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# Engineering Flavour in Environmental Science and Management Studies

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This paper describes the rationale for the incorporation of engineering topics in environmental science and environmental management courses at La Trobe University in Wodonga, Australia. The environmental science course is an undergraduate programme with the dual focus of natural resource management and waste management, thus offering potential employment in two distinct fields. The environmental management course is a postgraduate diploma programme based on waste management and catchment management, and is well supported by local industries and organisations.

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## INTRODUCTION

In Australia the natural environment and its associated resources form the nucleus of economic growth, and they need to be protected from the impacts of development activities. Environmental deterioration, whether it relates to water quality impairment, land degradation, atmospheric pollution or the loss of biological species, is identified as a direct consequence of the exploitation of natural resources and other human activities. Environmental science, which is interdisciplinary, deals with many complex and interrelated problems involving human population, natural resources of the earth and pollution of the environment. It uses and combines information from biology, ecology, chemistry, physics, geology, engineering, natural resource management, economics, sociology and politics.

## THE ROLE OF ENGINEERING IN ENVIRONMENTAL MANAGEMENT

Environmental engineering is a multidisciplinary branch of engineering in which engineering activities are planned, designed, established and managed in an ecologically sustainable manner. Improvements in community health in the recent past have been due principally to advances in the field of environmental engineering. The most important of these advances have been those reducing the spread of water-borne diseases through the improvement of drinking water qual-

ity, and the effective management of community wastewater and solid wastes. Environmental engineering also plays a part in the conservation and management of ecosystems. Australia's natural resources include water, soils, minerals, fossil fuels and native forests. Environmental problems such as water pollution, land degradation, greenhouse effect, loss of biological species and proliferation of exotic species are of concern to the environmental managers.

The Murray-Darling Basin, which occupies about 14% of the total area of Australia, is the sixth largest river basin in the world. About twenty major rivers and numerous smaller tributaries drain the region. It supports a population of around two million people, in addition to 25% of the nation's cattle and dairy farms, about 50% of its sheep, lambs and cropland, and almost 75% of its irrigated land. It is the *food basket* of the country and home for many food processing and light industries, mines and forestry activities. A recent review of the various resources of the Basin is contained in a publication by Crabb [1]. Studies have shown that in wet years more than 80% of the nutrient input to surface waters in the Murray-Darling Basin derive from diffuse sources, but that in dry years more than 50% derive from point sources, particularly sewage treatment plants [2]. These create environmental problems and the application of engineering principles and practices are required to minimise or eliminate them. The most effective best practice management approaches to environmental manage-

ment encompass both engineering and ecological principles.

### **DESCRIPTION OF THE COURSES AT LA TROBE UNIVERSITY, ALBURY/WODONGA CAMPUS**

There are a number of tertiary environmental courses conducted in Australian universities, with specialisations in a range of areas such as environmental engineering, cleaner production, environmental health, environmental law, environmental education, ecology, natural resource management, land management, hydrology and water resources, waste management and ecotourism [3]. At the Albury/Wodonga Campus, two environmental teaching programmes are offered:

- Bachelor of Science (Environmental Management and Ecology)
- Graduate Diploma in Environmental Management

#### **Bachelor of Science (Environmental Management and Ecology)**

The Bachelor of Science (Environmental Management and Ecology) is a unique three year science course within Australia and was established in 1994 after consultation with a number of organisations in the Murray-Darling River Basin and other environmental professionals. The course provides a sound foundation in biology and ecology, and specialist knowledge of natural resource management and waste management issues across a range of areas, and the skills and confidence necessary to use that knowledge in practice in a meaningful and effective manner. The students are taught biology, chemistry, environmental physics, statistics, theoretical and applied ecology, ecological genetics and evolutionary ecology, natural resource management, environmental pollution control and waste management.

The subject Environmental Pollution Control is spread over two semesters in the second year of the course, and the topics covered include water pollution, raw water treatment processes, wastewater flows and characteristics, sewer systems, low-cost waste water treatment systems design, stormwater management and drainage, solid waste characteristics and management strategies, and air pollution control.

In the third year the subject Waste Management and Pollution Control is taught over two semesters and the topics covered include process design of wastewater treatment systems, wastewater irrigation, design of constructed wetlands, operation and management of sanitary landfills, energy recovery systems,

planning of solid waste collection systems, cleaner production, industrial ecology and industrial waste management, and agricultural waste management. In addition the students are required to complete an equivalent of four weeks of work placement in an organisation to carry out a project related to either waste management and pollution control or natural resource management.

