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Conceptualising and Managing Trade-offs in Sustainability Assessment

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Abstract
One of the defining characteristics of sustainability assessment as a form of impact assessment is that it provides a forum for the explicit consideration of the trade-offs that are inherent in complex decision-making processes. Few sustainability assessments have achieved this goal though, and none have considered trade-offs in a holistic fashion throughout the process. Recent contributions such as the Gibson trade-off rules have significantly progressed thinking in this area by suggesting appropriate acceptability criteria for evaluating substantive trade-offs arising from proposed development, as well as process rules for how evaluations of acceptability should occur. However, there has been negligible uptake of these rules in practice. Overall, we argue that there is inadequate consideration of trade-offs, both process and substantive, throughout the sustainability assessment process, and insufficient considerations of how process decisions and compromises influence substantive outcomes. This paper presents a framework for understanding and managing both process and substantive trade-offs within each step of a typical sustainability assessment process. The framework draws together previously published literature and offers case studies that illustrate aspects of the practical application of the framework. The framing and design of sustainability assessment is vitally important, as process compromises or trade-offs can have substantive consequences in terms of sustainability outcomes delivered, with the choice of alternatives considered being a particularly significant determinant of substantive outcomes. The demarcation of acceptable from unacceptable impacts is a key aspect of managing trade-offs. Offsets can be considered as a form of trade-off within a category of sustainability that are utilised to enhance preferred alternatives once conditions of impact acceptability have been met. In this way they may enable net gains to be delivered; another imperative for progress to sustainability. Understanding the nature and implications of trade-offs within sustainability assessment is essential to improving practice.

Keywords: trade-offs; decision-making; sustainability assessment; offsets; acceptability; net gains

1. Introduction

A core purpose of any impact assessment process is to contribute to 'better political judgement and performance' (O'Riordan 1976, p215); if 'properly done, it should indicate who gets what, who loses what, how, when and why'. Thus from the earliest days of impact assessment practice, it has been recognised that the complexity of impact assessment decision-making is such that trade-offs, whereby gains in one area are made at the expense of losses in another, are an inherent aspect of the process. Similarly, Glasson et al (2012, p206) note that: 'it is important to remember that all decisions involve trade-offs', while Sadler (1996, p184) similarly asserts that: 'trade-offs among the commonwealth of goals is unavoidable when specific decisions are taken'.

Consideration of trade-offs in the impact assessment literature often focuses on those that become evident at the point of the approval decision, where the observation is commonly made that environmental standards are too often traded off for socio-economic gains (e.g. Lee, 2002; Sheate et al., 2003; Jenkins et al., 2003; Pope et al., 2004; Therivel et al., 2009). As Glasson et al (2012, p206) note, the discussion may be 'sometimes reduced to the "jobs vs. the environment" dilemma'. However, as we will show in this paper, there is much more to the conceptualisation of trade-offs in impact assessment decision-making than this. As Weston (2000) points out, the impact assessment process, from screening and scoping through to the point of approval decision and beyond to monitoring and follow-up involves many separate decisions made by different stakeholders. Trade-offs may be inherent in each of these decisions, though many will be obscured from the public eye, since they relate to decisions made 'behind closed doors'(Sadler, 1996, p16) during parts of the process in which most stakeholders have little or no direct involvement.

The focus of this paper is the management of trade-offs in sustainability assessment processes. Sustainability assessment can be simply defined as any process that directs decision-making towards sustainability (Bond and Morrison-Saunders 2011, derived from Hacking and Guthrie, 2008), and therefore this paper relates to any impact assessment process that has sustainability as its primary goal. In light of Sheate's (2009, p19) point that sustainability is a common cause shared by all environmental assessment and management tools even though many did not start out with that as the underlying purpose, it is useful to distinguish some of the principles that we believe set sustainability assessment apart from other forms of impact assessment.

We argue that the first defining characteristic of sustainability assessment is that it should seek to promote 'multiple reinforcing gains' from decision-making (Gibson, 2006). The pursuit of multiple reinforcing gains in sustainability assessment is more colloquially known as the win-win-win approach (e.g. Government of Western Australia, 2003; where win-win-win refers to simultaneous environmental, social and economic advancement or benefit), which calls for *more* than simply 'striking a balance' between economic, environmental, social and other criteria, which Sadler (1996, p16) maintains 'lies at the heart of integrated decision-making for sustainable development'. Thus a core objective of sustainability assessment should be to deliver net gains that will make a positive contribution to sustainability.

Secondly, sustainability assessment should reflect the complexity of the socio-ecological systems that define the context for the assessment (e.g. Slootweg and Jones, 2011). This inherent system complexity means that there are usually many competing objectives to consider within the scope of sustainability assessment, which may not be the case in many traditional forms of assessment such as project-based and biophysically oriented environmental impact assessment (EIA) . As Gibson (2006, p177) points out: 'Conventional assessment and planning processes today are not often well designed for addressing human and ecological effects within complex systems'.

Thirdly, sustainability needs to be considered in the context of long term time horizons (e.g. Bond and Morrison-Saunders 2011), as reflected in the sustainability principle of inter-generational equity. Traditional EIA practice typically considers only the lifetime of the proposed action (including its decommissioning where relevant). Favouring current generations or short-term benefits at the expense of future stakeholders and interests is one type of trade-off that can result during sustainability assessment decision-making.

Finally, and importantly for the purposes of this paper, Gibson et al., (2005, p128) suggest that one of the specific aims of sustainability assessment is that: 'it provides a forum and framework for explicit attention to the key trade-offs'. Arguably, therefore, the incorporation of a clear approach for addressing trade-offs in decision-making is a fourth distinguishing feature of sustainability assessment, compared with other forms of impact assessment. We argue in this paper that sustainability assessment calls for an explicit examination of trade-offs both during the (internal) development of the proposal and at the (external) approval decision point. An internal sustainability assessment is 'a tool to improve internal decision-making and the overall sustainability of the final proposal' in contrast with external assessment usually conducted by regulators for the purposes of approval (Pope 2006, pv).

While various authors have written about trade-offs in the published literature on impact assessment, these accounts are often secondary points to explorations of other decision-making or assessment issues. Here we attempt to bring together all the components of the discussion concerning trade-offs and to review how they may arise at each key stage of a sustainability assessment process. We draw upon a review of some seminal impact assessment literature as well as reflections upon some published sustainability assessment case studies in which trade-offs have been explicitly addressed to varying degrees. Our intention is to underscore the importance of effectively understanding and dealing with trade-offs throughout a sustainability assessment process if practice is to be realised and advanced, and also to demonstrate that this can and has been accomplished (at least to some extent) in practice to date.

The published literature clearly defines two broad classifications of trade-offs: those that are process-oriented and those that are substantive in nature (Glasson, 1999; Glasson et al., 2012, p206; Gibson et al., 2005, p125), and we begin by discussing these in Section 2. Our framework is then developed in Section 3 to broadly follow the key steps of a sustainability assessment process, highlighting the types of trade-offs (both process and substantive) that may arise in each step, how they relate to other steps in the process, and how they might effectively be managed. Several case studies from practice, illustrating attempts to explicitly address trade-offs, are discussed at the relevant junctures in Section 3. The concluding section (Section 4) highlights key lessons learned and principles for the way forward in addressing and managing trade-offs in sustainability assessment.

