** of change to the stream receptor because flow is contained within the channel over most of its length and the increase in velocity is not excessive. The receptor has a **Minor sensitivity** due to the absence of unique aquatic flora and fauna and the location of sensitive infrastructure outside of flow paths. Impacts will be of **Negligible significance**.

Mine water discharge – Akbastaubulak brook downstream of outlet

During open pit mining and underground mining water will be drained from the working area and collected within an in-pit sump. Prior to 2018 excess water from the in-pit sump will be discharged to Akbastaubulak brook after appropriate treatment to guideline standards. After 2018 it is expected that all dewatering water will be transferred to the processing plant to support mine water supply. Discharges from the Auezov wastewater treatment plant (WWTP) will increase due to the treatment of mine domestic water and effluent comprising 45 m^3/day in Stage 1 and 122 m^3/day in Stage 2.

A hydrological analysis shows that the quantity of excess water to be discharged to Akbastaubulak brook is likely to be an order of magnitude greater than flows within the brook during low flow conditions. During the period when water within the Akbastau channel is frozen discharges of warmer water from underground dewatering operations may pond at the discharge outlet due to downstream ice barriers. The extent of ponding and its potential to overflow on to nearby areas will depend on local topography and rates of freezing. Field studies and a review of satellite imagery suggests that the receiving channel at the discharge outlet is a braided channel within a relatively wide (150 m) floodplain with flows passing through a road culvert about 200 m downstream of the mine discharge outlet. The potential for mine water to pond upstream of the culvert should an ice blockage occur can be mitigated by frequent inspection of the culvert and clearance of debris or ice.

The hydrological analysis also shows that mine water discharges are likely to be an order of magnitude smaller than flows that currently occur (without the proposed waste dump diversion channel) along the Akbastaubulak brook during high flow snow melt conditions in spring. The braided nature of the receiving channel suggests that gradients are relatively flat in the vicinity of the discharge outlet and that scouring from outflows will be restricted to the immediate area around the pipe outfall. The small magnitude of mine water discharge relative to prevailing natural flows along the Akbastaubulak brook means that mine water discharges will not create new instances of out-of-bank flooding or channel erosion. Therefore, mine discharge will have minimal or no impact on infrastructure in or along the downstream reach or its aquatic flora and fauna.

There is likely to be a **Low magnitude** of change to the stream receptor for a short period (up to 2018) because the mine discharge has the potential to cause a detectable change to low flow conditions. It is unlikely that this change in flow would cause a deterioration in the underlying characteristics of the baseline situation. This receptor has **Minor sensitivity** due to the absence of unique aquatic flora and fauna and the location of sensitive infrastructure outside of flow paths. Impact will be of **Negligible significance.**

There is a positive aspect to the mine water discharge in that the addition of water downstream of the diversion partially compensates for the impact of the diversion.

1 Surface Water Quantity – Closure
It is anticipated that mine dewatering will cease and the greater magnitude of evaporation compared to precipitation will ensure a negative water balance and prevent pit overflow. Surface water discharges to Akbastaubulak brook will have ended resulting in **No Further Impact**.

Drawdown of groundwater levels and the resulting capture of base flow from watercourses will end due to the cessation of mine dewatering activities. Also, runoff will continue to discharge into the downstream reach of Akbastaubulak brook from the southern slopes of the waste dump but discharges from the Auezov wastewater treatment plant will revert to pre-mining levels. However, the diversion of a significant proportion of the catchment will remain and therefore, the significance will remain **Moderate** for the Akbastau downstream of the waste dump diversion inlet and **Negligible** for the Holodniy Klyuch downstream of the diversion outlet.

1 Mitigation and Monitoring Measures for Impacts to Surface Water Quantity

During the mine operations actions will be required to prevent blockage of the road culvert downstream of the mine discharge outlet on the Akbastaubulak brook. This will allow unimpeded flow of mine water discharge and prevent inundation of the road.

There are potential cumulative impacts of the diversion and discharge on the Akbastaubulak brook, for example the diversion will remove water and the mine water discharge will add water to the brook. Mine water discharge and discharge from the Auezov waste water treatment plant could potentially compensate for the removal of water upstream of the WRD depending on the timing and quantity of water released.

Because the waste dump diversion channel will alter the flow regime in both the Akbastaubulak brook and Holodniy Klyuch brook it is important that these changes are monitored. This will involve monitoring of flow in the diversion channel and upstream of its outlet into Holodniy Kyluch brook. Also, monitoring in Akbastaubulak brook at the weir on the crossing point immediately downstream of the mine site. This monitoring location is downstream of the Auezov waste water treatment plant and it will be necessary to measure outflows from the plant to establish the relative contributions to flow within the brook.

Agricultural land in the locality of the brooks, is supported by rain fed soil moisture, should soil moisture content reduce in the vicinity of the Akbastaubulak brook, due to increased overland flow into the brook, crops can be supported by irrigation fed from the Holodniy Klyuch brook. Therefore, following construction of the diversion, monitoring of the agricultural land adjacent to the Akbastaubulak brook downstream of the mine site will be undertaken to establish the need for irrigation. If any irrigation is required, the Project will implement a scheme that continues to support the agricultural activities adjacent to the Akbastaubulak brook. This monitoring will be supported with a dialogue between the project and farmers. The monitoring will also include highlighting the occurrence of any invasive species which demonstrably have been brought to the site as result of the Kyzyl project. Should an invasive species be identified then remedial actions will be undertaken to remove them.

2 Surface Water Quality – Construction

No additions to original ESIA.

2 Surface Water Quality – Operation

Waste dump diversion - Akbastaubulak brook downstream of inlet

There is the potential for a slight change to the water quality of the Akbastaubulak brook due to a reduction in downstream flow. Potentially contaminated groundwater from the mine site will be prevented from reaching watercourses due to the induced groundwater gradients towards the mine by pit dewatering. The magnitude of change will be **negligible**. The receptor has **Minor sensitivity** as there are no known water abstractions along the downstream reach and aquatic flora and fauna is not unique to this watercourse. Impacts will be of **Negligible significance.**

Waste dump diversion - Holodniy Klyuch brook downstream of outlet

There is likely to be **Negligible magnitude** of change to the stream receptor which has **Minor sensitivity** because water quality upstream of the diversion inlet on the Akbastaubulak brook is likely to be similar to the water quality in the receiving Holodniy Klyuch watercourse at the outlet given the close proximity of both catchments. Impacts will be of **Negligible significance.**

Mine water discharge – Akbastaubulak brook downstream of outlet

The water pumped out as part of mine dewatering will be collected within an in-pit water settling sump (open pit 2) and thereafter transferred to the process plant to support mine water supply or the tailings storage facility. Excess water will be treated and discharged to the environment prior to 2018. Thereafter, all water will be re-used in the plant.

Excess water to be discharged from the pit will be treated to a standard that complies with appropriate environmental regulations, (see Table 2 in Section 2.5). There will be no need for a mixing zone to achieve compliance with water quality threshold values in the receiving channel and treatment standards will be compatible with requirements to maintain the status of potential receptors. Consequently, there will be **Negligible magnitude** of change to downstream water quality. The receptor has **Minor sensitivity** as there are no known water abstractions along the downstream reach and aquatic flora and fauna is not unique to this watercourse. Therefore, the **significance** of impacts is **Negligible**.

2 Surface Water Quality – Closure

It is anticipated that mine dewatering will cease along with surface water discharges to Akbastaubulak brook. This will end any impacts caused by surface discharge of mine water. There will be **No further impact.**

Potentially acid forming rock will be placed away from the edges of waste dumps and encapsulated by non-acid forming material isolating it from surface runoff and preventing its transport off-site.

Evaporation is far greater than rainfall creating a negative water balance for the open pit. Consequently, the open pit may have a negative water balance during closure, in effect creating a 'sink' for groundwater. It is uncertain whether this will occur or whether pit water levels will return to pre-mining levels and restore natural groundwater gradients in surrounding rock. If the latter is the case, then there is potential for contaminated or acidic water to migrate to nearby watercourses.

The Mine Closure and Water Management Plans include mitigation and monitoring strategies for acidic mine water. The plans are preliminary and require ongoing development.

Where surface water features have been diverted, the continued operation of the Site will maintain their previous impact and the **significance** will remain **Negligible** for the Akbastau downstream of the WRD and **Negligible** for the Holodniy Klyuch downstream of the diversion outlet.

2 Mitigation and Monitoring Measures for Impacts to Surface Water Quality

In addition to monitoring of water quality in Akbastaubulak brook upstream and downstream of the mine discharge outlet it is essential that the health of the aquatic ecosystem is monitored by periodically recording a distribution of species including: caddis flies and worms, Common Minnow, Gudgeon, Siberian Loach and larvae of Diptera and Tench. It is also required that the occurrence of any deformities in fish are flagged as an indicator of pollution in receiving waters. It is expected that monitoring the water quality of waste water treatment discharges will also be carried out as part of the normal functioning of the plant.

3 and 4 Groundwater

No additions to original ESIA in terms of groundwater quantity or quality which reported a high magnitude and moderate significance.

During operations pit dewatering will lower the groundwater level in the pit and induce groundwater flow towards the mine preventing the migration of potentially contaminated groundwater. After closure groundwater levels will rise within and around the open pit towards pre-mining levels. However, it is unclear whether groundwater levels will recover completely, a condition that would be required in order to establish natural groundwater gradients and allow contaminated groundwater to migrate away from the mine site. Any contaminants or acidic water that does move away from the open pit will be diluted within the surrounding aquifer.

The Mine Closure and Water Management Plans include mitigation and monitoring strategies for acidic mine water during closure. The plans are preliminary and require ongoing development.

5.5.4 Summary of Impact Significance

The significance of impacts is a product of receptor sensitivity and magnitude of change as described in the input significance matrix shown in Table 5.16, and Table 5.17. The significance of the project to the surface water environment is summarised in the tables below for water quantity and quality.

No changes have been made to the baseline description of groundwater and the original impact assessment has not changed.

Table 5.16: Impact Significance Matrix for Identified Surface Water Quantity Receptors

Receptor	Receptor Sensitivity	Magnitude of Change			
		Negligible	Low	Moderate	High
Akbastaubulak brook downstream of diversion channel inlet*	Minor				**Moderate**
Holodniy Klyuch brook downstream of diversion channel outlet	Minor		**Negligible**		

Table 5.16: Impact Significance Matrix for Identified Surface Water Quantity Receptors						
Receptor		**Receptor Sensitivity**	**Magnitude of Change**			
			Negligible	**Low**	**Moderate**	**High**
Akbastaubulak brook downstream of mine discharge outlet		Minor		**Negligible**		
Notes	(no colour)	No active or on-going mitigation required – delivered through design and industry best practice;				
	(light grey)	Active and ongoing mitigation required. Measures designed to reduce the level of significance on the water environment. Framework management plans have been developed to define the mitigation strategy and/or reduce the level of uncertainty associated with a specific impact;				
	(dark grey)	The sensitivity of the receptor is such that mitigation and/or offsite compensation would not be sufficient to reduce them to non-significant;				
* The Akbastaubulak brook sustains local fish populations and offers little other value, particularly when compared to the main Kyzylsu river channel that it joins 4km downstream of the mine. The assignment of minor sensitivity and moderate impact significance is therefore conservative and precautionary.						

Table 5.17: Impact Significance Matrix for Identified Surface Water Quality Receptors						
Receptor		**Receptor Sensitivity**	**Magnitude of Change**			
			Negligible	**Low**	**Moderate**	**High**
Akbakstau brook downstream of diversion channel inlet		Minor	**Negligible**			
Holodniy Klyuch brook downstream of diversion channel outlet		Minor	**Negligible**			
Akbastaubulak brook downstream of mine discharge outlet		Minor	**Negligible**			
Notes	(no colour)	No active or on-going mitigation required – delivered through design and industry best practice;				
	(light grey)	Active and ongoing mitigation required. Measures designed to reduce the level of significance on the water environment. Framework management plans have been developed to define the mitigation strategy and/or reduce the level of uncertainty associated with a specific impact;				
	(dark grey)	The sensitivity of the receptor is such that mitigation and/or offsite compensation would not be sufficient to reduce them to non-significant;				

Within the matrix the effects that are defined as major and moderate are considered to be 'significant' in ESIA Terms.

5.5.5 Residual Impacts

No additions have been made to the residual impacts identified by the original ESIA except to restate that there is the potential for residual impacts on aquatic ecology along the Akbastaubulak brook due

to changes in the natural flow regime due to the waste dump diversion channel and mine water discharge.

This impact should be considered in the wider hydrological context as it relates to a small section of a relatively minor tributary of the Kyzylsu river. Furthermore, the mine water discharge proposed to this stretch of the Akbastaubulak brook will partially compensate for the loss of flow due to the diversion. Continued monitoring of aquatic flora and fauna and a review of mine water discharge quantities is recommended.

5.6 Biodiversity

A further biodiversity impact assessment is not required because recent surveys confirm that the Project area does not hold critical habitat or Priority Biodiversity Features for raptors or butterflies (see Chapter 4).

CONTENTS

6 ALTERNATIVES ASSESSMENT AND SAFETY

6.1 Introduction to Alternatives Assessment

The information contained within this chapter should be read in conjunction with the original Alternatives section of the ESIA (Chapter 6). This alternative assessment supplements those alternatives previously presented in the ESIA (see Chapter 6) and provides evidence of the further options considered in relation to the site design and location of mine related infrastructure.

The original ESIA Alternatives chapter contained a stability assessment, further information has been provided in relation to this as part of the projects design in Chapter 3 (Project description) of the SESR.

6.2 Selection of Waste Rock Dump location

The waste rock dump location was a result of consideration of options around the site and to some extent a prioritization process taking into account the location of other mine facilities. The open pit is located over the economically exploitable ore deposit and therefore its location is determined by the exploration results and mine design. Taking account of the need to minimise haulage distances to minimise costs and reduce potential environmental factors such as noise and dust generation, the preferred location of the waste dump is therefore in the immediate vicinity of the open pit.

In consideration of the surrounding area, the ore body and previous workings extend to the east and west of the proposed open pit. Whilst these are not currently part of the mine proposal, in order to avoid sterilisation of any future potential the waste dump was not located over the lateral extensions of the ore body structure. Furthermore, parts of the ore body to the east have already been extracted and the proposals include utilising these voids as pit water sumps.

The area to the south of the open pit includes the existing villages of Solnechniy and Auezov. There is also the location of future mine infrastructure to the south west and the existing processing plant and tailings facility to the south east. Space for a waste dump was therefore limited and parts of the area were topographically undulating, making them less suitable for stable construction of the base layers and the subsequent layering of waste rock during construction.

The area to the north was not occupied by other existing or proposed land uses, although the area to the north west includes a river valley with two watercourses. The area immediately north of the open pit was topographically suitable being relatively flat and geotechnically suitable in having competent sandstone strata at shallow depth to form a suitable foundation for the waste dump. One minor watercourse crosses the location, but this also crosses the proposed open pit and requires diversion. The site was also immediately adjacent to the open pit and was therefore selected as the most suitable site for the waste dump.

6.3 Tailing Storage Facility and Processing Plant Location

The existing tailings storage area was located to the south east of the open pit within a topographic valley. The existing processing plant was also located between the open pit and the tailings facility and it was desirable for them to be located close to the open pit to minimise transport distance, preferably with the plant located between the mine and the tailings facility.

Both the processing plant and tailings lagoon were capable of expansion and the valley to the south of the tailings facility had sufficient capacity to contain the projected tailing volumes. Previously the Kyzyl-Tu brook valley, located to the north, was considered, but this did not have the required capacity and is located in a vast area of steppe habitat.

Having regard to the discussion in section 6.2 above, the areas to the east and west and to the south west of the open pit were not topographically suitable or available for establishing tailings storage, and the area to the north was more suitable for the waste rock dump. Therefore, the location of the TMF takes advantage of the existing infrastructure and maintaining future management of the tailings facility through a combination of existing infrastructure and purpose constructed tailing lagoon and dam.

The existing infrastructure was originally put in place to minimise environmental and social risks. It is in proximity to the mine site yet far enough from Auezov and Solnyechni settlements (approx. 2 km from each) to minimise environmental and social risks to these. After consultation with local stakeholders, Polymetal have agreed to maintain a corridor of space between the fenced-off TMF and Solnyechni village territory, where herders can graze the livestock belonging to residents of Auezov and where residents of eastern Auezov and Solnyechni carry out agricultural activities (much of it on state land but activity that has carried on for over 20 years and is vital to livelihoods). The TMF is also at a distance of 1 km from the major waterways and reservoirs to the south of the project and from the main railway line (approximately 1.5 km), which also runs to the south of the project in a broadly east-west direction. The underlying strata of the TMF were shown to be stable in nature.

6.4 Other Aspects

Alternatives were considered for Project design as well as in order to guide the decision making processes around Project design.

6.4.1 Processing ore concentrate

Due to the chemical content of the concentrate that results from the flotation process, specialist processing plant is required to efficiently refine the gold concentrate. It is currently proposed that the dewatered concentrate will be transported to the Shalabay railway station, via road, where it will be placed on to a freight railway car. Once on the freight rail network the majority of the concentrate material will be transported to the final processing plant in Amursk, Russia. It should also be noted that limited amounts may also be sent to a suitable processing plant in China for smelting and roasting.

The alternative arrangement of undertaking further processing on site was assessed and discounted for a number of environmental and social reasons. Off-site processing allows the Kyzyl scheme to avoid having to import cyanide into the project, therefore removing a number of potential adverse environmental effects associated with its use, including additional transportation impacts. Using the existing plant at Amursk also helps to support the existing operational roles located there.

The Amursk plant accepts similar concentrates from a number of other gold mines, thus avoiding the

need for further individual processing plants on these sites. This centralised processing plant reduces the environmental footprint of this operation compared to several individual plants performing the same function. The Kyzyl project will further support this centralised processing plant by not installing an associated processing facility on site.

Undertaking additional processing on site would require significant further investment in additional plant and processing (ADR) within the mine complex. However, the resultant concentrate from this plant would still require further processing off site to refine the gold. Despite the potential for further jobs to be created on site at Kyzyl associated with the additional processing, this option was discounted. The additional highways movements associated with the use of the Shalabay rail way station and the requirements to review the off-site facilities that undertake the final processing were judged as being acceptable compromises compared to the benefits of avoiding further processing on site.

6.5 District heating boiler and boiler for the mine

A coal fired district heating system currently provides heat and hot water to the properties within Solnechniy and Auezov villages. This coal fired boiler will be replaced with a new and more efficient coal fired plant. The heat at the mine is provided by a separate boiler, which is also coal fired and this will also be replaced as part of the Kyzyl project.

The alternative of replacing the centralised district heating with heating units within individual properties, apartment blocks and commercial units was discounted as being impractical given the scale of works that would be required to each property and their supporting infrastructure. Furthermore, if the centralised boiler was replaced with a larger number of smaller, most likely coal fired boilers would be required and the operational efficiency for coal combustion would be significantly reduced. As a consequence, an alternative to that of retaining the central district heating system was not a viable option. In addition, the infrastructure associated with the centralised heating system is in place and works efficiently for both residents and commercial properties.

Despite coal's high carbon content, the installation of a replacement coal fired boilers has a number of practical benefits that alternative fuel sources and heating arrangements such as gas and oil (both heating oil and gas oil). The alternative of considering gas and oil as a fuel source for the district heating scheme was discounted due to the practicalities of delivering these fuels to this remote area. Auezov and the wider area does not have an available access to a piped gas (or gas oil) network therefore, the use of these as alternative to solid fuel would require both specialist transportation (as would heating oil) and containment to deliver fuel to the centralised heating system, which would require significant further infrastructure investment. Coal is likely to be sourced from the Sarykol field of Maikuben basin within Kazakhstan and can be stored in stockpiles that would have low ongoing maintenance costs. Whilst oil (gas oil and heating oil) and gas, like coal, would need to be transported to the site via road, the heat generation in relation to the capacity of haulage vehicle would be greater for coal compared to the equivalent compressed or liquid gas, or heating oil. As a result of the above considerations, the continued use of a coal fired district heating system has been assessed as being the most efficient and practical solution for the Kyzyl project.

The use of renewable fuels such as biomass is currently not practical in this part of Kazakhstan, given its remote location and absence of timber as the most readily available alternative solid fuel to coal. However, as the market for biomass expands in the country, as a whole, there are options in future to consider co-firing of biomass with coal, should this option become available on a commercial scale.

6.6 Akbastaubulak brook diversion

There are a number of potential alternatives to the existing proposed diversion of the Akbastaubulak brook channel, these include the creation of a storage dam upstream, diverting water from the north around the waste dumps or the re-alignment of the waste dump itself.

The first potential alternative is the storage of flow from the upstream catchments in a dam and use the high potential evaporation rate to dispose of water accumulating during the spring snow melt. Such a storage body would have a number of negative environmental impacts including the seasonal inundation of a large area of natural ground and undisturbed channels of watercourses immediately upstream of the mine. It would also result in the net loss of water from the Kyzylsu river catchment. The storage of water would impose a risk on downstream areas/infrastructure that would create the need for a highly engineered embankment with appropriate material (clay core and rockfill) that may not be readily available.

The second alternative would be to convey water from areas to the north of waste dumps around the waste dumps and back into Akbastaubulak brook to the south. If favourable gradients are not available for gravity flow, then pumping of water would be required and balancing storage to reduce the size of pumps. The use of pumps would be an expensive undertaking and creates a risk of inundation of unprotected areas should mechanical failure or power outage occur.

The gradient between areas to the north and south of the waste dumps makes it feasible for water to flow by gravity. However, there is limited space available for the positioning of the waste dump due to existing mine infrastructure and to prevent sterilisation of the ore body. Due to volume of waste material the waste dump needs to straddle the Akabastau brook valley (topography is generally gradual). A north – south diversion channel would therefore need to follow a path to the west of the dump where gradients begin to climb rather than fall preventing the creation of a gravity flow channel.

The final option would be the realignment of the waste dump footprint to remain outside the natural flow path of the Akbastaubulak brook with provision of protection measures to the toe of the dump to prevent erosion during high flow events which would help minimise environmental impacts. However, due to the large volume of waste material and the limitations on available space a separation of the dump into smaller dumps to maintain existing watercourses is not feasible. It would also add to the logistics of rock placement and therefore costs.

It is concluded that the placement of the waste dump across the valley of the Akbastaubulak brook and the diversion of its catchment runoff into Holodniy Klyuch brook is the most practical and technically competent option taking account of the cost of managing waste rock, the limitation on space (and minimising the footprint of the WRD, topographic (or landform) constraints and the need

for active water management, to minimise the impacts downstream, including on infrastructure.

6.7 Concentrate processing and rail facilities

The anticipated volume of concentrate taken from the site for further processing is 86,000 tonnes per annum. Due to the volume of material produced, the cost of undertaking further processing on site is not economically viable. It is likely that processed material will be sealed and packaged into bags on site and then transported without the need for specialist loading facilities to the Shalabay station. Due to the scale of the operations required to transport the expected volume of material, no alternatives Shalabay station were assessed as it is the closest rail facility to the site (Charsk Station is the next closest being a further 40km away from the site compared to Shalabay).

6.8 New road (Bursak bypass)

The highway between Shalabay and the Kyzyl will be subject to an increase in vehicle movements resulting from the transport of workers, materials, and contractors to and from the site (see Chapter 5.12 of the ESIA). To reduce the impact of this change on the highways network, the project includes the construction of a new road (the Bursak bypass road) will direct public traffic coming from the west (Shalabay) around Auezov, the new processing plant, haul road and TSF re-joining the main road to the east of the project.

The alternative, of not constructing the bypass, would be to continue to direct a project related traffic through the centre of Auezov past residential properties and other local facilities (shops and restaurants). A significant number of the vehicles using the site will be larger trucks, and running these through the existing village of Auezov would result in increased levels of noise and dust, and surface wearing of the local road network.

Whilst the bypass will not eliminate the need for all mine related vehicles to go through Auezov, the new road will help to alleviate the impact of mine traffic compared to the use of the existing road network. Following the construction of the bypass, the risk of accidents between local traffic and mine vehicles will be reduced, as mine traffic will be directed away from using the road in the built up areas of Auezov. Road construction, will also result in temporary employment opportunities and should be developed to foster training opportunities for the local community, in construction related activities. The potential environmental impacts of the temporary construction of the road and the retrenchment of workers (although most will be contractors) once the road has been completed are assessed as being acceptable compared to the benefits delivered through the construction of the new road.

6.9 Proposed water pipeline

Polymetal are constructing a new pipeline from the Kyzylsu reservoir, located approximately 7km south of Auezov. This pipeline will be the main source of water supply to the Auezov settlement once stage 1 has commenced. The supply from the pipeline will augment water that is currently abstracted from a groundwater borehole.

The purpose of installing the pipeline was to reduce reliance from water abstraction from the Kyzyltu bore field. Once the proposed water pipeline from the Kyzylsu reservoir has been constructed, the Kyzyltu bore field would be retained as a backup, should the project water requirements change (e.g.

as a result of seasonal variations in flow, processing requirements or emergency measures). At the current time, being restricted to one water source (groundwater) may result in operational delays to the mining programme and associated management requirements. The benefits that result as a consequence of constructing a reliable source of water supply for the Kyzyl project and to the residents of Auezov mitigate the short term environmental disturbance which will occur during the construction of the pipeline.

6.10 Transmission line diversion

Power will be supplied from the national power transmission grid via a new, approximate, 6km length 220kv transmission line, supported by steel pylons with overhead cables, delivering power to purpose designed 110/35/6Kv main transformer substation with 2 x 25,000Kva transformers via 6Kv package outdoor switch gear, located close to the process plant.

An alternative of using large scale renewable energy to power the mine instead of taking electricity direct from the Kazakhstan national grid was discounted due to a number of factors. The industrial power requirements for a mining operation of this size would be greater than could practically and reliably delivered through renewable energy sources alone without a substantial storage facility. Large areas of ground mounted solar PV or wind would generate a renewable source of power, but has the drawback of intermittent supply. Therefore, renewable schemes would require supply both to the grid (when generation exceeded demand) and from the grid, to balance supply both to the mine and to residents in Auezov.

The development of hydroelectric power scheme(s) would have the benefit of provide a constant energy source, however, the power output from run of river schemes (given that a suitable gradient exists) would be well below what would be required to operate the mine and supply electricity to the community in Auezov.

Diesel generators could be employed on site but their use would result in significantly greater environmental effects in terms of noise and air quality emissions. Furthermore, the increase in diesel use will also generate further highways movements to bring fuel into the site, this would unnecessarily increase the projects carbon footprint. The electricity sourced from the Kazakhstan national grid will have a lower carbon footprint than using a number of individual diesel generator plants on site.

The Kyzyl Projects relative isolated location necessitates a reliable power supply which could not be delivered in a cost effective way within this part of Kazakhstan. Installing new infrastructure is the most practical solution for to upgrade the supply of power form mining operations.

CONTENTS

7 CONSULTATION AND DISCLOSURE

7.1 Introduction

Wardell Armstrong International ("WAI") was commissioned by Polymetal JSC ("PM") to undertake an Environmental and Social Impact Assessment ("ESIA") of the Kyzyl Gold Project ("the Project") in Auezov, East Kazakhstan. The ESIA and accompanying Non-Technical Summary ("NTS") were publically disclosed in December 2015 (see ESIA Chapter 7, for details).

PM seeks financing from the European Bank for Reconstruction and Development ("EBRD") and this Supplementary Environmental & Social Report ("SESR") has been prepared following discussions with PM and EBRD to align the project disclosure in accordance with the environmental and social requirements of the EBRD. These requirements are published through Performance Requirements (PRs), which form a part of the EBRD's Environmental and Social Policy of May 2014.

In this context, the ESIA (specifically the consultation and disclosure of the project that has taken place to date and recorded in Chapter 7 of the ESIA, together with the Stakeholder Engagement Plan (SEP, see MP10 of the ESIA) are the primary documents that have recorded the disclosure process. Prior to the involvement of the EBRD as principle project funder, the Non-Technical Summary (NTS) was the only document that had been translated into Kazak. All other documents, include the ESIA were available in Russian and English. This method of disclosure has not, to date, aligned with the Performance Requirements and the EBRD's Public Information Policy. The ESIA identified that 8% of the local community in Zharminsky District are native Russian speakers, therefore 92% of local Affected Populations may not able to review the technical documents in a language which is understandable to them, as the native language version of the documents has not been made available during disclosure of the ESIA.

Furthermore, additional requirements for the disclosure to conform with PR10 have been discussed and agreed between the EBRD and Polymetal. These requirements have been articulated in this chapter of the SESR and in the updated SEP (SEP – MP10). The SESR, together with the ESIA and its supporting documents, form the complete ESIA disclosure package which will be publically available for a minimum of 60 days in line with the EBRD's Public Information Policy (2014), before the Project is presented to the EBRD's Board of Directors for approval. The Non-Technical Summary contains a succinct version of the findings of the ESIA and SESR.

7.2 International Good Practice

As part of the ESIA process, a Stakeholder Engagement Plan (SEP – MP10) has been prepared and will be developed further as the Project progresses through construction and into operations.

The ESIA disclosure requirements of the SEP has been augmented in order to disseminate information, on the Project, to the public in three languages: Kazakh, Russian and English. The purpose of disclosure is to inform stakeholders about the Project, the programme for development and the associated environmental risks and mitigation strategies that have been addressed in the ESIA and accompanying SESR. In addition, the purpose of the SEP is to ensure the comprehensive dissemination of information, in order to encourage stakeholders to engage with both the Project and Polymetal as developers and

operators of the mine. The ESIA and SESR also provide the framework for ongoing consultation, methods for external communication of the Project programme and a grievance procedure which is now fully operational in Auezov and Shalabay villages, and should be reviewed on a regular basis.

7.2.1 EBRD Requirements

'Good practice' relating to EBRD PRs requires that the project proposers (Polymetal) develop positive relationships with stakeholders and build a consensus through mutual trust and respect to ensure early, timely and regular communication with local community and stakeholders. This requires a commitment to increasing the involvement and participation of stakeholders in a project. This will be done through disseminating information widely amongst stakeholders in a transparent manner and providing stakeholders with regular opportunities to discuss aspects of a project, including time to ask questions and obtain information as the Project is developed through construction and into the operational phase. This includes establishing a formalised grievance procedure, which is currently operating in an efficient manner, but will require regular review to ensure that it is maintained.

EBRD PR10 necessitates identification of all project stakeholders in the process of developing and implementing a SEP. Its objectives are to:

- Outline a systematic approach to stakeholder engagement that will help clients build and maintain a constructive relationship with their stakeholders, in particular the directly affected communities;
- Promote improved environmental and social performance of clients through effective engagement with the project's stakeholders;
- Promote and provide means for adequate engagement with affected communities throughout the project cycle on issues that could potentially affect them and to ensure that meaningful environmental and social information is disclosed to the project's stakeholders; and
- Ensure that grievances from affected communities and other stakeholders are responded to and managed appropriately.

7.2.2 EBRD Information Session Requirements

In accordance with PR10, following disclosure by the EBRD and in order for the local community and interested stakeholders to become familiar with the findings of the ESIA and SESR, a series of three Information Sessions will be organised, one session each in the communities of Auezov, Shalabay and Ust-Kamenogorsk. The Information Sessions will be open for a period of 3 hours each within one calendar day and in accordance with the ESIA and SESP disclosure schedule, published prior to the events taking place. Sessions will be organised and staffed by Polymetal employees, who have a detailed working knowledge of the Project programme and the findings of the ESIA and SESR, in order to inform discussion during the Information Session.

Printed versions of the ESIA and SESR will be made available to the local communities, in addition to general information regarding the project (general plan, layout plan). Disclosure of the ESIA and SESR will also be available electronically on the official website for the Akimat and the Polymetal website

(by the time an announcement of the Information Session, is made in the press). An announcement with the locations and opening times for the information sessions will be made in the local press (a minimum of two sources), 14 days prior to the Information Sessions. Additional invitations will be sent to Akimat, to the Auezov and Shalabay villages. Any questions received electronically, or through representatives during the Information Sessions, will be recorded and included in the report.

Specific format
In order to comply with EBRD PR10 requirements, each information session should start with a short presentation on the project, the ESIA and SESR, and a summary of the main findings. This can be presented by a company representative and supported by a slideshow/PowerPoint presentation or similar. The presentation will be followed by a question and answer format, to encourage discussion and the exchange of information. Public hearings tend to last approximately 2 hours, but will depend on the number and nature of questions that are asked.

At least one copy each of the full ESIA (last year's ESIA and supplementary SESR report) should be available in Russian and in Kazakh. Multiple copies of the Non-Technical Summary should be available in Russian and Kazakh for people to take away with them. The number depends on prior experience with meetings in the area but a minimum of 10 Russian and 10 Kazakh copies should be available at each of the Information Sessions. The presentation can be in Russian, however, a Kazakh speaking presenter should be available to answer questions and translate, as required. The Information Sessions should be organised so that they can be held midway through the 60-day disclosure period. It is important to publish the period during which further questions and opinions can be received by email/letter/phone, which is usually no less than 14 days after the event.

The full package of ESIA documents will be made available on the website of Akimat, Polymetal and EBRD. English, Russian and Kazakh versions should be on the Polymetal and EBRD sites. Russian and Kazakh versions should be hosted on the Akimat site.

7.2.3 Summary of Information Disclosure and the SESR Report

PR10 defines best practice for disclosure of information relating to the Project. To that end, all information will be disclosed in the local languages (Kazakh and Russian at Kyzyl), and in a manner that is accessible and culturally appropriate.

As a Category A Project, EBRD require evidence of participatory engagement (meetings) to complete ESIA process and inform the 60 day disclosure period. Therefore, in addition to updating this chapter, to ensure conformance with PR10 and the accompanying SEP (MP10), there is a requirement for the Project Proposer to:

- Update and complement the ESIA work were gaps are identified in the analysis, through supplementary studies, these have been reported in the SESR;
- Update the SEP and Non-Technical Summary (NTS), to take account of the requirements of PR10 and supplementary information within the SEP;

- Translate the ESIA package, including supplementary documents and the SESR, into Kazakh.[1] All Environmental and Social information relating to the Project should be available in Kazakh, Russian and English.
- Disclose the current ESIA, the supplementary documents, management and mitigation plans, SEP, and NTS in English, Russian and Kazakh on the EBRD website in its London headquarters and in the Kazakhstan EBRD Resident Office, the client's (Polymetal's) website and locally in various locations for a minimum of 60 calendar days prior to consideration of the Project by EBRD's Board of Directors;
- Where new developments have occurred since the December ESIA was released, there will be a need for further meetings to update stakeholders, unless these activities are included in the disclosure of the updated ESIA; and,
- Recipient stakeholder groups should acknowledge potential Project Affected Parties, including those who took voluntary resettlement to Ust-Kamenogorsk.

[1] Appendices may be translated into Kazakh in response to requirements

CONTENTS

8 CUMULATIVE IMPACT ASSESSMENT

8.1 Introduction

This chapter provides supplementary information in relation to a number of cumulative impacts that were not assessed in the production of the original ESIA. These effects relate to the following matters;

- Potential cumulative effects caused by offsite processing of concentrate
- Cumulative effects upon water abstraction
- Cumulative effects of the diversion of the Akbastaubulak brook
- Cumulative effects upon Living Natural Resources.

The cumulative effects are discussed in the context of the EBRDs Performance Requirements 1, 3 and 6.

8.2 Cumulative effects final processing location

Due to the complex nature of the final processing required, concentrate material produced from the Kyzyl project will be removed from the site and processed at specialist facilities. At this stage plants Amursk, Russia and in China have been identified as potential destinations for the final processing. Potential cumulative effects created at these locations as a result of the additional processing caused by the Kyzyl produced concentrate has not been assessed at this stage.

To ensure that any potential cumulative effects are minimised as much as is practically possible, Polymetal will commit to undertaking appropriate due diligence of their supply chain network and this will include the final processing locations for the Kyzyl produced concentrate. This due diligence will include an assessment of the environmental controls in place at the processing plant to ensure it confirms to the appropriate control measures.

