CONSERVATION OF SCARCE WATER RESOURCES AT RÖSSING URANIUM MINE

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Introduction

The Rössing Uranium Mine is located approximately 65 km inland from the coast of Namibia in southern Africa (Figure 1). The mine is situated in the Namib Desert, which experiences low and erratic rainfall, high temperatures, and strong seasonal winds resulting in high evaporation rates. Currently the mining and milling process requires 2.4 million m^3 of fresh water per year.

This water is bought from the Namibian parastatal bulk water supplier who abstracts it from two wellfields in the ephemeral Omaruru and Kuiseb rivers (Figure 2). The mine and the growing coastal towns of Walvis Bay, Swakopmund, Henties Bay and Arandis share these water resources of which the mine uses about 25%. The limited and partly non-renewable potable water resources have been put under increasing pressure during the last decade. Recent total abstraction rates from the aquifers are not sustainable in the long term due to low recharge in the rivers under the present climatic conditions.

The fact that the aquifers are being mined has been recognized for a number of years and initiatives to manage demand and conserve the resources have been introduced by the Mine, the Municipalities and the water supplier. Construction of a seawater desalination plant has been proposed by the water supplier to augment the groundwater resources. Rössing Uranium Ltd. has contributed to the water conservation initiatives by:

- Implementing water recycling at the mine
- Minimising high evaporative water losses
- Using alternative lower quality water sources
- Creating awareness to conserve water
- Cooperating with local and regional authorities in preparation for seawater desalination.

