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Teaching process sustainability

A ROLE-PLAYING CASE FOCUSED ON FINDING NEW SOLUTIONS TO A WASTE-WATER MANAGEMENT PROBLEM

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When people think about sustainability, they often focus on 'content' issues. It is natural for people to want the outcomes of decisions to be sustainable: for example, for organisations to reduce their production of wastes, or for individuals to consume energy that is produced from renewable sources. What is sometimes forgotten, however, is that the *process* by which we move towards sustainable outcomes also needs to be sustainable.

This chapter examines the link between sustainable outcomes and process sustainability, by way of a case study. The 'outcome focus' of the case is the attempt to determine a new, and more sustainable, waste-water treatment option for a regional town in a particularly beautiful part of southern Western Australia. Its inhabitants have a strong interest in environmental preservation. In the early 1990s the Government Water Authority announced its intention to construct a new secondary waste-water treatment plant that would emit treated sewage from an outfall pipe on a cliff overlooking the Southern Ocean.

This interactive, role-playing case study investigates the problem by assigning stakeholder roles to students. The case allows students to reassess the way government bureaucrats made their original decision, and has them search for a better solution. It asks students to think about whether it is possible to find a sustainable solution to a problem, without addressing the sustainability of the decision-making process.

The chapter begins with an introduction to the content of the problem, and then outlines the development of conflict surrounding possible solutions. It moves on to introduce the concept of 'process sustainability', and then outlines the interest groups involved in the controversy. Finally, it presents some information on the timing of the development proposal, and finishes with some conclusions and a collection of background material that further illuminates the problem.

In large part, the chapter has been designed to allow for interactive role-playing, where students can participate in a public meeting and work towards resolving a conflict. Ideas for instructors are included as an attachment at the end of the chapter.

Background

The town of Albany, situated 410 km south of the capital city of Perth, is an economic focus for Western Australia's Great Southern region. Historically, the region's economy has been dominated by primary production, largely agriculture and fisheries, and in recent times it has become increasingly dependent on tourism.

The natural environment of the Albany district is a major attraction, and a reason for inward migration. The pristine, often rugged coastline is also prized for its tourism value and the region is marketed as the Rainbow Coast. Not surprisingly, Albany residents have high expectations for the quality of their surrounding environment and are thus especially sensitive to any developments that may affect it.

During the 1980s the Environmental Protection Authority (EPA) undertook a major study into the impacts of industrial, agricultural and residential developments on Albany's harbours (EPA 1990). That study showed that waste products from a variety of activities were elevating nutrient levels within the harbours to values that could not be assimilated by the system without leading to adverse effects. Consequently, the biotic environment of the harbours was being severely degraded. Part of the pollutant load entering the harbours was identified as the Water Authority of Western Australia's (Water Authority's) treated domestic sewage from Albany.

The EPA's report carried a number of recommendations, one of which was that the Water Authority should cease outflow from its 36-year-old King Point Treatment Plant (close to Middleton Beach) by 1994 (see Fig. 15.1). At the same time, around the end of the 1980s, the Water Authority had also realised that continued population growth was placing undue strain on ageing infrastructure and that the time had come for the upgrading of existing waste-water treatment facilities.

Sewerage development at Albany

A reticulated sewage collection, treatment and disposal system was first constructed in Albany in the 1960s to alleviate major health hazards. Since then, the system has undergone a series of modifications and expansions to meet the needs of a steadily growing number of users. During the period in which this case study developed—the early

