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Development offsets for ecosystem services in a rural residential development context: Issues for the Murrindindi Shire application.

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Rural residential development could have a positive or negative effect on the supply of ecosystem services. In most cases, the effect tends to be negative. One way of managing the impact is through a market based instrument. In this paper we present a development offset MBI as a way of cost effectively managing the ecosystem service impact of development in the Murrindindi Shire, Victoria. In this paper we note that design of the instrument is critical to the success of any MBI, including development offsets. Key development offset design issues discussed in this paper include defining what is traded (the metric), facilitating trades in a thin marketplace with high transaction costs, and ensuring the offset is commensurate with the impact.

Key words: Rural residential development, development offset, market based instrument, design.

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1. Introduction

Many regions across Australia are experiencing a rapid rate of land use change. A key driver of change in the neighbourhood of many Australian cities is the demand for rural residences and lifestyle farming opportunities. This is commonly called rural residential development (RRD). It is widely acknowledged that rural residential land use change can have a significant impact on the provision of ecosystem services – this impact can be positive or negative (The Australian Industry Commission 1998; Archer 1977; LaGro Jnr 1996; Tyser and Worley 1992 and Maetas *et al.* 2003). It is generally agreed that RRD will have a negative impact on at least some ecosystem services and a benign or slightly beneficial impact on others.

One particular region experiencing rapid RRD is the Murrindindi Shire, located in the upper foothills of the Goulburn Broken Catchment of Victoria, Australia. With historical land management already causing a reduction in ecosystem service supply and the predicted ecosystem service pressures from RRD, the local authorities (The Murrindindi Shire Council (MSC) and the Goulburn Broken Catchment Management Authority (GBCMA)) have begun to intervene in an effort to bring about better land management and ecosystem service supply. In doing this, the local authorities have set targets for the provision of higher than current ecosystem services to be achieved by both developers and non-developers across the region.

Pursuing ecosystem service targets could be conducted in a number of ways. A development offset market-based instrument (MBI) is the approach explored in this paper. MBI's applied in a natural resource management context have received increasing attention recently. This is because, in the right circumstances and when designed correctly, they have the potential to deliver outcomes at lower cost to government and with improved flexibility and lower compliance costs to landholders than comparable command and control regulatory instruments.

In general, development offsets require targets or minimum standards to be met but allow flexibility with how this is done. Development offsets were proposed for investigation in the Murrindindi Shire because it was recognised that the differences between landholders (land types, management practises etc) means that costs to reach standards would vary. Requiring all landholders to meet the targets in the same way and always on site is likely to be significantly more costly than allowing landholders the flexibility to achieve targets offsite or through a third party. Significant to achieving efficiency gains is the design of the development offset. The development offset design issues, as they relate to the Murrindindi case is the focus of this paper.

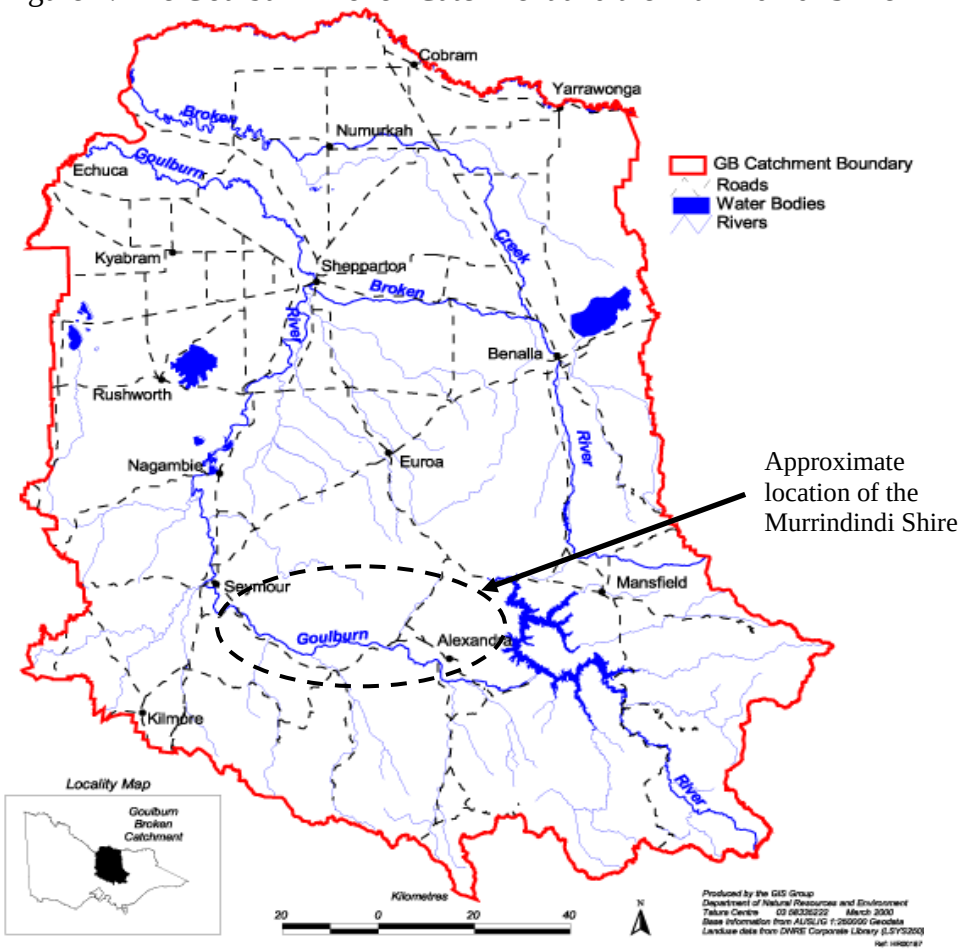
In section 2 the background to the Murrindindi case study area is described, here we outline the nature of RRD, the ecosystem services important to the region and the impact of RRD on these services. The conceptual framework, including a discussion on why ecosystem services are undersupplied in the current operating environment, is provided in section 3. The justification for government intervention is also set out in section 3. Here the ecosystem service targets set by the GBCMA are outlined and we argue why these targets will not be achieved with current management arrangements. In section 4, MBIs and development offsets particularly are introduced as a potential tool to facilitate developers achieving the ecosystem service gap. Key issues in the design of the development offset are discussed in section 5 and conclusions and policy implications are presented in section 6.

