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## **Water Management and Erosion Control Plan**

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# 1 Introduction

The *Water Management and Erosion Control Plan* is a comprehensive description of the measures Roşia Montană Gold Corporation (RMGC) will implement to satisfy the objectives of the Roşia Montană Project (referred to hereafter as the Project) as they relate to water management and erosion control activities. These objectives include minimising impacts to the environment at all stages of the Project while assuring adequate quantity and quality of water for proper operation over the life of the mine. The *Water Management and Erosion Control Plan* addresses the necessary elements of design, construction and operation of various facilities/structures/water constructional works provided in the Project for water management and erosion control purposes.

The Water Management portion of the *Water Management and Erosion Control Plan* describes the overall project water management strategy during operation, closure (including temporary cessation) and post-closure; how each physical facility is used for water management purposes; and provides plans and procedures to manage each function according to standard international Best Management Practices (BMPs) and applicable regulatory requirements.

The Erosion Control portion of the *Water Management and Erosion Control Plan* cites a series of standard operating procedures that may be selectively applied to specific mine planning issues. Monitoring activities identified in this plan will be managed as an element of the Project *Environmental and Social Monitoring Plan*.

## **2 Environmental and Social Management System Considerations**

As noted in Figure 2-1, Structural Relationship of Management Plans in Environmental and Social Management System, this plan is one of a suite of environmental or social management plans that have been developed to support the Environmental and Social Management System separately described in the current version of the Roşia Montană Project Environmental and Social Management Plan. Collectively, this management plan and its companion plans address key operational control needs where significant environmental or social impacts are either known to exist or are likely to occur in later phases of the mine life cycle.

The implementation of this management plan is also supported by a number of detailed, lower-tier standard operating and quality assurance procedures. These procedures are compiled in the Project Standard Operating Procedures Manual, itself controlled by the Roşia Montană Project Environmental and Social Management Plan.

The Water Management and Erosion Control Plan is subject to periodic review and update over the life of the mining operation, in response to internal and external reviewer comments, regulatory changes, changes in mining operations, stakeholder communications, internal audit and management review results, and other factors, as discussed in Sections 4.3 and 4.6 of the Roşia Montană Project Environmental and Social Management Plan. Compliance with the requirements of this plan will also be periodically evaluated in accordance with Section 5.4 of the Roşia Montană Project Environmental and Social Management Plan and procedure MP-13, "Internal Environmental and Social Management System Performance Verifications."

## 3 Water Management Plan

### 3.1 General Information

The purpose of this Section is to provide Plan users general background information regarding the major components of the water management system that will be developed and maintained over the life of the mine. Post-closure water management controls are summarised here and separately discussed in the Mine Rehabilitation and Closure Management Plan.

The information used to develop the initial iteration of the Water Management and Erosion Control Plan was primarily drawn from:

- the Mine Plan, Mine Capital and Operating Costs Roşia Montană Project (Mine Plan) developed by Independent Mining Consultants, Inc.
- the current version of the Project *Water Balance Report*<sup>i</sup> supplemented with subsequent technical memoranda concerning updates, or revised as appropriate;
- latest approved site development drawings; and
- the updated basic engineering design prepared by Ausenco<sup>ii</sup> and MWH in 2004 and 2005, respectively.

The mine site is located within a region that is subject to seasonal influences on precipitation and run-off with an overall positive water balance, i.e. higher average precipitation than average evapo-transpiration. Spring snow melt in particular gives rise to significant flow fluctuations. More significantly, the site is located within a region where mining has been carried out over some 2000 years, with a history of existing and past water contamination.

The minimum design requirements for the Project water management system are to:

- maintain an overall balance of water used and stored in the Project site throughout the life of the mine;
- ensure water quality according to operational, environmental and regulatory requirements;
- ensure the maintenance of adequate water supplies, whilst maintaining biological baseflows in the Corna and Rosia streams, avoiding derogation of water resources for other users, and minimising fresh water makeup demands;
- prevent contamination of existing surface and groundwater regimes; and
- mitigate existing/historical water contamination in areas affected by the Project.

An overall schematic of the Project water management system is provided in Figure 3.1, Water Management System Schematic. As indicated in the numbered locations on the figure, this system has been divided into the following main components:

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<sup>i</sup> MWH, 2005; Engineering Review Report, Appendix H

<sup>ii</sup> Ausenco, 2004, *Basic Engineering Review And Design Optimisation*

1. Cârnic waste drainage
2. Plant Site Stormwater and Spill Contingency Pond
3. Cetate Water Catchment Dam (incorporating Low Grade Ore Stockpile)
4. Wastewater Treatment Plant
5. Tailings Management Facility (TMF)
6. Contingency (secondary) cyanide treatment plant
7. Process plant water management considerations
8. Fresh water supply
9. Potable water system
10. Sewage Treatment
11. Process facilities and service complex

Descriptions of the management responsibilities, system components, and operational requirements for each of these main system components are provided in Section 3.3.

Table 3-1 summarises the water-related design criteria for the major dam structures that will be constructed for the Project., and Table 3-2 provides the precipitation values for the extreme events used in Table 3-1.

**Table 3-1. Principal water management component design criteria**

General				
Tailings throughput		13	Mt/yr	
		38000	tonnes/day (maximum)	
		35000	tonnes/day (average)	
Tailings densities	Pulp	48	% (nominal)	
		42	% (minimum)	
	In-situ (initial dry)	1.25	tonnes/m3	
	In-situ (final dry)	1.35	tonnes/m3	
Site meteorology				
	Average annual precipitation	722.8	mm	
	Average year evaporation	469.5	mm	
	Wet year precipitation	1190.7	mm	
	Dry year precipitation	496.1	mm	
	Low evaporation year	372.3	mm	
	High evaporation year	704.3	mm	
Dam flood criteria by	Class	Return Period (years)		Return Period (years)
Class of Importance		(Design Flood)		(Check-up Flood)
	I	1:1000		1:10,000
	II	1:100		1:1000
TMF catchment	Total area	6.9	km2	
Tailings Management Facility				

Coffer dam	Retention	1:10 24-hour event		
Starter Dam Design	Crest	84	m	
		739	m asl	
	Spillway	738	m asl	
	Volume required for tailings	11,217,600	m3	
	Volume required for decant pond	2,581,980	m3	95% of probabilistic
	Volume required for two winter PMPs	5,500,000	m3	
Main dam (Class I facility)	Crest elevation	185	m	
		840	m asl	
	Spillway elevation	839	m asl	
	Volume required for tailings	161,468,148	m3	@ 1,35 tonnes/m3
	Contingency volume	27,514,624	m3	@ 1,35 tonnes/m3
	Total storage to 837m	174,389,924	m3	
	Volume required for decant pond	7,421,775	m3	95% of probabilistic
	Volume required for two winter PMPs	5,500,000	m3	
Reclaim pond	Minimum volume	500,000	m3	
	Average volume	1,000,000	m3	
	Maximum volume	2,500,000	m3	
Diversion channel	Capacity	4	m3/s	
Secondary Containment Dam (SCD) - Class II facility	Catchment area	0.51	km2	
	Retention	1:100 24-hour event		
	Crest	11	m	
		646	m dM	
	Spillway elevation	645	m dM	
	Spillway capacity	1:1000 24-hour event		
	Operating water level	624	m (minim)	
		628	m (maxim)	
	Storage	43,000	m3	@ 645m (1:100 24-hour event) with 1m freeboard
Cetate Water Catchment Dam				
Class II facility	Catchment area	4.9	km2	Year 7 site development
	Retention	1:100 24-hour event		
	Crest	31	m	
		737	m dM	

	Spillway elevation	734	m dM	
	Spillway capacity	1:1000 24-hour event		
	Operating water level	710.0	m (nominal)	
	Storage	508,000	m <sup>3</sup>	for 1:100 24-hour event
Coffer dam	Retention	1:10 24-hour event		

Source – MWH design criteria memo 6 March 2006

**Table 3-2. Extreme event precipitation values (Drobot,2004)**

Return interval	Probability of exceedence in 17 years	Summer Rainfall	Winter Rainfall + Snowmelt
100	15.70%	112	122
500	3.30%	146	147
1,000	1.70%	161	158
10,000	0.20%	211	191
PMP		450	440

Climate change is likely to have an influence on the future water management of the project. Current prognoses for the period 2071-2100 (compared with a base period of 1961-1990) indicate the following principal projected changes for the region of Roşia Montană (ref: climate change appendix to EIA Chapter 4.1):

- Temperature increases of up to 6 degC with respect to annual mean and in winter
- Temperature increases of up to 9 degC in summer
- Winter rainfall increases of 10-30%
- Summer rainfall decreases of 20-60%
- Possible increases of maximum annual daily rainfall by up to 30% (with a corresponding increase in extreme 24-hour events)
- Reductions in snow fraction of precipitation by 10-40 percentage points

These are only indicative, and the full extent of any impact from climate change is only likely to be realised during the post-closure period of the Project. Nevertheless, all management activities in relation to water management must take account of the continuously evolving knowledge and experience of climate change, and critical design criteria may need to be modified accordingly.

Detailed water balance and hydrological studies have established that the Project waters can be safely managed over a full range of hydrological conditions that could occur over and after the mine life<sup>iii</sup>, including extreme events up to the Probable Maximum Precipitation (PMP). The proposed design features (i.e. water storage, full containment of large floods,

<sup>iii</sup> MWH 2005, op. cit, Appendices A and H.

diversion of unpolluted water, water treatment, controlled release of treated effluent and multiple water sources) are designed to provide safe operating capabilities throughout the life of the Project.

Assuming a design throughput of ore for the processing plant of 13 million tonnes/year, the process water demand will be about 1,500 cubic metres per hour (m<sup>3</sup>/hr) (approximately one cubic metre of water per tonne of ore). On average, about 80% of the process water demand will be met by recycling the water from the TMF, while the remaining 20% will be supplied from the fresh water supply system, the treated effluent from the Wastewater Treatment Plant, and the plant site stormwater and spill contingency pond. These multiple water sources are expected to provide a high operating flexibility for the plant, including periods in which extreme hydrological conditions are encountered.

Other project water demands are expected to be modest and include about 32 m<sup>3</sup>/hr (8.9 l/s) of fresh water for reagent mixing at the wastewater treatment plant potable water supplies for the construction camp and project operations, and additional fresh water that may be needed to provide environmental flows to the Roşia and Corna streams downstream of Project operations in extreme drought conditions. Discharge from the Wastewater Treatment Plant will also be used to augment environmental flows in the Roşia and Corna streams during drought conditions. The fresh water supply system has been designed for a peak flow of 350 m<sup>3</sup>/hr (97.2 l/s) (compared to the estimated 239 m<sup>3</sup>/hr (66.4 l/s) average demand) including non-process requirements and a contingency to cover adverse hydrological conditions.

### **3.2 Operational Criteria**

RMGC has established the following general water management objectives:

- to the extent practicable, divert clean run-off water away from areas where it may become contaminated by Project activities, to discharge points downstream of the Project;
- mitigate existing/historical water contamination in areas affected by the Project;
- protect structures, stockpiles, and active areas (e.g. plant yard, offices, or pits) from flood flows;
- intercept and store contaminated run-off for recycling within the mine process or for discharge into surface water receptors following treatment, in accordance with regulatory water quality standards (NTPA 001/2005);
- provide for storage of two Probable Maximum Flood (PMF) events in the TMF;
- monitoring and treatment of all waste waters discharges in the environment throughout the life of the Project;
- prevent contamination of groundwater and surface water;
- ensure water supply for mine operation throughout the life of the Project, whilst minimising fresh water resource uptake;

- maintain a biological base flow along the Corna and Roşia streams; and
- provide sustainable water management after the mine closure.

To meet these objectives, RMGC will construct appropriate engineered surface water diversion structures, catchment dams, pumpback systems, water treatment facilities, process water recycling systems, a fresh water supply system, and other water management systems or structures.

### **3.3 Overall Water Management Strategy**

#### **3.3.1 Introduction**

The overall water management strategy is presented to instruct Plan users regarding the general approach that will be taken to protect water resources at the site during construction, operations, closure and post-closure. The Roşia Valley and Corna Valley catchments were considered, along with operations during storm conditions and dry periods. Figure 3.2 shows the generalised distribution of water management facilities and elements.

Within the Corna Valley catchment, the TMF would be designed for storage of two PMF storms. If required, excess water in the TMF would be pumped through the treatment plant to achieve discharge standards for NTPA 001/2005. The Secondary Containment Dam (SCD) pond would be operated at a sufficiently low level to allow for natural dilution from storm water runoff to achieve NTPA 001/2005 standards for any water flowing over the spillway. Within the Rosia valley catchment, the Acid Rock Drainage (ARD) primary and secondary water treatment systems will be designed to achieve NTPA 001/2005 standards for normal operating conditions. The Cetate Water Catchment Dam pond will be operated at sufficiently low levels to allow for natural dilution from any storm water runoff to achieve NTPA 001/2005 standards or discharges will be made after treatment in the ARDWWTP.

The strategy meets all requirements for complying with NTPA 001/2005 discharge standards for normal operating conditions (NOC) and stormwater discharges.

The ARD treatment process will include optimisation of pH and lime addition within process to reduce calcium concentrations in the discharge, and an additional chemical precipitation step reduce sulphate, calcium and total dissolved solids concentrations (i.e., precipitation of ettringite  $[Ca_6Al_2(SO_4)_3(OH)_{12} \cdot 26H_2O]$  or similar process). The ARD treatment system will be designed to meet all NTPA 001/2002 standards. To ensure compliance with the NTPA 001/2002 standards, limited mixing with freshwater within the plant will be planned as a contingency measure in the event of variations in the water inflow chemistry.

In addition, a contingency treatment process for total cyanide will be developed and constructed to ensure that Process/TMF water can be discharged should a water balance correction be needed during the operational and closure periods.

#### **3.3.2 Construction Phase**

During the construction phase of the Project, Best Management Practices (BMPs) will be applied to manage water at each specific construction location. The primary objective of the BMPs will be to control erosion and sediment runoff as close to the source as possible. BMPs will consist of controlled and sequenced earthwork activities; placement of sediment retention structures such as silt fences, berms, sediment ponds, rip-rap drainage channels,

and check dams; and construction of sediment settling ponds to drop sediment before it enters a receiving stream. Specific BMPs are described in Section 4.0.

### **3.3.3 Operations Phase (Normal, Storm and Dry Conditions)**

#### **3.3.3.1 Introduction**

The project will impact the Roşia Valley and Corna Valley catchments, as discussed in the following sections.

#### **3.3.3.2 Roşia Montană Valley Watershed**

The Roşia Valley catchment will contain most of the mining operation. Figure 3.3 illustrates the primary components of the water management strategy during the operations phase.

##### **During normal operating conditions**

Water from undisturbed areas will be routed around the mining facilities and discharged to Roşia Stream. This will assist in maintaining biological base flows in Roşia Stream and reduce the water that has to be actively managed by the Project. As the mining expands in the Roşia Valley, the location of the diversion ditches will be adjusted so that flows from active mining areas are excluded.

All runoff water from the waste rock, open pits, low-grade ore stockpile, or the 714 Adit will be collected behind the Cetate Water Catchment dam and pumped to the Wastewater Treatment Plant. Water from the pond will be pumped to the wastewater treatment plant. The plant effluent will be used to supply much of the water required for the mineral processing. Alternatively, the effluent from the Wastewater Treatment Plant may be used to supplement flows in the Corna or Roşia Valleys. As mining expands, it may be necessary to expand the Wastewater Treatment Plant in about Year 7 of the project, because less water is then diverted around the mining areas.

In summary, the overall water management strategy for the Roşia Valley during normal operating conditions contains the follow components:

- An optimized lime and CO<sub>2</sub> – based ARD treatment plant (ARDWWTP) will assure the pH correction and metals precipitation (including calcium).
- The ARDWWTP will contain a secondary treatment to reduce concentrations of sulphate and total dissolved solids (TDS) to below NTPA 001/2005 requirements.
- All runoff water from the waste rock, open pits, low-grade ore stockpile, or the 714 Adit will be collected behind the Cetate Water Catchment dam and pumped to the Wastewater Treatment Plant.
- No cyanide-containing wastewater will normally be managed in the Rosia Basin. However, during or after extreme precipitation events the reclaim pond may need to be reduced in size. In this case, cyanide-containing water may be pumped to the treatment plant facilities Rosia Valley, treated using a contingency system to NPTA 001/2002standards and discharged.

- Discharge to the Rosia Stream will be in compliance with NPTA 001/2005. This discharge will be used to help maintain the project water balance and to supplement the compensation baseflow in Rosia Stream when needed.

### **During storm conditions**

Permits will also be required to allow for the discharge of excess storm water from the Cetate Water Catchment Dam. This impoundment will be used to collect ARD from the previously mentioned facilities in the Roşia Montană Valley. As a Class II dam under the Romanian regulations, the pond will have a designed capacity to retain a 1:100 year 24-hour event, above which a controlled discharge over a spillway will be allowed to protect the impoundment dam. The spillway structure on the dam will be constructed to carry a 1:1,000 year 24-hour event. Any such discharge would only occur during large storm events, which would have an inherent capacity to dilute the contents of the pond to a significant degree.

In summary, the overall water management strategy for the Roşia Valley during storm conditions comprises:

- Cetate pond levels will be operated at sufficiently low levels to allow storm water runoff to provide dilution to meet NPTA 001/2002 standards, except with the possible exception of pH. As a mitigation measure, the spillway and Cetate dam face will be constructed with limestone.
- The Wastewater Treatment Plant will continue to operate and to discharge water as during normal operating conditions. It is presumed that this plant will be operated at a maximum rate to reduce storm water storage in the water management system.
- The northern Rosia Valley will continue to operate during an extreme storm event, but spillways within the channel will direct a portion of the flow into the Cetate Water Catchment Pond and contribute to the storm event dilution of the pond.