8.3 Cumulative impact on water abstraction and supply

The Kysylsu surface water supply reservoir is located on the Kyzylsu River about 8km south of the Kyzyl mine and regulates the flow of the Kyzylsu River. It is used as a surface water intake to supply potable water to the current mine infrastructure and the Auezov village via a water pipeline. The Auezov village also takes water from the Kyzyltu wellfield.

A new pipeline will be constructed between Auezov village and Kyzylsu reservoir and following the commencement of Stage 1, the Kyzylsu reservoir will be the main source of water supply to Auezov village. Thereafter, Auezov village will still have the option to abstract water from the Kyzyltu wellfield, if necessary, but this would only happen under exceptional circumstances where water supply from Kyzylsu reservoir is cut off.

During mine construction and prior to construction of the new pipeline between the Kyzylsu reservoir and Auezov village there will be a period when water supply for mine construction and water supply to the Auezov village may both draw on the Kyzyltu borefield. Requirements for water use during construction will be relatively small and are not predicted to affect the available supply to Auezov village, which can in any case draw on the Kyzylsu reservoir through its existing pipeline.

During mine operations water for processing will be sourced from pit dewatering and water reclaimed from the new tailings storage facility. When necessary, water from the Kyzyltu borefield will be used to make up for water losses in the process water system, or in an emergency for fire-fighting. Also, the borefield will be used as the source of potable and household water for mine facilities. Therefore, once operational the mine will not rely on water from the Kyzylsu reservoir which will then be the primary water supply for Auezov village and therefore, any associated cumulative effects will be minimised and no significant effects are predicted.

8.4 Cumulative impacts as a result of the Akbastaubulak brook diversion

The diversion of flow from Akbastaubulak brook into Holodniy Klyuch brook will cause a significant reduction in the flow of Akbastaubulak brook downstream of the mine site (see page 5.18 in Chapter 5 for further details). This will have most effect in the reach of the Akbastaubulak brook immediately downstream of the mine site. The magnitude if the impact will reduce, as flow increases towards the confluence of the Akbastaubulak brook and Kyzylsu river as runoff from the remaining catchment increases and the channel benefits from treated mine water discharge. The Akbastaubulak brook is not used for water supply and any effect of changes to the flow regime will be on aquatic ecology and over a relatively localised scale due to the relatively small size of the watercourse, as such potential for cumulative effects will be minimal. Mine water discharges will be treated to a standard that is commensurate with the water use of the downstream channel.

The diversion of flow from Akbastaubulak brook into Holodniy Klyuch brook will result in flow from Akbastaubulak brook entering the Kyzylsu river several hundred metres downstream of its existing outlet. Both the existing and future outflow points of diverted flow into the Kyzylsu river are six kilometres downstream of the Kyzylsu river reservoir and therefore will not result in a cumulative impact upon the reservoir inflow or its water supply. Also, the close proximity of the existing and future outflow points into the Kyzylsu river means that its flow regime (magnitude and distribution) will remain unchanged.

The diversion will typically double the flow in the Holodniy Klyuch brook. The Akbastaubulak brook and Holodniy Klyuch brook are in close proximity to each other and thus geology, soils and land cover will be similar and water quality characteristics comparable. It is therefore not anticipated that the diversion would cause any change to the water quality of Holodniy Klyuch brook or the Kyzylsu river and thus have no cumulative impact on water users or the aquatic ecology.

8.5 Cumulative impact on Living Natural Resources (LNR)

As a result of the nature of the operations and land take involved with the Kyzyl project, there is the potential that a number of different environmental effects could combine and result in a cumulative effect upon LNR surrounding the site. This cumulative impact could have an effect upon the biodiversity surrounding the site and upon those who depend upon the land for their livelihoods (i.e. agricultural users).

To reduce the potential for cumulative effects occurring on LNRs, measures will be put in place to ensure that sensitive ecological receptors and users around the site remain closely monitored. As a result of this monitoring, if required, remedial actions will be undertaken.

The key issues in relation to potential cumulative impacts will be monitored, and the following actions undertaken:

- Annual ongoing surveys of the vegetation surrounding the project will be undertaken;
- Surveys will assess the quality of the vegetation around the site, including where applicable, crop yields from farming activities. Remedial action will be taken to improve these areas should it be demonstrated that the Kyzyl project has resulted in degradation of these resources.

Subject to the above monitoring and management steps being undertaken, any potential cumulative effects upon LNR will be minimised and no significant effects are predicted.

CONTENTS

TABLES

9 ENVIRONMENTAL & SOCIAL MANAGEMENT

9.1 Introduction

Several Environmental & Social Management Plans ("ESMPs") were updated to complement the ESIA and to take into account EBRD requirements (see Table 9.1).

At this stage in the development process the management plans will provide a framework for the ongoing control of a number of different facets of the site's operation. Polymetal will continue to develop each of these documents into full plans as the site progresses, ensuring that they reflect site specific conditions and incorporate any up to date best practice measures.

Table 9.1: SESR Amendments to ESMPs Compared to the ESIA Published in December 2015

ESMP#	Plan	Action
1	Water and Wastewater Management	Updated to reflect complementary data obtained for the SESR regarding water levels, aquatic flora and fauna. This specifically for the assessment of impacts downstream of the waste dump diversion outlet and mine water discharge outlet on the Akbastau brook and Holodniy Klyuch brook, respectively. Additions to original water management plan are: • Requirement for the monitoring of water quality upstream and downstream of mine water discharge outlet to assess compliance with the conditions of the environmental approval process (To IFC Environmental, Health and Safety Guidelines for water quality in Mining, see Chapter 2 and Table 2.3); • Controlled discharge of mine water to Akbastau brook in mitigation for reduced flow caused by the waste dump diversion channel; • Winter inspection and clearance of debris/ice from nearby culvert on Akbastau brook that could potentially impede the passage of mine water discharge and natural flow leading to inundation of the roadway; • Monitoring of water flow availability and selected aquatic species to assess the health of the downstream ecosystem and recording the occurrence of deformities in fish to highlight instances of pollution in receiving waters.
2	Tailings Storage	No change – see ESIA
3	Waste	No change – see ESIA
4	Emergency Response and Spill Prevention	No change – see ESIA
5	Mine Closure and Rehabilitation Plan	Updated to commit to progressive restoration and rehabilitation, where appropriate to use a range of techniques including active methods of seeding and vegetation.

Table 9.1: SESR Amendments to ESMPs Compared to the ESIA Published in December 2015		
ESMP#	**Plan**	**Action**
6	Air Quality	Updated to reflect complementary data obtained for the SESR, specifically on emissions from the Project. The assessment includes the management of arsenic in dust. Details regarding reference to relevant international best practice standards and emissions limits now added.
7	Soil Erosion	No change – see ESIA
8	Biodiversity	Updated to reflect complementary data obtained for the SESR, specifically on the presence of butterflies and raptors within the Project area. Further details provided in relation the management of impacts upon the Akbastaubulak Brook.
9	Traffic	No change – see ESIA
10	Stakeholder Engagement	Updated to describe the proposed disclosure plan for the updated ESIA to EBRD standards
11	Cultural Heritage	No change – see ESIA
12	Chance Finds Procedure	No change – see ESIA
13	Social	No change – see ESIA
14	Noise	Updated to reflect complementary data obtained for SESR.

Legend
Noise Monitoring Location (NQ)

Akbastaubulak
Zhumataybastau
Kyzyltu
Kyzyltu borefield
Mayranbastau
Settling pond No2
Settling pond No1
Protection dike No.1
Protection dike No.2
Ugulak
Settling sump No2
Water diversion channel of Akbastaubulak and Kyzyltu streams
Drainage Ditch No2
Explosion Storage Area
Waste Dump
Explosive test area
Topsoil Storage
Drainage Ditch No1
ROM ore pad
ROM ore pad
Open pit
Pit drainage water settling sump
Existing, disused arsenic waste dump
Dam of pit drainage water settling sump
Western Ventilation Shaft
Capital Shaft
Eastern Ventilation Shaft
Existing Auezov boiler-house to be decoommissioned
Settling sump No1
Backfill Plant
Mine Water Treatment Plant
Carbon concentrate storage facility
Pump and filtration plant
NQ1
NQ4
Upstream dam No.2
Existing tailings storage facility
Cut off Trench
Auezov
Akbastaubula
Brook 1
Upstream Dam No.1
NQ3
NQ2
Containment Dam No.2
Tailings Storage Facility (TSF)
Existing domestic sewage treatment facilities
New Auezov settlement coal-fired boiler house
Diversion Ditch
NQ5
Solnyechni
Bakyrchik-Bursak bypass road
Containment Dam No.1
Bezymyanny (Brook 3)
Alaigyr

0 500
metres
Scale: 1:11,000

1 : 40 000 000

WKG Ref:	14541819 : 5510091
Long : Lat DD	81.580° : 49.721°
Long : Lat DMS	81° 34' 48" : 49° 43' 16"

POLYMETAL
wardell armstrong

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Drawn By:	CD	Date: 23.09.2015
Checked By:	SA	Date: 24.08.2016

Noise Monitoring Locations
ESIA, Bakyrchik
Kazakhstan

NQ_52_0156 | Drawing B

Ситуационный план (1:10000)

Изм.	Колуч.	Лист	№ док.	Подп.	Дата
Разработал		Курбатова			08.15
Проверил		Шаповалов			08.15
Нач. отдела		Шаповалов			08.15
Н. контр.		Грицких			08.15
ГИП		Окунович			08.15

ТОО "Бакырчикское горнодобывающее предприятие"

34 01 03 020 19 - ГР

Проект руслоотводного канала ручьев Кызылту и Акбастаубулак в составе проекта промышленной разработки Бакырчикского золоторудного месторождения открытым способом

Руслоотводной канал ручьев Кызылту и Акбастаубулак	Стадия	Лист	Листов
	П	1	4
Ситуационный план	Филиал АО "ПОЛИМЕТАЛЛ ИНЖИНИРИНГ" в республике Казахстан		

Формат А1

Инв. № подл. | Подп. и дата | Взам. инв. №

С

План руслоотводного канала ручьев Кызылту и Акбастаубулак (1:5000)

Y=539000 Y=539500 Y=540000 Y=540500 Y=541000 Y=541500 Y=542000 Y=542500

X=512000 X=511500 X=511000

Руслоотводной канал ручьев Кызылту и Акбастаубулак

ПК 0 скв-185 412,87
ПК 5 скв-184 413,44
ПК 10 скв-183 412,70
ПК 15 скв-182 409,55
ПК 20 скв-181 411,30
скв-180 410,56
ПК 25 скв-179 411,99
скв-13 410,00
скв-12 405,45
скв-11 407,65
ПК 30 скв-10 403,59
скв-9 400,11
скв-8 398,59
ПК 35 скв-7 395,42
скв-6 391,98
ПК 40 скв-5 389,17
скв-4 387,29
ПК 45 скв-3 383,98
скв-2 380,45
ПК 48+92,50 скв-1 375,90

СКВ 1э

скв-26 409,21

						ТОО "Бакырчикское горнодобывающее предприятие"		
						34 01 03 020 19 - ГР		
						Проект руслоотводного канала ручьев Кызылту и Акбастаубулак в составе проекта промышленной разработки Бакырчикского золоторудного месторождения открытым способом		
Изм.	Колич.	Лист	№ док.	Подп.	Дата			
Разработал		Курбатова			07.15	Руслоотводной канал ручьев Кызылту и Акбастаубулак	Стадия	Лист	Листов
Проверил		Шаповалов			07.15		П	2	
Нач. отд.		Шаповалов			07.15				
Н. контр.		Грицких			07.15	План руслоотводного канала ручьев Кызылту и Акбастаубулак	Филиал АО "ПОЛИМЕТАЛЛ ИНЖИНИРИНГ" в республике Казахстан		
ГИП		Окунович			07.15				

Формат А1

Взам. инв. №
Подп. и дата
Инв. № подл.

Профиль по оси руслоотводного канала ручьев Кызылту и Акбастаубулак

М 1:5000 по горизонтали
М 1:500 по вертикали

Уклон, ‰ / Длина, м: 1,00 / 2500,00 (ПК0 – ПК25); 13,32 / 2391,50 (ПК25 – ПК48+92,50)

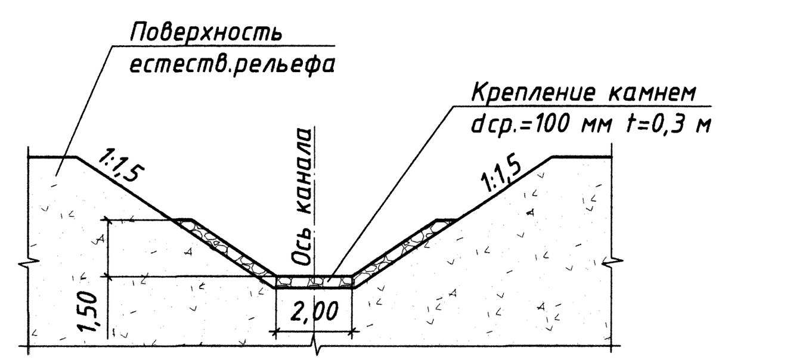
Проектные данные. Скорость, глубина наполнения:

- Поверочный расход $Q_{p=0,5\%}$ =4,54 м³/с: ПК0 – ПК25: V=1 м/с h=1,25 м; ПК25 – ПК48+92,50: V=2,50 м/с h=0,64 м
- Расчётный расход $Q_{p=3\%}$ =2,96 м³/с: ПК0 – ПК25: V=0,84 м/с h=1,00 м; ПК25 – ПК48+92,50: V=2,2 м/с h=0,50 м

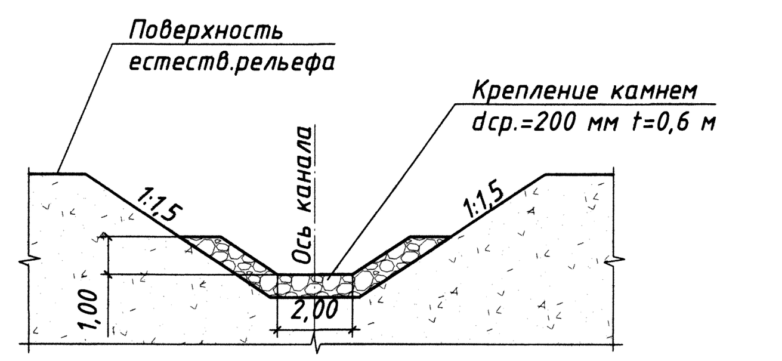
Пикет	Отметка поверхности земли, м	Отметка дна канала, м	Выемка/насыпь, м	Расстояние, м
ПК0	412,00	409,00	-3,30	100
ПК1	410,01	408,90	-1,41	100
ПК2	410,00	408,80	-1,50	100
ПК3	410,86	408,70	-2,46	100
ПК4	412,94	408,60	-4,64	100
ПК5	413,13	408,50	-4,93	100
ПК6	412,84	408,40	-4,74	100
ПК7	413,07	408,30	-5,07	100
ПК8	414,00	408,20	-6,10	100
ПК9	413,40	408,10	-5,60	100
ПК10	412,91	408,00	-5,21	100
ПК11	412,80	407,90	-5,20	100
ПК12	413,58	407,80	-6,08	100
ПК13	412,95	407,70	-5,55	100
ПК14	413,42	407,60	-6,12	100
ПК15	411,79	407,50	-4,59	100
ПК16	410,75	407,40	-3,65	100
ПК17	411,12	407,30	-4,12	100
ПК18	411,22	407,20	-4,32	100
ПК19	410,91	407,10	-4,11	100
ПК20	410,90	407,00	-4,20	100
ПК21	410,68	406,90	-4,08	100
ПК22	410,92	406,80	-4,42	100
ПК23	411,62	406,70	-5,22	100
ПК24	411,93	406,60	-5,63	100
ПК25	410,36	406,50	-4,16	100
ПК26	408,53	405,17	-3,96	100
ПК27	406,91	403,84	-3,67	100
ПК28	404,85	402,50	-2,95	100
ПК29	403,45	401,17	-2,88	100
ПК30	401,59	399,84	-2,35	100
ПК31	400,24	398,51	-2,33	100
ПК32	399,42	397,18	-2,84	100
ПК33	398,92	395,84	-3,68	100
ПК34	396,86	394,51	-2,95	100
ПК35	395,30	393,18	-2,72	100
ПК36	393,65	391,85	-2,40	100
ПК37	392,73	390,52	-2,81	100
ПК38	390,55	389,18	-1,97	100
ПК39	389,62	387,85	-2,37	100
ПК40	388,79	386,52	-2,87	100
ПК41	387,68	385,19	-3,09	100
ПК42	386,85	383,86	-3,59	100
ПК43	386,37	382,52	-4,45	100
ПК44	384,10	381,19	-3,51	100
ПК45	381,78	379,86	-2,52	100
ПК46	380,82	378,53	-2,89	100
ПК47	380,00	377,20	-3,40	100
ПК48	376,32	375,86	-1,06	92,50
ПК48+92,50	375,11	374,64		

Схема трассы в плане: L=293,64; R=50,00 L=58,85; L=97,74; R=50,00 L=52,41; L=189,54; R=50,00 L=46,38; L=76,83; R=50,00 L=73,46; L=135,02; R=50,00 L=36,74; L=81,84; R=50,00 L=28,36; L=86,62; R=50,00 L=18,49; L=129,81; R=50,00 L=30,46; L=236,33; R=50,00 L=129,57; L=248,28; R=50,00 L=17,99; L=277,59; УП 7°43'; L=768,64; R=50,00 L=11,45; L=695,31; УП 12°4'; L=1070,18

Типовое сечение руслоотводного канала ПК0 - ПК25



Типовое сечение руслоотводного канала ПК25 - ПК48+92,50



Основные объемы работ по руслоотводному каналу

Наименование работ	Ед. изм.	Кол-во	Примечание
1. Выемка грунта	м³	155400	
2. Устройство крепления камнем dср.=0,2 м	м³	9900	
3. Устройство крепления камнем dср.=0,1 м	м³	6100	

Условные обозначения

(5) Скальные выветрелые, трещиноватые и умеренно раздробленные песчаники

(17) Глина красновато-коричневая, плотная, жирная, тугопластичная

(22) Алевролиты углисто-глинистые, серого цвета и песчаники выветрелые, трещиноватые, умеренно раздробленные

▽ 381,18 / 21.04.15 — Уровень подземных вод спорадического распространения ("верховодка") в глинистых грунтах; Абсолютная отметка, м / Дата замера

						ТОО "Бакырчикское горнодобывающее предприятие"		
						34 01 03 020 19 - ГР		
Изм.	Кол.уч.	Лист	№ док.	Подп.	Дата	Проект руслоотводного канала ручьев Кызылту и Акбастаубулак в составе проекта промышленной разработки Бакырчикского золоторудного месторождения открытым способом		
Разработал		Курбатова			07.15	Руслоотводной канал ручьев Кызылту и Акбастаубулак	Стадия: П	Лист: 3
Проверил		Шаповалов			07.15			Листов:
Нач. отд.		Шаповалов			07.15			
Н. контр.		Грицких			07.15	Профиль по оси руслоотводного канала. Типовые сечения	Филиал АО "ПОЛИМЕТАЛЛ ИНЖИНИРИНГ" в республике Казахстан	
ГИП		Окунович			07.15			

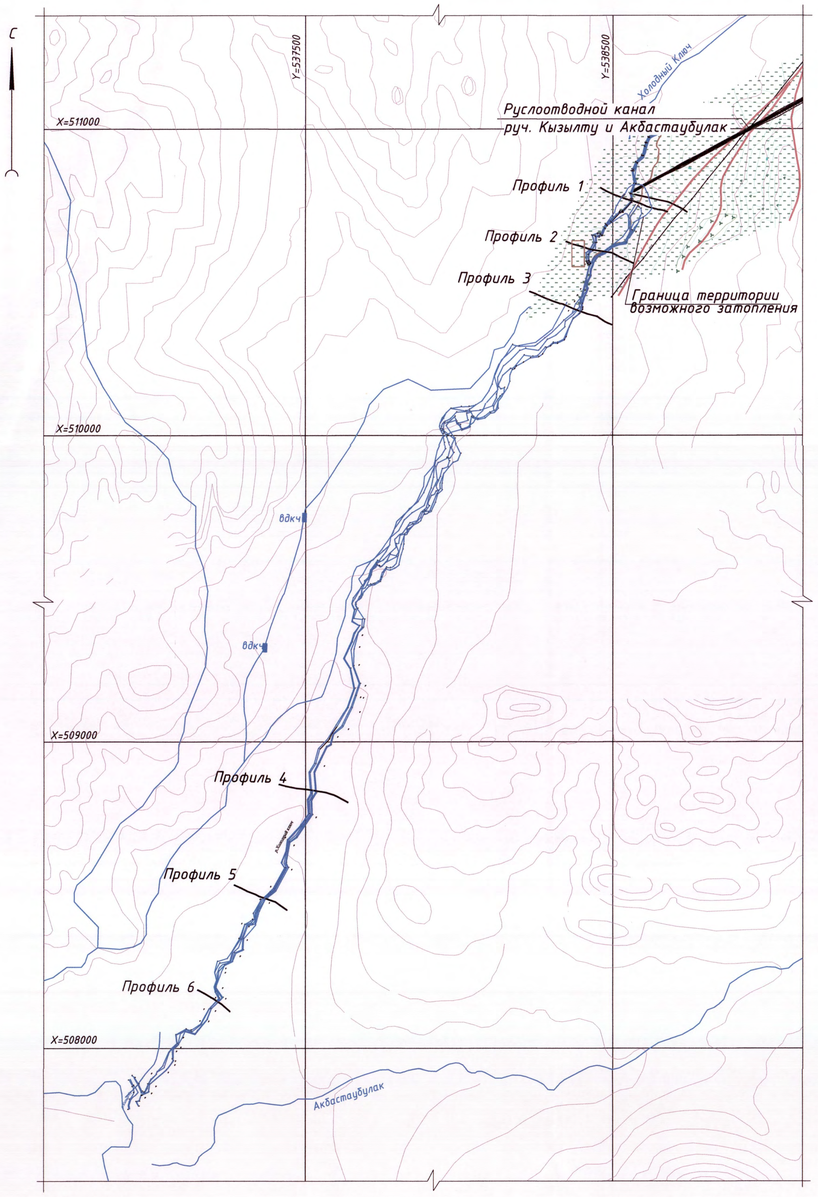
Формат А3х4

Взам. инв. №

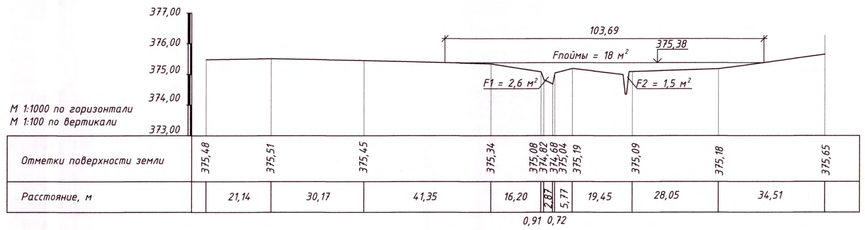
Подп. и дата

Инв. № подл.

План ручья Холодный ключ (1:10000)

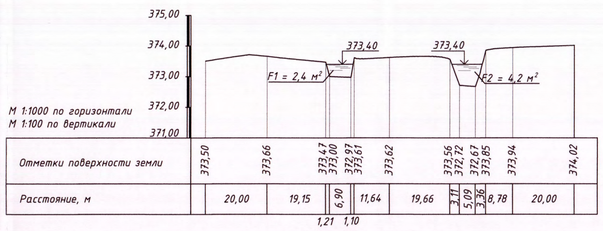


Профиль 1



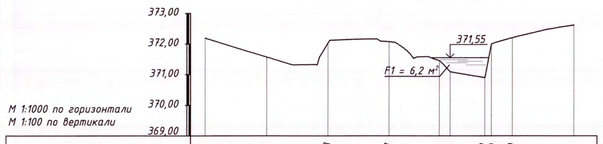
Отметки поверхности земли	375,48	375,51	375,45	375,34	375,08	374,82	374,68	375,04	375,19	375,09	375,18	375,65
Расстояние, м	21,14	30,17	41,35	16,20	2,87	5,77	19,45	28,05	34,51			
					0,91	0,72						

Профиль 2



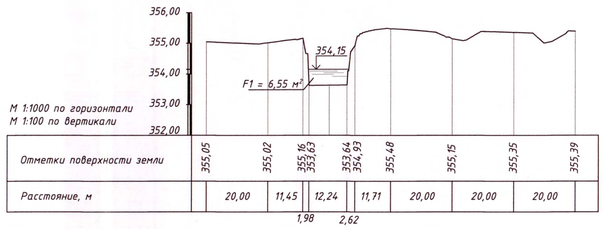
Отметки поверхности земли	373,50	373,66	373,47	373,00	372,97	373,61	373,62	373,56	372,72	372,67	372,85	373,94	374,02
Расстояние, м	20,00	19,15	6,90		11,64	19,66	3,11	5,09	3,36	8,78	20,00		
			1,21	1,10									

Профиль 3



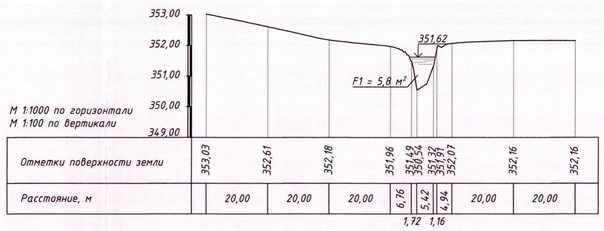
Отметки поверхности земли	372,19	371,57	372,03	372,07	371,46	371,09	370,89	372,00	372,20	372,61
Расстояние, м	20,00	20,00	20,00	16,31	3,58	11,16	6,86	20,00		
					2,09					

Профиль 4



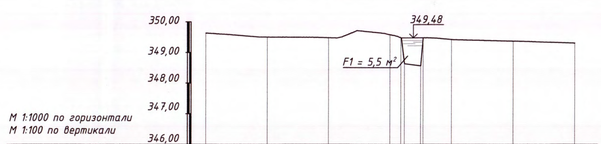
Отметки поверхности земли	355,05	355,02	355,16	353,63	353,64	354,93	355,48	355,15	355,35	355,39
Расстояние, м	20,00	11,45	12,24		11,71	20,00	20,00	20,00		
			1,98	2,62						

Профиль 5



Отметки поверхности земли	353,03	352,61	352,18	351,96	350,49	350,32	351,37	352,07	352,16	352,16
Расстояние, м	20,00	20,00	20,00	6,76	5,42	4,94	20,00	20,00		
				1,72	1,16					

Профиль 6



Отметки поверхности земли	349,63	349,50	349,48	349,58	349,48	348,64	349,45	349,42	349,37	349,30
Расстояние, м	20,00	20,00	20,00	3,53	5,20	9,30	20,00	20,00		
				1,17	0,80					

Взам. инв. №

Подп. и дата

Инв. № подл.

					ТОО "Бакырчикское горнодобывающее предприятие"
					34 01 03 020 19 - ГР
					Проект руслоотводного канала ручьев Кызылту и Акбастаубулак в составе проекта промышленной разработки Бакырчикского золоторудного месторождения открытым способом
Изм.	Кол.уч.	Лист	№ док.	Подп.	Дата
Разработал		Курбатова			07.15
Проверил		Шаповалов			07.15
Нач. отдела		Шаповалов			07.15
Н. контр.		Грицких			07.15
ГИП		Окунович			07.15

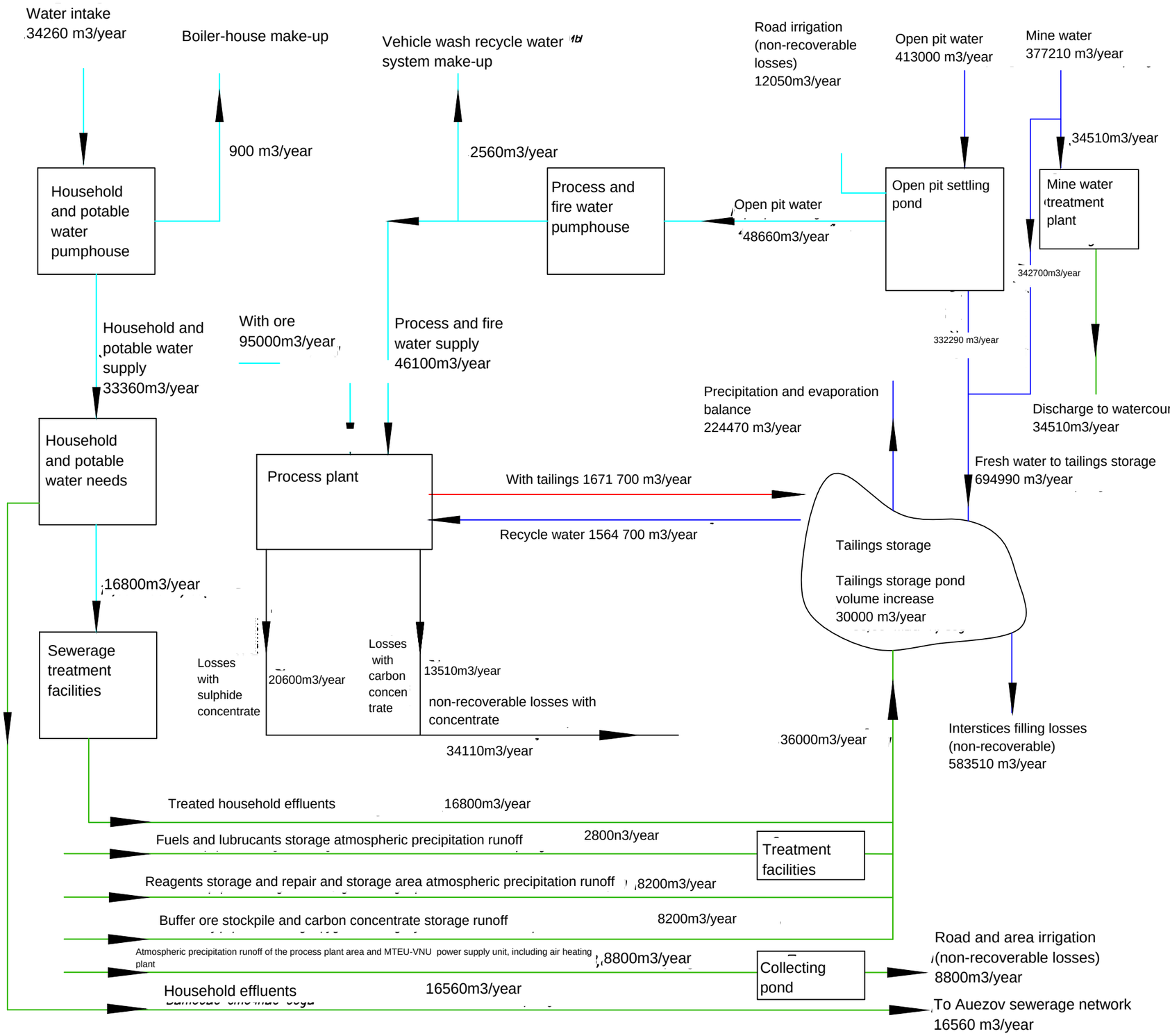
Руслоотводной канал ручьев Кызылту и Акбастаубулак

Стадия	Лист	Листов
П	4	

План ручья Холодный ключ. Профили по руслу ручья Холодный ключ

Филиал АО "ПОЛИМЕТАЛЛ ИНЖИНИРИНГ" в республике Казахстан

Формат А1

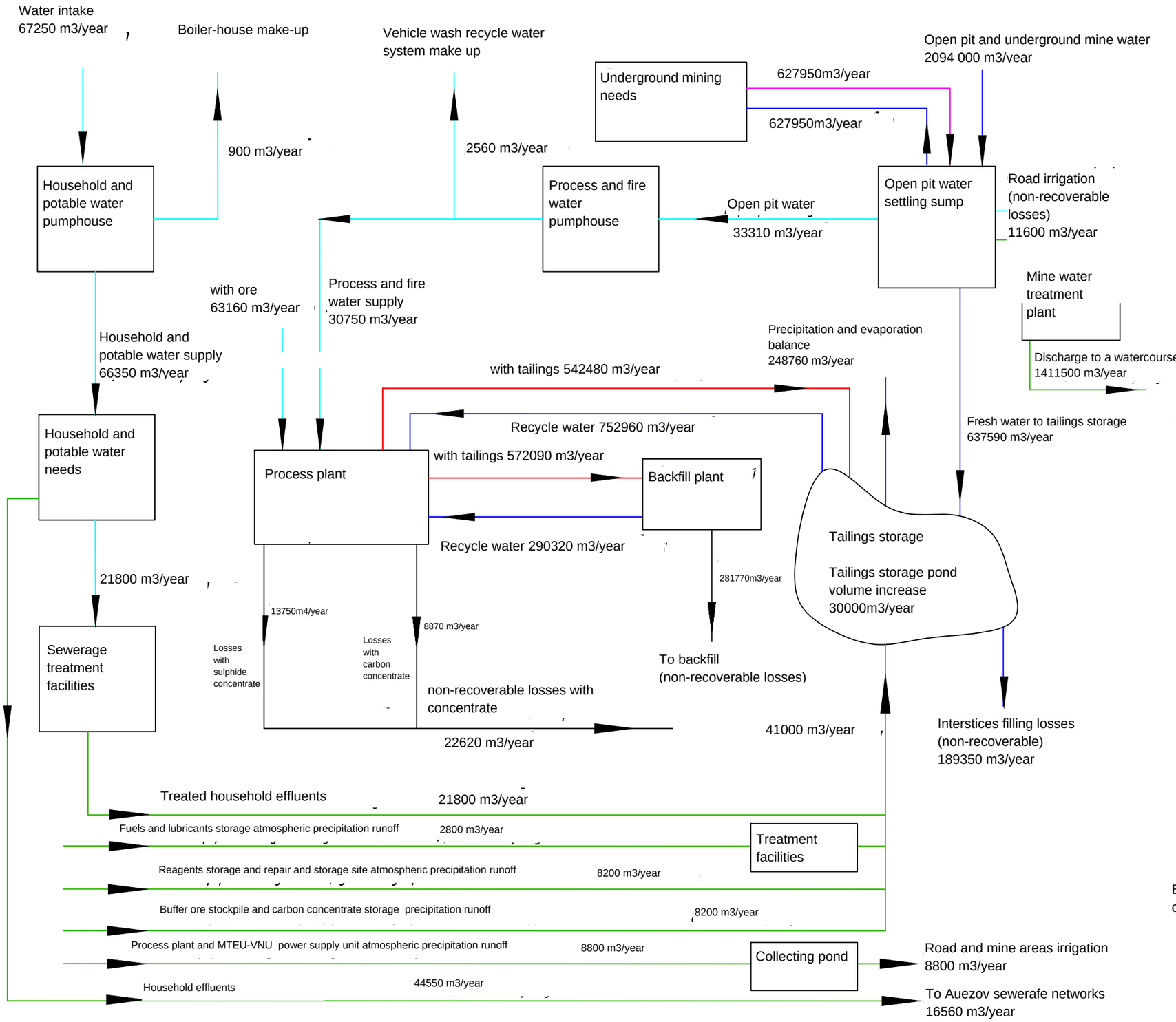


	,000 m3/year
1. Water, supplied to the mine and process plant, including:	947,47
– from Kyzyltu underground water intake	34,26
– with ore	95,00
– open pit water	413,00
– underground mine water	377,21
– Mine sites precipitation runoff	19,80
– buffer ore stockpile and carbon concentrate storage	8,20
runoff	
2. Mine and process plant effluents, including	51,07
– household effluents to the Auezov trearment plant	16,56
– Mine water to a water course	34,51
3. non-recoverable losses, including	866,40
– road and mine area irrigation	20,85
– tailings interstices filling	583,51
– losses with concentrate	34,11
– boiler house and vehicle wash recycle water	3,46
system make up	
– tailings storage evaporation	224,47
(precipitation and evaporation balance	
4. Tailings storage pond volume increase	30,00

n.1=n.2+n.3+n.4
947,47=51,07+866,40+30,00

The balance is provided for 2025 at the process plant operation without concentrate selection