Some of the projects carried out to date are:

- Evaluation of the efficiency of polymer addition in the wastewater treatment plant of a major pet-food processor (Uncle Ben's of Australia)
- Eastern Murray hydrogeological project
- Treatment options for reuse of biosolids
- Water audit at Uncle Ben's in Wodonga
- Green and building waste in Albury
- BOD reduction in aeration tanks at Australian Newsprint Mills
- Stormwater quality at Uncle Ben's in Wodonga
- The suitability of continuous microfiltration at Uncle Ben's wastewater treatment plant

The field trips and laboratory classes are centred around water and wastewater treatment plants and sanitary landfills. The main feature of the course is its strong base in biology and particular emphasis on engineering applications for the management of water, wastewater, solid wastes and land resources. Students learn by both theoretical and practical experience, and seek employment in government and semi-government agencies, private industries and research organisations.

#### **Graduate Diploma in Environmental Management**

This two-year part-time course is designed for people already employed in areas that involve the need to make decisions on environmentally sensitive issues and to justify these decisions to employers and to the local community. The general entrance requirement is a degree or an equivalent diploma in any field of study. Students in this course undertake subjects that are designed to improve their knowledge of the ecology of the local area, and to introduce them to the problems of waste management and catchment management, including the human, economic and legal aspects; in addition, all students undertake a project in the second year. Topics in waste management and catchment management subjects include water and wastewater treatment processes, cleaner production, biosolids management, sanitary landfill planning, design, operation and management, analysis of solid waste

collection systems, flow measuring techniques, flood damage mitigation, rainfall runoff estimations, open channel flows and stormwater management. The engineering principles relevant to the above topics are introduced and maintained at a level suitable for students with different backgrounds.

Some of the projects carried out by students in this course include:

- Evaluation of effluent irrigation at Beechworth farm
- The development of treatment processes for wastewater at a regional industrial solvent recycling facility
- Impact of river management on river bank vegetation and erosion
- An investigation of composting as a means of waste minimisation
- Use of paper mill sludge as a fertiliser and soil conditioner
- Waste management in beef cattle feedlots
- Waste treatment at a petfood cannery
- Chemical removal of phosphorus at the Albury sewage treatment plant
- Ozone treatment of wastewater from a meat/fish processing plant
- Investigation of urban stormwater runoff and associated nutrient pollution in the River Murray

The inclusion of waste management and catchment management has attracted engineers, scientists, teachers, lawyers, agricultural consultants, farmers, journalists and other officers from governmental and non-governmental organisations within the Murray-Darling Basin to undertake the course.

## CONCLUSION

The environmental science and environmental management studies at the Albury/Wodonga Campus of La Trobe university have engineering input in various subjects. The curriculum has been designed to ensure that students understand the engineering designs and applications commonly encountered in environmental management. The major outcome of these courses is that graduates employed individually as ecologists, environmental consultants, pollution control officers, waste managers, water quality officers, biologists, fisheries and wildlife officers or limnologists integrate well with the engineering profession for the better management of natural resources and the environment.

## REFERENCES

1. Crabb, P., Murray-Darling Basin Resources. Murray-Darling Basin Commission, Canberra, Australia (1997).
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3. Cockburn, T., Lello, P., Mergard, J. and Pagan, B., Directory of Environmental Courses in Australia. Document prepared for the Australian Environment Protection Agency, Canberra, Australia (1995).

## BIOGRAPHIES



Percival Thomas is a Civil Engineer with specialisation in environmental engineering. He obtained his PhD from the University of Wales in the United Kingdom and has about twenty years of teaching and research experience in different universities. Currently he is a Senior Lecturer at the Albury/Wodonga campus of La Trobe University. His research interests include solid waste management, recycling of biosolids, constructed wetlands for wastewater treatment and urban stormwater quality.



Roger Croome is presently Principal Lecturer in Environmental Management at the Albury/Wodonga campus of La Trobe University. Roger has a broad background in aquatic ecology and applied water resource management, particularly with respect to the maintenance of water supplies and the ecological management of both lakes and rivers. Much of his experience in water quality, algal taxonomy and ecology, environmental monitoring, and the conduct and overview of ecological research was gained while working for governmental water resource agencies in southeastern Australia.

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by A.I. Petrenko, V.V.Ladogubets, V.V. Tchkalov and Z.J. Pudlowski

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