2. Process and substantive trade-offs

Process, or procedural trade-offs reflect the realities of decision-making in an imperfect world in which neither resources nor the cognitive capacity or political power of key decision-makers are unlimited. Such trade-offs are compromises between the ideal and the practical and are often concealed within opaque organisational processes. Substantive trade-offs, on the other hand, as the actual win-loss outcomes of all the decisions made, tend to be more obvious and exposed. They may often arise from process trade-offs occurring throughout the decision-making process, whether these are acknowledged or not. We discuss each form of trade-off in turn.

2.1 Process trade-offs

Process trade-offs arise in the choices that organisations make in the way they conduct their activities. In an impact assessment context, Weston (2000, p190) notes that decision-making at all stages of impact assessment is 'inherently political in nature' with a 'reliance on intuitive professional judgement' by those making decisions, and that while the overall impact

assessment process might be seen as being systematic, the decisions made along the way 'will almost certainly not be based upon the rational principles of value free objectivity'. Process trade-offs will be inherent in the way an assessment process is designed from its earliest stages and further arise at key stages thereafter, as we explore in Section 3.

In terms of published examples, Wood (2003, p222) identifies process trade-offs related to the information base for decision-making: 'between simplification and the complexity of reality; between the urgency of the decision and the need for further information; between facts and values; between forecasts and evaluation; and between certainty and uncertainty'. Gibson et al. (2005, p129) provide more politically-oriented examples of process trade-off decisions such as:

- allocation of available resources to one activity versus another;
- deciding when to push a priority action a little further despite the risk of offending an influential client;
- which new alliances should be pursued when that means abandoning or weakening established relationships; and
- determining which matters (e.g. politically or commercially sensitive details) should or should not be disclosed in the interests of greater credibility through public openness.

It is important to realise that process trade-offs such as these may give rise to substantive trade-offs too, as we demonstrate in Section 3.

2.2 Substantive trade-offs

Substantive trade-offs arise whenever there are positives and negatives that must be weighed against each other in the selection among competing options and outcomes. They are experienced as positive gains with respect to some goals at the expense of adverse impact outcomes in other areas following the implementation of a decision. Decisions to favour, for example, socio-economic benefits over environmental losses as discussed previously are substantive trade-offs. As established in our introduction, many authors find these to be unavoidable in impact assessment.

For Gibson (2006, p173) compromising on, or failing to meet, any of the 'core-criteria' for sustainability assessment constitutes a substantive trade-off. His core criteria for sustainability assessment pertain to maintenance and enhancement of socio-ecological system integrity; livelihood sufficiency and opportunity; intra-generational and inter-generational equity; resource maintenance and efficiency; socio-ecological civility and democratic governance; precaution and adaptation; and immediate and long term integration of the preceding seven criteria simultaneously (Gibson et al., 2005, pp95-114; Gibson, 2006). Failure to consider the rights of future generations, a key requirement of sustainability assessment, is therefore a form of trade-off.

Substantive trade-offs can involve substitutions of impacts in time, place and kind (Gibson 2005, p127). Restoration of habitat at the completion of an operation that might take place over decades, such as mining, is an example of substitution in time. Construction of an artificial wetland to replace a natural wetland represents substitution in place. Gibson et al (2005, p128) note that substitutions in kind are perhaps the most dramatic and potentially controversial because of the difficulty in judging equivalence; they mention the loss of traditional aboriginal lands used for hunting, fishing or foraging in exchange for new community recreational facilities as an example here. The ‘jobs versus the environment’ dilemma is a common example of a substitution in kind, the case for which is often made by proponents and government decision-makers approving a proposal.

3. Trade-offs in sustainability assessment

Having taken as our starting point that impact assessment processes are rife with process trade-offs and almost always fail to prevent substantive trade-offs arising from the decisions to which they apply, we now focus on what has been said in the literature about trade-offs. We found it useful to undertake this literature review in the context of what might be considered procedural steps for sustainability assessment. In this way we highlight the types of trade-offs likely to occur in each step, the impacts of these on other steps, and how they might be managed, bringing together the literature in one place, in a way we do not believe has previously been attempted.

We acknowledge that there is no accepted generic procedure for sustainability assessment, and as we have already noted, the term can be used to mean many things. There are, however, fairly well established models of the generic impact assessment process, and sustainability assessment as a form of impact assessment must include these. Weston (2000, p185) for example, draws attention to eight decision-making stages in the EIA process regarding screening, scoping, prediction, impact significance determination, mitigation, environmental impact statement (EIS) review, approval decision-making and EIA follow-up. Since we have argued elsewhere that sustainability assessment should commence at the earliest stages of decision-making and continue through to the approval decision and beyond, taking both internal and external forms, we also draw upon Therivel's concept of strategic environmental assessment (SEA) fully integrated with the plan development process (Therivel, 2004) as adapted for sustainability assessment by Pope (2007), as well as Weston's (2000) decision-making stages to develop our model. Our generic process steps are thus:

1. Decision to conduct a sustainability assessment (screening)
2. Identification of the desired outcome and hence the sustainability assessment decision question to be addressed;
3. Establishment of sustainability goals and criteria for the decision (scoping);
4. Identification of alternatives and options to achieve the desired outcome;
5. Prediction and evaluation of the impacts of each alternative;
6. Selection and enhancement of the preferred alternative (mitigation);
7. Approval decision and announcement;
8. Implementation and monitoring (follow-up).

We briefly highlight the potential for trade-offs in each of these steps in the following sections.

3.1 Decision to conduct a sustainability assessment

The first obvious process trade-off lies is the decision to conduct sustainability assessment or not. Given that sustainability assessment is often not mandated but is undertaken at the discretion of the proponent (Bond et al. 2012), we suggest that the choice of pursuing a sustainability assessment rather than relying on the minimum statutory requirements in a given jurisdiction is already an important decision in favour of sustainability. Assessments of the City of South Perth (undated) tree planting proposal and the South West Yarragadee groundwater development (Strategen 2006), discussed later in this paper (Boxes 2 and 3 respectively), are both examples from Western Australia where the proponent voluntarily opted for sustainability assessment. Morrison-Saunders and Pope (2012) provide a further account of sustainability assessment initiatives in Western Australia in the absence of any regulatory requirement to do so.

3.2 Desired outcome and decision question

The desired outcome and decision question reflect the level of decision to which the sustainability assessment is applied, i.e. whether it is a policy, plan, programme or project, and define the specific purpose of the sustainability assessment (Morrison-Saunders and Therivel, 2006; Pope and Grace, 2006). Decision questions fall within a spectrum ranging from the most project and site specific and least strategic (e.g. Is proposal X acceptable at site Y?) through to more open and strategic questions corresponding to higher levels of decision-making (e.g. What should the future of area Z be?) (Table 3 in Morrison-Saunders and Therivel, 2006, p290).

Traditional project-based EIA is often associated with the least strategic sorts of decision questions (Hacking and Guthrie, 2008), and this in turn affects the alternatives that might be considered and therefore the scope of the sustainability issues that can be considered within the assessment process. We demonstrate this in Section 3.4 with some examples.

3.3 Sustainability goals and criteria

Closely related to the decision question is the setting of goals and criteria that establish and operationalise the vision for sustainability in the context of the proposed activity and provide the framework against which alternatives will be compared and the preferred option determined (e.g. Pope and Grace, 2006). Also referred to as sustainability objectives (e.g. ODPM 2005), principles (e.g. Bond and Morrison-Saunders, 2011) or core-criteria (e.g. Gibson, 2006) the sustainability vision needs to be contextualised in light of the decision question and ultimately will be evaluated using indicators. It is important to realise that although the sustainability objectives are often derived from overarching sustainability principles which are highly integrated, criteria or indicators developed from these typically revert to a compartmentalized structure in which the environmental, social and economic categories are treated separately. This tends to emphasise substantive trade-offs between the three categories of the 'triple bottom line'. To counter this, Bond and Morrison-Saunders (2011) emphasise the importance of selecting indicators such that a holistic understanding of sustainability is maintained.