Drawing 3.5: Water consumption and diversion flow chart in the period of the deposit open pit mining



	,,000 m3/year
1. Water, supplied to the mine and process plant, including:	2252,41
– from Kyzyltu underground water intake	67,25
– with ore	63,16
– Open pit and underground mine water	2094,00
– Mine sites atmospheric precipitation runoff	19,80
– Buffer ore stockpile and carbon concentrate storage	8,20
atmospheric precipitation runoff	
2. Mine and process plant effluents, including:	1456,05
– household effluents to Auezov treatment plant	44,55
– Open pit and mine water to watercourse	1411,50
3. Non-recoverable losses, including:	766,36
– tailings storage evaporation	248,76
(precipitation and evaporation balance)	
– road and mine areas irrigation	20,40
– tailings interstices filling losses	189,35
– losses with concentrate	22,62
– losses in backfill	281,77
– boiler house and vehicle wash recycle water	3,46
system make-up	
4. Tailings storage pond volume increase	30,00

n.1=n.2+n.3+n.4
2252,41=1456,05+766,36+30,00

Balance is provided for 2027 at the process plant operation without concentrate selection

Drawing 3.6: Water Consumption and Diversion Balance Flow Chart in the Period of the Deposit Undergro

1:25 000 @ A3

Akbakstay Bu

Waste Dump

Open pit

Auezov

Solnyechni

Tailings Storage Facility (TSF)

0 1,000
metres
Scale: 1:20,000

Mine site process water supply
Process and fire water supply
Domestic wastewater pipeline
Pit de-watering pipeline
Backfill supply pipeline
Potable water pipeline
Household and potable water intake from Kyzyltu water intake

Process water supply by description

process plant supply from dam	(1)
return water	(2)
tailings	(2)
Plant areas	
Arsenic waste dump	
Carbon storage dump	
Top soil storage	

1 : 10 000 000

Grid Ref: 14541819 : 5510091

Long : Lat DD 81.580° : 49.721°

POLYMETAL

wardell armstrong

Wardell Armstrong LLP
Wheal Jane Earth Science Park
Baldhu, Truro, TR3 6EH
email: info@wardell-armstrong.com
web: www.wardell-armstrong.com

Drawn By:	CD	Date:	25/09/2015
Checked By:	NR	Date:	25/09/2015

water reticulation, pipelines, sources, for the project
ESIA Bakyrchik
Kazakhstan

Section_300_water | Drawing 3.7

1:55 000 @ A3

ГП 4
GP18
ГП 3
ГП 1
GP25
ГП 3а
ГП 4а
ГП 5
ГП 7
ГП 2
ГП 14
ГП 6
ГП 10
ГП 11
ГП 12
ГП 8
ГП 9
ГП 13

Mayranbastau
Akbakstaubulak
Holodniy Klyuch
Kyzylsu
Brook 1
Solnyechni
Bezymyannyy (Brook 3)
Alaaigyr
Brook 2
Kyzylsu Resevoir

Existing Arsenic Waste Dump

0 2,000
metres
Scale: 1:55,010

Surface Water Monitoring Points
Existing Water Bodies
Existing Tailings Storage Facility
Main Road
Local River/Stream
Existing Pit and Waste Dump
Train Line

Note: projection system used ;

Gauss-Kruger [Pulkovo 1942]
GK Zone 14 [ESPG : 28414]

1 : 10 000 000

Grid Ref:	14541819 : 5510091
Long : Lat DD	81.580° : 49.721°
Long : Lat DMS	81° 34' 48" : 49° 43' 16"

POLYMETAL

wardell armstrong

Wardell Armstrong LLP
Wheal Jane Earth Science Park
Baldhu, Truro, TR3 6EH
Tel: +44 (0) 1872 560738
email: info@wardell-armstrong.com
web: www.wardell-armstrong.com

Drawn By:	CD	Date:	17/09/2015
Checked By:	NR	Date:	17/09/2015

Surface Water Monitoring Points, existing infrastructure
ESIA Bakyrchik
Kazakhstan

Section_400_biodiversity_studyareas	Drawing 4.8.1

4 ENVIRONMENTAL & SOCIAL BASELINE PHOTOGRAPHS

4.1 Water Resources

Figure 4.1: Locations of Photographs

Figure 4.2: Akbastau Brook at Proposed Waste Dump Diversion Channel Inlet (Photo 1)

Figure 4.3: Akbastau Brook at Proposed Waste Dump Diversion Channel Inlet (Photo 1)

Figure 4.4: Akbastau Brook Downstream Proposed Waste Dump Diversion Channel Inlet (Photo 2)

Figure 4.5: Akbastau Brook Downstream Proposed Waste Dump Diversion Channel Inlet (Photo 2)

Figure 4.6:Akbastau Brook Downstream Proposed Waste Dump Diversion Channel Inlet (Photo 3)

Figure 4.7: Akbastau Brook Near Auezov Village Water Treatment Facilities (Photo 4)

Figure 4.8: Akbastau Brook Near Auezov Village Water Treatment Facilities (Photo 4)

Figure 4.9:Akbastau Brook Downstream of Water Treatment Facilities (Photo 5)

Figure 4.10: Akbastau Brook Downstream of Water Treatment Facilities (Photo 5)

Figure 4.11: Confluence of the Akbastau brook with Kyzylsu River (Photo 6)

Figure 4.12: Confluence of the Akbastau Brook With Kyzylsu River (Photo 6)

Figure 4.13: Confluence of the Akbastau Brook With Kyzylsu River (Photo 6)

Figure 4.14: Waste Dump Diversion Channel (Photo 7)

Figure 4.15: Waste Dump Diversion Channel (Photo 7)

Figure 4.16: Waste Dump diversion channel (Photo 8)

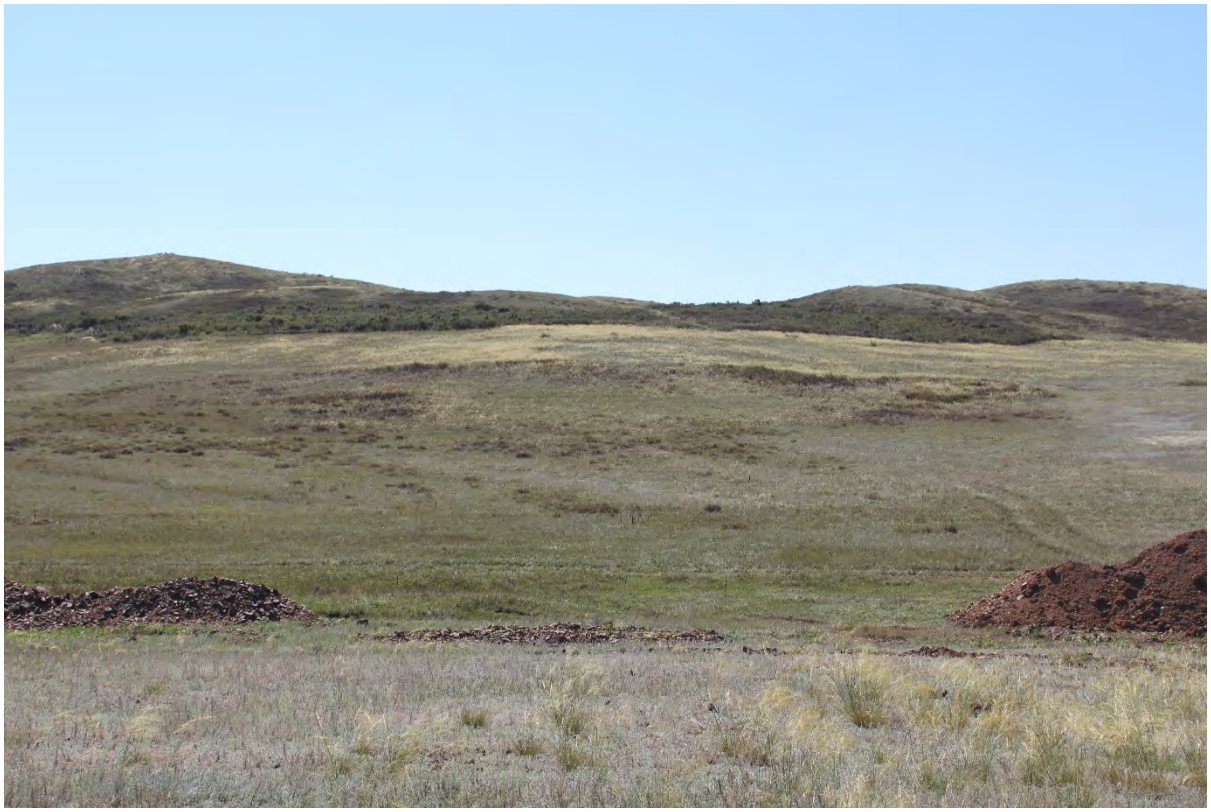


Figure 4.17: Waste Dump diversion channel (Photo 8)

Figure 4.18: Junction of Waste Dump diversion channel and Kholodniy Klyuch brook (Photo 9)

Figure 4.19: Junction of Waste Dump diversion channel and Kholodniy Klyuch brook (Photo 9)

Figure 4.20: Junction of Waste Dump diversion channel and Kholodniy Klyuch brook (Photo 9)

Филиал акционерного общества
«Полиметалл Инжиниринг» в Республике Казахстан

ТОО «Бакырчикское горнодобывающее предприятие»

Золоторудное месторождение «Бакырчик»

Проект руслоотводного канала ручьев Кызылту и Акбастаубулак в составе проекта промышленной разработки Бакырчикского золоторудного месторождения открытым способом

ПРОЕКТНАЯ ДОКУМЕНТАЦИЯ

Проект руслоотводного канала

34 01 03 020 19 – ПЗ.1

Том 1

Усть-Каменогорск
2015

Филиал акционерного общества
«Полиметалл Инжиниринг» в Республике Казахстан

ТОО «Бакырчикское горнодобывающее предприятие»

Золоторудное месторождение «Бакырчик»

Проект руслоотводного канала ручьев Кызылту и Акбастаубулак в составе проекта промышленной разработки Бакырчикского золоторудного месторождения открытым способом

ПРОЕКТНАЯ ДОКУМЕНТАЦИЯ

Проект руслоотводного канала

34 01 03 020 19 – ПЗ.1

Том 1

Управляющий директор	В.Н. Цыплаков
Директор дирекции по проектированию	А.В. Митропольский
Главный инженер проектов	А.И. Окунович
Директор филиала АО «Полиметалл Инжиниринг» в Республике Казахстан	С.А. Деннер

Усть-Каменогорск

2015

Обозначение	Наименование	Лист	Примечание
34 01 03 020 19 – ПЗ.1-С	Содержание тома 1	2	
34 01 03 020 19 – СП	Состав проектной документации	3	
34 01 03 020 19 – ПЗ.1	Текстовая часть	4	
	Графическая часть		
34 01 03 020 19 – ГР	Руслоотводной канал ручьев Кызылту и Акбастаубулак		
	лист 1 – Ситуационный план	47	
	лист 2 – План руслоотводного канала ручьев Кызылту и Акбастаубулак	48	
	лист 3– Профиль по оси руслоотводного канала. Типовые сечения	49	
	лист 4 – План ручья Холодный ключ. Профили по руслу ручья Холодный ключ	50	

Согласовано

Взам. инв.№

Подп. и дата

Инв.№ подл.

ТОО «Бакырчикское горнодобывающее предприятие»

34 01 03 020 19 – ПЗ.1-С

Изм.	Кол.уч.	Лист	№ док.	Подп.	Дата
Разраб.		Мошина			07.15
Пров.		Соколова			07.15
Н. контр.		Румянцев			07.15
ГИП		Окунович			07.15

Содержание тома 1

Стадия	Лист	Листов
П		1

АО «ПОЛИМЕТАЛЛ ИНЖИНИРИНГ»

Номер тома	Обозначение	Наименование	Примечание
1	34 01 03 020 19 – ПЗ.1	Проект руслоотводного канала ручьев Кызылту и Акбастаубулак в составе проекта промышленной разработки Бакырчикского золоторудного месторождения открытым способом	

Согласовано

Взам.инв.№

Подп. и дата

Инв.№ подл.

ТОО «Бакырчикское горнодобывающее предприятие»

34 01 03 020 19 – СП

Изм.	Кол.уч.	Лист	№док.	Подп.	Дата
Разраб.		Окунович			07.15
Пров.		Зеленский			07.15
Н. контр.		Румянцев			07.15
ГИП		Окунович			07.15

Состав проектной документации

Стадия	Лист	Листов
П		1

АО «ПОЛИМЕТАЛЛ ИНЖИНИРИНГ»

Исполнители

Дирекция по проектированию

Управление по технологиям переработки руд

Начальник управления	Ефремов А.С.

Гидротехнический отдел

Начальник отдела	Шаповалов В.А.
Ведущий инженер	Курбатова Т.В.
Нормоконтролёр	Грицких О.П.

Содержание

Перечень таблиц

Перечень рисунков

Введение

В настоящей проектной документации рассматривается проект строительства руслоотводного канала ручьев Кызылту и Акбастаубулак. Данная проектная документация затрагивает только решения по руслоотводному каналу, все технические решения по открытой разработке месторождения и размещению отвала пустых пород представлены в проекте промышленной разработки месторождения открытым способом.

Проектная документация подготовлена на основание задания на проектирования, приложение А.

Под строительство руслоотводного канала предполагается аренда земельного участка общей площадью 9,8 га из состава государственной собственности на основании Договора аренды земельного участка, приложение Б.

Дополнительно отдельной книгой ТОО «Лаборатория-Атмосфера» разработан раздел «Охрана окружающей среды».

При проектировании настоящего раздела использованы следующие материалы:

- Раздел 3 «Технологические решения по разработке месторождения. Открытые горные работы» золоторудное месторождение Бакырчик, выполненный Филиалом АО «Полиметалл инжиниринг» в РК, в 2015 г.;
- Технический отчет о проведении инженерно-геодезических изысканий на площадке строительства объектов инфраструктуры горно-обогатительного комбината на месторождении «Бакырчик», выполненный ТОО «TiRex», Республика Казахстан, в 2014 г.;
- Технический отчет по инженерно-геологическим изысканиям под строительство объектов и сооружений площадки рудника для Проекта промышленной разработки месторождения открытым способом на месторождении «Бакырчик» в пос. Ауэзов, Жарминского района, ВКО, выполненный ТОО «Геологоразведочная компания «Топаз», Республика Казахстан, в 2015 г.;

- Технический отчет о проведении инженерно-гидрометеорологических изысканий на площадке строительства объектов инфраструктуры ГОКа на месторождении «Бакырчик», выполненный ТОО «ВК центр геологических изысканий, Республика Казахстан, в 2015 г.;
- Инженерно-геодезические изыскания по ручью Холодный ключ, выполненные маркшейдерской службой ТОО «БГП», Республика Казахстан, в 2015 г.

1 Краткая характеристика района строительства

В административном отношении золоторудное месторождение Бакырчик расположено на территории Жарминского района Восточно-Казахстанской области Республики Казахстан в северо-западной части Калбинского хребта.

Площадь месторождения составляет около 1,8 км^2. Координаты центра площади: 49°43'07" северной широты и 81°35'23" восточной долготы.

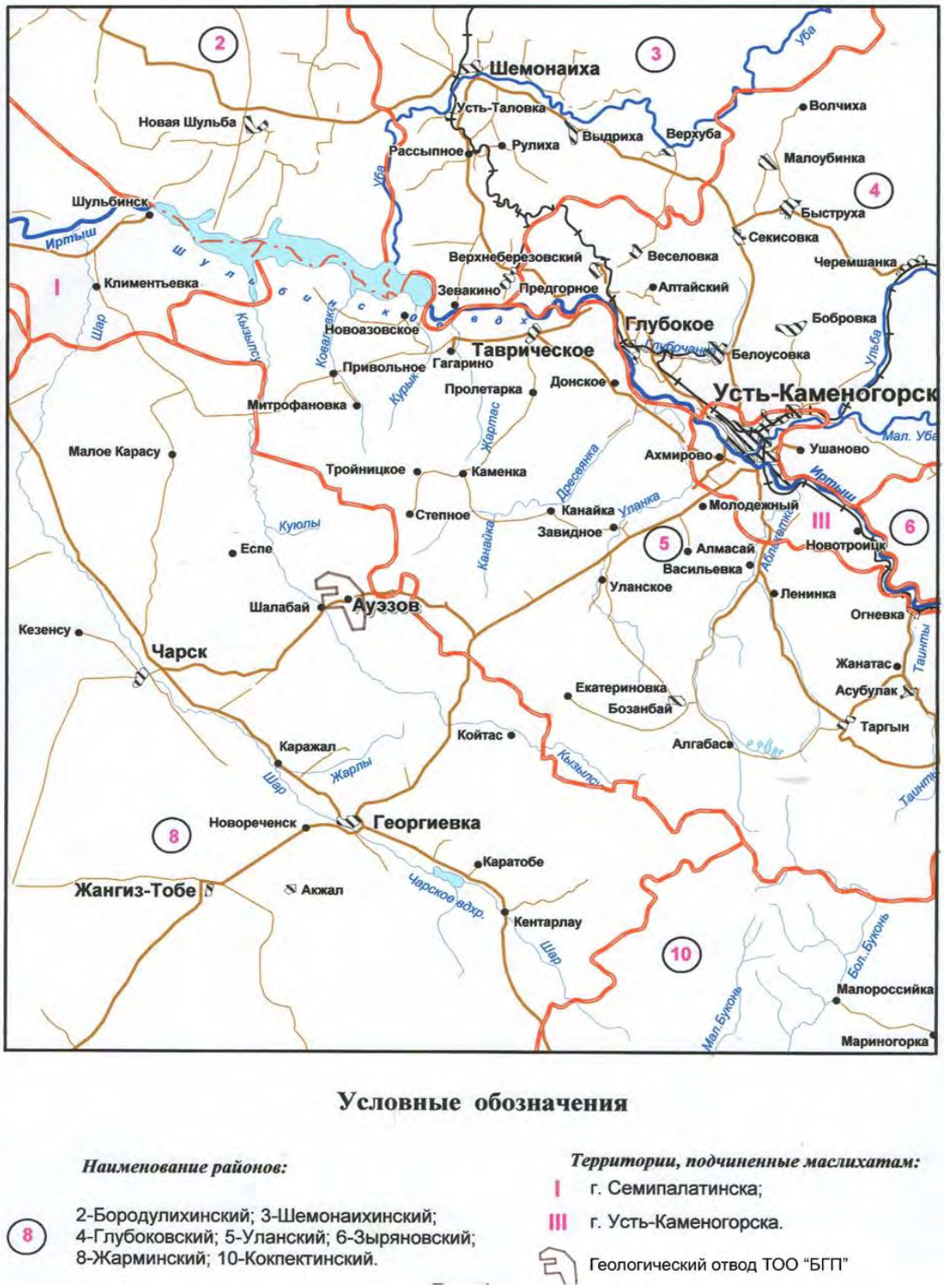
Областной центр г. Усть-Каменогорск находится в 90 км на северо-восток от месторождения. В непосредственной близости от предприятия на юго-запад находится рабочий пос. Ауэзов, в 4 км к западу – пос. Шалабай, в 2 км на юг – пос. Солнечный.

Обзорная карта района месторождения приведена на рисунке (Рисунок 1.1).

Инфраструктура в районе месторождения Бакырчик довольно хорошо развита: имеются автомобильные дороги, рабочий поселок с квалифицированной рабочей силой, линии электропередач (ЛЭП) с резервом мощности и водоснабжение, достаточное для обеспечения предприятия и населения хозяйственно-питьевой и технической водой.

Транспортная связь предприятия и поселков Ауэзов и Шалабай с областным центром и г. Семей, который находится в 170 км к северо-западу, осуществляется по автодорогам с гравийным и асфальтовым покрытием. В районе также имеется сеть грунтовых проселочных дорог, труднопроходимых для транспорта в весеннюю распутицу и в период снежных заносов зимой.

Ближайшая железнодорожная станция новой железной дороги Усть-Каменогорск – Шар – Алматы расположена в пос. Шалабай, а узловая железнодорожная станция Чарск – в 50 км от пос. Ауэзов.



Условные обозначения

Наименование районов:

8 — 2-Бородулихинский; 3-Шемонаихинский; 4-Глубоковский; 5-Уланский; 6-Зыряновский; 8-Жарминский; 10-Кокпектинский.

Территории, подчиненные маслихатам:

I — г. Семипалатинска;

III — г. Усть-Каменогорска.

Геологический отвод ТОО "БГП"

Рисунок 1.1 - Обзорная карта района месторождения

Электроснабжение населенных пунктов и производственных объектов осуществляется по ЛЭП электросети Восточно-Казахстанской области от Усть-Каменогорской ГЭС, находящейся в 90 км к северо-востоку от месторождения Бакырчик.

Источником производственного и хозяйственно-питьевого водоснабжения является водохранилище на р. Кызылсу, а также подземные воды эксплуатируемого участка водозабора Кызылту со среднегодовым водоотбором 1,0-1,3 тыс. м^3/сут.

Собственно, Бакырчикский рудник находится в 500-800 м от северной окраины пос. Ауэзов. Основной вид деятельности предприятия – добыча и переработка золотосодержащих руд Бакырчикского месторождения, которое приурочено к Кызыловской зоне смятия.

В географическом отношении рассматриваемый район приурочен к северо-западным отрогам Калбинского хребта. Рельеф территории представляет собой расчлененное низкогорье грядово-увалистого и мелкосопочного облика. Общий уклон рельефа направлен с северо-востока на юго-запад. Абсолютные отметки земной поверхности в этих же направлениях снижаются от 450-600 м на водоразделах до 320-350 м в долинах р. Кызылсу и ее притоков. Относительные превышения, в зависимости от глубины эрозионных врезов, изменяются от 20-30 до 50-60 м, на отдельных участках до 70-80 м.

Крутизна склонов большей части малая и средняя, склоны изрезаны логами и лощинами, сопряженными с долинами мелких ручьев и речек. На вершинах водоразделов и их склонах почвенный покров развит слабо, подстилается скальными трещиноватыми горными породами, что благоприятно сказывается на питании подземных вод за счет инфильтрации атмосферных осадков.

Геолого-литологическое строение характеризуется следующими разновидностями грунтов:

- четвертичные современные отложения, представленные повсеместно с поверхности почвенно-растительным слоем – гумусированным суглинком с содержанием дресвы и мелкого щебня от 5 до 30 %. Мощность почвенно-растительного слоя составляет от 0,05 м до 1,0 м;
- делювиально-пролювиальные средне-верхнечетвертичные отложения, представленные супесями и суглинками, как однородными без включений, так и с включением обломочного материала в виде дресвы и щебня от 5 до 30 %. Мощность супесчано-суглинистых грунтов

варьирует в пределах от 0,30 до 1,70 м. Мощность делювиально-пролювиальных щебенисто-дресвянистых и дресвянистых грунтов изменяется в пределах от 0,35-0,50 м до 6,80 м;

– скальные породы палеозоя – осадочные породы нижнего карбона Кокпектинской свиты, представленные интенсивно выветрелыми и трещиноватыми, рассланцованными песчаниками, алевропесчаниками и алевролитами. В верхней зоне гипергенеза исходные материнские породы изменены до рухлякового состояния и состояния «разборной скалы», формируя на отдельных участках рыхлый коренной элювий и кору выветривания мезозойского возраста.

Климат района резко континентальный с большими суточными, сезонными и годовыми амплитудами колебаний температуры воздуха, что определяется глубоким внутриконтинентальным положением территории. Зима здесь суровая, лето сравнительно продолжительное и жаркое.

По данным многолетних наблюдений на метеостанции «Шалабай» среднегодовая температура воздуха в многолетии составляет +2,6 °С, среднемесячная температура воздуха января – минус 15,7 °С при минимуме минус 49 °С; среднемесячная температура воздуха в июле составляет +20,5 °С при максимуме +41°С. Высокие летние температуры приводят к интенсивному испарению летних осадков с поверхности почвы.

При среднегодовой многолетней сумме осадков 50 % обеспеченности 335 мм испарения с водной поверхности составляют 915 мм, с суши – 268 мм. В теплый период года (апрель-октябрь) выпадает в среднем 70 % от общего количества осадков, среднемноголетнее количество осадков теплого периода составляет 233 мм.

Средняя продолжительность безморозного периода составляет 102 дня. Среднее число дней со снежным покровом – 148. Устойчивый снежный покров устанавливается в начале второй декады ноября, сход снега отмечается в первой декаде апреля.

Высота снежного покрова в районе крайне неравномерная из-за значительной расчлененности рельефа и постоянно-дующих ветров. Со склонов

западной и южной экспозиции снег сдувается в лога, где образуются значительные заносы.

Средняя высота снежного покрова до 24 см при обычных суровых зимах, обусловливает промерзание почво-грунтов до 1 м и более, при этом среднемноголетний запас воды в снежном покрове на начало снеготаяния составляет около 53 мм.

Преобладающее направление ветров в холодный период юго-восточное. Среднегодовая скорость ветра 3,2 м/с, в холодный период – 3,8 м/с, в теплый период – 2,7 м/с.

Повторяемость направлений ветра приведена в таблице (Таблица 1.1).

Таблица 1.1 - Средняя годовая повторяемость (%) направлений ветра по румбам

Направление ветра	**С**	**СВ**	**В**	**ЮВ**	**Ю**	**ЮЗ**	**З**	**СЗ**
Повторяемость направлений ветра, %	9	8	10	23	14	10	11	15

По классификации СНиП РК 2.04-01-2010 район пос. Ауэзов относится к климатическому району I, подрайону В.

Территория района характеризуется относительно развитой гидрографической сетью, которая представлена ручьями Майранбастау, Холодный Ключ, Акбастау, Кызылту, Акбастаубулак и Алайгыр. Все водотоки района месторождения «Бакырчик» являются притоками р. Кызылсу и образуют её бассейн. Река Кызылсу, в свою очередь, впадает на левобережье в р. Иртыш.

Река Кызылсу протекает в 4 км к юго-западу от поселка Ауэзов, является основной водной артерией района и берет начало далеко за его пределами к юго-востоку. В целом бассейн р. Кызылсу включает 14 основных приточных водотоков, относящихся к V классу, общая протяженность которых составляет около 390 км. Общая площадь водосбора – 3 030 км². Длина р. Кызылсу IV класса составляет 175 км. Устье р. Кызылсу, на впадении в р. Иртыш, располагается в 30 км юго-восточнее пос. Шульбинск. Сток р. Кызылсу зарегулирован водохранилищем, которое используется ТОО «БГП» как один из источников хозпитьевого водоснабжения.

Почвенный покров района площадки строительства представлен темно-каштановыми песчаными маломощными почвами. Прилегающие к месторождению сельскохозяйственные угодья представлены пастбищами.

Растительность района типично степная. Участки разнотравья в поймах речки, ручьев и логах чередуются с ковыльно-злаковой флорой на сухих склонах и холмах. Участками развиты заросли карагая. Лесных угодий нет.

Животный мир района беден. Редко встречаются волки, лисы, корсаки. Птиц тоже мало. Много грызунов, змей, клещей, но район не относится к опасным по клещевому энцефалиту.

В списке населенных пунктов Республики Казахстан по ВКО, расположенных в сейсмичных районах, поселок Ауэзов отсутствует.

2 Гидрологические изыскания и гидрохимические исследования на реках и водотоках района месторождения «Бакырчик»

2.1 Наблюдения за расходным режимом и температурой поверхностных вод

Гидрометрические и гидротермические исследования на поверхностных водотоках включали шестнадцать оборудованных гидропостов – створов гидрологических наблюдений (Рисунок 2.1):

- ГП-1 – руч. Майранбастау, устье;
- ГП-2 – руч. Холодный ключ, устье;
- ГП-3 – р. Акбастау, верхний створ, истоки;
- ГП-3а – р. Акбастау, нижний створ, устье;
- ГП-4 – р. Кызылту, верхний створ, истоки;
- ГП-4а – р. Кызылту, нижний створ, устье;
- ГП-5 – р. Акбастаубулак, перед дорогой Ауэзов-Шалабай, выше сброса с очистных сооружений;
- ГП-6 – руч. Акбастаубулак, ниже сброса с очистных сооружений;
- ГП-7 – руч. без названия № 1 в пос. Ауэзов, устье;
- ГП-8 – р. Алаайгыр, верхний створ;
- ГП-9 – руч. без названия № 2 левобережный приток р. Алаайгыр, устье;
- ГП-10 – руч. без названия № 3 правобережный приток р. Алаайгыр, истоки;
- ГП-11 – руч. без названия № 3 правобережный приток р. Алаайгыр, устье;
- ГП-12 – р. Алаайгыр перед водохранилищем;
- ГП-13 – р. Алаайгыр, устье;
- ГП-14 – р. Кызылсу, у с. Шалабай.

В целом бассейн р. Кызылсу включает 14 основных приточных водотоков, относящихся к V классу, общая протяженность которых составляет около 390 км. Общая площадь водосбора – 3 030 км^2. Длина р. Кызылсу IV класса составляет

175 км. Устье р. Кызылсу, на впадении в р. Иртыш, располагается в 30 км юго-восточнее пос. Шульбинск.

Величины максимальных расходов воды весенних и дождевых паводков различной обеспеченности, а также величины годового стока различной обеспеченности для вышеуказанных гидропостов приведены в таблицах (Таблица 2.2-Таблица 2.4).

Результаты полевых замеров расходов стока и температуры рек и ручьев района месторождения «Бакырчик» в отчетный период с ноября 2014 года по апрель 2015 года приводятся в таблице (Таблица 2.1).

Температура воды в зависимости от времени года на водотоках района варьирует в пределах 2.50С - 9.10С. Ледовые явления на водотоках отмечаются с первой декады декабря до второй декады марта. Вскрытие водотоков и ледоходные явления фиксируются со второй-третьей декады марта до первой декады апреля.

Полученные расходные характеристики водотоков района месторождения за период с ноября 2014 г. по март 2015 г. включительно, отражают в основном их меженные осенне-зимние расходы, когда поверхностный сток рек и ручьев формируется в основном за счет дренирования в них подземных вод. Начало межени на водотоках района фиксируется уже во второй декаде декабря, глухая межень приходится на конец февраля – начало марта и сменяется на большинстве мелких водотоках района месторождения частичным и полным перемерзанием русел.

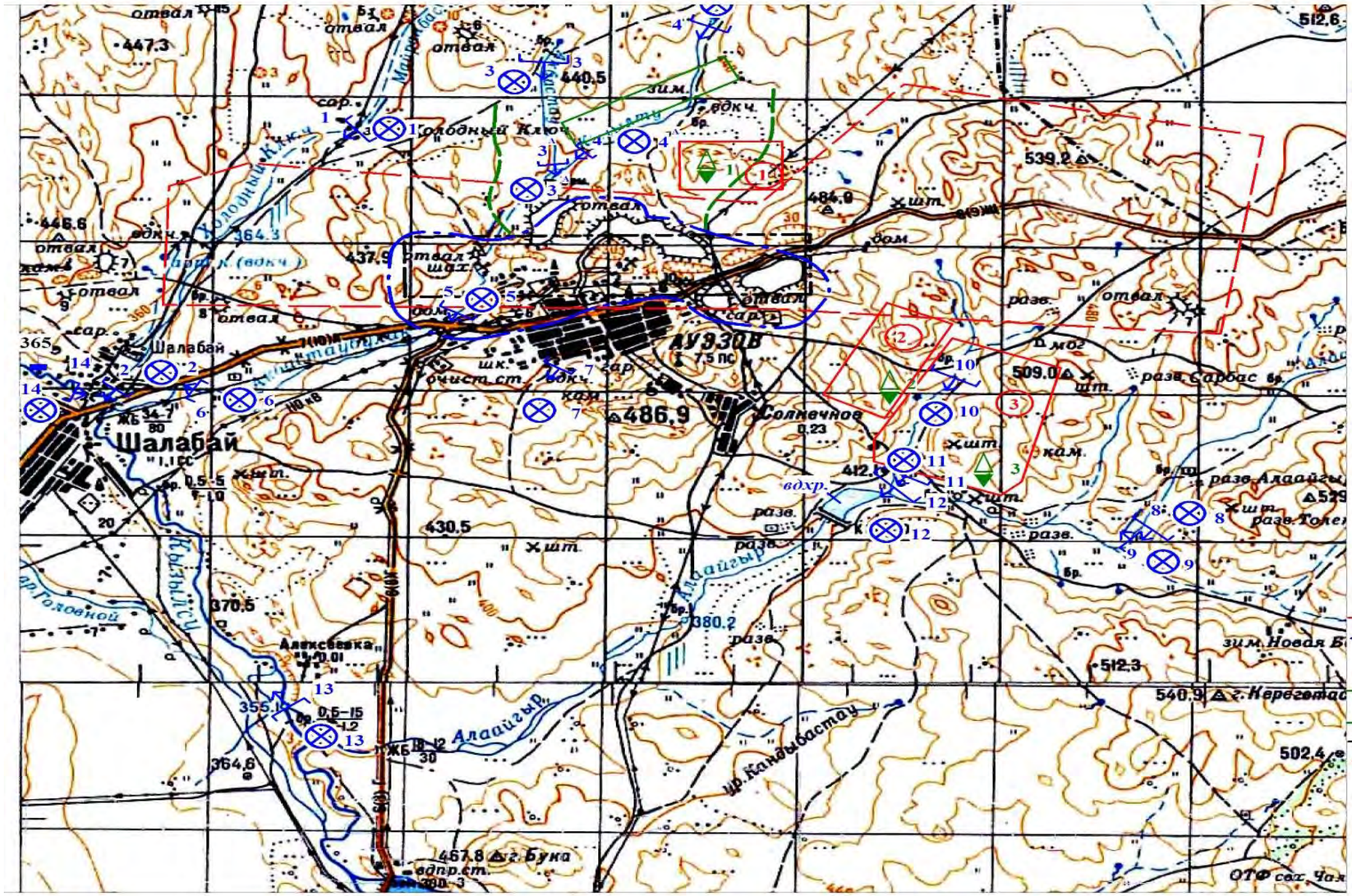
На р. Кызылту – верхний створ при проведении замеров расхода с ноября по апрель (I-я декада) сток реки отсутствовал, что обусловлено, по-видимому, дренирующим влиянием скважинного водозабора «Кызылту» в верховье р. Кызылту. Рассредоточенные по площади родниковой разгрузки подземных вод четыре эксплуатационные водозаборные скважины перехватывают основной подземный сток в верховье северной части площади водосборного бассейна реки. Сток р. Кызылту наблюдается в 0,5-0,8 км ниже (юго-западнее) участка подземного водозабора по долине реки.

На основных крупных речках района месторождения – р. Алаайгыр и р. Кызылсу глухая осенне-зимняя межень при полевых гидрологических

изысканиях 2014-2015 гг. отмечалась в конце февраля – начале марта. Русла указанных рек на замерных гидропостах в зимний период с поверхности практически не перемерзали, что связано с периодическими попусками из водохранилища на р. Алаайгыр. Замеры расходов водотоков в первой декаде апреля характеризуют начальную, но не максимальную фазу весеннего половодья-паводка.