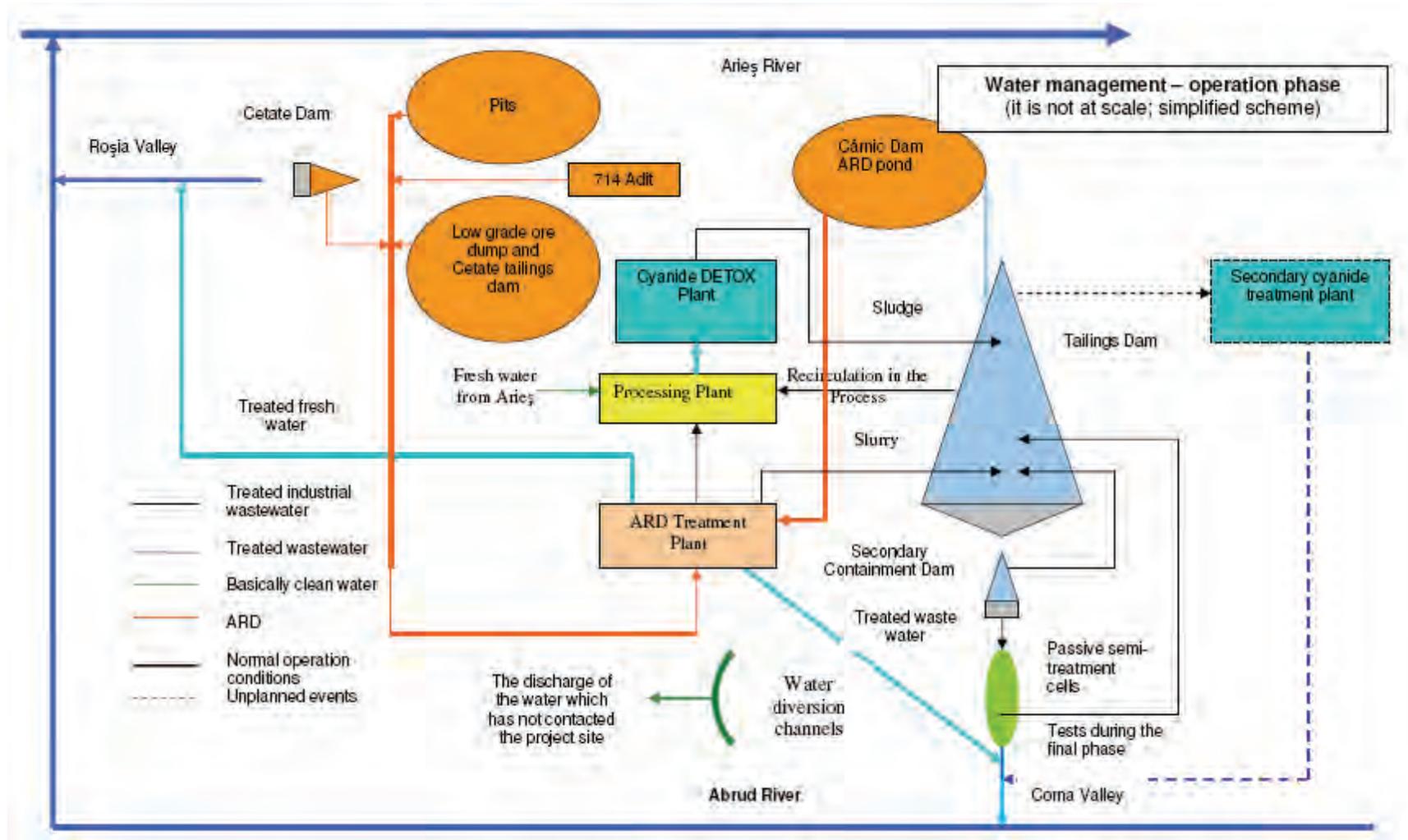
### **During dry weather**

During dry weather operation water from the diversion system may be used to supplement the flow to the processing plant. This water would be directed to the Cetate Water Catchment Dam impoundment. From there it will be pumped to the Wastewater Treatment Plant or directly to the processing plant if it is of suitable water quality. During dry weather operations, the flow from the diversion channel is unlikely to be sufficient to supply the compensation baseflow for the Roşia Stream, estimated at 20 l/s. Therefore, discharge from the Wastewater Treatment Plant may need to be discharged to the Roşia Valley for compensation requirements under dry conditions during operation.

### **3.3.3.3 Corna Valley Watershed**

#### **During normal operating conditions**

The general water management strategy during operations is presented in Figure 3.3 .



Similar to the strategy for the Roşia Valley, water from the non-mine areas will be diverted around the mine facilities. In the Corna Valley these facilities will largely consist of the Cîrnic Waste Rock area and the Tailings Management Facility. The flow from the diversion channel is unlikely to be sufficient to supply the compensation baseflow for the Corna Stream, estimated at 7 l/s. Therefore, freshwater from the freshwater supply system or discharge from the wastewater treatment plant will need to be discharged to the Corna Valley. for compensation requirements during operation.

During operation, the process water in the tailings decant pond, containing residual cyanide concentrations, will be recycled back to the processing plant for reuse.

Three potential sources of ARD are present in the Corna Valley. These include the Cîrnic Waste Rock Pile, the tailings in the TMF, and the waste rock used in the TMF dam construction. The waste rock stockpile will be constructed so that it is non-ARD producing and will routinely be allowed to flow into the TMF. However, as a contingency the Cîrnic waste rock seepage can be pumped to Wastewater Treatment. Because of the nature of TMF management operational practices, weathering of the TMF tailings will be limited and should not generate significant quantities of ARD. Saturated tailings will be pumped into the TMF at a rate that will limit the opportunity for oxidation. What little ARD that may be produced will be contained and recycled with the process water. The TMF dam will be constructed, to the extent practical, with waste rock with low or no ARD potential. If any ARD is generated it will be contained in the Secondary Containment System and recycled to the TMF, or discharged through a semi-passive treatment cell system, if testing indicates that established discharge requirements are met. This system will be constructed and trialed during the operational phase of the Project.

In summary, the overall water management strategy for the Corna Valley during normal operating conditions comprises:

- Seepage from the Tailings Management Facility (TMF) will be collected by the seepage collection system, which at its downstream point includes the Secondary Containment Dam (SCD) pond. This pond is actually a sump that will be used to depress the groundwater table and will act as a hydraulic sink.
- A line of three to five monitoring wells will be installed downstream of the SCD to confirm by monitoring that the TMF water is being contained by the seepage collection system. If TMF components are ever detected in the monitoring wells, groundwater recovery using wells will become a component of the seepage collection system.
- Seepage water collected in the SCD pond will be pumped back to the reclaim pond for recycling in the process.
- The process plant tailings discharge is expected to contain less than the regulatory maximum of 10 mg/L WAD cyanide in order to comply with Directive 2000/532/EC on mine waste. The natural degradation of cyanide will occur in the TMF, further reducing the cyanide concentration in the reclaim/decant pond and, to a lesser degree, the cyanide concentration in the pore spaces of the tailings mass.
- Runoff and seepage from the Cîrnic Waste Rock stockpile will be allowed to flow into the TMF if the water quality is not significantly impacted by ARD. If the water is

impacted by ARD, the seepage and runoff will be captured and pumped to the Wastewater Treatment Plant.

- Compensation flow requirements will be maintained using treated water from the Wastewater Treatment Plant that meets the NPTA 001/20021 standards, and/or water from the freshwater system, if needed.
- A contingency treatment system will be constructed during the operational period to treat any water containing low concentrations of cyanide, in order to meet the existing NPTA 001/2002 cyanide standards (0.1 mg/L total cyanide) during operational periods, even during extreme precipitation events. This system will be in place so that a surplus of cyanide-containing water in the water balance could be treated and discharged. Such a discharge would likely also have to be treated for sulphate and total dissolved solids (TDS) and would therefore need to be blended with the Roşia Wastewater Treatment Plant inflow.

A portion of the seepage water may also be used for pilot testing of a semi-passive seepage treatment system, and if the pilot system discharge meets permitted limits it could be discharged to the Corna Valley and become a permanent component of the water management system. If it does not meet permit requirements, it would be recycled back to the TMF during system development. This system will be an important component at closure and also for managing storm water accumulations in the TMF.

#### **During storm conditions**

During large storm events, the water falling in the TMF watershed will be retained in the decant pond. The TMF has the ability to store two successive Probable Maximum Flood (PMF) events. With the high amount of dilution associated with a large storm event, and the associated acceleration in cyanide degradation, water quality may quickly become acceptable for discharge with concentrations below NPTA 001/2002 permit limits. The option then exists to discharge this water to maintain the planned TMF storage capacity. However, if concentrations remain above permit limits, then the excess water will be treated in the contingency cyanide treatment system as during normal operation conditions described above, and/or pumped to the Wastewater Treatment Plant in the Roşia Valley (for sulphate and TDS removal).

The TMF main dam is a Class I facility (see Table 3-1) and as such has minimum design criteria of 1:1000 year 24-hour event retention (Design Flood) coupled with 1:10,000 year 24-hour event spillway capacity (Check-up Flood).

The Secondary Containment Dam is a Class II facility and is designed to retain a 1:100 year 24-hour event. Its spillway will pass a 1:1000 year 24-hour event. During a storm event exceeding the 1:100 year 24-hour event there will be sufficient dilution in the SCD Pond for cyanide and other TMF seepage constituents to allow a spillway discharge to the Corna Stream whilst meeting the NPTA 001/2002 standards. This calculation has been done using a conservative assumption that the seepage will resemble the TMF decant pond quality. In the actual condition, hydrochemical attenuation of the seepage is likely to result in lower concentrations of the important TMF constituents in the SCD pond.

The Cârnic waste rock stockpile collection pond would discharge to the TMF and will be designed to retain the 1:25 24-hour storm event.

In summary, the overall water management strategy for the Corna Valley during storm conditions comprises:

- The SCD pond/sump will be operated at low levels, below the natural water table, due to the necessity of maintaining a hydraulic sink.
- During a storm event there will be sufficient dilution in the SCD Pond for cyanide and other TMF constituents to allow a spillway discharge to Corna Creek and while meeting the NPTA 001/2002 standards.
- The TMF dam will provide containment of runoff from the entire drainage basin for two Probable Maximum Floods (PMFs) (2.75M m<sup>3</sup>).
- If the storage and dilution capacity is exceeded, water will be treated before discharge in the contingency cyanide treatment plant.
- Unimpacted runoff from the Cârnic waste rock stockpile will be allowed to flow into the TMF. If impacted by ARD, the runoff will be pumped to and treated at the ARD plant. If the Cârnic storm water exceeds the capacity of the collection pond or ditches, it will flow into the TMF. This flow is accounted for in the PMF calculation.

### **During dry weather**

Water management for the TMF during periods of prolonged dry conditions will consist of diverting storm water into the TMF reclaim pond and pumping back all seepage into the TMF pond. During these periods, the fresh water supply from the Arieş River system would be accessed to maintain the compensation or biological base flow in the Corna Valley.

## **3.3.4 Temporary Cessation, Closure and Post-closure Phases**

### **3.3.4.1 Introduction**

Temporary cessation occurs during the operational period when active mining stops for reasons such as economic conditions or instruction from regulators. The operations will restart when viable conditions have been reestablished. Formal closure starts when a facility is no longer used for its original purpose and ends when it has either been removed, rehabilitated and transferred to a future use (such as waste rock stockpiles), or has reached its final physical state (such as the flooded pit). Some facilities may have a post-closure period, which is characterised by continuous activities such as water treatment or maintenance, even if the physical state of the object is stable.

The requirement to manage water will be reduced after mining and processing operations have ended. In closure, both process water and domestic wastewater flows will be eliminated. ARD wastewater flows will also be reduced due to removal of the low-grade ore stockpile, which will be processed, and closure of other potentially ARD generating facilities. The waste rock facilities and TMF dam face will be managed during the operation phase so that ARD generation is mitigated, but elevated sulphate concentrations may still occur. It is conservatively considered that some ARD generation is possible, and that some residual flow containing ARD or elevated sulphate may continue to seep from these facilities for several years as source controls become fully effective. In addition, portions of the mine pit walls and remaining underground mine workings have the potential to be ARD generating.

Overall, with the implementation of the closure source controls (e.g. covering of potential ARD generating materials with soil), any remaining ARD generation at the site is expected to be much diminished compared to current conditions (since the current conditions originate from more numerous and smaller diffuse sources, most of which will be removed by the Project). In addition, as source controls become fully effective, the ARD management area will soon be reduced to the mine pit hydrologic system. Any remaining ARD will be managed to ensure that it does not impact downstream surface water and groundwater

quality. ARD management will largely occur in the lake that will form in the Cetate mine pit during closure. The formation of this pit lake, its management and the anticipated treatment strategy are summarised in the following sub-sections.

An additional water quality concern in closure may be the long-term seepage from the tailings contained in the TMF. To a certain extent, this water quality will likely continue to reflect the chemical composition of the process water for many years after closure. The seepage flow rate will gradually decrease as the tailings consolidate and drain down, but depending on the final site-specific discharge requirements, some level of treatment may be needed for a number of years. In addition, concentrations of nitrogen compounds (e.g. nitrate, nitrite, ammonia) from cyanide degradation, and some metals may potentially be an issue, and will have to be evaluated against the consented discharge permit. Discharge of this seepage will be facilitated through the contingency cyanide treatment system and the ARD treatment system in the Roşia Valley or a tested and permitted semi-passive treatment system downstream of the TMF.

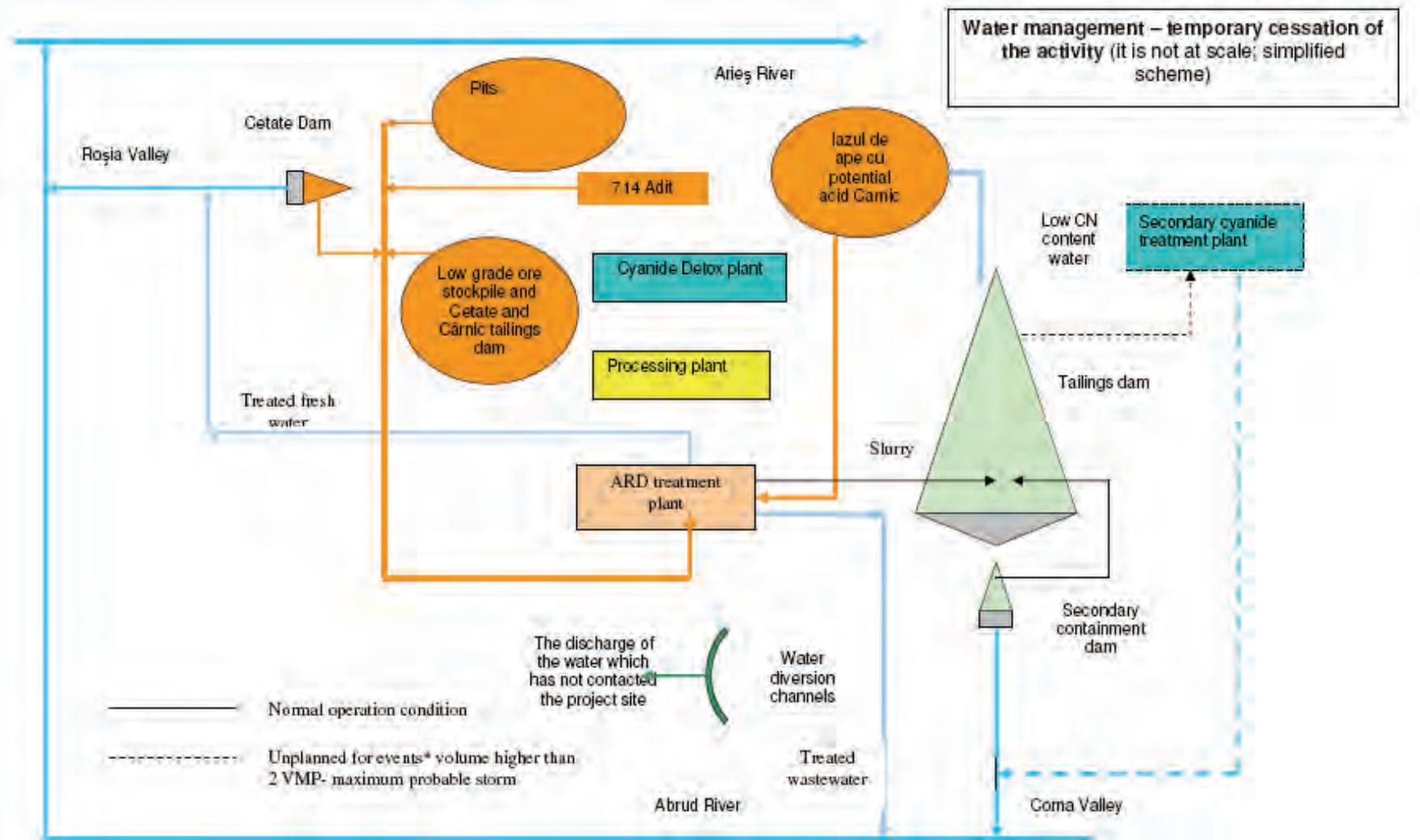
In summary, as a result of the residual ARD flows and TMF seepage, water will need to be managed in both the Roşia and Corna Valley catchments at closure. The primary strategy will continue to be to route clean water around the Project area and to collect and treat water impacted by the Project, as needed. At closure, the majority of the ARD sources that are currently impacting the Roşia and Corna Valleys will have been removed, and the management strategy will be largely focused on the features constructed or impacted as part of the Project. The advantage of this is that the Project facilities have known conditions and discrete boundaries or footprints, which will simplify the development of any necessary water management and treatment schemes. An important component of this strategy for all facilities is the source control that results from the closure activities. For example, the soil covering that will be placed on the TMF will reduce water contact with the tailings contained in this facility, and thereby reduce the potential for the formation and transport of any ARD, especially during the 'first flush' runoff. This will be especially effective in the case of runoff. However, such source controls are unlikely to be immediately effective in mitigating ARD or sulphate-impacted seepage from these facilities, if present. Therefore, some post-closure water management needs are assumed to exist in both the Roşia and Corna Valleys. The water management strategy at closure for both drainage basins is presented below.

#### **3.3.4.2 Roşia Valley Water Management Strategy**

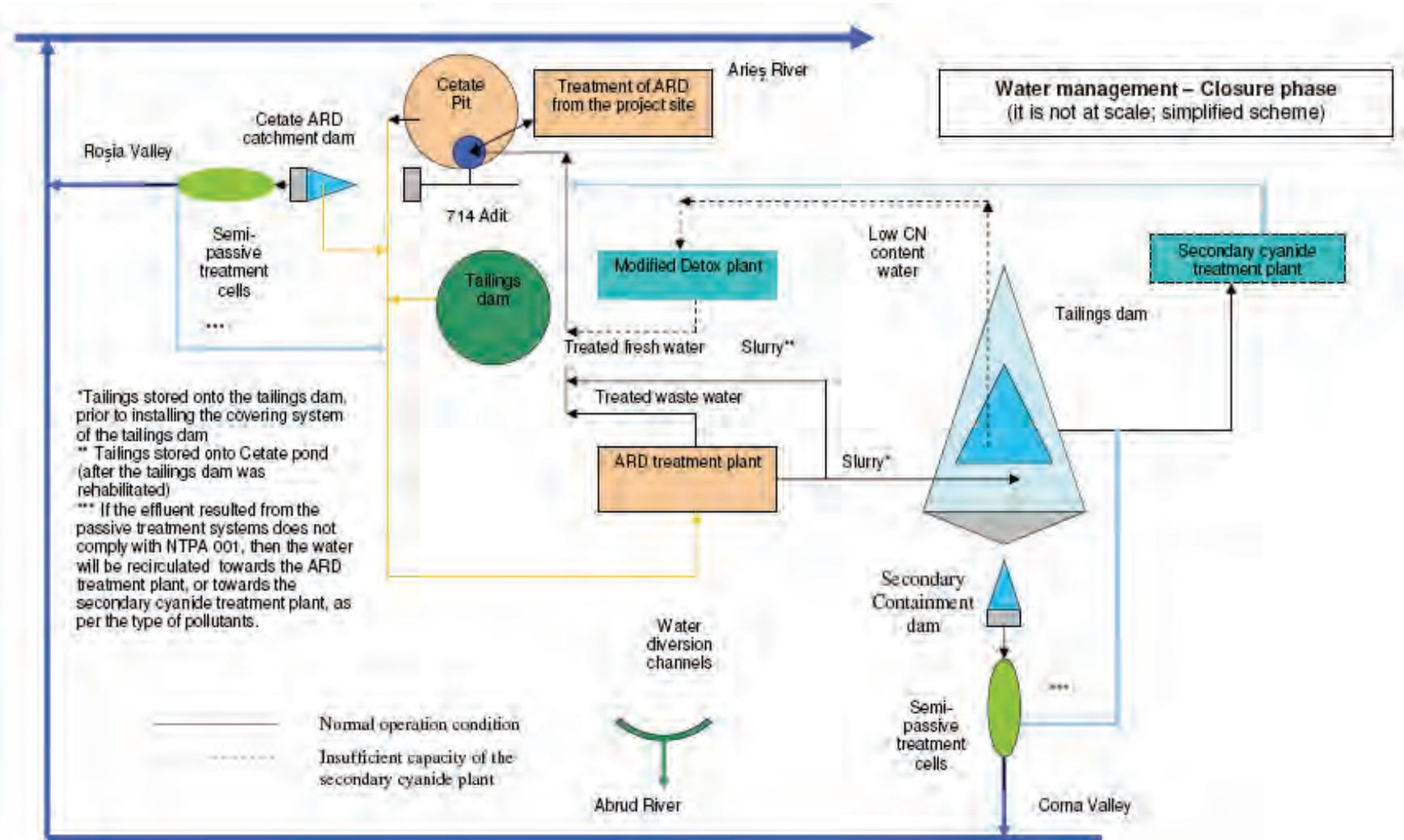
In temporary cessation, the water management strategy is summarised in Figure 3.4. This is effectively the same as the normal operating condition/storm condition. However, depending upon the stage of the Project additional water storage capacity may be available in the mine pits. This may allow for some additional flexibility in water management.