It has been argued that objectives set for sustainability assessment early in the process should be tested for potential conflict at an early stage of the assessment process to limit substantive trade-offs that may arise later. For example, the UK Office of the Deputy Prime Minister (OPDM) (2005, pp-120-121) advocate carrying out a test of the internal compatibility of sustainability assessment objectives in order to highlight and subsequently address any points of tension or conflict between them before investigations and information gathering on alternatives commences. In essence a design conflict between individual sustainability objectives would automatically invoke a trade-off situation in the subsequent assessment process irrespective of which alternatives are examined. The compatibility analysis is part of good process design representing an early initiative for managing (and in this case, avoiding) potential trade-offs in sustainability assessments.

3.4 Alternatives and options

The decision question (Section 3.2) effectively determines the broad alternatives that can be considered within the scope of the decision making process, which in turn define other, more specific options that are often considered in the form of a hierarchy of alternatives (e.g. Therivel, 2004, p111; ODPM, 2005, p123). For example, Gibson (et al. 2005, p126) observe that there are 'different possible purposes, different general approaches to serving the selected purpose, different locations and designs, different packages of mitigation and enhancement components, and different implementation plans'. The alternatives hierarchy

itself thus embraces several of our sustainability assessment steps, including sustainability goals and criteria already discussed in Section 3.3, and mitigation choices which we discuss in Section 3.6. At each step down this hierarchy the options become progressively narrower in scope and with less 'room to move' with respect to avoiding or minimising substantive trade-offs. We illustrate the relationship between the initial framing of a sustainability assessment in terms of a decision question, and the alternatives hierarchy and ensuing trade-offs with a case study from Western Australia in Box 1.

Box 1. Decision question, alternatives and substantive trade-offs for the Gorgon Gas Development

The sustainability assessment process undertaken for the Gorgon Gas Development in Western Australia has previously been described by Pope and Grace (2006), Pope (et al. 2005) and Morrison-Saunders and Pope (2012). The proposal under assessment related to the processing of natural gas on Barrow Island, a significant nature reserve, and the decision question framing the assessment was: 'Are the potential impacts of constructing a gas processing plant on Barrow Island acceptable?* (Pope and Grace 2006, p378). Given this decision question, which embedded the proponent's preferred location for the development, trade-offs between the unique ecology of Barrow Island and the jobs and royalties generated by the project were inevitable (Morrison-Saunders and Pope 2012).

A more strategic question, such as 'What is the most sustainable location for the Gorgon gas development?' would have permitted the exploration of alternative sites on the mainland within the sustainability assessment process. A solution could have been sought that ensured the protection of Barrow Island as well as arguably enhancing the socio-economic benefits to Western Australia, even though this may have required some level of public funding (Pope et al. 2005). Steinemann (2001) provides a detailed account of short-fallings in the consideration of alternatives in traditional EIA practice and the consequences for the potential substantive outcomes that result. Our key point here is that there is a direct link between the framing of a proposal (i.e. articulation of the decision question), the alternatives and options that are considered in the process, and the substantive sustainability outcomes that might be realised.

*This decision question was retrospectively distilled by the authors; it was not actually posited in the original assessment documents.

3.5 Impact prediction and evaluation

Both process and substantive trade-offs may be evident in the process of predicting and evaluating the likely impacts of each alternative in a sustainability assessment. Decisions that must be made regarding the conduct of the prediction process, for example the nature and duration of baseline monitoring, and choice of predictive models or techniques, involve process trade-offs that will directly affect the information base upon which predictions are made. The main focus of our discussion in this section, however, is the evaluation of the predicted impacts in terms of their significance and acceptability, since this a vital step in considering and managing substantive trade-offs. As Gibson (et al., 2005, p140) argue: '(a) significance test is clearly crucial… [to determine] whether an anticipated adverse effect is bad enough to make a proposed trade-off unacceptable'.

While earlier writers discussing impact significance tended to use classification scales of four or five categories with terms such as high/major, moderate and low/negligible (e.g. Haug et al., 1984; Duinker and Beanlands, 1986), for sustainability purposes a simpler classification is generally sought. For example Sippe (1990) distinguishes between 'negotiable' and 'non-negotiable' impacts and provides some suggested guidance for ecological and social

acceptability based around threat to life and life systems or carrying capacity (reproduced in Glasson et al. 2012, p207). In later work Sippe (1999) proposed threshold tests for environmental acceptability. Sadler (1996, p193) speaks in terms of 'critical' and 'non-critical' resource loss, while the Western Australian EPA (2008, p21) discuss 'critical assets', representing the most important environmental assets in the State that must be fully protected and conserved, with the implication that significant impacts on a critical asset would normally be considered unacceptable.

The notion of demarcating acceptable from unacceptable impacts is core to sustainability assessment and to the effective management of trade-offs. It is an essential part of identifying and enhancing the preferred alternative (see Section 3.6) and evaluating the substantive trade-offs involved in a proposal as input to the decision as to its overall acceptability (see Section 3.7). For example Sadler (1996, p184) notes that the task of making substantive trade-off decisions and the integrity of outcomes delivered will be made easier where the process for making trade-offs: 'is disciplined such that economic, environmental, and social objectives are all met at some "threshold level"'. Ideally, 'critical assets', 'non-negotiable' impacts (or thresholds or acceptability limits, to use alternative language) would be established as part of the identification of sustainability goals and criteria (as discussed in Section 3.3).

3.6 Selection and enhancement of the preferred alternative

Following prediction of impacts for each alternative, the results can be compared in order to select the preferred alternative. In complex situations it may be useful to employ decision-aiding tools such as multi-criteria decision analysis (MCDA) at this point. Such tools have the advantage of not only providing an overall score for each option (a sustainability score if the criteria with which the model is populated reflect sustainability considerations) but also in making explicit the trade-offs inherent in the selection of the best performing or preferred option. This in turn facilitates the mitigation of residual negative impacts to ensure acceptability, and the enhancement of positive benefits from the preferred alternative. An example from recent sustainability assessment practice in Western Australia is provided in Box 2.

To understand the trade-offs that can arise at this step in the sustainability assessment process, it is useful to consider the mitigation hierarchy (e.g. Mitchell, 1997; Tinker *et al.*, 2005), which commences with attempts to avoid adverse impacts altogether and thereafter to minimise, reduce and repair those that cannot be avoided. For the residual impacts remaining after these four steps in the mitigation hierarchy have been followed, which all directly address the source of the predicted impact, the remaining option is to provide compensation or offsets that will counter-balance any residual impact (e.g. Canter and Weems, 1995; Brown and Lant, 1999; Cuperus, et al., 2001; EPA, 2008). Thus offsets are the last resort in the classic mitigation hierarchy (e.g. Glasson et al., 2012, p138).

