

## 20. ANALYSIS AND INTERPRETATION OF RESULTS

Analysing your RHP results requires a thorough evaluation of incoming information. This includes checking all scores and comparing these to known standards and previous results. To assist with drawing meaningful conclusions from SASS and IHAS results, a set of guidelines have been produced (see SASS4 manual and NAEBP Report No8). Water quality conditions have been proposed for different categories of total score and average score per taxon.

The software packages (such as Rivers Database Query Centre and GIS programmes) mentioned in the previous section (section 19.2) offer a number of analytical tools to assist the user in analysing results. It may take some time to become familiar with all of these features and what they are capable of doing. Depending on your circumstances, you may wish to outsource the GIS spatial analysis component to a specialised GIS unit attached to a university or water board.

Interpretation implies deriving meaning from the analysis of the results. This is probably the most complex and demanding aspect of the RHP. A thorough knowledge of land-use and developments within the catchment is necessary to provide the context for understanding and interpreting your RHP results. Particularly for locating and identifying potential sources of environmental impacts and quantifying the effects of these on the aquatic ecosystem and prevailing water quality.

### ***Additional factors to take into account when interpreting results:***

- \$ Seasonality - the season when monitoring took place is an important factor to consider when analysing results. For SASS scores, expect the diversity of invertebrates to be considerably lower during the cold winter months, with no attendant deterioration in water quality. Some fish species migrate with the changing of seasons, which may also influence your FAIR results.
- \$ Flow conditions - South African rivers are renowned to possess highly variable flows, often independent of seasonality. Changes in flow conditions of a river during wet and dry climatic conditions will influence your results and may not necessarily point to major anthropogenic (man-induced) alterations in water quality.
- \$ Natural variation in invertebrate, fish and plant diversity - this may be independent of water quality and habitat conditions. Fauna and flora are known to vary from region to region or even from site to site and over time. This should be borne in mind when applying predetermined guidelines to your results.
- \$ The resolution of SASS scores is at invertebrate family level, so changes in species level composition of some invertebrate communities in response to alterations in water quality may not be detected. However, major changes in abundance of invertebrate taxa (especially of the environmentally tolerant groups) may be significant in this respect.
- \$ Level of training of the PMT staff. This may affect the consistency of your results, particularly in the first year of your programme.

As the RHP is a long-term commitment to the garnering of pertinent environmental information, it will take some time before a meaningful set of results is accumulated for analysis and interpretation. For example, a data set of one year may show seasonal trends and major impacts, whereas a time-series of several years of information for a particular catchment will be much more valuable in terms of understanding environmental trends.

### **NOTE:**

Your ability to analyse and interpret results will improve with experience and as you become more familiar with local environmental conditions and how these affect your RHP results. Other RHP practitioners can be consulted to assist in drawing meaningful conclusions from your results.



## 21. REPORTING

Now that the information has been captured, analysed and meaningful deductions have been made, the next step is to make these available to your target audience. This group of people includes environmental managers and the variety of organisations mentioned in the previous sections.

***Reporting should take into account the five key questions:***

- \$ What to report - what type of information is relevant to your target audience
- \$ To whom - who is your target audience
- \$ When - how often should reporting be conducted
- \$ How to report - which format to use to ensure that your information is understandable
- \$ Why - ensure that your target audience actually needs the information.

The level of reporting will determine the amount of detail required. RHP reporting may be required at local, regional or national scale, with different prerogatives attached to each (see NAEBP report No 8 for more details). However, at the provincial or catchment level where implementation actually happens, you will mostly concerned with local and regional reporting. Potential target audiences at the local and regional level include your relevant River Forum, CMAs, government departments and interested and affected parties.

The **presentation**, **format** and **content** of the information should preferably be tailored to suite the nature and background of the target audience to ensure that your audience derives the maximum benefit from your RHP. For example, aquatic scientists and managers who are familiar with the RHP indices, would probably be more interested in the actual results of the indices, while school groups would derive more meaning from synthesised graphical representations of the RHP results. However, there is no fixed recipe for which format to use for which audience. Various options will have to be tried and tested to determine which is the most effective for which audience. Other RHP practitioners should be contacted for guidance on reporting formats and content.

