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The Directors
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Date 12th May 2011

Dear Sirs,

Competent Persons Report of the Mining Assets of Kazakhmys Plc, Kazakhstan and Kyrgyzstan

Purpose of Report

This report has been prepared by IMC Group Consulting Ltd ("IMC") for the possible inclusion in a listing document (the "Listing Document") which may be published by Kazakhmys Plc (the "Company") in connection with a secondary listing of its ordinary Shares by the Company.

IMC was instructed by the Directors of the Company to prepare a Competent Person's Report (CPR) for the mining assets of the Company. This report, which summarises the findings of IMC's review, has been prepared in order to satisfy the requirements of a Competent Person's Report as set out in the Prospectus Directive in conjunction with the recommendations of the CESR, the Listing Rules of the UKLA and with Chapter 18 of the Listing Rules of the Stock Exchange of Hong Kong Limited.

IMC has reviewed the practices and estimation methods undertaken by the Company for reporting reserves and resources in accordance with Kazahkstan's 2006 classification which is largely based on the Former Soviet Union "Classification and Estimation Methods for Reserves and Resources," last revised in 1981, and submitted as is mandatory to the Committee of Geology at the Ministry of Industry and New Technologies of the Republic of Kazahkstan. This procedure establishes the nature of evidence required to ensure compliance with the Classification. Within this is a "Conditions for Estimation of Reserves and Resources" unique to each deposit. IMC has reviewed the reserves and resources statements of the individual units compiled by the Company and has restated the reserves and resources in compliance with the Prospectus Directive and in accordance with the criteria for internationally recognised reserve and resource categories of the "Australasian Code for Reporting Mineral Resources and Ore Reserves" (2004) published by the Joint Ore Reserves Committee ("JORC") of the Australasian Institute of Mining and Metallurgy, Australian Institute of Geoscientists and the Minerals Council of Australia (the "JORC Code"). In this report, all reserves and resources estimates, initially prepared by the Company in accordance with the FSU Classification, have been substantiated by evidence obtained from IMC's site visits and observation and are supported by details of drilling results, analyses and other evidence and takes account of all relevant information supplied by the management of the Company and its subsidiaries (the "Group").

In restating the Company's mineral inventory IMC has adopted the findings of the Committee for Mineral Reserves International Reporting Standards (CRIRSCO) which has in recent years worked with the Russian Federal Government Agency State Commission on Mineral Reserves to produce the "Guidelines on Alignment of Russian minerals reporting standards and the CRIRSCO Template", (the "CRIRSCO Guidelines"), published in August 2010. CRIRSCO is a body representing the minerals industry in Canada, Australasia, USA, Europe, South Africa and Chile.

In accordance with the Prospectus Directive in conjunction with the recommendations of the CESR, the Listing Rules of the UKLA and Chapter 18 of the Listing Rules of the Stock Exchange of Hong Kong Limited, only Proved and Probable Reserves have been valued. Other assets of the Company, which include resources, have not been included in the valuation.

Capability and Independence

This report was prepared by IMC, the signatory to this letter. The IMC signing Director is a Fellow of the Institute of Materials, Minerals and Mining; Chartered Engineer; European Engineer (Eur Ing) and has 35 years experience in the coal, base metals and industrial minerals mining industry and 8 years of directing Competent Person's and Mineral Expert's Reports. Details of the qualifications and experience of the consultants who carried out the work are in Appendix A to this report.

IMC operates as an independent technical consultant providing resource evaluation, mining engineering and mine valuation services to clients. IMC has received, and will receive, professional fees for its preparation of this report which is not dependent upon the report's findings. However, neither IMC nor any of its directors, staff or sub consultants who contributed to this report has any interest in:

- The Company or Kazakhmys Plc; or

- the mining assets reviewed; or
- the outcome of any possible financing initiative.

Drafts of this report were provided to the Company, but only for the purpose of confirming both the accuracy of factual material and the reasonableness of assumptions relied upon in the report.

Scope of Work / Materiality / Limitations and Exclusions

IMC reviewed the assets in accordance with the scope of work and exclusions and limitations and on the basis of the materiality criteria set out in Appendix B to this report.

IMC has independently assessed the mining assets of the Company by reviewing pertinent data, including resources, reserves, manpower requirements, environmental issues and the life-of-mine ("LOM") plans relating to productivity, production, operating costs, capital expenditures and revenues.

All opinions, findings and conclusions expressed in this report are those of IMC and its sub consultants.

There have been no indemnities provided to IMC by the Company in the preparation of this CPR.

Inherent Mining Risk

Open pit and underground mining is carried out in an environment where not all events are predictable.

Whilst an effective management team can, firstly, identify the known risks, and secondly, take measures to manage and mitigate these risks, there is still the possibility for unexpected and unpredictable events to occur. It is therefore not totally possible to remove all risks or state with certainty that an event that may have a material impact on the operation of a mine, will not occur.

Glossary of Terms

Defined and technical terms used in this report are set out in Appendix D.

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1 OVERVIEW

1.1 General

Kazakhmys operates from a number of operational and administrative centres reporting into a headquarters in Almaty. The main centres are the Zhezkazgan, Balkhash, East Region, Karaganda and Kyrgyzstan. The Zhezkazgan operations include mines and facilities producing copper metal and a slime containing silver sent to Balkhash. Balkhash comprises the mines and concentrators and facilities to produce copper, gold and silver metal. East Region includes mines and concentrators which produce copper and zinc concentrates. Karaganda includes mines, concentrators and facilities to produce copper, zinc and gold in concentrates as well as two coal mines.

The Zhezkazgan copper reserves lie in three discrete areas (Zhezkazgan, Zhilandy and Zhaman-Aybat) of the same sedimentary geological system and are exploited by underground and open pit mines. The ore feeds three concentrators, a smelter and a refinery. Silver slimes are sent to Balkhash for processing. The refinery provides the cathode processed by the copper rod plant. Power and heating is supplied from the combined heat and power ("CHP") station in Zhezkazgan and additional power from the national grid.

The geology of the Balkhash operations encompasses a number of discrete copper porphyry, skarn and intrusive-hosted iron oxide copper-gold deposits which are mined by underground and open pit methods feeding ore to the concentrator, smelter and refinery at Balkhash. The precious metals (gold and silver) slimes from all of the Kazakhmys' operations are treated in the precious metals refinery. Power is, in part, supplied from the CHP power plant in Balkhash and additional power is sourced from the national grid.

The geology of the East Region consists of a number of discrete volcanogenic massive sulphide (VMS) deposits exploited by underground mining methods. Copper and zinc concentrates are produced from the five concentrators, copper concentrate is railed to Balkhash, the copper for smelting and refining and the zinc concentrate is sold without further processing.

Karaganda has a geological regime which encompasses both copper and gold dominant deposits exploited by both underground and open pit mines. Copper and zinc concentrates are produced at one concentrator with copper concentrate only at the other. In addition, two coal mines supply the power generation plants at Zhezkazgan and Balkhash which supply electricity to the various Kazakhmys operations through the national grid.

Kyrgyzstan has a gold project at Bozymchak which is not yet developed. Mineralisation is generally in skarn zones, in the form of disseminated sulphides with associated gold and is to be exploited by open pit and underground mining and processed into gold metal on site.

1.2 Description of Assets

IMC reviewed the assets listed in Table 1-1 to Table 1-4, all of which are wholly owned by Kazakhmys and located as shown in Plate 1, Appendix C.

Table 1-1 Zhezkazgan Complex List of Assets

Asset	Status	Type	Product / Output	Date of Commencement of Operation
Zhezkazgan Complex Mining				
North	Operating	Open pits	Copper, silver	1980's
South	Operating	Underground	Copper, silver	1940's
Stepnoy	Operating	Underground	Copper, silver	2005
East	Operating	Underground	Copper, silver	1940's
West	Operating	Underground	Copper, silver	1940's
Annensky	Operating	Underground	Copper, silver	1995
Zhomart	Operating	Underground	Copper, silver	2007
Akchi Spassky	Project	Open pit	Copper, silver	NA
East Saryoba	Project	Underground	Copper, silver	NA
Itauz	Project	Underground	Copper, silver	NA
West Zhezkazgan	Project	Open pit	Copper, silver	NA
Zhomart II	Project	Underground	Copper, silver	NA
Processing, Smelting/Refining				
Zhezkazgan No. 1	Operating	Concentrator	Copper concentrate	1954
Zhezkazgan No. 2	Operating	Concentrator	Copper concentrate	1963
Satpaev	Operating	Concentrator	Copper concentrate	1985
Smelter	Operating	Electric smelter	Copper anodes	1973
Refinery	Operating	Electro-winning	Copper cathodes, silver slimes	1971
Other				
Rod Plant	Operating	Southwire plant	Copper rod (8 mm)	1994
Power Station	Operating	CHP	Electricity and heat	1959

Table 1-2 Balkhash Complex List of Assets

Asset	Status	Type	Product / Output	Date of Commencement of Operation
Balkhash Complex Mining				
Shatyrkul	Operating	Underground	Copper, gold, silver	1999
Konyrat	Operating	Open pit	Copper, silver	1934
Sayak I	Operating	Underground	Copper, gold	1970
Sayak II	Completed	Open pit	Copper, gold	1976
Sayak III and Tastau	Operating	Underground	Copper, gold	1970
Sayak IV	Developing	Underground	Copper, gold	NA
Aktogay	Project	Open pit	Copper, molybdenum	NA
Aidarly	Project	Open pit	Copper, gold, silver	NA
Zhaisan	Project	Open pit	Copper, gold, silver	NA
Processing, Smelting/Refining				
Balkhash	Operating	Concentrator	Copper concentrate	1937
Smelter	Operating	Vanyukov and reverberatory	Copper anodes	1930's
Refinery	Operating	Electro-winning	Copper cathodes	1952
Zinc Plant	Suspended	Hydrometallurgical	NA	2004
Precious Metals Refinery	Operating	Boliden	Gold bars, silver granules	1997
Other				
Power Station	Operating	CHP	Electricity and heat	1930's

Table 1-3 East Region List of Assets

Asset	Status	Type	Product / Output	Date of Commencement of Operation
East Region Mining				
Artemyevsky	Operating	Underground	Copper, zinc, gold, silver	2006
Belousovsky	Operating	Underground	Copper, zinc, gold, silver	1939
Irtyshsky	Operating	Underground	Copper, zinc, gold, silver	1952
Nikolayevsky	Operating	Underground	Copper, zinc, gold, silver	1964
Orlovsky	Operating	Underground	Copper, zinc, gold, silver	1977
Yubileyno-Snegirikhinsky	Operating	Underground	Copper, zinc, gold, silver	2003
Anisimov Kluch	Project	Underground or Open pit	Copper, zinc, gold, silver	NA
North Nikolayevsky	Project	Underground or Open pit	Copper, zinc, gold, silver	NA
Mukur	Operating	Open pit	Gold	2003
Zhaima	Suspended	Open pit	Gold	2007
Processing, Smelting/Refining				
Belousovsky	Operating	Concentrator	Copper and zinc concentrates	1939
Berezovsky	Operating	Concentrator	Copper and zinc concentrates	1952
Nikolayevsky	Operating	Concentrator	Copper and zinc concentrates	1980
Orlovsky	Operating	Concentrator	Copper and zinc concentrates	1988

Table 1-4 Karaganda and Kyrgyzstan List of Assets

Asset	Status	Type	Product / Output	Date of Commencement of Operation
KARAGANDA				
Mining				
Nurkazgan	Operating	Underground	Copper, zinc, gold, silver	2009
Abyz	Operating	Open pit	Gold, copper, zinc, silver	2005
Mizek	Operating	Open pit	Gold, silver	2003
Molodezhny	Operating	Surface strip mine	Coal	1980
Kuu-Chekinsky	Operating	Surface strip mine	Coal	1956
Akbastau	Project	Open pit	Copper, zinc, gold, silver	NA
Kosmurun	Project	Underground	Copper, zinc, gold, silver	NA
Bozshakol	Project	Open pit	Copper, gold, molybdenum, silver	NA
South East Nurkazgan	Project	Open pit	Copper, gold, silver	NA
Charsk Gold Belt	Project	Open pit	Copper, zinc, gold, silver	NA
Processing, Smelting/ Refining				
Nurkazgan	Operating	Concentrator	Copper concentrates	2004
Karagaily	Operating	Concentrator	Copper and zinc concentrates	1978
Kyrgyzstan				
Bozymchak	Project	Underground	Gold, silver, copper	NA

1.3 Company Ownership Structure

Figure 1-1 below shows the Kazakhmys company structure as at 1 January 2010.

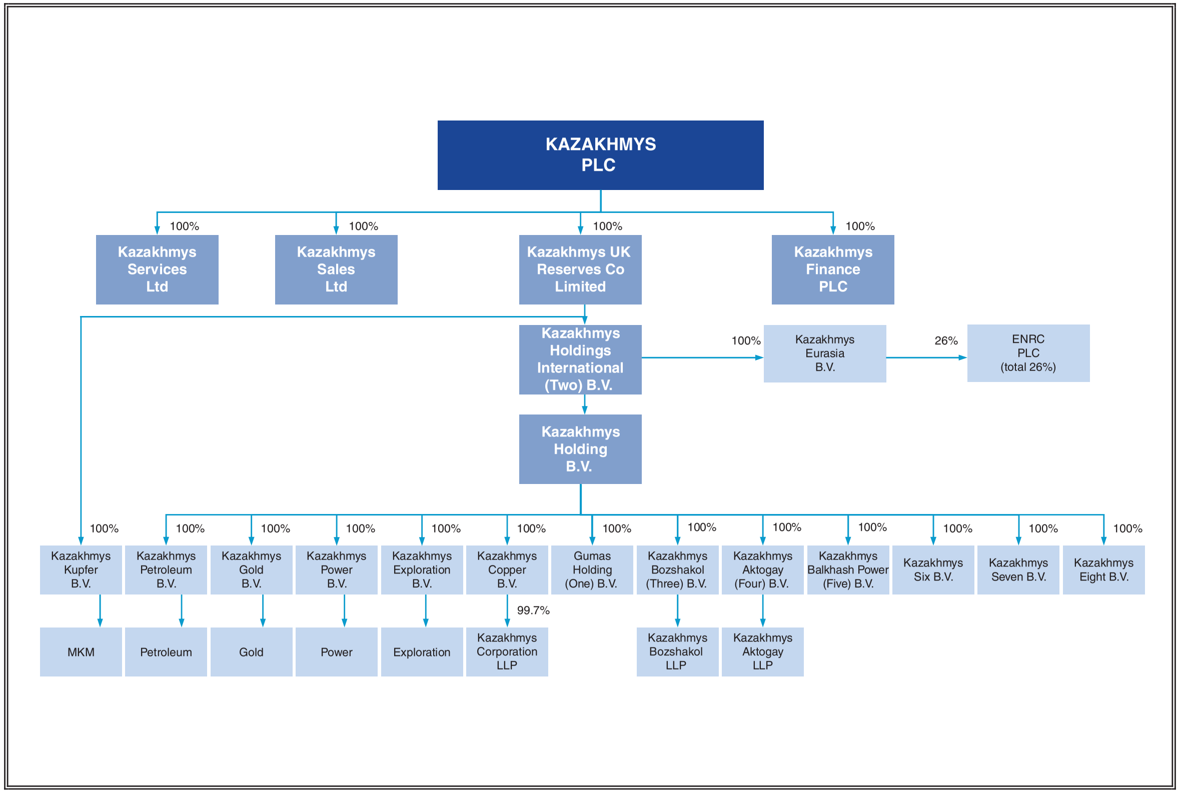

Figure 1-1 Company Structure as at 1 January 2010

1.4 Summary of Geological Characteristics

1.4.1 Zhezkazgan Complex

The North, South, Stepnoy, East, West and Annensky mines north west of Zhezkazgan exploit the Taskudukskya and Zhezkazganskaya sedimentary sequence comprising 10 horizons over the 630 metres sequence. The ore bodies average 3 metres to 5 metres in thickness with a maximum of 20 metres and are stratiform.

The Zhomart mine exploits the Zhaman-Aybat deposit and is located approximately 130 kilometres south east of Zhezkazgan and is interpreted as the same sequence. Only one horizon however is mineable although other horizons have been encountered in drillholes. The Zhaman-Aybat orebody varies from 2 metres to 6 metres in thickness with an average of 4.5 metres and is stratiform.

1.4.2 Balkhash

Shatyrkul is a copper, gold and silver deposit contained within steep shear zones associated with potassic hydrothermal alteration along a 5 kilometres strike distance.

The Konyrat copper deposit is porphyry resulting from felsic magmatic intrusions resulting in pervasive low grade mineralisation.

Sayak I and Sayak III are 10 kilometres apart and exploit the copper skarn deposits that occur as layered and lenticular irregular bodies up to 1,500 metres long, 700 metres wide and between 10 metres to 50 metres thick. The ores occur as massive, disseminated or stacked in vein systems.

Aktogay is a porphyry copper-molybdenum deposit with an inverted funnel form measuring approximately 1.8 kilometres across and extending to a depth in excess of 500 metres.

1.4.3 East Region

Kazakhmys exploit a number of unusually large, polymetallic, high grade copper / zinc, gold rich volcanogenic massive sulphide (VMS) ore bodies at Artemyevsky, Belousovsky, Irtyshsky, Nikolayevsky, Orlovsky and Yubileyno-Snegirikhinsky.

1.4.4 Karaganda

Nurkazgan occurs as both 300 metre diameter copper porphyry and quartz veined stockwork ore bodies.

The Abyz VMS deposit is located in a complex of lower and mid-Palaeozoic (Ordovician—Devonian) volcano-sedimentary strata which have suffered folding and locally intense faulting. It is both massive and disseminated and occurs as lenses.

The Mizek deposit is located in a complex structural environment and is hosted in a folded and faulted sequence of Ordovician—Silurian volcano-sedimentary strata with a predominant structural trend marked by sinuous NNE-SSW faults and fold axes.

The Molodezhny and Kuu-Chekinsky coal deposit is typical of inland basin deposition forming high ash content low sulphur coal. The seams at Molodezhny are 2 metres to 21 metres in thickness with low strata dips and few faults. The seams at Kuu-Chekinsky are typically 8 metres to 12 metres thick with a series of reverse faulted anticlines and synclines.

1.4.5 Bozymchak Kyrgyzstan

The Bozymchak deposits were generated by intrusion of a large granitoid stock with pinkish-grey porphyritic granites of the Dzhalgyzuriuk massif into carbonate country rocks of Devonian and Carboniferous age. Mineralisation is generally in skarn zones, in the form of disseminated sulphides with associated gold.

1.5 Reserves and Resources

1.5.1 Categorisation of Reserves and Resources under JORC

The Republic of Kazakhstan in 2006 incorporated by law a classification system and estimation methods for reserves and resources based largely on those established by the Former Soviet Union and last revised in 1981. In practice, this means that the statements of reserves and resources developed by Kazakhmys and the mining plans to which they relate must be submitted for approval to the corresponding committees of the Ministry of Industry and New Technologies for which adherence to the standardised national system of reserves and resources estimation is mandatory.

As part of the exploitation licence for each mineral deposit, a set of Conditions for Estimation of Reserves were prepared by the corresponding national design institute and were approved within the national State Plan. The conditions apply a well-defined process of classifying the specific deposit into one of three major deposit complexity categories, subject to which, the principles for exploration and classification of reserves and resources have been established. Reserves and resources are classified into five main classes and designated by the symbols A, B, C1, C2, P1 and P2, based on the degree of reliability of exploration data.

The Conditions for Estimation of Reserves for each deposit specify the minimum thickness for exploitation of the orebody and cut-off grades, plus special considerations which may apply where the conditions for mineral extraction are exceptional or present difficulties. With reference to these conditions, the reserves stated for each deposit are further categorised as "balance reserves", which means they meet the pre-determined criteria for economically justifiable extraction, or are "off-balance resources" considered to be uneconomic to exploit.

The major deposit categories are classified according to the size, continuity and structural disposition of the deposit. With respect to the deposits in exploitation or planned for future operation by Kazakhmys, the three complexity categories are:

- Category 1 deposits are large deposits, simple in form with uniform distribution of minerals (examples: coal deposits, the stratiform disseminated copper deposits of the Zhezkazgan). The highest confidence classes of reserves, A + B reserves, can be established on the basis of drillholes, trenches and trial pits.

- Category 2 deposits are large deposits with variable and sometimes complicated forms and an uneven distribution of minerals (examples include part of the Orlovsky deposits). Only B and C1 reserves may be defined based on exploration data, such as drillholes, trenches and pits, and higher confidence reserves classes can be established only by a combination of closely spaced drillholes and active exploitation.

- Category 3 deposits are smaller-sized deposits with uneven distribution of minerals (examples include vein-hosted or pegmatite deposits, skarns and dykes such as Orlovsky and Sayak deposits). Only C1 and C2 reserves may be defined based on exploration data and higher confidence reserves classes can be established only on the evidence of operational experience.

The classification of reserves and resources in higher confidence classes based on progressively higher density of observation points is broadly in line with Western resource categories. There is common consensus, supported by the experience of the Consultants, that the spacing of deposit definition points prescribed in the Soviet system is generally more exacting than commonly applies in Western exploration practice. The criteria for the classes of reserves and resources used in the Soviet system, as currently applies in Kazakhstan, may be summarised:

- Category A: the deposit is known in detail; boundaries of the deposit have been outlined by trenching, drilling, or underground workings. The quality and properties of the ore are known in sufficient detail to ensure the reliability of the projected exploitation.

- Category B: the deposit has been explored but is only known in fair detail; boundaries of the deposit have been outlined by trenching, drilling, or underground workings. The quality and properties of the ore are known in sufficient detail to ensure the basic reliability of the projected exploitation.

- Category C1: the deposit has been estimated by a grid of trenches, drillholes or underground workings. The quality and properties of the deposit are known tentatively by analogy with known deposits of the same type and the general conditions for exploitation are known tentatively. This category includes resources peripheral to the boundaries of the A and B category and also reserves allocated in complex deposits in which the ore distribution cannot be reliably determined even by a very dense grid.

- Category C2: deposit has been estimated from sparse sampling or extrapolated from limited data. This category includes resources adjoining areas designated as A, B, and C1 in the same deposit.

After inspection of the Conditions for Estimation of Reserves which apply to the specific deposits under exploitation and exploration by Kazakhmys, and the corresponding density of exploration data required for the classification of resources, the Consultants are of the view that classification of resources and resource blocks in the categories A, B, C1 and C2 is a reliable guide to the confidence for volumetric definition of resources in-place. The

Conditions for Estimation of Reserves define cut-off grades and minimum/maximum mining width constraints. These appear consistent with the current commercial performance of the operations and a relevant guide to the commercial exploitability of these resources.

The computation method for reserves and resources is also specified in the Conditions for Estimation of Reserves for each deposit. This follows methods defined under the Soviet administration, for which the detail of the method depends on the geometry of the deposit. Traditionally computation methods have been based on manual calculations but in recent years computer based methods have been approved for certain deposits. Calculation methods have been reviewed at the Zhezkazgan Project Office, previously the NIPITsvetMet Institute, and now part of Kazakhmys. Resource quantities are estimated based on a computed average grade of mineral within polyhedral blocks. These computations are readily checked and follow a set of standard rules. In the view of IMC, these methods are valid estimations of ore quantities and contained metal, supported by many years of production experience under a system requiring reconciliation of estimated and actual ore extraction on an annual basis.

The current management of resource extraction planning comprises a long-term strategic plan which establishes targets for ore production and ore grade, with allowance for standard dilution and losses, which are allocated on an annual basis to each production unit. It is the responsibility of each operating unit to prepare an annual exploitation plan to meet the strategic production target, within cost budget limits set by the central organisation of Kazakhmys. Each mine planning unit prepares a detailed annual plan for extraction of reserves, which is submitted to Kazakhmys for approval and then to the Zhezkazgan Project Office for checking, prior to submission to the government authorities ("Territorial Bodies of the Geology and Sub-Soil Use Committee" and "State Emergency Committee"). Reserve depletion is calculated on an annual basis, against the nominal reserves base, and reconciliation establishes reserves which may be required to be written off and restates the reserve base.

It is the opinion of IMC that this system represents a very traditional system of resource management as demanded by national legislation. The system is nevertheless a robust and reliable reflection of the utilisation and depletion of reserves and resources.

For sediment hosted deposits, the in-situ resource volume is estimated by the determination of the inclined area of the ore horizon within the lease areas and the multiplication of this area by the average horizon thickness as estimated from drillhole and mining data. The estimate of resource tonnage is obtained by multiplication of the estimated volume by the assumed specific gravity (SG).

The porphyry, vein and VMS deposit volumes are estimated by the determination of the areas at specific levels or cross sections and the multiplication of this area by the average thickness estimated from sections through the applicable area. Thereafter the calculation follows the same format as for the sedimentary deposits.

The Former Soviet Union system includes defined standards and procedures for exploration drilling and sampling as well as standards during subsequent development and during production. Drilling and channel sampling is carried out during development and samples analysed and included into plans. Similar standards and procedures are also defined for the production phase and channel samples in stopes, grab samples at loading points and from ore trucks are taken (usually at a weighbridge in the latter case). These are all analysed and, with check samples, sent for analysis. The results of the ore analysis are included in the plans.

Reserves and resources have been estimated according to the Former Soviet Union "Classification and Estimation Methods for Reserves and Resources."

The IMC has reviewed the reserves and resources statements of the individual units and have restated the reserves and resources in accordance with JORC as in Table 1-5 below.

Table 1-5 Classification of Reserves / Resources and Relationship of FSU Categories with International Definitions

FSU Reserve Category	Reserve blocks identified for extraction within Plans	Resources not allocated to detailed plans (may be scheduled in long-term strategic plans without cost support)
A	Proved reserve	Measured resource
B	Proved reserve	Measured resource
C1	Proved/probable reserve	Measured/Indicated resource
C2	Probable reserve	Indicated/Inferred resource
P1	—	Inferred resource/Exploration results
P2	—	Exploration results

All reserves quoted in tables in this report are discounted for ore losses and dilution. Resources are not discounted for losses and dilution and are inclusive of reserves. All figures in reserves and resources are in metric tonnes and are dated 1 January 2011.

In accordance with the Prospectus Directive in conjunction with the recommendations of the CESR, the Listing Rules of the UKLA and Chapter 18 of the Listing Rules of the Stock Exchange of Hong Kong Limited, only Proved and Probable Reserves have been valued. Other assets of Kazakhmys, which include extensive resources and MKM's assets, have not been included in the valuation.

1.5.2 Reserves and Resources Statement

Table 1-6 to Table 1-17 inclusive show the reserves and resources of Kazakhmys.

It will be noted that in most cases the reserves and resources are, excluding the discounts included in the reserves for losses and dilution, identical. This is a result of the maturity of the operations and the exploration programmes in a finite lease area. The FSU exploration programmes for these operations, many of which were carried out in the 1950's, were far more comprehensive both in the density of drilling and sample analysis than could ever be considered commercially viable in the west and more comprehensive than that required by most internationally recognised methods of classification. Most of the deposit would then have been stated as a reserve at establishment of the operation as opposed to commercially driven mining companies in the west who will confirm the minimum reserves to develop a project into an operation and subsequently, when a cash flow is established, convert resources to reserves and confirm additional resources. Subsequent operation during and since FSU times has resulted in further confirmation of probable reserves which have not, in the current Kazakhmys plans, been upgraded to proved reserves.

A similar statement is applied to the current and future projects. Kazakhmys tenders for these as do other interested parties. In the process, the interested parties have access to all of the information accumulated during the extensive drilling and sampling programmes associated with the project as well as the comprehensive feasibility studies completed at the time. The data will, in most cases, be sufficiently comprehensive that the majority, if not all, of the deposit can be quoted as a probable reserve.

Table 1-6 Zhezkazgan Operating Mines Reserves and Resources as at 1 January 2011

	Mineral Resources				Ore Reserves			
Mine	Category	'000 t	Cu%	Ag g/t	Category	'000 t	Cu%	Ag g/t
Annensky	Measured	6,881	0.72		Proved	5,168	0.66	
LOM 11.9 Years	Indicated	40,936	0.86		Probable	30,747	0.79	
	Total	47,817	0.84	9.42	Total	35,915	0.77	8.67
East	Measured	31,377	0.60		Proved	26,655	0.55	
LOM 13.2 Years	Indicated	22,805	0.85		Probable	19,373	0.79	
	Total	54,182	0.71	9.19	Total	46,028	0.65	8.49
South	Measured	57,042	0.65		Proved	48,271	0.59	
LOM 14.2 Years	Indicated	46,233	0.78		Probable	39,124	0.71	
	Total	103,275	0.71	12.46	Total	87,395	0.64	11.29
Stepnoy	Measured	49,879	0.68		Proved	40,932	0.63	
LOM 18.4 Years	Indicated	20,443	0.61		Probable	16,776	0.57	
	Total	70,322	0.66	11.90	Total	57,708	0.61	11.10
West	Measured	15,124	0.59		Proved	13,757	0.52	
LOM 9.9 Years	Indicated	8,517	0.64		Probable	7,747	0.56	
	Total	23,641	0.61	13.91	Total	21,504	0.53	12.14
Zhomart	Measured	67,222	1.64		Proved	63,087	0.96	
LOM 11.9 Years	Indicated	68,773	1.47		Probable	1,331	1.36	
	Total	135,995	1.56	18.69	Total	64,418	0.97	4.97
Akchi Spassky	Measured	21,307	0.61	8.33	Proved	14,963	0.56	7.70
	Indicated		—	—	Probable		—	—
	Total	21,307	0.61	8.33	Total	14,963	0.56	7.70
Sredny Spassky	Measured	7,095	0.53	4.50	Proved	3,427	0.47	3.95
	Indicated		—	—	Probable		—	—
	Total	7,095	0.53	4.50	Total	3,427	0.47	3.95
Other Open Pits	Measured	8,436	0.56	4.91	Proved	5,388	0.49	4.64
	Indicated	—	—	—	Probable	—	—	—
	Total	8,436	0.56	4.91	Total	5,388	0.49	4.64
Zhelandy Open Pits	Measured	4,879	1.01	7.97	Proved	727	0.89	10.02
	Indicated	—	—	—	Probable	—	—	—
	Total	4,879	1.01	7.97	Total	727	0.89	10.02
Zhezkazgan	**Measured**	**269,242**	**0.89**		**Proved**	**222,374**	**0.69**	
Total	**Indicated**	**207,707**	**1.01**		**Probable**	**115,098**	**0.72**	
	Total	**476,949**	**0.94**	**13.07**	**Total**	**337,472**	**0.70**	**9.10**

Note: Not all silver grades can be attributed to resource or reserve categories but are included in the totals.

Table 1-7 Zhezkazgan Projects Resources as at 1 January 2011

Zhelandy Project		Resources '000 t	Copper %	Silver g/t
Itauz	Measured	29,369	1.17	9.69
	Indicated	9,281	0.94	4.19
	Total	38,650	1.12	8.37
West Saryoba	Measured	26,608	1.57	18.65
	Indicated	7,102	1.63	32.02
	Total	33,710	1.58	21.47
East Saryoba	Measured	23,187	1.44	23.00
	Indicated	11,209	1.51	19.63
	Total	34,501	1.48	21.68
Kipshakpai	Measured	13,284	1.35	21.95
	Indicated	6,775	1.38	24.40
	Total	20,059	1.36	22.78
Karashoshak	Measured	5,124	1.51	6.22
	Indicated	1,978	1.34	6.22
	Total	7,102	1.46	6.22
Total	**Measured**	**97,572**	**1.39**	**16.78**
	Indicated	**36,345**	**1.35**	**18.34**
	Total	**133,917**	**1.38**	**17.21**

Table 1-8 Balkhash Operating Mines Reserves and Resources as at 1 January 2011

	Mineral Resources					Ore Reserves				
Mine	Category	'000 t	Cu%	Ag g/t	Au g/t	Category	'000 t	Cu%	Ag g/t	Au g/t
Shatyrkul LOM +20 Years	Measured	14,256	3.54	0.82	2.99	Proved	641	2.14	2.2	0.68
	Indicated	9,393	3.27	0.82	2.99	Probable	15,094	2.97	2.2	0.68
	Total	23,649	3.43	0.82	2.99	Total	15,735	2.94	2.2	0.68
Konyrat LOM 19 Years	Measured	54,997	0.38	0.02	0.38	Proved	56,111	0.37	0.37	0.02
	Indicated	114,182	0.29	0.02	0.38	Probable	116,494	0.28	0.37	0.02
	Total	169,179	0.32	0.02	0.38	Total	172,605	0.32	0.37	0.02
Sayak I LOM 9.5 Years	Measured	5,415	1.46	1.57	9.53	Proved	6,432	1.17	7.66	1.26
	Indicated	—	—	—	—	Probable	—	—	—	—
	Total	5,415	1.46	1.57	9.53	Total	6,432	1.17	7.66	1.26
Sayak III— Tastau LOM 4 years	Measured	1,816	1.04	0.11	3.74	Proved	2,102	0.86	3.09	0.09
	Indicated	793	0.88	0.11	3.74	Probable	918	0.73	3.09	0.09
	Total	2,609	0.99	0.11	3.74	Total	3,020	0.82	3.09	0.09
Balkhash Total	**Measured**	**76,484**	**1.06**	**0.28**	**1.59**	**Proved**	**65,286**	**0.48**	**1.19**	**0.15**
	Indicated	**124,368**	**0.52**	**0.08**	**0.60**	**Probable**	**132,506**	**0.59**	**0.60**	**0.10**
	Total	**200,852**	**0.73**	**0.16**	**0.98**	**Total**	**197,792**	**0.55**	**0.79**	**0.11**

Table 1-9 Balkhash Projects Resources as at 1 January 2011

Mine	Category	Mineral Resources '000 t	Cu%	Ag g/t	Au g/t
Sayak II	Measured				
	Indicated	1,177	1.3	0.72	7.98
	Total	1,177	1.3	0.72	7.98
Sayak III—West	Measured				
	Indicated	1,792	2.0	0.22	
	Total	1,792	2.0	0.22	
Kasimbek Block	Measured				
	Indicated	3,915	1.61	0.14	
	Total	3,915	1.61	0.14	
Sayak IV—Copper	Measured				
	Indicated	2,740	1.8	0.38	12.8
	Total	2,740	1.8	0.38	12.8
Sayak IV—West	Measured				
	Indicated	1,373	2.07		
	Total	1,373	2.07		
Sayak IV—Gold-Cobalt	Measured				
	Indicated	2,302	0.15	7.2	
	Total	2,302	0.15	7.2	
Aktogay	Measured	933,600	0.35	0.04	1.35
	Indicated	785,250	0.32	0.04	1.44
	Total	1,718,850	0.34	0.04	1.39
Aidarly	Measured	317,489	0.38	0.01	1.42
	Indicated	1,211,767	0.38	0.01	1.42
	Total	1,529,256	0.38	0.01	1.42
Zhaisan	Measured				
	Indicated	9,943	3.03		3.54
	Total	9,943	3.03		3.54
Balkhash Total Projects	**Measured**	**1,251,089**	**0.36**	**0.03**	**1.37**
	Indicated	**2,020,259**	**0.38**	**0.03**	**1.45**
	Total	**3,271,348**	**0.37**	**0.03**	**1.42**

Table 1-10 East Region Operating Mines Reserves and Resources as at 1 January 2011

	Mineral Resources						Ore Reserves					
Mine	**Category**	**'000 t**	**Cu%**	**Zn%**	**Au g/t**	**Ag g/t**	**Category**	**'000 t**	**Cu%**	**Zn%**	**Au g/t**	**Ag g/t**
Artemyevsky	Measured	8,156	2.37	7.40	1.55	121.73	Proved	8,427	2.13	6.76	1.41	111.02
LOM 11 Years	Indicated	16,981	1.93	5.68	0.86	106.59	Probable	3,047	2.64	1.28	0.36	21.97
	Total	25,137	2.07	6.24	1.08	111.5	Total	11,474	2.27	5.31	1.13	87.37
Belousovsky	Measured	4,326	0.75	4.18	0.66	57.95	Proved	264	1.85	1.12	0.38	27.50
LOM 3 Years	Indicated	8,027	0.41	3.58	0.35	46.79	Probable					
	Total	12,353	0.53	3.79	0.45	50.70	Total	264	1.85	1.12	0.38	27.50
Irtyshsky	Measured	7,833	1.98	5.47	0.33	73.02	Proved	10,944	1.35	3.72	0.22	49.65
LOM 23 Years	Indicated	4,326	2.06	3.99	0.31	72.29	Probable	6,044	1.40	2.71	0.21	49.16
	Total	12,159	2.01	4.94	0.32	72.76	Total	16,988	1.37	3.36	0.22	49.48
Nikolayevsky	Measured	3,114	1.31	4.96	0.25	28.57	Proved	3,410	1.05	3.97	0.20	22.86
LOM 11 Years	Indicated	4,311	1.28	3.47	0.43	41.92	Probable	4,583	1.03	2.78	0.34	33.53
	Total	7,425	1.29	4.10	0.36	36.32	Total	7,992	1.03	3.29	0.28	28.98
Orlovsky	Measured	17,817	4.12	3.67	0.89	40.76	Proved	18,007	3.88	3.45	0.84	38.31
LOM 12 Years	Indicated	3,763	3.68	3.94	0.81	36.22	Probable					
	Total	21,580	4.05	3.45	0.84	38.31	Total	18,007	3.88	3.45	0.84	38.31
Yubileyno-	Measured	1,177	3.41	5.22	0.61	41.05	Proved	1,353	2.73	4.18	0.49	32.84
Snegirikhinsky	Indicated	318	3.59	1.72	0.29	17.94	Probable	365	2.87	1.37	0.23	14.35
LOM 4 Years	Total	1,494	3.45	4.47	0.54	36.14	Total	1,718	2.76	3.58	0.43	28.91
East Region	**Measured**	**42,423**	**2.82**	**4.91**	**0.84**	**63.15**	**Proved**	**42,405**	**2.60**	**4.23**	**0.73**	**54.20**
Total	**Indicated**	**37,726**	**1.74**	**4.58**	**0.63**	**74.78**	**Probable**	**14,039**	**1.59**	**2.39**	**0.29**	**37.25**
	Total	**80,148**	**2.31**	**4.75**	**0.73**	**68.62**	**Total**	**56,444**	**2.35**	**3.77**	**0.62**	**49.99**

Table 1-11 East Region Project Resources as at 1 January 2011

Project		**Resources**	**Cu**	**Zn**	**Au**	**Ag**
		'000 t	*%*	*%*	*g/t*	*g/t*
Anisimov Kluch	**Measured**					
	Indicated	3,450	3.04	5.26	0.28	36.27
	Total	**3,450**	**3.04**	**5.26**	**0.28**	**36.27**

Table 1-12 Karaganda Operating Mines Copper Reserves and Resources as at 1 January 2011

	Mineral Resources						Ore Reserves					
Mine	**Category**	**'000 t**	**Cu%**	**Zn%**	**Au g/t**	**Ag g/t**	**Category**	**'000 t**	**Cu%**	**Zn%**	**Au g/t**	**Ag g/t**
Nurkazgan	Measured	106,847	1.12	—	0.39	2.64	Proved	115,719	0.93	0.1	0.32	2.19
LOM +20 Years	Indicated	93,749	0.63	—	0.38	1.31	Probable	8,481	0.83	0.1	0.41	3.25
	Total	200,596	0.89	—	0.38	2.02	Total	124,200	0.92	0.1	0.33	2.27
Abyz	Measured	4,847	1.72	3.20	4.65	39.02	Proved	1,826	1.3	3.7	5.49	41.48
LOM 2 Years	Indicated	1,729	1.04	3.42	3.89	38.45	Probable	82	0.71	4.97	9.72	76.93
	Total	6,576	1.54	3.26	4.45	38.87	Total	1,908	1.27	3.75	5.67	43
Karaganda	**Measured**	**111,694**	**1.15**	**0.14**	**0.57**	**4.22**	**Proved**	**117,545**	**0.94**	**0.16**	**0.40**	**2.80**
Total	**Indicated**	**95,478**	**0.64**	**0.06**	**0.44**	**1.98**	**Probable**	**8,563**	**0.83**	**0.15**	**0.50**	**3.96**
	Total	**207,172**	**0.91**	**0.10**	**0.51**	**3.19**	**Total**	**126,108**	**0.93**	**0.16**	**0.41**	**2.88**

Table 1-13 Karaganda Copper Projects Resources as at 1 January 2011

	Mineral Resources					
Mine	Category	'000 t	Cu%	Zn%	Au g/t	Ag g/t
Akbastau	**Measured**	8,199	1.70	1.10	0.54	13.79
	Indicated	2,852	1.65	0.70	0.53	12.58
	Total	11,051	1.69	1.00	0.54	13.48
Kosmurun	**Measured**	16,034	3.15	0.76	0.86	17.50
	Indicated	1,539	3.13	0.76	0.86	17.54
	Total	17,573	3.15	0.76	0.86	17.50
Bozshakol	**Measured**	122,000	0.43			
	Indicated	674,000	0.36		0.10	2.31
	Total	796,000	0.37		0.10	2.31
Karaganda Total	**Measured**	**146,233**	**0.80**	**0.15**	**0.12**	**2.69**
	Indicated	**678,391**	**0.37**	**0.00**	**0.10**	**0.09**
	Total	**824,624**	**0.45**	**0.03**	**0.12**	**0.55**

Table 1-14 Kazakhmys Copper Metal Reserves and Resources as at 1 January 2011

	Mineral Resources						Ore Reserves					
	Category	'000 t	Cu%	Zn%	Au g/t	Ag g/t	Category	'000 t	Cu%	Zn%	Au g/t	Ag g/t
Kazakhmys Totals	**Measured**	1,994,737	0.64	0.12	0.09		**Proved**	447,610	0.90	0.40	0.20	
	Indicated	3,203,723	0.46	0.06	0.07		**Probable**	270,206	0.71	0.12	0.08	
	Total	**5,198,460**	**0.53**	**0.09**	**0.08**	**3.87**	**Total**	**717,816**	**0.83**	**0.30**	**0.15**	**8.93**

Note Not all silver grades can be attributed to resource or reserve categories but are included in the totals.

Table 1-15 Kazakhmys Gold Reserves and Resources as at 1 January 2011

	Mineral Resources					Ore Reserves				
Mine	Category	'000 t	Cu%	Au g/t	Ag g/t	Category	'000 t	Cu%	Au g/t	Ag g/t
Kazakhstan Mines										
Mizek	**Measured**	5,031	0.71	2.47	5.79	**Proved**				
LOM 2 Years	**Indicated**	4,291	0.67	2.3	5.12	**Probable**				
	Total	9,322	0.69	2.39	5.48	**Total**				
Mukur	**Measured**					**Proved**				
LOM 3 Years	**Indicated**	872		1.35		**Probable**	922		1.23	
	Total	872		1.35		**Total**	922		1.23	
Zhaima	**Measured**					**Proved**				
Worked Out	**Indicated**	44		2.84		**Probable**				
	Total	44		2.84		**Total**				
Kyrgyzstan Project										
Bozymchak	**Measured**	6,240	0.96	1.63	9.77	Proved	6,639	0.84	1.43	8.54
LOM 18 Years	**Indicated**	13,714	0.80	1.52	7.45	Probable	8,788	0.84	1.36	8.36
	Total	19,954	0.85	1.56	8.18	Total	15,427	0.84	1.39	8.44
Kazakhmys Totals	**Measured**	**11,271**	**0.85**	**2.01**	**8.00**	Proved	**6,639**	**0.84**	**1.43**	**8.54**
	Indicated	**18,921**	**0.73**	**1.70**	**6.56**	Probable	**9,710**	**0.76**	**1.34**	**7.57**
	Total	**30,192**	**0.78**	**1.81**	**7.10**	Total	**16,349**	**0.80**	**1.38**	**7.96**

Table 1-16 Kazakhmys Metal Reserves and Resources (Copper and Gold) as at 1 January 2011

Mineral Resources						Ore Reserves					
Category	'000 t	Cu%	Zn%	Au g/t	Ag g/t	Category	'000 t	Cu%	Zn%	Au g/t	Ag g/t
Measured	2,006,008	0.64	0.12	0.10		Proved	454,250	0.90	0.44	0.21	
Indicated	3,222,645	0.46	0.06	0.08		Probable	279,916	0.71	0.12	0.12	
Total	5,228,652	0.53	0.09	0.09	3.98	Total	734,165	0.83	0.32	0.18	8.93

Note Not all silver grades can be attributed to resource or reserve categories but are included in the totals.

Table 1-17 Karaganda Operating Mines Coal Reserves as at 1 January 2011

Reserves	Proved Mt	Probable Mt	Total Mt	Ash (ad)%	CV (ncvar) kcal/kg	S%
Molodezhny	273.7	94.1	367.8	46.0	3,600	0.5
Kuu-Chekinsky	15.5	5.8	21.3	41.0	4,200	0.6
Total	**289.2**	**99.9**	**389.1**	**45.7**	**3,633**	**0.5**

Note includes coal loss and increase in ash content

* ad refers to Air Dried

** ncvar refers to net calorific value as received

1.6 Mines and Facilities

Zhezkazgan is a fully integrated facility, including mining, mineral processing, smelting and refining operations. In 2009, Zhezkazgan was responsible for 68% of Group mined ore output and 48% of Group's cathode output. The operations comprise six substantive underground mines and six operating small open pits. All underground mines utilise room and pillar methods with pillar extraction. The small open pit mines, constituting the North operation, have limited lives. The ore feeds the Satpaev and the two Zhezkazgan concentrators and is subsequently processed to final product in the form of cathode copper and copper rod in the smelter and refinery at Zhezkazgan. The slimes containing silver are sent to Balkhash for processing to final product.

The Balkhash operations comprise one surface mines and two underground mines. The two underground mines employ continuous retreat sub-level caving (Shatyrkul) and multi-lift room and pillar methods of mining (Sayak Sayak III). The open pit employs conventional shovel and truck with rail haulage (Konyrat) which suspended operations in 2008, due to the economical reasons. The ore is railed to the Balkhash concentrator and is subsequently processed to final product in the form of cathode copper and a small quantity of copper wire in the smelter and refinery at Balkhash. The smelter and refinery also process all copper concentrate railed from the East Region and Karaganda operations. The slimes, containing gold and silver, from the refining process are processed in the precious metals plant.

The East Region operations comprise five underground mines employing cut and fill mining (Orlovsky, Artemyevsky), shrinkage stoping (Irtyshsky, Belousovsky, ceased operations 2008 due to the economical reasons), and sub-level caving mining (Nikolayevsky, Irtyshsky, Yubileyno-Snegirikhinsky) methods. These operations feed four copper/zinc concentrators (Belousovsky, Irtyshsky, Nikolayevsky, Orlovsky). Additionally a portion of the Atremyevsky polymetallic ore is railed to Kazzinc's concentrator at Ziryanovsky. The East Region copper concentrate (including the concentrate produced at Ziryanovsky) is railed to Balkhash for processing and zinc is sold as concentrate as the hydrometallurgical plant is not operational.

Karaganda operations comprise an underground copper mine employing sub-level caving mining (Nurkazgan) one copper open pit employing conventional shovel and truck mining (Abyz) which will move underground, one gold open pit employing conventional shovel and truck (Mizek) and two coal strip mines employing conventional shovel and truck. Copper ore is processed in two concentrators (Nurkazgan, Karagaily) before smelting and refining at Balkhash, gold is produced with a heap leach at Mizek and coal is sold as a ROM product.

Kazakhmys also produces sulphuric acid at Zhezkazgan and Balkhash which is produced in significant quantities. Kazakhmys sells zinc in concentrate to KazZinc or Glencore.

1.6.1 Historic Production Figures

Historic production figures are given below in Table 1-18 to Table 1-27 inclusive. IMC has reviewed the forecast production levels and found them to be reasonable and attainable.

Table 1-18 Zhezkazgan Historic Production

Mine	Year	'000 t	Cu%	Contained Cu (t)
Annensky	2007	3,360	1.03	34,608
	2008	3,407	0.87	29,641
	2009	3,295	0.74	24,383
	2010	3,127	0.67	20,987
East	2007	5,615	0.82	46,043
	2008	5,188	0.78	40,466
	2009	5,143	0.66	33,944
	2010	4,363	0.65	28,360
North	2007	2,375	0.65	15,438
	2008	3,746	0.76	28,470
	2009	3,391	0.75	25,433
	2010	1,904	0.90	17,136
South	2007	5,220	0.69	36,018
	2008	3,311	0.64	21,190
	2009	5,272	0.69	36,377
	2010	5,272	0.60	31,632
Stepnoy	2007	2,849	0.80	22,792
	2008	2,940	0.82	24,108
	2009	3,334	0.82	27,339
	2010	3,371	0.76	25,620
West	2007	2,054	0.37	7,600
	2008	2,252	0.51	11,485
	2009	69	0.72	497
	2010	1,565	0.55	8,608
Zhomart	2007	2,882	1.27	36,601
	2008	3,280	1.39	45,592
	2009	3,275	1.80	58,950
	2010	3,707	1.56	57,829
Zhezkazgan	**2007**	**24,355**	**0.82**	**199,100**
Total	**2008**	**24,124**	**0.84**	**200,953**
	2009	**23,779**	**0.87**	**206,922**
	2010	**23,309**	**0.82**	**190,171**

Table 1-19 Balkhash Historic Production

Mine	Year	'000 t	Cu%	Contained Cu (t)
Shatyrkul	2007	351	2.05	7,196
	2008	371	2.48	9,201
	2009	545	2.26	12,317
	2010	559	2.25	12,578
Konyrat	2007	403	0.30	1,209
	2008	874	0.29	2,535
	2009			
	2010			
Sayak Total	2007	1,372	1.02	13,994
Including	2008	1,753	1.10	19,283
Tastau	2009	1,731	1.02	17,656
	2010	1,802	0.93	16,759
Balkhash	**2007**	**2,126**	**1.05**	**22,399**
Total	**2008**	**2,998**	**1.03**	**31,018**
	2009	**2,276**	**1.32**	**29,973**
	2010	**2,361**	**1.24**	**29,336**

Table 1-20 East Region Historic Production

Mine	Year	'000 t	Cu%	Contained Cu (t)	Zn%	Contained Zn (t)
Artemyevsky	2007	1,395	1.65	23,018	5.19	72,401
	2008	1,548	1.68	26,006	5.09	78,793
	2009	1,198	1.72	20,606	5.19	62,176
	2010	1,397	1.76	24,587	6.65	92,901
Belousovsky	2007	163	0.85	1,386	2.87	4,678
	2008	211	1.02	2,152	1.77	3,735
	2009					
	2010	18	1.28	230	0.28	50
Irtyshsky	2007	390	1.39	5,421	3.24	12,636
	2008	481	1.41	6,782	3.58	17,220
	2009	480	1.51	7,248	3.63	17,424
	2010	425	1.38	5,865	3.12	13,260
Nikolayevsky	2007	532	1.75	9,310	3.07	16,332
	2008	574	1.60	9,184	3.71	21,295
	2009	556	1.73	9,619	2.45	13,622
	2010	603	1.05	6,332	3.47	20,924
Orlovsky	2007	1,231	5.24	64,504	4.60	56,626
	2008	1,528	4.99	76,247	4.51	68,913
	2009	1,621	4.41	71,486	4.74	76,835
	2010	1,538	3.67	56,445	4.99	76,746
Yubileyno-	2007	429	3.31	14,200	3.27	14,028
Snegirikhinsky	2008	538	3.15	16,947	3.15	16,947
	2009	603	3.26	19,658	2.45	14,774
	2010	629	3.30	20,757	2.45	15,411
East Region	**2007**	**4,140**	**2.85**	**117,838**	**4.27**	**176,701**
Total	**2008**	**4,880**	**2.82**	**137,319**	**4.24**	**206,903**
	2009	**4,458**	**2.89**	**128,616**	**4.15**	**184,831**
	2010	**4,610**	**2.48**	**114,216**	**4.76**	**219,292**

Table 1-21 Karaganda Historic Production

Mine	Year	'000 t	Cu%	Contained Cu (t)	Zn%*	Contained Zn (t)
Nurkazgan	2007	1,842	1.11	20,446		
	2008	575	0.65	3,738		
	2009	1,729	0.85	14,697		
	2010	2,190	0.81	17,739		
Abyz	2007					
	2008	436	1.70	7,412	3.19	13,908
	2009	167	1.60	2,672	4.27	7,131
	2010	465	1.73	8,045	2.81	13,067
Akbastau	2007	40	3.91	1,564	2.84	1,136
	2008	2,363	2.50	59,075	0.63	14,887
	2009					
	2010					
Kosmurun	2007	1,464	3.55	51,972	2.77	40,553
	2008	299	2.73	8,163	3.93	11,751
	2009					
	2010					
Karaganda	**2007**	**3,346**	**2.21**	**73,982**	**2.77**	**41,689**
Total	**2008**	**3,673**	**2.13**	**78,387**	**1.31**	**40,546**
	2009	**1,896**	**0.91**	**17,369**	**4.27**	**7,131**
	2010	**2,655**	**0.97**	**25,784**	**2.81**	**13,067**

Note * The total weighted average Zn%s are based on Zinc producing mines only.

Table 1-22 Kazakhmys Summary of Historic Production

Region	Year	'000 t	Cu%	Contained Cu (t)	Zn%*	Contained Zn (t)
Zhezkazgan	2007	24,355	0.82	199,100		
	2008	24,124	0.84	200,953		
	2009	23,779	0.87	206,922		
	2010	23,309	0.82	190,171		
Balkhash	2007	2,126	1.05	22,399		
	2008	2,998	1.03	31,018		
	2009	2,276	1.32	29,973		
	2010	2,361	1.24	29,336		
East Region	2007	4,140	2.85	117,838	4.27	176,701
	2008	4,880	2.82	137,319	4.24	206,903
	2009	4,458	2.89	128,616	4.15	184,831
	2010	4,610	2.48	114,216	4.76	219,292
Karaganda	2007	3,346	2.21	73,982	2.77	41,689
	2008	3,673	2.13	78,387	1.31	40,546
	2009	1,896	0.91	17,369	4.27	7,131
	2010	2,655	0.97	25,784	2.81	13,067
Kazakhmys	**2007**	**33,967**	**1.22**	**413,319**	**3.87**	**218,390**
Total	**2008**	**35,675**	**1.26**	**447,677**	**3.10**	**247,449**
	2009	**32,409**	**1.18**	**382,880**	**4.15**	**191,962**
	2010	**32,935**	**1.09**	**359,470**	**4.58**	**232,358**

Note * The total weighted average Zn%s are based on Zinc producing mines only.

Table 1-23 Coal Mining Historic Production

	Coal Mined '000 t				Waste Stripped '000 bcm				Strip Ratio bcm:t			
	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010
Molodezhny	6,650	6,704	6,714	7,445	11,730	12,796	12,795	15,531	1.76	1.91	1.91	2.08
Kuu-Chekinsky	850	801	803	647	3,854	4,401	2,974	3,921	4.53	5.49	3.70	6.06
Total	7,500	7,505	7,517	8,102	15,584	17,197	15,769	19,452	2.08	2.29	2.10	2.40

Table 1-24 Copper Concentrate Historic Production

Concentrator	Year	Milled '000t	Cu%	Recovery%	Concentrate ('000t)	Cu%	Cu in Concentrate ('000t)
Zhezkazgan No 1	2007	8,126	1.04	90.91	195	39.40	76.8
	2008	7,719	1.10	89.69	202	37.70	76.2
	2009	8,123	1.20	90.37	223	39.50	88.1
	2010	8,097	1.15	92.24	218	39.40	85.9
Zhezkazgan No 2	2007	12,718	0.64	82.89	173	39.00	67.5
	2008	13,241	0.67	82.03	191	38.10	72.8
	2009	12,634	0.68	83.22	181	39.50	71.5
	2010	12,044	0.63	85.98	166	39.30	65.2
Satpaev	2007	3,747	1.00	91.24	123	27.80	34.2
	2008	3,433	0.88	90.39	101	27.00	27.3
	2009	3,285	0.75	90.11	88	25.10	22.1
	2010	3,336	0.66	87.32	79	24.50	19.4
Balkhash	2007	4,606	0.99	71.64	188	17.30	32.5
	2008	5,387	0.94	76.84	267	14.50	38.7
	2009	3,806	1.23	80.34	207	18.20	37.7
	2010	3,465	1.48	80.96	240	17.30	41.5
Belousovsky	2007	220	1.61	83.52	18	16.40	3.0
	2008	294	1.62	79.68	24	15.80	3.8
	2009	468	3.26	87.44	84	15.90	13.4
	2010	433	3.24	90.08	77	16.40	12.6
Berezovsky	2007	405	1.38	79.40	29	15.80	4.4
	2008	479	1.41	82.67	33	16.90	5.6
	2009	485	1.51	85.47	35	17.90	6.3
	2010	422	1.39	84.34	28	17.60	4.9
Nikolayevsky	2007	1,650	2.20	80.35	175	16.70	29.2
	2008	1,742	2.31	80.20	184	17.50	32.2
	2009	1,550	1.95	80.39	136	17.90	24.3
	2010	1,345	1.73	74.61	93	18.70	17.4
Orlovsky	2007	1,234	5.23	91.94	284	20.90	59.4
	2008	1,530	4.99	90.66	343	20.20	69.3
	2009	1,617	4.42	90.01	340	18.90	64.3
	2010	1,539	3.67	89.29	267	18.90	50.5
Nurkazgan	2007	12	0.91				
	2008	961	1.23	85.47	52	19.38	10.1
	2009	1,884	0.83	84.26	67	19.66	13.2
	2010	2,311	0.78	85.11	82	18.80	15.4
Karagaily	2007	1,158	3.88	74.25	232	14.40	33.4
	2008	1,213	2.90	80.51	201	14.10	28.3
	2009	610	1.78	88.47	206	4.66	9.6
	2010	801	1.87	82.48	223	5.53	12.3

Concentrator	Year	Milled '000t	Cu%	Recovery%	Concentrate ('000t)	Cu%	Cu in Concentrate ('000t)
Third Party	2007	882	1.18	73.49	29	26.40	7.7
	2008	708	1.36	69.82	25	26.90	6.7
	2009	779	1.53	71.24	33	25.70	8.5
	2010	833	1.61	72.12	37	26.10	9.7
Kazakhmys Total	**2007**	**34,758**	**1.19**	**84.00**	**1,446**	**24.07**	**348**
	2008	**36,706**	**1.20**	**84.51**	**1,623**	**22.85**	**371**
	2009	**35,241**	**1.18**	**85.95**	**1,600**	**22.43**	**359**
	2010	**34,626**	**1.12**	**86.16**	**1,510**	**22.17**	**335**

Table 1-25 Zinc Concentrate Historic Production

Concentrator	Year	Milled '000t	Zn%	Recovery%	Concentrate '000 (t)	Zn%	Zn in Concentrate '000 (t)
Belousovsky	2007	220	2.87	64.04	10	40.40	4.0
	2008	294	2.23	56.28	10	36.90	3.7
	2009	468	2.37	37.61	11	37.90	4.2
	2010	433	2.42	50.49	14	37.80	5.3
Berezovsky	2007	405	3.26	46.24	17	35.90	6.1
	2008	479	3.59	56.88	24	40.70	9.8
	2009	485	3.62	64.04	25	45.00	11.3
	2010	422	3.13	65.09	19	45.20	8.6
Nikolayevsky	2007	1,650	3.67	57.94	84	41.80	35.1
	2008	1,742	3.41	55.83	86	38.60	33.2
	2009	1,550	2.98	61.11	67	42.20	28.3
	2010	1,345	4.02	66.80	86	42.00	36.1
Orlovsky	2007	1,234	4.59	72.46	91	45.10	41.0
	2008	1,530	4.51	70.93	109	44.90	48.9
	2009	1,617	4.74	71.13	121	45.00	54.5
	2010	1,539	4.99	75.44	126	46.00	58.0
Karagaily	2007	1,158	2.58	2.96	3	29.50	0.9
	2008	1,213	1.10	3.65	2	24.30	0.5
	2009	610	3.07	39.09	18	40.70	7.3
	2010	801	1.64	39.58	13	40.10	5.2
Artemyevsky KazZinc	2007	882	6.28	82.02	86	52.80	45.4
	2008	708	7.04	82.97	80	51.70	41.4
	2009	779	6.77	83.67	86	51.30	44.1
	2010	833	7.67	84.64	105	51.50	54.1
Kazakhmys Total	**2007**	**5,549**	**4.00**	**59.73**	**291**	**45.56**	**133**
	2008	**5,965**	**3.61**	**63.82**	**311**	**44.19**	**137**
	2009	**5,509**	**4.05**	**67.10**	**328**	**45.61**	**149**
	2010	**5,373**	**4.31**	**72.20**	**363**	**46.07**	**167**

Table 1-26 Smelter and Refinery Historic Production

Smelter	Year	Concentrate '000 (t)	Cu%	Cathode '000 (t)	Acid '000 (t)	Copper Rod '000 (t)
Zhezkazgan	2007	646	30.2	188	149	36
	2008	723	25.8	181	528	48
	2009	336	32.6	105	911	10
	2010	447	34.9	117	927	35

Smelter	Year	Concentrate '000 (t)	Cu%	Cathode '000 (t)	Acid '000 (t)	Copper Rod '000 (t)
Balkhash	2007	1,176	18.3	192	0	
	2008	1,219	18.2	197	283	
	2009	1,248	18.9	199	791	
	2010	1,148	18.1	189	827	
Kazakhmys	**2007**	**1,822**	**22.52**	**380**	**149**	**36**
Total	**2008**	**1,942**	**21.03**	**378**	**811**	**48**
	2009	**1,584**	**21.81**	**304**	**1,702**	**10**
	2010	**1,595**	**22.81**	**306**	**1,754**	**35**

Notes: Totals include purchased and other concentrate (slag, scrap and ore) reprocessed at both smelters but excluding tolling. Copper Cathode production volumes include Copper Rod production volumes.

Table 1-27 Precious Metal Historic Production

Year	Dry Feed (t)	Copper Telluride (t)	Selenium Powder (t)	Gold ('000 oz)	Silver ('000 oz)
2007	2,099	2.52	144.19	113	18,985
2008	2,102	6.61	95.45	124	16,710
2009	2,228	6.29	115.10	135	16,894
2010	2,092	3.62	83.58	127	14,093

1.7 Management and Manpower

IMC's personnel were in regular contact and held numerous discussions with Company management at various levels. IMC is satisfied that Kazakhmys management is capable of implementing the proposed production plans based on this contact and on direct observations of operational management. Kazakhmys operates its management and financial programmes in accordance with International Financial Reporting Standards (IFRS) as part of a standardised electronic reporting system for health and safety, production and financial performance. This standardisation should now be extended to an electronic reserves and resources reporting, which IMC understand is part of an ongoing Company initiative. Management has also made significant progress in improving computer literacy throughout the organisation in recent years but this too is still an ongoing task.

Changes to the approved reserve statements and to certain approved mine production and staffing plans must be submitted to and approved by the relevant government authorities. IMC is not aware of any refusals in the past and Kazakhmys remains confident of obtaining this approval as and when necessary.

Kazakhmys has a track record of developing new properties to replace depleting reserves/resources and continues to pursue this effort primarily within Kazakhstan but also has gold deposits within Kyrgyzstan being developed by Kazgold. The data accompanying these properties is generally from exploration during the FSU era and has been prioritised and progressed with extensive Company exploration programmes in recent years. Kazakhmys had a total of 54,797 employees as at 31 May 2010, split almost equally between the Zhezkazgan Complex and the other centres of its operations in Kazakhstan. Administrative facilities are located at Karaganda, Zhezkazgan, Balkhash UskKamenogorsk and Semipalatinsk with a headquarters complex in Almaty. Trade Union representation is integrated into Kazakhmys' structure at all levels, relations are reportedly good with no disruption and wage agreements are negotiated on an annual basis.

Manpower wastage over the last three years has averaged 2.2% per year in a maturing labour force, although there was an increase in 2008 due to acquisitions. Kazakhmys actively recruits engineering graduates through a combination of university sponsorship and post graduate selection.

Kazakhmys provides free schooling and comprehensive medical facilities to employees. Major medical services are contributory for employees' families.

1.8 Health and Safety

Kazakhmys adheres to the Health and Safety Laws enacted in Kazakhstan in 1993 and revised in 2004 and 2009. This legislation is comprehensive but Kazakhmys is proactively moving towards internationally recognised systems. Activity based risk analysis and work procedures are now required as part of the 2009 regulations which the Company has and is implementing.

Kazakhmys has a safety policy supported by regulations and standing instructions applying to all operations and job categories and which are updated every five years under the Health and Safety Laws of Kazakhstan. Each complex and regional operation has a Health and Safety Directorate independent of the operations reporting to the Executive Director of the individual complex or region. Each also has a health and safety programme for operational and technical issues and programmes are updated and re-issued at the end of each year. Each has a representative coordinating safety inspection and investigation teams compiling shift reports on all aspects of safety. Government safety inspections are carried out and reports made to the units. Internal reports are reviewed and actioned at the daily meetings and the government reports on a weekly basis. IMC understands that all the CEO's video performance review meetings with the divisional heads always start with health and safety.

The Lost Time Injury Frequency Rate is one of the parameters used to monitor safety performance in industry and is usually measured per 100,000 manshifts or one million manhours. Kazakhmys use a rate that is not comparable to other figures but is believed to be higher than other comparable operations. The fatality rate remains higher than comparable similar mature mining operations taking into account the large number of administrative and non-production personnel in comparison to other operations which, in Kazakhmys' case, effectively reduces the fatality per thousand employees.

Table 1-28 below shows the Company health and safety statistics for the past six years.

Table 1-28 Health and Safety Statistics

	2005	2006	2007	2008	2009	2010 (5m)
Manpower	64,090	64,508	65,436	67,155	61,629	60,970
Total Accidents	279	245	184	219	146	168
Fatalities	37	32	23	32	15	26
LTI Frequency Rate	4.4	3.8	2.8	3.3	2.4	2.8
LTI Severity Rate	41.9	56.3	55.2	44.1	87.2	95.7

Table 1-29 below shows the record of fatal accidents for 2010. It can be noted that 23% were due to falls of ground and 23% resulted from explosion.

Table 1-29 Fatal Accidents

Category	2010
Falls of ground	6
Falling objects	3
Falling from height	2
Electrocution	2
Mechanical	2
Transport	3
Explosion	6
Hazardous substances	2
Total	**26**

Kazakhmys is actively pursuing:

- The use of safety awareness training and DVDs which focus on individual's responsibilities in the workplace and to their families,
- Risk analysis programmes and procedures in accordance with the 2009 Regulations,
- The continued introduction of remote controlled production equipment and new technology for potentially hazardous operations, and
- There has been established an in-house and international consultant management body chaired by the CEO to review and develop the Occupational Health and Safety Management System that is effective and conforms to a recognised international standard.

1.9 Regional Infrastructure

All areas are serviced by well developed road, rail and air transport networks. A limited regular commercial service operates to all of the major administrative centres utilising 3 jet aircraft owned by Kazakhmys.

Communications are good with land, mobile and satellite telephone links and a postal service.

Water is supplied from multiple sources at each one of the sites and Kazakhmys owns and operates 2 CHP and supplying the bulk of the operation's power requirements. Power is supplied to the sites or into the national grid on a credit system enabling Kazakhmys to effectively use its own power in other locations without purchasing at the commercial rate and only bearing the cost of distribution.

Most employees own their accommodation in blocks of flats freehold with the local government responsible for the frame of the building and the provision of services.

Kazakhmys owns and maintains a comprehensive system of site road and rail networks and also maintains critical provincial roads in the Zhezkazgan and Balkhash areas.

The Zhezkazgan rail network and rolling stock are owned by Kazakhmys and link to the national rail network using their wagons for the import of goods and export of finished product. Only site rail, locomotives and critical large items are owned in the other areas where Kazakhmys uses the national rail network's wagons. These are used to deliver all major goods and export the product.

1.10 Projects and Prospects

It is recognised that the Kazakhmys is entering a period of change where the surface mines are closing and replacement mines particularly underground mines are being developed. The future of the Company's stable production lies with two major new Projects, Aktogay and Bozshakol, and an expansion of the Nurkazgan mine which are expected to come on stream as the Zhezkazgan underground mines start to wind down. There are a significant number of other Projects and Prospects being evaluated and developed which are summarised below.

1.10.1 Projects

1.10.1.1 New Sites

— Aktogay: resources of 1,719 Mt of ore containing 5,780 kt of copper.

— Bozshakol: resources of 796 Mt of ore containing 2,951 kt of copper.

— Bozymchak: reserves of 15,427 kt at an average grade of 1.39 g/t Au and 8.44 g/t Ag. The production of ore is planned at 80,000 tpm from both an underground and surface operation. Capex of US$133.1 M with the process plant due to be commissioned in the first half of 2011.

1.10.1.2 Continuations of Existing Mines

— Akchi Spassky: reserves within the existing pit area of 15.0 Mt at an average grade of 0.56% Cu. A 1 to 2 Mtpa continuation of the open pit planned at an appropriate time in the future.

— East Saryoba: resources of 34,501 kt at an average grade of 1.48% Cu. An underground mine reaching full production of 2 Mtpa is being designed.

— Itauz: resources of 38,650 kt at an average grade of 1.12% Cu. An underground mine reaching full production of 800 ktpa is being designed.

— Zhomart II: resources of 86 Mt at an average grade of 1.73% Cu. The combined total production of Zhomart I and II will be 4 Mtpa.

— Nikolayevsky North: reserves are already included in the Nikolayevsky operational mine and is an underground extension.

— Anisimov Kluch: resources of 3,450 kt at an average grade of 3.04% Cu planned as an underground extension of Yubileyno-Snegirikhinsky mine with a production rate initially of 200 ktpa in 2013.

— Akbastau: resources of 11,051 kt at an average grade of 1.69% Cu planned as an open pit mine capable of producing 2 Mtpa but without specific timescale.

— Kosmurun: resources of 17,573 kt at an average grade of 3.15% Cu planned as an underground operation with a planned production of 1 Mtpa but without specific timescale.

1.10.2 Prospects

— Karashoshak: resources of 7,102 kt at an average grade of 1.46% Cu remain, exploration drilling continues without any development plans.

— Aidarly: resources of 1,529 kt at an average grade of 0.38% Cu but there are no development plans.

— Sayak IV: un-quantified gold resource with a well developed underground infrastructure requiring a processing plant but there are no development plans.

— South East Nurkazgan: resources within the P category (prognosticated) of the GKZ system give a preliminary 122,600 kt of ore at 0.94% Cu and 0.7 g/t Au with an ongoing exploration programme.

1.11 Environmental Issues and Environmental Permitting

1.11.1 Legislation

The Republic of Kazakhstan refers to its legislation as "the body of the Constitution, laws and other normative legal acts (including the Supreme Court resolutions) of the Republic of Kazakhstan, including the International Treaties to which the Republic of Kazakhstan is a party".

Environmental Legislation in Kazakhstan is based on the systems in use in the Former Soviet Union but has been revised significantly during recent years with the introduction of The Ecological Code, No 212, dated 9 January 2007, last amended 19 March 2010, which provides the framework for environmental protection and regulation. Other relevant articles of legislation concerning environmental protection in the mining industry include the following Codes and Laws, as amended:

— Water Code; 2003

— Land Code; 2003

— Forest Code; 2003

— Law on Obligatory Ecological Insurance; 2004

The Law with particular relevance is Law No 2828 dated 27 January 1996, on the "Sub-soil and Its Use" (the "Sub-soil Law") as amended. The Sub-soil Law includes provisions for protection of the sub-soil and the natural environment and for restoration of disturbed areas.

The primary legislative articles are supported by numerous regulations, rules and normative acts such as:

— The Rules to Estimate Environmental Damage; 27 June 2007

— Instructions to Assess the Expected Impact of Production Activities; 28 June 2007

— Methods to calculate payments for emissions; 8 April 2009

Under the Ecological Code, each production site must develop an approved Programme for Industrial Ecological Control which establishes the procedures for environmental management and monitoring.

Environmental protection is also enforced by the requirement to obtain and maintain the environmental permits that establish and regulate an economic mechanism levying taxes on permissible levels of emissions, discharges of water and storage of waste. A higher tax rate is applied for emissions and waste storage in excess of permissible amounts. The permissible levels for each production site are established in normative, technical documents which are subject to Ministry of Environment expert approval and are typically valid for 5 years unless a significant change is introduced. Renewal of permits is subject to submission of quarterly reports on monitoring, emission and waste inventories, compliance with specific provisions and payment of environmental charges at quarterly intervals. Renewals have not, historically, been withheld.

IMC is not aware of any pending legislation which could materially affect Kazakhmys' operations.

1.11.2 Status

Mining activities have been in progress in all areas for many years and smelting since the 1930's in Balkhash and 1971 at Zhezkazgan. The environmental impact of these historic operations has not been quantified and it is understood from the Company that the responsibility for the historic environmental liabilities lies with the State. A comprehensive monitoring system has been in place since the mid to late 1990's in anticipation of future legal requirements. Kazakhmys has engaged international consultants to assist in directing their environmental, occupational health and safety efforts and most of the major operations have achieved accreditation according to integrated quality, environmental, health and safety management systems: ISO9001, ISO14001 and OHSAS18001.

Kazakhmys maintains insurance to cover claims against environmental damage resulting from emissions and mining. The maximum insured for each main area is KZT39.7 M and KZT297.8 M for the whole of Kazakhmys operations.

During the last 5 years, Kazakhmys has established a licensed laboratory which is responsible for regular monitoring of the efficiency of dust and fume abatement systems, and air quality impact monitoring. Independent, certified organisations also undertake monitoring at each site according to approved programmes.

IMC visited all of the operations between June and September 2010 and, on the evidence provided by Kazakhmys, found all operations to be complying with the requirements of the environmental legislation in Kazakhstan and with a few minor exceptions in general compliance with the conditions of their environmental permits. Complaints from the general public are stated to be rare.

The general visual appearance and housekeeping of the main parts of the operations are consistent with good standards for this type of industry.

IMC understands from Kazakhmys that historically there have been no notable fines, prosecutions or court actions and that none are pending. One large fine received at Zhezkazgan Complex in 2009 for dust emissions from the tailings storage facility was revoked following appeal; Zhezkazgan is now implementing remedial actions. Other fines were received in 2009 for excess water discharge due to heavy rainfall; Zhezkazgan is now planning to expand the water storage facilities.

Parts of the smelting facilities at Zhezkazgan are old and in the near/medium term it will be necessary to replace the sulphuric acid plants and also improve the overall capture of sulphur dioxide to bring the smelter into line with modern smelter standards.

IMC notes the successful programme at Balkhash Smelter during the last 10 years to reduce the emissions of heavy metals and sulphur dioxide, culminating in the commissioning of a modern sulphuric acid plant in 2008. Emissions are now significantly lower than in 2005 and air quality in the locality has improved. Balkhash is also taking action to reduce dust emissions from the tailings storage facility. IMC's review raised a number of issues requiring further attention necessary to bring the environmental performance of the operations, particularly the processing facilities, to good industry standards.

Information provided leads IMC to believe that there are no outstanding major environmental liabilities and no factors likely to materially affect this valuation under current Kazakh legislation.

1.11.3 Rehabilitation

1.11.3.1 Progressive

Ongoing rehabilitation of the mine sites is focused on dust suppression, collection, treatment and reuse of water and back filling of underground mines and some open pit sites where feasible. Non-process waste materials are collected and stored either temporarily or in approved places. Waste rock, topsoil and tailings storage facilities are designed and constructed according to regulations. There is routine inspection and maintenance of tailings storage facilities by the designers and State authorities.

At Balkhash and Zhezkazgan there are programmes for cultivating the tailings storage facilities to reduce wind borne dusting.

1.11.3.2 Closure

Exploitation of mineral resources is governed by the Sub-soil Law. The Sub-soil Law includes provisions for protection of the sub-soil and the natural environment and for restoration of disturbed areas. According to the Sub-soil Law, man made mineral formations stored prior to 30 May 1992 or entered into state stock prior to the Sub-soil Law coming into force, are State property and not the responsibility of Kazakhmys. These items include rock, soil, tailings, slag, and power station ash.

Kazakhmys has contracted to assign annual amounts towards the cost of closure and rehabilitation for each mine or group of mines; typically the assignment is not less than 0.1% of operational expenses in the case of operating copper/zinc mines, 1% of exploration costs for developing mines, and 1% of sales revenue for coal mines. At the time of IMC's review there were 17 approved contracts and 8 new contracts pending approval. All of the programmes have received approval in April 2005 from the relevant Regional Authorities namely: the Department of Environment, the Committee on Geology and Subsoil Use, the Department of State Sanitary-Epidemiological Control, the State Inspectorate of Control in the Field of Emergency Situations.

Between 1997 and end of 2009 the total assigned to closure rehabilitation at the mines is KZT993.7million. The projected accrued fund for each mine or mine group at the end of the exploitation period is sufficient to cover the majority of the estimated cost of rehabilitation.

Preliminary rehabilitation programmes have been prepared for each mine or group of mines in accordance with the requirements of legislation and form the basis of detailed programmes to be developed prior to the mine closure. The planned restoration activities include either site clearance or transferring buildings and infrastructure to the local authority, sealing mine shafts, raising embankments at pit edges using waste rock and topsoil, allowing water ingress to attain natural levels and compacting waste heaps. Each programme includes an assessment of the ecological situation post closure and an estimate of the costs of the proposed restoration work.

1.12 Statutory Authorisations and Licensing

A registered 'Sub-soil Use Contract' is required to be entered into with the relevant governmental body for all commercial sub-soil use, exploration and/or exploitation operations in Kazakhstan under the Sub-soil Law.

IMC reviewed the statutory authorisations for the mines and operations and a summary of the status is given in Table 1-29 below. IMC believes all contracts permits are in place but has not proven the legal title.

Table 1-30 Statutory Authorisations—Principal Sub-Soil Operations

Licence No.	Minerals	Date / Period	Renewal	Operations
МГ No. 28	Copper ores	07/04/95	For 20 years. Possible extension.	Zhezkazgan Area
				East; Annensky; West; Umit; South; Stepnoy; North, Akchi Spassky and Sredne Spassky.
				To depth of -700 metres. Elevations -440 metres to 280 metres. Area 6190 hectare.
ГКИ No. 1383	Copper, silver, rhenium, sulphur, selenium	19/02/98	For 20 years. Possible extension.	Zhilandy Area
				Itauz; East Saryoba; Zapadny Saryoba; Kipshakbai; Karashoshak
				Itauz—to depth to 350 metres. Area 7.496 square kilometres.
				East Saryoba; West Saryoba—to depth of 350 metres. Area 19.166 square kilometres.
				Kipshakbai—to depth of 350 metres. Area 6.01 square kilometres.
				Karashoshak—to depth of 350 metres. Area 0.914 square kilometres.
АИ No. 1542	Copper and co-metals	04/03/99	For 25 years. Possible extension.	Zhaman-Aybat including Taskura—to depth below surface of Northern 900 metres, Eastern 550 metres, Central and Western 700 metres. Area 142.44 square kilometres. Subject to permission from Ministry of Defence to operate on Military Range.
				Prisarysuysky—exploration rights only.
				Sorkuduk-Zhartas - exploration rights only.
ГКИ 56Д	Copper, molybdenum, rhenium, sulphur	19/02/98	For 20 years. Possible extension.	Konyrat—to depth of -550 metres from surface. Area 5.3 square kilometres.
ГКИ 1180Д	Copper, molybdenum, selenium, tellurium	19/02/98	For 20 years. Possible extension.	Tastau (Sayak III)—to depth of -455 metres from surface. Area 3.12 square kilometres.
ГКИ 57Д	Copper ores.	19/02/98	For 10 years. Possible extension.	Sayak 1—to depth of -550 metres from surface. Area 3.6 square kilometres.
Contract No.583	Copper and molybdenum	04/12/00	For 25 years. Possible extension.	Shatyrkul—to a depth of 820 metres from surface. Area of 5.26 square kilometres.
ГКИ No.355Д	Polymetallic ores.	08/12/97	For 25 years. Possible extension.	Irtyshsky—to horizon 16, a depth of -350 metres. Area of 5.2 square kilometres

Licence No.	Minerals	Date / Period	Renewal	Operations
МГ No.354Д	Polymetallic ores.	04/12/97	For 25 years. Possible extension.	Belousovsky—to horizon 18, a depth of -800 metres. Area of 8.51 square kilometres.
ГКИ No.1525	Polymetallic ores.	21/10/98	For 20 years. Possible extension.	Yubileyno-Snegirikhinsky—vertical profile to a depth of 450 metres. Area 0.87 square kilometres.
МГ No.45	Copper and polymetallic ores.	07/06/95	For 20 years. Possible extension.	Orlovsky—to horizon 11, a depth of 500 metres. Area 1,403 square kilometres.
МГ No.197	Copper and zinc ores.	10/05/95	For 20 years. Possible extension.	Nikolayevsky—to horizon 58 metres, a depth of 420 metres. Area 225 hectare.
МГ No.567	Polymetallic ores.	29/01/96	For 23 years. Possible extension.	Artemyevsky—supplementary exploration and mining to absolute depth of -550 metres. Area 147.4 hectare.
МГ No.1343	Coal	04/12/97	For 25 years. Possible extension.	Molodezhny—to horizon +200 metres. Area of 16.257 square kilometres.
МГ No.1342	Coal	04/12/97	For 20 years. Possible extension.	Kuu-Chekinsky—to horizon +230 metres. Area of 7.64 square kilometres.
МГ No.701	Gold, copper and polymetallic ores.	28/08/95	For 29 years. Possible extension.	Samarsky Nurkazgan Western Nurkazgan (Samarsky)—to absolute depth of -550 metres. Area 1.63 square kilometres. South East Nurkazgan
Contract No.1668	Gold and cobalt ores.	18/02/04	For 15 years. Possible extension.	Sayak IV—Purchased Subsurface Agreement from 3rd party. Depth to -280 metres (300 metres msl). Area 0.31 square kilometres.
Contract No.1668	Gold and cobalt ores.	18/02/04	For 15 years. Possible extension.	Sayak IV—Purchased Subsurface Agreement from 3rd party. Depth to -280 metres (300 amsl). Area 0.31 square kilometres.
Contract No.1681	Gold, sulphide and polymetallic ores	03/03/05	For 17 years. Possible extension.	Abyz—Depth to 670 metres (130 amsl). Area of 0.89 square kilometres.
ГКИ No.1359	Copper ores.	19/01/98	For 25 years. Possible extension.	Aktogay—Kazakhmys ownership registered after purchase from Aktogaymys. Depth to 140 amsl. Area 6.1 square kilometres.

Licence No.	Minerals	Date / Period	Renewal	Operations
Letter of Intent with Aktogaymys	Polymetallic ores	10/06/04		Aidarly—Letter of Intent with Aktogaymys to transfer Subsurface Agreement to Kazakhmys when Aktogaymys ratifies Subsurface Agreement with Government.
Protocol No.6	Copper	29/04/04		Bozshakol—Successful tender bidder. Registration in progress.
				Mine to depth of 355 metres (105 amsl). Area of 4.5 square kilometres.
Protocol No.12	Polymetallic ores	06/06/03		Kosmurun—Successful tender bidder. Registration of Subsurface Contract to be completed.
				Depth to 620 metres (200 amsl). Area 1.02 square kilometres.
Protocol No.12	Polymetallic ores	06/06/03		Akbastau—Successful tender bidder. Registration of Subsurface Contract to be completed.
				Depth to 280 metres (550 amsl). Area 0.5 square kilometres.
Protocol No.12	Polymetallic ores	18/11/04		Severno-Nikolaevskoe—Successful tender bidder for exploration. Registration of Subsurface Contract to be completed.
Third Party Agreement				Anisimov Kluch—Kazakhmys has signed an agreement with "Ertis" (the sub soil licence holder) to jointly develop this deposit
No.2029	Ploymetallic ores	17/04/06	2009	North Nikolayevsky—Exploration Subsurface Contract
No. 710 AE	Gold, Copper, Silver	16/04/08	12/02/2028	Bozymchak—Exploration Subsurface Contract

1.13 Costs

Kazakhmys has two independent companies which produce copper and gold. Two other companies provide ancillary services and a sales function, KZM Services and KZM Sales. All costs for the latter two companies are recharged to the operational companies and, for the purposes of this study, any surplus or deficit after recharges is assumed to be zero, or at least immaterial. All other companies within the group have not been considered in detail but are also assumed to make recharges to the two operational companies with a zero or immaterial remainder.

Kazakhmys Copper is a mature copper operation of some up to 26 both open cut- and deep-mines in two regions. It has an on-going track record of operations and costs. Gold, silver, zinc and molybdenum are also produced as by-products.

Kazakhmys Gold was separated from the copper operations in recent years. It comprises two existing old mining operations and one major new scheme at Bozymchak in Kyrgyzstan which is projected to start soon. Both existing mines are due to cease mining in 2011 and will merely provide some cashflow towards the cost of developing Bozymchak. Indeed, the Company has not included these two mines in their cashflow model.

1.13.1 Operating Costs

Each mine, concentrator and smelter is individually budgeted as a cost centre, with the output from one operation being costed as an input for the next.

Future estimates of operational expenditures for operations have been made and input into a model. Within the model, 2010 budgeted figures have been used as a base. Each mine operation has been analysed based upon its fixed and variable cost elements. Fixed proportions vary from mine to mine. These have been reviewed and are considered reasonable. Estimates for future costs have been adjusted based on anticipated tonnages and the calculated split of fixed and variable costs.

Using a standard matrix of fixed and variable cost ratios, costs for concentration and smelting have been estimated and flexed according to the planned output again using 2010 as the basis. Standard fixed percentages of costs for the various cost centres making up the process are shown in Table 1-31 below.

Table 1-31 Operational Cost Fixed Proportions

	Fixed %	
	Balkhash	Zhezkazgan
Mining costs	75	70
Transport Costs (Mine to concentrator)	70	70
Copper Milling	70	70
Zinc Milling	70	
Transport costs (concentrator to smelter)	100	70
Smelting Costs	70	70
Zinc Smelting Costs	70	
Refining Costs	70	70
Overhead Costs	100	100
Market costs	100	100

Where spare capacity exists in concentrators or smelters, allowance is made for purchase of external material or for processing on a tolling basis. Such concentrate is assumed to be purchased at a standard price related to a percentage discount from LME prices. IMC has not assessed the cost-effectiveness of these contracts.

Costs for service providers such as administration and sales departments are similarly charged to each operation and are intended to achieve cost recovery only. Any surplus or deficit is stated by the Company to be immaterial.

Standard rates of recovery are used for each concentrator and smelter, which are deemed acceptable, given the age and condition of each plant. There is no significant cashflow allocated in the model for closures of mines or concentrators, nor for any new tailings ponds or reclamation of tailings ponds. The Company state that any costs for these in order to comply with national legislation are considered immaterial. Some mining operations and concentrators are suspended, but not closed, when metal prices make them temporarily unprofitable. In such circumstances, manpower may be redeployed and other costs minimised.

IMC examined the forecasts of operating costs for all operations as prepared by the management of Kazakhmys. The forecasts were compared with actual costs in previous years and, where considered appropriate, were modified following discussion with the Company. Operating costs were incorporated into the 25 year cash flows prepared by IMC for the purposes of the valuation of the Company's assets. IMC considers the production plans and budgets to be attainable. The historic cash operating costs per tonne of cathode copper produced, net of income credits for by-product sales and other income, for the years 2009 and 2010 are summarised in Table 1-32 below.

Table 1-32 Net Cash Cost per Tonne of Cathode Copper Produced

	2009 US$/Mt	2010 US$/Mt
Net cash cost per tonne	1,597	1,957

Income from the sales of by-products relates principally to gold, silver and zinc. Other income relates to sales to third parties principally of electricity, heat and coal.

Operational costs have a structure that is reasonably consistent, year on year. Typically, this structure is shown in Table 1-33 below, which are the averages for 2008 and 2009:

Table 1-33 Operational Cost Typical Breakdown

Cost Element	Percentage
Raw materials	22.05
Materials	20.89
Fuel	3.30
Power, heat and light	6.93
Mineral extraction taxes	7.59
Direct Wages	9.71
Direct wages on-cost	0.98
Technical equipment service	1.61
Major repairs	2.67
Other repairs	4.51
Depreciation	7.68
Communal services	1.93
Other services	6.65
Taxes	1.65
Other costs	1.84

IMC consider the costs used as a base reasonable and the method used for estimation logical.

Kazakhmys Gold historic results have no bearing on those likely to be achieved in the future since both current old mines will cease and a new mine in a different country will take their places.

1.13.2 Capital Costs

For Kazakhmys Copper, capital expenditure has been estimated by the Company in general terms only. Detailed expenditure plans exist only for 2011-2015, as follows:

Table 1-34 Capital Expenditure

Year	2011	2012	2013	2014	2015
Copper	407,170	619,100	718,400	641,364	643,136

Subsequently, a general estimate of US$200 M for expansion has been allowed for each year. In addition, an estimate for maintenance capital is added, flexed on tonnes of ore produced, based upon the estimated level of maintenance capital in 2012 of US$310 M per annum, with US$320 M assumed in 2011. In the opinion of IMC, the capital expenditure estimates are adequate for the estimated planned outputs.

For Kazakhmys Gold, the only capital expenditure item is to develop the Bozymchak mine and ancillary facilities.

IMC examined the capital cost estimates prepared by management for the period 2010-2034. Where considered appropriate, additions were made to the figures following discussions with the Company's management. The revised capital cost estimates were also incorporated into the cash flows. IMC considers the production plans and budgets to be attainable.

1.14 Sales and Marketing

Kazakhmys is a major producer of copper, zinc and associated by-products and has very detailed market knowledge and expertise in these products.

IMC has viewed and confirm that approximately 95% of the Group's sales of copper is on annual contracts to third parties.

Based upon the Business Plan models provided, an estimation of the value of the combined elements of the company was made on an all-equity, post-tax basis. Selling price for the various metals in the short-medium term are shown in Table 1-35. Post 2015 selling price is assumed to increase by 2% per annum.

Table 1-35 Estimated Selling Prices

		2011	2012	2013	2014	2015
Copper	$ /t	9,000	9,000	6,500	6,000	5,500
Zinc	$ /t	2,500	2,500	2,100	2,100	2,100
Silver	$/oz	25	25	25	22	18
Gold	$/oz	1,300	1,300	1,200	1,000	1,000

1.15 Valuation of Reserves

1.15.1 Methodology and Assumptions

The valuation of Kazakhmys has been performed using the discounted cash flow valuation method. IMC performed the valuation based on models of the operating costs, capital expenditures and revenues provided by Kazakhmys for the gold and copper operations. The division of the valuation into proved and probable reserves has been based on the amount of contained copper or gold production attributable to either proved or probable reserves in total and the total cash flow for each of the two operations (Balkhash/Zhezkazgan and Bozymchak) in that year pro-rated accordingly. IMC have assumed that proved reserves are worked before probable reserves. Depreciation, taxation and working capital requirements were provided by the Company to IMC for inclusion in this valuation to prepare a post-tax valuation with the allocation of the cash flow to proved and probable reserves as noted previously. IMC has accepted the depreciation, taxation and working capital as provided and accept no responsibility as to their accuracy.

The following key factors were considered in the valuation process.

Capital Expenditure

The level of capital expenditure as scheduled in the development of the Net Present Value (NPV) calculations is sufficient to both maintain current production capacity and to promote new production capacity where required. Capital forecasts include expenditures for replacing major equipment on a periodic basis, as well as development capital for opening new areas for mining and installing additional processing facilities where required.

Plant and Equipment

The cost of maintaining, repairing and, where necessary, replacing items or components, is included in the cash cost estimates or in the capital expenditure schedules.

Except in instances where equipment is planned to be transferred to another operation, plant and equipment have not been valued separately. As the plant and equipment is an integral component in the generation of the cash flows used to estimate the value of the reserves, the value of the plant and equipment is included in the reserve value. Any residual value is considered not to be material.

Selling Price

The main products of Kazakhmys, namely copper, zinc, gold and silver, are international commodities and are subject to both short term and cyclical variations. The valuation model is based on forecast prices of the major commodities (copper, zinc, gold and silver) provided by the Company.

Other Key Parameters

Other key valuation parameters used in the valuation include the following:

— The Kazakh Tenge to US Dollar ("KZT/US$") exchange rate is expected to average KZT147 to US$1.00 in 2011 based on a broker's consensus. It has been forecast to stay flat in real terms;

— The valuation is as at 1 January 2011;

— Cash flows are expressed in nominal terms and have been discounted according to an end of year convention;

— Cash flows are based on available reserves forecasted to the shorter of the mine life or 25 years; and

— The NPV was calculated using a discount rate of 12%.

The model covers a twenty-five year period of forecast. Where reserves will be worked-out earlier than the selected forecasting horizon, costs and income were calculated till the last year of scheduled mining works.

1.15.2 Valuation Results

Discounted cash flows (DCF) resulting from modelling reflect the cash value of reserves. The discount rate of 12% was adopted. However, calculations of WACC are always subjective and investors may have a different approach. Thus, IMC has calculated the Company valuation using a range of discount factors. Table 1-36 to Table 1-39 below summarise the value of the reserves both at the operational level and at the post-tax level.

Table 1-36 Summary of Valuation of Proved and Probable Reserves—Based on Operating Results

	Proved Reserves (US$ millions)	Probable Reserves (US$ millions)	Total Reserves (US$ millions)
Base case valuation	4,142	8,768	4,626

Table 1-37 Summary of Valuation of Reserves—Based on Operating Results

Real discount rate %	NPV (US$ million)
+2%	7,880
+1%	8,310
12%	8,768
-1%	9,284
-2%	9,861

Table 1-38 Summary of Valuation of Proved and Probable Reserves—Based on Post Tax Results

	Proved Reserves (US$ millions)	Probable Reserves (US$ millions)	Total Reserves (US$ millions)
Base case valuation	3,003	6,330	3,327

Table 1-39 Summary of Valuation of Reserves—Based on Post Tax Results

Real discount rate %	NPV (US$ million)
-2%	5,713
-1%	5,976
12%	6,330
+1%	6,489
+2%	7,088

1.15.3 Sensitivity Analysis

While IMC concludes that the key indicators for the company, as presented above, are realistic relating to costs and the production mine plans based on reserves, a sensitivity analysis has been prepared for a number of variables.

Mining and marketing copper and gold contain variables that are not always predictable. Potential variables include those directly associated with the mining and processing operations, such as cost and production levels, as well as those that are external to the mining and processing operations, such as market prices. Standard sensitivity analyses for cash flow have been undertaken with respect to variation in sales price, output, operating costs and capital investment costs.

Operating Cost

This could vary as a result of changes in component costs, such as labour or supplies, or from variances in productivity. IMC consider that the costs presented are reasonable but, in order to give a demonstration of the effect should costs escalate, has calculated a sensitivity of plus 10% in operating cost.

Production

Production level can be affected by variances in productivity or market place demands. Outputs predicted by the Company are achievable but, in order to demonstrate the effect, IMC has calculated a sensitivity of minus 10% in production. Costs do not reduce in proportion since operational expenditure has fixed and variable elements. Fixed elements for each aspect of the Company's activity have already been stated.

Capital Cost

Variances in capital costs could result from quantity or market prices of capital items. Note has already been made of recent difficulties experienced with processing plant construction. The effect of a simple increase of 10% in capital cost is calculated.

Copper/Gold Price

Market forces dictate the price of copper, gold and the by-product metals. In recent years, prices have been high until the global crisis. Indeed, gold has maintained a high level right through. There are clear indications that other prices have since recovered but, nevertheless, such commodities are subject to major fluctuations and therefore, IMC has calculated the effect of a drop in sales price of 10%.

A summary of the effect of sensitivity of the valuation of reserves to these variables is given in Table 1-40 below.

