NATIONAL RIVERS AUTHORITY

ECOTOXICOLOGY

A REPORT OF THE NRA R&D ECOTOXICOLOGY GROUP

NRA

ECOTOXICOLOGY

1. BACKGROUND

In 1989, prior to the introduction of the NRA's R&D programme (R&D matrix management scheme), NRA interests and aspirations in ecotoxicology were fragmented, uncoordinated and dispersed between the regions. National initiatives were not well defined or guided towards business needs. In general, accountability was poor, as was the dissemination of information.

This report details the progress made since then and identifies a way ahead to meet NRA requirements from the Topic.

2. THE R&D ECOTOXICOLOGY GROUP

The Topic Investment Appraisal for Ecotoxicology, originally composed in January 1990 and modified in March 1990, identifies the objectives of the Topic and itemises the projects together with their project objectives, timescales and budgets (Ref. 1). This appraisal formed the basis for the programme of work undertaken by the Ecotoxicology Group (membership appended) during 1990 which culminated with the dissemination of information at a seminar, on ecotoxicological techniques and issues, presented at WRc Medmenham in January 1991.

During 1990, the various regional and national interests in this topic area were structured by individual Project and Retrospective Project Investment Appraisals and by completion of the Topic Review, which identified the new initiatives for 1991.

This programme of work, together with a comprehensive review of ecotoxicological approaches undertaken by WRc under contract to the NRA (Ref.2), now permits the development of a strategy to deploy key elements of the ecotoxicology component of the R&D programme which is currently incurring expenditure in excess of £300,000 per annum.

3. ECOTOXICOLOGY - KEY ELEMENTS OF THE TOPIC

3.1 DIRECT TOXICITY ASSESSMENT AND TOXICITY BASED CONSENTS

In the United States, Canada and many European countries, the use of the Direct Toxicity Assessment approach for regulatory purposes is well established. This approach and the application of Toxicity Based Consents is little used in the UK but has been identified in the report of the Kinnersley Group (Ref.3), as an effective means of controlling the discharge of complex effluents, e.g. Flue-gas desulpherisation units, paper-mill semi-chemical pulp production, petrochemical industry.

Two projects in the Ecotoxicolgy Topic; one setting out a protocol for adopting DTA and Toxicity Based Consents, which has been completed, and one assessing the approach by case studies, due for completion in 1992 (Ref.1), will progress Recommendation 16 of the Kinnersley Group which reads: *"For environmentally significant discharges of complex composition where not all important constituents can be individually identified and numerically limited, consents should specify a clearly-defined toxicity limit, the appropriate form of toxicity test to be used, and the minimum frequency with which it should be applied."* Further actions are identified in section 4.

3.2 ECOTOXICOLOGICAL METHODS - DEVELOPMENT AND APPLICATION

Ecotoxicological information is of value to the NRA for the following reasons:

i) recommending Environmental Quality Standards which will be set to achieve the Use-Related Class to protect identified uses and to challenge existing standards where these are inadequate. The majority of standards currently employed to protect the aquatic environment are based on toxicity data which are derived from tests on non-indigenous species, often with death as the end point for measurement and often unrelated to the environment to which they are applied. The development of tests employing indigenous species with sub-lethal measures of effects are required.

ii) to assist with the assessment of deteriorations in water quality, resulting from either acute pollution incidents or more insidious chronic effects. Ecotoxicological responses provide a more sensitive measure of environmental change than do either chemical or biological routine sample analyses and thus have the potential to provide an early warning of possible problems. They also provide procedures for investigating unaccountable differences between chemical and biological quality and to monitor receiving water quality where pollutant sources are episodic or from non-point sources, e.g. farm waste. The effects of effluent from complex discharges on the environment, such as disinfected sewage and industrial wastes, may also be better assessed using ecotoxicological methods.

iii) to assist with the setting of consent conditions to protect the receiving water course. In addition to the initiatives on Toxicity Based Consents, the numerical parameters applied are done so with regard to the best available toxicological information. Ecotoxicological information can enhance consent setting procedures and improve the associated monitoring requirements e.g. watercress industry.

On-going projects in the Ecotoxicolgy Topic are progressing the development of ecotoxicological techniques and new initiatives are planned to apply selected procedures to investigate unaccountable differences between chemical and biological information collected during the 1990 Water Quality Survey of England and Wales (Ref.4). Further actions are identified in Section 4.

3.3 ECOTOXICOLOGICAL DATABASE

There are a number of toxicological databases in existence, all of which have certain merits, but which, in general, fail to satisfy the needs of the NRA. The NRA currently has access to WRc's database but it is important that the NRA requirements are clearly specified and that the ecotoxicological database be developed accordingly.

A new project, to start in April 1991, will assess the NRA requirements and progress the development of a sound ecotoxicological database (Ref.4). This work will include proposals for re-testing many substances for which inadequate toxicological data exists and new substances for which there is little or no information. The database will also provide the vehicle for the establishment of an Ecotoxicological Information Service. Further actions are identified in Section 4.

3.4 BIOACCUMULATION AND BIOMONITORS

A wide range of indicator species have been employed to establish accumulated body burden information for a variety of contaminants and habitat types. To improve the quality of controlled waters the NRA needs a better understanding of the significance, behaviour and fate of contaminants in the aquatic environment. In general, the toxic responses observed in aquatic organisms are only an indirect consequence of the ambient concentration of contaminants, but they are a direct result of the accumulated body burden.

A review, which will investigate the relationship between toxicity and body burdens, is currently being undertaken in the Ecotoxicology Topic and is due for completion by October 1991 (Ref.4). This work should provide valuable information for the design of future biomonitoring and modelling studies and may provide the basis by which more realistic standards can be applied to control complex effluents. Further action will await the outcome of the review.