Another important aspect to consider is whether your reporting is to other role-players within the RHP, or whether it is intended for external parties. This will influence the style, composition and presentation of the results. For example, the RHP NCT may require a very different report to say government officials or representatives from industry.

A useful starting point would be to categorise your potential audiences (based on information needs, type of information required and presentation format) into the following three broad groups:

### 21.1 POTENTIAL AUDIENCES

- \$ Political and administrative - includes national and provincial government department heads
- \$ Operational and managerial - includes directors and senior managers of government departments with an environmental responsibility, national and provincial Parks and Tourism Boards, Water Boards, Local and District Councils, River Forums, CMAs and Industry
- \$ Interested and Affected Parties - local communities, farmers, industry, scientists, conservationists, schools and the media.

**See NAEBP report No6 chapter 5 for more details on reporting and target audiences.**

## **21.2 TYPES OF ENVIRONMENTAL REPORTING TO WHICH THE RHP CAN CONTRIBUTE**

- \$ State of the Environment reporting - this is becoming increasingly important nationally, provincially and locally. The RHP is ideally suited to making significant contributions to the knowledge of the state of ecological conditions of rivers, as the RHP indices are useful predetermined indicators of ecosystem health.
- \$ State of Rivers reporting - is based on principles of State of the Environment reporting. A report has been produced for the Mpumalanga rivers.
- \$ Environmental reports of the relevant government departments and industries within the catchment.

## 22. MANAGEMENT ACTIONS

The RHP is specifically designed to **assist environmental decision makers with the management of South Africa's freshwater resources**. Hence the results obtained through data collection, analysis of results and interpretation and reporting on environmental trends should lead to **management actions** where these are required. Such management actions can only realistically arise from what the RHP is designed to monitor and assess.

The RHP is primarily **a tool for keeping “a finger on the pulse” of long-term environmental trends** such as the gradual deterioration in water quality and ecological integrity and the possible causes or sources of these. Hence, where this has been shown to occur, the RHP can contribute to **a management plan which addresses these issues**. The formulation and implementation of this management plan should involve all the stakeholders and interested and affected parties in an integrated manner, with clear roles and responsibilities assigned to each (Figure 7).

After discussion with your PIT, the next step in initiating such management actions is to identify the possible causes and sources of the ecological and water quality deterioration. Once these have been established, **contact the parties concerned and present your RHP findings**. These should be in the form of a report clearly showing the RHP results and an interpretation of these. Through a **participatory process**, managerial solutions may be reached and mitigatory measures can then be implemented, without resorting to legal litigation. However, if this fails, then the situation requires the attention of government authorities.

The RHP is also a **monitoring tool designed to “red-flag” environmental problems** detected at monitoring sites. Where your RHP has detected a severe ecological impairment due to a major catastrophic event (e.g. a pollution spill), the results can be used as **preliminary evidence** to initiate a more detailed investigation. The RHP can also be used to monitor the long-term ecological recovery of such impacted sites and assess the effectiveness of the rehabilitation measures.