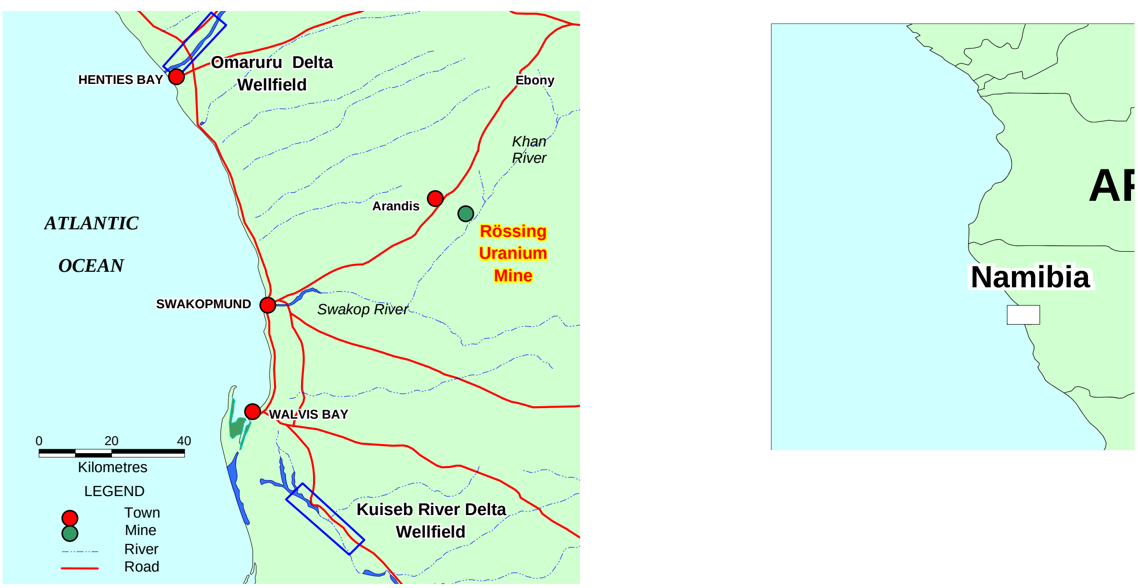

Figure 1: Location of the Rössing Mine along the Atlantic Coast of Namibia

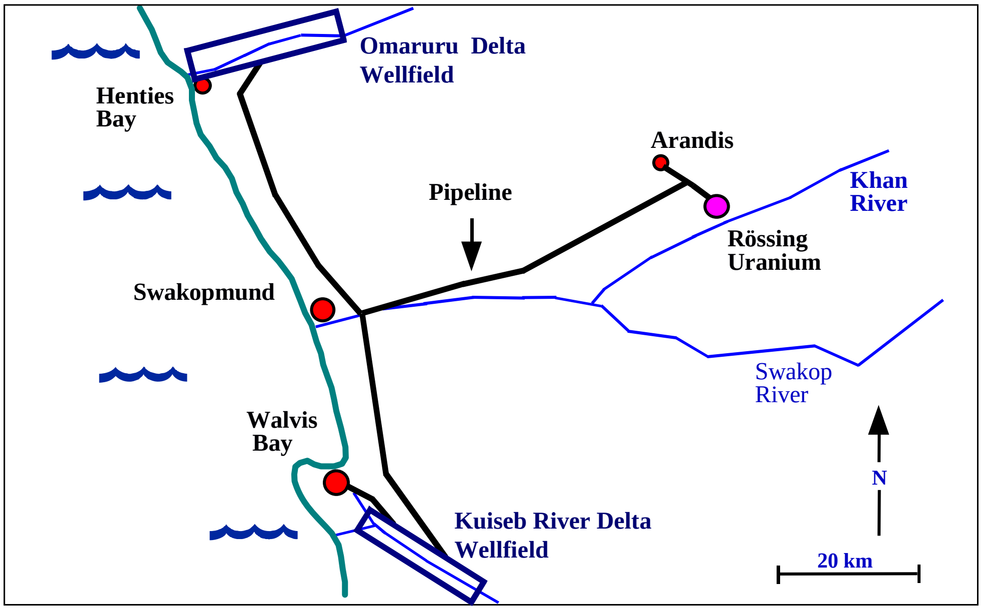

Figure 2: Central Namib Water Supply Scheme

Background

The Rössing Uranium process water balance shows input of fresh water from the water supplier, while the output is dominated by two major loss mechanisms: entrainment in tailings and evaporation from the tailings facility (Figure 3).

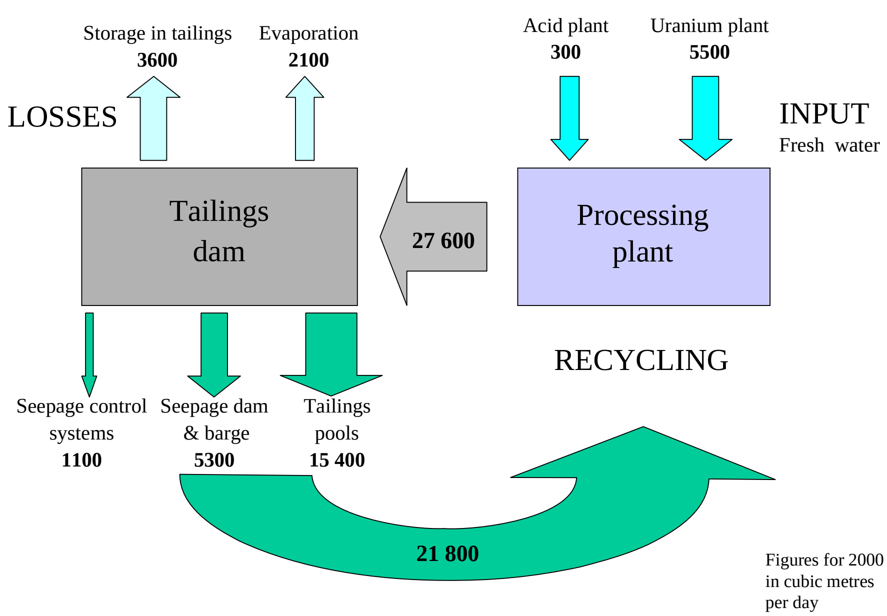

Figure 3: Rössing Uranium Process Water Circuit

Recycling

Between 1976 and 1980, only fresh water was used in the uranium production process and no recycling took place. Used water built up a huge inventory on the tailings facility. Consumption

averaged 25-30 ML/day, which was more than Swakopmund and Walvis Bay's combined consumption (Figure 4).