Table 1-40 Sensitivity Analysis of Reserve Valuation

NPV (US$ million)	Base Case	Selling Prices (+10%)	Operating Cost (-10%)	Production (-10%)	Capital Cost (+10%)
Based on operating results	8,768	6,437	7,088	7,886	8,266
Based on post tax results	6,330	4,468	4,999	5,484	5,837

1.16 Conclusions

IMC concludes from the independent technical review that:

- management's geological and geotechnical knowledge and understanding is of a satisfactory level to support short, medium and long term planning as appropriate and operations are well managed at an operating level;
- the mine plans appropriately consider geological and geotechnical factors to minimise mining hazards although IMC has reservations about the viability of the open pit designs in the final years of operation but any impact of a failure on production will be small;
- Kazakhmys' mining equipment (either in place or planned in the capital forecasts) is suited to its mine plans and is adequate, with minor adjustments, for the production plans;
- copper and zinc ore processing and associated smelter and refinery plants and other infrastructure are capable of continuing to supply appropriate quality products to the markets at the forecast production plans;
- IMC is unable to compare the LTIFR but believe this to be higher than other comparable operations. The fatality rate is higher than similar comparable operations;

- environmental issues are managed and there are no issues that could materially impede production nor are any prosecutions pending;
- the assumptions used in estimating both capital and operating costs are appropriate and reasonable;
- capital and operating costs used in the financial models incorporating minor adjustments by IMC reflect the mine plans, development and construction schedules and the forecast production levels;
- special factors identified by IMC are well understood by management and appropriate action to mitigate these risks is being taken. Further, the mine plans and cost forecasts appropriately account for these risks; and
- management operates a management accounting system and are able to monitor and forecast production and cost parameters. Management are updating the management accounting systems to IFRS over the short term.

IMC has estimated the value of Kazakhmys' copper, zinc, gold and silver assets at an operating level as US $8,768 million and at a post tax level as US $6,330 million assuming a real discount rate of 12%, an exchange rate of KZT/US$147/1.00, and product prices, capital and operating costs and production forecasts which are soundly based.

2 ZHEZKAZGAN COMPLEX

2.1 Maps and Plans

Plate 2 Map of Zhezkazgan Regional Geology
Plate 3 Zhezkazgan Mines
Plate 4 Zhomart Mine
Plate 5 East Saryoba Mine

IMC visited all of the operations between 15 June and 30 June 2010.

2.2 Zhezkazgan Geology

The copper mineralization of the Zhezkazgan-Satpaev mining region occurs in a thick sequence of Carboniferous sedimentary rocks. The host rock is primarily a grey medium-grained sandstone in which the copper mineralization is disseminated. Orebody distribution is controlled by the Zhezkazgan Syncline, which has an approximately N-S axis, plunging to the south with closure to the north in the Zhelandy area. The syncline is asymmetric with a steeply dipping western limb (50° to 80°) and shallow-dipping core and eastern limb (3° to 20°); the syncline is locally modified by parallel monoclinal structures associated with NNE-SSW trending fractures. The syncline encloses an orefield area which is 40 km from north to south and up to 16 km wide.

The ore-bearing sequence is of over 630 m thickness, attributed to the Taskuduk and Zhezkazgan suites of Middle-Upper Carboniferous age and comprises tabular grey sandstone layers with interbedded red siltstone and mudstone. Within this sequence, 10 groups (horizons) of ore-bearing strata have been distinguished, and within each of these a number of individual orebodies are defined. In practice the greater part of resources occur in eight of the horizons (numbers 9 to 2) and the thickness of individual ore bodies ranges up to 20 m although thickness generally averages 3 m to 5 m. Orebodies are stratabound and conformable with the country rocks; they are delimited by gradational boundaries defined by assay and prominent geological boundaries seldom control orebody distribution. For the planning and designation of mine operations, a vertical sequence of 26 individual orebodies is recognised. The area of the largest orebodies reaches 5 km^2 to 7 km^2.

The mineralization comprises primarily the copper sulphide minerals chalcocite, bornite and chalcopyrite, which account for over 90% of the quoted resource base. Oxidised ores, as malachite, azurite and chrysocolla are developed down to a depth from surface of approximately 100 m. In the Zhelandy area, where all production thus far has been by surface mining, there is a well developed oxidation zone to a depth of 20 m to 40 m.

A total of over 9,000 surface boreholes have been drilled in the area and surface drilling is on-going in the Zhelandy area for resource definition. In terms of their structural complexity the orebodies in the Satpaev area are in Class 1 (most simple structure) and the orebodies in the Zhelandy area are in Class 2 (medium structural complexity). For areas of resources defined only by boreholes, Category A level of definition requires a drilling density of maximum 75 m x 100 m, Category B, 150 m x 150 m and Category C1, 300 m x 300 m.

In those areas where resources are defined on the basis of exploratory drillhole intersections, resource tonnages have been calculated on the basis of the nearest neighbour polygon method. However, in those areas with extensive mining development, resources are commonly calculated on the basis of individual blocks defined on the basis of existing or planned mine infrastructure and the mine production schedule.

For the underground operations in the Zhezkazgan region, the cut-off grade used is 0.3% Cu, subject to 0.4% average copper content over a minimum mining width of 3 m (or minimum of 1.2 m% Cu content). In the underground mines, there is no maximum mining thickness. Only copper content is evaluated for reserves definition, although complex polymetallic ores and lead-zinc ores are identified in each mining operation. Silver makes a significant contribution to revenues but is not included as a value contributor for definition of reserves.

2.2.1 Reserves and Resources Statement, Underground Mines

There are currently five operational underground mines of the Zhezkazgan Complex in the Satpaev orefield. This is a mature orefield in which significant underground workings have been operational since the 1950's. Underground workings extend widely across the area and significant large areas can be considered blocked out for development with widespread under- and over-working. Reference to resources in terms of categories A, B and C1 based on exploratory drilling is to a large extent superfluous and certainly conservative.

With respect to the mineable resources recognised for each mine unit, the individual reserve blocks planned for extraction are generally categorised in terms of their planned method of working. This identifies those areas of reserves which have already been extracted in an initial phase of room and pillar working, and in which secondary extraction is planned to remove pillars.

The categorisation of scheduled blocks for mining also identifies those that are in the frequent NNE-SSW flexure zones. Orebody areas in these zones are steeply inclined to near-vertical and sub-level open stoping extraction methods are applied.

In the current analysis the total active balance reserve, as recorded by KCC, is taken to be the total of measured and indicated categories of JORC resources. KCC also provided data on the extent of development for extraction of resources at each underground mine. The standard for the mines is that 36 months worth of production should be exposed for further mining activities (tunnel development for the blocks preparation and ore extraction). IMC considers that the mines are in compliance with this standard. The ore that has been fully developed is quantified including modifying factors for dilution and mineral loss, and is taken to be equivalent to JORC proved reserve category. Individual categories of JORC resources and JORC probable reserve can hence be deduced. Dilution is expressed as a percentage of additional waste material with no copper content. Mineral loss is expressed as a percentage of contained copper that is lost during extraction.

2.2.1.1 Annensky Mine

This is the most easterly mine, and the deepest from surface. All the allocated reserves and resources are in the Annensky orefield area, characterised by moderate to steep dips, which on a regional scale are approximately 30° to the NE. The steep dip is reflected in the higher average dilution factor of 12% applied in the estimation of the mineable resources of this mine; losses are relatively high and have been estimated at 30%, but are defined by the mining method and parameters. The mine's resources are becoming more focused on the lower, deeper horizons and now 39% of the resource tonnes are in the No.2 Horizon, 23% in the No.3 Horizon, 13% in the No.4 Horizon and 13% in the No.5 Horizon; the remaining 12% is within the Nos.1,6,7,8 and 9 Horizons.

The current fully developed reserve, or JORC proved reserve, allows for 3.3 years of mining at the present rate, and the total reserve allows for a remaining life of 11.9 years. The mine is relatively unaffected by flexures, only 6% of the resource is within flexure areas, and 14% of the resource has a mining width of less than 4 m.

The active balance reserve at Annensky had a major addition in 2009 when 22.8 Mt of ore, previously designated as non-active balance was transferred to the active balance category. The area in question is affected by caving but it is now considered by KCC to be sufficiently stable to allow mining to go ahead.

2.2.1.2 East Mine

This operates over a widespread area of the orefield through two separate groups of shafts, Shaft 57 in the east close to Annensky Mine and Shafts 73/75 in the north-west of the orefield.

Shaft 57 accounts for 57% of resources and extracts remaining reserves in widespread and previously heavily worked areas, including in the central Kresto orefield area adjacent to the shaft site, areas of the Annensky orefield area to the east, the Pokro North area to the north-west and the Zlatoust orefield area to the north. Shaft 57 has reserves and resources in

21 different orebodies covering each of the Horizons 9 through to 1, the lowest recognised horizon. In the higher horizons its workings in the Annensky area are over-worked by Annensky Mine.

Shafts 73/75 account for 43% of resources and work only orebodies in the Akchi-Spassky area at the western margin of the orefield. 11 orebodies are scheduled for extraction, in Horizons 9 through to 5. The AC-6-II Horizon accounts for 10% of the total East Mine resource and is the highest contribution from any source, reflecting the maturity of the mine and dispersed nature of the remaining resource. In the western part of the orefield, horizons below Horizon 5 are uneconomic or not identified.

The current fully developed reserve, or JORC proved reserve, allows for 5.8 years of mining at the present rate, and the total reserve allows for a remaining life of 13.2 years. The mine in total has 11% of the resource affected by flexures and 28% of the resource has a mining width of less than 4 m. Average modifying factors used for East Mine are 20% mineral loss and 9% dilution. Most of the orebodies display shallow dip angles, except for the flexure areas and in the Annensky area where the beds dip at up to 30°.

2.2.1.3 South Mine

South Mine operates primarily in Pokro South-west area, in the south-central area of the orefield, by means of two adjacent main production units, Shaft 45 and Shaft 65. The mine hosts the largest resource of all the underground operations in the Satpaev orefield.

Shaft 65 is scheduled to extract up to 13 orebodies in Horizons 9 down to 6. Some planned operations also extend into the Akchi-Spassky area at the western margin of the operational area. Shaft 45 is scheduled to extract up to 9 orebodies in Horizons 9 down to 7. At the lowest horizon operations extend into the Kresto area at the eastern margin of the operational area. The AC-9-III Horizon accounts for 11% of the total resource and is the highest contribution from a single source, reflecting the maturity of the operation and the dispersed nature of the remaining resource.

The current fully developed reserve, or JORC proved reserve, allows for 7.6 years of mining at the present rate, and the total reserve allows for a remaining life of 14.2 years. The mine has 21% of resources in flexure areas. Average modifying factors used for South Mine are 20% mineral loss and 9% dilution. Outside of the flexure areas the orebodies display shallow dip angles.

2.2.1.4 West Mine

West Mine operates primarily in Pokro North and Pokro South-west areas, in the north-west and central-west areas of the orefield, by means of two main production units, Shaft 55 and Shaft 31. Shaft 55 is the more northerly unit and is scheduled for production from 12 orebodies in Horizons 9 down to 3. The greater part of the reserves are in the Pokro North area, in particular in the PN-5-I and PN-3-II orebodies. Some operations are also scheduled in the Akchi-Spassky area.

Only 74% of the Balance Reserve at West Mine is classified as Active Balance Reserve, the remainder is classified as Non-Active Balance and will not be mined due to geotechnical problems. The Non-Active Balance reserves are not considered as part of the JORC resource.

West Mine did not operate as a separate production unit during most of 2009 when its resources were allocated to the adjacent and interconnected South and East Mines. In 2010 it was reinstated as an operating unit.

The current fully developed reserve, or JORC proved reserve, allows for 4.6 years of mining at the present rate, and the total reserve allows for a remaining life of 9.9 years. The mine has 16% of resources in flexure areas and 52% of the resource is in areas where the orebody is less than 4m in width. Average modifying factors used for West Mine are 20% mineral loss and 9% dilution. Outside of the flexure areas the orebodies display shallow dip angles.

2.2.1.5 Stepnoy Mine

This operations area is in the south-western area of the orefield, and the mine operates by means of two main production units, Shaft 67 and Shaft 70.

Shaft 70 accounts for 78% of the total resource hosted in four horizons, including the AC-9-III horizon which accounts for 58% of the total resource and AC-9-I which accounts for 12%. Shaft 67 accounts for 22% of the resource hosted in 11 different horizons.

The current fully developed reserve, or JORC proved reserve, allows for 11.8 years of mining at the present rate, and the total reserve allows for a remaining life of 18.4 years. The mine has 13% of resources in flexure areas and only 6% of the resource is assessed as less than 4 m in width. Average modifying factors used for Stepnoy Mine are 20% mineral loss and 9% dilution. Outside of the flexure areas the orebodies display shallow dip angles.

Table 2-1 below shows the resource statement estimated as at 1 January 2011.

Table 2-1 Zhezkazgan Underground Resources as at 1 January 2011

Zhezkazgan Underground		Resources	Copper	Silver
		'000 t	*%*	*g/t*
Annensky	**Measured**	6,881	0.72	
	Indicated	40,936	0.86	
	Total	47,817	0.84	9.42
East	**Measured**	31,377	0.60	
	Indicated	22,805	0.85	
	Total	54,182	0.71	9.19
South	**Measured**	57,042	0.65	
	Indicated	46,233	0.78	
	Total	103,275	0.71	12.46
Stepnoy	**Measured**	49,879	0.68	
	Indicated	20,443	0.61	
	Total	70,322	0.66	11.9
West	**Measured**	15,124	0.59	
	Indicated	8,517	0.64	
	Total	23,641	0.61	13.91
Total	**Measured**	**160,303**	**0.65**	
	Indicated	**138,934**	**0.78**	
	Total	**299,237**	**0.71**	**13.97**

Note Resources include undiscounted reserves.

Table 2-2 below shows the reserves statement estimated as at 1 January 2011. All resources identified as Measured and Indicated are considered sufficiently planned to be converted to reserves.

Table 2-2 Zhezkazgan Underground Reserves as at 1 January 2011

Zhezkazgan Underground		Reserves	Copper	Silver
		'000 t	*%*	*g/t*
Annensky	Proved	5,168	0.66	
LOM 11.9 Years	Probable	30,747	0.79	
	Total	35,915	0.77	8.67
East	Proved	26,655	0.55	
LOM 13.2 Years	Probable	19,373	0.79	
	Total	46,028	0.65	8.49
South	Proved	48,271	0.59	
LOM 14.2 Years	Probable	39,124	0.71	
	Total	87,395	0.64	11.29
Stepnoy	Proved	40,932	0.63	
LOM 18.4 Years	Probable	16,776	0.57	
	Total	57,708	0.61	11.1
West	Proved	13,757	0.52	
LOM 9.9 Years	Probable	7,747	0.56	
	Total	21,504	0.53	12.14
Total	**Proved**	**134,783**	**0.59**	
	Probable	**113,767**	**0.71**	
	Total	**248,550**	**0.65**	**10.43**

Note Reserves include adjustments for loss and dilution modifying factors.

2.2.1.6 New Projects

Replacement production capacity within the perimeter of the Satpaev orefield is limited, and currently identified resources for longer-term capacity are largely within the planning horizons of current operations.

Resources for new underground production have been identified in the Zhelandy area in the northern part of the Zhezkazgan Syncline. The deposits, which have been previously worked by open pit methods, are geographically from west to east, Itauz, West Saryoba, East Saryoba, Kipshakpai and Karashoshak. Portal and decline access for underground mining has been started at Itauz and West Saryoba. Scoping studies are currently underway to investigate the concept of linking the development of all these underground operations but the plans are not yet sufficiently advanced to allow for the conversion of JORC resources to reserves. Resources are reported on the basis of GKZ reserve categories B and C1 equating to measured resources and GKZ reserve category C2 equating to indicated resource.

Table 2-3 below shows the resource statement estimated as at 1 January 2011.

Table 2-3 Zhelandy Underground Resources as at 1 January 2011

Zhelandy Project		Resources	Copper	Silver
		'000 t	%	g/t
Itauz	**Measured**	29,369	1.17	9.69
	Indicated	9,281	0.94	4.19
	Total	38,650	1.12	8.37
West Saryoba	**Measured**	26,608	1.57	18.65
	Indicated	7,102	1.63	32.02
	Total	33,710	1.58	21.47
East Saryoba	**Measured**	23,187	1.44	23.00
	Indicated	11,209	1.51	19.63
	Total	34,501	1.48	21.68
Kipshakpai	**Measured**	13,284	1.35	21.95
	Indicated	6,775	1.38	24.40
	Total	20,059	1.36	22.78
Karashoshak	**Measured**	5,124	1.51	6.22
	Indicated	1,978	1.34	6.22
	Total	7,102	1.46	6.22
Total	**Measured**	**97,572**	**1.39**	**16.78**
	Indicated	**36,345**	**1.35**	**18.34**
	Total	**133,917**	**1.38**	**17.21**

2.2.2 Reserves and Resources Statement, Surface Mines

All the surface mine operations of the Zhezkazgan area are administered as one operational unit named North Mine. The planned operations under the administration of North Mine in the period to 2017 are around the perimeter of the Satpaev orefield and in the Zhelandy area some 30 km north of Satpaev.

The Taskura deposit in the Zhaman-Aibat area to the south of Zhezkazgan was mined as an open pit during 2009 but closed prematurely due to lower than expected copper grades.

For resource to reserve conversion, modifying factors of 10% dilution and 4% mineral losses have been applied at all the open pit deposits.

2.2.2.1 Satpaev Orefield

Historically extensive open-pit mining has taken place in the Satpaev orefield around the perimeter of the structure. Remaining reserves are identified in two remaining operations on the western margin of the orefield and in some small remnant pockets on the eastern margin.

The Sredne Spassky open pit is currently in operation and will continue until 2012 when it reaches the 270 mL bench. The ore here dips at 70° to the south. The open-pits on the western margin of the Satpaev orefield are exploiting orebodies in the uppermost Horizon 9.

The Akchi Spassky open-pit is the largest in the Zhezkazgan region with a history of operation since 1980. Additional resources have been identified down-dip and approximately half of this resource has been converted to reserve and will support production through to 2017. Mining here is due to recommence during 2010 with overburden stripping of the western and southern high-wall areas. Ore production will begin in 2012 and reach full capacity by 2013 and eventually deepen the pit by 75 m to the 130 mL bench. The ore here dips at 30° to the south.

Other open pits in the Satpaev orefield with resources remaining are Annensky, Pokro North and the Kresto group. These are relatively small shallow pits occupying the eastern perimeter of the orefield. The remaining resources are impacted by protection pillars for infrastructure such as roads and villages and hence the conversion of resource to reserve is limited.

For surface mine operations in the Zhezkazgan region, the cut-off grade is 0.2% Cu, subject to average 0.5% Cu content over any one selected mining unit.

2.2.2.2 Zhelandy Orefield

In the Zhelandy area the orebodies are attributed only to Horizon 1 and are situated at the top of the Taskuduk series. Up to three orebody layers occur within Horizon 1 (1-I up to 1-III).

The Zhelandy open-pits are sited around the outcrop which defines the closure of the Zhezkazgan Syncline. Only Kipshakpai is currently operating and has a resource which converts to a reserve allowing for production to continue until 2011. The nearby Small Kipshakpai also has a small reserve which will be mined out by 2011. The Kipshakpai structure consists of shallow dipping strata over a number of broad anticlines.

The largest single resource is at the Itauz open-pit, situated on the overturned eastern limb of a tight syncline with steep dips of the order of 70°. It is not considered feasible to deepen the current pit to access the remaining resource. All these open-pit operations are of relatively short life; the longer duration operations are Karashoshak and Itauz, scheduled for completion by the end of 2010.

For the surface mines of the Zhelandy area, a cut-off grade of 0.5% Cu has been used.

Table 2-4 below shows the resource statement estimated as at 1 January 2011.

Table 2-4 Zhezkazgan Surface Resources as at 1 January 2011

Zhezkazgan Surface		Resources '000 t	Copper %	Silver g/t
Akchi Spassky	**Measured**	21,307	0.61	8.33
	Indicated	—	—	—
	Total	21,307	0.61	8.33
Sredny Spassky	**Measured**	7,095	0.53	4.50
	Indicated	—	—	—
	Total	7,095	0.53	4.50
Other Zhezkazgan Open Pits	**Measured**	8,436	0.56	4.91
	Indicated	—	—	—
	Total	8,436	0.56	4.91
Zhelandy Open Pits	**Measured**	4,879	1.01	7.97
	Indicated	—	—	—
	Total	4,879	1.01	7.97
Total	**Measured**	**41,717**	**0.63**	**6.95**
	Indicated	**—**	**—**	**—**
	Total	**41,717**	**0.63**	**6.95**

Note Resources include undiscounted reserves.

Table 2-5 below shows the reserves statement estimated as at 1 January 2011. All resources identified as Measured and Indicated are considered sufficiently planned to be converted to reserves.

Table 2-5 Zhezkazgan Surface Reserves as at 1 January 2011

Zhezkazgan Surface		Reserves '000 t	Copper %	Silver g/t
Akchi Spassky	Proved	14,963	0.56	7.7
	Probable	—	—	—
	Total	14,963	0.56	7.7
Sredny Spassky	Proved	3,427	0.47	3.95
	Probable	—	—	—
	Total	3,427	0.47	3.95
Other Zhezkazgan Open Pits	Proved	5,388	0.49	4.64
	Probable	—	—	—
	Total	5,388	0.49	4.64
Zhelandy Open Pits	Proved	727	0.89	10.02
	Probable	—	—	—
	Total	727	0.89	10.02
Total	Proved	**24,504**	**0.54**	**6.53**
	Probable	**—**	**—**	**—**
	Total	**24,504**	**0.54**	**6.53**

Note Reserves include adjustments for loss and dilution modifying factors.

2.2.3 Zhaman Aibat Geology

The Zhaman-Aibat orefield, including the adjacent Taskura deposit, is situated on the eastern margin of the major Zhezkazgan-Sarysu Depression, an extensive depositional basin of sediments ranging in age from lower-mid Carboniferous to lower Permian. The Zhezkazgan Syncline, controlling the occurrence of the Satpaev and Zhilandy orefields, represents the northern exposures of the Zhezkazgan-Sarysu Depression, and a broadly equivalent sediment-hosted sequence of orebody horizons is present both in the Satpaev-Zhilandy (Zhezkazgan) and Zhaman-Aibat mining areas. The latter area is 130 km to the SE of Zhezkazgan. Although in part obscured by younger formations, the Zhezkazgan and Taskuduk formations, the ore-bearing sedimentary sequences of both mining areas trace the eastern margin of the Zhezkazgan-Sarysu Depression between the Zhezkazgan area and the Zhaman-Aibat area.

The Zhaman-Aibat and Taskura deposits are controlled primarily by a major ENE-WSW monoclinal Azat Flexure system with associated sub-parallel faults, which cuts across the prevailing regional structure of strata dipping generally to the west. Immediately to the north of the ore deposits this structural system downthrows the Carboniferous and Permian strata. Along the south side of this flexure system are a series of fault-controlled sub-parallel blocks with broad anticlinal folds. The orebodies are concentrated along the anticlinal axes representing a linear mineralised zone of some 25 km length.

The Zhezkazgan and Taskuduk series show the same general characteristics as in the Satpaev-Zhilandy area, comprising reddish sandstones and siltstones interbedded with grey coarser sandstones and conglomerates.

Correlation between the Satpaev-Zhilandy and the Zhaman-Aibat sequences is established by marker horizons notably the thin organic limestone at the base of the Taskuduk series, the conglomeratic horizons in the Raimond unit at the base of the Zhezkazgan series and the presence of a strontium enriched horizon in the lower part of the Zhezkazgan series. Copper mineralization, with subsidiary polymetallic and lead-zinc mineralisation, occurs predominantly in the grey sandstones and conglomerates, with apparently higher concentrations in coarser sediments. In a similar manner to that employed in the Satpaev-Zhilandy deposits, mineralised sequences are distinguished as 10 groups (horizons), within each of which are a number of individual orebodies.

In the Zhaman-Aibat and Taskura mining areas, mineralization is recognised in horizons which occupy a stratigraphic thickness of up to 1,000 m. However, drilling shows that horizons of economic interest are of very limited extent.

In the Zhaman-Aibat mining area only one orebody, horizon 4-I at the base of the Zhezkazgan series, is of significance, and has supported large scale production since 2006. Initial deposit appraisal had identified potentially economically exploitable mineralization in 5 layers (4-III, 4-II, 4-I, 3-IV, 3-I), but detailed investigation showed these, with the exception of 4-I, to be of lenticular form and of limited lateral extent. The 4-I orebody has been identified as occupying the nearly horizontal, or broadly flexured, axis of an ENE-WSW anticline, which plunges gently to the west at around 3° to 5°. This area extends over a length of approximately 14 km with a maximum width N-S of 4 km. Mineralisation, comprising primarily copper sulphide ores, is laterally and vertically variable. Zoning of the orebody has been interpreted in which richer ore intersections, consisting predominantly of chalcocite, show a concentric change in relative composition through bornite dominant to chalcopyrite dominant areas. Orebody development is correspondingly patchy. Significant silver values occur consistently, but polymetallic and lead-zinc values are of localised occurrence.

The current mine development and its corresponding reserve and resource area is defined within an elongate elliptical area of some 6 km length with maximum width of 1.8 km.

The Taskura area, at some 10 km to the west of the Zhaman-Aibat orefield, is different in that mineralization is concentrated in the Permian Zhidely-Sai series, which is at a significantly higher stratigraphic level than the mineralised horizons in the Zhaman-Aibat area. Nevertheless, these sediments form part of the same overall sedimentary sequence, albeit with some intra-formational unconformities. Only one horizon has been identified for economic extraction but open pit mining at the site was suspended in 2009 after a year which returned lower than expected copper grades.

2.2.3.1 Reserves and Resources Statement, Zhomart

The reserves and resource statement has been developed on the basis of 865 boreholes, which, over the greater part of the area of the mine, are at a spacing of approximately 100 m x 200 m, although at the extremities of the resource block, this spacing is wider at up to 200 m x 300 m. Review by the State Committee on Reserves in 1997, led to the decision that these boreholes spacings justified assignment of the resources only to the C1 category, where the spacing did not exceed 200 m x 200 m, and where wider than this, resources were categorised as C2. A 100,000 m drilling programme is earmarked to start in late-2010 to upgrade the remaining C2 category resource to C1 and B categories.

Resource tonnages were calculated on the basis of the nearest neighbour polygon method. A cut-off grade of 0.4% Cu was applied for the inclusion of polygons in the assessment of "balance reserves". For those polygons at the margins of assessed areas a minimum average content of 0.8% Cu was also applied. Corresponding nominal Cu grades were applied for polymetallic ores.

Resource tonnages have been expressed as a mineable reserve base, after application of modifying factors for mining extraction. Average mining losses of 5% and dilution of 19%, assuming the dilutant material is of zero metal grade have been taken based on an assessment of KCC spreadsheets which lists modifying factors for all the mine blocks.

In the current analysis, according to the CRIRSCO Guidelines, GKZ resources of category C1 are assigned to measured resources and category C2 to indicated resources. Resources within the currently active Zhomart Phase 1 development are converted to reserves but those falling within the Phase 2 area, which has yet to be formally planned and approved, have not been converted to reserves. A loss factor of 4.8% and dilution factor of 24.7% have been used to convert resources to reserves.

The current fully developed reserve, or JORC proved reserve, allows for 16.1 years of mining at the present rate.

Table 2-6 below shows the resource statement estimated as at 1 January 2011.

Table 2-6 Zhomart Underground Resources as at 1 January 2011

Zhomart Underground		Resources	Copper	Silver
		'000 t	%	g/t
Zhomart	Measured	67,222	1.64	
	Indicated	68,773	1.47	
	Total	135,995	1.56	18.69

Note: Resources include undiscounted reserves.

Table 2-7 below shows the reserves statement estimated as at 1 January 2011. All resources identified as Measured and Indicated within Zhomart Phase 1 are considered sufficiently planned to be converted to reserves.

Table 2-7 Zhomart Underground Reserves as at 1 January 2011

Zhomart Underground		Reserves	Copper	Silver
		'000 t	%	g/t
Zhomart	Proved	63,087	0.96	
LOM 11.9 Years	Probable	1,331	1.36	
	Total	64,418	0.97	4.97

Note: Reserves include adjustments for loss and dilution modifying factors.

2.2.3.2 New Projects

KCC recognises the potential for finding further large copper deposits similar to Zhaman-Aibat within the Carboniferous sedimentary basin between Zhezkazgan and Zhomart and to the south of Zhomart. One such prospect which is midway between Zhezkazgan and Zhomart is Sarysusky where copper mineralisation has been identified in a similar but deeper lying structure to Zhomart. This is clearly a target that warrants further investigation.

Previous, Soviet era, exploration has been conducted in the area for oil, gas and uranium. The data for this work is archived in various Russian institutes and is not automatically accessible to KCC. The data would undoubtedly be very useful in assisting KCC geologists to interpret the regional geology and home in on drilling targets for exploration.

After the suspension of open pit mining at Taskura, the remaining balance reserve there of 442 kt at 0.41% Cu is not considered by IMC to represent a viable resource.

2.3 Mining

2.3.1 Zhezkazgan Underground Mines

2.3.1.1 Annensky Mine

The mining method employed is mechanised room and pillar mining. Ore is drilled and blasted in rooms and handled by trackless methods on the working levels and tipped into orepasses and passes through a number of district crushers from which it is conveyed by the main conveyor system to the hoisting shaft. It is hoisted via skip shafts to the surface for transport by rail to the Satpaev concentrator for processing.

Entry into the mine for personnel is via the Annensky shaft which is fitted with a single cage for both personnel and supplies. The mine is extracting ore from 9 layers of the ore body, from different levels.

The ore is drilled in rooms 6 m wide with a fleet of electric-hydraulic drill jumbos. Square pillars, 6 m square, are left for support. Ore body thicknesses are variable here and stopes can be as high as 12 m. Stopes up to 8 m high are taken in a single lift and thicknesses above this are taken in a subsequent bench downwards. The broken ore is loaded out with diesel load-haul-dump units and tipped into 50 t capacity diesel haul trucks. The trucks haul the ore to orepasses that drop the ore to one of a number of district crushers. There are crushers, Nordberg ST100s, at three levels, one at the –30 m elevation, one at –70 m and the lowest one at –120 m elevation. The crushed rock from these falls onto the main series of conveyors which convey the ore directly to the main 10,000 t capacity underground bunker at the base of the hoisting shaft. From here, it is hoisted by skip to surface. The shaft is equipped with two 25 t skips each independently hoisted. The hoists are, as at the majority of the mines, 4-rope friction winders. The total hoisting capacity is 26 skips per hour, indicating a production capacity of 650 tph. Hoisting is fully automatic. The hoisted ore drops into two 2,500 t capacity ore bunkers on surface, from where it is loaded into trains. All ore from Annensky is processed at the Satpaev concentrator.

Details of the main mobile equipment is summarised in the Table 2-8 below.

Table 2-8 Annensky Mobile Plant

Equipment	Description	Units	Comments
Tamrock Paramatic	Electric hydraulic drill jumbo 2 boom	4	Mine development and production
Tamrock Monomatic	Electric hydraulic drill jumbo 1 boom	3	Mine development and production
Atlas Copco Boomer	Electric hydraulic drill jumbo 1 boom	1	Mine development
Tamrock Solo	Hydraulic stope drill		Stope or bench drilling
Toro LH514H	Diesel load-haul- dump unit	1	Ore loading
Caterpillar 980 G2 and H	Diesel load-haul- dump unit	7	Ore loading
Caterpillar R1700	Diesel load-haul- dump unit	1	Ore loading
Toro 50 and 50+	Diesel haul truck with 50 t capacity	10	Ore haulage
Caterpillar AD55	Diesel haul truck with 55 t capacity	1	Ore haulage
Toro Robolt	Rockbolter	4	Roof support

All of this equipment is of current design and appears well maintained. This equipment fleet is currently handling 9,600 tpd of ore from both sections and will be able to handle the ore extraction requirements for foreseeable future. However, as the extraction operations reach the fringes of the orebody, stoping heights get smaller and more ore will come from pillar recovery, probably leading to lower production rates. Mining in the flexure areas is planned to commence in 2011, and a Solo drill rig is proposed to drill out these steeper dipping portions of the orebody.

The orebody is sedimentary, meaning that the roof is quite laminated. It is important to bolt the roof to give the necessary degree of support. At present, roofbolts of 2.2 m lengths are used on a 1 m by 1 m pattern. These are secured with steel polymer resin. Failures of the roof do occur, particularly in flexure areas, which might indicate that a longer bolt should be used. It is important to ensure that the roof skin is securely anchored to the more stable strata above the disturbed layer.

Ventilation at Annensky mine is an exhaust system via two shafts, Ann 2 and Ann 3. Ann 2 is fitted with a VOD 3.3 electric fan, rated at 461 m^3/sec of air. Ann 3 shaft is fitted with a VCD47N fan rated at 351 m^3/sec. Intake air enters the mine via the main Annensky shaft and three smaller auxiliary shafts. Intake air is heated in the winter months to prevent freezing in the shaft. The Annensky ventilation overlaps with the ventilation at East mine, which provides a further air intake. Ventilation at the mine is good and adequate for the current rate of production.

There are two pumping stations at Annensky: one on the –125 m L and one on the +170 m L. The –125 m station is equipped with 7 settlers and 7 pumps of the CNS-320 type, two operational, and three on standby and two on maintenance. Each pump handles 300 m^3/hr. Water is pumped from here to the +170 m station from where it is pumped to surface. The +170 m is similar in layout to the lower station but is equipped with 5 CNS300 pumps.

IMC considers the mine is well run with no major defects observed, the underground mobile equipment appears well maintained and operated and the mine has the current capacity to produce and deliver ore at the rate of 3.65 Mtpa.

2.3.1.2 East Mine

East Mine is configured as two separate areas, the 57 Section, centred on 57 shaft and the 73/75 Section, centred on the 73 shaft. Access into the 57 Section is via the main 57 shaft. Entry into the 73/75 Section is via the 73 cage shaft. The mining method employed at both sections is mechanised room and pillar mining. Ore is drilled and blasted in rooms and handled by trackless methods on the working levels and tipped into ore passes and hauled on the collector levels by train to the tipping and crusher complex underground. It is hoisted via skip shafts to the surface for transport by rail to the Zhezkazgan concentrators for processing.

57 Section

Entry into the mine for personnel is via the 57 shaft which is fitted with a single cage for both personnel and supplies. The two mine sections are divided into a number of districts working the various layers of the mineral zone. Six districts are termed extraction areas, and six are termed driving areas. The workings are relatively level with some minor undulations and flexures.

The ore is drilled in rooms up to 6 m wide with a fleet of electric-hydraulic drill jumbos. Ore body thicknesses are variable here and stopes can be as high as 18 m. First pass stoping is usually 8 m high, and the thicker areas are taken in subsequent slices downwards. The broken ore is loaded out with diesel load-haul-dump units and tipped into 50 t capacity diesel haul trucks. The trucks haul the ore to ore passes that drop the ore to the collector level on 90 m elevation. There is a second collection level at the 180 m elevation. Ore pass chutes load the ore into electrically hauled trains of, typically, 12 cars of 14 t capacity. These haul the ore to the shaft crusher at 57 shaft. This crusher, a KKD 1200 gyratory, has a capacity of 1,200 tph. From here, it is hoisted by skip to surface. In 57 shaft, two skips, each with a capacity of 30 t, operate independently, and jointly hoist ore at a rate of 900 tph. The hoists are, as at the majority of the mines, 4-rope friction winders. Hoisting is fully automatic. The hoisted ore drops into a 2,500 t capacity ore bunker on surface, from where it is loaded into trains and transported to the Zhezkazgan concentrators.

73/75 Section

The mining operation is identical to the operations at 57 Section. Ore is hoisted at 75 shaft which handles ore from the 73/75 section of the mine. This shaft has two 12 t skips, operating in balance, and the system has a capacity of 450 tph. The crusher at 73 shaft is a jaw crusher with a capacity of 500 tph. The 73/75 Section has its own locomotive haulage circuit.

Details of the main mobile equipment is summarised in the Table 2-9 below.

Table 2-9 East Mine Mobile Plant

Equipment	Description	Units		Comments
		57 Section	*73/75 Section*	
Tamrock Paramatic	Electric hydraulic drill jumbo 2 boom	1	1	Mine development and production
Tamrock Monomatic . . .	Electric hydraulic drill jumbo 1 boom	6	1	Mine development and production
Tamrock Minimatic	Electric hydraulic drill jumbo 1 boom	2		Mine development
Tamrock Solo	Hydraulic stope drill	1		Stope or bench drilling
Cat 980G, G2 and H . . .	Diesel load-haul- dump unit	5	3	Ore loading
Toro 50 and 50+	Diesel haul truck with 50 t capacity	8	6	Ore haulage

This equipment fleet is currently handling 12,000 tpd of ore from both sections and correctly managed, will be able to handle the ore extraction requirements for foreseeable future. All of this equipment is of current design and appeared in good condition.

The orebody is sedimentary, meaning that the roof is quite laminated. It is important to bolt the roof to give the necessary degree of support. At present, roofbolts of 2.2 m or 2.3 m lengths are used. These are either resin grouted or cement grouted. Either way, there are failures of the roof, which might indicate that a longer bolt should be used. It is important to ensure that the roof skin is securely anchored to the more stable strata above the disturbed layer.

Ventilation at East mine is interlinked with the Annensky mine. There are four exhaust shafts, namely 41 shaft, South shaft, 58 shaft and Annensky 1 shaft. Each is fitted with a VTsD electric fan of various models, exhausting in total 690 m^3.sec of air. Intake air enters the mine via the main 57 shaft. Intake air is heated in the winter months to prevent freezing in the shaft. Ventilation at the mine is good and adequate for the current rate of production.

There are two pumping stations: one on the –140 L and one on the +30 L. Each is equipped with 5 pumps of the CNS-300 type, three operational, and two on standby or maintenance. Water is pumped from –140 L to the +30 m station from where it is pumped to surface. Thus there is a degree of redundancy.

IMC considers the mine is well run with no major defects observed and that it has the current capacity to produce and deliver ore at the rate of 3.65 Mtpa.

2.3.1.3 South Mine

South Mine has been in operation since the 1940s. As in all of the Zhezkazgan underground mines, the mining method employed is mechanised room and pillar mining. Ore is handled by trackless methods on the working levels and is tipped into ore passes and hauled by train on the 30 m collector level by train to the tipping and crusher complex underground. It is hoisted in one of two shafts to the surface for further shipment to the Zhezkazgan concentrators.

There are a number of operating levels in the mine working the various layers of the mineral zone. The workings are relatively level with some minor undulations and flexures. As the workings approach the extremities of the orebody, they tend to become narrower and more likely to folding.

The ore is drilled with a fleet of electric-hydraulic drill jumbos. The broken ore is loaded out with diesel load-haul-dump units and tipped into diesel haul trucks. These haul the ore to the tips that pass the ore to the lower gathering level. Here, it is picked up by ore trains and transported to the main tip and crusher system. The crushed product falls into a 9,000 t capacity ore bunker, from which it is hoisted to the surface by one of two shaft systems, the 65 shaft and the 65 bis shaft. Each shaft is equipped with twin skips, 26 t capacity in the case of 65 shaft and 12 t capacity in 65 bis shaft. This latter shaft is under reconstruction at the time of the visit in June 2010, with new hardware being installed. The skips dump the ore onto large concrete bunkers at the shaft head, from where it is loaded into trains and transported to the Zhezkazgan concentrators.

Details of the main mobile equipment is summarised in the Table 2-10 below.

Table 2-10 South Mine Mobile Plant

Equipment	Description	Units	Comments
Tamrock Paramatic	Electric hydraulic drill jumbo 2 boom	3	Mine development and production drilling
Tamrock Minimatic	Electric hydraulic drill jumbo 1 boom	1	Mine development
Cat 980G, G2 and H	Diesel load-haul-dump unit	10	Ore loading
Toro 50+	Diesel haul truck	1	Ore haulage
Locomotive	Electric trolley loco	13	Ore haulage

The mining fleet appears in good condition and is well managed and operated. This equipment fleet, correctly managed, will be able to handle the ore extraction requirements for the up until 2013, after which there will be a reduction in production targets. At this stage, there may be a requirement to review the fleet downwards, but this can be decided nearer the time. The equipment would be of the same or similar types.

Ground support is a major issue at the Zhezkazgan mines. The orebody is sedimentary, meaning that the roof is quite laminated. It is important to bolt the roof to give the necessary degree of support. At present, roofbolts of 2.2 m or 2.3 m lengths are used. These are either resin bonded or cement grouted. Either way, there are failures of the roof, which might indicate that a longer bolt should be used. It is important to ensure that the roof skin is securely anchored to the more stable strata above the disturbed layer.

Ventilation at South mine is via a number of shafts, with three principal ventilation shafts and a number of ancillary shafts. Ventilation is mechanical, with exhaust fans extracting the air. Ventilation at the mine is good and more than adequate for the current rate of production.

The mine is not a wet mine, and there are two pumping stations. The +30 m station is equipped with 6 centrifugal pumps, one operational, four on standby and one on heavy maintenance. Pumping here is at the rate of 300 m^3/hr. Thus there is a high degree of redundancy. This layout is repeated at the second pump station on the –134 m elevation, which at present is pumping 50 m^3/hr.

Production targets will remain at the 5 Mtpa rate until 2013, after which, production will decline to around 3.5 Mtpa as the orebody limits are reached, stoping widths become less, and a larger proportion of the mined tonnage comes from the more difficult pillar recovery process.

The current mineable ore reserves are rather less than the total mine resource at South mine. Much of the difference is due to reserves being sterilised by collapsed mining areas. While there are plans to develop a draw point level below these collapsed areas, it is not known how effective this approach will be and therefore, whether any of this sterilised resource can be brought back into mineable reserves.

IMC considers that the mine is well run with no major defects observed, the underground equipment appeared in good condition and was well operated and has the capacity to produce and deliver ore at the rate of 5 Mtpa, although there will be pressure on the management to achieve these production rates.

Technical and geological constraints are limiting the production, as the orebody limits are being reached, the technical issues relating to the extraction of the collapsed area have not been finally solved and ore production from this mine will start to decline after 2013.

2.3.1.4 Stepnoy Mine

Stepnoy mine was, prior to 2005, a part of the South mine complex. It was given a separate identity in 2005. As in all of the Zhezkazgan underground mines, the mining method employed is mechanised room and pillar mining. Ore is drilled and blasted in rooms and handled by trackless methods on the working levels and tipped into orepasses and hauled on the 30 m level by train to the tipping and crusher complex underground. It is hoisted via 67 shaft to the surface for transport by rail to the Zhezkazgan concentrators for processing.

Entry into the mine for personnel is via the 67 shaft which is fitted with a single cage.

There are a 7 –8 operating levels in the mine at present, working the various layers of the mineralised zone. The workings, as at South mine, are relatively level with some minor undulations and flexures. As the workings approach the extremities of the orebody, they do tend to become narrower and more likely to folding. This section of the mine is reported to have remaining life of 15 years, although of increasingly lower copper grades.

The ore is drilled with a fleet of electric-hydraulic drill jumbos. The broken ore is loaded out with diesel load-haul-dump units and tipped into 50 t capacity diesel haul trucks. The trucks haul the ore to ore passes that deliver the ore directly into one of four Nordberg ST100 crushers above the –140 Level (L). From these crushers, the ore passes directly onto the main conveyor on –140 Level to the shaft bunker, from where, it is hoisted by skip to surface. Two hoists each with two 25 t skips operate independently and each raise 13 skips per hour. The hoists are, as at the majority of the mines, 4-rope friction winders. Hoisting is fully automatic. The hoisted ore drops into a 2,500 t ore bunker on surface, from where it is loaded into trains and transported to the Zhezkazgan concentrators.

Details of the main mobile equipment is summarised in the Table 2-11 below.

Table 2-11 Stepnoy Mobile Plant

Equipment	Description	Units	Comments
Tamrock Paramatic	Electric hydraulic drill jumbo 2 boom	2	Mine development and production
Tamrock Monomatic	Electric hydraulic drill jumbo 1 boom	5	Mine development and production
Tamrock Minimatic	Electric hydraulic drill jumbo 1 boom	1	Mine development
Cat 980G, G2 and H	Diesel load-haul-dump unit	10	Ore loading
Toro 50 and 50+	Diesel haul truck with 50 t capacity	11	Ore haulage

This equipment fleet is currently handling 10,000 tpd of ore and correctly managed, will be able to handle the ore extraction requirements for foreseeable future. It all appeared in good condition and was well operated.

The orebody is sedimentary, meaning that the roof is quite laminated. It is important to bolt the roof to give the necessary degree of support. At present, roofbolts of 2.2 m or 2.3 m lengths are used. These are either resin grouted or cement grouted. Either way, there are failures of the roof, which might indicate that a longer bolt should be used. It is important to ensure that the roof skin is securely anchored to the more stable strata above the disturbed layer.

Ventilation at Stepnoy mine is via three shafts, numbers 66, 68 and 69. Each is fitted with a VOD 31.5 electric fan, each capable of exhausting 264 m^3/sec. Intake air enters the mine via the main skip and the main personnel and materials shaft. Intake air is heated in the winter months to prevent freezing in the shaft. Ventilation at the mine is good and adequate for the current rate of production.

There are two pumping stations: one on the –140 L and one on the +30 L. Each is equipped with 5 pumps of the CNS-300 type, three operational, and two on standby or maintenance. Water is pumped from –140 L to the +30 m station from where it is pumped to surface. Thus there is sufficient pumping capacity for the mine.

IMC considers that the mine is well run with no major defects observed and has the capacity to produce and deliver ore at the rate of 3.65 Mtpa.

2.3.1.5 West Mine

West Mine has two separate and distinct sections: the Akchi decline and 55 shaft. The mining method employed in both is mechanised room and pillar mining. Ore is drilled and blasted in rooms and handled by trackless methods on the working levels. In Akchi section, ore is hauled by a conveyor to surface, and in 55 section, ore is hoisted up 55 shaft. Ore is railed to the Zhezkazgan concentrators.

Akchi Section

Entry into the mine for personnel and for all materials is via the Akchi decline developed from the Mali Spassky open pit. The decline ramp is accessible by 4WD personnel and utility vehicles. A second decline ramp has been constructed for the conveyor haulage, which daylights in the adjacent Akchi Spassky open pit.

The ore is drilled in rooms 6 m wide with a fleet of electric-hydraulic drill jumbos. Square pillars, 6 m square, are left for support. Stopes are usually up to 6 m in height, but thicker sections are taken out in two lifts. The broken ore is loaded out with diesel load-haul-dump units and tipped into 50 t capacity diesel haul trucks. The trucks haul the ore to an underground jaw crusher which discharges the ore onto a series of three conveyors for conveying to the surface. The total conveyor length is 960 m. The conveyor transports the ore to the surface stockpile located in the open pit. The open pit is currently idle, but there are plans to restart operations there in the latter half of 2010. The new operations in the pit are not expected to affect ore handling from the West mine. Ore from the stockpile is picked up by an EKG-5 rope shovel and transported with a Caterpillar 777 truck to the railhead, from where the ore is transported to the Zhezkazgan concentrators. The Akchi section has a capacity of 2,500 tpd.

55 Shaft Section

This section of the mine dates back to 1964 when 55 shaft was commissioned. The mining method at 55 shaft is the same as the Akchi section. The ore is loaded from the room and pillar stopes and hauled to orepasses for rail haulage on the +180 m elevation to the single underground crusher, a KKD-1200 cone crusher at the +160 m elevation. The ore is discharged into a bunker and hoisted to the surface via the skip shaft, which is equipped with two 25 t skips. The shaft has a capacity of 24 skips per hour, indicating a shaft capacity of 600 tph. Ore hoisting is fully automatic. The 55 shaft section has an operating capacity of 3,500 tpd. Together with the Akchi section, West Mine has a total capacity of 6,000 tpd. The ore at 55 shaft is discharged into each of two bunkers, each of 3,000 t capacity. From here, it is hauled by train to the Zhezkazgan concentrators. The 55 shaft is also equipped with a cage for hoisting personnel and materials.

Details of the main mobile equipment is summarised in the Table 2-12 below.

Table 2-12 West Mine Mobile Plant

Equipment	Description	Units: Akchi Section	Units: 55 Shaft Section	Comments
Tamrock Monomatic	Electric hydraulic drill jumbo 2 boom	1	3	Mine development and production
Tamrock Minimatic	Electric hydraulic drill jumbo 1 boom	2		Mine development and production
Tamrock Axera	Electric hydraulic drill jumbo 1 boom	1		Mine development
Tamrock Solo	Hydraulic stope drill	2		For flexure stope mining in both sections
Caterpillar 980 G2 and H	Diesel load-haul- dump unit	1	2	Ore loading
Toro 50 and 50+	Diesel haul truck with 50 t capacity	2	4	Ore haulage
Toro Robolt	Rockbolter	1	1	Roof support

Underground mining equipment appeared in good condition, although some units were older than seen elsewhere. It was well operated. This equipment fleet is currently handling 6,000 tpd of ore from both sections and will be able to handle the ore extraction requirements for foreseeable future. However, the mine is quite mature and extraction operations will get increasingly constrained by working at the orebody fringes and by the need for pillar extraction and a larger proportion of flexure mining.

The orebody is sedimentary, meaning that the roof is quite laminated. It is important to bolt the roof to give the necessary degree of support. At present, roofbolts of 2.3 m lengths are used on a 1 m by 1 m pattern. These are steel bonded with polymer resin. Failures of the roof do occur, particularly in flexure areas, which might indicate that a longer bolt should be used. It is important to ensure that the roof skin is securely anchored to the more stable strata above the disturbed layer.

Ventilation at the Akchi section is a forced exhaust system with two exhaust shafts to surface. Each is fitted with a VCD 3.3 fan of 700 kW, and each exhausting 54 m^3/sec. Intake air enters the mine via a dedicated intake shaft, with heating for winter conditions. A small amount of air intakes at the Akchi decline ramp to ensure adequate conditions in the ramp. The 55 shaft ventilation overlaps with the ventilation at East and South mines. Four exhaust shafts handle the air for West mine, numbers 60, 61, 74 and 31bis. Total air for the mine is 486 m^3/sec. Air enters the mine at 55 shaft and some from the East and South mines. Ventilation at the mine is good and adequate for the current rate of production.

All water from West mine is collected on the +180 m rail haulage level and flows to two settler tanks. The pumping station is on same level and is equipped with 4 CNS-300 pumps each rated at 300 m^3/hr. In normal operation, two pumps are in use and two on standby. The water is pumped to surface to a second set of settlers and is used as process water at the mine. Excess water is pumped to the municipal water treatment plant and use in the neighbouring town of Satpaev.

IMC considers that the mine is adequately run with no major defects observed, it is mature and despite the increasing constraints on production it has the capacity to produce and deliver ore at the rate of 2 Mtpa.

2.3.1.6 Zhomart Mine

Zhomart mine was built in the early 2000s and the first ore production was in 2006. The mining method employed is room and pillar mining, with, typically, 5.5 m wide rooms and 5.5 m square pillars. Broken ore is loaded with diesel LHD units into Toro 50+ haul trucks. The ore is hauled to one of three underground district crushers that crush the ore and discharge it onto a series of conveyor belts that transport the ore to the skip loading station for hoisting up the shaft. Ore is then railed to the Zhezkazgan concentrator. Current production rates are 10,000 tpd at a recovered copper grade of around 1.4%.

Access into the mine is via the skip shaft which is fitted with a cage for personnel. There is also access to the mine via a ramp from surface, accessible by 4WD vehicles and utility vehicles.

The orebody at Zhomart is a single geological unit at about the 190 m level, around 540 m below surface. The workings are relatively level with a slight dip of between 0 – 3°. The ore zone is generally around 5 – 6 m in height, and can be up to 8 m high in the more folded areas. As the workings approach the extremities of the orebody, they will tend to become narrower.

The ore is drilled with a fleet of electric-hydraulic drill jumbos. The broken ore is loaded out with diesel load-haul-dump units and tipped into diesel haul trucks which haul the ore to one of the three underground crushers. The rated capacity of the crushers are 500 tph of ore. The primary crushed ore discharges onto district conveyors that deliver the ore to a trunk conveyor for transport to the skip shaft. The ore is delivered into a 1,250 t capacity ore bunker, from which it is hoisted to the surface via a shaft is equipped with twin 24 t skips. At a hoisting rate of 30 skips per hour, the shaft can achieve the 10,000 tpd. On the surface, the skips discharge the ore into a 5,000 t bunker, from where it is loaded into trains and transported to the Zhezkazgan concentrators. The trains comprise between 20 – 30 cars of 105 t capacity, and 100 cars are delivered per day.

Details of the main mobile equipment is summarised in the Table 2-13 below.

Table 2-13 Zhomart Mobile Plant

Equipment	Description	Units	Comments
Atlas Copco Boomer	Electric hydraulic drill jumbo 2 boom	4	Mine development and production
Atlas Copco ST1520	Diesel load-haul-dump unit 9 m^3 bucket	4	Ore loading
Toro 50+	Diesel haul truck 50 t	1	Ore haulage
Atlas Copco MT5020	Diesel haul truck 50 t capacity	6	Ore haulage
Normet Charmec	Explosives charging unit	3	Stope blasting
Atlas Copco Boltec	Rock bolter	4	Roof support

This equipment fleet, correctly managed, will be able to handle the ore extraction requirements for the up until the time that the new mine extension is constructed. At that time, the fleet will be reviewed, but there it is reasonable to expect that the equipment will be of similar size and capacity. All the equipment seen appeared in good condition and was of modern design.

Ground support is handled with resin grouted rock bolts. The bolts are 2.2 m long and are placed on a 1 m by 1 m pattern. There are ground support issues in certain areas although generally, roof conditions are controlled well.

The ventilation circuit consists of two ventilation shafts at the extremities of the mine, both fitted with exhaust fans. The air is directed into the mine via the main shaft and the decline. Ventilation air is directed to the working places as required. The system does not always cope with the installed equipment and temperatures in the working places are sometimes high. The overall quantity of air in the mine is adequate, but the air is not managed efficiently.

The mine is particularly dry, with 24 m^3 of water pumped per hour. The water is pumped by a CNS300 pump with a capacity of 300 m^3 per hour. There is more than sufficient redundancy in the system.

IMC considers that Zhomart is a particularly well operated mine, aided in part by its relative young age, and the extraction from a single ore horizon, the underground equipment appeared well maintained and operated, roof conditions should be improved by using a longer bolt and ventilation conditions in the working faces need to be improved by improving the management of airflow around the mine.

2.3.2 Zhezkazgan Opencast Mines

The North mine division manages all of the open pit mines in the Zhezkazgan group. The open pits include the Zhilandy operations to the north of Satpaev, and the Spassky open pit mines to the west of Satpaev.

2.3.2.1 Middle Spassky

Middle Spassky has been operating as an open pit mine since 1993. Operations have been suspended due to economic reasons from time to time, including more recently the period from 2003-07. The pit was re-opened in 2008 for overburden stripping and was worked for 6 months in that year and the whole of 2009. The first ore was produced from the re-established pit in April 2010. During 2010, some 860,000 t of ore are planned with a waste removal of 3.8 Mm^3. The pit bottom is currently 315 m and the final pit bottom is planned to be 270 m.

Details of the main mobile equipment is summarised in the Table 2-14 below.

Table 2-14 Middle Spassky Mobile Plant

Equipment	Description	Units	Comments
Terex RH 90C	Electric hydraulic front shovel. 10 m^3 bucket	2	Principal production units
Cat 777D	Haul truck 91 t capacity	8	Ore and waste haulage
DML	Blasthole rotary drill 215 mm dia hole	1	Blasthole drilling ore and waste
SBSh 250	Blasthole rotary drill 250 mm dia hole	1	Blasthole drilling ore and waste
T250	Tracked dozer	2	Pit and dump clean up
Cat 824	Wheel dozer	1	Road maintenance
EKG 5	Electric rope shovel	1	Ore rehandling onto railway

The pit is developed with a bench height of 15 m. Ore at a grade of around 0.5 % Cu is mined and hauled to a railway loading stockpile. Waste is hauled to adjacent waste dumps. The remaining 7.7 Mm^3 of waste stripping for the life of the pit will be placed within the designed waste dumps. The expected life of the open pit is 2012 with the remaining 3.6 Mt of ore to be mined.

There are no technical constraints to the execution of this programme. The current fleet is more than adequate for this remaining mining programme, and by the latter half of 2010, some of the equipment will become redundant and be available for the start up of operations in Akchi Spassky.

The maintenance of equipment at the mine is undertaken by the Kazakhmys Service facility. The maintenance facility is of a good standard, and the equipment appeared to be in good condition.

2.3.2.2 Akchi Spassky

This open pit, immediately to the south of Middle Spassky, is currently idle. There are some 8.8 Mt of ore at a grade of around 0.61% remaining in this pit. It is planned to recommence stripping in the 3rd quarter of 2010 when some mobile plant from Middle Spassky and Kipshakpay becomes available. During 2011, it is planned to increase the mining fleet and continue waste stripping operations, leading to the start of ore production in 2012. Operations are planned to be completed in 2017 when the available ore will be depleted. Ore production will be at a rate of between 1 – 2 Mtpa. Mining will be conventional open pit mining with drilling and blasting. The ore will be hauled to the rail loading stockpile and the waste will be stored on extensions to the current waste dumps. There are no constraints to the continued mining of this pit, once the necessary equipment is made available. The pit is accessible in its current state, and the roads and benches only require the necessary clean-up before operations can commence. The drainage of the pit is in order, and there are no unusual volumes of water to deal with prior to renewed operations.

2.3.2.3 Annensky 3

This is a small open pit adjacent to the Annensky underground mine. Operations here started in September 2009 and are scheduled to finish in December 2010. The ore is a complex polymetallic ore containing copper, lead and zinc. The planned production for 2010 is 253,000 t of ore at a grade of around 1.0% Cu. Blasthole drilling is being done with 2 SBSh 250 drills, and the blasted material is loaded by 2 EKG-10 rope shovels into a fleet of Cat 777 trucks. The ore is railed to the concentrator.

2.3.2.4 Annensky West

This is another of the small pits in the Annensky area. This pit started in January 2009, but operations ceased in August of that year due to signs of instability in the pit caused, it is believed by the proximity to underground workings. There are some 300,000 t of resource at a grade of around 1% Cu remaining, but it is not planned to extract this material until a solution is found to the instability problem.

2.3.2.5 West (Zapadny)

This small open pit is in the same location as the two pits discussed above, started in 1998 but was stopped in the same year. The pit was re-opened in January 2010, and it proposed to produce 250,000 t of oxide ore at a grade of 0.6% Cu in 2010. Operations will cease during 2011. Equipment at the mine consists of 2 blasthole drills, 2 EKG rope shovels, one Belaz 130 t haul truck (on lease) and one Cat 777. The ore is stockpiled and sent to Zhezkazgan concentrator in batches for oxide flotation.

2.3.2.6 Pokro North

This is a resource containing 1.9 Mt of copper oxide at a grade of 0.86% Cu plus 905 kt of copper sulphide at a grade of 0.39% Cu. It lies under the main highway to Arkalyk. Production from the mine is planned to commence in 2015, building to an annual rate of around 1 Mtpa. The actual date of commencement depends on the ability to re-align the road to Arkalyk. No design yet exists for an open pit.

2.3.2.7 Kresto pits

This chain of small pits is adjacent to the village of Krestovsky. Some of the Kresto pits have been mined, and Kresto 12, Kresto 10,8 and Kresto Centre remain. The total resource contained in thee pits totals some 500 kt of material at a grade of 0.47% Cu. It is planned to extract these pits in 2011. The equipment will be pooled from the existing equipment operating the Annensky 3.

2.3.2.8 Kipshakpay

This is the only operating mine in the Zhilandy group of mines. Operations at the mine commenced in 2003 and are planned to continue up until the middle of 2011, when the open pit resource will be depleted. Production is currently at an annualised rate of 700 ktpa, at a grade of 0.87% Cu. The pit is currently operating on the 300 m bench. The final pit bottom will be at the 270 m level.

Details of the main mobile equipment is summarised in the Table 2-15 below.

Table 2-15 Kipshakpay Mobile Plant

Equipment	Description	Units	Comments
Terex RH 90C	Hydraulic front shovel. 10 m^3 bucket	3	Principal production units. One electric and two diesel powered.
EKG 8	Electric rope shovel. 8m^3 bucket	1	Back up shovel
Cat 777D	Haul truck 91 t capacity	6	Ore and waste haulage
DML	Blasthole rotary drill 215 mm dia hole	1	Blasthole drilling ore and waste
DM	Blasthole rotary drill 215 mm dia hole	1	Blasthole drilling ore and waste
T250	Tracked dozer	2	Pit and dump clean up
Cat 824	Wheel dozer	1	Road maintenance

This is a standard open pit operation. Blasting operations are conducted by a blasting contractor, using ANFO based blasting agents. Ore is hauled to a rail loading stockpile, where an EKG-5 shovel loads up to 2 trains per day for transport to the Zhezkazgan concentrators. Water in the pit is drained into a sump from where it is pumped by a CNS 300 centrifugal pump at the rate of 160 m^3/hr. The pit is well operated and equipment well maintained. There are no technical constraints to the continuing operation of this pit until the conclusion of operations in 2011.

2.4 Projects/Prospects

2.4.1 Akchi Spassky

This open pit mine ceased operations in 2006. An interim open pit was developed between the Akchi Spassky and Middle Spassky pits in 2007. Some 8.8 Mt of resource still exists in the Akchi Spassky pit area at an average grade of 0.61% Cu. It is now planned to recommence mining operations in the pit, and it is expected that waste stripping will commence later in 2010, when equipment is available from the Kipshakpay open pit. Kipshakpay will complete ore extraction during 2011, but by the latter part of this year, waste development will reduce significantly. Ore extraction will recommence at Akchi Spassky late in 2012 and build up to an annual ore tonnage in the range 1 to 2 Mtpa.

2.4.2 East Saryoba

East Saryoba is in the Zhilandy group of mines. It was worked as an open pit up until 2008. Some 29.6 Mt of resource is estimated to remain below the open pit workings at a grade of 1.51% Cu. The project, at the scoping study stage, envisages an underground mine with a production rate of 2 Mtpa. It is likely that room and pillar extraction will be used but the definitive method awaits the completion of further drilling. The outline plan at present indicates a system of district conveyors with moveable crushers, transferring to a main conveyor in an incline drift to surface. This main conveyor may eventually connect to the West Saryoba and Kipshakpay underground projects should these be further progressed.

Once approval has been given, the project has a timescale of 6 years including the design stage. However, this project has not yet reached that stage. Two declines, one a conveyor tunnel and one a man and service way have already been started at a site around 5 km from the East Saryoba open pit. Work was stopped early in 2010. It was reported that the declines have been driven to about 1 km, and are being kept de-watered.

2.4.3 Itauz

The original open pit was designed to go to down to the 230 RL. The pit was developed far as 310 RL. However, the design slopes could not be maintained and the additional waste on the hanging wall side that was required to maintain a lower, but more stable, slope angle, rendered the economics of deepening the pit uneconomic. The deposit is steeply dipping and there remain some 46 Mt of mineral from the bottom of the pit to a point 800 m below the original surface. In a bid to access the remaining resources, new underground project has been produced as a scoping study.

The project entails the mining of a series of ramps from the base of the current open pit to access the 280 m, 240 m and 200 m RL levels. There is a resource of 6 Mt of ore in this section, at an average grade of around 0.85% Cu. This part of the resource will be mined by sub-level caving methods at a planned rate of 800,000 tpa. The life of the first stage is approximately 7 years and the capacity of the second stage project is 2 Mtpa at a grade of 0.89% copper. Mining will be by sub-level caving methods using trackless mobile equipment. The mobile plant fleet is expected to be as shown in Table 2-16 below. The life of the second stage project is reported as around 20 years to mine the resource of 40.0 Mt of ore at an average grade of 0.89% copper.

Table 2-16 Itauz expected Mobile Plant

Equipment	Description	Units
Solo	Stope blasthole drill	2
Atlas Copco Rocket Boomer	Mine development drill jumbo	3
Toro 0010	Loader	3
Toro 50+	Haul truck	7

The Stage 1 study has been done to scoping level and has been presented to the Kazakhmys Investment Committee for approval which had not been granted at the time of the visit in mid June 2010. The second stage project has also been done to scoping level but its status is also not approved. A decline portal already exists at Itauz open pit, but work on this decline has been halted until a decision on the scoping study is made.

2.4.4 West Zhezkazgan

This is a small open pit that was commenced in January 2009 bit operations ceased here in August 2009 because of the possible danger caused by nearby underground workings. Some 300 kt of mineral are reported to remain here, but it is not clear when operations might resume.

2.4.5 Karashoshak

Karashoshak is in the Zhilandy group of mines. It was worked as a series of three small open pit mines until early 2009. The resources continue below the economic pit limits, and it is estimated that some 6 Mt of resource at 1.4% Cu remain. Exploration drilling continues and a 3D block model, using Datamine has been produced. It is planned to prepare a scoping study in due course, but no timescale has been discussed.

2.4.6 Zhomart II

Zhomart underground mine started producing ore in 2004 and in 2007, the production rate was increased to the design capacity of 10,000 tpd. This mine is now fully operating to its design capacity, extracting the reserves in the central part of the deposit. There are significant additional resources to both the west and east of this central area. The Zhomart II project is based on the extraction of the resources which extend a further 8 km to the west of the 6 km length of the current Zhomart mine. These additional resources are some 650 – 700 m below the surface. Most (62%) are in the range of 3 – 8 m thick, with 24% being less than 3 m thick and 14% being more than 8 m thick. The resources under consideration total some 39 Mt at 1.96% copper.

Three variants are being studied at the scoping level. The variants consider either joining up to the existing mine, or sinking new shafts to the west along with the construction of new infrastructure. Haulage variants within the projected mine are trackless haulage to the new skip shaft or rail haulage.

It is likely that the production levels will be established at a rate such that the combined total of Zhomart I and II will be 4 Mtpa, probably evenly split between the two mines. This 4 Mtpa total capacity is predicated based on the capacity of the railway haulage to the Zhezkazgan processing complex some 150 km distant. No timescale has been attributed to the project.

2.4.6.1 Pokro North

This small resource is the possible subject of a study for an open pit operation. There are logistical complications since the deposit lies below the main Satpaev—Arkalyk road, and the deposit is in an area of instability due to underground mining operations.

2.5 Concentrators

There are three concentrators, Zhezkazgan No.1, Zhezkazgan No.2 and Satpaev, in the Zhezkazgan area built in 1953, 1963 and 1977 respectively. All three concentrators have undergone alterations over time to meet changing production requirements and whilst the general layouts may appear illogical and confusing they typical 1960/70s design and are in fact all similar involving three stages of grinding producing a finely ground flotation concentrate mainly minus 74 microns. All three concentrators are undoubtedly serviceable for the foreseeable future with ample capacity for the present production rates which have been falling in recent years as shown in the updated attached tables. Whilst IMC was unimpressed with the general appearance of all three concentrators particularly with reference to HSE issues, there is no doubt that production targets can be met in spite of operating old equipment which is continuously abused by the abrasive high silicate ores being processed and has no argument with the reported recoveries. The use of local casting facilities (and those at Karaganda) to produce all requirements of grinding balls, mill liners, pump impellors, flanges, clamps, mill liner bolts, spiral classifier wearing plates and other wearing parts was impressive but would no doubt be further assisted in this respect if there was a local rubber coating facility for coating screen decks in the crushing circuits for example. As none of the plants were under production pressures further measures are no doubt side lined. Maintenance of major items of plant appeared to be well under control albeit undertaken in a somewhat cramped environment. Each of the concentrators is discussed in turn, describing the equipment and the flow sheet, and updating the plant's recent production history. The two Zhezkazgan concentrators are operated by the same administration and their costs are combined.

2.5.1 Zhezkazgan Concentrator No.1

The two concentrators at Zhezkazgan occupy adjacent sites and are operated by a single management. No.1 concentrator was built in 1953. It was subsequently expanded to increase its throughput and the mill feed storage facilities have been split into six sections along the primary grinding aisle giving a facility to treat various copper ores separately as required. Ore from the South mine is processed by mills one to twelve (sections 1 to 4) whilst ores from the East mine and from the new Zhomart mine are processed in mills 13 to 18 (sections 5 and 6). In general the flow of material gravitates for the mill feed bins down to the flotation circuits at the lowest levels.

Ore is received from the mines in 100 t side dump rail cars and tipped into a bunker. There is a railcar tippler over the bunker, so that ore can be received in normal rail cars. All cars are weighed approaching the dump point and the tare weights measured as they depart. The ore is withdrawn from the bunker by two apron feeders that deliver the ore to two steeply inclined grizzlies. The overflow from the grizzlies is fed to two, side-discharge, gyratory primary crushers. The grizzly underflow is combined with the crusher product and conveyed to the bunkers in the crushing building. Ore is drawn from the bunker to three single-deck vibrating screens and the screen overflow discharges into three 2,200 mm secondary cone crushers. The crusher product is combined with the product of the six 2,200 mm tertiary cone crushers and conveyed to the tertiary crusher feed bunker.

Six feeders draw the ore from this bunker to single-deck vibrating screens, whose oversize fraction feeds the tertiary crushers. The undersize fraction from the screen is combined with the undersize fraction from the secondary crusher screens and conveyed to the fine ore bin. As previously stated, facilities are in place to separately crush and screen the ores received from the South, East and Zhomart mine deposits.

The closed circuit crushing produces a closely sized product, less than 20 mm in size. The ore is highly abrasive and secondary and tertiary cone crusher liners have a life in the order of two to three months and all are imported from Russia.

2.5.1.1 Description of the Plant

Ore is drawn from the fine ore bins and fed at 65 t/hour to the 18 primary ball mills (100 mm diam. balls), each 3.2 m diameter and 3.1 m long and directly driven by a 600 kW synchronous motor. The mills each operate in closed circuit with a single spiral classifier. The classifier overflow gravitates to the pumps ahead of the secondary mill cyclones, situated on the other side of the plant. The classifier overflow from the primary mills is pumped to the cyclones ahead of the secondary mills and the cyclone underflow feeds the 3.6 m diameter, 4 m long, 1,100 kW ball mills (80 mm diam. balls), which operate in closed circuit with the cyclones.

The secondary mill cyclone overflow is pumped to separating hydro cyclones, the overflow from which feeds the slimes flotation circuit. The underflow from the separating cyclones is pumped to the hydro cyclones ahead of the 3.2 m diameter and 3.1 m long tertiary ball mills (40 mm diam. balls). The underflow from these hydro cyclones feeds the tertiary mills, which operate in open circuit. The tertiary mill discharge is combined with the tertiary mill cyclone overflow and pumped to the sands flotation circuit.

There are two identical flotation circuits in the No.1 concentrator and a third circuit adapted from the original and now decommissioned polymetallic circuit. In principle, the third circuit is the same as the other two circuits but with some minor differences of equipment and arrangement for sections 5 and 6 as previously described. One of the main circuits will be described here. All the flotation cells are mechanical cells of Russian manufacture similar to the Denver type utilising air from blowers in a ring circuit around the flotation floor. Reagents, collectors Butyl Xanthate and Sodium Sulphide Na2S are mixed here as 10% solutions and distributed where necessary to the other concentrators whilst the frothing agents including light industrial oils and Methyl Butyl Carbinol (MIBC) are added as neat reagents.

The slimes flotation feed gravitates to two banks each of 14 rougher flotation cells of 6.3 m^3 each. Tailing from the rougher banks flows to two similar banks of 14 scavenger cells also of 6.3 m^3 each. Scavenger tailings join the sands flotation scavenger tailings and flow to the tailings pump house. Rougher concentrates join the rougher concentrates from sands flotation in the first cleaner flotation cells. Scavenger concentrate from the slimes flotation is re-cycled to the sands flotation circuit.

The sands flotation feed is distributed to four banks, each of 22 nos., 3.2 m^3 flotation cells. The tailing from each bank flows to a similar bank of 22 nos., 3.2 m^3 flotation cells. The first ten cells operate as roughers and their concentrate joins the slimes rougher concentrate in the first cleaner cells. The concentrate from the remaining 34 cells is pumped to the tertiary grinding cyclones for re-grinding and return to the head of the sands circuit.

The cleaner flotation circuit is common for both sands and slimes circuits. The rougher concentrates are combined and distributed to two banks each of ten 3.2 m^3 first cleaner cells. The first cleaner tailing goes to the tertiary grinding cyclones for regrinding and re-cycling to the head of the sands flotation circuit. The first cleaner concentrate gravitates to two double spiral classifiers from which the sands are fed to the concentrate regrind ball mill. The mill operates in closed circuit with the classifiers and the classifier overflow is distributed to four banks of six 1.8 m^3 second cleaner cells. The second cleaner concentrate goes to four banks each of four 1.8 m^3 third cleaner cells while the second cleaner tailing returns to the first cleaner cells. The third cleaner tailing reverts to the second cleaner feed and the third cleaner concentrate is pumped to the smelter for dewatering and filtration.

Butyl Xanthate is used as the copper collector in flotation and is added at many addition points as required. Sodium hydrosulphide is used as a sulphidising agent to allow flotation with the Xanthate collector of oxidised Copper minerals when required. Frother and light mineral oil are also added to the circuits.

2.5.1.2 Plant Performance

The production and recovery of concentrator No.1 over the past four years are summarised in Table 2-17

Table 2-17 Zhezkazgan No.1 Concentrator Historic Production

Year	Milled '000t	Cu%	Contained Cu '000t	Recovery%	Concentrate '000t	Cu%	Cu in Concentrate '000t
2007	8,126	1.04	84.5	90.91	195	39.4	76.8
2008	7,719	1.10	84.9	89.69	202	37.7	76.2
2009	8,123	1.20	97.5	90.37	223	39.5	88.1
2010	8,097	1.15	93.1	92.24	218	39.4	85.9

Although the copper concentrate from Zhezkazgan, at 40% copper, has a higher copper grade than most copper concentrates, it also contains about 24% silica, indicating that it is not a very clean copper concentrate.

2.5.2 Zhezkazgan Concentrator No.2

No.2 concentrator is situated alongside No.1 concentrator and was commissioned in 1963. It uses larger and, in some respects, more modern machines although the grinding circuit utilises rod mills in the primary grinding circuit to ensure optimum grinding characteristics and to liberate the minerals in the mixed ore feed. The ball mills are also larger than those in No 1 concentrator. Ore deliveries from the Itauz open pit were suspended in 2008 whilst further mining development was completed, mixed ores from the open pit and the sulphide ores of the North mine, as well as smelter slag and substantial tonnages of ore from the South mine were treated. Slag from the smelter is also reprocessed in the oxide ore circuit.

The oxide minerals are predominately malachite, cuprite, azurite and chrysocolla and the remainder of the copper content is present as the sulphide minerals chalcocite, bornite and chalcopyrite. The oxide ore is processed in batches through the crushing plant and directed to the fine ore bins to feed two of the twelve grinding sections.

2.5.2.1 Plant Description

Ore arrives from the mines in side-tipping rail cars with a nominal capacity of 100 t. Each car is tipped directly into one of two KKD 1500/180 primary gyratory crushers. The crushers discharge the ore, reduced to less than 350 mm into bunkers from where it is discharged by apron feeders on to a conveyor feeding the bunker ahead of the secondary crushers. Eight feeders draw ore from the secondary crusher bunker to eight single-deck vibrating screens with decks made of parallel round steel bars, welded to the frame. The screen undersize fraction is conveyed with the tertiary crusher screen undersize fraction and the tertiary crushed product to the fine ore bin. The oversize fraction from the screens discharges into the eight 2,200 mm secondary cone crushers. From the secondary crushers the ore is conveyed via an intermediate bunker to the tertiary crusher bins from which it is drawn by vibrating feeders to the tertiary crusher screens, which have rubber decks with 30 mm x 30 mm apertures. The screen oversize fraction discharges directly into the 2,200 mm tertiary cone crushers. There are twelve tertiary crushers of which four are reserved for oxide ore.

The open circuit crushing circuit at the No.2 concentrator provides a coarser and less closely sized fine ore product with a maximum size of 35 mm. As at the No.1 concentrator, the ore is abrasive and the crusher liners last about three to four months but the use of rubber screen decks is an improvement on No 1 Concentrator crushing plant.

At the No.2 concentrator the grinding circuit comprises 3½ stages. Ore is drawn from the fine ore bin by belt feeders across a belt weigher to give a controlled feed rate of 170 t/h to each of the ten, 3.2 m diameter, 4.5 m long, 1,100 kW rod mills (the rods of 120mm diameter are imported from Russia). Each rod mill discharge feeds a 3.6 m diameter, 4 m long, 1,100 kW ball mill, which operates in closed circuit with a spiral classifier. The classifier overflows to the secondary ball mill sump, from where the pulp is pumped to a hydro cyclone. The underflow from the hydro cyclone gravitates to the 3.6 m diameter, 4 m long 1,100 kW secondary ball mill, whose product discharges into the sump in closed circuit with the hydro cyclone.

The overflow from the hydro cyclone is pumped to a classifying hydro cyclone whose overflow, at a particle size of 78% <74 μm, goes directly to the slimes flotation circuit. The underflow is pumped to the tertiary ball mill hydro cyclone, whose underflow is ground again in a 3.6 m diameter, 4 m long, 1,100 kW ball mill. The mill discharge is combined with the tertiary cyclone overflow and forms the feed to the sands flotation circuit at a particle size of 54% <74 μm.

The flotation circuit at No.2 concentrator is similar in concept to that at No.1 concentrator, with separate flotation of sands and slimes. Both are subject to rougher and scavenger flotation from which the tailing gravitates to the tailing pump house. Rougher concentrates go to the first cleaner cells, while scavenger concentrates are re-cycled to the quaternary mill sump, to be reground and returned to the head of the sands flotation circuit.

The combined first cleaner concentrates are pumped to the hydro cyclone of the 3.6 m diameter, 4 m long, 1,100 kW concentrate regrind ball mill. The cyclone underflow gravitates to the mill and the mill discharge is pumped back to the cyclone. The cyclone overflow goes to the second cleaner flotation cells. The second cleaner tailing goes to the first cleaner cells and the second cleaner concentrate goes to the third cleaner cells. The third cleaner concentrates from both sands and slimes circuits are pumped with the concentrates from No.1 concentrator to the smelter.

As at concentrator No.1, Butyl Xanthate is used as a copper collector and sodium hydrosulphide is used as a sulphidising agent to promote the flotation of oxidised minerals. Frother and mineral oil are also used. In the flotation of oxide ore, higher dosages of sodium hydrosulphide are employed.

In 1990, some of the original 6.3 m^3 flotation cells in the rougher and scavenger banks were replaced by 16 m^3 cells, but very many small cells remain. However, as in most oxide flotation circuits the flotation froth appeared subdued and the circuit did not give a good appearance. Some cells were out of action and there may well have been dayshift maintenance under way which often gives visitors the wrong impression. The reported recoveries in general compare well with accepted concentrator practice.

2.5.2.2 Plant Performance

The production and recovery of concentrator No.2 over the past four years are summarised in Table 2-18, with concentrate composition in Table 2-19.

Table 2-18 Zhezkazgan No.2 Concentrator Historic Production

Year	Milled '000t	Cu %	Contained Cu '000t	Recovery %	Concentrate '000t	Cu %	Cu in Concentrate '000t
2007	12,718	0.64	81.4	82.89	173	39	67.5
2008	13,241	0.67	88.7	82.03	191	38.1	72.8
2009	12,634	0.68	85.9	83.22	181	39.5	71.5
2010	12,044	0.63	75.9	85.98	166	39.3	65.2

Table 2-19 Concentrate Composition

Element	Content	Element	Content
Cu	39.3%	CaO	1.7%
Pb	2.08%	Ag	798 g/t
Zn	0.85%	S	14.95%
SiO_2	24.16%	Cd	0.002%
Fe	6.2%	As	0.06%
Al_2O_3	3.65%		

The crushers in the Zhezkazgan concentrators are not worked very hard at this time and their product, at <350 mm is coarser than most, with the possible exception of those producing feed for autogenous mills. It may well be the policy to give a coarser product to the mills at <20 mm to save crusher wear and where mill throughput is not that important.

Some time was spent in the QA/QC department and IMC was impressed at the skills in this department and the sample preparation and physical / chemical analyses being undertaken. The plants do not have any automatic on stream analysers for control purposes but hourly tail samples for example are taken and QC can have samples ready for x-ray powder analyses with results available within the hour for the operational staff. The drying, screening and analysis of all samples taken was very impressive.

The copper levels in the Zhezkazgan concentrates now run nearer 40% Copper (and further discussed re smelter matte grades) and are generally higher than most copper concentrates produced elsewhere but also contain about 24% silica; however, these levels are acceptable since the Zhezkazgan smelter is electric and silica is needed for fluxing purposes. However the ore is very siliceous and contains about 67% silica, and flotation is not a perfect separation process so it is not a surprising contaminant in the concentrate. However, whilst most concentrators would expect silica contamination of the concentrate to be less than 15%, there could be a number of reasons for the high silica content in these concentrates given the characteristics of the ores. A few silica minerals, such as chrysocolla, talc and mica, are naturally floatable and, if present, will tend to contaminate the concentrate.

If the cleaner flotation section is not working efficiently or the flotation cells are incapable of dealing with finely ground silicate minerals then free quartz may well become entrained in the concentrate.

If the ore is not ground fine enough to completely liberate the copper minerals from the gangue, then composite particles containing both copper minerals and silica minerals will both go into the tailing, with a consequent loss of recovery, and into the concentrate, with consequent silica contamination of the concentrate.

The concentrate screen analyses done during the visit appear to reflect a finely ground concentrate and it was deemed impossible to screen these concentrates to produce sensible screen fractions < 74 micron for further chemical analysis with the screening equipment available and mineralogical examination of the concentrate would be required to determine whether the fine particles contain free silica. However, the analysis indicates that silica is high >20% in all the screen fractions analysed for No. 1 plant concentrate and abnormally high in the small amount of coarser fractions >74 microns.

Various discussions have confirmed that the oxide recoveries were of the order of 20% on the so called oxide ores which probably explains the discontinuation of processing oxide ores through No 2 concentrator. It is also noted that the copper assay of the tailings has dropped considerably in 2010 (some 23%) since discontinuation of oxide flotation. Any alternative process such as heap leaching, solvent extraction and electro winning would have to be considered on its merits particularly the leaching process, oxide ore tonnages available and the proposed operating costs and return on the capital investment.

The operating costs of the two concentrators at Zhezkazgan were briefly discussed but little interest was shown in revealing current statistics. However it was disclosed that the current Concentrator cost was $3.50 per tonne of ore in 2009 compared with $1.70 in 2004. That cost per tonne milled for 2009 in the view of IMC is reasonable but when related to recovered Copper in concentrate for No 2 concentrator for example gives a cost per tonne of contained Copper in concentrates of $635 per tonne compared with $332 for No 1 concentrator. The produced concentrate tonnages for No 2 for 2010 are also now running 20% lower than 2009.

It is not possible to make a sound appraisal of the costs but IMC accounting personnel at site have detailed costs analyses and current budgets available to make suitable cost comparisons particularly of the three concentrators in the Zhezkazgan operating area. No 2 concentrator appears to be most affected by lower grades and tonnages and one must question its continued operation if these trends continue. There is no doubt that operating costs are under the microscope as are the transport costs of imported ores from mines further afield.

Both concentrators appear to be in a reasonable operating condition for their age and type but IMC is concerned with the general condition of the walkways, stairs and the poor lighting. Machinery guards were seen to be in place and the staff were wearing some PPE.

However, until the uneven wooden walking areas are either replaced with metal grids or level wooden surfaces, there will always be a trip hazard. All observed switch gears were generally dirty and elderly. An engineer operated the 'lock out' system for plant down for repair etc but no examination was possible of local/remote switching. If a detailed safety audit has not been done then it should be. There was little sign of any process control and the control rooms were not visited.

Although the possibility of finding good tonnages of new ore resources at higher grades or increased output from the mines in the Zhezkazgan area did not appear feasible at this time, should this change in the future it may be better to build a new, modern concentrator in the best location to save on transport costs and to provide the additional capacity rather than a further extension of the existing plants.

The new dam which is an Eastern extension of the former dam operating in 2004 appeared to be working well and has a substantial available area for future tailings disposal (estimated 40 years). The tailings delivery pipeline divided at the apex of the dam wall and discharge into the dam is carefully monitored at the East and West discharge points. The site supervisor had his own portacabin office and a site contractor team was busy using a variety of trucks and tracked vehicles for wall maintenance and rock filling duties.

There was a good beach between the discharge points and the main wall. The installed piezometer tubes in the toe of the wall were very visible and assurance was given that regular readings were taken to check the water levels in the wall and results relayed to the relevant dam consultants.

Conditions in the strong winds during the visit were very dusty and it was noted that there was little evidence of any planned grass planting on the filled and now disused sections of the dam. This should be pursued as a future solution to this sand erosion problem.

2.5.3 Satpaev Concentrator

The Satpaev concentrator was built in 1986 to process the polymetallic ores from the mines to the north of Zhezkazgan. It operated as a polymetallic concentrator until 1993 after which the amount of polymetallic ore was reduced. From 1995, it processed slag and the polymetallic circuit was dismantled and the concentrator has since been operated for copper alone, although the ore still contains 0.3% Pb and up to 0.8% Zn as well as 1.4% Cu. No attempt is made to either recover or depress lead and zinc in the process, with the result that Satpaev copper concentrate commonly contains up to 12% of zinc. A proportion of the lead in the copper concentrate is recovered to lead dust, which is sold, but the zinc eventually reports to the slag as an oxide, passes through the concentrator unchanged and is deposited in the tailings dam.

It is understood that the grade of the zinc concentrate that was produced was lower than normal. Such a concentrate would cost more to transport and the smelter charges would be high so that in recent years, when the zinc price was low, its production might well have been uneconomic. There would be some reluctance to resume polymetallic operations, as the depression of zinc in flotation commonly entails the use of sodium cyanide. Residual amounts of cyanide in the tailing can cause environmental problems, especially if, as at Satpaev, the tailing is used for underground sand fill.

2.5.3.1 Plant Description

There is no primary crushing plant at Satpaev. Ore is delivered in 100 t side tipping rail cars at a particle size of less than 350 mm. Typically, each car carries 86 t and this is tipped from one of two tracks into a 12,000 t bunker. Four apron feeders discharge the bunker on to two conveyor belts, each feeding a double-deck vibrating screen with an 80 mm aperture top deck and a 20 mm aperture lower deck. The bottom deck undersize fraction falls to the conveyor that feeds the fine ore bin. The intermediate fraction discharges to the conveyor that feeds the tertiary crusher bin and the oversize fraction from each screen goes to a 2,200 mm secondary cone crusher. The crusher product joins the intermediate fraction and the product of the tertiary crusher on the conveyor that feeds the tertiary crusher feed bin. The tertiary crusher feed bin is discharged by four conveyors, each feeding a single-deck vibrating screen with a 20 mm aperture deck. The undersize fraction from the screen falls to the conveyor feeding the fine ore bin and the oversize from the four screens feeds four 2,200 mm tertiary crushers whose product is re-cycled to the tertiary crusher feed bin.

The fine ore from this closed circuit crushing plant is closely sized less than 20 mm and is conveyed to a 12,000 t fine ore bin. As at Zhezkazgan, the ore is abrasive and crusher liners last only 2 to 3 months.

There are three grinding circuits at the Satpaev concentrator. Two circuits operating at about 190 t/h each and have three mills and the third circuit, which has just two mills, operates at about 150 t/h, giving an aggregate throughput of about 530 t/h.

Ore is drawn from the fine ore bin by belt feeders to three 3.6 m diameter, 5.5 m long 1,000 kW rod mills. Two of these discharge into spiral classifiers whose oversize fraction feeds two 4.5 m diameter, 6 m long, 2,500 kW ball mills. Ball mill discharge and classifier overflow discharge into a sump from which they are pumped to hydrocyclones operating in closed circuit with the ball mill. The cyclone overflow goes to the primary flotation circuit.

The third rod mill discharges to a 3.6 m diameter, 4m long 1,100 kW ball mill operating in closed circuit with a hydrocyclone. The hydrocyclone overflow goes to the primary flotation circuit.

The two primary flotation circuits each consist of 12.5 m^3 cells with eight roughers and eight scavenger cells. The rougher concentrate goes directly to the third cleaner cells while the scavenger concentrate goes to the first cleaners. The tailing from primary flotation goes to a cyclone feed pump ahead of the two 4.5 m diameter, 6m long 2,500 kW regrind ball mills, which operate in closed circuit with the hydrocyclones. The cyclone overflow feeds the main flotation circuit, whose rougher cells comprise two 16 m^3 and eight 12.5 m^3 cells. The scavengers comprise two banks of six 16 m^3 cells. Concentrate from the first two rougher cells goes to the first cleaner cells, a second rougher concentrate is re-cycled to the primary flotation circuit and the scavenger concentrate is pumped to the regrind mill sump. The scavenger tailing is pumped to the tailings dam or to the sand fill plant as required by the mines.

First cleaner tailing is pumped to the regrind mill cyclones. First cleaner concentrate goes to the second cleaner cells and second cleaner concentrate goes to the third cleaner cells and the third cleaner tailing is recycled to the second cleaner cells. Second cleaner tailing is recycled to the first cleaner cells. Third cleaner concentrate is pumped to one of three 25 m diameter thickeners. The thickener overflow goes to another 25 m thickener for clarification. The combined underflow from both thickeners is pumped to a filter plant. This originally housed eight vacuum drum filters, of which five are now serviceable. Normally two are operating and one is down. The filter cake is conveyed to a loading shed where it is loaded into rail cars for transport to the smelter at Zhezkazgan.

2.5.3.2 Plant Performance

The statistics for the Satpaev concentrator performance for the period 2007 to 2010 are shown in Table 2-20. For 2010 in comparison with 2007 the milled tonnages have dropped by some 11%, the copper head grade by 36%, contained copper in concentrates by 12% and the plant recovery has fallen some 3.9%. The concentrates produced also have to be transported to the Zhezkazgan smelter.

This concentrator is relatively new compared to the two Zhezkazgan concentrators but until new deposits are found in the area the operating costs are going to remain high. Table 2-20 shows the historic production for the last four years with the concentrate composition data shown in Table 2-21.

Table 2-20 Satpaev Concentrator Historic Production

Year	Milled '000t	Cu %	Contained Cu '000t	Recovery %	Concentrate '000t	Cu %	Cu in Concentrate '000t
2007	3,747	1.00	37.5	91.24	123	27.8	34.2
2008	3,433	0.88	30.2	90.39	101	27.0	27.3
2009	3,285	0.75	24.5	90.11	88	25.1	22.1
2010	3,336	0.66	22.2	87.32	79	24.5	19.4

Table 2-21 Satpaev Copper Concentrate Composition

Element	%	Element	%
Cu	25 – 27	Al_2O_3	4.20
inc CuO	2.7	S	15.12
Pb	4.02	Cd	0.04
Zn	8.70	As	0.07
SiO_2	25.81	Fe	5.5

IMC was not impressed with the general cleanliness and housekeeping of the plant but all these HSE issues could be easily resolved. The flotation circuits were not impressive and many cells were idle and/ or under maintenance and no further progress was reported on ideas put forward to improve cleaner efficiencies and to reduce the high silica content of the concentrate produced. Until a decision is made regarding possible changes in the flotation circuitry to produce a higher grade Cu concentrate by eliminating the sphalerite from the Cu circuit without the use of Cyanide as the depressant further progress in this respect is not possible.

The concentrator plant tailings are pumped from the 2 x 18m thickener U/Fs via 2 x 630 mm pipelines to the tailings dam and there are 2 return lines for the water circulation back to the concentrator.

A visual inspection from the discharge points on the dam wall indicated that the area available for tailings disposal was relatively small and the dam supervisor estimated only another 6 years at the very maximum. Plans for a future disposal area will have to be finalised soon ready for 2016. Some exhausted open pits in the area were apparently being considered for future tailings disposal. Piezometer tubes were in evidence and the dam consultants were being updated with readings on a regular basis.

2.6 Smelter and Copper Refinery

The Zhezkazgan smelter and copper refinery treats all the copper concentrates in the Zhezkazgan area. Some materials are brought from outside the area but these represent a minor contribution to the smelter feed. The reported manning level was 2,004 persons (a reduction of 17% from that reported in 2004).

Smelter construction started in 1972 and by 1974 the two electric furnaces, four Pierce-Smith convertors, four anode furnaces with two casting wheels, refinery tankhouse and all associated equipment were completed. Many of the current employees were there at the start and many were sent outside the country for suitable training prior to commissioning.

Copper smelters convert copper concentrates to metallic copper anodes with a purity of about 98.5% Cu. The copper refinery converts the copper anodes to cathodes with a purity of 99.99% Cu, which is acceptable to markets throughout the world.

2.6.1 Plant Description

Copper concentrates are fine powders made up of a variety of copper bearing minerals, which typically contain copper, iron and sulphur and also, in some cases, lesser amounts of carbon, oxygen and silica. Sulphide minerals of other heavy metals, such as lead, zinc, arsenic, and bismuth are usually also present in minor quantities, as are precious metals such as silver and gold. The concentrates also contain some gangue, or waste minerals, because of the imperfections of the chosen concentrating process route which is never optimum. Significant amounts of silica, alumino-silicates and calcium and magnesium minerals may make up this gangue. The concentrates are partially dried and blended with flux and with dusts captured during the process stages and re-cycled. The blended furnace burden may then be pelletised to improve the handling properties and porosity before being fed to the primary smelting furnaces, in this context, the electric furnaces.

A variety of primary smelting furnaces are used including the traditional reverberatory furnace, the flash smelter, the electric furnace and several modern developments including Ausmelt and the Mitsubishi continuous smelter. The primary smelting furnace melts the burden, which then separates into two liquid phases in the furnace; the matte, at the bottom of the furnace, which contains copper, iron and sulphur, the precious metals and some heavy metal contaminants, and the slag, which contains the gangue minerals. Both phases are tapped from the furnace; the slag may be granulated and used for sand blasting or for cement manufacture, or it may be slow cooled and re-cycled for the recovery of residual copper, the matte is poured into ladles and charged to a converter.

The Pierce-Smith converter is by far the most common converter in use in copper smelters although other types, such as Ausmelt, Teniente, and flash converters are used. The Pierce-Smith converter consists of a horizontal cylindrical steel vessel lined with refractory brick and mounted so that it can be rotated through about 180°. It has a large opening or mouth in its cylindrical surface and a line of tuyeres, or air ports, along the length of the cylindrical surface at about 90° to the mouth, when seen from the end of the furnace. Ladles of matte are poured into the furnace and silica flux is added and the furnace is rotated so that the mouth faces a gas discharge hood and the tuyeres are submerged and air (sometimes oxygen enriched) is blown through the matte, oxidising the iron to iron oxide, which chemically reacts with the silica flux to form an iron silicate slag during this first stage or 'slag blow' and creating much heat during this exothermic process. The slag, which may contain 5% copper or more, is poured into ladles and returned to the primary smelting furnace. More matte is charged to the converter and the process is repeated a number of times until the converter is full and all iron removed as slag. Sulphur is then burnt off by further blowing of the converter in the second stage 'copper blow'. A great deal of heat may be generated in the converters and the temperature of the molten copper is controlled by adjusting the oxygen content or by adding scrap copper from the smelter aisle or re-cycled cold anode scrap from the refinery. The product at the end of the copper blow of the converter is called blister copper and contains about 98% copper. It is poured into ladles and transferred to the anode furnaces. Gas from the converters and also from the primary smelting furnace contains sulphur dioxide. The gas is normally cleaned to remove dust and transferred to an acid plant where the sulphur dioxide is catalytically oxidised to sulphur trioxide and then absorbed in water to make sulphuric acid. Residual gas is discharged to the atmosphere.