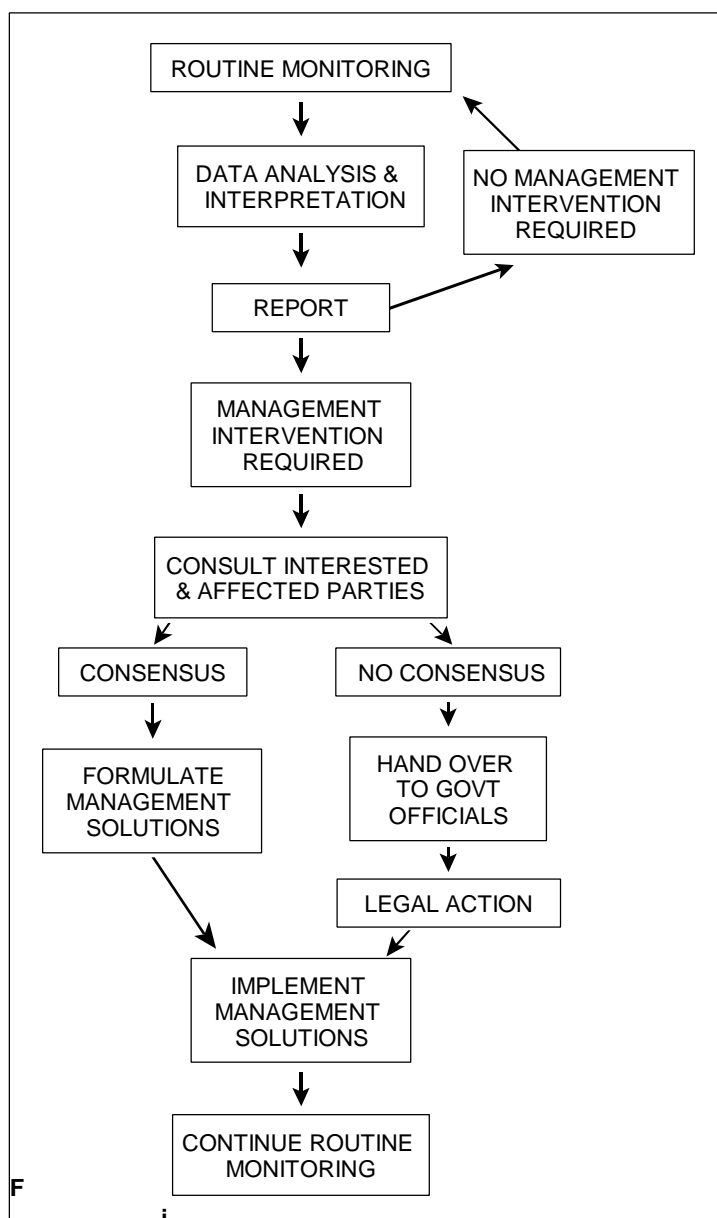


Figure 1. A diagram for the instituting management actions for the RHP.

**Non-compliance** by industry to Environmental Impact Assessment permit conditions or DWAF permit conditions may also be detected through the RHP monitoring and bring about management interventions to protect the river system from further degradation. The relevant DWAF and provincial environmental affairs officials should be alerted to this immediately. Municipal and local council officers should also be informed.

If a consultative management solution is not reached, then **legal litigation** is required. This is the domain of the DWAF, environmental affairs and local council officials. Where such legal litigation is called for, it must be remembered that your RHP results obtained from the various indices do not have legal standing in a court of law. For this, **legally recognised methods of gathering environmental evidence** must be used. These normally involve the collecting of water samples by an externally approved agency for chemical analysis at an accredited laboratory.

**See legal context section (section 2) for more information on the RHP and the law.**

## 23. QUALITY CONTROL AND ASSURANCE

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To ensure that your RHP results are reliably comparable over time and between sites, it is vital that **biomonitoring and data collection be performed in a consistent and standardised way**. It is no use having a brilliantly designed RHP programme, if the information being gathered is unreliable. Quality control and quality assurance (QC/QA) are the procedures which ensure that **set standards are maintained** throughout your programme.

The QC/QA is very important as persistent undetected errors that occur at the biomonitoring stage, could ultimately distort the interpretation of the perceived ecological trends and condition of a catchment. Preferably all aspects of the RHP process (programme design and implementation, sampling, recording of results, data capture, analysis and reporting) should be subjected to periodic audits (inspections) and quality control measures.

Quality control and assurance **should begin with your RHP programme design and implementation plan**. To make sure that your programme is realistically designed and incorporates all important aspects, it should be reviewed by the NCT. Once this has been successfully achieved, standards and procedures need to be set for the different aspects of your programme.

