2. **A set of suitably located piezometers should be installed in properly designed water-level monitoring boreholes, at appropriate intervals along the lower Swakop River, to assist with routine monitoring of ground water levels. Ideally, additional piezometers should be installed in the Khan River and Swakop River immediately above the confluence of the two rivers. Water quality samples should also be collected from these boreholes whenever water levels are recorded. Water levels should be recorded at least on a monthly basis and used to analyze ground water contributions from the two rivers, as well as changes in water level depth along the lower Swakop River. The information should be made available to the general public.**

3. **All stakeholders should contribute to the formal development of an integrated catchment management plan for the Khan-Swakop catchment. Whilst the major responsibility for water resource management in Namibia lies with the Department of Water Affairs, it is essential that every water user group in these catchments contribute to the development, implementation and maintenance of a catchment management plan. This will allow clear and unambiguous decisions to be made as to the best use of an extremely scarce resource.**

4. **The type of bund design proposed for use in the KARS Project offers a simple yet effective method of increasing the infiltration of surface flood waters into the ground water in the river bed. This technique could be implemented in the lower Swakop River, say between Palmenhorst and Goanikontes, or even further downstream. This would provide water users along the lower Swakop River with an immediate improvement in both the quantity and quality of water available for agricultural use.**

5. **Farmers along the lower Swakop River should implement improved irrigation techniques (particularly drip irrigation), together with the cultivation of salt-tolerant crops, to minimize the adverse effects of saline ground water.**

6. **The Swakopmund Municipality should initiate a routine monitoring programme to record the profiles of beaches between the mouth of the Swakop River and the outskirts of Vineta. This will provide firm evidence as to whether or not the beaches are eroding, and the rate of such erosion.**

ENVIRONMENTAL IMPACT ASSESSMENT OF THE PROPOSED KHAN AQUIFER RECHARGE SCHEME

7. PRELIMINARY ESTIMATE OF MONITORING REQUIREMENTS

It is anticipated that all monitoring associated with the construction of the KARS aquifer recharge scheme will be considered to form part of the overall recommendations of the project. The monitoring programme should strive to ensure that any impacts on the Khan River (litter collection, garbage disposal, sewage disposal, rehabilitation of borrow pits and earth-works, etc.), which may be associated with the construction phase of the project, are kept to an absolute minimum.

Monitoring of the relevant ecological and social aspects of the Khan and Swakop rivers in Namibia presents a complex problem. In this type of situation, it is extremely difficult, if not impossible, to require or force a project proponent to undertake any form of additional environmental monitoring which may require resources (money and manpower) to be expended at locations distant from where the project is undertaken. However, an appropriate monitoring programme, coupled with an effective communications strategy, will make a substantial contribution towards long-term sustainable use of the region's water resources.

The impacts from the proposed aquifer recharge scheme will be most easily visible in the lower reaches of the Swakop River. These impacts are likely to occur several months to several years after the project has been commissioned. This situation will require that any monitoring efforts must be carefully and closely co-ordinated in order to ensure that the greatest value is obtained from the data and information collected.

Similarly, there must be clear and shared agreement on the following:

- which agencies are to be involved and take responsibility for the monitoring programme and any subsequent management actions that may be required;
- what information is to be collected and by whom is it collected;
- how and where the data will be collected;
- how the data will be transformed and integrated into useful management information;
- how and where will the data be stored;
- who will have access to this information; and
- in what form and by what means will information be distributed to interested and affected parties.

Only once these decisions have been taken, and the necessary resources of money, equipment and man-power have been made available, does it become a relatively straight-forward matter to design an appropriate and cost-effective monitoring programme. If these decisions are not resolved at an early stage, then any monitoring

programme will lack cohesion and will lose a large measure of its potential value through being fragmented and incomplete.

Given that there is, as yet, no decision to proceed with the proposed KARS aquifer recharge scheme, there is little point is defining all the details of an appropriate monitoring programme. Ground water levels and quality will always remain a critical issue for land-owners along the lower Swakop River, whether or not the KARS project proceeds. It is strongly recommended that a suitable routine monitoring programme should be implemented as soon as possible so that baseline information can be made available. This will allow trends of change to be established and will facilitate decision-making.

At this time, no attention needs to be directed towards the development of a decommissioning programme for the KARS Dam, until a firm decision has been taken to proceed with construction. Only then will the full cost implications of the KARS project be available.

Nevertheless, there are a number of general issues and principles which can be dealt with at this early stage and statements can be made as to several specific components which should form a central part of any monitoring programme which may be launched in the future. The major environmental (ecological and social) components which should form part of any monitoring programme include the following issues.