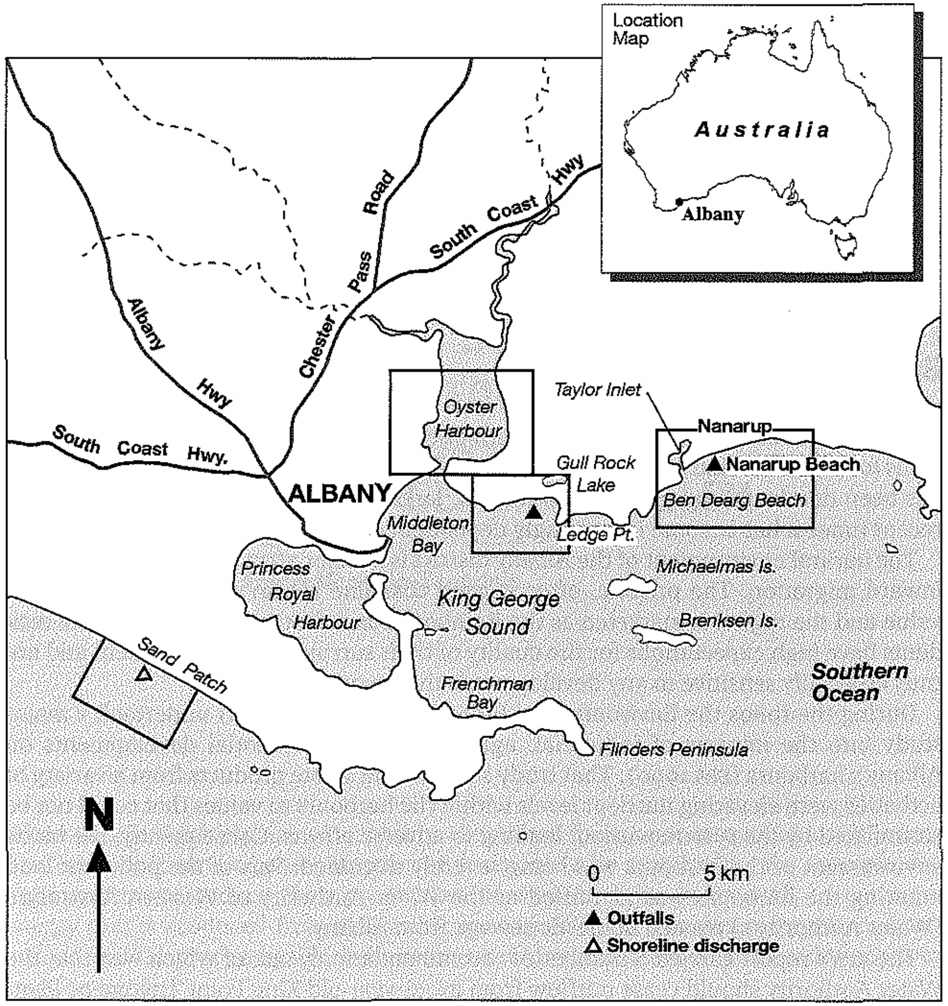

FIGURE 15.1 Proposed location of options for marine disposal of waste-water for Albany

1990s—it consisted of four waste-water treatment plants, each with its own disposal system.

The King Point waste-water treatment plant (No. 1) handled the majority (approximately 70%) of Albany's sewage: in mid-1988, this represented 2,900 domestic connections (servicing about 8,700 people). Sewage here underwent primary treatment and treated waste-water was discharged to nearby King George Sound.[1]

The Timewell Road waste-water treatment plant (No. 2) treated the bulk of the remaining effluent: in July 1988, this represented 1,150 domestic connections (servic-

1 Primary treatment involves screening and sedimentation to remove solid materials from the waste-water.

ing about 3,450 people), plus the discharge from Masters Dairy (equivalent to that of about 830 people). Secondary treated waste-water from this plant was discharged through a small wetland watercourse into Five Mile Creek, eventually leading to the Southern Ocean through the Torbay Inlet.[2]

Remaining waste-water treatment plants (No. 3 and No. 4) handled small amounts of effluent—sewage from 400 and 220 people respectively, in 1988. After treatment with activated sludge, reclaimed waste-water from these plants was disposed of on-site into sandy soils.[3]

A major internal review of the Albany sewerage system found that the capacity of all plants to expand in response to increasing flows was extremely limited. The review developed and compared seven treatment and disposal options to cater for the increase in demand into the next century. These options covered a variety of waste-water treatments at single or multiple plants, and a range of disposal options including discharge to ocean, inland watercourses and land. The review's final recommendation was that effluent be treated to secondary level by aerated ponds both at No. 2 waste-water treatment plant (Timewell Rd) and at a new plant to be sited near Cuthbert (to be No. 5 waste-water treatment plant), and then be discharged to the Southern Ocean at a site 700 m west of Sand Patch (see Fig. 15.1). Plants numbers 1, 3 and 4 would be closed down.