2. Background

2.1 The Murrindindi Shire

The Murrindindi Shire is located in Victoria's upper Goulburn Broken Catchment (GBC) (Figure 1), approximately two hours drive north of Melbourne.

Figure 1: The Goulburn Broken Catchment and the Murrindindi Shire



Source: Victorian State Government Department of Primary Industries LandLearn education program

Whilst the Murrindindi region developed around broadscale and intensive agriculture, its close proximity to Melbourne is now seeing a high demand for rural residential living. In 2001 the number of households in the Shire was projected to increase at a rate of about 60% per year over the period 2001 to 2021 (Habitat Planning 2003). Such an increase in households will inevitable bring an increasing demand for houses of which a large proportion of these will be rural residential.

2.2 Ecosystem services and rural residential development

One major attractor of rural residential development to the Murrindindi Shire is the natural environment and its supply of ecosystem services. An 'ecosystem' is commonly defined as the interactions among and between species and their surrounding environments (Binning *et al*. 2001). Ecosystems provide many services from which humans benefit. Ecosystem services contribute to the economic and social wellbeing to human beings in two key ways (Binning *et al*. 2001):

1. Through the use of natural resources (derived from natural assets) they provide an input to the production of a good; and
2. By maintaining natural assets through two different pathways. One, by regenerating the natural assets. Two, through the assimilation of by-products arising from production processes or from consumption of goods.

Binning *et al.* (2001) provides an extensive analysis of ecosystem services in the Goulburn Broken. The main ecosystem services provided by natural assets for this region were reported to be the provision of clean water, the maintenance of liveable climates and atmospheres, pollination of crops and native vegetation, control of species that could become pests and the fulfilment of intellectual, cultural and spiritual needs. Ecosystem services considered important to the Murrindindi Shire and particularly for RRD are:

- Aesthetics or visual and amenity quality (includes pest plants and animal, ridgeline appearance, agriculture and rural land conflict);
- Biodiversity (includes aspects such as quantity and quality of flora and fauna and management of pest animals and plants);
- Water quality (includes management of sediment and nutrients); and
- Soil quality (erosion and salinity management).

Whilst the ecosystem services of the region are a major attractor to the rural residential developers, development is also having an impact on the supply of these services. The nature of the impact could be positive or negative. The direction of the impact tends to be a function of the current land condition (which is influenced by past land management decisions) and the nature of the proposed development. In the Murrindindi it is estimated that the impact of development on ecosystem services is most likely to be negative.

The GBCMA (2003) report that even before development, land management is resulting in a decline in ecosystem services. For the GBC, about 70% or 1.7 million ha of native vegetation has been cleared since European settlement. The GBCMA also report that a vast amount of the remaining vegetation on private land is of poor quality (limited diversity, lack of understorey, lack of ground litter etc) and 98% of the remaining patches of vegetation are less than 1 ha. The GBCMA has also identified declining water quality as a major problem for the catchment. For example, the GBC contributes 33% of the Murray River water flow above the Murrumbidgee, but 58% of the turbidity (GBCMA 2003).