7.1 Climate and water flow data

Climate data should continue to be monitored at existing weather stations along the Khan and Swakop rivers. Ideally, each weather station should be capable of recording maximum and minimum temperatures, relative humidity, daily rainfall, wind speed and hours of sunlight. Data to be available within 6-8 weeks of collection.

River flows should continue to be monitored in both the Khan and Swakop rivers. These flow gauging stations should ideally be capable of continuous flow gauging with data storage on chart or tape. Data must be available for analysis no later than 6-8 weeks after collection. Each flow gauging station should be calibrated (or re-calibrated) regularly, and particular attention should be paid to their ability to accurately record low flows.

Flows into the lower Swakop River should be monitored. Inflows are currently calculated from flows measured at upstream stations; whilst this provides a reasonable level of accuracy, it is not ideal. Data should be stored on chart and tape and should be made available for analysis within 8 weeks of collection. Gauging stations should have their calibrations checked regularly.

Estimates of ground water levels and flow rates within the Khan and Swakop rivers provide extremely useful information as to what changes can be expected to occur.

This monitoring needs to be started as soon as possible, and should be closely co-ordinated and conducted regularly if it is to be of any use in evaluating the consequences of management actions.

7.2 Sediment transport

Sediment transport is a critically important mechanism upon which many of the ecological functions of the Khan and Swakop rivers depend. In the past, attempts to obtain accurate data on the quantities of sediment transported by flood waters in the Khan River revealed values of between 2 % and 23 % of the flood water volume. This variation indicates clearly the problems of accurate sampling and the variability of suspended sediments in flood waters. In future, accurate measurements of suspended sediment loads will enable better estimates to be made of the likely life of the KARS dam.

Accurate measurements of sediment load and rates of transport require specific field sampling apparatus and trained personnel; the measurements themselves are both tedious and time-consuming. Nevertheless, they provide extremely useful information which improves not only our understanding of river functioning, but also of the rate of sediment accumulation.

7.3 Standard water quality parameters

The normal range of water quality parameters (major cations and anions, pH, conductivity, nutrients (nitrogen and phosphorus), should be monitored routinely at boreholes and at the flow-gauging stations to evaluate ground water quality in the Khan and Swakop rivers. Given the number of people who rely on the river for all their water requirements, routine water quality monitoring will provide an assessment of the fitness-for-use of the lower Swakop River.

7.4 Radio-isotopes

Given the public concern around the issue of radio-isotopes and radio-activity in general, it will be very important to continue with routine measurements of selected radio-isotopes in ground water. These measurements should be carried out by Rössing staff, but there should also be independent verification by an external organization. This will help to resolve the concern that Rössing may not be reporting enough information.

7.5 Riparian vegetation

The current vegetation monitoring programme along the Rössing Mine frontage should be expanded from its current level of to include the lower Khan River down

to its junction with the Swakop River. The current intensity and frequency of sampling should continue. This will allow firstly, comparisons to be made against the vegetation condition which has prevailed since the start of the monitoring programme and, secondly, will allow evaluation of any effects which the proposed Khan Dam and the aquifer recharge scheme may have on downstream vegetation.

Fixed-point photography should be used to provide a basis for visual comparisons with earlier stages. Great care should be taken in any decision to use direct measurements of moisture stress in the riparian trees. The preferred techniques of moisture stress measurement require several measurements to be made using living tree material. This can result in the removal of considerable quantities of small branches and leaves. Since most of the riparian trees do not have dense foliage, this can lead to a relatively rapid loss of foliage and can cause a rapid increase in moisture stress levels within individual trees.

7.6 Human and socio-economic impacts

Clearly, if the proposed KARS aquifer recharge scheme is expected to have even minor adverse ecological impacts, it is likely also to have adverse impacts on people. Accordingly, these should be identified and monitored to assess the reliability and scale of predictions, as well as to provide a focus for possible remedial actions such as compensation.

The most important issue is to identify those individuals along the lower Swakop River who are likely to be adversely impacted or might benefit from the scheme. Given the anticipated spatial scale and location of the expected impacts, this will involve a relatively small number of people in a restricted area. Regular ground surveys should be undertaken to develop a clear picture of the scale and duration of any impacts, as they occur. These should then be evaluated, together with representatives of the affected communities, against criteria drawn up previously, regarding remedial management actions and even financial compensation. It is unwise to attempt to deal with these issues after impacts start to be experienced.

Issues which should be monitored include the extent of change in water table and the degree of change in water quality that has taken place over time, the financial and economic value of these changes, the extent to which these uses are (or may be) impaired or altered, the availability and suitability of possible alternative resources, and the effectiveness of procedures for allocating resources to communities or compensating them for losses experienced.