The components of the water management strategy at closure are illustrated in Figure 3.5. Diversion of water around the mined area will continue in permanent diversion channels. The low-grade ore will be processed near the end of the operational phase, and the area of the low-grade stockpile will be revegetated. Therefore, runoff water from this area will not be collected. However, residual ARD or sulphate-impact water may still seep from the Cetate waste rock stockpile and form in the mine pits with the remaining interconnected underground mine workings (the pit lake system). The flow of residual ARD from the Cetate waste rock stockpile will be reduced by the closure soil cover, and the residual seepage will be routed to the pit lake system through collection in the Cetate Water Catchment dam and pumping. The primary means of treatment will be in the Pit Lake System using an ARD treatment plant to dose water in the Pit Lake System with lime (see Mine Rehabilitation and Closure Management Plan).

In temporary cessation, the water management strategy is summarised in Figure 3.4



The components of the water management strategy at closure are illustrated in Figure 3.5



Most water formally collected in the Cetate Water Catchment Pond will be routed to the pit lake treatment system, and the Cetate Water Catchment Dam and Pond may be decommissioned once seepage from the Cetate Waste Rock Stockpile meets discharge standards or is manageable through passive/semi-passive treatment or pumping to the mine pit lake system. However, the Cetate Water Catchment Pond may also collect seepage from the pit lake system when the lake level exceeds the 714 Adit level, and its maintenance for this use may continue to be required.

The method of treatment in the pit lake system will be selected based on the quality characteristics of the water in the pit lakes. The goal will be to treat the water in the mine pits to a quality that is suitable for discharge through a low maintenance, semi-passive treatment system for final polishing (quality improvement). An active ARD treatment system (.e. the Wastewater Treatment Plant) will be used during the early stages of treatment to help manage pit lake water quality and provide a means of discharge, if needed. The Wastewater Treatment Plant may be modified and relocated to a location closer to the pit lake system if engineering evaluations indicate that such relocation would be beneficial. The water from either treatment system will mix with other site water and be discharged. The long-term goal will be to improve water quality in the Pit Lake System so that a direct, untreated discharge can occur. Additional detail on this concept is presented in the Mine Rehabilitation and Closure Management Plan.

A treated water discharge will periodically be needed to maintain the compensation flow in the Roşia Valley, similar to the operational period. This will be required because the pit lake system will form a hydraulic sink as the pit lake system is filling with water. Once hydrological and hydrogeological conditions in the pit area equilibrate, this discharge would not be needed assuming water quality is suitable for discharge.

Mine pit water quality data collected during the operation and early closure phases of the Project will help define the water quality issues in closure and possible treatment needs. It is considered likely that at least some level of semi-passive treatment would be needed to facilitate a discharge from the pit lake system. However, it is also likely that because of ARD generation on the pit walls and in the remaining underground mine workings, a higher level of treatment will be needed for a period of time. In this case, in-pit and on-shore water treatment will begin soon after closure.

A lake will form in the Cetate mine pit at closure, and because of the positive site water balance, the pit lake/groundwater system is anticipated to overtop the level of the Orlea pit rim if not managed or unless the groundwater outflow exceeds the excess inflow. The flooding of the pit lake system will occur up to the level of the 714 Adit if a bulkhead were not placed in the adit or if the water level is not managed below the adit level. Because the 714 Adit will be bulkheaded, overflow would occur at an elevation of approximately 745 metres above sea level as seepage from the rim of the backfilled Orlea pit. A valving system in the bulkhead will allow for a controlled discharge from the pit lake system to the external semi-passive treatment system.

An important component of the pit lake management scheme will be accelerated flooding of the pit lake. This flooding will help reduce potential ARD generation by submerging potentially ARD generating rock exposed on the side-walls of the pit and contained in pit backfill. In addition, the accelerated flooding of the pits will help ensure the continuity of closure operations so that a prolonged period does not occur between site closure and the need to treat mine pit water. The flooding of the pit lake will be accelerated by pumping the TMF decant water to the pits at closure. This offers an additional benefit by facilitating closure of the tailings surface sooner than may otherwise be possible. Residual cyanide concentrations will be treated in the contingency cyanide treatment system to below TN001 standards if not already degraded by the time this water is used for the flooding of the pits.

Cyanide concentrations in the TMF decant water at closure are discussed in Section 4.1 of the EIA.

A pit water balance model has been used to estimate the rate of pit lake formation in the Cetate pit once mining ends and dewatering is discontinued. The details of this model are described in the Pit Lake Closure Hydrology and Chemistry Report, which is attached to the Mine Rehabilitation and Closure Management Plan.

Pit lake filling is affected by the amount of pit wall runoff that must be captured by the pit lake system and the volume used for TMF decant water. Filling of the pit lake system is expected to be rapid, which is ideal for reducing ARD generation from the pit walls. However, this also means that pit lake water will have to be managed (treated) shortly after closure. The addition of the TMF water will increase the level above the 714 adit, at which point seepage is expected to begin. This seepage will be collected by the 714 adit, downstream of the bulkhead, and be directed to the Cetate Water Catchment Pond.

Without the addition of the TMF water, filling to the 715 m level would occur in approximately 6 years, and to 740 m level in 18 years assuming a modest amount of seepage loss as the pit lake approaches the 740 m level (5 L/sec). With a seepage loss of 21 L/sec the pit lake system would not obtain the 740 m level within 100 years, and appears to equilibrate at approximately the 739 m level.

Due to a relatively small volume of storage in the lower portion of the pit system, and the addition of TMF water to the pit lake system, filling to the 714 Adit level is relatively rapid and is estimated to occur with the addition of TMF water four years after mining ends. The addition of the TMF water raises the pit lake level to approximately 737 m. Filling to the spillover point of 740 masl is estimated to occur in approximately 7 years with a net seepage rate of 5 L/sec at the maximum pit level.

It is presumed that the 714 Adit will be bulkhead midway between the portal and its intersection with the mine pits. The downstream end of the adit will function as a vertical dewatering tunnel and collect this seepage and direct it to the mine water collection system (.e., the Cetate Water Catchment Pond). However, it may be necessary to draw water from the 714 Adit, or by pumping the Cetate pit lake, to maintain a lower lake level and manage the seepage as long as pit lake water quality requires management. Based on the modelling, such management would be required in approximately four years after dewatering ends, or one year after the end of operations.

The exact composition of the pit lake water cannot be known at this stage; it strongly depends on the ratio between sulphidic and neutralizing minerals in the pit walls, and it is likely that the pit water will need treatment when flooded.

The water in the pit lake can be neutralized with suitable methods such as liming. This method will generate sustainable improvements in water quality if the sulphidic parts of the pit walls are sealed.

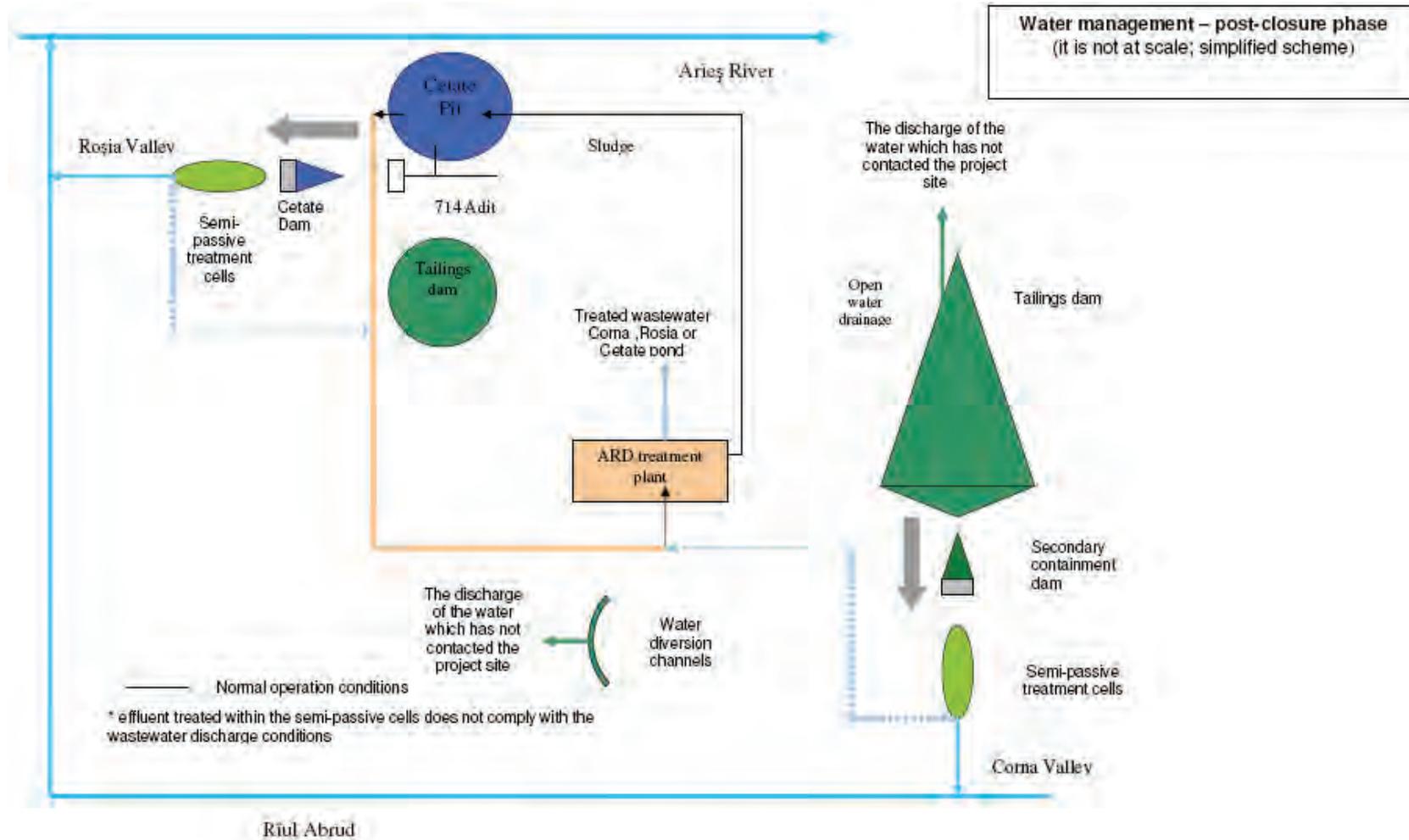
A more detailed prediction of the pit lake quality will be possible only during the operations phase, when more statistically relevant mineralogical samples become available. This Mine Closure and Rehabilitation Management Plan and other Management Plans within the Project's ESMP will be continuously updated accordingly.

In summary, the overall water management strategy for the Roşia Valley during closure conditions comprises:

- It is expected that the pit lake system will collect ARD from pit walls.

- Water will be allowed to accumulate in the Cetate pit lake. This accumulation will be accelerated by pumping from the TMF decant pond. If  $\text{CN}_i^-$  concentration will exceed 0,1 mg/l, water will be treated in the cyanide contingency treatment system. In-pit water treatment will be conducted if needed and functional. All ARD water will be directed to the pit lake system or directly to the Wastewater Treatment Plant.
- The Cetate Water Catchment Dam will be operated at sufficiently low levels to allow storm water runoff to provide dilution to meet TN001 standards, except pH. The slight pH exceedances will be mitigated by construction of the spillway and Cetate dam face with limestone.
- While the pit lake system is filling, the requirement to discharge treated water will be reduced to that needed to provide the Roşia compensation flow.
- If the pit lake system reaches an optimal operating level during the closure period, a discharge through the Wastewater Treatment Plant will likely be needed. This will then operate and discharge in a similar manner to that under normal operating conditions.

The components of the water management strategy in the Roşia Valley during post-closure are illustrated in Figure 3.6.



In the post-closure phase, .e., when the Cetate pit water has reached its final flooding level, water which is captured behind the Cetate Water Catchment Dam will be treated as necessary to meet the discharge consent standards before being discharged into the Roşia valley or will be pumped back to the pit lake.

The period of time over which treatment of the Cetate Water Catchment Dam water will be necessary can be estimated only after more is known on the final flooding level of the Cetate pit. The more permeable the pit walls towards the Roşia valley are with respect to the underground mine workings and geological faults, the lower the flooding level in the pits will be and hence some mine workings which are ARD generating will never be submerged. Oxidation will continue so that the need to treat water may extend far into the future, depending on discharge consent details.

In summary, the overall water management strategy for the Roşia Valley during post-closure conditions comprises:

- The Cetate Water Catchment pond will be present to collect seepage from the Cetate pit lake system and seepage from the Cetate waste rock stockpile. This water will be pumped back to the Cetate pit lake system or treated in the Wastewater Treatment Plant and discharged to Roşia Stream.
- The 714 Adit downstream of the bulkhead will act to intercept pit lake seepage and direct it to the Cetate Water Catchment pond.
- The Cetate Water Catchment Dam will be operated at sufficiently low levels to allow storm water runoff to provide dilution to meet TN001 standards, except pH. The slight pH exceedances will be mitigated by construction of the spillway and Cetate dam face with limestone.
- The Wastewater Treatment Plant will continue to operate and to discharge water as during normal operating conditions. The plant will be used to help treat the pit lake water in-situ, and when needed, provide a means to discharge pit lake water to Roşia Stream while meeting discharge standards.
- In pit treatment will be evaluated and implemented to improve pit lake water in-situ. This will include the liming from the ARD plant but may also include biological treatments.
- Semi passive biological treatment cells can replace the active Wastewater Treatment Plant once water quality has sufficiently improved in the Cetate pit lake system.

#### **3.3.4.3 Corna Valley Water Management**

In summary, the overall water management strategy for the Corna Valley during temporary cessation comprises:

- Recycling of water from the reclaim pond will stop. The reclaim pond will then grow due to a positive water balance. However, due to a large reserve storage capacity, there will be excess capacity in the reclaim pond above that required for extreme storm events. The amount of excess capacity will depend upon the stage of the Project and required storm capacity storage.
- Once the excess capacity is filled in the pond, water would have to be treated and discharged through the contingency cyanide treatment system.
- Seepage collected in the SCD pond will continue to be pumped to the reclaim pond.
- The contingency cyanide treatment capacity and ARD treatment will be available to correct the water balance, if needed.

- Seepage and runoff from the Cârnic waste rock stockpile will be allowed to flow to the TMF unless the water quality would impact restart of the process. In this case, the runoff and seepage would be pumped to the ARD treatment plant.

As there is sufficient capacity in the TMF there is no concern about water management in the Corna valley during a period of temporary cessation. There is sufficient time to decide to implement final closure, resume operations, or implement contingency CN water treatment to address the possibly elevated CN content in the seepage and/or the reclaim pond water. The above is illustrated in Figure 3.4.

The water management strategy for closure is illustrated in Figure 3.5.

An initial component of this closure strategy will be to pump the decant pond water to the Cetate mine pit. This will assist in the closure of the Tailings Management Facility, as well as achieving accelerated filling of the Cetate mine pit lake system.

Seepage will continue to be derived from the TMF tailings, TMF dam, and the Cârnic waste rock stockpile in the Corna Valley, although the long-term seepage rates will be significantly reduced by closure source control measures.

No water will be pumped from the TMF to the Cetate mine pit lake unless it has a residual total cyanide concentration less than 0.1 mg/l. If not achieved by natural degradation, the contingency cyanide treatment system will be utilised for this purpose. However, depending upon seepage water quality and discharge quality requirements, it may be possible to implement a semi-passive form of biological treatment downstream of the TMF in the Corna Valley. This type of system will be evaluated and tested during the operational period.

Water discharged through the Corna Valley in during closure will include the water from the undisturbed catchment, and the water running of the cover placed on the TMF impoundment and dam. If seepage is treated in the Corna Valley, it may also be discharged to the Corna Stream; however, the primary route for this water will be through treatment systems in the Rosia Valley.

Two options will be available for treatment of residual Cârnic waste rock stockpile seepage. The water may be channel and pumped to the pit lake system or directed to the TMF seepage treatment system. The management of this water will be dependent upon the water quality observed during the final operation stages of the Project.

In summary, the overall water management strategy for the Corna Valley during closure comprises:

- Immediately after processing ends, the cyanide concentrations in the reclaim pond will drop due to natural degradation. Once levels are reduced to below 0.1 mg/l total cyanide, the water can be pumped to the pits to facilitate pit lake formation. If it will be necessary to be pumped before reaching 0,1 mg CN<sub>T</sub>/l, water will be treated in the contingency cyanide treatment system. However, this needs to be balanced by the need to maintain storm water capacity in the TMF.
- After the end of processing, the TMF pond volume will increase due to a positive water balance. If a reduction in water volume is needed, early discharge of a portion of the water to the pit lake system can be made through the contingency cyanide treatment system.
- Seepage water in the SCD pond will continue to be pumped to the decant pond as long as it is present. Once the TMF decant pond is removed the seepage water will be pumped to the mine pits. If necessary, the water will be treated prior to discharge

to the pits. Alternatively, it may be treated in a series of treatment cells below the SCD, to be constructed and trialed during the operational phase of the Project, and discharged to Corna Stream (subject to meeting discharge consents).

- Seepage from the Cârnic waste rock stockpile will be pumped to the pit lake system if impacted by ARD where it will be treated in-situ or through the Wastewater Treatment Plant. Otherwise, the water will be allowed to discharge to the Corna Basin.

The water management strategy for post-closure is illustrated in Figure 3.6

During post-closure, as the result of covering the deposited tailings and TMF dam with soil cover, the runoff from these facilities could be allowed to discharge directly to Corna Valley. The diversion ditches will also continue to discharge to the Corna Valley. These measures will eliminate the need for supplementing flow in the Corna Valley to maintain compensation flow.

The semi-passive treatment cells, which have served for testing purposes, will be finalized in order to have a long-term solution in place. Most likely the footprint of the lagoons can be diminished due to the cover placed on the tailings, which will eventually reduce the seepage rate. If the semi-passive treatment system is not capable of achieving the permitted discharge standards, the water can be pumped back to the Wastewater Treatment Plant and then discharged to the environment. If required, the additional residual cyanide removal stage can be kept operating in order to meet the 0.1 mg/l limit for CN.