Development of conflict

Early in 1990 the Water Authority released the findings of its internal review to the public, in the form of a 'glossy' brochure promoting the cliff-edge discharge option at Sand Patch. The publication of this decision raised considerable opposition from a range of interest groups, including surfers, salmon fishermen, abalone divers, environment action groups and the general public. Such was the concern that the Water Authority decided to undertake a programme of community consultation to assess the overall community reaction to the proposal. It established a community-based committee under the chairmanship of retired Murdoch University Environmental Science Professor Des O'Connor.

The O'Connor Committee was given access to the Water Authority's internal review. The seven options investigated by the Water Authority included:

- Secondary treatment and dispersal to Sand Patch, Nanarup Beach or Ledge Point (see Fig. 15.1)

2 Secondary treatment involves a biological treatment process, following primary treatment, in which organic wastes are consumed by bacteria under controlled conditions.

3 Activated sludge derives from the bacterial consumption of organic waste during the secondary treatment process. Aerated bacteria from the sludge converts the organic component of waste-water into bacterial mass and stabilised compounds such as nitrates, sulphates and carbon dioxide.

- Tertiary treatment[4] and dispersal to Sand Patch
- Secondary treatment and dispersal to land within a reasonable radius from Albany

Following a number of public meetings and the receipt of submissions, the O'Connor Committee—with public support—suggested that the Water Authority pursue a 'zero' discharge option where fully treated waste-water would be recycled and used again for domestic purposes. This suggestion was essentially an extension of the tertiary treatment option, without the need for a disposal outfall. The Water Authority refused to accept the 'zero' discharge option, believing that it would be too expensive and could not be justified given the relatively small amount of waste-water requiring disposal, and the turbulence of local ocean environments.

Towards the end of 1990, opposition became even stronger, as local people's perceptions of Water Authority intransigence hardened. It became clear at this point that if the Water Authority continued to pursue secondary treatment and pipeline disposal at Sand Patch then local opponents would fight the decision, possibly in the courts.

What is 'process sustainability'?

While the definition of 'sustainability' is still problematic, it is fair to say that there is a growing understanding that sustainable outcomes need to somehow balance the 'triple bottom line' of economic, social and environmental goals. The Water Authority's choice of secondary treatment and pipeline disposal at Sand Patch could well be viewed as a sustainable outcome from the point of view of the Authority. It clearly leads to a better environmental outcome than what went before, and it appears to be economically attractive.

As the background material presented above indicates, however, it would be difficult to consider the Water Authority's decision as being sustainable from a process perspective. Two tactics—the Authority's initial 'decide–announce–defend' approach, and the later more open O'Connor committee—both resulted in a dissatisfied community. This suggests that a good (i.e. sustainable) outcome might be reached only if a sustainable *process* is used to guide decision-making. If we want to design sustainable decision-making processes, it would help if we had an understanding of how they have been defined in the literature.

A recent approach to establishing a Sustainability Strategy for Western Australia presented seven 'foundation sustainability principles' and four 'process principles'. The process principles were: integration of the triple bottom line; accountability, transparency and engagement; precaution; and hope, vision, symbolic and iterative change (Government of Western Australia 2002).

4 Tertiary treatment is the further treatment of effluent from the secondary treatment process by either physical, chemical or biological means to remove nutrients that cause eutrophication. Tertiary treated waste may be treated to a level at which it can be re-used by humans. This is often described as a 'zero discharge' option.

