Hindsight Review of EPA Assessed Projects

Brynne Jayatilaka

Professor Ben White
School of Agricultural and Resource Economics

Richard Sutherland
CEED Client: Environmental Protection Authority

Abstract

The Environmental Protection Authority (EPA) is the primary body responsible for the defence of environmental assets in Western Australia. They assess all major infrastructure projects with the potential to cause environmental damage through an Environmental Impact Assessment (EIA). Fundamental to the success of the EPA in meeting its objective is a comprehensive EIA, leading to effective environmental conditions. Woodside's Pluto LNG Project and Fremantle Ports' Inner Harbour Deepening Project, which involved substantial amounts of dredging, were used as case studies when analysing the EPA's EIA principles, process and outcomes. An economic model was created in order to assess the efficiency of the monitoring and compliance aspects of the environmental conditions.

1. Introduction

The overarching objective of the EPA comes from the governing legislation for the Authority, the *Environmental Protection Act 1986,* and is to 'use its best endeavours

a) to protect the environment; and

b) to prevent, control and abate pollution and environmental harm.'

The Act defines the environment as 'living things, their physical, biological and social surroundings, and interactions between all of these' (EPA, 2011). The EPA uses an Environmental Impact Assessment (EIA) to assess the potential impacts of developments on the environment. The EPA defines EIA as a systematic and orderly evaluation of a proposal and its impact on the environment. The assessment includes considering ways the proposal, if implemented, could avoid or reduce any impacts on the environment. The results of the EIA are provided as a report to the Minister for the Environment, to advise on whether or not projects should be permitted to go ahead, and if so, under what conditions. Issues can arise when the fundamental principles underpinning these processes are not explicit within the appraisal, leading to deficient assessment and the possibility of environmental degradation. In addition, the EPA often only receives compliance reports which state whether conditions have been met. This report does not state if the proponent found the conditions reasonable, practical and/or cost-effective to implement, limiting information feedback within the process.

Woodside's Pluto LNG Project

The Woodside Energy Ltd Pluto LNG Project was centred around the Pluto gas field located offshore on the North West Shelf, approximately 190 kilometers north-west of Dampier. This project included the construction and operation of facilities within Western Australian State territorial waters and on the Burrup Peninsula which allowed the gas field to be exploited. The gas is transported by a sub-sea trunkline to the west coast of the Peninsula where the gas processing plant is located on two designated Industrial Lease areas. Extensive dredging was required for shipping tanker access to the export facility and for gas trunkline installation.

Fremantle Ports Inner Harbour Deepening Project

The Fremantle Ports Project involved deepening the Inner Harbour, Entrance Channel and Deepwater Channel, construction of an extension to the Rous Head seawall and reclamation of 27 hectares of seabed, rebuilding Berth 10 on North Quay and strengthening the existing container berths. Now that the Inner Harbour has been dredged to 14.7 metres, the port is able to provide access for container ships which were previously unable to load to full capacity.
Approved dredging was for approximately 3.1 million cubic meters, to provide for further reclamation at Rous Head of approximately 27 hectares.

1.1 Objectives

The overall objectives of the Project were as follows.

1. Describe how the EPA applied EIA to the case study projects in order to determine how effective the impact assessment and the associated Ministerial Conditions were in achieving environmental objectives.
2. Describe the regulatory burden imposed on the proponents by the requirements in the Ministerial Conditions and investigate how this burden could be reduced.
3. Discuss how the process could be made more efficient and effective at protecting the environment by breaking down the underlying principles of the EPA and EIA and adopting a formalised review process tool; an economic model focused on minimisation of the costs involved with compliance monitoring.

1.2 Key Findings of the Literature Review

It has been found that although the Precautionary Principle outlines the idealistic goal of policy, because its definition is short, ambitious and sometimes ill-defined, its value as a management tool is limited (Ashford, 2004). The Principle of the Conservation of Biological Diversity and Ecological Integrity is a difficult principle to define, as it involves aspects (within the environment) which are difficult to measure, and offers no suggestions as to how to carry this out. The use of Principles relating to improved valuation, pricing and incentive mechanisms are outlined to make sure all costings, prices, taxes and payments include a realistic estimate of the financial costs and savings involved in protecting natural and human capital, that financial incentive mechanisms operate to maximise the maintenance and, or enhancement of natural and human capital. However, no economic analysis (in terms of environmental valuation, e.g. Cost Benefit Analysis) is considered at the EPA of Western Australia.