There is a considerable interest and literature on offsets and guidance for their use within impact assessment (e.g. Shabman and Scodari, 2005; BBOP, 2009; Middle and Middle, 2010) including the notion of 'going beyond full compensation or no net less offsets to achieve net gain' (Rajvanshi et al., 2011, p183) which aligns well with the net sustainability benefits goal of sustainability assessment discussed previously. Here we focus solely on understanding offsets within the context of trade-offs. A key point to realise is that offsets are themselves a particular type of trade-off. In the words of Strategen (2006, p6-10): 'offsets are a deliberate form of trade-off … [within a given environmental, social or economic category] in which a negative impact with respect to one factor may be compensated for by an enhancement in another, and a loss is traded off for a greater gain elsewhere'.

Box 2. Enhancing the preferred alternative for South Perth tree-planting

This small-scale sustainability assessment conducted by the City of South Perth, a municipal government in Western Australia, illustrates firstly how process decisions can minimise substantive trade-offs, and secondly how MCDA tools can assist in explicitly identifying trade-offs and developing mitigation strategies to ensue their acceptability (Pope and Klass, 2010). The proposal that was the subject of the internal sustainability assessment involved planting additional trees within a major park on the banks of the Swan River opposite the central business district of Perth. The decision-framing question posed by the proponent was 'What is the most sustainable way to plant trees on Sir James Mitchell Park?' (City of South Perth, undated).

Sustainability criteria relevant to the project (including, for example, enhancement of ecological integrity, maintenance of views, public safety, maintenance costs) were established in collaboration with stakeholders as the basis of the assessment. Stakeholders were also involved in identifying a range of options, representing different ways that the desired outcome of the project could be met, reflecting variations in the species, number and location of trees within the park. The key decision was made to utilise an MCDA process to compare the five tree-planting options. The performance of each option against each criterion was scored and these results were displayed in graph highlighting the comparative pros and cons of each option, as well as presenting an overall 'sustainability score' for each option. This facilitated firstly the selection of the preferred option (the one with the highest sustainability score) and then the optimisation of this option by incorporating strengths of other options into the design. For example, the preferred option scored well against most criteria, but it performed less strongly when compared with other options against the criterion 'Provision of suitable habitat for birds and other fauna' (City of South Perth, undated). This provided an opportunity to refine the preferred option by adding a small number of a particular species of tree to the tree-planting species mix for the preferred option and in a particular zone within the park that would not jeopardise any of the other sustainability criteria.

A conceptual model showing the relationship between trade-offs and offsets and employing the negotiable/non-negotiable terminology of Sippe (1990) is depicted in Figure 1. The dark shading for each of the environmental, social and economic categories of the triple bottom line of sustainability represents the non-negotiable issues with the straight-edged border of the darker areas denoting the critical threshold point. Thus the figure indicates that critical thresholds need to be established for each of the categories for the specific context in which a sustainability assessment decision is being made in order for assessment of acceptability to be determined. Although we favour systems-oriented models of sustainability over the triple bottom line conceptualisation, the latter is used here for ease of illustration; the concepts represented in Figure 1 with respect to the relationship between offsets and trade-offs apply equally to other more sophisticated models of sustainability.

Figure 1 establishes a presumption against allowing any impact that would cross a critical threshold into the realm of the 'non-negotiable', although sustainability imperatives will differ in different parts of the world and such a position would be context specific (Gibson, 2006). Offsets are depicted as falling within the 'negotiable' domain of environmental, social and economic categories and these are the type of trade-off that correspond to substitutions in time, place or kind discussed previously.

Another form of permissible trade-off depicted in Figure 1 is the substitution of negotiable capital in one category with that from another. In this way the model is consistent with notions of strong sustainability (e.g. Cabeza Gutés, 1996), meaning that overall capital within each of the environmental, social and economic categories is maintained. However, although common in practice Gibson et al (2005) advocate 'restricting cross-category trade-offs' on the grounds that this 'might push efforts to find alternatives that provide positive results in all categories' while at the same time recognizing that such options may not always be available.

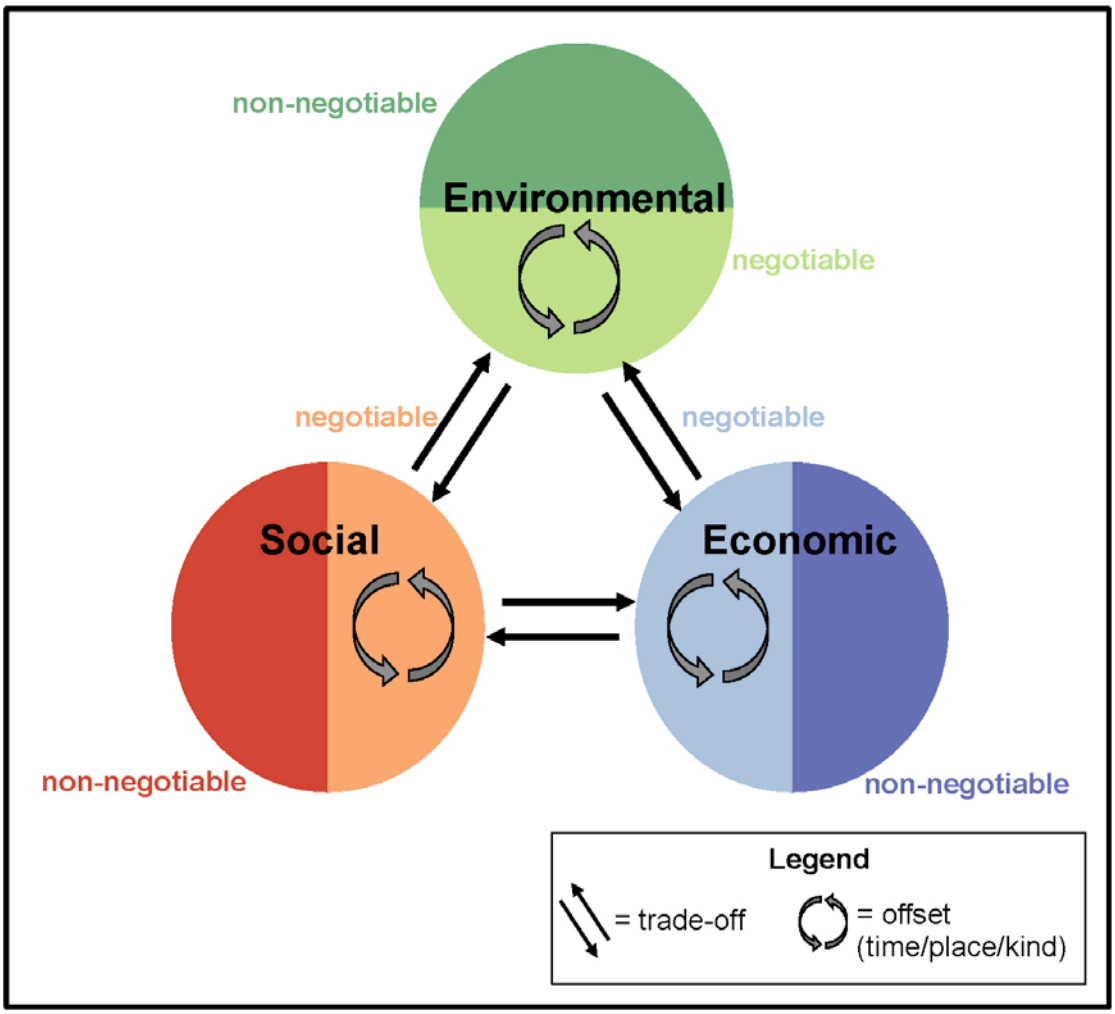

Figure 1 Conceptual model of critical thresholds and offsets for substantive trade-offs

As a form of substantive trade-off, offsets can involve substitutions of impacted resources in time, place and kind (Gibson 2005, p127). A 'like for like' principle should apply to offsets (e.g. Rundcrantz and Skärbäck, 2003; Cuperus, 2004, Hayes and Morrison-Saunders, 2007) so that the integrity of substitutions in time or place is guaranteed. For biodiversity offsets the like for like approach is intended to ensure that the offset site is located in the same local vicinity and restores or protects the same ecosystems or flora and fauna species as those being impacted. The concept of 'like for better' (EPA 2008, p7) has also been advanced whereby a better outcome could be achieved through an offset that restores or protects a more highly valued environmental asset which might be identified in strategies for regional development as priority areas for protection.