The anode furnaces are also rotating horizontal cylindrical steel vessels, lined with refractory brick and similar in appearance to the converters, but without tuyeres. They are used for the removal and fine adjustment of the sulphur and oxygen content of the copper before casting anodes. Compressed air lances are used to remove any residual sulphur, after which it is necessary to reduce the oxygen content of the copper, usually with hydrocarbon fuel, to enable anodes to be cast with a satisfactory set surface without any inclusions gaseous or otherwise. The copper is then poured from the furnace into a launder and flows into a tilting ladle. A horizontal casting wheel, typically with 24 to 30 moulds around its periphery, rotates to align one or two moulds with the ladle(s) and the copper is poured into the mould. The wheel rotates further and the moulds are cooled with water sprays and the solid copper anode is removed, the moulds are continuously sprayed with mould wash, an inert Barium Sulphate solution, to prevent anodes sticking in the moulds and damaging the moulds.

The anodes are flat, rectangular slabs of copper, approximately one metre square cast with hanger lugs, from which they are then suspended. They are transported to the copper refinery, where they are hung in rectangular cells, formerly constructed from concrete sections and lined with lead or PVC, but in more modern plants of polymer concrete composite seamless constructed cells. The anodes are suspended parallel to each other and at about 100 mm spacing with cathodes of pure copper sheets between them. The cells are filled with a circulating electrolyte containing about 50 g/l copper and 150 g/l sulphuric acid at about 60°C and a direct electric current is passed from anode to cathode through the electrolyte. The copper then migrates from the + anode to the - cathode. Impurities in the anode either dissolve in the electrolyte and remain there or precipitate as anode slime on the bottom of the cell. Two or three crops of cathode are made from each anode before it is reduced to about 20% of its original weight, is removed from the cell and re-cycled to the converter or anode furnace. The anode slime is removed from the cell at the end of this cycle and a new cell full of anodes is charged to the cell. The cathodes are removed and washed and weighed and bundled for despatch. The anode slime is filtered, dried and bagged for despatch to a precious metals refinery.

2.6.2 Smelter Feed Preparation

Zhezkazgan concentrate slurry is sent to a receiving tank where 'magna floc' (pre mixed at 60°C) is added prior to transfer to a 30 m diameter thickener in the smelter building. A second similar thickener is used as a clarifier to remove the remaining concentrate from the first thickener overflow. The water overflowing the second thickener is returned to the concentrator. A third thickener is used for wash water from the feed preparation area. The thickener underflow, at 60% solids is pumped to the filter plant, where it is delivered to a choice of three rows of five, 40 m^2 vacuum drum filters or three ceramic disk filters. Normally five filters are available, the other four being under maintenance. The disc filters installed in 2008 are preferred for their ease of operation and maintenance, better throughput and lower cake moisture content. The filter cake, which contains up to 13% moisture, falls on to three conveyors, each discharging to a 2.8 m diameter, 14 m long, heavy fuel oil fired rotary kiln drier. The drier product contains about 6% moisture. Gas from the driers is cleaned in cyclones and scrubbers before discharging to the atmosphere. All loading/offloading was via crane grabs with a sample taking area high in the shed for the sample operator.

The partially dried concentrate goes to the burden preparation section. The concentrate is laid down in windrows to which concentrate from Satpaev, re-cycled dusts and flux are added. When the complete blend is assembled on the windrow, a reclaimer recovers the windrow from one end on to a conveyor, which feeds the pelletising plant. This blending operation is overseen by two ladies in the control room where mimic panels show all the materials handling systems and continuous calculations are made to obtain the correct feed blend to the pelletising discs (5x7 m diam) on which a lignin sulphonate binder is sprayed to combine the burden into pellets at a rate of 650 t of burden per day. The green pellets are conveyed to a vertical cylindrical kiln (choice of three) in which the pellets are fired by air at 1200°C, heated by heavy fuel oil burners. Fired pellets are removed from the bottom of the kiln and conveyed to the electric furnace feed bins.

2.6.3 Primary Smelting

Primary smelting at Zhezkazgan is carried out in two identical 27 MVA electric furnaces. Electric furnaces have the advantage over the traditional reverberatory furnaces in that the gas stream from the furnace is more concentrated and more suitable for acid recovery. The electric power consumption, in the order of 300 to 600 kWh/t concentrate, makes them more expensive to operate than flash smelters in most applications so electric furnaces are not commonly used for copper smelting. However the combination of the low cost of electric power at Zhezkazgan, with the comparatively low calorific value of the Zhezkazgan concentrate, makes this a suitable application for electric furnaces.

Each of the two furnaces is 24 m long, 8 m wide and 6.4 m high, with six 1.2 m diameter electrodes evenly spaced along the centre of the furnace. The electrodes are of the Soderberg type, made up with 4 kg of paste per tonne of concentrate smelted and charged into the top of each electrode as small briquettes. The matte layer at the bottom of the furnace ranges from 400 mm to 800 mm deep above which the layer of molten slag is 1.8 m to 2.2 m deep. The depth of immersion of the electrodes in the slag is adjusted to maintain a power draw of about 25.9 MVA. Each furnace is charged with 1,250 t of concentrate per day and 100 t of limestone flux. About 16 t per day of converter dust is re-cycled to each electric furnace per day and smelting furnace dust is recycled to the furnace directly and not measured. Energy consumption is 465 kWh/t to 480 kWh/t concentrate.

Pelletised burden is charged to the furnace through 24 charging ports with twelve arrayed along each side of the furnace roof. The furnaces are installed perpendicular to the converter aisle with three matte tap holes at the end of the furnace adjacent to the aisle. There are three slag tap holes at the opposite end of the furnace, from which 840 t to 900 t of slag are tapped each day into ladles on rail cars. The slag, containing 0.3% to 0.5% Cu, is tipped on a dump, allowed to cool, then drilled and blasted, loaded on rail cars and sent to the concentrator for recovery of the residual copper.

About 1,500 Nm^3 per minute of gas, with about 1.5% to 2.0% SO_2 goes from each furnace to the acid plant.

About 945 t of matte at about 58/60% Copper grade (a considerable increase since 2004) is poured into ladles from each furnace per day and transferred to the converters across the aisle. The typical chemical composition of matte and slag from the electric furnaces is shown in the smelter flow diagram.

At the time of IMC's visit only one furnace was in operation together with two converters across the aisle. It was also noted that some concentrate was being exported to the Balkhash smelter at this time. The operation of the central control room was impressive where all process were displayed on mimic screens. Smelting operations were seen to be running smoothly and working well.

The furnaces were clean and tidy and appeared to be well managed and expertly operated. The control room operated the electrode power on automatic control much of the time, the main variable being the feed to the furnaces. This makes for a good electric furnace operation where feed interruptions and consequential power adjustments can have an adverse effect on smelting efficiencies. The furnaces are stopped for maintenance for three hours on four days per week and are shut down annually for inspection and to change the refractory lining particularly on the slag line where necessary.

2.6.4 Converters

There are four converter furnaces, each 3.9 m diameter and 11.6 m long, of which three are normally in operation at any time and the other is down for maintenance. Each furnace produces a 100 t charge of blister copper in about 6 to 7 hours. Medium pressure blowers provide 50,000 Nm^3/h of air at 5 to 6 atmospheres and this can be supplemented with oxygen if the furnace should become too cool. However, in practice oxygen, which is brought from an oxygen plant close to the concentrator, is rarely used. Between 8 and 9 converter cycles are commonly completed each day and the maximum possible is estimated to be 10 cycles.

Refractories around the tuyeres and between the tuyeres and the furnace mouth are normally changed twice per year and the remainder of the refractories once per year (dependant on throughput of the campaign cycle). Tuyere reaming was operated almost automatically as it is essential to keep the tuyeres free of slag/copper at all times to allow maximum air flow and formerly done manually by an operator with a metal reaming rod or utilising punching machines bolted on the back of the converter. In this smelter a reaming 'gun' on a rail was situated behind the converter and at the appointed time when the converter was turned out, the operator would ream all 52 tuyeres in about 15 minutes.

The converter area was the place where high densities of sulphur dioxide were generally encountered but due to the fact that the smelter environs were protected from the outside by the bricked building design (and no evidence of any roof fans), there was little escape for these noxious gases. All operators used gas respirators fitted with the appropriate cartridges as did most operators in the overall smelter operational area. The fact that the converter aisle was clear of any reverts and other in-process materials was evidence of a good operation.

2.6.5 Anode Furnaces

There are four anode furnaces, each 3.9 m diameter and 9 m long, with a capacity of 200 t of copper. They are arranged beside two 24 mould casting wheels. The furnaces, when fully charged, are blown with compressed air lances to remove residual sulphur and then 'poled' with heavy fuel oil to reduce the oxygen content to provide a suitable set surface. The copper is then tapped from the furnace along a launder to a rocking ladle. The rocking ladle tips alternately to left and right to fill the two casting ladles, which have wide shallow lips to pour into the anode moulds. The casting ladles are mounted on load cells which control the weight of the anode cast. The anode blades are 960 mm long, 820 mm wide and 38 mm thick and weigh 260kg (± 5kg). They are lifted out of the mould by a plunger close to the top of the blade and hoisted by their lugs into a tank full of water. From the tank they are loaded by crane into rail mounted anode cars but prior to despatch to the refinery are firstly inspected and reamed by operators to remove edging materials and other protuberances before being flattened under a large press recently installed in 2009.

2.6.6 Sulphuric Acid Plant

Gas from the electric furnaces is cleaned above the furnace and the dust is returned directly to the furnace. Gas from the converters is collected and the dust removed for recycling to the burden preparation plant. Lead dust is then separated from the gas stream and about 240 t per month is sold to the Chinese Chimkent Lead plant. It is now pelletised into damp pellets and loaded manually into 2 t polypropylene bags for onward transportation and has a typical analysis shown in Table 2-22 below. This lead laden dust is highly toxic and why the pumping of dried dust to rail tankers was discontinued. However, it is still a labour intensive operation and the operators were open to continual contamination.

Table 2-22 Composition of Zhezkazgan Lead Dust

Element	%	Element	%
Lead (Pb)	45 – 50	Cadmium (Cd)	1.2
Zinc (Zn)	8 – 10	Selenium (Se)	0.9 – 1.2
Copper (Cu)	4 – 7	Sulphur (S)	3 – 5

The dust free gas is then transferred to four parallel and identical single contact, single absorption acid plants. At any time, one plant is usually down for major repair and three are in operation. Each plant takes 6,000 Nm^3/h of gas containing about 3% SO_2. Designed acid production is for 750 t/day and each plant requires a major overhaul every two years. The plants have to be heated by firing with heavy fuel oil because of the low SO_2 content of the gas when 95% to 96% conversion of the SO_2 to acid is achieved.

While it was necessary to neutralise acid only a few years ago in Kazakhstan, the market is now growing and a superphosphate fertilizer plant in Taraz is in operation and may ultimately require 1.5 Mt of acid per year. Acid is also sent to a uranium plant for the Ministry of Economic Industry. The current production at Zhezkazgan is about 120,000 t/year. The acid plants were built in 1973, 1975, 1977 and 1978 and in the opinion of their operators are becoming a maintenance problem. There was also evidence of cannibalisation of plant in some sections and severe corrosion of support steel work and pipelines was evident. The updated smelter statistics support the view that matte grades have risen in recent years. It is forecast that the sulphur content of the concentrate may rise from the present 14% to 30% or 35% over the years ahead and it would then become necessary to replace the present plants with double contact, double absorption plants.

2.6.7 Copper Refinery

The copper tank house was built in 1971 and has been extended since. There are 72 cell sections in the refinery tank house, each comprising two parallel rows of 13 cells. At the time of the visit 40 cell sections were in operation, only 55% utilisation Monolithic concrete cells with lead linings were initially installed but during the last 4 years approximately 50% have been replaced with cells made from a composite and appear to be a 1-piece casting manufactured in country at Ust-Kamenogorsk. Each cell is 7,350 mm long, 1,160 mm wide and 1,500 mm deep. 35 anodes and 36 cathodes are loaded into each cell and the anode spacing is 110 mm. The cell current is 19,600 Amps giving a cathode current density of about 350 A/m^2. The anodes are loaded as received with no manual or automatic preparation, however the introduction of the press in the casting plant was considered a major step in producing straighter anodes as seen when viewing the way the sets were hanging in the anode cars.

There are six separate electrolyte circuits, with by-pass filtration on part of the electrolyte. The electrolyte is heated by low-pressure steam from the power plant in shell and tube heat exchangers and circulated to the cells at 60°C at a rate of 18 l to 24 l/minute per cell. The electrolyte composition is shown in Table 2-23 below.

Table 2-23 Typical Zhezkazgan Tank House Electrolyte Composition

Element	g/l	Element	g/l
Copper (Cu)	50 – 65	Bismuth (Bi)	0.052
Sulphuric Acid (H_2SO_4)	130 – 180	Nickel (Ni)	0.77
Arsenic (As)	12 – 12.5	Chlorine (Cl^-)	90 mg/l
Antimony (Sb)	0.57	Iron (Fe)	1.82

The copper content in the electrolyte is regulated by the use of lead anodes in liberator cells distributed through the tank house. Typically 41 liberator cells will be in use. The other electrolyte impurities, most notably arsenic, are controlled by purging the electrolyte, crystallising the copper sulphate and precipitating the other impurities before returning the liquor to the circuit. About 60 t per month of $CuSO_4.5H_2O$ is produced, bagged and sold to the agricultural market. About 80 g of gelatine per tonne of cathode and 90 g of thiourea per tonne of cathode are added as smoothing agents.

Starting sheets are made in six sections using titanium cathodes, which are stripped daily. The sheets are stripped manually and Wenmec loop slitting machines are used to prepare cathode loops. A Wenmec starting sheet assembly machine is in use but has insufficient capacity for the whole tank house so manual assembly is also used. At the time of the visit the physical quality of the starting sheets was excellent. These assembled cathodes are finally rigidised by embossing five vertical stripes on them in the starting sheet machine.

The anode life is 15 days and three crops of cathode are taken from each anode. Anode scrap is about 20% of the new anode weight. The current efficiency improves from the first to the third crop and averages up to 96%. Short circuits are detected using thermal indicating paint. Cathodes are unloaded to washing machines situated in the tank house basement, where they are steam cleaned and stacked and hanger bars are manually removed. The stacks are removed to the despatch area where the bundles are strapped with an automatic weighing and strapping machine and the brand is painted on each bundle before despatch in closed rail cars for export or sent to the nearby copper rod plant. Typical cathode analysis is shown in the Table 2-24.

Table 2-24 Typical Cathode Composition — Zhezkazgan Cathode

Element	%	Element	%
Copper (Cu)	99.99	Antimony (Sb)	<0.00015
Silver (Ag)	0.0016	Bismuth (Bi)	<0.000016
Selenium (Se)	<0.0001	Nickel (Ni)	<0.0003
Tellurium (Te)	<0.0001	Sulphur (S)	<0.0010
Arsenic (As)	<0.0001	Gold (Au)	<0.00001
Lead (Pb)	0.00018		

Anode slime is washed out of the cells when the anode scrap is removed. It is filtered and dried and then bagged for despatch to the precious metals refinery in Balkhash. Approximately 5 kg of anode slime is produced per tonne of cathode with the composition approximately as described in Table 2-25 below.

Table 2-25 Approximate Composition of Anode Slimes

Element	%	Element	%
Copper	20	Silver	47
Lead	27	Silica	4
Gold	1	Tellurium	0.7

IMC found the refinery operations to be very satisfactory. The 96% current efficiencies currently quoted is a significant increase from figures quoted in 2004 and confirmed by the cathode chemical quality and appearance. The thiourea/gelatine reagent regime was considered optimum and together with the other points mentioned resulted in smooth fine grained cathodes virtually free of any nodulations. The basement under the cells was dry and also in good condition, acid proof brick floors and all steelwork coated with a protective cement. The tank house is of a very traditional design typical of its age and quite labour intensive. For example, each day up to 12,000 starting sheets are manually loaded into cells and about 13,000 are manually stripped off the titanium blanks. Sample cathodes are drilled on a pattern for chemical analysis.

There is limited potential to increase the capacity of the tank house apart from simply building additional sections. If a significant increase in capacity is foreseen it might be better to build a modern high-productivity tankhouse and gradually transfer capacity to the new plant.

2.6.8 Copper Rod Plant

In November 1994, a Southwire SCR 2000 continuous copper rod plant was built at Zhezkazgan with an annual capacity of 50,000 t of 8 mm rod. This is an efficient, self-contained modern operation, which has been certificated under ISO 9001 since 2000.

Copper cathodes are brought in from the smelter and stacks are loaded on a hoist and hoisted to the top of a Southwire vertical shaft furnace (similar to the Asarco shaft furnace in Zambia). The copper is continuously melted by burning a mixture of propane and butane in two rings of burners in the lower half of the furnace. Molten copper flows from the furnace along a gas fired upper launder to the 7 tonne capacity cylindrical holding furnace, which serves to smooth the flow of copper from the furnace to the casting wheel. From the holding furnace the copper flows along the lower launder to a silica pouring spout. There is a continuous but small removal of slag from the holding furnace.

The casting wheel is approximately one metre in diameter and rotates about a horizontal axis with a rim made from a special copper, chrome, zirconium alloy. The rim has a trapezoidal groove approximately 63 mm wide and 36 mm deep around its circumference. A flat steel band bears against the outer surface of the groove around half of the circumference of the wheel and moves with the wheel as it rotates.

Copper from the pouring spout is poured into the space between the groove and the band on the downward moving side of the wheel and solidifies between the groove and the band to produce a continuous bar with a trapezoidal section. This bar leaves the wheel on the upward moving side of the wheel, passing over the top of the wheel to rollers that straighten the bar. Cutters then cut off the acute angles at the top of the bar before it passes to a 9 stand Morgan rolling mill, in which the rollers reduce the size of the bar by 2 mm at each stand, alternately top and bottom and side to side. The final product is an 8 mm round bar, which then passes through a pickling tube in which it is cleaned and pickled with an aqueous solution of iso propyl alcohol. The bar, which at this stage is moving at 9 m/s, is then dried, waxed and transferred to a coiling machine, which loads the bar on to 3 t coils on pallets. The pallets are labelled, weighed and shrink wrapped before loading on a rail car for despatch.

For some years after the commencement of operations, the production was severely constrained by the collapse of its intended Russian market, but in recent years new markets have been found and production has been close to the nominal capacity of the plant. The copper bar has been exported to a wide range of customers from Europe to Japan and especially China and also including some in Kazakhstan, of which the biggest is Kazenergokabel, of Pavlodar who buy 200 t/month. At the time of the visit the monthly target of 3,000T had been achieved with almost a week to spare so the casting section was shut down.

The quality control procedure is supported by a comprehensively equipped laboratory alongside the plant. Physical controls include a continuous electromagnetic inspection of the bar ahead of the coiler, and measurements of conductivity, tensile strength and spiral elongation (for annealability). The bar is also twisted to reveal surface defects and samples are subjected to Mass spectrometry(Swiss ThermoARL) to determine the 18 trace element impurities, whilst a modern Gas Chromatograph (Perkin Elmer) and a Leco Analyser for Oxygen content. Chemical control of the pickling solution is also maintained.

The maximum hourly throughput is 13 t and the maximum daily production rate is 267 t/day. The nominal capacity is 50,000 tpa. There is a substantial maintenance requirement. The refractories in both the furnace (Silicon Carbide) and the launders are replaced every two years in a 20 day shut down when Southwire provide a skilled refractory crew to do the work (next due in September 2010). The casting wheel rim lasts about 12,000 t and has to be re-cut to restore its shape regularly, while the steel band lasts from 17 to 24 hours in operation. The rolls in the rolling mill have to be replaced every 6 months and the pickling solution has to be changed from time to time.

The gas is supplied in rail cars from Pavlodar in liquid form. It is stored in eight 50 m^3 tanks at a tank farm 300 m from the plant and vaporised at the plant. The consumption is 43 kg/t of copper rod.

A total of 130 people work for Kazkat, the rod making subsidiary of Kazakhmys and the overall cost was reported as $75/tonne of produced wire. The plant has currently worked 2841 days (7+ years) without a lost time accident and is a modern, efficient operation closely comparable with similar operations in Europe or North America.

Typical copper rod impurity levels are shown in Table 2-26 below. Whilst the results for Pb and Ag are the most important, the levels of S, As, Se and Te are also carefully monitored.

Table 2-26 Typical Copper Rod Impurity Analysis

Analyses (ppm)									
Sn	Zn	Pb	Fe	Ni	P	Si	Mn	S	
0.8	1.5	1.1	2.2	1.1	0.2	0.6	0.3	6.9	Actual
		<2.0						<15.0	Spec.
Cd	Bi	Cr	Sb	As	Se	Te	Ag	Co	
0.3	0.4	0.3	1	0.1	0.1	1.2	12.6	0.1	Actual
								<15.0	Spec.

2.6.9 Smelter/Refinery Control Laboratories

The control laboratories occupying three floors of the main building were installed when the smelter and refinery were commissioned and were expansive. However it was very evident that the analytical equipment formerly installed is now mainly obsolete and spares to keep many running were unobtainable. For example the emission spectrometer for trace metal analysis of refinery cathodes which completely filled 1 room, was dated 1964, did have a PC attachment but now awaiting spares. Meantime a Perkin Elmer atomic absorption unit was being used but entailed a much longer process time. A Baird spectrophotometer for Uranium analysis was also down awaiting spares and was also over 20yrs old. It was evident that moneys were not available to repair analytical equipment or to purchase replacements. (The Copper rod plant by contrast had good up to date equipment). However, by reverting to wet chemistry analysis in many instances, it was clear that operations were generally well supported.

2.6.10 Plant Performance

The smelter production and performance over the years 2007 to 2010 are illustrated in Table 2-27.

Table 2-27 Zhezkazgan Smelter Historic Production

Year	Concentrate '000t	Cu%	Cathode '000t	Acid '000t	Copper Rod '000t
2007	646	30.2	188	149	36
2008	723	25.8	181	528	48
2009	336	32.6	105	911	10
2010	447	34.9	117	927	35

Although no accurate audit can be prepared from these figures, it appears that some 98.7% of the copper is recovered directly as cathode and the silver recovery will be similar. About 45% of the lead in the concentrates is recovered to the lead dust. While there is no reason to doubt that 96% of the sulphur dioxide in the gas going to the acid plant is converted to acid and captured, it appears that only about 80% of the sulphur in the concentrate is accounted for in acid, slag or by-products and the remainder may well be lost in fugitive emissions borne out by the general levels of sulphur dioxide in the smelter operational areas and the general wearing of protective respirators. This does not compare well with the most modern smelters, which aim to capture 96% of the sulphur or more. This is not a criticism of the quality of operations; it merely reflects the design of the smelter and the nature of the concentrate processed.

In making comparisons of this kind, it should be borne in mind that, worldwide, most copper concentrates contain about one tonne of sulphur per tonne of copper. The concentrate processed at Zhezkazgan smelter contains only about 400 kg of sulphur per tonne of copper resulting in relatively high matte grades (58/59% at the time of the visit) which keeps the converter operators busy as although less slag is produced on the slag blow there is less exothermic heat to play with. The reported Sulphur and Copper in the matte correspond almost exactly with the typical concentrate sulphide mineral content figures supplied by KCC. The complete smelter operation was impressive particularly that of the converters where full use was made of the process instrumentation to enable the operators to understand and control the exothermic reaction and to successfully slag off the iron as it oxidises to FeO at the appropriate time and to minimise any magnetite production (over blowing). The future ore mined in the respective areas of Zhezkazgan will be from deeper deposits as open cast areas become exhausted and the sulphur levels in the concentrates produced are expected to increase which is favourable for the smelter operations.

While modern best practice would require double contact double absorption acid plants for sulphur recovery, it would seem that a more important priority at Zhezkazgan is to address the overall sulphur recovery. As stated above, the acid plant was showing signs of fatigue due not only to its age but also to lack of suitable spares from some of the now defunct Russian suppliers.

IMC considers that the overall smelter operation is generally clean and tidy and apparently well-maintained although the maintainability of parts of the acid plant was open to question. The smelting complex is now quite old and this is reflected in the relatively low levels of automation and quite high manning levels, with a total of 2,004 employees. However the fact that the smelter complex was built from scratch and operates as per design and there are no drag link conveyors and very few bucket elevators is also a plus as the plant requires a continuous and uninterrupted operation without unnecessary breakdowns. There were HSE issues such as the unsafe wooden walkways around the concentrate thickeners and the feed preparation areas where there were many tripping hazards and poor lighting in general. The slag and matte tapping operators should also have leather aprons and gaiters around the tops of their boots for hot slag/matte protection. However all these HSE issues can be resolved.

2.7 Power Utility

The district heating for Zhezkazgan and Satpaev industrial units, processes, mines and domestic dwellings originate from three independent sources depending upon location and industrial process and comprise:

- — Zhezkazgan Combined Power Station and Steam Raising Plant (CHP);
- — Satpaev No1 Steam Raising and Hot Water Plants; and
- — Satpaev No2 Steam Raising and Hot Water Plant.

Zhezkazgan CHP plant comprises of five Impulse type steam turbo generators of the following capacities which generate electrical power for the Zhezkazgan and Satpaev area and the KEGOC national grid and most importantly provides regional heat supplies from the electrical generation process.

The CHP station provides half of the electrical power and the whole of the heat energy requirements for Zhezkazgan area with a further two heating plants located at Satpaev providing the remaining heat energy requirements for this region.

The maximum electrical demand load of the complex is estimated to be 300 MW which occurs during the winter months of copper production processes and with associated heating demands.

The maximum electrical power demand generated from the CHP complex is estimated to be 200 MW with a nominal operating load for the summer months of 100 MW which rises to 150 MW the months of winter.

CHP generated power has to be supplemented during these periods of demand by importing 150 MW from the Karaganda power station which is owned and operated by KCC. Imported power is transmitted over 220/514 kV transmission lines belonging to KEGOC (the national grid company) and ZHREK (a regional transmission company).

The supply security of high voltage transmission systems is good comprising of duel supply lines but is less so at the lower voltage levels comprising mainly of single circuit distribution systems. It is to be expected that there will be very limited equipment failures or power outages at the individual circuit level especially during winter months.

The overall efficiency of the plant is claimed to be between 40-45% and most of the electrical generation, transmission and distribution equipment comprises of old and outdated designs but is kept in reasonable running order. An engineering programme needs to be undertaken of gradual replacement of old switchgear, control switchgear and instrumentation and refurbishment of transformers.

The consumption of boiler pulverised coal mined from the Borly Coal Mine for 2009 was 1.2 Mt, the coal has a calorific value of 3,400 kcal/kg with 0.8% sulphur and 40% ash content. Total consumption of boiler start up furnace fuel oil was 9,500 t and the average production cost for 2009 was 3.94 Tenge/kWh.

Hot waste spent steam from high pressure turbines of the CHP plant is employed to provide heating for industrial and domestic consumption and is fuelled by coal with fuel oil for boiler start up. The spent steam from the CHP turbines passes through heat exchanges and the hot water stored and collected and pumped around the Zhezkazgan Complex district with booster pumps at various locations to provide heating for homes and offices as well as hot domestic water for washing and bathing facilities.

The Satpaev system comprises two plants:

- Satpaev No1 Steam Raising and Hot Water Plant is located in the town and comprises of four water boilers each capable of producing 70 Giga-calories of energy per hour, maximum total 280 Giga-calories and dates from 1964.

- Satpaev No2 Steam Raising and Hot Water Plant is located 13 km from Satpaev in the village of Vesovaya and comprises of three water boilers each capable of producing 100 Giga-calories of energy per hour, maximum total 300 Giga-calories and dates from 1983.

The plant uses a combination of crushed coal and furnace fuel oil to provide the source of heat energy to fuel the boiler furnace. The severe heat and combustion gases generated in the process are used to heat the tube boiler water which is raises to 110°C under a pressure of 10 bars. This superheated water is then transmitted by lagged water transmission pipes and dilute prior to use to 90°C prior to domestic and industrial use.

Satpaev region is supplied via two steam raising stations; steam is stored and pumped around the district with booster pumps at various locations to provide heating for homes and offices as well as hot domestic water for washing and bathing facilities. The system comprises of four separate heating circuits with the dedicated supply lines for company mines.

This facility has its own workshop which services the mechanical electrical and civil works and appears to functions efficiently producing and manufacturing spare and replaceable consumable items such as boiler tube and assemblies.

The civil structure and engineering service infrastructure dates from the 1960's and is in some state of disrepair and requires rehabilitation and improvements environmentally in the plant with coal dust suppression and collection systems. The heating process could be greatly improved with major efficiency savings achieved with modern boilers systems and closed water heat exchangers for domestic and industrial users.

2.7.1 Power Distribution

Electric power is transmitted and distributed over the national grid at 514/220 kV and over the Zhezkazgan industrial and mining area networks at both 110 kV and 35 kV depending upon transmission distance and load. The power utilisation voltage of 6.3/10 kV is derived at each industrial process intake substations via step down transformers for surface and underground mines, concentrators, smelters and copper mills. The 6.3/10 kV voltage is utilised for high capacity motor drives and for transmission and distribution voltage to various load centres for each industrial process located within the complex.

The Zhezkazgan and Satpaev mine and industrial sites have a mixed protective earthing system with the mine underground HT and MT supplies and surface (rod mills, concentrator, smelter plants) operating on an Isolated Neutral System (IT) with earth monitoring protection. The surface industrial and domestic areas 400/220 V system operates on a solidly grounded neutral earth system (TN).

The mine and industrial power distribution network and operating philosophy is to share the mine load between the two independent intake supply transformers for both surface and underground power demands. The mine and process plants loadings being shared equally between the two independent intake supply transformers.

In the event of loss of power of either transformer each should be capable of supplying 100% of the load whilst the other remains isolated from the supply. This transformer system with dual feed lines ensures a stable and secure power supply with little down time due to power supply disturbances which are reported to be limited to, on average, two power interruptions per year.

In IMC's opinion an audit review should be undertaken of the actual reactive compensation and make recommendations, as a significant improvement in power, transmission and distribution costs could be achieved.

The domestic cost of electrical power per kWh is 4.7 Tenge/kWh compared with 12-13 Tenge/kWh in Almaty.

The Zhezkazgan Complex electrical loads are listed in Table 2-28 below:

Table 2-28 Zhezkazgan Complex Electrical Loads

Item	Load (MW) at 0.9 PF	MVA
Copper Smelter	97	121
Concentrators No 1 and No 2	85	106
Concentrators No 3	14	17.5
Mines	78	97.5
Townships	26	32.5
Total Load	**300**	**375**

2.8 Infrastructure

The Zhezkazgan Complex mine and industrial areas comprise the main source of industry for this remote location of Kazakhstan and the townships are serviced by road, rail and air transport networks. This infrastructure has been created, developed, and maintained during the past 60 years by KCC and its precursor for the exploitation of copper resources in this remote region. Zhezkazgan airport serves the local area and industrial complexes of Zhezkazgan and Satpaev with regular internal flights by KCC air lines from Almaty. The total population of the area is approximately 110,000 with 35,000 persons employed by KCC.

2.8.1 Access

2.8.1.1 Roads

Most of the Zhezkazgan Complex mine sites and the associated industrial processes and service areas are provided with all weather roads constructed from concrete and asphalt. Gravel roads and mine haul clay/earth roads are owned and maintained by KCC. The major part of the road network system consists of four and two lane asphalt highways to each mine complex and Zhezkazgan Complex industrial areas. Parts of the road infrastructure between Zhezkazgan and Satpaev belong to the local state provincial government but KCC still maintain these areas. The major strategic parts of the road network are kept open during bad weather conditions and for the winter KCC and local provincial government employ snow ploughs. The road network is capable of servicing mine consumable supplies and equipment with 20 ton vehicles and for open pit operations the roads have been designed and constructed to support 10 t of axle weight loads of normal road haulage.

The majority of the road-haulage, vehicle and worker passenger transport for the area is operated by KCC owned companies.

Adandzo Logistic

KCC provide the capital for lease hire vehicles to Adandzo Logistic who operates the road transport systems for the municipality, mine areas, Zhezkagan and Satpaev region as well as providing construction plant hire equipment to company and private contractors. Adandzo Logistic operation presently has a fleet of 1,321 vehicle units and also has its own extensively equipped workshops.

Road Maintenance and Road Construction Division

The KCC Road Maintenance and Road Construction Division maintain and upgrade the entire roadway network for the Zhezkazgan and Satpaev region which is funded by the Company. The Division also designs rail network base for rail track systems and maintains other country wide ore mine and associated roads for industrial complexes and interconnected transport facilities.

The Zhezkazgan Complex operation also has its own workshops to support its motorised fleet of trucks, cars, and road building and construction equipment. Unfortunately the infrastructure buildings shells and floors require major rehabilitation. Servicing equipment is minimal and covered service areas have clay or sand floors. Major overhauls are carried out by specialist service contractors. The Division maintains 258,819 m^2 of roadway per year with a projected expenditure of US$4,785,957.

2.8.1.2 Rail

Most mines have a comprehensive rail system commencing at the surface of each mine to transport ore to the concentrators and then concentrate to the smelters. The finished copper tube product and copper cathodes are then transported via the internal and national rail links for Kazakh internal consumption or exported by rail to European customers via Russia, and China.

The dispatching of trains for ore rail transport is carefully programmed over 24 hours to match concentrator and smelting demand requirements. The mine head ore is loaded into 105 t six axle side tip ore wagons (or 8 axle ore wagons) which have pneumatic brakes and pneumatic tipping cylinders which unload the ore into hoppers at the concentrator. Each train comprises of between 18-20 wagons which are powered electrically by DC locomotives operating via overhead trolley wires operating at 1500 V (DC) system. The locomotive and train operate on a standard track gauge of 1520-1524 mm with diesel powered electric driven units complimenting the electric trolley locomotives where the electric line fails to operate. The trolley electric locomotives are of old variable resistance motor control technology of East German origin (EL21 class locomotives) and require expensive replacement parts. The majority of the rail infrastructures is in excess of 55 year of age, with its associated signalling and dispatch systems much of which requires replacement or refurbishment including rolling stock. The diesel electric Russian/East German/Chinese manufactured 120 t locomotives, type TEM series which are diesel powered operating at 1200/2000 hp are aged from 1980 to 1993.

The rail company initiated major capital purchase in 2006 to replace older traction units and purchased ten Chinese locomotives. Unfortunately these units have been plagued with problems and spares are expensive and are limited in availability. A detailed list of the current locomotive fleet is shown in Table 2-29 below.

Table 2-29 Summary of Locomotives

Type	Manufacture	Units	Age (y)	Draw Bar Pull (t)	Capacity (kW)
Electric Locomotives					
EL-21	East German	14	20	3000	2100
Diesel Electric Locomotives					
2TE-116	Ukraine	6	20	3000	2142
T7162-SDD4	Chinese	5	4	3000	2500
T7162-SDD5	Chinese	5	4	3000	2800
TEM7	Russian	7	20	3000	1400
TEM2	Russian	3	20	1500	735
TEM15	Russian	1	20	1500	735

The KCC internal rail transport department maintain and upgrade the entire local rail network for the Zhezkazgan and Satpaev Township and industrial areas. The rail operation company supports its own workshops to maintain and repair electrical locomotives and rolling stock and rail freight wagons. This comprehensive rail network gives access to all major locations as KCC imports all heavy plant by rail to the mine or industrial area in one piece.

Each rail network's power supply sub-station comprises 35 kV 3-phase 50 Hz incoming supply which is transformed and converted to DC and transmitted over the trolley overhead electric cable network at 1500 V for up-to a maximum distance of 8-9 km. Greater distant mine and service locations employ diesel locomotive powered traction units to haul the mine and freight trains.

The yearly budget for this department varies with the output and demand for ore and copper finished products but cost details for 2009 were US$32,469,146 and equates to $0.0267 t/km of trail track.

2.8.1.3 Air

The airport was originally constructed in the 1950's and improved to international standards in 1973. The airport fell into disrepair during the late 1990's but was refurbished in 2007 to accommodate international flights. The airport is owned by the State but is now managed by KCC on a renewable annual lease basis. The lease system was negotiated by KCC to ensure good standards of maintenance and reliable services for the airport which fell into disrepair when owned and managed by the State. The airport accommodates two air companies, one owned by KCC (Zhez Air) with a total staff of 125 persons, 20 of which are pilots, and Air Astana which provides service to Karaganda and Astana.

The Zhez Air fleet is shown in Table 2-30 below. The airport remains open most of the year, for all seasons and is only closed during conditions of poor visibility (less than 300 m) due to fog or snow storms.

Table 2-30 Zhezkazgan Airways Fleet

No	Type	Seats	Status	Age	Comment
1	Yak 40	32	Operational	1977	KCC owned
1	Yak 40	16	Operational	1977	Leased
1	Yak 40	13	Operational	1973	Leased
1	AN-2	6	Operational	1972	Leased
2	I-410	19	Operational	1990	KCC owned

2.8.2 Tele-Communications

The Zhezkazgan Complex and Kazak regions appear to have a well developed communications networks which comprise of a number of systems. Two telephone systems are integrated into the National telephone service which is government owned. Audio conference facilities, purchased in 2008, are available for Zhezkazgan, Balkhash and Belousovsky. Data transmission is by the telephone provider Kaz-telecom company as it is more economical than by satellite.

2.8.3 Water

Zhezkazgan and Satpaev townships have a minimum of two water supply sources and are interconnected to compliment each other.

2.8.3.1 Zhezkazgan Water Supply

Zhezkazgan's primary water supply is the Kengirsky Reservoir which is located on the industrial perimeter of Zhezkazgan and has a storage capacity of 319 Mm^3 and is formed by a dam on the River Kengir. KCC is the major consumer with industrial processes and associated mining services consuming between 47-54 Mm^3 per year.

The pumping station and reservoir is owned by KCC but is operated by the municipal water company which maintains and repairs the pump station, reservoir and the city water supply network. The pump station infrastructure and equipment is over 50 years of age with some installations in need of refurbishment which includes the civil structures, mechanical and electrical installed service equipment.

The pump station supplies 65 Mm^3 of water per year to both Zhezkazgan and Satpaev townships and industrial processes comprising eight pump motor sets operating on a 3-phase 50 Hz 6.3 kV system.

Zhezkazgan's secondary water supply is from the Uytas-Aidos deep well boreholes which produces 8 Mm^3 per year from twenty one boreholes located up to a depth of 120 m. Each borehole pump set has a capacity of 600 m^3/h operating on a 3-phase 50 Hz 380 V system powered by 100-250 kW pump motor.

2.8.3.2 Satpaev Water Supply

Satpaev water supply is KCC owned and is abstracted from three sources of supply which are listed below:

— Eskula deep well boreholes

— Zhanyay deep well boreholes

— Zhezkazgan water company (Kengirsky Reservoir)

The water is chemically treated with chlorine and checked before discharge to the townships and industrial areas.

Eskula deep well boreholes are owned and operated by KCC producing 13 Mm^3 per year which supplies the Satpaev region and are located in Eskula 23 km from Satpaev. The borehole pump sets have a capacity of between 400-600 m^3/h operating on a 3-phase 50 Hz 380 V system powered by 32-250 kW pump motor depending upon well location and depth.

Zhanyay deep well boreholes are owned and operated by KCC producing 1.5 Mm^3 per year which supplies the Satpaev region and are located 30 km form Satpaev. Each borehole pump set has a capacity of between 400 m^3/h operating on a 3-phase 50 Hz 380 V system powered by 65 kW pump motor depending upon well location depth.

2.8.3.3 Sewage, Process and Storm Water

Generally the process water from the industrial areas, the treated sewage and all of the general collected drainage and storm water from the industrial area facilities are drained into the River Kengir.

The domestic and industrial sewage from the Zhezkazgan region is collected and pumped to a storage collector tank of installed capacity 70,000 m^3 then pass to a water treatment plant comprising of four filter tanks or other digesters with treatment consisting of primary storage and settlement tanks, aeration ponds and second storage settlement tanks and finally to aeration lagoons with final discharge into River Kengir downstream from the Kengirsky Reservoir. The system is designed to handle 100,000 m^3 per day.

Process water for the concentrator involves a closed water system. Spent process water is pumped from the concentrate primary pond and then to settling ponds. The solids are settled out and the water pumped back to the tailings dam. This water is then re-used again for the concentrator process via the pumped systems. The concentrator process water is supplemented by water supplied from Kengirsky Reservoir.

2.8.4 Workshops

The Mining Equipment Workshops overhaul and repair entire Zhezkazgan mine operational equipment which includes drilling units, scoop trams, dump trucks and man access platforms and multi use mine vehicles. Each piece of mine equipment is logged into a service bay and major parts such as engines, axles and transmissions stripped down into component parts. Hydraulic pumps are scrapped after 30,000 hours of service. Each unit then goes to specialist workshops where the unit is stripped and examined and a complete overhaul for each major component part is carried out. The vehicle is re-assembled, tested and returned to service.

The workshop appears to be well managed and efficiently run with each department well served by competent skilled craftsman. The system allows KCC to retain a well disciplined experienced workforce which can manufacture, overhaul and refurbish a whole range of smelting, refinery, process and mining equipment. The workshop, general facilities, work environment and outside infrastructure are excellent facilities.

All engineering works and facilities have to comply with the following state regulations for the maintenance and overhaul of equipment:

— Uniform system of maintenance and operation of technological equipment and machinery

— Regulation of maintained repair of equipment and vehicles at non ferrous enterprises

— Recommendations and instructions for servicing imported equipment.

2.8.4.1 Routine Condition Monitoring

Annensky surface facilities house the Routine Condition Monitoring service and laboratory for the whole of Zhezkazgan mining operations. Euro Tech Service is a German contractor who advises KCC and carry out the routine condition monitoring service for all the mine equipment. This involves a planned programme of taking in situ oil samples from the mine equipment at specified intervals whilst mine equipment is operational for the mine production. The oil sample undergoes a series of tests to determine its condition and also determine any abnormal wear characteristics of engine gearbox or transmission form oil debris.

— Euro Tech Service also overhauls and maintains engines at this plant comprising small Detroit and Caterpillar engines.

— Sandvic Engineering Services is another KCC contractor who overhauls and maintains gearboxes, transmission torque converters, power trains and mine drilling equipment of Toro and Tamrock manufacture.

— Borosun is a Turkish company and is the Caterpillar agent for KCC. They overhaul and maintain engines at this plant comprising of Caterpillar units engines and gearboxes.

— Mascom is another KCC contractor who supplies spare parts for the overhauls and refurbishments.

Most of the above equipment supply companies offer parts and consumable and technical support and specific training courses tailored to operational requirements based in the classroom, workshop, underground and surface mines locations. KCC in conjunction with the above equipment manufacturers utilise training schemes for both theory and practice, infusing the relevant precautions, techniques, routines and remedies so devised to ensure maximum safety, high machine availability and high productivity.

2.8.5 Housing

Originally the housing was Russian State and KCC owned but since independence from Russia all apartment housing is privately owned with existing tenants receive free ownership. The shell of the building still belongs to and is maintained by the local authority with the exception of Satpaev town which is KCC's responsibility. KCC have refurbished a number of apartment blocks purchased from local government and lease them to employees of the Complex. These become the property of the tenant in the event of death, disablement at work, or retirement.

2.9 Environmental

IMC visited Zhezkazgan between 6 and 10 September 2010 focussing on the areas with the greatest potential for environmental impact, such as the metallurgical complex and concentrators, waste storage facilities and particularly on measures for abatement of air emissions. A general tour of the mining operations in the Satpaev area included the concentrator, selected underground mines, small open casts and facilities for water management.

2.9.1 Environmental Management

2.9.1.1 Organisational Structure

Kazakhmys has a centralised environmental management system; the Kazakhmys head of environment is based in Zhezkazgan and Chief Ecologists are based in the 4 regional divisions. The chief ecologist responsible for Zhezkazgan region is assisted by specialists in air, water and waste for permitting and tax calculations. At each of the main operating sites there is an ecologist assisted in some cases by a deputy who is supported by technicians and mechanics of the dust and fume control departments.

2.9.1.2 Management System

Most of the principal operating sites at Zhezkazgan have gained accreditation according to integrated standards for quality systems ISO 9,001, environmental management ISO 14,001 and occupational health and safety OHSAH 18,001. The quality and environmental standards are integrated with the requirements of Kazakhstan environmental legislation, in particular Chapter 14 of the Ecological Code, 2007. Under the Code the appointed ecological specialists are responsible for:

— Compliance with the requirements of the ecological legislation of the Republic of Kazakhstan;

— Minimizing the influence of the activities on the environment and health;

— Increase in the efficiency of use of natural and power resources;

— Emergency preparedness and response;

— Development of environmental awareness amongst management and workers;

— Informing the public on ecological activity and risks for health;

— Increase the level of conformity to ecological requirements;

— Preservation of the environment; and

— Accounting of ecological charges.

The Programme of Industrial Ecological Control is developed for each site taking account of the projects for specifications of maximum permitted limits for air emissions, water discharges and storage of waste and is valid for 3 years. Under the framework of this programme, Zhezkazgan has engaged the company ECO AIR, a company licensed in the field of ecological auditing and monitoring, to carry out quarterly monitoring of all activities under the Zhezkazgan region with respect to:

— Climatic data;

— Stationary sources of emission such as exhaust gases from boiler and dust capture equipment;

— Air quality in terms of particulate matter and specified gaseous substances at the border of the sanitary protection zones;

— Soil analyses at the border of the sanitary protection zones;

— Quality of surface and underground water;

— Volumes of waste products, process and non-process; and

— Assessing the influence on the environment.

Quarterly reports are issued to the company and the Ministry of Environment.

Zhezkazgan Complex requires a Permit from the Ministry of Environment for the use/ management of nature, which defines the permissible amounts of emissions to atmosphere, discharges to water and placement of solid waste. The permissible limits are determined in total and also for a wide range of individual substances by detailed projects which are approved by conclusion of the State Expertise of the Ministry of Environment. Separate projects are required for emissions to air, use and discharge of water and production and placement of waste and are typically valid for 5 years.

Under the general conditions and obligations of the permit, the holder must:

— Work according to the approved Programme for Industrial Ecological Control;

— Submit a declaration of the emissions, discharges and waste and pay environmental charges quarterly; and

— Maintain environmental protection insurance according to the Law.

The Environmental Management Plan is approved by the Ministry of Environmental and is typically valid for 2 years. A range of general and specific measures, together with monitoring requirements for:

— Protection of air quality;

— Protection of water;

— Protection of land resources;

— Protection of flaura and fauna;

— Waste treatment and disposal;

— Radiological, biological and chemical safety; and

— Environmental training for specialists and information dissemination to the general public.

The plan also specifies the annual expenditure for each action, and where applicable the environmental and economic benefits achievable.

2.9.2 Zhezkazgan Industrial Complex

2.9.2.1 Status

The Zhezkazgan integrated metallurgical complex and power station are located in an isolated region in the central part of Karaganda Oblast, Kazakhstan. Zhezkazgan town lies in close proximity to the north and west and a large tailings storage facility to the east of the site. Satpaev town, associated mines and infrastructure are located approximately 25 km to the north east of Zhezkazgan. The local populations and the economy of the region are almost totally dependent on Kazakhmys.

Outside of Zhezkazgan and Satpaev there is little human habitation for several hundred kilometres in any direction. The surrounding land is typical of steppe conditions characterised by poor topsoil, sparse vegetation and wildlife, and a generally arid climate. The river Kara Kengir flows in a general northerly direction between the tailings storage area and the Zhezkazgan metallurgical complex. The river has been dammed at Zhezkazgan to form the Kengirsky reservoir, which serves as cooling water supply for the power station and industrial water supply for metallurgical processes.

The wind direction is predominantly from the north east. In this respect, the relative positions of the Metallurgical Complex and Zhezkazgan residential areas are favourable with the wind direction away from urban areas for a large proportion of the year. A sanitary or health protection zone is established with the perimeter extending approximately 1,000 m outwards from the edge of the industrial sites.

The Metallurgical Complex is a large integrated facility covering an area of approximately 12 km^2 and includes 56 production sites and numerous sources of releases to the environment. The principal sites are:

Coal fired heat and power station.

— Copper concentrators, No 1 and 2, each comprising ore crushing and flotation;

— Tailings and ash storage facilities;

— Metallurgical plant comprising 2 electric copper smelting furnaces, converters and electrolytic refinery;

— Copper wire rod plant;

— Sulphuric acid plant;

— Oxygen plant;

— Xanthate plant;

— Mechanical and electrical workshops;

— Foundry;

— Ferro-concrete construction department;

— Road transport departments;

— Rail transport department.

2.9.2.2 Air Emissions and Control Measures

Metallurgical processing of copper ore involves a multi stage operation of concentration, smelting to copper matte and slag, converting of copper matte to blister copper, pyrometallurgical refining and electrolytic refining. In all stages of the process there is potential for emissions to atmosphere of gaseous and solid substances. Air emissions fall into two categories:

— Organised emissions which are controlled or point source emissions collected and dispersed to atmosphere via a stack or vent usually after passing through an abatement system.

— Non-organised emissions commonly referred to as diffuse or fugitive emissions.

The Ecotera programme for environmental control and monitoring identifies more than 340 organised sources of air emissions and over 40 designated as non-organised within the Zhezkazgan industrial area. Of these there are 145 organised sources at the concentrator plants and 67 at the smelter.

Fugitive emissions of mineral dusts containing silica and heavy metals arise during material handling, storage and crushing operations. They also arise during furnace operations of tapping and pouring metal, matte and slag or by poor seals in hooding or gas ducting. The copper smelting complex is the most significant source of emissions at Zhezkazgan. Off-gases from the two electric smelting furnaces and the converter furnaces comprise:

— Dust containing heavy metal oxides or sulphides.

— Volatile elements such as lead, cadmium, arsenic, antimony and possibly mercury.

— Sulphur dioxide and sulphur trioxide.

Particulate matter in the smelting and converting furnace gases are captured using a system of dust drop out chambers and cyclone scrubbers, combined and then cleaned at a temperature of approximately 350°C, using electrostatic precipitators to reduce dust content from approximately 10 to 15 g/Nm^3 to less than 0.2 g/Nm^3. The electrostatic precipitators are arranged in 6 sections, each of two units with three electrical fields, with a total gas capacity of 200,000 Nm^3/hr. Normally 5 sections are in operation with one under maintenance or in reserve. The cleaned gases, at 250°C to 300°C and containing up to 6% sulphur dioxide, 0.2 g/Nm^3 dust are ducted to the sulphuric acid plant.

The sulphuric acid plants are of Russian design using single contact, single absorption technology with a total capacity of 240,000 tpa sulphuric acid. Each of the 4 lines consists of equipment for gas washing, drying, conversion and absorption. The inlet and tail gases are monitored continuously for sulphur dioxide and are typically 3.5% to 5.0% and 0.10% to 0.15% SO_2 respectively. An overall efficiency of 95-97% for conversion of sulphur dioxide to sulphuric acid is typical for this type of acid plant.

Ventilation gases collected in hygiene hooding over the converters during pouring and charging, and over matte and slag tapping ladles at the electric furnaces are discharged to atmosphere without cleaning. In addition, fugitive gases from the smelting and converting furnaces are vented via the sides and roof of the building.

A summary of the significant point and fugitive emission sources within the operations of the Zhezkazgan Complex is given in Table 2-31 below.

Table 2-31 Summary of Main Sources of Air Emissions

Area/Operation	Emission type	Control measures/Abatement method
Concentrator 1 and 2		
Ore unloading, primary crushing	Dust	Partially enclosed building, ventilation system and water sprays on the discharge bin
Intermediate crushing	Dust	Venturi wet scrubbing, 95% capture efficiency. Water sprays for dust suppression in the building
Milling	Dust	Ventilation system
Flotation	Flotation reagents, H_2S	Ventilation systems. Emission are generally confined to workplace and are an occupational H&S issue.
Tailings storage	Wind blown dust	Capping and cultivation of the old TSF, water cover on the active TSF
Copper Smelter		
Concentrate drying	Dust, heavy oil combustion products.	Wet venture scrubbing
Feed preparation	Dust.	Material handling in a partially closed building. Fabric filters for dust control on the feed conveyors
Smelting	Dust, sulphur dioxide, volatile metals.	Cyclone and electrostatic precipitators for dust capture, sulphuric acid plant for capture of volatile elements and sulphur dioxide. Discharge of tail gases via 220m stack
Converting	Dust, sulphur dioxide, volatile metals	Cyclone and electrostatic precipitators for dust capture, sulphuric acid plant for capture of volatile elements and sulphur dioxide. Dispersal of tail gases via 220m stack
Tapping and pouring	Dust, sulphur dioxide	Hygiene gases collected and discharged via 220m stack
Anode refining	Dust, sulphur dioxide, heavy oil combustion products.	Drop out chamber for dust control, gases discharged to atmosphere via individual stacks.
General operations	Fugitive dust and sulphur dioxide	Vented out of the building
Copper Refinery	Sulphuric acid mist, potential for arsine gas.	Forced ventilation system in the cell house
Power Station		
Coal storage and handling	Dust	Water spray if necessary during summer
Boilers	Combustion gases, ash, sulphur dioxide	High efficiency, 97%, venturi wet scrubbers for ash capture. Dispersal via a 230 m stack

The concentrators and smelter each have departments responsible for maintaining the efficiency of all emission control equipment such as cyclones, scrubbers and electrostatic precipitators. Monitoring of the inlet and exhaust gases from individual equipment is carried out at prescribed intervals either monthly or quarterly to ensure operation at the design specification. The sulphuric acid plant has on-line instrumentation for continuous monitoring of parameters such as dust and sulphur dioxide both for operational and environmental control.

2.9.2.3 Water Management

Industrial water is abstracted from the reservoir by the power station and treated to remove calcium and magnesium salts. The bulk of the water is used for turbine cooling at the power station and the resulting hot water is used for domestic and office heating; return water is discharged to the lake. The main users of industrial water are:

— The concentrator.

— Power station gas scrubbers.

— Gas scrubbers in the concentrator, smelter and sulphuric acid plant.

Tailings slurry from the concentrator together with ash slurry from the power station gas scrubbers are pumped to the TSF. Clarified water from the TSF is recycled back to the processes. There is no discharge of waste water from the metallurgical complex to surface waters; all water is recycled within the process or via the tailings pond. Only treated communal waste waters from Zhezkazgan and Satpaev are discharged to the local surface water, the River Kara Kengir.

Surface run-off water at the smelter is collected via a network of drains, treated by settlement and then used at the concentrator.

2.9.2.4 Waste Management

Low hazard category wastes consist of tailings slurry from the Zhezkazgan concentrators and ash slurry from the power station. Tailings and ash slurry are pumped to the TSF which has a circumference of approximately 12km with a wall height reaching approximately 15 m. Clarified water is decanted from the pond and returned for reuse in the concentrator.

The smelting furnace slag is cooled slowly and then reprocessed in the concentrator plant to recover some of the copper value. All captured dusts are recycled within the smelting process with the exception of dust collected in the electrostatic precipitators which is agglomerated and sold to a lead smelter.

Non-process wastes are collected and according to their hazard classification either stored on the site in a dedicated area or sent for recycling or disposal by approved companies.

2.9.2.5 Permitting and Compliance

Air Emissions

The permission for use/management of nature, No 0055492, is valid from 01.01.2009 to 31.12.2010 is an integrated permit for all operations in the Zhezkazgan region and assigns maximum permissible levels for emissions to atmosphere, water discharge and placement of solid waste.

The smelter is the main source of emissions and the permit includes 12 solid and 7 gaseous substances, many of which are classified as hazardous. Sulphur dioxide, mainly from the smelter but also from the Power Station, represents approximately 75% of all the permissible emissions as shown in Table 2-32 below. The total permissible emissions in 2010 are lower compared with 2004 due to factors such as higher efficiency of ash capture at the power station and lower sulphur in concentrates.

Table 2-32 Zhezkazgan Maximum Permissible Emissions 2010

Emissions (ppm)	Concentrator	Power Station	Smelter	Total
Solids, including	1,106	16,723	3,458	22,736
Silica dust/ash		16,697	2,372	
Copper sulphide			535	
Lead sulphide			524	
Gaseous, including	43	17,188	47,645	65,518
Sulphur dioxide		12,098	47,425	
Nitrogen dioxide		3,433		

The reported emissions in the 2nd quarter of 2010 are within the permissible amounts and no excess charges were incurred.

Water Discharge

Permitted discharges are related to power station cooling water and water from the district heating system, totalling 155 Mm^3pa and 17.7 Mm^3pa respectively. Limits on suspended solids and dissolved substances are expressed in mg/l and tpa for 10 parameters in the heating water and 4 parameters in the power station cooling water.

Waste

The permissible amounts of process waste materials, hazard classes IV and V, produced and permanently stored for 2010 are summarised in Table 2-33 below. Other more hazardous, non-process waste materials have permission for temporary storage before sending for re-use, recycling or specialised disposal.

Table 2-33 Permissible Solid Waste 2010

Waste	Category	Volume (m^3pa)
Concentrator Tailings	IV	26,405,225
Power station ash	IV	880,240
General waste	V	5,283

Compliance

Under the terms of the permit, Zhezkazgan submits quarterly emission and waste inventories to the Ministry of Environment and pays charges to the Karaganda Oblast according to the actual amounts. The reported emissions are based on the results of monitoring but also on parameters such as material throughputs, fuel consumption and unit operating times and then applying factors determined in design projects. Permissible emission levels are not directly comparable with standards generally applied internationally, which usually specify limits in terms of concentration or mass per unit of production.

Charges amount to approximately KZT12 Mpa. The Company is in compliance with the permissible amounts and no excess charges are incurred.

2.9.2.6 Monitoring

The Programme for Ecological Control and Monitoring, prepared by Ecotera covers the period 2008-2010 and specifies the nature and frequency of operational and environmental monitoring including:

— Sampling points and places of measurements.

— The period, duration and frequency of operational monitoring and measurements.

— Methods of carrying out monitoring.

Monitoring is extensive and includes air emissions, ambient air quality, water discharge, river water quality, underground water and soil as shown in Table 2-34 below.

Table 2-34 Monitoring Programme

Monitoring	Positions	Measurement Frequency
Emissions monitoring		
Air	All organised and non-organised sources	Some smelter sources monthly. Remainder quarterly
Water	Discharge of cooling water, district heating water and treated effluent.	Monthly or quarterly
Impact monitoring		
Air quality	5 positions in the industrial area and 1 in the city	Each position, 3 measurements on each of 2 days/month.
River water quality	500m upstream and downstream of disposal points	Monthly
Underground water	Border of the sanitary protection zone at the TSF	2 per year
Soil	18 positions at intervals up to 12km north, west and south of the reservoir and TSF	Annually

According to the smelter ecologist the results of air emission monitoring are available quickly and actions can be taken to remedy any abnormal emissions.

Kazakhmys engages ECO AIR, a company certified in the field of environmental auditing and monitoring, to fulfil the obligations of the Programme for Operational and Ecological Control at Zhezkazgan. The impact assessment report for 2009 indicates:

— Average air quality at all positions complying with the maximum allowable concentrations of 0.5mg/m^3 for sulphur dioxide, 0.5mg/m^3 for dust, 0.085 mg/m^3 for nitrogen dioxide and 5.0 mg/m^3 for carbon monoxide. The maximum allowable concentrations of these parameters in Kazakhstan are similar to the guideline values recommended by the World Health Organisation.

— No significant impact on river water quality.

— No significant occurrences of exceeding of maximum allowable concentrations of heavy metals in soil samples. However this is difficult to assess because of variations in natural background levels.

2.9.2.7 Hazardous Materials Management

Hydrocarbon Fuels and Reagents

Heavy fuel oil, mazut, is widely used for process heating, drying copper concentrates and for preheating the Power Station boilers. At the smelting complex, mazut is transported by rail using heated tanker wagons and discharged into 2 underground concrete tanks, each 500 t capacity and then pumped to 3 above surface steel tanks, each 5,000 m^3 capacity maintained at a temperature of approximately 90°C. The above surface tanks are installed within a spill containment area consisting mainly of an earth bund area with one short concrete section. However the joint between the earth and concrete sections is not effectively sealed.

Sulphuric Acid

The acid storage facilities include 3 tanks, 2,800 t capacity surrounded by a low brick wall which is inadequate for emergency spill containment. According to Kazakhmys only a small stock of sulphuric acid is typically held under the present conditions of high market demand and relatively low production.

Asbestos

Kazakhmys has carried out an asbestos survey and has identified some areas where asbestos materials are used for insulation and sealing.

Radioactive Sources

A number of radioactive sources are used in automatic monitoring instruments. There are strict regulatory procedures governing certification, monitoring and disposal of radioactive materials. Kazakhmys has designated an authorised person for maintaining records.

Polychlorinated biphenyls (PCB)

Kazakhmys has identified some electrical equipment containing PCB based oil but according to Kazakhmys the government funds intended to replace the equipment and dispose of the oil are no longer available.

2.9.2.8 Site Observations

IMC personnel received a brief safety instruction and appropriate PPE before visiting the smelter and concentrator. However, IMC noted that full PPE was not used by operators and staff in some areas.

Concentrators No 1 and 2

The two concentrator plants at Zhezkazgan are over 40 years old, constructed in 1954 and 1963. All areas of the concentrator were maintained in a clean and tidy condition with trees and shrubs in verges around the process areas to improve the visual appearance. There was no unorganised storing of waste materials. The concentrator has a relatively low potential for impact on air quality, any dust emissions being relatively small and localised.

The dust and ventilation department has a staff of 31 and its own workshop devoted to the checking and maintenance of ventilation and gas cleaning systems. The ore receiving hopper is equipped with hygiene extraction and water sprays which confine the dust to the building during rail wagon tipping. In No 2 crushing plant all scrubbers have been modified to a more efficient design giving a quoted dust capture efficiency of 96%. The working atmosphere was very good with no accumulations of dust in any of the areas visited. No 1 crushing area, being an older design, was originally built without ventilation equipment. The systems added later appear less efficient in controlling dust as in No 2 crushing plant.

The milling and flotation building is equipped with hygiene extraction systems at the reagent mixing and dosing station. Forced air ventilation systems are used to maintain a good working atmosphere in the flotation section. The area dedicated to the mixing the flotation reagents has an operating ventilation system and tanks and vessels are installed in a tiled area designed to contain leaks and spillage. Control measures include regular monitoring of the workplace atmosphere. It is only necessary to store the xanthate requirement for a few days at the concentrator because of the proximity of the production plant at Zhezkazgan.

Tailings Storage Facility

The concentrator tailings and power station ash are pumped to a TSF which has a circumference of approximately 12 km with a maximum dam height of approximately 30m, retained on one side by the former TSF and on the upstream side by the natural land contours. Rock and course tailings extracted from the beach are used to progressively raise the dam walls. There are two pumping stations for transporting tailings and ash slurry to the pond. Clarified water is decanted from the pond and returned for reuse in the concentrator. Based on visual appearance the retaining walls are in good condition and the beach of approximately 300 m is well in excess of mandatory requirements. Piezometers are located at 1,000 m intervals.

The main environmental issues associated with the tailings storage facility are:

— Wind blown dusting of the dry, fine particle size material onto the surrounding land and the river Kara Kengir.

— Seepage of water from the dam into the surrounding area giving potential for ground and groundwater contamination and pollution of the river Kara Kengir. The seepage water is retained by a channel at the base of the dam wall and pumped back to the TSF.

— Risk of failure of the dam wall with potential impact on the surrounding land and the river Kara Kengir.

The TSF is inspected at least twice per year by the designers, Mechanobr and also by Roztechnadzor, the State supervisory inspectorate. No incidents have occurred during the last 5 years with respect to the dam safety. However, a KZT2 M penalty was imposed in 2009 followed failure of the pipeline used for recirculating water back to the concentrator.

The active tailings pond is the third to be constructed at Zhezkazgan and commenced operation in 2008. TSF No 2 has commenced a closure programme to prevent wind borne dusting by capping with 2 million m^3 of gravel plus 0.7 Mm^3 of soil followed by cultivation with grass at a total cost of KZT1.14 M.

Smelter

There were no excessive emissions during IMC's inspection of the smelting facilities and apart from some dust and fume escape from the smelting and converting operations the air quality in all parts of the plant was good. Only one electric smelting furnace and 2 converters are presently in operation due to shortage of concentrate.

Copper concentrate is filtered, dried in mazut fired kilns, mixed with flux materials and then pelletised. This is a potentially dusty operation and the use of "dirty", high sulphur mazut fuel adds to the pollution potential. The venture scrubbers used for cleaning the off-gases are inefficient having a dust capture of approximately 55%.

The conveying system used for transferring pellets to the electric furnaces was recently equipped with high efficiency Dalamatic fabric filters to control dust emissions at changeover points. However these have not been successful and other options are now being considered. Conditions in the feed preparation department are not ideal from the perspective of occupational hygiene and safety; the work place atmosphere has a high dust concentration and poor lighting.

The smelting and converting building was in reasonable condition with only a small amount of fugitive emissions above the furnaces and in the converter aisle. The 4 anode furnaces are heated using mazut and are equipped with relatively inefficient drop out chambers for capturing dust from the off-gases; the off gases are then discharged to atmosphere without further abatement.

All of the gas handling and dust control equipment inspected appeared in a reasonable state of repair although accumulations of dust were evident in some places. The 4 lines of sulphuric acid plants are of Russian design, almost 40 years old and appear in poor condition. Although the efficiency of conversion of captured sulphur dioxide to sulphuric acid is in the order of 97%, a sulphur balance for the first 8 months of 2008 indicates that over 30% of the sulphur in the feed to the smelter is emitted to atmosphere. This is high by modern smelter standards which aim for an overall sulphur capture of greater than 90%.

The weak acid liquor produced in the gas cooling and washing section of the sulphuric acid typically contains arsenic and metal compounds and would normally require treatment. However weak acid produced at Zhezkazgan is treated in a State owned plant to recover rhenium.

Refinery

The refinery has basement facilities for containment of electrolyte spillages and leaks but the integrity of these may be poor in view of the age of the plant. The refinery is ventilated to control acid mist in the working atmosphere but in general air emissions are of relatively low significance.

Combined Heat and Power Plant

IMC did not visit the power station but the programme to re-equip the boilers with high efficiency wet scrubbers is continuing. These scrubbers have an ash capture efficiency of 99.3% compared with 96% for the conventional scrubber. There is also a programme in the environmental action plan to reduce NO_x emissions using 2 stage coal burning.

2.9.2.9 Action Plans

The environmental management plan for 2009/2010 indicates a total expenditure of KZT93.6 M, of which approximately 85% is associated with actions to reduce dust emissions. These include dust suppression on roadways, repair and improvement of gas scrubbing systems. Installation of pipelines for re-use of water accounts for KZT10 M.

2.9.2.10 Summary of Potential Risks and Liabilities

Mining in the area has been in progress for much of the last century and copper smelting at Zhezkazgan since 1971. Although environmental control has improved significantly over this period, historically there have been emissions to air of sulphur dioxide, heavy metals and metalloids, discharge of waste water to the River Kara Kengir and seepage to land around the tailings storage. As is typical of all similar operations, it is likely that some contamination of the ground has occurred in areas where processing is carried out. However it is understood that there is no underground abstraction of potable water in the vicinity of the mines or the metallurgical complex.

Zhezkazgan Complex is presently in compliance with the requirements of Kazakhstan environmental legislation. Some penalties have been imposed by the Ministry of Environment during the last few years for unauthorised discharge of recycled water following frost damage to a pipe.

Data from monitoring in Zhezkazgan and at the perimeters of the sanitary protection zones of the metallurgical complex indicates that concentrations of dust, SO_2, NO_2 and CO meet the Kazakhstan standards for air quality, which are similar to the World Health Organisation guideline values. The conclusions of soil monitoring at a number of locations suggest that there is no significant contamination by heavy metals.

There is a high rate of water recycling and no discharge of process wastewater from the metallurgical complex.

Although in compliance with the current requirements of Kazakhstan legislation, the environmental performance of the Complex is generally below recognised international standards and guidelines for control of air emissions and hazardous material management. In particular 30% of the sulphur in the concentrate feed to the smelter is emitted to atmosphere. IMC notes that Kazakhmys is continuing with efforts to improve the environmental performance by the establishment of departments responsible for checking and maintaining emission control systems.

The key issues are associated mainly with the metallurgical complex:

— A relatively low capture of sulphur dioxide emitted from the copper smelting and converting processes.

— Inefficient control of fugitive gases, mainly at the copper smelter, resulting in emissions of sulphur dioxide and dust containing heavy metals. Since these are emitted directly from the building and not dispersed at high level, there is significant potential for impact within the complex and the town.

— The sulphuric acid plants are almost 40 years old, difficult to maintain and approaching the end of their life. Kazakhmys should now be planning for their replacement.

— Potential for wind borne dust from the tailings storage facility impacting on the town and surrounding areas under adverse weather conditions. A plan to cap and cultivate the old TSF is now in progress.

— Inadequate secondary containment at storage facilities for sulphuric acid.

2.9.3 Satpaev Area

2.9.3.1 Status

Satpaev mining and processing operations cover an area of approximately 100 km^2, approximately 1 km south east of Satpaev town, which is approximately 20 km north of Zhezkazgan. The area is heavily disturbed by historical mining operations and the landscape is dominated by the headgear of mine shafts, overburden mounds and old surface excavations. Several villages have been abandoned in this area.

Apart from artificial lakes for storing and evaporation of water pumped from the underground mine shafts, there are no permanent surface waters. The land outside the mining area is typical of desert steppe with poor quality soil and sparse vegetation and wildlife.

Industrial features within the Satpaev area having potential for environmental impact include:

— 6 underground mines with access and ventilation shafts, Annensky, Stepnoi, North, South, East and West Mines;

— small scale open pit operations;

— Concentrator No 3;

— Tailings storage facility;

— Coal fired heating plant;

— Reservoir for storage of mine water; and

— Facilities for infrastructure support, such as workshops, transport, mine development.

2.9.3.2 Main Impacts and Control Measures

Residential areas of Satpaev town are within 2 km of the perimeter of the industrial area and there is potential for significant impact particularly due to air emissions from the concentrator and heating plant. Mining activities in the Satpaev region are now mainly underground and considering the remote location and barren landscape, have low potential for significant environmental impact. The small open pit excavations are exploiting ore pillars previously left to protect surface facilities, such as an old village which was relocated.

The main environmental issues are associated with:

— Historical disturbance of land for the development of the open pits and underground mines, and the visual effects of storage of the overburden/waste rock.

— Effects on land surface due to subsidence.

— Dust emissions during ore handling at the rail loading facilities.

— Dust emissions on mine access roads during summer months.

— Emissions of dust at the ore crushing plant at Satpaev concentrator.

— Emissions of ash and products of coal combustion at the coal fired heating plant.

— Storage of concentrator tailings and heating plant ash.

All waste rock produced in the current underground mining is used for backfilling. Overburden and waste rock from the small open pits which are currently active are used for creating a protective barrier around the pit perimeters. Waste rock, produced during mine shaft development and old open pit exploitation, is stockpiled in numerous, flat topped heaps approximately 40 m high with slopes at the natural angle of repose. Some natural vegetation has occurred on the older heaps.

The underground mines in the Satpaev group are concentrated within a relatively small area and subsidence has occurred causing the original settlement of Zhezkazgan to be abandoned. According to Kazakhmys there are no items of surface infrastructure or buildings likely to be affected by current mining within the license areas.

The ECOTERA monitoring programme lists over 100 sources of organised emissions and also sources of non-organised emissions at operations in the Satpaev region. Although only operating between October and May the coal fired heating plant is the most significant source of air emissions which consist of ash and gaseous products of coal combustion. Ash is captured from the boiler off-gases by venturi scrubbers. The area around the plant was in reasonably clean condition during IMC's visit albeit with the boilers not operating. In previous visits in 2005 the snow covering was black for some distance around the plant due to soot and ash emissions. IMC is not aware of any improvements to the efficiency of the gas cleaning facilities.

At Satpaev concentrator the ore is crushed in 2 stages and dust emissions are controlled by ventilation systems and wet scrubbing. During IMC's visit the concentration of dust in the atmosphere of the crusher building was very high and not possible to enter without respirators. The exhaust stack of the venture scrubber also contained visible dust loading; the dust cleaning efficiency is in the order of 70%.

Dust emissions from material handling activities and vehicle movements at the mines are likely in summer months but are relatively insignificant and localised. All ore is transported to the concentrators by rail.

Water is pumped from the underground into settling ponds at the mine and then some is returned for use underground and the surplus pumped via pipeline to evaporation ponds. At Annensky mine the dewatering rate is approximately 9,000m^{3}pd. The three evaporation ponds have capacities of 20 Mm^3, 7.7 Mm^3 and 0.7 Mm^3. In 1992 the dam wall of the large pond failed and a project is currently underway to strengthen and raise the dam. The concentrator uses water from the ponds to make up for process losses in concentrate and tailings.

At present the sediment collected in the mine settling ponds is stored on the mine sites and at Annensky the storage is in an unorganised manner close to canteen facilities. Wind borne dusting is a potential problem during summer. The environmental personnel are aware of the problem but recent organisational changes in the transport department have left the mine with no means or budget to transport the material to the disposal area.

Satpaev concentrator tailings are thickened to approximately 55% solids and pumped to the nearby TSF along with ash slurry from the Satpaev coal fired heating plant. In 2004, approximately 40% of the tailings were used for back filling the underground mines but for operational reasons in the mines this has now stopped. The TSF designed by Mechanobr has operated since 1985 and has a circumference of 13 km. There are 8 tailings discharge points and 3 decant wells for return of clarified water to the concentrator. The fifth lift of the dam wall, by 2 m, is presently underway and this will provide sufficient capacity for a further 5 years operation. Kazakhmys will need to examine options for future tailings storage within the next 3 years.

The TSF is inspected by Mechanobr at least once per year and twice per year by Roztechnadzor. Piezometers are monitored monthly. According to Kazakhmys no incidents have occurred in recent years.

2.9.3.3 Permitting and Compliance

The integrated permit for the Zhezkazgan region, No 0055492 valid from 01.01.2009 to 31.12.2010, includes the maximum permissible emissions and waste storage for all industrial activities around Satpaev. The permitted emissions to air are predominantly associated with the Satpaev heating plant and to a lesser extent the concentrator and underground mines as shown in Table 2-35 below.

All emissions reported for the 2nd quarter of 2010 were within the permitted amounts.

Table 2-35 Maximum Permitted Emissions 2010

Emissions (ppm)	Heating plant	Concentrator	Underground Mines
Solids, ash or dust	6,205	387	1,894
Gaseous, including	4,431	8	2,369
Sulphur dioxide	3,570		
Nitrogen dioxide	203		

Permanent storage of solid waste is permitted for category IV and V waste comprising overburden, concentrator tailings and ash with maximum amounts for 2010 of:

— tailings 2.54 Mm^3.

— ash 0.15 Mm^3.

— overburden 29.4 Mm^3.

Other non-process waste materials have permission for temporary storage on site and this includes 43 tpa of sediment from the mine water settling ponds.

Pumping of mine water to the evaporation ponds does not require permission because the facilities are constructed and managed for that purpose. Seepage water from the ponds is collected and returned and there are no other outlets to land or surface waters.

2.9.3.4 Monitoring

The Programme for Ecological Control and Monitoring, prepared by Ecotera covers the period 2008-2010 and specifies the nature and frequency of operational and environmental monitoring including:

— Sampling points and places of measurements.

— The period, duration and frequency of operational monitoring and measurements.

— Methods of carrying out monitoring.

Monitoring is extensive and includes air emissions, ambient air quality, water discharge, river water quality, underground water and soil as shown in Table 2-36 below.

Table 2-36 Monitoring Programme

Monitoring	Positions	Measurement Frequency
Emissions monitoring		
Air	All organised and non-organised sources	Quarterly
Water	Discharge from the domestic waste water treatment plant	Weekly
Impact monitoring		
Air quality	4 positions in the town, 4 positions at the boundary of the sanitary protection zone of the TSF	Each position, 3 measurements 2 days/month.
Water	Water abstraction from the reservoir	Monthly
Underground water	Well No 6	Twice per year.
Soil	3 positions up to 6km west of the TSF	Annually

Kazakhmys engages ECO AIR, a company certified in the field of environmental auditing and monitoring, to fulfil the obligations of the Programme for Operational and Ecological Control at Satpaev. The report for 2009 indicates:

— The average air quality at all positions was within the maximum allowable concentrations of 0.5 mg/m^3 for sulphur dioxide, 0.5 mg/m^3 for dust, 0.085 mg/m^3 for nitrogen dioxide and 5.0 mg/m^3 for carbon monoxide. Maximum allowable concentrations of these parameters in Kazakhstan are similar to the guideline values recommended by the World Health Organisation.

— No significant occurrence of exceeding maximum allowable concentrations of heavy metals in soil samples. However this is difficult to assess because of variations in natural background levels.

2.9.3.5 Hazardous Materials Management

Fuels

The facilities for receipt by rail and bulk storage of fuels for the Zhezkazgan region are located within the Satpaev industrial area. A large number of tanks are located within a walled, guarded impoundment.

Explosives

The main explosives storage is located remotely from Satpaev and sufficient amounts for a few days requirement is held underground at the mines. IMC did not inspect the facilities but has no reason to doubt the security or safety aspects.

Reagents

Only small quantities of xanthate are held at the concentrator since the production plant is nearby at Zhezkazgan.

2.9.3.6 Action Plans

The environmental action plan for 2009-2010 lists includes a number of items specifically related to the Satpaev area with a total planned expenditure of KZT49 M:

— Dust suppression on roadways and loading points.

— Maintenance of the domestic waste water treatment plant and evaporation ponds.

— Maintenance of the tailings pipeline and clear up of previous spillages from the pipeline.

— Landscaping work.

2.9.3.7 Site Observations

The industrial area between the mines, heating plant and concentrator bears the legacy of historical activities as well as lesser impacts from the current operations. Derelict buildings and unorganised disposal of construction waste add to the visual impact created by the numerous overburden heaps and old open pits.

The underground mines observed during a tour of the area and specifically Annensky Mine, appeared well managed from an environmental perspective. No dust or fume emissions were observed except for dust on the mine access roads. As noted previously the sediment removed from the mine settling ponds is not stored in an appropriate manner but this can be resolved relatively easily.

During the visit to the crushing plant at Satpaev concentrator the ventilation and gas cleaning systems were not functioning efficiently. Apart from visible emissions in the exhaust stack the dust was largely contained within the building. However the poor working atmosphere is an occupational health issue.

The TSF appeared well managed with a large beach area and no apparent concerns regarding the dam construction or stability. As with the Zhezkazgan TSF, wind borne dusting is a concern alleviated by a good water covering over most of the area.

2.9.3.8 Rehabilitation

Progressive

Measures for ongoing rehabilitation include the waste management system for collecting and segregating non-process waste materials, generally good housekeeping at the mine sites and concentrator, clearing spillages of tailings and some landscaping activities.

Closure

Exploitation of mineral resources is governed by the Law on the Subsurface and its Use, January 1996. The Law includes provisions for protection of the subsurface and the natural environment and for restoration of disturbed areas. According to the Law, man made mineral formations stored prior to 30 May 1992 or entered into state stock prior to the Law coming into force, are State property.

Kazakhmys has contracted to assign annual amounts towards the cost of closure and rehabilitation for each mine or group of mines; typically the assignment is not less than 0.1% of operational expenses in the case of copper/zinc mines. Up to 2003 assignments were transferred to specific funds but following changes to taxation rules in 2002, Kazakhmys stated that it is no longer necessary to transfer assigned money to a bank account or fund. Between 1997 and end of 2009 the total assigned to Zhezkazgan and Satpaev mines was KZT391 M of which KZT62 M had been transferred to funds prior to 2003. The relevant contracts are:

— No 114 dated 21/05/97 for Satpaev mines.

— No 403 dated 10/02/2000, under contract No 114 for Zhelandy group mines.

2.9.3.9 Summary of Potential Risks and Liabilities

The historic liabilities are associated with the land disturbance caused by the large scale of mining activities, particularly open cast mining. Part of this liability would fall under State responsibility since some of the overburden dumps date from the pre-privatisation era. However it would be difficult to assign responsibility for rehabilitating the disturbed areas between the mine sites and power station.

The current operations are reasonably well managed from an environmental perspective and are compliant with Kazakhstan legislation, the conditions of the environmental permit and air quality standards. There is no discharge of mine water or process waters. Contracts are in place for closure and rehabilitation of the mines. Potential issues identified during IMC's visit include:

— Inadequate control of dust in the ore crushing plant.

— Inappropriate storage of sediment removed from the mine water settling ponds due to lack of transport budget to remove to the permanent storage.

— The capacity of the TSF is sufficient for a further 5 years. Options for future tailings storage will need to be considered in the next 3 years.

2.9.4 Zhomart Mine

2.9.4.1 Status

Zhomart underground mine is located in an isolated region approximately 170 km west of Zhezkazgan and commenced operation in 2007. There are no communities within the vicinity of the mine and the surrounding land is desert steppe with sparse vegetation and wildlife. The workers are housed in accommodation blocks at the mine.

The potential impacts are of low significance, mainly associated with:

— Emissions of ash and combustion gases from 2 coal fired heating plants.

— Dust emissions from loading ore into rail wagons.

— Dewatering of the mine and pumping to evaporation ponds formed by the natural contours of the land. Some water is recycled for use underground.

— Storage of waste rock.

2.9.4.2 Permitting and Compliance

The integrated environmental permit for all activities in the Zhezkazgan region includes the permissible emissions and discharges from Zhomart Mine, which for 2010 consist of:

— Emissions to air of 1,043 t including 467 t of solids and 156 t of gaseous substances.

— Discharge of 212,000m^{3}pa of water from 2 mine shafts to the evaporation pond.

The reported air emissions in the 2nd quarter of 2010 were well below the permissible amounts.

2.9.4.3 Monitoring

EcoAir carries out control monitoring at the 2 boilerhouse stacks and 2 ventilation shafts for dust, sulphur dioxide, nitrogen oxides and carbon monoxide and also air quality monitoring at 4 positions on the boundary of the sanitary protection zone for the same parameters. The average concentrations in the ambient air were within the maximum allowable for each quarter of 2009.

Water pumped from the 2 mine shafts is monitored each quarter for 8 parameters. In 2009 all of the measurements complied with the maximum allowable concentrations.

No excessive concentrations of copper, zinc and lead were detected in the soil samples taken annually at 3 positions on the boundary of the sanitary protection zone.

2.9.4.4 Rehabilitation

The rehabilitation contract for Zhomart, No 663 commenced in 2006 and at the end of 2009 the calculated closure fund was KZT35.5 M.

3 BALKHASH COMPLEX

3.1 Maps and Plans

Plate 6 Shatyrkul Mine
Plate 7 Konyrat Open Pit
Plate 8 Sayak I Mine Model
Plate 9 Tastau Mine
Plate 10 Tastau—Sayak IV Mine Project

3.2 Shatyrkul Geology

Shatyrkul Mine is located in Zhambyl Oblast at a distance of 42 km east of Shu city and at 220 km to the west-north-west of Almaty (Shatyrkul: latitude 43°36'48"; longitude 74°16'34"); surface elevation is approximately 930 m amsl.

The Shatyrkul deposit is located within an extensive complex of igneous intrusive rocks generated by the Caledonian orogenic event, in which are represented quartz-syenodiorite, granodiorite and a range of granitoid intrusives. The presence of mineralization is controlled by a number of tectonic crush zones and zones of intense hydrothermal alteration.

The main ore zone extends along a tectonically controlled NE-SW trend of over 5 km strike in which up to five orebodies are located as tabular lens oriented along fracture zones. The main ore zone and its constituent orebodies are near vertical or dip steeply to the west and thickness of the orebodies ranges 0.25 m – 29.20 m. A second ore zone, recognised as the western sector of the mine area is orientated along a sinuous N-S strike with a much reduced dip of the order of 45° and intersects the main ore zone in plan and in depth; this zone is less attractive for development because of the shallow dip of the orebody and has not yet been developed. The ground between the two ore zones is heavily affected by hydrothermal alteration of the granodiorite country rock. Massive granodiorite forms the host rock for the mineralization.

The evaluation of the deposit was carried out by core drilling to depths of 2,000 m over the main ore zone. Category C_1 resources were defined by a drillhole grid comprising profile lines 100 m apart on which holes were a maximum of 100 m apart, and 50 m apart for shallower depths; category B resources have been defined by a drillhole grid of 50 m by 50 m.

Some oxide mineralisation continues to be encountered at worked levels; generally the depth from surface of the oxide zone is reported as up to 40 m but in localised areas this can extend down to 100 m. Virtually all production is from sulphide mineralisation in which the principal orebody minerals are chalcopyrite, magnetite, haematite, quartz and calcite. Gold is a significant product from the ore and silver is also present but of less economic significance.

3.2.1 Reserves and Resources Statement

All resources and production are treated as sulphide ore. For official GKZ resource estimates the cut-off grade applied for sulphide ore is 0.8% Cu which applies for blocks for which the minimum average grade is 1.8% Cu. In compliance with the CRIRSCO guidelines, C1 category reserves have been assigned to measured resources and C2 category to indicated resources.

Table 3-1 below shows the resource statement estimated as at 1 January 2011.

Table 3-1 Shatyrkul Resources Estimated as at 1 January 2011

Shatyrkul Mine		Resources	Copper	Zinc	Gold	Silver	Lead
		'000 t	*%*	*%*	*g/t*	*g/t*	*%*
Shatyrkul	**Measured**	14,256	3.54	—	0.82	2.99	—
	Indicated	9,393	3.27	—	0.82	2.99	—
	Total	**23,649**	**3.43**	**—**	**0.82**	**2.99**	**—**
	Inferred	—	—	—	—	—	—

Table 3-2 below shows the reserves statement estimated as at 1 January 2011.

Table 3-2 Shatyrkul Reserves Estimated as at 1 January 2011

Shatyrkul Mine		Reserves	Copper	Zinc	Gold	Silver	Lead
		'000 t	*%*	*%*	*g/t*	*g/t*	*%*
Shatyrkul	**Proved**	641	2.14	—	0.68	2.2	—
LOM +20 Years	**Probable**	15,094	2.97	—	0.68	2.2	—
	Total	**15,735**	**2.94**	**—**	**0.68**	**2.2**	**—**

3.2.2 Estimates of Tonnages and Grades

Proved reserves are that portion of the measured resources which have been prepared for extraction; at 1 January 2011 this comprised 641,000 t of commercial ore at a grade (diluted) of 2.14% Cu. Silver content, quoted in the official GKZ reserves estimate as 7.45 g/t, has been adjusted downwards to reflect the silver content of in-situ resources actually experienced from production over the five years 2005 – 2009. The remaining measured resource is assigned to probable reserve category.

All resources in the C1 category are considered measured resources and have been identified above the 400 m level in the mine; the lowest current mine development comprising preparatory works is at the 700 m level. C2 category resources have been identified down to a projected mine level of 180 m and are considered Indicated Resources but the level of mine planning and development is considered insufficient to allow consideration of these resources as reserves.

3.2.3 Expected Recovery and Dilution Factors

For the estimation of commercial ore, official calculations allow for losses of 8.4% and dilution of 15%. In practice actual losses are close to the planned total but actual dilution is around 38%, and averages 35.7% over a five year period. Losses of 8.4% and dilution of 35.7% has been applied for the calculation of reserves. Moisture in loaded ore is reported at 4.2%.

3.3 Konyrat Geology

Konyrat Mine is located 16 km north of the city of Balkhash (latitude 46°59'31"; longitude 74°59'03"); surface elevation is approximately 450 m amsl. Mining of this deposit commenced in 1934 and the depth of the pit is over 380 m to the 117 m level.

The Konyrat deposit is a porphyry copper located within a large granodiorite intrusive stock; mineralization is interpreted to be controlled by a columnar body of felsic secondary silicification. Sulphide mineralization was present as a fracture stockwork over the top and peripheral to the zone of silicification and was richest closer to the core of this zone, now largely worked out. Mineralization peripheral to this core zone becomes reduced and is present in thin veins of 1-2 cm thickness or more generally disseminated. Mineralization has been identified to a depth of 600 m from surface.

The main ore minerals are pyrite, chalcopyrite, molybdenite and enargite with subsidiary presence of sphalerite, magnetite, bornite and galena. A profile of secondary copper enrichment is recognised by the presence of chalcocite, which has been identified to a depth of 420 m from surface.

3.3.1 Reserves and Resources Statement

For official GKZ resource estimates the cut-off grade for this deposit is 0.2% Cu. Table 3-3 below shows the resource statement estimated as at 1 January 2011.

Table 3-3 Konyrat Resources Estimated as at 1 January 2011

Konyrat Mine		Resources	Copper	Zinc	Gold	Silver	Lead
		'000 t	*%*	*%*	*g/t*	*g/t*	*%*
Konyrat	**Measured**	54,997	0.38	—	—	—	—
	Indicated	114,182	0.29	—	—	—	—
	Total	**169,179**	**0.32**	**—**	**0.015**	**0.38**	**—**
	Inferred	—	—	—	—	—	—

Table 3-4 shows the reserves statement estimated as at 1 January 2011. All resources identified as Measured and Indicated are considered sufficiently planned to be converted to reserves.

Table 3-4 Konyrat Reserves Estimated as at 1 January 2011

Konyrat Mine		Reserves	Copper	Zinc	Gold	Silver	Lead
		'000 t	*%*	*%*	*g/t*	*g/t*	*%*
Konyrat	**Proved**	56,111	0.37	—	—	—	—
LOM 19 Years	**Probable**	116,494	0.28	—	—	—	—
	Total	**172,605**	**0.32**	**—**	**0.015**	**0.37**	—

3.3.2 Estimates of Tonnages and Grades

The current open-pit configuration is based on in-pit rail haulage and incorporates correspondingly wide benches at 15 m vertical intervals. Remaining ore resources have been evaluated in the base of the pit and also, to a large extent, in the pit walls and benches.

During 2006-2007 some 70 shallow (15 m) holes were drilled for exploration on the in-pit benches and ore resources were correspondingly recategorized. Production was last recorded from the mine in 2007 when 534,600 t were produced in the 12-month period of 2007. A major push-back and stripping programme was planned for 2007 to access resources but was only partly achieved and no further preparation has since been undertaken.

3.3.3 Expected Recovery and Dilution Factors

Based on records of production prior to 2008, commercial ore production incurs losses of 1.33% and dilution of ore, on a dry basis, of 3.4%. These factors have been applied for estimation of reserves from the Measured and Indicated resource base.

3.4 Sayak Mines Group Geology

The Sayak Group of mines are located in the Aktogai District of Karaganda Oblast at a distance of approximately 200 km east from the city of Balkhash (Sayak III Mine: latitude 46°59'37"; longitude 77°16'45").

The Sayak copper mines and prospects comprise a well-defined line of genetically related deposits extending over an E-W distance of approximately 20 km, extending from Sayak IV West in the west, to Sayak I, the most easterly. The deposits were first evaluated in 1966, using a cut-off grade of 0.5% Cu (minimum average copper grade in evaluated blocks of 0.85% Cu). Further exploration was carried out over the Tastau deposit in the period 1983-1984. Substantial surface mine excavation occurred on the Sayak I, Sayak II, Tastau (north and south pits) and Sayak III orebodies in the 30-year period mid-1970s to mid-2000s. Preparation for underground mining commenced in 2001 and from the mid-2000s virtually all production has been obtained by underground mining.

Kazakhmys has also held the licence for the Sayak IV Gold-Cobalt deposit since consolidation with Balkhashsvetmet; however no production has been undertaken by the Company. This licence area was separate from the main area of copper licences and lies at 6 km to the west of Sayak III. The Sayak IV Gold-Cobalt deposit was evaluated in the 1960s, as part of which an 8 m diameter vertical shaft was constructed and fully equipped and a large decline also constructed to connect to the three levels defined in the main shaft.

In 2009 Kazakhmys applied for and was granted a major extension of its licence area west of Sayak III. This extension encompassed additional deposits originally identified and evaluated in the period 1969 – 1980 and designated Sayak III West, Kasimbek Block, Sayak IV Copper and Sayak IV West. The resources in these blocks are included in the total resource for the Sayak area for the first time in the total quoted for 1 June 2010.

Approval for exploitation of the deposits west of Sayak III has been requested in July 2010. A conceptual design has been developed for underground mining, with linking underground infrastructure connecting from the current Sayak III operations with access to each of these new areas and then to the shaft and incline in the Sayak IV Gold-Cobalt deposit.

The Sayak mining area lies within a belt commonly described as the "Inner Zone of the Hercynian Fold Belt" which represents a major continental collision zone and orogenic belt, with correspondingly complex history of deformation and of phases of intrusion by plutonic and hypabyssal (sub-volcanic) igneous rocks. In the immediate area of the Sayak mining field there are a number of major igneous intrusions which have intruded, deformed and locally metamorphosed a sequence of Lower to mid-Carboniferous sedimentary units. The Lower Carboniferous sedimentary sequence comprises limestones, sandstones, siltstones, tuffs and other volcanoclastics. This sequence shows well-developed stratification and the bedded sequence describes a generally WNW-ESE trend, with structural dip to the south, but becomes strongly flexured and deflected around the major intrusive bodies. The largest area of intrusive rock is an elliptical stock of andesitic porphyry lying immediately west of the Sayak 1 mine and north of Tastau and the Sayak II group of prospects, covering an area of over 15 km^2; the host strata are strongly deflected and folded around this stock. A large dioritic intrusion occupies the area south of the Sayak IV and Kasimbek prospects and defines the southern edge of the WNW-ESE lineament of the Sayak deposits.

The various Sayak deposits display mineralization largely governed by metasomatism generated by the main intrusive episode, which has given rise to characteristic skarn mineralization, recorded as pyroxene or garnet-pyroxene skarn, where it affects calc-silicate host rocks, and also some mineral assemblages are interpreted as representing some related hydrothermal mineralization.

For the copper deposits the main sulphide mineral is chalcopyrite with secondary pyrite; chalcocite and covellite also occur reflecting zones of secondary enrichment. Molybdenum is a characteristic presence in these ores, particularly in Sayak I, although virtually absent in Sayak II; the presence of arsenic as a contaminant is recorded in Sayak I. Magnetite occurs in close association with chalcopyrite in the Sayak I ore.

At the western end of the Sayak mineralized belt, the Sayak IV-Gold-Cobalt deposit displays a significantly different mineralization in which arsenopyrite is the principal sulphide mineral and other sulphide minerals are very subordinate and may include pyrrhotite, chalcopyrite and molybdenite. Axinite (boro-silicate of aluminium and calcium) is a common mineral and is reflected in a very high presence of boron of up to 5.5% B_2O_3; this is a characteristic mineral of the contact metamorphic environment. Elevated levels of boron are also found in the adjacent Sayak IV-West deposit, but its presence is not recognised further east along the mineralized belt. Similarly, significant presence of cobalt is recognised only in the furthermost west deposits of the Sayak group.

3.4.1 Reserves and Resources Statement

The copper resources of the Sayak deposits have been defined in accordance with parameters approved by GKZ including the use of a cut-off grade of 0.30% Cu.

The resources of Sayak I have been planned for extraction to 2019 and are considered convertible to reserves. The reserves have however been estimated to exclude balance resource tonnage assessed as inactive at 1 January 2010 (1.02 Mt @ 1.28% Cu).

Sayak II resources comprise mixed oxide and sulphide ores from three separate ore zone areas.

The resources of the Sayak III-Tastau unit, as reported to GKZ, include resources specifically identified as remaining for open-pit mining and which are clearly excluded from draw-down from current underground operations. These are included in the resource statement but excluded from conversion to reserves; there are no plans for returning to open-pit mining in these areas and any such development may jeopardise access to underground mines planned for long-term use. The reserves have also been estimated to exclude balance reserves tonnage assessed at 1 January 2011 as inactive (0.22 Mt @ 1.43% Cu).

The newly acquired resource areas west of Sayak III have all been defined by drilling and exploration to the standards required under the FSU system to be classified as C_1 or C_2 resources. Reflecting the level of investigation required to meet these categories, all such resources are considered as Indicated Resources; the absence of detailed plans for mining excludes these resources from consideration as reserves.

Table 3-5 below shows the resource statement estimated as at 1 January 2011.