4. RECOMMENDATIONS TO PROGRESS AND IMPLEMENT ECOTOXICOLOGICAL RESEARCH AND DEVELOPMENT IN THE NRA

The agreed strategy to progress R&D in the Ecotoxicology Topic is financed in the range of £250,000 - £400,000 each year. Clearly it is important to justify this level of expenditure by demonstrating application to NRA business needs.

To this end a number of actions are required from NRA regional staff to help progress the R&D to obtain maximum benefit. The following recommendations are made:

4.1 DIRECT TOXICITY ASSESSMENT AND TOXICITY BASED CONSENTS

Recommendation 1: Chief Scientist's Department to provide an agreed NRA interpretation of recommendation 16 of the Kinnersley report and the policy for setting Toxicity Based Consents.

Recommendation 2: Environmental Quality Managers should consider the application of Toxicity Based Consents in their Region and identify a priority list of potential candidate discharges.

Recommendation 3: The NRA Ecotoxicology Group, in conjunction with the WRc, should consider the list of potential candidate discharges, together with all relevant details regarding the discharge type, during the course of the current R&D case study programme. On completion of this programme guidance should be given on the procedures for applying a Toxicity Based Consent and on the associated implementation and monitoring requirements.

4.2 ECOTOXICOLOGICAL METHODS - DEVELOPMENT AND APPLICATION

Recommendation 4: The Ecotoxicological - New Approaches Review (Ref.2) identifies a number of methods showing most promise for further development. The criteria used to select these methods include; ecological relevance, use of indigenous species, sub-lethal testing etc. The Ecotoxicology Group should consider these in detail to recommend a selection of methods to meet NRA requirements. These will be issued as a series of operational guidelines.

Recommendation 5: Following the selection of suitable methods, the Ecotoxicology Group should agree standard operating conditions which should be strategically deployed to assess the value of such methods to the management of water quality. A variety of potential problems where ecotoxicological methods might prove useful should be identified by regional staff and case studies selected.

Recommendation 6: The Ecotoxicology Group, in conjunction with the WRc, should organise technical workshops to instruct Regional Water Quality Officers in the application of ecotoxicological methods.

4.3 ECOTOXICOLOGICAL DATABASE

Recommendation 7: The Ecotoxicology Group should clearly define the type of ecotoxicological information required to meet the needs of the NRA, be it for setting standards, assessing water quality changes or deriving consent criteria.

Recommendation 8: Once the ecotoxicological database has been established, the Ecotoxicology Group should consult Regional staff and identify a priority list of substances for testing. An extensive, yet well-defined, programme of ecotoxicity testing (which will include many substances for which only standard acute toxicity data exists) should ensue.

Recommendation 9: The establishment of a good ecotoxicological database should support a Toxicity Information Service to the NRA. The Ecotoxicology Group should consider the requirements, which will depend largely on the end-users, and identify the development programme.

4.4 BIOACCUMULATION AND BIOMONITORS

4.4.1 Further action will await the outcome of the review (Ref.4).

4.5 DISSEMINATION OF RESULTS

Recommendation 10: The Ecotoxicology Group to advise the R&D Commissioner for Water Quality on the most appropriate methods of disseminating ecotoxicology R&D results.

5. A STRATEGY TO DEPLOY KEY ELEMENTS OF THE ECOTOXICOLOGY RESEARCH AND DEVELOPMENT PROGRAMME

Ecotoxicology offers the NRA much potential to enhance current procedures for water quality management. In some cases international initiatives have clearly demonstrated the value of some ecotoxicological techniques and the NRA has wisely supported R&D in this Topic area.

To justify the R&D expenditure, it is important that the Topic Investment Appraisal and Topic Review be linked to a strategy to deploy key elements of the research.

The key elements of ecotoxicological R&D and the further actions necessary to progress the research have been identified. To obtain the maximum benefit from these initiatives it is suggested that the Ecotoxicology R&D Group progress the R&D programme, monitor the recommendations and report to Environmental Quality Committee via the R&D Commissioner for Water Quality.

The following timescales are proposed:

RECOMMENDATION	1991			1992			1993	1994
	AUG	OCT	DEC	FEB	APR	JUN	AUG	
1.	----------							
2.	----------							
3.	----------							
4.	----------							
5.	----------			----------				
6.					----------			
7.	----------							
8.							----------	
9.							----------	
10.			----------					

At the end of each phase the Ecotoxicology R&D Group should actively monitor the implementation of ecotoxicological procedures in the NRA and review the requirement for new R&D initiatives.

6. REFERENCES

1. NRA Research and Development - Commission A Water Quality, Topic Investment Appraisal for Ecotoxicology. March 1990, amended June 1990.

2. Ecotoxicology - New Approaches. NRA commissioned review. WRc Report NR2676. March 1991.

3. Discharge consent and compliance policy: a blueprint for the future. A report of the policy group on discharge consents and compliance - D.Kinnersley (Chairman). NRA Water Quality Series No.1, July 1990.

4. NRA Research and Development - Commission A Water Quality, Topic Review for Ecotoxicology. August 1990.

APPENDIX

ECOTOXICOLOGY

NRA R&D Group representation :

J.Wharfe	- Southern Region (Topic Leader),
D.Lowthion	- Southern Region (Project Leader and Group secretary to December 1990),
J.Lillywhite	- Southern Region (Group secretary from January 1991)
R.Sweeting	- Thames Region (Project Leader),
D.Tinsley	- Thames Region (Project Leader),
R.Milne	- Welsh Region (Project Leader),
G.Llewellyn	- HQ (R&D Planning Officer),
T.Crawshaw	- Anglian Region (from January 1991).