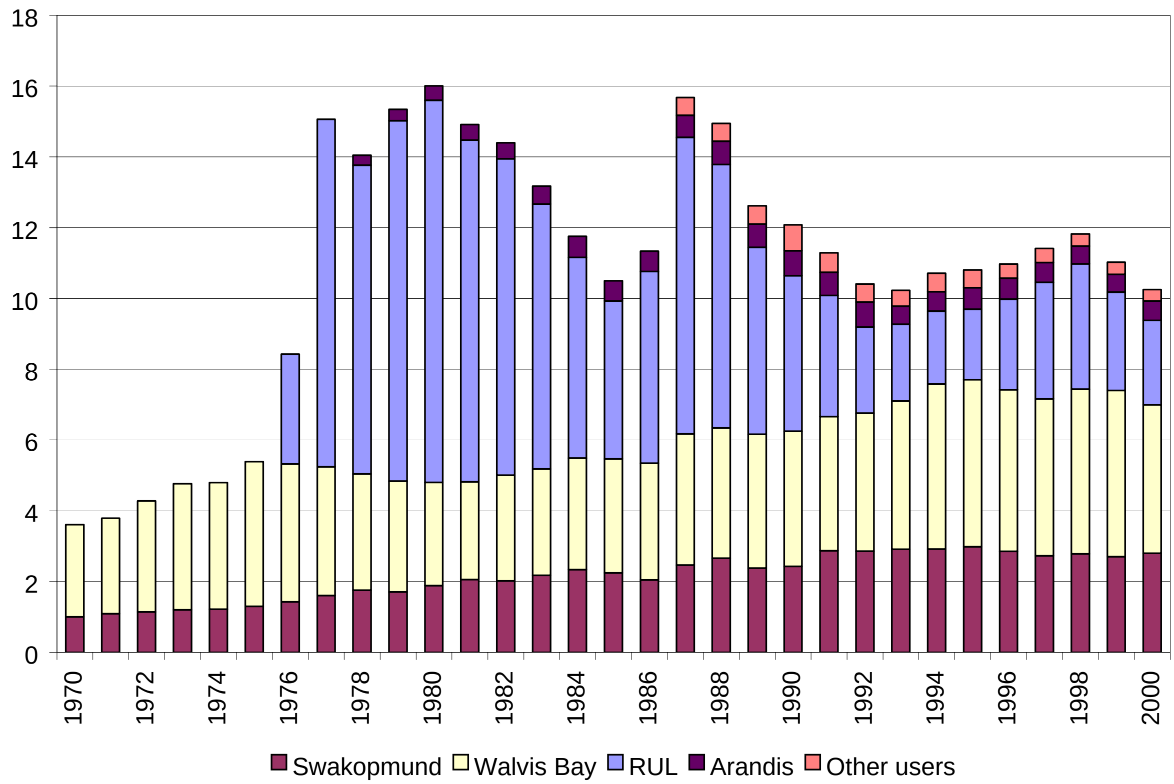

Figure 4: Water Consumption in the Central Namib Area in Mm^3/year

In 1980, recognising the concerns of the authorities, the Department of Water Affairs, Rössing decided to implement a recycling programme. This was done to such an extent that by the middle of 1987 the accumulated water on the tailings dam was depleted. As a temporary measure large volumes of fresh water were added in 1987/88 to re-provide sufficient solution for processing.

Since the early 1980s seepage control installations such as boreholes and cutoff trenches were in place around the tailings facility to prevent contamination of groundwater. Any water recovered by these systems is returned to the processing plant.

A new approach to seepage control at source was introduced in 1999 with the commissioning of a number of production boreholes extracting water directly from the tailings dam. The system will be extended in the near future with the potential to produce up to 700 ML/year. Abstraction and recycling of water from the tailings dam will reduce the mine's fresh water consumption even further.

In addition to tailings solution and seepage Rössing Uranium also recycles smaller streams of effluent. Water used for cleaning and dust suppression in the processing plant is returned to the mills or tailings pumps. Effluent from workshops is pumped to an oil separation plant. The separated water is mixed with semi-purified sewage effluent and used for tailings transport while the recovered oil is added as an ingredient to explosives.