Table 3-5 Sayak Group Resources Estimated as at 1 January 2011

Sayak Group		Resources	Copper	Gold	Silver	Molybdenum	Cobalt
		'000 t	%	g/t	g/t	%	%
Sayak I	**Measured**	5,415	1.46	1.57	9.53	0.031	—
	Indicated						—
	Total	5,415	1.46	1.57	9.53	0.031	—
Sayak II- all areas	**Measured**	—	—	—	—	—	—
	Indicated	1,177	1.27	0.72	7.98	—	—
	Total	1,177	1.27	0.72	7.98	—	—
Sayak III-Tastau	**Measured**	1,816	1.04	0.11	3.74	0.005	—
	Indicated	793	0.88	0.11	3.74	0.005	—
	Total	2,609	0.99	0.11	3.74	0.005	—
Sayak III-West	**Measured**	—	—	—	—	—	—
	Indicated	1,792	2.00	0.22	—	0.005	0.004
	Total	1,792	2.00	0.22	—	0.005	0.004
Kasimbek Block	**Measured**	—	—	—	—	—	—
	Indicated	3,915	1.61	0.14	—	0.002	0.008
	Total	3,915	1.61	0.14	—	0.002	0.008
Sayak IV-Copper	**Measured**	—	—	—	—	—	—
	Indicated	2,740	1.80	0.38	12.8	0.005	—
	Total	2,740	1.80	0.38	12.8	0.005	—
Sayak IV-West	**Measured**	—	—	—	—	—	—
	Indicated	1,373	2.07	—	—	—	0.039
	Total	1,373	2.07	—	—	—	0.039
Sayak IV-Gold-Cobalt	**Measured**	—	—	—	—	—	—
	Indicated	2,302	0.15	7.20	—	—	0.141
	Total	2,302	0.15	7.20	—	—	0.141
TOTAL SAYAK	**Measured**	7,231	1.36	1.20	8.08	0.010	0.018
	Indicated	14,092	1.43	1.38	3.37	0.010	0.018
	Total	21,323	1.41	1.32	4.96	0.010	0.018

Table 3-6 shows the reserves statement estimated as at 1 January 2011. The status of developed mining plans dictates that only those resources in Sayak I and Sayak III-Tastau are eligible to be upgraded to reserves.

Table 3-6 Sayak Group Reserves Estimated as at 1 January 2011

Sayak Group		Reserves	Copper	Gold	Silver	Molybdenum	Cobalt
		'000 t	%	g/t	g/t	%	%
Sayak I	**Proved**	6,432	1.17	1.26	7.66	0.027	—
LOM 9.5 Years	**Probable**						
	Total	6,432	1.17	1.26	7.66	0.027	—
Sayak III-Tastau	**Proved**	2,102	0.86	0.09	3.09	0.004	—
LOM 7 years	**Probable**	918	0.73	0.09	3.09	0.004	—
	Total	3,020	0.82	0.09	3.09	0.004	—
TOTAL	**Proved**	8,534	1.10	0.97	6.53	0.020	
	Probable	918	0.73	0.09	3.09	0.020	—
	Total	9,452	1.06	0.89	6.20	0.020	—

3.4.2 Estimates of Tonnages and Grades

Sayak I: the open-pit working of Sayak I ceased in 2006 at a depth of approximately 170 m, at elevation 350 m; all subsequent production has been from underground. Up to seven orebodies have been identified, which are lenticular but generally tabular and concordant with the structure of the host strata. The predominant strike for all orebodies is NNW-SSE. The main orebody shows a strongly flexured structure, which at the top and eastern side of the open-pit is almost flat and gently dipping at 12°-25° to the west, curving sharply downwards to become near vertical in the base of the open-pit. This orebody, and also others, has been accessed for underground mining from the walls of the open-pit; orebodies 2 and 7 are accessed from the western pit wall, orebody 3 is exploited under the western pit wall of the northern half of the open-pit. The near vertical main orebody is also currently being extracted below the bottom of the open-pit, currently at the 290 m level.

Sayak II: the Sayak II orebodies, prospects and the mined area of Sayak II East, lie along a well-defined and mapped skarn deposit, extending as an approximately 5 km strip to the ESE of the Tastau deposit. The mapped skarn unit is concordant with the stratification of the country rocks and shows a maximum width at outcrop of approximately 300 m at its western end. The Sayak II orebodies comprise Sayak II East, Sayak II Central, Sayak II West and Sayak II Aureole. Sayak II Aureole is part of a separate genetic regime and is not part of the linear skarn deposit but represents a mineralized area in the aureole of an intermediate intrusive stock immediately south of the Sayak II lineation. Resources are recognised only in the linear skarn deposits and comprise a number of isolated areas of mineralization which are mostly oxide ores also with a variable component of mixed and sulphide ore. These resources are readily accessible for open-pit working and are planned to be taken on an essentially ad hoc basis. Considerable difficulties for maximum recovery of the metal grades are identified and it is also envisaged that heap leaching for oxide ore may be developed. Official resource returns to GKZ for 2009 recognise only out-of-balance resources for Sayak II East for underground working. However, an operational recalculation for 1 January 2010 recognises resources in isolated orebodies for underground and open-pit working which comprise mixed oxide and sulphide ores; these resources are C_1 category.

Sayak III-Tastau: these were originally worked as independent open-pits. However, the same sequence of up to 5 tabular orebodies are present in a continuous structure between and below the two open-pits and underground mining has exploited these since 2006. The mineralization is hosted in an interbedded sequence of volcaniclastic sediments, shales and limestones. The structure is effectively a shallow syncline with a structural dip in the Sayak III area of approximately 25° to the south-east, which then flattens between the two open-pits and then rises with a dip of 8°-15° to the north-west in the Tastau area. The mineralization occurs as tabular bodies of skarn metasomatism with dominant chalcopyrite; orebody thickness ranges from 1 m – 3 m for the thinner units up to 22 m – 44 m for the thickest.

Sayak III-West: this forms part of the newly acquired resource area and is directly contiguous with the Sayak III open-pit. The geological structure shows direct continuity across both blocks and surface skarn outcrops of ENE-WSW strike, as mapped and exploited in Sayak III, continue uninterrupted into Sayak III-West. Investigation of the deposit has identified resources in the C_2 category, all of which are categorized as sulphide ore; thickness of the orebodies ranges 2 m – 15 m. Future extraction is planned to be only from underground.

Kasimbek Block: this block forms part of the newly acquired resource area and lies at approximately 2 km west of the current Sayak 3 open-pit but, due to important NNW-SSE faulting, is not interpreted as directly continuous from the orebodies of Sayak III and Sayak III-West. Investigation of the deposit has identified resources in the C_2 category, all of which are categorized as sulphide ore; thickness of the orebodies ranges 1 m – 12 m. Future extraction is planned to be only from underground. Kazakhmys are undertaking a further drilling programme over this block, for which a total of 96,000 m of core drilling has been planned and of which 35,000 m are to be completed in 2010.

Sayak IV-Copper: this area forms part of the newly acquired resource area and lies at approximately 3 km west of the current Sayak 3 open-pit. It is detached from the closely adjacent Kasimbek Block and strongly developed N-S faulting occurs in the intervening interval although the prevailing fault direction through resource area is NE-SW. Investigation of the deposit has identified resources in C_1 and C_2, all of which are categorized as sulphide ore; thickness of the orebodies ranges 1 m – 19 m. Future extraction is planned to be only from underground.

Sayak IV-West: this area forms part of the newly acquired resource area and is a closely adjacent block immediately west of Sayak IV-Copper, with which it is essentially continuous. Investigation of the deposit has identified resources in the C_2 category only, all of which are categorized as sulphide ore; thickness of the orebodies ranges 1.8 m – 9 m. Future extraction is planned to be only from underground. The resources are characterised by a relatively high presence of cobalt and more particularly by a high presence of boron (recorded as 3.5% B_2O_3).

Sayak IV-Gold-Cobalt: this deposit is located at approximately 3.5 km to the west of the current Sayak III open-pit and has been the object of considerable investigation and development; resources are in category C_1. Mineralisation is hosted in a sequence of volcanoclastic and carbonate sediments of mid-Carboniferous age which have only a shallow dip up to a maximum of 15°. The orebodies are constrained in lenticular, tabular bodies parallel with the stratification. The continuity of structure and mineralization is affected by frequent steep dykes of quartz diorite porphyry and related intermediate rock types which generally are orientated NE-SW. There are two principal orebodies and a number of thinner and less extensive units; orebody thicknesses range 0.8 m – 32.5 m.

3.4.3 Expected Recovery and Dilution Factors

Sayak I: underground production records since 2006 show variable losses and dilution reflecting different mining methods in relation to orebody geometry. Similarly, dilution shows annual variations in the range 16% – 23%. For conversion of resources to reserves the modifying factors have been applied as 4.5% losses and 19.6% dilution.

Sayak II: currently no production from these orebodies. Only Sayak II East has been worked, as an openpit to a maximum depth of approximately 35 m (level 515 m), with some underground adits opened over short lengths from the base of the pit wall; there was a small level of production from underground in 2008 and 2009. Assessed resources are relatively shallow and available for a combination of open-pit and underground extraction.

Sayak III-Tastau: these units are worked as a single underground unit. However, since commencing underground mining, a different mining method has been applied in each area, reflecting the different style at each extremity of the worked area. In consequence the estimation and losses for each area have been evaluated independently. Based on the record of 5 years underground working at Tastau, losses of 8.1% have occurred with dilution of 17.3%; in contrast in the period of underground working at Sayak III, since 2008, it has been assessed that there are no direct losses but an overall dilution of 21.9% has occurred. For the purposes of applying modifying factors to the resource base of the combined units, reference has been made to production performance in the five months January – May 2010, and using the same relation between balance reserves drawdown and actual production, losses of 4.4% have been applied and dilution of 17.4%.

3.5 Mining

3.5.1 Shatyrkul Mine

The Shatyrkul mine began operations in 1999 as an open pit mine and continued until 2002 (depth 65 m), when operations were moved underground. There are 2 ore bodies which vary from 0.25 to 29.2 m.

The deposit is in two sections: north-eastern and south-western. The boundary between them is a rock mass 250 m long and 270 m deep. Mining is undertaken by trackless equipment using continuous retreat sub-level caving method. Most of the underground equipment is less than ten years old.

The main openings are transport inclines which carry galleries and two transport tunnels to the lower levels. There are ventilation shafts servicing each section of the mine together with an air inlet shaft. Ventilation is supplied via the inlet shaft and transport inclines. Despite this arrangement IMC found the air quality to be poor with an obvious excess of diesel exhaust fumes.

The north-eastern operates on 20 – 24 levels and the south-western on 13 – 15. The sub level caving is creating a controlled collapse of the galleries. Both surface and underground roadways use excessively steep gradients, however, the roads are maintained in good condition. The blasting is carried out to a high standard and this has helped produce well shaped and stable underground workings. Rock bolting and shotcrete are used as roadway support.

Average daily production is 1,300 to 1,400 t of ore at an average grade of 2.7%. Should the mine continue to operate at this level of production, it will have a life of approximately 30 years.

Table 3-7 below shows the complement of mobile plant at the mine. The mining fleet is quite new, mostly purchased between 2008 and 2009, and each machine carries a first aid kit.

Table 3-7 Shatyrkul Mobile Plant

Mobile Plant	Units
Toro 50 dump trucks	4
Sandvik LH514 loaders	3
Cat 980 loaders	2
Toro 009 loader.	1
Kamaz truck	1
Monomatic drills	3
Solo drills	2

Ore is transported by rail to the Balkhash concentrator, an old electrically powered rope face shovel is used to load the rail trucks.

In 2010 a roof fall caused the death of one man and serious injuries to another. A revised support has now been implemented to accommodate poor ground conditions. A rescue centre is being constructed with a fire engine but was considered to be unserviceable in an emergency.

3.5.1.1 Infrastructure

Access

The mine situated at the south western end of lake Balkhash is at the end of a minor sealed road some 40 km from the nearest main town Shu. Power and potable water come from Shu and run of mine ore is delivered to a rail head 20 km beyond Shu.

Power

There is a 35 kV single line from Shu to the mine site. This terminates at a small sub station equipped with incoming 35 kV switchgear, 4 MVA step down transformer and three 6 kV feeders spreading out around the site. Power consumption is very small with the biggest loads being a 250 kW vent fan and an electric shovel. Other consumers being the domestic load and a small amount of road lighting underground.

Water

Underground water is in fairly small quantity there being just enough to spread on the roads for dust suppression. Potable water is more of a problem and has to be trucked to site from Shu by bowser once per day.

There are plans to establish an underground pump station at the 810 level and to this end a bore hole around 400 mm diameter has been sunk to bring the pipe column to the surface. There is a second borehole with a 6 kV cable suspended in it.

Plant Workshop

The plant workshop at Shatyrkul is the best of the sites visited, with a substantial building, good wash down for vehicles entering, better lighting and adequate space. There is a small area underground for maintenance of drills.

Offices and Accommodation

This mine is sufficiently remote to have a roster system with 4 panels two on site working 12 hrs on and 12 hrs off changing every 15 days. The accommodation for 140 people looked serviceable. There is a small mine office connected to headquarters by satellite link.

Explosives

There is a magazine for explosives storage at the entrance to the site.

Fuel Storage

Fuel oil is stored in tanks lying on the ground with little or no bunding around them.

3.5.2 Konyrat Mine

Konyrat mine is an open pit copper mine where operations have been suspended. Mining was carried out using a conventional shovel and railway truck being linked to Balkhash by a direct rail line. The Konyrat mine began production in 1934 and most of the ore has been extracted, it covers an area of 2.2 x 1.8 km and is 330 m deep.

The mine has been benched very skilfully developed with fourteen 20 m benches each angled at approximately 10° to 15° off vertical. Beneath these benches are cut backs that were worked to a much lower standard. The base of the mine is flooded and said to contain 800,000 m^3 of water.

Full production ceased in 1996 and operations were suspended during 1999 in order to allow the existing pit wall to be moved back to gain access to deeper ore. In 2007, extensive overburden removal was accompanied by modest ore output, mining activity ceased at the end of 2008.

Konyrat mine is now reported to have the lowest grade across all Kazakhmys copper mines with a reported grade of 0.32% copper. It is understood that substantial amounts of low grade ore remain in side lobes and the base of the mine, the side lobes could readily be mined, the base would likely require a further cut back. Should any further development of the mine be considered, then the standard of blasting and excavation should be significantly improved from the more recent works.

IMC was not shown the geology nor was a mining plan provided. It is likely that cost effective mining from Konyrat has ended, however, further extraction of copper from the low grade dumps may be a possibility.

Waste and low grade ore dumps occupy 23 km^2 are variously stated to contain 795, 860 t of pure copper, those that are owned by the Company have a volume of approximately 7,667 m^3.

Commensurate with a contract on subsoil use JSC "NC SBC Saryarka" and Mining Company "Sary Kazna LLP" signed an agreement on joint operating an in situ (heap) acid leaching process on one of the low grade dumps. SX Kinetics from Cobourg, Ontario, Canada were appointed to design and supply a pilot plant who designed and manufactured a complete "turn-key" solvent extraction and electro-winning pilot plant capable of producing 240 kg per day of copper cathodes from 100 L per minute of leach solution (PLS).

In 2008 an administrative office was constructed and in August 2008 the first copper was produced. If this pilot operation proves to be cost effective and not detrimental to the environment, there is the potential for winning very large quantities of copper.

3.5.3 Sayak I

The original Sayak I mine consisted of three small open pits, the largest with 10 benches. Extraction began in the 1970s and continued until 1997. The open-pit is closed and an underground mine is in production.

The original benches were produced to an acceptable standard, however, later work is to a much lower standard. The condition of the benches is important, because these have been used as the starting points to drive several adits into the ore body. Instability in the benches will lead to rockfalls.

The current Sayak I mine is an underground development that began production in 2002 and consists of adits from the old open pit being developed to access the remaining ore body. IMC was not shown the underground geology nor was a mining study or plan provided.

Mining is undertaken by trackless equipment using multi-lift room-and-pillar operations. Planned output is approximately 600 kt of ore per year. The commercially recoverable ore is calculated as 5,868 kt. This provides a mine life of approximately 9.5 years with an average metal content of 1.57%.

Management report that the planned production is being met and IMC believes that the operators are competent to continue production until completion.

There are waste dumps located in many areas of the Sayak mines, some are owned by the government and some by Kazakhmys.

The low grade dumps that are reported as being owned by the Company are separated as sulphides of 28.6 Mt at 0.33% or 9,400 tonnes of metal and oxides of 0.34 Mt at 0.64% or 2,200 tonnes of metal.

3.5.4 Sayak II

Sayak II consists of a shallow three surface mines, Eastern, Central and Oreolnyi. Work commenced in 1976 and ceased in 2008. The ore body has been excavated from the surface to a depth of less than 100 m. The high walls are poorly defined and are stable mostly by virtue of their partial collapse.

Work started on underground extraction in 2001 and is now complete.

During the IMC visit there were no apparent signs of mining activity which was confirmed by management.

It is likely that the mines will be used in the future as a starting point to develop these small ore bodies. IMC was not provided with a mining study or plan.

3.5.5 Sayak III and Tastau Mine

The mine consists of two open pits and two underground pits, Tastau and Sayak III. This group of surface mines are closed but the underground complex of mines is in production. The open pits commenced mining in early nineteen seventies and ceased in 1998. The mines should now be under a scheme of care to make them safe, at present the pit walls are unstable. In 1998, underground development began consisting of several adits being driven from the two surface pits into the ore bodies. The adits were driven simultaneously from both Tastau and Sayak III. The main declines are cut cleanly and well maintained, the main portals are concrete lined. Some of the other portals are still to have the concrete installed. Where the two underground developments join, the roof has been bolted.

The method of mining is conventional room and pillar carried out over two and three levels. The rooms are 10 m wide with height following the ore body, giving variations up to 35 m. The pillars are also ten metres wide. The floor thickness varies between 8 and 20 m. Generally the floors are not ore, however in some areas close to Tastau up to three levels were mined by room and pillar with the floor in ore, in these instances, blast hole open stoping was used to recover the ore. Details of the mining plan were not provided to IMC but it is recognised that the ore body connects the two mines and each mine operates a substantial ore body.

Table 3-8 below shows the complement of mobile plant at the mine. The mining fleet is new and each machine carries a first aid kit.

Table 3-8 Sayak Mobile Plant

Mobile Plant	Units
Toro 50 t trucks	6
Cat 980 loaders	5
Sandvik LH514 loader	1
Belaz trucks	10
Drills	7
Excavators	3

There is no underground facility for providing first aid and accidents are dealt with from the surface. All the plant carries first aid kits and each year the operators are given first aid training. It was stated that there have been no plus three day accidents in the new development.

IMC considers this to be a well managed mining operation, using modern equipment and a competent workforce. The underground workings were satisfactory and the roadways were well maintained. The plant is being replaced and upgraded on a continuous basis.

3.5.6 Sayak IV

There are two distinct resources at the Sayak IV site; a zone of gold/cobalt mineralisation, and a zone of copper mineralisation. The gold/cobalt project has been considered for many years but technical problems associated with the arsenopyrite content of the deposit have precluded commercial development of the site, notwithstanding the large amount of mine development that has already been constructed.

The site has little topsoil and sparse vegetation and the water table is at a depth from the surface of 90 m, water inflows the mine at up to 20 m^3 per hour and currently, the mine is flooded. This underground development is reported to contain gold, silver, cobalt and boron. The ore has been found in six ore bodies of which three contain 98.8% of the metals. The ore bodies are close to horizontal with a thickness of between 0.8 and 32.5 m.

The workings consist of a vertical shaft that was sunk in 1993 and a decline in 2004. The shaft is collared at 601 mamsl and reaches the two main ore bodies, one at 385 m and one at 425 m. The decline has a length of 1,600 m, 4 m height and 3 m width which accesses the ore bodies. As the mine is currently flooded it is not possible to enter the decline. The entrance to the decline has been cut through a narrow dyke and blasting has caused this to be unstable. The condition of the remainder of the decline and shaft is not known. Spoil from the shaft and decline has been informally dumped close to the entrance of the decline.

Currently the mine can only be reached by a cross country track, there is no rail connection. The mine has benefitted from substantial investment and on the surface are:

— Shaft head gear;

— Winding station;

— Mine ventilation fans;

— Electrical sub station;

— Various workshops and office facilities; and

— Concrete batching plants.

All the above have been comprehensively stripped and damaged, before any further development is considered, these facilities should be re-instated.

A mining plan was been prepared by Zheskazgan Design Institute in 2004. The ore body is horizontal and a room and pillar method of mining is planned on four levels.

In 2010 water was pumped from the mine and a trial blast was made, the ore was sent to Balkhash concentrator for test processing. IMC understands that in the future, Sayak IV will be considered as part of a larger development and it will be connected underground with a series of new developments.

It is proposed to work the mine by room and pillar methods using diesel mobile equipment. Production would be at a rate of 300,000 tpa and the product would be added to the existing Sayak ore stream for railing to the Balkhash processing complex. This work is still in progress and it is expected that the scoping study will be presented to the Investment Committee later in 2010. Further timing of the project has not been defined.

3.5.7 Infrastructure

Access

Sayak is situated about 150 km east of Balkhash along a difficult road. Roads in the area are unsealed except in the mine town.

Power

Power is supplied to the substation on the edge of the town at 110 kV and distributed to the pits at 35 kV. Power used by the pits is limited to lighting, a small amount of pumping and in the case of Sayak 3 a ventilation fan.

Water

Town water is pumped from Balkhash around 100 miles and this pipe is old and giving problems. Three solutions have been studied as follows, either a new line from Balkhash, a shorter direct line from the lake (unfortunately saline at this point) plus a desalinisation plant or to develop the water available in the pits. The latter is the cheapest option and is being pursued.

Sayak III has a pump chamber with 4 x 250 kW pumps, two running two standby, pumping 180 m^3ph and Sayak 1 two pumps in series 630 kW each raising the water a total of 550 m.

Plant Workshops

At Sayak III there is an underground maintenance facility just inside the portal. This includes the usual containers with tools, oil and grease etc. but there was not enough lighting available.

At Sayak I the workshop consisted of several containers in a horse shoe on the bottom of the pit. This is satisfactory in the summer but may not be ideal in the winter.

The mine has contracted out the maintenance of its mining fleet to Sandvik.

Mine Town

The mine town is situated 25 km south of the mine sites. It currently houses 520 permanent staff and 200 contractor's staff. About 1,100 people are accommodated in total. The town has all the necessary facilities such as an airstrip, schools, first aid and shops to support the inhabitants. It is also the rail head for the despatch of ore to the Balkhash concentrator. One train per day with 63 trucks makes the journey transporting 4,500 t.

Explosives

About half way between the town and the pits is an explosives magazine with a railway siding.

3.6 Projects/Prospects

3.6.1 Aktogay

3.6.1.1 Aktogay Geology

Copper mineralisation at Aktogay consists predominantly of chalcopyrite and occurs in quartz-carbonate filled stockwork fractures and as disseminations. It forms a compact body shaped like a flattened goblet within the rocks of the first intrusive phase and the volcanogenic sedimentary rocks of the Keregetas formation. The copper mineralisation is spatially associated with small stocks and dykes of porphyritic granodiorites and later granodiorite porphyries.

The deposition of copper and associated minerals was structurally controlled by faulting. About 70% of the copper-molybdenum mineralisation is hosted by intrusive rocks, mainly diorites and granodiorites, and about 30% by volcanogenic-sedimentary rocks of the Keregetas Formation.

The stockwork and disseminated copper mineralisation with average grade in excess of 0.2% Cu was delineated by trenching and drilling over an area of 2.1 km by 1.6 km and to a depth of 600 m to 860 m. The vertical extent of the mineralisation at a 0.15% threshold is at least 1,000 m. The copper mineralisation is accompanied by molybdenite and low but recoverable quantities of gold, silver, rhenium and selenium.

The thickness of the oxide capping is variable, the average being 18 m and maximum about 60 m. There is a general tendency for the oxide capping to thicken eastwards. The base of oxidation was defined visually during core logging. In some drillholes it was also defined by a phase analysis. The visually determined base is on average 1.8 m lower than the base defined from a phase analysis.

The oxide zone passes downwards into a weak supergene sulphide enrichment zone. Secondary copper sulphide minerals – bornite, chalcocite and covelline – are accompanied by chalcopyrite and other primary copper and by some cuprite and native copper.

AMC completed resource modelling and estimation for the Aktogay deposit. The model and estimates are based exclusively of drillhole information, which comprised the following:

— 531 drillholes from the 1975-1980 period;

— 19 verification drillholes drilled by Kazakhmys in 2006-2007; and

— 95 recently completed NQ oxide drillholes.

The mineralised volumes were broken in domains based on the oxidation state and lithology after geological and geostatistical review. Ordinary Kriging, with parent cell estimation was used to fill model with grades.

The sulphide resource has been classified using a combination of search pass and drilling density. There are marked variations in depth of drilling which impacts on resource classification.

The sulphide mineralisation was contained inside the 0.2% copper mineralisation cut off grade shell with block grades being estimated on a first search pass. Resources were classified according to the following criteria:

— Measured: Mineralisation above 275 m level

— Indicated: Mineralisation between 100 m and 275 m level

— Inferred: Mineralisation below 100 m level

IMC's resource figures are reproduced from Fluor's Ultimate Pit Design as of 1 May 2009.

3.6.1.2 Reserves and Resources Statement

Table 3-9 below shows the resource statement estimated as at 1 January 2011.

Table 3-9 Aktogay Resources Estimated as at 1 January 2011

Aktogay		Resources	Copper	Zinc	Gold	Silver	Molybdenum
		'000 t	*%*	*%*	*g/t*	*g/t*	*%*
Aktogay	**Measured**	933,600	0.35		0.04	1.35	0.009
	Indicated	785,250	0.32		0.04	1.44	0.010
	Total	**1,718,850**	**0.34**		**0.04**	**1.39**	**0.009**
	Inferred	467,550	0.30		0.04	1.44	0.010

There are no Company or State approved feasibility studies for mining at Aktogay and hence no conversion of resources to reserves has been made.

3.6.1.3 Mining and Processing

The Aktogay Oxide-Sulphide Project involves the establishment of a green field open pit mine and copper concentrator near the village of Aktogay in eastern Kazakhstan. Mining technology will be by conventional open pit mining method of two pits. A copper concentrator, an oxide copper leach pad and solvent extraction and electrowinning plant (SXEW), waste disposal area, tailings disposal storage facility, concentrate load-out facility, road and rail access to the site, site infrastructure and buildings, power supply from Karaganda and water supply from ground water reserves located near the site will also be built for the Project.

During the time of the IMC visit, 3 major activities were in progress.

— Review the Aktogay resource potential to include other deposits in the vicinity like Aidarly;

— Finalization of financing schemes; and

— Start of a Definitive Feasibility Study

IMC understands that the Project can be considered to be very robust and has a strong potential for development for the Company in conjunction with a Joint Venture third party.

3.6.2 Aidarly

The Aidarly project site is located in the Ayaguz district of East Kazakhstan, at 20 km to the east-north-east of Aktogay town and at a distance of 380 km in an east-north-east direction from the city of Balkhash; the prospect area is 2.5 km to the west of the Aktogay copper project (Aidarly: latitude 46°58'53", longitude 79°54'51", approximate elevation 386 m amsl).

The Aidarly deposit is a copper porphyry located in the extensive Aktogay Intrusive Complex which is in the "Inner Zone of the Hercynian Fold Belt", comprising an extensive area of granodiorite or diorite, with a complex history of successive igneous intrusive phases, which has been emplaced in a thick Carboniferous sequence of andesitic volcanics and tuffs. The prospect is centred on an extensive granodiorite or quartz diorite stock which displays a number of cross-cutting intrusive stocks and dykes and evidence of successive and pervasive episodes of alteration and metasomatism.

The deposit was discovered in 1974 and was the subject of exploration in the period 1980 – 1985. Geophysical investigation, including seismic, gravity and magnetic surveys defined an overall anomaly of 26 km^2. The orebody is approximately circular in outline with a diameter of between 1,100 m and 1,750 m. Mineralization has been proved to a depth of approximately 700 m over the centre of the granodiorite and in the peripheral envelope mineralization has been proved to a depth in excess of 1,300 m from surface. Over the orebody approximately 270 drillholes have been completed on 100 m centres, the majority in the depth range 700 – 800 m.

Widespread areas of oxide zone mineralization have been mapped, and as a general rule this extends to a depth of around 10 m. The principal ore mineralization in the underlying sulphide zone occurs as extensive stockwork in which the principal ore minerals are: pyrite, chalcopyrite, molybdenite, magnetite and titanomagnetite. Common associated gangue minerals are plagioclase, quartz, sericite, chlorite and biotite. Subsidiary presence is recorded of chalcocite, bornite, pyrrhotite, sphalerite and galena.

Evaluation of the resource base, as approved by GKZ in 1985, envisaged extraction by an open-pit constructed to a depth of 760 m and covering an area of over 8 km^2. Resources were estimated to the depth of 760 m from surface.

Resources have been estimated with reference to conditions established by GKZ in 1985. The cut-off grade applied for balance reserves is 0.20% Cu with the additional constraint that all assessed blocks must contain a minimum 0.32% Cu_{eq}. The copper equivalent grade is assessed by the following relationship:

$$Cu_{eq}\ \% = (Cu\ \% + (Mo\% \times 9.6) + (S\% \times 0.025))$$

Table 3-10 below shows the resource statement estimated as at 1 January 2011. Molybdenum values of less than 0.002% are excluded from any calculation of copper equivalent.

Table 3-10 Aidarly Copper Project Resources Estimated as at 1 January 2011

Aidarly Copper Project		Resources	Copper	Molybdenum	Gold	Silver
		'000 t	*%*	*%*	*g/t*	*g/t*
Oxide ore	**Measured**	—	—	—	—	—
	Indicated	5,878	0.35	—	—	—
	Total	5,878	0.35	—	—	—
	Inferred	—	—	—	—	—
Sulphide ore	**Measured**	317,489	0.38	—	—	—
	Indicated	1,205,889	0.38	0.013	—	1.80
	Total	1,523,378	0.38	0.010	0.009	1.42
	Inferred	—	—	—	—	—
Aidarly Total	**Measured**	**317,489**	**0.38**	**—**	**—**	**—**
	Indicated	**1,211,767**	**0.38**	**0.013**	**—**	**—**
	Total	**1,529,256**	**0.38**	**0.010**	**0.009**	**1.42**
	Inferred	**—**	**—**	**—**	**—**	**—**

There is no updated mining plan nor an economic appraisal in support of future planned extraction and accordingly reserves cannot be recognised for this deposit.

3.6.3 Zhaisan

Kazakhmys has recently acquired the undeveloped Zhaisan copper deposit, which is a moderately sized (8.0 Mt) resource with relatively high copper grade and low molybdenum values. It comprises a series of narrow (roughly 1m thick), sub-parallel, steeply-dipping vein sets with strike lengths in the range 600-1,800 m and down-dip persistence of 700-800 m. There are two groups of these relatively closely-spaced vein sets about 400 m apart, with less well developed groups 400 m in the hanging wall and 200 m in the footwall of these principal structures.

The deposit was extensively explored by surface drilling in the 1960s, but beyond this there is limited information available at the present time. It is strategically located close to its Shatyrkul deposit, which is seen as being essential for its economic potential.

IMC understands that KCC is unlikely to develop this project and it is intended to allow this licence to lapse. Table 3-11 below shows the resource statement estimated as at 1 January 2011.

Table 3-11 Zhaisan Resources Estimated as at 1 January 2011

Zhaisan	Resources '000 t	Copper %	Silver g/t	Molybdenum %
Measured	—	—	—	—
Indicated	9,943	3.03	3.54	0.016
Total	**9,943**	**3.03**	**3.54**	**0.016**

3.7 Process Plants

3.7.1 Balkhash Concentrator

Balkhash concentrator is an old plant that dates back to 1938, when it was constructed to concentrate the ore from the Konyrat open pit mine. The mine had a very long life but the remaining mineralised rock in the mine is too low grade to support economic extraction by conventional means. For many years the concentrator has processed the ores from many other parts of Kazakhstan, including Artemievsky, Nurkazgan and others. The peak production was in 1988, when the concentrator processed 14.4 Mt of ore. At that time a 7 m diameter autogenous mill was used, but this has now been dismantled.

In recent years, Konyrat mine has closed and the concentrator has processed ore from Sayak and Shatyrkul mines, as well as slag from the smelter and also, more recently, converter slag. The present capacity of the concentrator is 8,150 tpd for ore, in addition to which around 3,000 t of slag are milled per day.

3.7.1.1 Plant Description

Ore is received in rail cars containing 65 – 68 t each, while slag is received in 100 t rail cars. The materials are processed sequentially, crushed and conveyed to different parts of the fine ore bin. There are two rail car tipplers that discharge the cars directly into a 300 t bunker directly over the primary gyratory crusher. The ore is conveyed by two parallel conveyors to eight 2200 mm standard cone crushers operating in parallel. The discharge from each crusher is conveyed to a vibrating screen with a rubber deck with 25 mm apertures and each screen oversize passes to a 2200 mm tertiary cone crusher.

The screen undersize and the tertiary crusher product, at about 90% finer than 20 mm, are combined on a conveyor that goes to the top of the fine ore bin. There are travelling trippers to direct the fine ore to the required part of the bin. Ore is reclaimed from the bins with disc feeders and conveyed over a belt weigher to the mills of the grinding circuit.

There is a facility for stockpiling primary crushed ore and subsequently reclaiming it. This facility is provided to enable re-lining and other major maintenance work on the primary crusher without interrupting production. The stockpile presently contains a large stock of crushed limestone. This is processed to milk of lime in the concentrator when acid production at the smelter exceeds sales. The surplus acid is then neutralised.

Grinding is carried out in seven sections. Each section has two 2.8 m diameter, 4.4 m long rod mills each directly driven by a 500 kW synchronous motor and pinion. The discharge from each rod mill is pumped to a 2.8 m diameter, 4.4 m long secondary ball mill directly driven by a 500 kW synchronous motor and pinion. The overflow from the ball mill is pumped to a hydrocyclone whose underflow feeds a tertiary ball mill of the same size as the secondary mill. Some sections have two tertiary mills and others have only one. The tertiary mill(s) operate in closed circuit with the hydrocyclones and the cyclone overflow at about 58% <74 microns is directed to rougher flotation.

The mill feed rates depend on the hardness of the ore. Sayak ore is presently fed to sections 1 and 2 at about 150 tph per section (two mills), section 3 grinds Shatyrkul ore at about 200 tph and section 4 mills a mixture of ore and slag. Sections 5 and 6 grind slag and section 7 is out of use.

Sections 1 and 2 use OK16, 16 m^3 supercharged flotation cells for the roughers with three banks of six cells in series. The other sections use Mechanobr 3 m^3 self aspirating cells of the Denver Sub-A type. The cleaning sections all use Mechanobr 3 m^3 cells. The roughing sections are independent but the ore concentrates are combined for cleaning. Concentrates from slag are kept separate.

A quite separate section of the concentrator processes slow-cooled converter slag. A separate dump pocket receives converter slag in side tipping rail cars. An apron feeder delivers this to a small single toggle jaw crusher. The crushed slag is conveyed to a secondary cone crusher which prepares the slag for grinding. Two small ball mills are housed in an old original building and grind the slag, before it is floated in a separate section of the main building. The final concentrate goes to low intensity magnetic separation and the magnetic fraction is removed and joins the tailings as it is undesirable in the smelter. The overall recovery from converter slag is about 75% and would be higher, but for the need to discard the magnetic fraction.

Concentrates are thickened in two 30 m diameter thickeners, one for ore concentrate and the other for concentrate from slag. The thickener underflow is pumped to storage tanks in the filter plant, which is situated in the smelter, although operated by the concentrator. Only one product is filtered at a time. The filter plant could filter more than one product simultaneously but there is only one conveyor to the smelter so separate products are filtered in campaigns and the filter plant is carefully cleaned between campaigns to avoid contamination between the products. The filter plant has three Outotec Ceramec filters and four 2.5 m diameter, ten disc vacuum disc filters of conventional type. The Ceramec filters are also vacuum disc filters but with ceramic disc segments. They operate with very small vacuum pumps and produce quite dry cakes with between 7 and 8.5% moisture. Ceramic disc segments from the Russian Bakor company are also used, but their ceramic is coarser. They are quite suitable for coarser material but produce a wetter cake with about 8 to 9% moisture. The cake from the vacuum disc filters contains 12 to 14% moisture and has to be dried in a rotary drier. Although the buildings of the filter plant are old, they are kept very clean and the filter plant as a whole is operated and maintained in an exemplary fashion.

The tailing from the concentrator is pumped to a tailings pumphouse about 1km from the plant. It is then pumped in two stages by centrifugal slurry pumps to the tailings dam. The dam is very large indeed, covering approximately 20 square kilometres. Even this is only about half of the original area, for the western half of the dam was partitioned off by a dividing wall many years ago and functions as an evaporation pond. The dam was designed by Mechanobr of St. Petersburg, but responsibility for its management has now passed to the Karaganda Institute. The design evidently permits a further 6 m raise of the walls but it seems unlikely that this will be necessary in the foreseeable future.

There is a large amount of grassy and reedy vegetation growing naturally in the tailings dam itself and even more in the evaporation pond. The vegetation is clearly supporting a wide variety of bird life; ducks, egrets, swallows and gulls were seen in a short visit. The life of the dam probably far exceeds the useful life of the concentrator that feeds it.

In 2009, part of the Sayak ore contained magnetite, so the tailing was reprocessed using the low intensity wet magnetic separators and 15,000 t of iron ore concentrate was made. This remains at the concentrator pending sale and despatch.

The plant is old, a recent structural survey has indicated the need for substantial repairs, which are likely to be quite expensive, and most of the equipment is also quite old. Even the Outokumpu OK16 16m^3 flotation cells are now 20 years old. Most of the slurry pumps in the plant are of the Wilfley type, although all of the components are locally made. Much of the equipment can be maintained almost indefinitely, although the maintenance is quite burdensome. A total of 850 people work in the concentrator, so the productivity is only about 20 t of ore or slag per man-shift.

3.7.1.2 Plant Performance

The plant performance of the Balkhash concentrator over the past four years is illustrated in the Table 3-12 below.

Table 3-12 Balkhash Concentrator Historic Production

Year	Milled '000t	Cu %	Contained Cu '000t	Recovery %	Concentrate '000t	Cu %	Cu in Concentrate '000t
2007	4,606	0.99	45.4	71.64	188	17.3	32.5
2008	5,387	0.94	50.4	76.84	267	14.5	38.7
2009	3,806	1.23	46.9	80.34	207	18.2	37.7
2010	3,465	1.48	51.3	80.96	240	17.3	41.5

The concentrate grades at Balkhash concentrator are all low by international standards. In common with most Kazakhmys concentrates, the gangue content is quite high, between 20 and 50%. In some cases it is argued that the gold recovery falls if the concentrate grade rises and, in the case of gold locked in or associated with pyrite, this may well be true. It is also true that lower concentrate grades result in higher copper recoveries in the concentrator, but the consequent increased slag production in the smelter results in lower recovery and higher costs in the smelter. While some of the copper lost in the smelter slag can be recovered by reprocessing it through the concentrator, it is difficult to reduce the slag flotation tailing grade below 0.3%Cu, so losses are still incurred and the overall costs rise. The writer does not have data to examine the economics of low concentrate grades at Kazakhmys but wonders if the Company's situation makes the optimum grade so much lower than for other land-locked producers.

The froth on cleaner flotation cells in Kazakhmys concentrators (and in others) commonly appears sticky and immobile and gives the impression to the experienced observer that not much cleaning is happening. The problem arises because the frother reagent is concentrated with the froth, and if sufficient reagent is used to provide adequate froth cover on the rougher cells, there will tend to be a very sticky froth on the second or subsequent cleaner cells. Column flotation overcomes this problem and that of gangue entrainment and is widely used elsewhere.

3.7.2 Balkhash Smelter and Copper Refinery

The Balkhash smelter was first commissioned in 1938 when it used reverberatory furnaces to smelt copper concentrate and Pierce Smith converters to produce blister copper. A copper refinery was built in 1952 and extended in 1954. In 1985, a Vanyukov furnace was installed. This is a Russian developed furnace with a vee shaped trough with tuyeres along each side through which oxygen enriched air is blown. The furnace uses the thermal value of the low grade concentrate to produce high grade copper matte. In 2004, a second Vanyukov furnace was installed and the reverberatory furnaces were taken out of use. A sulphuric acid plant with the capacity to process gas containing 14% SO_2 to make sulphuric acid was commissioned in 2008. The plant has a nominal capacity to produce 250 ktpa of copper cathode.

3.7.2.1 Plant Description

Concentrate received from the concentrator is filtered as described in the report on Balkhash Concentrator, dried as necessary and conveyed to the blending area. Concentrates are received from outside sources in rail cars each containing approximately 70 t that are delivered to two stockyards, one inside and one outside. The outside stockyard is satisfactory in the summer, but in winter, the concentrate is stored in the inside stockyard. Concentrate is unloaded by overhead travelling cranes with clamshell grabs, which are also used to reclaim the concentrate to hoppers which feed the conveyors that feed the blending stockpiles.

Blending is carried out on three long piles each of which is fed by an overhead conveyor with a travelling tripper. The trippers cycle continuously from end to end so that the selected concentrate is distributed along the length of the blending stockpile. The complete blend is made up of several different concentrates, including gold bearing silica concentrates to provide a stockpile containing approximately 15%Cu, 15% silica, 26% iron and 27% sulphur. A reclaimer then recovers the blended stockpile from one end and discharges the blend to a conveyor that feeds the two Vanyukov furnaces.

Concentrate is fed to the upper part of the furnace and melts. Each Vanyukov furnace has the form of an 18m long, steeply angled trough with a rectangular section at the bottom, along which there are 28 opposed horizontal tuyeres on each side. Oxygen enriched air (84% O_2) is blown through selected tuyeres and heat is generated by the partial combustion of the concentrate blend. Slag is continuously removed to an electric settling furnace at one end of the Vanyukov furnace, while matte is tapped at the other end. Gas exits via an uptake near the slag tapping end of the furnace and passes through a boiler and gas cleaning electrostatic precipitators.

Matte tapped from the furnaces is transferred in ladles to one of five 80 t Pierce Smith converters where it is oxidised in conventional fashion to produce blister copper. Of the five converters, three are in use at any time, one is on standby and the fifth is under repair. Off gas from the converters is cooled and cleaned and combined with gas from the Vanyukov furnaces to supply the acid plant.

Converter slag is transferred to rail cars and tipped on a separate part of the slag dump to cool. It is then returned to the concentrator where it is processed in a separate circuit that includes low intensity wet magnetic separators, which remove magnetite from the final concentrate, to avoid returning this to the Vanyukov furnaces. Conventional copper smelter practice is to return converter slag, containing 3 – 5%Cu, to the primary smelting furnace, but experience with the Vanyukov furnaces showed that this resulted in a build up of magnetite in the bottom of the furnace.

Blister copper from the converters is transferred in ladles to the anode furnaces. There are small reverberatory anode furnaces with a capacity of 200 – 240t of molten copper, which are fired by heavy fuel oil. Two furnaces are in use and the third on stand-by. Anode scrap from the refinery is loaded on to the floor of the furnace using a charging crane and blister copper is then poured in from ladles to fill the furnace. The charge is melted, aired with compressed air lances and poled with mazut (heavy fuel oil) and cast using a semi automatic casting wheel. Anodes are removed from the wheel automatically and hung in a bosh tank to cool.

A new sulphuric acid plant was built to the designs of Aker Kvaerner Chemetics and commissioned in 2008. Although acid plants had operated before at Balkhash, none had been operating for many years and the introduction of the acid plant has improved the air quality in the town and much improved the outlook for the tourist industry along the lake shore. Gas from the duct to the smelter stack is diverted to feed the acid plant, where it is scrubbed in a venturi scrubber, cleaned in two wet electrostatic separators and dried before entering a conventional double absorption contact process acid plant. The plant is designed to process 300,000 m^3ph of gas containing 14% SO_2 and produce 3,800 t of acid per day. The acid is pumped out to four 10,000 t storage tanks alongside a rail track. Most of the acid is sold to the uranium mining industry but at times, the demand is insufficient and, for example, in 2009, acid was neutralised for two months.

Anodes are prepared by manual straightening as necessary and transferred to the copper refinery. The anodes have cast-in grooves in one lug in which the cathode hanger bar from the adjacent cell rests to transmit current. This is an old system that the writer has not seen for many years. The copper refinery is a conventional electrolytic tankhouse with 120 sections each of 20 cells in series. The cells are of reinforced concrete with "Viniplast" PVC liners. Two sections have been dismantled and, of the remaining 118, 70 were in use at the time of the visit. Anode spacing is 104 mm and there are 36 anodes and 37 cathodes per cell.

Electrolyte with about 50 g/l Cu is circulated at 58 – 63°C and heated by low pressure steam from the power plant. Thiourea, glue and gelatine are used as smoothing agents. There is apparently no need for cascades of liberator cells but some cells had lead anodes the control the electrolyte copper tenor.

Eight sections are presently devoted to the preparation of starting sheets that are grown on titanium cathodes with plastic edge strips. The starting sheets are manually stripped and are of the high quality that is usually produced on titanium cathodes. The starting sheets are passed through a pair of rolls to straighten them and the rolls emboss vertical grooves on the sheets to stiffen them. Sufficient starting sheets are slit to make cathode loops in the usual way and the loops are attached to the sheets on a manual press.

The current density is 220 – 240 A/m^2 and the cell current is 17,100 A. Short circuit detection is confined to passing a rod between anode and cathode to feel for contact and to dislodge any dendritic growths on the cathodes. Current efficiency is reported to be 90 – 92%.

3.7.2.2 Plant Performance

The smelter performance over the past four years is summarised in Table 3-13 below. The copper production has steadily increased by a combination of increased tonnage of concentrate smelted and a small increase in the copper content of the concentrate processed. The concentrates remain of low grade and this must increase the smelting costs and slag losses.

Table 3-13 Smelter and Refinery Historic Production

Year	Concentrate '000t	Cu%	Cathode '000t	Acid '000t	Copper Rod '000t
2007	1,176	18.3	192	0	
2008	1,219	18.2	197	283	
2009	1,248	18.9	199	791	
2010	1,148	18.1	189	827	

The Vanyukov furnaces are well suited to the concentrates that are processed and operate reliably. The oxygen consumption, at between 400 and 570kg of oxygen per tonne of concentrate, is high by the standards of alternative smelters (an Outokumpu flash smelter might typically consume 150 – 250kg O2/t concentrate). Because of the low concentrate grade, the oxygen consumption per tonne of copper produced appears very high at 2.5 to 3.5 t of oxygen per tonne of copper. (cf 0.5 – 1.0t O_2/t copper in flash smelters)

The production of slag has declined from nearly six tonnes per tonne of blister copper to just over four tonnes per tonne of blister copper over this period, but slag production remains high by the standards of copper smelters elsewhere. The reason for this is the low grade and consequent high gangue content of the copper concentrate produced at the Kazakhmys mines. It is noted that concentrates from the Zhezkazgan area have a higher grade because of the high bornite content of the ores of the Zhezkazgan district, but even these concentrates still have relatively high gangue content.

The slag is slow-cooled, crushed, ground and copper is recovered by flotation and returned in a low grade concentrate to the smelter. It has not been possible to reconcile the figures for slag production with those for slag retreatment.

An acid plant was built in 2008 and has operated successfully since then. Roughly 80% of the sulphur in the concentrates is captured and although fugitive emissions are noticeable in the plant area, they are not particularly bad and not normally noticeable in the town.

The copper refinery is an old-fashioned plant and labour intensive to a degree that the writer has not seen elsewhere. It appears that the PVC liners in the cells and the use of titanium starting sheet blanks are the only innovations since the plant was built. The cathode quality appeared to be satisfactory. The anode scrap recycle to the smelter, at 25% of the new anode weight, is unusually high. 15 – 20% is a more typical figure, but the cell-to-cell current transmission arrangement results in heavy lugs and may account for this in part.

3.7.3 Precious Metals Refinery

The Balkhash precious metals plant was built in 1997 to designs provided by Boliden, to process the anode slime produced at the Kazakhmys copper refineries at Zhezkazgan and Balkhash. Up to the present time, these are the only raw materials that have been processed there. The plant has the nominal capacity to process 2,000 t of anode slime per year, or 1,700 t after leaching to remove copper. It is designed to produce up to 400t/year of silver and up to 10 tpa of gold.

Over the first three years of operation, production built up to 2,300 t of leached slime, or 136% of design capacity after which production of anode slime declined to 1788 t in 2004. Since then the slime arising has increased steadily and 2010 may match the peak production of 2001.

The precious metals plant is presently seeking accreditation on the London Bullion Market to open options for marketing of the products.

3.7.3.1 Plant Description

Dried anode slime is received in batches from the copper refineries. Commonly it contains up to 25% copper or more. The copper content can be reduced to about 15% by flotation, producing a copper concentrate for return to the smelter. The remaining copper is reduced to less than 1% by leaching in sulphuric acid in an autoclave. The slurry is then cooled and filtered. About 30% of the tellurium content of the slime is also leached, so copper powder is added to the filtrate to cement out the copper telluride that is filtered and sold.

The leached slime is then dried and ground, sampled and analysed and placed in 1t bunkers. The slime is then charged to a diesel fired Kaldo Converter furnace. The slag from the furnace is skimmed and sent to the lead smelter at Chimkent for treatment. Converter slag is recycled to the furnace. The metal from the furnace is Dore alloy containing approximately 98% Ag and 1% Au. It is cast into anodes for silver refining.

Gas from the Kaldo furnace is scrubbed with a recirculating solution of caustic soda. The solution is filtered and the residue is returned to the furnace. Heavy metals are precipitated from the filtrate using lime and soda ash and these residues are returned to the Vanyukov furnace. Selenium is then precipitated from the solution by addition of sulphur dioxide and is filtered and sold as a powder containing 80 – 95% Se. the filtrate is then re-precipitated with thiourea to remove remaining selenium and this precipitate is filtered and returned to the Kaldo furnace.

The silver is refined conventionally in an electrolyte of silver nitrate solution in GRP cells with the dore anodes contained in filter bags interspersed with stainless steel cathodes.

Plastic scrapers continuously scrape the deposited silver off the cathodes and it falls to the bottom of the cells. The anode life is approximately 22 hours, after which each cell is emptied and the silver is strained out of the electrolyte.

The silver powder goes into a bunker from which it is fed to a furnace. From the furnace the silver is granulated in water and sold as silver granules. A furnace has been set up to produce silver ingots and sample ingots have been sent to the London Bullion Market with an application for accreditation.

The doré anode slime is leached with hydrochloric acid to remove remaining copper and tellurium and the residue is placed in a reactor with water and hydrochloric acid and chlorine in sparged into it. Remnant silver is precipitated as silver chloride and the gold goes into solution as $HAuCl_4$. The solution is transferred to another vessel where gold is precipitated with sodium acetate. The gold sand is 99.99% pure. It is melted and cast into 12.5 kg bullion bars. Platinum and palladium are precipitated from the remaining solution.

3.7.3.2 Plant Performance

The production of leached anode slime from Zhezkazgan reached a peak of 1,374 t in the year 2000 and has been in steady decline since then. Production at Balkhash has steadily increased with the processing of ores and concentrates from Sayak, Nurkazgan and Abyz as shown in Table 3-14 and Table 3-15 below.

Production detail is shown in Table 3-14 and Table 3-15 below.

Table 3-14 Historic Precious Metal Plant Throughput

	Zhezkazgan			Balkhash		
Year	Dry tonnes	% Au	% Ag	Dry tonnes	% Au	% Ag
2006	950.95	0.04	42.58	1,054.26	0.44	25.96
2007	807.77	0.07	40.15	1,291.65	0.29	21.34
2008	723.63	0.08	35.68	1,378.27	0.26	21.05
2009	577.40	0.11	33.94	1,650.46	0.25	20.23
2010	249.31	0.06	30.85	640.98	0.25	18.48

Table 3-15 Historic Precious Metal Plant Products

Year	Dry Feed (t)	Copper Telluride (t)	Selenium Powder (t)	Gold '000oz	Silver '000oz
2007	2,099	2.52	144.19	113	18,985
2008	2,102	6.61	95.45	124	16,710
2009	2,228	6.29	115.10	135	16,894
2010	2,092	3.62	83.58	127	14,093

Without taking account of stock movements, the cumulative recovery of gold over this period is about 98.8% and that of silver is about 97.2%. These are competitive values for precious metals plants that are producing gold and silver from anode slime.

IMC considers the precious metals plant is a modern efficient facility that appears to be performing well. As with most modern plants, it has a single process line and limited stand-by equipment. The equipment is all imported and provision of spares can be time consuming. As the plant gets older, it may become prudent to add more stand-by equipment to maintain production rates.

This plant has not been used to refine the bullion from Kazakhmys' gold mines. The lack of accreditation with the London Bullion Market may account for this, but in principle, there seems no reason not to refine doré bullion at this facility.

3.7.4 Balkhash Zinc Plant

In 2004, a zinc plant was constructed at Balkhash to process the zinc concentrates that came from the Kazakhmys mines in eastern Kazakhstan and produce up to 100,000 tpa of zinc in ingots. At that time, there was no acid plant at Balkhash and the emission of sulphur dioxide and its effect on air quality in the region were contentious issues. The decision was made, therefore, to avoid roasting the concentrate and, instead, to use an autoclave to leach the zinc instead.

The autoclave design and specification was assigned to Sherritt, of Canada. The process design was prepared by Viitsvetmet and the plant design was entrusted to Kazgiprosvetmet. The plant started operations in March 2004 but encountered many problems, mainly in the autoclave and in the tankhouse. These problems were mainly unresolved to the time of the plant's eventual closure in April 2009, when the plant was mothballed.

3.7.4.1 Plant Description

The plant was designed to process 250,000 t of concentrate per year. Concentrate was received in rail cars that were unloaded in the concentrate shed by overhead cranes and clamshell grabs. Different concentrates were stored in different parts of the shed and the grab was used to blend the concentrate fed to hoppers from which it was conveyed to ball mills. The ball mills operated in closed circuit with hydrocyclones and it appears that the cyclone overflow of the first mill was fed to the second mill. The cyclone overflow of the second mill went to a thickener.

Thickened concentrate slurry with a particle size 95% finer than 44 microns was then pumped, together with second stage autoclave liquor, spent electrolyte and sulphuric acid into the first stage autoclave. Oxygen was sparged into the pulp in the autoclave and a lignosulphonate solution was added as a sequestering agent for the sulphur. The product from the first stage autoclave was cooled and thickened. The thickener underflow was pumped to the second stage autoclave with further spent electrolyte and lignosulphonate and oxygen was sparged into the autoclave. The product of the second stage autoclave was also cooled, thickened and the liquor was returned to the first stage, while the thickener underflow was filtered, repulped in water, neutralised with milk of lime and pumped to a tailings pond.

Thickener overflow from the first autoclave stage was pumped to the purification plant where it was first partially neutralised by adding zinc dust and fine zinc dross, which cemented out most of the copper. The slurry was thickened and the underflow filtered and washed and sent to the copper smelter as copper cake. The thickener overflow was agitated with air to oxidise iron present and lime was added precipitate it. Again the slurry was thickened and the underflow filtered and sent to the tailings dam. The overflow was then again treated with further zinc powder to precipitate most of the remaining copper and the slurry was again thickened. The thickener underflow was pumped back to the first stage of neutralisation. The overflow passed on to the final two stages of purification. Zinc dust and sodium antimony sulphide were added to precipitate a copper cadmium cake that was filtered out and the filtrate was again dosed with zinc powder to excess and filtered, the filter cake being returned to the penultimate purification stage. The purified filtrate was cooled to precipitate gypsum, clarified and pumped to the tankhouse electrolyte circuit.

Zinc electrolysis was carried out in a conventional electrowinning tankhouse. The electrolyte contained between 130 and 170 g/l zinc, <50 mg/l iron, <0.1 mg/l copper, <0.5 mg/l of cobalt and cadmium and <0.1 mg/l of nickel arsenic and antimony. There are 256 cells in two sections, each with a separate electrical circuit. Lead silver anodes were prepared in a separate shop on site and conventional aluminium cathodes were used. There were 35 anodes and 34 cathodes in each cell. Large anodes and cathodes were used and the cathode area (both sides) was 3.51 m^2/ cathode. The current density was 400 A/m^2. Cathodes were pulled every 48 hours, half of the cathodes in each cell being pulled at a time by a manually operated crane. They were carried to a wash tank and then to an automatic cathode stripping machine. Cathodes that failed to strip were removed and stripped manually. The electrolyte was circulated through cooling towers and the tankhouse cells at 90 l/cell minute. One sixth part of the spent electrolyte was returned to the autoclave plant, the remainder was cooled and combined with the fresh electrolyte.

Zinc cathode was melted in an induction furnace. Dross was removed from the furnace, cooled and screened, the coarse fraction being re-charged to the furnace and the fines being used in purification. Zinc dust was made from the molten zinc for use in the purification circuit and the zinc metal was cast into ingots for the market. The ingots were packed and despatched by rail.

3.7.4.2 Plant Performance

The plant was commissioned in March 2004 but unfortunately never achieved its designed output of 100,000 tpa.

It seems that the wrong zinc plant was built. The reasons for avoiding the use of a roaster are clearly understood, but a roaster and acid plant would probably not have cost more than the feed preparation plant, autoclaves and oxygen plant, although it is appreciated that the oxygen plant supplies the smelter as well. While the autoclave consumed energy, a zinc roaster might have generated it. While the sulphur in the residue is valueless and a problematic constituent, sulphuric acid is commonly a marketable product.

Copper in a roaster circuit would have been equally recoverable but if the neutral leach residue were roasted in a Waelz kiln, the clinker product could have been returned to the copper smelter and a high proportion of the gold and silver recovered. In the plant, the silver and gold in the residue were lost in the tailings dam.

If the decision to use an autoclave rather than a roaster was wrong but understandable, the decision to use an inexperienced engineer to design the tankhouse is harder to defend. Major problems with electrolyte cooling were apparently not resolved.

The plant was closed in April 2009 and mothballed. It is unlikely to be re-commissioned, but sections of the plant might be used for other purposes.

3.7.5 Enamelled Wire Plant

In 1995, a plant was constructed at Balkhash to produce copper wire in a range of sizes and to enamel the wire to provide insulation. The plant was designed and built by Henrich and has the capacity to draw 8mm copper rod into wire in a range of sizes and to enamel the wire to insulate it.

The plant has a nominal capacity to draw 16,000 tpa of 8 mm rod down to sizes between 3.2 mm and 1 mm. Up to 12,000 tpa can be enamelled and 4,000 tpa can be prepared for cable production.

In practice, sales have fallen far short of the potential production capacity as the export potential is limited. Russia has about 36 such wire producing plants and China has stopped imports of wire. Uzbekistan has its own factory and there's little demand from Kyrgyzstan. As a result, the plant production has fairly accurately reflected the progress of the Kazakhstan economy.

3.7.5.1 Plant Description

Continuous cast 8 mm copper rod is brought from Kazkat at Zhezkazgan and is drawn down to between 3.2 and 1 mm on two parallel horizontal drawing machines. The product is coiled and, for the production of finer wire the coils are transferred to the vertical drawing machines. These can draw the wire to whatever size is required down to 0.2 mm.

From the vertical drawing machines the wire is taken to the enamelling machine where it is first annealed and then coated with up to twelve coats of enamel using two different enamel types.

Wire between 0.71 mm and 2 mm is enamelled on one of two vertical enamelling machines. There is a comprehensive laboratory that checks the physical properties of the wire product and its insulation. A small workshop is used for all of the plant's maintenance.

There is a fully automated warehouse for the finished products, but this is hardly used as the market is quite small.

3.7.5.2 Plant Performance

Output of enamelled wire has been far below capacity owing to the marketing limitations alluded to above. Table 3-16 below shows total production since 2005.

Table 3-16 Historic Enamelled Wire Production

	2005	2006	2007	2008	2009	2010
Production (t)	506.48	558.44	843.35	989.2	1,198.56	821.78

The plant operates 24 hours per day and has a total of 62 workers. The labour turnover is small, about 6 to 8 workers leave each year, mainly for family reasons. The copper processed varies and it was found that Russian copper from Norilsk was not as good as Kazakh copper. Although most of the copper processed at Kazkat comes from the Zhezkazgan refinery, some Balkhash copper has also been processed and it was claimed that there was a significant difference between the two sources. There is some variation in the oxygen content of the copper and some variation in the chemical composition as well. Such variations affect the drawing characteristics of the wire but the plant is flexible and is able to accommodate such variations. The plant is in excellent condition, meticulously maintained and scrupulously tidy throughout. All of the equipment is European and the supply of spare parts, especially electronic components, can sometimes take time.

Given the range of potential products, the realistic maximum capacity of the plant is probably around 8,000 tpa. So far, the growth in production has reflected the growth in the Kazakh economy and it will probably continue to do so.

3.8 Power Utility

The power station is relatively old with at least two generators dating from 1935/6. Power production is currently 65 MW, of which 13 MW is consumed internally, leaving 52 MW for export. The boiler plant is generally as old as the generators with a 250 tph unit undergoing a major re build. Ash from the plant is pumped to the tailings dam. Pumping water is recovered from the dam. Cooling water is drawn from the lake and returned to the lake, typically at 260 m^3ph but with a maximum of 300 m^3ph. Steam is distributed around the metallurgical plant along with steam generated from the smelter waste heat boilers, the principal user being the refinery tankhouse. Waste heat is supplied to the town.

The station burns 1,850 tpd of coal at this level of output which is delivered by rail.

The plant consumes around 102 MW and the shortfall between this and whatever is generated by the plant power station is made up by imported energy. The two main distribution sub stations within the plant are fed by dual 110 kV overhead lines and power is distributed at 110 kV to Sayak about 100 miles away.

3.8.1 Power Distribution

The Balkhash area is connected to the national grid via a 220 kV distribution system. Power is distributed from a 220 kV substation on the edge of Balkhash at 110 kV and 2 feeders enter the power plant substation. There are a further two 110 kV lines to the power plant substation from a 220 kV sub at Konyrat which is fed from Kazakhmys power in Karaganda. The combination of these incoming feeders and the plant power station mean that power supplies to the plant are more than adequate.

Concentrator

The concentrator complex uses 15 MW of power. Switchgear and Motor control centres are classic open frame chassis mounted equipment. 6 kV low oil volume circuit breakers are being replaced by vacuum switches on an ongoing basis. The open frame nature of the MCCs has made connection to computer monitoring equipment somewhat easier than it might have been in a newer type of MCC.

Smelter

The smelter is similar to the concentrator and is equipped with a number of large fans collecting flue gas for delivery to the acid plant. There is an arc furnace at the back end of the smelter for slag cleaning which uses a significant amount of power.

Refinery Tankhouse

The large totally enclosed refinery tankhouse is supplied at 6 kV with four transformer rectifier units. Switchgear is mostly fairly old low oil volume switches but the rectifier units are only 2/3 years old. At the time of the visit only two units were operating providing a total of 17,000 A at 396 V DC. The combined smelter and tankhouse total load runs at around 32.8 MW.

Oxygen Plant

There is a large oxygen production facility on the site. This has a central compressor station with 2 x 10 MW compressors and 5 x smaller units supplying 4 x cold boxes. Total oxygen production is currently 37.2 m^3/min. At this level the electrical load is 32.8 MW

Acid Plant

The acid plant is a relatively recent addition to the site and is the fourth biggest electrical user at 7.7 MW.

Zinc Plant

There is a 100,000 tpa zinc plant on the site which worked for few years but is now completely shut down and has been mothballed. Although it is included on the list of electrical users it draws no power.

3.9 Infrastructure

Access

The Balkhash metallurgical plant is a major facility on the northern shore of Lake Balkhash with a large town alongside. The town is of significant size with some 66,000 inhabitants and has a well developed network of roads and railways. There is a large airfield on the edge of town. The majority of feedstocks (Run of mine ore, concentrates and coal) are delivered to the plant by rail and there are many sidings within the plant.

Water

Water for the plant is drawn from Lake Balkhash and directed to a water treatment plant on the site for distribution around the site. Water used to transport power station ash and tailings to the tailings dam is recycled as much as possible but any make up required is supplied from water drawn from the lake.

Compressed Air

Compressed air is produced in a central compressor station for distribution around the site. There is a relatively new station equipped with 3 large compressors backed up by what is left of an older compressor plant.

Workshops

There are extensive workshops at the eastern end of the site, clearly capable of maintaining production as required. There is a metal foundry where mill liners and other wear parts are cast.

Lime Kilns

There are three very old fashioned lime kilns burning lime for the site requirements for reagents and acid neutralisation where required.

3.10 Environmental

3.10.1 Organisational Structure

Environmental management in the Balkhash region is based at the Balkhash Combinat and encompasses the operations and facilities of:

- The Balkhash Industrial Complex.
- Sayak Mining Group.
- Konyrat Mine, which is temporarily non operational.
- Shatyrkul Mine.

IMC understands that the Balkhash Heat and Power Station is now under separate environmental management.

The head of environmental protection at Balkhash is assisted by 3 engineers dealing with air protection, water and waste. In addition, there is a dust/gas control laboratory with 8 personnel, and one ecologist based at Shatyrkul Mine. The Metallurgical Plant and the Concentrator achieved accreditation according to environmental, safety and quality standards in 2008 and 2009 respectively.

3.10.2 Management System

The system for environmental protection and control is standardised throughout Kazakhmys' operations and all industrial activities in Kazakhstan according to Chapter 14 of the Ecological Code, 2007, whereby the appointed ecological specialists are responsible for:

- Compliance with the requirements of the ecological legislation of the Republic of Kazakhstan;
- Minimizing the influence of the activities on the environment and health;
- Increase in the efficiency of use of natural and power resources;
- Emergency preparedness and response;
- Development of environmental awareness amongst management and workers;

— Informing the public on ecological activity and risks for health;

— Increase the level of conformity to ecological requirements;

— Preservation of the environment; and

— Accounting of ecological charges.

The Programme of Industrial Ecological Control is developed for each site taking account of the projects for specifications of maximum permitted limits for air emissions, water discharges and storage of waste and is valid for 3 years. Under the framework of this programme, Kazakhmys has engaged the company ECOTERA, a company licensed in the field of ecological auditing and monitoring, to carry out quarterly monitoring of all activities under the Balkhash region with respect to:

— Climatic data.

— Stationary sources of emission such as exhaust gases from boiler and dust capture equipment.

— Air quality in terms of particulate matter and specified gaseous substances at the border of the sanitary protection zones.

— Soil and snow analyses at the border of the sanitary protection zones.

— Quality of surface and underground water.

— Volumes of waste products, process and non-process.

— Assessing the influence on the environment.

Quarterly reports are issued to the company and the Ministry of Environment.

Each operating site requires a Permit from the Ministry of Environment for the use/management of nature, which defines the permissible amounts of emissions to atmosphere, discharges to water and placement of solid waste. The permissible limits are determined in total and also for a wide range of individual substances by detailed projects which are approved by conclusion of the State Expertise of the Ministry of Environment. Separate projects are required for emissions to air, use and discharge of water and production and placement of waste and are typically valid for 5 years.

Under the general conditions and obligations of the permit, the holder must:

— Work according to the approved Programme for Industrial Ecological Control;

— Submit a declaration of the emissions, discharges and waste and pay environmental charges quarterly;

— Maintain environmental protection insurance according to the Law.

The Environmental Management Plan is approved by the Ministry of Environmental and is typically valid for 3 years. A range of general and specific measures, together with monitoring requirements for:

— Protection of air quality.

— Protection of water.

— Protection of land resources.

— Protection of flaura and fauna.

— Waste treatment and disposal.

— Radiological, biological and chemical safety.

— Environmental training for specialists and information dissemination to the general public.

The plan also specifies the annual expenditure for each action, and where applicable the environmental and economic benefits achievable.

3.10.3 Shatyrkul

3.10.3.1 Status

Shatyrkul copper deposit is located in the Shuisky region of Zhambyl province approximately 500km south west of Balkhash. The nearest community is the railway terminal Birlik where there are stocking and loading facilities for transport of ore to Balkhash concentrator. Other small communities are 40-50km distance, notably the regional centre, Shu.

The mine site occupies an area of 552 ha in hilly terrain in the foothills of the Kendyktasskih mountain range. Nearby surface waters include the River Shatyrkul which flows south of the mine site and a small ephemeral stream, the River Mayatas, which has its source within the mine license area. Agriculture forms the basis of the economy of the region with arable farming and animal breeding in the Shu River valley and along the approaches to the mine. There are no designated areas of nature protection close to the mine.

Extraction of cooper ore was initially by open pit technique but now underground mining is used with a planned capacity of 500 ktpa of ore. The main features and potential sources of environmental impact at the mine site are:

— An electrical sub-station.

— The open pit now partially backfilled.

— The underground mine access in the open pit.

— Overburden mounds.

— Water treatment ponds.

— Ore storage pad.

— Fuel and lubricant store.

— Vehicle repair workshop.

— Explosives magazine.

— Office buildings.

— Accommodation for 250 and dining facilities.

— Domestic waste water treatment using septic tanks.

At Birlik railway station, Shatyrkul is allocated an area of 5.8 ha for storage of ore and there is a platform for loading onto rail wagons using front end loaders.

3.10.3.2 Potential impacts

The underground mining operations and surface activities have a low potential for environmental impact. However the immediate surroundings being an agricultural region have some sensitivity to the environmental effects. The main sources and characteristics of potential impacts are:

— Emissions of dust during ore handling and transport.

— Emissions of dust in mine ventilation air.

— Dust blown from the overburden mounds.

— Emissions from the coal fired boiler.

— Discharge of mine water to the river Mayatas.

— Depletion of underground water reservoirs.

— Domestic waste water.

The Programme for Industrial and Environmental Control, 2010 to 2013, identifies 15 sources of emissions to air and 23 substances. Since the mine is assigned Class 1 category of environmental hazard a normative sanitary protection zone of 1,000 m is applied beyond which ambient air quality should not exceed maximum allowable concentrations.

Mine waters are pumped from the 2 mine portals to collection/ evaporation pond formed by a retaining dam 90 m wide and 2.5 m high. According to some measurements the resulting depletion of the local water table has moved the source of the River Mayatas downstream but the flow is compensated by water from the collection pond.

Domestic waste water is treated using a 2 stage, septic tank system and residues are pumped out and removed under contract.

Currently the mine is not producing waste rock for storage outside the open pit confines but approximately 9 Mm^3 of overburden from the open pit excavation are stored in several mounds around the open pit. All non process waste material is collected, stored temporarily and then removed by contractors.

3.10.3.3 Permitting

Shatyrkul's permission for nature use forms part of the Balkhash Combinat integrated permit, No 0056037 valid from 01.01.2010 to 31.12.2011, and specifies maximum permissible quantities of:

— 50.6 tpa of solids in emissions to atmosphere, mainly as silica containing dust.

— 57.6 tpa of gaseous emissions to atmosphere, mainly as nitrogen oxides and carbon monoxide.

— 695,000 m^3pa of mine water with maximum limits specified for 11 parameters.

— 12,994 m^3pa of domestic waste water with limits specified for 14 parameters.

The projects for specification of maximum permissible limits which support the permission are all currently valid:

— For maximum permissible emissions to air, 2008 – 2012.

— For maximum permissible discharge of water, 2009 – 2013.

— For specification and storage of waste products, 2008 – 2012.

General environmental management and the monitoring requirements are specified in the Programme for Industrial and Environmental Control, 2010 – 2013.

All data required to fulfil the provisions of the permission is passed to Balkhash Environmental Department which is responsible for preparing the quarterly emissions and paying environmental charges to Zhambyl department of the Ministry of Environment.

3.10.3.4 Monitoring

Monitoring of ambient air quality for dust and nitrogen dioxide is carried at 4 positions each quarter by the Balkhash laboratory. ECOTERA also undertakes quarterly monitoring at the same positions for dust, nitrogen dioxide, sulphur dioxide and carbon monoxide. Similarly air quality at the rail loading terminal is monitored at 2 positions. Radioactivity levels are also monitored at the mine site and loading area. Mine water, domestic water and underground water are monitored each quarter.

The ECOTERA report for the 2nd quarter of 2010 concludes that:

— Ambient air quality at all positions is within the maximum concentration limits for the parameters monitored.

— Background radioactivity levels are within the allowable levels.

— Mineral oils and arsenic were not detected in the mine waters but other substances exceed the maximum allowable concentration (MAC). It is noted that although the levels recorded are generally decreased compared with the same period in 2009, the MACs for 2010 are lower than in 2009.

— Domestic waste water exceeded the MACs with respect to 6 parameters, notably chemical and biological oxygen demand and ammonium nitrate.

— Underground water is generally within the MAC and not significantly changed from the same period in 2009.

3.10.3.5 Action Plans

The Environmental management programme for 2010-11 has a budget of Tenge16.9million mostly for actions involving mine water discharge and the evaporation pond but also for temporary storage areas and some landscaping around the site.

3.10.3.6 Hazardous Materials

Explosives are stored in a fenced, guarded compound approximately 2km from the main surface facilities. IMC did not inspect the inside of the facilities.

3.10.3.7 Rehabilitation

Shatyrkul has a contract, No 583 dated 04/12/2000, for closure rehabilitation and assigns a percentage of the profits to cover the costs. The current value of the fund was not available at Balkhash.

A preliminary rehabilitation programme has been prepared in accordance with the requirements of legislation. This forms the basis of a detailed programme to be developed two years prior to the mine closure. The planned restoration activities include:

— Dismantling and removing process equipment.

— Either site clearance or transferring buildings and infrastructure to the local authority.

— Sealing and infilling mine shafts.

— Raising embankments at the perimeters of open pits using waste rock and topsoil.

— Allowing water ingress to shafts and open pits to attain natural levels.

— Levelling and compacting waste heaps.

— Re-cultivation of disturbed areas where conditions are suitable.

3.10.3.8 Summary of Potential Risks and Liabilities

Shatyrkul has a low potential for significant environmental effect but environmental issues require careful management because of the potential for impacting surrounding agricultural land and nearby surface waters.

IMC's review of information indicates that Shatyrkul is in compliance with its permit conditions for emissions to air and meets ambient air quality requirements at the boundary of the sanitary protection zone. However maximum allowable concentrations of some parameters in mine waters and domestic waste water are exceeded. At some point Shatyrkul may be required to install facilities for more efficient treatment of domestic waste water.

3.10.4 Konyrat Mine

Mining at Konyrat stopped in 2009 and there are no Kazakhmys activities on the site likely to cause significant environmental impact. The environmental issues are associated with the effects of 70 years of mining on the site, mainly the open pit approximately 430m deep, the overburden mounds and infrastructure. IMC understands that most of the overburden is under State ownership.

Balkhash environmental management was unable to give an indication of the future for Konyrat. However if no further mining is planned there is a requirement to leave the site and open pit in a safe manner and carry out rehabilitation work. IMC assumes that approval of a detailed rehabilitation scheme will be required. Cultivation of the site and overburden heaps will not be possible because of the lack of topsoil and the climate.

Kazakhmys has contractual agreements, No 243 dated 18/02/98 for Konyrat, Sayak-1 and Tastau mines, to assign 0.1% of the annual operational expenses for ore extraction towards the cost of closure and rehabilitation of the mines. The current value of the fund was not available at Balkhash.

3.10.5 Sayak Mines

3.10.5.1 Status

Copper mining in the Sayak region commenced in 1970 and the total area affected covers 1663 ha. The Sayak deposits are located in Karaganda Oblast 210 km east of Balkhash and connected by rail and dirt road. All ore is transported by rail to the Balkhash concentrator. Approximately 520 employees and 200 contractors are engaged in activities on the site, mostly residing in the village of Sayak approximately 10km from the mines. Kazakhmys has social obligations to support the community, such as maintaining the water supply and treatment of sanitary waste.

The mining area lies 500-700 mamsl with a general relief towards Lake Balkhash to the south. It is characteristic of desert steppe with an arid climate, sparse vegetation and wildlife. Except for Lake Balkhash to the south there are no permanent surface waters. Underground waters are present but of relatively low importance. The land surrounding the Sayak deposits has no agricultural value and is not within or close to designated areas of nature protection.

The significant features of the mining area, main activities and potential sources of emissions include:

— Sayak 1 consisting of 2 open pits which stopped working in 2000 but underground mining now taking place.

— Sayak 2, a small open pit with no current mining activity.

— Sayak 3/Tastau area, which includes 3 open pits of which the small south pit is now flooded. Sayak 3 and Tastau open pits have portals and associated infrastructure for access to the underground mine.

— A marble quarry.

— Overburden dumps totalling approximately 30million t located around the open pits.

— Storage pads for ore and rail wagon loading facilities.

Other features include small coal fired heating plant, fuel storage facilities and workshops.

3.10.5.2 Potential Impacts

Activities at the Sayak deposits are now mainly underground and considering the remote location and barren landscape, there is a low potential for significant environmental impact. The main issues are associated with:

— Historical disturbance of a large area of land for the development of 6 open pits and storage of the overburden/waste rock.

— Dust emissions during ore handling at the rail loading facility.

— Dust emissions on haulage routes during summer months.

— Depression of the underground water due to dewatering the underground mines.

— Gaseous emissions from the coal fired heating plant.

Water is pumped from Sayak 3 and Tastau underground mines into a small open pit, the South Pit, which is approximately half full. It is also used for dust suppression on haulage routes. Excess water is discharged onto adjacent land where it either infiltrates or evaporates.

The Programme for Industrial and environmental Control, 2010-2013 identifies 7 organised sources of emissions, mainly boiler chimneys, and 52 unorganised or fugitive sources. Gases from the boilers contain particulate matter, sulphur dioxide and nitrogen oxides but are small in volume and likely to have negligible impact outside the perimeter of the sanitary protection zone.

3.10.5.3 Permitting

Sayak's permission for nature use is integrated with that of the Balkhash Combinat, No 0056037 valid from 01.01.2010 to 31.12.2011, and specifies maximum permissible quantities of:

— 462 tpa of particulate emissions to air, mainly as calcium carbonate and silica containing dust.

— 289 tpa r of gaseous substances to air, mainly sulphur and nitrogen oxides.

— 85,000 m^3pa of water discharge from Sayak 1 underground mine.

— 314,400 m^3pa of domestic waste water from Sayak village.

— 1,147 tpa of boiler ash.

According to the quarterly emissions declarations, Sayak was in compliance with the provisions of the permit for all parameters during 2009 and no excess charges were incurred.

3.10.5.4 Monitoring

Environmental monitoring is undertaken by ECOTERA, a company certified in the field of ecological auditing and monitoring, and reports are submitted quarterly to Balkhash and the Ministry of Environment. Within the framework of the Programme for Industrial and Environmental Control, 2010-2013, ECOTERA is responsible for monitoring:

— Boiler chimneys once per quarter for soot, SO_2, NO_2 and CO.

— Ambient air quality at monthly intervals at Sayak (3 points), Tastau Mine (4 points) and the marble quarry (3 points). The parameters monitored are NO_2, SO_2, Co, Cu, Zn, Pb and As.

The ECOTERA report for the 2nd quarter of 2010 indicates that all parameters were within the maximum permissible concentrations at all of the ambient air monitoring points and that arsenic was not detected. Similarly boiler emissions were within the maximum permissible concentration. The conclusion is that air quality outside the sanitary protection zone is not influenced significantly by the mining activities.

In the mine waters all parameters monitored are within maximum allowable concentrations and similar to levels recorded in the same period of 2009. Some parameters of domestic waste waters exceed the maximum allowable concentrations but not by significant amounts.

3.10.5.5 Rehabilitation

Progressive rehabilitation is restricted to collecting and storing waste materials according to the Permission for nature use and the Programme for Industrial and Environmental Control.

Kazakhmys has contractual agreements, No 243 dated 18/02/98 for Konyrat, Sayak-1 and Tastau mines, to assign 0.1% of the annual operational expenses for ore extraction towards the cost of closure and rehabilitation of the mines. The current value of the fund was not available at Balkhash.

The conceptual closure plan involves:

— Constructing protective rock berms around the open pits.

— Levelling and contouring overburden heaps.

— Clearing equipment and unwanted structures.

— Sealing the underground mine portals.

The harsh climate and lack of top soil are not conducive to cultivation of the overburden heaps and other damaged areas.

3.10.5.6 Summary of Potential Issues and Liabilities

The current activities at the Sayak mines have a low potential for causing environmental impact and the region in general has a low susceptibility to environmental damage. However the development of several open pits and storage of overburden over the past 40 years has impacted a large area of land. Apart from exploitation of minerals the land has little value.

Sayak is operating within the provisions of its Permission for Nature Use and is fulfilling the obligations of the Programme for Industrial and Environmental Control.

IMC has not identified any liabilities apart from the need to plan for and maintain the fund for closure and rehabilitation.

Balkhash Combinat has a continuing responsibility to provide community support to Sayak village, specifically for potable water supply and maintaining the dirt road to Balkhash. IMC understands that the water use is currently restricted to a few hours per day because of inadequate infrastructure. There are plans to provide a paved road between Balkhash and Sayak and IMC understands that Kazakhmys may share the costs if the project proceeds.

3.10.6 Balkhash Industrial Complex

IMC visited the industrial complex between 17 and 20 July 2010 focussing on the areas with the greatest potential for environmental impact, such as the metallurgical complex and concentrator, and particularly on measures for abatement of air emissions including gas handling and cleaning systems and the sulphuric acid plant. A general tour of the whole site included the TSF, slag dump, waste dumps and oil storage areas.

3.10.6.1 Status

Balkhash Complex is located in Karaganda Oblast on the north western shore of Lake Balkhash close to Balkhash, a city of approximately 75,000 inhabitants. Except for the small communities which developed in conjunction with the mining activities at Sayak and Konyrat, there is little habitation until the nearest major cities of Karaganda approximately 500 km to the north and Almaty to the east. There is a long history of copper mining and processing in the region but development of the modern facilities started in the 1930s. The city and the Combinat are mutually dependent with over 12,000 of the population in employment with the Company.

The area is flat lying at an altitude of approximately 150 m above sea and is characteristic of desert steppe with an arid, continental climate, poor quality soil and sparse vegetation and wildlife. Surface waters include the River Tokrau, which is mostly dry except in the upper reaches, and Lake Balkhash, which is the 3rd largest lake in Kazakhstan covering an area of 18,000 km^2. Balkhash obtains potable water from 4 pumping stations abstracting from aquifers associated with the River Tokrau.

The relative positions of the industrial complex and the city are favourable in respect of the prevailing wind direction. Nevertheless, the lake and surrounding land have been impacted by discharges and emissions from the metallurgical complex over many years. Stricter environmental controls have improved the ecological situation over the last decade.

The Industrial Complex is a large integrated facility covering an area of approximately 4,682 ha and includes numerous sources of releases to the environment:

— Coal fired heat and power station.

— Copper concentrator comprising ore crushing and flotation.

— Metallurgical plant comprising copper smelters, converters and electrolytic refinery.

— Precious metals plant.

— Sulphuric acid plant.

— Zinc pressure leach plant and electrolytic refinery, currently not operating.

— Oxygen plant.

— Copper wire drawing and enamelling factory.

— Lime kilns.

— Tailings and ash storage facility, (TSF).

— Slag storage dump.

— Dumps for domestic and construction waste.

— Oil and fuel storage complex.

— Derelict buildings of the original sulphuric acid plant.

— Mechanical workshops, including a foundry.

— Transport and railway complex.

3.10.6.2 Main Sources of Air Emissions and Control Measures

Metallurgical processing of copper ore involves a multi stage operation of concentration, smelting to copper matte and slag, converting of copper matte to blister copper, pyrometallurgical refining and electrolytic refining. In all stages of the process there is potential for emissions to atmosphere of gaseous and solid substances. The Programme for Industrial Ecological Control specifies 206 sources of emissions to atmosphere of which:

— 171 are defined as organised, that is point source emissions released via a stack or vent, most of which involve a cleaning or abatement system.

— 35 are termed non-organised or fugitive emissions, which arise from operations such as material handling and storage, and also during furnace operations of tapping and pouring metal, matte and slag or by poor seals in hooding or gas ducting.

A summary of the significant sources and nature of emissions within the operations of the Balkhash Complex is given in Table 3-17 below.

Table 3-17 Summary of Main Sources of Air Emissions

Area/ Operation	Emission type	Control measures/Abatement method
Mineral Processing		
Ore unloading, primary crushing	Dust	Partially enclosed building, water sprays on discharge bin
Intermediate crushing	Dust	Venturi wet scrubbing, 92-94% capture efficiency
Milling	Dust	Ventilation system
Flotation	Flotation reagents, CS_2, H_2S	Ventilation systems; emission generally confined to workplace
Concentrate drying	Dust, combustion products	Cyclone and Venturi wet scrubbing, 92-94% efficiency
Tailings storage	Wind blown dust	Vegetation, water cover
Copper Smelter		
Feed preparation	Dust	Material handling in a partially closed building
Smelting	Dust, sulphur dioxide, volatile metals.	Waste heat boiler, cyclones and electrostatic precipitators, sulphuric acid plant
Slag cleaning	Dust, sulphur dioxide	No abatement, furnace off-gases vented through building roof
Converting	Dust, sulphur dioxide, volatile metals	Cyclones, electrostatic precipitators, sulphuric acid plant
Tapping and pouring	Dust, sulphur dioxide	Hygiene gases collected and discharged via a high stack
Anode refining	Dust, sulphur dioxide, combustion products.	No abatement, gases discharged to atmosphere
General operations	Fugitive dust and sulphur dioxide	Vented out of the building
Copper Electro-Refinery	Sulphuric acid mist, potential for arsine gas.	Ventilation system
Precious Metals Refinery		
Ventilation	Dust	Fabric filters
Smelting slimes	Dust, volatile compounds - selenium	Cyclone and wet scrubbing. Selenium recovered from scrubber liquor
Power station		
Coal storage and handling	Dust	Suppression using water sprays in summer
Boilers	Combustion gases, ash	Each boiler has 3 series of gas cleaning, consisting of cyclone and wet scrubber, operating in parallel; two 160 metre stacks

In comparison to the copper metallurgical facilities, the other sources of emissions to air are of relatively low significance. Off-gases from the two Vanyukov, autogenous smelting furnaces and the 5 converter furnaces are likely to comprise:

— Dust containing heavy metal oxides or sulphides.

— Volatile metals such as lead, cadmium, arsenic, antimony.

— Sulphur dioxide and sulphur trioxide.

Smelting furnace gases are cleaned in a system comprising waste heat boiler, cyclone collectors, and balloon flue drop out chambers to capture coarse dust. Converter furnace gases are cleaned using cyclone collectors and drop out in a balloon flue to capture dust. The partially cleaned gas streams, at a temperature of approximately 350oC, are combined and then cleaned using electrostatic precipitators to reduce dust content from approximately 12 g/Nm^3 to less than 0.2 g/Nm^3. The electrostatic precipitators are arranged in 7 units, each of three electrical fields, with a total gas volume capacity of 305,000 Nm^3/hr. Gas temperature and pressure and concentration of sulphur dioxide are measured continuously.

Cleaned gases containing approximately 7 to 12% sulphur dioxide, 0.2 g/Nm^3 dust are treated in a sulphuric acid plant which commenced operation in 2008. The acid plant has a design capacity of 1.2milliont/year sulphuric acid, is of modern design using double contact, double absorption system conforming to best available technology. Tail gas leaving the plant contains typically less than 400 mg/Nm^3 sulphur dioxide and the overall capture of Sulphur dioxide of 93%.

Dust captured in the waste heat boilers, cyclones and drop out chambers is recycled to the charge preparation area. The electrostatic precipitator dust, containing approximately 35% lead plus arsenic and antimony is agglomerated with water and then sold to a lead smelter.

Ventilation gases collected in hygiene hooding during operations such as pouring and charging, matte and slag tapping, typically contain less than 2% sulphur dioxide and are discharged directly to atmosphere via a 140 m stack. Fugitive gases from the smelting and converting furnaces, from the electric slag cleaning furnaces and from ladles, are vented via the sides and roof of the building.

A department within the organisation of the metallurgical complex is responsible for maintaining the efficiency of all emission control equipment such as cyclones, scrubbers, electrostatic precipitators. Monitoring of inlet and exhaust gases from individual equipment is carried out at prescribed intervals either monthly or quarterly to ensure operation at the design specification. Other parts of the process have on-line instrumentation for continuous monitoring of parameters such as dust and sulphur dioxide both for operational and environmental control.

3.10.6.3 Water Management

There is no discharge of waste water from the industrial complex to surface waters. All water is recycled within the process or via the tailings pond.

Industrial water is abstracted from Lake Balkhash using pumps at the power station and after treatment the bulk of the water is used for turbine cooling. The resulting hot water is used for heating in the industrial complex and Balkhash town. The return water is discharged to the lake.

Water for make up in the metallurgical complex is taken from the returned cooling water at the power station. The main users are:

— The concentrator.

— Power station gas scrubbers.

— Gas scrubbers in the concentrator and smelter.

Tailings slurry from the concentrator together with ash slurry from the power station gas scrubbers are delivered to the TSF and clarified water is returned to the concentrator.

3.10.6.4 Waste Management

The main process waste materials are in the low hazard categories, IV and V, and comprise:

— Tailings from the concentrator.

— Smelting furnace slag.

— Gypsum sludge produced by neutralisation and precipitation of sulphuric acid.

— Ash slurry from the power station.

All captured dusts are recycled within the smelting process with the exception of dust collected in the electrostatic precipitators which is agglomerated and sold to a lead smelter. Non-process wastes are collected and according to their hazard classification either stored on the site in a dedicated area or sent for recycling or disposal by approved companies.

Tailings and ash are delivered via four pipelines to the Balkhash tailings storage facility (TSF). Clarified water is decanted from the pond and returned by pumping for reuse in the industrial complex.

Molten smelting furnace slag, containing 0.6% to 0.8% copper, is transferred in ladles by rail to the slag dump area, poured into cooling bays and then. The slag is retreated in the concentrator plant to recover some of the copper value as a concentrate and re-smelted. As a result of re-treating the slag the stockpile, accumulated over many years and covering an area of approximately 400ha, is gradually being reduced.

The sulphuric acid plant includes a cooling stage where the gas is scrubbed with water and volatile elements and any remaining particulate matter are recovered from the gas stream. A bleed of weak acid from the gas cooling/washing circuit is neutralised by the addition of lime and the resulting gypsum precipitate is discharged to the TSF. IMC understands that some of the concentrated sulphuric acid is also neutralised when there is insufficient demand for the product and the gypsum slurry is also discharged to the TSF.

3.10.6.5 Permitting

The permission for use/management of nature, No 0056037, is valid from 01.01.2010 to 31.12.2011 and assigns maximum permissible emissions to atmosphere, water discharge and placement of solid waste from the Metallurgical Complex and the industrial sites at Sayak, Konyrat and Shatyrkul. A separate permit is issued to the Heat/Power station.

In order to receive the permission there must be an approved design project which determines the normative emissions, waste and water discharge for each activity and an agreement for environmental insurance. The current design projects are valid to 2013 for air emissions and waste, and until 2011 for water discharge.

Maximum permissible emissions assigned to the metallurgical complex include 30 solid and 34 gaseous substances, many of which are classified as hazardous. Sulphur dioxide and dust represent over 98% of all the permissible emissions as shown in Table 3-18 below, which also includes for comparison the permissible emissions in 2004. The significant reduction in the permitted quantities of all types of emissions, particularly sulphur dioxide and heavy metals, reflects the overall improvement in operational control of the smelting complex as well as the installation of the sulphuric acid plant in 2008.

There is no discharge of waste water from the metallurgical complex, waste water discharges assigned in the permit are associated with the mine sites at Sayak, Shatyrkul and Konyrat.

Table 3-18 Maximum Permissible Air Emissions, 2010 and 2011

	Maximum Emission (tpa)	
Substance	2010 and 2011	2004
Total emissions	136,453	759,455
Solid substances, including	8,508	28,976
Silica containing dust	6,890	20,206
Copper oxide	527	2,235
Lead compounds	763	5,516
Arsenical compounds	189	965
Gaseous substances, including	127,945	730,479
Sulphur oxides	127,101	727,985
Nitrogen oxides	283	602
Carbon monoxide	480	389
Arsenic compounds		808

The permissible amounts of process waste materials stored at the site are summarised in Table 3-19 below.

Table 3-19 Permissible Solid Waste 2010 and 2011

Waste	tpa
Tailings	3,851,203
Metallurgical slag	797,780
Sulphuric acid sludge	2,434,424
Lime waste	1,201

Under the terms of the permission for nature use, Balkhash submits quarterly emission and waste inventories to the Ministry of Environment and pays charges according to the actual amounts. IMC has reviewed the quarterly declarations for 2009 and notes that all emissions to atmosphere are within the maximum permissible quantities and that all charges are at the standard rate.

The reported emissions are based largely on parameters such as material throughputs, fuel consumption and unit operating times and then applying factors determined in design projects. Permissible emission levels are not directly comparable with standards generally applied internationally, which usually specify limits in terms of concentration or mass per unit of production.

3.10.6.6 Monitoring

The Programme for Operational and Ecological Control is valid for the period 2010 to 2013 and specifies the nature and frequency of operational and environmental monitoring including:

— The period, duration and frequency of operational monitoring and measurements;

— Methods of carrying out of industrial monitoring;

— Sampling points and places of carrying out of measurements;

— Frequency of monitoring;

— The schedule of internal auditing and procedure of elimination of infringements of the ecological legislation;

— Mechanisms of maintenance of monitoring instruments;

— Report of actions taken;

— Organizational and functional structure of the internal responsibility of workers for carrying out of the industrial ecological control.

Kazakhmys engages ECOTERA, a company certified in the field of environmental auditing and monitoring, to fulfil the obligations of the Programme for Operational and Ecological Control. Monitoring of air quality, surface and underground water and land is carried out according to Government standards. ECOTERA monitors the ambient air quality at 4 positions on the border of the sanitary protection zone and the results are reported each quarter. The frequency of monitoring depends on the potential for impact:

— Sulphur dioxide and particulate matter, twice daily at 2 monitoring positions and monthly at the others.

— Monthly for copper, lead, arsenic and nitrogen oxides.

The results for the second quarter of 2010, given in Table 3-20 below indicate that:

— Average concentrations of sulphur dioxide did not exceed the maximum concentration limit of 0.5 mg/m^3.

— Average concentrations of dust did not exceed the maximum concentration limit of 0.5mg/m^3.

— Concentrations of copper, lead and nitrogen oxides did not exceed the maximum concentration limits and were lower than the corresponding period in 2009. Arsenic was not detected.

The maximum concentration limits are similar to those used internationally, for example The World Health Organisation Guidelines.

The average concentrations of sulphur dioxide and dust are lower than the corresponding period in 2009 and demonstrate a significant improvement in air quality, particularly with respect to dust, compared with the situation in 2002 and 2003, as shown in Table 3-21 below.

Table 3-20 Air Quality Data 2nd Quarter 2010

	SO_2		Dust	
Month	Average of all samples mg/m^3	Maximum recorded mg/m^3	Average of all samples mg/m^3	Maximum recorded mg/m^3
April	0.019	0.50	0.126	0.38
May	0.008	0.50	0.162	0.50
June	0.023	0.40	0.139	0.32

Table 3-21 Air Quality Data 2nd Quarter 2002 and 2003

		SO_2		Dust	
Year/ Month		Average of all samples mg/m^3	% of samples above limit	Average of all samples mg/m^3	% of samples above limit
2002	April	0.23	7	0.76	85
	May	0.34	10	0.8	70
	June	0.2	7	0.71	67
2003	April	0.7	20	1.54	92
	May	0.39	11	1.40	95
	June	0.1	4	1.10	93

ECOTERA monitors surface waters monthly for suspended solids, oil and heavy metals at:

— Lake Balkhash in the gulf adjacent to the industrial site.