RRD does not necessarily have a negative impact on ecosystem services, in fact changing land use from agriculture to rural lifestyle blocks could improve the land management or reduce the agricultural intensity of the land. For example the Commonwealth Department for Environment and Heritage noted that "*because of their off-farm income, hobby farmers [lifestyle farms] often could afford to retain native vegetation and biodiversity and are [more] likely to enter into conservation agreements*" (The Australian Industry Commission 1998). Positive effects of RRD are presented further in Table 1.

Of course the impact from rural residential development could also be negative. Negative impacts could occur from short term, direct and site specific impacts such as construction or indirectly and in an ongoing basis from residual changes such as increased water run off from paved surfaces or the impact on vegetation from more intensive land use (for example intensive hobby activities such as horses) or generally poor land management. Individual impacts from RRD could also impact on broader ecosystem services supply. For example, poorly sited development could interrupt habitat corridors or preclude future improved management (Table 1). That is, there could be cumulative and threshold impacts from individual actions.

The current reduced levels of ecosystem services that result from a history of poor land management along with the potentially negative impacts on land from development, lead to the conclusion that development is likely to also have a negative effect on the provision of ecosystem services in the Murrindindi Shire. This is particularly the case as it is believed that the development will lead to increasingly fragmented landscapes. Despite what the Australian Industry Commission report, it is believed that many RRD landholders do conduct some agricultural activities on their property and tend to do so with low land management capacity and skills.

Table 1: Potential positive and negative effects of RRD

Direction of effect	Action	Outcome
POSITIVE EFFECTS	Rural lifestylists with less or no stock result in less production pressure on the land	Degraded land rehabilitated
	Rural lifestylists may have a greater interest, time and finance to revegetate land with native vegetation	Revegetation of cleared land
	Smaller parcels of land and increased financial and time capacity to manage pests	Improved pest and weed control
	Improved land management that results in improved groundcover and vegetation of riparian zones and stream banks	Improved water quality.
	Off farm income and new residents	Increased income in the local community, strengthened local community spirit and facilities. Increased investment maintaining local supplier viability
	Higher population density	Enhanced property security
	Increased property values	Significant capital gains to existing landholders
NEGATIVE EFFECTS	Poor land management – unsustainable stocking rates and poor pest control	Increased land degradation
	Clearing of native vegetation - may be sustainable at site level but not at the landscape scale (increase fragmentation)	Habitat destruction and fragmentation
	Increased roads and driveways	Soil disturbance and concentrated runoff, particularly on steep slop
	Increased paved surfaces	Increased and concentrated water runoff
	Degraded pasture leading to increased sediment in runoff. Increased fertilizer and sewerage resulting in increased nutrients.	Water quality decline
	Cumulative individual water harvesting	Water quantity decline
	Increased small blocks	Loss of agricultural land and Conflict with operational commercial farms
	Increase in property value	May prohibit the expansion of commercial farms

Note: Developed with reference to Habitat Planning 2003 and from discussions with Murrindindi Shire Council Planners.

3. The conceptual framework

3.1 Why are ecosystem services undersupplied and declining?

Historically ecosystem services have been freely and widely available. However, their significance is not recognised in our current frameworks for signalling information and incentives. For example, whilst there is no shortage of markets for goods such as clean water or apples; the services underpinning the production of these goods (water purification and pollination) are essentially free in current market operation (Salzman *et al.* 2003).With no market for these services, those who produce ecosystem services are not rewarded for the benefits that they provide, whilst those who damage these services do so without bearing the cost that they impose on others (Murtough *et al.* 2002). Because of the 'free' nature of these goods, the level of provision is generally less than what is socially desirable and often in decline.

When markets do not efficiently allocate resources, market failure is said to occur. There are a range of market failures likely to contribute to poor ecosystem service production. The key market failure generally responsible for the undersupply of ecosystem services is an inadequate property right structure. A lack of fully defined and allocated property rights then results in inadequate information to support ecosystem service production (Murtough *et al.* 2002; Wills 1997).

Property rights do not necessarily relate to the possession of a physical resource but rather to the potential benefit stream from the resource; both in isolation and when used in combination with other resources (Bromley 1991; Kasper 1998). Property rights must be excludable, divisible (in space and scope) and transferable to be effective (Kasper 1998). Whitten and Bennett (2005) describe these attributes further as:

1. Excludability allows the owner to prevent others from consuming the outputs from the good and relies on the practicality of identifying and stopping potential consumers;
2. Divisibility is the ability to separate the bundle of property rights in space and scope. Divisibility allows the owner of the property right to manage sub components of the resource separately or to divide up and sell off excess resources; and
3. Transferability grants the ability to sell the property rights to others. This feature also requires that property rights can be functionally transferred.

3.2 The current management of ecosystem services with RRD

In theory, the supply problems for goods arising from market failure may be remedied through some level of government intervention (Murtough *et al.* 2002). The nature of government intervention is commonly either;

- Facilitative, where measures are designed to improve the flow of information and corresponding signals and incentives. This may involve the reform of property rights but does not involve direct incentive payments to landowners;
- Market based or financial, where measures are designed to directly alter the structure of pay-offs to land managers; or

- Regulatory, where non-voluntary measures are designed to compel management change using the coercive powers of government.