In the Albany case, the most important process sustainability principles are likely to be triple-bottom-line integration, and accountability, transparency and engagement. Recent literature has shown that careful design of public participation exercises is an integral part of developing accountability and transparency (Webler *et al.* 2001).

The interest groups

Water Authority

Involved Water Authority staff are almost entirely professional engineers. The project is being run from the Authority's Albany office, with input from Perth where required.

Salmon fishers

Family groups of professional salmon fishers have earned their living from beach netting for generations. They are concerned about the effects ocean outfalls could have on the migratory patterns of salmon along the coast. Fisheries scientists claim that there is evidence to show that salmon move away from the coast to deeper water when they encounter fresh water.

Abalone divers

A select group of abalone divers operate, as individuals, all around the Great Southern coastline. Abalone are very sensitive to environmental contamination. Abalone licences trade for approximately $1 million, but they are not harvested near Sand Patch, so divers have no concerns about this option.

Conservation groups

There are a number of very active conservation groups in the Albany area, all of which are entirely opposed to the Water Authority's ocean outfall plans. Members cover the socioeconomic spectrum, but the most active players tend to be teachers, public servants and retired people.

Environmental Protection Authority

The EPA has had a long-term interest in the environmental condition of the Albany Harbours, and its Marine Investigations Branch undertook detailed studies of water quality throughout most of the 1980s. It is not concerned about which option is chosen, as long as the King Point outfall and treatment plant is closed and a new system is operating by the end of 1994. However, the EPA will impose discharge standards on the Water Authority when it licenses the new treatment and disposal system.

Environmental Consulting company

Early in 1991 the Water Authority chose an environmental consulting company to undertake the required environmental impact assessment (EIA) on the chosen option. The company chosen by the Water Authority has offered a team made up of two marine biologists, a waste-water treatment engineer, and a social scientist. The company has a client relationship with the Water Authority and must advocate for them. It also, however, has a professional responsibility to undertake an objective environmental assessment.

Surfers

Surfers use the area close to the proposed Sand Patch outfall extensively. This beach is remote, although it can be reached by four-wheel-drive tracks west of Torndirrup National Park. Some surfers are vocal opponents of the Sand Patch option. No surfing is to be had at Ledge Beach or Nanarup Beach.

Town of Albany

This local government is responsible for the urban areas of Albany. The Town of Albany's jurisdiction does not extend to any of the ocean outfall areas but it may encompass land disposal areas if the latter is close to the centre of Albany. Ninety per cent of waste-water is generated by people living and/or working in the Town of Albany.

Shire of Albany

This local government is responsible for the rural areas surrounding the Albany townsite. The Shire of Albany has jurisdiction over all of the ocean outfall sites. It has a history of conflict with the Town of Albany.

Department of Conservation and Land Management

The Department of Conservation and Land Management (CALM) is responsible for the management of a National Park close to the Ledge Bay area. The proposed pipeline to Ledge Beach would cross the National Park. This area also contains Declared Rare Flora.

Timing

Participants in this case-study exercise should consider that the period during which they are attempting to resolve this conflict is early 1992. The Water Authority was required to act by the end of 1994 to meet EPA requirements. When an option is finally

chosen, it must be presented to the EPA in the form of an EIA. The *Environmental Protection Act 1986* (WA) requires project proponents, in this case the Water Authority, to present the EIA for formal public review.

In total it would take the Water Authority approximately eight months to complete the EIA on the chosen option. Allowing for a public review period of up to ten weeks, an assessment by the EPA and issue of EPA recommendations, and the assignment of Ministerial Conditions, the project could quite easily take 12–18 months before it obtains formal go-ahead.

Conclusions

This case study contains many useful insights into the sustainability conundrum. It requires students to analyse a public decision-making process that clearly went wrong in the early stages. When taken to its conclusion as an interactive public meeting, students often arrive at a different technical solution to the Albany waste-water management problem than that which was originally proposed by the Water Authority. This also tends to make students aware that the original decision-making process chosen by the Authority was not, in itself, sustainable. Another outcome of the case, therefore, can be discussion about the nature of process sustainability.