— Storm water drains

— The TSF sedimentation pond, evaporator pond and drainage channels.

Oil was not present in any of the samples. Compared with 2009 some parameters are lower and some higher although not by significant amounts.

Monitoring boreholes down gradient of the TSF indicate concentrations of copper, zinc, molybdenum and lead up to 3 times greater than the background concentration measured at a control borehole, whereas arsenic levels were within the background concentration.

3.10.6.7 Hazardous Materials Management

Hydrocarbon Fuels and Reagents

The fuel storage facilities were not inspected in detail but observed during the general tour of the industrial complex. All oil and fuels are received by rail into a central, fenced storage compound, stored in heated tanks and pumped to the users, principally the smelter. The facilities for storage and handling hydrocarbons appear to be unchanged from IMC's previous visit and include:

— underground mazut storage tanks constructed of concrete having a total capacity of 10,000 m^3.

— 2 above surface, steel tanks for mazut with a combined capacity of 6,000 m^3. According to Kazakhmys these have not been used for 2 years.

— 25 above surface tanks for diesel with an average stock of 500 t.

— 8 above surface tanks for gasoline holding an average stock of 300 t.

— 10 above surface tanks for xanthate flotation reagent with an average stock of 250 t.

— Lubricating oils are stored either in 200 l drums or underground tanks; an average of 200 t is held in stock.

The tanks above surface are surrounded by a concrete bund wall which in places appeared in poor condition.

Asbestos

Kazakhmys previously indicated that asbestos is no longer used as a construction, insulation or fire resistant material. However, given the age of the plant it is likely that asbestos has been used previously particularly in the derelict sulphuric acid plant area. The permission for production and placement of waste includes a limit of 148 tpa of asbestos materials.

Sulphuric Acid

The new sulphuric acid plant includes storage capacity for 30,000 m^3 of 98% sulphuric acid in 4 tanks installed within a suitably bunded area and adjacent to rail tanker loading facilities.

Flotation Reagents

The building for mixing the xanthate based flotation reagent, used at the rate of 900kg/day, has an operating ventilation system and tanks and vessels are installed in a tiled area designed to contain leaks and spillage. However a strong smell of chemicals was evident at the time of the visit. Control measures include regular monitoring of hydrogen sulphide.

Emergency Response

The fire station, located at the Combinat also serves Balkhash town but there is tender with special equipment dedicated to the Combinat. There are procedures for curtailing smelter operations if the air quality at the border of the sanitary protection zone is above maximum concentration for a prolonged period.

3.10.6.8 Site Observations

It is noted that IMC personnel received a brief safety instruction and appropriate PPE before visiting the operational areas.

The metallurgical complex is a mix of new, well designed and constructed plant, such as the zinc refinery, sulphuric acid plant and copper enamel wire plant, and older facilities such as the copper smelter, electrolytic refinery and concentrator. All of the operating areas visited had a good standard of housekeeping and no accumulations of material were observed on verges or roadways.

There were no excessive emissions during IMC's inspection of the metallurgical facilities and apart from some dust and fume escape from the smelting and converting operations the air quality in all parts of the plant was good. All of the emission control equipment inspected appeared in good state of repair.

During IMC's stay in Balkhash there were several periods when observed from a distance dusting from the TSF was evident. Compounded with fume and dust emitted at low level from the smelter buildings, this represents an ongoing risk to air quality in Balkhash.

Ore Crushing and Flotation

The ore crushing plant is working at a level well below its capacity due to shortage of copper ore. Dust emissions were not in evidence from this and the flotation area.

Tailings/Ash Storage Facility

The TSF is approximately 1km at the nearest point to the smelter and has a total circumference of approximately 20 km, a dam wall with a maximum height of approximately 30 m and an estimated volume of material in the order of 100 Mt. The planned capacity of the TSF is the equivalent of 56 years at the present production rate assuming raising the retaining wall by 3 further lifts each of 2.5 m.

Two main problems associated with the tailings storage facility are:

— Wind blown dusting of the dry, fine particle size material. Accumulations of dust were evident in areas around the dam wall.

— Seepage of water from the dam into the surrounding area giving potential for ground and groundwater contamination. The seepage water is collected in a drainage channel and recycled back to the pond.

Since IMC's previous visit 27 ha of the TSF have been cultivated and 90ha flooded to reduce the potential for dust blowing from the surface. The retaining walls of the TSF appeared well maintained based on IMC's visual inspection of the total circumference. 22 piezometers, arranged in 11 pairs are monitored quarterly. The TSF is inspected regularly by various State organisations.

Copper Smelter

Although the primary gas streams are now collected and controlled with a reasonably high efficiency, the copper smelter has, by modern standards, inadequate containment of secondary emissions, particularly during converter pouring. Observed from a distance, the smelter building is often enveloped in a cloud of dust and fume which can be seen blowing towards the perimeter of the complex. However, IMC considers that the operational and environmental control have improved significantly since previous visits in 2004/5.

The acid plant which came into operation in 2008 has reduced the emissions of sulphur dioxide and also of particulate matter and volatile elements such as arsenic which are now completely captured in the gas washing system. This is reflected in better ambient air quality.

Zinc Refinery

Treatment of zinc concentrates has now ceased and the plant is under care and maintenance. IMC did not inspect the facilities.

Derelict Plant and Waste Storage Areas

An area to the west of the smelter complex bounded by the slag storage and tailings pond contains derelict, partly demolished buildings and equipment of the old sulphuric acid plant. The buildings appear in a dangerous condition and in view of the age of the plant it is possible that there is some ground contamination from sulphuric acid and heavy metal residues.

The other part of this area is a general dumping ground for a variety of waste materials such as scrap metal and equipment, construction materials, used electrorefinery cells and tyres. The area appears better organised than during IMC's previous visits but if material has been accumulating for over 60 years there is a potential for ground contamination.

Precious Metals Refinery

Due to time constraints and the necessary security arrangements IMC did not inspect the facilities. However IMC would expect that facilities for control of air emissions from the Kaldo smelting furnace are maintained in good condition due to the valuable metals contained in the off-gases. Any emissions from the process are considered to have a relatively low environmental impact.

3.10.6.9 Improvement Plans

The installation of the sulphuric acid plant in 2008 culminated a series of improvements to reduce sulphur dioxide and heavy metal emissions from the smelting complex:

— Reconstruction of the second Vanyukov smelting furnace. In comparison with the original reverberatory furnaces, the Vanyukov furnace is more energy efficient and produces a high SO_2 strength gas stream which is more amenable to treatment.

— Renewal of the collection and duct system for primary gases from the smelting and converting furnaces.

— Installation of electrostatic precipitators with sufficient capacity to clean the combined gas streams from the two Vanyukov furnaces and the converter furnaces.

— Installation of a double contact/double absorption sulphuric acid plant with a design capacity of 1.2 Mtpa.

In addition actions have been taken to minimise dust blow from the dry areas of the TSF.

As a result the emissions to atmosphere of sulphur dioxide and heavy metals have reduced significantly. This is reflected in an improvement in ambient air quality at the perimeter of the sanitary protection zone and in the city. Deposition of heavy metals on land, property and water are similarly reduced.

The environmental management plan for 2010/2011 indicates a total expenditure of Tenge 506 million, over 40% of which is for maintenance, repair and monitoring of emission control systems and over 50% for protection of water resources mostly in connection with the tailings dam.

3.10.6.10 Summary of Potential Issues and Historic Liabilities

The environmental situation at the date of privatisation in 1992 is not known but environmental monitoring has been obligatory since 2001 and it is understood that voluntary measurements have been undertaken since about 1998. Following recent implementation of modern smelting technology, improved efficiency of gas cleaning and total recycle of process waste water the smelter complex now has a significantly lower environmental impact.

Current Operations

Balkhash Industrial Complex is presently complying with the requirements of Kazakhstan environmental legislation and all emissions declared in 2009 were within the maximum permissible amounts.

On the basis of monitoring results the ambient air quality at the border of the sanitary protection zone, in terms of dust and sulphur dioxide concentration, has improved significantly since 2003. In most parts of the world it is now common practice to monitor respirable dust, particles of less than 10 micron and 2.5 micron diameter, since these are likely to disperse over a wider distance and pose a greater threat to health. IMC recommends that Kazakhmys considers implementing this more stringent level of monitoring even though not a requirement of Kazakhstan regulations.

Observations from outside the industrial complex during IMC's visit suggest that fugitive dust and gas emissions at low level from the furnace operations and the slag dump, along with wind blown dust from the TSF still have a significant potential for impact on air quality and the surrounding area. IMC notes the actions taken to reduce dusting on the tailings pond by cultivation and water coverage and this is expected to continue.

The next stage in the smelter improvement should involve better control of secondary emissions from the furnaces.

IMC understands that the company has an agreement with the Karaganda authorities that there is no obligation to demolish the derelict buildings and rehabilitate the site of the former acid plant unless the area is required for either expansion or construction of new facilities. Any further work in this area should include a survey of ground contamination.

4 EAST REGION

4.1 Maps and Plans

Plate 14 Artemyevsky Mine
Plate 15 Belousovsky Mine
Plate 16 Irtyshsky Mine
Plate 17 Nikolayevsky Open Pit
Plate 18 Orlovsky Mine
Plate 19 Yubileyno-Snegirikhinsky Mine

4.2 East Region Geology

Most of the deposits and mines in the East region are of volcanogenic massive sulphide (VMS) type forming high grade bodies or narrow lenses of mineralisation sometimes with considerable strike and down-dip extent. The orebodies are broadly conformable with the host volcanic or metasedimentary rocks. The ore typically comprises pyrite, chalcopyrite, sphalerite and galena, and is sometimes associated with significant associated gold and silver. Most of the deposits have been mined for several years so that surface oxidised material has already been mined out.

Exploration of the VMS deposits currently involves fan or horizontal drilling underground, with core or sludge samples being collected at approximately 2m intervals. Geophysical (resistivity) measurements are taken down the hole to determine the boundary between the orebody and the host rock. Chemical analyses of the core and sludge are made at Kazakhmys' laboratories with check assays being carried out at independent laboratories, according to standard procedures.

IMC has taken the Active Balance of the VMS deposits as the basis for its resource estimates in the East Region, after subtraction of pillars or other permanent sterilized ground. The Active Balance comprises those balanced resources with reasonable prospects for eventual economic recovery. Thus, small, isolated mineralised bodies that may be in balance are excluded from the Active Balance.

4.2.1 Artemyevsky Geology

Artemyevsky is an operating underground mine exploiting a large (14.59 Mt), high grade, polymetallic, gold and silver-rich VMS deposit. A number of different steeply dipping ore bodies have been identified in the deposit, the most important of which is the Main Orebody, with a strike length of 1,300 m and maximum thickness of 200 m. This is the sole source of ore at the present time, with working on the 7, 8, 9 and 10 Levels. The higher-grade but less continuous Talovskaya Orebody is located 50-150 m in the footwall of the Main Orebody, while the Kamishinskaya orebody forms a protective pillar below an old open pit and to protect the underground workings from flooding.

There are a further six orebodies that form a series of sub-parallel lenses gently pitching to the east of the Main and Talovskaya orebodies. They comprise some 55% of the total resource but are less well explored through deep surface drill holes. A prefeasibility study for the mining of these orebodies was completed in 2007.

The ore shows a vertical gradation through the individual bodies of polymetallic ores at the top, barite/polymetallic ores, polymetallic ores, copper/zinc ores and copper ores at the base. There are copper rich mineralised zones below these orebodies within the footwall volcanics of the Talovka formation.

IMC's resource estimate is based on the (C1+C2) Active Balanced Resources for the deposit. Reserves are adequate for a further 11 years of mining, assuming levels of production similar to those from 2006-09.

4.2.1.1 Reserves and Resources Statement

In accordance with the CRIRSCO Guidelines all C1 category reserves have been assigned to measured resources and C2 category to indicated resources. Only the measured and indicated resources for the Main Orebody have been converted to proved and probable reserves.

Table 4-1 below shows the resource statement estimated as at 1 January 2011.

Table 4-1 Artemyevsky Resources Estimated as at 1 January 2011

Artemyevsky Mine		Resources	Copper	Zinc	Gold	Silver	Lead
		'000 t	*%*	*%*	*g/t*	*g/t*	*%*
Artemyevsky	**Measured**	8,156	2.37	7.40	1.55	121.73	2.28
	Indicated	16,981	1.93	5.68	0.86	106.59	1.74
	Total	**25,137**	**2.07**	**6.24**	**1.08**	**111.50**	**1.92**
	Inferred						

Table 4-2 below shows the reserves statement estimated as at 1 January 2011. All resources identified as Measured and Indicated are considered sufficiently planned to be converted to reserves.

Table 4-2 Artemyevsky Reserves Estimated as at 1 January 2011

Artemyevsky		Reserves	Copper	Zinc	Gold	Silver	Lead
		'000 t	*%*	*%*	*g/t*	*g/t*	*%*
Artemyevsky	**Proved**	8,427	2.13	6.76	1.41	111.02	2.09
LOM 11 Years	**Probable**	3,047	2.64	1.28	0.36	21.97	0.27
	Total	**11,474**	**2.27**	**5.31**	**1.13**	**87.37**	**1.60**

4.2.1.2 Expected Recovery and Dilution Factors

Ore loss at Artemyevsky during mining is estimated at 5%, and dilution at 10% reflecting actual performance in 2010. These factors have been applied in deriving the reserves.

4.2.2 Beloussovsky Geology

Belousovsky is a polymetallic VMS deposit forming a large number of widely spaced ore lenses (over 10 have been identified to date) occurring at three different stratigraphic levels over a 600 m vertical extent from surface. Zinc grades appear to be relatively evenly distributed but copper grades show a pronounced decrease from the base of the ore lenses to the top. The bulk of the remaining resources are remnant blocks located at substantial distances from the access shafts and currently considered to be uneconomic to recover.

IMC's resource estimate is based on KCC three-year production schedule for the adit development.

4.2.2.1 Reserves and Resources Statement

In accordance with the CRIRSCO Guidelines all C1 category reserves have been assigned to measured resources and C2 category to indicated resources. Only resources located above the current adit level have been converted to reserves.

Table 4-3 below shows the resource statement estimated as at 1 January 2011.

Table 4-3 Belousovsky Resources Estimated as at 1 January 2011

Belousovsky Mine		Resources	Copper	Zinc	Gold	Silver	Lead
		'000 t	*%*	*%*	*g/t*	*g/t*	*%*
Belousovsky	**Measured**	4,326	0.75	4.18	0.66	57.95	1.05
	Indicated	8,027	0.41	3.58	0.35	46.79	0.80
	Total	**12,353**	**0.53**	**3.79**	**0.45**	**50.70**	**0.89**
	Inferred						

Table 4-4 below shows the reserves statement estimated as at 1 January 2011. All resources identified as Measured and Indicated are considered sufficiently planned to be converted to reserves.

Table 4-4 Belousovsky Reserves Estimated as at 1 January 2011

Belousovsky		Reserves	Copper	Zinc	Gold	Silver	Lead
		'000 t	*%*	*%*	*g/t*	*g/t*	*%*
Belousovsky	**Proved**	264	1.85	1.12	0.38	27.50	0.18
LOM 3 Years	**Probable**						
	Total	**264**	**1.85**	**1.12**	**0.38**	**27.50**	**0.18**

4.2.2.2 Expected Recovery and Dilution Factors

Reserves for the proposed adit mining at Belousovsky are estimated at a 5% ore loss and 37% dilution. These figures are based on historical figures for the main mine before its closure and have been used in deriving the reserves.

4.2.3 Irtyshsky Mine

Irtyshsky is an operating underground mine exploiting a polymetallic volcanogenic massive sulphide (VMS) deposit of average size (8.66 Mt) and grade. The mineralisation is of lenses with extensive strike extents but more limited down-dip persistence. There are three principal ore bodies with the dimensions and percentage share of the Measured and Indicated resource shown in Table 4-5 below.

Table 4-5 Irtyshsky Principal Orebodies

Orebody	Strike length	Down-dip length	Thickness	Resource %
	(m)	*(m)*	*(m)*	
Main	2,500	750	3.5	17
South East	3,000	400	2.7	75
No 2	1,600	300	1.35	8

The orebodies pitch slightly to the NW with their long axes roughly parallel. The average strike of the Irtyshsky ore body is NW-SE and the dip of the ore body is steep to sub-vertical (70-80°). The ore body is gently folded with secondary thickening of the ore lenses in the fold axes. The copper and zinc grades increase with increasing depth from surface.

Most mining is currently taking place in the lower parts of the Main (12 and 13 levels) and SE (11 level) orebodies. The No 2 Orebody is not being mined at the present time.

IMC's resource estimate is based on the (B+C1+C2) Active Balanced Resources for the deposit, after subtraction of resources sterilized in pillars. Reserves are adequate for a further 23 years of mining, assuming levels of production similar to those from 2005-09.

4.2.3.1 Reserves and Resources Statement

In accordance with the CRIRSCO Guidelines all C1 category reserves have been assigned to measured resources and C2 category to indicated resources. All resources have been converted to reserves.

Table 4-6 below shows the resource statement estimated as at 1 January 2011.

Table 4-6 Irtyshsky Resources Estimated as at 1 January 2011

Irtyshsky Mine		Resources	Copper	Zinc	Gold	Silver	Lead
		'000 t	*%*	*%*	*g/t*	*g/t*	*%*
Irtyshsky	**Measured**	7,833	1.98	5.47	0.33	73.02	0.78
	Indicated	4,326	2.06	3.99	0.31	72.29	0.63
	Total	**12,159**	**2.01**	**4.94**	**0.32**	**72.76**	**0.73**
	Inferred						

Table 4-7 below shows the reserves statement estimated as at 1 January 2011. All resources identified as Measured and Indicated are considered sufficiently planned to be converted to reserves.

Table 4-7 Irtyshsky Reserves Estimated as at 1 January 2011

Irtyshsky		Reserves	Copper	Zinc	Gold	Silver	Lead
		'000 t	*%*	*%*	*g/t*	*g/t*	*%*
Irtyshsky	**Proved**	10,944	1.35	3.72	0.22	49.65	0.53
LOM 23 Years	**Probable**	6,044	1.40	2.71	0.21	49.16	0.43
	Total	**16,988**	**1.37**	**3.36**	**0.22**	**49.48**	**0.49**

4.2.3.2 Expected Recovery and Dilution Factors

Irtyshskoe reserves are estimated at a 5% ore loss and 32% dilution. The dilution figure is high for shrinkage stoping, and IMC would consider a dilution of 15% is attainable. However, these KCC figures, which reflect actual performance from 2007-09, have been applied in deriving the reserves.

4.2.4 Nikolayevsky Geology

Nikolayevsky is an operating underground mine exploiting a relatively low-grade, polymetallic VMS deposit. The deposit was mined by open pit methods until 2005 when a collapse in the north wall of the open pit caused its temporary closure and reversion to underground mining. The remaining resources (5.56 Mt) are located below the open pit and at the base of the deposit.

The remaining orebody largely comprises massive ore with lenses of disseminated material. Some 40% of the remaining resource comprises fine-grained "metacolloidal" ore, which is refractory and difficult to process by flotation giving a low metallurgical recovery for copper.

The main ore lens is typically some 50-70 m thick swelling at times up to 80-100 m. The deposit persists for some 600m from outcrop to the down dip extremity, pinching away at depth. The ore body at surface strikes approximately NE-SW with the original outcrop stretching for some 500 m along strike. The dip of the ore body averages some 40° to 50° to the SE, but is sub-horizontal at its base.

The Nikolayevsky resources are currently being re-estimated by a local firm, Geos, based in Ust Kemenogorsk. This estimate should clarify anomalies noted in the reported balanced reserves, as recorded in the 5GR Form. IMC's resource estimate is based on the reported Active Balanced Resources for the Nikolayevsky deposit and the balanced resources at Nikolayevsky North.

IMC's resource estimate is based on the (B+C1+C2) Active Balanced Resources for the deposit, after subtraction of resources sterilized in pillars. Reserves are adequate for a further 10 years of mining, assuming levels of production similar to those from 2006-09.

4.2.4.1 Reserves and Resources Statement

In accordance with the CRIRSCO Guidelines all C1 category reserves have been assigned to measured resources and C2 category to indicated resources.

Table 4-8 below shows the resource statement estimated as at 1 January 2011.

Table 4-8 Nikolayevsky Resources Estimated as at 1 January 2011

Nikolayevsky Mine		Resources	Copper	Zinc	Gold	Silver	Lead
		'000 t	*%*	*%*	*g/t*	*g/t*	*%*
Nikolayevsky	**Measured**	3,114	1.31	4.96	0.25	28.57	0.48
	Indicated	4,311	1.28	3.47	0.43	41.92	0.73
	Total	**7,425**	**1.29**	**4.10**	**0.36**	**36.32**	**0.62**
	Inferred						

Table 4-9 below shows the reserves statement estimated as at 1 January 2011. All resources identified as Measured and Indicated are considered sufficiently planned to be converted to reserves.

Table 4-9 Nikolayevsky Reserves Estimated as at 1 January 2011

Nikolayevsky		Reserves	Copper	Zinc	Gold	Silver	Lead
		'000 t	%	%	g/t	g/t	%
Nikolayevsky	**Proved**	3,410	1.05	3.97	0.20	22.86	0.38
LOM 11 Years	**Probable**	4,583	1.03	2.78	0.34	33.53	0.58
	Total	**7,992**	**1.03**	**3.29**	**0.28**	**28.98**	**0.50**

4.2.4.2 Expected Recovery and Dilution Factors

Ore loss during mining at Nikolayevsky is estimated at 12.4%, and dilution at 20% reflecting actual performance in 2010. These modifying factors have been applied in deriving the reserves.

4.2.5 Orlovsky Geology

Orlovsky is an active underground mine exploiting a large (18.7 Mt), polymetallic, high grade, and gold rich VMS deposit. It comprises the Main Orebody, which comprises an upper and lower part with an irregular pod-like shape, 20° to 30° dip to the SW, average thickness of 35m and down-dip extent of 600 m. It is now almost worked out, with the remaining resources consisting of remnant blocks distributed in the lower part of the orebody and representing some 25% of the whole deposit. A 0.85 Mt oxidised cap on the upper part of the orebody has been excluded from the resources since until now, no technology has been successfully developed to treat it.

350 m to the SW of the lower part of the Main Orebody is the New Orebody comprising a southern portion with a 10° to 15° dip to the SW and thickness of up to 56m and a northern portion with very high grade and thickness of 5-20 m. The combined New Orebody occupies a surface area in long section of some 250 m by 150 m and accounts for the rest of the resources in the deposit.

An exploration programme is proposed for 2012 that will explore the NW and SE flanks of the deposit. It will comprise some 10 holes with an aggregate length of 11,200 m.

IMC's resource estimate is based on the reported (B+C1+C2) Active Balanced Resources for the deposit. Reserves are adequate for a further 12 years of mining, assuming levels of production similar to those from 2005-09.

4.2.5.1 Reserves and Resources Statement

In accordance with the CRIRSCO Guidelines all C1 category reserves have been assigned to measured resources and C2 category to indicated resources.

Table 4-10 below shows the resource statement estimated as at 1 January 2011.

Table 4-10 Orlovsky Resources Estimated as at 1 January 2011

Orlovsky Mine		Resources	Copper	Zinc	Gold	Silver	Lead
		'000 t	%	%	g/t	g/t	%
Orlovsky	**Measured**	17,817	4.12	3.67	0.89	40.76	1.26
	Indicated	3,763	3.68	3.94	0.81	36.22	0.94
	Total	**21,580**	**4.05**	**3.45**	**0.84**	**38.31**	**1.18**
	Inferred						

Table 4-11 below shows the reserves statement estimated as at 1 January 2011. All resources identified as measured are considered sufficiently planned to be converted to proved reserves. The indicated resource at the Main and New South orebodies have been converted to probable reserves but the portion of the indicated resource at the New North Orebody has not been converted to reserve.

Table 4-11 Orlovsky Reserves Estimated as at 1 January 2011

Orlovsky		Reserves	Copper	Zinc	Gold	Silver	Lead
		'000 t	*%*	*%*	*g/t*	*g/t*	*%*
Orlovsky	**Proved**	18,007	3.88	3.45	0.84	38.31	1.18
LOM 12 Years	**Probable**						
	Total	**18,007**	**3.88**	**3.45**	**0.84**	**38.31**	**1.18**

4.2.5.2 Expected Recovery and Dilution Factors

Orlovsky mineable reserves are estimated at 5% ore loss and 6% dilution. These figures are based on a considerable amount of historical data and are considered by IMC to be appropriate for the mining method employed. These factors have been applied in deriving the reserves.

4.2.6 Yubileyno-Snegirikhinsky Geology

Yubileyno-Snegirikhinsky is an operating underground mine exploiting a small (1.55 Mt), high grade, polymetallic VMS deposit made up of a number of ore bodies. These form a series of sub-parallel elongate pods extending in a steep to sub-vertical down dip direction that are gently folded. Orebody thicknesses vary from 2-30 m, with an average of 18 m. The Western Orebody, which contains about two thirds of the remaining resources, measures approximately 150 m wide by 600 m down dip, while the Central Orebody has dimensions of approximately 20 m wide by 600 m down dip. It extends to the deeper Central No 2 Orebody, which measures 150-200 m wide and over 500 m down dip. They collectively account for almost all the other resources at Yubileyno-Snegirikhinsky. The small No 7 Lens lies to the east of the Central Orebodies and measures approximately 100 m wide by over 600 m down dip.

IMC's resource estimate is based on the (B+C1+C2) Active Balanced Resources for the deposit. There are no resources sterilized in permanent pillars. Reserves are adequate for a further 4 years of mining, assuming levels of production similar to those from 2005-09.

4.2.6.1 Reserves and Resources Statement

In accordance with the CRIRSCO Guidelines all C1 category reserves have been assigned to measured resources and C2 category to indicated resources.

Table 4-12 below shows the resource statement estimated as at 1 January 2011.

Table 4-12 Yubileyno-Snegirikhinsky Resources Estimated as at 1 January 2011

Yubileyno- Snegirikhinsky Mine		Resources	Copper	Zinc	Gold	Silver	Lead
		'000 t	*%*	*%*	*g/t*	*g/t*	*%*
Yubileyno- Snegirikhinsky	**Measured**	1,177	3.41	5.22	0.61	41.05	0.89
	Indicated	318	3.59	1.72	0.29	17.94	0.23
	Total	**1,494**	**3.45**	**4.47**	**0.54**	**36.14**	**0.75**
	Inferred						

Table 4-13 below shows the reserves statement estimated as at 1 January 2011. All resources identified as Measured and Indicated are considered sufficiently planned to be converted to reserves.

Table 4-13 Yubileyno-Snegirikhinsky Reserves Estimated as at 1 January 2011

Yubileyno-Snegirikhinsky		Reserves	Copper	Zinc	Gold	Silver	Lead
		'000 t	*%*	*%*	*g/t*	*g/t*	*%*
Yubileyno-Snegirikhinsky	Proved	1,353	2.73	4.18	0.49	32.84	0.71
LOM 4 Years	Probable	365	2.87	1.37	0.23	14.35	0.19
	Total	**1,718**	**2.76**	**3.58**	**0.43**	**28.91**	**0.60**

4.2.6.2 Expected Recovery and Dilution Factors

The reserves at Yubileyno-Snegirikhinsky are estimated using an 8% ore loss and 20% dilution, reflecting actual performance over recent years. IMC considers that these figures are appropriate for the sub-level caving method employed. These factors have been applied in deriving the reserves.

4.2.7 Estimates of Tonnages and Grades

Kazakhmys' VMS deposit resource estimates in the East Region area are based on classical, geometric, cross-sectional estimation methods. They are approved by the requisite Kazakh regulatory and administrative authority and are reported using Soviet-style classifications. Kazakhmys updates these resource estimates annually with due allowance being made for depletion through ore production, increase through additional exploration or re-classification of categories. They are then re-approved. The "balanced" resources in these estimates are used by Design Institutes to derive reserves on which a mining project is based. Using due care and attention, IMC inspected these resource and reserve estimates and found them to be acceptable.

Kazakhmys reports an "active balance" for its VMS deposits in the East Region, which is that portion of the balanced resource that has reasonable prospects of eventual economic recovery. IMC has derived its resources and reserves from this "active balance".

4.2.8 Mukur and Zhaima Gold Mines

Mukur and Zhaima are small gold mines situated near Semey. They were not visited as part of the IMC technical review.

The Mukur reserves and resources are based on a GKZ sectional estimate originally made in 2003 but subsequently modified to reflect increases in resources arising from further exploration and depletion through mining production up to the end of 2010. This estimate recognises C_1 and C_2 categories and uses a 0.5 g/t gold cut-off grade.

The Zhaima resources are based on a GKZ sectional estimate made in January 2007, which recognised C_1 and C_2 categories and used a 0.5 g/t Au cut-off grade. Due allowance was made for subsequent resource depletion through mining production up to the end of 2008. The mine is now closed but a small residual resource remains on the State balance but it is unlikely that it will be mined.

The Mukur mine uses conventional truck and shovel open pit mining methods. Heap leaching is used to extract the gold from the oxidised ore followed by resin-in-pulp extraction. Electrowinning takes place in Semey.

Table 4-14 shows the resource statement for Mukur and Zhaima estimated as at 1 January 2011.

Table 4-14 Mukur and Zhaima Resources Estimated as at 1 January 2011

		Resources	Gold
		'000 t	*g/t*
Mukur	**Measured**	—	—
	Indicated	872	1.35
	Total	872	1.35
	Inferred	163	1.45
Zhaima	**Measured**	—	—
	Indicated	44	2.84
	Total	44	2.84
	Inferred	382	1.72
Total	**Measured**	—	—
	Indicated	**916**	**1.42**
	Total	**916**	**1.42**
	Inferred	**545**	**1.64**

Table 4-15 below shows the reserves statement for Mukur estimated as at 1 January 2011.

Table 4-15 Mukur Reserves Estimated as at 1 January 2011

Mukur		Reserves	Gold
		'000 t	*g/t*
	Proved	—	
	Probable	922	1.23
LOM 3 Years	**Total**	**922**	**1.23**

4.3 Mining

4.3.1 Artemyevsky Mine

Artemyevsky is an operating underground mine exploiting a large high grade, polymetallic, gold and silver-rich VMS deposit. A number of different steeply dipping ore bodies have been identified in the deposit, the most important of which is the Main Orebody, with a strike length of 1,300 m and maximum thickness of 200 m.

This is the sole source of ore at the present time, with workings on the 7, 8, 9 and 10 Levels. Mechanised open stoping and cut and fill is used with cemented fill to enable pillar recovery. Current mining rate is 1.6 Mtpa. Ore is delivered to Nikolayevsky Concentrator 20 km away and some to third party processors. Total number employees is 1,077.

Access to the mine is through three vertical shafts and an adit from the mined-out Kamishinskaya Open Pit. Ore production is by drilling and blasting roadways 4 x 4 m or 15 x10 m stopes with lengths varying up to 50 m. Monomatic drills from Finland are used for horizontal drilling and Atlas Copco Simba drills for Vertical fan drilling. ANFO based explosives are prepared on site. Other blasting accessories are provided by authorised explosives suppliers.

Blasted ore is loaded and hauled to an ore pass using TORO LHDs with 3.2 m^3 buckets. The ore passes are equipped with the grizzley bars and hydraulic rock breakers. The sized ore goes to the underground storage bunkers via a conveyor system and is loaded into 20 t EJC underground dump trucks and transported to the surface stockpile. Another ore stream goes to the underground crusher for hoisting to the surface via an 8 m dia. shaft. 42 t Belaz trucks haul the ore from the shaft bunkers to an adjacent surface stockpile. From the stockpile ore is transported to the Nikolaevsky Concentrator by trucks. A part of this ore goes to the third party concentrator. Table 4-16 below shows the major mobile plant used in the mine.

Table 4-16 Artemyevsky Mobile Plant

Activity	Equipment	Capacity	Units
Drilling	Monomatic Drills	—	8
	Simba	—	2
Loading	LHD's	3.2 m^3	8
Hauling	EJC's	20 t	4

Future plans are focused on increasing capacity from 1.6 to 2 Mtpa. An estimated US$30 M has been included in the business plan which will cover capital costs for major mine development, shaft deepening and equipment. There is capital provision for the upgrade of the hoisting system to increase the hoisting capacity to 2 Mtpa as well as planned procurement of the main underground equipment such as 1 unit Simba Drill, 2 units Monomatic Drills and 2 units TORO40 LHDs. IMC believes that it is safer to project a capacity of 1.6 Mtpa for the next two years based on present equipment and the soon to be commissioned fleet. Present actual mining is way below designed capacity and target of 2 Mtpa would be challenging. The issue of backfilling must be addressed since time will eventually catch up with the development of workable production stopes, levels and the various works required for the development plans.

4.3.1.1 Infrastructure

Access

There is a train loading station 4 km from the main shaft and surface stockpile. Ore from the mine is delivered by 20 t truck under contract with the KCC. Ores are stockpiled according to grades and ore quality. From here, ore designated for third party processing (KAZZINC) is loaded on 70 t wagons and railed by a private rail company Kazakhstan Temir Zholy through Federal owned railways at 2,100 tpd.

Power

Power is supplied by an outside contractor Ust and Buhtarma Electrical Stations. Substations and transformers and overhead power lines and substations are owned by KCC.

Ventilation and Drainage

Ventilation is through a 7 m diameter ventilation shaft equipped with a 3.2 m diameter Korfmann fan with a capacity of 305 m^3/sec and driven by a 1250 kW motor.

Mine dewatering is by stage pumping using 500 hp /640 metre head pumps delivering water via pipe columns to the surface. The design has redundancy with 3 pumps installed at each station; 1 operating, 1 on standby and one on repair.

Back Filling Plant

A backfilling plant is installed to support the mining operations. However, since its commissioning in 2006, the plant has always performed below its designed 50 km^3 per month capacity. Several reviews have been done on its operation. It was determined that climatic conditions of East-Kazakhstan region were not taken in to account when the selection of rock-crushing and distributing plant was made, namely low temperature and heavy snowfalls. As a result when the temperature is below 25°C the plant shuts down.

4.3.2 Belousovsky Mine

Belousovsky mine is an old underground mine acquired by KCC in 1999. It has 3 vertical shafts which were commissioned in 1939 to access the copper/zinc/gold/silver ore. The mine was closed in 2008, having produced approximately 25,000 tpa over the previous three years.

A labour intensive shrinkage stoping method was employed in the upper levels. Trackless equipment in a room and pillar method in the lower levels has been introduced. Ore was transported to the shafts by rail, hoisted and railed to the Berezovsky Concentrator. There are plans to resume mining of remnants and pillars at a rate of 60 ktpa by mechanized mining but no information was available at the time of the visit.

In addition IMC understands that there are now proposals to access a small (0.26 Mt), relatively low-grade resource via an adit and spiral decline in the upper parts of the orebody.

4.3.3 Irtyshsky Mine

Irtyshsky mine is an old copper, zinc, gold and silver mine first commissioned in 1952. It was bought by Kazakhmys in 1999 and after 2 years of dewatering and rehabilitation of the mining facilities, and the sinking of another 2 shafts it resumed underground mining operations.

The deposit is a polymetallic, high grade, and relatively gold rich volcanogenic massive sulphide (VMS) deposit which forms lenses that are really large but thin in longitudinal section. Most of the ore is contained either in the upper or main orebody measuring approximately 2,700 m long and 400 m down-dip or at the lower or southeast orebody measuring approximately 3,000 m long and 400 m downdip.

Due to the nature of the deposit, the mining technology used is shrinkage stoping and sub-level caving for wider veins. Lately, mechanized room and pillar has been introduced as well. At present, the mine depends 66% of their ore production to room and pillar and sub-level caving methods, with the remaining 34% on shrinkage stoping. The mine has a capacity to produce 500 ktpa ROM. Ore is delivered by truck 70 km to the Berezovsky Concentrator and the concentrates are railed to Balkhash Smelter. The mine has a total of 642 employees.

Access to the underground mine is through established shafts driven to the 650 m level. A concrete lined production shaft is equipped with a hoist and 10 t skip. A service shaft is equipped with a cage designed to carry 19 people at a time, which is also used for the materials and other supplies transport.

Mining in narrow veins is undertaken by the drilling and blasting and using manual equipment—neumatic drifters and scraper winches. After blasting with ANFO explosives the ore is scraped into 2.2 m^3 rail cars and transported to the main tipping area.

TORO LHD's with 2.3 m^3 buckets are used in wider veins for loading and hauling blasted ore to ore passes. From the ore passes the blasted ground gets loaded into the rail cars and gets transported to the main tipping area. An SMD 110 jaw crusher installed at the production shaft to crush the blasted ore before loading into the skips capable of approximately 10,000 tpd.

IMC consider that the mining techniques employed are appropriate to the varying ore thickness and ground conditions. Shrinkage stoping is relatively labour intensive but it is reasonable to assume that it can be profitable at the current rates of production. Room and pillar and sub-level caving require additional capital for replacement of equipment. Table 4-17 below shows the major equipment used in the mine.

Table 4-17 Irtyshsky Production Equipment

Activity	Shrinkage	Room and Pillar/Sublevel Caving
Drilling	PR63 Horizontal drills (2 m long, 42 mm dia) PR80 PR2	PR63 Horizontal drills (2 m long, 42 mm dia) PR80 PR2
Rock Bolting	PT48 Vertical Drills (1.8 m for rock bolts) CNP-1 Pneumatic	PT48 Vertical Drills (1.8m for rock bolts) CNP-1 Pneumatic
Loading	NC17 Rope Winch NC30 Rope Winch NC55 Rope Winch Earth Moving Scraper (0.3 m^3) Earth Moving Scraper (0.45 m^3)	NC17 Rope Winch NC30 Rope Winch NC55 Rope Winch Earth Moving Scraper (0.3 m^3) Earth Moving Scraper (0.45 m^3)
Hauling	K10 Electric Locomotive. BT2.2 Trolley Locomotive	TORO 6M EJC-2

Short-term plans include the on-going de-silting of the water collection tunnels. The importance of this installation is acknowledged before any other developments could be successfully implemented. There is a 3 month backlog in roadway development which will have to be addressed to guarantee future production.

IMC understands that there are plans to increase production to 600 ktpa. In preparation for the increase in capacity, 4 new K10 electric locomotives are expected to arrive in September. All these development works and capital expenses have been included in the Company business plan.

4.3.3.1 Infrastructure

Power

Power is contracted out by way of a supply agreement with Al T'uay Energy. Company substations are available in the surface as well as underground to feed and supply requirements of the whole mine.

Ventilation and Drainage

The mine ventilation system is based on a single downcast shaft equipped with a 3.2 m diameter centrifugal fan with a capacity of 600 m^3 per sec., all the other existing shafts are exhaust.

The underground dewatering system involves stage pumping from Level 12 to Level 9 pumping station. Each pumping station is designed with three pumps one operating, one on stand-by and one under repair. On Levels 12 and 9 pumps have a capacity of 330 hp/660 m head.

Dewatering became a major problem in 2009 when the underground was flooded when one of the 2 pipe columns installed collapsed due to corrosion. Operations were suspended for the whole month of April last year while dewatering was undertaken.

4.3.4 Nikolayevsky Mine

The Nikolayevsky underground mine has been developed below the old open pit when a portion of the pit's North wall collapsed. The slide debris has significantly increased the stripping ratio that continued open pit mining has left it economically unfeasible. In order to recover the approximately 6 Mt of ore remaining, sublevel caving method was adopted which suited the ore body configuration and rock conditions of the deposit. The mine has a capacity of 600 ktpa ROM producing Cu and Zn with associated Au and Ag. Ore is delivered for processing to Nikolayevsky Concentrator 4 km away. Concentrates are railed to Balkhash Smelter.

Underground access is via a decline from the open pit high wall at 12% grade. It connects to a series of ramps which leads to 5 working levels, -13, -28, -43, -58 and -73. Collapsed ore from the sub level caves is loaed and hauled to an ore passes using TORO/ Sandvik LHDs for onward transportation to the surface stockpiles An EKG Excavator, or Caterpillar front end loader will then load the fleet of 42 t Belaz trucks to another stockpile area 6 km from the mine and onward delivery of the Nikolayevsky Concentrator. This last phase of hauling is contracted out and the equipment is not owned by the Company. Table 4-18 below shows the major production equipment used at the mine.

Table 4-18 Nikolayevsky Production Equipment

Activity	Equipment	Units
Drilling	Sandvik DD 410-40	1
	Sandvik DL420-7	1
Loading	Toro Underground LHDs	5
	Caterpillar 980 Front End Loader	2
	EKG Rope Excavators	3
Hauling	EJC 417 D	1
	Belaz 42 t Rigid Dump Trucks	12
	Пa-30, MoA3, OKHT-2b	3

Despite the significant reserve available for the Nikolayevsky Mine, the forward plans are all focused towards the development of the North Nikolayevsky deposit. With the decline in copper grades being mined it is projected that the ROM ore will be below 1% Cu by 2012. The early development of the new deposit will allow blending to improve total mine grades delivered to Nikolayevsky Concentrator until the original Nikolayevsky deposit is mined out.

4.3.4.1 Infrastructure

Power

Power supply for the mines is provided by independent power companies; Ust and Buhtarma Electrical Stations. Substations and transformers are provided and maintained by Kazakhmys.

Ventilation and Drainage

Ventilation for the underground is critical for the diesel powered mining equipment. Access roadways driven into the highwall of the open pit provide air intake and return with Korfmann Fans 1.7 m diameter, 250 kW and 100 m^3 per sec.

Underground dewatering is by stage pumping. In April 2009, an inrush of water which has accumulated in the open pit above overwhelmed the pumping system and eventually flooded the mine. At the time of the visit, the mine had only been partially dewatered although minimal production had resumed in the upper levels.

4.3.5 Orlovsky Mine

Orlovsky Mine is now known as the Zhezkent which is a Cu and Zn underground mine of unusually large, polymetallic, high grade and gold rich VMS deposit. The designed capacity of the mine is 1.5 Mtpa of ROM ore. Mining is drift and fill with ore delivered to the Zhezkent Concentrator by conveyor. Concentrates are railed to Balkhash Smelter. The Zhezkent Chemical Complex as it is collectively known has a total of 2,968 employees. Table 4-19 below shows the major production equipment being used at the mine.

Table 4-19 Orlovsky Production Equipment

Activity	Equipment	Units
Drilling	Boomer Drill	2
	Monomatic Drills	4
	Mini Boring Machine	1
	Solo Drill	1
Loading	Caterpillar LHDs	8
Hauling	EJC Underground Dump Trucks	9
	Electric Locomotives	Unspecified

At the time of the visit there was an apparent problem with availability of equipment. Only 3 of the 8 Caterpillar LHDs and 5 of the 9 EJCs were operational due to the supply of replacement parts which was taking too long to arrive on site.

Plans are all focussed on the development of new ore bodies adjacent to and below the existing production orebody. This will involve development drivage of approximately 10,000 m and the sinking of sub-level shafts to access the ore below.

4.3.5.1 Infrastructure

Ventilation and Drainage

Ventilation is presently a major issue due to the presence of combustible sulphur underground. The authorities have only approved access to a limited area which is deemed to have adequate ventilation for personnel and the safe operation of equipment. The present ventilation configuration has 2 intake and 2 return shafts installed with Korfmann fans but there is still inadequate ventilation to continuously maintain safe working conditions.

Dewatering is by stage pumping through shaft pipe ranges to the surface.

4.3.6 Yubileyno-Snegirikhinsky Mine

The Yubileyno-Snegirikhinsky operation is in a remote area of the mountains exploiting a small (1.55 Mt), high grade, polymetallic VMS deposit made up of a number of ore bodies. These form a series of sub-parallel elongate pods extending in a steep to sub-vertical down dip direction that are gently folded. Orebody thicknesses vary from 2-30 m, with an average of 18 m. The Western orebody, which contains about two thirds of the remaining resources, measures approximately 150 m wide by 600 m down dip, while the Central orebody is approximately 20 m wide and 600 m down dip. Ore from the sub-level caving operation is transported by road 120 km to the Nikolayevsky Concentrator. Annual designed capacity is

600 ktpa of ROM ore, started production in 2003 and is already nearing the end of its mine life. The mining operation has a complement of 298 employees.

The mine is a sub-level caving operation with 5 x 4 m production roadways. The ore bodies were developed by a system of declines driven from the surface down dip. It has 5 mining levels with production now at the bottom level. Access to the mine is through Adit No.5 and a spiral ramp. Production is by drilling and blasting using ANFO based explosives with the vertical fan drilling. Blasted ore is load and transported by TORO LHDs to an ore pass. Ore is then hauled to the surface using EJC underground dump trucks into a stockpile area just adjacent to the portal of Adit No.5. A Caterpillar 980K front end loader loads ore to 20 t trucks contracted by KCC for hauling to the concentrator. Table 4-20 below shows the major production equipment used in the mine.

Table 4-20 Yubileyno-Snegirikhinsky Production Equipment

Activity	Equipment	Capacity	Units
Drilling	Simba Rig		2
Loading	Caterpillar Loaders	3.2 m^3	2
	EJC	20 t	2
Hauling	TORO 40	20 t	3

Production at Yubileyno-Snegirikhinsky at the current rate will be completed in 2013 and is being phased with the development of the Anisimov Kluch deposit which will be accessed from the existing infrastructure of Yubileyno-Snegirikhinsky Mine.

4.3.6.1 Infrastructure

Ventilation and Drainage

The mine uses diesel mobile equipment underground and ventilation quantity is based on the diesel fumes dilution factor. The ventilation layout consists of an air intake roadway and return air way both driven from the former open pit. The main intake fan is a Korfmann, 1.7 m diameter with 250 kW drive and a capacity of 100 m^3 per sec.

Mine dewatering is by stage pumping at a rate of 50 m^3ph to the surface water treatment plant which improves water quality before discharge.

4.4 Projects/Prospects

4.4.1 Anisimov Kluch

4.4.1.1 Geology

Anisimov Kluch is a small (3.18 Mt), unworked, high grade, polymetallic VMS deposit comprising five principal orebodies that have been traced by drilling to a depth of about 600 m from surface. The orebodies are sub-vertical or overturned, strike NE-SW, and pitch at between 25 55° to the NE. Table 4-21 below shows the principal dimensions and average metal contents of the orebodies.

Table 4-21 Anisimov Kluch Principal Orebodies

Orebody	Down-dip (m)	Strike length (m)	Thickness (m)	Cu %	Pb %	Zn %
Main No 1	370	300	1.45	3.32	1.02	7.05
Main No 2	600	350	0.4-29.8	3.05	0.65	4.93
New	200	70	5.5	2.78	0.33	3.07
Lens 3	280	50-120	1.7	4.00	0.87	4.89
Lens 5	300	70	10	2.51	0.27	2.30

The deposit has not been mined and the Western Siberian Geological Management Co has recently completed a conceptual scoping study on the deposit, for which the resources have yet to be entered into the State balance.

IMC's resource estimate is based on the reported (C1+C2) Active Balanced Resources for the deposit.

4.4.1.2 Reserves and Resources Statement

Table 4-22 below shows the resource statement estimated as at 1 January 2011, based on figures approved in 1983. Due to the antiquity of the approval IMC considers both C1 and C2 category reserves as equivalent to indicated resources.

Table 4-22 Anisimov Kluch Resources Estimated as at 1 January 2011

Anisimov Kluch		Resources	Copper	Zinc	Gold	Silver	Lead
		'000 t	%	%	g/t	g/t	%
Anisimov Kluch	**Measured**						
	Indicated	3,450	3.04	5.26	0.28	36.27	0.72
	Total	**3,450**	**3.04**	**5.26**	**0.28**	**36.27**	**0.72**
	Inferred						

4.4.1.3 Mining

The deposit is located adjacent to the currently operational Yubileyno-Snegirikhinsky mine. The development plan for Anisimov Kluch is to drive a 2 km roadway from the existing Level 5 to reach the deposit with a total of 5,460 m required to prepare the deposit for production. A creek on the surface will also need to be diverted for about 800 m before stoping can begin at production rate initially of 200 tpa in 2013. To achieve this, 3 tunnelling crews need to be deployed for the development beginning 4th quarter of 2010.

The mining method is a subject for further detailed examination. The projected steady state production will be at 400 ktpa which provides for approximately 10 years life of the mine. However, this will be finally determined during the next study stages.

4.4.2 North Nikolayevsky

The Nikolayevsky North deposit comprises two shallow (30°) dipping orebodies developed at the boundary between brecciated lavas (footwall) and acidic tuffs (hanging wall). The thickness of the orebodies is highly variable with the average thickness about 3 m. The plan view dimensions of the orebodies are approximately 500 m by 200 m and are located about 10 m apart. The mineralisation is represented by massive ore, with no fine-grained, metacolloidal material being reported. It is intended that the Nikolayevsky North orebodies will be accessed from the Nikolayevsky mine. Another mineralised horizon has been located in a drill hole intersection 300 m below the Nikolayevsky orebody.

IMC's resource and reserve estimate as shown in Table 4-8 and Table 4-9 above is based on the reported Active Balanced Resources for the Nikolayevsky deposit and the balanced resources at Nikolayevsky North.

4.4.2.1 Mining

North Nikolayevsky Project is the development of a deposit 1.3 km north of the Nikolayevsky mine. It is intended to be accessed from the operations. The projected capacity is between 4 to 4.6 Mtpa with a mine life of 12 years based on currently delineated reserves.

Two shafts will be sunk for air intake and return as to supplement the ramp roadways. Pumping will be staged with 3 pumps on each station to meet required inflow of 250 m^{3}ph.

According to the preliminary estimates, approximately 3,000 m will have to be developed in order to prepare for production. The projected start of production activities is 2012 but the mining method is still being considered.

Another mineralised horizon has been intercepted 300 m below the Nikolayevsky orebody by a single exploration hole. There are plans for a further exploration drilling once the preparation of the new orebody for production is complete.

4.5 Concentrators

4.5.1 Belousovsky Concentrator

The concentrator is fed with ore from the Yubileyno-Snegirikhinsky mine and the majority from the Yubileyno-Snegirikhinsky mine where the ore is transported by road.

The feed ores are polymetallic containing 3.26% Cu and 2.37% Zn where separate copper and zinc concentrates are produced. Metal recoveries are 86% copper in copper concentrate and 38.92% Zn in zinc concentrate. The copper concentrates from the various ore feeds contained 16% copper with lower lead values of 1.5% Pb and the zinc concentrates contained 40 to 42% Zn.

4.5.1.1 Plant Description

The concentrator was commissioned in 1945. There are two crushing lines, for local ores primary crushing is done underground with two stages of crushing on the surface and for ores from other mines a three stage crushing is undertaken.

Following crushing, the ore is fed to three stages of ball milling. The first stage is in close circuit with a spiral classifier the second and third stages are in closed circuit with hydrocyclones. Overflow from the tertiary ball mill cyclones is fed to the flotation circuit. Flotation of copper consists of rougher stage followed by three cleaner stages. Zinc flotation follows a similar process.

The concentrate received from the flotation cells is thickened and filtered with pre-coated disk filters or ceramic disk filters, however, IMC understand that the pre-coated filter will be replaced. No further drying is undertaken after filtering.

The feed is sampled at the overflow of the grinding sections, the tailings at the end of the rougher banks and the final concentrate at the feed to the thickeners. Inter-stage flotation products are also sampled. Plant feed tonnage is measured and recorded by truck loads fed to the crusher section. Concentrate is weighed after loading onto railway wagons. There is no local smelter or refinery capacity and copper concentrates are railed to the Balkhash smelter and refinery. Zinc concentrate is sold to KazZinc and processed in their Ust-Kamenogorsk plant.

4.5.1.2 Plant Performance

Table 4-23 below shows the historic production from the Belousovsky concentrator since 2007.

Table 4-23 Belousovsky Concentrator Historic Production

Year	Milled '000t	Cu %	Contained Cu '000t	Recovery %	Concentrate '000t	Cu %	Cu in Concentrate '000t
2007	220	1.61	3.5	83.52	18	16.4	3.0
2008	294	1.62	4.8	79.68	24	15.8	3.8
2009	468	3.26	15.3	87.44	84	15.9	13.4
2010	433	3.24	14.0	90.08	77	16.4	12.6

Year	Milled '000t	Zn %	Contained Zn '000t	Recovery %	Concentrate '000t	Zn %	Zn in Concentrate '000t
2007	220	2.87	6.3	64.04	10	40.4	4.0
2008	294	2.23	6.6	56.28	10	36.9	3.7
2009	468	2.37	11.1	37.61	11	37.9	4.2
2010	433	2.42	10.5	50.49	14	37.8	5.3

There is a lack of automatic control on the flotation circuit. Reagent addition is based on results of hourly composite samples the results of which are received some 2 hours after receipt at the laboratory.

The crushing plant was in a fair condition and is running below its capacity. The lighting levels were very poor and the buildings represent their old age. Some of the equipment was recently replaced and a disk filter and a bank of flotation cells are being replaced.

The tailings dam was originally constructed in a valley in 1945. The dam wall is well above its originally planned maximum height of 54 m. With an estimated rise of 2 mpa the overall height is now approximately 64 m. The dam has been lifted 10 times by the upstream method where a 6 m wide berm is left at each lift giving an average overall slope of about 1 in 2.7. The dam is constructed on relatively steeply sloping ground in a valley without any interceptor channel to collect water upstream of the dam. The depth of water on the dam was 6 m whilst the proportion of sand in the tailings is low.

The dam is beyond the end of its life span but IMC understands that an external consultant has recently assessed and approved the tails dam for future use.

4.5.2 Berezovsky Concentrator

The plant was built in 1952 lay idle from 1996 to 1999. Currently the concentrator is fed only with ore from the Irtyshsky mine which is some 16 km away where ore is transported by road. The concentrator was originally fed with ore from the Belousovsky mine.

The ore treated in the plant is polymetallic with a high lead (0.4 % Pb) content, which results in high lead content in the copper concentrate (up to 5.6 %). The products of the concentrator are separate copper and zinc concentrates.

4.5.2.1 Plant Description

There are two crushing sections which are each fed at 40 to 42 tph. At the time of visit one section was non operational. Primary crushing is undertaken underground with two stages of crushing on the surface. The primary mill size is 2.7 m by 3.6 m whilst the secondary, tertiary and regrind mills are each 2.1 m by 3.0 m.

Following crushing, the ore is fed to three stages of ball milling. The first stage is in close circuit with a spiral classifier, the second and third stages are in closed circuit with hydrocyclones. Overflow from the tertiary ball mill cyclones is fed to the flotation circuit. The regrind mill in the flotation circuit is currently not in use as the nature of the ore has changed and there are fewer impurities than previously.

Flotation of copper consists of rougher stage followed by three cleaner stages. Zinc flotation follows a similar circuit wit cell sizes of 3.2 m^3, 2.4 m^3 and 1.5 m^3. The concentrate is thickened and then dewatered in ceramic disc filters down to 10% moisture. No further drying is undertaken prior to rail transport to the refining operations. The feed is sampled at the overflow of the grinding sections, the tailings at the end of the rougher banks and the final concentrate at the feed to the thickeners. Inter-stage flotation products are also sampled. Plant feed tonnage is measured by truck loads to the primary crusher with concentrate weighed after loading onto rail wagons. There is no local smelter or refinery capacity and copper concentrates are railed to the Balkhash smelter and refinery. Zinc concentrate is sold to Kaz Zinc and processed in their Ustkaminogorsk plant.

4.5.2.2 Plant Performance

Table 4-24 below shows the historic production from the Berezovsky concentrator since 2007.

Table 4-24 Berezovsky Concentrator Historic Production

Year	Milled '000t	Cu %	Contained Cu '000t	Recovery %	Concentrate '000t	Cu %	Cu in Concentrate '000t
2007	405	1.38	5.6	79.40	29	15.3	4.4
2008	479	1.41	6.7	82.67	33	16.9	5.6
2009	485	1.51	7.3	85.47	35	17.9	6.3
2010	422	1.39	5.8	84.34	28	17.6	4.9

Year	Milled '000t	Zn %	Contained Zn '000t	Recovery %	Concentrate '000t	Zn %	Zn in Concentrate '000t
2007	405	3.26	13.2	46.24	17	35.9	6.1
2008	479	3.59	17.2	56.88	24	40.7	9.8
2009	485	3.62	17.6	64.04	25	45	11.3
2010	422	3.13	13.2	65.09	19	45.2	8.6

There is a lack of automatic control on the flotation circuit. Reagent addition is based on results of hourly composite samples the results of which are received some 2 hours after receipt at the laboratory. During the IMC visit, it was observed that, while some cells were pulping, some were depressed and some were operating satisfactorily. The concentrator has a laboratory for carrying out flotation and other test-work.

The crushing plant was in a fair condition and is running below its capacity. A lot of the old equipment is replaced with the plan to replace more. The buildings are in a poor condition with the exception of the administration building which has been recently refurbished. The lighting condition throughout the plant is very poor. A young and enthusiastic management does a lot to upkeep and improve the plant.

The tailings dam was originally constructed in 1950 and subsequently re-constructed in 1977. The height is now 47 m and the banks are built up using waste rock covered in rip rap. The level can be raised a further 6 m to 328.0 m amsl giving a final height of 51 m. Further height increases above that level are being considered. The dam has to be regarded as a potential problem for the future with its environmental impact.

4.5.3 Nikolayevsky Concentrator

The Nikolayevsky concentrator is the mayor concentrator serving Nikolayevsky, Yubileyno-Snegirikhinsky Artemyevsky and mine. The concentrator has been in operation since 1980 and was reconstructed in 2006 to 2008 by BGRIMM from China. Presently the concentrator produces separate copper, zinc, and lead concentrates. The lead flotation was not in operation on the day of the IMC visit. In the past separate copper, zinc and pyrite concentrates were produced. With the re-engineering by the end of 2010 it is expected to produce copper, zinc, lead and additionally precious metal concentrates

The ore from all three mines are of polymetallic blend where the different ores vary in chemical and mineralogical composition and hardness. The main ore constituents are pyrite, chalcopyrite, sphalerite and galena. There is also bismuth, silver, gold, arsenic, cadmium, selenium, thallium, gallium, tellurium, germanium and indium present in trace amounts.

Presently the ore from the different mines are treated in separate campaigns with no mixing. A campaign cycle for each mine ore is in the region of a week. This allows the plant insufficient time to stabilise before a new ore with different operation conditions is handled.

The Nikolayevsky ore of various grades is stockpiled at the open pit site where up to 300,000 t can be stockpiled at any time. The ore is brought by road in 40 t trucks to the concentrator approximately 5 km from the mine.

Yubileyno-Snegirikhinsky ore is also brought to the concentrator by road in 25 t trucks over a distance of approximately 100 km to a stockpile of 15 000 to 20 000 t.

Artemyevsky ore is brought to the concentrator by road in 25 t trucks over a distance of approximately 20 km to a stockpile of 50 000 t.

4.5.3.1 Plant Description

Ore is received in the feed storage building and tipped into the primary crusher and reduced down to less than 300 mm. Crushed ore is fed separately to two SAG mills, 7 m by 2.3 m with a design capacity of 95 tph, actual throughput of 100 tph and the maximum capacity is 130 tph. The increase in capacity to the design capacity was achieved by the introduction of rubber liners to the mill and the addition of 100 mm steel balls.

Each SAG mill feeds two ball mills (3.6 by 4 m) which are in series with closed circuit classification cyclones. Output from the secondary ball mills is fed to a common tertiary ball mill (4.5 by 5 m) in closed circuit with cyclones. Cyclone overflow is fed to the copper flotation circuit.

The copper flotation is a four-stage process, involving rougher and three stages of cleaning. There is some regrinding in another ball mill after the first flotation. Various float products of different grades report to the copper concentrate stream while the tailings from the rougher stage report to the zinc circuit. Cell sizes range from 2.5 to 3.2 m^3.

The thickened copper concentrate slurry is pumped to a series of vacuum filters and from there dried in a direct heated rotary kiln. The dewatered concentrate is stored in bins for loading into rail wagons to be transported to the Balkhash smelter. The zinc-pyrite is concentrate is thickened, filtered and stored for transport to the Kazak Zinc smelter.

The filtering plant consists of 6 ceramic disk and 2 filter presses. The rotary kilns used for further drying will be soon taken out of service.

The feed is sampled at the overflow of the grinding sections, the tailings at the end of the rougher banks and the final concentrate at the feed to the thickeners. Inter-stage flotation products are also sampled. Plant feed tonnage is measured and recorded by weightometers installed on each of the rod mill feed conveyors and concentrate is weighed after loading onto rail wagons. There is no local smelter or refinery capacity and copper concentrates are railed to the Balkhash smelter and refinery. Zinc concentrate is sold to Kaz Zinc and processed in their Ustkaminogorsk plant.

4.5.3.2 Plant Performance

Table 4-25 below shows the historic production from the Belousovsky concentrator since 2007.

Table 4-25 Nikolayevsky Concentrator Historic Production

Year	Milled '000t	Cu %	Contained Cu '000t	Recovery %	Concentrate '000t	Cu %	Cu in Concentrate '000t
2007	1,650	2.20	36.4	80.35	175	16.7	29.2
2008	1,742	2.31	40.1	80.20	184	17.5	32.2
2009	1,550	1.95	30.3	80.39	136	17.9	24.3
2010	1,345	1.73	23.3	74.61	93	18.7	17.4

Year	Milled '000t	Zn %	Contained Zn '000t	Recovery %	Concentrate '000t	Zn %	Zn in Concentrate '000t
2007	1,650	3.67	60.6	57.94	84	41.8	35.1
2008	1,742	3.41	59.5	55.83	86	38.6	33.2
2009	1,550	2.98	46.3	61.11	67	42.2	28.3
2010	1,345	4.02	54.1	66.80	86	42	36.1

There is a lack of automatic control on the flotation circuit. Reagent addition is based on results of hourly composite samples the results of which are received some 1.5 hours after receipt at the laboratory. The concentrator has a laboratory for carrying out flotation and other test-work.

The crushing plant was in a good condition and is operational but the lighting levels were very poor. Overall IMC considers the plant is adequate for the planned throughput but requires a clean-up campaign to remove spillage from the floor and return it into the process.

The performance of the Chinese in the start up did not demonstrate the results expected from the pilot scale testwork. Presently the Russian company RIVES is requested to present a plan for improving the performance of the plant. Results are expected end of 2010 and thus a start of reconstruction could take place end of 2010.

Tailings from the concentrator feed into either of two dams in a valley to the east. The upper dam is known as the Pyrites Dam and the lower, the Tailings Dam.

Construction of the Pyrites Dam started in 1984. The lifts are built by the upstream method to an average slope of 1 in 3 using clay excavated from an adjacent borrow pit. The clay is covered on the downstream side by a 1 m thick layer of riprap. The toe is protected from erosion by wave action in the Tailings Dam by a bank of tailings placed from the berms on the Pyrites Dam.

By 2010 the dam had been lifted four times to the current height of 39 m. The dam can then still be lifted a further twice to a level of about 384 m amsl giving a further 3 Mm^3 of capacity and making the total volume of tailings about 12.5 Mm^3. The length of the dam is 700 m. Water level is at 371 m, the depth of water 1.5 m and the freeboard 3.5 m.

Construction of the Tailings Dam started in 1980 and has a current volume of approx. 13 Mm^3. The dam has been lifted by upstream construction in five lifts to give a current height of 46 m. Top soil was stripped prior to construction and spread on adjacent fields. There is a shortage of clay and the lifts were built of rock from the mines. This is covered on the upstream side by a 1 m thick layer of clay and completed with a 0.2 m thick layer of riprap. A buttress was built at the toe in 1995 as a precaution.

Both dams will be full by 2013. There is a valley 300 m to the east of the Pyrites Dam which could be suitable for a new dam. No plans have been made but this will require a 2,000 m long starter dam.

A new pumping system comprising either new pumps or a new station will be needed to allow the Pyrites Dam to be used after 2011. This new pumping system will only operate 2 years before the dam is full so the effective limit of the current system may therefore be 2011.

4.5.4 Orlovsky Concentrator

There is a single concentrator, known as the Zhezkent facility, dedicated to the Orlovsky mine and processes ore to produce separate copper and zinc concentrates.

The Zhezkent concentrator has been in operation since 1988 and was constructed well after the mine commenced production and is currently treating 1.6 to 1.7 Mtpa. The original design capacity is 1.6 Mtpa with the limit being on the tertiary milling capacity. Presently a maximum of 1.75 Mtpa has been achieved.

The ore consists of arsenopyrite, pyrite, chalcopyrite, pyrotite, chalcocite, covaline, bornite, sphalerite, galena and cerrusite. There is also bismuth, silver, gold, and mercury present in trace amounts.

Lead is a dominant pollutant of the concentrates, which is extremely fine and thus not fully liberated or flotation is not specific enough. Nevertheless presently 70% of the lead reports to the copper concentrate, 10 to 15 % reports to the zinc concentrate and 10 to 15% reports to the tailings. The lead value in the copper concentrate climbs up to 5 to 7% when the lead in ore value exceeds 1.05%. The average value for lead in copper concentrate was analysed to be 4.11% in the period of January to July 2010.

4.5.4.1 Plant Description

Ore is fed from the shaft via an incline conveyor to four main storage bins of approx 1000 t capacity and three secondary storage bins with a capacity of 500 t. There is no crusher at the plant and ROM ore is fed directly to the primary autogenous (AG) mill (7 m by 2.5 m) at approximately 190 t/h. Two AG mills are operated in parallel with a three stage system.

Feed size to the AG mill is -400 mm and the outlet screen of the AG mill cuts off at 5 mm and oversize is fed back into the AG mill. The undersize goes to spiral classifiers where the oversize from the spirals is fed into the second stage ball mill operated in close circuit with a bank of hydrocyclones. The undersize from the spiral goes directly to the bank of hydrocyclones. The undersize from the cyclones is fed to copper flotation and the oversize is fed back into the second stage ball mill (4.5 m by 6 m). The ball mill with a size of 4.5 m by 6 m is charged with 60 mm steel balls.

The copper flotation is a multi-stage process involving some regrinding in the third stage ball mills after the first flotation. Tailings from the first stage are fed to hydrocyclones where the sinks go to a further third stage grinding stage in 2.7 m by 3.6 m mills. The overflow goes through two further copper flotation stages.

The copper concentrate is dewatered on large rotating horizontal ceramic filters and/or disc filters and/or a press filter and then further dried in a rotary drier. The dewatered and dried copper concentrate is stored in bins for loading into rail wagons for despatch to Balkhash. Zinc products are sold as concentrates.

The zinc stream is similar to the copper stream. A part of the lead content appears as the tails from the zinc stream and reports directly to the tailings. There is currently no lead concentrate produced on site but IMC understands that this is planned for 2011.

The feed is sampled at the overflow of the grinding sections, the tailings at the end of the rougher banks and the final concentrate at the feed to the thickeners. Inter-stage flotation products are also sampled. Plant feed tonnage is measured and recorded by weightometers installed on each of the AG mill feed conveyors. And concentrate is weighed after loading onto railway wagons.

4.5.4.2 Plant Performance

Table 4-26 below shows the historic production from the Orlovsky concentrator since 2007.

Table 4-26 Orlovsky Concentrator Historic Production

Year	Milled '000t	Cu %	Contained Cu '000t	Recovery %	Concentrate '000t	Cu %	Cu in Concentrate '000t
2007	1,234	5.23	64.6	91.94	284	20.9	59.4
2008	1,530	4.99	76.4	90.66	343	20.2	69.3
2009	1,617	4.42	71.4	90.01	340	18.9	64.3
2010	1,539	3.67	56.5	89.29	267	18.9	50.5

Year	Milled '000t	Zn %	Contained Zn '000t	Recovery %	Concentrate '000t	Zn %	Zn in Concentrate '000t
2007	1,234	4.59	56.6	72.46	91	45.1	41.0
2008	1,530	4.51	69.0	70.93	109	44.9	48.9
2009	1,617	4.74	76.6	71.13	121	45	54.5
2010	1,539	4.99	76.8	75.44	126	46	58.0

There is a lack of automatic control on the flotation circuit. Reagent addition is based on results of hourly composite samples the results of which are received some 1.5 hours after receipt at the laboratory. The concentrator has a laboratory for carrying out flotation and other test-work. Presently a study for a process control and monitoring system is in progress. Maintenance is based on a paper based planned preventative system.

The milling and flotation plant was in a good condition, the milling plant is running at maximum capacity and the flotation plant still has some spare capacity. The lighting levels were very poor.

The only tailings dam is located in flat land to the north of the road to Semipalatinsk. It measures 1.8 km north to south and 0.9 km east to west. The distance between plant and tailings dam is approximately 5 km.

The starter dam was built in 1976 but the dam was not used until 1989 when the concentrator started work. The volume of the dam is now 6.17 Mm^3. The final level will be 274.5 m amsl giving a maximum height of 12.5 m. Two settlement ponds at the western toe receive water from the mine and from the sewage system. Supernatant water is used for preparing paste for underground back filling.

The starter dam was lifted upstream in 3 m high lifts typically leaving a 7.0 m wide berm using the upstream method with clay from an adjacent quarry with riprap cover. The clay in the lifting of the banks was compacted in 50 cm layers. A buttress of gravel and sand is being built with lift 3 using material imported from 20 km away.

The current third lift is the final lift and will be full in 2010. Then the plan is either to construct a new dam or try to operate the remaining Section 2 alone with a floating pump, which will provide an adequate capacity until 2012. IMC understands that plans are being prepared for a new site.

IMC considers the tailings dam to be stable and well looked after but the monitoring system should be improved.

4.6 Infrastructure

4.6.1 Belousovsky Complex

The Belousovsky Complex together with its industrial complexes is one of the largest employers of labour in the region. The other major employers in this location are AES (Electric Power Generation and Distribution), KazZinc and Government service agencies. The townships and villages are serviced by road and rail. This infrastructure has developed over the past 250 years by the exploitation of copper and zinc deposits located in the East Kazakhstan region.

4.6.1.1 Roads

The Belousovsky Complex is located in three villages Alti, Belousovsk and Beryozovsky. All of the mine sites and industrial areas are served with all weather roads constructed from concrete and asphalt most of which are proficiently constructed and maintained. The major roads belong to the state provincial government. The Company has ownership of one road which is 17 km long and runs between Ailty mine and the Berezovsky Concentrator. The local road networks are capable of carrying consumables and major plant equipment of up to 50 t in vehicles weight. The majority of the road haulage and worker / passenger transport are operated by local haulage contractors and local government but the Company operate their own transport services. A transport department is responsible for transportation of the Company workers and road freight. This department is also responsible for snow clearance of the local roads during winter conditions. It has its own workshops to support its motorised fleet of trucks, cars and road building and construction equipment.

4.6.1.2 Rail

The Irtyshsky Mine used to have a comprehensive rail system commencing at the mine head to transport ore to the concentrator. Together with the suspension of operation of the Belousovsky mine, the rail system is now just intended for the delivery of concentrates from the Berezovsky concentrator to the smelter. The dispatching of the trains for concentrate rail transport is programmed through monthly plan as the concentrate wagons are owned by the state rail company with KCC paying penalty fines for delays in returning the rail wagons. The rail tariff for the concentrate wagons are charged on the use of the state owned rail line and is weight and distance related as 63 t and 71 t wagons are employed. The two different concentrates are transported to the Balkhash zinc smelter/refinery and the copper to Zhezkazgan smelter/refinery on the state network.

The Company internal rail system operates on a gauge of 1,520 mm with a number Russian manufactured TEM 120 t 1200 hp diesel locomotives. The internal rail transport department maintain and upgrade the local rail network for the complex and is responsible for 37 km of track and handles 513 wagons per month. The Company also has its own workshops to support, maintain and repair diesel locomotives and rolling stock. Rail passenger travel is by the state owned rail company with the national line serviced by local and national trains.

4.6.1.3 Air

The Öskemen city airport was constructed in the 1935 and is capable of accepting local and international flights. The terminal building's external and internal structure and services is comparable to western standards. The airport is owned by the local government and airport management ensures good standards of maintenance and with reliable services. The airport accommodates two air freight companies and passenger carriers; one owned by Kazakhmys. The airport has one runway 2,560 m long by 40 m wide and designed for a maximum aeroplane with landing load capacity of 300 t and will accept Boeing 757,747 and Antonov AN124. The airport is only closed during conditions of poor visibility from fog or severe snow storms.

The airport has snow and ice runway clearance equipment to ensure efficient runway clearance with competent staff. The airport is serviced by workshops and maintenance bays and major fuel storage facilities as previously it was a military airport.

4.6.1.4 Communications

There is a well developed communications network which comprise of the following systems. Three telephone systems integrated into the National telephone service which is government owned.

4.6.1.5 Power

The electrical power originates from hydro electric schemes operated by AES from the Shulba and Öskemen Hydro electric plants. These plants feed into the national grid system for transmission and distribution to supply electric power to this region of Kazakhstan. The national grid in this region is operated by KEGOC. A supply agreement is also in place with Al Tay Energy. Electric power is transmitted and distributed over the industrial and mining area networks at both 110 /35/ 6 kV depending upon transmission distance and load. The power utilisation voltage of 6.3 kV is derived at intake substations from step down transformers at the mine, and concentrator sites for utilisation for high capacity motor kW drives and transmission and distribution voltages to various load centres for each industrial complex. Details of the incoming supplies for each mine are shown below:

— Irtyshsky Mine has three 110 kV incoming overhead power lines with step down transformers 110/6.3 kV.

— Belousovsky Mine and Concentrator has two 110 kV incoming overhead power lines with step down transformers 110/6.3 kV.

— Berezovsky Concentrator has one 35 kV incoming overhead power lines and 6 kV overhead power line.

The Irtyshsky, and Belousovsky mines operate on an Isolated Neutral system (IT) with earth monitoring protection employing Russian flameproof equipment (FLP). The FLP equipment is employed for its reliability and robustness. Concentrator and industrial sites have a mixed protective Earthing System with the mine underground HT and MT supplies and surface concentrator operating on an Isolated Neutral system with earth monitoring protection. The surface industrial and domestic areas 400/220 V system operates on a solidly grounded neutral earth system (TN). Most industrial systems operate on the two transformer feed 100% stand-bye principle in which all incoming feeds have two supply transformers:

— One Operating.

— One spare powered as a hot standby.

These systems together with dual feed lines ensure a stable and secure supply with very little down time. Power supply disturbances reported to be limited to two power interruptions per year of short duration (1 to 3 hrs each). The electrical power system classifications are as follows:

Surface distribution

— 3 phase 50Hz 110/6 kV- IT system.

— 3 phase 50Hz 35/6 kV- IT system.

— 3 phase 50Hz 400/220 V-TN-C.

— 3 phase 50Hz 400/220 V-TN-S.

4.6.1.6 District Heating Scheme

Hot steam is supplied from steam raising boiler plants which are employed to provide heating for industrial and domestic consumption. The steam is stored and pumped around the district with booster pumps at various locations which provide room heating for homes offices, mines and industrial processes as well as hot domestic water for washing and bathing facilities. Belousovsky has two boiler plants, one located close to the settlement and the other to heat the mine complex and mine ventilating air. Alti has one plant with three boilers located close to the settlement two operating and one standby. Berezovsky has two steam locomotive employed as boilers as the original boiler house fell into dis-repair during the independence period; one supplies the concentrator and the other the heating water for settlement. The use of domestic hot water provided by the district heating schemes involves no heat exchange in the final system but is drawn straight from the heat store supply. This means energy is being expended and requires constant injection of steam 'topping up' water at origin as the hot water for domestic use is constantly being drawn off.

4.6.1.7 Water

The Irtyshsky reservoir is located 14 km on from Belousovsky mine and covers 100 Ha with a capacity of 1.3 Mm^3. Belousovsky maintains six boreholes (100 m depth) producing between 240 m^3 to 480 m^3/hr. Each deep well borehole is capable of producing 40 to 80 m^3ph depending upon the season. This water is pumped to a 50 m^3 holding water treatment tank where it is dosed with chlorine and purified by anti-bacterial lamps and then pumped on to two holding water storage tanks of capacity 1,000 m^3 each. This stored water is then pumped to supply the townships potable water via two steel pipes each of 500 mm diameter. The water distribution system comprises of two supply ranges for security of supplies and for maintenance purposes. The Alti Reservoir is located 18 km from Belousovsky mine and covers 24 Ha and capacity of 0.36 Mm^3. Alti comprises three boreholes at 100 m depth producing 40 to 100 m^3ph. Each deep borehole is capable of producing 20 to 30 m^3ph depending upon the season. This water is pumped to a 50 m^3 water treatment tank where it is dosed with chlorine and purified by anti bacterial lamps and then pumped on to a holding water storage tank of capacity 600 m^3. The water is then pumped to supply the townships with potable water via two steel pipes each of 219 mm diameter. The water distribution system comprises of two supply ranges for security of supplies and for maintenance purposes.

Process water comes from a closed water system pumping from reservoir concentrate and then to settling ponds. The solids are settled out and the water pumped back to the concentrate reservoir. This water is supplemented by mine water in times of hot weather due to evaporation. With the closure of the Belousovsky mine, the underground itself has been a source of industrial water since the underground has been flooded.

All domestic sewage associated with the Berezovsky Complex involves treatment plants. The sewage and storm water is pumped into tanks or other digesters with treatment consisting of primary storage and settlement tanks, aeration towers and second storage settlement tanks and finally to aeration lagoons with final discharge into the river situated some distance from the potable water courses.

4.6.1.8 Social Amenities

Originally the housing was government and Company owned but since independence from USSR all apartment housing is now privately owned with existing tenants receiving free ownership. Most of the town housing were built in the 1930's, 1940's and 1950's and are in poor condition. Apartment blocks up to five and seven stories high were erected in the 1970's, 1980's and 1990's and are classed as satisfactory. All tenants have to pay for repair and maintenance of their dwellings but the water heat and sewage systems are maintained by the company. The external appearance of most of the apartment blocks seems poor although some units are being renovated and refurbished. The town suburbs and remote dwellings consist of single and duplex buildings with corrugated roofing and wooden cladding.

Health care is provided to all to all employees with good local hospitals and dental treatment. Hospital facilities are provided by the Company who fund 100% of medical care for all employees and 90% of medical fees for Sanatoriums and Rehabilitation centres. Spouses, children and close relatives are charged at rate of 50% of the rate. Surgical operations and other medical operations are performed by the company and state owned hospitals.

4.6.2 Copper Chemical Complex

With three operating mines and a concentrating facility in the region, Kazakhmys PLC is the largest employer in this part of Kazakhstan. The other major employers in this location would be Government service agencies. It has road and rail transport networks connected to adjoining regions and nearby Russian borders. This infrastructure has been developed and maintained for the last 50 years due to the exploration and exploitation of mineral deposits in the area.

4.6.2.1 Roads

Artemyevsky, Nikolayevsky and Yubileyno-Snegirikhinsky Mine sites and the Nikolayevsky Concentrator and its associated industrial service areas are provided with all weather roads constructed from concrete and asphalt. Such is not the case, however, for the haul route of ore through the 120 km distance between Yubileyno-Snegirikhinsky Mine and Nikolayevsky concentrator where the road conditions have become deteriorated. Continuous surfacing and ballasting by the Company makes the road passable. There are two lane highways to each mine and industrial area which belong to the local state provincial government. The rail head to Nikolayevsky Concentrator section of road was constructed and maintained by Kazakhmys and is kept open for all weather conditions by the use of snow ploughs, and road graders. On site internal roads are capable to handle dump trucks. The state owned local road networks are also available for use by the operating mines. The local government roads have been designed and constructed to support 10 t axle weight of road haulage. Passenger and cargo transport are mostly by the Company although small one man operated local haulage contractors, private vehicles and local government transport services also utilise the roads.

4.6.2.2 Rail

The dispatch of the trains for ore rail transport from the Nikolayevsky concentrator is usually for the delivery of concentrate to the Balkhash smelter. These are programmed regularly based on delivery requirements over 24 hours to match concentrator stockpile inventory and demand requirements. At Artemyevsky rail head, ore from the mine is loaded into contracted train and wagon units for delivery and unloading of ore into the Kazzinc receiving station as a third party processor of ore. The Company's internal rail system operates on a gauge of 1,520 mm with four Russian manufactured 120 t locomotives type TM2 series which are diesel powered operating at 1,200 hp and aged from 1985 up to 1990. The internal rail transport department maintains and upgrades the local rail network for the complex and is responsible for 32 km of track. The comprehensive rail network gives access to all major locations and is vital in the transport of heavy plant by rail to the mine or industrial area in one piece.

4.6.2.3 Air

The Semey and Öskemen city airports serve this area of east Kazakhstan. Öskemen airport was constructed in the 1935 and is capable of accepting local and international flights. The terminal building external and internal structure and services is comparable to western standards. The Öskemen city airport is owned by the local government and management ensures good standards of maintenance and reliable services. The airport accommodates two air freight and passenger carrier company's; one owned by Kazakhmys. The airport has one runway 2,560 m long by 40 m wide and designed maximum landing load capacity of 300 t. It can accommodate Boeing 757,747 and Russian Antonov AN124 aircraft. The airport remains open most of the year and is only closed during conditions of poor visibility from fog or snow storms. The airport has major snow and ice runway clearance equipment for runway clearance as well as competent staff and well serviced workshops and maintenance bays and major fuel storage facilities as it was previously a major military airport.

4.6.2.4 Communications

There is a well developed communications networks which comprise of two telephone systems integrated into the National telephone service which is government owned.

4.6.2.5 Power

Power is provided by two hydro electric schemes operated by AES from the Shulba and Öskemen Hydro electric plants and the KEGOC national grid. These plants feed into the national grid system for transmission and distribution to supply electric power to this region of Kazakhstan operated by KEGOC. There is a supply agreement between the Company and Al Tay Energy. Electric power is transmitted and distributed over the industrial and mining area networks at both 220/110 kV and 35 kV depending upon transmission distance and load. The power utilisation voltage of 6.3 kV is derived at intake substations from step down transformers at the mine and concentrator for high capacity motor kW drives and also for transmission and distribution voltage to various load centres for each industrial complex. The East Kazakhstan Copper Chemical Complex electrical power system operates on a mesh system having one or two incoming supplies for each substation but can be interconnected to ensure security of power supply. Nikolayevsky Industrial concentrator complex intake has one 110 kV overhead line incoming feed from the national grid substation and two 110 kV supplies from the Shemonaikhinsky open pit substation. The mine and industrial sites have a mixed protective Earthing System with the mine underground HT and MT supplies and surface concentrator operating on a Isolated Neutral system with earth monitoring protection. The surface industrial and domestic areas 400/220 V system operates on a solidly grounded neutral earth system. Most industrial systems operate on the two transformer feed 100% stand-bye principle in which all incoming feeds have two supply transformers.

— One Operating.

— One spare powered as a hot standby.

This system, together with dual feed lines, ensure a good stable secure supply with little down time due to power supply and is reportedly limited to two power interruptions per year. The system classifications are as follows:

— 3 phase 50Hz 220/110 kV- IT system.

— 3 phase 50Hz 110/6 kV- IT system.

— 3 phase 50Hz 6/10 kV- IT system.

— 3 phase 50Hz 400/ 220 V-TN-C.

— 3 phase 50Hz 6/0.4 kV- IT system for mine sites.

4.6.2.6 District Heating Scheme

Hot steam from the boiler plant is employed to provide heating for industrial and domestic consumption. The steam is stored and pumped around the district with booster pumps at various locations to provide heating for homes and offices as well as hot domestic water for washing and bathing facilities. The use of domestic hot water provided by the district heating schemes involves no heat exchange in the final system but is drawn straight from the heat store supply. This means energy is being expended and requires constant injection of hot steam water 'topping up' water at origin as the hot water for domestic use is constantly being drawn off. Ust-Talovka and Shemonaikhinsky region are supplied from one steam raising station with four boilers for steam. The steam is stored and pumped around the district with booster pumps at various locations to provide heating for homes and offices as well as hot domestic water for washing and bathing facilities. The domestic hot water is provided by the same district heating boiler house with four boilers for hot water. Note that all boiler water is treated as is the domestic hot water which is expelled.

4.6.2.7 Water

There are two separate supplies of water for the complex.

Ust-Talovka comprising six deep well boreholes at 45 m depth producing 2,000 to 2,500 m^3per day. Each deep well boreholes is capable of producing 350 to 420 m^3 per day depending upon the season. This water is pumped to a 50 m^3 water treatment tank where it is dosed with chlorine and purified by anti bacterial lamps and then pumped on to two holding water storage tanks with a capacity of 1,000 m^3 each. This stored water is then pumped to supply the townships with potable water via two steel pipes each of 150 mm diameter. The water distribution system comprises of two supply ranges for security of supplies and for maintenance purposes.

Shemonaikha comprise of twenty deep well boreholes at 27 m depth producing 10,000 m^3 per day. Each deep well borehole is capable of producing 500 m^3 per day depending upon the season. This water is pumped to a water treatment tank where it is dosed with chlorine and purified by anti bacterial lamps and then pumped on to one holding water storage tanks located on the mountain. This stored water is then flows under gravity to supply the townships with potable water via two steel pipes ranging from 530 to 150 mm diameter depending upon system requirements. The water distribution system comprises of two supply ranges for security of supplies and for maintenance purposes.

Process water for the concentrators is provided by a closed water system involving water being pumped from reservoir concentrate and then to settling ponds. The solids are settled out and the water pumped back to the concentrate reservoir. This water is supplemented by water in times of hot weather due to evaporation.

The sewage and storm water is pumped into tanks or other digesters with treatment consisting of primary storage and settlement tanks, aeration tanks and second storage settlement tanks and finally to aeration lagoons with final discharge into the River Uba situated some distance from the potable water sources.

4.6.2.8 Social Amenities

Since independence from USSR all apartment housing is privately owned with existing tenants receiving free ownership. The company is still responsible for maintenance of external services. Most of the town housing consists of apartment blocks up to five/seven stories high and were erected in the 1960 (two storey blocks) 1970 (4 storey blocks) and 1980 (5 storey blocks). From the external appearance most of the apartment blocks appear to be in poor condition although some units are being renovated and refurbished. The town suburbs and remote dwellings consist of single and duplex buildings with corrugated roofing and wooden cladding.

The area has a number of health, educational and social amenities whose capacity depend upon location and activity and Ust-Talovka has one of the best sporting facilities in the area with gymnasium, boxing, sauna, football and ice hockey grounds.

Health care is provided to all employees with good local hospitals and dental treatment. Hospital facilities are providing by the Company who fund 100% of medical care for all employees and 90% of medical fees for Sanatoriums and Rehabilitation centres. Spouses, children and close relatives are charged at rate of 50%.

4.6.3 Orlovsky

The Zhezkent or Orlovsky Complex is the largest employers of labour in this side of the region. The other major employers in this location are Government service agencies. The infrastructure has been developed over the past 30 years as the complex was founded in 1974 for the exploitation of copper deposits located in this region and now employs approximately 3,000 people.

4.6.3.1 Roads

The majority of the road haulage and worker passenger transport is operated by local haulage contractors and local government. The Company transport department is responsible only for transportation of the workers and road freight from townships of Zhezkent and Orloka. Snow ploughs keep open the local roads during winter weather conditions. The Company provides workshops to support its motorised fleet of trucks, cars, and road building and construction equipment.

4.6.3.2 Rail

Orlovsky mine has a comprehensive rail system commencing at the mine to transport concentrate to the smelters in Balkhash and Zhezkazgan.

The complex has 4 main rail lines which serve the complex with the following designations:

- Two rail lines to reserved for the concentrator product.
- One rail line to reserved to serve the coal supplies.
- One rail line reserved to serve the cement used for the mine backfill process.
- One rail line reserved to for miscellaneous products such as fuel oil supplies for the central heating boiler plant.

The Company rail division operates with two types of rail wagon depending upon axles and size they consist of the following.

- Polish type rail wagon consists of six axles and has a payload of 105 t
- Russian type rail wagon consists of four axles and has a payload of 60 t.
- One flat car is employed for internal miscellaneous use.

The Company internal rail system operates on a gauge of 1,520 mm with three Russian manufactured 120 t locomotives type TEM which are diesel powered operating at 1,200 hp. The internal rail transport department maintains and upgrades the local rail network for the complex and is responsible for 54.4 km of track and manages 700 to 1,000 wagons per month. The rail operation company also has its own workshops to support, maintain and repair diesel locomotives and rolling stock but major overhauls are contracted out to specialist rail repair organisations. Rail passenger travel is by the state owned rail company with the national line serviced by local and national trains starting from the Neverousky local station.

4.6.3.3 Air

The Semy airport and Öskemen city airports service this area and both are capable of accepting local and international flights. The terminal building's external and internal structure and services are of a high standard. The Öskemen city airport is owned by the local government and airport management ensures good standards of maintenance and with reliable services. The airport accommodates two air freight companies and passenger carriers; one owned Kazakhmys.

The airport has snow and ice runway clearance equipment to ensure efficient runway clearance with competent staff. It is serviced by workshops and maintenance bays and major fuel storage facilities as it was previously a major military airport.

4.6.3.4 Communications

The Complex has developed communications networks which comprise of the three telephone systems integrated into the National telephone service which is government owned.

4.6.3.5 Power

Electrical power originates from the AES owned and operated Shulba and Öskemen hydro-electric plants feeding into the KEGOC national grid. Electric power is transmitted and distributed over grid area networks at both 220/110 kV depending upon transmission distance and load. The power utilisation voltage of 6.3 kV is derived at intake substations from step down transformers at the mine, and concentrator sites for high capacity motor kW drives and also for transmission and distribution voltage to various load centres for each industrial complex. The Zhezkent grid substation is supplied with the following incoming grid feeds:

— Shulba grid feed No1 220 kV main grid power supply (transformed down to 110 kV.

— Ust-Talouke grid feed No 2 110 kV main grid power supply (reserve power supply).

— Russian grid feed No 1 110 kV main grid power supply (emergency power supply).

— Russian grid feed No 2 110 kV main grid power supply (emergency power supply).

Zhezkent is supplied from the grid substation at 110 kV via two feeds from the grid substation. The 6.3 kV supply is derived from two 40 MVA step down transformers with dual 6.3 kV secondary windings. This voltage is employed via a double bus section system to the major loads. The mines operate on a on an Isolated Neutral system with earth monitoring protection employing Russian flameproof equipment. The FLP equipment is employed for its reliability and robustness. Concentrator and industrial sites have a mixed protective Earthing System with the mine underground HT and MT supplies and surface concentrator operating on an Isolated Neutral system with earth monitoring protection. The surface industrial and domestic areas 400/220 V system operates on a solidly grounded neutral earth system. Most industrial systems operate on the two transformer feed 100% stand-bye principle in which all incoming feeds have two supply transformers:

— One Operating.

— One spare powered as a hot standby.

This system together with dual feed lines ensure a good stable secure supply with little down time due to power supply and is reportedly limited to two power interruptions per year. The system classifications are as follows:

— 3 phase 50Hz 220/110 kV- IT system.

— 3 phase 50Hz 110/6 kV- IT system.

— 3 phase 50Hz 400/220 V-TN-C.

— 3 phase 50Hz 6/0.4 kV IT system for underground use.

4.6.3.6 District Heating Scheme

Hot steam is supplied from steam raising boiler plants which are employed to provide heating for industrial and domestic consumption. The steam is stored and pumped around the district with booster pumps at various locations to provide heating for homes and offices as well as hot domestic water for washing and bathing facilities. Zhezkent industrial area has one boiler plant with 4 units and each has a capacity 50 t of steam per hour at 14 bar located close to the settlement and the other to heat the mine complex and mine ventilating air. The use of domestic hot water provided by the district heating schemes involves no heat exchange in the final system but is drawn straight from the heat store supply. This means energy is being expended and requires constant injection of steam 'topping up' water at origin as the hot water for domestic use is constantly being drawn off.

4.6.3.7 Water

Process water is abstracted from the River Aley which is located in nearby Russia. The supply water system is owned and operated by a Russian water company which charges \$0.17 /m^3 for the water abstracted from the River Aley. The abstraction plant is 27 km from Zhezkent and process water is pumped directly from the river to the two underground storage tanks located in Zhezkent industrial area. Each tank has a capacity of 6,000m^3 and, to ensure security of supply, two steel transmission pipelines of 600 mm diameter transport the process water. The water is then distributed from the storage tanks to the Zhezkent industrial area to the process systems and, when finally expended, discharged into the settling ponds and tailings dam. Process water for the concentrators operates on a closed water system involving water being pumped from reservoir concentrate and then to settling ponds. The solids are settled out and the water pumped back to the concentrate reservoir. This water is supplemented by process water supply in times of hot weather evaporation and natural leakage and absorption.

Potable water is abstracted from twelve boreholes located in nearby Russia in the township of Georgievka 33 km from Zhezkent. The twelve boreholes are capable of producing 785 m^3ph at depths of between 90 to 160 m. The potable water supply water system is owned and operated by a Russian water company which charges US\$0.25 / m^3 for the water. The water is stored in 1000 m^3 tanks at Georgieyka and pumped directly two underground storage tanks located in the Zhezkent industrial area. Each tank has a capacity of 2,000 m^3 and two steel transmission pipelines of 500 mm diameter, to ensure security of supply, transport the potable water. The water is then distributed from the storage tanks to the Zhezkent domestic and industrial areas.

All domestic sewage and storm water is treated by pumping it into tanks or other digesters with treatment consisting of primary storage and settlement tanks, aeration towers and second storage settlement tanks and finally to aeration lagoons with final discharge into the tailings dam.

4.6.3.8 Social Amenities

Originally the housing was government owned but since independence from USSR all apartment housing is privately owned with existing tenants receiving free ownership. Most of the town housing was built in the 1970's, and 1980's and are in satisfactory condition. Apartment blocks up to three to five stories high were erected during the same period and are classed as satisfactory. All tenants have to pay for repair and maintenance of their dwellings but the water heat and sewage systems maintenance is paid by the company. Kazakhmys owns the shell of the 50 apartment blocks and pay for the maintenance which consist of varying number of apartments from 30 to 170 apartments per block. From the external appearance most of the apartment blocks appear to be in satisfactory condition although some units are being renovated and refurbished.

Hospital facilities are providing by the company who fund 100% of medical care for all employees and 90% of medical fees for Sanatoriums and Rehabilitation centres. Spouses, children and close relatives are charged at rate of 50%.

4.7 Environmental

4.7.1 Environmental Management System

Kazakhmys has a centralised environmental management system based in and co-ordinated from Zhezkazgan, with local control provided by environmental managers at each of the main operating centres. It is not a recognised, formal system and there was no evidence of a corporate environmental policy.

The environmental department appears to be focussed on the compilation of information for the calculation of environmental taxes and preparing the annual emission reports necessary for the permitting process. Responsibility for monitoring programmes, acting on emission monitoring results and developing environmental initiatives is limited.

There are no routine meetings or consultation with community representatives but it was stated that there are very few complaints or issues raised by the local population.

Environmental training is co-ordinated at central level and includes training on legislation at the Ministry of Environment for environmental managers and assistants. A responsible person at each main division provides general environmental training.

4.7.2 Belousovsky Complex

The sites within the Belousovsky Complex (Belousovsky concentrator, Berezovsky concentrator and mine) are located at small settlements within an area of approximately 20 km^2 approximately 30 km to the north east of Ust Kamenogorsk, the regional capital. Outside the city the countryside is rural, characterised by low hills, with trees and some agriculture. The main surface water features are the rivers Uba and Glubochanka, which flow into the River Irtysh, and the Shulbinskoye reservoir to the west of Berezovka.

The climate is continental with calm wind conditions prevailing for over 40% of the time. Wind is mainly from the south-east and north-west.

4.7.2.1 Status

The facilities within the Belousovsky complex have been in operation for up to almost 70 years. Although no specific or accidental releases of materials have been reported, some local contamination of the ground may have occurred particularly around storage areas for tailings and the general concentrator area. No treatment of wastewater is currently taking place prior to disposing of it at the tailings facility.