Overall, the ultimate aim of this step in a sustainability assessment process is to identify a preferred alternative that does not involve any unacceptable impacts and for which any trade-offs are deemed acceptable from a sustainability perspective, prior to submitting the proposal for public review and approval. Determining whether or not a proposal is in fact acceptable according to these criteria is usually the responsibility of the approval decision-makers, and we discuss the question of overall proposal acceptability in Section 3.7.

3.7 Approval decision and announcement

Trade-offs are particularly prominent at the approval decision-making and announcement stage of an assessment. It is the responsibility of decision-makers to determine whether or not these trade-offs are acceptable for the community on whose behalf they are acting, since trade-offs will vary in degree of acceptability from context to context (Glasson, 1999; Gibson et. al., 2005; Gibson, 2006). This is a complex task, and the need for processes to evaluate and manage trade-offs is frequently acknowledged in the literature (e.g. O'Riordan, 1976; Sadler, 1996; Glasson et al., 2012).

The starting point here might be to determine whether or not predicted impacts are acceptable, or whether acceptability thresholds will be crossed (as per the discussion in Section 3.5). Beyond this, however, the work of Gibson (et al., 2005; 2006) in extending this thinking provides a far more robust and helpful framework for managing trade-offs than has previously been available. Gibson proposes rules through which the acceptability of trade-offs can be evaluated. Gibson's trade-offs rules are summarised here, and detailed discussion can be found in Gibson et al., 2005, pp130-141 and Gibson 2006):

1. *Net gains:* Any acceptable trade-off must deliver net sustainability gains (over the long-term);
2. *Burden of argument:* The proponent of the trade-off must be required to provide justification;
3. *Avoidance of significant adverse effects:* no trade-off involving significant adverse effect is acceptable unless all alternatives are worse;
4. *Protection of the future:* No displacement of significant adverse impact from present to future can be justified unless all alternatives are worse;
5. *Explicit justification:* All trade-offs must be explicitly justified (including a context specific account of priorities and sustainability decision criteria); and
6. *Open process:* Stakeholders must be involved in trade-off making through open and effective participatory processes.

While these rules can be invoked for any decision made during impact assessment to some extent, they have particular resonance for the evaluation of the acceptability of substantive trade-offs at the approval decision point. In the following discussion we explore how the concepts embedded in the Gibson trade-off rules are located within the broader impact assessment literature, observing that Rules 1, 3 and 4 relate to the substantive acceptability of trade-offs while Rules 2, 5 and 6 guide the process of evaluating substantive acceptability.

Net gains (Rule 1)

Any substantive trade-off should be subject to a test that it will deliver an overall net benefit, a requirement correlating directly with one of the core objectives of sustainability assessment discussed in Section 1. As Gibson et al (2005, pp128-129) suggest, net effects judgments underlie the vast majority of undertakings that might be subjected to a sustainability assessment. As well as determining whether negative impacts are acceptable (see Section 3.5 and discussion of Rule 3 below), it may also be necessary to determine whether predicted benefits are 'good enough' (Pope et. al., 2004). In a Canadian context, the term 'contribution to

sustainability test' is used in practice (e.g. Gibson, 2011) which translates to achievement of overall net benefit. Later (see Box 3) we discuss the South West Yarragadee groundwater case study in this context. Offsets are an important consideration too; previously in Section 3.6, we noted the potential role for offsets in achieving net gains, including application of the 'like for better' concept.

Burden of argument (Rule 2)
The burden of argument rule is a process rule that is essentially an extension of the 'polluter pays principle' that arguably underpins all forms of impact assessment (Morrison-Saunders 2011). The polluter pays principle within environmental law requires polluters to bear the costs of any pollution and its associated treatment or clean-up arising from their actions (Bates 1997, p157). Similarly the proponent of an impact assessment is expected to report on the likely impacts of their proposed activities along with proposed mitigation measures (i.e. in traditional EIA such a report is generically known as the environmental impact statement). The burden of argument trade-off rule is simply a further extension of this thinking to ensure that proponents of sustainability assessment give a full account and justification of the trade-offs that they are proposing in order to implement their desired activities.

It can be expected that regulators and decision-makers may build upon the initial sustainability analysis presented by proponents when proposing additional trade-off or mitigation measures that would modify a proposal as originally filed by the proponent, as exemplified by the evaluation report for the Mackenzie Gas Project by the Joint Review Panel (JRP, 2009). Gibson (2011, p232) believes that the JRP report for the Mackenzie Gas project: 'represents the most detailed effort so far by an environmental assessment hearing body in Canada to adopt and apply a contribution to sustainability test, identifying a suite of key issue areas covering the general requirements for progress towards sustainability…' Thus while the principal burden of argument should fall to the proponent of the proposed action, the assessment agencies will nevertheless also play an important role with respect to rigour and accountability for sustainability performance and outcomes.

Avoidance of significant adverse effects (Rule 3)
The net gain test (Rule 1) involves consideration of the positive outcomes likely to arise from a decision and what is a 'good enough' gain. As already emphasised (see Section 3.5 and Figure 1), it is at least as important to also consider the acceptability of negative impacts, such that overall progress towards a more sustainable world is maintained. This should include the potential for cumulative effects; for example, where the adverse impacts of an individual project considered on its own might not cross a threshold, but may do so when combined with other existing or proposed projects nearby. Seeking opportunities to counterbalance existing cumulative effects is obviously desirable when evaluating net gain contributions.

Protection of the future (Rule 4)
This is a sub-set of Rule 3 that specifically highlights the time dimension of sustainability, i.e. intergenerational equity. A good example is provided in the assessment of the Mackenzie Gas Project in Canada. In undertaking their sustainability evaluation the JRP (2009) compared the gas pipeline project as filed by the proponent with the same project as if implemented with the full recommendations of the Panel with respect to five key sustainability issues categories, one of which was 'legacy and bridging impacts' (JRP, 2009, pp585-615; the other four sustainability issues categories were: cumulative impacts on the biophysical environment; cumulative impacts on the human environment; equity impacts; and cumulative impacts management and preparedness). When drawing their conclusions, the Panel also considered the long term implications for the people and regions of Canada affected by the proposal if the

gas project did not proceed and reported on the trade-offs involved. Some of their key conclusions were that (JRP, 2009, p612):

- '…unavoidable trade-offs resulting from approval of the Project with full implementation of the Panel's recommendations would be acceptable in the circumstances';
- 'The null alternative is not acceptable. Current trends, especially in socio-economic well-being, are not encouraging and continuation along the current trajectory does not promise progress towards sustainability'; and
- 'The Project could be implemented in a way that would contribute to sustainability, especially if its cumulative impacts are anticipated and managed effectively and if the opportunities involved are used to foster transition to a more desirable and durable legacy for future generations'.

