



ATTACHMENT B

INFLUENT DESIGN BASIS



Information for Influent Design Basis

The information for forming the influent design basis is based on two studies:

- 1) Communication from RMG by email 22nd November 2018 regarding quality of the flow to the WRD II & Kazretula Facility
- 2) The Preliminary Design Basis (Technical Memorandum 1663363.507 B0 dated 10 September 2018), an extract of which is included below. Please note WRD III and Madneuli TMF are not now currently required due to an update to the RMG mine water management scheme.

1. RMG Water Quality Information for WRD II & Kazretula Facility

Quality summary is indicated to be the maximum readings obtained from multiple analysis (all mass concentrations are assumed to be mg/l)

Parameter	Concentration/Reading (mg/L)
pH	4.3
Copper (Cu)	38.6
Zinc (Zn)	192
Iron (Fe)	10.07
Sulfate (SO ₄)	1400
Cadmium (Cd)	1.21
Silica (SiO ₂)	82.2
Calcium (Ca)	400
Magnesium (Mg)	1421
Nitrite (NO ₂)	<0,1
Nitrate (NO ₃)	12.6
Manganese (Mn)	121
Chemical Oxygen Demand (COD)	62.6
Conductivity	0.6812
Arsenic (As)	<0,01
Cyanide (CN)	<0,04
Chromium (Cr)	<0,02
Lead (Pb)	0.23
Selenium (Se)	0.021

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2. Extract from Design Brief Technical Memorandum

Design Discharge Criteria

One objective of mine water management is that discharges from RMG's proposed facilities should meet any site-specific requirements for discharges to the water environment assigned by the local environmental authorities.

The regulatory requirements for discharges may allow for mixing and dilution in any receiving water. Additionally, upstream natural water quality, if elevated above local baseline conditions, could also be accounted for by adjusting the criteria applied. RMG should aim to confirm the discharge criteria and their application with the environmental regulator (e.g. Ministry of Environment Protection and Natural Resources (MoE)) at the earliest opportunity.

Until these discharge criteria are agreed, and to allow an initial assessment, Golder has assumed that the water quality standards listed in Table 1 shall apply to the effluent forming the treated water output from each of the proposed plants. Preference is given to the Georgian and local water quality standards over WHO and EU.

We have assumed that all results for metals represent the dissolved form. RMG should confirm if this assumption is correct.

Table 1: Discharge Criteria

	Units	Technical Regulations†	Maximum Allowable Concentrations†	Maximum Permissible Norms from Nalco report†	Georgian Standard*	WHO Drinking Water Quality Standard
pH		6.5 – 8.5	6.5 – 8.5	6.5 – 8.5	6.5 – 8.5	
Petroleum hydrocarbons	mg/l	5.0			0.05	
Total nitrogen	mg/l					
Biological Oxygen Demand	mg/l	25			6.0	
Chemical Oxygen Demand	mg/l	125			15**	
Total Suspended Solids	mg/l	60	60	60	0.25**	
Chloride (Cl)	mg/l				300	
Fluoride (F)	mg/l				0.05	1.5
Carbonate (HCO ₃)	mg/l					
Phosphate (PO ₄)	mg/l					
Nickel (Ni)	mg/l	1	0.1	1	0.01	0.07
Zinc (Zn)	mg/l	4	1		0.01	
Potassium (K)	mg/l	2				
Iron (Fe)	mg/l	2	0.3	0.3	0.005	

