EXECUTIVE SUMMARY

Development of water quality methods within ecological Reserve determinations

This project was initiated in 2000 to allow the ecological Reserve team for water quality to undertake additional research while working on ecological Reserve determinations funded by the Department of Water Affairs and Forestry. The results of this work form the basis of the methods reported in the Water Research Commission report Hughes DA (Ed)(in press) *SPATSIM, an integrating framework for ecological Reserve determination in implementation: incorporating water quality and quantity components for rivers;* specifically in Chapter 6: Palmer, Muller and Hughes "*Water Quality in the ecological Reserve*".

This documentation of processes of development is especially important since some of the recorded "lessons learned" have not yet been taken up.

The concept of the ecological Reserve was accepted by Parliament, and became the cornerstone of the resource protection policy (DWAF 1997), with ecological Reserve assessments being required by law in 1998 (National Water Act No. 36 of 1998). During the process of policy formulation and drafting it was argued that methods existed to quantify the ecological Reserve. This was true for water quantity (Palmer 1999) – water flow and the associated ecological responses of ecosystem integrity, geomorphology, riparian vegetation, fish and invertebrates. However it was recognized that supplying adequate flows in space and time would not necessarily lead to ecosystem health if water quality (water chemistry) was impaired. The NWA therefore specifically included water quality criteria within the ecological Reserve.

Formal methods for determining water quality aspects of the Ecological Reserve were then developed in two major processes:

- DWAF organised method-development workshops and contracts; and
- DWAF contracted ecological Reserve assessments.

The combined workshop/contract process led to the publication of the first official water quality method in 1999. As ecological Reserve assessments were undertaken, methods were extended and modified. Three major ecological Reserve assessments contributed to this process: the Crocodile (Mpumalanga), Olifants (Mpumalanga) and Breede (Western Cape) Rivers. Members of the WRC project team for this project were closely involved in the Olifants and Breede River assessments, and this project was planned on the basis of using the data and methods developed during those studies. However, it became clear that other innovative approaches were developed during the Crocodile River Ecological Reserve assessment and details of this study were included.

Main contributions from Case Studies

Olifants River

- The first methods were developed and applied, including a method relating salt toxicity to resource classes.

- The need for a range of skills in a water quality team was identified: aquatic ecology, aquatic ecotoxicology, water chemistry, and flow/concentration modelling.

- The lack of routine monitoring of key variables was identified (temperature, dissolved oxygen and total suspended solids), and a recommendation made for data collection over one or two seasons preceding the study, not just during the execution of the study.

- The principal was established that environmental flows are not recommended to solve water quality problems, rather that water quality consequences of recommended environmental flows are noted. Managers then have the option of allocating flows for dilution, or enforcing stricter source directed controls. However, it was noted that there was perception amongst water resource managers that all water quality problems will be solved by source directed controls. This leads to a lack of attention to the consequences of flows on water quality. The time frame to implement source control measures is often very long and to see results often even longer. There is therefore the need to control abstractions or to find some other way to allow for interim dilution.

- The importance of the appropriate scale of management decisions was highlighted. In the Olifants study there was not the opportunity to evaluate catchment scale impacts. An attempt by the water quality team to address this was to identify "Hot spots" and "Refugia". "Refugia" were the Blyde and Mohlapitse Rivers which were essential to maintain or reach water quality objectives in the Olifants River in the Kruger Park. "Hot spots" were areas that needed urgent attention, e.g. Selati and Klip Rivers.

Breede River

- The Breede River study allowed for the simultaneous, and comparative application of water quality methods within the Downstream Responses to Instream Flow Transformations (DRIFT) and Building Block Methodology (BBM) methods:
  - DRIFT: more critical and rigorous use of water quality data (generic and specific descriptors useful).
  - DRIFT: tentative "minimum degradation flows" is useful for the water quality team to focus thinking. Water quality consequences can be refined with the information from other specialists.
  - DRIFT: Resource Quality Objectives (RQO) should be an explicit product of DRIFT (as in BBM) (some of this is captured but hidden in the descriptors and database) and linked to Classes/flow-reduction scenarios.
  - BBM: (in the current workshop) used water quality more analytically due to recent exposure to the DRIFT method (see point 1).
  - For water quality, DRIFT is a more useful approach as water quality consequences are consequences for summer and winter base flows vs. a single month in summer and winter for BBM. The latter may lead to missing peaks (e.g. TDS water high flow peak in the Western Cape) outside of the 2 selected months.
  - BBM: confidence in prediction per site while in DRIFT give confidence, severity, data source and direction of change for each water quality variable and element of flow reduction.

- In the Breede River study the water quality procedure was better integrated with the quantity-based workshop procedure. Data and actions required for the workshop were listed:
  - A starter document describing both reference conditions (RC) and present ecological state (PES) for specified water quality variables per identified reach/Instream Flow Requirement (IFR) site.
  - Prepared scatter plots (especially flow vs. water quality variable, and trend of changes in water quality over time).
  - Box and whisker plots to examine and describe seasonal distributions.

- Summary statistics (recommend inclusion of 5% and 95%): mean, median, 5%, 25%, 75% and 95%.
- Maps of **all** the water quality monitoring points and biomonitoring points on a catchment land-use map (including point sources etc.).
- All available water quality data, biomonitoring data, toxicology data, pollution data (POLMON).
- Flow-concentration water quality modelling templates for RC and PES (NB: need hydrological information).
- Time-series profiles: if doing stressor-responses (T-Soft) for RC and PES (if data available) flow-concentration matrices, concentration-stress matrices for IFR sites and for specified water quality variables are needed.
- Prepare generic descriptors for water quality variables (required for DRIFT workshop only).

- Toxicology data was confirmed as being invaluable.

- The mismatch between **daily** hydrology data and **monthly** water quality data was noted.

Main contributions from this report

A proposed modified method was provided to DWAF and formed the basis of developments reported in Hughes (Ed)(in press).