Further analysis of the Mackenzie Gas Project sustainability assessment, including emphasis on how the JRP sought to ensure protection for the future, is provided in Gibson (2011).

Explicit justification (Rule 5)

The explicit justification rule, which is closely linked to Rule 2, calls for proponents (and their consultants) to provide more information than might be customary at present in their pre-approval decision-making documentation. Decision-makers already are expected to disclose the nature and reasons for their decisions in accordance with natural justice expectations (e.g. Morrison-Saunders and Early, 2008; and provisions of the *Aarhus Convention on Access to Information, Public Participation and Access to Justice in Environmental Matters* 1998), Rule 5 calls for explicit articulation and justification of trade-offs inherent in the proposal.

Open process (Rule 6)

Call for transparency and openness in discussing trade-offs in sustainability assessment decision-making are consistent with long established basic principles for any impact assessment process that they should be 'participative' and 'transparent' (e.g. IAIA & IEA 1999). Doelle and Sinclair (2006), note that 'the more openly you engage the public, the earlier you do it, the better you do it, the better the project, and everyone wins' (p204). While they are speaking of engagement in general rather than engagement with respect to trade-offs explicitly, we consider that engagement with respect to evaluating and managing trade-offs should be a vital component of sustainability assessment if the previously noted tendency for traditional trade-off decision-making to occur 'behind closed doors' is to be avoided.

Applying the Gibson trade-off rules in practice

Attention has been drawn to the Gibson trade-off rules frequently within the sustainability assessment literature. For example, in response to environmental trade-offs identified in sustainability appraisals conducted in England, Therivel (et al 2009, p166) identified application of the rules as a possible way to clarify the 'circumstances in which an environmental cost can be acceptable in relation to social and/or economic benefits, and identification of circumstances under which no environmental harm will be acceptable'. However they are less evident in sustainability assessment practice.

The only assessment we are aware of that has explicitly invoked the Gibson trade-off rules to demonstrate the acceptability of a proposal was sustainability assessment of the South West Yarragadee Water Supply Development in Western Australia, which related to a proposal by the Water Corporation of Western Australia to extract 45 GL/day of groundwater from an aquifer approximately 300km south of Perth, the capital city of Western Australia, to supply Perth and its surrounds. Chapter 6 of the proponent's sustainability impact statement was entitled 'Assessment Against State Sustainability Principles and Gibson Tradeoff Rules', and

each of the rules was applied in some detail to demonstrate the perceived acceptability of the proposal. Some extracts from this chapter along with associated comments in the subsequent evaluation by the Sustainability Panel appointed to report to Government on the overall sustainability of the proposal (Sustainability Panel 2007) are reproduced in Box 3. The extracts in Box 3 discuss 'positive contribution to sustainability' or 'net benefit' separate to the Gibson trade-off rules notwithstanding that Rule 1 encompasses this aspect of sustainability.

Box 3. Application of the Gibson trade-off rules in the sustainability assessment of the South West Yarragadee Groundwater Development

Extracts from the proponent's sustainability impact statement (Strategen, 2006)
This evaluation looks at the proposal as a whole, and also at the level of the three accounts of sustainability – the environmental, social and economic aspects of sustainability. It asks whether the proposal as a whole can be considered to make a positive contribution to sustainability overall, and to each of the three accounts (p6-1).

Assessment against the Gibson trade-off rules plays an important supplementary role in the sustainability decision-making process. As already stated, the aim of sustainability assessment should always be to achieve mutually beneficial outcomes with respect to sustainability objectives, since to begin with an assumption that trade-offs are unavoidable will compromise the assessment and limit opportunities to find these win-win-win outcomes. The Gibson trade-off rules arise from the acknowledgement that despite the best efforts of planners and decision-makers, almost every decision offers both advantages and disadvantages and, therefore, the process of making any decision inherently involves trade-offs since gains are rarely achieved in one area without some losses in another. The question then is whether the losses (which we may also term as adverse impacts or trade-offs) are acceptable. It is important to bear in mind that finding ways to manage trade-offs is a "last resort" option and should not be the starting point of the assessment (p6-1).

The Gibson trade-off rules provide the basis for dealing with tensions and conflicts that may be identified in the process of applying a well considered set of sustainability principles. They can be used to guide the evaluation of the acceptability of a proposal within a sustainability context by examining the acceptability of the inherent trade-offs that would be made in approving the process. They are therefore an extremely valuable tool to aid sustainability decision-making (p6-2).

Extracts from the Sustainability Panel evaluation (Sustainability Panel, 2007)
The Sustainability Panel has concluded that the sustainability assessment process conducted for the South West Yarragadee proposal was adequate for its purpose having covered relevant environmental, social, and economic issues sufficiently well that sound conclusions may be drawn on the project… The Sustainability Panel has concluded that the South West Yarragadee proposal as presented by the Water Corporation should be allowed to proceed as it has planned well to achieve 'net benefit' outcomes socially, economically and environmentally (p3).

As part of the process the Sustainability Panel sought the views of an international expert, Professor Robert Gibson from the University of Waterloo in Canada… As a result of the involvement of Professor Robert Gibson the project was subjected to an evaluation based on a set of 'Sustainability Decision Making Principles' he developed to assess whether the processes used were adequate. In particular, his principles were developed to try to minimise trade-offs. His principles were outlined in Section 3, Chapter 6 of the Sustainability Evaluation report and include: 'Net Gains'; 'Avoidance of Significant Adverse Effects'; 'Protection of the Future'; and 'Open Process' (p13).

Applying these principles, trade-offs between the three core areas of economic, social and environmental would not be acceptable. For example, if the project inflicted significant harm on the environment, it would not be deemed sustainable even if the economic benefits were considered to exceed the environmental costs. However, within the environmental, economic and social 'accounts', offsets would be acceptable to ensure that the project delivers a net benefit in each of the three 'bottom lines'. Offsets should be adopted only when reasonable steps have been taken to avoid or minimise harm. A 'bottom line' that included offsets and still delivered severe detrimental impacts would not be acceptable in any of the three core areas of environment, economy and society (p13).

The Sustainability Panel finds that an evaluation process based on the Gibson rules is sufficient to assess sustainability (Sustainability Panel, 2007, p13).

The South West Yarragadee case study demonstrates that the Gibson trade-off rules can be applied in practice. We provide this example here as a 'call to arms' for practitioners to promote the explicit adoption of such an approach to sustainability assessment approval decision-making.

3.8 Implementation and monitoring

We are not aware of any literature or case studies specifically pertaining to managing trade-offs during the follow-up stages of impact assessment. Nevertheless it is not difficult to imagine process trade-offs or compromises being made due to constraints on the capacity or willingness of proponents and regulators to implement and enforce follow-up programs. Any such trade-offs made in the area of follow-up would have direct implications for the potential learning that should ideally be generated at this point in the process (e.g. Marshall et. al., 2005). In the context of our discussion, effective follow-up should generate knowledge about the actual impacts and substantive trade-offs associated with the implementation of decisions, which in turn can be applied in Step 5 of our generic process to aid with the prediction and evaluation of similar impacts in future proposals.

4. Conclusions: the way ahead for managing trade-offs in sustainability assessment

What we hope is evident by now is that the consideration and management of trade-offs has both procedural (process) and substantive (outcome) dimensions that are equally important, and that consideration of trade-offs must begin well in advance of approval decision-making. We have highlighted in our framework how good process throughout the eight essential steps of sustainability assessment is more likely to deliver better, more sustainable substantive outcomes, incorporating trade-offs minimised to acceptable levels.