Reducing Evaporation Losses

After the depletion of the large tailings water inventory in 1987 it became clear that permanent water savings could only be achieved by a new approach to tailings and water management.

Evaporation was the primary target for water conservation. The original tailings dam configuration in 1976 showed an evaporation pond of 150 ha at the center and 500 ha of wetted area around the pond (Figure 5). In 1988, the paddock deposition method was introduced. This entailed the subdivision of the facility into smaller areas of typically 40 ha, which were successively used for deposition (Figure 6). The tailings solution was at first decanted by means of a penstock arrangement, which was in 1995 replaced by decanting pumps for every operational paddock. The recycling rate was increased with water returning directly into operations before much evaporation could take place.

Figure 5: Tailings Dam 1976 - 1987

Figure 6: Tailings Dam 2001

Tailings pumping operations were optimised concurrently with dam reconstruction. The tailings delivery systems were originally designed to run at 4.2 m/s to prevent choking of the tailings pipelines. To maintain this velocity, large volumes of up to 30 ML/day of tailings transport water were required. These were reduced by a change in pumping control philosophy and subsequent efforts to operate the plant circuits consistently at the highest possible tailings slurry density.

Since start up, seepage from the toe of the tailings dam was channelled into a seepage collection dam 1 km downstream and recycled from there for use in the processing plant. To reduce evaporation from the surface water streams and the seepage collection dam, cut off trenches were constructed at the toe of the tailings dam in 2000 and seepage is now pumped directly from these trenches into the recycle system.

Other Supply Sources

Alternative supply of lower quality industrial water was already established in the commissioning phase of the mine and currently 0.4 million m^3 per year (see figure 8) are pumped from the nearby Khan River to be used for dust suppression purposes. The aquifer is managed by the Mine under permission of the Namibian Department of Water Affairs ensuring that no damage to the vegetation in the riverbed results from water extraction.

Demand Management

A water awareness programme was launched in 1998 to increase employees' understanding of the need to save water at work and at home. This resulted in a 50% reduction in domestic water consumption on the mine (Figure 7).