In summary, the overall water management strategy for the Corna Valley during post-closure comprises:

- The reclaim pond will no longer be present during the post-closure period.
- Surface water runoff from the basin will be routed around or off the TMF and discharged into Corna Stream below the SCD.
- Similar to other periods, the dilution would be sufficient to reduce concentrations of TMF constituents to below discharge standards if a storm water discharge were to occur from the SCD.
- Seepage water in the SCD pond will be pumped to the pits. If necessary, the water will be treated prior to discharge to the pits. Alternatively, it may be treated in a series of semi-passive treatment cells below the SCD and discharged to Corna Creek.
- The Cârnic waste rock stockpile will have been covered and runoff will be directed to Corna Stream. Stockpile seepage will be greatly reduced. If present in a quantity and quality that requires additional management, this water will be pumped to the mine pits.

### **3.4 Water Management Physical Site Components**

#### **3.4.1 Mine Site Drainage**

Three main valleys control the mine site drainage: the Corna, the Roşia, and the Salistei Valleys (see Figure 3.7, Drainage Basins). The projected disturbed areas within the mine footprint are located in these valleys. An east-west ridge separates the Roşia from the Corna and Salistei Valleys; a west-northeast ridge separates the Salistei and the Corna

Valleys; and a ridge that runs along the east side of the mine site constitutes the limit of the Corna Valley basin. Mine facilities are concentrated in the Roşia and Corna Valleys.

In order to meet water management objectives, a series of channels and dams will be established along the Roşia and Corna Valleys. The following paragraphs discuss the major mine facilities and how drainage from these facilities will be controlled, as well as describe the surface water diversion channels that will be placed to prevent or minimise the potential contamination of clean run-off water.

### **3.4.2 Cârnic, Cetate, Orlea, and Jig Pits**

The mine plan provides for the development of four open pits: Cârnic, Cetate, Orlea, and Jig. These pits are located along the north end of the mine property, within the Roşia Valley. During operation, these pits will perform as catchment basins for direct precipitation and groundwater seepage. The water levels in these pits will be maintained at a low level to allow mine equipment operation. Consequently, the pits will perform as sinks for groundwater in their vicinity. Dewatering will occur during the early stages of mining due to drainage to the existing underground mine workings. Low water levels in the pits will be maintained in later stages by pumping the pit water into the Roşia Valley where it will be collected in the Cetate Water Catchment Dam. The Roşia site water balance will be regularly reviewed and if necessary updated, including completion of a pit dewatering study that will be performed to evaluate pit dewatering below 720 metres elevation.

### **3.4.3 Cârnic waste rock pile**

The Cârnic waste rock stockpile will be located on the east side of the mine site, immediately west of the ridge that constitutes the limit for the northeast boundary of the Corna drainage basin. basins.

Surface water and seepage will flow into the Corna Valley where it will be controlled by the Cârnic waste drainage holding pond and/or the TMF.

The plan is to manage the waste rock placement in the Cârnic waste rock stockpile so that ARD effluent is not generated. The runoff and seepage will be allowed to flow directly to the TMF if the water quality does not affect the plant processes. However, if ARD or other constituents are present that would affect the mineral processing, the Cârnic water collection system will be constructed and used. Regardless of how the water is managed, it will be retained within the Project water management systems and not discharged to the environment.

The Cârnic water collection system will consist of channels and a holding pond. The Cârnic waste drainage holding pond will collect direct precipitation, seepage and surface water drainage from the Cârnic waste rock stockpile. The Cârnic waste rock stockpile and pond will be located on the Corna drainage, upstream of the TMF. Excess water from the holding pond will be pumped to the Wastewater Treatment Plant. Excess water collected in this pond due to extreme rainfall events will be allowed to discharge over an emergency spillway into the upstream end of the TMF. The facility will have a design criterion of 1:25 year 24-hour flood retention, although in practice it will accommodate a 1:50 year event. Overspill is considered to have limited impacts on the storage capacity of the reclaim pond or on the chemical characteristics of the reclaim pond water quality. Runoff collection channels will be located on each side of the Cârnic waste rock stockpile to divert runoff into the collection system for further treatment.

### **3.4.4 Cetate waste rock pile**

The Cetate waste rock stockpile and Low grade ore stockpile will be located on the northwest area of the mine site, in the Roşia Valley, immediately west of the Cetate pit. Surface water and seepage will flow to the Cetate Water Catchment Dam, from where it will be pumped to the wastewater treatment plant.

### **3.4.5 Plant Site**

After construction site grading, the plant will be located in the Roşia watershed. Surface water and spills from the plant site will be diverted and collected in the Storm Water and Spill Contingency Pond located to the north, downgradient of the plant in the Roşia Valley. Water collected in the pond will be pumped to the plant and used as process water. Surplus water from floods that exceed the plant storm water pond capacity (flood higher than the 1:25 year 24-hour design flood) will drain into the Cetate Water Catchment Dam.

### **3.4.6 Historic Acid Rock Drainage and 714 Adit**

The ore bodies in the Roşia Montană area have been mined since pre-Roman times, both from the surface and underground, and small mining operations in the Roşia Valley are currently ongoing. Minvest S.A., the formerly Romanian state-owned mining company, is responsible for previous mining operations near the Project site. Underground mining by Minvest ceased in 1985 and further production at Roşia Montană has taken place from the Cetate open pit. Recent mining practices, in combination with the historical mining operations in the area, have resulted in surface and underground acid rock drainage (ARD).

The disturbance from these historic operations is evident in a number of locations along the Roşia Valley. In addition to the surface disturbance, the 714 Adit is known to collect and discharge acidic seepage from historic underground mine workings. Prior to the Project, monthly average flows from the 714 Adit varied from 18 to about 63 m<sup>3</sup>/hr (5 – 17.5 l/s) with reported average flow of about 51 m<sup>3</sup>/hr (14.2 l/s). Surface water from historic and present mine operations, and waters discharged from the 714 Adit, will be collected in the Cetate Water Catchment Dam, from where it will be pumped to the Wastewater Treatment Plant.

### **3.4.7 Tailings Management Facility**

The TMF is a major component of the water management system described within this Plan. Additional details are provided in the Tailings Facility Management Plan. The TMF will be located in the Corna Valley, on the southeast side of the Project area and immediately west of the ridge that constitutes the limit of the Corna Valley basin (see Figure 3.7). The TMF catchment, including the Cărnic waste rock stockpile, will occupy approximately 6.9 km<sup>2</sup> and is composed of four main land-use components: tailings pond, tailings beach, Cărnic Waste Rock Stockpile and undisturbed land. A part of the surface runoff from the area northwest of the tailings pond will be diverted, with only seepage from the diversion channels reporting to the tailings pond. Surface water and seepage in the areas upstream of the TMF will be collected in the tailings impoundment, with the exception of the waters collected in the Cărnic Waste Drainage Collection Pond, which will be pumped to the Wastewater Treatment Plant, if required.

The operation of the Roşia Montană mine will generate tailings at a rate of approximately 13 million tonnes per year for a period of 16 years, producing a total of approximately 214.905 million tonnes. Tailings will be treated to reduce the level of residual cyanide below the EU Extractive Waste regulatory limits (10 mg/l weak acid dissociable (WAD) cyanide) prior to delivery to the tailings impoundment.

Tailings will be delivered from the treatment plant by means of a pipeline and will be discharged into the TMF from the dam and perimeter of the impoundment to manage the

decant pond location, as required at various stages of operation. Water will be recycled from the TMF to the mill via a floating barge pump station, located in the decant pond.

Site investigations indicate that both the colluvial soil overburden and underlying Cretaceous bedrock are of low permeability; as a consequence, seepage from the tailings impoundment will be limited, and will be readily contained and recovered in the Secondary Containment System. The low permeability bedrock results in a hydrogeological condition, which prohibits deep groundwater flow to adjacent valleys. Furthermore, laboratory testing results and site specific characterization testing presented in the ERR confirm that the colluvial soil overburden is generally of very low permeability, which is favourable from a hydrogeological perspective as a material that would provide additional containment of shallow seepage. Additionally, groundwater gradients in the Corna Valley are shallow and toward the stream channel, demonstrated by the Corna stream being a gaining stream as it flows down the valley. Thus, geological and hydrological conditions within the TMF basin are favourable, providing a high degree of natural containment. Areas where the natural, low permeability, colluvial soil layer is found to be discontinuous will be repaired during the construction phase by patching, using compacted low permeability colluvial soil material. This will further help reduce the seepage volume that will need to be managed.

#### **3.4.8 Low-Grade Ore Stockpile**

The low-grade ore stockpile will be located north of the processing plant, between the Cetate Waste Rock Stockpile on the west and the Cetate Pit on the east. Surface water and seepage will flow to the Cetate Water Catchment Dam, from where it will be pumped to the wastewater treatment plant.

#### **3.4.9 Clean Surface Water Diversion Channels**

Surface water diversion channels will be constructed in both the Roşia and Corna basins. Their main purpose is to reduce storage requirements of the containment ponds by diverting non-contact water around the Project site. Within the Roşia basin, the water diversion will also help to reduce the treatment requirements and the capacity of the wastewater treatment plant. To the extent practicable, these channels will be located and designed to divert clean run-off water away from areas where it may become contaminated to discharge points downstream of the Project.

The clean surface water diversion channels planned for the Project include:

- **Roşia Diversion Channel** will run along the north side of the Roşia drainage and will collect unpolluted run-off from the north slope of the Roşia Valley, thus providing a by-pass of unpolluted flows around the Cetate Water Catchment Dam. The channel will be about 1.7 km long, starting with a concrete diversion weir and discharging at the Cetate dam spillway. The structure will be designed for a flow of 300 m<sup>3</sup>/hr (83 l/s) at the canal upstream end, increasing to 480 m<sup>3</sup>/hr (133 l/s) at the channel end. The channel will be concrete-lined and will include a number of lateral spillways, the purpose of which is to discharge flows in excess of the channel capacity into the Cetate Water Catchment Dam. The design for the capacity of the channel was not based on a specific size of storm event, but was based on optimizing the performance of the Cetate Water Catchment Dam.
- **Corna Diversion Channels** will run north and south of the TMF and the Secondary Containment Dam and pond area. The channels will capture unpolluted flows from the higher areas of the Corna basin and direct them downstream of the Secondary Containment Pond. The channels will be lined by rip-rap. These channels are

designed for a 1:10 year, 24-hour storm event. Failure of these channels is assumed for larger events with the majority of the water reporting to the TMF. This additional water volume has been included in calculations of TMF storm capacity.

### **3.5 Function-Specific Water Management**

#### **3.5.1 Fresh water supply system**

##### **3.5.1.1 Introduction**

This Section provides guidelines for the management of the fresh water supply system according to the requirements of the overall Project water management system. The fresh water supply system is shown schematically on **Figure 3.1** as System 7. The intake structure, intake tank and pumping components for the Fresh Water System will be located at the Arieş River, approximately 10 kilometres north of the Roşia Montană mine site.

##### **3.5.1.2 Management Responsibility**

Approximately 85% of the fresh water requirements will be for mineral processing, therefore, the Process Plant Manager will be responsible for the fresh water supply system operation and management. At a minimum, the Plant Manager's responsibilities relative to fresh water supply system will be to:

- co-ordinate activities related to the operation of the fresh water supply system;
- ensure sufficient fresh water supply for mine operation;
- ensure fresh water supply for the Fire Water Distribution System;
- ensure fresh water supply for camp operation;
- co-ordinate contacts with stakeholders and authorities as they relate to the water abstraction licenses and fresh water requirements for the Project, and permits for the operation of the system;
- forecast capital investments and co-ordinate studies and engineering work;
- review construction designs and schedules;
- prepare and control operational budgets;
- review operating, maintenance and training manuals;
- review and update the Project Risk Assessment Analysis in accordance with TF-06, "Engineering Risk Analysis", and provide necessary recommendations to higher management;
- ensure that records are retained in accordance with MP-11, "Management of Environmental and Social Management System Records";

- prepare environmental and operational reports; and
- co-ordinate operational and environmental monitoring in accordance with this Plan and the requirements of the *Roşia Montană Project Environmental and Social Monitoring Plan*.

### 3.5.1.3 Fresh Water Facility Description

Water will be pumped from the Arieş River at an average rate of 238 m<sup>3</sup>/hr (66 L/s) for the following use:

- process water make-up requirements and reagent mixing at an average rate of 207 m<sup>3</sup>/hr (57.5 L/s);
- freshwater supply for ARD wastewater treatment plant operation at an average rate of 18 m<sup>3</sup>/hr (5 L/s);
- potable water, at an average rate of 5 m<sup>3</sup>/hr (1.4 L/s);
- fresh water supply for camp operation at an average rate of 7.9 m<sup>3</sup>/hr (2.2 l/s); and
- compensation flow to Roşia and Corna Streams, especially during droughts, at an average rate of 237.4 m<sup>3</sup>/hr (minimum required flow of 72 m<sup>3</sup>/hr (20 L/s) in the Rosia Valley and 25 m<sup>3</sup>/hr (7 L/s) in the Corna Valley.

The Arieş River passes some 10 kilometres to the north of Roşia Montană, collecting water from the Abrud River, as well as from numerous smaller local valleys. The Arieş River is the most important water resource in the Apuseni Mountains. Rainfall is typically about 750 millimetres per year, and recorded flows in the Aries River at Cimpeni are on average approximately 45,300 m<sup>3</sup>/hr (12,580 l/s).

An assessment of the Aries River as a potential Project water source has been conducted. The assessment included a review and analysis of 25 years of river flow data to provide input parameters for the design of a fresh water supply system. In addition, the study reviewed the existing licensed water abstractions and recognised the requirement to maintain an environmental base flow in the Arieş River. The results of the assessment indicated that raw water could be drawn from the Arieş River in a cost-effective manner, within the context of local community water supply initiatives and maintaining environmental base flows.

Based on previous studies performed on the flows of the Arieş River and the water balance completed for the Project, this version of the *Water Management and Erosion Control Plan* assumes that the Project will obtain the licence to abstract a specific volume from the Arieş River over the life of the mine project.

An adequate supply of fresh water in terms of quantity and quality is critical to the operation of the mine. Major components of the fresh water supply system are noted on the updated basic engineering drawings provided by Petrostar and MWH in 2004<sup>iv</sup>. They include:

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<sup>iv</sup> MWH 2005, *op. cit.*

- **Fresh Water Intake and Pump Station:** The Fresh Water intake will be located upstream of the confluence of the Abrud River. The proposed intake will be an infiltration gallery below the riverbed, leading into the sediment sluice and intake chambers of the pumping station. Three horizontal pumps, two operational and one stand-by, will deliver water from the pump station to a Fresh Water Storage Tank, located at the plant site. Each pump will have the capability to deliver 175 m<sup>3</sup>/hr at a rated head of 515 metres.
- **Fresh water pipeline:** Water will be pumped from the Arieş River through a pipeline to the fresh water storage tank at the plant site. The steel 250 mm pipeline will follow the Abrud River from the pump station to Guri Roşia and from there to the plant site the pipeline will be buried along the plant access road.
- **Fresh water storage tank:** The fresh water storage tank located at the plant site will provide a three-day water storage capacity for the plant operation plus a dedicated reserve for fire-fighting. This tank will have a diameter of 40 metres and a height of 12 metres, a volume of approximately 15,000 m<sup>3</sup>.
- **Fire water distribution system:** The fire water distribution system will draw water from the fresh water storage tank by means of three pumps:
  - a diesel fire pump capable of delivering 340 m<sup>3</sup>/hr (94 l/s) with a head of 88 metres;
  - an electric fire pump capable of delivering 340 m<sup>3</sup>/hr (94 l/s) with a head of 88 metres; and
  - a jockey pump capable of delivering 15 m<sup>3</sup>/hr (4.2 l/s) with a head of 88 metres.

#### 3.5.1.4 Operations

Water will be pumped from the Arieş River through a pipeline to the fresh water storage tank at the plant site. Fresh water will be diverted to the camp, as required, from this pipeline. A supervisory control and data acquisition and telecommunication system will automatically adjust the pumping rate based on the water level in the water storage tank, flow conditions in the Arieş River and the system hydraulic parameters. The fresh water supply system will be controlled from the plant.

The fresh water supply system will be managed according to the following criteria:

- an adequate water supply must be provided for mineral processing, acid rock drainage treatment, camp and potable use while maintaining the dedicated fire-fighting reserve, in accordance with applicable regulations and Project permits;
- in rare occasions of extreme droughts, the fresh water system can also provide water for compensation flows in the Roşia and Corna Streams.

- fresh water must be of a quality acceptable for the intended use;
- the fresh water supply system must be designed to minimise the potential for environmental and social impacts.

### **3.5.1.5 Facility Management Activities**

The facility will be managed to ensure that water supplied to the mine is of sufficient quality and quantity to provide an uninterrupted operation. In order to meet the aforementioned criteria, the following management actions will be undertaken:

- operate the fresh water supply system in accordance with procedure WT-06, "Operation and Maintenance of Fresh Water Supply System", and participate in periodic reviews and updates of the procedure;
- with the support of the Project legal and environmental departments, maintain current records of water rights and regulations associated with the use of the Arieş River as a fresh water source, in accordance with MP-02, "Identification of Legal and Regulatory Requirements", MP-09, "Regulatory Compliance Verifications", and MP-11, "Management of Environmental and Social Management System Records";
- monitor water requirements during mine operation according to the Project *Environmental and Social Monitoring Plan* and standard operating procedures for the mine facilities that could affect the *Water Management and Erosion Control Plan*, and update the Project Water Balance according to WT-01, "Preparation, Review, and Periodic Update of Project Water Balance";
- with the support of RMGC legal and environmental departments, maintain a valid permit to abstract the volume of water from the Arieş River as required for the mine operation;
- update records of water quality requirements for mine operations that use the fresh water supply System, and provide input to update the Water Quality Model according to WT-03, "Preparation, Review, and Periodic Update of Project Water Quality Model";
- monitor and maintain record of water flow and quality at the fresh water abstraction point on the Arieş River; water quality sampling, monitoring and data analysis will be performed according to the requirements of the Project *Stream Flow Measurement Process Operation Manual*, the *Project Meteorological Station Operation Manual*; and the current release of the *Roşia Montană Environmental Database*;
- monitor and maintain records of quantity of water abstracted from the Arieş River and quantity of raw water fed to the mill, potable and fire extinguish use, according to WT-02, "Management of Meteorological, Flow, and Environmental Quality Data" and the *Environmental and Social Monitoring Plan*;
- co-ordinate operational and environmental inspections and verifications according to MP-08, "Surveillance Inspection" and MP-09, "Regulatory Compliance Verifications";

- maintain and implement training programs for the Fresh Water System personnel according to procedure MP-03, “Environmental and Social Management System Training”;
- with the support of RMGC environmental department, maintain a record of the flows and meteorological data affecting the Arieş River, according to WT-02 “Management and Recordkeeping of Meteorological, Flow and Environmental Water Quality Data” and MP-11, “Management of Environmental and Social Management System Records”;
- with the support of RMGC legal and environmental departments, prepare reports or other submittals required by governing legal and regulatory requirements (see MP-02, “Identification of Legal and Regulatory Requirements”);
- maintain and update personnel roles, responsibilities and organisational structure, as required, according to Project requirements and Section 4.1 of the *Roşia Montană Project Environmental and Social Management Plan*;
- develop, maintain and update the Emergency Response Plan for the fresh water supply system according to the Project *Emergency Preparedness and Spill Contingency Plan*, based on the effects of the system in the overall mine operation.