Solid Waste

The main solid waste materials are tailings from the concentrator plants. Tailings from the Belousovsky concentrator are stored in a dam close to the concentrator with a present height of approximately 5 m. The Berezovsky tailings are pumped to a dam, with a present height of approximately 22 m, located 2 km from the concentrator.

No reporting on the quantities of waste materials produced and stored by the operations within the complex was provided. According to Kazakhmys, the quantities of all materials produced and stored were within the permitted amounts. The tailings stored at Belousovsky and Berezovsky totalled approximately 21 and 14 Mt respectively.

Air Quality

The major impact on air quality at both concentrators is dust and currently no dust suppression is taking place.

Chemicals and Reagents

Reagents used for selective flotation of copper and zinc concentrates include Xanthate, other organic reagents, sodium sulphide, copper sulphate, zinc sulphate and lime. Some of these are stored in dedicated, locked areas at the reagent preparation plants at each concentrator.

Surface Water

There is no obvious system for collection of water run-off from the concentrator plant areas. As no permits conditions were provided, groundwater monitoring results were compared with the local Kazakhstan normative standards for maximum allowable concentrations. These results are indicated in Table 4-27 below.

Table 4-27 Down Stream Surface Water Monitoring

No	Parameter	Max permissible concentration (mg/l)	Belousovsky— Glubockanka River	Irtyshsky— Krasnoyarka River
1	pH	6.5 - 8.5	8.33	8.433
2	TSS	BG + 0.25	8.7	6.7
3	TDS	1000	406.33	476
4	Ca	180	91.7	80.88
5	Mg	40	31.19	26.65
6	Chloride	300	20.73	7.85
7	Sulphate	100	141.51	88.78
8	Nitrate	40	10.93	11.8
9	Nitrite	0.08	0.035	0.048
10	Fe	0.1	0.0697	0.084
11	Cu	0.001	0.014	0.019
12	Zn	0.01	0.32	1.97
13	Pd	0.1	0.0163	0.023
14	Cd	0.005	0.0036	0.014
15	Mn	0.01	0.0173	0.108
16	Hydro-carbons	0.05	0.028	0.0455
17	Ammonium	0.5	<0.01	0.35

The most significant surface water non-compliant parameters at both concentrators are sulphates, copper zinc and lead. These high concentrations may be due to the non-existent system for the collection of water runoff, and the lack of wastewater treatment prior to disposal at the tailings facility.

Waste Water

There is currently no discharge of waste water from the concentrator plants. However, water quality monitoring is performed above and below the plants.

There is no obvious system for collection of water run-off from the concentrator plant areas. As no permits conditions were provided, groundwater monitoring results were compared with the local Kazakhstan normative standards for maximum allowable concentrations.

Acidic water pumped from Irtyshsky mine is treated in a neutralisation plant where lime is added using an automated dosing system to control the pH at between 9.5 and 11. The neutralised slurry is settled in two thickener vessels and the water overflow is discharged to the River Krasnayorska. Thickened slurry is pumped to ponds where the sludge is allowed to dry by evaporation during summer.

All waters decanted from the tailings storage ponds are recycled back to their respective concentrators. However, some water is released to the rivers.

4.7.2.2 Potential Impacts

A summary of the significant point and fugitive emission sources within the operations is shown in Table 4-28 below.

Table 4-28 Main Sources of Air Emissions

Area/Operation	Emission type	Management Measures
Belousovsky Concentrator		
Ore crushing	Dust	No hygiene extraction system
Reagent preparation	Dust, chemicals	Mixing tanks have hygiene extraction systems vented to atmosphere.
Flotation	Mist, H_2S, CS_2	Natural ventilation via roof vents
Berezovsky Concentrator		
Ore crushing	Dust	Cyclone collector, dust capture efficiency only ~65%
Reagent preparation	Dust, chemicals	Mixing tanks have hygiene extraction systems vented to atmosphere.
Flotation	Mist, H_2S, CS_2	Natural ventilation via roof vents

4.7.2.3 Permitting

Belousovsky has a single environmental permit but each of the operating sites is assigned permissible release quantities.

The permissible quantities for substances released to water are summarised in the following sections. The permit includes general requirements to carry out programmes to minimise emissions and to report annually the emissions inventory. No permit for permissible quantities of emissions to air was presented. In addition, no air quality monitoring data was presented upon request. It is thus assumed that no air quality monitoring is currently taking place at the two concentrators.

No copies of environmental permits were supplied. According to Kazakhmys, all annual water monitoring reports were submitted to the Ministry of Environment. Furthermore, all environmental tax payments due are up to date.

4.7.2.4 Monitoring

Monitoring is carried out according to established schedules with frequencies dependant on the hazard classification of substances emitted. The site laboratories carry out routine monitoring to check efficiencies of emission control equipment and water treatment systems.

A certified independent laboratory, Kazecology, prepares an annual report on water quality and underground water contamination. Kazecology reports the results directly to the environmental authority at Ust Kamenogorsk as well as to Kazakhmys.

Kazecology monitors river water upstream and downstream of the points of discharge both for chemical and biological parameters. Underground water is monitored for dissolved metals and minerals at positions near the tailings storage ponds.

No monitoring results for air quality (including dust) or soil were provided. However, the environmental monitoring programme confirms that only surface and groundwater monitoring is currently taking place. Although no water discharge is taking place within the complex, surface water monitoring is done within the River Globochanka and the River Krasnoyarka, downstream from the concentrator plants.

Groundwater monitoring is also taking place at three sites: at the water inlet, near the storage facilities and downstream of the tailings dams.

4.7.2.5 Action Plans

The main actions to be addressed are:

— General housekeeping at Belousovsky concentrator;

— Fencing of the tailings facility at Belousovsky concentrator;

— Dust suppression to take place at both concentrators; and

— Inclusion of air quality, soil and sediment monitoring within the complex.

4.7.2.6 Summary of Potential Risks and Liabilities

Belousovsky Concentrator

The concentrator was constructed in 1945 and appears in reasonable clean condition considering its age. General housekeeping is however required, as it was noted that various leaks in the pipe system exist. Dust suppression at the concentrator site is also required. According to Kazakhmys, the tailings facility has sufficient capacity until 2013. However, it was noted that the facility is not fenced off, and cattle were drinking from the tailings dam.

Berezovsky Concentrator

The concentrator was installed in 1957 and has a good state of housekeeping in all areas. Dust suppression at the concentrator site is however required. It was noted that the concentrate loading facility is situated directly adjacent to a water course. Due to a lack of dust suppression, this water course may be polluted by existing operations.

4.7.3 Copper Chemical Complex

The Copper-Chemical Complex consists of the Artemyevsky mine, Nikolayevsky mine and concentrator. The operations are located in the Shemonaikhinsky district of East Kazakhstan within an approximately 10 km radius of the town of Shemonaika, approximately 100 km from Ust Kamenogorsk. Nikolayevsky mine lies to the east of the settlement of Ust Talovka, approximately 10 km south of Shemonaika.

Outside the urban areas the country is characterised by gentle hills, with some wooded areas and agriculture. The important surface water features of the region are the Rivers Uba a tributary of the Irtysh, which flows through Shemonaika and Ust Talovka, and the tributaries Talovka, Shamonaika and Berousovska.

The atmospheric conditions are generally calm with winds in January from a northerly direction for approximately 21% of the time and from a southerly direction for approximately 31 % of the time. In July the wind is from the north for 32% of the time.

4.7.3.1 Status

Generally the operations within this complex have a low to moderate potential for environmental impact. The most significant issues relate to inefficient dust control systems and the concentrate dryer off-gases. These fall below modern equipment standards. However the plan to replace concentrate dryers with pressure filters will eliminate a significant source of air emissions.

Solid Waste

The main solid waste materials are:

— Waste rock from the mines;

— Tailings from the Nikolayevsky concentrator; and

— Sludge produced by neutralisation of mine water.

Topsoil and waste rock from the mines are stored in separate stockpiles close to the pit.

Nikolayevsky concentrator tailings are pumped to two ponds close to the concentrator. According to Kazakhmys the ponds have sufficient capacity for tailings up to 2013. All of the tailings decant water is recycled back to the concentrator. Sludge produced from the water neutralisation is stored at a special site and covered with topsoil. The tailings at Nikolayevsky total approximately 28 Mt. The permitted quantities for storage of hazardous waste materials in 2010 are given in Table 4-29 below.

Table 4-29 Permitted Quantities of Solid Waste

Waste	Hazard Classification	Permitted Quantity (t)
Tailings	III	1,938,000
Nikolayevsky mine waste rock	IV	2,850,000
Nikolayevsky water treatment sludge + topsoil	V	1,800
Artemyevsky water treatment sludge	IV	540

Air Quality

The main point sources of air emissions are the concentrate dryer at the Nikolayevsky concentrator. Rotary kilns used for drying concentrate and calcining lime are heated using mazut heavy oil. Emissions to air from the Artemyevsky mine, formerly an open pit operation but now being developed under ground, are of low significance.

During 2008 – 2009, all parameters were found to be within the permissible limits. The reported emissions are based largely on normative indices and material balance calculations and therefore they correlate mainly with the actual production levels achieved.

Chemicals and Reagents

Dust is suppressed using water sprays in summer if necessary. Mazut heavy fuel oil, used at the concentrator for heating the kilns, is delivered by rail tanker and stored in two underground tanks capacity 700 t each. Petrol and diesel are stored in above surface tanks without spill containment bunds.

Reagents used for selective flotation of copper and zinc concentrates include Xanthate, small amounts of other organic reagents, sodium sulphide, copper sulphate, zinc sulphate and sodium cyanide. Small quantities, sufficient for a few days supply, are stored in dedicated areas at the reagent preparation plant at the Nikolayevsky concentrator. The sodium cyanide store is a restricted area and breathing apparatus is required for access.

The main chemical store is in a secure, guarded compound approximately 2 km from the concentrator and access is only by special permit.

Surface Water

The latest (2010 first quarter) surface water results, 500 m below the Nikolayevsky operations within the River Uba was assessed. These results are indicated in Table 4-30 below and show that all parameters fall within the normative standards for maximum allowable concentrations.

Table 4-30 Down Stream Surface Water Monitoring

Parameter	Permissible Concentration (mg/l)	River Ulba
Ca	180	50.83
Mg	4	11.93
Chloride	300	—
Sulphate	100	52.967
Nitrate	40	6.297
Nitrite	0.08	0.02
Fe	0.1	0.058
Cu	0.001	0.009
Zn	0.01	0.01
Pd	0.1	0.004
Cd	0.005	0.0004
Mn	0.01	0.01
Hydrocarbons	0.05	—
Ammonium	0.5	0.23

4.7.3.2 Potential Impacts

A summary of the significant point and fugitive emission sources within the operations is shown in Table 4-31 below.

Table 4-31 Main Sources of Air Emissions

Area/Operation	Emission Type	Management Measures
Nikolayevsky Open Pit Mine		
Drilling and blasting	Dust	Mine water used for suppression during summer.
Material handling	Dust	Mine water used for suppression during summer.
Ore transport	Dust	Mine water used for suppression during summer.
Nikolayevsky Concentrator		
Ore crushing	Dust	Fabric filter, ~85% dust capture efficiency.
Reagent preparation	Dust, chemicals	Mixing tanks hygiene extraction system vented to atmosphere.
Flotation	Mist, Carbon bisulphide	Natural ventilation via roof vents.
Concentrate drying	Dust, products of heavy oil combustion	Cyclone dust collectors followed by wet scrubbers, overall dust capture efficiency~85%.
Lime calcining	Dust, products of heavy oil combustion	Cyclone and wet scrubbers.

4.7.3.3 Permitting

The Copper-Chemical Complex has a single environmental permit but each of the operating sites is assigned permissible release quantities.

The permissible quantities for substances released to water are summarised above. The permit includes general requirements to carry out programmes to minimise emissions and to report annually the emissions inventory.

All permits relating to air quality, soil and water monitoring were presented. The complex is in compliance with all the provisions of the permits. The permitted air emission levels are not directly comparable with internationally accepted standards, which generally specify limits in terms of concentration rather than mass emission. However, according to Kazakhmys, there is a move towards more definitive regulatory standards in Kazakhstan legislation, which are either comparable or more rigorous than international standards.

4.7.3.4 Monitoring

Monitoring is carried out according to established schedules with frequencies dependant on the hazard classification of substances emitted. Nikolayevsky laboratory carries out routine monitoring to check the efficiencies of emission control equipment and water treatment systems.

A certified independent laboratory, Kazecology, prepares an annual report on air and water quality, soil, snow and underground water contamination and radioactivity. Kazecology reports the results directly to the environmental authority at Ust Kamenogorsk as well as to the complex.

Off-gases from the concentrate dryer are monitored at frequencies of 4 to 8 times annually. Concentrations of dust and lead in the ambient air are monitored monthly by the Company's laboratory at points on the perimeters of the protection zones surrounding the main sites. In addition, Kazecology carries out independent monitoring 2 to 3 times per year.

Treated water from the Nikolayevsky mine is monitored every shift for pH and some dissolved metals and less frequently for other parameters. Treated water from the Artemyevsky mine is analysed infrequently because the flow is not continuous throughout the year. Water quality in the rivers and streams upstream and downstream of the waste water discharge points are monitored monthly for most parameters and quarterly for others.

Underground water is monitored for dissolved metals and minerals at positions near the Nikolayevsky tailings ponds.

4.7.3.5 Action Plans

The main actions to be addressed are:

— Bunding of the petrol and diesel storage facility at Nikolayevsky mine;

— Rehabilitation of contaminated soils where AMD-related spillages occurred;

— Re-commissioning of the water treatment facility at the Nikolayevsky mine;

— Replacing the concentrate dryer with pressure filters; and

— Replacing the current concentrate drying system.

4.7.3.6 Summary of Potential Risks and Liabilities

Nikolayevsky Mine

The operation appeared in a tidy condition and waste dumps well constructed. Some vegetation is becoming established on the lower sides of some heaps. Facilities for treating mine water and water from the waste stockpile were however not in a working condition and acid mine drainage (AMD) is evident. Evidence of occasional flooding of the treatment was also noted.

Nikolayevsky Concentrator

The working atmosphere and state of housekeeping were reasonable in most areas except in the concentrate drying plant. The smell of sulphur oxide in the atmosphere was evident. The ore crushing plant was under maintenance and therefore the effectiveness of dust ventilation systems could not be assessed.

There are two tailings dams with sufficient capacity up to 2013 at the current production rate. Piezometers for monitoring water levels are located in the dam walls and the dams are inspected four times annually by a state organisation. IMC understands that there have been no failures or incidents since the dam was constructed in 1978.

Artemyevsky Mine

Mining in the open pit has ceased and the activities are focussed on the underground development.

4.7.4 Orlovsky

Orlovsky mine and concentrator are located in north east Kazakhstan, 3 km from the small town of Zhezkent and approximately 5 km from the Russian border. Zhezkent has a population of about 10,000 and its economy is almost totally dependent on the mine. The nearest large cities in the region are Ust Kamenogorsk, approximately 270 km to the east, and Semipalatinsk approximately 130 km to the south west.

The land in the immediate vicinity of the site is flat and featureless with sparse vegetation. The wind is predominantly from the south. There are no nearby surface water features; industrial water and drinking water are supplied from Russia.

4.7.4.1 Status

Solid Waste

The main solid waste materials are:

— Waste rock from construction of mine shafts and mining; and

— Tailings from the Orlovsky concentrator.

Waste rock produced during shaft sinking is stored in heaps close to the shaft heads. The current mine production of waste rock is all used for back fill. Approximately 35% of the concentrator tailings are used as a constituent of the backfill used in the underground mine. The balance is pumped to a storage facility approximately 3 km from the plant. IMC understands that seepage water is collected in a channel surrounding the dam and returned to the pond.

No reporting on the quantities of waste materials produced and stored by the operations within the complex was provided. According to Kazakhmys, the quantities of all materials produced and stored were within the permitted amounts.

Air Quality

All emissions are within the permissible limits. The reported emissions are based to some extent on monitoring results but also on normative indices and material balance calculations and therefore they correlate mainly with the actual production levels achieved. Dust is suppressed using water sprays in summer if necessary.

Chemicals and Reagents

Reagents used for selective flotation of copper and zinc concentrates include Xanthate, small amounts of other organic reagents, sodium sulphide, copper sulphate, zinc sulphate and lime. Small quantities, sufficient for a few days consumption, are stored in dedicated areas at the reagent preparation area of the concentrator. The mixing tanks are equipped with hygiene ventilation systems and the working area is also ventilated.

The main chemical store is within a secure, guarded compound approximately 1 km from the concentrator and access is only by special permit. Chemicals are delivered directly to the store by rail. Each chemical has a dedicated storeroom secured with a sealed padlock and equipped with ventilation systems. Some sodium cyanide is still held in the store but additional restrictions and precautions are applied to gain access.

Mazut heavy fuel oil, used at the concentrator for heating the kilns, is delivered by rail tanker and stored in three above surface tanks having a combined capacity of approximately 1,300 t. There is no spill containment bunding.

Petrol and diesel are stored in a fenced compound containing 24 above surface tanks with individual capacities ranging from 5 to 400 m^3 and combined capacity of approximately 1,000 m^3. The area is not bunded but there are facilities for spill collection around the tanks.

Waste Water

There is no discharge of water from the Orlovsky site. Water pumped from the mine is slightly alkaline and only requires treatment by settlement to remove suspended solids. The clarified water is recycled for use underground and for making cement for underground construction. All water decanted from the tailings storage facility is recycled back to the concentrator.

4.7.4.2 Potential Impacts

A summary of the significant point and fugitive emission sources are shown in Table 4-33 below.

Table 4-32 Main Sources of Air Emissions

Area/Operation	Emission Type	Management Measures
Orlovsky Mine		
Ventilation air	Dust	
Material handling	Dust	Ore is moist
Orlovsky Concentrator		
Reagent preparation	Flotation reagents	Mixing tanks have hygiene extraction system vented to atmosphere.
Flotation	Flotation reagents, carbon bisulphide	Natural ventilation via roof vents
Concentrate dryers	Dust, products of heavy oil combustion	Cyclone dust collectors followed by wet scrubbers, overall dust capture efficiency~85%

4.7.4.3 Permitting

The Orlovsky or Zhezkent Complex has a single environmental permit but each of the main operating areas is assigned permissible release quantities.

All permits relating to air quality, soil and water monitoring were presented. The complex is generally in compliance with all the provisions of the permits. The major sources of non-compliance are in the presence of excess sulphates and lead in waste water. An excess of SO_2 is also anticipated.

4.7.4.4 Monitoring

Monitoring is carried out according to established schedules with frequencies dependant on the hazard classification of substances emitted. The Zhezkent laboratory carries out routine monitoring to check efficiencies of emission control equipment and water treatment systems. Ambient air quality, snow, underground water and industrial water are also monitored.

A certified independent laboratory, Vostok Vodochistka, prepares an annual report on air and water quality, soil and underground water contamination and radioactivity. The results are reported directly to the environmental authority at Ust Kamenogorsk as well as to Kazakhmys.

Emissions are monitored at quarterly intervals by KCC and annually by Vostok Vodochistka for dust, SO_2, NOx and CO. Concentrations of dust, CO, SO_2 and NO_2 in the ambient air are monitored monthly by the Company's laboratory at points on the perimeter of the protection zone and other points in the surrounding area. Daily average limits for dust in air are not exceeded at the monitoring positions on the perimeters of the sanitary protection zones.

The Zhezkent laboratory routinely monitors drinking water, industrial water, recycled mine water and waste water. Underground water is monitored quarterly, by Zhezkent laboratory and annually by Vostok Vodochistka, for dissolved metals and minerals at positions near the tailings storage facility and at a control point at a higher level.

4.7.4.5 Action Plans

The main actions to be addressed are:

- Bunding of the petrol and diesel storage facility at Orlovsky mine.

4.7.4.6 Summary of Potential Risks and Liabilities

Orlovsky Mine

The site, including fuel and chemical storage facilities, was in a reasonably clean and tidy condition.

Orlovsky Concentrator

The working atmosphere and state of housekeeping were reasonable in most areas except in the concentrate drying plant. Ore contains approximately 9% moisture as delivered from the mine and is not crushed prior to grinding. The ore receiving bin is equipped with a ventilation system.

The tailings storage facility appeared well managed. Since it was originally designed to receive three types of tailings there are 5 delivery pipes from the concentrator. Only 3 of these are normally in use and this provides a high degree of flexibility and sufficient spare capacity for maintenance.

5 KARAGANDA REGION

5.1 Maps and Plans

Plate 20	Nurkazgan Open Pit
Plate 21	Abyz Mine
Plate 22	Akbastau Open Pit Project
Plate 23	Kosmurun Mine Project
Plate 24	Bozshakol Open Pit Project

5.2 Nurkazgan Geology

The Nurkazgan mine site is located at 38 km NNW of the centre of the city of Karaganda, latitude 50° 09’ 30”, longitude 72° 59’ 50”. It lies at 155 km to the south-east of Astana.

The Nurkazgan mine area is sited immediately to the west of a major tectonic structure representing proximity to the line of an ancient continental suture; this structure is marked by a major regional fault of strike approximately N-S. This fault zone affects the area immediately east of the Nurkazgan orebodies and is interpreted to cut the eastern orebody and to separate it from the South-East Nurkazgan Prospect currently under investigation.

The Nurkazgan mineralization is controlled by a major intrusive quartz diorite porphyry stock, which forms part of the Karaganda Intrusive Complex. The host rocks are a sedimentary sequence of clastic and volcanoclastic strata of Devonian age which have been intruded successively by two or three phases of igneous intrusion during the period late Devonian to late Carboniferous.

The orebodies are arranged peripheral to the quartz diorite in the contact zone within the Devonian sediments and volcanics. The west zone comprises ore shoots and breccia pipes generally dipping steeply to the west and south-west, reflecting the steep contact of the quartz diorite stock. The east zone is the opposite margin of the intrusion with oreshoots dipping steeply and generally eastwards; this zone is more affected by steep diorite porphyry dykes which are sub-parallel with main N-S regional fault. This major fault zone dips steeply westwards and cuts the east zone orebodies at depth and apparently displaces the mineralized structure such that the SE Nurkazgan Prospect appears to have been in continuity with the main Nurkazgan east zone, from which it is now separated by the fault zone.

5.2.1 Reserves and Resources Statement

The orebodies for which resources have been estimated have been defined in accordance with parameters approved by GKZ: for open-pit resources a cut-off grade of 0.3% Cu is applied and for underground resources a cut-off grade of 0.5% Cu is applied but always subject to a minimum average grade in all assessed sections of 0.62% Cu.

In accordance with the CRIRSCO Guidelines all C1 category reserves have been assigned to measured resources and C2 category to indicated resources.

Table 5-1 below shows the resource statement estimated as at 1 January 2011.

Table 5-1 Nurkazgan Resources Estimated as at 1 January 2011

Nurkazgan Mine		Resources	Copper	Zinc	Gold	Silver	Molybdenum
		'000 t	*%*	*%*	*g/t*	*g/t*	*%*
	Measured	106,847	1.12	—	0.39	2.64	0.1
	Indicated	93,749	0.63	—	0.38	1.31	0.1
	Total	**200,596**	**0.89**	**—**	**0.38**	**2.02**	**0.1**
	Inferred						—

Reflecting that current schedules envisage production only from underground, the estimation of reserves has been restricted to Measured and Indicated Resources identified for underground extraction in the West Block only. Table 5-2 below shows Proven Reserves relate to those blocks which, at 1 January 2011, had been accessed or were, to a further degree, prepared and ready for extraction.

Table 5-2 Nurkazgan Reserves Estimated as at 1 January 2011

Nurkazgan Mine		Reserves	Copper	Zinc	Gold	Silver	Molybdenum
		'000 t	*%*	*%*	*g/t*	*g/t*	*%*
Nurkazgan	**Proved**	115,719	0.93	0.1	0.32	2.19	0.1
LOM + 20 Years	**Probable**	8,481	0.83	0.1	0.41	3.25	0.1
	Total	**124,200**	**0.92**	**0.1**	**0.33**	**2.27**	**0.1**

5.2.2 Estimates of Tonnages and Grades

Surface mining of the main West Pit was completed at a depth of 160 m from surface, at level 400 m. A small amount of ore was also extracted from the North Pit area in 2008 but all surface mine extraction ceased in that year.

The underground mine currently exploits two blocks, the western block around the periphery of and under the now completed West Pit surface mine, and also a southern block, linked by a tunnel at the 245 m level. The underground mine has now developed down to the 245 m level, with corresponding preparation of access to mining blocks at this level.

All resources in the Nurkazgan West Block are assessed as for underground mining only; these comprise C_1 and C_2 category reserves in the FSU system down to the -420 m level. All resources in the East and North blocks are in the C_2 category and have been estimated on the basis of being worked by open-pit, although for the East block over half of the assessed reserves fall outside the conceptual open-pit perimeter.

For the West block, the total of C_1 category represents resources which may be considered both Measured and Indicated. Resources above the 240 m level are considered to be Measured, reflecting the extent of mine development and preparation at and above this level. All remaining C_1 category in the West Block plus C_2 category in the West, North and East blocks which fall within mine design perimeters are considered Indicated Resources. The C_2 category tonnage in the East block which falls outside the conceptual pit perimeter and for which potential extraction in future is not clear, are considered to be Inferred Resources.

5.2.3 Expected Recovery and Dilution Factors

For underground mining, losses on extraction of in situ resources are assessed at 10%; dilution is assessed as 16.9%.

5.3 Abyz Geology

The Abyz mine site is located at 250 km ESE of the city of Karaganda; latitude 49° 25' 07", longitude 76° 29' 40".

Abyz mine is located in a complex of lower and mid-Palaeozoic (Ordovician—Devonian) sedimentary strata which have suffered folding and locally intense faulting, a sequence of intrusive episodes and corresponding metasomatism. This structural complexity reflects that this area is lies within an arcuate zone marking the major tectonic divide through Central Kazakhstan and caused by the collision between large continental plates giving rise to a complex orogenic episode. In the immediate vicinity of Abyz Mine the country rock comprises Devonian volcanoclastic sediments, tuffs, andesites and some basalts, with a steep dip of over 70^{o} to the west. This sequence hosts the mineralization which occurs in generally sub-parallel lenticular orebodies; both the host sequence and mineralized units are cut by near-vertical and steep-sided diorite intrusions and pervasive metasomatism occurs throughout.

Up to thirteen orebodies occur as a number of lenticular and tabular units which dip steeply to the west with a more or less N-S strike, extending in total over a distance of approximately 800 m. The main orebody shows a thickness of up to 30 m and has been largely exploited in the open-pit. The orebodies which comprise the majority of resources for underground working are in tabular units of thickness generally less than 5 m thickness. The orebodies show a general distribution in two ore zones, of which the east ore zone is at more shallow depth and has been to a large extent exploited in the open-pit, while the western ore zone is a at greater depth and has been identified down to the depth of the 140 m level and will be worked exclusively by underground methods.

Copper-zinc-gold ore occurs as both massive and disseminated mineralization. Principal ore minerals are pyrite, sphalerite and chalcopyrite; minor lead mineralization also occurs mostly in the form of galena.

5.3.1 Reserves and Resources Statement

Orebodies have been defined in accordance with parameters approved by GKZ in 1993. For open-pit resources a cut-off grade of 1.0 g/t Au equivalent has been applied and for underground resources a cut-off grade of 2.0 g/t Au equivalent. For underground resources a minimum average grade for any assessed ore zone must be in excess of 2.4 g/t Au equivalent. The minimum orebody thickness for inclusion in open-pit resources is 3.0 m and for underground resources this is 1.0 m; the maximum thickness of non-ore material to be included within the assessment of resources in the orebody is 4.0 m.

The gold equivalent grade is assessed by the following relationship:

$$Au_{eq}\ g/t = (Au\ g/t + (Au\ g/t \times 0.01) + (Cu\% \times 1.20) + (Zn\% \times 1.17))$$

For calculation of gold equivalent the GKZ ruling is that only values shall be used which are greater than: 0.7 g/t Au, 8.0 g/t Ag, 0.25% Cu and 0.50% Zn.

A revised estimate of remaining resources for open-pit extraction down to the 670 m level, due for extraction before the end of 2012, has been estimated as at 1 January 2010 and is considered a reliable statement of Measured Resources. Table 5-3 below shows the resources estimate as at 1 January 2011. In accordance with the CRIRSCO Guidelines, C1 category reserves have been assigned to measured resources and C2 category to indicated resources.

Table 5-3 Abyz Resources Estimated as at 1 January 2011

Abyz Mine		Resources	Copper	Zinc	Gold	Silver	Lead
		'000 t	*%*	*%*	*g/t*	*g/t*	*%*
Abyz	**Measured**	4,847	1.72	3.20	4.65	39.02	0.4
	Indicated	1,729	1.04	3.42	3.89	38.45	0.4
	Total	**6,576**	**1.54**	**3.26**	**4.45**	**38.87**	**0.4**
	Inferred	—	—	—	—	—	—

It is considered that the level of planning and development of operations and the detail of knowledge of the remaining orebodies in the open-pit are commensurate with requirements for the definition of reserves. However, given that neither detailed planning and scheduling nor preparatory works for underground working have commenced, it is considered inappropriate that the resources for underground working should be considered reserves. Table 5-4 shows the reserves statement estimated as at 1 January 2011.

Table 5-4 Abyz Reserves Estimated as at 1 January 2011

Abyz Mine		Reserves	Copper	Zinc	Gold	Silver	Lead
		'000 t	%	%	g/t	g/t	%
Abyz	**Proved**	1,826	1.3	3.7	5.49	41.48	0.5
LOM 2 Years	**Probable**	82	0.71	4.97	9.72	76.93	0.5
	Total	**1,908**	**1.27**	**3.75**	**5.67**	**43**	**0.5**

5.3.2 Estimates of Tonnages and Grades

Open-pit production in the years 2004 – 2009 has been very variable, reflecting that some years, and in particular 2007, the primary effort was in preparatory stripping. Mining of the current open-pit will cease in 2012, when the base of the pit will reach the 670 m level.

A conceptual design for the underground mine comprises a project of two shafts to attain the maximum planned depth of the underground mine at 190 m.

5.3.3 Expected Recovery and Dilution Factors

Reserves for the open-pit operation have been estimated with the modifying factors experienced in open-pit operations since 2004: losses of 3.5% and 8.4% dilution of non-grade material.

5.4 Mizek Geology

Mizek mine is located in the East Kazakhstan Region at 325 km ESE of the city of Karaganda and at 270 km SW of the city of Semey (Semi-Palatinsk): latitude 48° 52' 12", longitude 77° 25' 12".

The deposit was discovered in the 1930s. Initial exploration was primarily directed to evaluate the gold-bearing oxide zone of the deposit and then from 1982 detailed exploration was performed to evaluate the polymetallic sulphide zone.

Mining of oxide ore commenced in 2001, for which two open-pits have been developed to supply the heap-leach operation. Of these the southern pit has exhausted all oxide ore and is now closed, while operations continue in the northern pit, although there is now very limited ore accessible in the base of the pit and mining operations for oxide ore were completed in September 2010 but leach recovery will continue into the first half of 2011.

The Mizek deposit is located in a complex structural environment and is hosted in a folded and faulted sequence of Ordovician—Silurian volcano-sedimentary strata with a predominant structural trend marked by sinuous NNE-SSW faults and fold axes. Also adjacent to the ore zone are elongate bodies of hypabyssal andesite porphyry and plagioclase porphyry of Ordovician and Silurian age, while the terrain further to the west is occupied by a more extensive Devonian igneous complex. The deposit has been interpreted as occupying the core of a Lower Palaeozoic strato-volcano and orebody genesis can be considered to correspond to a VMS (volcanogenic massive sulphide) style. However, there is pervasive prophyllitic alteration (sericite, epidote mixed layer clays) and metasomatism through the immediate country rocks and the extent of secondary silicification has been interpreted as a control on economic sulphide mineralization, possibly related to remobilization of gold and by controlling lateral continuity.

The oxide zone has been well-developed over the mineralized area and is characterized by weakly-cemented ferruginous and locally kaolinized material. In the mine the contact between oxide and sulphide material can be generally visually identified; it is a very uneven line of contact with some narrow extensions of oxide material extending in depth below the general undulating contact surface. As a general rule the oxidation zone extends between 40 m – 75 m depth from surface.

In the sulphide zone the orebody morphology, based on block modelling of grades, is interpreted to comprise up to 9 separate orebody structures or lineations within which there are a number of lenticular oreshoots. While the linear structure of the orebody units can be traced for 100s of metres, individual oreshoots may be isolated and of small dimensions. Structural sections based on interpretation of lithologies in borehole core indicate that the orebody units are sub-parallel and dip at 75° – 80° to the east and are cut by near-vertical dykes of andesitic porphyry and plagioclase-horneblende porphyry and also by wedges of secondary quartz hornfels.

Ore minerals in the sulphide zone are predominantly represented by pyrite and chalcopyrite. There is a minor presence of sphalerite and rarely native gold may occur. Non-metallic minerals comprise chlorite, feldspar, mica, quartz and small amounts of barite and carbonate. The mineralization process is interpreted to have occurred in a number of hydrothermal stages. Gold formed in an early phase associated with quartz and polysulphides represented by a quartz-chalcopyrite-tennantite association. In a subsequent phase gold was re-mobilised and re-precipitated on colloform aggregates of goethite in a goethite-barite association.

5.4.1 Reserves and Resources Statement

The official resources statement approved by GKZ in 2008 comprised an estimate prepared by conventional manual methods using a cut-off grade of 1 g/t Au_{eq} (gold equivalent) for open-pit mining of oxide ores and 2 g/t Au_{eq} for underground mining of sulphides.

Subsequent estimates of sulphide ore have also been prepared using geostatistics-based block modelling. The IMC Montan resources estimate as at 1 January 2010 has been prepared using a cut-off grade of 3.0 g/t Au_{eq} for sulphide ore assessed for underground mining; this estimate accepts a concept proposed by NBL Gold to include only "mineable" resources and excludes ore below the 350 m level and ore in isolated small orebodies interpreted as unmineable. The Company estimate as at 1 January 2010 also includes sulphide ore assessed as exploitable by open pit working and defined at a cut-off of 2.0 g/t Au_{eq}. These estimates for sulphide ore remain unchanged as at 1 January 2011.

The oxide ore estimated at 1 January 2010 for open-pit extraction comprises oxide and transition ore estimated at a cut-off of 0.5% Au_{eq}, which is assessed both as accessible in the pit bottom and in existing pit walls and remains unchanged. Table 5-5 below shows the resource statement estimated as at 1 January 2011.

Table 5-5 Mizek Resources Estimated as at 1 January 2011

Mizek Gold Mine		Resources	Gold	Silver	Copper
		'000 t	*g/t*	*g/t*	*%*
Mizek Total	Measured	5,031	2.47	5.79	0.71
	Indicated	4,291	2.3	5.12	0.67
	Total	**9,322**	**2.39**	**5.48**	**0.69**
	Inferred	2,166	2.46	5.74	0.71

Reserves are estimated only for the oxide ore which remains in the pit bottom and for which a mining programme is in place to the end of 2010. A mine-site recalculation has been prepared of the remaining oxide ore in the pit bottom and available for working in the current pit configuration; this estimate represents the basis for definition of reserves as planned and scheduled for mining. Oxide resources remaining in the pit walls will become accessible only through widening of the pit wall for open pit extraction of sulphides and are not considered appropriate to upgrade to reserves.

Given that no decision has yet been determined as to whether to mine the sulphide ore and in what sequence and by what mining method, measured and indicated resources for sulphide ore cannot be upgraded to reserves.

5.4.2 Estimates of Tonnages and Grades

The south pit was exhausted of oxide ore at a pit base of 890 m. The north pit is currently working on benches 925 m, 915 m and 905 m. A very limited amount of oxide ore remains in the floor below the 905 m level and is scheduled to be extracted by September 2010. Some open-pit sulphide ore is recorded as extracted in the early months on 2010, but as there is no option for treating this ore, open-pit extraction will cease with the exhaustion of the readily accessible oxide ore. No mine plan has been demonstrated for underground extraction of the sulphide orebodies if the decision is taken to develop underground.

For the assessment of ore resources, the mine defines oxide material as yielding a greater than 60% recovery of gold in a 72-hour acid leach bottle-roll test; the mine site laboratory undertakes this testwork.

5.4.3 Expected Recovery and Dilution Factors

Based on open-pit production records since 2003, the losses on production for 2010 are anticipated as 4.7% and dilution is taken as 7.3%.

5.5 Borly Coal Mines Geology

The coal bearing strata at both Molodezhny and Kuu-Chekinsky are of Carboniferous age, being in the Visian Stage of the Karaginsky Series. The seams are within predominantly sandstone sequences and the coal is typical of inland basin deposition forming high ash low sulphur coal. The thin seams at Molodezhny are 2 to 4 m but the principal H1 seam is 21 m in thickness. The structure at Molodezhny is an isolated open asymmetric syncline with low strata dips and few faults. The seams at Kuu-Chekinsky are typically 8 to 12 m thick with a structure of a series of reverse faulted anticlines and synclines.

5.5.1 Reserves and Resource Statement

IMC have checked a portion of each operation's reserves and confirm the reserves estimated in Table 5-6 below.

Table 5-6 Borly Coal Reserves Estimated as at 1 January 2011

Reserves	Proved Mt	Probable Mt	Total Mt	Ash (ad) %	CV (ncvar) kcal/kg	S %
Molodezhny	273.7	94.1	367.8	46.0	3,600	0.5
Kuu-Chekinsky	15.5	5.8	21.3	41.0	4,200	0.6
Total	**289.2**	**99.9**	**389.1**	**45.7**	**3,633**	**0.5**

Note ad refers to Air Dried
ncvar refers to net calorific value as received
Includes coal loss and increase in ash content

5.5.2 Losses and Dilution

IMC were unable to obtain either historical or estimated figures and have applied the discounts given in Table 5-7 below based on the mining methods, seam geometry, and equipment utilised. The increase in ash content decreases the calorific value and this has been incorporated into the quoted figures.

Table 5-7 Coal Reserve Discounts

Mine	Tonnage Loss %	Ash % (ad)
Molodezhny	3	1
Kuu-Chekinsky	10	3

Note the increase in Ash content reduces the CV which has been incorporated into the CVs quoted.

5.6 Mining

5.6.1 Nurkazgan Mine

5.6.1.1 Surface Operations

Nurkazgan operated a small open pit which has now been closed. The pit displays an inverted truncated cone shape with a helical haul road extending around its perimeter. On cessation of mining the road was removed leaving the cone structure. As a result of failing to use controlled blasting techniques the pit now displays poor wall stability, with overhangs and loose hanging boulders.

This method of developing a small size mine may be questioned on grounds of health and safety; by international standards as the haul roads were too narrow and too steep. The excavation equipment used in the open pit was not seen, nor was any substantive workshop facilities for maintenance of the mining plant. There are two other small surface developments.

The pit was in operation for five years and produced 4.3 Mt of ore at an average grade of 1.4% copper or an average of 2,500 tpd.

5.6.1.2 Underground Operations

Underground mining was brought into production in February 2009 and now operates, beneath the open pit. This is a multi-level development that is intended to be worked on 6 levels by sub level caving, at the time of IMC's review there was active mining operations on four levels. Operation of the mine has been planned in detail until 2015, although the ultimate life of mine is estimated at more than forty years. Any changes to the plan will require approval from the appropriate authorities.

The operators expect to extract close to 100% of the ore, however waste dilution and ore losses are known drawbacks for sublevel caving. Waste dilution can vary between 15% and 40%, and ore losses from 15% to 25%.

The mine has been in production for less than two years, and because of this, the production figures may not be typical of what can be expected when all parties gather more knowledge and experience of the operation. Sublevel caving is systematic and repetitive therefore the miners should rapidly become experienced in exploiting this mine.

The mine started operating in 2009 and produced 1.8 Mt of ore at an average grade of 0.8% copper or an average of 5,206 tpd. For the first six months of 2010 the mine produced 1.2 Mt of ore at an average grade of 0.84% copper or an average of 6,870 tpd.

The planned output is 3.5 Mtpa, currently approximately 70% of this planned rate is being produced. Copper production was improved in 2009 by high grading the deposit. The lack of production is attributed to problems with the three Metso (Nordberg NW110UG) 1100 mm x 850 mm jaw crushing plants that reduce the ore to a size suitable for conveying and their associated conveyors.

The installation of the three crushers is poor in virtually every respect and although only two years old, a lack of facilities and maintenance now shows that they are ready for a major overhaul. The manufacturers give a maximum throughput per machine of 900 tph but in reality it is unlikely that capacity would ever exceed 200 to 250 tph.

The three crusher conveyors and the main transport conveyor are fitted with 1200 mm wide belts. The main transport conveyor is fitted with a steel cored belt at a speed of 3.86 mps giving it a theoretical maximum capacity of 2,700 tph, currently the load is designed to be less than 700 tph. It is reported that both the crushers and conveyor will be replaced within two years.

Access to the mine is provided via a decline where a 1200 m conveyor carries both ore and waste. An adit has been developed from the high wall of the open pit to give access to the underground workings. This also provides added ventilation and an escape route.

Table 5-8 below shows the complement of mobile plant at the mine.

Table 5-8 Nurkazgan Mobile Plant

Mobile Plant	Units
Toro and Cat Dump Trucks	3
Scoops	8
Drill Rigs	7
16 Seat Busses.	3
Explosives truck	1
Anfo Pumps	2
Fuel Bowser	1

The mine is still being developed and currently operates with a single ventilation shaft A second shaft is being sunk to operate a man cage and provide additional ventilation. Spare ventilation fans are on site and it is reported that a further ventilation shaft will be sunk. The mine does not suffer from a large water intake and the water is handled by a 180m^3 pumping facility.

The mine has a written Health and Safety Policy and a Health and Safety Officer, unfortunately the miners do not have to undergo formal training in either health and safety or first aid. The mine keeps an ambulance on site.

Generally, the mine lacks the quality of installation that would be found in a long term mining project, this is apparent in inadequate lighting, badly installed cables, safety barriers and facilities such as bridges over the conveyors, steps, walkways all of which fall well below an acceptable standard.

The mine workers are provided with training and direct supervision, visitors are given a basic induction. The miners do not carry any first aid equipment and there is no first aid facility. Although there are many fire extinguishers, not all are readily available. The local fire service provides coverage in case of a major incident.

5.6.1.3 Infrastructure

Access

The mine is situated north of Karaganda the provincial capital and a small town called Temirtau where the mine head office is situated. The roads in the area are good and there is a tarmac road right up to the gate of the property. Within the site the roads are wide haul roads, adequate for the application. There are quite extensive rail sidings on the site. These date from the time when crushed ore was railed to a concentrator somewhere else so are more than adequate for the current operation.

Power

Power is supplied to the mine via a 110 kV line with a 35 kV standby line. This second line is adequate to supply essential loads and keep the lights on but is not sufficient to enable full production to continue in the event of a trip out on the 110 kV system. This is not what was planned when the mine was designed and the electrical drawings show two 110 kV lines feeding the site as well as the 35 kV connection. IMC understand that the second 110 kV line may be installed sometime in the future.

The 110 kV is transformed down to 6 kV via a 25 MVA transformer and to 35 kV via a 6.3 MVA transformer. 6 kV is distributed around the site.

Water

Water is pumped from an underground pump station on the 275 level to surface via a water raise. There are 2 pumps each of 630 kW one running and one standby. These pump untreated water which runs into a settler by the concentrator. It is proposed to install a settling system and a new pump station at the base of the new vent shaft some time in the future. Volumes of 2,400 m^3/day are quoted and this is insufficient for the concentrator requirements so fresh water is pumped from a small lake to the south of the site. At the concentrator there is a settling pond for the mine water and two large water storage tanks for the fresh water.

Workshops

There are three main workshops on the surface, loosely, one for small vehicles one for the bigger ones and one which was built for the open pit fleet now redundant. The bigger vehicles are maintained by an in-house company Kazakhmys Service but this contract may go to Sandvik in the near future. The building is more than adequate with an EOT crane stores and offices.

The underground workshop was a disappointment in that it was not big enough, had poor lighting and inadequate house keeping. There is a plan to subcontract the maintenance operation to Sandvik and this might provide an opportunity to improve this facility.

Explosives

There is conventional magazine at the entrance to the site with a rail connection.

Fuel Storage

Fuel is stored in two large tanks alongside the railway; these were installed to supply the open pit fleet and are clearly adequate for the current fleet. At the moment diesel is transported underground in a dedicated bowser but there is apparently a plan to install a pipeline underground.

5.6.2 Abyz Mine

The Abyz mine development is completed at 670 m (above Baltic Sea Level) and the excavation is currently at 686 m and employs 339 personnel, who work a 12 hour shift on 15 day rotation. IMC expects that the final depth will be reached before year 2012.

The mine extracts a polymetallic sulphide deposit and operates at a planned monthly output of 70,712 m^3. In 2009 the production was 116% of plan with contained metal grades of 1.7% Cu and 4.56% Zn, gold at 4.23 gpt and silver at 40.7 gpt.

5.6.2.1 Surface Operations

The top mined benches have been cut into soil and this has in many cases collapsed, poor blasting techniques have contributed to overcut, undercut and hanging faces. Although these indicate poor blasting management, the walls do not currently represent a highly significant risk. A plan has been prepared to re-profile the worst areas of collapse. If this mine is to be used as a portal to the underground operation, then the benches should be stabilised. Generally, the standard of mining is poor, with over-steep and unstable walls, uneven benches, poor haul road management and old equipment.

The mine operates a minimum of plant and equipment and some of this, dates back to 1982. There is a basic workshop facility and generally the plant seems to give good availability. The main excavation uses three electrically powered face shovels, haulage is by 80 t dump trucks. Other plant includes old drill rigs and modern wheeled front end loaders. Modern hydraulic excavators would enable more effective mining techniques to be used.

Table 5-9 below shows the complement of mobile plant at the mine.

Table 5-9 Abyz Mobile Plant

Mobile Plant	Units
Electric Excavators	3
Belaz 55 t Trucks	5
Belaz 30 t Trucks	2
Drills	2
Bulldozers	2
Loaders	2
Grader	1

5.6.2.2 Underground Operations

The ore of the West Zone occurs 350 to 550 m below the surface and requires underground mining methods. IMC believes that it is extremely unlikely that the infrastructure for the underground mine will be developed sufficiently to begin production by 2012. Planning for underground extraction was not seen by IMC.

This mine has been planned and operated to be as cost effective as possible; unfortunately this has left an unstable site that is soon to be abandoned.

5.6.2.3 Infrastructure

Access

The mine is situated 60 km North east of Karagaily where the concentrator is situated, and connected to it by an unsealed haul road. Roads in the area are generally good. Ore is transported to the Karagairly concentrator with a contract fleet of between 20 and 25 trucks which do three trips a day to move 600 ktpa. The road from the mine to the concentrator is an unsealed road in good order.

Power

Power is delivered to the site at 35 kV via a 110 kV line. This will enable an easy upgrade sometime in the future if after going underground the power requirements increase. The line terminates at a 35/6 kV 6.3 MVA transformer which feeds the mine site at 6 kV. Power is distributed via three overhead lines to the offices, the workshops, and the pit. The excavators are electric and there is a small pump for pumping water.

Workshops

The mine workshop is a simple corrugated iron clad structure which appears to be not much used during the summer. Maintenance work on the pit fleet was being carried out in the open and the opportunity is being taken to relay the complete floor inside. There seemed to be little or no provision for dealing with winter conditions and no washdown for vehicles entering for maintenance. This may be why there is some improvement work proceeding on the building and floor.

Offices

This is a simple building adequate for the purpose. The mine is connected to the outside world by satellite link.

Explosives

There are no explosives kept on site and a blasting expert visits the mine once or twice a week to do the blasting.

Fuel Storage

Fuel storage consists of several horizontal tanks lying on the ground with no bunding arrangements of any sort.

5.6.3 Mizek Mine

The Mizek gold mining operation consists of two relatively small surface mines working in shallow oxides. The mines have been in operation since year 2003 and have been producing oxides for metal recovery by heap leach. They have now reached the base of the oxides and are encountering sulphides. Extraction from the North mine ceased in 2009 and extraction from the South mine is due to be discontinued in 2011. Development of the south mine is to complete at 905 m (above Baltic Sea Level) and is currently at 930 m.

The two mines have to date produced, 5.9 Mt of ore at an average grade of 1.7 gpt giving a total of 10.03 t of gold. Assuming these figures to be correct, the leach heap should now be exhausted.

5.6.3.1 Surface Operations

Generally, both pits have been operated to a high standard and the high walls are acceptable, where they have shown signs of instability they have been re-profiled. Assuming that the surface mines will be closed, an existing plan will be initiated to recover the site and make it environmentally acceptable. By local standards, this was a well run operation.

Should an underground mine be developed, then it is likely that sub level mining will be used and the surface will be allowed to subside. The haul roads have a good surface with sufficient width and earth barriers.

The mine operates a minimum of plant and equipment and some of this dates back to 1986. There is a basic workshop facility and generally the plant seems to give good availability. The main excavation uses an electrically powered face shovel, a hydraulic excavator, a tracked dozer and haulage is by 30 tonne dump trucks. Other plant includes three old drill rigs. No underground plant was seen on site. The mine employs over 300 personnel, who work a 12 hour shift on 15 day rotation.

5.6.3.2 Underground Operations

A Technical Report on an underground project was completed in 2007. Based on this report, the mining methodology is sub level open stoping, as the ore morphology does not allow long hole open stoping. The stope height and sub levels for extraction are based on 20 m intervals.

A pre-feasibility study on the sulphide ore body was due to be completed by June 2008. IMC was not shown the geological data or a mining plan and believes that it is extremely unlikely that infrastructure for the underground mine will be developed within the next two years.

5.6.3.3 Processing

5.6.3.3.1 Process Description

The ore currently mined at Mizek is categorised as oxide, copper and sulphide ores. Only the oxide and copper ores are treated to recover gold, silver and some copper. The Mizek plant has been operating since the end of 2002 and comprises a standard process for gold recovery using:

— Cyanide heap leaching of gold and some silver.

— Gold recovery from the pregnant solution by adsorption onto activated carbon.

— Elution of gold from the carbon.

— Electrowinning gold and silver from solution.

Ore is delivered to the plant by trucks and dumped into a feed bin over a grizzly screen and then to the primary jaw crusher. The crusher product passes to a double-deck vibrating screen from which the underflow (-25 mm) reports to a small fine ore storage silo while the screen overflow passes to the secondary cone crusher and then to the fine ore silo. The fine ore is conveyed via a weigh belt feeder to a rotary drum agglomerator where it is mixed with cement, at the rate of 4-5 kg/t ore, and cyanide solution. Agglomeration with cement binds the clay and fines to the coarse ore particles to provide improved percolation of leach solution in the heap. The agglomerated ore is conveyed by a series of conveyors, each approximately 20 m long, and then via a stacker onto the heap leach pad.

Individual heaps over an impermeable pad incorporating a layer of HDPE (high density polyethylene) covering a total heap leach area of approximately 300 m x 800 m. At present ore is being stacked on the 3rd level, each level being approximately 9 m in height. Barren cyanide solution is applied at a rate of 240 to 300 l/m^{2}pd and the cyanide level is maintained at 0.04% cyanide by the addition of strong cyanide solution (5% NaCN). The pH is controlled between 10.5 and 11.5 by addition of sodium hydroxide. Irrigation is undertaken during summer using sprinklers and in winter the sprinklers are removed to avoid freezing but irrigation is slightly less efficient. Pregnant solution from each active heap is collected separately to allow control of the process and then combined in a common collection pond.

Pregnant solution is pumped to cylindrical storage tanks and then to two series of carbon adsorption columns, each consisting of three columns operating in a counter current manner. Barren solution from the last column is screened to remove entrained carbon particles and then collected in storage vessels where the solution parameters are adjusted before pumping back to the heap leach.

Loaded carbon leaving the first adsorption vessels is washed with acid to remove impurities such as base metals and gold is eluted using the Zadra technique with caustic cyanide solutions at 125°C. Gold and silver are recovered from the eluate by electrowinning onto steel wool cathodes. The loaded steel wool is calcined to give a product containing approximately 20-25% gold and 50% silver which is sold for further refining. The stripped carbon is regenerated in a rotary diesel fired kiln at 700-800°C before returning to the adsorption columns, fines being periodically removed and replaced with fresh carbon.

Since 2007, some copper is recovered from solution in a small, fully automated process using precipitation by sodium sulphide and then filtration. The incoming and outgoing liquors contain typically 350 and 70 mg/l copper respectively.

5.6.3.3.2 Process Control

The laboratory operates 24 hours per day and carries out ore and carbon analyses by aqua regia digestion and using modern Atomic Absorption Spectroscopy (AAS) equipment. Final gold production is analysed by fire assay. Process solutions are also monitored on a routine basis.

Metallurgical testwork equipment consists of crushing and pulverising and bottle roll facilities for determining the leaching characteristics of the ore before stacking on the heaps. A gold extraction of 60% is used as the criteria for stacking and leaching ore.

5.6.3.4 Historic Production

Ore is mined generally between March and October and the heap leach stacking operation corresponds roughly to this period whilst leaching continues throughout the year. The stacking rate is approximately 3,000 tpd. In the last 3 years all ore suitable for leaching has been stacked. Since the start of the current operation in 2002 the plant has produced approximately 10 t of gold. The production statistics from 2007 to 2010 are summarised in Table 5-10 below.

The exact gold recovery is difficult to calculate due to the long residence time in the heap and that the active heaps are not fully leached. However the gold produced between 2007 and 2010 indicates an overall recovery of approximately 55%. Although a silver balance is not given in Mizek's production summary, the silver recovery is estimated at approximately 10% based on a head grade of approximately 19 gpt.

Table 5-10 Mizek Historic Production

Ore stacked on heaps	Units	2007	2008	2009	2010
Oxide ore	t	530,094	464,300	460,200	594,206
Au	g/t	1.39	1.72	1.37	1.23
Au	kg	738.9	798.1	628.6	730.9
Cu ore	t	474,321	302,200	236,700	67,300
Au	g/t	2.095	1.67	1.67	1.14
Au	kg	993,852	505.1	395.8	76.7
Cu	t	68.82	401.6	162.3	100.9
Stockpiled ore	t			116,000	
Au	g/t			1.50	
Au	kg			174.58	
Cu	t			162.3	
Total ore stacked	t	1,004,411	766,500	813,510	661,506
Au	g/t	1.725	1.70	1.47	1.72
Au	kg	1,732.8	1,303.2	1,199.0	1,137.2
Au extracted	kg	935.4	718.7	646.0	564.2
Production					
Au in doré	kg	633.7	712.7	662.5	557.4
Ag in doré	kg	1,374.2	1,302.7	1,358.9	1,045.2
Cu precipitate	t	7.3	56.9	26.8	21.2

Note: Small discrepancies in the data are due to rounding of decimal places.

5.6.3.5 Plant Condition

On the basis of IMC's brief inspection of the facility, the plant appears well managed and based on visual inspection the main items of equipment are in reasonably good condition. Ore crushing and stacking were in progress with a throughput of 200-400 tpd. The moisture of the ore is typically 4% and normally there is no problem with blinding of screens due to wet clay particles. A small oil fired kiln is available for drying the ore if necessary.

One active heap was viewed and was well irrigated. The emergency storage pond for excess rain water, with a capacity of 45,000 m^3 was approximately 30% full.

All plant areas inspected had a good standard of housekeeping.

5.6.3.6 Production Plan

Mizek's plan for the remainder of 2010 is to stack ore at the rate of 100,000 tpm from June to September and then at 50,000 tpm in October and November. Mining of oxidising ore is scheduled for completion in Autumn 2010. After this the heap leach operation will continue for some time until the target gold extraction has been achieved.

Mizek has still to make a decision on whether to develop and exploit the sulphide ore by underground mining. However cyanide heap leaching is not suitable for recovery of gold from sulphide ore. IMC understands that metallurgical testwork on sulphide ore has been conducted to examine alternative processes for gold recovery. Details of the testwork were not available at Mizek but one option is to process the ore by flotation to recover gold as a sulphide concentrate.

5.6.3.7 Infrastructure

Access

The site is 150 km past Abyz on an unsealed road in good order. This serves a number of mines in the area.

Power

Power is delivered to the site at 35 kV via a 42 km line which continues on to Kosmurun via an overhead line at 110 kV. The Mizek substation is equipped with a 35/6 kV 4 MVA transformer which feeds the mine site at 6 kV. Power is distributed via three overhead lines to the offices, workshops, process plants and the pit. Total site load is as 2.5 MW.

The gold plant is fed at 6 kV and has two standby generators, one older one of 500 kVA and a new containerised unit of 200 kVA. The older generator is housed in a building with the plant compressor. There is a boiler plant with 3 heating units which were in the process of a complete rebuild. As this plant runs throughout the year there was much evidence of precautions against the cold. Inside the gold plant in the power distribution room the two generators each feed different sections of the MCC.

The copper plant has a 1 MVA substation and two new containerised standby diesel sets. In the event of a power trip one of the units back feeds through the sub to a pumping station nearby whilst the other feeds the copper plant itself. This plant has a bigger boiler house with 4 units. There are covered storage tanks for acid and other reagents.

The crushing plant is fed from another 1 MVA substation and comprises crushers screens and conveyors delivering crushed ore to the leach pad.

The biggest load in the pit is the excavator which is fed at 6 kV from a skid mounted switch unit. Material is trucked out of the pit with quite new looking dump trucks of around 50 t capacity.

Water

Domestic water comes from a dedicated borehole whilst process water comes from several boreholes around the property. The water is all of the same quality and there is a degree of interconnection to give flexibility. There is a small water pump in the pit but this is used at the end of the snow melt in the spring to pump out the pit but thereafter there is little or no water to pump.

Workshops

The mine workshop is a substantial building although quite small appears adequate to deal with the small mining fleet.

Offices

This is quite a large building with offices and canteen downstairs and workers dormitory upstairs. The kitchen which feeds the entire crew is immaculate. The mine is connected to the outside world by satellite link and the office block has a100 kVA standby diesel set.

5.6.4 Borly Coal Mines

The Molodezhny open pit mine commenced in 1980 with a walking dragline commissioned in 1988. A smaller dragline was introduced at a later date. As mining proceeded down dip the intermediate seam and subsequently the upper seam entered the workings. Overburden and interburden of the intermediate and upper seams is removed by shovel and truck operations as are the coal seams. Strip mining requires the systematic removal of each horizon ahead of the lower horizon such that working the lower horizon is not delayed by the lack of stripping above it. IMC is of the opinion that there is sufficient stripping machinery available on site at present to advance the waste removal and expose the principal H1 seam at the rate necessary to maintain the current level of production and create in-pit inventory for the winter months. The mine has sufficient reserves at the current mining capacity of 8.0 Mtpa to continue in production for 60 years. Coal mined is dispatched by rail principally to the Kazakhmys power stations.

Kuu-Chekinsky open pit mine coal production commenced in 1957. There are sufficient reserves for about 20 years production at the current rate of 0.8 Mtpa. The folding and faulting of the stratigraphy together with the earlier removal of the more easily mined coal results in a more difficult and costly mining environment. The operation utilises shovel and trucks due to the difficult geology but a systematic approach to operations impossible. IMC are of the opinion that, although the current production can be classed as modest, the sustained achievement of the current output could be at risk with the overburden stripping requirements for the foreseeable future. Coal mined is dispatched by rail principally to the local but external Temirtau power station.

It should be noted that the common rail system servicing both Molodezhny and Kuu-Chekinsky which, is mainly owned by Kazakhmys, is working at fully capacity and is the limiting production constraint to especially Molodezhny mine.

5.7 Projects/Prospects

5.7.1 Akbastau

5.7.1.1 Geology

Akbastau is a relatively large (9.2 Mt), but low-grade copper-zinc VMS deposit located some 12 km from the Kosmurun deposit. It was mined by open pit to a depth of about 50 m in 2007-08, producing 1.4 Mt of ore, most of which was trucked 220-230 km for processing at the Karagaily concentrator. In 2008 the mine was closed under the then prevailing copper prices. AMC is currently carrying out a resource re-estimation and pre-feasibility study on the project using a different Cu cut-off grade from that used in the original 1976 estimate.

This used "traditional" estimation methods and was used by the Zhezkazgan Design Institute in its 2007 design study on the project. The AMC study, which envisages mining the orebody using open pit methods, will also examine the possibility of establishing a single concentrator to treat both Akbastau and Kosmurun ore.

The Akbastau deposit essentially comprises a single, outcropping orebody with dip of about 75°, strike length of 550 m and thickness of up to 150 m. The mineralisation thins and divides with depth, thereby forming thin orebodies that pinch out at 350 m down-dip. Some

35% of the resource is classified as comprising "mixed" (oxide and sulphide) ore, the remaining being sulphide. Oxidation persists to a depth of about 100 m. Only 10-20% of the mineralisation is of massive sulphide type, the rest being disseminated.

Kazakhmys is completing a 15,000 m drilling programme at Akbastau, with the principal intention of increasing the resources and promoting the original categories by closer-spaced drill holes. A further 3-4,000 m of drilling is planned, along with further work on defining the oxide-sulphide interface.

IMC's resource estimate is based on the (C1+C2) Balance Reserves for the deposit, as reported on 1 January 2009. C1 reserves have been assigned to measured resources and C2 category to indicated resources.

5.7.1.2 Reserves and Resources Statement

Table 5-11 below shows the resource statement estimated as at 1 January 2011.

Table 5-11 Akbastau Resources Estimated as at 1 January 2011

Akbastau		Resources	Copper	Zinc	Gold	Silver	Lead
		'000 t	*%*	*%*	*g/t*	*g/t*	*%*
Akbastau	**Measured**	8,199	1.7	1.10	0.54	13.79	
	Indicated	2,852	1.65	0.70	0.53	12.58	
	Total	**11,051**	**1.69**	**1.00**	**0.54**	**13.48**	
	Inferred						

5.7.1.3 Mining

The Akbastau Project is an open pit mine located just about 8 km from the Kosmurun mine. The ore contains a mix of oxide and sulphide minerals. The development of this project is timed with that of Kosmurun mine as it is envisaged that both mine will be the sources of ore feed for the concentrator to be built. The final location of the concentrator has yet to be determined. With the short proximity between the two deposits, it does not appear to be a major issue.

The latest study was undertaken the Zhezkazgan Design Institute in 2008. The open pit mine is capable of producing 2 Mtpa. With a total minable reserve of 16.95 Mt and a life of mine estimated at about 10 years including ramp-up. Stripping ratio is 2.85 m^3/t. This has a similarity with an earlier study done in 2003, both pits are 285 m deep with the bottom level at 550 mamsl. Slopes of the final walls of the pit followed the Yun Design method which uses steep supported slopes to reduce stripping ratio. Pit walls in this case range from 60 to 70 degrees around the pit which IMC considers to be high risk when mining the bottom levels.

The 2 Mtpa capacity can be reduced later when Kosmurun underground mine has attained its designed capacity. The ratio of ore to come from the two mines will be a dictated by mining operational matters but it is envisaged that each mine is to deliver 1 Mtpa or 50% of the concentrator's feed.

5.7.2 Kosmurun

5.7.2.1 Kosmurun Geology

Kosmurun is a large (16.5 Mt), and relatively high-grade copper-zinc VMS deposit located some 12 km from the Akbastau deposit. It comprises an upper, lens-shaped oxidised orebody that was mined by open pit to a depth of about 100 m, but is now worked out. It overlies a much larger sulphide orebody, which is amenable to underground mining methods. Kosmurun produced about 2.7 Mt of ore in 2006-08, most of which was trucked 220-230 km to the Karagaily concentrator for processing. Along with Akbastau, the Kosmurun mine was closed in 2008 following a pit wall failure and low prevailing copper prices. AMC is currently carrying out a resource re-estimation and pre-feasibility study on the project using a different Cu cut-off grade from that used in the original 1976 estimate. This used "traditional" estimation methods and was used by the Zhezkazgan Design Institute in its 2007 design study on the project. As noted above, the AMC study will also examine the possibility of establishing a single concentrator to treat both Akbastau and Kosmurun ore.

The lower orebody lies at a depth of about 200 m from surface and roughly 75 m in the footwall of the upper orebody. It is a huge body of massive sulphide mineralisation up to 150 m thick with a strike length of 400-450 m and down-dip extent of about 300 m. It tapers and thins towards its margins.

IMC's resource estimate is based on the (C1+C2) Balance Reserves for the sulphide deposit, as reported on 1 January 2009. C1 reserves have been assigned to measured resources and C2 category to indicated resources.

5.7.2.2 Reserves and Resources Statement

Table 5-12 below shows the resource statement estimated as at 1 January 2011.

Table 5-12 Kosmurun Resources Estimated as at 1 January 2011

Kosmurun		Resources	Copper	Zinc	Gold	Silver	Lead
		'000 t	*%*	*%*	*g/t*	*g/t*	*%*
Kosmurun	**Measured**	16,034	3.15	0.76	0.86	17.5	
	Indicated	1,539	3.13	0.76	0.86	17.54	
	Total	**17,573**	**3.15**	**0.76**	**0.86**	**17.5**	
	Inferred						

5.7.2.3 Mining

The Kosmurun deposit is composed of ore bodies of graded and sharp stratification from the surface to the depth of 600 m. Ore below this level will be mined by an underground operation using cut and fill. Mine output is planned at 1 Mtpa for a mine life of about 18 years.

The mine will be accessed by surface declines close to the proposed concentrator will be located. Further development will include extending the denclines into each level, development of access roadways for production stopes and decline ramps for ore passes. Main levels will be 100 m apart and connected to shafts for ventilation and ore clearance. Ore will be delivered by LHD's and underground trucks to designated ore chutes and a system of conveyor belts will transfer ore to the skip shaft where it will be hoisted to the surface.

Mine dewatering is a simple system of stage pumping to meet the required 90 m^3ph inflow. The design has exhaust ventilation via the shafts and drifts.

It should be noted that a new concentrator is planned to be built for the Kosmurun and Akbastau mines with a capacity of 2 Mtpa. The ratio of ore to come from the two mines will be a dictated by mining operational matters but it is envisaged that each mine is to deliver 1 Mtpa or 50% to the concentrator in feed.

5.7.3 Bozshakol

5.7.3.1 Geology

Fluor produced a pre-feasibility study on the Bozshakol copper project in October 2009, from which the following summary is drawn. Participation in the project by a Chinese group is currently under negotiation.

The copper mineralisation at Bozshakol occurs in ENE-trending stockwork zones with steep, mostly northerly, dips and an overall northeast plunge. The copper mineralization is preferentially developed in stockworks hosted by basalts and basaltic tuffs of the lower unit of the Bozshakol Series. Molybdenite is distributed throughout the deposit and is also associated with stockwork and localised brecciation.

The Central Bozshakol stockwork extends over a distance of 4.4 km and to a depth of at least 600 m, as indicated by drilling results. The width is variable attaining 550 m at shallow depths in western and central parts of Central Bozshakol but rapidly decreasing with depth.

The East Bozshakol stockwork zone follows a relatively narrow subvertical zone but widens towards the surface, particularly on the south-eastern side. Drilling has established a strike length of about 550 m to 600 m. The stockwork zone remains open in the east-northeast direction and will be a target for further drilling in 2011.

The oxidised zone has a variable thickness and generally ends a short distance above the groundwater level, which is currently at a depth of 6 to 30 m from the surface. The host rocks within this zone have been more or less thoroughly kaolinised. Depending on the form in which secondary copper occurs, oxidised mineralization is subdivided into floatable and non-floatable types.

Kaolinised ore is the product of a progressive collapse of the weathering surface as sulphide is leached which is most advanced in the west of the deposit. The kaolinised zone is characterized by fine black chalcocite replacing root material in clay.

The Upper Cambrian supergene sulphide enrichment zone along the southern flank of the deposit contains abundant bornite, both disseminated and in veinlets with chalcopyrite. Chalcocite and covelline occur in subordinate quantities. The copper grades frequently exceed 1%.

The primary metalliferous mineral assemblage comprises pyrite, chalcopyrite and magnetite with subordinate molybdenite, sphalerite, galena, hematite and mushketovite. The main gangue minerals are quartz and calcite.

KCC carried out a drilling programme involving twinned holes after the Fluor pre-feasibility study resource estimates were reported in 2009. The purpose of these holes was to validate the results of historic drill holes, particularly the gold and silver grades. IMC's resource grades reflect the preliminary findings of this check drilling. The sulphide resources are contained within a geological grade shell, reflecting a possible open pit envelope. No pit design or in-pit resource estimate has yet been made. A new feasibility study by AMC and Aker Solutions is currently being prepared.

5.7.3.2 Reserves and Resources Statement

Table 5-13 below shows the resource statement estimated as at 1 January 2011 and based on the work reported by AMC in July 2010.

Table 5-13 Bozshakol Resources Estimated as at 1 January 2011

Bozshakol		Resources	Copper	Zinc	Gold	Silver	Molybdenum
		'000 t	*%*	*%*	*g/t*	*g/t*	*%*
Bozshakol	**Measured**	122,000	0.43				
	Indicated	674,000	0.36		0.10	2.31	0.009
	Total	**796,000**	**0.37**		**0.10**	**2.31**	**0.009**
	Inferred	320,600	0.31		0.10	2.79	0.009

Because there is no Company or State approved feasibility study for the development of the Bozshakol deposit there is no conversion of resources to reserves.

5.7.3.3 Mining

The mining method adopted for the Project is the conventional open pit truck and shovel system.

The Project will involve mining two separate pits, the main Central Pit and the smaller Eastern Pit. Both pits will be approximately 350 m deep. Although the Eastern Pit is significantly smaller than the Central Pit, it contains about 25% of the total ore, 27% of the waste and 21% of the recoverable copper.

The preliminary pit design is based on the initial block model and grade tonnage calculations that are available for the deposit. There are five distinct mineralised ore zones within the Bozshakol deposit. The sulphide zone, which is the deepest zone, comprises the main volume of the ore-body. This zone trends on a long-axis striking at 070° and exhibits undulating and lenticular characteristics.

The mining operation will require movement of 1,418 Mt of waste rock. This waste rock will be delivered by trucks and stored in two waste dumps. Ore from the mine will be delivered and dumped by truck into 600 t stock piles at the primary crusher.

Processing of the ore will initially involve the primary crushing ROM ore and magnetic separation to remove iron. Stockpiled ore will be used to ensure the continuous operation of the SAG mills.

At the time of the visit, a definitive feasibility study was being prepared and is due for completion by November 2010.

5.7.4 South East Nurkazgan

This prospect is located at approximately 1.5 km to the south-east of the Nurkazgan Mine West Pit.

The SE Nurkazgan Prospect is in close proximity to the eastern zone of the Nurkazgan Mine area and appears to demonstrate effective continuity from the latter. However, a major regional fault zone separates the SE Nurkazgan deposit from the eastern part of the main Nurkazgan area.

The genetic relationship to the major quartz diorite intrusion appears to be similar to that known for the Nurkazgan deposits, in which mineralization occurs in the contact zone peripheral to a steep sided stock of quartz diorite. Drillholes in the SE Nurkazgan Prospect penetrate a thick sequence of Devonian andesitic tuffs and metasomatised sediments before encountering the ore zone which lies closely above and essentially parallel with the contact with a major quartz diorite intrusion, which appears continuous with that known in the main Nurkazgan area.

The primary high grade mineralization is mostly chalcopyrite which is particularly developed associated with magnetite in metasomatically altered Devonian sedimentary strata. However highest grade mineralization has been found in an extensive later stage stockwork of veins in which gold is also present and most consistently occurs in association with magnetite. The ore bodies encountered in drillholes this far have shown a maximum vertical intersection of approximately 400 m. The thicker intersections show values between 0.70% Cu and 1.10% Cu, with gold values from zero up to 1.12 g/t Au.

The disposition of the orebodies has been interpreted as a number of thick interdigitating lenses which dip generally to the east. Close to the regional fault which limits the prospect to the west, the apparent dip of the orebodies is steep, of the order of 70°, reflecting the structure in the east zone of the main Nurkazgan deposit. However to the east and further from the major fault, there appears to be a flattening out of the contact with the quartz diorite intrusion and an undulating saddle structure of low dip is interpreted. The main thickness of the orebodies identified to date lies between depths of 650 m – 1,000 m to the upper contact, extending down to depths in the range 1,300 m – 1,400 m to the lower contact.

The further exploration programme for the prospect south-east from the main Nurkazgan deposit was based on the indications of high resolution magnetic survey and the presence of a steep and narrow geophysical response (Induced Polarization); the latter is now interpreted as the major fault zone while the magnetic anomaly is considered to define the quartz diorite porphyry intrusion. An initial programme of drillholes did not extend deep enough. However, the current programme has a programmed target of 45 drillholes to a total of at least 58,000 m, with anticipated bottom-of-hole depths of up to 1,500 m. Of this programme 12 drillholes were completed in 2009 and a further 12 are programmed for completion in 2010. Over the main target drillholes have been sited at approximately 100 m centres, and subsequent phases are planned to step out from the main target area on 200 m centres.

A preliminary in-house estimate of resources has been prepared by Kazakhmys Exploration Department. This estimate would be considered to equate to the estimation of

P category (prognosticated) resources under the FSU system. A total of 122.6 Mt of ore at 0.94% Cu and 0.7 g/t Au has been estimated in a preliminary assessment as at 1 June 2010.

It is considered that this estimate does not meet criteria for inclusion in any of the categories of international classification systems, because of the preliminary nature of the estimate and also because, given the great depth of the orebodies, it is premature to anticipate that, as defined to date, that these will be extracted at a foreseeable time in the future and it is accordingly premature to consider the tonnage as resources. Exploration drilling continues.

5.7.5 North Nurkazgan

This is a discrete deposit situated a short distance to the north of the Nurkazgan mine. Disseminated chalcopyrite mineralisation occurs in Middle Devonian quartz diorites in the north of the deposit and in Lower Devonian andesitic tuffs in the south. The mineralisation in quartz diorites forms a compact body dipping at moderate angles to the west (width c. 150 m, depth extend along dip c.350 m). The mineralisation in tuffs occurs in numerous subparallel narrow zones separated by barren tuffs. Proximal quartz-sericite alteration passes laterally into a broad propylitic zone.

The deposit was initially worked in a shallow open pit from surface at approximately 505 m elevation to the 450m level. The output totalled 0.565 Mt at 0.32% Cu, 0.23 g/t Au and 2 g/t Ag, of which 0.118 Mt has been processed. A conventional resource estimate totalling 76.8 Mt at 0.36% Cu and 0.27 g/t has been submitted for GKZ approval, classified as C_2.

5.7.6 Charsk Gold Belt

IMC understands that the prospect in the Charsk Gold belt is no longer of interest to the Company and that the licence has been allowed to lapse.

5.8 Concentrators

5.8.1 Nurkazgan Concentrator

Open pit operations started at Nurkazgan in 2004. The ore was crushed and loaded into rail cars and sent to the concentrator at Balkhash. In 2005, Kazakhmys let a lump sum contract to TOMC, a construction company from Irkutsk, to build, commission and hand over a 4 Mtpa concentrator by the beginning of 2006. It was anticipated that the concentrator would incorporate second hand imported equipment and it was planned that this concentrator would incorporate a number of innovations to gain experience in advance of the development of the much larger operation at Aktogai.

In particular the project was intended to incorporate five innovations:

— Primary crushing will be in the pit.

— Ore will be crushed by high pressure grinding rolls (HPGR) in two stages.

— One large grinding mill will be installed.

— Large volume flotation cells (160m^3) will be used.

— Tailings will be thickened to 70%w/w solids and deposited on the waste rock dump.

5.8.1.1 Plant Description

In practice, crushing for the open pit was carried out close to the pit perimeter, but jaw crushers have been installed underground so that ore can be brought to surface by a conveyor in the decline. The concentrator incorporated a conventional open circuit secondary and tertiary cone crusher circuit, using imported second hand Symons 7' crushers, to produce a nominal <30mm product.

The tertiary crushed ore was fed by conveyor to the first stage of a high pressure grinding roll (HPGR) circuit. The product was split, approximately half being recycled to the HPGR and the remainder was conveyed to a drum scrubber where water was added to disaggregate the ore. The scrubber discharged on to a vibrating screen with 5mm apertures and water sprays. The screen oversize was conveyed to the second stage. The screen undersize was pumped to a bank of hydrocyclones whose underflow discharged on to another vibrating screen with a 0.2mm aperture. This screen undersize returned to the hydrocyclones. The hydrocyclone overflow at an anticipated particle size of 95% <0.2 mm gravitated to the mill sump.

The combined oversize fractions from the 5mm and 0.2 mm screens was conveyed to the second stage HPGR. The secondary HPGR discharge was also split between product and recycle streams. The product was conveyed to a vibrating screen with a 20mm aperture deck and water sprays, whose oversize was conveyed back to the drum scrubber and whose undersize was pumped to the mill sump.

From the mill sump the combined streams were pumped to a bank of hydrocyclones from which the underflow fed the 4.5 m diameter, 6 m long primary ball mill, driven by a 2.5 MW motor. The overflow was directed to rougher flotation in two banks of 38 m^3 Outotec cells in series.

The rougher flotation tailing went to the tailing thickener; the rougher concentrate was cleaned in one stage and the first cleaner concentrate was reground in a 4m diameter, 5.5m long regrind mill in closed circuit with hydrocyclones. The first cleaner tailing was scavenged in a single flotation stage, the scavenger concentrate returning to the cleaner feed while the scavenger tailing joined the final tailing.

The reground cleaner concentrate was then cleaned in two further stages with the final concentrate being thickened and filtered in a filter press before being loaded for despatch by rail.

Thickened tailing was pumped to a conventional tailings dam built with a filter wall through which water seeps into a return water pond, from which it is pumped back to the plant.

There are no ore bins in the whole concentrator flow scheme, so that a temporary stoppage in any part of the plant directly stops all operations. There are stockpiles to which ore can be directed as it comes from the mine and also after tertiary crushing. Ore can be reclaimed from these stockpiles by front end loader to sustain downstream operations when the decline conveyor stops operating. This may contribute to the apparent low utilisation of the plant.

5.8.1.2 Operating Experience

The Nurkazgan concentrator started operations on ore from the open pit mine at Nurkazgan in 2007, prior to which the ore had been railed to Balkhash and processed at the concentrator there. The concentrator was closed in 2008 on account of the prevailing economic situation. The concentrator was re-opened in 2009 and processed underground ore.

The concentrator has been plagued with problems from the start and has yet to achieve its rated 4 Mtpa throughput.

Presumably as a measure to reduce the number of conveyors, the Nordberg Symons 7' secondary crusher was mounted on a steel frame 16 m above ground, so that its product could gravitate to the vibrating screen whose oversize fed the normally mounted 7' Symons shorthead tertiary crusher. Vibration from the secondary crusher threatened the structural integrity of the building. This crusher was taken out of use and will be replaced by a Metso crusher to be installed on a new foundation at a lower level. In the meantime, a portable crushing plant was brought in to maintain production. At the time of the visit this was functioning well although the plant was very dusty. High silica dusts (the ore contains 62% SiO_2) are a serious health hazard so prompt improvement of this part of the plant is strongly recommended.

Problems were also encountered with the secondary HPGR. After scrubbing and wet screening, the ore feeding the rolls at 11% moisture, was too wet and caused major problems at the HPGR. The machine suffered excessive wear and corrosion and was badly damaged. It is presently being re-built.

The drum scrubber proved unsatisfactory and was replaced by a Barmac type vertical shaft impactor, which served to dis-aggregate the HPGR product.

At the time of the visit, the <30 mm tertiary crushed product was being fed to one HPGR at a net rate of about 400 tph. The gross throughput was about 930 tph and about half of the discharge was directly recycled. About 500 tph was conveyed to a Barmac crusher which dis-aggregated the ore which was then conveyed to a vibrating screen with 5 mm aperture and water sprays. The screen oversize returned to the HPGR feed, while the screen undersize was pumped to the mill sump.

From the mill sump the ore was pumped to the hydrocyclones and the cyclone underflow was split between the primary and re-grind mills. The combined cyclone overflows were coarser than desired at about 45% <74 microns.

The first cells of rougher flotation appeared to operate well with a well-mineralised froth. Further down the bank, froth cover was incomplete and some cells were pulping over. This may have been caused by low ore grade at the time and will not have been helped by the reduced throughput. It was suggested that, if this was a common condition on the plant, the froth from the second rougher bank might be re-directed to the start of the flotation circuit, to build up a re-circulating load and stabilise the froth cover.

As the re-grind mill was being used as a primary mill, the three cleaner flotation stages were being operated as a conventional three-stage cleaning circuit with a cleaner scavenger on the first stage, whose tailing went to the tailings thickener. The cleaner cells were operating well, although the froth on the third cleaners was rather sticky. Column cells might be a useful innovation to improve the concentrate quality and simplify the flowsheet.

The tailings thickener was functioning well with underflow densities in the order of 50 – 55% solids by weight. The thickener underflow was pumped to a tailings pumphouse from which it was delivered the short distance to the dam by single stage centrifugal pumps.

The concentrate thickener was also functioning well, although problems had been encountered with freezing in winter. It was proposed to extend the flotation building to cover the concentrate thickener. Both filter presses and a Bakor ceramic disc vacuum filter were installed and in use for concentrate filtration and both were operating satisfactorily.

Table 5-14 below shows the early history of operations at the Nurkazgan concentrator since 2007.

Table 5-14 Nurkazgan Concentrator Historic Performance

Concentrator	Year	Milled '000t	Cu %	Contained Cu '000t	Recovery %	Concentrate '000t	Cu %	Cu in Concentrate '000t
Nurkazgan	2007							
(Akbastau)	2008	186	3.04	5.7	81.75	23	20.1	4.6
	2009	28	2.75	0.8	90.42	4	17.4	0.7
	2010							
Nurkazgan	2007	12	0.91	0.1	0.00			0.0
(Nurkazgan)	2008	775	0.79	6.1	88.90	29	18.8	5.5
	2009	1,856	0.80	14.9	83.94	63	19.8	12.5
	2010	2,311	0.78	18.1	85.11	82	18.8	15.4
Nurkazgan	2007	12	0.91	0.1				
Total	2008	961	1.23	11.8	85.47	52	19.4	10.1
	2009	1,884	0.83	15.6	84.26	67	19.7	13.2
	2010	2,311	0.78	18.1	85.11	82	18.8	15.4

The copper recovery is stable at 85% and only a finer grind is likely to improve it. There is a pronounced relationship between the ore grade and recovery, each 0.1% increase in the head grade producing, on average, a 0.35% increase in the recovery. Significantly higher recoveries were achieved when this ore was processed at Balkhash, but the ore grades were also higher and the concentrate grades were lower, so it is not possible to say whether the Balkhash concentrator performance was better.

IMC witnessed an instantaneous throughput of 400 tph, but the figures above indicate that either this was an exceptional value or the plant utilisation is low at around 70%. It seems that the ore production from the underground operations is insufficient to sustain the concentrator throughput, but even with unrestricted supplies of ore, the concentrator probably could not process more than about 3.1 Mtpa.

5.8.1.3 Proposed Development

The plan is to re-install HPGR's so that both are receiving dry feed and operate in parallel. A large recycle will be put on both machines and their product will be conveyed to the Barmac crushers that will disaggregate it. The Barmac product will be wet screened at 5 mm and the oversize will be returned to the HPGR.

An additional primary ball mill, 4.5 m diameter and 6 m long will be procured and installed. It is hoped that the primary grind will be improved from 45% <74μm as at present to 65% <74μm as planned, and that the throughput will rise from the 3.5 Mtpa target for 2010 to 4 Mtpa.

The design of the concentrator at Nurkazgan was taken as an opportunity to test mineral processing design concepts for the subsequent development of the larger Aktogai porphyry deposit. In particular, it was intended to explore the potential to reduce the consumptions of energy and water, which often dominate the economics of mineral concentration of low grade ores in arid regions.

5.8.1.4 Energy Consumption

Most of the energy in a concentrator is expended in crushing and grinding the ore. This is necessary to liberate the copper bearing minerals from the waste or gangue minerals. Grinding is a very inefficient process. Crushing of ore is much less inefficient, in the sense that a given amount of energy achieves much more size reduction in a crusher than the same amount of energy will achieve in a grinding mill. Usually, crushing is used for the first stage of size reduction, but grinding has to be used for the very fine sizes needed to liberate the copper minerals. Conceptually, if the amount of crushing can be increased and the amount of grinding reduced, the overall energy consumption per tonne of ore can be reduced.

In Kazakhmys operations, the top size of tertiary crushed ore is commonly 30 mm. Conventional three-stage crushing plants can, if operated in closed circuit with vibrating screens, produce a product with a top size of 10mm, so there is clearly benefit to be gained from optimising the designs of crushing plants in use in the company. Modern developments of cone crushers have enabled even finer products with a top size down to about 5 mm to be produced.

The high pressure grinding roll (HPGR) is a development of the 1980's, which aims to reduce the energy consumption in rock breakage. The ore is squeezed between two steel rollers at high pressure. Apart from breaking the ore, the pressure induces cracks in the rock structure, which reduce the energy required for subsequent grinding. This technique has been quite widely used in the cement and other industries but remains uncommon in the non-ferrous metal mining industry. The main concern that has delayed its acceptance is uncertainty about the effects of abrasive wear on the rollers, for many ores are highly abrasive. Nurkazgan ore was tested by HPGR manufacturers KHD Humboldt Wedag in 2005 and it is assumed that the design used was based on their report.

The design for the first stage fine screen underflow assumed that that material was 95% finer than 0.2 mm. The second stage product, however, had only to pass through a 20 mm screen so could contain particles up to 20 mm. The proportion of first and second stage products is not known to the writer who has not seen the design criteria.

If, however, it is assumed that the HPGR caused a 30% reduction in the Bond Work Index, and that the 2.5MW ball mill was sufficient to reduce 500 tph of ore to 80% finer than 105 microns, then the assumed feed size to the mill circuit must have been in the order of 80% finer than 0.2 mm. This seems amazingly fine for an HPGR product.

Analysing the current plant performance in which a 2.5 MW mill and a 1.6 MW mill are together grinding 400 tph to approximately 80% finer than 160 microns, this suggests that the mill feed particle size is 80% finer than 2 mm, which seems more realistic for an HPGR in the current circuit.

If this represents the current situation, which it may not, then the proposed remedy of adding a second 2.5MW mill will be insufficient to grind the proposed 500 tph to 80% finer than 105 microns. A larger 3.75 MW mill will be required.

An alternative analysis, assuming only a 10% reduction in post-HPGR Bond work index, implies that the current mill feed particle size is 80% finer than 1mm. If this is indeed the case then the additional mill will need to be larger still, about 4.5 MW.

It will, of course, be argued that two HPGR's operating in parallel, each producing 250 tph of product, will produce a finer product than one machine on its own producing 400 tph. Much will depend on how the recycle is managed—it may prove practical to reduce the aperture of the screen from 5mm to, say, 3mm. It may, however, prove that the HPGR is operating close to the limit of fineness that can be achieved with this ore, in which case no further size reduction may be achieved.

At the conclusion of this exercise, it will be necessary to calculate the energy saving. It is a drawback with crushing that the associated equipment, necessary to achieve the crushing, but not actually breaking the rock, such as feeders, conveyors, screens, dust extractors, etc., typically consumes energy at the rate of about 30% of the energy consumed by the crusher itself. The ancillary equipment associated with a ball mill is largely confined to the sump pump that feeds the cyclones, and that, typically, consumes energy at the rate of about 10% of the energy consumed by the mill. This tends to offset the efficiency benefit of crushing. The ancillary equipment associated with the HPGR's at Nurkazgan includes quite sizeable conveyors, Barmac crushers and vibrating screens. This "parasitic" power consumption may offset the savings that are achieved.

Large flotation cells can also reduce the energy consumption of the plant and the modern filters, beside producing a dryer cake, also use much less energy than the old vacuum disc filters.

5.8.1.5 Water Consumption

Usually, flotation is carried out at about 30% solids in the pulp by weight, so for every tonne of ore, 2.33 m^3 of water are required. Additional water is used to flush launders, provide gland sealing water, etc. If no attempt is made to minimise consumption in a mineral concentrator, the water consumption is usually about 3 – 4 m^3 of water per tonne of ore.

The simplest means of reducing water consumption is to thicken concentrate and tailings slurries and re-cycle the water to the mills. This alone should reduce consumption to about 1 m^3/t ore. Returning the supernatant water from the tailings dam can recover more water, but the settled tailing in the dam will typically contain 30% moisture, and the evaporation of water from the pond surface may be large in some environments. Evaporation also occurs on the concentrator plant—a flotation machine is a good evaporator. Reducing the water consumption to less than 0.5 m^3/t ore usually requires the filtration of the tailing.

An alternative that has been used is to thicken the tailing to 70% and then co-deposit this material as a paste on the waste rock dump of an open pit mine. Such densities cannot always be achieved by thickening, but it may be possible to reach these densities by filtering part of the tailing and re-pulping in the remainder. This process has the advantage that mixing with waste rock reduces the tendency for wind to raise dust as it commonly will on a dry tailings dam. The feasibility of this process does depend on the availability of waste rock in suitable proportion to the volume of tailing. By the time that the Nurkazgan concentrator was operating regularly, the mining operation was underground and waste rock quantities were insufficient to support such a technique.

The existing operation is providing Kazakhmys with experience of conventional thickened tailings disposal and decanted water reclaim and the eventual water balance of this process will provide guidance for the water balance for proposed new mines operating this system.

5.8.1.6 Conclusions

IMC considers the experimental aspects of the design of this concentrator were a realistic approach to gain information for the subsequent development at Aktogay. It is probably better not to build such a concentrator on a lump sum contract.

The installation of a 7' Symons crusher on a 16 m high steel structure was unwise and should have been rejected in a design review.

The inadvisability of feeding wet material to an HPGR has been a useful lesson learned.

The design criteria for the ball mill seem to have been either very optimistic, or to have made very optimistic assumptions about the fineness of the HPGR product, and the proposed remedy may not be sufficient to achieve the desired combination of throughput and fineness of grind. It seems likely that the desired throughput of 4 Mtpa will be achieved but that the grind may be rather coarser than intended.

The flotation, thickening and filtration aspects of the design appear to work satisfactorily but have yet to be tested at the design throughput.

The capital cost of a concentrator can be considerably reduced by eliminating bunkers and reclaim facilities, but this saving may be offset by the reduced operating availability.

When the modifications to the plant are complete, it will be necessary to review the dust management in the crushing and HPGR sections. It may be more effective and considerably cheaper to use water mist sprays rather than fans, ducts and filters.

5.8.2 Karagaily Concentrator

The Karagaily concentrator was bought by Kazakhmys in 2004. It had been lying disused since the closure of the Karagaily open pit barite mine in 1993. The concentrator was re-equipped in 2004/05 and re-commissioned in 2005 to process annually 500,000t of copper, gold, zinc ore from the Abyz mine.

In 2007, ore mining at Abyz was suspended to permit further development of the pit and during that year, the flowsheet was adapted to process Kosmurun ore according to designs of the Moscow Institute of Steel and Alloys MISIS following pilot scale tests at Kazmechanobr in Almaty. Kosmurun ore was processed throughout 2007, but this was largely unsuccessful.

From 2008, as well as processing ore from Abyz, 300,000 tpa of copper ore from the Akbastau mine has also been processed. This ore was mined and stockpiled at the mine and it has been transported the 220 km by road to Karagaily.

5.8.2.1 Plant Description

Ore, with a nominal top size of 350 mm, from Abyz and from Akbastau is delivered by the highway tipper trucks of contractors to separate stockpiles close to the primary crusher. At the time of the visit there was about 40 kt of Abyz ore and about 110 kt of Akbastau ore as well as a smaller amount of Kosmurun ore stockpiled at Karagaily.

Ore is processed through the crushing plant in campaigns. It is reclaimed by front-end-loader and tipper truck and delivered to the bin ahead of the primary crusher. An apron feeder draws ore from the bin to a 1500 mm x 2100 mm Blake type double toggle jaw crusher with a closed side setting of 180 – 200 mm. The crushed ore is conveyed to a 2200 mm secondary cone crusher and its product is conveyed to a splitter chute that divides the ore stream between two 2200 mm tertiary cone crushers. The tertiary crushed product, at a nominal size of <25 mm, is conveyed to the appropriate part of the fine ore bin, depending on whether ore from Abyz or Akbastau is being crushed.

5.8.2.1.1 Processing of Abyz Ore

Abyz ore is drawn from the fine ore bins at about 80 tph to feed two 3.6 m diameter, 5 m long primary ball mills driven by 1250kW synchronous motors. The primary ball mills operate in closed circuit with double spiral classifiers and the spiral sands are recycled to the mill. Classifier overflow gravitates to the secondary ball mill sump, from which it is pumped to hydrocyclones whose underflow feeds two 3.6 m diameter, 5 m long secondary ball mills driven by 1250 kW synchronous motors.

The hydrocyclone overflow, at a nominal size of 80% <74 microns, flows to the copper pyrite rougher flotation. Zinc is depressed by the addition of zinc sulphate and copper and pyrite are recovered in a rougher concentrate. The rougher tailing goes to the copper pyrite scavenger flotation, from which the scavenger concentrate is returned to the head of the circuit and the scavenger tailing is pumped to the regrind mill sump. From the sump the slurry is pumped to a hydrocyclone whose underflow gravitates to the 2.7 m diameter, 3.6 m long regrind ball mill, driven by a 400 kW synchronous motor. The mill discharge returns to the sump.

The hydrocyclone overflow is conditioned by the addition of lime and copper sulphate to reactivate the zinc and the pulp flows to zinc rougher flotation. The zinc rougher concentrate is then cleaned in three stages of cleaner flotation in the conventional way and the third cleaner concentrate goes to the zinc concentrate thickener. The zinc rougher tailing goes to the scavenger section and the scavenger concentrate is returned to the zinc rougher flotation.

The zinc scavenger tailing goes to a final pyrite flotation stage that scavenges residual pyrite. The concentrate from this final stage joins the copper pyrite rougher concentrate in the copper concentrate thickener. Final tailing is pumped to the old open pit.

5.8.2.1.2 Processing of Akbastau Ore

Akbastau ore is drawn from the fine ore bin at 60 tph to feed a 3.6 m diameter, 5m long primary ball mill driven by a 1250 kW synchronous motor. The primary ball mill operates in closed circuit with spiral classifier and the spiral sands are recycled to the mill. Classifier overflow gravitates to the secondary ball mill sump, from which it is pumped to hydrocyclones whose underflow feeds the 3.6 m diameter, 5m long secondary ball mill driven by a 1250 kW synchronous motor.

The cyclone overflow gravitates to rougher flotation. The rougher concentrate goes to a conventional three stage cleaner flotation circuit and the third cleaner concentrate joins the Abyz concentrate in the copper concentrate thickener. The rougher tailing passes to a scavenger flotation stage from which the concentrate returns to the head of the flotation circuit. Scavenger tailing joins the Abyz final tailing and is pumped to the old open pit.

The combined copper and copper pyrite concentrates are thickened in two 30 m diameter thickeners. The thickener overflows are clarified in two 18m thickeners. Underflows from all four thickeners are pumped to holding tanks from which the slurry is filtered. There are two Bakor ceramic disc filters which reduce the moisture in the copper pyrite concentrate to 16%. There are also two Larox vertical plate filter presses which have been restored after working in the eastern mines, but are no longer in ideal condition. These presses can reduce the concentrate to 14% moisture but this is still too high and results in freezing concentrate in winter. There are plans to install a drier to reduce the moisture level to 7%.

The zinc concentrate is thickened in an 18 m thickener, whose overflow is clarified in another 18m thickener. The thickener underflows are pumped to a storage tank from which it is pumped to two Bakor ceramic disc filters. The zinc concentrate is reduced to 11% moisture and despatched by rail.

The concentrates are stockpiled outside and then transported by front end loader to a loading platform beside the rail track. There is a weighbridge adjacent to the loading bay and an excavator is available to adjust the weights of concentrates in cars before despatch.