Схема расположения пунктов наблюдений при проведении гидрометеорологических изысканий в районе месторождения "Бакырчик" ТОО "БГП"

Масштаб 1:50 000



Условные обозначения:

Гидрологические и гидрохимические исследования:

а) Гидрометрические посты на поверхностных водотоках (замеры расхода, уровня, температуры, толщина снега и льда):
ГП1 - Майранбастау
ГП2 - Холодный ключ
ГП3 - Акбастау, верхний створ, истоки
ГП3а - Акбастау, нижний створ, устье
ГП4 - Кызылту, истоки, верхний створ
ГП4а - Кызылту, устье, нижний створ
ГП5 - Акбастаубулак, перед дорогой Ауэзов-Шалабай, выше сброса с очистных сооружений
ГП6 - Акбастаубулак, устье, ниже сброса с очистных сооружений
ГП7 - пос. Ауэзов, ручей №1 без названия
ГП8 - Алаайгыр, верхний створ
ГП9 - Ручей без названия №2, левобережный приток Алаайгыра, устье
ГП10 - Ручей без названия №3, правобережный приток Алаайгыра, истоки
ГП11- Ручей без названия №3, правобережный приток Алаайгыра, устье
ГП12 - Алаайгыр перед водохранилищем
ГП13 - Алаайгыр, устье
ГП 14- р. Кызылсу, с. Шалабай

б) Гидрохимическое опробование поверхностных водотоков на гидропостах (сокращенный химический, органолептический, бактериологический, радиационный анализы воды, определение взвешенных и донных наносов)
⊗ 7 Пункты опробования

г) Почвенные наблюдения
△ 1 Точки отбора проб на водные вытяжки, испарение и радиационный фон, определение температуры и глубины промерзания

Прочие знаки:
- метеостанция "Шалабай", вверху-абсолютная отметка (Балтийская система высот, 1977г)
Координаты: 81°30'23,25" в.д. 49°42'19,32" с.ш.
- граница горного отвода ТОО "БГП"
- контур депрессионной воронки от шахтного водоотлива (в пределах границы водосбора рудника Бакырчик) при Qср=57м³/час (1,37 тыс. м³/сут)
- контур депрессионной воронки от эксплуатации скважинного водозабора на р. Кызылту Qср=54 м³/час (1,3 тыс. м³/сут)
- участок подземного водозабора "Кызылту" (скв. 1э-4э)
- контур существующей основной промплощадки ТОО "БГП"
- проектируемые основные площадки под строительство зданий и сооружений:
1 - отвал пустой породы
2 - промплощадка (АБК, ОФ и т.п.)
3 - хвостохранилище

Рисунок 1

Рисунок 2.1 - Схема расположения пунктов наблюдений

Таблица 2.1 - Результаты наблюдений за расходным, режимом и температурой поверхностных водрайона месторождения «Бакырчик» ТОО «БГП»

Замеры: год, месяц, квартал	Характе-ристики	Пункты наблюдений															
		ГП-1 руч. Майранбастау	ГП-2 руч. Холодный ключ	ГП-3 р. Акбастау, верхний створ	ГП-3а р. Акбастау, нижний створ	ГП-4 р. Кызылту, верхний створ	ГП-4а р. Кызылту, нижний створ	ГП-5 р. Акбастаубулак, выше сброса ОС	ГП-6 руч. Акбастаубулак, ниже сброса ОС	ГП-7 руч. без названия № 1	ГП-8 р. Алаайгыр, верхний створ	ГП-9 руч. без названия № 2, устье	ГП-10 руч. без названия № 3, истоки	ГП-11 руч. без названия № 3, устье	ГП-12 р. Алаайгыр перед водохранилищем	ГП-13 р. Алаайгыр, устье	ГП-14 р. Кызылсу, у с. Шалабай
2014 г. Ноябрь II декада	$Q\frac{м^3/час}{м^3/с}$	5,1 / 0,00141	26,4 / 0,0073	8,4 / 0,0023	14,8 / 0,0041	-	10,8 / 0,003	53,4 / 0,015	231 / 0,064	29,1 / 0,008	46 / 0,013	21,3 / 0,0059	13,6 / 0,0038	46,5 / 0,013	115,4 / 0,032	127 / 0,035	2364 / 0,66
	t°,c	7,6	6,8	6,6	6,5	6,4	5,8	5,8	8,8	7,4	4,8	3,9	6,0	5,8	5,4	5,6	9,1
2014 г. Ноябрь III декада	$Q\frac{м^3/час}{м^3/с}$	2,4 / 0,0007	18,6 / 0,0052	6,8 / 0,0019	11,4 / 0,0032	-	7,6 / 0,0021	59,3 / 0,016	264 / 0,073	34,4 / 0,0095	39 / 0,011	19,0 / 0,053	12,5 / 0,0035	42,8 / 0,012	110,8 / 0,031	116 / 0,0322	2510 / 0,70
	t°,c	8,1	7,0	6,0	6,2	6,3	5,6	5,8	8,6	7,2	4,5	4,1	5,6	5,4	4,8	5,4	8,6
2014 г. Декабрь I декада	$Q\frac{м^3/час}{м^3/с}$	лед	лед	лед	4,1 / 0,0011	-	лед	61,4 / 0,017	237 / 0,066	28,7 / 0,008	лед	лед	лед	лед	96,4 / 0,027	129 / 0,036	2420 / 0,67
	t°,c	6,9	7,0	5,6	6,0	6,1	5,6	5,6	8,2	8,0	4,2	4,0	5,2	5,4	4,6	5,0	8,4
2014 г. декабрь II декада	$Q\frac{м^3/час}{м^3/с}$	лед	лед	лед	лед	-	лед	54,3 / 0,015	241 / 0,067	25,3 / 0,007	лед	лед	лед	лед	88,0 / 0,024	105 / 0,029	2534 / 0,703
	t°,c	6,1	5,8	5,4	5,8	6,0	5,4	5,4	8,0	7,2	4,0	3,8	5,0	5,2	4,2	5,0	8,0
2014 г. декабрь III декада	$Q\frac{м^3/час}{м^3/с}$	лед	лед	лед	лед	-	лед	лед	лед	лед	лед	лед	лед	лед	лед	118 / 0,033	1967 / 0,55
	t°,c	6,0	5,6	5,2	5,6	5,8	5,0	5,2	7,6	7,3	3,6	3,8	4,8	5,0	4,0	4,6	7,6
2015 г. Январь I декада	$Q\frac{м^3/час}{м^3/с}$	лед	лед	лед	лед	-	лед	лед	лед	лед	лед	лед	лед	лед	лед	136 / 0,038	2126 / 0,59
	t°,c	4,8	4,5	4,8	5,6	5,4	4,8	5,1	7,2	3,4	3,6	3,8	-	4,0	3,8	4,4	7,4
2015 г. январь II декада	$Q\frac{м^3/час}{м^3/с}$	лед	лед	лед	лед	-	лед	лед	лед	лед	лед	лед	лед	лед	лед	124 / 0,034	1774 / 0,492
	t°,c	4,6	4,4	4,6	5,5	5,2	4,9	5,0	7,2	3,0	3,4	3,6	-	3,8	3,8	4,2	7,4
2015 г. январь III декада	$Q\frac{м^3/час}{м^3/с}$	лед	лед	лед	лед	-	лед	лед	лед	лед	лед	лед	лед	лед	лед	лед	1584 / 0,44
	t°,c	4,4	4,0	4,5	5,5	5,2	4,6	5,2	7,2	3,0	3,2	3,6	-	3,8	3,6	4,2	7,2
2015 г. Февраль I декада	$Q\frac{м^3/час}{м^3/с}$	лед	лед	лед	лед	-	лед	лед	лед	лед	лед	лед	лед	лед	лед	лед	1720 / 0,48
	t°,c	4,2	4,0	4,5	5,4	5,0	4,6	5,2	7,5	3,0	3,2	-	-	3,8	3,6	4,0	7,2

Замеры: год, месяц, квартал	Характе-ристики	Пункты наблюдений														
		ГП-1 руч. Майранбастау	ГП-2 руч. Холодный ключ	ГП-3 р. Акбастау, верхний створ	ГП-3а р. Акбастау, нижний створ	ГП-4 р. Кызылту, верхний створ	ГП-4а р. Кызылту, нижний створ	ГП-5 р. Акбастаубулак, выше сброса ОС	ГП-6 руч. Акбастаубулак, ниже сброса ОС	ГП-7 руч. без названия № 1	ГП-8 р. Алаайгыр, верхний створ	ГП-9 руч. без названия № 2, устье	ГП-10 руч. без названия № 3, истоки	ГП-11 руч. без названия № 3, устье	ГП-12 р. Алаайгыр перед водохранилищем	ГП-13 р. Алаайгыр, устье	ГП-14 р. Кызылсу, у с. Шалабай
2015 г. февраль II декада	$Q\frac{м^3/час}{м^3/с}$	лед	лед	лед	лед	-	лед	лед	лед	лед	лед	лед	лед	лед	лед	лед	$\frac{1685}{0,468}$
	t°,c	4,0	3,8	4,4	5,4	4,6	4,6	5,2	7,6	2,8	3,3	-	-	3,9	3,6	4,0	6,8
2015 г. февраль III декада	$Q\frac{м^3/час}{м^3/с}$	лед	лед	лед	лед	-	лед	лед	лед	лед	лед	лед	лед	лед	лед	лед	$\frac{1564}{0,434}$
	t°,c	4,0	3,6	4,5	5,8	4,3	4,8	5,2	7,5	2,7	3,0	-	-	3,8	3,5	4,0	6,6
2015 г. Март I декада	$Q\frac{м^3/час}{м^3/с}$	лед	лед	лед	лед	-	лед	лед	лед	лед	лед	лед	лед	лед	лед	$\frac{164}{0,046}$	$\frac{1472}{0,408}$
	t°,c	3,8	3,5	4,6	5,6	4,0	5,0	5,6	8,2	2,7	3,0	-	-	4,4	3,5	3,8	6,2
2015 г. март II декада	$Q\frac{м^3/час}{м^3/с}$	лед	лед	лед	лед	-	лед	лед	лед	лед	лед	лед	лед	лед	лед	$\frac{173}{0,048}$	$\frac{1365}{0,38}$
	t°,c	4,0	3,4	4,5	5,8	3,6	5,2	5,9	6,4	2,5	3,5	4,0	-	4,8	3,8	4,0	6,0
2015 г. март III декада	$Q\frac{м^3/час}{м^3/с}$	$\frac{31,6}{0,0088}$	$\frac{74,3}{0,021}$	$\frac{41,0}{0,0114}$	$\frac{61,4}{0,017}$	-	$\frac{68,6}{0,019}$	$\frac{83,0}{0,023}$	$\frac{274}{0,076}$	$\frac{49}{0,0136}$	$\frac{76}{0,021}$	$\frac{27,0}{0,0075}$	$\frac{18,4}{0,0051}$	$\frac{39,6}{0,011}$	$\frac{79}{0,022}$	$\frac{216}{0,06}$	$\frac{2808}{0,78}$
	t°,c	6,2	3,8	5,4	6,2	2,8	6,4	6,5	5,8	3,2	3,5	4,5		5,4	3,7	3,6	5,4
2015 г. апрель I декада	$Q\frac{м^3/час}{м^3/с}$	$\frac{45,4}{0,0126}$	$\frac{91,1}{0,0253}$	$\frac{59,8}{0,0019}$	$\frac{70,3}{0,0195}$	-	$\frac{105,4}{0,029}$	$\frac{188,6}{0,052}$	$\frac{286}{0,079}$	$\frac{61}{0,017}$	$\frac{91}{0,025}$	$\frac{39}{0,011}$	$\frac{38,9}{0,011}$	$\frac{94,6}{0,026}$	$\frac{210}{0,058}$	$\frac{268}{0,074}$	$\frac{9165}{2,54}$
	t°,c	7,6	5,9	6,7	7,2	5,8	7,0	7,2	6,4	4,8	4,6	5,2	-	5,9	3,5	4,0	5,8

Примечание: обозначения: Q- наблюдения за расходом воды, $\frac{м^3/час}{м^3/с}$;
t° - наблюдения за температурой воды, ^{0}C;
знак (-) указывает на отсутствие стока

Таблица 2.2 - Модуль стока 1 %-обеспеченности и величины максимальных расходов воды весенних паводков различной обеспеченности, $м^3/с$

Наименование водотока	Модуль стока 1 %, л*с/км^2	Расход 0,1 %, $м^3/с$	Расход 0,5 %, $м^3/с$	Расход 1 %, $м^3/с$	Расход 3 %, $м^3/с$	Расход 5 %, $м^3/с$	Расход 10 %, $м^3/с$	Расход 25 %, $м^3/с$	Расход 50 %, $м^3/с$
руч. Майранбастау устье	176	1,03	0,87	0,71	0,57	0,48	0,37	0,25	0,15
руч. Холодный ключ устье	120	3,76	3,17	2,58	2,06	1,75	1,37	0,90	0,54
р. Акбастау верхний створ	180	1,52	1,28	1,04	0,84	0,71	0,55	0,37	0,22
р. Кызылту устье	210	2,19	1,85	1,50	1,20	1,02	0,80	0,53	0,32
р. Акбастау перед дорогой Ауэзов-Чалобай	147	3,37	2,84	2,31	1,84	1,57	1,22	0,81	0,48
руч. Акбастаубулак устье	113	5,39	4,54	3,69	2,96	2,51	1,96	1,29	0,78
руч. Без названия № 1 в пос. Ауэзов устье	164	0,91	0,76	0,62	0,50	0,42	0,33	0,22	0,13
р. Алаайгыр верхний створ	349	9,28	7,82	6,36	5,08	4,32	3,37	2,22	1,34
руч.Без названия № 2 левобережный приток Алаайгыр, устье	338	11,3	9,55	7,77	6,21	5,28	4,12	2,72	1,63
руч. Без названия № 3 правобережный приток р. Алаайгыр, истоки	168	2,66	2,11	1,71	1,35	1,02	0,84	0,55	0,27
руч.Без названия № 3 правобережный приток р. Алаайгыр, устье	225	3,14	2,64	2,15	1,72	1,46	1,14	0,75	0,45
р. Алаайгыр перед водохранилищем	197	18,2	15,30	12,44	9,95	8,46	6,59	4,35	2,61
р. Алаайгыр устье	142	22,8	19,23	15,63	12,50	10,63	8,28	5,47	3,28
р. Кызылсу - с.Чалобай	283	418	352	286	229	195	152	100	60,1

Таблица 2.3 - Максимальные расходы воды летне-осенних дождевых паводков различной обеспеченности, $м^3/с$

Наименование водотока	**Расход 0,1 %, $м^3/с$**	**Расход 0,5 %, $м^3/с$**	**Расход 1 %, $м^3/с$**	**Расход 3 %, $м^3/с$**	**Расход 5 %, $м^3/с$**	**Расход 10 %, $м^3/с$**	**Расход 25 %, $м^3/с$**	**Расход 50 %, $м^3/с$**
руч. Майранбастау устье	0,32	0,25	0,19	0,14	0,11	0,074	0,036	0,019
руч. Холодный ключ устье	1,15	0,93	0,70	0,50	0,39	0,27	0,13	0,070
р. Акбастау верхний створ	0,47	0,38	0,28	0,20	0,16	0,11	0,054	0,028
р. Кызылту устье	0,67	0,54	0,41	0,29	0,23	0,16	0,077	0,041
р. Акбастау перед дорогой Ауэзов-Чалобай	1,03	0,83	0,62	0,45	0,35	0,24	0,12	0,062
руч. Акбастаубулак устье	1,65	1,33	1,0	0,72	0,56	0,39	0,19	0,10
руч. Без названия № 1 в пос. Ауэзов устье	0,28	0,22	0,17	0,12	0,094	0,065	0,032	0,017
р. Алаайгыр верхний створ	2,83	2,28	1,72	1,24	0,96	0,67	0,33	0,17
руч. Без названия № 2 левобережный приток Алаайгыр, устье	3,46	2,79	2,10	1,51	1,17	0,82	0,40	0,21
руч. Без названия № 3 правобережный приток р. Алаайгыр, истоки	0,75	0,59	0,42	0,31	0,25	0,14	0,078	0,034
руч. Без названия № 3 правобережный приток р. Алаайгыр, устье	0,96	0,77	0,58	0,42	0,33	0,23	0,11	0,058
р. Алаайгыр перед водохранилищем	5,54	4,47	3,36	2,42	1,88	1,31	0,64	0,34
р. Алаайгыр устье	6,96	5,61	4,22	3,04	2,36	1,65	0,80	0,42
р. Кызылсу - с.Чалобай	127	102	77,3	55,6	43,3	30,1	14,7	7,73

Таблица 2.4 - Годовой сток различной обеспеченности водных объектов на территории изысканий, м^3/с

Наименование водотока	0,1 %, м^3/с	0,5 %, м^3/с	1 %, м^3/с	3 %, м^3/с	5 %, м^3/с	10 %, м^3/с	25 %, м^3/с	50 %, м^3/с	75 %, м^3/с	90 %, м^3/с	95 %, м^3/с	99 %, м^3/с
руч. Майранбастау устье	0,01	0,008	0,007	0,006	0,005	0,004	0,003	0,002	0,001	0,001	0,0003	0,0002
руч. Холодный ключ устье	0,054	0,046	0,037	0,032	0,026	0,022	0,015	0,009	0,005	0,003	0,002	0,001
р. Акбастау верхний створ	0,015	0,012	0,01	0,009	0,007	0,006	0,004	0,003	0,001	0,001	0,001	0,0003
р. Кызылту устье	0,020	0,017	0,013	0,012	0,010	0,008	0,005	0,003	0,002	0,001	0,001	0,0003
р. Акбастау перед дорогой Ауэзов-Чалобай	0,039	0,033	0,027	0,023	0,019	0,016	0,011	0,007	0,004	0,002	0,001	0,001
руч. Акбастаубулак устье	0,083	0,070	0,057	0,049	0,041	0,033	0,023	0,014	0,008	0,004	0,003	0,001
руч. Без названия № 1 в пос. Ауэзов устье	0,010	0,008	0,007	0,006	0,005	0,004	0,003	0,002	0,001	0,001	0,0003	0,0002
р. Алаайгыр верхний створ	0,074	0,062	0,050	0,043	0,036	0,030	0,020	0,013	0,007	0,0039	0,003	0,001
руч. Без названия № 2 левобережный приток Алаайгыр, устье	0,088	0,074	0,061	0,052	0,043	0,035	0,024	0,015	0,009	0,005	0,003	0,002
руч. Без названия № 3 правобережный приток р. Алаайгыр, истоки	0,026	0,022	0,018	0,015	0,013	0,011	0,007	0,0085	0,002	0,001	0,0007	0,0006
руч. Без названия № 3 правобережный приток р. Алаайгыр, устье	0,029	0,025	0,020	0,017	0,014	0,012	0,008	0,010	0,003	0,002	0,001	0,001
р. Алаайгыр перед водохранилищем	0,18	0,15	0,12	0,11	0,0889	0,07	0,050	0,031	0,017	0,010	0,006	0,003
р. Алаайгыр устье	0,83	0,70	0,57	0,49	0,41	0,33	0,23	0,14	0,080	0,044	0,029	0,014
р. Кызылсу - с.Чалобай	6,62	5,58	4,5360	3,89	3,24	2,66	1,83	1,13	0,64	0,35	0,23	0,11

2.2 Наблюдения за уровненным режимом поверхностных вод

Наблюдения за уровнем поверхностных вод на водотоках района месторождения заключались в измерении относительной и абсолютной отметки уреза воды (в Балтийской системе высот) от нивелированного нуля верха сваи. При замерзании поверхности воды и ледовых явлениях в оборудованных лунках замерялась толщина льда. Результаты наблюдений за уровнем поверхностных вод и ледовые характеристики стока за период наблюдений с ноября 2014 г. до начало первой декады апреля 2015 г. отражены в таблице (Таблица 2.5).

Абсолютные отметки уровня воды поверхностных вод рек и ручьев района месторождения «Бакырчик» в период глухой межени (конец февраля-начало марта) в зависимости от их гипсометрического расположения на местности изменяются в пределах 358,29-440,64 м, в начальной фазе весеннего половодья-паводка при открытом русле 358,5-441,0 м. Амплитуда колебания уровня для данного периода наблюдений составляет 0,21-0,36 м. Максимальная же амплитуда колебания уровня воды на водотоках района месторождения по данным многолетних наблюдений Казгидромета, в зависимости от водности года, приходится пик паводка – на середину-конец апреля и составляет 0,50-1,5 м. По водности 2014 год и зимне-весенний период 2015 года для района левобережья Иртыша характеризуется как близкий к среднему.

Таблица 2.5 - Результаты наблюдений за уровнем поверхностных вод района месторождения «Бакырчик» ТОО «БГП»

Замеры год, месяц, декада	Параметры	Пункты наблюдений															
		ГП-1 руч. Майранбастау	ГП-2 руч. Холодный ключ	ГП-3 р. Акбастау, верхний створ	ГП-3а р. Акбастау, нижний створ	ГП-4 р. Кызылту, верхний створ	ГП-4а р. Кызылту, нижний створ	ГП-5 р. Акбастаубулак, выше сброса ОС	ГП-6 руч. Акбастаубулак, ниже сброса ОС	ГП-7 руч. без названия № 1	ГП-8 р.Алаайгыр, верхний створ	ГП-9 руч. без названия № 2, устье	ГП-10 руч. без названия № 3, истоки	ГП-11 руч. без названия № 3, устье	ГП-12 р. Алаайгыр перед водохранилищем	ГП-13 р. Алаайгыр, устье	ГП-14 р. Кызылсу, ус. Шалабай
2014 г. Ноябрь II декада	Абс. отм. нуля верха сваи, м	398,64	361,72	419,0	398,7	439,85	405,75	398,7	362,72	420,85	441,86	439,75	437,68	397,68	395,7	359,1	363,0
	Высота до воды h, м	0,93	0,92	1,18	0,75	Отсут.	0,91	0,84	1,02	0,42	0,99	0,86	0,96	1,06	0,88	0,72	1,28
	Толщина льда, м	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-
	Абс. отм. уровня воды, м	397,71	360,8	417,82	397,95	Отсут.	404,84	397,86	361,7	420,43	440,87	438,89	436,72	396,62	394,82	358,38	361,72
2014 г. Ноябрь III декада	Абс. отм. нуля верха сваи, м	398,64	361,72	419,0	398,7	439,85	405,75	398,7	362,72	420,85	441,86	439,75	437,68	397,68	395,7	359,1	363,0
	Высота до воды h, м	1,01	1,02	1,26	0,86	Отсут.	1,05	0,88	1,10	0,48	1,05	0,92	0,89	1,09	0,91	0,76	1,36
	Толщина льда, м	0,03	0,02	0,03	0,02		-	-	-	-	-	-	-	-	-	-	-
	Абс. отм. уровня воды, м	397,63	360,7	417,74	397,84	Отсут.	404,70	397,82	361,62	420,37	440,81	438,83	436,79	396,59	394,79	358,34	361,64
2014 г. Декабрь I декада	Абс. отм. нуля верха сваи, м	398,64	361,72	419,0	398,7	439,85	405,75	398,7	362,72	420,85	441,86	439,75	437,68	397,68	395,7	359,1	363,0
	Высота до воды h, м	1,13	1,14	1,39	0,97	Отсут.	1,12	0,94	1,19	0,54	1,12	0,95	0,96	1,14	0,95	0,81	1,45
	Толщина льда, м	0,08	0,06	0,10	0,08		0,05	0,06	-	0,01	0,04	0,03	0,04	0,03	-	-	-
	Абс. отм. уровня воды, м	397,51	360,58	417,61	397,73	Отсут.	404,63	397,76	361,53	420,31	440,74	438,80	436,72	396,54	394,75	358,29	361,55
2014 г. декабрь II декада	Абс. отм. нуля верха сваи, м	398,64	361,72	419,0	398,7	439,85	405,75	398,7	362,72	420,85	441,86	439,75	437,68	397,68	395,7	359,1	363,0
	Высота до воды h, м	1,13	1,22	1,43	1,05	Отсут.	1,18	0,99	1,16	0,58	1,16	0,95	1,0	1,17	0,99	0,78	1,52
	Толщина льда, м	0,12	0,16	0,16	0,14		0,13	0,11	-	0,03	0,06	0,05	0,04	0,05	-	-	-
	Абс. отм. уровня воды, м	397,51	360,5	417,57	397,65	Отсут.	404,57	397,71	361,56	420,27	440,70	438,8	436,68	396,51	394,71	358,32	361,48

Замеры год, месяц, декада	Параметры	Пункты наблюдений															
		ГП-1 руч. Майранбастау	ГП-2 руч. Холодный ключ	ГП-3 р. Акбастау, верхний створ	ГП-3а р. Акбастау, нижний створ	ГП-4 р. Кызылту, верхний створ	ГП-4а р. Кызылту, нижний створ	ГП-5 р. Акбастаубулак, выше сброса ОС	ГП-6 руч. Акбастаубулак, ниже сброса ОС	ГП-7 руч. без названия № 1	ГП-8 р.Алаайгыр, верхний створ	ГП-9 руч. без названия № 2, устье	ГП-10 руч. без названия № 3, истоки	ГП-11 руч. без названия № 3, устье	ГП-12 р. Алаайгыр перед водохранилищем	ГП-13 р. Алаайгыр, устье	ГП-14 р. Кызылсу, ус. Шалабай
2014 г. декабрь III декада	Абс. отм. нуля верха сваи, м	398,64	361,72	419,0	398,7	439,85	405,75	398,7	362,72	420,85	441,86	439,75	437,68	397,68	395,7	359,1	363,0
	Высота до воды h, м	1,22	1,18	1,43	1,05	Отсут.	1,16	1,03	1,11	0,69	1,19	0,95	1,0	1,17	1,03	0,74	1,56
	Толщина льда,м	0,16	0,15	0,16	0,17		0,15	0,14	0,03	0,11	0,10	0,08	0,07	0,05	0,07	-	-
	Абс. отм. уровня воды, м	397,42	360,54	417,57	397,65	Отсут.	404,59	397,67	361,61	420,16	440,67	438,8	436,63	396,51	394,67	358,36	361,44
2015 г. Январь I декада	Абс. отм. нуля верха сваи, м	398,64	361,72	419,0	398,7	439,85	405,75	398,7	362,72	420,85	441,86	439,75	437,68	397,68	395,7	359,1	363,0
	Высота до воды h, м	1,22	1,18	1,42	1,03	Отсут.	1,18	1,05	1,07	0,69	1,22	0,95	1,0	1,17	1,03	0,81	1,61
	Толщина льда,м	0,20	0,17	0,15	0,16		0,15	0,16	0,03	0,11	0,10	0,09		0,07	0,10	0,06	0,02
	Абс. отм. уровня воды, м	397,42	360,54	417,58	397,67	Отсут.	404,57	397,65	361,65	420,16	440,64	438,8	436,68	396,51	394,67	358,29	361,39
2015 г. январь II декада	Абс. отм. нуля верха сваи, м	398,64	361,72	419,0	398,7	439,85	405,75	398,7	362,72	420,85	441,86	439,75	437,68	397,68	395,7	359,1	363,0
	Высота до воды h, м	1,22	1,18	1,40	1,03	Отсут,	1,18	1,05	1,14	0,68	1,22	0,95	1,0	1,17	1,03	0,81	1,68
	Толщина льда, м	0,20	0,17	0,15	0,16		0,15	0,16	0,02	0,11	0,10	0,10	0,11	0,09	0,10	0,10	0,05
	Абс. отм. уровня воды, м	397,42	360,54	417,6	397,67	Отсут.	404,57	397,65	361,58	420,17	440,64	438,8	436,68	396,51	394,67	358,29	361,32
2015 г. январь III декада	Абс. отм. нуля верха сваи, м	398,64	361,72	419,0	398,7	439,85	405,75	398,7	362,72	420,85	441,86	439,75	437,68	397,68	395,7	359,1	363,0
	Высота до воды h, м	1,20	1,18	1,40	1,03	Отсут.	1,18	1,05	1,12	0,68	1,22	0,95	1,0	1,17	1,03	0,81	1,68
	Толщина льда,м	0,20	0,18	0,15	0,16		0,15	0,17	0,02	0,11	0,10	0,10	0,10	0,10	0,10	0,12	0,21
	Абс. отм. уровня воды, м	397,44	360,54	417,6	397,67	Отсут.	404,57	397,65	361,60	420,17	440,64	438,8	436,68	396,51	394,67	358,29	361,32

Замеры год, месяц, декада	Параметры	Пункты наблюдений															
		ГП-1 руч. Майранбастау	ГП-2 руч. Холодный ключ	ГП-3 р. Акбастау, верхний створ	ГП-3а р. Акбастау, нижний створ	ГП-4 р. Кызылту, верхний створ	ГП-4а р. Кызылту, нижний створ	ГП-5 р. Акбастаубулак, выше сброса ОС	ГП-6 руч. Акбастаубулак, ниже сброса ОС	ГП-7 руч. без названия № 1	ГП-8 р.Алаайгыр, верхний створ	ГП-9 руч. без названия № 2, устье	ГП-10 руч. без названия № 3, истоки	ГП-11 руч. без названия № 3, устье	ГП-12 р. Алаайгыр перед водохранилищем	ГП-13 р. Алаайгыр, устье	ГП-14 р. Кызылсу, ус. Шалабай
2015 г. Февраль I декада	Абс. отм. нуля верха сваи, м	398,64	361,72	419,0	398,7	439,85	405,75	398,7	362,72	420,85	441,86	439,75	437,68	397,68	395,7	359,1	363,0
	Высота до воды h, м	1,20	1,18	1,40	1,03	Отсут.	1,18	1,05	1,06	0,68	1,22	0,95	1,0	1,17	1,03	0,81	1,68
	Толщина льда, м	0,20	0,18	0,15	0,16		0,16	0,17	0,06	0,11	0,10	0,10	0,10	0,10	0,10	0,12	0,19
	Абс. отм. уровня воды, м	397,44	360,54	417,6	397,67	Отсут.	404,57	397,65	361,66	420,17	440,64	438,8	436,68	396,51	394,67	358,29	361,32
2015 г. февраль II декада	Абс. отм. нуля верха сваи, м	398,64	361,72	419,0	398,7	439,85	405,75	398,7	362,72	420,85	441,86	439,75	437,68	397,68	395,7	359,1	363,0
	Высота до воды h, м	1,20	1,18	1,40	1,03	Отсут.	1,18	1,05	1,12	0,68	1,22	0,95	1,0	1,17	1,03	0,81	1,68
	Толщина льда,м	0,20	0,18	0,15	0,16		0,16	0,17	0,08	0,11	0,10	0,10	0,10	0,10	0,10	0,12	0,21
	Абс. отм. уровня воды, м	397,44	360,54	417,63	397,67	Отсут.	404,57	397,65	361,60	420,17	440,64	438,8	436,69	396,51	394,67	358,29	361,32
2015 г. февраль III декада	Абс. отм. нуля верха сваи, м	398,64	361,72	419,0	398,7	439,85	405,75	398,7	362,72	420,85	441,86	439,75	437,68	397,68	395,7	359,1	363,0
	Высота до воды h, м	1,20	1,18	1,40	1,03	Отсут.	1,18	1,05	1,04	0,68	1,22	0,95	1,0	1,17	1,03	0,81	1,68
	Толщина льда,м	0,20	0,18	0,15	0,16		0,16	0,17	0,08	0,11	0,10	0,10	0,10	0,10	0,10	0,12	0,26
	Абс. отм. уровня воды, м	397,44	360,54	417,6	397,67	Отсут.	404,57	397,65	361,68	420,17	440,64	438,8	436,68	396,51	394,67	358,29	361,32
2015 г. Март I декада	Абс. отм. нуля верха сваи, м	398,64	361,72	419,0	398,7	439,85	405,75	398,7	362,72	420,85	441,86	439,75	437,68	397,68	395,7	359,1	363,0
	Высота до воды h, м	1,16	1,14	1,34	0,96	Отсут.	1,14	1,02	0,98	0,64	1,20	0,95	0,98	1,17	1,03	0,81	
	Толщина льда,м	0,18	0,15	0,12	0,13		0,14	0,15	0,01	0,09	0,09	0,10	0,09	0,10	0,10	0,12	0,26
	Абс. отм. уровня воды, м	397,48	360,58	417,66	397,74	Отсут.	404,61	397,68	361,74	420,21	440,66	438,8	436,7	396,51	394,67	358,29	361,32

Замеры год, месяц, декада	Параметры	Пункты наблюдений															
		ГП-1 руч. Майранбастау	ГП-2 руч. Холодный ключ	ГП-3 р. Акбастау, верхний створ	ГП-3а р. Акбастау, нижний створ	ГП-4 р. Кызылту, верхний створ	ГП-4а р. Кызылту, нижний створ	ГП-5 р. Акбастаубулак, выше сброса ОС	ГП-6 руч. Акбастаубулак, ниже сброса ОС	ГП-7 руч. без названия № 1	ГП-8 р.Алаайгыр, верхний створ	ГП-9 руч. без названия № 2, устье	ГП-10 руч. без названия № 3, истоки	ГП-11 руч. без названия № 3, устье	ГП-12 р. Алаайгыр перед водохранилищем	ГП-13 р. Алаайгыр, устье	ГП-14 р. Кызылсу, ус. Шалабай
2015 г. март II декада	Абс. отм. нуля верха сваи, м	398,64	361,72	419,0	398,7	439,85	405,75	398,7	362,72	420,85	441,86	439,75	437,68	397,68	395,7	359,1	363,0
	Высота до воды h, м	1,10	1,11	1,28	0,88	0,95	1,03	0,98	0,72	0,57	1,17	0,95	0,98	1,14	1,0	0,81	1,68
	Толщина льда, м	0,05	0,09	0,10	0,09	-	0,04	0,13	-	-	0,08	0,10	0,09	0,10	0,07	0,10	0,26
	Абс. отм. уровня воды, м	397,54	360,61	417,72	397,82	438,9	404,72	397,72	361,90	420,28	440,69	438,8	436,7	396,54	394,7	358,29	361,32
2015 г. март III декада	Абс. отм. нуля верха сваи, м	398,64	361,72	419,0	398,7	439,85	405,75	398,7	362,72	420,85	441,86	439,75	437,68	397,68	395,7	359,1	363,0
	Высота до воды h, м	0,72	0,82	1,08	0,74	0,80	0,94	0,89	0,76	0,43	1,02	0,83	0,79	0,77	0,81	0,66	1,64
	Толщина льда, м	-	0,03	-	-	-	-	0,02	-	-	-	-	-	-	-	-	0,24
	Абс. отм. уровня воды, м	397,92	360,9	417,92	397,96	439,05	404,81	397,81	361,96	420,42	440,84	439,92	436,89	396,91	394,89	358,44	361,36
2015 г. апрель I декада	Абс. отм. нуля верха сваи, м	398,64	361,72	419,0	398,7	439,85	405,75	398,7	362,72	420,85	441,86	439,75	437,68	397,68	395,7	359,1	363,0
	Высота до воды h, м	0,54	0,62	0,89	0,61	0,76	0,68	0,65	0,72	0,35	0,86	0,72	0,68	0,63	0,70	0,60	1,10
	Толщина льда, м	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Абс. отм. уровня воды, м	398,10	361,1	418,11	398,09	439,09	405,07	398,05	362,0	420,50	441,0	439,03	437,0	397,05	395,0	358,5	361,9

3 Руслоотводной канал ручьев Кызылту и Акбастау

3.1 Описание основных технических решений

Руслоотводной канал проектируется для отвода руч. Кызылту и руч. Акбастаубулак с территории площадки промышленного предприятия на которой планируется размещать отвалы пустой породы и вести открытые горные работы. Руслоотводной канал расположен севернее отвала пустой породы и заканчивается впадением в руч. Холодный ключ.

Конфигурация руслоотводного канала разделена на два участка, что обусловлено рельефом местности.

Первый участок имеет протяженность 2,5 км, уклон дна 1 ‰, ширину по дну – 2,0 м, крутизну откосов – 1:1,5. Дно и борта закреплены камнем, крупностью Дср=0,1 м (0,05-0,15 м). Толщина крепления – 0,3 м. Максимальная расчетная скорость в канале – 1,0 м/с. Максимальная глубина при пропуске поверочного расхода – 1,25 м.

Второй участок имеет протяженность 2,4 км, уклон дна 13,3 ‰, ширину по дну – 2,0 м, крутизну откосов – 1:1,5. Дно и борта закреплены камнем, крупностью Дср=0,2 м (0,1-0,3 м). Толщина крепления – 0,6 м. Максимальная расчетная скорость в канале – 2,5 м/с. Максимальная глубина при пропуске поверочного расхода – 0,64 м. План, продольный профиль и типовые сечения канала представлены на чертежах 34 01 03 020 19-ГР, листы. 2, 3.

По результатам расчетов расчетная пропускная способность руслоотводного канала составляет Q P=3 % =2,96 м³/с и поверочного расхода $Q_{P=0,5\%}$=4,54 м^3/с.