Appendices

The following should also be studied: A. Further details on marine and land disposal options; B. Environmental values and impacts associated with the three marine disposal options; C. Capital costs and net present values of options using a 4% discount rate; D. Glossary; and E. Ideas for instructors.

A. Further details of marine disposal options

Sand Patch

- The discharge of secondary treated effluent, subsequently disinfected (bacterial levels effectively zero), or tertiary treated effluent from a shoreline outfall 700 m to the west of the main Sand Patch Road
- Effluent would be conveyed to the site from waste-water treatment plant No. 2 or No. 5 or both
- Final pipeline route would follow the present prison pipeline, descend to the beach and cross to the beginning of the surf zone

Ledge Bay

- The discharge of secondary or tertiary treated effluent through an outfall and diffuser into Ledge Bay
- The pipeline route would convey effluent from waste-water treatment plant No. 2 or No. 5 or both, across Oyster Harbour and around the landward side of Mt Martin to Ledge Beach
- The outfall would be constructed through the dunes near the end of Ledge Beach Road and continue seaward for 1,100 m

Nanarup

- The discharge of secondary or tertiary treated effluent through an outfall and diffuser off Nanarup Beach
- The pipeline route would convey effluent from waste-water treatment plant No. 2 or No. 5 or both, follow the road reserve over bridges crossing the King and Kalgan rivers across the top of Oyster Harbour, and then along the Nanarup Road
- The outfall would be constructed through dunes 100–200 m east of Taylor Inlet and extend offshore for a distance of 1,300 m

B. Environmental values and impacts associated with the three marine disposal options

a. Frequency/intensity of human uses

	Site		
	Sand Patch	*Ledge Bay*	*Nanarup*
Swimming	–	++	++
Surfing	++	–	+
Diving	–	+	++
Aesthetic enjoyment	++	++	+++
Beach walking	+	–	++
Hang gliding	+	–	–
Recreational fishing			
Shore-based	++	–	++
Boat-based	–	++	–
Abalone	–	–	+
Spear fishing	–	+	++
Commercial fishing			
Salmon	–	–	+++
Pilchard	+++	+	++
Abalone	–	–	–
Other	–	–	–

– Minor or non-existent
\+ Moderate/low
++ Considerable in parts
+++ Heavy

b. Beneficial uses

	Site		
	Sand Patch	*Ledge Bay*	*Nanarup*
Direct contact	+	++	++
Harvesting aquatic life (non-mollusc)	+	++	++
Harvesting molluscs	n.a.	n.a.	+
Passage of fish	++	n.a.	++
Preservation of ecosystem	++	++	++

n.a. Not applicable
\+ Applies to parts of the area only
++ Applies to whole area

c. Environmental impacts predicted to arise from disposal of secondary treated waste-water at marine sites evaluated

	Site		
	Sand Patch	*Ledge Bay*	*Nanarup*
Negative impacts on			
Aesthetic enjoyment	+	–	–
Fishing	?	–	?
Algal growth	–/?	++*	–
Seagrass	–	+*	–
Public health	–	–	–
Adjacent coast	?	+	–

– No impact
\+ Minor impact
++ Major impact
? Impact may occur—uncertain
* Mitigated by use of superior tertiary treated effluent

C. Capital costs and net present values (NPV) of options using a 4% discount rate ($ millions)

Disposal options	Initial capital*	Total capital**	NPV capital and operating	NPV income of farm	NPV
Sand Patch					
Secondary	14.17	37.32	36.69		36.69
Tertiary	14.77	40.04	45.23		45.23
Zero-discharge tertiary	15.97	44.84	48.90		48.90
Ledge Beach					
Secondary	20.42	50.45	44.93		44.93
Nanarup					
Secondary	24.88	61.63	53.12		53.12
Land disposal	15.79	41.28	41.28	3.56	37.72

Notes

- Effluent would be disinfected for all Sand Patch options.
- Tertiary treatment reduces nitrogen to 10 mg/l and phosphorus to 3 mg/l.
- Zero discharge tertiary reduces both nitrogen and phosphorus to 0.5 mg/l.