**Some RHP aspects for QC/QA include:**

- \$ Equipment checks
- \$ Biomonitoring sampling techniques
- \$ Identification proficiency (invertebrates, fish, riparian vegetation)
- \$ Recording of results on standard forms
- \$ Adherence to RHP index methodology
- \$ Coverage of Monitoring and Reference sites
- \$ Adherence to biomonitoring frequencies
- \$ Data capturing on computer
- \$ Maintenance of data
- \$ Analysis of information
- \$ Presentation of information
- \$ Reporting methods
- \$ Remedial actions by management.

The auditing of biomonitoring sampling techniques and use of instruments can be done by random spot checks in the field. Auditing of invertebrate identifications can be done by preserving whole samples and bringing these back to the laboratory for analysis. The results obtained can then be compared to the field based results. This should be done preferably by either a central auditor or one of the members of the PIT with biomonitoring experience. Occasional checks on the accuracy of the recording of results on the database are also recommended. We are all human, so occasional mistakes can be expected!

**NOTE:**

A Proficiency Testing Scheme (PTS) has been developed by Umgeni Water to test the SASS identifying ability of SASS practitioners countrywide. Once practitioners have qualified, then their data collected will be flagged as "validated" on the national Rivers Database. A similar system could be devised for fish identification.

Auditing may also be done during the process of analysing your RHP results for the detection of environmental

trends. Due to the discriminatory nature of data analysis, major anomalies during data capture can be detected and checked. Follow up investigations can then be made to ascertain where the error crept in.

**NOTE:**

It is very important that QC/QA should not be seen as a policing exercise. It should rather be a process of enhancing the performance and proficiency of all personnel, from the PMT to the provincial champion.

**For more information on QC/QA, see report by Chris Dickens on the RHP website and Procedures for Provincial Implementation. Chapter 3. Quality Control and Assurance by Rob Palmer.**



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## 24. ADDITIONAL CONSIDERATIONS

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### 24.1 THE RHP AND TRANSBOUNDARY RIVERS AND SHARED CATCHMENTS

Rivers form the borders of a number of the provinces in South Africa. Hence the issue of shared catchments (between two or more provinces) and transboundary rivers (headwaters in one province and lower reaches in another) is likely to arise. For example, the Vaal River catchment straddles five provinces!

Transboundary rivers and shared catchments may occur both at a provincial and WMA scale and this basically translates into shared responsibilities for RHP monitoring of these rivers. It is essential to coordinate and plan your RHP initiatives with your neighbouring provincial RHPs for these rivers and to exchange pertinent information on a regular basis. In this way, a holistic picture of the entire river system can be developed and that the river catchment is managed in an integrated way.

### 24.2 INTERNATIONAL RIVER SYSTEMS

The RHP implications for the management of international river systems such as the Limpopo are not being considered in the short and medium term. However, this is presumed to be an important aspect in the long-term as it is envisaged that the national RHP will eventually become a southern African freshwater resources management programme.

### 24.3 COLLABORATING WITH THE STATE-OF-RIVERS (SOR) INITIATIVE

This is a relatively new initiative in South Africa which has its roots in the State of the Environment (SOE) reporting. The state of the rivers is a catchment-based assessment of how climate, topography and human activities such as land-use and population interact and the effect of these to the general condition of the river. SoR reports have already been produced for the Crocodile, Sabie-Sand, and Olifants Rivers in Mpumalanga Province.

The SoR approach is based on the Drivers, Pressures, States, Impacts and Responses (D,P,S,I,R) model used in the State of the Environment (SoE) reporting. A set of standardised environmental indicators is used to evaluate environmental trends. The RHP's objectives of "measuring, assessing and reporting on the ecological state of aquatic ecosystems" and the programme's use of standardised indices to "measure" aquatic ecosystem health, makes the RHP an ideal partner of SoR reporting.