Расчет пропускной способности руслоотводного канала приведен на рисунке (Рисунок 3.1).

Гидравлический расчет канала
(Определение величин расхода и скорости)

1. Использованная литература:

1.Справочник по гидравлическим расчетам .Под редакцией П.Г.Киселева.
Москва.Стройиздат.1983г.(Гл.6)
2.Гидротехнические сооружения.Справочник проектировщика.
Москва.Стройиздат.1983г.(п.3.3.2)
3.Гидравлика Р.Р.Чугаев (Гл.6)

2. Исходные данные

Параметры	Величина	Ед. изм.	Наименование
hмакс.	0,64	м	Максимальная глубина воды в канале
b	2,00	м	Ширина канала по дну
i	0,01300		Уклон дна канала
n	0,0275		Коэффициент шероховатости канала.
m	1,5		Коэффициент заложения откоса

3.Расчетные формулы

$W= (b+mh)h$	м2	площадь живого сечения канала
$X= b+2h(1+m^2)^{1/2}$	м	длина смоченного периметра
$R= W/X$	м	гидравлический радиус
$C= 1/n*R^{1/6}$		коэффициент Шези
$Q= WC(Ri)^{1/2}$	м3/с	расход воды в канале
$V= C(Ri)^{1/2}$	м/с	скорость воды в канале

4.Результаты расчета значений расхода и скорости:

h м	W м	X м	R м	C	Q м3/с	V м/с
0,000	0,00	2,00	0,000	0,00	0,00	0,00
0,064	0,13	2,23	0,060	22,76	0,085	0,64
0,128	0,28	2,46	0,114	25,32	0,27	0,97
0,192	0,44	2,69	0,163	26,88	0,54	1,24
0,256	0,61	2,92	0,209	28,01	0,89	1,46
0,320	0,79	3,15	0,252	28,89	1,31	1,65
0,384	0,99	3,38	0,292	29,62	1,81	1,83
0,448	1,20	3,62	0,331	30,25	2,38	1,98
0,505	1,39	3,82	0,364	30,73	**2,95**	**2,12**
0,576	1,65	4,08	0,405	31,27	3,74	2,27
0,640	1,89	4,31	0,440	31,71	**4,54**	**2,40**

Рисунок 3.1 - Гидравлический расчет руслоотводного канала

3.2 Строительно-монтажные работы

Руслоотводной канал является земляным сооружением, согласно графику строительства объектов по проекту промышленной разработки месторождения открытым способом все строительно-монтажные работы по данному объекту будут выполнены в 2016 году в течение 3-х месяцев.

Основными работами при строительстве руслоотводного канала будут: выемка грунта по трассе канала и крепление дна канала камнем различной крупности в зависимости от уклона. На первом этапе СМР производиться выемка грунта в объеме 155,4 тыс. $м^3$ экскаватором типа ЭО-4121 емкость ковша 1,25 $м^3$, далее производиться засыпка камнем первого и второго участка дна канала. Транспортировка камня до места производства СМР осуществляется автосамосвалами типа КАМАЗ-6520. Первый участок засыпается камнем крупностью 100 мм. в объеме 6,1 тыс. $м^3$, второй участок камнем крупность 200 мм в объеме 9,9 тыс. $м^3$. Уплотнение камня на первом и втором участке производиться ручными электрическими трамбовками ИЭ-4502 и ИЭ-4505.

4 Расчет водопропускной способности ручья Холодный ключ

Ручей Холодный ключ протекает западнее проектируемой площадки предприятия и является притоком реки Кызылсу. Так как весь объем отводимых руслоотводным каналом вод будет сбрасываться в ручей Холодный ключ, с целью обоснования возможности пропуска данного объема выполнены расчеты, которые подтверждают возможность сброса воды без негативных последствий для окружающей среды. План и поперечные профили по руслу ручья Холодный ключ представлены на чертеже 34 01 03 020 19 – ГР, лист. 4. Данные материалы подготовлены на основе маркшейдерской съемки русла ручья специалистами ТОО БГП в 2015 году.

Гидрологические характеристики ручья Холодный ключ были определены для гидрологического створа, расположенного в устье ручья.

В период прохождения весеннего половодья расходы в устье ручья Холодный ключ составляет для паводка с обеспеченностью 3 % – $Q_{P=3\ \%}$ =2,06 м³/с и для паводка с обеспеченностью 0,5 % – $Q_{P=0,5\ \%}$ =3,17 м³/с.

Руслоотводной канал обеспечивает отведение расходов весеннего половодья ручьев Кызылту и Акбастаубулак в ручей Холодный ключ. Суммарный расчетный расход ручьев Кызылту и Акбастаубулак составляет для паводка с обеспеченностью 3 % – $Q_{P=3\ \%}$ =2,96 м³/с и для паводка с обеспеченностью 0,5 % – $Q_{P=0,5\ \%}$ =4,54 м³/с.

Максимальные расчетные расходы, протекающие по ручью Холодный ключ после впадения руслоотводного канала ручьев Кызылту и Акбастаубулак в русло ручья Холодный ключ, составляют: расчетный расход $Q_{P=3\ \%}$ =5,02 м³/с и поверочный расход $Q_{P=0,5\ \%}$ =7,71 м³/с.

Величины расходов дождевых паводков ручьев Акбастаубулак, Кызылту и Холодный ключ, не превышают величины расходов паводков весеннего половодья соответствующей обеспеченности, поэтому пропускная способность канала и русла ручья определялась на основании величин паводков именно весеннего половодья.

Для определения способности русла ручья Холодный ключ пропустить не только расходы, поступающие с собственной водосборной площади ручья, но и

расходы, поступающие по руслоотводному каналу, была выполнена топографическая съемка русла ручья и шесть поперечников. Поперечные профили № 1, 2, 3 расположены в районе впадения руслоотводного канала. Поперечные профили № 4, 5, 6 расположены ближе к устью ручья.

На основании топографической съемки определены средние уклоны дна ручья и площадь живого сечения в ручье при пропуске расхода Q=7,71 м^3/с.

Средний уклон дна ручья –изменяется от i=0,094 до i=0,005. Борта русла и пойма покрыты густой травой. Коэффициент шероховатости русла принят n=0,04. Коэффициент шероховатости поймы принят n=0,15.

В расчетных профилях № 2, 3, 4, 5, 6 выход воды из русла на пойму при прохождении паводка с расходом 7,71 м^3/с не наблюдается. Выход на пойму будет наблюдаться только в районе профиля № 1. Граница затапливаемой поймы приведена на плане ручья Холодный ключ. (чертеж 34 01 03 020 19 – ГР, лист 4).

Расчет пропускной способности русла ручья Холодный ключ приведен ниже на рисунке (Рисунок 4.1).

На основании графических материалов и выполненных расчетов русло ручья Холодный ключ обеспечивает пропуск расхода с обеспеченностью 0,5 % – $Q_{P=0,5\ \%}$=7,71 м^3/с.

Ситуационный план расположения руслоотводного канала ручьев Кызылту и Акбастаубулак и ручья Холодный ключ приведен на чертеже 34 01 03 020 19 – ГР, лист 1.

1. Использованная литература:

2.Гидротехнические сооружения.Справочник проектировщика.
Москва.Стройиздат.1983г.(п.3.3.2)

3.Гидравлика Р.Р.Чугаев (Гл.6)

СНиП2,06,03-85 Мелиоративные системы и сооружения (Неразмывающие скорости)

2. Исходные данные:(заполни выделенное бирюзовым цвето: Таблица №1

Параметры	Ед. изм.	Наименование
i		Уклон дна канала
n		Коэффициент шероховатости канала.
W	м2	площадь живого сечения канала
X	м	длина смоченного периметра

3.Расчетные формулы		
R= W/X	м	гидравлический радиус
C= $1/n*R^{1/6}$		коэффициент Шези
Q= $WC(Ri)^{1/2}$	м3/с	расход воды в канале
V= $C(Ri)^{1/2}$	м/с	скорость воды в канале

4.Результаты расчета значений расхода и скорости:

Назв створа	Название	i	n	W м	X м	R м	C	Q м3/с	V м/с
1	русло -п	0,009	0,04	1,50	3,61	0,416	21,60	**2,02**	**1,35**
	русло-л	0,009	0,04	2,60	5,70	0,456	21,93	**3,73**	**1,44**
	пойма	0,009	0,15	12,50	94,00	0,133	4,76	**2,10**	**0,17**
								7,86	
2	русло -п	0,009	0,04	2,40	9,00	0,267	20,06	**2,36**	**0,98**
	русло-л	0,009	0,04	4,20	10,00	0,420	21,63	**5,59**	**1,33**
								7,94	
3	русло	0,009	0,04	6,20	15,50	0,400	21,46	**7,76**	**1,25**
4	русло	0,006	0,04	6,55	13,70	0,478	22,11	**7,76**	**1,18**
5	русло	0,005	0,04	5,80	8,90	0,652	23,28	**7,71**	**1,33**
6	русло	0,005	0,04	5,50	7,70	0,714	23,64	**7,77**	**1,41**

Рисунок 4.1 - Расчет водопропускной способности ручья Холодный ключ

Приложение А

Техническое задание на разработку проекта

Согласовано:

Директор Филиала
АО «Полиметалл Инжиниринг»
в Республике Казахстан

_____ С.А. Деннер

«____» _____2015 г.

Утверждаю:

Генеральный директор
ТОО «Бакырчикское
горнодобывающее предприятие»

_____Ю.Б. Овчинников

«_____»_____2015 г.

ТЕХНИЧЕСКОЕ ЗАДАНИЕ

на разработку проекта «Проект руслоотводного калана ручьев Кызылту и Акбастаубулак в составе проекта промышленной разработки Бакырчикского золоторудного месторождения открытым способом»

№	Перечень основных данных и требований	Основные данные и требования
1	Заказчик	ТОО «Бакырчикское горнодобывающее предприятие» Республика Казахстан, РК, ВКО, Жарминский р-н, пос. Ауэзов 070605, БИН 930 340 000 251
2	Исполнитель	Филиал ПМИ в РК
3	Источник и условия финансирования	Договор на разработку проекта промышленной разработки золоторудного месторождения Бакырчик открытым способом.
4	Наименование проектируемого объекта	«Проект руслоотводного калана ручьев Кызылту и Акбастаубулак в составе проекта промышленной разработки Бакырчикского золоторудного месторождения открытым способом»
5	Месторасположение объекта проектирования	Республика Казахстан, Восточно-Казахстанская область, Жарминский район, поселок Ауэзов, участок горных работ Бакырчикского горнодобывающего предприятия.
6	Вид строительства	Новое
7	Дата начала проектирования	10.07.15
8	Сроки разработки проекта	30.07.15 (не включает срок согласования раздела в экспертных организациях)
9	Требования, предъявляемые к Исполнителю	Наличие лицензии I категории на: - проектно-изыскательскую деятельность - проектирование инженерных сетей и систем - технологическое проектирование
10	Состав документации	При проектировании учесть следующие нормативные документы: – Водный кодекс Республики Казахстан (с изменениями и

№	Перечень основных данных и требований	Основные данные и требования
		дополнениями по состоянию на 01.01.2015 г.); – Земельный кодекс Республики Казахстан (с изменениями и дополнениями по состоянию на 22.04.2015 г.); – ВСН 33-2.2.12-87 «Мелиоративные системы и сооружения». А также другую действующую нормативную документацию РК.
11	Данные, на основе которых осуществляется проектирование	Для выполнения работ Исполнителю предоставляются: 1. Для начала работ – основные проектные решения по Проекту промышленной разработки месторождения, с последующим предоставлением, по мере готовности, разделов: Раздел 1. Общая пояснительная записка Раздел 2. Геологическая часть Раздел 3. Технологические решения по разработке месторождения. Открытые горные работы Книга 1. Текстовая часть Книга 2. Графическая часть Раздел 4. Генеральный план и транспорт. Сведения о сетях инженерно-технического обеспечения Книга 1. Текстовая часть Книга 2. Графическая часть Раздел 5. Гражданская защита Подраздел 1. Промышленная безопасность, мероприятия ГО и ЧС, пожарная безопасность Подраздел 2. Промышленная безопасность. Охрана труда и техника безопасности Раздел 6. Меры, обеспечивающие соблюдение требований по рациональному и комплексному использованию недр, и рекультивация земель Раздел 7. Оценка воздействия на окружающую среду (ОВОС) Раздел 8. Декларация промышленной безопасности Раздел 9. Финансово-экономическая модель 2. Отчеты по инженерно-геодезическим и инженерно-геологическим изысканиям; 3. Отчет по инженерно-гидрометеорологическим изысканиям
12	Генеральный план	Генеральный план в Приложении 1 к настоящему ТЗ.
13	Объем работ	В объем работ исполнителя входит: 1. Разработка «Проект руслоотводного канала ручьев Кызылту и Акбастаубулак в составе проекта промышленной разработки Бакырчикского золоторудного месторождения открытым способом»; 2. Сопровождение проекта (в части объема работ, указанного в п. 1) при согласовании в государственных экспертных организациях.
14	Этапность выполнения работ	Работы выполняются в два этапа: 1. Подготовка «Проект руслоотводного канала ручьев Кызылту и Акбастаубулак в составе проекта промышленной разработки Бакырчикского золоторудного месторождения открытым способом»;

№	Перечень основных данных и требований	Основные данные и требования
		2. Согласование в контролирующих органах.
15	Комплектность и форма представления документации	Электронная версия материалов на CD – 2 экз. Формат предоставляемых материалов: Текстовые – DOC MS Word; Электронные таблицы – XLS MS Excel (с сохранением формул и связей); Графические – DWG AutoCAD 3D. Бумажный носитель, с подписями и печатями – 5 экз.

Приложение Б

Договор аренды земельного участка

ДОГОВОР АРЕНДЫ ЗЕМЕЛЬНОГО УЧАСТКА

село Калбатау **№ 170** **«17» июля 2015 года**

Мы, нижеподписавшиеся, **и.о. руководителя ГУ «Отдел земельных отношений Жарминского района» ВКО Наушабаев Мейрхан Таурбекович,** именуемый в дальнейшем Арендодатель с одной стороны, и, **генеральный директор ТОО «Бакырчикское горнодобывающее предприятие» Овчинников Юрий Борисович,** именуемый в дальнейшем Арендатор, с другой стороны, заключили настоящий Договор о нижеследующем:

1. ПРЕДМЕТ ДОГОВОРА

1.1 Арендодатель предоставляет земельный участок, находящийся в государственной собственности во временное возмездное землепользование сроком на **11 (одиннадцать) лет**, на основании **постановления Акимата Жарминского района №207 от 24 июня 2015 года,** согласно границам, указанным в акте на право землепользования, прилагаемом к настоящему договору.

1.2 Месторасположение земельного участка: **ВКО, Жарминский район, Шалабайский сельский округ.**

Учетный квартал /Кадастровый номер: **05-243-052-113**

Площадь – **263,3 га,** в том числе: пастбища – **261,5 га,** прочие земли – **1,8 га.**

Целевое назначение: **для размещения отвала пустой породы.**

Ограничения в использовании и обременении: **запрет на совершение сделок, за исключением передачи в залог.**

Делимость или неделимость: **делимый.**

2. ПЛАТА ЗА ЗЕМЛЮ

2.1. Стоимость годовой аренды установлена Арендодателем, является неотъемлемой частью договора и подлежит уплате Арендатором равными долями, не позднее 25 февраля, 25 мая, 25 августа и 25 ноября текущего года, путем перечисления платежей на единый расчетный счет государственного учреждения «ВК областное Управление Казначейства Комитета Казначейства Министерства Финансов РК» ИИК KZ24070105KSN0000000 БИК KKMFKZ2A, код платежа 105315, РНН 510 800 000 358.

2.2. Расчет суммы платы за пользование земельным участком, являющейся неотъемлемой частью Договора, может пересматриваться Арендодателем в случаях изменения условий договора или порядка исчисления платы за пользование земельным участком, устанавливаемого Налоговым законодательством Республики Казахстан.

3. ПРАВА И ОБЯЗАННОСТИ СТОРОН

3.1 Арендатор имеет право:

1) вести на земельном участке самостоятельное хозяйство;

2) собственности на посевы и посадки сельскохозяйственных и многолетних насаждений, на произведенную сельскохозяйственную продукцию и доходы от ее реализации;

3) без преследования цели заключения последующих соглашений, согласно установленному порядку, использовать для собственных хозяйственных нужд имеющиеся на земельном участке песок, глину, гравий и другие общераспространенные полезные ископаемые, торф, насаждения, поверхностные и подземные воды, а также эксплуатировать иные полезные свойства земли;

4) на полное возмещение убытков в случае принудительного отчуждения земельного участка для государственных нужд;

5) в соответствии с целевым назначением земельного участка заниматься строительством производственных, бытовых и других зданий, строений, сооружений;

6) в соответствии с установленными строительными, экологическими, санитарно-гигиеническими и иными специальными требованиями проводить оросительные, осушительные и иные мелиоративные работы, строить пруды, и иные водоемы;
7) в случае исполнения обязательств по данному договору в должном порядке, иметь преимущество перед другими арендаторами при заключении договора с Арендодателем на новый срок;
8) если права на настоящий земельный участок принадлежит ему, то по установленным земельным законодательствам Республики Казахстан земельный участок выкупить в собственность;
9) если срок временного землепользования, установленного в Договоре составляет свыше 5-и лет, то поставить земельный участок под залог.

3.2 Арендатор обязан:
1) использовать землю в соответствии с целевым назначением;
2) осуществлять мероприятия по защите земли, установленные Земельным законодательством Республики Казахстан;
3) своевременно производить платежи за пользование земельным участком;
4) обеспечить соблюдение порядка пользования животным миром, лесными, водными и другими природными ресурсами, защищать историко-архитектурные памятники, археологическое наследие и другие объекты, расположенные на земельном участке и находящиеся под защитой государства в соответствии с законами Республики Казахстан;
5) соблюдать строительные, экологические, санитарно-гигиенические и другие специальные требования (нормы, правила, нормативы) при осуществлении на земельном участке хозяйственной и иной деятельности;
6) своевременно представлять в государственные органы установленные земельным законодательством Республики Казахстан сведения о состоянии и использовании земель;
7) не нарушать права других собственников и землепользователей;
8) не допускать загрязнения, засорения, истощения и ухудшения плодородия почв, а также снятия плодородного слоя почвы с целью продажи или передачи его другим лицам, за исключением случаев, когда такое снятие необходимо для предотвращения безвозвратной утери плодородного слоя;
9) обеспечивать сохранение сервитутов в порядке, предусмотренном Земельным кодексом Республики Казахстан;
10) в случае отчуждения земельного участка из собственности в связи с обнаружением под земельным участком полезных ископаемых, досрочно расторгнуть право пользования землей, также досрочно расторгнуть право пользования землей в связи с отчуждением земельного участка для государственных нужд;
11) зарегистрировать Договор аренды земельного участка в Налоговом управлении Жарминского района.

3.3 Арендодатель имеет право:
1) осуществлять контроль за использованием земельного участка по целевому назначению;
2) вносить изменения в договор в части годовой суммы аренды земельного участка согласно пункта 2.2. настоящего договора;
3) в случае отчуждения земельного участка из собственности в связи с обнаружением под земельным участком полезных ископаемых, досрочно расторгнуть право пользования землей, также досрочно расторгнуть право пользования землей в связи с отчуждением земельного участка для государственных нужд.

3.4 Арендодатель обязан:
1) передать Арендатору земельный участок в состоянии, соответствующем условиям Договора;
2) при отчуждении земельного участка для государственных нужд возместить Арендатору в полном объеме убытки или по его желанию предоставить другой земельный участок.

4. ОТВЕТСТВЕННОСТЬ СТОРОН

4.1 В случае неуплаты арендной платы в установленные сроки, Арендатор уплачивает штраф за каждый день просрочки, включая день оплаты, в размере 2,0 –кратной официальной ставки рефинансирования Национального Банка Республики Казахстан.
4.2 За невыполнение либо ненадлежащее выполнение условий Договора Стороны несут ответственность в соответствии с действующим законодательством Республики Казахстан.

5. ПОРЯДОК РАССМОТРЕНИЯ СПОРОВ

5.1 Все разногласия, вытекающие из Договора, которые не могут быть решены путем переговоров, рассматриваются в судебном порядке.

6. ДЕЙСТВИЕ ДОГОВОРА

6.1 Договор действует до **«24» июня 2026 года** и вступает в силу с момента регистрации в органах регистрации (если срок пользования землей больше одного года).
6.2 Внесение изменений и его расторжение производится по согласию сторон. В случае приостановления права пользования землей, установленных земельным законодательством Республики Казахстан, допускается расторгнуть договор в одностороннем порядке.
6.3 Договор составлен в двух экземплярах, один из которых передается Арендатору, второй - Арендодателю.

ЮРИДИЧЕСКИЕ АДРЕСА И ПОДПИСИ СТОРОН:

Арендодатель:
Восточно-Казахстанская область
ГУ «Отдел земельных отношений Жарминского района»

Адрес:
ВКО, Жарминский район
село Калбатау, улица Достык, 98

И.о. руководителя отдела
М.Т. Наушабаев

Арендатор:
ТОО «Бакырчикское горнодобывающее предприятие»
БИН: 930340000251

Адрес:
Жарминский район
поселок Ауэзов

Генеральный директор
Ю.Б. Овчинников

Отметка о регистрации.

ДОГОВОР АРЕНДЫ ЗЕМЕЛЬНОГО УЧАСТКА

село Калбатау **№ 171** **«17» июля 2015 года**

Мы, нижеподписавшиеся, **и.о. руководителя ГУ «Отдел земельных отношений Жарминского района» ВКО Наушабаев Мейрхан Таурбекович,** именуемый в дальнейшем Арендодатель с одной стороны, и, **генеральный директор ТОО «Бакырчикское горнодобывающее предприятие» Овчинников Юрий Борисович,** именуемый в дальнейшем Арендатор, с другой стороны, заключили настоящий Договор о нижеследующем:

1. ПРЕДМЕТ ДОГОВОРА

1.1 Арендодатель предоставляет земельный участок, находящийся в государственной собственности во временное возмездное землепользование сроком на **11 (одиннадцать) лет**, на основании **распоряжения Акима Шалабайского сельского округа №32 от 26 июня 2015 года,** согласно границам, указанным в акте на право землепользования, прилагаемом к настоящему договору.

1.2 Месторасположение земельного участка: **ВКО, Жарминский район, Шалабайский сельский округ.**

Учетный квартал /Кадастровый номер: **05-243-051-385**

Площадь – **107,52 га.**

Целевое назначение: **для размещения отвала пустой породы.**

Ограничения в использовании и обременении: **запрет на совершение сделок, за исключением передачи в залог.**

Делимость или неделимость: **делимый.**

2. ПЛАТА ЗА ЗЕМЛЮ

2.1. Стоимость годовой аренды установлена Арендодателем, является неотъемлемой частью договора и подлежит уплате Арендатором равными долями, не позднее 25 февраля, 25 мая, 25 августа и 25 ноября текущего года, путем перечисления платежей на единый расчетный счет государственного учреждения «ВК областное Управление Казначейства Комитета Казначейства Министерства Финансов РК» ИИК KZ24070105KSN0000000 БИК KKMFKZ2A, код платежа 105315, РНН 510 800 000 358.

2.2. Расчет суммы платы за пользование земельным участком, являющейся неотъемлемой частью Договора, может пересматриваться Арендодателем в случаях изменения условий договора или порядка исчисления платы за пользование земельным участком, устанавливаемого Налоговым законодательством Республики Казахстан.

3. ПРАВА И ОБЯЗАННОСТИ СТОРОН

3.1 Арендатор имеет право:

1) вести на земельном участке самостоятельное хозяйство;

2) собственности на посевы и посадки сельскохозяйственных и многолетних насаждений, на произведенную сельскохозяйственную продукцию и доходы от ее реализации;

3) без преследования цели заключения последующих соглашений, согласно установленному порядку, использовать для собственных хозяйственных нужд имеющиеся на земельном участке песок, глину, гравий и другие общераспространенные полезные ископаемые, торф, насаждения, поверхностные и подземные воды, а также эксплуатировать иные полезные свойства земли;

4) на полное возмещение убытков в случае принудительного отчуждения земельного участка для государственных нужд;

5) в соответствии с целевым назначением земельного участка заниматься строительством производственных, бытовых и других зданий, строений, сооружений;

6) в соответствии с установленными строительными, экологическими, санитарно-гигиеническими и иными специальными требованиями проводить оросительные, осушительные и иные мелиоративные работы, строить пруды, и иные водоемы;
7) в случае исполнения обязательств по данному договору в должном порядке, иметь преимущество перед другими арендаторами при заключении договора с Арендодателем на новый срок;
8) если права на настоящий земельный участок принадлежит ему, то по установленным земельным законодательствам Республики Казахстан земельный участок выкупить в собственность;
9) если срок временного землепользования, установленного в Договоре составляет свыше 5-и лет, то поставить земельный участок под залог.

3.2 Арендатор обязан:
1) использовать землю в соответствии с целевым назначением;
2) осуществлять мероприятия по защите земли, установленные Земельным законодательством Республики Казахстан;
3) своевременно производить платежи за пользование земельным участком;
4) обеспечить соблюдение порядка пользования животным миром, лесными, водными и другими природными ресурсами, защищать историко-архитектурные памятники, археологическое наследие и другие объекты, расположенные на земельном участке и находящиеся под защитой государства в соответствии с законами Республики Казахстан;
5) соблюдать строительные, экологические, санитарно-гигиенические и другие специальные требования (нормы, правила, нормативы) при осуществлении на земельном участке хозяйственной и иной деятельности;
6) своевременно представлять в государственные органы установленные земельным законодательством Республики Казахстан сведения о состоянии и использовании земель;
7) не нарушать права других собственников и землепользователей;
8) не допускать загрязнения, засорения, истощения и ухудшения плодородия почв, а также снятия плодородного слоя почвы с целью продажи или передачи его другим лицам, за исключением случаев, когда такое снятие необходимо для предотвращения безвозвратной утери плодородного слоя;
9) обеспечивать сохранение сервитутов в порядке, предусмотренном Земельным кодексом Республики Казахстан;
10) в случае отчуждения земельного участка из собственности в связи с обнаружением под земельным участком полезных ископаемых, досрочно расторгнуть право пользования землей, также досрочно расторгнуть право пользования землей в связи с отчуждением земельного участка для государственных нужд;
11) зарегистрировать Договор аренды земельного участка в Налоговом управлении Жарминского района.

3.3 Арендодатель имеет право:
1) осуществлять контроль за использованием земельного участка по целевому назначению;
2) вносить изменения в договор в части годовой суммы аренды земельного участка согласно пункта 2.2. настоящего договора;
3) в случае отчуждения земельного участка из собственности в связи с обнаружением под земельным участком полезных ископаемых, досрочно расторгнуть право пользования землей, также досрочно расторгнуть право пользования землей в связи с отчуждением земельного участка для государственных нужд.

3.4 Арендодатель обязан:
1) передать Арендатору земельный участок в состоянии, соответствующем условиям Договора;
2) при отчуждении земельного участка для государственных нужд возместить Арендатору в полном объеме убытки или по его желанию предоставить другой земельный участок.

4. ОТВЕТСТВЕННОСТЬ СТОРОН

4.1 В случае неуплаты арендной платы в установленные сроки, Арендатор уплачивает штраф за каждый день просрочки, включая день оплаты, в размере 2,0 –кратной официальной ставки рефинансирования Национального Банка Республики Казахстан.
4.2 За невыполнение либо ненадлежащее выполнение условий Договора Стороны несут ответственность в соответствии с действующим законодательством Республики Казахстан.

5. ПОРЯДОК РАССМОТРЕНИЯ СПОРОВ

5.1 Все разногласия, вытекающие из Договора, которые не могут быть решены путем переговоров, рассматриваются в судебном порядке.

6. ДЕЙСТВИЕ ДОГОВОРА

6.1 Договор действует до **«26» июня 2026 года** и вступает в силу с момента регистрации в органах регистрации (если срок пользования землей больше одного года).
6.2 Внесение изменений и его расторжение производится по согласию сторон. В случае приостановления права пользования землей, установленных земельным законодательством Республики Казахстан, допускается расторгнуть договор в одностороннем порядке.
6.3 Договор составлен в двух экземплярах, один из которых передается Арендатору, второй - Арендодателю.

ЮРИДИЧЕСКИЕ АДРЕСА И ПОДПИСИ СТОРОН:

Арендодатель:
Восточно-Казахстанская область
ГУ «Отдел земельных отношений Жарминского района»

Адрес:
ВКО, Жарминский район
село Калбатау, улица Достык, 98

И.о. руководителя отдела
М.Т. Наушабаев

Арендатор:
ТОО «Бакырчикское горнодобывающее предприятие»
БИН: 930340000251

Адрес:
Жарминский район
поселок Ауэзов

Генеральный директор
Ю.Б. Овчинников

Отметка о регистрации.

Жоспар шегіндегі бөтен жер учаскелері
Посторонние земельные участки в границах плана

Жоспар дағы № на плане	Жоспар шегіндегі бөтен жер учаскелерінің кадастрлық нөмірлері Кадастровые номера посторонних земельных участков в границах плана	Алаңы, га Площадь, га
1	ЖУ 05243035070 ЗУ 05243035070	0,0040
2	Елді мекендердің жерлері (автожол) Земли населенных пунктов (автодорога)	0,8

Осы акт "ЖерҒӘО" РМК ШҚФ Семей қалалық бөлімшесімен жасалды
Настоящий акт изготовлен Семейским городским отделением ВКФ РГП «НПЦзем»
М.О. _____ **С.В. Кузнецов**
копия, подпись
М.П. 2015 ж/г "08" 04

Осы актіні беру туралы жазба жер учаскесіне меншіктік құқығын, жер пайдалану құқығын беретін актілер жазылатын Кітапта № 1154 болып жазылды
Қосымша: жоқ
Запись о выдаче настоящего акта произведена в Книге записей актов на право собственности на земельный участок, право землепользования за № 1154
Приложение: нет

Шектесулерді сипаттау жөніндегі ақпарат жер учаскесіне сәйкестендіру құжатын дайындаған сәтте күшінде
Описание смежеств действительно на момент изготовления идентификационного документа на земельный участок

№ 0147895

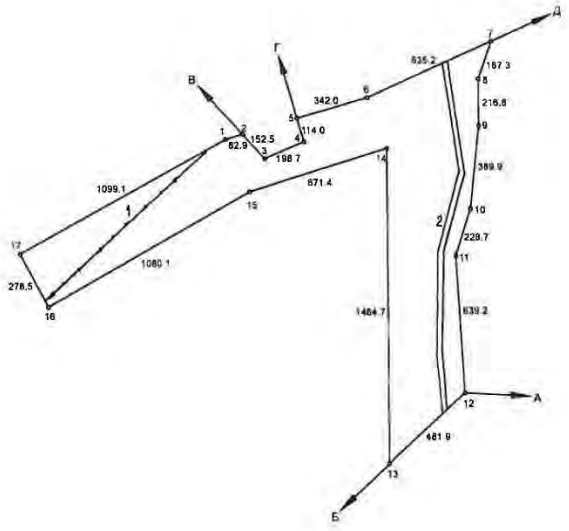
Жер учаскесінің кадастрлық нөмірі: **05-243-051-385**
Жер учаскесіне уақытша өтеулі жер пайдалану (жалға алу) құқығы 2026 жылғы мерзімге дейін
Жер учаскесінің алаңы: **107,52 га**
Жердің санаты: **Елді мекендердің (қалалар, поселкелер және ауылдық елді мекендер) жерлері**
Жер учаскесін нысаналы тағайындау:
бос жыныс үйіндісін орналастыру үшін
Жер учаскесін пайдаланудағы шектеулер мен ауыртпалықтар:
кепілге беруді қоспағанда, мәмілелер жасауға тыйым салынады, шектеулер Шалабай ауылдық округі әкімдігінің 26.06.2015 жылғы № 32 өкімі бойынша
Жер учаскесінің бөлінуі: **бөлінеді**

Кадастровый номер земельного участка: **05-243-051-385**
Право временного возмездного землепользования (аренды) на земельный участок сроком до 2026 года
Площадь земельного участка: **107,52 га**
Категория земель: **Земли населенных пунктов (городов, поселков и сельских населенных пунктов)**
Целевое назначение земельного участка:
для размещения отвала пустой породы
Ограничения в использовании и обременения земельного участка:
запрет на совершение сделок, за исключением передачи в залог, ограничения согласно распоряжения акима Шалабайского сельского округа от 26.06.2015 г. № 32
Делимость земельного участка: **делимый**

№ 0147895

Жер учаскесінің ЖОСПАРЫ
ПЛАН земельного участка

Учаскенің мекенжайы, мекенжайының тіркеу коды (ол бар болған кезде): **ШҚО, Жарма ауданы, Шалабай ауылдық округі**
Адрес, регистрационный код адреса (при его наличии) участка:
ВКО, Жарминский район, Шалабайский сельский округ



Шектесу учаскелерінің кадастрлық нөмірлері (жер санаттары)
А-дан Б-ға дейін: Елді мекендердің жерлері
Б-дан В-ға дейін: ЖУ 05243052352
В-дан Г-ға дейін: Елді мекендердің жерлері
Г-дан А-ға дейін: Босалқы жер

Кадастровые номера (категории земель) смежных участков
от А до Б: Земли населенных пунктов
от Б до В: ЗУ 05243052352
от В до Г: Земли населенных пунктов
от Г до А: Земли запаса

МАСШТАБ 1:25000

Жоспар шегіндегі бөтен жер учаскелері
Посторонние земельные участки в границах плана

Жоспар дағы № на плане	Жоспар шегіндегі бөтен жер учаскелерінің кадастрлық нөмірлері Кадастровые номера посторонних земельных участков в границах плана	Алаңы, га Площадь, га
1	су қоры жері земли водного фонда	1,0
2	Өнеркәсіп, көлік, байланыс, ғарыш қызметі, қорғаныс, ұлттық қауіпсіздік мұқтажына арналған жер және ауыл шаруашылығына арналмаған өзге де жер - Земли промышленности, транспорта, связи, для нужд космической деятельности, обороны, национальной безопасности и иного несельскохозяйственного назначения	0,0140
3	ЖУ 05243062003 ЗУ 05243062003	1,86

Осы акт "ЖерҒӨО" РМК ШҚФ Семей қалалық бөлімшесімен жасалды
Настоящий акт изготовлен Семейским городским отделением ВКФ РГП «НПЦзем»

М.О. _____ **С.В. Кузнецов**
қолы, подпись

М.П. 20 15 ж/г ' 04 ' 04

Осы актіні беру туралы жазба жер учаскесіне меншіктік құқығын, жер пайдалану құқығын беретін актілер жазылатын Кітапта № 1155 болып жазылды
Қосымша: жоқ

Запись о выдаче настоящего акта произведена в Книге записей актов на право собственности на земельный участок, право землепользования за № 1155
Приложение: нет

Шектесулерді сипаттау жөніндегі ақпарат жер учаскесіне сәйкестендіру құжатын дайындаған сәтте күшінде
Описание смежеств действительно на момент изготовления идентификационного документа на земельный участок

УАҚЫТША (ҰЗАҚ МЕРЗІМДІ, ҚЫСҚА МЕРЗІМДІ) ӨТЕУЛІ ЖЕР ПАЙДАЛАНУ (ЖАЛҒА АЛУ) ҚҰҚЫҒЫН БЕРЕТІН

АКТ

НА ПРАВО ВРЕМЕННОГО ВОЗМЕЗДНОГО (ДОЛГОСРОЧНОГО , КРАТКОСРОЧНОГО) ЗЕМЛЕПОЛЬЗОВАНИЯ (АРЕНДЫ)

№ 0147893

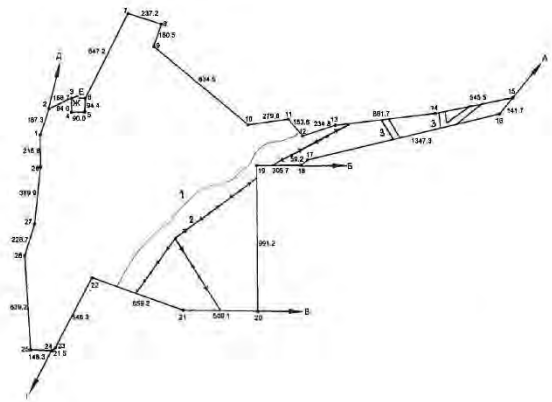
Жер учаскесінің кадастрлық нөмірі: **05-243-052-113**
Жер учаскесіне уақытша өтеулі жер пайдалану (жалға алу) құқығы 2026 жылғы мерзімге дейін
Жер учаскесінің алаңы: **263,3 га**
Жердің санаты: **Өнеркәсіп, көлік, байланыс, ғарыш қызметі, қорғаныс, ұлттық қауіпсіздік мұқтажына арналған жер және ауыл шаруашылығына арналмаған өзге де жер**
Жер учаскесін нысаналы тағайындау:
бос жыныс үйіндісін орналастыру үшін
Жер учаскесін пайдаланудағы шектеулер мен ауыртпалықтар:
кепілге беруді қоспағанда мәмілелер жасауға тыйым салынады, шектеулер Жарма ауданы әкімдігінің 24.06.2015 жылғы № 207 қаулысы бойынша
Жер учаскесінің бөлінуі: **бөлінеді**

Кадастровый номер земельного участка: **05-243-052-113**
Право временного возмездного землепользования (аренды) на земельный участок сроком до 2026 года
Площадь земельного участка: **263,3 га**
Категория земель: **Земли промышленности, транспорта, связи, для нужд космической деятельности, обороны, национальной безопасности и иного несельскохозяйственного назначения**
Целевое назначение земельного участка:
для размещения отвала пустой породы
Ограничения в использовании и обременения земельного участка: **запрет на совершение сделок, за исключением передачи в залог, ограничения согласно постановления акимата Жарминского района от 24.06.2015 года № 207**
Делимость земельного участка: **делимый**

№ 0147893

Жер учаскесінің ЖОСПАРЫ
План земельного участка

Учаскенің мекенжайы, мекенжайының тіркеу коды (ол бар болған кезде): **ШҚО, Жарма ауданы, Шалабай ауылдық округі**
Адрес, регистрационный код адреса (при его наличии) участка: **ВКО, Жарминский район, Шалабайский сельский округ**



Шектесу учаскелерінің кадастрлық нөмірлері (жер санаттары)
А-дан Б-ға дейін: ЖУ 05243052115
Б-дан В-ға дейін: ЖУ 05243052111
В-дан Г-ға дейін: ЖУ 05243039416
Г-ден Д-ға дейін: Елді мекендердің жерлері
Д-дан Е-ға дейін: Босалқы жер
Е-дан Ж-ға дейін: ЖУ 05243052112
Ж-дан А-ға дейін: Босалқы жер

Кадастровые номера (категории земель) смежных участков
от А до Б: ЗУ 05243052115
от Б до В: ЗУ 05243052111
от В до Г: ЗУ 05243039416
от Г до Д: Земли населенных пунктов
от Д до Е: Земли запаса
от Е до Ж: ЗУ 05243052112
от Ж до А: Земли запаса

МАСШТАБ 1:25000

RESOURCE INFORMATION-ANALYTICAL CENTER
"THE WILD LIFE LABORATORY"

AGREED:

Director of Proektservis LLP

_____ O. Yu. Yaroshenko
_____«_____», 2013

APPROVED:

Director of Wild Life Laboratory RIAC

_____ V. N. Kraynyuk
_____«_____», 2013

AQUATIC WILDLIFE IN THE SURFACE WATERCOURSES AND IN THE BAKYRCHIK DEPOSIT QUARRIES

Karaganda 2013

CONTENTS

INTRODUCTION

Minor streams, creeks and related fauna in the different regions of Kazakhstan are extremely poor studied. Usually such examinations cover the major water systems of a high commercial importance. This largely explains the lack of data on the many mostly non-exploited species. Commercially valuable species inhabiting these basins are also little studied because of the low, unexploited populations. However, these populations give certain contribution to the common genofond of species too and examination of their biological parameters allows to evaluate species response to particular external factors, as well as to determine consistent pattern of dynamic processes taking place in the populations, etc.