* Expenditure in first 3 years
** Expenditure until 2015

D. Glossary

Activated sludge process	The entire process by which aerated bacteria from recycled sludge convert the organic component of waste-water into bacterial mass and stabilised compounds such as nitrates, sulphates and carbon dioxide. This process is at the heart of the secondary treatment step
Aerated ponds	A secondary, biological waste-water treatment technique, intermediate between waste stabilisation lagoons and activated sludge processes. They entail artificial means of aeration, but do not include a sludge recycling step
Aeration	The first stage in secondary treatment and a component of the activated sludge process. Aeration, either by agitation or trickling filtration, brings the organic matter into contact with sludge which is heavily laden with bacteria
BOD	Biological oxygen demand—an indication of the amount of oxygen needed to oxidise the organic matter in a water sample by biological means
Land treatment (or disposal) system	A system that utilises the filtering, bacterial and adsorbent properties of soil and vegetation to remove impurities from waste-water
Primary treatment	The first step in the treatment of waste-water. It includes screening sedimentation, and sometimes—although rarely—chemical precipitation
Secondary treatment	A biological treatment process, subsequent to primary treatment. Secondary treatment is very similar in concept to the processes of decomposition in nature. Organic wastes are consumed by bacteria under controlled conditions so that most of the BOD is removed in the treatment process. Secondary treatment can utilise waste stabilisation ponds, land treatment, aerated lagoons, or the activated sludge process
Sewage	Raw, untreated effluent/waste-water
Sewerage	The physical system (that is, pipes, pumps, etc.) by which sewage is transported
Tertiary or advanced treatment	Not clearly defined but generally relating to the further treatment of secondary effluent by either physical, chemical or biological means to remove nutrients that cause eutrophication. Physical techniques include filtration, distillation and reverse osmosis; chemical processes include electrodialysis, precipitation, carbon absorption, ammonia stripping and ion exchange; biological processes include the harvesting of algae grown on nutrients and bacterial nitrification and denitrification. Tertiary treated waste may sometimes be treated to a level at which it can be re-used by humans. This is often described as a 'zero discharge' option
Waste stabilisation ponds (lagoons)	A secondary, biological waste-water treatment technique intermediate between land treatment and other more controlled forms of biological treatment such as aerated lagoons or activated sludge. Lagoons require little experience to operate but demand large areas of land and provide little control over process effectiveness

E. Ideas for instructors

a. Structuring the role-play

In our experience, the most effective way to run this case as an interactive exercise is to organise it as a public meeting.

If this approach is taken, a Water Authority engineer can run the public meeting, presenting the Sand Patch cliff outfall as the Authority's chosen option. This will lead to arguments inside the meeting format. The roles outlined above under the heading 'The interest groups' can be taken by one or two students. If there are lots of students, those not assigned to a role can play general 'members of the public'.

We recommend that the instructor take the role of the Water Authority engineer running the public meeting (and thus the development of the case itself).

b. Timing

Timing can be variable, depending on how long students are given to prepare their roles. In our experience, the minimum amount of time it takes to run the case is 50 minutes. This can be easily expanded to 120 minutes.

c. Leading to an outcome

While this role-playing case exercise can take on a life of its own, our experience has indicated that there are advantages for the instructor in attempting to lead towards a conclusion.

Our favoured approach is to have the interest groups argue their positions for 30 minutes or so. This tends to accentuate the differences, and lead to an unresolved, 'locked' outcome.

At this point it may be best to halt the role-playing exercise, and begin to analyse the case outcomes, and the public meeting process.

d. Analysing the outcomes

Perhaps the first thing to do is to ask the students how the Water Authority engineer could extract him/herself from this difficult situation.

Sometimes the role-playing participants realise that land disposal may be a good solution that was not properly investigated in the Water Authority's earlier work. If this outcome is reached, then the Water Authority engineer can suggest the commissioning of a consultant to further investigate feasibility and to suggest sites. This is, in fact, what happened in practice. This is one way of addressing the 'accountability' process sustainability principle introduced earlier.