**For more on the State-of-Rivers reporting consult the RHP website:**  
**[www.csir.co.za/rhp/state\\_of\\_rivers.html](http://www.csir.co.za/rhp/state_of_rivers.html)**

### 24.4 LINKING YOUR RHP WITH EXISTING CONSERVATION AND BIODIVERSITY PROGRAMMES

The RHP has the potential to make a significant contribution to freshwater conservation and biodiversity research programmes. For a little extra effort, your RHP fieldwork could also include the collection of representative samples of aquatic fauna and flora which can be sent to museums and universities for further research.

The Albany Museum in Grahamstown houses the National Collection of Freshwater Invertebrates, the largest freshwater fish collection in South Africa as well as a large herbarium. The JLB Smith Institute of Ichthyology in Grahamstown also houses a large freshwater fish collection. The Port Elizabeth Museum houses a major reptile and amphibian collection. The National Botanical Institute (NBI) could be contacted for the RHP contributions to further research into plant biodiversity. Apart from making a contribution to the knowledge of local biodiversity and ecology by donating specimens to these organisations, researchers there are generally willing to share ecological and taxonomic information which will benefit your RHP.

It is suggested that provincial RHP implementers contact the aforementioned organisations to investigate the potential for collaborative biodiversity and ecological research. They may be able to supply you with bottles, labels, preservatives and advice on collecting techniques. Most essential is to record the date, locality, latitude and longitude and possibly habitat on a label attached to each sample or specimen. Any other field notes will be useful.

#### **24.5 WORKING-FOR-WATER PROGRAMME**

The Working for Water (WFW) programme is a national programme initiated by the DWAF to remove thirsty alien tree species growing in river catchments. These include black wattle, pinetrees, bluegums and poplars and many others. Apart from increasing the flow, the sudden removal of these trees can alter the river catchment characteristics significantly, particularly in the upper reaches of the river.

The RHP is an ideal monitoring tool for assessing the before, during and after effects of removal of alien tree species from river catchments. The RHP could also be a useful source of information of long-term environmental trends associated with the monitoring of the ecological status of alien tree cleared catchments. The geomorphological index can be used to assess whether the river channel condition becomes significantly altered through possible erosion or siltation after the alien tree infestations have been chopped out. Habitat quality for fish and invertebrates may also be affected.

## 25. ORGANISATIONS OFFERING SUPPORT FOR THE RHP

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- \$ DWAF - National. Dr Henk van Vliet is chairperson of RHP National Coordinating Committee and can be contacted regarding major policy issues.
- \$ DWAF - IWQS. For expert advice and training. On site training in SASS and IHAS and preliminary site selection can be arranged with the IWQS staff. They can also offer advice on equipment issues, sampling and other practicalities. The IWQS water quality laboratory has capacity for chemical analysis of water samples, including heavy metals. Ms Annelize Gerber and Ms Mary-Jean Gabriel have produced a SASS colour pictorial guide to identifying invertebrates in the field. Dr Neels Kleynhans has spearheaded the research and development of the Fish Assemblage Integrity Index (FAII) as well as the Index of Habitat Integrity (IHI).
- \$ DWAF - Cape Town. Ms Toni Belcher is the Western Cape RHP Champion. Various initiatives are currently taking place such as training, customising of RHP indices and applying the Rivers Database.
- \$ DEAT. Dr Geoff Cowan is currently the DEAT representative on the RHP NCC and is involved with the national wetlands initiative.
- \$ WRC. Dr Steve Mitchell is the WRC representative on the RHP NCC who is responsible for the coordination of RHP training requirements. He can also be contacted for RHP research and funding issues.
- \$ CSIR. Dr Dirk Roux for general assistance regarding the design and implementation of the RHP and coordination of the programme as well as NCT matters. Ms Anna Ballance is compiling the State-of Rivers reports for several Mpumalanga rivers.
- \$ NFHR Consulting. Ms Nomsa Ntshingila for training and capacity building requirements of provincial RHP initiatives.
- \$ Umgeni Water. Dr Chris Dickens and his team have considerable experience in biomonitoring programmes (especially SASS) and implementation of the KwaZulu-Natal RHP.
- \$ Provincial Environmental Affairs Depts - particularly Mpumalanga Parks and Tourism Board. The Mpumalanga RHP was the first provincial RHP and is now well established in many rivers. Dr Johan Engelbrecht and his biomonitoring team have considerable experience in applying the Fish Assemblage Integrity Index (FAII), SASS and Riparian Vegetation Index (RVI). Mr Mick Angliss of the Northern Province Dept of Agriculture, Environment and Land Affairs has been involved with applying and developing the FAII and the RHP is well established in the province. Mr Pierre de Villiers of the Free State Dept of Agriculture, Environment and Conservation has been using the FAII and launching the provincial RHP. Mr Piet Muller of the Gauteng Dept of Agriculture, Environment and Conservation has taken command of the Gauteng provincial RHP. Dr Margaret Kalule-Sabiti and Mr Stuart Mangold of North West Dept of Agriculture, Conservation and Environment have conducted initial site surveys and training in selected rivers in the province.