Under the conditions of anthropogenic influence, these water systems are the most vulnerable. Ingress of significant quantities of pollutants usually leads to degradation and disappearance of biohydrocenosis in the small rivers. This is caused by the weak recovery capacity in case of low water content.

These waterways play important role in the lives of local communities, which are often highly dependent on these ecosystems' condition. Therefore, maintaining stable condition of the biohydrocenosis is of the significant socio-economic importance too.

The aim of this research is to study biological diversity of aquatic ecosystems available in the Kyzylsu river basin (the left-bank tributary of Irtysh river) in the influence zone of Bakyrchik Mining Enterprise LLP (hereinafter to be referred as "BME").

The objectives of this research included the following issues:

1. Assessment of the aquatic and coastal fauna diversity;
2. Assessment of the aquatic wildlife diversity;
3. Assessment of the condition of main fish species' populations in the examined water bodies;
4. Preparation of recommendations related to monitoring and preservation of the hydrobiocenoses.

Research objects included main water bodies located in the BME territory as well as in its influence zone:

1. Water body of Dalniy quarry
2. Water body of Dalniy quarry No.1
3. Water body of quarry No. 2
4. Water body of quarry No. 5-6
5. Water body of Zagadka (Sorokovaya) quarry
6. Kyzylsu water-storage basin
7. Alaiagyr dam
8. Alaiagyr creek
9. Bezymyannyi creek
10. Akbastaubulak creek

This study allowed to obtain data on the flora and fauna diversity of this area, to assess condition of populations of several major fish species, as well as develop recommendations for monitoring condition and conservation of the water bodies' ecosystems.

CHAPTER 1. MATERIALS AND TECHNIQUES

The material was collected in the process of field visits conducted in July 2013. Ten water bodies were examined, 30 samples of zooplankton, zoobenthos, and phytoplankton (10 samples of each species) were analyzed. Sampling sites are shown in Figure 1.

Figure 1 – Sampling points in the examined region (black circles represent sampling locations)

Sampling and analysis of hydrobiological samples were carried out according to the respective technique [1]. Hydrobiological material was collected in accordance with the generally accepted methods [2, 3]. Zooplankton samples were taken by filtering 100 liters of water through the Apshtein net with the subsequent sample fixation with the help of 40% formalin solution.

Identification and calculation of plankton organisms under the laboratory conditions was carried out with the help of MBS-10 and MCX-300 microscopes. Well-known identification guides [4-7] were used in the process of species composition identification. Zooplankton organisms were counted in the certain part of the sample in the Bogorov's chamber followed by the subsequent examination of the half of a sample volume or the entire remaining part with the aim of identification of the large and rare species. Linear - weight dependence equations [3] were used for calculation of the individual weight of zooplankters. The number and weight of all development stages were taken into account for every crustaceans' species. The number of species and weight index of all identified species were then summarized with respect to the main groups of organisms and the community as a whole. The number and weight of zooplankton were calculated for 1 m^3 of water column.

Benthic samples were taken with the help of a scraper equipped with 1.0 m^2 catch followed by samples washing in the different mesh sieves. Benthic organisms were placed in 4-10% formalin solution. 10% formalin solution was used in case of presence of the significant

number of the bivalve shellfish in the sample, because water from the mantle cavity diluted preservative solution. Samples were kept in the wide-mouthed jars made of dark glass. Samples were placed in the Petri dish in order to calculate the number of organisms; forms, which were identified in the process of organisms' calculation, were distributed with respect to systematic groups up to the type, class, or unit level followed by the more detailed determination of systematic species position up to the genus and species level, with the exception of difficult-to-detect organisms' groups [7-13]. Weighing was carried out after the preliminary sample drying in the weighing cups on the analytical scales. Determination of the abundance and biomass indices was performed according to methodological recommendations' provisions [14].

Analysis of algae present in collected water samples was carried out. Samples were taken by a simple drawing of 0.5 liter of water followed by samples' fixation in 4% formalin solution, thickening, qualitative and quantitative processing. Phytoplankton concentration was carried out by the sedimentation method. Species identification was performed with the help of identification guides and "Biolam" microscope. Number of cells was counted with the help of the Goryaev's counting chamber, biomass was calculated by summation of the individual populations' biomass [15]. Food capacity of the water body was determined according to provisions of S.P. Kitaev's technique [16].

Ichthyological analysis included determination of linear dimensions, weight, fatness, morphological and physiological indicators, female fertility and age of species, in some cases it included back calculation of growth rates too.

Determination of linear-weight parameters was carried out according to the standard methods' provisions [17]. Fatness was calculated with the help of two indicators - Fulton's (Q_f) and Clark's (Q_c) [18]. Absolute individual fecundity (AIF) was calculated according to the standard method involving the weighed amount and gonads' ratio [19].

Morphological and physiological indicators were determined by weighting the individual organs (liver, heart) and were presented in the form of the carcass mass indices [20].

Species age was determined according to the annual rings' method. For that purpose, scales were taken from the carps (except tench), operculum from the other families' representatives (pickerels and perches) and the tench [18].

Statistical processing of collected material was carried out by L.A. Zhivotovsky [21] with the help of MS Office Excel 2003 and MS Office Excel 2007.

CHAPTER 2. CHARACTERISTICS OF EXAMINED WATER BODIES

Five manmade and five natural water bodies were studied in the examined area.

2.1 Water Body of Dalniy Quarry

Water body area is 4.4 hectares. It is λ-shaped. Weak border thickets consisting of reeds and cats tail (Figure 2) grow along the water edge on the quarry slopes. Water body depth in these places reaches 3-5 m. On the open part of the water body it comes to 15 m depth. Of all man-made water bodies this basin has some productivity because of organic matter, which comes into it from the Mairanbastau creek, (the tributary of the Kholodnyi klyutch creek). Water body co-ordinates: N 49º 44' E 81º 33'.

Figure 2- Water body of Dalniy quarry

2.2 Water Body of Dalniy Quarry No. 1

Water body area is 0.6 hectares, it is of the irregular oval shape. Its depth reaches to 20 m. It is the ultra-oligotrophic pond. Water body co-ordinates: N 49º 45' E 81º 31'.

2.3 Water Body of Quarry No. 2

Water body area is 6.2 hectares (Figure 3). In addition to that there is the isolated basin in the Northern part of the water body. Isolated basin, which is fed by the subsurface water outlet, is also there in the southern part of the quarry.

Water body has the curved bow like shape. Water body depth increases by steps according to design of waste material transportation system from the quarry. Maximum depth reaches 30 m. Water body co-ordinates: N 49º 43' E 81º 36'.

2.4 Water Body of Quarry No. 5-6

This basin was under pumping out during the water bodies' research period, therefore no study was conducted in this water body. Water body area at that time was 0.7 hectares. Water body co-ordinates: N 49º 43' E 81º 33'.

Figure 3 - Water body of quarry No. 2, the approach available in the Northern part

2.5 Water Body of Zagadka (Sorokovaya) Quarry

Water body area is 0.4 hectares. It is oval in shape (Figure 4). Shores are steep, almost naked. Depths gradually increase up to 12 m. Water body co-ordinates: N 49º 42' E 81º 31'.

Figure 4 – Water body of Zagadka (Sorokovaya) quarry

2.6. Kyzylsu Water-Storage Basin

This water-storage basin was built on the same-name river. Its area makes about 38.6 hectares. It is water body of the run-off-river type with the reasonably deep water floods in its Western part (Figure 5). Right bank is steep, left one is sloping covered with border thickets consisting of reeds and cats tail. Soft underwater vegetation is present up to 5 m depths.

Figure 5 – Kyzylsu water-storage basin

Main depths are within 4-5 m range, in the shallow water depth is about 2-3 m. Maximum depth comes to 20 m. Water body co-ordinates: N 49º 38' E 81º 33'.

2.7 Alaiagyr Dam

Water body is formed at the confluence of the Alaiagyr and Bezymyannyi creeks (Figure 6). Its area makes 7.6 hectares. Toe wall is currently broken. Depths reach 3.5 m, the average water depth is 1.5-2.0 m. This water body is of the freezing up type. In winter situation is saved only by the streams joining this water body.

Thickets of hard surface vegetation do not form strong border, but the Eastern part of water covered space together with the adjacent area is heavily overgrown. Soft floating vegetation spreads along the entire water body bed. Dam co-ordinates: N 49º 41' E 81º 36'.

2.8 Alaiagyr Creek

Creek length is 7.9 km up to the confluence into the Alaiagyr dam and 7.2 km from the dam exit up to the confluence into the Kyzylsu river (Figure 7). Its width in the headwaters rarely exceeds 2 m. Below the Alaiagyr dam this creek represents small stream with the formed flood bed of 5-10 m width. Alaiagyr creek joins Kyzylsu river near the railway bridge.

Creek co-ordinates: from N 49º 42' E 81º 41' up to N 49º 39' E 81º 32'.

Figure 6 – Alaiagyr dam

Figure 7 – Alaiagyr creek in the headwaters

2.9 Bezymyannyi Creek

Creek length is 4.7 km. Creek co-ordinates: from N 49º 43' 23" E 81º 39' 13" up to N 49º 41' 25" E 81º 37' 17". Ii is the narrow watercourse with the considerable stream flow. Near the Alaiagyr dam it joins the same-name stream.

2.10 Akbastaubulak Creek

Creek length is 12.1 km. It is the less water flowing confluent of Kyzylsu river compared to Alaiagyr river. Several dams of agriculture purpose (Figure 8) are built on t his creek's bed. Akbastaubulak creek flows into the Kyzylsu river near Shalabay village.

Figure 8 – Akbastaubulak creek at the outlet from one dam

Akbastaubulak creek co-ordinates: from N 49º 44' E 81º 34' up to N 49º 42' E 81º 30'.

CHAPTER 3. AQUATIC VEGETATION

3.1. Phytoplankton and Periphyton

Special hydrochemical conditions of examined water bodies produce peculiar algocenosis, in which predominant forms are represented by the diatomic algae as well as by the rheophilic and eurytopic algae of the other groups. Limnophilic forms are added to these algae in the reed thickets. Due to high water exchange in streams this area'a microflora is rather poor with respect to variety of species. All water bodies are dominated by the Navicula, Diatoma, Synedra, Zygnaema, Scenedesmus, Pediastrum and Chlorella genus species. Oscillatoria genus species are the most frequently encountered ones of the blue-green algae. On the whole the latter group was rather small. Main concentration of phytoplankton and periphyton biomass was located in the reed thickets growing near banks.

More eutrophic water bodies such as the Kyzylsu water-storage basin and Alaiagyr dam had the highest phytoplankton biomass index, which comes to about 5.4-9.5 mg/l level. Euglena algae presence in samples considerably increases phytoplankton biomass in these water bodies. Phytoplankton biomass fluctuations in streams lie within 0.9 to 3.1 mg/l range, which is probably normal for these water bodies. In case of water bodies situated in quarries alflora biomass indicators lie within 0.2-1.5 mg/l range. Green and Chrysophyte algae dominated in creeks and streams, diatomic algae mostly grew in water bodies situated in quarries.

3.2 Higher Aquatic Vegetation

Hard surface vegetation covers negligible areas of water bodies situated in quarries. In the water-storage basins and along the streams' banks vegetation is richer with respect to numbers and species. Hygrophilous macroflora is mainly represented by common reed (*Phragmites communis Trin.*), narrow-leaved catoptric (*Thypha angustifolia L.*) (Figure 9) and lake bulrush (*Scirpus lacustris L.*). Clumps of flowering rush (*Butomus umbellatus L.*), sedges (*Carex spp.*) (Figure 10), willow grass (*Polygonum amphibium L.*), water mint (*Mentha aquatica L.*), branched burr (*Sparganium erectum L.*), common bladderwort (*Utricularia vulgaris L.*) and water plantain (*Alisma plantagoaquatica L.*) grow along the shores and in the shallow water. Willows (Salix spp.) and introduced tree species grow along the banks.

Submergent vegetation is mainly represented by the following kinds of pondweed: common floating pondweed (*Potamogeton natans L.*), shining pondweed (*P. lucens L.*), fennel-leaved pondweed (*P. pectinalis L.*), curly-leaved pondweed (*P. crispus L.*), clasping-leaved pondweed (*P. perfoliatus L.*) and their hybrids. The following vegetation can be also met: meakin (*Myriophyllum spicatum L.*), morass-weed (*Ceratophyllum demersum L.* and *C. submersum L.*), spiral wild celery (*Vallisneria spiralis L.*). Musk grass (*Charaphyta*) can be also quite frequently seen. Neuston flora is represented by the scarce ivy-leaved duckweed (*Lemna trisulca L.*). Occasional bushes of Canadian pondweed (*Elodea canadensis Michx.*) were also noted in the Kyzylsu water-storage basin.

Because of the considerable depth of water bodies the growing environment conditions do not allow to create favorable conditions for mass development of underwater communities and emergent vegetation. At the same time the areas occupied by the hard emergent vegetation are quite sufficient for ensuring normal functioning of the natural water bodies' ecosystems. Development of adequate hydrophytocoenotic communities is not possible in the water bodies, which are situated in quarries.

In the whole biological diversity and quantitative characteristics of the micro and macroflora correspond to hydrological characteristics of water bodies and the level of organic matter inflow to them.

Figure 9 – Narrow-leaved catoptric in the headwater of the Alaiagyr creek

Figure 10 – Sedge clumps on the bank of the Zagadka quarry's water body

CHAPTER 4. AQUATIC ANIMALS

4.1 Plankton Communities

Diversity of planktonic organisms' species in the examined water bodies includes about 35 species:

Rotatoria class

1. *Asplachna priodonta Gosse, 1850*
2. *Brachionus angularis Gosse, 1851*
3. *B. urceus (L., 1758)*
4. *Filinia longiseta (Ehrenberg, 1834)*
5. *Filinia sp. cf. cornuta (Weisse, 1847)*
6. *Keratella cochlearis (Gosse, 1851)*
7. *K. quadrata (Muller, 1786)*
8. *Lecane luna (Muller, 1776)*
9. *Notholca squamula (Muller, 1786)*
10. *Polyarthra luminosa Kutikova, 1962*
11. *P. remata Skorikov, 1896*
12. *Pompholyx sulcata Hudson, 1885*

Crustacea class

Cladocera subclass

13. *Alona quadrangularis (O.F. Muller, 1785)*
14. *A. guttata Sars, 1862*
15. *Bosmina longirostris Schoedler, 1866*
16. *B. coregoni Baird, 1857*
17. *Ceriodaphnia reticulata (Jurine, 1820)*
18. *C. laticaudata RE. Muller, 1867*
19. *Chydorus ovalis Kurz, 1875*
20. *Ch. spaericus (O.F. Muller, 1785)*
21. *Daphnia longispina O.F. Muller, 1785*
22. *D. pulex Leydig, 1860*
23. *D. cucullata Sars, 1862*
24. *Moina macrocopa (Straus, 1820)*
25. *Polyphemus pediculus (Linnaeus, 1761)*
26. *Sida cristallina (O.F. Muller, 1776)*
27. *Simocephalus serrulatus (Koch, 1841)*

Copepoda subclass

28. *Arctodiaptomus bacillifer (Koelbel, 1885)*
29. *Eudiaptomus graciloides (Lilljeborg, 1888)*
30. *E. vulgaris (Schmeil, 1898)*
31. *Cyclops abyssorum Sars, 1863*
32. *C. strenuus Fischer, 1851*
33. *C. vicinus Uljanin, 1875*
34. *Eucyclops serrulatus (Fischer, 1851)*
35. *Mesocyclops leuckarthi (Claus, 1857)*

The basis of quantitative composition of zooplankter communities included several types of the following species: *A. priodonta, K. cochlearis, P. remata (Rotatoria), D. longispina, Ch. ovalis, C. reticulata (Cladocera), C. abyssorum, Eu. graciloides (Copepoda).*

Zooplankton biomass index in the water bodies ranged from 8.551 to 0.583 g/m^3 (Table 1). According to these data water bodies belong to ultraoligotrophic, β-oligotrophic and β-mesotrophic types.

Table 1 – Zooplankton numbers (number of specimen/m^3) and biomass index (g/m^3) in the examined water bodies

Water body	Numbers	Biomass index	Trophicity level [16]
Kyzylsu water-storage basin	11.65	5.347	β-mesotrophic
Alaiagyr dam	9.53	8.551	β-mesotrophic
Alaiagyr creek	5.19	1.540	β-oligotrophic
Bezymyannyi creek	4.11	1.363	β-oligotrophic
Akbastaubulak creek	5.58	2.315	β-oligotrophic
Water body of Dalniy quarry	7.58	3.342	β-mesotrophic
Water body of Dalniy quarry No.1	3.03	0.583	ultraoligotrophic
Water body of quarry No. 2	3.37	1.772	β-oligotrophic
Water body of Zagadka quarry	4.11	2.202	β-oligotrophic

Planktocoenosis of the most part of water bodies is of the rotiferic nature. This group dominates in numbers, but because of the low individual weight indicators it does not play significant role in the plankton biomass formation in water bodies. The only exception is the Alaiagyr dam water body, where the nature of planktonic fauna was cladoceranic (dominated by cladocerans). The same can be partly said about the Kyzylsu water-storage basin.

The level of food capacity currently available in the Kyzylsu water-storage basin and Alaiagyr dam water body may provide acceptable conditions for ensuring trophism of fish-plankton feeders' and juveniles' populations. Accordingly commercial and recreational fishing may be developed in these water bodies.

Trophicity level of water bodies situated in the quarries is very low - up to the ultraoligotrophic one because of the low organic matter content in their water. The only exception is water body of Dalniy quarry, organic matter to which is being supplied by the Mairanbastau stream.

4.2. Benthos and Nektobenthos

Benthofauna of examined area is represented by about 50 species, which belong to the following five classes.

4.2.1 Oligochaetes (*Oligochaeta)*

Lumbricidae family

Earthworms *Lumbricus terrestris L., 1758* were occasionally found in the coastal benthic samples taken in the Kyzylsu water-storage basin. Probably it is not the native form and it was brought from some other water bodies.

It is the amphibious species which prefers habitation in the wet soil under the layer of fallen leaves, but it can live in the aquatic environment too.

4.2.2 Leeches (*Hirudinea)*

Erpobdelidae family

Leech *Erpobdella octoculata (L., 1758)* is the only species of leeches, which was detected in the benthofauna of this region. It was found in the Kyzylsu water-storage basin,

Alaiagyr dam water body, Alaiagyr and Akbastaubulah creeks, but this species was not detected in the quarries' water bodies. It is a predator.

4.2.3 Pearl Shell Bivalved Molluscs (*Bivalvia)*

Unionidae family

Both naiad species were found in the Kyzylsu water-storage basin only, which has conditions suitable for large bivalves' habitation.

Swan mussel *Colletopterum ponderosum* (Pfeiffer, 1825) is the most dispersed species in the bentofauna of this water body.

Swan mussel *Colletopterum piscinale* (Nilsson, 1822) - Only one instance of this species presence was found in this water body.

Fingernail clam *Pisidiidae* family

Fingernail clam *Pisidium amnicum O. F. Müller (1774)* – Several instances of this species presence were noted in the Kyzylsu water-storage basin.

4.2.4 Gastropods (*Gastropoda*)

This class is represented by 8 species mainly preferring standing-water habitat, but one species (*L. intermedia*) is fairly well adapted in the flowing water systems too.

Pectinibramchia suborder

Valve snails (*Valvatidae)* family

Cincinna depressa (Pfeiffer, 1828) This species was noted in the Kyzylsu water-storage basin.

Bythinidae snails' family

Bithynia tentaculata (L., 1758) – This species was noted in the Kyzylsu water-storage basin. One of potential intermediate hosts of *Opistorchis felineus* species (Siberian liver fluke), which is the opisthorchis causative agent (Figure 11).

Figure 11 – Bythinidae *Bithynia tentaculata* snail' shell from the Kyzylsu water-storage basin

Pulmonata suborder

Pond snail *Acroloxidae* family

Pond snail *Acroloxus lacustris (L., 1758)* – Only one instance of this species presence was noted in the Alaiagyr dam water body.

Pond snails Limnaeidae family

The great pond snail *Lymnaea stagnalis (L., 1758*) - This species was noted in the water body of Dalniy quarry (the main basin and the isolated Northern water body, in which this species were noted in large numbers), the Alaiagyr dam water body and the Kyzylsu water-storage basin.

Pond snail *Lymnaea fragilis (L., 1758)* – This species was noted in the Kyzylsu water-storage basin.

Pond snail *Lymnaea auricularia (L., 1758)* - This species was noted in the Kyzylsu water-storage basin, water bodies of Alaiagyr dam and Dalniy quarry.

Pond snail *Lymnaea intermedia Lamarck, 1822* - This species was noted in the water body of quarry No. 2 and Alaiagyr creek.

Fresh water snails Planorbidae family

Pond snail *Anisus acronicus (Férussac, 1807)* - This species was noted in the Kyzylsu water-storage basin (Figure 12)

Figure 12 – Pond snail *Anisus acronicus* from the Kyzylsu water-storage basin

4.2.5 Crustaceans (*Crustaceae)*

Higher crustaceans' fauna in the studied area is rather poor, it consists of two species from the two orders: Amphipoda, and Decapoda.

Crayfish Amphipoda order

4.2.5.1 Pond amphipod (*Gammarus lacustris Sars, 1864)* – This is one of the widespread species in the examined area. This species was found in the streams and water-storage basins. It probably does not live in the quarries because of the big water depths and predators' presence or it has been eaten away, with the exception of water body of Dalniy quarry, in which it regularly comes from the Mairanbastau creek. Especially dominant this species was noted in the upper courses of streams, where virtually no natural enemies of this species exist.

Crayfish Decapoda order

4.2.5.2 Crayfish (*Astacus leptodactylus Eschscholtz, 1823)* – This species was collected in the Alaiagyr creek's water system, including its upper courses, water bodies of quarry No. 2 and Zagadka, Kyzylsu water-storage basin and Alaiagyr dam water body.

Slow growing form of crayfish, length of which rarely exceeds 8 cm (from the rostral thorn to the end of the central plastron), is available in the water body of quarry No 2. This is mainly explained by the acute shortage of food organisms in this water body.

Somewhat larger specimens of up to 13 cm long crayfish were found in the water body of Zagadka quarry. Some crayfish from this water body had blue shell coloration (Figure 13). The reasons of such color variations are not clear, but intermediate color crayfish were noted along with the ordinary and blue color species.

Crayfish also inhabits Kyzylsu water-storage basin and Alaiagyr dam water body, in which quite ordinary species with respect to growth rates for adventitious systems' conditions were noted.

Figure 13 – Crayfish *Astacus leptodactylus* from the water body of Zagadka quarry (from right to left: ordinary colour, blue colour and intermediate type of color)

4.2.6 Insects (Insecta)

Habitat consisting of about 35 species of insects, which belong to 6 orders, was noted in the examined water bodies' area. Mostly these species were represented by the instar stages, but number of groups, such as Hemiptera and partly Coleoptera was also detected in the adult stage.

4.2.6.1 Dragonflies Odonata

Dragonflies represent one of the most dominant insect groups in the benthos of examined water bodies. Dragonflies often play significant part in the nutrition of fish, such as river perch, at the time dragonflies actively prey upon the other insects too. In total 10 species from 6 families were noted in the examined water bodies.

Agrionidae family

Agrion virgo (L., 1758) – This species was noted in the Kyzylsu water-storage basin, water bodies of Alaiagyr dam and Dalniy quarry.

Lestidae family

Lestes nympha (Selys, 1840) – This species was noted in the Kyzylsu water-storage basin.

Coenagrionidae family

Coenagrion puella (L., 1758) – This species was noted in all natural water bodies.

Coenagrion pulchellum (van der Linden, 1823) – This species was noted in all natural water bodies.

Ischnura elegans (van der Linden, 1823) – This species was noted in all natural water bodies. Adult species were observed along the banks of all examined water bodies.

Gomphidae family

Gomphus vulgatissimus (L., 1758) – This species was noted in the Alaiagyr, Bezymyannyi creeks and Kyzylsu water-storage basin.

Aeschnidae family

Aeschna viridis Eversman, 1836 – This species was noted in the water body of Alaiagyr dam and Kyzylsu water-storage basin.

Aeschna cyanea (O. F. Müller, 1764) – This species was noted in the Kyzylsu water-storage basin.

Corduliidae family

Somatochlora metallica (van der Linden, 1885) – This species was noted in the upper reach of Alaiagyr creek.

Epitheca bimaculata (Charpentier, 1825) – This species was noted in the Alaiagyr creek.

4.2.6.2 Hemiptera

This is the richest insects' order with respect to number of species. Total 16 insects' species belonging to 5 families were found in the water bodies of examined area.

Nepidae family

Водяной скорпион *Nepa cinerea L., 1758* – This species was noted in the Kyzylsu water-storage basin.

Ранатра *Ranatra linearis (L., 1758)* – This species was noted in the water bodies of Dalniy quarry, Alaiagyr dam and the Kyzylsu water-storage basin.

Corixidae family

Corixia affinis Leach, 1817 – This species was noted in the Kyzylsu water-storage basin.

Corixia linnaei (Fieber, 1848) – This species was noted in the water body of Dalniy quarry, Mairanbastau creek and in the Akbastaubulak creek system.

Sigara gebleri (Fieber, 1848) – This species was noted in the water bodies of Dalniy and Zagadka quarries.

Sigara semistriata (Fieber, 1848) – This species was noted in the water bodies of Zagadka quarry, quarry No. 2 and in the Alaiagyr creek.

Sigara fossarum (Leach, 1817) – This species was noted in the Alaiagyr and Bezymyannyi creeks, water body of Alaiagyr dam.

Sigara falleni (Fieber, 1848) – This species was noted in the low course of the Alaiagyr and Bezymyannyi creeks, water body of Alaiagyr dam.

Cymatia coleoptrata (Fabricius, 1776) – This species was noted in the Bezymyannyi creek.

Notonectidae family

Notonecta lutea Mueller, 1776 – This species was noted in mass number in the Northern isolated part of quarry No. 2 water body.

Notonecta glauca L., 1758 – This species was noted in the Alaiagyr dam water body, the Akbastaubulak creek and the Kyzylsu water-storage basin.

Veliidae family

Velia affinis Kolenati, 1856 – This species was noted in the Bezymyannyi and Akbastaubulak creeks.

Gerridae family

Limnoporus rufoscutellatus (Latreille, 1807) – This species was noted in the Akbastaubulak creek and water body of Dalniy quarry.

Gerris paludum Fabricius, 1794 – This species was noted in the water body of Alaiagyr dam.

Gerris costae (Herrich-Schäffer, 1853) – This species was noted in the Akbastaubulak creek, water body of Zagadka quarry and in the Kyzylsu water-storage basin.

Gerris odontogaster (Zetterstedt, 1828) – This species was noted in the water body of quarry No. 2 (the main part).

4.2.6.3 Coleoptera

Predaceous diving beetles' (*Dytiscidae)* family

Great diving beetle *Dytiscus marginalis L., 1758* – This species was noted in the water body of Dalniy quarry No. 1 (adults) and the Alaiagyr creek (grubs).

Platambus spp. – This species was noted in the Kyzylsu water-storage basin, water bodies of Alaiagyr dam and Dalniy quarry. There are several hard-to distinguish species.

4.2.6.4 Diptera

In spite of presence of suitable habitat stations in some areas, Diptera maggots were rather rarely sampled in all water bodies of the examined area.

Only one Ephydridae sp. maggot was caught in the water body of Alaiagyr dam, several Chironomidae specimens were caught in the Kizilsu water-storage basin, which were not identified with respect to certain species.

4.2.6.5 Stone Flies (*Plecoptera)*

Stone flies are rather widely distributed in the natural water bodies of this region, reaching particular abundance in the streams and rivers with the noticeabl water e current. Species diversity is rather poor - only one species was found. It is possible that because of the ecological characteristics of some other species they can also dwell in the examined area, but due to the working season they were not recorded in samples.

Leuctridae family

Leuctra fusca L., 1758 – This is rather dominant species in the Alaiagyr, Akbastaubulak and Bezymyannyi creeks. This species can be found under the rocks or other objects present in the water bodies with the noticeable water current. Lower part of the Alaiagyr creek plays quite a significant role in perch nutrition.

4.2.6.6 Caddis Flies and Worms (*Trichoptera*)

Caddis flies and worms represent quite normal inhabitants of mainly flowing waters of the examined area. Species diversity is limited to 4 species belonging to 2 families.

Annulipalpia suborder

Hydropsychidae family

Hydropsyche ornatula McLachlan, 1878 – These species can be found under the rocks in the Alaiagyr and Bezymyannyi creeks, they stay in the refuges made of sand, stone rubbles, which are attached to the bottom of the large rocks. These species were found in the examined areas in the rather bulk quantities.

Integripalpia suborder

Limnephilidae family

Potamophylax rotundipennis (Brauer, 1857) – This species was noted in the the Akbastaubulak and Bezymyannyi creeks.

Limnephilus flavicornis (Fabricius, 1787) – This species was noted in the Kizilsu water-storage basin (Figure 14).

Figure 14 - Fragment of caddis *L. flavicornis* house, Kizilsu water-storage basin

Limnephilus decipiens (Kolenati, 1848) – This species was noted in the bulk quantities in the upper reach of Alaiagyr and Akbastaubulak creeks.

4.3. Ichthyofauna

4.3.1. Prussian Carp (*Carassius gibelio (Bloch, 1782))*

This species was mainly recorded in the Akbastaubulak creek's system with the cascade of small dams, which ensure appropriate conditions for this limnophilic species habitation. Water steam takes young fishes to the creek's bed and water body of Dalniy quarry, where it is recorded in the diet of perch.

4.3.2 European Carp (*Cyprinus carpio L., 1758)*

This species is widely used for stocking water bodies with fish. In the examined area it was found in the water body of Zagadka quarry (Figure 15). Local stories tell about habitation of 20 kg carps in the water body of Dalniy quarry No. 1 and some other water bodies, but all such stories are baseless. Food potential for ensuring this weight increase should be at the mesotrophic level at least, which was not observed.

Actual growth rates of carps sampled from the water body of Zagadka quarry are shown in Table 2. These data allow us to characterize this population as extremely slow growing and unproductive.

Table 2 – Back calculation of growth rate of carp sampled from the water body of Zagadka quarry

Age	Linear growth, cm.			
	1	2	3	4
4+	6.3	9.3	12.3	15.5
3+	6.1	8.5	12.4	
2+	6.6	10.8		

Figure 15 – Carp sampled from the water body of Zagadka quarry

Carps from the water body of Zagadka quarry reach puberty on the fourth year of their life with a body length exceeding 15 cm and body mass above 100 g. Carps at the age of 5 years already had one egg-laying.

Carps group from the water body of Zagadka quarry is probably self-replicating population, although it has extremely low intensity of reproduction, which is caused by the oligotrophic food potential. Plankton and periphyton with the insignificant fraction of aerial insects represent the basis of this food potential.

According to the questionnaire data certain carp population is available in the Kyzylsu water storage basin, in which presence of productive carp population is really possible.

4.3.3 Dace (*Leuciscus leuciscus (L., 1758))*

This is a moderately rheophilic species, which is available in the Alaiagyr creek and water body of Alaiagyr dam. Ii also represents the primary species forming fauna of quarry No. 2 water body (Figure 16).

Liver index of examined populations is sex and age dependent (Table 3). Large indices are characteristic for females and larger (older) specimens. Differences between samples collected from the water bodies of Alaiagyr dam and quarry No. 2 on the one hand and the Alaiagyr creek on the other hand are related to dimensional characteristics.

Table 3 - Morphophysiological indices of Dace obtained on the basis of results collected from three examined populations

Water body	HSI			CSI		
	Total	Females	Males	Total	Females	Males
Alaiagyr dam	1.54	1.90	1.18	0.14	0.14	0.14
Alaiagyr creek	1.21±0.10	1.23±0.17	1.21±0.09	0.15±0.01	0.15±0.01	0.15±0.01
Quarry No. 2	1.55±0.11	1.71±0.19	1.41±0.11	0.11±0.004	0.12±0.01	0.11±0.005

Figure 16 – Dace sampled from the water body of quarry No. 2

Low heart indices of dace sampled from the quarry are likely associated with the total saving of energy consumption, including significant movements in the water column. This is possible because of the lack of predators, insufficiency of animal food in this water body they make up by consumption of weed growing on the quarry rocks and stones.