### **3.5.2 Cârnic Waste Drainage Holding Pond**

#### **3.5.2.1 Introduction**

This Section provides guidelines for the management of the Cârnic waste drainage holding pond according to the requirements of the overall Project water management system. The Cârnic waste drainage holding pond is shown schematically on **Figure 3.1** as System 1. The physical location of the Cârnic waste drainage holding pond, as well as the Cârnic waste rock stockpile is shown on **Figure 3.17**.

#### **3.5.2.2 Management Responsibility**

The runoff and seepage will be allowed to flow directly to the TMF if the water quality does not affect the plant processes. However, if impacted by ARD, these waters will have to be collected in the Cârnic waste drainage holding pond and treated. Waters collected at the Cârnic waste drainage holding pond will be pumped to the wastewater treatment plant or, in the event of extreme storm events, allowed to flow into the TMF,. The facility will have a design criterion of 1:25 year 24-hour flood retention, although in practice it will accommodate a 1:50 year event. Since the operation of this pond will impact facilities associated with the process, the Plant Manager will be responsible for managing this installation. The Plant Manager’s responsibilities as they relate to the Cârnic waste drainage holding pond will include:

- monitoring seepage and runoff water quality to determine if the water needs to be collected and treated or can be allow to discharge into the TMF for use in the process plant;
- co-ordinate activities related to the operation of the pond;

- co-ordinate peer reviews and inspections of the dam;
- forecast capital investments and co-ordinate studies and engineering work;
- review construction designs and schedules;
- prepare and control operational budgets;
- review operating, maintenance and training manuals;
- review and update the Project Risk Assessment Analysis in accordance with TF-06, “Engineering Risk Analysis”;
- provide necessary recommendations to higher management;
- ensure that records are retained in accordance with MP-11, “Management of Environmental and Social Management System Records”;
- prepare environmental and operational reports; and
- co-ordinate operational and environmental monitoring in accordance with this document and the requirements of the Project *Environmental and Social Monitoring Plan*.

### **3.5.2.3 Cârnic Waste Drainage Holding Pond Facility Description**

The Cârnic waste drainage holding pond will be located within the TMF basin, immediately downstream of the Cârnic waste rock stockpile (reclamation of this facility will be completed by Year 13 of the Project). The catchment area for this pond will be approximately 191 hectares. The purpose of this facility is to collect the possible acidic runoff and seepage from the Cârnic waste rock stockpile and pump it to the treatment plant, so that it will not be mixed with tailings pond water and impact the reclaim water quality that the process plant requires. A collection channel will be constructed in the upper Corna Valley separating the Cârnic waste rock stockpile from the tailings pond, to direct runoff from the Cârnic waste rock stockpile to the Cârnic Waste Drainage Holding Pond.

Construction timing of the dam cannot be defined in this version of the *Water Management and Erosion Control Plan*, since the facility is a contingency to be implemented if the water quality degrades beyond that suitable for use in the processing plant. If monitoring during operations indicates no acid generation, then the Cârnic waste rock runoff will be allowed to drain directly to the TMF without treatment.

General details of the tailings dam design and the pumping and piping system to the wastewater treatment plant are provided in the *Tailings Facility Management Plan*. Additional details will be provided in future versions of this *Water Management and Erosion Control Plan*.

The main installations that constitute the Cârnic waste drainage holding pond are described in the following paragraphs.

### 3.5.2.4 Operations

If utilised, the Cârnic waste drainage holding pond will collect direct precipitation and surface water drainage from the Cârnic waste rock stockpile. The Cârnic waste rock stockpile and pond will be located on the Corna drainage, upstream of the TMF. In this location, seepage from the Cârnic stockpile will flow into the Cârnic waste drainage holding pond. Surface water will be collected in the pond from where it will be pumped to the wastewater treatment plant. Excess water collected in the pond due to extreme storm events will be allowed to discharge over an emergency spillway into the upstream end of the TMF. The facility will have a design criterion of 1:25 year 24-hour flood retention, although in practice it will accommodate a 1:50 year event.

The dam crest will be at 840 metres elevation with the spillway invert at 838 metres elevation. Minimum and maximum normal operation levels for pumping will range between 825.4 metres and 838 metres elevation. The pond will need to be dredged periodically to remove sediment that would occupy the storage available for runoff containment. Sediments removed will be placed in the TMF, back in the Cârnic waste rock stockpile, or into other stockpile or pit backfill. Water from the pond will be pumped to the wastewater treatment plant as required to keep the flood storage space available. The design pumping rate will be on the order of 60 m<sup>3</sup>/hr (16.7 l/s) which is sufficient to draw the 50 year flood level down over a three month period. The average annual pumping rate is expected to be of the order of 31.5 m<sup>3</sup>/hr (9 L/s).

The Cârnic waste drainage holding pond will be managed according to the following general criteria:

- the holding pond will be designed to collect acidic waters from the Cârnic waste rock stockpile to prevent quality degradation of the waters in the TMF that are used for mine processes;
- the holding pond will be sized to manage waters collected from the Cârnic waste rock stockpile, which will occupy an area of about 191 hectares once the Cârnic waste rock stockpile is constructed to its final size<sup>v</sup>;
- precipitation higher than the 1:25 year, 24-hour event, in combination with the decant pond volume, will dilute the acidic waters to a level that will not impact the mine process, and therefore, will be allowed to discharge directly into the TMF (in practice the facility will accommodate a 1:50 year event).; and
- the holding pond will operate with a minimum volume of 10,000 cubic metres for sediment containment and two weeks of storage, under normal climatic conditions.

### 3.5.2.5 Cârnic Pond Management Activities

The Cârnic waste drainage holding pond will prevent direct discharge of acidic water from the Cârnic waste rock stockpile to the TMF decant pond, which would degrade the water quality used in the mine process. To meet this objective, the management activities that are envisioned include:

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<sup>v</sup> The pond will have the capacity to store runoff from a 50-year precipitation and snowmelt event, with a total of 112 mm over a 24-hr period and is sized based on a 60% runoff coefficient. This translates into the pond required storage volume of about 130,000 cubic metres; this estimate may be revised as necessary in future versions of this Plan.

- monitoring and maintenance of the level of sediments in the pond according to operating requirements, through the processes established in WT-04, “Measurement of Sediment Loads in Ponds”;
- maintenance of runoff diversion channels so that they convey flows according to design capacity;
- extension of diversion channels according to currently approved Cârnic waste rock stockpile layout drawings;
- operation of the pumping and piping system to the wastewater treatment plant, according to applicable standard operating procedures;
- based on pond water quality, performance of periodic analyses to determine if pond water may be discharged directly to the TMF;
- monitoring of inflow into the pond with respect to volume and quality, according to the requirements of the *Environmental and Social Monitoring Plan* and the surface water quality sampling, flow measurement, quality analysis, and reporting protocols defined by the *Project Stream Flow Measurement Process Operation Manual*, *Project Meteorological Station Operation Manual*, and the current release of the *Roşia Montană Environmental Database*;
- monitoring of water quality in the pond according to the *Environmental and Social Monitoring Plan* and the surface water quality sampling, quality analysis, and reporting protocols defined by the *Project Stream Flow Measurement Process Operation Manual* and the current release of the *Roşia Montană Environmental Database*;
- maintenance of flow records from the pond to the wastewater treatment plant, in accordance with MP-11, “Management of Environmental and Social Management System Records”;
- co-ordination of operational and environmental inspections and performance verifications in accordance with MP-08, “Surveillance Inspection” and/or MP-12, “Internal Environmental and Social Management System Performance Verifications”;
- maintenance and periodic review of the adequacy of facility-specific training programs in accordance with procedure MP-03, “Environmental and Social Management System Training”;
- periodic review and update of applicable standard operating procedures operations and maintenance manuals;
- with the support of RMGC legal and environmental departments, prepare any required submittals and reports according to the legal and regulatory requirements identified under MP-02, “Identification of Legal and Regulatory Requirements”;

- maintenance and update of personnel roles, responsibilities, and organisational structure, in accordance with Project requirements and Section 4.1 of the *Roşia Montană Project Environmental and Social Management Plan*; and
- develop, maintain and update the Emergency Response Plan for the fresh water supply system according to the Project *Emergency Preparedness and Spill Contingency Plan*, based on the effects of the system in the overall mine operation.

### **3.5.3 Plant Storm Water and Spill Contingency Pond**

#### **3.5.3.1 Introduction**

This Section provides guidelines for the management of the plant storm water and spill contingency pond according to the requirements of the overall Project water management system. The plant storm water and spill contingency pond and the Plant are shown schematically on **Figure 3.1** as System 2. **Figure 3.9, Plant Site Stormwater and Spill Contingency Pond**, shows the physical location of the plant storm water and spill contingency pond and the major features of the plant.

#### **3.5.3.2 Management Responsibility**

Waters collected at the plant storm water and spill contingency pond will be directed to the Cetate Water Catchment Dam or to the process plant to be mixed with the tailings stream, depending on its quality. The operation of this pond is directly related to the plant, therefore, the Plant Manager will be responsible for managing this facility. The Plant Manager's responsibilities as they relate to the plant storm water and spill contingency pond will include:

- co-ordinate activities related to the operation of the pond;
- co-ordination of periodic inspections of the pond in accordance with procedure WT-05, "Inspection and Monitoring of Lined Ponds";
- prepare and control operational budgets;
- periodic review and update of procedure WT-07, "Operations and Maintenance of the Storm Water and Spill Collection Pond";
- periodic review and update the facility-specific risk assessments in accordance with TF-06, "Engineering Risk Analysis";
- provide necessary recommendations to higher management;
- ensure that records are retained in accordance with MP-11, "Management of Environmental and Social Management System Records";
- preparation of environmental and operational reports as required by governing regulations (see MP-02, "Identification of Legal and Regulatory Requirements"); and

- co-ordinate operational and environmental monitoring in accordance with this Plan and the requirements of the *Roşia Montană Project Environmental and Social Monitoring Plan*.

### **3.5.3.3 Plant Storm Water and Spill Contingency Pond Facility Description**

Drainage of the plant site will be designed so that surface water and spills are collected in the plant storm water and spill contingency pond, located to the northwest of the crushed ore pad, downgradient of the plant. The drainage area contributing to the pond is approximately 28.5 hectares, while the runoff from the unpolluted area of about 34 hectares around the plant will be diverted to the Cetate Water Catchment Dam. The purpose of this facility is to contain and treat contaminated or contact waters in order to minimise degradation of clean water sources. Water collected in the pond will be pumped to the process plant, while the flood flows in excess of the pond design capacity (flows exceeding the 1:25 year 24-hour event) will spill into the Cetate Water Catchment Dam.

This storm water and spill contingency system consists of the plant site drainage and surface water collection system; the storm water and spill collection pond; and the piping system to the tailings delivery system. A general discussion of the pumping system components and the overall operation of the pond are provided in the following paragraphs. Additional details on these and other components will be provided in future versions of this *Water Management and Erosion Control Plan*.

The pumping system will be sized for a pumping rate of 180 m<sup>3</sup>/hour (50 l/s) and it will be capable of removing the water accumulated in the pond within 48 hours.

### **3.5.3.4 Operations**

The storm water and spill contingency pond will collect direct precipitation and surface water drainage from the plant site. The plant site will be graded to convey the surface water to the low point at the storm water and spill contingency pond on the north side of the plant area. This surface water will be conveyed to the pond by the grading plan, channels, culverts, pipes and embankments. The pond will have a storage capacity of 16,500 cubic metres. Collected waters will be pumped to the plant and used as process water. Under normal conditions, the pond will be empty and ready to store the precipitation runoff.

The storm water and spill contingency pond will be managed according to the following criteria:

- potentially contaminated surface water in the plant area resulting from spills or normal precipitation events will only be allowed to run off the plant area into the plant storm water and spill contingency pond;
- surface water conveyance channels and structures will be designed to convey the 1:25 year 24-hour precipitation and snowmelt event;
- the pond will be sized to manage waters collected from the plant area (28.5 hectares) and will have a capacity of 16,500 cubic metres; the plant area comprises the whole process plant area, excluding the run-of-mine (ROM) ore pad, the stockpile pad, the substation area, the administration building, and the car park and site approach road areas, which will drain to the Cetate Water Catchment Pond.

- water from the pond will then be mixed with the tailings stream and pumped to the TMF.

It should be noted that the storm water and spill contingency pond is dedicated to storm runoff only and does not serve as containment for accidental releases from the Carbon-in-Leach (CIL) area. The entire CIL area will be constructed within a containment system, with provisions made to recycle any accidental releases of cyanide-bearing compounds directly back into the plant cyanidation circuit. Containment in the CIL area will be specifically designed to ensure that there is no hydrological connection to the storm water drainage system or the storm water and spill contingency pond.

Additional storm event details will be provided in future iterations of this Plan.

### **3.5.3.5 Management Activities**

The objective of the storm water and spill contingency pond is to prevent the discharge of potentially contaminated water from the plant site and to effectively collect these waters for treatment, disposal or reuse according to environmental and plant operation requirements. To meet this objective, the management activities that are envisioned include:

- maintenance of the surface water drainage system at the plant site so that it conveys flows according to design capacity;
- maintenance of a complete separation of the plant surface drainage and possible leakage from the plant CIL tanks;
- periodic inspections of the pond according to WT-09 “Inspection and Monitoring of Lined Ponds”;
- operation of the pond and associate pumping systems according to WT-11, “Operation and Maintenance of the Storm Water and Spill Contingency Pond”;
- engineering drainage systems for plant site expansions or modifications so that applicable water management operating and environmental criteria are satisfied;
- monitor water quality in the pond in accordance with the *Environmental and Social Monitoring Plan* and the surface water quality sampling, quality analysis, and reporting protocols defined by the *Project Stream Flow Measurement Process Operation Manual* and the *Roşia Montană Environmental Database* [and subsequently determine where to deliver the collected waters (i.e. the Cetate Water Catchment Dam or process plant)];
- maintenance of flow records from the pond to the Cetate Water Catchment Dam or process plant;
- co-ordination of operational and environmental inspections and verifications in accordance with MP-08, “Surveillance Inspections” and MP-09, “Regulatory Compliance Verifications”;
- maintenance and periodic update of employee training programs in accordance with MP-03, “Environmental and Social Management System Training”;

- periodic review and update of other facility-specific standard operating procedures;
- with the support of RMGC legal and environmental departments, preparation of applicable reports, as identified under MP-02, “Identification of Legal and Regulatory Requirements”;
- maintenance and update of personnel roles, responsibilities, and organisational structure, in accordance with Project requirements and Section 4.1 of the *Roşia Montană Project Environmental and Social Management Plan*; and
- development, maintenance, and update of the Project *Emergency Preparedness and Spill Contingency Plan* to adequately address the as-built characteristics of the storm water and spill contingency drainage system and pond.

### **3.5.4 Tailings Management Facility**

#### **3.5.4.1 Introduction**

This Section provides overall additional guidelines for the management of the TMF with respect to the overall Project water management system. Details regarding the day-to-day management of the TMF are presented in the *Tailings Facility Management Plan*. Within the context of this *Water Management and Erosion Control Plan*, the TMF shall include the Secondary Containment Dam located downstream of the main dam, a reclaim water system, surface water diversion channels, and a tailings distribution system. The TMF is shown schematically on **Figure 3.1** as System 5, and the physical location of the various parts of the system is presented in **Figure 3.10**, *Tailings Management Facility*.

Environmental monitoring and mitigation of potential environmental impacts outside of the operational area of the TMF are addressed in Sections 3.1, 3.3, and 5.1 of the *Roşia Montană Project Environmental and Social Management Plan* and relevant sections of the *Environmental and Social Monitoring Plan*.

#### **3.5.4.2 Management Responsibility**

The TMF is the most important source of process water, providing on average 80% of water for the processing plant. Therefore, the Plant Manager will be primarily responsible for water management at this installation. The Plant Manager’s responsibilities as they relate to water management within the tailings facilities include:

- co-ordination of activities related to tailings distribution from the mill, and tailings disposal within the impoundment;
- periodic review of the *Tailings Facility Management Plan* and provision of recommendations to maximise the volume of water available for recycling back to the plant;
- ensuring that quality and quantity of recycled water is adequate for mill processes;
- periodic review of the water balance of the TMF, in accordance with WT-01, “Preparation, Review, and Periodic Update of Project Water Balance”;

- co-ordination of all activities related to operation of the reclaim water system from the tailings impoundment to the mill;
- co-ordination of activities related to the pump back system from the Secondary Containment pond to the tailings pond;
- forecast capital investments and co-ordinate studies and engineering work;
- review construction designs and schedules;
- prepare and control operational budgets;
- review operating, maintenance and training needs and ensuring that appropriate procedural controls are established via MP-06, "Preparation of Standard Operating Procedures";
- periodic review and update the facility-specific risk assessments in accordance with TF-06, "Engineering Risk Analysis";
- provide necessary recommendations to higher management;
- ensure that records are retained in accordance with MP-11, "Management of Environmental and Social Management System Records";
- preparation of environmental and operational reports as required by governing regulations (see MP-02, "Identification of Legal and Regulatory Requirements"); and
- co-ordinate operational and environmental monitoring in accordance with this Plan and the requirements of the *Roşia Montană Project Environmental and Social Monitoring Plan*.

### **3.5.4.3 Tailings Management Facility Description**

The operation of the Roşia Montană mine will generate tailings at a nominal rate of 13 million tonnes/year for a period of 16 years. The TMF is designed as a mine process waste depository for treated tailings slurry and also as a containment facility to recycle process water.

From the perspective of water management, the purpose of the TMF is to contain process water in a manner that allows it to be recycled to the plant. In addition, the TMF will capture and contain contaminated waters from areas in the Corna Valley basin that are disturbed or impacted by mine operations.

As noted in the Project Cyanide Management Plan, a detoxification circuit within the process plant will be used to reduce the Weak Acid Dissociable (WAD) cyanide concentration in the water discharged with the tailings slurry. WAD cyanide concentrations will be reduced using the SO<sub>2</sub>/air process to levels that comply with applicable EU standards (10 mg/l WAD CN),

before the treated tailings leave the confines of the process plant. Tailings will be delivered at percent solids of approximately 48.5 percent. The quality of treated tailings slurry and recycled process water will be monitored.

Surface water quality and flow measurement stations, as well as groundwater monitoring wells will be installed downstream of the TMF to ensure compliance with environmental and operational permits.

For water management purposes, the TMF is considered to include the installations described in the following paragraphs.

### **Tailings Impoundment**

The tailings watershed, including the Cârnic waste rock stockpile, will be approximately 6.9 km<sup>2</sup> and it is composed of four main land-use components: tailings pond, tailings beach, Cârnic waste rock stockpile and undisturbed land. Surface runoff from an area to the northwest of the tailings pond will be diverted and, therefore, will not report to the tailings pond under normal operating conditions.

The tailings impoundment will be formed by a zoned embankment that will be built in phases over the life of the mine. The dam height will be raised in increments in order to provide appropriate containment of the tailings and satisfy the design and operational criteria of the TMF.

Selected design parameters of the TMF in the Corna Valley provide a full containment of all flood events, including the two consecutive PMF events for first 2 years. During the remainder of the mine life, the TMF pond storage would be sufficient to accommodate several consecutive PMFs.

### **Tailings Delivery and Distribution System**

The tailings delivery and distribution system will comprise a pump station at the process plant that conveys the tailings 4.35 km through an 800 mm outside diameter (O.D) HDPE pipeline to the TMF and the tailings distribution system. The discharge will be through either one of two single point discharge lines, or through spigoting on the dam (approximately 50 metres spigot spacing). The spigot system will be used during normal operation of the pipeline, but the single point discharges are available for intermittent use. Each spigot will be controlled by a knife gate.