If the possibility of land disposal does not present itself in the public meeting, then the Water Authority engineer does not have too many options for saving face.

In reality, the Water Authority did employ consultants to further investigate land disposal. The consultants produced a study that identified a small number of sites that were not waterlogged, and had the correct combination of soils for binding phosphorus (nitrogen is bound by plants). This options study became the basis for a full environmental impact assessment document, which was presented to the EPA for approval.

Approval was granted, and Albany waste-water is now secondary-treated and used to grow hardwood trees for woodchip export.

This was a significant cultural change for the Water Authority. To its credit, it made the jump from a 'hard' engineering organisation that traditionally saw ocean outfall as the only way to deal with this kind of problem, to an organisation that could accept land disposal and tree farming as part of its remit. The Authority also learned that sustainable outcomes from controversial development proposals can be achieved only by addressing decision-making process issues.

e. Questions for students

The case offers a number of possible learning objectives for instructors. We have used the case to amplify issues such as: conflict resolution theory and practice, the structure of the environmental regulatory framework, and the importance of 'process' in moving towards sustainability.

Questions that might be put to students when analysing the case include:

- What are the main characteristics of this conflict? Are they mostly substantive, procedural or psychological?
- What strategies could be used to slow down this conflict?
- How could the Water Authority have done a better job in the first place? Here the issue of structuring the decision-making process is important. The Water Authority could have arguably done a better job earlier on by allowing public input into the original options choice exercise. This would have met the 'accountability/transparency/engagement' process sustainability principle, and the 'triple bottom line' principle. Techniques such as multi-criteria analysis could have been used to structure this open options choice exercise (Annandale and Lantzke 2000)

f. Providing materials to students

Students should be provided with all materials up to the end of the section above titled 'The interest groups', prior to the case study. They need to have enough time before the running of the case to properly understand their roles.

As mentioned above, the 'additional financial resources' should be given out at some point during the public meeting, preferably when the Water Authority engineer is trying to make a point about costs.

The newspaper cuttings should be shown only at the end of the analysis.

g. Additional resources

Additional financial information is attached at the end of this section. A set of two tables converts the financial information given in Section C above to rate increases. You should distribute this information whenever you think that it might assist discussions, but it should probably not be distributed until the public meeting is well under way. The Water Authority engineer can use the tables to argue against tertiary treatment from a cost point of view. It could also be suggested that individual ratepayers would have to pay additional costs, if Albany decides to go beyond the Sand Patch secondary treatment option.

Additional information by way of newspaper clippings is also attached at the end of this section. There are two clippings:

- Effluent, trees a winning combination (see Fig. 15.2)
- How the Albany community helped us clean up at the environmental awards (see Fig. 15.3)
- Because these clippings point to the benefits of the land disposal option, they should be kept from students until the end of the case exercise.

Jumping for joy: Treatment plant operator Brian Green leaps over one of the thousands of blue gums that are fed on effluent. PICTURE: JOHN EVANS

Effluent, trees a winning combination

By Carmelo Amalfi

A PRIZE-WINNING "living laboratory" of 500,000 fast-growing trees is expected to handle Albany's effluent disposal demands until at least 2020.

The trickle of treated effluent on experimental eucalypts earned WA's Water Corporation the Australian Water and Wastewater Association's Environment Merit Award, announced in Melbourne this week.

The award recognises the WA authority's innovative solution to an environmental problem facing the world — how to reuse wastewater.

The first 300ha of mainly Tasmanian blue gums near Albany airport, 10km north of the town, will be ready for harvest and sold by 2002 — having fed on 3000 kilolitres of treated effluent pumped more than 10km each day from the King Point treatment plant.

The project was developed in 1993 to reduce the flow of nutrients into Albany's Princess Royal Harbour and King George Sound. It was set up after intense community debate over water pollution.