Regional sustainability

In the GBC and the Murrindindi Shire, there are already a number of policies and plans in place that regulate for the maintenance of the supply of ecosystem services[1]. These policies and plans are to be followed regardless of whether a landholder is developing or not. With the recognition that simply maintaining the current level of ecosystem services does not align with community values and objectives (the current and future community actually desire a higher than current level of service provision), the GBCMA (2003) has developed a regional catchment strategy (RCS) setting out targets for the higher level of supply of specified ecosystem services. Targets in the RCS are for water quality, soil quality, pest plants and animals, native vegetation and climate. The RCS targets are considered to be those that will enable the region to achieve 'whole of landscape' or regional sustainability (Figure 2). Whilst these targets will need to be achieved by both non-developing and developing landholders alike, the remainder of this paper concentrates on a mechanism to aid developing landholders achieve regional sustainability targets.

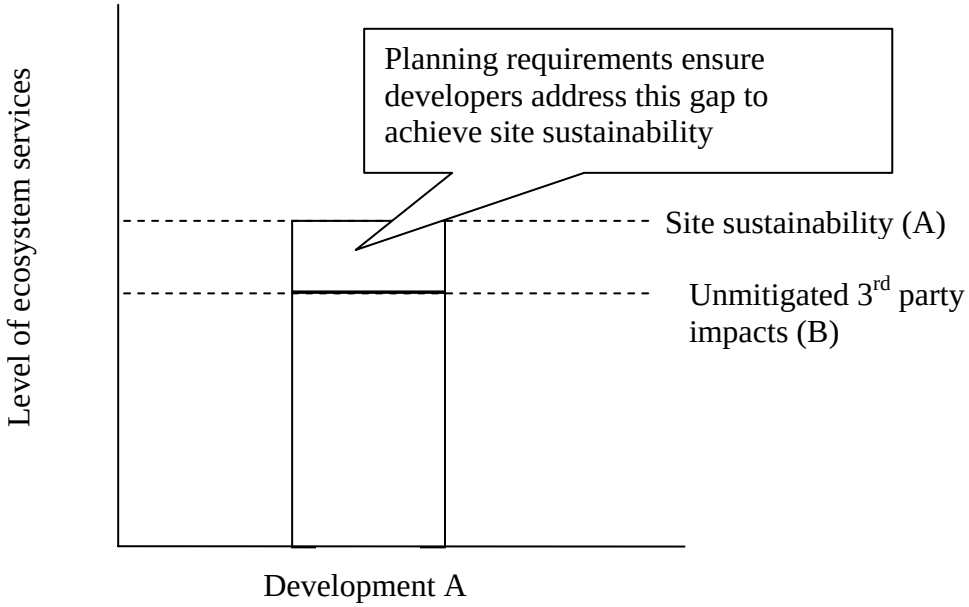
Site sustainability

Responsibility for the management of the direct impacts of development falls largely to the Murrindindi Shire Council. The MSC employ a range of regulatory and facilitative processes such as limiting development type and location (zoning and overlay provisions) as well as administering a formal development approval process. To assist developers in managing the supply of ecosystem services on development sites, the Murrindindi Shire have also developed a set of guidelines called the Rural Living Development Guidelines (RLDGs) (MSC 2001, 2004). These require all development applications to generate a whole farm plan demonstrating ecosystem service management activities on the development site.

Regulation of development aims to achieve a development outcome that has no negative and un-substitutable third party impacts. In this paper we refer to this as site sustainability but this is also referred to as duty of care. For example, an unmitigated development might result in direct third party impacts of B in Figure 2 (this might be water runoff impacts), however the development might be approved as long as works are conducted to manage water runoff such that there are no direct third party effects (Back to A in Figure 2). Also significant to site sustainability is that the actions to mitigate these impacts are not substitutable with any other action, they have to occur on site or they are of a different value.

[1]Both the regional and shire policies for development and ecosystem services must also comply/compliment State policy for the same. The Victorian Native Vegetation management framework is one policy that specifically influences the management of native vegetation and also includes a framework in which offsetting can occur.