The system is designed for nominal and maximum flows of about 2,350 (650) and 2,730 (760) m<sup>3</sup>/hr (l/s) respectively, slurry solids content of up to 48.5% and a minimum discharge velocity of 1.5 m/s. The slurry pH is expected to be between 9 and 11. An earthen dyke will be built along the tailings delivery line to contain accidental spills that may occur during the mine life.

### **TMF Reclaim Water System**

The reclaim water system will convey water from the TMF decant pond to the process water storage tank at the processing plant. The system design accommodates the rising pond level throughout the life of the project.

Floating low-hydraulic lift pumps located on the TMF pond will transport the water a short distance to the on-shore booster pump station supply sump through a 150 metre flexible hose and 680 metres of HDPE pipeline.

The second stage pumps will be connected directly to this supply sump. In order to accommodate the rising pond level, both a low elevation and high elevation booster pump station will be built to handle the pumping requirements throughout the project life. The high elevation booster pump station will be built in year 4 of the mine life. The mainline pipeline will consist of a 429-metre section of PN 16 HDPE pipe and 1,600 metres of PN 8 HDPE pipe.

The system is designed for an average and peak discharge of 1,520 (420) and 1,820 (505) m<sup>3</sup>/hr (l/s) respectively and it will provide most of the processing water requirement.

### **Secondary Containment Pond**

The Secondary Containment Pond will be located immediately downstream of the main dam and will be designed to collect and contain seepage from the tailings impoundment. The system will consist of an 11 metre deep sump excavated into weathered rock. The zoned rock fill dam will be about 11 m high above the riverbed with a 11 m deep positive cut-off to minimise seepage (total 22 metre dam height). The dam will include a broad crested emergency spillway on the right abutment. The dam is a Class II structure under Romanian regulations, and so is designed to retain a 1:100 year 24-hour flood event at maximum normal operating condition. The spillway is designed to pass a 1:1000 year 24-hour flood event. Hydrological study indicates that the pond will actually contain floods in excess of the 1:200 year 24-hour event. Spills during 500-yr, 1,000-yr floods and the PMF would be in the order of 36 m<sup>3</sup>/hr, 150 m<sup>3</sup>/hr and 1,500 m<sup>3</sup>/hr respectively. The cut-off under the dam and the dam construction materials were designed to minimise the chance of collected seepage contaminating natural waters. As long as the sump is pumped down, the cut-off and sump will effectively eliminate any groundwater flow down the valley. The cut-off also acts as backup containment if the sump water level become elevated for a short period due to a storm event or a pump failure.

The Secondary Containment Pond catchment area is approximately 54 hectares, including the tailings dam downstream face.

### **Pump Back System from Secondary Containment Pond**

Floating low-hydraulic lift pumps located on the secondary containment pond will transport water a short distance to the on-shore booster pump station supply sump through a flexible pipeline. The second stage pumps will be connected directly to this supply sump. The mainline will consist of approximately 1.0 km of 219 mm O.D. steel pipe discharging into the TMF.

The secondary containment pumping system is designed for intermittent operation, which will depend on the water level in the pond.

### **3.5.4.4 Operations**

The water balance and hydrological studies indicate that the TMF can be managed in both water deficit and water surplus conditions under all climatic conditions throughout the life of the Project. Adequate storage will be provided in the TMF to contain the runoff from a two Probable Maximum Precipitation events. During spring runoff and after storm events, water in excess of process requirements will be stored in the TMF for later use in the process. The TMF will be managed to avoid discharges; however, a contingency treatment system will be

available should a discharge be needed. The construction schedule for embankment and basin staging will be completed to ensure that Probable Maximum Precipitation storage requirements are available throughout the project life. The tailings pond will collect waters from direct precipitation and runoff that is not captured in the Cărnic waste drainage holding pond or the overflow of clean water from the diversion channels. Most of the water will be retained within the pores of the tailings.

Water will be recycled from the TMF to the mill via a floating barge located at the northeast end of the basin. The barge will pump water to the process water tank above the plant site, from where recycled water will flow by gravity back to the mill.

Treated tailings will be delivered from the mill via a pipeline to pre-determined locations on the basin perimeter. A distribution main will be located along the northwest edge of the basin, across the embankment, and on the southeast side of the basin. The discharge points for the treated tailings will be managed to keep the tailings supernatant pond centred around the reclaim barge and, to the maximum extent possible, to keep the pond away from the embankment.

Water will be managed in the TMF in accordance with current water balance information; see WT-01 "Preparation, Review and Update of Project Water Balance."

Minor seepage through the main dam is expected and incorporated into the designed operation. This seepage will be collected directly in the Secondary Containment Pond, and will be pumped back to the tailings basin. The level in the Secondary Containment Pond will be kept low to produce a gradient into the pond, therefore minimising the chances of uncontrolled seepage losses of potentially contaminated water.

During operation a semi-passive treatment system will be trialed. Flow will be routed through the system for testing and demonstration purposes. At this stage, the effluent from the treatment system will be pumped back to the Secondary Containment Pond if water quality standards are not met, or if a discharge permit has not yet been granted. If this system is tested, discharge to Corna Creek is permitted and reliably meets water quality standards, this discharge will become a component of the TMF seepage water management. Operation of this system would then be incorporated into this plan. In closure, this system may become a key component of the TMF water management system.

The management of the tailings facility water issues will address the following operational and environmental criteria:

- At all times, adequate storage volume will be reserved in the TMF to contain the runoff from two Probable Maximum Precipitation events. A PMF could be on the order of 2.75 million cubic metres of water, based on the revised combined Probable Maximum Precipitation and snowmelt of 440 millimetres over 24 hours, 90% runoff coefficient and the total catchment area of 6.9 km<sup>2</sup>.
- The TMF will be designed to prevent inadvertent spills or discharges. However, should they occur, emergency cleanup protocols will be invoked as noted in the Project *Emergency Preparedness and Spill Contingency Plan*.
- Before commencement of ore processing, the initial stage of the TMF must be capable of providing sufficient water storage capacity for mill start-up and for the first several months of operation. An initial pond volume of approximately 0.5 to 2.1 million cubic metres is required for start-up. A minimum pond volume of 0.5 to 1.0 million cubic metres is estimated to be required during operation.

- In order for the supernatant waters to be used in the mill process or to meet operational permit and environmental regulations, they will have to meet specific water quality standards, as indicated in governing standard operating procedures or applicable permits.
- The elevation of each stage of the facility is determined as the sum of the design volume required to:
  - accommodate the storage of process water and tailings for the maximum normal operation volume, as well as runoff from two PMP events; and
  - provide at least two metres of freeboard for wave protection.
- The site investigations at the TMF indicate that both the overburden and underlying Cretaceous bedrock are of low permeability and as such provide a natural liner to the basin. Furthermore, groundwater gradients in the Corna Valley are toward the stream channel and Secondary Containment pond. This precludes the need for a man-made liner system in the basin.
- Adverse downstream water quality impacts will be prevented by recycling any seepage water captured in the Secondary Containment Pond.

#### **3.5.4.5 TMF Management Activities**

The primary purpose of the TMF with respect to the overall water management system is the containment of process water in a manner that allows such water to be recycled to the plant and prevents its escape to the environment. The facility is also designed to capture and contain contaminated waters from areas in the Corna Valley basin that are disturbed or impacted by mine operations.

To meet this objective, the management activities that are envisioned include:

- operation of the tailings distribution system in accordance with TF-03, “Normal Operating Procedures – Tailings Water Management” and to TF-02, “Normal Operating Procedures – Tailings Deposition”;
- operating the recycled water system in accordance with established standard operating procedures;
- monitoring of the water quality in the tailings in accordance with established operational and environmental requirements<sup>vii</sup>; sampling and reporting monitoring of water quality will conform to *Environmental and Social Monitoring Plan* requirements and the surface water quality sampling, quality analysis, and reporting protocols defined by the *Project Stream Flow Measurement Process Operation Manual* and the *Roşia Montană Environmental Database*, and frequencies and locations will be as specified therein;

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<sup>vii</sup> Note: specific water quality requirements for the supernatant pond will be established in future versions of this Plan.

- monitoring and report groundwater and surface water quality at the predetermined control points downstream of the TMF, to ensure compliance with environmental permits; such activities will be performed in accordance with the requirements of the *Project Stream Flow Measurement Process Operation Manual* and the *Roşia Montană Environmental Database*;
- monitoring surface water flow in the Corna Valley downstream of the TMF to ensure compliance with permit requirements; such monitoring will be performed in accordance with the requirements of the *Project Stream Flow Measurement Process Operation Manual*;
- reviewing and updating the tailings impoundment filling plans (TF-02, “Normal Operating Procedures – Tailings Deposition”) based on actual operational and meteorological data;
- reviewing and updating the TMF water balance according to WT-01, “Preparation, Review and Periodic Update of Project Water Balance”;
- maintaining records of the tailings that go into the impoundment with respect to flow and concentration;
- maintaining and inspecting clean surface water diversion channels so that they continue to operate at design capacity;
- maintaining records of the flow of recycled water delivered to the mill and to the head tank;
- maintaining records of the flow of treated water delivered from the wastewater treatment plant to the tailings pond;
- maintaining records of the flow of water pumped back from the Secondary Containment Pond; and
- periodically reviewing and updating supernatant water quality standards in response to changes in operational and environmental requirements.

### **3.5.5 Cetate Water Catchment Dam**

#### **3.5.5.1 Introduction**

This Section provides additional background information for end users as well as specific guidelines for the management of the Cetate Water Catchment Dam. The Cetate Water Catchment Dam and facilities that drain to it are described schematically on **Figure 3.1** as System 3; the physical location is presented in **Figure 3.11**, *Cetate Water Catchment Dam*.

#### **3.5.5.2 Management Responsibility**

Waters collected at the Cetate Water Catchment Dam will be routed to the wastewater treatment plant. Since the operation of this pond will impact facilities associated with the

process, the Plant Manager will be responsible for managing this installation. The Plant Manager's responsibilities as they relate to the Cetate Water Catchment Dam will include:

- co-ordinating activities related to the operation of the pond and the associated structures;
- co-ordination of periodic inspections of the pond in accordance with procedure WT-05, "Inspection and Monitoring of Lined Ponds";
- forecast capital investments and co-ordinate studies and engineering work;
- review construction designs and schedules;
- prepare and control operational budgets;
- review operating, maintenance and training needs and ensuring that appropriate procedural controls are established via MP-06, "Preparation of Standard Operating Procedures";
- periodic review and update the facility-specific risk assessments in accordance with TF-06, "Engineering Risk Analysis";
- provide necessary recommendations to higher management;
- ensure that records are retained in accordance with MP-11, "Management of Environmental and Social Management System Records";
- preparing environmental and operational reports as required by governing regulations (see MP-02, "Identification of Legal and Regulatory Requirements"); and
- co-ordinate operational and environmental monitoring in accordance with this Plan and the requirements of the *Roşia Montană Project Environmental and Social Monitoring Plan*.

### **3.5.5.3 Cetate Water Catchment Dam Facility Description**

The Cetate Water Catchment Dam will be located in the Roşia Valley, downstream of the Cetate Waste Rock Stockpile and mine pits (Cetate, Cărnic, Orlea and Jig). The purpose of this facility will be to collect the contaminated waters from historic and present mine disturbances that drain into the Roşia Valley, and prevent any water contamination associated with the Project beyond the Project boundaries.

This pond will be built in a location suitable for collecting runoff from the historic mine wastes, the Cetate waste rock stockpile, water pumped from the open pits, and the water that drains from the 714 Adit. The 714 Adit is an underground mine entrance which surfaces at an elevation of 714 metres above sea level and drains the area under the proposed pits to this pond. Under the proposed open pit operation, this adit will be controlled with a check valve incorporated within a hydraulic bulkhead inside the portal. Water that accumulates in the pit will flow by gravity into the Cetate Water Catchment Dam, from where it will be pumped to the wastewater treatment plant.

## Hydrogeological Conditions

The interpreted groundwater contours indicate that the direction of groundwater flow is variable (northerly, southerly and westerly) towards the axis of the valley. These data indicate that the stream is a gaining stream. At the Cetate Water Catchment Dam, January 2004 water levels indicated a horizontal gradient of about 0.02 to 0.14.

Hydrographs of the water levels collected from April 2002 to January 2004 (see 2003 *Geotechnical Investigation for the Tailings and Water Management Dams* by MWH) indicate that, in general, water levels are seasonally stable, although some piezometers did appear to indicate seasonal variation. A comparison of water levels in the piezometers located in the streams that drain from the Plant Site and Cetate Pit to flow rates in the streams indicated that there was no response in the piezometers to short-term precipitation events, even in piezometers as shallow as four metres.

This suggests that the stream water and groundwater screened by the piezometers are not in direct hydraulic connection in this area. It is likely, that the short-term precipitation events occurred as runoff and were not of sufficient duration to influence groundwater levels.

## Appurtenant Structures

- Pumping and Piping System to the Wastewater Treatment Plant

Floating low-hydraulic lift pumps located on the Cetate waste pond will transport the water a short distance to the on-shore booster pump station supply sump through a flexible pipeline. The second stage pumps will be connected directly to this supply sump. The mainline will connect to the ARD Treatment Plant located at the processing plant. The pipeline will consist of 1.8 km of 356 mm O.D. steel pipe.

The pumping system is designed for an initial capacity of 380 m<sup>3</sup>/hr (106 l/s), expandable to 731 m<sup>3</sup>/hr (203 l/s) after year 6 of the mine operation (i.e. once the acid drainage area is enlarged by opening of the Jig and Orlea Pits).

- Northern Diversion Channel

A clean water diversion channel will be constructed on the north side of the Roşia Valley to collect non-contact runoff water from the north side of the Roşia Valley. The channel will be about 1.7 km long, starting at a concrete diversion weir and discharging into the Roşia stream downstream of the Cetate Water Catchment Dam. The structure will be designed for a flow of 300 m<sup>3</sup>/hr (83 l/s) at the canal upstream end, increasing to 480 m<sup>3</sup>/hr (133 l/s) at the channel end. The channel will be concrete-lined and will include a number of lateral spillways, the purpose of which is to discharge flows in excess of the channel capacity into the Cetate Water Catchment Dam.

Once the Pit and Orlea Pits are opened in year 7 of the mine life, the canal will be extended along the northern border of the two pits.

### 3.5.5.4 Dam Design

#### General Concept

The Cetate Water Catchment Dam will collect and impound acid rock drainage from the current site features, as well as possible new acid rock drainage runoff and seepage water

from the Roşia Valley catchment. Much of the water collected by the impoundment will be drainage from historic underground mine workings via the 714 Adit. During the later portions of the mine life when the base of the pits are below the elevation of the 714 Adit, the storage capacity will be used to store water pumped from the mine pits.

The water impounded behind the Cetate Dam will be pumped to the wastewater treatment plant. A possible addition to this system may include installation of a valved plug in the 714 adit. This plug would allow for controlled release of water in the underground mine workings, or to prevent water impounded behind the Cetate Dam from backing up into the open-pits when these are developed below the 714-adit level.

### **Design Criteria**

The Cetate Water Catchment Dam will collect contaminated waters from the open pit, mine waste rock stockpiles and the pre-existing mine adit system. The Cetate Water Catchment Dam has a low-permeability central core with upstream and downstream transition and filter layers protected by rockfill shells. (see **Drawing 06**). The construction materials for the dam will be non-acid generating. A low-permeability core trench will be excavated into competent bedrock to provide for seepage cutoff. Surface concrete placement and contact and slush grouting will be executed as required during foundation preparation. The Cetate Water Catchment Dam is designed according to the following design criteria:

- the Cetate Water Catchment Dam requires sediment monitoring and possible removal during the life of mine and closure;
- the normal pool operating level is near elevation 710 metres above sea level;
- the Cetate Water Catchment Dam is sized to contain the 1:100 year, 24-hour storm event (Romanian Class II facility);
- dam crest elevation is 737.0 metres above sea level (see **Drawing 05**);
- the coffer dam is sized to contain the 1:10 year, 24-hour, storm event;
- the coffer dam height is 31 metres as measured from the crest at centreline to original ground surface;
- the spillway is designed to pass the 1:1000 year, 24-hour storm event (Romanian Class II facility);
- spillway invert elevation is 734.0 metres above sea level and have a flow capacity of 1,860 m<sup>3</sup>/hr (517 l/s);
- dam upstream and downstream slopes are at 2H (horizontal):1V (vertical);
- foundation preparation will consist of clearing, grubbing, removing and stockpiling topsoil (average depth 0.15 metres) from beneath the dam footprint. Alluvium from the dam footprint upstream of the core trench will be excavated (see **Drawing 04**).
- the required storage volume for the 24-hour, 100-year storm event is 508,000 m<sup>3</sup>;

- total Cetate catchment area is 4.9 km<sup>2</sup>, which is based on Year 7 Site Development;

### **Instrumentation and monitoring**

The instrumentation proposed for Cetate Dam is shown on **Drawing 07**.

A total of three vibrating wire piezometers will be installed within the central core of the dam. In addition, three vibrating wire piezometers are planned within the foundation downstream of the cutoff trench to determine if there is any unexpected excess pore water pressure build-up on the downstream side of the cut-off trench. The leads from the piezometers will be routed to a permanent monitoring station located downstream from the dam for remote readings of the phreatic surface within the dam.

One inclinometer will be installed on the downstream slope of the dam along the upper berm. The purpose of the inclinometer is to check for possible downstream shear deformation within the dam body and the foundation.

Six survey monuments will be installed (three along the crest, and three along the downstream berm). These will be monitored by scheduled survey.

A V-notch weir is planned directly downstream of the Cetate Dam to monitor quality and quantity of flow. Flow measurements and water quality during dry periods should be representative of the seepage through the dam.

The existing piezometer at drillhole 02DH-IF-05 downstream of the Cetate Dam will be preserved and monitored for groundwater quality during operations.

Facility performance and monitoring includes inspection and visual observation of the facility, structural integrity and safety. It includes both qualitative and quantitative comparisons of actual performance to expected or planned behaviour. Regular inspection and observation can provide an early indication of performance trends that warrant further evaluation and/or action.

Table 3-3, *Cetate Dam Monitoring*, lists the monitoring parameters and recording frequency that will be used to evaluate the Cetate Dam performance.

**Table 3-3. Cetate Dam Monitoring**

Parameter	Frequency
Visual Inspection of Dam	Daily
Vibrating Wire Piezometer	Weekly
Inclinometer	Weekly
Deformation monitoring stations	Monthly
Expert Review of TMF	Annual

### 3.5.5.5 Operations

Water will be collected in the pond from where it will be pumped to the wastewater treatment plant. The dam crest will be at elevation of 737 metres above sea level. A spillway will be provided at the dam right abutment. The spillway elevation will be at EL 734.0 and it is designed to safely pass the 1:1,000 year 24-hour flood.

Hydrological studies, based on the revised meteorological parameters (Prof. Drobot, 2004), indicate that in reality the Cetate Water Catchment Dam can safely retain all floods up to and including the 1:200 year 24-hour event with water at the maximum operating level (compared with the design retention of 1:100 year 24-hour event). At the normal operating level, events in excess of the 100,000 year, 24-hour event can be retained.