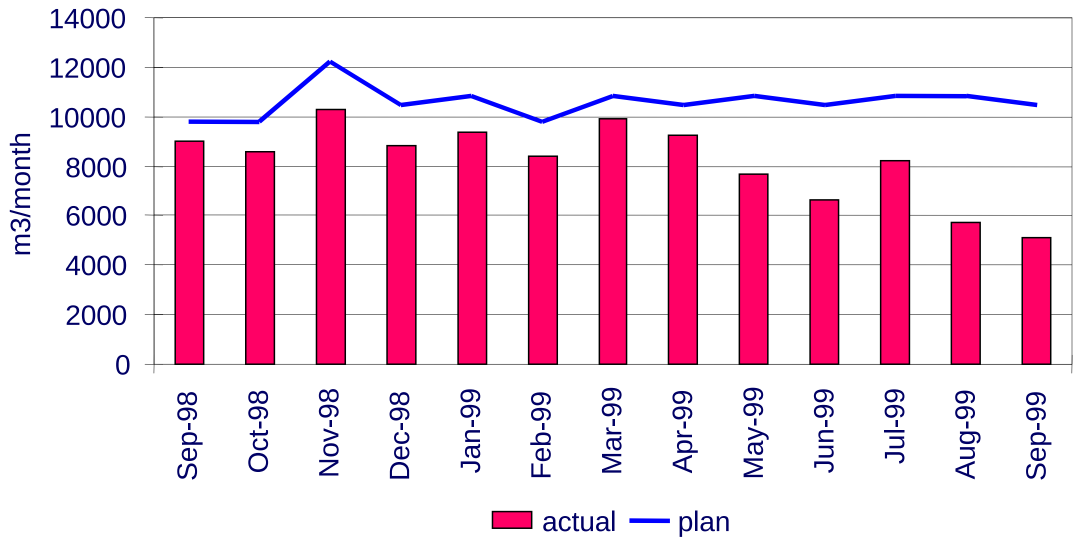

Figure 7: Effect of the Water Awareness Programme on Domestic Water Consumption

Benefits

Modification of the tailings disposal facility and recycling of wastewater reduced the mine's freshwater demand by over 50% from 0.66 m^3 per ton of ore milled in 1980 to 0.21 m^3 per ton of ore milled in 2000 (Figure 8, showing total annual water consumption), ensuring that its operations will remain sustainable with regard to water availability. Through this reduction in freshwater consumption Rössing has prevented a major impact on the coastal aquifers and other users of this scarce resource. Water supply augmentation by seawater desalination was delayed by a number of years.

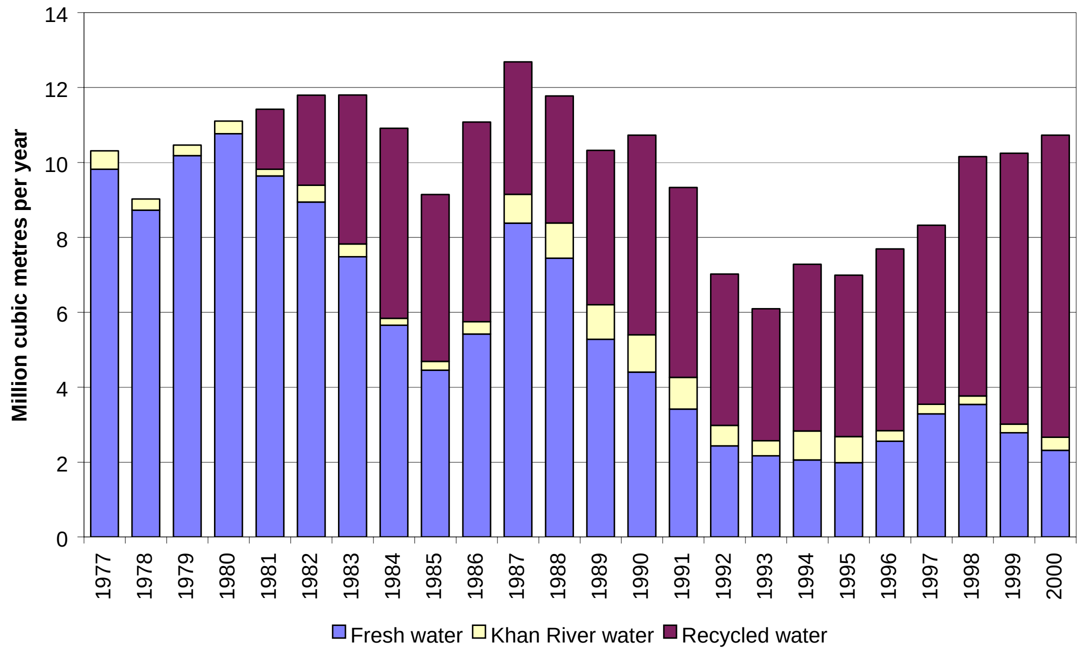

Figure 8: Trend of Fresh and Recycled Water Usage

Regional Cooperation

Although all stakeholders of the Central Namib Area are committed to reducing the regional demand, industrial development and urbanisation caused an increase in water consumption above the sustainable limits. Seawater desalination to augment groundwater supply was delayed by a number of years but has now become inevitable. During the feasibility studies carried out by the bulk water supplier, demand projections and supply contract negotiations were done in close cooperation between the municipalities and the mine. Cooperation has been established for a number of years now and forms a basis for collaboration on other projects of mutual interest.

Acknowledgments

The Rössing case study is based on “The Story of Water at Rössing Uranium Mine”, an internal report produced in September 1997 by R.W Kloot, E. Griebel and C. Brent, Rössing Uranium Limited.

References:

C. Leiner, R. Schneeweiss, Dr. J. Stoddart (2000). Rio Tinto – Improving Its Management Of Scarce Water Resources. Paper given at the 10th World Water Congress, Melbourne, 2000.