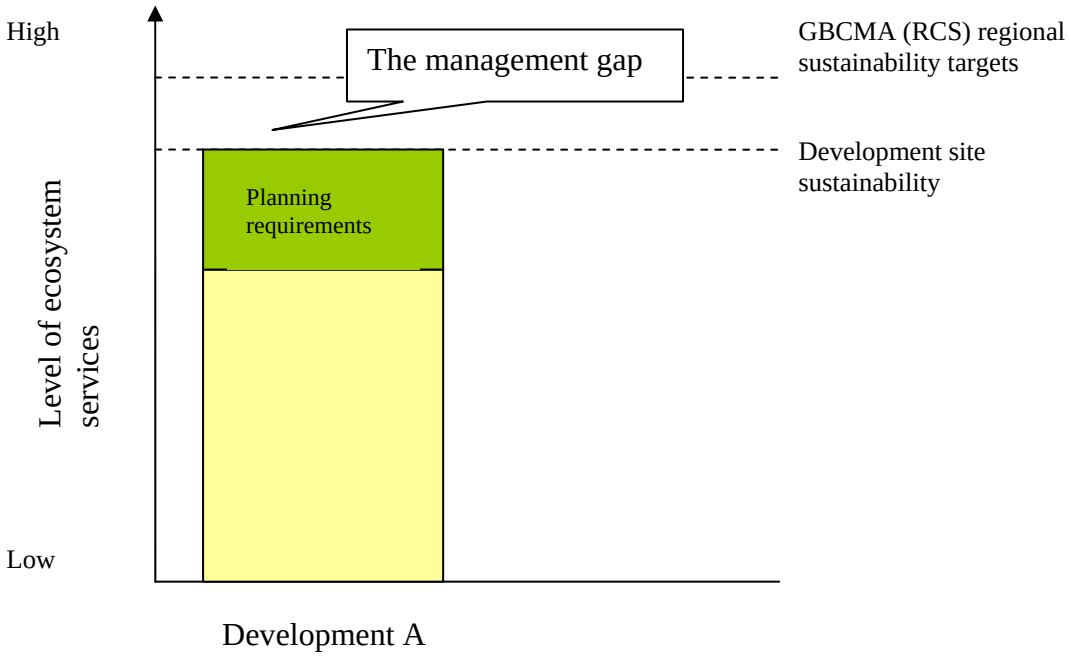
Figure 2: Development site sustainability



The management gap between site and regional sustainability

From an individual site perspective, the planning requirements are an effective means to manage the ecosystem services impacts of development and achieve site sustainability. Achieving site sustainability will not move the region any closer to achieving regional sustainability. This is because site sustainability does not take into account important features of the landscape that are needed for regional sustainability nor does this mitigate the cumulative, incremental and often residual impacts of development at the broader landscape scale. The management gap between regional and site sustainability is demonstrated in Figure 3. It is the management of this ecosystem service gap that is the focus of the remainder of this paper.

Figure 3: Current management and the management gap



4. A development offset Market Based Instrument (MBI) to address the ecosystem service gap

The options to address the management gap are more regulation, some form of facilitative approach or an incentive based approach that may include a market-based instrument (MBI).

Market-based instruments (MBIs) operate through market signals to change the incentives faced by landholders, rather than the explicit directives of the comparable command and control approach. MBIs have the potential to deliver improved ecosystem service outcomes at lower costs than alternative instruments because they:

1. Allow flexibility in the way participants choose to respond to the instrument;
2. Encourage change amongst those who can achieve change most cheaply, as opposed to broadly levelling change requirements on all; and
3. Place positive incentives on better land management, as compared to the negative incentives evident in regulatory approaches. This then encourages innovation in land management.

Significantly, MBIs address the cause of market failure and by changing the market forces faced by players, redefine the agenda such that improved environmental outcomes are in the landholders own interest (Whitten *et al.* 2003).

Development offsets require a specified level of performance to be achieved (usually couched in the language of 'no net impact') but allow flexibility with how this level can be achieved. An offset is an action taken offsite to compensate for on-site development impacts. Offsets can be conducted by the developer on another site or by a landholder contracted and paid by the developer. Offset works can also occur on site, if this is deemed the most cost effective approach. In this case the works are called 'mitigating actions'.

Development offsets have emerged because it is recognised that the cost of reducing the environmental impact of development through a specified and inflexible action may dramatically increase the cost of compliance for developers without any substantial environmental gain. Through development offsets, it is recognised that at the same time some developers can only make environmental gains at very high cost there are likely to be landholders who can make large environmental gains at relatively low cost. Offsets allow the party facing relatively high compliance costs to pay another party with lower costs to conduct compensatory actions on their behalf.