Normal operation of the Cetate Water Catchment Dam will be to maintain pond levels of approximately 710 metres above sea level. The pond level will exceed the elevation 728.2 metres only during extreme floods and will be lowered by pumping to the Wastewater Treatment Plant. The pond may need to be dredged periodically to remove sediment that could accumulate within the dedicated to sediment storage.

The Cetate Water Catchment Dam will be managed according to the following criteria:

- Non-contact runoff water on the north side of the Roşia Valley will be diverted around the Cetate Water Catchment Dam and return to the Roşia Stream below the dam.
- The pond will be designed to collect contaminated waters from historic and current disturbed areas in the permitted mine area within the Roşia Valley, and to prevent contamination of the waters of the Roşia Stream downstream of the Project area.
- The pond will be sized to manage the predicted volume of water collected from a drainage area associated with mine operations and from pit water.
- The pond will be sized to at a minimum contain flood events up to 1:100-year 24-hour events and to safely pass floods up to a 1:1,000-year 24-hour event. The reserve capacity of the pond relative to such events will be noted in future versions of this *Water Management and Erosion Control Plan*.
- With the pond at normal operating level, storm water inflow to the pond will be sufficient to dilute the contaminated waters to the extent that they will be acceptable for discharge over the emergency spillway.

- The pond will be designed to accommodate an additional volume for sediment containment and two weeks of storage under normal climatic conditions. The sediment capacity of the pond will be reflected in the final operational capacity of the pond, which will be noted in future versions of this *Water Management and Erosion Control Plan*.

### **3.5.5.6 Cetate Dam Management Activities**

The objective of the Cetate Water Catchment Dam is to capture contaminated water from the areas disturbed by mine operations in the Roşia Valley and minimise contamination of clean waters that flow along the same valley. To meet this objective, the management activities that are envisioned include:

- maintaining the level of sediments in the pond according to operating requirements;
- maintenance of runoff diversion channels so that they convey flows according to design capacity;
- operation of the pumping and piping system to the wastewater treatment plant, according to applicable standard operating procedures;
- maintaining the spillway free of any obstructions that could reduce its design capacity;
- monitoring water quality in the pond in accordance with protocols defined in the Project Stream Flow Measurement Process Operation Manual and the Roşia Montană Environmental Database.
- maintaining records of the flows from the pond to the wastewater treatment plant;
- monitoring and maintenance of the level of sediments in the pond according to operating requirements, through the processes established in WT-04, "Measurement of Sediment Loads in Ponds";
- co-ordinate operational and environmental inspections and verifications according to MP-08, "Surveillance Inspection" and MP-09, "Regulatory Compliance Verifications";
- maintenance and periodic update of employee training programs in accordance with MP-03, "Environmental and Social Management System Training";
- reviewing and updating WT-12, "Operations and Maintenance of the Cetate Water Catchment Dam" and other applicable standard operating procedures;
- with the support of RMGC legal and environmental departments, prepare reports or other submittals required by governing legal and regulatory requirements (see MP-02, "Identification of Legal and Regulatory Requirements");

- maintenance and update of personnel roles, responsibilities, and organisational structure, in accordance with Project requirements and Section 4.1 of the *Roşia Montană Project Environmental and Social Management Plan*; and
- developing, maintaining, and updating emergency response actions for Cetate Water Catchment Dam in accordance with the detailed requirements of the Project *Emergency Preparedness and Spill Contingency Plan*.

### **3.5.6 Mill and Process Water**

#### **3.5.6.1 Introduction**

This Section explains the water needs for the mill and ore separation process, so that the mine is operated according to applicable operational criteria and environmental requirements. This section will be revised to provide a summary of water management issues within the process facility in future versions of this *Water Management and Erosion Control Plan*. The water supply system providing for Mill and Process Water is shown schematically on **Figure 3.1** as System 6.

#### **3.5.6.2 Management Responsibility**

Water needs and requirements for this facility are the responsibility of the Plant Manager, and include:

- co-ordination of activities related to the operation of the fresh water supply system from the fresh water storage tank to the process plant;
- co-ordination of activities related to the delivery of recycled water from the Process Water Tank to the process plant;
- co-ordination of activities of delivery of tailings slurry from the process plant to the TMF;
- ensuring adequate quantities and quality of process water for plant operation;
- periodically reviewing and updating Plant-specific risk assessments per TF-06, “Engineering Risk Analysis”;
- provide necessary recommendations to higher management;
- ensure that records are retained in accordance with MP-11, “Management of Environmental and Social Management System Records”;
- preparing environmental and operational reports as required by governing regulations (see MP-02, “Identification of Legal and Regulatory Requirements”); and
- co-ordination of operational and environmental monitoring in accordance with this *Water Management and Erosion Control Plan* and the Project *Environmental and Social Monitoring Plan*.

#### **3.5.6.3 Mill and Process Water Facility Description**

Process water sources will include:

- water recycled from the tailings pond, estimated at a maximum rate of 1,183.55 cubic metres per hour (359 L/s);
- treated water from the wastewater treatment plant, at a maximum rate of 600 cubic metres per hour (167 l/s);
- fresh water from the Arieş River, at a maximum rate of 350 cubic metres per hour (97 L/s); and fresh water from the Arieş River, at a maximum rate of 350 cubic metres per hour (97 L/s); and
- water present in the ore being processed, at a maximum rate of 78 m<sup>3</sup>/hr (22 L/s).

Process water will be discharged with the tailings at a maximum rate of 2,214 cubic metres per hour (615 L/s). Tailings slurry solids concentration will be approximately 48.5%. The rate of water loss due to evaporation from the TMF is expected to average 35 cubic metres per hour (9.7 l/s).

Major components of the process water system are described below.

#### **Process Fresh Water Pump Supply System**

Fresh water for process will be pumped from the fresh water storage tank by means of a pipeline and three centrifugal pumps in parallel, each with a flow capacity of 300 cubic metres per hour (83 l/s) and a head of 60 metres. Additional details will be provided in future versions of this *Water Management and Erosion Control Plan*.

#### **Recycled Water Supply System**

Recycled water will be supplied from the Process Water Tank, and will flow to the Plant by gravity. The Process Water Tank will be 15 metres in diameter and 12.5 metres high; it will also receive treated waters from the wastewater treatment plant. The tank will be equipped with an overflow that will discharge into the TMF. Additional details will be provided in future versions of this *Water Management and Erosion Control Plan*.

#### **3.5.6.4 Operations**

Process water will be conveyed to the plant from four sources:

- fresh water will be pumped from the fresh water storage tank by means of a pipeline with three centrifugal pumps in parallel;
- recycled water from the TMF will flow by gravity by means of a pipeline from the Process Water Tank, where it will be mixed with treated water from the wastewater treatment plant;
- treated water, from the wastewater treatment plant will be pumped from the wastewater treatment plant to the Process Water Tank, where it will be mixed with recycled water;

- additional process water will be provided by the natural moisture in the ore, as previously noted.

The process water at the plant will be managed according to the following criteria:

- ensuring the availability of appropriate quantities of process water with suitable quality; and
- minimising water losses within the process while meeting all applicable operational and environmental criteria.

### **3.5.6.5 Facility Management Activities**

In order to meet the aforementioned criteria, the following management actions will be undertaken:

- operating the supply system from the fresh water storage tank according to WT-06, “Operations and Maintenance of Fresh Water Supply System”;
- operating the supply system from the Process Water Tank according to the Operations and Maintenance Manual;
- operating the supply system from the wastewater treatment plant to the Process Water Tank according to applicable standard operating procedures;
- operating the tailings delivery according to the Operations and Maintenance Manual;
- deliver tailings to the TMF at the design concentrations;
- monitoring process water requirements during mine operation and update the Project water balance according to WT-01, “Preparation, Review, and Periodic Update of Project Water Balance.”
- monitoring and updating water quality requirements for the process water sources according to WT-03, “Preparation, Review, and Periodic Update of Project Water Quality Model” and protocols defined in the *Project Stream Flow Measurement Process Operation Manual* and the current release of the *Roşia Montană Environmental Database*;
- co-ordinate operational and environmental inspections and verifications according to MP-08, “Surveillance Inspection” and MP-09, “Regulatory Compliance Verifications”;
- maintenance and periodic update of employee training programs in accordance with MP-03, “Environmental and Social Management System Training”;
- reviewing and updating applicable standard operating procedures per MP-06, “Preparation of Standard Operating Procedures”;

- with the support of RMGC legal and environmental departments, prepare reports or other submittals required by governing legal and regulatory requirements (see MP-02, “Identification of Legal and Regulatory Requirements”);
- maintenance and update of personnel roles, responsibilities, and organisational structure, in accordance with Project requirements and Section 4.1 of the *Roşia Montană Project Environmental and Social Management Plan*; and
- developing, maintaining and updating the Emergency Response Plan for the Roşia Montană Catchment Dam, in accordance with the Project *Emergency Preparedness and Spill Contingency Plan*.

### **3.5.7 Wastewater Treatment Plant**

#### **3.5.7.1 Introduction**

This Section describes the wastewater treatment plant and provides guidelines pertaining to how it will be managed as part of the Project overall *Water Management and Erosion Control Plan*. The wastewater treatment plant is shown schematically in **Figure 3.1** as System 4.

#### **3.5.7.2 Management Responsibility**

A primary purpose of the wastewater treatment plant is to treat contaminated acid runoff to the level that will allow its discharge into the environment, while at the same time producing water that meets the quality and quantity requirements of the process plant. Therefore, management of this facility is the overall responsibility of the Process Plant Manager.

Wastewater treatment management responsibilities will include:

- co-ordinating activities related to the operation of the wastewater treatment plant;
- co-ordinating activities for delivery of waters for treatment from the Cetate Water Catchment Dam and the Cârnic waste drainage holding pond;
- co-ordinating activities for delivery of fresh water to the wastewater treatment plant;
- co-ordinating disposal of sludge from the wastewater treatment plant;
- co-ordinating the delivery of treated water for process, dust control and/or discharge to the environment;
- forecast capital investments and co-ordinate studies and engineering work;
- review construction designs and schedules;
- preparing and controlling operational water budgets;

- reviewing and updating applicable standard operating procedures per MP-06, “Preparation of Standard Operating Procedures”;
- periodic review and update the treatment plant-specific risk assessments in accordance with TF-06, “Engineering Risk Analysis”;
- provide necessary recommendations to higher management;
- ensure that records are retained in accordance with MP-11, “Management of Environmental and Social Management System Records”;
- preparing environmental and operational reports as required by governing regulations (see MP-02, “Identification of Legal and Regulatory Requirements”); and
- co-ordinating operational and environmental monitoring in accordance with the Project *Environmental and Social Monitoring Plan*.

### **3.5.7.3 Wastewater Treatment Plant Facility Description**

The wastewater treatment plant will be designed to treat contaminated runoff water from the historical mining operations within the Project area, the mine pits, site runoff, drainage from the proposed Cetate and Cârnic waste rock stockpiles and Low Grade Ore stockpile. This contaminated runoff will be captured in the Cetate Water Catchment Dam, from where it will be pumped to the wastewater treatment plant. A portion of the treated effluent will be utilised in the process plant during drought periods, some water will be used for dust control and the remainder of the treated water will be discharged into Roşia and Corna Streams.

The wastewater treatment plant will be located in the northwest side of the process plant. Apart from the neutralisation process, the plant will also be designed to reduce dissolved metal concentrations and other parameters to meet the Romanian Technical Norms for Water Protection (NTPA)-001/002<sup>viii</sup>, and other applicable standards and guidelines.

The major components associated with the wastewater treatment plant as part of this *Water Management and Erosion Control Plan* are indicated in the following paragraphs.

#### **Fresh Water Supply System for Acid Rock Drainage Treatment**

The wastewater treatment plant will require a certain amount of fresh water to operate according to design and environmental criteria. Fresh water for process will be pumped from the Fresh Water Storage Tank. Freshwater requirements will average about 19 cubic metres per hour (5.3 l/s). Additional details will be provided in future versions of this *Water Management and Erosion Control Plan*.

#### **Wastewater Treatment Plant**

Over the first 6 years of the mine life, the plant will treat average and maximum flows of 272 and 400 cubic metres per hour (75 and 111 l/s), respectively. After the end of the year 6, the plant will be expanded to treat on average 375 cubic metres per hour (104 l/s) with a maximum rate of 650 cubic metres per hour (180 l/s). Additional details will be provided in future versions of this *Water Management and Erosion Control Plan*.

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<sup>viii</sup> Government of Romania, 2004; *Romanian Technical Norms for Water Protection (NTPA)-001/2002*

### **Contingency cyanide treatment system**

Treatment plant will be provided before commencement of operations to remove residual cyanide concentrations in the TMF decant pond and/or SCD pond to a concentration below the TN001 limit of 0.1 mg/L total CN, so that discharges can be made to the environment under certain conditions for the purposes of effective water management (e.g. for storage volume recovery after a PMP).

Design and management criteria for this plant have yet to be finalised and will be included in future versions of the *Water Management and Erosion Control Plan*.

### **Treated Water Discharge System**

Treated water will be conveyed to the following areas:

- gravity discharge into Roşia Stream and pumping into Corna Stream;
- dust control; and
- plant process water particularly during droughts;

A section of pipeline will be provided to allow discharge of water directly into the TMF in case of emergencies.

### **Sludge Waste Discharge System**

Sludge generated by the ARD Treatment Plant will be mixed with the tailings at the plant and will be pumped to the TMF. The sludge will be added to the tailings pump box at the plant and mixed with tailings before pumping.

#### **3.5.7.4 Operations**

Contaminated waters will be pumped from the Cetate Water Catchment Dam at a maximum rate of up to 565 cubic metres per hour (157 L/s) and from the Cărnic waste drainage holding pond at a maximum rate of 172 cubic metres per hour (47.7 L/s). Freshwater will be added to the process from the Fresh Water Storage Tank, at an average rate of 8 cubic metres per hour (2.2 L/s). This freshwater supply will come from the same line that supplies fresh water to the process plant.

The wastewater treatment process selected for the Project is lime neutralisation/precipitation, which includes the following unit operations:

- Air oxidation;
- Lime neutralization/precipitation and pH control;
- pH adjustment with carbon dioxide (CO<sub>2</sub>);
- flocculation with solids recycle; and
- Solids / liquid separation by gravity settling in a clarifier.
- optimisation for calcium concentration, and sulphate/TDS removal.

Effluents from the wastewater treatment plant will include treated water and the sludge.

Treated water will be allowed to flow for the use as detailed in prior paragraphs. Treated water will also be allowed to discharge directly into the TMF.

The wastewater treatment plant will be managed according to the following criteria:

- effluents from the process plant will meet the requirements to be established for effluent quality; additional details will be provided in future versions of this *Water Management and Erosion Control Plan*; and
- RMGC will maintain base flows in the Corna and Roşia Valleys according to applicable permits and regulations; a year-round base flow of 97.2 m<sup>3</sup>/hr (27 L/s) is to be provided through a continual release from the wastewater treatment plant or from diverted water flows, which is to be discharged at a ratio of 72 m<sup>3</sup>/hr (20 L/s) into the Roşia Valley and 25.2 m<sup>3</sup>/hr (7 L/s) to the Corna Valley.

### **3.5.7.5 Facility Management Activities**

In order to meet the aforementioned criteria, the following management actions will be undertaken:

- operating the supply system from the fresh water storage tank according to WT-06, “Operations and Maintenance of Fresh Water Supply System”;
- operation of the wastewater treatment plant according to applicable standard operating procedures;
- operation of the treated water system according to applicable discharge standards operating procedures and to the needs for Plant Process, dust control, and maintenance of base flows in the Corna and Roşia Valleys;
- monitoring the quantity and quality of contaminated waters delivered from the Cetate Water Catchment Dam and the Cărnic Waste Drainage Holding Pond and the stormwater and spill collection pond, in accordance with the surface water quality sampling, quality analysis, and reporting protocols defined by the *Project Stream Flow Measurement Process Operation Manual* and the *Roşia Montană Environmental Database*;
- monitoring the quantity and quality of treated water according to WT-07, “Operations and Maintenance of the Storm Water and Spill Collection Pond” in accordance with the surface water quality sampling, quality analysis, and reporting protocols defined by the *Project Stream Flow Measurement Process Operation Manual* and the *Roşia Montană Environmental Database*;
- providing input for the periodic review and update of the Project Water Balance and Water Quality Model according to WT-01, “Preparation, Review, and Periodic Update of Project Water Balance” and WT-03, “Preparation, Review, and Periodic Update of Project Water Quality Model”;
- updating effluent standards according to current mine permits and regulations;

- co-ordination of operational and environmental inspections and verifications in accordance with MP-08, “Surveillance Inspections” and MP-09, “Regulatory Compliance Verifications”;
- maintaining and periodically reviewing employee-training programs according to MP-03, “Environmental and Social Management System Training”;
- reviewing and updating other standard operating procedures for maintenance and operation in accordance with MP-06, “Preparation of Standard Operating Procedures”;
- with the support of RMGC legal and environmental departments, preparing reports as required by current legal and regulatory requirements (see MP-02, “Identification of Legal and Regulatory Requirements”);
- maintenance and update of personnel roles, responsibilities, and organisational structure, in accordance with Project requirements and Section 4.1 of the *Roşia Montană Project Environmental and Social Management Plan*; and
- developing, maintaining, and updating the Emergency Response Plan for the wastewater treatment plant in accordance with the Project *Emergency Preparedness and Spill Contingency Plan*.

### **3.5.8 Potable water system**

#### **3.5.8.1 Introduction**

This Section describes the potable water system and provides guidelines how it will be utilised as part of the *Water Management and Erosion Control Plan*. This Section will be revised in future versions to further address potable water needs at the mine camp. **Figure 3.1** provides a schematic representation of the components of the potable water system as System 8.

#### **3.5.8.2 Management Responsibility**

Potable water needs at the mine site will occur primarily at the process plant installations, therefore management of this facility will be responsibility of the Plant Manager. Potable water system management responsibilities will include:

- co-ordination of activities related to the operation of the Potable Water Treatment Plant;
- co-ordination of activities related to the delivery of fresh water from the fresh water storage tank to the Potable Water Treatment Plant;
- co-ordination of activities related to the delivery of potable water to the plant installations;
- ensuring potable water quality and quantity;

- forecasting capital investments and co-ordinating related studies and engineering work;
- review construction designs and schedules;
- prepare and control operational budgets;
  
- reviewing and updating facility-specific risk assessments per TF-06, “Engineering Risk Analysis”;
- provide necessary recommendations to higher management;
  
- ensure that records are retained in accordance with MP-12, “Management of Environmental and Social Management System Records”;
  
- preparing environmental and operational reports as required by governing regulations (see MP-02, “Identification of Legal and Regulatory Requirements”); and
  
- co-ordinating operational and environmental monitoring in accordance with the Project *Environmental and Social Monitoring Plan*.

### **3.5.8.3 Potable Water System Facility Description**

The potable water system will be designed to produce and convey potable water to the mine installations. The system will consist of a pipeline that conveys freshwater by gravity from the fresh water storage tank to the Potable Water Treatment Plant located at the plant site. Water will then be piped to the Potable Water Tank. The Potable Water Treatment Plant will be a package design enclosed in a dedicated building. Potable water needs will be drawn from this tank at an average rate of 5 cubic metres per hour (1.4 l/s). Potable water will be pumped to the different installations at the process plant while maintaining the operating pressures typical for the potable water supply.

Additional details will be provided in future versions of this *Water Management and Erosion Control Plan*.