Maturity degree with respect to the gonadosomatic index is also susceptible to the size-sexual dependency (Table 4). GSI value increase of dace sampled from the quarry is associated with the increase of reproduction intensity in order to maintain stable population in the harsh conditions of food shortage.

Table 4 - Gonadosomatic index of dace sampled from three quarries of the examined area

Water body	Females	Males
Alaiagyr dam	48.95	4.89
Alaiagyr creek	42.43±5.15	3.36±0.33
Quarry No. 2	51.13±3.38	4.95±0.64

Sex structure of the examined populations is characterized by the approximately equal ratio of sexes. The fecundity of females is higher in the лентических water bodies compared to the fast water current in the Alaiagyr creek. However, dimensional characteristics of sample make some contribution here too (Table 5). Fecundity of daces sampled from the water body of quarry No. 2 is slightly higher, which indicates the relatively unfortunate reproduction situation.

Table 5 – The fecundity of dace females sampled from three examined water bodies

Water body	F_I (thousand pcs.)		RF_{SL} (pc./cm)		RF_m (pc./g)	
	Limits	Average	Limits	Average	Limits	Average
Alaiagyr dam	-	9.5	-	565	-	111
Alaiagyr creek	2.9-11.2	5.4	224-744	393	75-208	149
Quarry No. 2	7.9-15.6	10.3	445-872	579	78-166	108

Aerial insects and periphyton are present in the diet of dace inhabiting water body of quarry No. 2, while aerial insects and macrophytes are also available in the water body of Alaigyr dam. Stomach fullness indices of the water body of quarry No. 2 are equal to 16.2‰ and 12.7‰ of the Alaiagyr dam water body. Fatness indices of dace sampled from the water body of Alaiagyr dam are higher compared to specimens from the water body of quarry No. 2 and all the more for dace sampled from the creek. In both cases this is explained by the food supply situation. Water bodies of quarry and creek have less food compared to the Alaiagyr dam water body (Table 6).

Table 6 – Fatness indices of dace sampled from the examined water bodies

Water body	Q_f			Q_c		
	Total	Females	Males	Total	Females	Males
Alaiagyr dam	2.01	2.07	1.95	1.79	1.78	1.81
Alaiagyr creek	1.72±0.04	1.71±0.05	1.75±0.07	1.57±0.03	1.52±0.03	1.63±0.05
Quarry No. 2	1.92±0.02	1.86±0.03	1.97±0.03	1.70±0.02	1.68±0.03	1.71±0.03

On the whole, noted facts of the ill-being of dace populations are associated with the shortage of food resources. No evidence regarding pollutants' impact on the population & biological parameters of species in the studied hydrocoenoses was provided.

4.3.4 Roach *Rutilus rutilus (L., 1758)*

It is the most popular species in the examined area. It was noted in the water bodies of Dalnyi quarry, quarry No. 2, Zagadka quarry, Alaiagyr dam, Kyzylsu water storage basin and in the Alaigyr creek downstream of the dam (Figure 17).

Figure 17 – Roach sampled from the water body of Dalnyi quarry

Morphophysiological indices of roach sampled from the examined water bodies show ambiguous variability trends (Table 7). The only thing, which you can more or less confidently state, is the increase of CSI value of specimens sampled from the fast running water (such as the Alaiagyr creek). There is also some tendency to CSI value increase in males, with the exception of water body of Dalnyi quarry. However, small sample size does not allow us to make concrete conclusions.

Table 7 - Morphophysiological indices of roach sampled from the examined water bodies

Water body	HSI			CSI		
	Total	Females	Males	Total	Females	Males
Kyzylsu water storage basin	-	1.54±0.29	-	0.13±0.003	0.13±0.003	0.14±0.01
Zagadka quarry	1.17	1.05	1.42	0.10	0.10	0.10
Quarry No. 2	-	1.55	-	-	0.12	-
Dalnyi quarry	1.20	1.10	1.39	0.12	0.13	0.10
Alaiagyr dam	1.39±0.18	1.48±0.29	1.31±0.25	0.13±0.01	0.12±0.01	0.14±0.01
Alaiagyr creek	-	-	-	0.15	0.15	0.14

Hepatosomatic index was higher in the roach specimens sampled from the natural water bodies and one specimen, which was sampled from the water body of quarry No. 2. Roach sampled from other man-made water bodies shown greatly reduced HIS value. This is probably explained by the food type or size-age characteristics of samples.

Macrophytes mainly were noted in the diet of roach sampled from the Kyzylsu water storage basin, plankton and benthos were also present there. In the Alaiagyr creek this species consumes higher aquatic vegetation, in the water bodies of quarries - periphyton and insignificant fraction of aerial insects in the water body of Zagadka quarry. Fatness index of roach sampled from the examined water bodies is shown in Table 8.

Table 8 – Fatness indices of roach sampled from the examined water bodies

Water body	Q_f			Q_c		
	Total	Females	Males	Total	Females	Males
Kyzylsu water storage basin	2.05±0.02	2.06±0.02	2.04±0.05	1.84±0.02	1.84±0.02	1.85±0.03
Zagadka quarry	2.38	2.36	2.43	2.17	2.12	2.28
Quarry No. 2	-	2.27	-	-	1.96	-
Dalnyi quarry	2.14	2.18	2.08	1.92	1.94	1.90
Alaiagyr dam	2.21±0.05	2.32±0.05	2.11±0.04	2.02±0.04	2.10±0.05	1.93±0.03
Alaiagyr creek	2.01	2.03	1.99	1.84	1.88	1.80

As can be seen from Table 8, specimens sampled from the man-made and Alaiagyr dam water bodies were more well-fed. This can be explained by low numbers of roach in them, absence of large mass of trophic competitors and large predators, in case of the Alaiagyr dam it can be explained by the high food capacity of that water body.

With respect to gonads' maturity level, which was estimated according to the gonadosomatic index, roach sampled from the examined water bodies is subdivided into three groups: increased indices (water body of the Alaiagyr dam), medium values (Kyzylsu water storage basin, water bodies of Zagadka quarry and quarry No. 2) and low values (water body of Dalnyi quarry and Alaiagyr creek).

Table 9 - Gonadosomatic index of roach sampled from the examined water bodies

Water body	Females	Males
Kyzylsu water storage basin	15.17±0.67	5.30±1.40
Zagadka quarry	16.99	4.80
Quarry No. 2	16.97	-
Dalnyi quarry	11.20	4.05
Alaiagyr dam	19.78±2.82	7.40±0.31
Alaiagyr creek	10.00	3.45

The increase of GSI value of roach sampled from the water body of Alaiagyr dam is caused by the need to ensure intensive reproduction at the expense of grazing significant proportion of roach by predators. Low indices of specimens sampled from the Alaiagyr creek are related to dimensional parameters of sample. The reasons of decreased GSI value of roach sampled from the water body of Dalnyi quarry are unknown.

Sex structure of population is characterized by the significant predominance of females over males, which it is 9:1 for the Kyzylsu water storage basin. Equal ratio was observed for water body of Alaiagyr dam only, which indicates high reproduction intensity.

Populations of roach from the Kyzylsu water storage basin and water body of Alaiagyr dam are quite numerous and they have some commercial potential. This species in the man-made water bodies are represented by the sparse self-reliant populations. No obvious signs of pollution impact on the reduction of roach population were noted.

4.3.5 Common minnow (fresh-water) (*Phoxinus phoxinus (L., 1758))*

This is rheophilic species. Its greatest number was reached in the streams. This species was not noted in the Kyzylsu water storage basin, water bodies of Alaiagyr dam and quarries, including water body of Dalnyi quarry, which is joined by the Mairanbastau creek (Figure 18).

Figure 18 – Common minnow (fresh-water) sampled from the Mairanbastau creek at its inflow to the water body of Dalnyi quarry (fixed sample)

4.3.6 Bream (*Abramis brama (L., 1758))*

This species was noted in the Kyzylsu water storage basin only, where it is considered as the introduced species. Proportion of this species in the catches was rather small, 7 specimens only were caught: 4 females and 3 males.

Figure 19 – Bream sampled from the Kyzylsu water storage basin

Fatness indices of specimens sampled from the Kyzylsu water storage basin were at the satisfactory level (Table 10) as well as the other indexes.

Table 10 – Morphophysiological indices of bream sampled from the Kyzylsu water storage basin

Index	Females	Males
GSI	19.28	4.57
HSI	1.49	1.32
CSI	0.11	0.12
Q_f	2.18	2.12
Q_c	1.99	1.95

Remains of benthic organisms and detritus were found in the diet of bream sampled from the Kyzylsu water storage basin.

It can be assumed that bream available in the Kyzylsu water storage basin is represented by the stable population. It is difficult to judge about its size, but probably this species form small clusters of commercial importance in this water body. No ontogenetic abnormalities and disorders were noted in the sampled specimens.

4.3.7 Tench (*Tinca tinca (L., 1758))*

In 2013 this species was noted in the Kyzylsu water storage basin only (Figure 20). In 1995 young species, hibernating by burying in the water body detritus, were caught as the outlet of one of the dams available in the Akbastaubulak creek.

Caught tench was represented by the large mature specimens. Sex ratio was equal to 1:3 with the tendency towards males domination. This research was conducted in the end of July, which is the post-settlement period for tench, and females probably have not yet started active feeding. Most likely, sex ratio in the population is almost equal.

Figure 20 – Tench sampled from the the Kyzylsu water storage basin

Indicators of nutritional status of tench sampled from the Kyzylsu water storage basin were at the good level (Table 11). High values of GSI indices of females in the post-settlement period can be explained by the fact that they did not finish egg laying. Its remnants were passing fat resorption stage. No sex differences were observed with respect to morphological characteristics.

Table 11 – Morphophysiological indices of tench sampled from the Kyzylsu water storage basin

Index	Females	Males
GSI	29,25	2,47
HSI	1,54	1,53
CSI	0,11	0,11
Q_f	3,02	3,01
Q_c	2,75	2,77

Tench in this water body forms sufficient commercial aggregations and it can be used for capture. No developmental anomalies were noted there.

4.3.8 Gudgeon (*Gobio gobio (L., 1758)*)

This species was found in the water system of Akbastaubulak creek only (including Kholodnyi klyutch and Mairanbastau creeks) (Figure 21). Gudgeon was not noted in the other water bodies. Its penetration to the upper reaches of the Alaiagyr creek is prevented by the dam. It is difficult to explain gudgeon absence in Alaiagyr creek below the dam. According to all indicators it should come to Alaiagyr creek from the Kyzylsu water storage basin. This reasoning perhaps can be confirmed in the process of the more detailed examination.

Figure 21 – Young gudgeon sampled from the Akbastaubulak creek (registered specimen)

4.3.9 Siberian loach (*Cobitis melanoleuca Richardson, 1925)*

This species is localized in the water system of Alaiagyr creek (Figure 22). It was not found in the water body of Alaiagyr dam, it is also missing in the diet of predatory species. It can be found in the running water only, which distinguishes this population from the other species, that can inhabit in the low flow water bodies.

Figure 22 – Siberian loach sampled from the Alaiagyr creek behind the Alaiagyr dam (registered specimen)

4.3.10 Bearded stone loach (*Barbatula toni (Dybowsky, 1869))*

This rheophilic species was noted only at the considerable water flow in the Alaiagyr, Bezymyannyi and Akbastaubulak creeks (Figure 23). In the light of recent revisions [23, 24] its taxonomic status is not completely understood yet, but most probably bearded stone loach from tributaries of Kyzylsu belongs to the trivial *B. toni*.

Figure 23 – Young bearded stone loach sampled from the Bezymyannyi creek (registered specimen)

4.3.11 Freshwater cod (*Lota lota (L., 1758))*

This is coldwater, oxyphilic species. According to the questionnaire data it resides in the Kyzylsu water storage basin. Freshwater cod was not sampled because of mismatch of sampling season and its environmental features.

4.3.12 Pike (*Esox lucius L., 1758)*

In the examined area this species inhabits in the Kyzylsu water storage basin and water body of Alaiagyr dam (Figure 24). It is also available in the upper and lower reaches of Alaaigyr creeek, to which pikes from the Kyzylsu river come too.

Specimens of up to nine years (8+) old (Table 12) were found in the catches. Pikes contrary to perch are characterized by the tendency to growth rate increase. This can be probably explained by increase of victims' number (which is particularly assumed for the perch). In the Kyzylsu water storage basin males grow somewhat faster compared to females, growth rates of both sexes in the water body of Alaiagyr dam are approximately the same.

Figure 24 – Pike sample from the water body of Alaiagyr dam

Table 12 – Back calculation of pike growth rate in the Kyzylsu water storage basin and water body of Alaiagyr dam

Water body	Generation	Linear growth rate, cm per year							
		1	2	3	4	5	6	7	8
Alaiagyr dam	2004	16.3	22.9	27.2	33.8	38.1	41.4	44.7	47.9
	2005	18.5	25.9	30.8	34.5	39.4	43.1	45.6	
	2006	18.6	26.5	31.4	35.0	38.1	41.3		
	2007	19.2	25.2	31.4	34.7	38.3			
	2008	19.0	26.1	32.1	35.6				
	2009	19.3	24.3	28.7					
	Females	18.8	25.4	30.8	34.7	38.3	41.8	45.1	47.9
	Males	19.0	24.7	30.2	34.7	38.5			
Kyzylsu water storage basin	2007	17.4	22.8	27.4	32.2	37.7			
	2008	17.6	24.0	29.9	33.9				
	2009	18.3	24.9	29.8					
	2010	13.9	21.4						
	Females	17.7	22.7	27.5	30.8	36.4			
	Males	17.2	24.2	29.8	34.3	39.0			

In general according to available data [22] pike in the examined water bodies grows more slowly compared to the other water bodies of Kazakhstan.

In the process of morpho-physiological parameters' study it was noted that pike has certain dimensional variation with respect to cardiosomatical index (Table 13).

Young specimens with the carcass weight (body weight without bowels) up to 350 g have higher cardiosomatical index compared to larger specimens. This can be probably explained by the higher agility of small animals because they are forced not only to hunt but to escape from predators (larger pikes) too.

Table 13 – Variability of cardiosomatical index (CSI) values of pikes sampled from the Kyzylsu water storage basin and water body of Alaiagyr dam

Carcass weight, g	Water body of Alaiagyr dam	Kyzylsu water storage basin
Up to 350 g	0.14±0.004	0.15±0.019
Above 350 g	0.11±0.005	0.08±0.002
Total:	0.12±0.005	0.09±0.032

CSI values of pikes sampled from the water body of Alaiagyr dam are slightly higher compared to pikes caught from the Kyzylsu water storage basin. In this case it is possible that this phenomenon can be explained by the lesser pollution impact, because Kyzylsu water storage basin is situated rather far from mining areas. Hepatosomatic index increase (Table 14) is also related to this factor.

Table 14 – Level or hepatosomatic index (HSI) values of pikes sampled from the Kyzylsu water storage basin and water body of Alaiagyr dam

Water body	Total	Females	Males
Alaiagyr dam	1.38±0.29	1.41±0.31	1.33±0.26
Kyzylsu water storage basin	0.98±0.26	1.01±0.25	0.95±0.28

Species characteristic of pike's habitats are present in its diet in the examined water bodies. For example, roach and perch, approximately in equal proportions, were noted in the food bolus of pikes sampled from the Alaiagyr dam water body. In the Kyzylsu water storage basin tench is added to these components of pike's diet.

Fatness values of pikes sampled from the examined water bodies are found at the high level (Table 15).

Table 15 – Fatness values of pikes sampled from the Kyzylsu water storage basin and water body of Alaiagyr dam

Water body	Q_f			Q_c		
	total	females	males	total	females	males
Kyzylsu water storage basin	1.00±0.05	1.02±0.06	0.99±0.04	0.95±0.05	0.95±0.06	0.94±0.04
Alaiagyr dam	1.02±0.11	1.05±0.08	0.98±0.14	0.92±0.07	0.94±0.03	0.89±0.10

4.3.13 River perch (*Perca fluviatilis L., 1758)*

In the examined area perch inhabits the following water bodies: Dalnyi and Zagadka quarries, Alaiagyr dam, Alaiagyr creek in the middle and lower reaches, Kyzylsu river and Kyzylsu water storage basin (Figure 25).

Figure 25 – Perch sampled from the water body of Zagadka (Sorokovaya) quarry

Specimens of up to 11 years old were noted in the examined water bodies. Back calculation of perch growth index has shown gradual decline of growth rate from 2003 to 2009 (Table 16).

Table 16 – Back calculation of perch growth rate in the examined water bodies

Water body	Generation	Linear growth rate, cm per year									
		1	2	3	4	5	6	7	8	9	10
Kyzylsu water storage basin	2003	7.4	11.1	12.6	14.1	17.1	20.0	22.3	24.5	25.2	28.2
	2005	7.1	10.0	12.3	15.6	17.5	19.3	21.2	23.4	-	-
	2006	6.8	9.5	12.0	14.1	16.3	18.0	20.0	-	-	-
	2008	6.6	9.4	12.5	14.5	16.1	-	-	-	-	-
	2009	6.6	8.9	11.4	13.2	-	-	-	-	-	-
Alaiagyr dam	2006	6.6	8.9	12.2	14.5	16.5	18.5	21.1	-	-	-
	2008	6.0	8.5	10.7	12.7	14.6	-	-	-	-	-
	2009	6.3	8.8	11.0	13.0	-	-	-	-	-	-
Alaiagyr creek	2011	6.0	8.8	-	-	-	-	-	-	-	-
Dalnyi quarry	2005	6.8	10.2	14.2	16.9	19.0	21.0	23.0	25.0	-	-
	2006	6.2	9.5	12.5	15.0	17.4	20.0	22.2	-	-	-
	2007	6.2	10.4	12.4	15.2	17.9	20.0	-	-	-	-
	2008	5.4	8.3	13.1	15.4	17.3	-	-	-	-	-
Zagadka quarry	2007	6.8	10.5	13.2	15.9	18.6	20.3	-	-	-	-

In principle, all populations show rather good linear growth rates, even in the oligotrophic water bodies. This is explained by the diet type. Oligotrophic characteristics of water bodies represent limiting factor at the early ontogenesis stages only. Basic population was formed exactly during this period. Therefore, perch in quarries' water bodies is represented by the small but stable populations, which have enough food resources such as fish and benthic invertebrates.

Slowdown of growth rates is most probably explained by the increase of species number of in water bodies and depends on generations' yield.

Morphological indication shows environmental species' conditions in general terms only. Hepatosomatic index values are primarily characterized by the dietary dependence. Populations showing themselves as predators and benthophages have larger HSI values compared to facultative zooplanktophages (Table 17).

Table 17 – Variability of morphophysiological indices of perch sampled from three examined water bodies

Water body	HSI			CSI		
	total	females	males	total	females	males
Kyzylsu water storage basin	1,23±0,09	1,34±0,11	0,98±,10	0,12±0,005	0,12±0,01	0,12±0,11
Alaiagyr dam	0,77±0,04	0,78±0,05	0,71±0,01	0,11±0,01	0,11±0,01	0,13±0,02
Alaiagyr creek	1,21±0,06	1,25±0,05	0,97	0,15±0,01	0,14±0,005	0,18
Dalnyi quarry	1,07±0,14	1,00±0,17	1,32±0,14	0,13±0,004	0,12±0,01	0,14±0,01

So larvae of dragonflies and fish (roach at the age of 2+ years) are present in diet of perch sampled from the Kyzylsu water storage basin, the same dragonflies and fish (perch at the age of 1+ years and carp at the age of 0+-1+ years) are present in the diet of perch sampled from the water body of Dalnyi quarry. In the Alaiagyr dam water body this species feeds on zooplankton and fish (roach at the age of 0+ years). Thus perch sampled from the first two water bodies consumes food, which a priori contains more pollutants in its tissues, both because of the lifestyle as well as its life duration. This is also true for perch sampled from the water body of Zagadka quarry, where it was eating crayfish, its average HSI value is equal to 1.32. Diet of specimens sampled from the water body of Alaiagyr dam had less "contaminated" food mainly because of the short period of its existence.

Morphophysiological indices of perch sampled from the Alaiagyr creek are quite different, but in this case we can see natural HSI value increase in the young groups (2+ years old). Their diet was dominated by nektobenthos (freshwater hoppers), though benthos (stone flies) and zooplankton were also present.

At the same time we cannot exclude influence of generation variability of morphophysiological parameters (Table 18).

Table 18 – Age variability of morphophysiological indices of perch sampled from three examined water bodies

Water body	Age					
	4+	5+	6+	7+	8+	10+
HSI						
Kyzylsu water storage basin	1.18±1.07	0.84±0.01	-	1.45±0.18	1.37	1.04
Alaiagyr dam	0.82±0.17	0.73±0.08	-	0.84±0.14	-	-
Dalnyi quarry	-	0.69±0.14	0.80	1.25±0.36	0.99	-
CSI						
Kyzylsu water storage basin	0.10±0.01	0.14±0.01	-	0.12±0.01	0.13	0.11

Alaiagyr dam	0.12±0.01	0.12±0.02	-	0.10±0.01	-	-
Dalnyi quarry	-	0.13±0.01	0.12	0.13±0.01	0.11	-

Examined samples have their own unique weight ratios with respect to internal organs. And most probably they depend not only on the habitat but on the sex & age structure of samples and some other factors too.

Fatness index (Table 19) of perch sampled from the examined water bodies was at the satisfactory level.

Table 19 – Fatness values of perch sampled from three examined water bodies

Water body	Q_f			Q_c		
	Total	Females	Males	Total	Females	Males
Kyzylsu water storage basin	2.15±0.05	2.22±0.06	1.96±0.06	1.98±0.04	2.05±0.04	1.83±0.06
Alaiagyr dam	2.02±0.04	2.00±0.05	2.09±0.10	1.90±0.04	1.90±0.05	1.93±0.11
Alaiagyr creek	2.16±0.06	2.19±0.06	2.03	1.99±0.04	2.02±0.04	1.86
Dalnyi quarry	2.25±0.07	2.26±0.09	2.23±0.002	2.07±0.06	2.08±0.07	2.02±0.04

Thus evaluating these two predators we can state that perch and pike sampled from the examined water bodies had fairly good indices for specimens living in small water bodies. In some cases contamination may probably affect formation of morphological and physiological indicators, but the size-age variability is of a big importance.

Populations of these types from the Kyzylsu water storage basin and Alaiagyr dam water body can be used in the fishing industry, specimens from the other water bodies can be used for a sport and recreational fishing.

CHAPTER 5. RECOMMENDATIONS FOR MONITORING CONDITION AND PROTECTION OF THE AQUATIC BIOCENOSES IN THE BME INFLUENCE ZONE

Species diversity of flora and fauna of this region has formed at the junction of steppe zone and mountain-steppe associations of Northern part of Kalbinskiy ridge. Its unique feature lies in the mix of species, imposing different, sometimes polar, preferences and requirements related to ecosystem.

Any offset of environmental factors in this or that direction will lead to disbalance within ecosystems of this region and change of predominants. It is impossible to categorically state whether it will be for good or for evil, but unique feature of the region will be definitely lost.

In this connection the issue regarding necessity to monitor biological diversity of the region is to be solved. In this case we would like to suggest to use a set of simple instruments in order to monitor aquatic flora and fauna of the region.

It is necessary to assess condition of species characterized by narrow reaction norms with respect to some important ecosystem indices. These objects should be noticeable and well-defined for a average skilled expert.

Such objects should include the following: caddis flies and worms, common minnow, gudgeon, Siberian loach on the one hand and larvae of Diptera and tench on the other hand (with respect to oxyphility, relation to lotic water condition and stability to eutrophication).

First of all for these objects we should monitor the range of their distribution in water bodies of the region, which will be considered as the simplest indicator of ecosystem's dynamics. In addition to that, in case of fish being the more simple and accessible objects, it is necessary to take into account emergence of various abberation forms, which represent indicators of developmental disorder of the organisms. In this case type and frequency of these violations will be considered as the main indicator.

Assessing dynamics of these indicators we can follow up eutrophication or oligotrophicity tendencies of water bodies, appearance of external anthropogenic factors and many other reasons, which may cause the change of populations' and ecosystems' dynamics.

As to the program of measures aimed at preservation of existing biohydrocenosis we would like to recommended to raise level of Alaiagyr dam water body by 2 meters, that is possible by restoration of the dam and construction of bypass channel, which will allow to discharge excess flood water from the water body and maintain necessary level.

Considering the fact that water bodies of Alaiagyr dam and Kyzylsu water storage basin are currently included in the reserve fund of local importance water bodies we would like to recommended BME management to take them for use through the tender invited by the Akimat of the East Kazakhstan region. This will allow to ensure overall control over these water bodies and carry out necessary social policy by the way of organization of commercial fishery as well as sport and recreational fishing.

It goes without saying that measures aimed at the protection of hydrocoenoses should include the following: prevention of various pollutants' ingress into water sources as well as unreasonable technological modifications of water body course, floodplain and catchment basins.

CONCLUSION

Thus, at present flora and fauna of the examined area are represented by various types of plain, piedmont and mountain complexes, which creates really unique character of this region's biohydrocenoses.

10 water bodies of natural and man-made origin with different nutrient status were investigated.

Algal flora of water bodies is mainly represented by the diatom and green algae. The largest biomass is characteristic of slow current natural water bodies with the strong organic matter supply such as Kyzylsu water storage basin and water body of Alaiagyr dam. The lowest indices are typical for water bodies situated in the quarries.

The higher water flora consists of hygrophilous and hydrophilic forms. Most common plants are the southern reed, narrow-leaved cattail, sedges and various species of pondweed.

Plankton of the examined water bodies includes 35 species. In number the most part of water bodies is dominated by rotifers and rarely by cladocerans. The nature of nutrient status depends on the organic matter supply and in water bodies it varies from β-mesotrophic to ultraoligotrophic.

Benthal fauna consists of about 50 species. It includes numerous larvae of dragonflies, caddis flies and worms, Hemiptera (bugs), gammarids. The last species form mass swarms along all streams and creeks of the region. Crayfish *Astacus leptodactylus Eschscholtz* is met in 4 water bodies. In the water body of Zagadka quarry it forms an interesting blue color form, origin of which is not clear.

Area ichthyofauna is represented by 13 species, out of which only 2 (carp and bream) are considered introduced species. With respect to numbers it is dominated by roach, perch, pike, in the creeks and streams - by common minnow and bearded stone loach.

Condition of these species' populations is quite satisfactory. No developmental disorders were authentically noted in the specimens of all examined species, which could be caused by the pollutants' impact. Number of species in future may be used for fishery.

In order to ensure ecosystem condition monitoring it is recommended to use the set of simple tests, which includes the following:

1. Assessment of distribution changes of 4 fish species and 2 insects' orders (with respect to larvae);

2. Measurements of abnormal specimens' proportion in the populations of clearly distinguishable and dominant species.

In order to ensure biohydrocenoses' protection and preservation it is recommended to carry out reconstruction of Alaiagyr dam. It is also recommended to take for use fishery resources of the Kyzylsu water storage basin and Alaiagyr dam.

In addition to the above, it is necessary to prevent ingress of pollutants to water courses and to avoid anthropogenic destruction of river beds, floodplains and catchment areas of water bodies unless necessary.

Address	Owner			
Sotsialisticheskaya st., 1-1	A.K.Trushlyakova			
Sotsialisticheskaya st., 1-2	K.Akhmetbaev			
Sotsialisticheskaya st., 2-1	M.D.Zhangubekov			
Sotsialisticheskaya st., 2-2	D.R.Musabaev			
Sotsialisticheskaya st., 3-1	B.K.Sembinov			
Sotsialisticheskaya st., 3-2	T.S.Pevchenko			
Sotsialisticheskaya st., 4-1	O.B.Zalesnykh			
Sotsialisticheskaya st., 4-2	A.M.Trushlyakov			
Sotsialisticheskaya st., 5-1	D.P.Dementyev			
Sotsialisticheskaya st., 5-2	K.K.Zhanuzakova			
Sotsialisticheskaya st., 5A-1	S.K.Zhakupbaev			
Sotsialisticheskaya st., 5A-2	G.I.Kazakova			
Sotsialisticheskaya st., 6-1	I.A.Zotova			
Sotsialisticheskaya st.,, 6-2	A.T.Zhanuzakova			
Sotsialisticheskaya st., 7-1	A.Zh.Masalimov			
Sotsialisticheskaya st., 7-2	D.N.Dolsylkhanov			
Sotsialisticheskaya st., 8-1	Zh.Zhakiyanov			
Sotsialisticheskaya st., 8- 2	V.I.Pravdyuk			
Sotsialisticheskaya st., 9 - 1	R.K.Murzakhanova			
Sotsialisticheskaya st., 9- 2	N.V.Pushkareva			
Sotsialisticheskaya st., 10-1	K.S.Sadvakasova			
Sotsialisticheskaya st., 10 -2	N.K.Patsuk			
Sotsialisticheskaya st., 11 -1	V.V.Pushkarev			
Sotsialisticheskaya st., 11/2-4	S.U.Zhumagulov			
Sotsialisticheskaya st., 11 - 3	E.I.Karpushina			
Sotsialisticheskaya st.,, 12-1	O.K.Kadyrkhanov			
Sotsialisticheskaya st.,, 12-2	R.Zh.Bitikova			