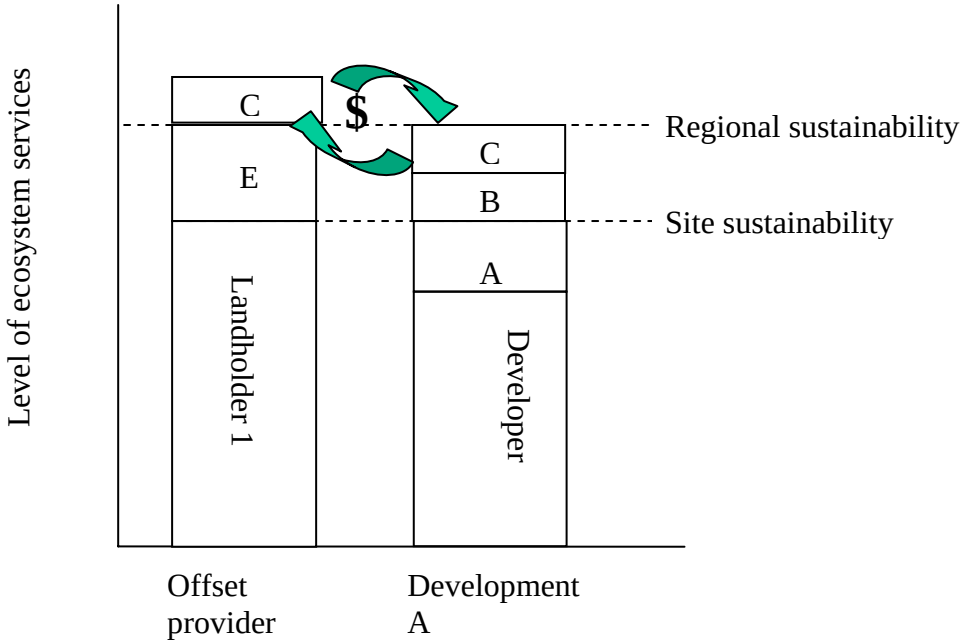
In the GBC all landholders must achieve regional sustainability targets. A development offset for the Murrindindi provides developers with the choice to either achieve targets on site or pay another landholder to conduct equivalent actions off site.

Refer to Figure 4 as an example. Here the proposed development has direct and non substitutable impacts on third parties (A) (once again this might be water run off impacts), in order to proceed, the developer must conduct actions that mitigate these impacts. These actions are not substitutable, that is they must occur on site to directly mitigate the impact. Once (A) has been fulfilled the developer now has to make contributions towards regional sustainability to get development approval (B and C in

Figure 4). Because actions B and C are not required to mitigate direct third party affects of development, these actions are substitutable. That is, the landholder can decide what actions to conduct to fulfil requirements and whether or not these actions will be done on or off site, by the developer or by a third party. In this case the developer decides that some of the actions can be done on site at low cost (B in Figure 4). Doing all the regional sustainability actions on site (B and C), however, is too expensive for this developer. In this example, the developer looks to find a supplier offsite to conduct actions equivalent to C[2].

At the same time, Landholder 1 (who is not developing) also has to take actions to contribute to achieving regional sustainability (E). In this example Landholder 1 finds conducting works for E can be done at very low cost. In fact, landholder 1 finds that they can make a profit by exceeding the targets and selling the oversupply to the developer. Landholder 1 produces "C" and sells this credit to the developer and the overall regional targets are achieved at a lower cost than a regulation.

Figure 4. Murrindindi development offsets



5. The importance of mechanism design

One of the best known environmental offset schemes in the international arena is the wetland mitigation banking program in the United States. Under certain conditions a developer is allowed to substantially alter a wetland if they ensure the protection, restoration or enhancement of another wetland. The early operation of the scheme indicates that whilst in theory an offset should be a more efficient management option compared with regulation, poor design could result in negative environmental outcomes. For example, a wetland offset scheme in Maryland gained 122 acres of wetland area through mitigation from 1991 to 1996 but lost the wetland function equivalent to a loss of 51 acres (Morrison 2004). The question then is "what makes a development offset well designed?"

[2] The supplier could also be another developer who can exceed requirements relatively cheaply.

A well designed MBI is one that addresses the reasons why the good is undersupplied in the first place, the market failures. In the Murrindindi case (and for most cases of undersupply of ecosystem services) the market fails to provide the socially optimal level of ecosystem services because the property rights for this good are ill defined and poorly allocated. Design of this MBI should therefore focus on specifying and allocating property rights as well as facilitating a means by which these can be exchanged. Care must also be taken to ensure that the cost of addressing the market failures is less than the benefits.

Design of the Murrindindi development offset was guided by Murtough *et al's* (2002) disaggregation of the desirable characteristics for property rights as listed in Table 2.

Table 2: Desirable property right characteristics

Characteristic	**Description**
1. Clearly defined	Nature and extent of the property right is unambiguous.
2. Verifiable	Use of the property right can be measured at reasonable cost.
3. Enforceable	Ownership of the property right can be enforced at reasonable cost.
4. Valuable	There are parties who are willing to purchase the property right.
5. Transferable	Ownership of the property right can be transferred to another party at reasonable cost.
6. Low scientific uncertainty	Use of the property right has a clear relationship with an outcome.
7. Low sovereign risk	Future government decisions are unlikely to significantly reduce the property right's value.