	Units	Technical Regulations†	Maximum Allowable Concentrations†	Maximum Permissible Norms from Nalco report‡	Georgian Standard*	WHO Drinking Water Quality Standard
Copper (Cu)	mg/l	3	1	1	0.001	2
Sulphate (SO ₄)	mg/l			500		
Sodium (Na)	mg/l					
Ammonium (NH ₄)	mg/l				0.39	
Cadmium (Cd)	mg/l			0.001	0.005	0.003
Silica (SiO ₂)	mg/l					
Calcium (Ca)	mg/l					
Magnesium (Mg)	mg/l			0.1	0.1**	
Nitrate (NO ₃)	mg/l				40	50
Nitrite (NO ₂)	mg/l				0.08	3
Manganese (Mn)	mg/l		0.1	0.02	0.01	
Arsenic (As)	mg/l				0.05	0.01
Cyanide (CN)	mg/l				0.05	0.1^^
Chromium (Cr)	mg/l	0.1	0.1	0.1	0.001	0.05
Mercury (Hg)	mg/l					0.006

	Units	Technical Regulations†	Maximum Allowable Concentrations†	Maximum Permissible Norms from Nalco report‡	Georgian Standard*	WHO Drinking Water Quality Standard
Lead Pb	mg/l	1			0.1	0.01
Selenium (Se)	mg/l				0.0016	0.04
Total Phosphorus	mg/l	2				
Total Nitrogen	mg/l	15				
Detergents	mg/l	2				
Fats	mg/l	5				
Phenols	mg/l	0.1				
Formaldehyde	mg/l	0.05				

† Based on RMG information, source regulation not identified

* Regulation on the protection of Georgian surface waters from pollution. MoE order N147, 17/09/96 – water for fish

** from drinking water sanitary standard

^ Dependent on water hardness. Class 1 (<40 mg CaCO3/l) to Class 5 (>200 mg CaCO3/l) shown as range

^^ IFC guideline for free cyanide in effluent discharges (IFC, 2007. Environmental, Health and Safety Guidelines for Mining)

Water Quality of Influent

The surface water quality monitoring points nearest to the each of the proposed WTP locations are as follows:

- WRD III (Madneuli) - N10;
- WRD IV (Madneuli) - N11;
- Tailings Management Facility (Madneuli) - N6; and
- Central location at Sakdrisi - N18.

For the purposes of this assessment, Golder has assumed that these will be the most representative of influent water quality.

To identify potential contaminants of concern, the monthly quality data from the Gamma Consulting laboratory from February 2017 to May 2018 (for N10, N11 and N18) and the site laboratory data (for N6) was used. Site laboratory data has been used for N6 as currently N6 samples have been analysed for a smaller suite at the site laboratory and not submitted for analysis to Gamma Consulting laboratory.

The concentrations reported were summarised to average and maximum concentrations and compared to the available water quality standards listed in Table 2. To generate summary values from the dataset, results reported as less than detection limits were used as values of the limit halved.

All of the analytes reported by Gamma Consulting were selected to allow a full overview of water quality; where no local standard is identified, other water quality standards are used for comparison to give an indication of quality.

RMG to note that Golder has previously identified that the current sampling programme does not include key water quality analytes (Technical Memorandum August 2018 Water Quality Review), including total suspended solids, total dissolved solids, dissolved oxygen, aluminium, molybdenum, boron, total phosphorus, petroleum products, total nitrogen, detergents, fats, oils and greases, phenols, potassium, ammonia, formaldehyde. Nickel has also been identified as being required for water quality analysis.

Based on the information currently available, potential contaminants of concern are shown by highlighting and bold text in Table 2 (with highlighted summary values being over the criteria).

Accordingly, the parameters that Golder has identified to be the main focus for treatment are:

- WRD III & WRD IV (N10 and N11) (Madneuli) - Cu, Fe, Mn, SO₄, Zn, Cd, Mg, Se, and pH;
- Tailings Management Facility (Madneuli) (N6) - Fe, SO₄, Zn; and
- Central location at Sakdrisi (N18) – NO₂, Mn and Mg.

Further observation of the dataset indicates that several parameters at all, or some, of the locations do not warrant treatment; these are cyanide, lead, selenium, sulphate, nitrite and cadmium. These parameters are not included in the summary lists above.