In summary we emphasis the following key points from our review:

- Trade-offs, and the implications of process compromises that may be made, should be considered as early as possible in the framing and design of any sustainability assessment process. The nature and type of alternatives considered in a sustainability assessment is a particularly important determinant of the substantive outcomes that can be realised.
- The demarcation of acceptable from unacceptable impacts is core to sustainability assessment and to the effective management of trade-offs. It is an essential part of identifying and enhancing the preferred alternative and evaluating the substantive

trade-offs involved in a proposal as input to the decision as to its overall acceptability. Ideally 'non-negotiable' impacts would be established as part of the identification of sustainability goals and criteria.

- Offsets can be considered a form of trade-off within a category (e.g. environmental, social or economic). Offsets in place, time or kind should be used only as a last resort when all other mitigation options have been applied and the residual impacts have been determined to be acceptable, to ensure that a net benefit outcome overall is attained where resources are being traded-off.
- Gibson's trade-off rules provide acceptability criteria for substantive trade-offs that are particularly useful at the approvals decision-making stage, as well as process rules for how the evaluation of acceptability should occur. They have been successfully employed at least once in sustainability practice to date and we advocate their broad uptake.

It seems to us that governments and elected officials do not relish having to make difficult decisions. The greater the number and significance of trade-offs, the more (politically) difficult it will be to make decisions; after all, it stands to reason that a win-win-win approval decision should be easier to make than a win-lose one. Dealing with trade-offs earlier in impact assessment processes, rather than leaving them for the 'behind closed doors' decision-making at the political level, should theoretically make decision-making easier, especially if proponents, regulators and other impact assessment stakeholders are actively involved in the process of seeking positive outcomes and minimising trade-offs.

Finally, we suggest that understanding and managing trade-offs in sustainability assessments is vital to reverse current trends towards deepening unsustainability, underpinned by the repeated trade-off of environmental values for socio-economic gain. The Gibson trade-off rules make an extremely valuable conceptual contribution, but their uptake has been almost non-existent in sustainability assessment practice to date. We argue that their application should be an essential component of sustainability assessment practice, if sustainability assessment is to fulfill its mandates of promoting net benefit from development, managing inter-generational impacts, and providing a framework for the explicit consideration of trade-offs within complex socio-ecological systems. We also argue, however, that consideration of trade-offs must occur throughout the sustainability assessment process, from the very earliest stages. Experience from Western Australia and Canada highlights some successful examples of trade-off management at different points in the process, but we are yet to see a process that demonstrates best practice management of trade-offs throughout the eight steps as posited in this paper. There are roles for proponents and their consultants, regulators and other stakeholders in impact assessment including researchers and educators in taking these matters on board in order to advance the way trade-offs are framed and managed in sustainability assessments in the future.

References

Bates, G (ed) *Butterworths Environmental Management and Law Dictionary*, 1997; Butterworths Australia, Sydney

BBOP – Business and Biodiversity Offsets Programme. *Biodiversity Offset Design Handbook* 2009; BBOP, Washington, DC.

Bond A, Morrison-Saunders A. Re-evaluating Sustainability Assessment: Aligning the Vision and the Practice, Environmental Impact Assessment Review, 2011; 31(1):1-7 (Available: http://dx.doi.org/10.1016/j.eiar.2010.01.007)

Bond A, Morrison-Saunders A, Pope J. Sustainability Assessment: The State of the Art, Impact Assessment and Project Appraisal 2012; 30(1): 56–66 http://dx.doi.org/10.1080/14615517.2012.661974

Brown P, Lant C. The effect of wetland mitigation banking in the achievement of no-net-loss. Environmental Management 1999; 23(3): 333–345.

CabezaGutés M, The concept of weak sustainability. Ecological Economics 1996; 17(3): 147–156.

Canter L, Weems W. Planning and operational guidelines for mitigation banking for wetland impacts. Environment Impact Assessment Review 1995; 15(3): 197–218

City of South Perth. Sir James Mitchell Park tree planting project draft sustainability assessment report, (undated); City of South Perth, Western Australia, Available: http://old.southperth.wa.gov.au/sustainability/pdf/DraftSustAssessReport_JP_v6Final.pdf [accessed 19 July 2011]

Cuperus R, Ecological compensation of the highway impacts: negotiated trade-off or no-net-loss? 2004; Delft, The Netherlands: Strapatz.

Cuperus R, Bakermans M, Udo De Haes H, Canters K. Ecological compensation in Dutch highway planning. Environmental Management 2001; 27(1): 75–89.

Doelle M, Sinclair A. Time for a New Approach to Public Participation in EA: Promoting Cooperation and Consensus for Sustainability, EIA Review2006; 26: 185-205.

Duinker P and Beanlands G. The significance of environmental impacts: an exploration of the concept. Environmental Management 1986; 10:1-10

EPA – Environmental Protection Authority. South West Yarragadee Water Supply Development: Water Corporation: Report and recommendations of the Environmental Protection Authority. Bulletin 1245, EPA, Perth, Western Australia; 2006, 53pp.

EPA – Environmental Protection Authority. Guidance for the assessment of environmental factors in accordance with the Environmental Protection Act 1986: Environmental offsets - biodiversity. No. 19, EPA, Perth, Western Australia; 2008, 39pp.

Gaudreau K, Gibson R. Illustrating integrated sustainability and resilience based assessments: A small-scale biodiesel project in Barbados. Impact Assessment and Project Appraisal 2010;28(3):233–243.

Gibson R 2006 Sustainability assessment: basic components of a practical approach, *Impact Assessment and Project Appraisal*, **24**(3): 170–182.

Gibson, R Application of a contribution to sustainability test by the Joint Review Panel for the Canadian Mackenzie Gas Project, *Impact Assessment and Project Appraisal* 2011; **29**(3): 231-244

Gibson, R, S. Hassan, S. Holtz, J. Tansey & G. Whitelaw, *Sustainability Assessment Criteria, Processes and Applications* 2005; Earthscan Publications Ltd, London.

Glasson J. Environmental impact assessment - impact on decisions. In: J. Petts (ed). Handbook of Environmental Impact Assessment Volume 1 Environmental Impact Assessment: Process, Methods and Potential. 1999; Blackwell Science Ltd, pp121-144.

Glasson J, Therivel R, Chadwick A. Introduction to Environmental Impact Assessment. 4th edition, Routledge Taylor and Francis, London; 2012, 392.

Government of Western Australia. Hope for the future: the Western Australian state sustainability strategy. Western Australia: Department of the Premier and Cabinet Perth; 2003.

Hacking T, Guthrie P. A framework for clarifying the meaning of triple bottom-line, integrated, and sustainability assessment. Environmental Impact Assessment Review 2008;28(1): 73-89.

Haug P, Burwell R, Stein A, Bandurski B. Determining the significance of environmental issues under the National Environmental Policy Act. Journal of Environmental Management 1984; 18: 15-24.

International Association for Impact Assessment and Institute for Environmental Assessment UK [IAIA & IEA] Principles of Environmental Impact Assessment Best Practice, 1999 Available: http://www.iaia.org/publications/ (accessed 18 April 2012)

Jenkins B, Annandale D, Morrison-Saunders A. Evolution of a sustainability assessment strategy for Western Australia. Environ Plan Law J 2003;201(1):56– 65.