Source: Murtough, Aretino and Matsyek (2002)

The remainder of this paper outlines the key design issues that were considered when a development offset was investigated for the Murrindindi Shire[3]. These issues are presented based on the principles of fully defined, allocated and exchangeable property rights with discussion disaggregated into the key steps of:

1. Defining/measuring what is being exchanged;
2. Defining who can demand and supply an offset;
3. Enabling exchange; and
4. Supporting and enforcing exchange.

[3] The research only looked at the issues associated with an offset scheme. At the time of writing an offset scheme has not been implemented in the Murrindindi Shire.

5.1 Measuring what is being exchanged – the defined, verifiable and scientifically certain property right.

The first component of making a property right fully defined and verifiable involves measuring and articulating what you are exchanging. The end result of this is referred to as the metric.

Just as in an exchange for wheat, information on quality attributes of the product such as moisture and protein content of the grain is required to establish its quality and therefore its value, those engaged in an exchange in ecosystem services need to know the quality attributes of the good that they are exchanging. For an offset, the quality attributes necessary for an exchange are those that indicate that the exchange complies with the offset requirements. That is, in order to achieve the required environmental outcome, the offset credit must be of equivalent type, have an equivalent landscape role, be of equivalent quality, be located such that the offset occurs close to the impact or target action and occur in a reasonable time period. The metric must signal these attributes to exchanging parties. The metric is THE critical element in evaluating alternative actions in providing ecosystem services.

Nine principles[4] have been identified that should be considered in designing a suitable metric for any MBI (Whitten *et al* 2006). These principles are summarised in Table 3. Whitten *et al* (2006) point out that while quantity and quality criteria are critical to any metric, the other components should be included according to the MBI and associated objectives. Critical factors such as irreversibility may be incorporated through filters (for example the NSW BioBanking offset system has a system that signals for a permit refusal if irreversibility criteria are triggered). Other factors may be incorporated through weighting. For example, distance of improvement from the point of damage may be used to weight the scale of the offset required or even provide thresholds where offsets may not be appropriate. For many offset schemes, the initial metric tends to be developed with high scientific uncertainty. High scientific uncertainty means that there is a stronger reliance on case by case assessment to achieve outcomes. As science improves the metric, the entire scheme can evolve into a rules based trading scheme.

It is important to note that the nine principles presented only refer to a single ecosystem services. Where multiple ecosystem services are considered within an offset program, consideration needs to be given to a translation between them. For example, two different pollutions (eg phosphorous and nitrogen) may be tradable if there is a ratio that enables them to be considered equal in overall affect.

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[4] It is important to note that whilst the principles have been presented separately, in practice they are interrelated and need to be considered collectively. Also metrics for ecosystem services are often based on proxies (ie can't trade biodiversity but can get an idea of biodiversity from species – see for example the quality indexes approach of the habitat hectares metric developed by Parkes *et al*). This introduces tradeoffs for metric accuracy, workability and risk. These issues are not discussed any further in this paper but should be kept in mind in metric and offset design.

Table 3: Principles of metric design

Design principle	Description
Quantity/Quality (type)	There are usually a number of measures that deliver different messages to landholders and represent subtly different outcomes. For example, hectares of native vegetation does not reflect the quality of the biological diversity and therefore the resilience, nor does hectares reflect the soil, recharge or water quality benefits of an action.
Spatial Relationships	The relative location of the work can influence the value. A management option that provides corridors may have greater value to one that has unconnected and scattered vegetation. Spatial relationships are also significant to the thresholds in the landscape. The crossing of any needs to be carefully considered.
Relative Change	The goal of policy is usually to improve outcomes from a baseline (eg duty of care) rather than to pay for some absolute maximum quantity. Therefore the baseline outcome must be identified and estimated. Second, the measure must be sufficiently robust to quantify the improvement from the baseline with confidence.
Location	The location at which the change occurs can generate different values to the community. This may be particularly important for issues such as recreation and amenity.
Timing	The time of outcome is important in many circumstances, not least because of competing investments that generate payments in different time periods. All things equal, earlier outcomes are preferred over more distant outcomes.
Risk / certainty of management change effectiveness	Some management changes may be more likely to be successful than others. The key factor in success may be the initial establishment or the on-going management. It is important to consider whether the likelihood of success should be considered within the metric design or the payment mechanism.
Risk / certainty of outcome success	Even with successful establishment of the management change there may be uncertainty about the eventual impacts on outcomes. Trading ratios can assist in managing risk. For example requiring more than a one for one relationship for offsetting trees will allow for the risk that some trees established as offsets will not survive
Irreversibility	Irreversibility is related to risk. Where thresholds are anticipated, such as extinction of species there is a case for favouring less risky actions that achieve change sooner than other options. Actions with irreversible consequences should not be offset.
Spillover impacts	Spillover impacts are consequences of the specific management change elsewhere in the system. For example, revegetation will also reduce base-flows in streams and rivers in the catchment. The potential for and consequences of spillover impacts should be carefully considered.