7.7 Data storage and handling

If at all possible, all data relating to the Khan and Swakop river system should be kept at a central facility, even if the data are collected by different agencies. This will facilitate curation of the data and will allow rapid comparisons to be made of

data from different sectors and of different aspects of the system. All data tapes and files should be backed up with the backup copies kept in a fire-proof facility.

Monitoring data should be reported regularly, in accordance with any statutory requirements laid down in terms of water abstraction permits issued by the Department of Water Affairs.

In addition, it would be very useful to Rössing if summarized monitoring data could be made available to the general public. Whilst this is not presently required in terms of any Namibian legislation, this would help to alleviate some of the public's suspicion that information is being concealed from them. Preferably, the Department of Water Affairs should be involved in the dissemination of such information to the general public, together with a clear statement as to whether or not the data indicate that Rössing are complying with the terms of their water abstraction permit and effluent control permits.

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Dr J.S. De Wet, Deputy Director: Water Environment Division, Department of Water Affairs, Windhoek. Water demand in the West Coast region of namibia.

Ms A. Eggars, Geohydrologist, Department of Water affairs, Namibia. Aquifer characteristics of ephemeral rivers in the Namib Desert.

Mr P. Hamman, Swakopmund, member of the 1958-1962 CSIR team who studied the hydrology of the Swakop River.

Mr L. Hesse, Project Director, Swakopmund Municipality. Specialist information on landowners and irrigation agriculture along the lower Swakop River.

Members of the KARS Working Group elected at a Swakopmund public meeting.

Owners of farms and smallholdings along the lower Swakop River, Swakopmund.

Dr J. Ward, Chief Geologist, NAMDEB. Coastal zone dynamics and geology specialist. Dune geomorphology and movements, beach erosion and sediment transport in Namib Desert rivers.

Mr J.S. Schoonees, Coastal Engineer, Environmentek, CSIR, Stellenbosch. Beach erosion along Namibia West Coast.

Dr D. Scott, Hydrologist, Environmentek, CSIR, Stellenbosch. Water consumption of riparian vegetation along West Coast rivers.

Dr J. Vogel, Isotope Specialist, Environmentek, CSIR, Pretoria. Dune geomorphology, uranium isotopes in water.

Mr E. Braune, Director: Geohydrology, South African Department of Water Affairs & Forestry. Aquifer characteristics of the Khan and Swakop rivers.

Ms P. Caldwell, Senior Policy Programme Officer, Environmental Assessment Branch, Environment Canada, Quebec. International environmental regulations affecting uranium mining operations.

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CSIR RESPONSES TO COMMENTS RECEIVED ON THE DRAFT E.I.A. REPORT

As part of the consultative process followed during the execution of the technical studies for the KARS Project proposed by Rössing Uranium, the Draft E.I.A. Report and its Executive Summary were made available for public review and comment. In addition, Dr Mary Seely of the Desert Research Foundation of Namibia and Mr Peter Tarr of the Namibian Ministry of Environment and Tourism were requested to review the entire Report. The Namibian Department of Water Affairs was also invited to comment on the entire Report.

A wide variety of verbal and written comments and suggestions for improvement have been received from the External Reviewers, Government Departments, Local Authorities and members of the general public. All of these have been summarized, as well as listed in detail, in the Comments Report prepared by Brian Gibson Issue Management (BGIM, 1997b). This list formed the basis for the responses prepared by the CSIR.

A few of the comments made by members of the public dealt with issues specific to Rio Tinto's international operations; these were considered to fall outside the scope of this E.I.A. Report and therefore have not been addressed in the Final Report.

All of the other verbal and written comments and suggestions were carefully evaluated. Wherever possible, the text of the E.I.A. Report and the Executive Summary were amended to reflect the issues raised. In this process, the Executive Summary and several sections of the E.I.A. Report were re-written to reflect the suggestions. The table below and on the following pages notes the E.I.A. Report chapter where each of the comments made has been dealt with by the CSIR. Where comments were considered to address issues outside the scope of the E.I.A. Report, this has been listed as "Not appropriate to the KARS study".

Table 1: Responses to comments received on the Draft E.I.A. Report.

Comment made by:	Issue	Response
Verbal comments made at the Usakos Public Meeting on 27 May 1997	*Impacts* • How were levels of uncertainty derived in matrix • More information on vegetation impacts	• Uncertainty levels removed from report • Chapter 5
	Project information • How much water will Rössing extract • Improved information on Khan River floods • Was ming grant extended for KARS	• Chapter 4 • Chapter 4 • Yes.