- \$ The RHP National Coordinating Team should be your starting point to support your local RHP. Dr Dirk Roux, Ms Liesl Hill and Ms Vassie Maharaj can be contacted for more information on the various aspects of the RHP.
- \$ Southern Waters Ecological Research and Consulting. This organisation can be contacted for information about the Rivers Database and aquatic ecological surveys and general RHP issues. Also Dr Helen Dallas for assistance with the establishment of ecological reference conditions for riverine macroinvertebrates. This organisation has been involved with the RHP from its inception.
- \$ Institute for Water Research (IWR), Rhodes University. Prof. Jay O'Keeffe, Dr Patsy Sherman and Dr Nikite Muller. IWR offers a comprehensive biomonitoring training course twice per year. IWR has also been involved with various aspects of the RHP from its inception.
- \$ Dept of Freshwater Invertebrates (FWI), Albany Museum, Grahamstown . FWI can be consulted for specialist identification of freshwater invertebrates and initial baseline surveys of freshwater invertebrates in selected rivers and housing of aquatic invertebrate collections and biodiversity research. In collaboration with the WRC, FWI is developing a series of invertebrate guides with keys to most groups. Contact Dr Ferdy de Moor and Ms Helen James.
- \$ Dept of Freshwater Fishes, Albany Museum, Grahamstown . Dr Jim Cambray can be contacted for initial baseline surveys of freshwater fishes in selected rivers and housing of fish collections and biodiversity research.
- \$ AfriDev Consultants. This company does ecological assessments, catchment management studies, community consultation and participation and runs SASS training courses. Dr Mark Chutter developed SASS for South African conditions. Dr Rob Palmer has developed criteria for RHP quality control.
- \$ Manyaka Greyling (Pty) Ltd - for communication and promotion of the RHP as well as public participation and liaison issues. They are the editors of the RHP Newsletter. Contact Ms Vassie Maharaj.
- \$ Catchem Biomonitoring. This company specialises in making biomonitoring equipment, particularly SASS nets and SASS sampling kits. Contact George Johnstone.

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## 26. LIST OF CONTACTS

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**For a comprehensive and up to date list of contacts, contact the RHP Communication Office:**

Mayaka Greyling (Pty) Ltd  
P O Box 95823  
Waterkloof  
Pretoria 0145  
**Tel:** (012) 362 0848  
**Fax:** (012) 362 0869  
**Email:** [vassie@liaison.co.za](mailto:vassie@liaison.co.za)

Alternatively, visit the **RHP website:** <http://www.csir.co.za/rhp/>



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## 27. USEFUL READING

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***For a comprehensive list of reading material relevant to the RHP:***

- \$ NAEBP Report No6. *Overview of the design process and guidelines for implementation* Appendix A (Roux, 1997).
- \$ NAEBP Report No8 *National Implementation Assessment* reference list (Murray, 1999).
- \$ The national RHP website: <http://www.csir.co.za/rhp/>.
- \$ Water Research Commission Report No. *Procedures for Provincial Implementation of the National River Health Programme* (available on the RHP website).





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