Managing director Jim Gill said he was delighted that the corporation had been recognised nationally for its environmental leadership in waste disposal technologies.

"That is exactly what we wanted to be — responsible environmental managers," he said.

"The award gives us a position of leadership in Australia and opens up new doors internationally and locally in terms of intellectual property and consulting opportunities."

Mr Gill said 12 other sites, mainly in the South-West, were being considered in plans to expand the project in WA, starting with Manjimup.

Water Resources Minister Kim Hames, who described the scheme as a pacesetter in wastewater reuse, said the award was a fitting tribute to the community whose support was crucial.

Bob Silifant, Great Southern region manager of field support services, said Albany's $18 million tree farm project also had become a popular tourist and educational attraction for Australian and overseas visitors.

The computer-controlled liquid fertiliser farm would create jobs and revenue from a woodchip industry based on quality paper pulp from trees that could grow to 15m within seven years.

Barry Sanders, general manager of bulk water and wastewater, said the biennial award was the town's second.

The first was scooped up five years ago by engineering consultant Sinclair Knight Mertz, which developed a way to improve the quality of CSBP effluent entering local waters.

About 250 million litres of wastewater are collected each day in WA. Only five million litres are recycled.

FIGURE 15.2

the Albany community helped us clean up at the environmental awards.

Thirteen kilometres north of Albany you'll come across a rather unique, 400 hectare farm.

Its produce is trees - heavy-drinking Tasmanian blue gums.

What makes this farm unique is that the trees are thriving on what was once a threat to the local environment - wastewater being discharged into Albany's harbour.

Thanks to the wholehearted support of the local community that wastewater is now pumped from the Albany Wastewater Treatment Plant to the tree farm where it trickle irrigates some 500,000 Tasmanian Blue Gums.

The Albany Tree Farm is an innovative solution to an environmental problem, and a shining example of the Water Corporaton and the community working together to help protect our fragile environment.

WATER CORPORATION

Additional financial information

1. **Charge increases necessary to recover capital and operating costs (assuming a present residential rate of 6.23¢/$ gross rental value [GRV] and non-residential rate of 6.98¢/$GRV).**

Disposal options	Residential (¢/$GRV) increase	Non-residential (¢/$GRV) increase
Sand Patch		
Secondary	2.95	3.31
Tertiary	3.69	4.13
Zero-discharge tertiary	4.00	4.49
Ledge Beach		
Secondary	3.66	4.10
Nanarup		
Secondary	4.37	4.89
Land disposal	3.04	3.41

2. Examples of range of increase in annual rates for typical properties ($)

Property	Rental value	Increase residential		Increase non-residential	
	(RV)	R_1	R_2	NR_1	NR_2
Houses					
Chester Pass Rd	3,588	86	156		
Parade St	4,264	103	186		
Spencer Park	5,408	130	236		
Serpentine Road	5,928	143	259		
Commercial properties					
Shop York St	29,640			800	1,449

Notes

R_1 Rate increase of 2.41¢/$RV land disposal/Sand Patch secondary
R_2 Rate increase of 4.37¢/$RV Nanarup
NR_1 Rate increase of 2.70¢/$RV land disposal/Sand Patch secondary
NR_1 Rate increase of 4.89¢/$RV Nanarup

References

Annandale, D., and R. Lantzke (2000) *Making Good Decisions: The Role of Decision-Aiding Techniques in Waste Facility Siting* (Perth, Australia: Murdoch University).

EPA (Environmental Protection Authority) (1990) *Albany Harbours Environmental Study 1988–1989* (A Report to the Environmental Protection Authority from the Technical Advisory Group; Bulletin 412; Perth, Australia: Environmental Protection Authority).

Government of Western Australia (2002) *Focus on the Future. The Western Australian State Sustainability Strategy: Consultation Draft* (Perth, Australia: Department of the Premier and Cabinet).

Webler, T., S. Tuler and R. Krueger (2001) 'What is a Good Public Participation Process? Five Perspectives from the Public', *Environmental Management* 27.3: 435-50.

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