### **3.5.8.4 Operations**

The potable water system will be managed according to the following criteria:

- Freshwater from the Arieş River will be treated to meet applicable potable water requirements; definition of quality parameters will be provided in future versions of this *Water Management and Erosion Control Plan*.
  
- The system must supply potable water to all major mine installations at approximately five cubic metres per hour (1.4 l/s).

### **3.5.8.5 Facility Management Activities**

In order to meet the aforementioned criteria, the following management actions will be undertaken:

- operating the supply system from the fresh water storage tank according to the WT-06, "Operations and Maintenance of Fresh Water Supply System";
- operating the Potable Water Treatment Plant according to applicable standard operating procedures;
- operating the potable water delivery system according to applicable standard operating procedures;
- monitoring the quantity and quality of freshwater delivered to the Potable Water Treatment Plant, in accordance with protocols defined in the *Roşia Montană Environmental Database* and the *Environmental and Social Monitoring Plan*;
- monitoring the quantity and quality of potable water delivered to the Potable Water Tank, according to the protocols defined in the *Project Stream Flow Measurement Process Operation Manual* and the *Roşia Montană Environmental Database*;
- monitoring the quantity of potable water delivered to plant installations from the Potable Water Tank, in accordance with the *Environmental and Social Monitoring Plan*;
- providing input for the review and update of the Project Water Balance and Water Quality Model according to WT-01, "Preparation, Review, and Periodic Update of Project Water Balance" and WT-03, "Preparation, Review, and Periodic Update of Project Water Quality Model";
- updating potable water standards according to mine permits and regulations, when necessary (see MP-02, "Identification of Legal and Regulatory Requirements");
- co-ordinating operational and environmental inspections and verifications per MP-08, "Surveillance Inspection" and MP-09, "Regulatory Compliance Verifications";
- maintaining and periodically reviewing employee-training programs according to MP-03, "Environmental and Social Management System Training";
- reviewing and updating other standard operating procedures for maintenance and operation in accordance with MP-06, "Preparation of Standard Operating Procedures";
- with the support of RMGC legal and environmental departments, preparing reports as required by applicable legal and regulatory requirements (see MP-02);
- maintenance and update of personnel roles, responsibilities, and organisational structure, in accordance with Project requirements and Section 4.1 of the *Roşia Montană Project Environmental and Social Management Plan*; and

- developing, maintaining, and update the Emergency Response Plan for the potable water system in accordance with the *Emergency Preparedness and Spill Contingency Plan*.

### **3.5.9 Sewage Treatment**

#### **3.5.9.1 Introduction**

This Section describes the sewage treatment system and provides guidelines as to how it will be utilised as part of the *Water Management and Erosion Control Plan*. This Section does not address sewage treatment needs at the camp. The sewage treatment system is shown schematically on **Figure 3.1** as System 9.

#### **3.5.9.2 Management Responsibility**

Sewage will be generated at the process plant installations and the treated sewage treatment plant effluents will be discharged into the TMF. Therefore, management of this facility will be the responsibility of the Plant Manager.

Sewage treatment system management responsibilities will include:

- co-ordination of activities related to the operation of the sewage treatment plant;
- co-ordination of activities related to the delivery of sewage from the plant installations to the sewage treatment plant;
- co-ordination of activities related to the delivery of effluent waters from the sewage treatment plant to the TMF;
- ensuring the current validity of sewage treatment plant effluent quality standards;
- forecast capital investments and co-ordinate studies and engineering work;
- review construction designs and schedules;
- prepare and control operational budgets;
- reviewing and updating other standard operating procedures for maintenance and operation in accordance with MP-06, "Preparation of Standard Operating Procedures";
- reviewing and updating facility-specific risk assessments per TF-06, "Engineering Risk Analysis";
- provide necessary recommendations to higher management;
- ensure that records are retained in accordance with MP-12, "Management of Environmental and Social Management System Records";

- preparing environmental and operational reports as required by governing regulations (see MP-02, “Identification of Legal and Regulatory Requirements”); and
- co-ordinate operational and environmental monitoring in accordance with this Plan and the requirements of the *Roşia Montană Project Environmental and Social Monitoring Plan*.

### **3.5.9.3 Sewage Treatment Facility Description**

Domestic sewage discharges will be treated by the sewage treatment plant, which will be provided to treat domestic effluent from showers, toilets, sinks, and washing machines originating from the mine plant site, including the mine workers change rooms. The sewage treatment plant will be a self-contained unit, with complete provisions for heating and ventilation.

Sanitary sewage from the plant site will drain to a manhole located immediately upstream of the sewage treatment plant. Balancing tanks will be supplied, as well as booster pumps to pass the raw sewage through the treatment process.

The sewage treatment plant will be designed for continuous, unsupervised duty 24 hours per day, 365 days per year with an average daily flow rate of five cubic metres (1.4 l/s) per hour. The peak flow rate of 15 cubic metres per hour (4.2 l/s) is expected to occur during the three daily, one-hour shift changes. Sludge generated by the plant will be disposed of in accordance with specified requirements

The treated effluent will discharge into the tailings box, where it will be mixed with the tailings before being pumped to the TMF.

Additional technical details will be provided in future versions of this Water Management and Erosion Control Plan.

### **3.5.9.4 Operations**

Sewage water will be treated to meet effluent standards and sludge disposed of as indicated in governing permits, laws, or regulations (see MP-02, “Identification of Legal and Regulatory Requirements”).

### **3.5.9.5 Facility Management Activities**

In order to meet the aforementioned criteria, the following management actions will be undertaken:

- operating the sewage treatment plant according to current standard operating procedures;
- disposal of sewage treatment sludge according to governing permit requirements or regulations;
- operating the sewage effluent delivery system according to current standard operating procedures;

- Monitor the quantity and quality of sewage treatment plant effluents delivered to the TMF, according to the *Roşia Montană Project Environmental and Social Management Plan*;
- Monitor the quantity and quality of sewage treated at the Plant according to the *Roşia Montană Project Environmental and Social Management Plan*;
- providing input for the review and update of the Project Water Balance and Water Quality Model according to WT-01, "Preparation, Review, and Periodic Update of Project Water Balance" and WT-03, "Preparation, Review, and Periodic Update of Project Water Quality Model";
- updating sewage treatment effluent water standards and sludge disposal according to mine permits and regulations (see MP-02, Identification of Legal and Regulatory Requirements");
- co-ordinating operational and environmental inspections and verifications per MP-08, "Surveillance Inspection" and MP-09, "Regulatory Compliance Verifications";
- maintaining and periodically reviewing employee-training programs according to MP-03, "Environmental and Social Management System Training";
- reviewing and updating other standard operating procedures for maintenance and operation in accordance with MP-06, "Preparation of Standard Operating Procedures";
- with the support of RMGC legal and environmental departments, preparing reports according to legal and regulatory requirements and MP-05, "Review, Approval, Controlled Distribution, and Update of ESMS Documents";
- maintenance and update of personnel roles, responsibilities, and organisational structure, in accordance with Project requirements and Section 4.1 of the *Roşia Montană Project Environmental and Social Management Plan*; and
- developing, maintaining and updating the Emergency Response Plan for the Roşia Montană Catchment Dam, in accordance with the Project *Emergency Preparedness and Spill Contingency Plan*.

## **4 Erosion Control**

### **4.1 General Requirements**

Soil erosion occurs when soil is transported by rainfall run-off and wind. Earth-moving operations, such as open pit mining, expose soil to erosive forces and may promote erosion. When soil particles are mobilised, deposition will occur down gradient once the transporting force no longer has enough energy to move the soil particle. Excessive sediment transport, and subsequent deposition in water bodies, can lead to multiple environmental impacts including adverse water quality and aquatic habitat impairment. Erosion and sedimentation are typical environmental issues at virtually all mine sites.

The Water Management and Erosion Control Plan addresses the necessary elements of design, construction and operation of the proposed facilities for water management and erosion control. This section provides an overview of the standard operating procedures that will be implemented to eliminate or minimise environmental and social impacts associated with erosion, while at the same time assuring water quantity and quality for operation over the life of the mine. Monitoring and quality assurance/quality control activities associated with erosion control are also addressed.

A combination of practices will be implemented at various stages and in various operations in order to maintain an effective measure of control over erosion throughout the various stages of mining operations and closure. For example, grading alone can reduce erosion, but may be much more effective in minimising contaminant transport when used in combination with erosion control practices for soil stabilisation and erosion and sediment control.

A suite of standard operating procedures for erosion control has been developed in accordance with Sections 4.5 and 4.6.2 and of the Roşia Montană Project Environmental and Social Management Plan, and are listed as follows:

- WT-13, "Erosion Control Considerations in Mine Planning";
- WT-14, "Waste Rock Management Erosion Control Considerations";
- WT-15, "Water Management Erosion Control Considerations"
- WT-16, "Soil Stabilisation and Sediment Control"; and
- WT-17, "Seeding and Revegetation"

Collectively, these procedures describe how erosion control measures will be implemented to manage each impact area according to standard international BMPs.

### **4.2 Management Responsibilities for Erosion Control**

Management responsibilities for specific erosion control actions will be as defined in the individual procedures noted in Section 4.1. In general, however, the RMGC Production Department will be responsible for planning, design, construction, and/or proper operation or maintenance of all required erosion control structures and processes. Environmental monitoring staff and/or monitoring contractors reporting to the Environmental Department will be responsible for all monitoring, inspection, and reporting actions, as also specified in the noted procedures.

### **4.3 Mine Planning**

The forecasting of possible future impacts associated with mine operations and the siting of mine facilities permits the development of facility placement and operational strategies to avoid or reduce these impacts. Such planning will facilitate the achievement of overall goals for minimising the environmental and social impacts associated with its operations. Complete and comprehensive mine planning for operations and mine closure and remediation may be the single most important best management practice for reducing contaminant impacts to the environment; see Section 4.6.1 of the Roşia Montană Project Environmental and Social Management Plan and MP-14, "Mine Planning Process." WT-13, "Erosion Control Considerations in Mine Planning" presents a variety of erosion management practices that will be considered in the mine planning process; these practices are focused on controlling erosion during construction and siting of mine facilities and roads, minimising disturbed areas, scheduling of mining operations to consider seasonal weather-related issues, appropriate placement and management of mineralised materials, and control of surface water on disturbed areas.

### **4.4 Waste Rock Management**

How a mining operation manages its overburden and development material will ultimately have a significant impact on its ability to meet soil salvage guidelines, and potentially, applicable vegetation standards. Managing waste rock by planning for its removal and placement for the short- and long-term can affect potential metals mobilisation. The objective for maintaining erosion control as an element of waste rock management is to:

- minimise contact of precipitation with disturbed areas/material;
- minimise the infiltration of precipitation into mineralised wastes;
- create a more reducing environment to inhibit metal solubility; and
- reduce the availability of metals for uptake to terrestrial vegetation, and subsequent grazing by livestock or ingestion by wildlife.

Procedure WT-14, "Waste Rock Management Erosion Control Considerations" presents a series of management practices that may be selectively implemented to minimise impacts in the following waste rock management areas:

- waste rock characterisation;
- waste rock handling and placement;
- geochemical sampling methods;
- slope shaping;
- contour terraces; and
- capping.

### **4.5 Water Management**

Planning for the control of water, erosion, and sediment are key aspects in minimising the impacts from mining operations. The most important aspect of water management is controlling the interaction of precipitation, surface water runoff, and groundwater with unsuitable geologic materials. By limiting water contact, mine operators can reduce the opportunity for soils and contaminants to mobilise.

Any mine activity or feature that comes in contact with precipitation, surface water, or groundwater should be considered early in the mine planning process for assessment and management in the context of erosion control. Areas to be considered include location of ponds, catch basins, settling ponds and other surface water collection facilities away from materials (e.g. overburden piles) known to have elevated contaminant concentrations. Overburden piles should also be located away from sources of water including existing surface water, seeps, springs, and snowfields, as well as areas of runoff collection and discharge.

Surface water controls, diversions, and channels (particularly within the mine pit) will be constructed as necessary to manage water that may be impacted by mineralised materials. Interception and conveyance of runoff are important for those mining operations that disturb the natural hydrology and protective cover of an area. Management of runoff allows the operator to isolate and control water at source and minimises the risk of erosion and possible contaminant mobilisation/migration. Design of water control structures includes the calculation of appropriate storm event runoff and peak flows.

WT-15, "Water Management Erosion Control Considerations" presents a series of management practices that will be selectively implemented to minimise such impacts, and will address the following areas:

- diversion dike/channel construction;
- interceptor trenches;
- road sloping;
- rolling dips;
- waterbar installation;
- installation of open top box culverts;
- installation corrugated metal culverts;
- drop structures;
- stream alteration; and
- snow removal.

Typical details for some of these components are shown on **Drawing 08**, Typical Sediment Control Details.

#### **4.6 Soil Stabilisation and Sediment Control**

Soil stabilisation and sediment control are primarily used to control the erosion of soils and the transport of soil offsite. There are three major issues related to soil stabilisation and sediment control:

1. Geologic materials used for erosion control must be relatively benign so the materials do not contribute soluble constituents that could be taken up by vegetation and/or infiltrate water bodies.
2. Surficial geologic materials salvaged for topsoil during reclamation must have low metals concentrations to limit contaminant availability to reclamation vegetation.
3. Materials placed on the surface of overburden and other disturbed soils must not be permitted to erode, which could cause downgradient impacts to water bodies and/or

the exposure of geologic materials underlying the surface that might be high in metals or other contaminants.

Thorough operational planning for surface-disturbing activities can limit erosion and sedimentation impacts via construction scheduling and the area exposed at any one time. Typical soil stabilisation practices include compaction, mulching, use of erosion control blankets, rip-rap, gabions, slash management, and dust suppression. Sediment collection practices include the use of straw bale barriers, silt or filter fences, brush sediment barriers, vegetated buffer strips, gravel/rock filter berms, sediment traps or catch basins. WT-16, "Soil Stabilisation and Sediment Control" addresses these practices, which can be selected to support the overall Project design and the minimisation of associated impacts.

#### **4.7 Seeding and Revegetation**

Common mine reclamation management activities include seeding and revegetation, which are intended to enhance the establishment of a vegetative cover on disturbed soil. This not only helps to control erosion, but it also helps return disturbed areas to beneficial uses as quickly as possible. A vegetative cover reduces erosion potential, slows down runoff velocities, and physically holds soil in place with roots. In addition, it can help reduce infiltration through evapotranspiration.

WT-17, "Seeding and Revegetation" will be selectively implemented to minimise impacts, and will address the following practices:

- topsoil management;
- seedbed preparation;
- general planting and seeding;
- broadcast seeding;
- drill seeding;
- vegetative planting;
- wattling;
- soil amendment and fertilisation;
- willow cuttings; and
- maintenance of revegetated areas.

#### **4.8 Range Management**

Range management practices reduce surface water and groundwater quality degradation resulting from grazing as well as reduce livestock and wildlife exposures to mining contaminants and trace metal releases. WT-18, "Erosion Control and Range Management" will be selectively implemented to minimise such impacts, and will address the following areas:

- vegetation sampling and testing;
- fencing; and,
- wildlife management.

## **4.9 Water Management and Erosion Control Monitoring and Evaluation**

The Project Environmental and Social Monitoring Plan includes the evaluation of water management activities and erosion control practices, as implemented over the entire life cycle of the mine. The Environmental and Social Monitoring Plan will cross-reference the specific methods, frequencies, and locations specified in:

- WT-14, "Waste Rock Management Erosion Control Considerations";
- WT-15, "Water Management Erosion Control Considerations"
- WT-16, "Soil Stabilisation and Sediment Control"
- WT-17, "Seeding and Revegetation"; and
- Per WT-18, "Erosion Control and Range Management"

The overall effectiveness of the mine planning process (see MP-14, "Mine Planning Process") with regard to the integration of the erosion control practices recommended in WT-09, "Erosion Control Considerations in Mine Planning" will be addressed by the management review process described in Section 6.0 of the *Roşia Montană Project Environmental and Social Management Plan* and MP-13, "Management Reviews."

## **5 Health and Safety Program Considerations**

All RMGC and contractor activities addressed by this Plan are subject to the requirements of the RMGC Occupational and Health and Safety Plan, as applicable to the hazards associated with specific project assignments and as specifically noted in Section 3.5 and the standard operating procedures cited in Section 4. Any personnel observing unsafe conditions shall notify their supervisors or RMGC Health and Safety staff for initiation of appropriate corrective and preventive action, as noted therein.

## **6 Records Management**

All monitoring and inspection records and all other records specified by governing standard operating procedures shall be forwarded to the RMGC Environmental Management office and retained in accordance with MP-11, "Management of Environmental and Social Management System Records."

## References

### Roşia Montană Project Environmental and Social Management System References

*Roşia Montană Project Environmental and Social Monitoring Plan*  
*Environmental and Social Monitoring Plan Management Plan*  
*Emergency Preparedness & Spill Contingency Plan*  
*Mine Rehabilitation and Closure Plan*  
*Project Meteorological Station Operation Manual*  
*Roşia Montană Environmental Database*  
*Steam Flow Measurement Process Operation Manual*  
*Tailings Management Facility Plan*

#### *Project Standard Operating Procedures Manuals*

- MP-02, "Identification of Legal and Regulatory Requirements"
- MP-03, "Environmental and Social Action Program Training"
- MP-05, "Review, Approval, Controlled Distribution, and Update of Environmental and Social Management System Documents"
- MP-08, "Surveillance Inspection"
- MP-09, "Regulatory Compliance Verifications"
- MP-11, "Management of Environmental and Social Management System Records"
- MP-13, "Management Reviews"
- MP-14, "Mine Planning Process"
- TF-02, "Normal Operating Procedures – Tailings Deposition"
- TF-03 "Normal Operating Procedures - Tailings Water Management"
- TF-06, "Engineering Risk Analysis",
- WT-01, "Preparation, Review, and Periodic Update of Project Water Balance"
- WT-02, "Management of Meteorological, Flow, and Environmental Quality Data"
- WT-03, "Preparation, Review, and Periodic Update of Project Water Quality Model"
- WT-04, "Measurement of Sediment Loads in Ponds"
- WT-09, "Inspection and Monitoring of Lined Ponds"
- WT-10, "Operations and Maintenance of Fresh Water Supply System"
- WT-11, "Operations and Maintenance of the Storm Water and Spill Contingency Pond"
- WT-12, "Operations and Maintenance of the Catchment Dam"
- WT-13, "Erosion Control Considerations in Mine Planning";
- WT-14, "Waste Rock Management Erosion Control Considerations";
- WT-15, "Water Management Erosion Control Considerations"
- WT-16, "Soil Stabilisation and Sediment Control"
- WT-17, "Seeding and Revegetation"
- Per WT-18, "Management of grazing for erosion control"

## External References

1. MWH, 2005; Engineering Review Report, Appendix H
2. Ausenco, 2004, Basic Engineering Review And Design Optimisation
3. MWH 2005, op. cit, Appendices A and H.
4. MWH 2005, *op. cit.*
5. The pond will have the capacity to store runoff from a 50-year precipitation and snowmelt event, with a total of 112 mm over a 24-hr period and is sized based on a 60% runoff coefficient. This translates into the pond required storage volume of about 130,000 cubic metres; this estimate may be revised as necessary in future versions of this Plan.
6. MWH 2005, op. cit., Appendice A2
7. Note: specific water quality requirements for the supernatant pond will be established in future versions of this Plan.
8. Government of Romania, 2004; *Romanian Technical Norms for Water Protection (NTPA)-001/2002*

## **Appendix 1. Figures and Drawings**