When the concentrator was recommissioned in 2005, permission was sought and gained to deposit the tailing in the old open pit. This permission has recently been rescinded and although the tailing is presently deposited in the pit, this will shortly have to cease. A new tailings dam is in the course of construction to the designs and under the direction of the Karaganda Institute.

5.8.2.2 Plant Performance

All sulphide mineral ores are, to some extent, susceptible to surface oxidation. The flotation process that is used to concentrate these ores depends on the surface properties of the minerals. When the mineral surfaces are tarnished by oxidation, the flotation performance deteriorates markedly. At mines where the ore is particularly susceptible to oxidation, it is considered good practice to process the ore within 24 hours of breaking it. Quite often, depending on the mining method, this is simply not feasible. Methods such as shrinkage and block caving and many open pit practices preclude such rapid processing of the ore, but it is generally considered bad practice to maintain large stocks of broken ore on surface.

The ores that are most vulnerable to surface oxidation generally include massive sulphide ores. That is to say their host rock, as well as the valuable minerals in the ore, is in large measure made up of sulphide minerals. The ores that have been processed at Karagaily are mostly massive sulphide ores.

The ore of Abyz is not as badly affected by oxidation as some of the other ores processed at Kargaily. The record of processing of Abyz ore is shown in the table below. As most of the contained value is in the gold, the main objective in concentrating has been to maximise the recovery of gold into the copper concentrate. As the gold is mainly hosted in the pyrite, the pyrite is recovered into the copper concentrate, which has, therefore, a very low copper grade. Initially, recoveries of copper were only in the low 70's%, while gold recoveries were in the high 60's %. More recently, with developments in the processing flowsheet and possibly also with the deepening of the pit, these recoveries have improved to the high and low 80's respectively.

Half of the zinc has also been recovered into the copper concentrate and this is ultimately lost in the copper smelter, so that even in 2010, only about 70% of the value of the metal in the ore is effectively recovered into the copper concentrate. The recovery of zinc into zinc concentrate has also improved in recent years to 42% and the concentrate grade, although still low, has improved to about 40%. Table 5-15 below shows the processing of Abyz, Akbastau and kosmurun Copper Gold Zinc ore at Karagaily since 2007.

Table 5-15 Karagaily Historic Production

Concentrator	Year	Milled '000t	Cu %	Contained Cu '000t	Recovery %	Concentrate '000t	Cu %	Cu in Concentrate '000t
Karagaily (Abyz)	2007							
	2008	60	1.73	1.0	70.82	10	7.3	0.7
	2009	529	1.69	9.0	88.31	184	4.3	7.9
	2010	387	1.65	6.4	86.31	145	3.8	5.5
Karagaily (Akbastau)	2007	18	3.89	0.7	59.01	3	14.1	0.4
	2008	1,013	2.97	30.1	82.76	165	15.1	24.9
	2009	63	2.52	1.6	88.04	14	9.9	1.4
	2010	302	1.31	4.0	82.01	37	8.8	3.3
Karagaily (Kosmurun)	2007	1,139	3.88	44.3	74.50	229	14.4	33.0
	2008	140	2.91	4.1	66.35	26	10.4	2.7
	2009	18	1.76	0.3	95.01	8	3.8	0.3
	2010	113	4.08	4.6	77.56	41	8.7	3.6
Karagaily Total	2007	1,158	3.88	45.0	74.25	232	14.4	33.4
	2008	1,213	2.90	35.2	80.51	201	14.1	28.3
	2009	610	1.78	10.9	88.47	206	4.7	9.6
	2010	801	1.87	15.0	82.48	223	5.5	12.3

During 2007, the concentrator processed the ore from Kosmurun and during the year 1.139 Mt were processed at an average grade of 3.88% Cu, 2.3g/t Au, 36.4g/t Ag and 2.5% Zn. The copper grade actually declined from 5% to 2 – 3% towards the end of the year, while the gold grade rose from 1.2 g/t to 4 g/t over the same period.

Initially, the concentrator performance was acceptable, with copper recoveries in the order of 80 – 85% and gold recoveries of 50 – 60%. After about three months, the gold recoveries deteriorated and after six months the copper recoveries also fell. Over the last five months of this operation, only 45 – 64% of the copper and 16 – 28% of the gold were recovered. There remains a substantial stockpile of Kosmurun ore at Karagaily. Clearly, the mineralogy of the ore varied during the year and this may have contributed to the reduced recovery. It seems likely that surface oxidation of the minerals also played a role in reducing the effectiveness of this operation, for transport alone would have exposed this ore to too much oxidation and the stockpiling of this ore didn't help.

Since 2008, the concentrator has been processing ore from Akbastau at the rate of 300,000 tpa. Ore is no longer being mined at Akbastau but it is understood that there remains a large stockpile of mined ore at the mine and there is still approximately 110,000 t of Akbastau ore at Karagaily. IMC understands that the ore grade was initially as high as 3.5 – 4% copper, but is now 2-2.5%. This ore is clearly oxidising on the stockpiles to a serious extent, for when processing started, 6 – 10% of the contained copper was oxide (acid soluble), but recently up to 30% of the copper is as oxide. The flotation recovery has fallen correspondingly from 85% to the present 71%. It could, of course be argued that the falling head grade is likely to have reduced the recovery somewhat anyway, but that would not explain the present tailing grade of about 0.7% Cu. It seems likely that further slight deterioration of the recovery of copper from Akbastau ore is likely.

Karagaily concentrator has been successfully re-equipped to process the ore from Abyz mine. It appears that mineral surface oxidation has played a significant part in diminishing the metal recovery from the ores processed at Karagaily. Future such operations might benefit from close synchronisation of mining and processing so the stockpiling of ores prior to processing is kept to a minimum. A better arrangement for the despatch of concentrate from Karagaily might reduce losses by spillage.

5.9 Infrastructure

Access

Karagaily is situated some 250 km east of Karaganda. Roads in the area are generally good. The plant is connected to Balkhash by rail.

Power

The power supplies to the concentrator site reflect its past history as a major facility. The 110 kV bus has 5 feeds to or from it and the plant is fed by two transformers one of 31.5 MVA and one of 40 MVA. The current plant load is between 4 and 6 MVA in the summer and 8 MVA in the winter. The site is quite old and the original slate panel MCC s have been upgraded by the expedient of bolting modern variable speed drives to them. 6 kV switchgear has been improved by replacing low oil volume circuit breakers with vacuum switches.

Water

Water to the site comes from a bore field about 5 km away. 6 bores each around 30 m deep pump to a 1,200 m^3 storage tank from whence it is pumped via a booster pump to two 5,000 m^3 storage tanks at the plant.

5.10 Environmental

5.10.1 Organisation Structure

Environmental management for all operations in the Karaganda Region is based at the Temirtau office where the head of HSE assisted by 2 specialists. In addition, there are environmental officers at each of the operating sites, Nurkazgan Mine, Nurkazgan Concentrator, Abyz Mine and Karagaily Concentrator. The head of HSE reports to the corporate Environmental Department at Zhezkazgan as well as the management of Karaganda Region. Abyz Mine and Karagaily Concentrator have received accreditation according to integrated health and safety, environment and quality standards whereas Nurkazgan has starting to implement the systems.

The ecologist responsible for Mizek, which is under the organisation of Kazakhmys Gold, is based at Semipalatinsk.

In IMC's opinion the Karaganda region is assigning adequate human resources to environmental management in the context of Kazakhstan requirements. However a large amount of the effort appears to be devoted to administrative tasks to fulfil the permitting obligations and tax payments.

5.10.2 Management System

The system for environmental protection and control is standardised throughout Kazakhmys' operations and all industrial activities in Kazakhstan according to Chapter 14 of the Ecological Code, 2007, whereby the appointed ecological specialists are responsible for:

— Keeping up to date with ecological policy, regulations and objectives.

— Observing the requirements of the ecological legislation.

— Minimizing the influence of activities on the environment and health.

— Increase the efficiency of use of natural and power resources.

— Emergency preparedness and response.

— Environmental training.

— Public information on ecological activity and risks for health.

— Compliance with ecological requirements.

— Accounting of ecological risks.

The Programme of Industrial Ecological Control is developed for each site taking account of the projects for specifications of maximum permitted limits for air emissions, water discharges and waste and is valid for 3 years. Under the framework of this programme an independent company, licensed in the field of ecological auditing and monitoring is engaged to carry out quarterly monitoring of:

— Climatic data.

— Stationary sources of emission such as exhaust gases from boiler and dust capture equipment.

— Air quality in terms of particulate matter and specified gaseous substances at the border of the sanitary protection zone.

— Soil and snow analyses at the border of the sanitary zone.

— Quality of surface and underground waters.

— Volumes of waste products, process and non-process.

— Assess the influence on the environment.

Kazakhmys has engaged the company ECOTERA to monitor all its activities in the Karaganda region. Quarterly reports are issued to the company and the Ministry of Environment. Mizek uses the services of PK Eco Air.

Each operating site requires permission from the Ministry of Environment for the use/management of nature, which defines the permissible limits on emissions to atmosphere, discharges to water and placement of solid waste. These limits are specified in total and also for a wide range of individual substances in detailed projects approved by conclusion of the State Expertise of the Ministry of Environment. Separate projects are implemented for emissions to air, use and discharge of water and production and placement of waste and are typically valid for 5 years. Under the general conditions and obligations of the permit, each site must:

— Work according to the approved Programme for Operational and Environmental Control.

— Submit a declaration of the actual emissions, discharges and waste and pay environmental charges quarterly.

— Maintain environmental protection insurance according to the Law.

The actual emissions are determined by the results of monitoring, calculations based on material throughputs, fuel consumption, and unit operating times and applying normative factors. Each substance has a hazard classification which determines the taxation rate. Emissions and waste above the permissible quantities incur higher taxation rates.

An Environmental Management Plan, approved by the Ministry of Environmental and typically valid for 3 years, includes a range of general and specific actions together with the planned expenditure on:

— Protection of air quality.

— Protection of water.

— Protection of land resources.

— Protection of flora and fauna.

— Waste treatment and disposal.

— Radiological, biological and chemical safety.

— Environmental training for specialists and dissemination of information to the general public.

Where applicable the plan estimates the environmental and economic benefits achievable as a result of the actions.

5.10.3 Nurkazgan Mine and Concentrator

IMC visited Nurkazgan on 7 and 8 July 2010.

5.10.3.1 Status

The Nurkazgan mine and concentrator are located in Pashtau District, Karaganda Oblast, approximately 45 km north of Karaganda and 2 km north of the Samarkanski water reservoir which extends over an area of 82 km^2. The area is approximately 500 m above sea level with generally flat topography typical of steppe country. Land surrounding the mine is predominantly grass but with some agriculture. There are no national parks or areas of conservation in the area and apart from the reservoir no permanent surface waters in the vicinity of the mine.

The nearest community is the small village of Aktau approximately 5 km distance. There are no other industries close to the mine although the region around Temirtau is heavily industrialised with coal mining, steel making complex and coal fired power station. Mining commenced approximately 7 years ago using open pit techniques but the ore is now recovered using underground mining.

The total area of land disturbed by the mining and processing areas covers an area of approximately 900ha and comprises:

— The western open pit approximately 180 m deep and no longer used for ore extraction.

— 2 trial open pits, the largest being the north pit approximately 30 m deep.

— Overburden and waste rock dumps.

— Portals for the underground mine.

— A ventilation shaft and coal fired ventilation air heater which are presently under construction.

— The concentrator plant and tailings storage facility.

— Surface infrastructure comprising offices, boiler house and workshops.

5.10.3.2 Potential Impacts

The land disturbed by mining and surrounding the perimeter of the mine is of low agricultural value and is sufficiently remote from communities that visual and noise impacts are negligible. The potential impacts of significance are associated with:

— Effects on air quality due to fugitive emissions of dust from material handling and crushing operations and to a lesser extent from gaseous emissions from coal and diesel fired heating plant.

— Depression of the underground water resource resulting from pumping mine water at the rate of approximately 2,500 m^3pd.

— Storage of overburden and waste rock.

— Storage of tailings waste.

The concentrator operates with a closed water circuit; clarified water from the tailings storage facility is returned to the process supplemented by water pumped from the underground mine and fresh water from the reservoir. There is no discharge of waste water. The western open pit is dry due to depression of the water table as a result of pumping underground mine water. Run-off water collecting in the north trial pit is seasonal and it is not necessary to pump.

The ore crushing plant at the concentrator is equipped with dust extraction systems but problems associated with the crusher design and installations have led to the use of mobile plant and considerable dust accumulations in the area. During IMC's visit there was significant wind blown dusting but not likely to be sufficient to significantly on the ambient air quality beyond the border of the sanitary protection zone. This is likely to be more of a health and safety issue rather than having significant environmental impact. IMC expects the problem to be resolved when the permanent crusher circuit is reinstated.

Gaseous and particulate emissions from the heating plant are relatively minor in quantity and are routinely checked according to the approved monitoring programme. The maximum coal burning rate in winter is only 1 tpd.

Overburden and waste rock are stored in heaps, adjacent to the open pit, with a maximum height of approximately 40m. According to Nurkazgan the overburden and waste rock do not have potential for acid generation and IMC's observation supports this. The region has an arid climate and surface run-off water is only significant in spring.

At the present rate of processing, the tailings waste amounts to approximately 2.2m t per year and is stored in a temporary TSF covering an area of approximately 80 ha, 150 km from the concentrator. Tailings contain approximately 50% solids and clarified water from the tailings percolates through a filtration dam wall into an adjacent collection pond which also collects water pumped from the underground mine. The dry surface of the tailings appears stable and not prone to dusting, due according to Nurkazgan, to the use of flocculating agent in the tailings thickening. A new, larger TSF with a capacity for 20 years production is planned for construction approximately 3 km from the concentrator.

5.10.3.3 Environmental Management

Implementation of systems to receive accreditation under ISO14001 commenced some time ago but has now stopped for economic reasons. Nevertheless the basis of the system is in place and all information requested was readily available. General and specific measures for environmental protection and costs are included in a 3 year programme, approved by the Ministry of Environment, with a total planned cost over the period 2008-2010 of Tenge 68.26million most of which is sanctioned for water use and protection measures.

The programme for industrial environmental control, 2010, prepared by ECOTERA includes:

— Monitoring of emissions from boilers.

— Measurement of efficiency of gas cleaning systems on the crushers.

— Monitoring of ambient air quality at the boundary of the sanitary protection zone, which is a maximum of 600m from the centre of the facility.

— Ground water monitoring around the TSF is planned as soon as drilling equipment becomes available to prepare the boreholes.

5.10.3.4 Permitting and Compliance

The operation of the concentrator facilities were approved by conclusion of the State Expertise, Ministry of Environment in 2008. The conclusion took into account the EIA, public disclosure and meetings, together with conclusions of the departments responsible for environmental protection, sanitary and epidemiology, and water resources. Within the conclusion are the stipulated norms for emissions and waste based on the findings of the EIA process.

The mine and concentrator are considered as separate entities for environmental taxation purposes but have a single Permit for Nature Use, No 0055349, issued by the Ministry of Environmental Protection 11.09.2008 and valid until 31.12.10. For 2010 the permissible emissions are:

— 1,238 t to atmosphere, consisting mainly of dust containing 20-70% silica.

— Waste (tailings, waste rock and boiler ash), 4.1 Mt.

In order to renew the permit in 2011, Nurkazgan has commissioned technical projects to re-establish the normative values for air emissions, water use and discharge and generation of waste. These will be valid for 5 years. IMC understands that these projects have been completed and are now undergoing expertise approval. On this basis it is unlikely that issue of a new permit will be delayed.

Nurkazgan is in compliance with the conditions of its permission in that emissions and waste are declared and taxes paid at quarterly intervals, monitoring is undertaken according to the approved programme, and the status of the environmental management plan is reported as required. IMC review of the quarterly emission declarations for the mine and concentrator confirms that air emissions and waste production are well within the permissible limits and environmental payments are at the standard rate, helped to some extent by the fact that production is significantly below plan.

5.10.3.5 Hazardous Materials Management

The main fuel depot comprises:

— 2 bulk diesel tanks, each 1000t capacity filled from rail tankers.

— 2 vehicle fuelling tanks 73m^3 capacity, one each for diesel and petrol.

— 4 small diesel tanks, with integral spill containment, at the concentrator for supplying heating plant, filled from road tankers.

The large tanks are mounted within spill containment constructed of earth bunds and surrounded by lightening conductors. Although the bunding may be adequate to contain minor spillage or leaks it is not compliant with regulations in the EU. Hazard warning signs and fire fighting equipment are provided but not considered adequate.

Explosives are stored underground but the facilities were not inspected.

Chemicals for use in the process, consisting of xanthanate based flotation reagent, frother and magnafloc, are stored in locked 20 t containers with restricted access. This is a temporary arrangement until a purpose designed warehouse is completed. Reagents are mixed in a purpose designed facility with good ventilation and spill containment.

Lime is stored in bulk bags in the open. An area near the reagent containers contained numerous damaged lime bags and lime spillage as well as accumulations of assorted building waste and used packaging.

5.10.3.6 Rehabilitation

There is only limited planning for closure rehabilitation although Nurkazgan pays a percentage of its profits to a fund which is planned to cover closure costs. Under the approved rehabilitation contract for Nurkazgan mine, No 109 of 28/02/97, the assignment is 0.1% of operational expenses for extraction.

Ongoing rehabilitation measures include the removal and storage of topsoil, constructing waste rock storage mounds according to the approved design, collecting waste in designated areas. According to Nurkazgan the completed waste rock heaps will be covered with topsoil and allowed to vegetate naturally. The benches of the western pit are collapsing and this will be allowed to continue so that the pit slopes stabilise. A protective rock barrier will be constructed around the pit perimeter. Nurkazgan did not have a timetable for these measures.

5.10.3.7 Potential Risks and Liabilities

The mine and concentrator are relatively new and the general site condition is reasonable. Haul roads are in good condition and dust suppression is carried out in summer, no excessive disorganised dumping of mining waste was observed. However some areas have accumulations of building/construction waste and disused equipment.

IMC has not identified any liabilities beyond the need for the continuing environmental management plan and payment of environmental charges. The major requirements are for:

— Improved control of dust in the crusher area, expected to be achieved following reinstatement of the crushing facilities.

— Construction of a new TSF.

— Completion of the warehouse for reagent storage.

5.10.4 Abyz Mine

IMC visited the mine on 12 July 2010.

5.10.4.1 Status

Abyz open pit mine is in a remote location approximately 300 km east of Karaganda, 100 km north of Karagaily, in the eastern part of Karaganda Oblast. The region is sparsely inhabited, the nearest community being the small village of Abyz, approximately 5 km distance, where the mine workers are housed on a 15 day rotation system.

The surrounding terrain is typical of hilly steppe country with poor quality, stony soil. Vegetation consists of mainly grassland with some sparse shrubs and trees. Apart from some animal grazing the land in the immediate vicinity has little agricultural value. There are no permanent surface waters likely to be impacted by the mine and no designated protected areas close to the likely zone of influence.

An iron ore mine with processing facility is located approximately 30km south of Abyz Mine and this is the only other industrial operation within a very large area.

Open cast mining commenced in 2004 and has a planned mine life up to 2012. After 2012 there is potential for underground mining. The mine and surface facilities occupy a relatively small footprint which includes:

— The open pit, approximately 150m deep.

— Overburden heaps surrounding the pit.

— Ore storage and truck loading pad.

— Offices.

— Vehicle Workshop.

— Fuel storage and fuelling depot.

Electrical heating of water and buildings is used therefore emissions associated with coal fired heating plant are avoided.

5.10.4.2 Main Impacts

The mine is remote from any communities and agricultural land and in IMC's opinion has low potential for significant environmental impact. However potential issues are associated with:

— Storage of overburden.

— Pumping of water from the mine.

— Dust emissions from material handling and transport.

— Collection and disposal of non-mining waste.

The mine produces approximately 2 Mtpa of overburden and waste rock, which is stored around the pit in flat topped heaps generally lying at the angle of repose. According to Abyz there is no potential for acid generation and observation confirms this. Significant water run-off is only likely during the spring thaw.

Water is pumped from the mine at approximately 150 m^3ph, some of which is used for dust suppression on haulage routes in summer. The remainder is discharged without treatment to an area of grassland adjacent to the mine where it either evaporates or soaks into the ground. The typical mine water discharged is slightly above maximum permissible concentrations in respect of nitrate and nitrite but IMC does not consider this significant. According to the project design the water should be pumped to an evaporation pond of appropriate construction.

Mine access roads are watered during summer to suppress dust. IMC did not observe any excessive dust emissions and none likely to exceed air quality standards at the perimeter of the site.

Abyz has permission to store general domestic waste within the overburden heaps. Other more hazardous waste is collected in appropriate containers for collection and either recycle or disposal.

5.10.4.3 Permitting and Compliance

Abyz has a permit No 0054883, for nature use/management, valid from 01.07. 2009 to 31.12.2010, which assigns maximum permissible quantities for 2010 of:

— 2,314 t of solid and gaseous substances in emissions to air, predominantly in the form of dust containing 20-70% silica.

— 543.8 t of substances in water, consisting mainly of dissolved minerals.

— 3 Mt of solid waste, mainly overburden of low hazard classification.

In the first quarter of 2010 the declaration to the Ministry of Environment indicated that all emissions, discharges and waste were within the permissible limits and no excess charges were incurred. According to Abyz, the situation was the same in previous years. The design projects for specifying the norms and maximum permissible limits for the operation are valid and have received approval of the Expertise of the Ministry of Environment:

— Emissions to atmosphere, 2007-2011

— Water discharge, 2009-2011.

— Mining and domestic waste, 2007-2011.

Eight Boreholes have been prepared for monitoring groundwater around the mine and particularly the area where mine water is discharged. However monitoring has not commenced.

5.10.4.4 Hazardous Materials

Diesel is stored in 8 tanks, each approximately 20 t capacity, and there is an adjacent vehicle fuelling facility. The tanks are within a concrete bunded area which in many places has deteriorated and collapsed. There is no protection in the form of fencing and hazard notices. Used lubricants are collected in drums and collected for recycle.

Blasting in the mine is carried out by a contracted company and no explosives are stored on site.

5.10.4.5 Management Plans

Improvement actions specified in the management programme include:

— Bunding of the fuel station.

— Arrangement of the area for collection of non-mining waste

— Truck wash facility.

— Concrete parking area for trucks.

— Domestic waste water treatment facilities.

5.10.4.6 Rehabilitation

Ongoing rehabilitation includes segregation of non-mining waste to be disposed of by agreed methods or collection for recycle.

Plans for closure rehabilitation are of a preliminary nature and include constructing a protective berm around the open pit perimeter, demobilisation of equipment and contouring waste heaps. No biological restoration is planned because of the poor quality and quantity of topsoil.

Under the approved contract for rehabilitation, No 1681 dated 03.03.2005, 0.1% of operating expenses for ore extraction are assigned to the rehabilitation fund.

5.10.4.7 Potential Risks and Liabilities

Apart from the need to fund closure rehabilitation, IMC has not identified any material liabilities. The site is well organised and has a reasonable standard of housekeeping. The major deficiencies are identified in the environmental management plan which has a budget of Tenge 14.2 million for 2010.

5.10.5 Mizek

IMC visited Mizek Mine on 13 July 2010.

5.10.5.1 Status

Mizek mine occupies a site of approximately 3,000 ha in a remote area of the Abralinsky and Chubatausky regions of the East Kazakhstan Oblast in the northeast of Kazakhstan. The mine lies approximately 340km southwest of the city of Semipalatinsk and 150 km east of the nearest railhead at Karagaily. The nearest community is the small village Kainer.

The project area is characterised by low rolling hills in the large watershed between the Irtysh River and Lake Balkhash. Mizek mountain at 1029.5 masl, where the oxidized gold bearing material of the deposit is located, dominates the region and the land falls to 850 to 870 masl in the dry river beds. The climate is arid, soil is thin and of low depth resulting in sparse vegetation consisting mainly of natural grassland and some low shrubs. The nearest watercourse is the Tiulkubas River, approximately 10 km from the mine site but only containing flowing water in the spring. There is no evidence of surface water channels within the Mizek site. There are no designated areas of protection close to the mine and the land immediately surrounding the mine has little agricultural value.

Most of the Mizek workers reside in Semipalatinsk and are housed in accommodation at the mine during their duty period. Domestic water supply for the Mizek mine is provided from a borehole situated 1.5 kilometres north of the mine site. Process water is sourced from 5 borehole wells located 0.5 to 2.5 kilometres from the deposit.

Mining at Mizek has been intermittent since the 1990s and on a continuous basis since 2002. The main features and facilities within the site include:

— Two open pits where the oxide ore has been extracted.

— Overburden mounds and ore stockpiles.

— Ore crushing plant and stacking conveyors.

— Heap leach pads, including spent ore and active heaps.

— 2 HDPE lined ponds for storing the cyanide leach liquors plus 1 emergency storage pond for rainfall run-off.

— The gold processing plant.

— The copper recovery plant.

— Storage facilities for chemicals and fuel.

— Support facilities consisting of offices, workshops, heating plant, accommodation block.

5.10.5.2 Main Impacts

In view of the remote location and low level of agricultural use in the immediate area, the potential for significant impact from the mine is low. However protection of ground and underground water resources from cyanide migration is critical. The potential impacts include:

— Emissions of dust from the ore crushing and handling circuit.

— Emissions of dust from vehicle movements and ore/overburden handling and blasting.

— Protection of ground and groundwater from chemicals used in the heap leach and gold recovery.

— Discharge of domestic waste water.

— Storage of overburden/waste rock and low grade ore.

Ore crushing and agglomeration take place in an area confined between the ore stockpile and the heap leach pad. The potential for dust emission is reduced by the moisture in the ore and agglomeration of the fines. From observation during the site, it is unlikely that fine material produced during crushing and screening would transgress the boundary of the sanitary protection zone, approximately 500 m from the operations. Dust suppression is used on haulage routes during dry months.

The heap leach and process plant are constructed to appropriate standards for this type of operation and designed to contain any spills and leaks. The emergency storage pond, 45,000 m^3 capacity, is available for containing excess rain run-off water from the heaps and process areas. It was approximately 25% full at the time of the visit providing ample spare volume.

Overburden is stored in organised heaps around the open pit generally constructed at the natural angle of repose. At present there appears little potential for acid drainage from the heaps.

Treated domestic waste water is discharged to the land under the terms of Mizek's permission for nature use.

5.10.5.3 Permitting and Compliance

Mizek's Permission for Use/Management of Nature, No 0054888, is valid from 08.07.09 to 31.12.2011 and specifies the maximum permissible quantities per year for 2010 and 2011 of:

— Emissions of solid and gaseous substances to atmosphere of 402.6 t.

— Discharge of 12,000m^3 of domestic waste water containing 3.4 t of dissolved and suspended solids.

— Placement of 1 Mt of waste rock of low hazard classification IV.

Mizek also has a license, dated 14.03.2007, for abstraction and use of underground water from boreholes.

Independent ecological contractors PK Eco Air, based in Ust-Kamenogorsk, certified for ecological assessment and monitoring, conducted the original environmental impact assessment and subsequent studies to determine maximum permissible emissions, water discharge and waste. The project for specification of maximum permissible limits on emissions to air was approved by conclusion of the expertise, the Ministry of Environment, on 27.04.2009 and the project is valid until 2013. The conclusion of the expertise for maximum discharge of substances in water is dated 20.04.2010 and is valid until 2014.

Mizek is complying with the terms of the permission and according to the ecologist the company is not incurring additional charges for exceeding the maximum specified limits.

For compliance with the Programme for Industrial Ecological Control, Eco Air is contracted for quarterly monitoring of ambient air quality at the border of the sanitary protection zone, and ground water at the 4 observation boreholes at the toe of the heap leach pad. In addition Mizek monitors the boreholes weekly. According to Mizek there is no deviation from maximum allowable concentrations at any of the monitoring boreholes.

5.10.5.4 Management Plans

The environmental management plan is valid from July 2009 to the end of 2011 and has a total budget of Tenge 8.765 million over this period, a large proportion of which is payment for monitoring. Other major planned expenditure is for dust control in the process area and for waste storage.

5.10.6 Hazardous Materials

Mizek is generally complying with requirements of the cyanide code of practice in that the heap leach pads and solution ponds are constructed on an impermeable base incorporating HDPE. There is an emergency storage pond for excess solution during heavy rainfall. Ground water down gradient of the heap leach pads is monitored frequently. The cyanide storage ponds are fenced with hazard signs, sodium cyanide is stored in a locked compound with restricted access and workers exposed to cyanide solution have the appropriate PPE.

Other chemicals, such as sulphuric acid and sodium sulphide are stored in suitable containers.

5.10.6.1 Rehabilitation

The mine undertakes progressive reclamation as part of its normal operations, such as storing topsoil, contouring waste heaps, collection and storage/disposal of non-production waste.

The remaining oxidised ore will be fully exploited by the end of 2010 and Mizek has then to decide whether to develop underground mining to extract sulphide ore or to close the mining operations. In either case the heap leach operation and gold recovery may continue through to 2011 in order to maximise gold recovery from the existing heaps and to treat any remaining ore stockpiles.

A preliminary closure and rehabilitation plan is included in the approved environmental impact assessment and includes generally accepted procedures such as:

— Constructing a berm around the open pits to prevent access.

— Neutralising the heap leach followed by capping and vegetation.

— Contouring overburden mounds and vegetating if sufficient topsoil is available.

— Removal of process equipment and buildings not required.

— Allowing process solutions to evaporate and then disposing of the residue according to regulations.

A technical design project for the final closure plan must be approved before rehabilitation work can commence. Such a project should include ongoing aftercare and particularly monitoring of groundwater.

Mizek was unable to provide a cost estimate for rehabilitation but confirmed that a contract to fund the closure was established and that Mizek contributed a percentage of the annual profit.

5.10.6.2 Potential Risks and Liabilities

IMC has not identified any potential liabilities associated with the existing operation. However there will be a requirement to close the heap leach operation in a safe manner during 2011/2012 by decontaminating and removing the equipment and the remaining cyanide solutions or residue.

5.10.7 Karagaily Concentrator

IMC visited Karagaily concentrator on 12 July 2010

5.10.7.1 Status

Karagaily Concentrator is on the site of the former Glavny Barite Mine and Processing facilities which operated from the 1960s. Kazakhmys acquired the site in 2004 and rehabilitated the concentrator for processing copper ore initially from the Kosmurun deposit but presently from Abyz mine. Along with the concentrator, Kazakhmys inherited a large amount of derelict structures, many of which appear in unsafe condition. The site contains large accumulations of construction waste and scrap metal. IMC understands that liability for the overburden heaps and the Glavni open pit also falls under the responsibility of Karagaily.

The plant is located approximately 1km from the small town of Karagaily, which grew alongside the former mining operation, but now has a population of approximately 6,000 compared with twice that number in former times. Surrounding terrain is hilly steppe land, mainly grass with some sparse trees. The nearest surface water is approximately 5km and designated areas of protection are the Karkaralinsk and Kent National Forests, 12 km and 20 km respectively from the plant; all are well outside the zone of likely influence of the concentrator.

Facilities on the site include:

— Ore receiving and crushing plant.

— Milling and flotation building.

— Offices.

— Numerous derelict structures.

— The tailings storage facility of the former processing plant.

— The Glavny open pit, 1.6 km to the south west, approximately 200 m deep and partially filled with tailings and water to a depth of approximately 50 m.

5.10.7.2 Main Impacts

The potential impacts of the Karagaily concentrator are associated with:

— Dust emissions to atmosphere during unloading of ore trucks from Abyz Mine.

— Dust emissions from the 3 stage crushing circuit and ore conveyors.

— Storage of tailings waste.

— Gaseous emissions and odour from the reagent preparation.

According to Karagaily the crushing circuit is only operated at night giving potential for noise impact. However, Karagaily village is over 1km from the plant and unlikely to be impacted.

All stages of the crushing circuit are equipped with cyclone dust collectors having a dust capture efficiency in the order of 70%. Each cyclone exhaust discharges via a local stack, approximately 15m high. The crushers were not operating during IMC's visit but the workplaces were in reasonably clean condition with no large accumulations of material beneath screens and conveyors.

The concentrator operates in closed circuit with the tailings storage facility and no process waters are discharged. Tailings waste is currently discharged into one end of the disused open pit approximately 1km from the concentrator. Clarified water is returned to the concentrator using a pontoon mounted pump at the opposite end of the pit. Although there is ample room in the pit, IMC understands that this is a temporary arrangement for which a permit is under application and will allow tailings storage for 2 years. According to Karagaily, the application process is 60% complete and no problems are envisaged in gaining the permission. The existing tailings storage facility adjacent to the concentrator is being extended to allow future tailings storage.

The reagent storage and preparation building is in very poor condition and does not appear to have a forced ventilation system. IMC did not inspect this area closely because of the potential hazardous nature. Karagaily indicated that there was a serious fire in 2009 and part of the building is now isolated from use.

A further liability is associated with the demolition and clearance of a large number of derelict structures and equipment of the former process plant. These are currently cordoned off from the areas of the site currently used.

5.10.7.3 Permitting and Compliance

The Permission for Nature Use/Management, No 0054883 is valid from 01.07.2009 until 31.12.2010 and specifies emissions to air, discharges and placement of waste for:

— The Company sanatorium.

— Abyz Mine.

— Kosmurun Akbastau mine, which is not currently operating.

An additional permit allows the abstraction of underground water from 2 boreholes for use at the company sanatorium. In 2010, the permissible quantities for Karagaily concentrator include:

— 320 t of solid and gaseous substances to atmosphere, mostly as dust containing 20-70% silica.

— 1.1 Mt of tailings waste.

The declaration for the 1st quarter of 2010 indicated that all quantities are within the permissible limits and no excess charges were incurred.

The project for specifying the maximum emissions to atmosphere is valid from 2007 to 2011 whilst the project for maximum quantities of waste runs from 2005 to 2010. A new project to determine the normative values for waste is in progress.

5.10.7.4 Management Plans

IMC was provided with a copy of an environmental improvement programme covering the period 2009-2011, the major items of which include:

— Dismantling the derelict structures and equipment of the former processing plant including a boiler house, concentrator and mixing plant at an estimated cost of Tenge 68 million.

— Construction of a new reagent storage and preparation plant.

— Providing a hard surface for the truck refuelling station.

— A project for improvement of dust capture at the crushing plant.

— A warehouse for finished product.

— Project for thickening tailings.

— Recultivation of the tailings pond.

5.10.7.5 Rehabilitation

Rehabilitation of parts of the site is underway with the clearance of buildings and structures of the former processing plant. There is a cost allocation in the environmental improvement programme of Tenge 68 million. Karagaily did not have a timescale for completion. Other ongoing rehabilitation involves collection and removal of non-process waste by contractors.

IMC understands that the Company bears responsibility for rehabilitation of the whole site including the open pit and overburden heaps. A preliminary plan was not available nor details of funding requirement for the future work required.

5.10.7.6 Potential Risks and Liabilities

The main liabilities are identified in the management plan and involve the demolition of redundant structures, the temporary nature of the current method of tailings disposal and providing better facilities for reagent storage and preparation. According to Karagaily the approval of permission for the present method tailings disposal is in progress. In IMC's opinion it is unlikely that permission would be refused.

5.10.8 Mine Projects

Akbastau, Kosmurun and Bozshakol mine projects are in the process of being evaluated from an environmental perspective and have not yet established their rehabilitation requirements. IMC has therefore made an appropriate adjustment in the business plan model.

6 KYRGYZSTAN

6.1 Maps and Plans

Plate 25 Bozymchak Mine Project

6.2 Bozymchak Geology

The project site is located in the Alabuka Region, Jalalabad District, Kyrgyz Republic: latitude 41° 15' 30", longitude 71° 03' 43".

The deposit was discovered in the 1950s and a number of exploration phases have since been undertaken. Development of the project is proceeding on the basis of a Detailed Feasibility Study for Bozymchak Mine prepared by Worley Parsons (October 2009) and incorporating a review of previous resource estimates undertaken by AMC Consultants (UK) Limited and mine design, for open-pit and underground, prepared by CSA Global. Other studies for specific areas of the project concept have been prepared, included detailed engineering prepared by the Non-Ferrous Minerals Company of China in the period 2009-2010.

Project construction has commenced over the industrial site covering 260 ha, for which major equipment items are on order and in some cases have been delivered and major infrastructure is over 70% constructed as at end-July 2010. Overburden removal over the open-pit commenced in June 2010 and the first extraction of ore is expected in November 2010.

The Bozymchak deposits were generated by intrusion of a large granitoid stock with pinkish-grey porphyritic granites of the Dzhalgyzuriuk massif into carbonate country rocks of Devonian and Carboniferous age. Devonian sediments are polymict clastics, calcareous sandstones and limestones of Frasnian-Famennian age; Carboniferous sediments are sandstones and limestones, sometimes siliceous and bituminous, of Tournaisian-Visean age and pyroclastic sedimentary rocks (andesitic and dacitic tuffs) of mid-Carboniferous age.

Mineralisation is generally in skarn zones, in the form of disseminated sulphides with associated gold. The major sulphide component is chalcopyrite with lesser bornite and covellite; there is some rare presence of sphalerite and arsenopyrite. Surface oxide mineralization is only weakly developed and is primarily marked by the occurrence of malachite. The skarn mineralization is of garnet-wollastonite and garnet-pyroxene types; metamorphosis of limestone and dolomite has occurred locally to form marble and siliceous limestone. The thickness of the skarn horizon varies from a minimum of around 7 m up to 85 m.

To the east of the main central deposit massive sulphide zones are found which contain chalcopyrite, pyrite and pyrrhotite, with, in this zone, serpentinites which are the products of alteration of pyroxenite; some fibrous asbestos is also found.

The Bozymchak deposit comprises four sectors separated as discrete areas by faulting:

— South-western Sector

— Central Sector

— Eastern sector

— Davan Sector

In the Central Sector the skarn horizon occurs along a bow-shaped strike along the contact of country rock and the intrusion, along a 2 km strike with dip to the south of between 75° – 86°. In general, the hanging wall will consist of dense quartzitic granodiorite and the foot wall will be massive dense quartzitic marbles and marbled limestone.

6.2.1 Reserves and Resources Statement

A number of comprehensive resource estimation exercises have been performed since 2007. The Kyrgyzstan State Reserve Commission (GKZ) approved a conventional resource estimation performed by NBL Gold in 2007 using a cut-off grade of 0.6% Cu_{eq} but did not incorporate the resource estimate into the state balance. Subsequent reserve estimates have used geostatistics based resource modelling programmes each with somewhat different modelling parameters. However, as a general rule all such exercises which have expressed resource grade as a copper equivalent grade have used the same relationship as approved by GKZ for the 2007 exercise:

$$Cu_{eq}\ \% = (Cu\ \% + (Au\ g/t \times 0.41) + (Ag\ g/t \times 0.007))$$

This relationship has been established on the basis of a reference copper price of US$5,000/t, a reference price for gold of US$550/oz (US$17.68/g) and a reference price of US$12/oz for silver and assuming copper recovery of 94.55% and gold recovery of 87.5%.

As part of the October 2008 Detailed Feasibility Study a composite resource model was prepared by AMC Consultants through amalgamation of two earlier models for use as the as the basis for mine design. This exercise first defined resource perimeters with reference to boundary grades of 0.5 g/t Au and 0.1% Cu as used in an earlier model by Y. Kaputin; within the resource perimeters resources were estimated with no internal cutoff. This estimation has been used as the basis of mine design and evaluation for the South-western, Central and Eastern Sectors and is considered the appropriate resources statement valid as at 1 June 2010. There has however been considerable continuing exploration in the Davan Sector. For this sector only a new resources modelling and estimation exercise has been performed by Y. Kaputin, reported as at May 2010.

Table 6-1 below shows the resource statement estimated as at 1 January 2011 which, uses the AMC resources estimate for the Central, South-western and Eastern sectors, but uses the new Kaputin estimate for the Davan Sector.

Table 6-1 Bozymchak Project Resources Estimated as at 1 January 2011

Bozymchak Gold-Copper Project		Resources	Gold	Silver	Copper
		'000 t	g/t	g/t	%
Bozymchak	**Measured**	**6,240**	**1.63**	**9.77**	**0.96**
	Indicated	**13,714**	**1.52**	**7.45**	**0.80**
	Total	**19,954**	**1.56**	**8.18**	**0.85**
	Inferred	**5,920**	**1.37**	**6.97**	**0.65**

Reserves are recognised in those sectors where the Detailed Feasibility Study has developed mine plans and schedules. Open-pit mining has been planned and scheduled only for the Bozymchak Central Sector and a contiguous part of the East Sector. For this operation production has been scheduled over a five year period.

Underground production has been designed and scheduled for blocks in the Bozymchak Central Sector below the level of 2,170 m down to 1,888 m, and also for all of the South-West Sector and that part of the East Sector below the open-pit operation. Current scheduled underground extraction includes blocks still identified as in the Inferred Resource category, which cannot yet be upgraded to reserves; the stated Probable Reserve for underground mining is calculated only for the balance of Measured plus Indicated Resources in all blocks excluding the Davan Sector.

Table 6-2 Bozymchak Project Reserves Estimated as at 1 January 2011

Bozymchak Gold-Copper Project		Reserves	Gold	Silver	Copper
		'000 t	%	g/t	g/t
Bozymchak	**Proved**	**6,639**	**1.43**	**8.54**	**0.84**
LOM 18 Years	**Probable**	**8,788**	**1.36**	**8.36**	**0.84**
	Total	**15,427**	**1.39**	**8.44**	**0.84**

6.2.2 Estimates of Tonnages and Grades

In the period 1953 – 1964 exploration included trenching, underground exploratory adits and core drilling to a total of 10,200 m; this formed the basis for resource estimation under the FSU system of C_1 category resources down to the 2,088 m level and C_2 category resources below the 2,088 m level down to the 1,880 m level. Renewed evaluation of the deposit in the period 2006 – 2007 was undertaken with a programme of 20 vertical and angled surface diamond drill holes for a total 3,940.6 m in the Central Sector, with a corresponding extensive sampling and analytical programme. Subsequent infill core drilling was performed in 2008 and since that date there has been a continuing exploration drilling programme. Ongoing exploration consists of drilling in the Central Sector from an underground exploratory adit to upgrade resources currently categorized as C_2 under the FSU system plus continuing surface drilling in the Davan Sector.

6.2.3 Expected Recovery and Dilution Factors

For the planned open-pit working for the Bozymchak Central Sector and a contiguous part of the East Sector for the first five years the optimization and scheduling exercise has assumed losses in production of 5% and dilution of 10% at zero grade.

For the underground operations an average overall loss of 16% is anticipated and an average dilution of 17%.

6.3 Mining

Bozymchak has a surface pit which is currently at development stage and an underground mine project. The Company has the license to develop the central part of the Bozymchak deposit from September 2008 to December 2027. In December 2008 the exploration license was extended from January 2009 to December 2013.

6.3.1.1 Surface Development

The dimensions of the final pit will be 350 m deep, 700 m long and 300 m wide, the main benches are 30 m with sub benches at 10 m giving a total of 12 benches. A full mining plan is provided in the feasibility study.

The volume of the waste has been calculated 29.0 Mm^3 and the ore at 5.255 Mt including planned dilution. The production is planned as waste 208,000 m^3pm and ore at 80,000 tpm. The mine will work a continuous cycle; equipment is planned as 8x55 tonnes Belas dump trucks and hydraulic face shovels. The mine is planned to operate for five years and both the surface mine and underground mine will produce simultaneously for one transitional year.

6.3.1.2 Underground Project

The mine will start development after surface has worked three years. The ore will be mined by sub level caving using stoping method, detailed plans are provided in the feasibility study. The production of waste is planned as 4,000m^3pm for first year then 20,000m^3pm. The production of ore is planned at 80,000 tpm. The combined surface and underground mine scheduled to operate for 13 years. A definitive feasibility study was completed in November 2008.

6.4 Processing Plant

6.4.1 Test Work

Samples of the ore have been tested by Irgiredmet, of Irkutsk, in 2008. Testing included a combination of gravity and flotation. Prior to gravity concentration, the sample was classified, apparently by screening, to give the gravity separation tests in a Knelson concentrator the best possible chance. In practice, the gravity gold recovery was 37.44% to a concentrate containing 51.6 g/tAu. Silver and copper recoveries were 5% and 2% respectively. The gravity tailing was subjected to flotation in which 85% of the remaining gold and 70% of the silver and 93% of the copper were recovered. As an alternative to the gravity plus flotation route, a bulk flotation test was tried and gave good results. Closed circuit tests gave the results in Table 6-3 below.

Table 6-3 Initial Process Test Results

Product	Grade			Recovery		
	g/t Au	*g/t Ag*	*% Cu*	*Au %*	*Ag %*	*Cu %*
Concentrate	53.0	346	24.5	93.9	91.45	93.04
Tailing	0.07	1.0	0.055	6.1	8.55	6.96
Ore	1.66	11.35	0.79	100	100	100

These are remarkably good results and led designers to use a flotation only flow sheet. Subsequent tests were carried out by Kazmechanobr of Almaty and gave rather less encouraging results as shown Table 6-4 below.

Table 6-4 Supplementary Process Test Results

Product	Grade			Recovery		
	g/t Au	*g/t Ag*	*% Cu*	*Au %*	*Ag %*	*Cu %*
Concentrate	40.9	339.7	23.35	65.89	68.35	88.07
Tailing	0.7	5.20	0.11	34.11	31.65	11.93
Ore	1.987	15.90	0.89	100	100	100

Subsequent open circuit flotation tests at the Alex Stewart Assay Laboratory at Karabalta gave gold, silver and copper recoveries of 94%, 87.8% and 88% respectively from an ore sample grading 1.20 g/tAu, 10.5 g/tAg and 0.75%Cu.

Finally, open circuit tests were carried out at the Kyrgyzia Central Research Laboratory and Table 6-5 below summarises the results under the best conditions tested.

Table 6-5 Open Circuit Process Test Results

Product	Grade			Recovery		
	g/t Au	*g/t Ag*	*% Cu*	*Au %*	*Ag %*	*Cu %*
Concentrate	17.64	124.6	12.1	91.2	84.8	90.0
Tailing	0.15	2.00	0.12	8.8	15.2	10.0
Ore	1.59	12.4	1.10	100	100	100

No cleaning of the concentrate was carried out in these tests and this accounts for the lower concentrate grade.

Apart from the recoveries achieved at Kazmechanobr, these results are broadly consistent. It is understood that the samples upon which the testwork was based were extracted from adits, but the precise detail of their representativity is unknown.

The plant design foresees metallurgical performance as outlined in Table 6-6 below:

Table 6-6 Expected Plant Performance

Product	Grade			Recovery		
	g/t Au	g/t Ag	% Cu	Au %	Ag %	Cu %
Concentrate	38.60	193.81	23.20	80	75	86
Tailing	0.31	2.10	0.12	20	25	14
Ore	1.52	8.14	0.85	100	100	100

This seems to be a realistic projection for the project as a whole, but lower recoveries may be encountered in early years when more oxidised mineralogy may be found.

6.4.2 Mineralogy

The mineralogy of the ore as reported is shown in the table below together with the calculation that indicates that around 15% of the copper is present in the basic copper carbonate minerals malachite and azurite, as shown in Table 6-7 below.

Table 6-7 Mineralogy

Mineral	Abundance %	%Cu in mineral	%Cu in sample	Minerals as proportion of Cu in ore
Chalcopyrite	0.5	34.5	0.1725	12.02
Bornite	trace	~63%		
Chalcocite	1.3	79.8	1.0374	72.31
Covellite	trace	66.4		
Malachite	0.2	57.3	0.1146	7.99
Azurite	0.2	55.1	0.1102	7.68
Total	2.2		1.4347	100

Malachite and azurite will not normally be recovered by the xanthate flotation that is planned, so if this mineralogy is representative of the ore, copper recoveries in the low 80's percent may be expected. Commonly it is found that the abundance of oxide minerals is higher nearer surface and lower at depth. It may be wise to extract samples representative of the first year's ore production and test them in the laboratory before the start of the operation. If poor recoveries are obtained because of the abundance of "oxide" minerals, there will be an opportunity to experiment with e.g. sulphidising reagents or alternative collectors before start-up, rather than have to combat such problems while also coping with the usual commissioning difficulties.

6.4.3 Plant Design

The selected plant design is conventional and generally well considered. Ore will be delivered by truck or front end loader to a fixed grizzly above a bunker that will be discharged by an apron feeder that will feed a vibrating grizzly from which the oversize will feed the TST 1200 primary jaw crusher. Vibrating grizzly undersize and the primary crushed product will be conveyed to a vibrating screen from which the oversize will discharge into a surge bin ahead of the secondary crusher. A belt feeder under the surge bin will feed the XL 300 secondary cone crusher and the vibrating screen undersize will join the secondary crushed product and the tertiary crushed product on a conveyor to another vibrating screen. The oversize from the second vibrating screen will be conveyed back to the two XL 300 tertiary cone crushers. The second vibrating screen undersize at 80% passing 7.7 mm, will be conveyed to a 50 m diameter stockpile. This will provide ore for the mills for 72 hours to allow time for repair and relining of the crushers.

Fine ore will be drawn by apron feeders under the stockpile to two parallel conveyors, each feeding a 3.7m diameter, 7.2 m long ball mill with a 1600 kW motor at about 65 tph. The mills will operate in closed circuit with hydrocyclones with a 350% re-circulating load. The cyclone overflow at a particle size of 80% passing 52 microns and a pulp density of 30% w/w solids will gravitate to rougher flotation in five 20 m^3 flotation cells.

The rougher concentrate will be cleaned in two 4 m^3 cells and the cleaner concentrate will be re-cleaned in one 4 m^3 cell. The rougher tailing will be scavenged in six 20 m^3 cells. The scavenger concentrate will return to the head of the flotation circuit, while the scavenger tailing will be the final tailing. Two complete flotation circuits are planned; one for each mill circuit, and this will provide useful flexibility, as well as an admirable arrangement for "back to back" experimentation to optimise the plant performance.

Final concentrate will go to the 9 m diameter concentrate thickener from which the underflow will be pumped to a surge tank ahead of 2 ceramic disc vacuum filters. The filter cake will be conveyed directly to two bagging plants, where the concentrate will be loaded into big bags for despatch. Final tailing will go to the 24 m diameter tailing thickener from which the underflow will be pumped approximately 1km to surge tanks at a filter plant on the edge of the tailings enclosure. Eight ceramic disc filters (of which two in reserve) will be used to dewater the tailing that will then be conveyed by a succession of movable conveyors to the tailing dam. All filtrate will be returned to the plant to the mill water sump.

A tailings dam with a rock filled wall will be constructed in the valley about two kilometres from the plant site. The wall has an initial height of 46m and is planned to be raised by the downstream method in two 15m lifts in subsequent years. A sub-drain will be provided to permit ground water to drain from under the enclosure, under the wall into the downstream drainage. An HDPE liner will cover the entire enclosed area of the dam and a seepage drain will allow drainage through the wall to a collection pond from which it will be pumped back to the filter plant. Tailing will be placed in the enclosure by conveyor. This method of tailings disposal will enable the maximum amount of tailing to be stored in the available space in this mountainous area. It also minimises the seismic risk of tailings dam stability and minimises the water requirements for the plant.

IMC would have liked to see the first vibrating screen placed on the discharge from the surge bin, rather than on the feed to it, in order to provide for independent operation of the primary crusher, this is a detail. The plant appears to be carefully and competently designed and should be suitable for its purpose.

6.4.4 Capital Costs

The capital budget for the project is shown in Table 6-8 below:

Table 6-8 Capital Cost

Element	Cost (US$ M)
Plant and Infrastructure	75.01
Dam	Not included
Power Lines	3.00
Open Pit	11.31
Underground	27.24
Total	116.57
Contingency	10.63
Total with Contingency	127.20
Total with Inflation Allowance	133.10

IMC was advised that the project was presently on budget.

6.4.5 Construction Schedule

The development of the Bozymchak gold-copper deposit located in Kyrgyzstan was impacted by social unrest, which delayed the commencement of stripping works and the delivery of equipment to the site. The processing plant was built in China and delivered to the site in 2010, and although construction work on infrastructure was delayed, resulting in first concentrate sales being pushed back from the initial fourth quarter 2010 target, the situation at the mine site is currently stable. The Group expects operations to commence and first ore produced at the end of 2011 with the first concentrate being produced in 2012.

6.5 Infrastructure

Access

The mine at Bozymchak is some 700 km SW from Bishkek the capital of Kirgizstan. Bishkek to Tash Kumyr is 510 km of main road followed by 140 km of secondary road to Ala-Buka and then 50 km of unsealed mine road to the site. Concentrates will be loaded in big bags and delivered to Ala-Buka.

Power

Power supplies to the area substantial with a 110/220 kV ring straddling the border between Kyrgyzstan and Uzbekistan. The supply to the mine site is a single 100 kV feeder 32 km long from Shekaftar sub station to the mine incoming sub station. Because of the insecure nature of this single line 3 MW of diesel standby generation has been provided. The mine sub follows typical Kazakhmys practice with incoming 110 kV SF6 switchgear, a 12.5 MW 110/6.0 kV step down transformer and distribution to the plant at 6.0 kV. Because of the de-rating factor for an altitude of 2,500 mamsl 10 kV equipment is used for the 6.0 kV distribution and 690 V equipment for the 400 V distribution.

The total load of the plant is expected to be around 9 MW and the biggest load is that of the 2 x Ball mills with 6.0 kV 1,500 kW motors. These are designed to be started with a series current limiting reactor. There is 2.0 MVar of static compensation capacitors connected to the system for power factor correction with a view to running at a power factor of 0.93.

There are a number of 6.0 kV/400 V transformers around the plant for supplies to all of the rest of the equipment and lighting circuits.

Water

Water is pumped to the site from the Jalgyzuryk river 2 km away. About 900 m^3pd is required for the plant.

Mine Camp

A camp suitable for 300 people has been built. Whilst the Chinese company Nerin are building the concentrator Kazakhmys Gold are responsible for all of the ancillary services. These include the water supply, mine garage, fuel storage, explosives magazine, stores buildings etc. This is all ongoing.

6.6 Environmental

IMC has not visited the mine site. Information was obtained from discussions with the Bozymchak ecologist in Almaty on 23.07.2010 and from the Environmental Impact Assessment for the project.

6.6.1 Legislation

Environmental legislation in the Kyrgyzstan Republic is based on the system used in all countries of the former Soviet Union. The framework articles of legislation dealing with general environmental protection are Laws on:

— Environmental Protection, No.53 of 16.06.1999

— Ecological impact Assessment, No.54 of16.06.1999

— Atmospheric Air Protection, No.51of 12.06.1999

— Water, No.1422-XII of 14.02.1994

— The Water Code, No.8 of 12.01.2005

— Subsoil, No.42 of 02.07.1997

— Protection of Flaura, No.53 of 20.06.2001

— Fauna, No.59 of 17.06.1999

— Land Code, No.45 02.06.1999

— Historical and Cultural Heritage Protection and Usage No. 91 of 26.07.1999

Kyrgyzstan Republic is currently a Party to a number of international environmental treaties and conventions.

Specific requirements for environmental protection at each stage of a mining project including construction, mine operation and completion, liabilities arising from environmental damage, damage compensation are covered under Laws on:

— Tailings Storage Facilities and Dumps, No.57 of 26.06.2001

— Production and Consumption Waste, No. 89 of 13.11.2001

— Operational Safety of Hazardous Production Facilities, No. 93 of 19.11.2001

— Mining, No. 151 of 01.11.2002

Environmental impact assessment is required for each phase of a project according to the instructions for OVOS procedure in the Kyrgyzstan Republic, Ministry of Environment Protection 1997, and Manual for Environment Impact Assessment in a trans-boundary context for countries of central Asia.

Environmental protection is enforced mainly by an economic mechanism levying taxes on permissible levels of emissions, discharges and storage of waste. A higher tax rate is applied for emissions and waste storage in excess of permissible amounts. Environmental permits, specifying the permissible quantities of air emissions, water discharge and waste storage are based on technical projects which establish the normative levels for a particular operation.

6.6.2 Status

Bozymchak deposit is located in the Alabukinskiy region of Jalalabad Oblast in the south western part of Kyrgyzstan 695 km from Bishkek city. The nearest communities are the regional centre Ala-Bugaa and Kok-Tash and Kok-Sarek villages which are 80km, 8km and 10km respectively from the mine site.

The deposit lies in a remote region in the south of the Chatkalskiy mountain range at an altitude between 2000 and 2500 m in the upper catchments of the Jalgyzuryuk and Jalgyzarach streams, tributaries of the Gava river, with a confluence 12km from the mine site. A road along the Jalgyzuryuk river valley links Bozymchak with the regional centre. The Gava river is the main waterway flowing to the Naryn River into Uzbekistan.

Potable and process water for the mining operation will be abstracted from the Jalgyzuryuk stream. The stream is fed mainly by snow melt and ground water and baseline studies indicate a reasonably constant flow throughout the year.

Vegetation consists of grass, shrubs and sparse forest becoming denser in the river valleys. Two species of mammals recorded in the Kyrgyzstan Red List have been positively identified in the region and there are indications of two others. The mine site was previously used as occasional pasture land.

The regional economy depends mainly on cattle breeding and farming. A small gold mine 120km from Bozymchak is the only other operating industry.

Bozymchak has permission for land use on a site of 260 ha. The open pit development and overburden stacking are in progress and extraction of the first gold ore is planned for November. Other activities presently underway include construction of a power line and sub-station, and civil work for the concentrator. Detail design projects for the construction of the concentrator, accommodation block and other infrastructure, tailings storage facility are nearing completion and approval.

6.6.3 Impact Assessment

The Environmental Impact Assessment (OVOS) for the project was prepared by the Chu Ecological Laboratory in 2008 according to the Kyrgystan Laws on Environmental Protection and standards for OVOS procedure. Following public consultation and review by the Expertise of the Department of Environmental Safety, a positive conclusion was received in 2008. IMC considers that the OVOS generally follows international standards for environmental assessment and includes:

- Ecological baseline characterisation and current condition assessment.
- Assessment of alternative methods of mining and processing.
- Characteristics and assessment of locations of the process, infrastructure and waste storage.
- Sources and characteristics of emissions and assessment of the impact on air.
- Water consumption, discharge and assessment of the impact on underground and surface waters.
- Characteristics of solid waste production, storage and impact on land resources.
- Restoration of disturbed areas.
- Ecological management and monitoring.
- Ecological and social impact.

The OVOS concluded no significant overall environmental impact but moderate influences on the local landscape and ecology for the duration of the project. Impacts on air and water outside the project area are assessed as insignificant. There are positive social aspects in the region resulting from employment and providing services but potential negative effects due to an influx of workers and increased pressure on local resources.

Apart from the disturbance of land in unspoilt environment the potential impacts within the project area are mainly associated with:

- Emissions of dust to air resulting from blasting, ore and overburden handling and transport.
- Emissions of dust from ore crushing.

— Emissions from coal fired heating plant.

— Storage of tailings waste.

— Storage of overburden.

— Use of water resources.

— Management of non-process waste including domestic waste water.

Visual and noise impacts are of low significance given the remote location and distance from the nearest communities.

6.6.4 Management and Control Measures

The study is based on mining and processing of 1 Mtpa gold ore over an 18 year life firstly by open pit and then underground mining. The planned measures for minimising the impact include:

— Stripping and storing of topsoil for subsequent use in rehabilitation.

— Storing overburden in 2 external dumps, approximately 20 million m^3.

— Cyclone dust collectors on crushing equipment.

— Appropriate facilities for the safe storage of explosives, fuel oil, lubricants and flotation reagents.

— Collection of mine water and surface run-off waters in a clarification pond, 11,000m^3 capacity, with facilities for trapping oil.

— Closed circuit processing and no discharge of process waters.

— Biological treatment of domestic waste water.

Flotation tailings will be filtered to approximately 15% moisture content before delivery by conveyor to the TSF which is to be constructed in the upper Jalgyzarach valley 400 m north east of the processing facilities. The preliminary design consists of a dam wall constructed of gravel and clay and incorporating an HDPE liner to prevent filtration. Similarly the base will also be impermeable with clay and HDPE construction. Diversion channels and a drainage trench will be constructed to control surface water flow around the TSF and underground water below the base. A second dam immediately down gradient of the TSF creates the collection pond for clarified water which is returned to the concentrator.

This approach of semi-dry tailings storage rather than the more conventional wet method was adopted to ensure no discharge of process water to the river which is used for irrigation and potable water of the village downstream. The nearest villages are 12 km downstream of the TSF at the confluence of the Gava River. A breach of the TSF collection dam could potentially release up to 75,000 m^3 of water into the Jalgyzarach stream. However the OVOS assessment is that the surge would be reduced by the tortuous nature of the valley and any flooding restricted to the first 3.5 km.

A preliminary environmental monitoring programme, according to Kyrgystan Law, involves checks on:

- The efficiency of dust abatement equipment.
- Ambient air quality at the perimeter of the sanitary protection zone.
- Control of the efficiency of domestic waste water treatment.
- River water quality.
- Soil contamination.
- General ecology and geotechnical stability.

6.6.5 Permitting

Bozymchak currently has permits for land use and construction activities. The annual permission for nature use/management and conditions for maximum permissible emissions, water discharge and waste storage are based on estimations derived in the OVOS. Environmental taxes are paid quarterly according to the actual emissions and during the last 3 years payments have been for normative levels only and are relatively small.

When ore mining and processing commence technical studies will be required to specify the normative levels of emissions, discharges and waste. Following approval by the Ministry of Environment, the studies will form the basis of the Permission for the operating phase of the project.

6.6.6 Closure and Rehabilitation

A preliminary plan for closure and rehabilitation of disturbed area is included in the OVOS. The plan follows normal procedures for mine closure and has provision for placement of topsoil on dumps, the TSF and other disturbed areas and then allowing natural vegetation. The aim is to return the land to its former state and occasional use as pasture land. A protection embankment will be constructed around the perimeter of the open pit but otherwise no restoration work is planned. The pit slopes will be allowed to erode and vegetate by natural water action and the pit allowed to partially fill via infiltration of groundwater and rainwater run-off.

The cost of closure will be covered by a fund accumulated from annual contributions based on profits but details were not available.

6.6.6.1 Potential Risks and Liabilities

On the basis of information in the OVOS and received during discussions, the project is being designed and constructed according to good standards for environmental protection.

IMC has not conducted a full geotechnical evaluation of the TSF design but has no reason to doubt that it will be constructed to good standards. The mine site is located in a seismic region and there is a potential risk to land and communities downstream in the event of a breach in the TSF or water collection dams. This risk is assessed in the OVOS. Storage of tailings in dry form minimises any potential damage due to breach of the TSF dam. Although a breach in the water collection dam could release a large volume of water, the water is of good quality and the characteristics of the river valley suggest that any flooding of land would be limited to approximately 3 km downstream.

Apart from the need to budget for environmental management and monitoring, and fund for closure rehabilitation, IMC has not identified any potential financial liabilities.

7 SPECIAL FACTORS

Risks likely to impact on Kazakhmys forecast production, capital and operating costs by less than 10% are not considered significant. Any significant risks not adequately addressed in Kazakhmys production plans are considered to be "material" and are listed below.

There was, reportedly, a country-wide increase in the minimum wage of 30% in 1999 and again in 2002 as a result of an 'advisory note' from the President of the Republic of Kazakhstan. IMC believes that additional unexpected rises of such a nature would impact on the business of Kazakhmys.

8 CONCLUSIONS

IMC concludes from the independent technical review that:

- management's geological and geotechnical knowledge and understanding is of a satisfactory level to support short, medium and long term planning as appropriate and operations are well managed at an operating level;

- the mine plans appropriately consider geological and geotechnical factors to minimise mining hazards although IMC has reservations about the viability of the open pit designs in the final years of operation but any impact of a failure on production will be small;

- Kazakhmys' mining equipment (either in place or planned in the capital forecasts) is suited to its mine plans and is adequate, with minor adjustments, for the production plans;

- copper and zinc ore processing and associated smelter and refinery plants and other infrastructure are capable of continuing to supply appropriate quality products to the markets at the forecast production plans;

- IMC is unable to compare the LTIFR but believe this to be higher than other comparable operations. The fatality rate is higher than similar comparable operations;

- environmental issues are managed and there are no issues that could materially impede production nor are any prosecutions pending;

- the assumptions used in estimating both capital and operating costs are appropriate and reasonable;
- capital and operating costs used in the financial models incorporating minor adjustments by IMC reflect the mine plans, development and construction schedules and the forecast production levels;
- special factors identified by IMC are well understood by management and appropriate action to mitigate these risks is being taken. Further, the mine plans and cost forecasts appropriately account for these risks; and
- management operates a management accounting system and are able to monitor and forecast production and cost parameters. Management are updating the management accounting systems to IFRS over the short term.

IMC has estimated the value of Kazakhmys' copper, zinc, gold and silver assets at an operating level as US $8,768 million and at a post tax level as US $6,330 million assuming a real discount rate of 12%, an exchange rate of KZT/US$147, and product prices, capital and operating costs and production forecasts which are soundly based.

Yours Faithfully,

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	Signature	Name /Designation
Production:		John Warwick Project Director
Verification:		Peter Robinson Project Manager
Approval:		John Warwick IMC Managing Director
Date:		

Appendix A

QUALIFICATIONS OF THE CONSULTANTS

***J S Warwick Project Director**

J S Warwick (B.Sc Electrical Engineering (Hons), Newcastle University (1973); B Sc Mining Engineering (Hons), Nottingham University (1975) was the project director for this Competent Person's Report. John is a former mine manager with Mine Manager's 1st Class Certificate, Chartered Engineer and European Engineer (Eur Ing) being a Fellow of the Institute of Materials, Minerals and Mining and Member of Institute of Directors with more than 35 years experience in the coal, base and precious metals and industrial minerals mining industry and 8 years of directing Competent Person's and Mineral Expert's Reports. He is very experienced in extraction and processing of base and precious metals, coal and various industrial minerals in UK and overseas. As Managing Director of IMC, he worked in Ukraine, Russia, Czech Republic, Kosovo, Poland, Bulgaria, Hungary, Bangladesh, Albania, Iran, South Africa, DR Congo, Kazakhstan, China, North Korea, USA, Indonesia, Mozambique, Jordan, Morocco, Zambia, Argentina, Peru, Mexico, India, Madagascar, Botswana, Georgia and Acting as a Project Director for Competent Persons Reports and Due Diligence for stock market floatation's and company sales assignments in several commodities including chrome, potash, phosphate, copper, nickel, iron ore, cobalt, gold, silver, oil shale, and coal operations.

He also completed some years as Resident Consultant to the Chinese Contractor on the construction of the first coal mine in Bangladesh.

John Warwick is a Competent Person under the requirements of the JORC Code.

***P C Robinson Project Manager—Core Team**

Peter Robinson is an Associate Member of Chartered Institute of Management Accountants Peter has over 30 years worldwide experience in mine extraction and minerals industries with specific experience of financial investment for mine purchases, project management, and competent persons report for international stock exchanges including UK, Toronto, Hong Kong, Moscow and Warsaw; he is presently a Senior manager of IMC responsible for the execution and preparation of worldwide international projects. Peter's project manager expertise with past proven ability in planning of capital investments and controlling high value projects involves preparation of mineral expert's reports for stock market floatation's and assessment of mine financial plans. His consultancy career developing and appraising the financial plans of mining operations has taken him to many countries around the world including UK, Russia, Kazakhstan, China, Ukraine, South Africa, USA, D.R. Congo.

Peter was formally employed by the British Coal Corporation for 20 years controlling all aspects of management accounting finishing as Head of Finance for the Midlands region of BCC. Peter was actively involved in the financial evaluation and preparation of the valuation of Kazakhmys PLC for the successful IPO on the London Stock Exchange in 2005.

***Dr J A Knight Geologist—Balkhash Region**

Dr J A Knight (B.Sc Geology, Aston University (1968); PhD Geology Sheffield University (1972); Fellow of the Geological Society, London; Chartered Geologist; Member Society of Mining Engineers (US); Member of Institute of Directors. He is a senior associate and former managing director of IMC and was the senior project geologist for this technical review. John has over 32 years experience in metalliferous and coal geology including 7 years in copper and other base metals. John Knight is experienced in negotiating with senior management of finance institutions, mining houses and national mining administrations. Management experience senior manager of multi-disciplinary project teams in a variety of cultures, languages and in remote locations, covering coal, phosphate, ferrous, base and precious metals; familiar with a wide range of national mining codes and mineral development legislation. Experienced in the preparation and management of multidisciplinary mining sector investment studies, covering resource and reserves assessment, production scenarios, transport, infrastructure and markets; John is also very experience with investment decisions by major organisations undertaking preparation of financial packages for investment (e.g. due diligence of Bogdanka Mine, Poland for a major international banking group) John has participated as lead geologist for major technical, environmental and social audits e.g. Kazakmys , the national copper corporation of Kazakhstan, and planning of environmental action plans to meet the standards of multilateral banks and the preparation of Competent Person's Reports for Stock Exchange listing documents (London, Jakarta, Hong Kong, Melbourne ASX and New York stock exchanges).

John Knight is a Competent Person under the requirements of the JORC Code.

***J Bennett Mining Engineer—Zhezkazgan**

J Bennett (B Sc Engineering in Mining (Hons), Royal School of Mines, London (1964); Associate of the Royal School of Mines; Institute of Materials, Minerals and Mining (UK); Chartered Engineer) Julian is a senior associate of IMC with over 40 years experience in surface and underground copper and gold mining operations and senior management. He has worked in the mine construction industry, and the consultancy sector. His career has taken him to Central and Southern Africa, Canada, Central and South America, Central Asia and Australia. During that time, he has worked in both developed and developing countries with a wide range of personnel. He has been instrumental in working with indigenous personnel in the mining sector, in Zambia and Zimbabwe. In Canada, he was involved in the construction of new gold mine at a green field operation. He was formerly the Manager of Mining for the UK office of an international minerals engineering company, in sole charge of the geological and mining aspects of a number of feasibility studies, due diligence and operational audits, performing the role of independent engineer and mine design projects for international clients.

Julian Bennett is a Competent Person under the requirements of the JORC Code.

***R Wilkinson Concentrator, Smelter and Refinery Engineer—Balkhash Region**

R Wilkinson (B Sc (Hons) Chemical Engineering University of Edinburgh; Member Institute of Materials, Minerals and Mining; Chartered Engineer; Associate Member, Institution of Chemical Engineers, has over 35 years experience in the metal mining industry specifically in process engineering. Dick Wilkinson graduated from the University of Edinburgh in 1969 with BSc in chemical engineering and joined Roan Consolidated Mines as a metallurgist at Mufulira in Zambia. He has worked in a range of technical and managerial roles in hydrometallurgical and mineral processing plant, culminating in the management of a small remote open pit mine and concentrator and as a senior metallurgist with Billiton International Metals in The Hague. He has participated in the evaluation of investment opportunities and entry negotiations in non-ferrous mining in five continents, work encompassed industrial minerals, oil shale, and coal as well as non-ferrous metals. Richard established himself as an independent consultant, based in England and serving the international mining industry and is a senior associate participating in numerous IMC feasibility studies and Mineral Experts reports in Asia, Africa and the Americas participating in project management, operations management, research, project evaluation and environmental management.

Richard Wilkinson is a Competent Person under the requirements of the JORC Code.

***M George Environmental Engineer—Core Team**

Mike George (B Sc Hons in Applied Chemistry, Kingston-upon-Thames University (1971); Specialist courses in Hydrometallurgy, Solvent Extraction, Management in Industry, Assessment of Competence in Process Operations, Radiological Protection Supervision, Environmental and Safety Auditing, Health and Safety at Work Regulations, COSHH (Control of Substances Hazardous to Health) Assessment, Integrated Pollution Control. Mike is a senior associate of IMC and will be the senior environmental engineer for this project and has over 30 years experience in base metals processing including environmental aspects and specialising in the environmental field for the last 5 years. Has acquired a good understanding of the guidelines now adopted by the financial sector as policy for assessing and managing environmental risk and has practical experience in most aspects of environmental auditing and appraisal, including; Due diligence for project finance, privatisation and acquisitions; Compliance audits; Environmental impact and risk assessment; IPPC; Benchmarking of environmental, health and safety management systems; Evaluation and specification of environmental control systems. Mike has considerable experience with associate international exposure working in geographically, culturally and linguistically challenging regions. He has the ability to liaise effectively with senior executives to obtain relevant information quickly and meet the demanding time schedules of pre-acquisition and project finance reviews.

***W Lewis Financial Analyst—Core Team**

Winsor Lewis (Fellow, Chartered Management Accountant, Chartered Institute of Management Accountants (1991); BSc Hons Physics; Imperial College, London (1974)) Winsor is a senior associate of IMC and will be the Financial Analyst for this project with over 20 years of experience in coal and metal mining and in business modelling, mine evaluations, mine investment proposal production, costing of production and general investment appraisal for underground and surface mine operations. Has an in-depth understanding of underground coal mining from both a financial and practical mining viewpoint. Worked over 20 years in the coal mining as a financial expert, research engineer and social mitigation expert and, internationally, has completed many reviews of deep coal mine operations in many countries, he has a extensive knowledge of the FSU, has completed projects in Serbia, Russia, Ukraine, Hungary, Czech Republic and China, has reviewed mine operations and their future plans. Has produced business plans for mines and mining operations with the intent of seeking international investment for capital expenditure to increase production and reduce costs. Understands the business environment, having helped two consultancies start up and operate commercially selling their services. This has included business development, negotiation of contracts and delivery; has over ten years of experience in business modelling, mine evaluations, mine investment proposal production, costing of production and general investment appraisal. He has spent over ten years conceiving capital projects, producing the related business plans and implemented them successfully. This has included over twenty major capital investments.

***D Wilks Project Co-ordinator—Core Team**

Dominic Wilks. MSc Mining Geology (Merit), Camborne School of Mines (University of Exeter), 2008, B Sc (Hons) Geology, University of Liverpool, 2007. Exposure to numerous deposit types and mining/processing operations in Namibia, Kazakhstan, India, Indonesia and the UK; Dominic is an experienced user of the following software applications; AutoCAD, Surpac, Minex, Datamine, Isatis, Arc Map and Map Info software's. Dominic has strong analytical and critical thinking skills, proven report writer with associated oral presenter.

***S Pepper Geologist—Zhezkazgan Region Team Leader**

Simon Pepper M.Sc. Mining Geology, Camborne School of Mines (1981); B.Sc. (Hons) Geological Sciences, Aston University (1980); South African Mine Manager's Certificate of Competency (1997); Member, Institution of Mining and Metallurgy; Registered, South African Council for Natural Scientists. Simon has over 30 years experience in a wide range of geology and mining related functions including engineering, metallurgy, environmental management and financial planning, this is allied to a broad business awareness and commercial acumen. Simon possesses strong analytical and critical thinking skills, proven management prowess, effective negotiation and persuasive skills, good report writer and oral presenter.

Simon Pepper is a Competent Person under the requirements of the JORC Code.

***J. Archer Process Engineer—Zhezkazgan**

John Archer M.Sc. Imperial College, London (1978) extractive metallurgy, B.Sc. Southampton University (1962) Chemistry; Member of the Institute of Materials, Minerals and Mining; Chartered Engineer; European Engineer (Eur. Ing.). John has over 45 years experience in metalliferous and copper and other base metals is experienced in negotiating with senior management John has been involved at a senior level with operational and project management roles in both the Minerals and Oil extractive arenas in the UK and overseas. Roles also included marketing, procurement, logistics, cost control and engineering management, contract law, claims management and negotiations. John has extensive overseas experience in Zambia, Nigeria and East Africa, Europe, USA and the UK. John possesses good report writing skills and oral presentation.

John Archer is a Competent Person under the requirements of the JORC Code.

***H. Hind Electrical, Mechanical and Infrastructure Engineer—Zhezkazgan**

Howard Hind. Electrical and Electronic Engineering Diploma; MQB Electrical Engineering Certificate; MQB Class I Certificate; Fellow Institution of Mining Mechanical and Mining Electrical Engineers. Howard has 45 years experience as an electrical, mechanical and infrastructure engineer in major projects worldwide including coal mining, metalliferous base metals civil engineering, shaft sinking, and mine development and tunnelling. Howard is experienced in power generation, transmission and distribution networks and major mine infrastructure facilities. Electrical power network design, electrical and mechanical winder drives and haulage safety systems employed in worldwide mining operations. Howard possesses strong analytical, communication skills, critical thinking and communication skills developed during his EPCM engineering career. Howard has proven management and effective negotiation and persuasive skills, good report writer and oral presenter. Howard has extensive overseas experience with a great variety of works in Peru, Ukraine, Poland, Democratic Republic of Congo, Bangladesh, Bulgaria, Czech Republic, Russia, Iran, Spitsbergen Artic Circle, Germany, Kosovo, Kazakhstan, Ireland, Turkey and the UK.

***J Mills Mining Engineer—Balkhash Region**

Jack Mills Chartered Engineer, C Eng. (England); Chartered Scientist, C.Sci (England); Euro Engineer, Eur. Ing. (France); European Certificate in Shotfiring (EFEE) Fellow of the Member of the Institute of Materials, Minerals and Mining, FIMM. (England); Fellow of the Institute of quarrying, FIQ. (England); Fellow of the Institute of Explosives Engineers, FIExpE. (England) Jack has over 45 years experience in the design, construction and commissioning of processing plants, operation of surface mines and quarries, environmental management, steel fabrication explosive and demolition works. Jack has extensive overseas experience with a great variety of works in Africa, Iran, Middle East, South America, Falkland Isles and UK.

Jack Mills is a Competent Person under the requirements of the JORC Code.

***F. Rothera Infrastructure—Balkash Region**

Frank Rothera CEI PtII Electrical Engineering, Cambridgeshire College Arts and Technology, (1977); HND in Mechanical Engineering, Staffordshire College Of Technology, (1968) Frank has over 30 years' experience in Project Management related to the mining and construction industries having built several process plants overseas. The most recent management of the preparation of two major feasibility studies for mine re-opening and design reviews at a senior level of responsibility. With a secondment to Australia supervising the design and construction of a new Vanadium mine and process plant. Frank has extensive overseas experience with a great variety of engineering works in Africa, Australia, Asia, Greenland and UK.

***R. Bolano Mining Engineer—Team Leader—East Region**

Ray Bolano Bachelor of Science in Mining Engineering, Mapua Institute of Technology, Philippines, 1987; Graduate Member, Institute of Materials, Minerals and Mining.

Ray has 15 experience in the mining industry with high level exposure to open pit mining both in engineering and operations. Involved in the preparation of Pre-Feasibility and Bankable Feasibility Studies as Senior Lead engineer for mining department which was responsible for short term and long term planning including life of mine final designs. Mining works with associate consultants dealing with Due Diligence Studies, Mineral Experts Reports, Feasibility studies and Technical reports. Ray has also operational mine experience with surveying, grade control and cost control with contracted mining works. Geology and computerized mine planning methods employing Datamine; and extensive experience in massive porphyry copper and vein type gold deposits.

***N. Scott Geologist—East Region**

Neil Scott BSc Geology, London University Neil has over 35 years experience in metalliferous and copper and other base metals is experienced in negotiating with senior management and has been involved at a senior level with operational and project management roles in minerals extraction arenas in the UK and overseas. Neil has been recently been involved with reviews of the exploration methods and results, reserves and resources of 15 copper deposits or mines, two gold mines, seven major iron ore mines, three nickel laterite deposits, three igneous phosphate mines, two potash deposits, one platinum-palladium deposit, one rare earth deposit, one titanium deposit, one coal mine and one industrial mineral (shungite) deposit in order to determine their compliance with JORC exploration, resource and reserve reporting criteria. Neil has extensive overseas experience in different types of metalliferous and industrial mineral deposits in 50 countries; including works in Africa, Europe Asia, Middle East, FSU and UK.

Neil Scott is a Competent Person under the requirements of the JORC Code.

***Dr. H. Osthorf Process Engineer—East Region**

Harald Osthof M.Sc. Metallurgical Engineer, RWTH Aachen, Germany; Phd in Metallurgy, University Leoben, Austria. Harald has over 25 years experience in layout and design of Processing Plants; Feasibility Studies; Risk Management / Assessment; Project Management for Engineering Projects, Consulting Projects dealing with the commercial -, process - engineering -, construction and quality assurance aspects and is a Lecturer (part time base) at the University of applied Science, Frankfurt. Harald has extensive experience in project management and evaluation of process projects in Europe, Africa and America with specific expertise in metallurgy, ore beneficiation and project management of projects of the copper, zinc, gold, chemical and petrochemical industry, Competent Persons Report on Mining Assets and has produced a number of technical papers. Harald has extensive overseas experience having worked in Botswana, South Africa, Chile, Canada, USA, Asia and Europe.

***J. Hayes Environmental—East Region**

Johan Hayes BSc (Biol) Zoology and Botany. University of Stellenbosch; BScHons (Zoology). University of Stellenbosch; MSc (Ecological Assessment). University of Stellenbosch; MBA Subjects read: Operations Management, Economics, Human Resources; Management, Marketing Management and Management Information Systems. MANCOSA. Johan has over 7 years experience involving numerous environmental projects within various sectors and acted as project manager for Environmental Impact Assessments, Strategic Environmental Assessments, Environmental and Compliance Monitoring, Environmental Management Plan Amendments and Pre-feasibility Studies. Johan's experience encompasses the following sectors Potable water, waste water, mining, energy, fuel supply and compliance audits. Most of these works where carried out in Africa but most recently assignments where carried out in Asia.

* - denotes visited operations.

Appendix B

SCOPE OF WORK, MATERIALITY & LIMITATIONS

Scope of Work

IMC carried out the following scope of work for the Competent Person's or Mineral Expert's Report in compliance with the listing requirements of the Hong Kong and London Stock Exchanges:

— Introductory meetings with Kazakhmys directors and management to understand the business plan;

— Site visits and collection of data. Consultants marked with an asterisk (*) in Appendix A visited the assets relevant to their disciplines and inspected:

  — Geological maps, plans and sections;

  — Mining operations and equipment;

  — Copper and zinc concentrating plants;

  — Copper and zinc smelting and associated refining plants;

  — Precious metals refining plant;

  — Infrastructure including transport systems and maintenance facilities; and

  — Power and heat generating plants.

— Data and documentation was supplied to IMC personnel at each complex or site and financial data at Kazakhmys' base in Karaganda, Zhezkazgan, Semipalatinsk Uskomenigorsk, Bishkek and Almaty. This included:

  — Historical production and costs on an annual basis;

  — Budgets and plans; and

  — Feasibility studies.

— A technical review was undertaken at each asset including the following elements:

  — Data suitability;

  — Geology and mining hazards;

  — Resources and reserves;

  — Copper and polymetallic mining operations;

  — Copper and polymetallic ore processing to concentrates;

  — Gold and polymetallic development and mining operations;

  — Gold and polymetallic ore processing and recovery;

— Gold smelting to bullions;

— Copper concentrate smelting to matte;

— Copper converting and refining to anode and to the finished copper cathode, rod and wire products;

— Zinc concentrate hydrometallurgical processing to zinc ingots;

— Smelter slimes refining to gold and silver;

— Environmental issues;

— Capital and operating costs;

— Review of budget forecasts; and

— Valuation of reserves.

The CPR covers Kazakhmys' copper, gold and polymetallic operations that are materially relevant to the valuation of the reserves estimated according to the FSU "Classification and Estimation Methods for Reserves and Resources," last revised in 1981 and the unique provisions identified for each deposit in the "Conditions for Estimation of Reserves and Resources." IMC has reviewed the reserves and resources statements of the individual units compiled by Kazakhmys and has restated the reserves and resources in compliance with Prospectus Directive in conjunction with the recommendations of the CESR Listing Rules of the UKLA and the Hong Kong Stock exchange and in accordance with the criteria for internationally recognised reserve and resource categories as included in the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC code). IMC produced its report and valuation model based on actual 2007 to 2010 production data and Kazakhmys' 2011 to 2025 budget data.