Environmental CBA refers to the economic appraisal of policies and projects which have the potential to improve the provision of environmental services or whose actions might affect the environment as an indirect consequence (Atkinson and Mourato, 2008). It is a tool that assists in the preliminary stages of assessment, quite often evaluating environmental impacts. This is important, as Allett (1986) defines the general stages of EIA as: identify the relevant environmental factors, measure the existing environment, predict and assess changes to the environment and aggregate the environmental effects. Although CBA is not required to identify factors or predict changes, if no CBA is done to determine the monetary value of these environmental assets, it is difficult to aggregate the total effects into a measure that is meaningful to all parties involved in the development. The US and UK environmental agencies, as well as the Queensland and Victorian EPA's all use some form of CBA in their EIA. This has been found to improve the effectiveness of environmental conditions, as they are more targeted, and if used ex-ante, can help design a project or policy so that costs are minimised and benefits maximised (Görlach, 2008). The key underlying factors in CBA (identified by Görlach in 2008) which compel its use in EIA are that individuals' preferences are what matter for choosing certain paths of action as they can be aggregated to reflect the preferences of society. These values are reflected in individual's willingness to pay (WTP). If a significant sample of the population's individual WTP values are taken, then statistically, this should represent the overall values of society (Görlach, 2008). There are many of overlaps between CBA and EIA, and these have been explored by Hundloe (1990) as well as Hanley and Spash (1993).

2. Analysis

Woodside's Pluto LNG Project, and Fremantle Ports Inner Harbour Deeping Project both involved substantial amounts of dredging; $14Mm^3$ and $3.1Mm^3$ respectively. A similar assessment procedure was therefore taken by the EPA when evaluating the potential for these projects. The Key Environmental Factors for both projects relating to marine impacts and ecology (or equivalent) and involved the consideration of the EPA's key overarching Principles. The conditions applied by the Minister to the Pluto Project were outcome-based, meaning the focus was on the environmental outcomes of activities. This is in contrast to the Fremantle IHD Project, for which the conditions were written in a prescriptive manner, which focuses on how outcomes were to be achieved. Through analysis of compliance, and effectiveness of the conditions at protecting the environment, it appears as though both strategies achieved the objective of environmental protection. For the Pluto Project no exceedances of coral criterion, mortality of marine turtles or introduced marine pests were detected, or directly attributed to project dredging activities. For the Fremantle Ports Project pH and toxicant levels (metals, PCBs, pesticides) in the water or sentinel mussels, coral and nearly all seagrass surveys did not exceed trigger levels. The project was also centered on dredging, with a more easily accessible location, meaning that compliance monitoring could be more efficiently performed. However, because the outcome-based method of writing conditions is more focused on achieving environmental standards, rather than achieving a process, it too resulted in favourable outcomes. This is thought to be due to the fact that they allow the firm to find the least cost way of achieving these outcomes, rather than with the prescriptive approach, which forces them to use a certain methodology. This will be tested by the model at a later date.

3. Review Process Tool: Model

A cost-effectiveness model was created in order to assess the efficiency of the conditions advised by the EPA (in their Report and Recommendations) and set by the Minister. 'Efficiency' is an important issue, as compliance costs depend on the extent to which businesses comply with regulatory requirements in the most cost-effective manner (EE, 2003). Objective Function: $E[W] = B - C - dc(e) - mC^m$. Subject to:

1. The Environmental Standards; Threshold(s) identified in the Ministerial Conditions
2. Activity Completion
3. The Incentive Compatible (Constraint); which requires the agent to prefer to act in accordance with the solution (compliance). In this model, there are two players, the regulator (principle) and the firm (agent).

Table 1 Nomenclature: model symbol, expanation and assumed value

m	probability of monitoring: $0 \leq \mathrm{m} \leq 1$	
B	benefits of the project to; society+/or the firm	Constant
C	cost of the project	Constant
dc	damage cost associated with emissions	$f(e)$
$C(e)$	private cost of reducing emissions; achieving the thresholds	$\beta_0(e^* - e)\beta_1$
C^m	cost of compliance monitoring to the regulator	\$118,800
e	level of emissions chosen	variable
e^*	profit maximising emissions levels; non-compliance	62.5%
$\bar{e}$	'standard' level of emissions chosen by regulator; thresholds	10%
P	penalty for non-compliance	\$50,000

*Where β_0 and β_1 are scalars

The probability of monitoring is a percentage of the total possible level of monitoring. As the Benefits and Costs are assumed to be constant, we remove these from the objective function, leaving a minimisation of costs equation: $Minimise: dc(e) + mC^m$. The damage cost of emissions is the loss of environmental value to society. The cost of reducing emissions is the (private) per unit increase in abatement cost as a result of regulation. The cost to the regulator is the cost of 100% monitoring; by looking into the number of sites visited, monitoring frequency and estimating the associated costs, this was assumed to be \$118,800. It is multiplied by m in the equation to represent most likely monitoring probability, and therefore expected actual cost.

4. Process

The first objective involved analysis of all the major documents involved in the environmental assessment process for the two case study projects. This included, but was not limited to the Environmental Scoping Documents, the EPA Report and Recommendations, the Public Environmental Review, Management Plans, Compliance Reports, the Dredge Management Guidelines and peer-reviewed literature.