Address	Owner	Available documents (copies)	Sales Agreement	Registration	Amount and date of payment	Status	Date of eviction
9/1, Sotsialisticheskaya st.	R.K. Murzakhanova	facility certificate, decision on legalization dated 04.05.2007, Land use entitlement 05-243-040-235, acceptance commission certificate dated 10.01.2007, KRG	28.11.14 Sales agreement No.78-5116	03.12.2014 Notice No.14-0523-2049	8 139 150 tenge No.56 dated 09.12.2014	land and real estate title belongs to LLP BGP, documents have been submitted for payment, 04.12.14 Documents (original and notarized copy of the Sales agreement, notarized copy of the Land use entitlement, original facility certificate, notice of registration) are handed to A.Kalieva 08.12. 14 the originals and copies are handed to E.Sasenov to draw up the land title, agreement made on the land inspection, 10.02.15 new land use entitlement is obtained No.294 dated 06.02.15, resolution of akim No.10 dated 05.02.15	28/01/2015
6/2, Sotsialisticheskaya st.	A.T. Zhanuzakova	authority to sell for R.Satanova, F-2 statement dated 04.11.14, A.T.Zhanuzakova's certificate of no record of marriage, gift agreement for 1/2 house No.78-1565 dated 11.04.2014, Certificate of inheritance for 1/2 house, Land use entitlement dated 18.04.2014, Certificate of Authorisation of A.T.Zhanuzakova, bank account of A.T.Zhanuzakova	24.11.2014 Sales agreement No.78-5059	02.12.2014 Notice No.14-0523-2032	7 234 800 tenge No.53 dated 09.12.2014	land and real estate title belongs to LLP BGP, documents have been submitted for payment, 04.12.14 Documents (original and notarized copy of the Sales agreement, original land use entitlement, original facility certificate, notice of registration) are handed to A.Kalieva	24/01/2015
10/2, Sotsialisticheskaya st.	N.K.Patsuk	decision on legalization dated 21.11.2006, acceptance commission certificate dated 10.01.2007, Land use entitlement dated 15.03.2004, facility certificate dated 17.04.2007, authority to sell for I.A.Zotova, Certificate of Authorisation of N.K.Patsuk	27.11.2014 Sales agreement No.78-5098	02.12.2014 Notice No.14-0523-2033	8 139 150 tenge No.54 dated 09.12.2014	land and real estate title belongs to LLP BGP, documents have been submitted for payment, 04.12.14 Documents (original and notarized copy of the Sales agreement, original land use entitlement, original facility certificate, notice of registration) are handed to A.Kalieva	27/01/2015
6/1, Sotsialisticheskaya st.	I.A.Zotova	decision on legalization dated 21.11.2006, acceptance commission certificate dated 10.01.2007, Land use entitlement dated 26.11.2003, facility certificate dated 17.04.2007, application from A.Zotov, Certificate of Authorisation of I.A.Zotova.	24.11.2014 Sales agreement No.5061	02.12.2014 Notice No.14-0523-2022	8 139 150 tenge No.55 dated 09.12.2014	real estate title belongs to LLP BGP, documents have been submitted for payment, 04.12.14 Documents (original and notarized copy of the Sales agreement, notarized copy of the Land use entitlement, original facility certificate, notice of registration) are handed to A.Kalieva 08.12. 14the originals and copies are handed to E.Sasenov to draw up the land title, agreement made on the land inspection, new land use entitlement is obtained No.606 dated 22.12.2014	24/01/2015
9/2, Sotsialisticheskaya st.	N.V.Pushkareva	Certificate of Authorisation of N.V.Pushkareva, facility certificate dated 04.06.2007, Land use entitlement dated 15.05.2007, decision on legalization dated 16.11.2006, inspection report dated 03.03.1993, acceptance commission certificate dated 10.01.2007, privatization agreement 03.03.1993	02.12.2014 Sales agreement 78-5149	03.12.2014 Notice No.14-0523-2047	8139150 tenge No.154 dated 15.12.2014	land and real estate title belongs to LLP BGP, Documents datedрпавлены на оплату,04.12.14 Documents (original and notarized copy of the Sales agreement, notarized copy of the Land use entitlement, original facility certificate, notice of registration) are handed to A.Kalieva 08.12. 14the originals and copies are handed to E.Sasenov to draw up the land title, agreement made on the land inspection, 10.02.15 new land use entitlement is obtained No.293 dated 06.02.15, resolution of akim No.11 dated 05.02.15	02/05/2015
7/1, Sotsialisticheskaya st.	A.Zh.Masalimov	Land use entitlement dated 25.05.2007, facility certificate dated 31.05.2007, Certificate of Authorisation of A.Zh.Masalimov, decision on legalization No.50 dated 04.05.2007, acceptance commission certificate dated 20.02.2007	08.12.2014 Sales agreement 78-5201	11.12.2014 Notice No.14-0523-2080	8163000 tenge No.156 dated 15.12.2014	land and real estate title belongs to LLP BGP 11.12.2014 04.12.14 Excuting purchase and sales transactions failed due to the inconsistency between the documents and the database of the Public Service Center. A.Masalimov has to go to Charsk to introduce some changes, 08.12.14 notarization of the transaction, 09.12.14 submitted for payment. 11.12.14 Documents (original and notarized copy of the Sales agreement, notarized copy of the Land use entitlement, original facility certificate, notice of registration) are handed to A.Kalieva 11.12.14 the originals and copies are handed to E.Sasenov to draw up the land title, agreement made on the land inspection, 10.02.15 new land use entitlement is obtained No.295 dated 06.02.15, resolution of akim No.12 dated 05.02.15	08/05/2015
11/1, Sotsialisticheskaya st.	V.V.Pushkarev	ID of V.V.Pushkarev, decision on legalization dated 21.11.2006 No.16, privatization agreement,inspection report, facility certificate dated 08.06.1993, Land use entitlement	02.12.2014 Sales agreement No.78-5143	03.12.2014 Notice No.14-0523-2048	8139150 tenge No.155 dated 15.12.2014	land and real estate title belongs to LLP BGP, documents have been submitted for payment, 04.12.14 Documents (original and notarized copy of the Sales agreement, notarized copy of the Land use entitlement, original facility certificate, notice of registration) are handed to A.Kalieva 08.12. 2014 the originals and copies are handed to E.Sasenov to draw up the land title, agreement made on the land inspection, 10.02.15 new land use entitlement is obtained No.292 dated 06.02.15, resolution of akim No.13 dated 05.02.15	02/05/2015
5/2, Sotsialisticheskaya st.	K.K.Zhanuzakova	ID of K.K.Zhanuzakova, facility certificate dated 24.01.2012, Land use entitlement dated 09.04.2012 cadastral No. 05-243-039-131, Sales agreement No.70-3562 dated 28.12.2011	04.12.2014 Sales agreement No.78-5168	08.12.2014 Notice No.14-0523-2060	8163000 tenge No.150 dated 15.12.2014	05.12.14 Documents are submitted for payment, 09.12.14 Documents (original and notarized copy of the Sales agreement, original land use entitlement, original facility certificate, notice of registration, original of the personal account) are handed to A.Kalieva land and real estate title belongs to LLP BGP	04/07/2015
1/2, Sotsialisticheskaya st.	K.Akhmetbaev	ID of K.Akhmetbaev, decision on legalization dated 19.10.2006 No.10, ,acceptance commision act dated 20.02.2007, Land use entitlement dated 05.03.2007 cadastral No.05-243-040-195, facility certificate dated 03.05.2007	08.12.2014 Sales agreement 78-5207	11.12.2014 Notice No.14-0523-2079	8163000 tenge No.157 dated 15.12.2014	land and real estate title belongs to LLP BGP, documents have been submitted for payment, 04.12.14 Documents (original and notarized copy of the Sales agreement, notarized copy of the Land use entitlement, original facility certificate, notice of registration) are handed to A.Kalieva 08.12. 14 the originals and copies are handed to E.Sasenov to draw up the land title, agreement made on the land inspection, 10.02.15 new land use entitlement is obtained No.294 dated 06.02.15, resolution of akim No.10 dated 05.02.15	08/05/2015
8/2, Sotsialisticheskaya st.	V.I.Pravdyuk	ID of V.I.Pravdyuk, decision on legalization dated 21.11.2006 No.16, acceptance commision act dated 10.01.2007, Land use entitlement dated 15.03.2004 cadastral No.05-243-039-128, facility certificate dated 10.04.93г	25.12.14 Sales agreement 78-5433, new land ownership certificate No.1062102 dated 16.01.15	31.12.2014 Notice No.14-0523-2223	8202150 tenge No.31 dated 12.01.15	Land and real estate title belongs to LLP BGP. notarization of the transaction on 25.12.14, Documents are prepared for registration on 26.12.14, submitted for payment on 25.12.14 Documents (original and notarized copy of the Sales agreement, notarized copy of the Land use entitlement, original facility certificate) are handed to A.Kalieva , the land is being re-excuted by Sasenov	25/08/2015
11/2-4, Sotsialisticheskaya st.	S.U.Zhumagulov	decision on legalization dated 19.10.2006 No.10, acceptance commision act dated 10.02.2007, Land use entitlement dated 18.04.2007 cadastral No.05-243-039-101, facility certificate dated 25.07.2007	Sales agreement dated 03.02.15 No.78-395	06.02.2015 Notice on governmental registration No. 15-0523-180	16600500 tenge No. 339 dated 19.02.15	04.02.15 Documents (original and notarized copy of the Sales agreement, copy of the land use entitlement, original facility certificate) are handed to A.Kalieva , 04.02.15 Submitted for payment, 13.04.15 submitted to E.Sasenov to re-execute the land.	03/07/2015
11/3, Sotsialisticheskaya st.	E.I.Karpushina	ID of E.I.Karpushina, decision on legalization dated 07.02.2007 No.32, acceptance commision act dated 21.03.2007, Land use entitlement dated 30.04.2007 cadastral No.05-243-039-101, facility certificate dated	25.12.14 Sales agreement 78-5430	31.12.2014 Notice on governmental registration No.14-0523-2224	8202150 tenge No.32 dated 12.01.15	land and real estate title belongs to LLP BGP 25.12.14 notarization of the transaction, Documents have been prepared and submitted for registration, 26.12.14 submitted for payment 25.12.14 Documents (original and notarized copy of the Sales agreement, notarized copy of the Land use entitlement, original facility certificate) are handed to A.Kalieva, the land is being re-issued by E.Sasenov 10. 02.15 new Land use entitlement was obtained dated 06.02.15 No.296, resolution of akim No.8 dated 05.02.15	25/08/2015
2/1, Sotsialisticheskaya st.	M.D.Zhangubekov	ID M.D.Zhangubekov, decision on legalization No.10 dated 19.10.2006, acceptance commision act dated 10.02.2007, Land use entitlement dated 05.06.2006 cadastral No.05-243-039-104, facility certificate dated 03.05.07	30.01.15 Sales agreement 78-350	05.02.15 Notice No.15-0523-96	8300250 tenge No.339 dated 19.02.15	land and real estate title belongs to LLP BGP.21.01.15 Documents submitted to the notary for verification, it is required to reconcile the documents for the land and F-2 form in the Public Service Center, Documents were adjusted, 30.01.15 notarisation of the sales agreement. 02.02.15 Documents (original and notarized copy of the Sales agreement, copy of the land use entitlement, original facility certificate) are handed to A.Kalieva , 02.02.15 submitted for payment, 11.02.15 Documents are handed to E.Sasenov to issue a new land ownership certificate, Documents were submitted to the PSC, 19.02.15 new land use entitlement is obtained.	30/06/2015
Sotsialisticheskaya st., fuel station	TOO "East Plast" (represented by F.P.Lychagin)	ID of F.P.Lychagin, charter, Land use entitlement dated 12.09.01 cadastral No.05-243-039-366, director appointment order, shareholder's resolution, certificate of incumbency, technical data sheet dated 09.01.2012	09.01.15 Sales agreement 78-42	05.02.2015 Notice No.15-0523-121	7500000 tenge No.140 dated 27.01.15	land and real estate title belongs to LLP BGP 09.01.15 notarization of the transaction, submitted for registration, 12.01.15 submitted for payment 12.01.15 Documents (original and notarized copy of the Sales agreement, original land use entitlement, original facility certificate) are handed to A.Kalieva	09/02/2015
10/1, Sotsialisticheskaya st.	K.S.Sadvakasova	Land use entitlement dated 09.06.2003, gift agreement dated 25.03.2007, resolution of the akim No.7 a dated 13.03.2003, facility certificate dated 15.03.07, act on extended premises dated 12.03.2007	12.03.15 Sales agreement No.78-866	30.03.15 Notice on governmental registration No.15-0523-399	8340750 tenge bank transfer receipt No.719 dated 10.04.15	land and real estate title belongs to LLP BGP 16.02.15 the docs were submitted to the notary for verification - ready for transaction, 12.03.15 sales transaction was executed. 13.03.15 Documents are handed for payment,Documents (original and notarized copy of the Sales agreement, notarized copy of the Land use entitlement, original facility certificate) are handed to A.Kalieva , it is required to replace the Land use entitlement, the land ownership certificate is being processed by E.Sasenov, 17.04.15 new land use entitlement is obtained No.1062257 cadastral No.05-243-039-105	12/07/2015
4/2, Sotsialisticheskaya st.	A.M.Trushlyakov	ID of A.M.Trushlyakov, decision on legalization dated 21.11.2006 No.16, acceptance commision act dated 15.02.2007, Land use entitlement dated 23.05.2007 cadastral No.05-243-039-106, facility certificate dated 31.05.2007	17.03.15 Sales agreement No.78-938	30.03.15 Notice on governmental registration No.15-0523-400	8340750 tenge bank transfer receipt No.721 dated 10.04.15	16.02.15 the docs were submitted to the notary for verification- it is required to take the address reference at the Auezov akimate as there was an inconsistency in the F-2 form address, then go to Shar and introduce changes into the F-2 form, the transaction was executed 17.03.15, 18.03.15 submitted for payment to PED, 13.04.15 documents are handed to E.Sasenov to re-issue the land	17/07/2015
2/2, Sotsialisticheskaya st.	D.R.Musabaev	ID of D.R.Musabaev, decision on legalization dated 16.04.2007 No.46, acceptance commision act dated 26.01.2007, Land use entitlement dated 23.05.2007 cadastral No.05-243-040-240, facility certificate dated 31.05.2007, certificate of marriage registration, spouse's letter of consent to sell	20.04.15 Sales agreement 78-1402	28.04.15 Notice on governmental registration No.15-0523-575	7 803 600 tenge	ready for transaction, 20.04.15 the transaction was executed, 21.04.15 Documents are handed for payment	20/09/2015
12-1, Sotsialisticheskaya st.	O.K.Kadyrkhanov	ID of O.K.Kadyrkhanov, decision on legalization No.10 dated 19.10.2006, acceptance commision act dated 10.02.2007, Land use entitlement dated 13.03.2007 cadastral No.05-243-040-207, facility certificate dated 03.05.07, application from K.T.Kadyrkhanova	20.04.15 Sales agreement 78-1396	28.04.15 Notice on governmental registration No.15-0523-573	7 803 600 tenge	the data is saved in the list of real estate folder - ready for transaction, 20.04.15 the transaction was executed, 21.04.15 Documents are submitted for payment	20/09/2015
12-2, Sotsialisticheskaya st.	R.Zh.Bitikova	ID of R.Zh.Bitikova, Land use entitlement dated 10.03.2013, cadastral No.05-243-040-207, Certificate of right to inheritance by operation of law dated 11.12.2012, facility certificate dated 24.05.2007	20.04.15 Sales agreement 78-1399	28.04.15Notice on governmental registration No.15-0523-574	7 803 600 tenge	land and real estate title belongs to LLP BGP 16.02.15 the docs were submitted to the notary for verification - ready for transaction, 20.04.15 the transaction was executed, 21.04.15 Documents are handed for payment	20/10/2015
3-2, Sotsialisticheskaya st.	T.S.Pevchenko	ID of T.S.Pevchenko, decision on legalization dated 31.07.07 No.65, acceptance commision act dated 31.07.2007, Land use entitlement dated 14.08.2007 cadastral No.05-243-040-262, facility certificate dated 14.09.2007	13.05.15 Sales agreement No.78-1654	Agreement No. 15-0523	7 420 000 tenge	02.04.15 Documents were verified by the notary, tansaction execution is set on 07.04.15 - cancelled due to the Seller's refusal 13.05.15 the transaction was executed at the notary	01/09/2015
7/2, Sotsialisticheskaya st.	D.N.Dosylkhanov		06.02.15 Agreement No.78-440	06.02.2015 Notice on governmental registration No.15-0523-179	8313750 tenge No.338 dated 19.02.15	the title belongs to LLP BGP. Sales transaction was notarized on 06.02.15 08.02.15 Documents (original and notarized copy of the Sales agreement, original land use entitlement, original facility certificate, originial personal account), are submitted for payment 09.02.15	06/07/2015
1-1, Sotsialisticheskaya st.	A.K.Trushlyakova		22.05.2015 Agreement No.78-1869		8 340 750 tenge	Documents are verified by the notary, the transaction is set to be executed on 22.05.15 22.05.15 the trasaction was executed at the notary	01/09/2015
3-1, Sotsialisticheskaya st.	B.K.Sembinov		22.05.2015 Agreement No.78-1866		7,432,000	Documents are verified by the notary, the transaction is set to be executed on 22.05.15 22.05.15 the trasaction was executed at the notary	01/09/2015
5-1, Sotsialisticheskaya st.	D.P.Dementyev				7,432,000	Documents are verified by the notary, the transaction is set to be executed on 28.05.15	01/09/2015
4-1, Sotsialisticheskaya st.	O.B.Zalesnykh				11,190,000	Documents are verified by the notary, require to be corrected. the trasaction was executed on 18.06.15	01/09/2015
8-1, Sotsialisticheskaya st.	ZH.Zhakiyanov				10241000	the trasaction was executed on 02.07.2015	01/05/2016
5A-1, Sotsialisticheskaya st.	S.K.Zhakupbaev				8500000	the trasaction was executed on 21.10.2015	01/05/2016

	Action	Deadline	Note
1	Submission of lists and scanned copies of documents of title for the buildings in Sotsialisticheskaya street to E.A.Sasenov for further work	18/04/2016	Result: Preparation of the general list of real state properties subject for post-utilization
2	Wwithin a week ONiZR (Center of real estate properties and land resources) shall issue and request for post-utilization of all buldings.	20/04/2016	Result: permission for demolition
3	Procurement of permits for post-utilization	22/04/2016	
4	The permit will be directed to the legal department. Director general will determine the deadline and managers responsible for demolition	22/04/2016	Result: Notification of the responsible managers and preparation for demolition.
5	Start of demolition. Garbage removal. Reclamation.	01.05.2016 - 13.06.2016 , postponed till 20.06.2016	Result: to prepare the order for utilization. Demolition of the buildings
6	Upon completion of demolition, E.A.Sasenov shall obtain the statement on demolition and submit it to the legal department for registration	15 working days	Result: statement on demolition, no registration
7	1) Submission of the statements for registration. 2) Submission of scanned statements with legal marks to ONiZR to E.A.Sasenov to re-issue the end use of the lands.	02.06.2016 A visit to the PSC is planned to submit the statements for registration. 09.06.2016 Statements were obtained	Result: Registered statements on demolition for each building
8	E.A.Sasenov will re-issue the end use and submit the new docs for the lands to the legal departnebt for registration and storage.	The deadline extended till 01.08.2016 Upon E.Sasenov's request, the deadline was prolonged till 31.08.2016.	Result: change of the end use of the lands

Appendix 5.1 : Air Quality Assessment Report

Contents

1 INTRODUCTION

This report provides a detailed air quality assessment for the point source emissions associated with the operation phase of the Kyzyl Gold Project.

During Phase 1 of the project, two new boiler houses, village boiler house and mine boiler house, will be constructed and the existing Auezov boiler house will be decommissioned. The village and mine boiler house will have a total installed capacity of 7.5MW (3 boilers (1 as backup) of 2.5MW each) and 12.5MW (5 boilers (1 as backup) of 2.5MW each) respectively. The boilers will be coal fired and will provide heat for the settlement, mining and processing facilities' needs. The mine boiler house will also include one 1.6MW oil fired boiler which will provide heat for the mining facilities.

1.1 Objectives

This assessment aims to predict the contribution from the operation of the boilers to the local air quality. The main objectives of this assessment are to provide quantitative information and a better understanding of the potential impacts from pollutants emitted from the following sources:

- Mine – Boiler House
    - 4 boilers in operation and 1 standby with coal combustion of 635kg/hr for each boiler – operational for 206 days in a year
    - 1 oil fired boiler 1.6MW which will be operational for 145 days in a year
- Auzeov Boiler House
    - 2 boilers in operation and 1 standby with coal combustion of 635kg/hr for each boiler – operational 365 days a year

To accomplish these objectives, the aerial dispersion of pollutants has been carried out using the steady-state Gaussian plume dispersion model, AERMOD. The assessment has been carried out based on a worst-case approach and therefore all boilers have been assumed to be operational for the entire year and seasonal variations have not been accounted.

The results obtained from the model were compared with the Ambient Air Quality Limits specified in the Rules of the Republic of Kazakhstan and other international guidelines (WHO, International Finance Corporation and European Union).

2 NATIONAL AND INTERNATIONAL AIR QUALITY STANDARDS

Air pollution is regulated by the Environmental Code in the Republic of Kazakhstan. Permits for air pollution are issued within the integrated permitting regime. Limits for discharge of pollutants into the air are defined in the permits for environmental emissions, issued by the Ministry and Akimats. Kazakhstan has established standards for acceptable levels of each contaminant in the air (New Sanitary Norms and Rules of the Republic of Kazakhstan #168, 25 January, 2012).

Table 1 below lists the Kazakh standards for ambient air quality, along with the international standards presented in the International Finance Corporation (IFC) Environmental, Health, and Safety (EHS) Guidelines, which refers to the World Health Organisation Air Quality Guidelines (WHO, 2005), and in the European Directive EC/50/2008 on ambient air quality (EU, 2008).

Table 1: Ambient Air Quality Standards

Parameter	Averaging Period	IFC Guideline Values (WHO Guideline Value) µg/m3	EU Directive 2008/50/EC[3]	Kazakh limit[4] µg/m³
Particulate Matter - PM_{10}	1 hr	-	-	300
	24-hour	150[1]	50	-
	Annual	70[1]	40	-
Nitrogen dioxide (NO_2)	1 hr	200[1]	200	-
	24 hr	-	-	-
	Annual	40[1]	40	40
Sulphur dioxide (SO_2)	1 hr			-
	24 hr	125[2]	125	125
	Annual	-	-	-
Carbon Monoxide	1 hr	30,000[2]	-	-
	24 hr	10,000[2]	10,000	-
	Annual	-	-	-

[1] World Health Organization (WHO). Air Quality Guidelines Global Update, 2005. PM 24-hour value is the 99th percentile. Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines.
[2] These standards are not included in the WHO Air Quality Guidelines Global Update 2005 but can be found in the WHO Air Quality Guidelines for Europe (WHO, 2000).
[3]EU Directive 2008/50/EC
[4]Based on new Kazakh Sanitary Norms and Rules #168, 25, January, 2012

3 BACKGROUND AIR QUALITY

The Environmental Code of Republic of Kazakhstan requires monitoring of ambient air quality on the boundary of the designated SPZ, according to the approved industrial environmental control programme. The detailed results are provided in Chapter 4.4 of the Environmental and Social Impact Assessment report for the project and the maximum concentrations recorded for the monitoring points during 2015 are presented in Table 2.

Table 2:Background Concentrations

Pollutant	Baseline Concentration (µg/m³; 24-hour maximum)	Ambient air quality standard (µg/m³; 24-hour mean)
Particulate Matter (PM_{10})	39.54	TSP: 150.00 PM_{10}: 50.00
Nitrogen Oxides (NO_2)	20.53	NO_2: 40.00
Sulphur dioxide (SO_2)	8.47	125

4 MODEL DESCRIPTION

AERMOD (Lakes Environmental model version 9.1) is a comprehensive multi-level air dispersion modelling system based upon the Gaussian theory of plume dispersion. The model simulates the essential atmospheric physical processes and provides refined concentration estimates over a wide range of meteorological conditions and modelling scenarios.

The model uses input data, including the characteristics of the release (rate, temperature, velocity, height, location etc.), the terrain, meteorological data and the locations of the buildings in the vicinity of emission sources, to predict the concentration of the substance of interest at a specified point. The concentrations of the pollutants are calculated for each hour of the year and for each receptor within the grid. The maximum values (or average values, depending on the environmental specifications) are calculated for each receptor.

5 EMISSION SOURCES

5.1 Stack Characteristics

The flues associated with each boiler within the village/mine boiler house will be accommodated within a single shared stack. Each stack has been included as a point source within the model and the parameters included in the model are shown in Table 3.

Table 3 : Model Parameters for Stack Emissions

Parameter	Mine Boiler House	1.6MW Oil Fired Boiler	Village Boiler House
Total Installed Capacity	12.5MW	1.6MW	7.5MW
Boiler Configuration	5 boilers (4 operational, 1 standby)	1 boiler	3 boilers (2 operational, 1 standby)
Number of stacks	1	1	1
Stack Location	111142 5520396	111129, 5520430	107937, 5520237
Stack Diameter	1.0	0.3	0.8
Stack gas flow (Am^3/s)	12.9	1.2	8.3
Temperature of exhaust gases (^oC)	75	60	70
Stack efflux velocity (m/s)	16.47	16.47	16.47

5.1.1 Emission Limits

The EBRD refers to the EU emission standards for the projects it finances. The EU's Industrial Emissions Directive is one of the main EU instrument regulating pollutant emissions from industrial installations. The IED was adopted on 24 November, 2010. The IED applies to all combustion plants with a total rated thermal input of or greater than 50 MW.

While smaller and bigger plants were covered by respective EU directives, the emissions from medium combustion plants were not regulated at EU level at the time of preparation of the ESIA report. On November 10, 2015, the European Council adopted the Medium Combustion Plant Directive, to limit the emissions from combustion plants of medium size.

The EU's Medium Combustion Plant Directive, regulates emissions of SO_2, NOx and dust into the air with the aim of reducing those emissions and the risks to human health and the environment they may cause. The Directive regulates pollutant emissions from the combustion of fuels in plants with a rated thermal input equal to or greater than 1 megawatt (MWth) and less than 50 MWth.

The emission limits prescribed in the Directive are presented in Table 4.

Table 4: Emission Limit Values

Parameter	EU Medium Combustion Plants Directive (mg/Nm^3)[1]	EU Industrial Emissions Directive (mg/Nm^3)[2]	IFC's Emission Guidelines for Small Combustion Facilities Emissions (3MWth – 50MWth)[3]
Sulphur dioxide	400	400	0.5 percent Sulphur or lower percent Sulphur if commercially available without significant excess fuel cost
Nitrogen Oxides	300	300	N/A
Total suspended particulates	20	30	96 ppm (Electric generation) 150 ppm (Mechanical drive)

The European Council has agreed the following timeframes for the adoption of the emission limits prescribed in the Directive:

- for bigger existing plants (5-50 MW): from 2025
- for smaller existing ones (1-5 MW): from 2030
- for new plants: after a transposition period of two years following entry into force (20 December, 2018 onwards)

Unless the boilers are exempted from the Directive, the boilers for the proposed project are installed after December 20,2018, the emission limit values specified in the Medium Combustion Plant Directive will apply to the project.

5.2 Emission Rates

[1] Directive (EU) 2015/2193 of the European Parliament and the Council of 25 November 2015 on the limitation of emissions of certain pollutants into the air from medium combustion plants
[2] Directive 2010/75/EU of the European Parliament and the Council on industrial emissions
[3] IFC's General EHS Guidelines: Environmental - Air emissions and ambient air quality

5.2.1 Assumptions

The following assumptions have been made to calculate the emission factors based on the data provided in the technical design report for the boilers.

- The total emissions for NO_2 have been calculated as the total of emission factor provided for NO_2 and equivalent NO_2 emission factor for NO using the following equation:

$$Total\ Emission\ Factor\ for\ NO_2 = Emission\ factor\ for\ NO_2 + Emission\ factor\ for\ NO\ x\ \frac{46(molecular\ weight\ of\ \ NO_2}{30(molecular\ weight\ of\ NO)}$$

- A dust removal efficiency of 85% has been considered for the cyclones and the emission factors for total suspended particulate have been carried out using the following equation:

$$Emission\ Factor\ for\ TSP = Emission\ Factor\ before\ mitigation\ x\ (1 - 0.85)$$

5.2.2 Emission Factors

The emission rates included in the AERMOD model are presented in Table 5.

Table 5 : Emission Rates

Parameter	Emission Factors					
	Mine Boiler House		1.6MW oil fired boiler		Village Boiler House	
	mg/m³	g/s	mg/m³	g/s	mg/m³	g/s
Total Suspended Particulates	70.7	0.728	-	-	70.7	0.472
Sulphur Dioxide (SO_2)	598.3	6.2	651.7	0.6	598.3	4.0
Nitrogen Dioxide (NO_2)	140.3	1.4	274.2	0.26	140	0.94
Carbon Monoxide (CO)	379.0	3.9	2160.0	2.1	379.0	2.5

The emission factors for TSP and SO2 for the mine and village boilers exceed the EU's Medium Combustion Plant Directive and additional mitigation measures have been discussed in Section 7 of the report.

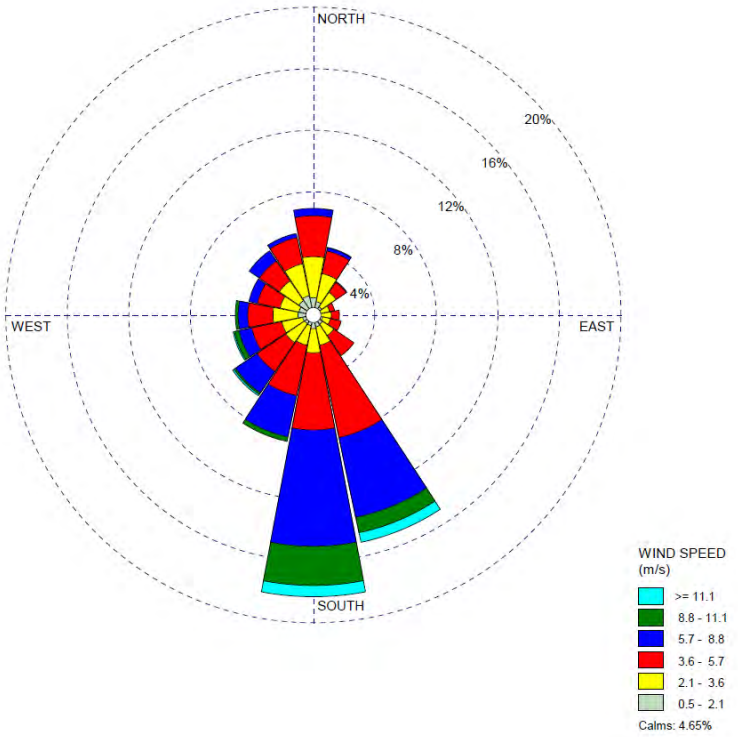
6 MODEL INPUT DATA

6.1.1 Meteorological Data

Pre-processed meteorological data using the MM5 prognostic model, which uses data provided by the National Centres for Environmental Prediction (NCEP) Global Reanalysis was purchased from Lakes Environment for use in the model. MM5 is designed to simulate or predict mesoscale (from 5 to 100 km) atmospheric circulation and uses meteorological data provided by a vast network of meteorological stations. It then uses conservation equations to calculate how the wind field would behave in between met stations.

The meteorological data used in the model comprised of a complete series of hourly values of surface observations and upper soundings for the study area during the period 2015. The surface dataset included wind speed, wind direction, dry bulb temperature, cloud cover, and ceiling height. Upper soundings include wind speed, dew point, atmospheric pressure and measurement height. The windrose for the meteorological data for the period 2015, with the main wind direction from the South, is shown in Figure 1.

Figure 1: Wind rose for MM5 Pre-processed Data (wind blowing from) for the Project Area, 2015



The surface observations, upper soundings and land use parameters (albedo, Bowen ratio and surface roughness) were used as input data in the meteorological pre-processor AERMET to calculate the boundary layer parameters (friction velocity, Monin-Obukhov length, convective velocity scale, temperature scale, mixing height and surface heat flux). The output of the AERMET pre-processor comprised of two files that were used as inputs into the AERMOD air dispersion model.

6.1.2 Topography

Elevated terrain was used in the model and the AERMAP pre-processor was used to account for terrain features, using terrain data of the area provided by the client.

6.1.3 Receptors

The assessment has focused on five receptors in the settlement of Auezov and nearby hamlet of Solnyechni, all of which are residential in nature. The details of these receptors are provided in Table 6 and Figure 2.

Table 6: Sensitive Receptor Locations Included in the Dispersion Modelling Assessment

Receptor	Address	Receptor Type	Location		Approximate Distance and Bearing to Point Source of Emissions (m)	
			Latitude	Longitude	Mine Boiler House	Village Boiler House
ESR 1	Northern corner of Auzeov settlement	Residential	49°42'50.62"N	81°34'31.03"E	2252, northwest	1025, northeast
ESR 2	Southern corner of Auzeov settlement	Residential	49°42'23.07"N	81°34'50.55"E	1817, southwest	1443, southeast
ESR 3	Auzeov school	Residential	49°42'21.90"N	81°34'9.36"E	2634, west	646, east
ESR 4	Eastern corner of Auzeov settlement along	Residential	49°42'52.57"N	81°35'17.55"E	1318, west	2098, northeast
ESR 5	Solnyechni village along Bakyrchik-Bursak bypass road	Residential	49°42'4.50"N	81°35'52.44"E	1130, south	2780, southeast

Figure 2: Environmental sensitive receptor locations

In addition to the identified receptor locations, a uniform Cartesian grid has also been modelled. The parameters of the modelled Cartesian grid are included in Table 7.

Table 7 : Uniform Cartesian Grid Parameters

Parameter	X	Y
South West Grid Coordinates	107170 (81°33'9.063" E)	5518191 (49°41'16.452"N)
Number of Points	21	21
Spacing (m)	306.55	294.59
Length (m)	6131.0	5891.8
Total Number of Grid Receptors	441	

6.1.4 Building downwash effects

The presence of buildings can affect plume rise and the initial dispersion of pollutants within the atmosphere. Turbulent wake zones can be created around buildings that force pollutants to the ground instead of allowing them to rise freely within the atmosphere. Building downwash occurs as the wind flows over and around buildings and impacts the dispersion of pollution from nearby stacks. To account for these effects, the dimensions of the nearby buildings, as available from the design drawings were incorporated in the model. The free standing machinery and the piping network was not included for building downwash effects as it couldn't be accurately represented in the model.

Table 8 : Buildings considered in the model

Building	Description	Base Elevation (m)	Building Height (m)	Easting (X)	Northing (Y)
BLD_1	Mine Boiler House Building	460	8.2	111133 (81°36'17.998")	5520420 (49°42'37.551")
BLD_2	Hopper - Mine Boiler House	460	5.82	111173 (81°36'19.962")	5520427 (49°42'37.87")
BLD_3	Village Boiler House Building	380	8.2	107917 (81°33'38.706")	5520262 (49°42'24.959")
BLD_4	Hopper - Village Boiler House	380	5.8	107950 (81°33'40.346")	5520262 (49°42'25.036")
BLD_5	1.6MW Boiler Building	460	5.65	111130 (81°36'17.788")	5520437 (49°42'38.092")

7 RESULTS AND DISCUSSIONS

This section provides details of the model output and results. The maximum concentrations estimated at the receptor locations have been added to the background concentrations available for the area (as described in Section 3) to calculate the Predicted Environmental Concentrations. The Predicted Environmental Concentrations (PEC) have been compared to the Ambient Air Quality Limits for human health.

7.1 Total Suspended Particulates(TSP)

The maximum predicted concentrations at each of the receptor locations are provided in Table 9. The background concentrations available for PM10 have been used to estimate the predicted environmental concentrations in the absence of background concentrations for total suspended particulates.

Table 9 : Estimated Concentrations - Total Suspended Particulates

Receptor	Averaging Period	Maximum Predicted Process Contribution	Background Concentration (µg/m³)*	Predicted Environmental Concentration (µg/m³)	Ambient Air Quality Limits (AQL) (µg/m³)	
					WHO Guideline	National Limits

		(µg/m³)				
ESR 1	1-hour	2.64	-	-	-	300
	24 – hour	0.47	39.54	40.01	150/50	-
	Annual	0.05	-	-	70/40	-
ESR 2	1-hour	2.70	-	-	-	300
	24 – hour	0.55	39.54	40.09	150/50	-
	Annual	0.04	-	-	70/40	-
ESR 3	1-hour	3.37	-	-	-	300
	24 – hour	0.84	39.54	40.38	150/50	-
	Annual	0.10	-	-	70/40	-
ESR 4	1-hour	15.98	-	-	-	300
	24 – hour	1.06	39.54	40.60	150/50	-
	Annual	0.08	-	-	70/40	-
ESR 5	1-hour	14.54	-	-	-	300
	24 – hour	1.28	39.54	40.82	150/50	-
	Annual	0.08			70/40	-

** - Background concentrations for PM_{10}*

The results indicate that the predicted environmental concentrations are within the prescribed ambient air quality limits and the contribution from the boilers associated with the project is minor. Unless the boilers are exempt from the Medium Combustion Plant Directive, and are installed after December 20, 2018, it is recommended that a higher efficiency dust control system such as Electrostatic Precipitator is considered to comply with the EU's Medium Combustion Plant Directive.

7.2 Sulphur Dioxide(SO_2)

The results for the maximum predicted concentrations and predicted environmental concentrations at each of the receptor locations for sulphur dioxide is presented in Table 10.

Table 10 : Estimated Concentrations –Sulphur Dioxide

Receptor	Averaging Period	Maximum Predicted Process Contribution (µg/m³)	Background Concentration (µg/m³)	Predicted Environmental Concentration(µg/m³)	Ambient Air Quality Limits (AQL) (µg/m³)	
					IFC/EU Guidelines	National Limits
ESR 1	1-hour	22.28	-	-	-	-
	24 – hour	3.96	8.47	12.43	125	125
	Annual	0.52	-	-	-	-
ESR 2	1-hour	23.17	-	-	-	-
	24 – hour	4.66	8.47	13.13	125	125
	Annual	0.40	-	-	-	-
ESR 3	1-hour	28.46	-	-	-	-
	24 – hour	7.14	8.47	15.61	125	125
	Annual	0.88	-	-	-	-
ESR 4	1-hour	135.05	-	-	-	-
	24 – hour	8.98	8.47	17.45	125	125
	Annual	0.75	-	-	-	-

ESR 5	1-hour	122.95	-	-	-	-
	24 – hour	10.87	8.47	19.34	125	125
	Annual	0.91	-	-	-	-

The results indicate that the increase over the background concentrations is significant, however, this is due to the lower baseline concentrations in the region due to its pristine settings and is within the prescribed EU/IFC/national guidelines. Unless the boilers are exempt from the Medium Combustion Plant Directive, and are installed after December 20, 2018, it is recommended that low sulphur coal is considered and/or a flue gas desulphurisation system is considered for the project to meet the EU's Medium Combustion Plant Directive.

7.3 Nitrogen Dioxide (NO_2)

The process contribution and predicted environmental concentrations for nitrogen dioxide are presented in Table 11.

Table 11 : Estimated Concentrations – Nitrogen Dioxide

Receptor	Averaging Period	Maximum Predicted Process Contribution (µg/m³)	Background Concentration (µg/m³)	Predicted Environmental Concentration (µg/m³)	Ambient Air Quality Limits (AQL) (µg/m³)	
					WHO/EU Guideline	National Limits
ESR 1	1-hour	8.42	-	-	200	-
	24 – hour	1.08	20.53	21.61	-	-
	Annual	0.13	-	-	40	40
ESR 2	1-hour	9.75	-	-	200	-
	24 – hour	1.30	20.53	21.83	-	-
	Annual	0.11	-	-	40	40
ESR 3	1-hour	6.70	-	-	200	-
	24 – hour	1.68	20.53	22.21	-	-
	Annual	0.22	-	-	40	40
ESR 4	1-hour	31.75	-	-	200	-
	24 – hour	2.11	20.53	22.64	-	-
	Annual	0.20	-	-	40	40
ESR 5	1-hour	28.90	-	-	200	-
	24 – hour	2.56	20.53	23.09	-	-
	Annual	0.25	-	-	40	40

The results indicate that the predicted environmental concentrations are well within the ambient air quality limits.

7.4 Carbon Monoxide (CO)

The model results for Carbon Monoxide are presented in Table 12.

Table 12 : Estimated Concentrations – Carbon Monoxide						
Receptor	**Averaging Period**	**Maximum Predicted Process Contribution (µg/m³)**	**Background Concentration(µg/m³)**	**Predicted Environmental Concentration (µg/m³)**	**Ambient Air Quality Limits (AQL) (µg/m³)**	
					WHO Guideline	**National Limits**
ESR 1	1-hour	66.32	-	-	30,000	-
	24 – hour	7.86	-	-	10,000	-
	Annual	0.50	-	-	-	-
ESR 2	1-hour	76.78	-	-	30,000	-
	24 – hour	9.64	-	-	10,000	-
	Annual	0.47	-	-	-	-
ESR 3	1-hour	52.81	-	-	30,000	-
	24 – hour	6.15	-	-	10,000	-
	Annual	0.69	-	-	-	-
ESR 4	1-hour	84.62	-	-	30,000	-
	24 – hour	8.00	-	-	10,000	-
	Annual	0.77	-	-	-	-
ESR 5	1-hour	77.04	-	-	30,000	-
	24 – hour	12.95	-	-	10,000	-
	Annual	1.15	-	-	-	-

The results indicate that the estimated process contribution from boiler is negligible and will therefore not result in exceedances of the ambient air quality limits.

8 CONCLUSIONS

Dispersion modelling using AERMOD was undertaken for the boilers associated with the project and the process contribution of TSP, SO_2, NO_2 and CO were compared against the ambient air quality limits (for the protection of human health) prescribed by EU/IFC and national guidelines.

The results of the assessment indicate that, for the receptor locations assessed, the short and long term predicted concentrations for all the pollutants modelled, lie within the respective ambient air quality limits. Unless the boilers are exempt from the Medium Combustion Plant Directive, and are installed after December 20, 2018, the following mitigation measures have been recommended to ensure compliance with the Medium Combustion Plant Directive:

- Use of low sulphur fuel and/or use of a flue gas desulphurisation unit
- Use of higher efficiency dust removal equipment such as high efficiency cyclones or Electro-static Precipitators.