Appendix C

MAPS AND PLANS

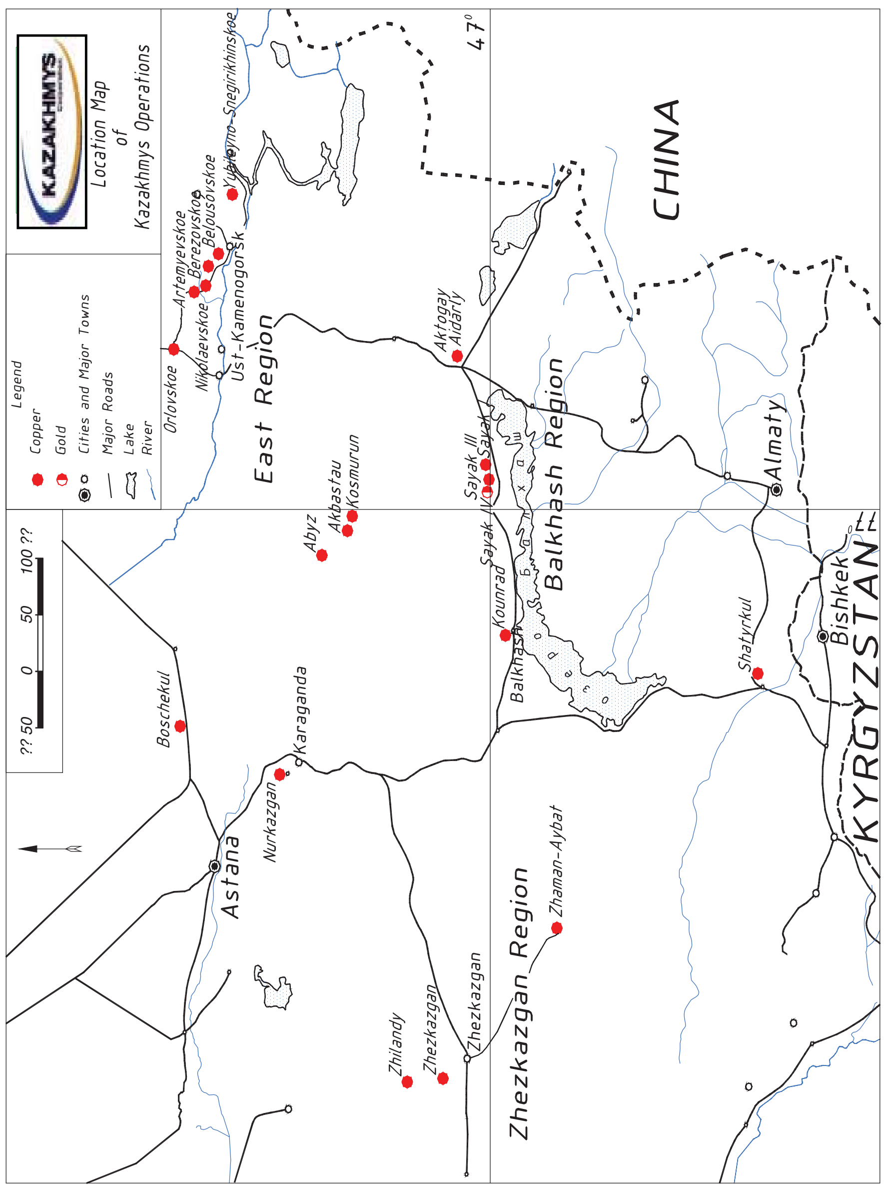

Plate 1. Location Map of Kazakhmys Operations

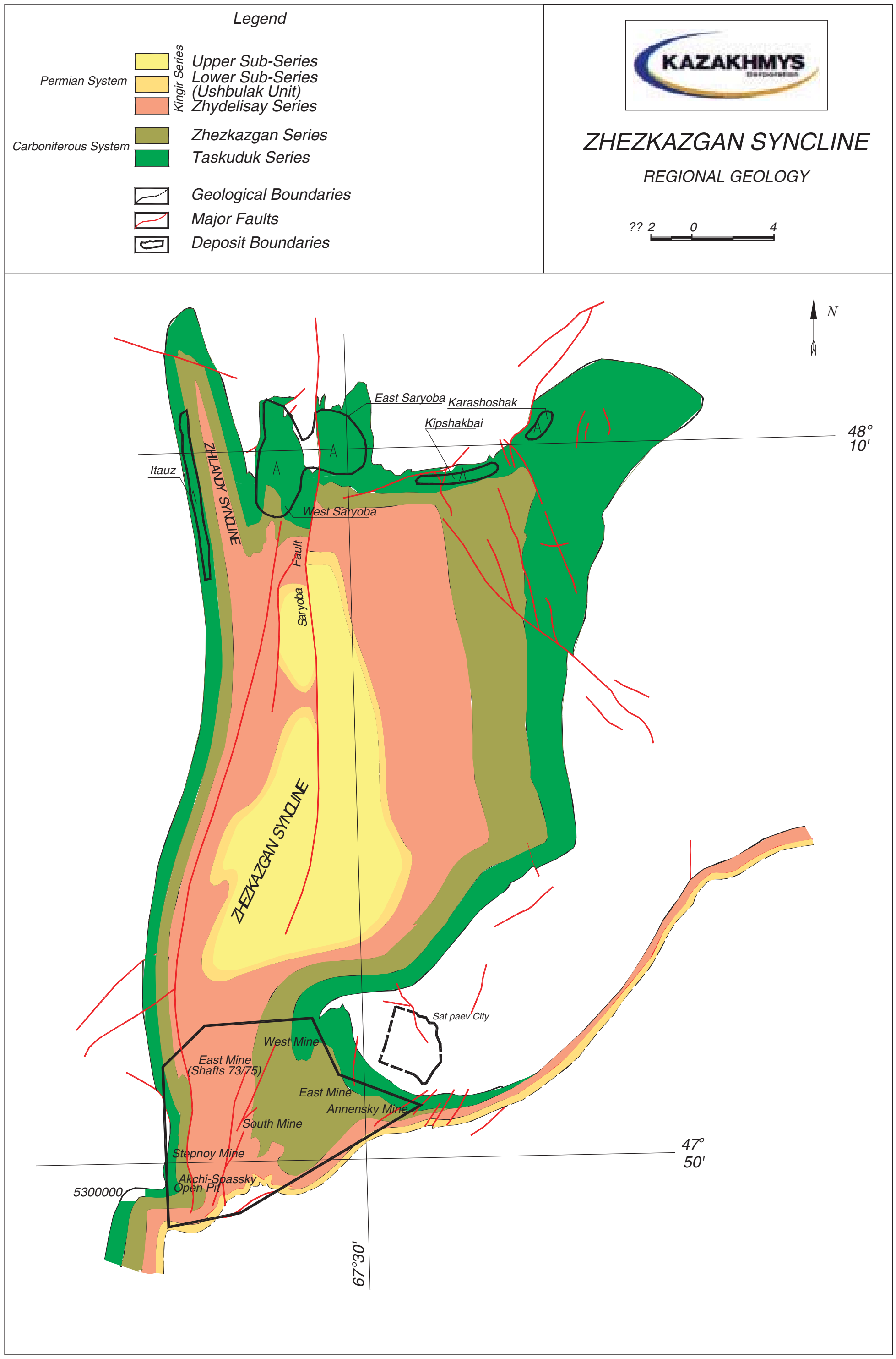

Plate 2. Map of Zhezkazgan Regional Geology

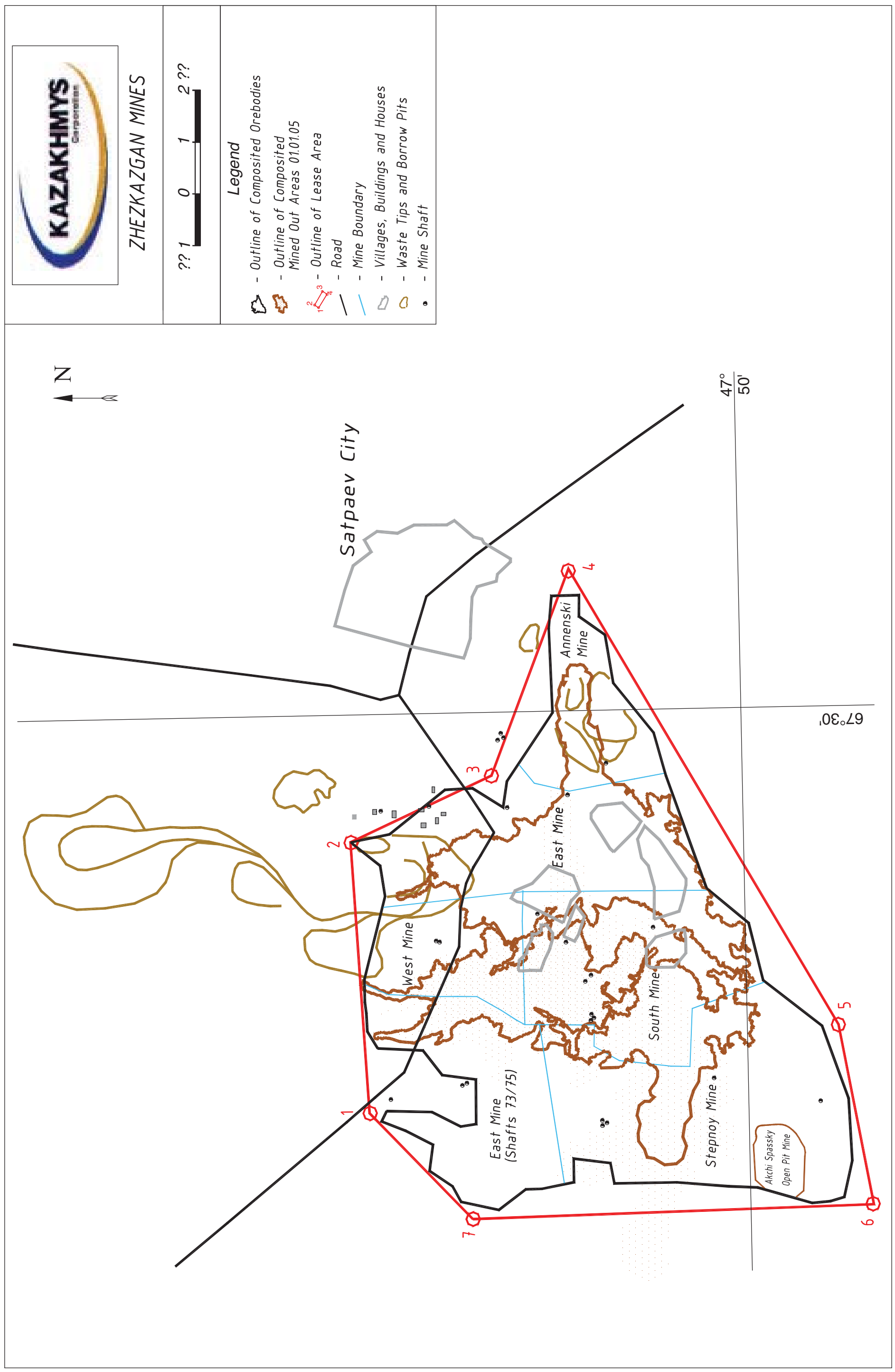

Plate 3. Zhezkazgan Mines

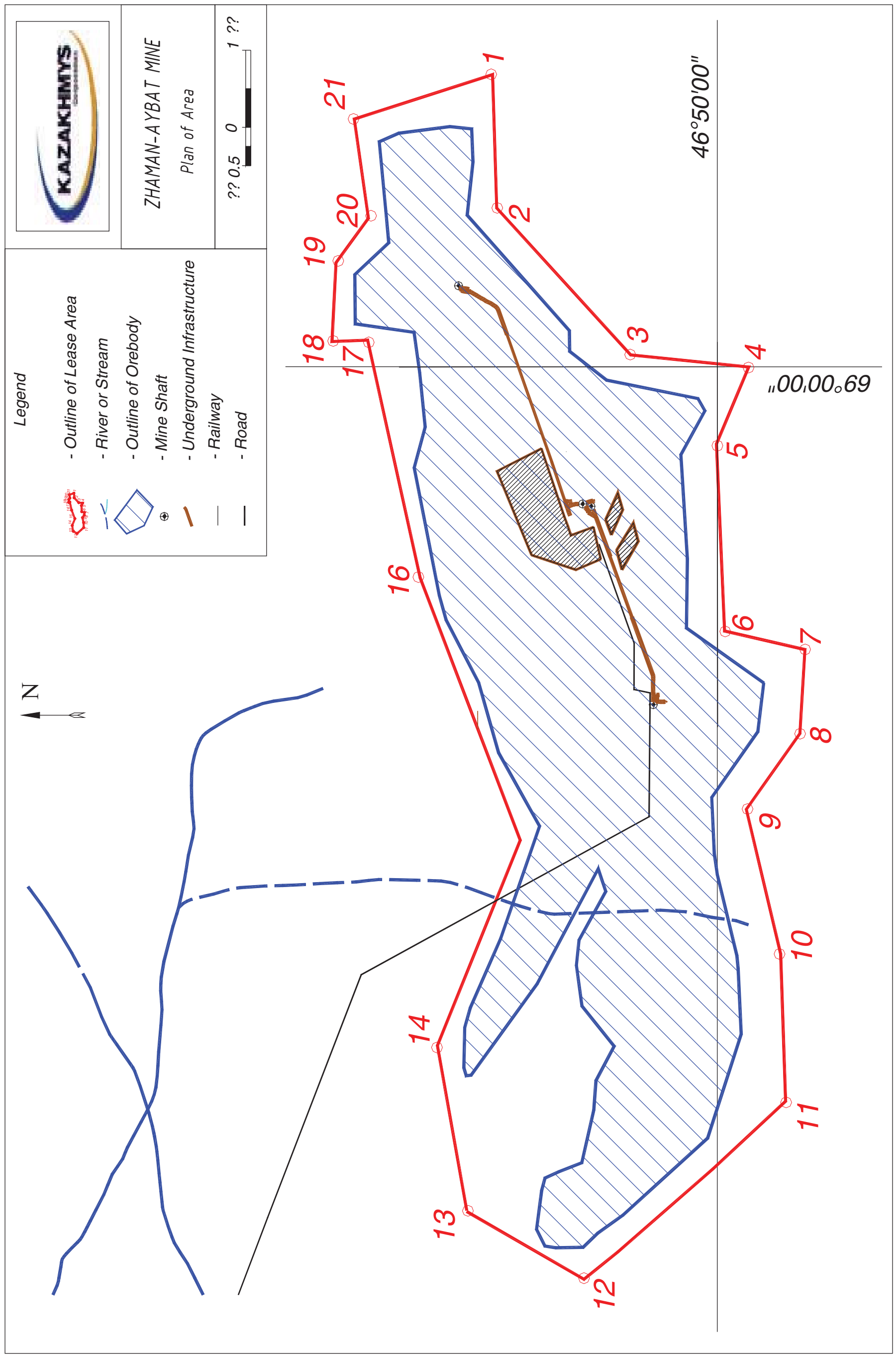

Plate 4. Zhomart Mine

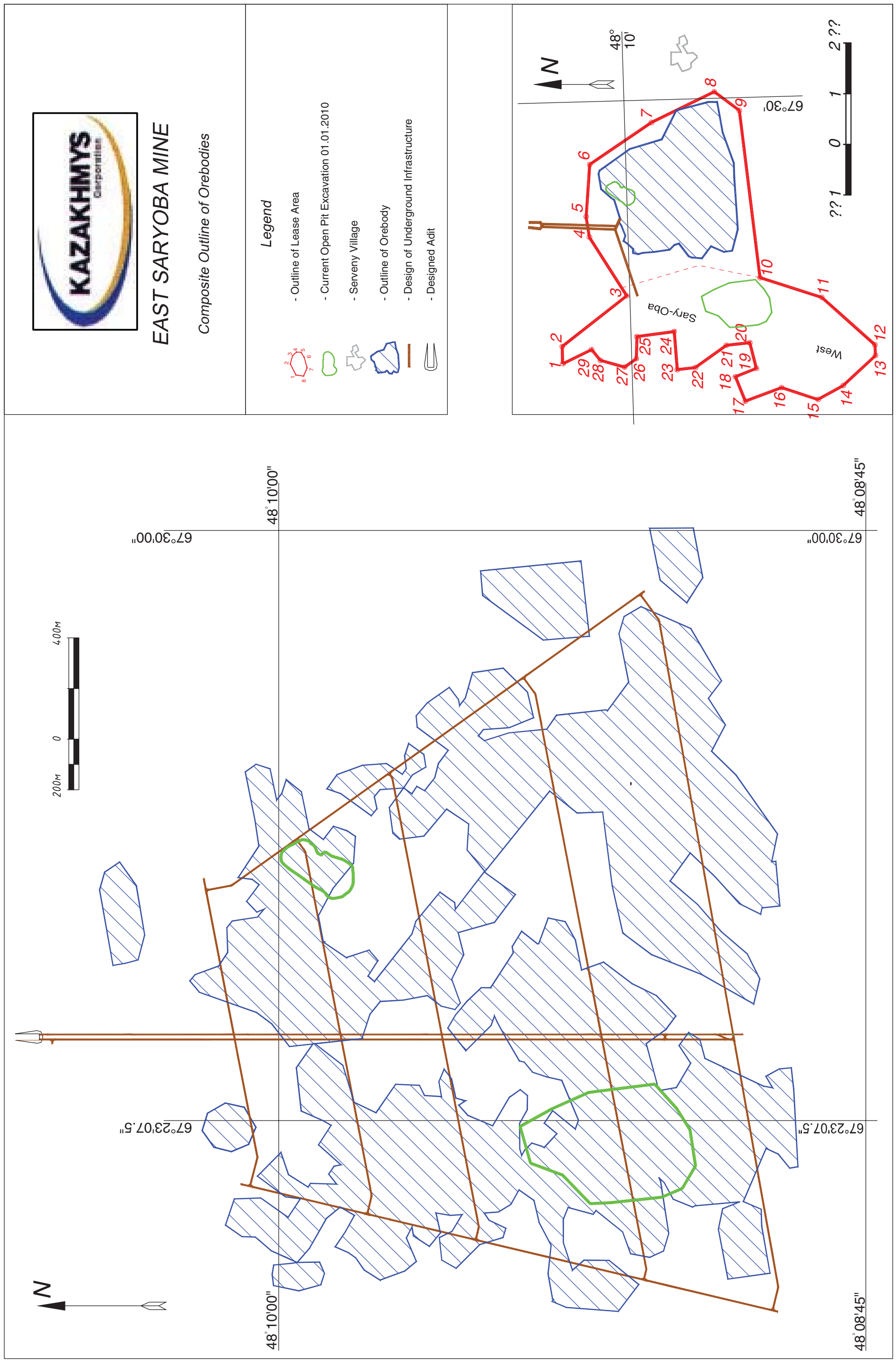

Plate 5. East Saryoba Mine Project

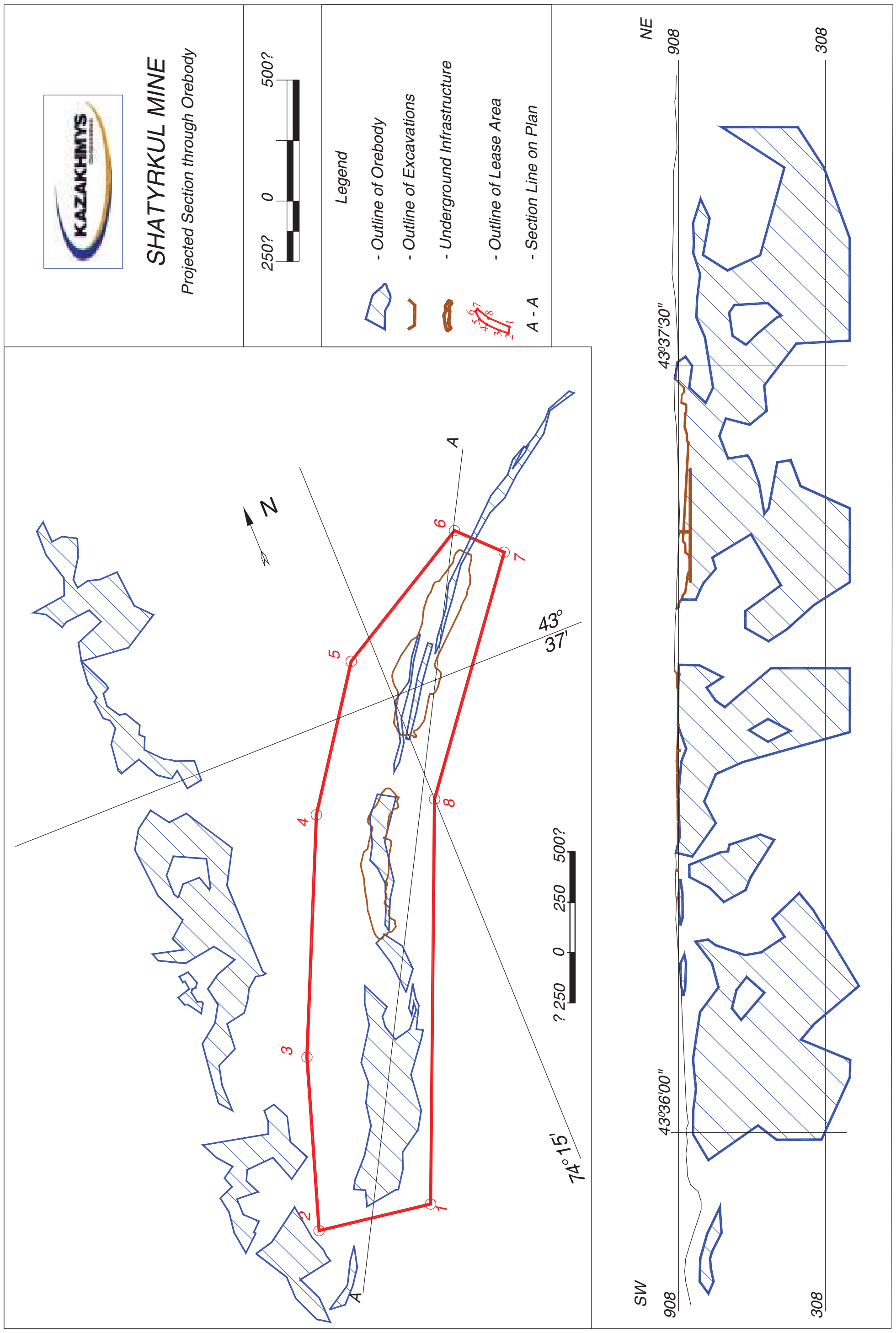

Plate 6. Shatyrkul Mine

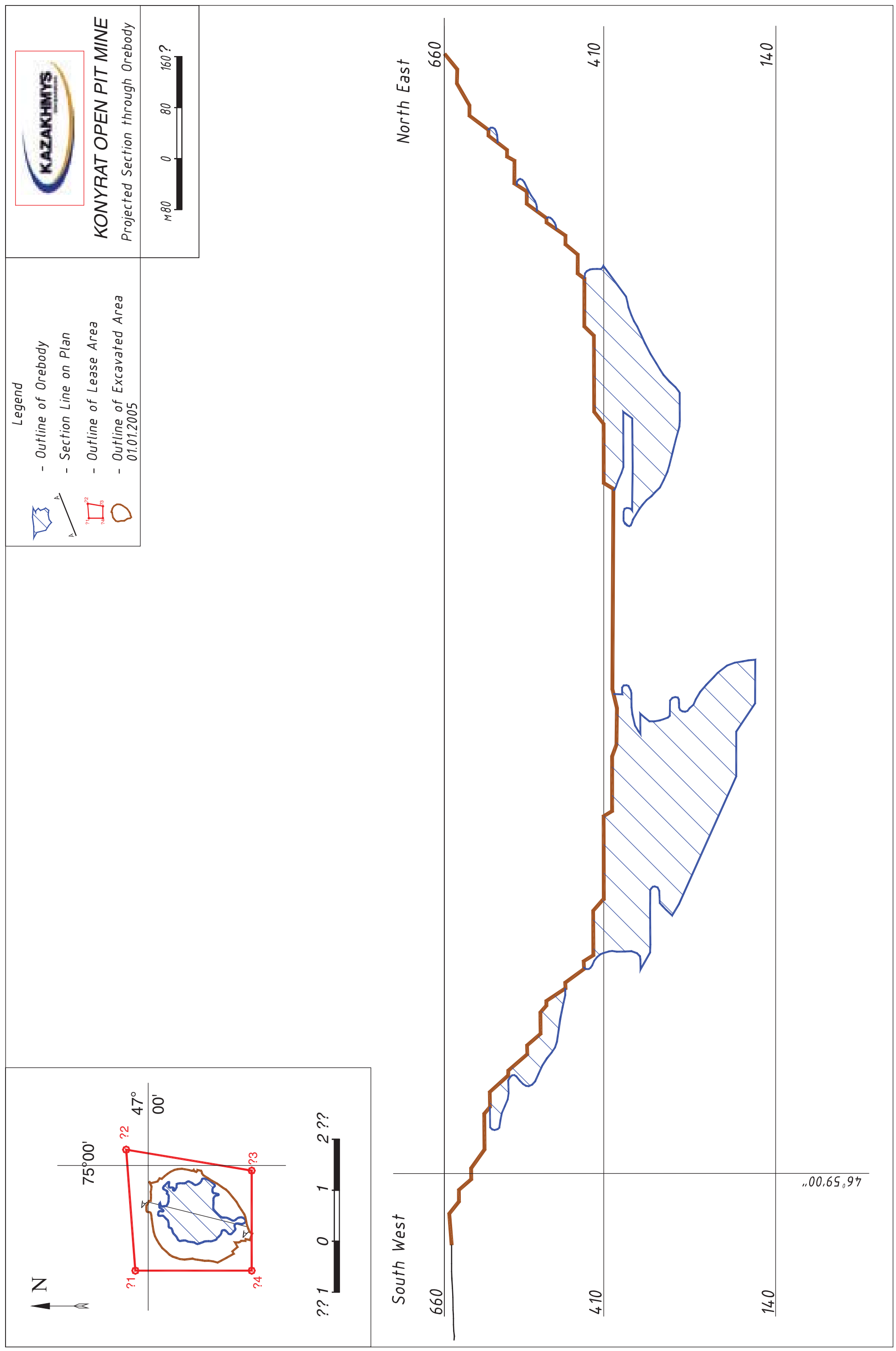

Plate 7. Konyrat Open Pit

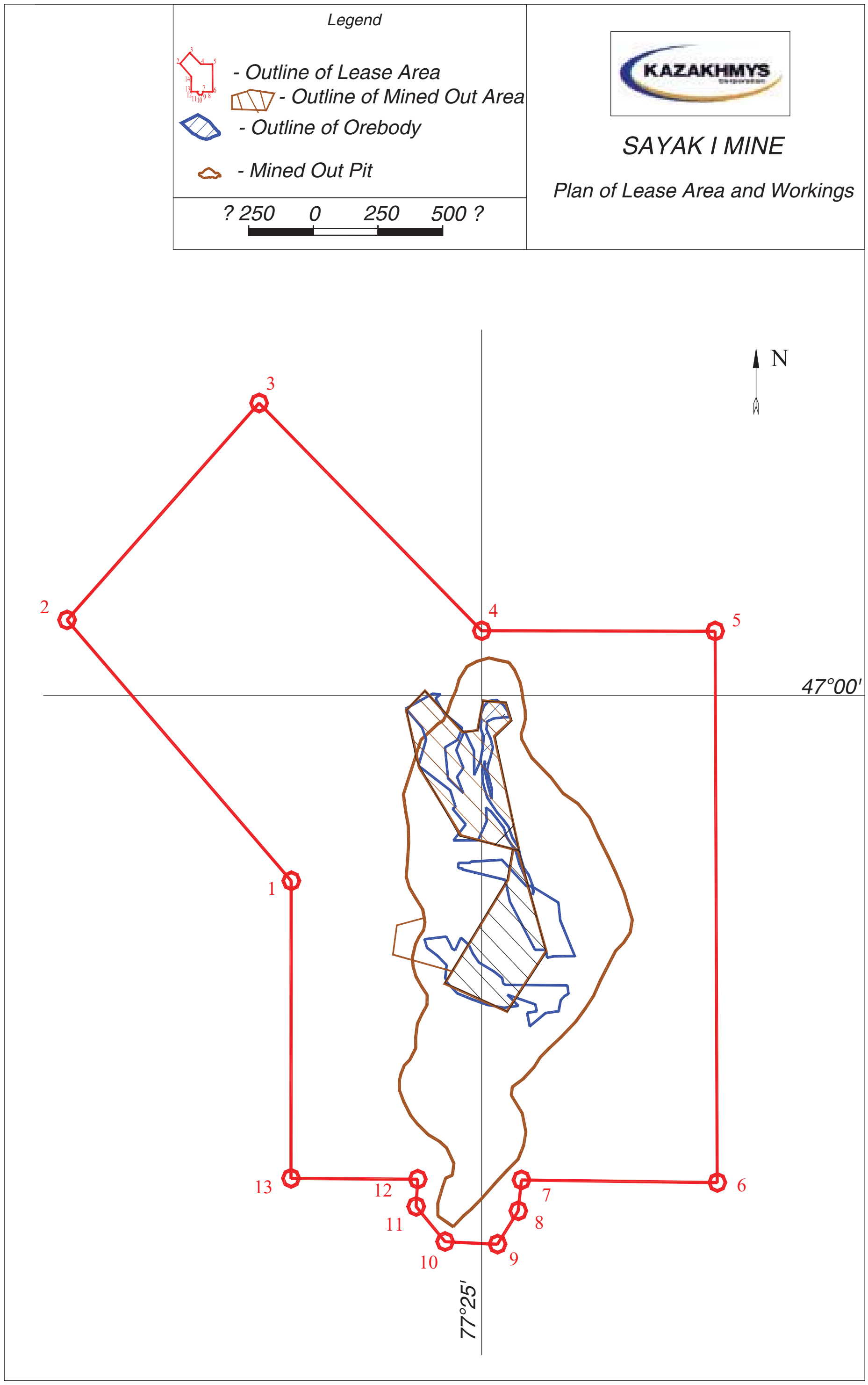

Plate 8. Sayak I Mine

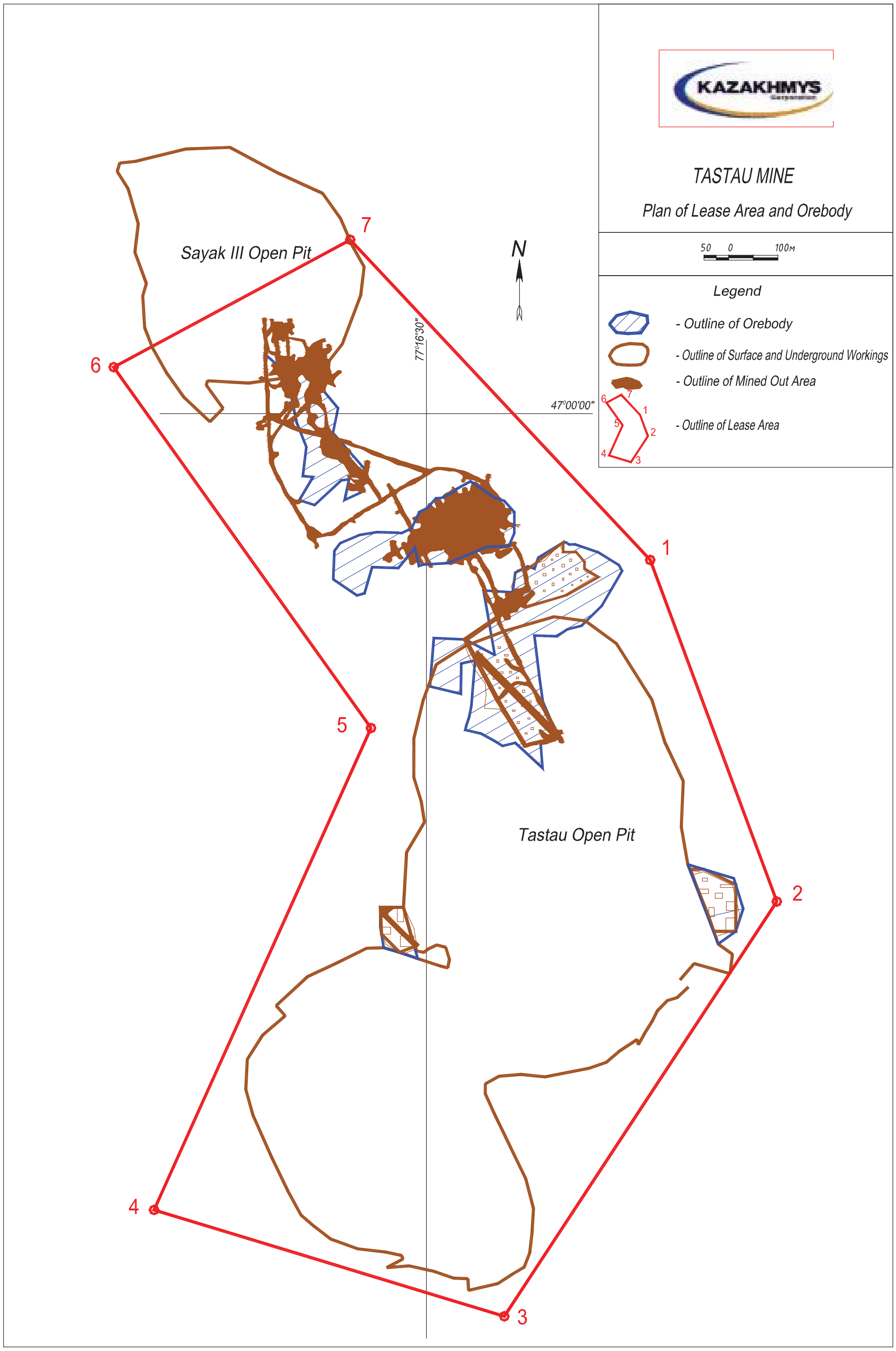

Plate 9. Tastau-Sayak III Mine

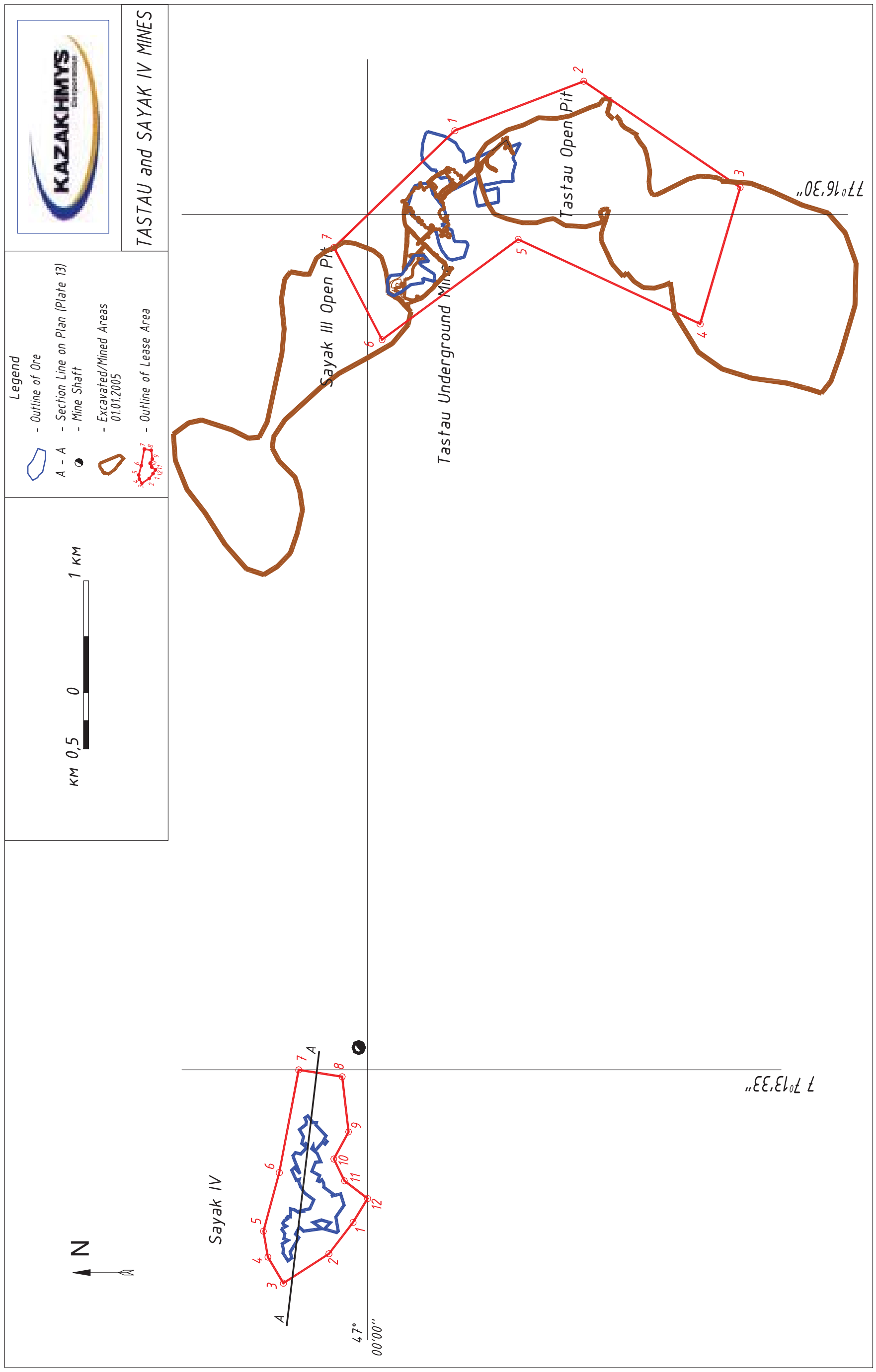

Plate 10. Sayak IV Mine Project

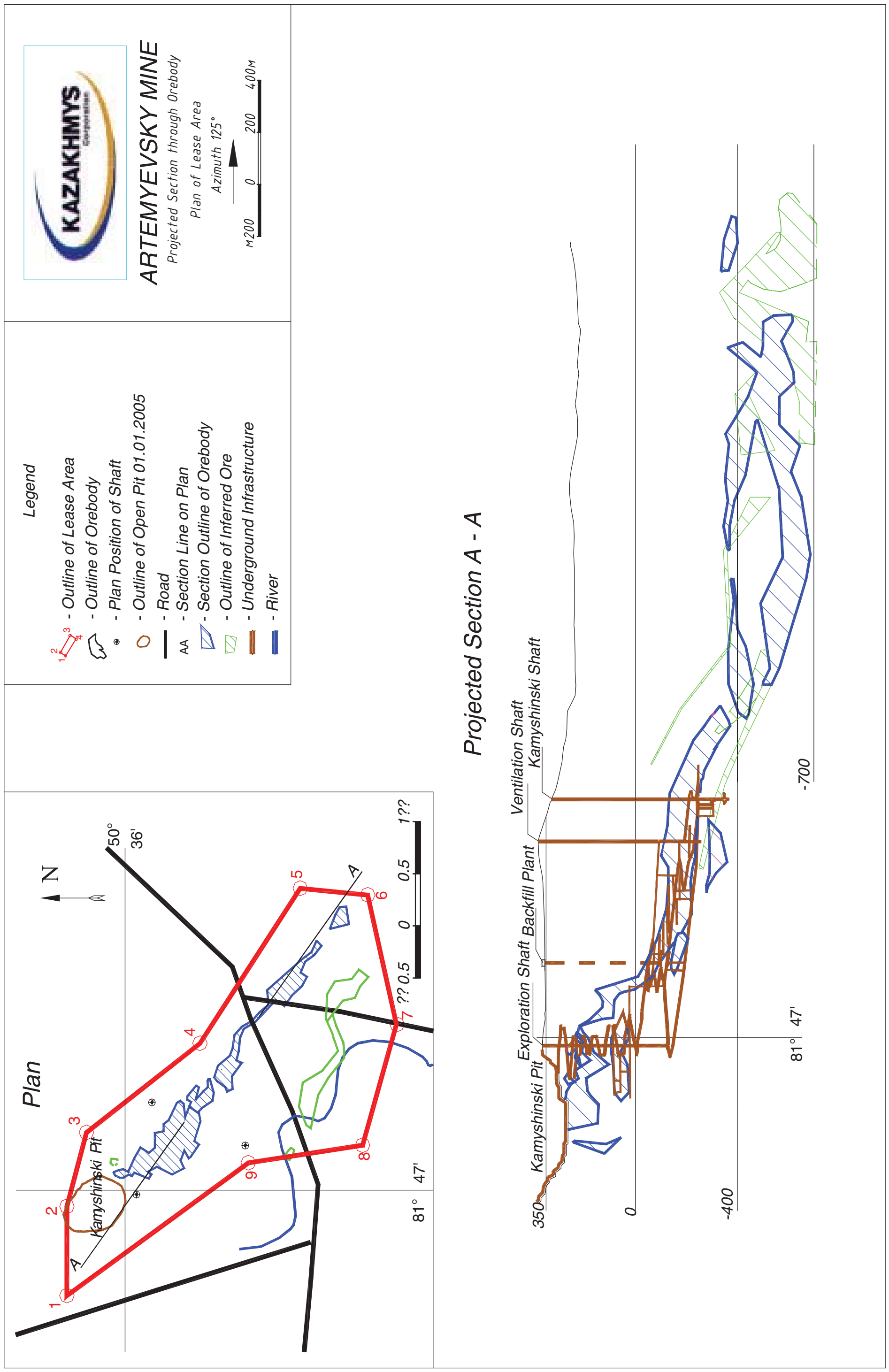

Plate 11. Artemyevsky Mine

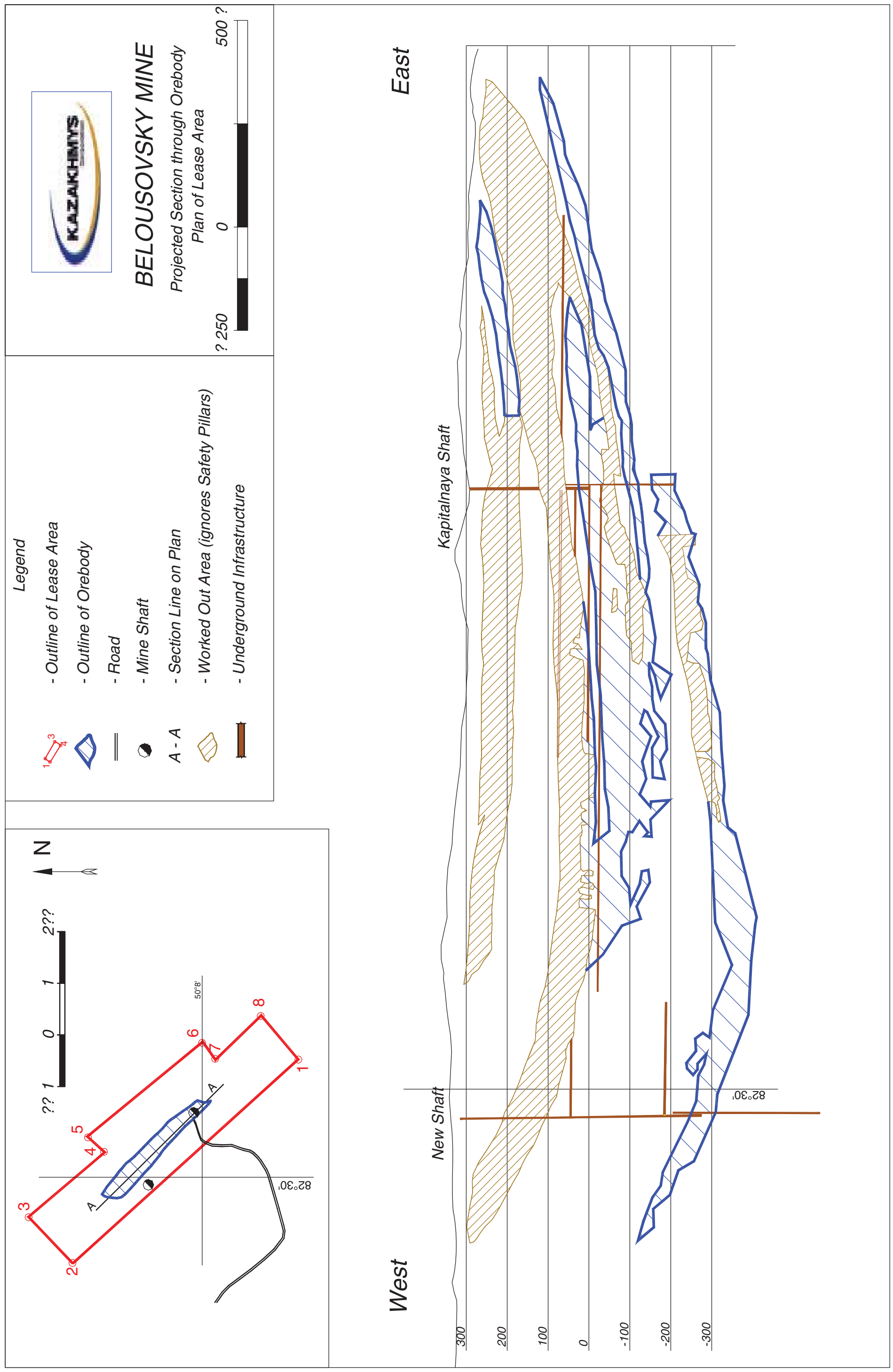

Plate 12. Belousovsky Mine

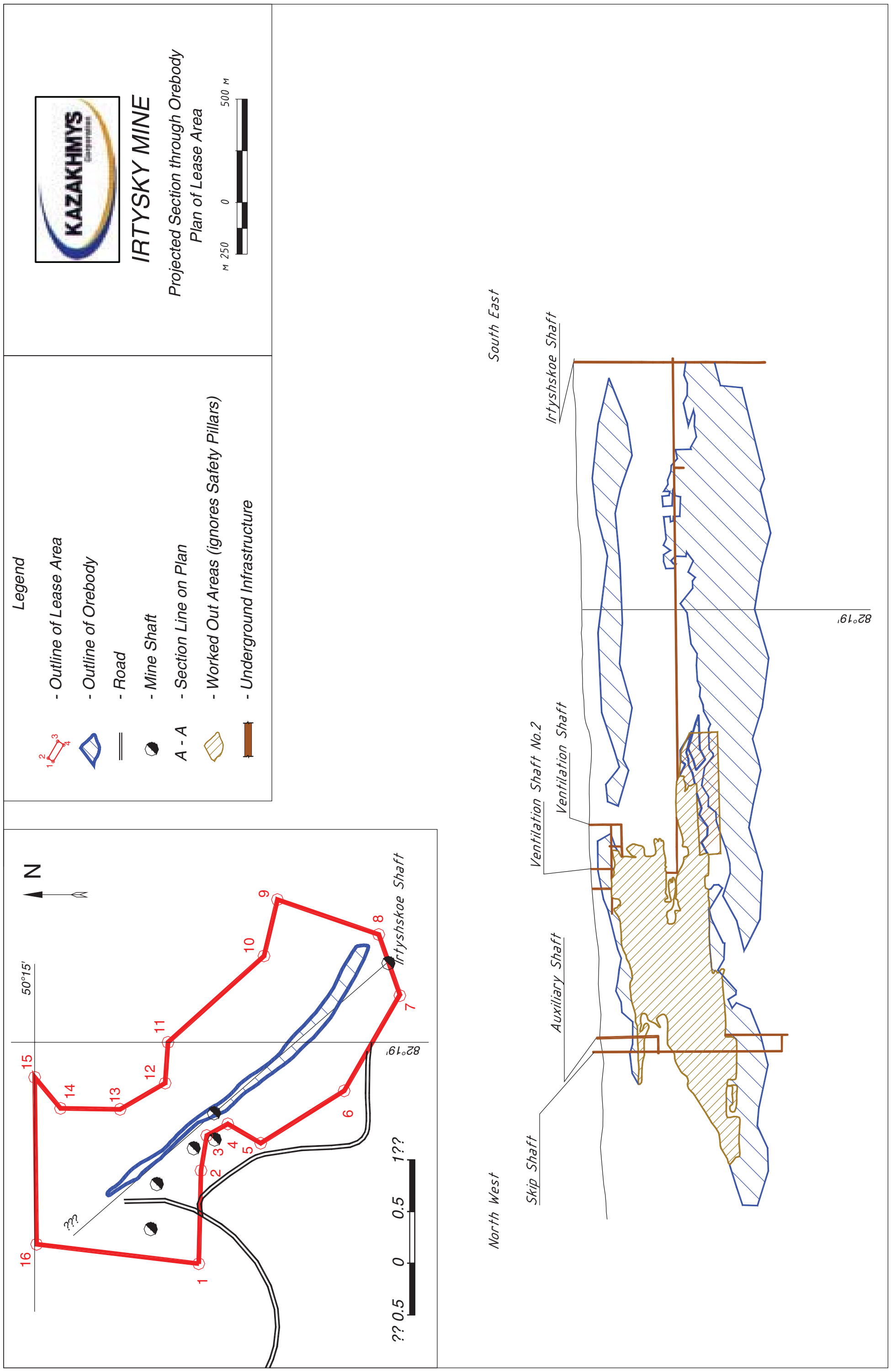

Plate 13. Irtysky Mine

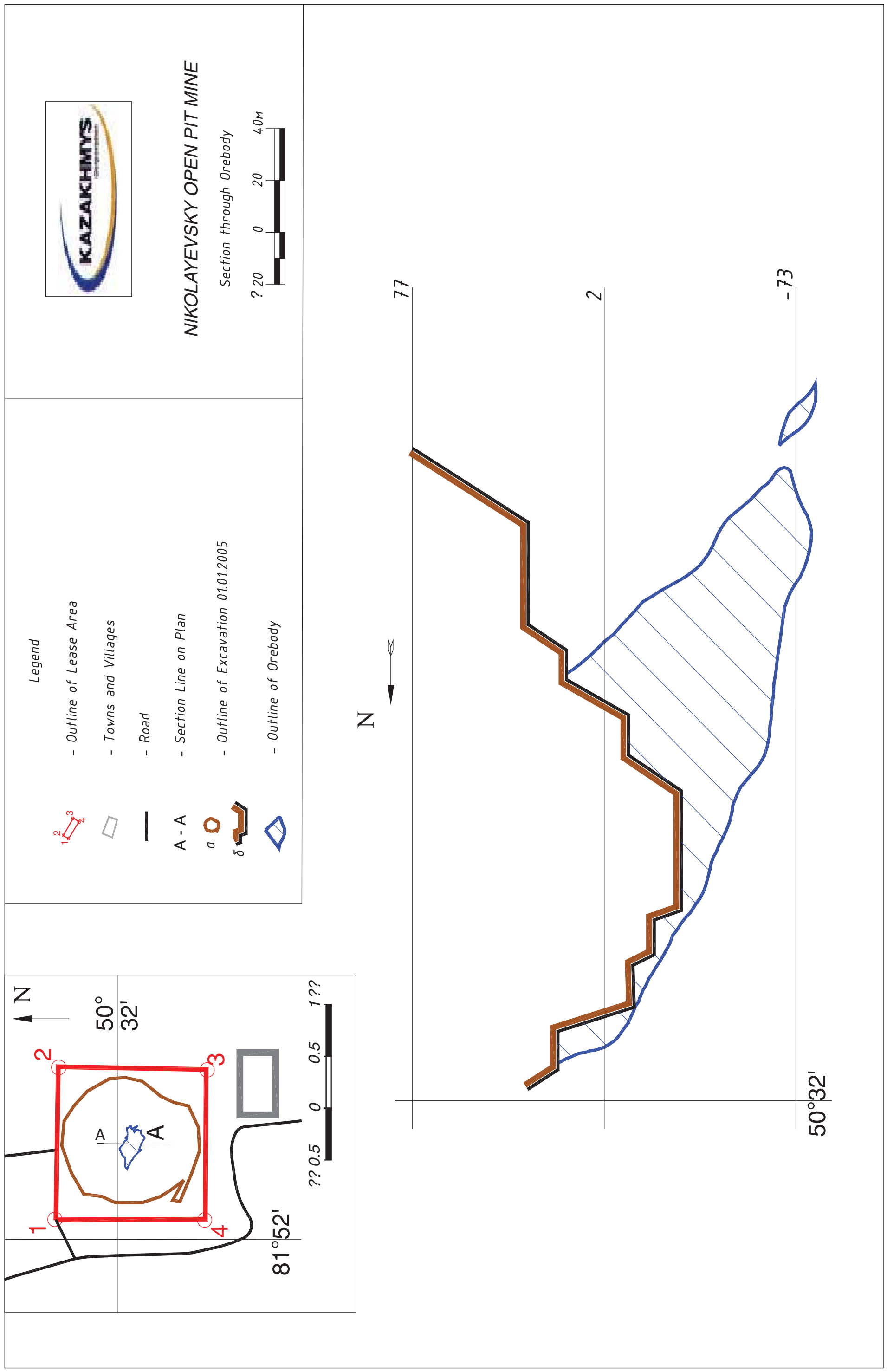

Plate 14. Nikolayevsky Open Pit

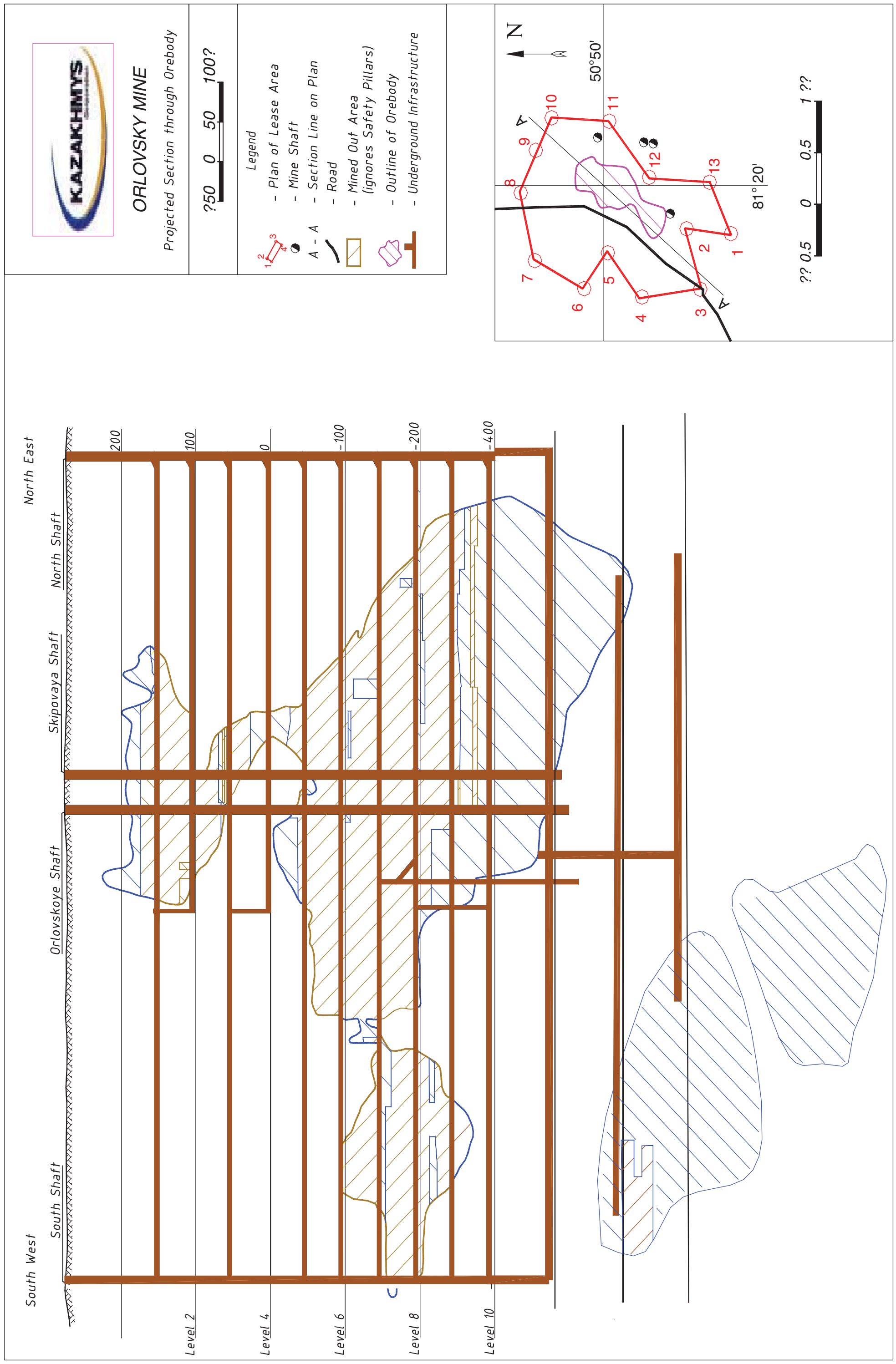

Plate 15. Orlovsky Mine

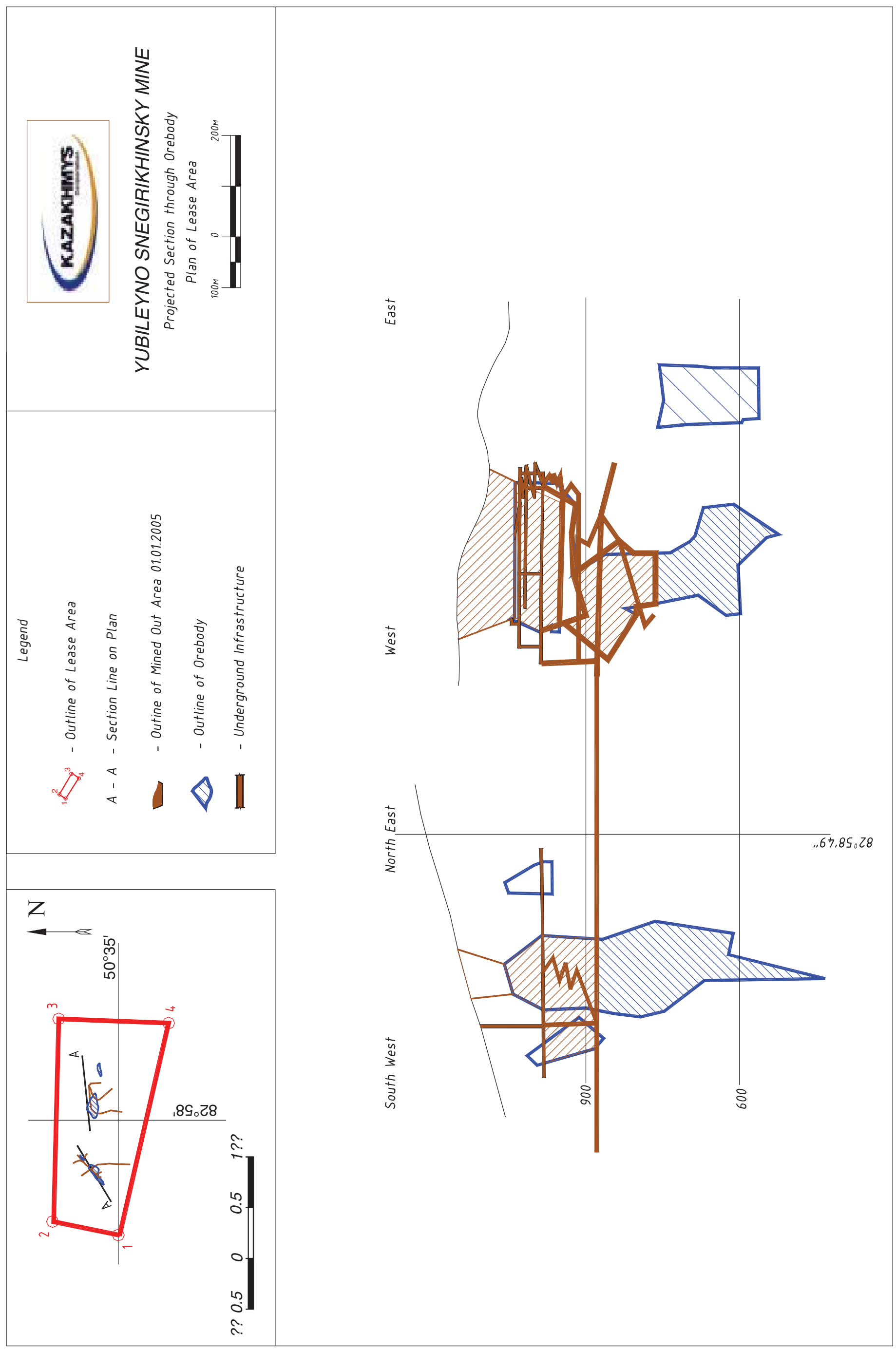

Plate 16. Yubileyno Snegirikhinsky Mine

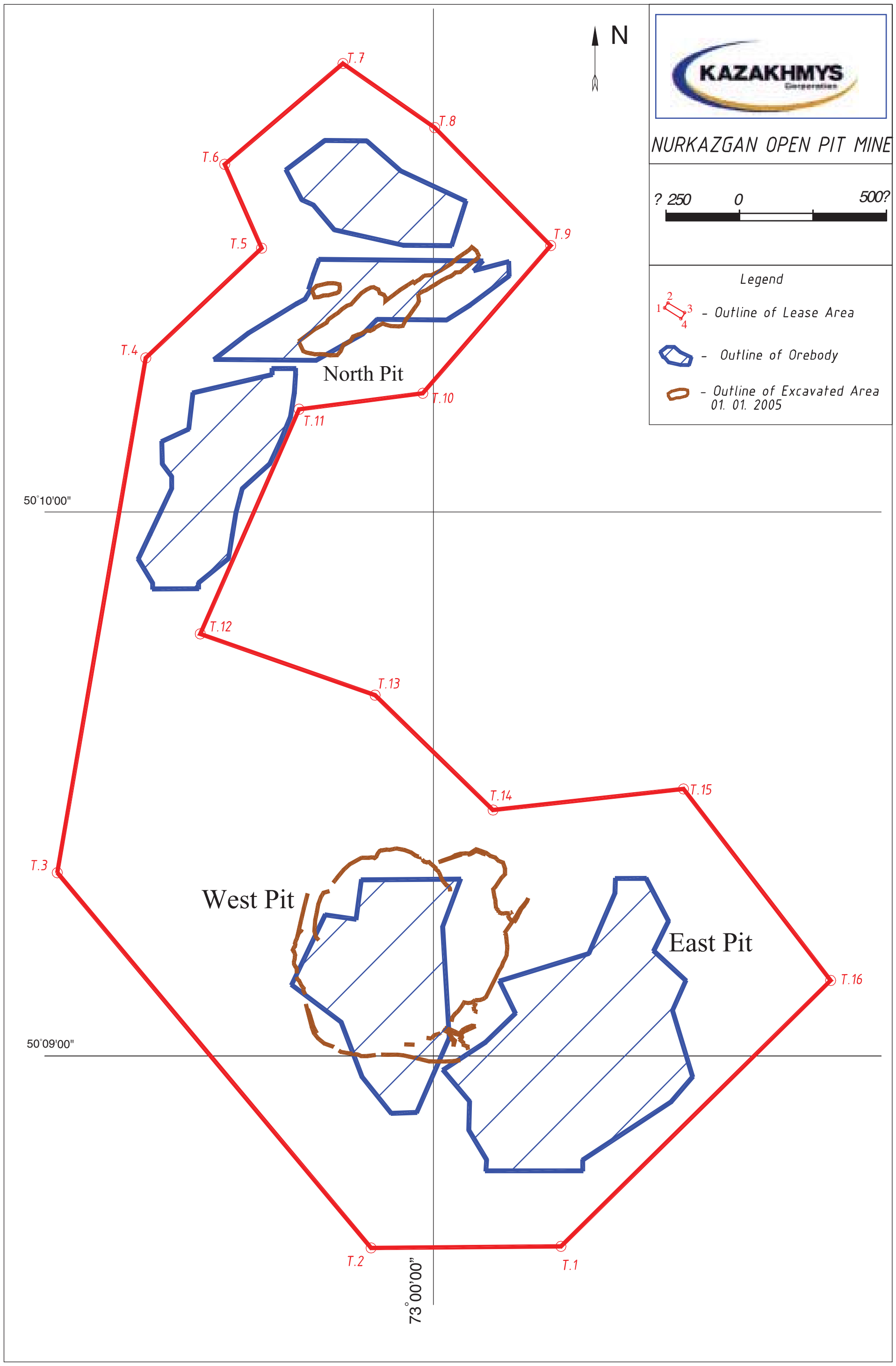

Plate 17. Nurkazgan Open Pit

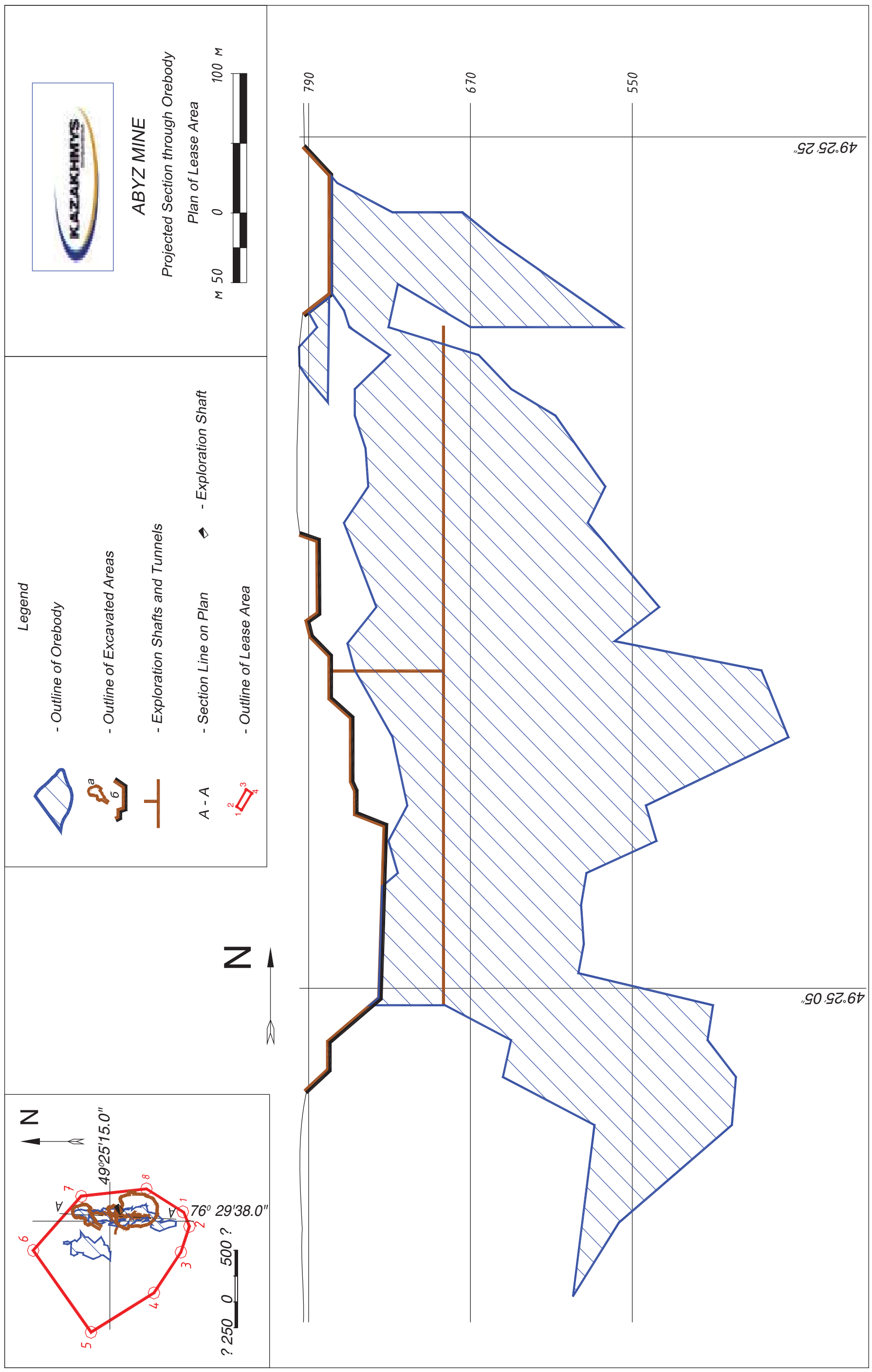

Plate 18. Abyz Mine

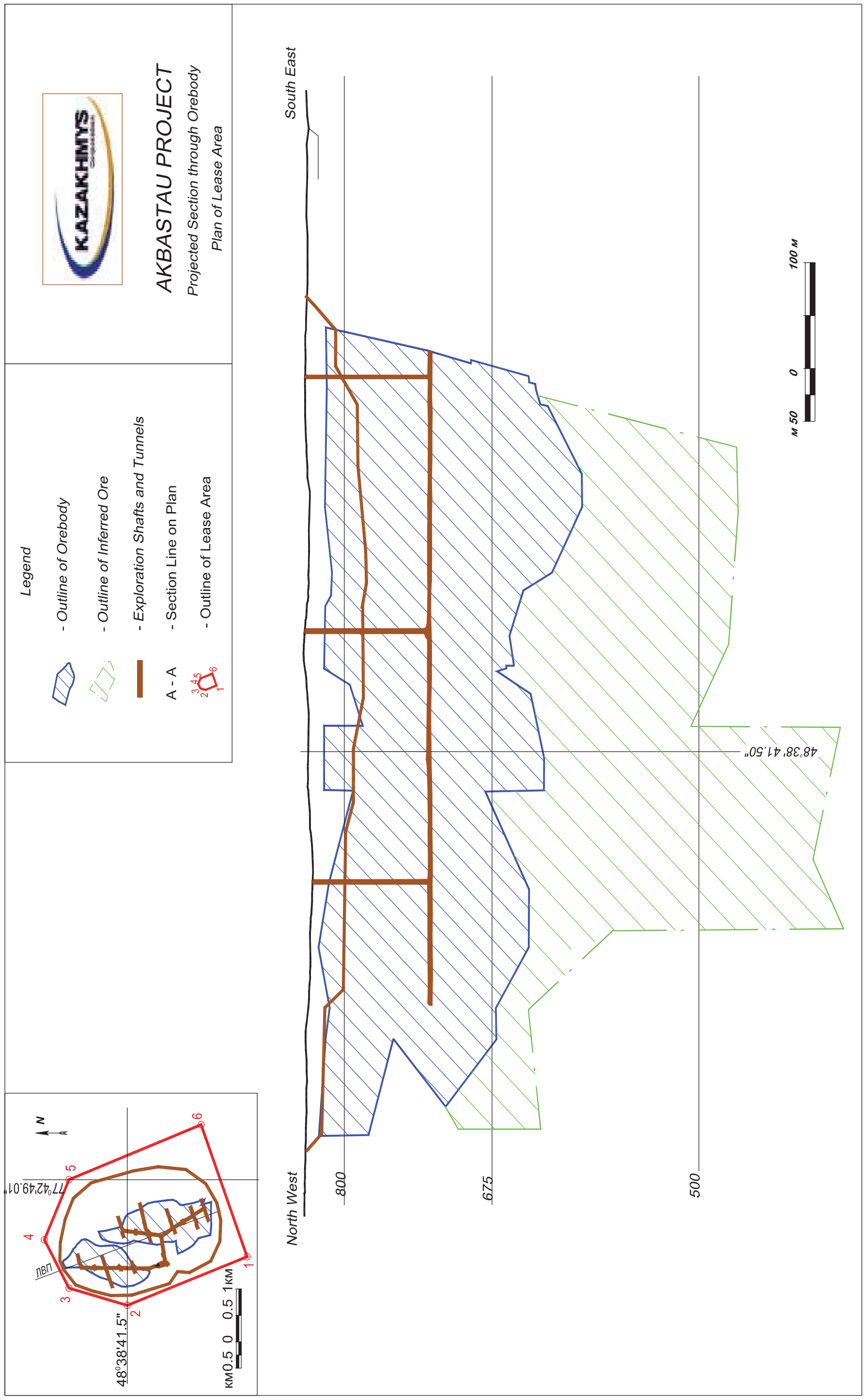

Plate 19. Akbastau Mine Project

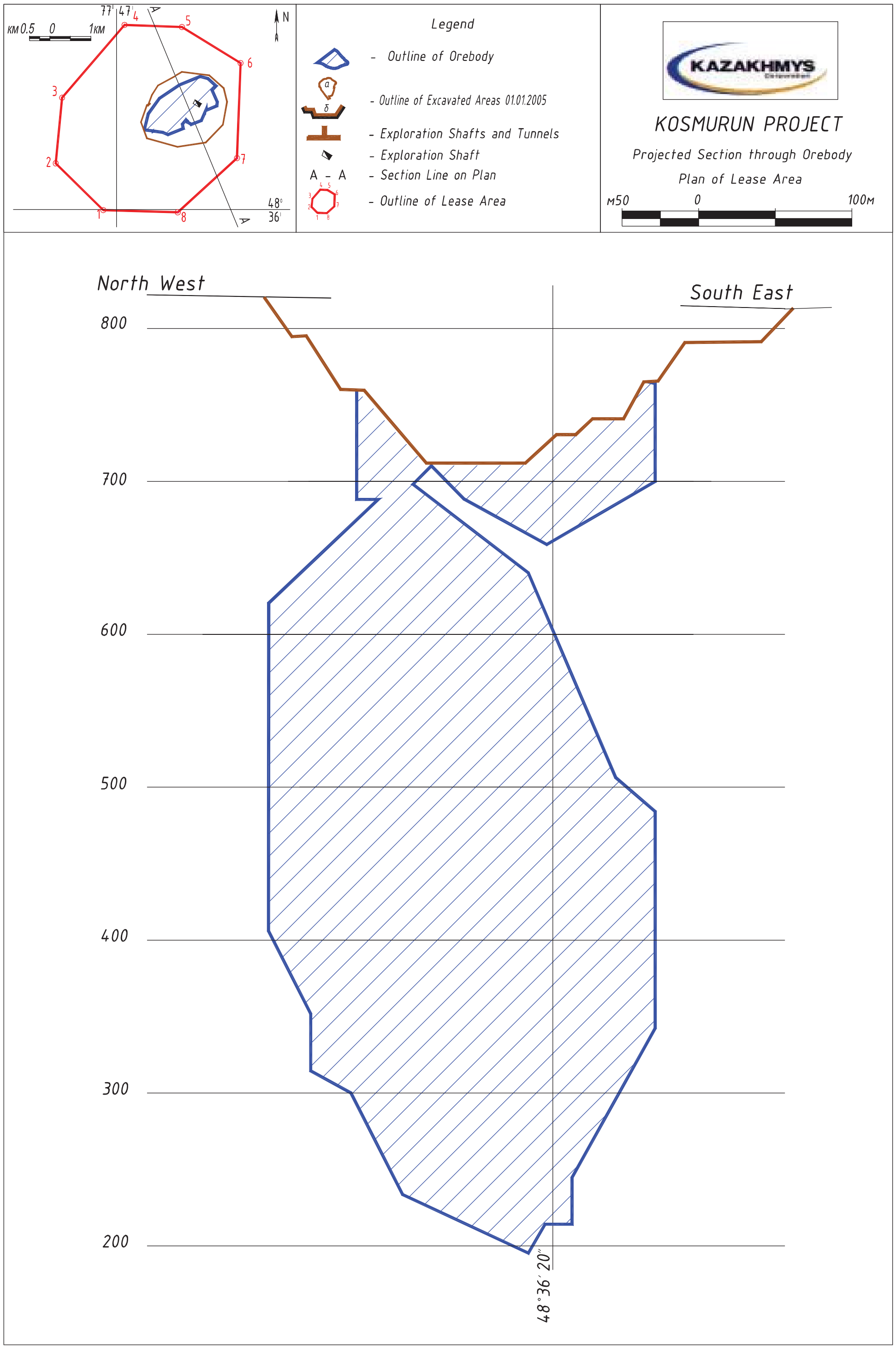

Plate 20. Kosmurun Open Pit Project

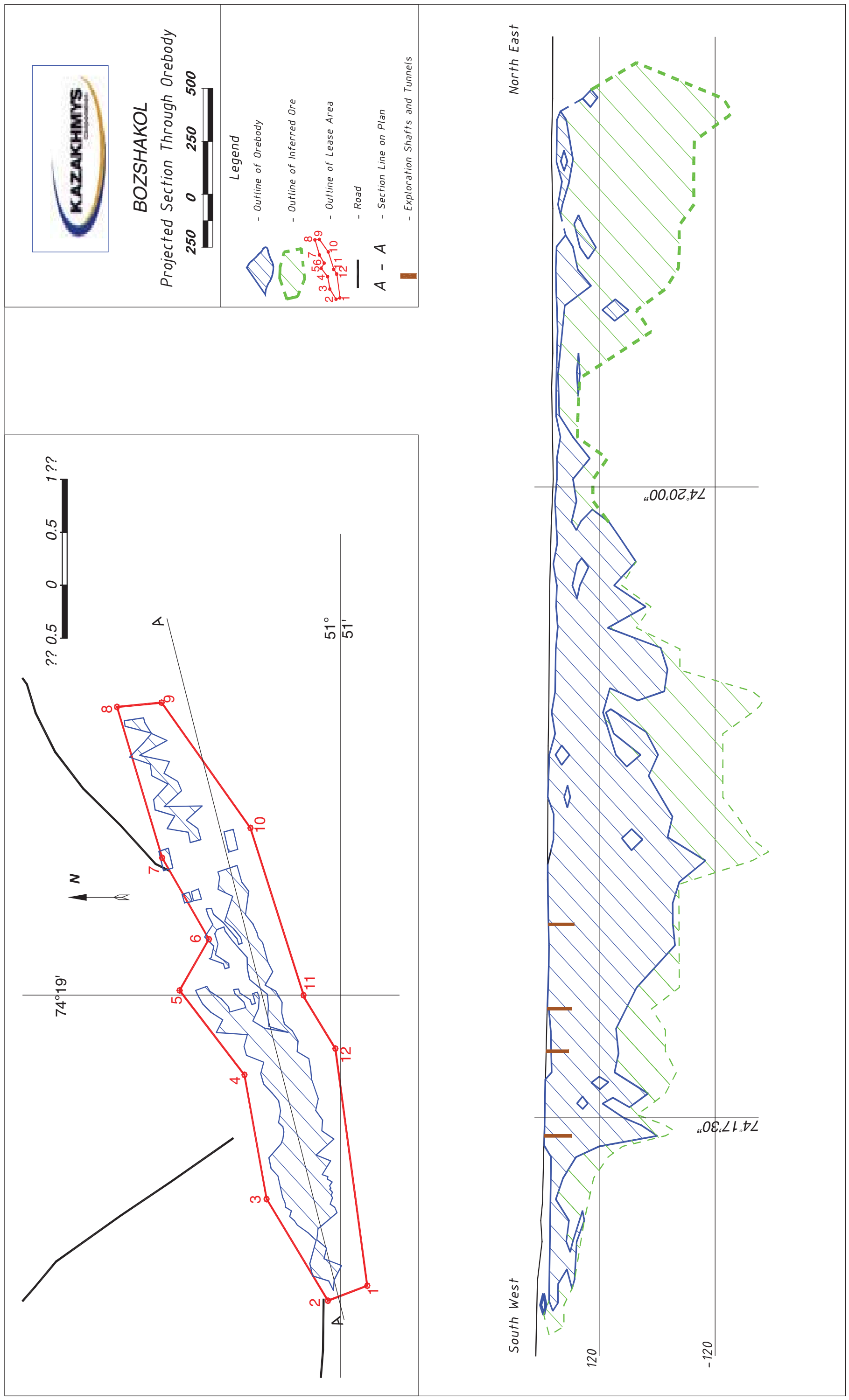

Plate 21. Bozshakol Mine Project

Appendix D

GLOSSARY OF TERMS

$	United States Dollars.
$M	Million United States Dollars.
Acid Plant	A plant attached to a roaster or smelter which converts sulphur-bearing gases to sulphuric acid (H2S04).
ADB	Air dried basis, analysis of coal where by coal is air dried at ambient temperatures leaving the inherent moisture within the coal.
Adit	A horizontal or nearly horizontal entrance/access to an underground mine from surface. Often starting from the side of a hill.
Air Dried Basis	Air dried basis, analysis of coal where by coal is air dried at ambient temperatures leaving the inherent moisture within the coal.
Air pollution	The presence of contaminant or pollutant substances in the air that do not disperse properly and interfere with human health or welfare or produce other harmful environmental effects.
Ambient air	Any unconfined portion of the atmosphere: open air, surrounding air.
Andesite	A fine-grained igneous rock
Anode	The positively charged electrode in a direct current electrolytic cell. Anodes are cast in the smelter at approximately 99.7% Cu. They are converted into cathodes by electrolysis to 99.99% Cu.
Anticline	A strata fold that is concave downwards.
Aquifer	An underground geological formation, or group of formations, containing usable amounts of groundwater that can supply wells and springs.
ASCu	Acid soluble copper
Ash	The uncombustible residue from mineral matter contained as either contamination (rocks) or inherent within the coal. On combustion the mineral matter is reduced to ash the refractory component of mineral matter. Some minerals dissociate on heating to release carbon dioxide or moisture.
Ash Analysis	Analysis of the ash for the major components such as silica, alumina, calcium, magnesium, potassium, sodium, titanium, manganese.
Ash content	The percentage of a laboratory sample of coal remaining after incineration to a constant weight under standard conditions.
Ash free	A theoretical analysis calculated from basic data expressed as if the total ash had been removed.

Assay	The percentage of a particular element or compound in a given sample.
Assay Laboratory	Facility in which the proportions of metal in ores or concentrates are determined using analytical techniques.
Autogenous Mill	Mill using the feed material to reduce through friction and breakage without the assistance of other forces.
Backfill	Waste sand, rock and classified mill tailings used to fill voids in mines after removal of ore from stopes or other underground openings.
Backfilling	The operation of depositing waste into a previously mined out void.
Background level	In air pollution control, the concentration of air pollutants in a definite area during a fixed period of time prior to the starting up or on the stoppage of a source of emission under control. In toxic substances monitoring, the average presence in the environment, originally referring to naturally occurring phenomena.
Bank cubic metre, (bcm)	One cubic metre of in-situ undisturbed rock (coal or overburden).
Bench	A near horizontal working area in a mine at least one side of which is defined by a significant vertical drop.
Bench preparation	Loosening in-situ material by blasting or ripping or otherwise to allow the material to be excavated.
Beresite or Beseritisation	The Soviet term for hydrothermal alteration characterised by the presence of pyrite, sericite and carbonate.
Best Practice	Operating procedures that are recognised in the international mining community which maximise productivity and return on investment commensurate with stewardship of the assets.
Billion	One thousand million.
Blending	Mixing two or more materials together to give a mixture of the desired quality.
Block Caving	An inexpensive mining method in which large blocks of ore are undercut and allowed to break and cave under their own weight.
Bolted roadways	Roadways that are supported using full column resin bolts (a drill hole filled with quick setting resin and through which a steel rod is rotated to mix resin and hardener).
Boom-drilling machine	A rock drilling machine mounted on an articulated arm.
Bord and Pillar	A system of mining in which interlacing tunnel excavations are made at right angles to one another into the orebody (reef), leaving square or rectangular pillars to support the overlying rock.

Borehole	A hole made with a drill, auger or other tool for exploring strata in search of minerals.
Bornite	Dark blue, purple or reddish copper-iron sulphide mineral containing 63% copper.
By-product	Material, other than the principal product, that is generated as a consequence of an industrial process.
Calorific value, (CV)	The heat value of coal per unit weight. This is normally reported in kilocalories per kilogram, (kcal/kg).
Capex	Capital expenditure.
Carboniferous	Geological Period in which the coal basins of northern Europe were formed.
Cash Flow	The sum of cash generated and spent by a business, usually computed on an annual basis.
Cathode	The negatively charged electrode in a direct current electrolytic cell on which the copper is deposited in a pure form (99.99% Cu).
Chalcopyrite	A brassy-coloured mineral composed of copper, iron and sulphur containing 34 percent copper.
Cleanup	Actions taken to deal with a release or threat of release of a hazardous substance that could affect humans, the environment, or both. The term is sometimes used interchangeably with the terms remedial action, removal action, response action, or corrective action.
Coal	A readily combustible rock containing more than 50% by weight and 70% by volume of carbonaceous material, including inherent moisture. It is formed from plant remains that have been compacted, indurated, chemically altered and metamorphosed by heat and pressure during geological time.
Coaling	The act of extracting coal.
Concentrate	Material that has been separated from an ore which has a higher concentration of mineral values than the mineral values originally contained in the ore. Concentrates are produced in a plant called a concentrator.
Concentrator	Equipment used in the reduction of ore.
Converter	A furnace in which air is blown through a bath of molten metal or matte, oxidizing the impurities and maintaining the temperature through the heat produced by the oxidation reaction.
Conveyor	A rubberised belt running on rollers transporting the coal or other material from the faces to the endpoints. They can be reversed and used for manriding (carrying personnel to their working places.

Copper Equivalent	The value of associated metals expressed in terms of % Cu determined using defined metal prices.
Core	A cylindrical sample of rock obtained during core drilling.
Cross Section	A diagram or drawing that shows features transected by a vertical plane drawn at right angles to the longer axis of a geologic feature.
Crush, Crushing, Crushed	A mechanical method of reducing the size of rock.
Crusher	A machine for crushing rock.
Cu	Copper conductors.
Cut and Fill	A method of stoping in which ore is removed in slices, and the resulting excavation filled with waste material (backfill) which supports the walls of the stope when the next cut is mined.
Cut-off Grade	The lowest grade of mineralised material considered economic to extract; used in the calculation of the ore reserves in a given deposit, and in operations to segregate ore and waste.
CV	See calorific value.
DAF	Dry ash free basis—conversion of analyses to present data that has all ash and moisture removed, i.e. represents the analysis of the organic matter only.
DB	Dry basis, analysis of coal where-by the coal is dried at 105 °C before proximate analyses are undertaken.
Deposit	An area of coal resources or reserves identified by surface mapping, drilling or development.
Development	Excavations or tunnels required to access the coal or ore. (i) The initial stages of opening up a new mine, and/or (ii) The tunnelling to access, prove the location and value, and allow the extraction of ore.
Diamond Drilling or Core Drilling	A drilling method, where the rock is cut with a diamond bit, attached to hollow rods. It cuts a core of rock, recovered in cylindrical sections for geological analysis.
Dilution	The contamination during the mining process of excavated ore by non-ore material from the roof, floor or in-seam partings.
Dip	The angle that a structural surface, i.e. a bedding or fault plane makes with the horizontal measured perpendicular to the strike of the structure.
Discount Rate	The interest rate at which the present value, if compounded, will yield a cash flow in the future.
Discounted Cash Flows (DCF)	The present value of future cashflows.

Disposal	Final placement or destruction of toxic, radioactive, or other wastes; surplus or banned pesticides or other chemicals; polluted soils; and drums containing hazardous materials from removal actions or accidental releases.
Down-Dip	Parallel to or in the general direction of the dip of the reef, stratum, vein seam or bed.
Drillhole	A circular hole made in rock, often in conjunction with a core barrel in order to obtain a core sample.
Drives—related to mining	A horizontal excavation or tunnel.
Dump	A site used to dispose of solid wastes without environmental controls.
Dyke	A discordant tabular body of igneous rock that was injected when molten, that cuts across the structure of the adjacent country rock.
Electrolytic Refining	Process using electric current to transport metal ions from an anode via a solution (eleótrolyte) to a cathode.
Emission	Pollution discharged into the atmosphere from smokestacks, other vents, and surface areas of commercial or industrial facilities, from residential chimneys; and from motor vehicle, locomotive, or aircraft exhausts.
Emission standard	The maximum amount of airpolluting discharge legally allowed from a single source, mobile or stationary.
Environment	The sum of all external conditions affecting the life, development, and survival of an organism.
Environmental assessment (EA)	A process whose breadth, depth, and type of analysis depend on the proposed project. EA evaluates a project's potential environmental risks and impacts in its area of influence and identifies ways of improving project design and implementation by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and by enhancing positive impacts.
Environmental audit	1. An independent assessment of the current status of a party's compliance with applicable environmental requirements. 2. An independent evaluation of a party's environmental compliance policies, practices, and controls.
Exploration	The search for mineral. Prospecting, sampling, mapping, diamond drilling and other work involved in the search for mineralisation.
Fault	A structural discontinuity in the earth's crust formed by movement between adjacent blocks resulting from tectonic forces.

Fault Throw	The amount of vertical displacement in an upward or downward direction produced by a fault.
Feasibility Study	A comprehensive engineering estimate of all costs, revenues, equipment requirements and production levels likely to be achieved if a mine is developed. The study is used to define the technical and economic viability of a project and to support the search for project financing.
Felsic	relating to or denoting a group of light-coloured minerals including feldspar, quartz, and muscovite.
Float	The product of the flotation process.
Flocculation	The process by which clumps of solids in water or sewage are made to increase in size by biological or chemical action so that they can be separated from the water.
Floor (seam)	The bottom of the seam.
Flotation	A recovery process by which valuable minerals are separated from waste to produce a concentrate. Selected minerals are induced to become attached to air bubbles and float.
Flux	A substance that absorbs the mineral impurities, or promotes the fusing of minerals or metals, or prevents the forming of oxides.
Fold	Any bending or wrinkling of rock strata.
Footwall	The underlying side of a fault, an orebody, or mine workings. An assay footwall is the lower surface of an orebody which separates ore- and waste-grade material.
Fractured—relating to geology	Breaks in rock formations due to intense faulting or folding.
FSU	Former Soviet Union.
ft	Foot.
Galena	A metallic grey or black mineral consisting of lead sulphide.
Geological losses	Losses deducted from proven reserves due to geological constraints, eg faults, seam splitting.
Geotechnical Conditions	The engineering behaviour of rocks as a result of an excavation.
Grab Sample	Samples taken manually.
Grade	The relative quality or percentage of metal content.
Grade (ore)	The classification or value of ore.
Granodiorite	A coarse-grained plutonic rock between granite and diorite in composition.
Grinding	Size reduction of crushed rock into relatively fine particles.

Groundwater	The supply of fresh water found beneath the Earth's surface (usually in aquifers), which is often used for supplying wells and springs. Because groundwater is a major source of drinking water, there is growing concern about areas where leaching agricultural or industrial pollutants or substances from leaking underground storage tanks are contaminating it.
Hangingwall	The overlying side of a fault, an orebody or mine workings. An assay hangingwall is the upper surface of an orebody which separates ore- and waste-grade material.
Haul Truck	A self propelled vehicle used to transport material.
Hazardous wastes	By-products of society that can pose a substantial or potential hazard to human health or the environment when improperly managed. Substances classified as hazardous wastes possess at least one of four characteristics—ignitability, corrosivity, reactivity, or toxicity—or appear on special lists.
HDPE	High Density Polyethyline geomenbranes for hydraulic applications in canals and ponds for the containment of chemicals.
High wall	The face of the excavation limit where the depth from original ground level is greatest.
High-ash coal	Coal containing more than 15% total ash on an as-received basis.
Highgrading	Intentional concentration of mining operations in the highest grade areas of a mineral deposit.
Hoisted	Coal, ore, men or materials lifted up the shaft to surface
Horizon	A layer or level with particular characteristics or representing a particular period.
Hydrocyclones	Cyclones using water-based material.
Hydrology	The science dealing with the properties, distribution, and circulation of water.
hydrometallurgical	Of or pertaining to hydrometallurgy; involving the use of liquid reagents in the treatment or reduction of ores.
Hydrothermal	Relating to or denoting the action of heated water in the earth's crust.
In Situ	In place, i.e. within unbroken rock.
Indirects	Costs not directly attributable to specific construction activities.
Inherent Moisture	That moisture held within the internal porosity of the coal. It is the moisture released after air dying of the coal at 20° C when the coal is heated to 105°C. Low rank coals have high inherent moisture and high rank coals have low inherent moisture.

Interburden	Sterile soil and rock material lying between coal seams.
Intrusion	Any injection of igneous material into country rock.
Jig	A separator that uses pulsating water to separate coal from waste; less accurate that dense medium.
Joints—relating to geology	A fracture or parting that cuts through and abruptly interrupts the physical continuity of a rock mass.
Kcal/kg	Kilocalories per kilogram of coal, the energy content of coal used in the countries that do not conform to SI units. In countries where SI units are adhered to, the measure of energy is in megajoules per kilogram or MJ/kg.
km	Kilometre.
kPa	Kilo Pascals.
kt	Thousand metric tonnes.
ktpy	Thousand metric tonnes per year.
kV	Kilo Volt.
kVA	Kilo Volt Amperes.
kVAr	Kilo volt—reactive/compensating.
kW	Kilo Watts power rating.
kWh	Kilowatt hour lb pound.
kWh	Kilowatt hour.
Lagoon	1. A shallow pond in which sunlight, bacterial action, and oxygen work to purify wastewater; also used for storage of wastewaters or spent nuclear fuel rods. 2. A shallow body of water, often separated from the sea by coral reefs or sandbars.
Leach Process	To dissolve mineral or metals out of the ore using acids or other solutions.
Leachate	A liquid that results when water collects contaminants as it trickles through wastes, agricultural pesticides, or fertilizers.
Leaching	A process used to extract metals from ore using a liquid containing chemicals, or the natural process in which ground waters dissolve minerals from rock. Leaching may occur in farming areas, feedlots, and landfills and may result in hazardous substances entering surface water, groundwater, or soil. See also Leachate.
Lease	Contract between two parties enabling one to search for and/or produce minerals from the other's property.

Lenticular	Shaped like a lentil; biconvex.
Level	The workings or tunnels of an underground mine which are on the same horizontal plane. Level numbers usually designate depth below the shaft collar.
Loading rate	The number of tonnes loaded per day (of 24 hours).
Load-out	Clearing debris or mineral onto the transport system usually after blasting.
LOM	Life of Mine.
Loose cubic metre, (lcm)	One cubic metre of overburden or interburden after blasting or excavation.
Losses—Geological	Ore lost due to unpredictable geological phenomena.
Losses—Mining	Ore lost due to less than perfect mining operations.
LTIFR	Lost Time Injury Frequency Rate, usually measured per 100,000 manshifts or one million manhours.
M	Million.
Magmatic	Result of motion or activity of magma.
Matte	An impure product of the smelting of sulphide ores, especially those of copper or nickel.
Mechanised Mining	Mining operations which are partly or fully conducted using machines powered by electricity or diesel fuel.
Metallurgical Recovery	Proportion of metal in plant feed which is recovered by a metallurgical process or processes.
Metallurgy	The practice of extracting metals or minerals from ores and preparing them for sale.
Mill Feed Grade	The grade of material feed to the mill, equivalent to received at mill.
Milling/Mill	The comminution of the ore, although the term has come to cover the broad range of machinery inside the treatment plant where the minerals and/or metals are separated from the ore.
Mineable	Capable of being mined under current mining technology and environmental and legal restrictions, rules and regulations.
Mined-out	An area where all economic material has been extracted.
Mineral Deposit	A mineral occurrence of sufficient size and grade to have potential or existing commercial value; sometimes referred to as mineralisation.
Mineral Rights	The ownership of the minerals on or under a given surface with the right to remove the said minerals.
Mineralisation	Any mass of host rock in which minerals of potential commercial value occur.

Mining Licence	Permission to mine minerals from a Mineral Rights area.
Mining Permit	Permission to mine minerals from a Mineral Rights area.
Mitigation	Measures taken to reduce adverse impacts on the environment.
mm2	Cross sectional area of phase conductor.
Monitoring	Periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements or pollutant levels in various media or in humans, animals, and other living things.
Mt	Million metric tonnes.
Mtpa	Million tons per annum.
Mtpy	Million metric tonnes per year.
MV	Mega Volt.
MVA	Mega Volt Amps.
MW	Megawatt.
Native Copper	Copper metal occurring naturally.
Net Present Value	The sum of a series of discounted cash flows.
Net present value, (NPV)	The present value of the net cashflow of the operation, discounted at a rate, which reflects a combination of the cost of capital of the company and the perceived risk attaching to the project or operation.
NPV	Net present value.
Open Pit	Surface mining in which the ore is extracted from a pit. The geometry of the pit may vary with the characteristics of the orebody.
Open Pit Mine	A mine working or excavation open to the surface where material is not replaced into the mined out areas.
Opex	Operating expenditure.
Overburden	Sterile soil and rock material overlying the coal.
Oxide	That portion of a mineral deposit within which all or the majority of sulphide minerals have been oxidised, usually by surficial weathering processes.
Pa	Pascal unit of pressure.
Pegmatoid Intrusion(s)	A very coarse grained pegmatic facies of igneous rock.
Permeability	The rate at which liquids pass through soil or other materials in a specified direction.
pH	A measure of the acidity or alkalinity of a liquid or solid material.

Pillar(s)	An area of ore left during mining to support the overlying strata or hangingwall in a mine. Blocks of ore left intact to act as support for shafts or other underground workings.
Pit	A hole in the ground—an excavation below original ground level—a surface mine may comprise one or more pits.
Plant	Fixed or moveable equipment required in the process of winning or processing the ore.
Pollutant	Generally, the presence of matter or energy whose nature, location, or quantity produces.
Polymetallic	Ore containing more than one target metal.
Porphyry	A hard igneous rock containing crystals of feldspar in a fine-grained, typically reddish groundmass.
Potable water	Water that is safe for drinking and cooking.
potassically	Altered of its potassium composition.
ppm/ppb	Parts per million/parts per billion, a way of expressing tiny concentrations of pollutants in air, water, soil, human tissue, and food and or other products.
Pre- Feasibility Planning Study	A study with an overall accuracy of +/- 25%.
Prospect	A mineral deposit with insufficient data available on the mineralisation to determine if it is economically recoverable, but warranting further investigation.
Prospecting Licence	An area for which permission to explore has been granted.
Prospecting Permit	Permission to prospect for minerals from a Mineral Rights area.
Pulveriser	A device used in an assay laboratory to reduce rolls crushed feed to 0.1 mm grains.
Purchaser	A sole-purpose company which is acquiring the Assets.
Pyrite	A brassy-coloured mineral of iron sulphide (containing 53 percent sulphur).
Pyritic sulphur	All that sulphur contained within iron sulphur minerals such as pyrrhotite, pyrite, marcasite, generally represented a (FeS_2). The mineral pyrite is generally formed as a secondary mineral after the formation of the coal. Pyrite is often a source of acidic water when oxidised in the presence of air. Pyritic sulphur can be removed by gravity separation.
Quartz	A mineral compound of silicon and oxygen, generally white-coloured to transparent.
Refractory Ore	Any ore that does not respond to conventional mineral processing to produce acceptable product recoveries without an intermediate step to address its refractory attributes.

Refinery	An industrial installation where a substance is refined.
Rehabilitation	Land restored to its former condition.
Reverberatory Furnace	A furnace, with a shallow hearth, usually non-regerative, having a roof that deflects the flame and radiates the heat toward the hearth or the surface of the charge.
Rhyolite	A pale fine grained volcanic rock of granitic composition.
Rights—Surface Rights	The ownership of the surface land under which minerals occur.
Risk assessment	The qualitative and quantitative evaluation performed in an effort to define the risk posed to human health or the environment by the presence or potential presence and use of specific pollutants.
Rolls Crusher	A crusher with two revolving metal cylinders with parallel horizontal axes separated by a small gap; in an assay laboratory, a properly gapped crusher should reduce jaw-crushed feed to 2 mm grains.
ROM	Run of mine.
Roof of the seam	The top of the seam.
Room	The excavated tunnel between the pillars in the underground mine workings.
Room and Pillar Mining	A method of mining flat-lying deposits in which the mined areas, or rooms, are separated by pillars of lesser or equal size.
Royalty	A share of the product or profit reserved by the owner for permitting another to exploit the property.
Runoff	That part of precipitation, snowmelt, or irrigation water that runs off the land into streams or other surface water; can carry pollutants from the air and land into the receiving waters.
Sample	A representative fraction of a coal seam collected by approved methods, guarded against contamination, and analysed to determine the nature, chemical, mineralogical or petrographic composition, percentage content of specified constituents, and heat value.
Sampling	Taking small pieces of rock at intervals along exposed mineralisation for assay (to determine the mineral content).
Screen	A device for separating by size.
Seam	A layer or bed of coal. Correlated seams of coal are normally assigned a name, letter or number. A single seam can contain one or more non-coal partings resulting in a sub-division into leaves.
Seam outcrop	A manifestation of a coal seam at the Earth's surface.

Seam splitting	When a coal seam splits into two or more leaves or subsidiary seams.
Secondary Mineralisation	Mineralisation resulting from the weathering of primary ore, usually leading to an increase in metal content.
Sedimentary	Formed by the deposition of solid fragmental material that originates from weathering of rocks and is transported from a source to a site of deposition.
Sediments	Soil, sand, and minerals washed from land into water, usually after rain. Sediments pile up in reservoirs, rivers, and harbours, destroying fish-nesting areas and holes of water animals and clouding the water so that needed sunlight may not reach aquatic plants. Careless farming, mining, and building activities will expose sediment materials, allowing them to be washed off the land after rainfalls.
Septic tank	An underground storage tank for wastes from homes having no sewer line to a treatment plant. The wastes go directly from the home to the tank, where the organic waste is decomposed by bacteria and the sludge settles to the bottom. The effluent flows out of the tank into the ground through drains; the sludge is pumped out periodically.
Settleable solids	Material heavy enough to sink to the bottom of a wastewater treatment tank.
Sewage	The waste and wastewater produced by residential and commercial establishments and discharged into sewers.
Shaft	A mine-working (usually vertical) used to transport miners, supplies, ore, or waste.
Shaft pillar	A prescribed area of ground around the shaft in which mining is not permitted. The pillar affords stability to the shaft ensuring this essential access is preserved.
Shovel and truck mining	Excavating overburden, interburden and coal using stand-alone excavators loading into dump trucks, dumpers and highway trucks.
Shrinkage Stoping	Mining method whereby the blasted material is used as floor and material is extracted from below.
Skarn	lime-bearing siliceous rock produced by the metamorphic alteration of limestone or dolomite.
Skips	The conveyance/vessels into which coal/ore is tipped at the bottom of the shaft and then hoists to the top where the ore is tipped into a receiving bin and then the cycle is repeated.
Slag	stony waste matter separated from metals during the smelting or refining of ore.
Slimes	Water-based waste product.

Slurry	A suspension of coal or waste in water.
Smelting	Thermal processing whereby molten metal is liberated from beneficiated ore or concentrate with impurities separating as lighter slag. The plant where this is performed is called a smelter.
Sphalerite	A shiny mineral, yellow to dark brown or black in colour, consisting of zinc sulphide.
Specific Gravity (SG)	The ratio of the mass of a unit volume of ore or waste material to the mass of an equal volume of water at 4 degrees C.
Split	An in-seam parting which attains a thickness such that the resultant leaves of coal are considered as separate seams from a mining point of view.
Spoil	Excavated material of no commercial value also referred to as waste.
Spontaneous combustion	The propensity of some types of coal to oxidise rapidly on contact with air. The oxidation reactions produce heat that increases the rate of oxidation to the point that the coal ignites. Low rank coals are the most prone to spontaneous combustion.
Spot	The purchase price of a commodity at the current price, normally this is at a discount to the long term contract price but currently coke, coking coal and thermal coal are being sold at a premium to the long term contract prices.
Stratiform	In layers.
Stockpile	An accumulation of ore or mineral.
Stope	The underground excavation from which ore is extracted.
Stoping	The act of excavating ore, either above or below a set level, in a series of steps in an underground mine.
Strata	Layers of sedimentary rock.
Strike	Bearing of direction of a horizontal line on the surface of a planar feature; 90° to the true dip.
Strike Length	Length of a feature in the strike direction.
Stripping	Non economic material which must be removed to expose ore in an open-pit mine or the process of removing such material to expose ore.
Stripping ratio, (SR)	The amount of overburden that must be removed to gain access to a unit amount of coal. This is normally reported as bank cubic metres (bcm) overburden per recoverable tonne of coal (bcm/t).
Sub-Level Caving	A mining method whereby ore is allowed to cave into drifts located on sub-levels from which the ore is extracted.

Sub-Level Open Stoping	A mining method whereby ore is blasted from horizontal workings placed at intermediate levels (sub-levels) into drawpoints located on main levels, from which the ore is hauled away.
Sulphide	A mineral characterised by the bonds of sulphur with a metal or semi-metal, such as pyrite, FeS2 (iron sulphide). Also a zone in which sulphide minerals occur.
Sump	A pit or tank that catches liquid runoff for drainage or disposal.
Supergene	Mineralisation formed by leaching, transportation and deposition via groundwater.
Surface water	All water naturally open to the atmosphere (rivers, lakes, reservoirs, streams, impoundments, seas, estuaries, etc.); also refers to springs, wells, or other collectors that are directly influenced by surface water.
Suspended solids	Small particles of solid pollutants that float on the surface of or are suspended in sewage or other liquids. They resist removal by conventional means. See also Total suspended solids.
Sustaining Capital	Periodic capital expenditures required to replace or overhaul equipment. Also known as replacement capital.
Swell factor	The ratio of a material's in-bank density (in its unexcavated state) to its loose density (after it has been excavated).
Syncline	A strata fold which is concave upwards.
t	Metric tonne = 1000 kg.
Tailing(s)	The fluid slurry after treatment and extraction of the economically extracted mineral.
Tailings Dam	One to which the slurry is transported, the solids settling while the liquid may be withdrawn.
Tankhouse	A building in which an electrolytic refinery is housed; the refinery consists of tanks in which electrolytic refining takes place.
TCu	Total copper.
Tectonic influence	The influence of primary and secondary geological activity on an area.
Thermal coal	Any coal that has energy and can be burnt to release that energy. Normally thermal coals do not have coking properties.
Topographical	The physical features of a district or region delineated on a map.
Total Moisture	The sum of the inherent moisture and the free (or surface) moisture.

Total sulphur	The total amount of sulphur contained within the coal comprising sulphur from pyrite, sulphate minerals and organic sulphur.
Total suspended solids (TSS)	A measure of the suspended solids in wastewater, effluent, or water bodies. See also Suspended solids.
tpd	Metric tonnes per day.
tpm	Tonnes per month.
tpy	Metric tonnes per year.
Trackless	Mining without the use of locomotives.
trenches	Lines excavated to a pre determined depth to establish the geological structure of a deposit.
Ultimate analysis	Analysis of the elemental components of coal—carbon, hydrogen, nitrogen, oxygen and sulphur. Normally reported on a dry or dry ash-free basis.
Ultrabasic Rocks	Igneous rocks containing less than 45% silica.
Ultramafic Igneous Complex	A complex containing less than 45% SiO_2.
Volatile Matter	That portion of the coal comprising both gases and liquids that is released following heating from 105°C to 800°C. The amount of volatile matter in a coal is a function of the rank of the coal (thermal maturity) and of the coal type. High rank coals have a low volatile matter content (<20%) medium rank coals have a higher volatile matter content (20 – 30 %) and low rank coals have a high percentage of volatile matter. The type of coal also effects volatile matter, coal with a high inertinite content will produce less volatile matter than a coal with high vitrinite content that will produce less volatile matter than a coal with high liptinite content.
Volcanogenic	From volcanic rock.
Waste	Rock lacking sufficient grade and/or other characteristics of ore to be economic.
Waste—Internal	Rock or material of no commercial value residing within the ore horizon/reef.
Wastewater	Spent or used water from individual homes, communities, farms, or industries that contains dissolved or suspended matter.
Wastewater treatment plant	A facility containing a series of tanks, screens, filters, and other processes by which pollutants are removed from water.
Water makes	The quantity of water flowing into an area or the mine.
Water pollution	The presence in water of enough harmful or objectionable material to damage water quality.

Winders	An electrically driven drum with rope attached to either skips (coal) or cages (men and materials) used to remove coal or ore from a mine and facilitate en and materials to the underground workings.
Wirebar	A cast copper ingot used to manufacture wire.
Workable	See mineable.
Working Capital	Accounts receivable less accounts payable.