For the second and third objectives an economic model was created to demonstrate the regulatory burden imposed on the proponents (by the requirements in the Ministerial Conditions), explore how this burden could be reduced without compromising the environmental outcomes and determine the overall efficiency of the process. Creation of the model involved breaking down the key elements within the assessment process; the cost, or regulatory burden of monitoring for compliance to the determined thresholds, and the cost to the proponent of abatement. The notion of compliance costs have been defined by Alfon and Andrews (1999) as the costs to firms of those activities required by the regulator that otherwise would not have been undertaken. Compliance costs therefore refer to the "incremental costs of compliance caused by regulation" (Alfon and Andrews, 1999).

The basic structure of the model was influenced by Russell (1990) and includes a repeated game design, where Markov Chains are used to determine the level of compliance expected given the current costs of abatement and monitoring, penalties (for non-compliance) and the probabilty of being caught. The idea for an expected welfare objective function was influenced by Cohen (1992). Greenberg's (1984) original repeated game-theoretic model was also considered. Here we assume: $z(\varepsilon, \rho) < m$, where z is the acutal monitoring probability and ε is the expected proportion of firms in noncompliance. There are three groups. The firms in Group 1 always cheat, or, do not comply. In Group 2, firms (always) have the incentive to comply, as the monitoring probability is ρ; a probability lower than the value m that would induce compliance. They therefore face a larger fine. Finally, we expect Group 3 to remain empty, as this group entails a scenario of more frequent monitoring, or "compliance hell". The major assumption of this game is that all firms are noncompliant, and the overall aim is to get them to comply.

Table 2 Transition matrix [Q]

	G1	G2
G1	1-z(ε,ρ)	z(ε,ρ)
G2	ρ	1-ρ

The model was optimized using General Algebraic Modelling System (GAMS), which was used to solve the regulators objective function, subject to the determined constraints, in order to find the optimal conditions for compliance. These include the appropriate monitoring levels and penalties, as well as whether or not the current environmental standards are successful at inducing compliance.

5. Results and Discussion

This basic models shows that the current system of condition setting, compliance monitoring and enforcement are inefficient. This is predominantly due to the fact that the cost of complying to the Ministerial Conditions (in terms of abatement) is too high for the firm, as is the cost of complete compliance monitoring for the regulator. In addition, monitoring probabilities and therefore the probability of being caught in non-comliance are too low. As penalties are not significantly high, non-compliance or partial compliance will be the optimal strategy employed by firms. If the implications of Russel's (1990) repeated game are considered, in order to see the benefits of the model structure it is important that the conditions are upheld. This means more follow up inspections and increased compliance monitoring after instances of non-compliance, as part of the compliance incentive.

6. Conclusions and Future Work

The findings of the basic model indicate that the current costs of abatement for the firm and compliance monitoring for the regulator associated with the conditions imposed by the Minister are too high, and the penalty for non-compliance is too low to efficiently encourage compliance. Although the process resulted in (satisfactory levels of) compliance for the case study projects, this may not always be the case. An approach to monitoring which involves a greater compliance disincentive for violations, such as significantly more frequent monitoring of firms with a history of violations, will allow for the benefits of saving and using information on past detected non-compliance. In addition, a greater financial disincentives will improve the efficiency of the current process. It is hoped that the model will be extended to include the implications of outcome-based, versus prescriptive Ministerial Conditions, to add to the usability of model results.

7. References

ALFON, I. & ANDREWS, P. 1999. Cost-benefit analysis in financial regulation — how to do it and how it adds value. *Occasional Paper Series 3.* Financial Services Authority.

ALLETT, E. J. 1986. Environmental Impact Assessment and Decision Analysis. *The Journal of the Operational Research Society,* 37**,** 901-910.

ASHFORD, N. 2004. Implementing the Precautionary Principle: Incorporating Science, Technology, Fairness and Accountability in Environmental, Health and Safety Decisions. *International Journal of Occupational Medicine and Environmental Health,* 17**,** 59-67.

ATKINSON, G. & MOURATO, S. 2008. Environmental Cost-Benefit Analysis

Annual Review of Environment and Resources, 33**,** 317-344.

COHEN, M. A. 1992. Environmental Crime and Punishment: Legal/Economic Theory and Empirical Evidence on Enforcement of Federal Environmental Statutes. *The Journal of Criminal Law and Criminology (1973-),* 82**,** 1054-1108.

EE 2003. Costs of Compliance- A Report by Europe Economics. London: London.

GÖRLACH, B. 2008. Cost-Benefit-Analysis as a Tool for Impact Assessment. Berlin: Federal Environment Agency.

GREENBERG, J. 1984. Avoiding tax avoidance: A (repeated) game-theoretic approach. *Journal of Economic Theory,* 32**,** 1-13.

HANLEY, N. & SPASH , C. 1993. *Cost-benefit analysis and the environment,* Cheltenham, UK, Edward Elgar.

HUNDLOE, T., MCDONALD, G. T., WARE, J. & WILKS, L. 1990. Cost-benefit analysis and environmental impact assessment. *Environmental Impact Assessment Review,* 10**,** 55-68.

RUSSELL, C. S. 1990. Game Models for Structuring Monitoring and Enforcement Systems *Natural Resource Modelling,* 4**,** 143-173.