Joint Review Panel for the Mackenzie Gas Project. Foundation for a sustainable northern future: report of the Joint Review Panel for the Mackenzie Gas Project. December 2009; 2 volumes, 679pp. Available at http://www.ceaa-acee.gc.ca/default.asp?lang=En&n=155701 CE-1.

Lee N. Integrated Approaches to Impact Assessment: Substance or Make-Believe? In Institute of Environmental Management and Assessment 2002. ''Environmental Assessment Yearbook 2002. The EA agenda for Johannesburg and beyond''. IEMA Centre University of Manchester; 2002.

Marshall R, Arts J, Morrison-Saunders A International Principles for Best Practice EIA Follow-up. *Impact Assessment and Project Appraisal* 2005; 23(3): 175-181

Middle G, Middle I. A review of the use of environmental offset as a policy mechanism in the environmental impact assessment process (EIA) in Western Australia. Impact Assessment and Project Appraisal 2010; 28(4): 313-322.

Mitchell J. Mitigation in Environmental Assessment - Furthering Best Practice. Environmental Assessment 1997; 5(4): 28-29.

Morrison-Saunders A. Principles for Effective Impact Assessment: Examples from Western Australia, presented at: *IAIA11 Impact Assessment and Responsible Development for Infrastructure, Business and Industry*, 31st Annual Conference of the International Association for Impact Assessment, 28 May – 4 June 2011, Puebla, Mexico 2011; Available: http://iaia.org/conferences/iaia11/proceedings/presentations.aspx (Concurrent Session: 'Environmental Compliance: Theory and Practice') accessed 20 September 2011

Morrison-Saunders A, Early G. What is necessary to ensure natural justice in EIA decision-making? Impact Assessment and Project Appraisal 2008; 26(1): 29-42

Morrison-Saunders A, Jenkins B and Bailey J. EIA follow-up and adaptive management. In: Morrison-Saunders A, Arts J. (eds) *Assessing Impact: Handbook of EIA and SEA Follow-up*. 2004; Earthscan, London: 154-177.

Morrison-Saunders A and Pope J. Learning by doing: sustainability assessment in Western Australia, in: Bond A, A Morrison-Saunders and R Howitt (eds) *Sustainability Assessment Pluralism, Practice and Progress*. forthcoming May 2012; Taylor & Francis, London: Chapter 10

Morrison-Saunders A, Therivel R. Sustainability integration and assessment. Journal of Environmental Assessment Policy and Management 2006; 8(3): 281–298

Noble B, Storey K. Towards increasing the utility of follow-up in Canadian EIA. Environmental Impact Assessment Review 2005; 25(2): 163-180.

ODPM – Office of the Deputy Prime Minister (UK) Sustainability Appraisal of Regional Spatial Strategies and Local Development Documents: Guidance for Regional Planning Bodies and Local Planning Authorities 2005; ODPM, London, 156pp.

Pope J Facing the Gorgon: SA and Policy Learning in Western Australia2007; PhD thesis, Murdoch University: Available: http://researchrepository.murdoch.edu.au/264/

Pope J. Editorial: What's so special about sustainability assessment? Journal of Environmental Assessment Policy and Management 2006; 8(3): v-ix

Pope J, Annandale D, Morrison-Saunders A. Conceptualising Sustainability Assessment. Environmental Impact Assessment Review 2004;24:595–616.

Pope J, Grace W. Sustainability assessment in context: issues of process, policy and governance. Journal of Environmental Assessment, Policy and Management 2006; 8(3): 373–398.

Pope J, Klass D. Decision Quality for Sustainability Assessment. presented at: *IAIA10 Transitioning to the Green Economy* 2010; 30th Annual Conference of the International Association for Impact Assessment, 6-11 April 2010, Geneva, Switzerland, [Available http://www.iaia.org/iaia10/documents/reviewed_papers/Decision%20Quality%20for%20Sustainability%20Assessment.pdf (accessed 27 Feb 2011)].

Rajvanshi A, Brownlie S, Slootweg R, Arora R. Maximizing benefits for biodiversity: the potential of enhancement strategies in impact assessment. Impact Assessment and Project Appraisal 2011; 29(3): 181-193.

Rundcrantz K, Skärbäck E. Environmental compensation in planning: a review of five different countries with major emphasis on the German system. European Environment 2003; 13(4): 204–226.

Sadler B. International Study of the Effectiveness of Environmental Assessment, Final Report, Environmental Assessment in a Changing World: Evaluating Practice to Improve Performance. Minister of Supply and Services, Canada; 1996, 248pp.

Shabman L, Scodari P. The future of wetlands mitigation banking. Choices 2005; 20(1): 69–70. Milwaukee WI: American Agricultural Economics Association.

Sheate W. The evolving nature of environmental assessment and management: linking tools to help deliver sustainability - tools, techniques & approaches for sustainability, In: W R Sheate (ed) Tools, techniques and approaches for sustainability: collected writings in environmental assessment policy and management. 2009; World Scientific, Singapore, Chapter 1, pp1-29, [available: www.worldscibooks.com/etextbook/7519/7519_chap01.pdf (accessed 11Feb11)].

Sheate W, Dagg S, Richardson J, Aschemann R, Palerm J, Steen U. Integrating the environment into strategic decision-making: conceptualizing policy SEA. Eur Environ 2003;13(1):1–18.

Sippe R. Power and accountability: the contribution of environmental impact assessment to sustainable development in Western Australia". Presented at: *Science, Assessment and Sustainability* conference, International Association for Impact Assessment, Vancouver, Canada 24 March 1990.

Sippe R. Criteria and standards for assessing significant impact. In: Petts J, editor. Handbook of environmental impact assessment, vol. 1. Oxford: Blackwell; 1999. pp. 74– 92.

Slootweg R, Jones M. Resilience Thinking Improves SEA: A Discussion Paper. Impact Assessment and Project Appraisal 2011; 29(4): 263-276

Steinemann, A. Improving Alternatives for Environmental Impact Assessment. EIA Review 2001; 21(1): 3-21.

Strategen. SouthWestYarragadee water supply development: Sustainability evaluation/ environmental review and management programme Volume 1 introduction, sustainability overview, methodology and conclusions. 2006; Strategen, Report prepared for Water Corporation, Perth, Western Australia, 220pp.

Sustainability Panel. Sustainability assessment of the South West Yarragadee water supply development. An independent report commissioned by: State Water Council. 2007; Department of Premier and Cabinet, Perth, Western Australia, 61pp.
Therivel R. Strategic Environmental Assessment in Action, Earthscan, London; 2004.
Therivel R, Gemma C, Craig C, Grinham R, Mackins D, Smith J, Sneller T, Turner R, Walker D, Yamane M. Sustainability-focused impact assessment: English experiences. Impact Assessment and Project Appraisal 2009; 27(2):155–168.
Tinker L, Cobb D, Bond A, Cashmore M. Impact mitigation in environmental impact assessment: paper promises or the basis of consent conditions? Impact Assessment and Project Appraisal 2005; 23(4):265-280
Water Corporation. Water Forever Sustainability Assessment, December 2008; Water Corporation of Western Australia, Leederville, Available: http://www.thinking50.com.au/go/publications (accessed 16 April 2012).

Weston, J. EIA, decision-making theory and screening and scoping in UK practice. Journal of Environmental Assessment, Policy and Management 2000; 43(2):185-203.
Wood C. Environmental Impact Assessment: A Comparative Review. Second edition, Pearson Education Ltd, Harlow, England; 2003, 405pp.