The basis for this is due to single values for cyanide (CN) and sulphate (SO₄) (N18), lead (N10) exceeding the discharge criteria. In the case of Nitrite (NO₂) at N10 and N11, the exceedance is due to the maximum value being based on a non-detect result. In a similar way the exceedance for Cadmium (Cd) at N18 is based on average and maximum values from a series of non-detect data series. Selenium is also identified at N11 and N18 as having average and maximum values based on a series non-detection results.

There is limited information from N6, due to the results being from on-site laboratory analysis suite; fuller analysis may show that N6 requires similar treatment to the other locations.

Comparison of the total number of parameters identified for treatment between each of the sampling points suggests that water quality at N18 may not be as impacted as at other locations. This may indicate that this sampling point is representative of water flow through the Sakdrisi site with limited mine water input. RMG should confirm that this sampling point will be representative of potential mine water flows requiring treatment at the Sakdrisi mine location to allow the correct treatment processes to be identified.

Golder notes that the method detection limit for selenium (Se) is greater than the applicable water quality standards used as discharge criteria. RMG should discuss with Gamma Consulting if the method detection limit can be lowered so that the potential impacts from selenium (and need for treatment) can be better characterised.

The discharge criteria identified for magnesium (Mg) is very low and can be considered conservative. Based on experience it is unusual for specific limits to be set for this parameter, particularly at such a low level.

Table 2: Potential contaminants of concern

Parameter	Criteria (mg/l)	Type	N10		N11		N18		N6	
			Average (mg/l)	Maximum (mg/l)	Average (mg/l)	Maximum (mg/l)	Average (mg/l)	Maximum (mg/l)	Average (mg/l)	Maximum (mg/l)
As	0.05	Georgian Standard	0.0058	0.01	0.005	0.005	0.005	0.005		
Ca			583.3	800	600	800	78.4	146		
CN	0.05	Georgian Standard	0.02	0.02	0.02	0.02	0.027	0.1		
COD	125 (O ₂ mg/l)	Technical Regulations	21.03	64.8	28.53	58.24	6.45	7.5		
Cu	3	Technical Regulations	53.65	65	124.67	209	0.064	0.39	0.396	2.9
Fe	2	Technical Regulations	53.3	77.5	99.55	220	0.096	0.13	0.864	7.5
Mn	0.1	Maximum Allowable Concentrations	163.42	210	146.88	185	0.0957	0.33		
NO ₂	0.08	Georgian Standard	0.0333	0.1	0.0333	0.1	0.253	0.57		
NO ₃	40	Georgian Standard	7.96	33.2	5.13	24.4	6.56	11.1		
Pb	1	Technical Regulations	0.425	1.39	0.238	0.32	0.005	0.005		
pH	6.5-8.5 pH units	Georgian Standard		2.75-3.1 (min to max)		2.6-3.05 (min to max)		7.15-8.6 (min to max)		6.51-8.38 (min to max)
Se	0.0016	Georgian Standard	0.0125	0.014	0.005	0.005	0.005	0.005		

Parameter	Criteria (mg/l)	Type	N10		N11		N18		N6	
			Average (mg/l)	Maximum (mg/l)	Average (mg/l)	Maximum (mg/l)	Average (mg/l)	Maximum (mg/l)	Average (mg/l)	Maximum (mg/l)
SO ₄	500	Max Permissible Norms	11440	16000	12841.33	18800	138.6	505	1072.042	2020
Zn	4	Technical Regulations	489	670	331.83	490	0.0416	0.12	0.837	7
Cd	0.001	Max Permissible Norms	1.693	1.99	1.345	1.71	0.00179	0.005		
SiO ₂			76.22	118.8	76.87	97.59	24.13	42.2		
Mg	0.1	Max Permissible Norms	3410	4500	2910	5520	31.34	73.2		
Cr	0.1	Technical Regulations	0.025	0.1	0.025	0.1	0.0229	0.1		