5.2 Who will buy and sell offset rights?

Once the measurement component of the property right is established, the remaining property right characteristics to fulfil are those associated with the ability to easily exchange these rights. An exchangeable right is one that is valuable, transferable and

enforceable. The first component of this is establishing who can buy and sell offset rights.

Who will demand/buy offsets

Offset buyers are those who are required to provide ecosystem services and can legally do this through a third party. Regulatory frameworks are significant to establishing who is an offset buyer and therefore creating offset demand. Frameworks need to specify what ecosystem services are protected, where these are located and who is providing these. Frameworks also need to specify what resource uses and activities are permissible under what conditions and where substitution of ecosystem services at alternative sites is permissible.

Whilst offsetting may be allowed in the development process, it is not considered to be environmentally and politically appropriate to allow offsetting without some development impact minimisation and mitigation standard. Regulatory frameworks are also needed to specify the level of impact management and mitigation that must occur before offsets are allowed. The NSW State Government (NSW EPA 2002) in a public concept paper on offsets, "Green offsets for sustainable development" listed some guiding principles which could be used to guide the use of offsets in development projects:

- Environmental impacts must be avoided first by using all cost effective prevention and mitigation measures on site;
- All standard regulatory requirements must still be met;
- Offsets must never reward poor environmental performance (only reward effort and outcomes above the duty of care);
- Offsets must complement other government programs;
- Offsets must result in at least a neutral outcome. To achieve a neutral baseline, offsets must be based on ratios that account for risk and uncertainty;
- Parties must be accountable to ensure offsets achieve their objectives; and
- Offsets should only be considered where developments and activities demonstrate significant public, social and economic benefits.

In the Murrindindi, the demand for development offsets could primarily be managed through the development approval process. Here, a whole farm plan must be submitted with a development application and the MSC would be able to determine what actions need to be conducted to achieve site and regional sustainability and which actions were substitutable and therefore able to be offset.

Who will supply offset credits

Even if the demand for offsets is created, offsets will not achieve targets unless there are landholders that can supply the required on ground actions. In addition, just as development offsets can only occur above a certain level of impact mitigation compliance, the supply of offset credits should also be bounded by a starting minimum. It is inefficient to purchase offset credits for actions that landholders should have been doing anyway or are already being paid to do. Landholder duty of care is a good baseline from which landholders can supply offset credits to

developers. A baseline duty of care could be incorporated in the metric. Of course the problem here is measuring and enforcing this starting point. In the Murrindindi example, it is recommended that offset credits can only be supplied once landholders have made their on site contribution to regional sustainability (that is, C can only be produced in addition to E for the landholder in Figure 4).

5.3 Enabling exchange

Even with rights surrounding the demand and supply of offsets specified, market exchange may be less than optimal without a clear process which supports the value of the rights and minimises the transaction costs of exchange. The efficiency gains from a market will also be greatest with high market liquidity.

Some components required for the matching up the demand and supply of offset right holders has already been discussed in some detail in the previous sections. For example, a regulatory framework is needed to inform developers what can be offset and a metric is needed to inform market participants that what is supplied is correct for the demand. In order to maintain the value of the offset right, verification of the demand and supply must also be conducted. Verification could be conducted by an independent and accredited auditor or by the scheme administrator. For the Murrindindi, it is recommended that verification of offset demand and supply occur through site inspections and submission of development and site plans.

Even with these processes in place, the MBI will be no good at achieving objectives if the cost of information in the market is prohibitive to participation. The measures to structure the market discussed above are fundamental to creating market liquidity (high number and variety of exchanges). Additional measures that can influence liquidity include disclosing quantities exchanged and prices received, enabling brokers to operate in the market and providing banking or borrowing provisions (Whitten *et al* 2006). Each is discussed below.

Information on the potential surpluses that can be made attracts participants to a market. This is particularly important for new markets where the high levels of uncertainty generate high information costs. Disclosing market exchange information such as the nature of the goods exchanged, the quantity and the price can inform potential participants of the operation of the market and reduce uncertainty enough for them to begin to participate. Allowing brokers to operate in an offset market is another way of reducing the transaction costs of an exchange. Brokers can significantly reduce search costs by identifying suitable partners for exchange. Brokers can further increase liquidity if they can buy and hold offset credits to be sold on when a suitable buyer appears.

Offset banking refers to the management of offset credits by one body with the supply of offset credits generally occurring before demand. An offset bank has a number of benefits. First, with credits supplied before demand, the scientific uncertainty associated with matching a supply with a demand is reduced (but not eliminated as there will be cases where the supply is not appropriate for a demand). Second, an offset bank can be strategic in the generation of offset credit supply. For example, an offset bank can secure credits that generate a connected landscape and thus gain exponentially beneficial environmental outcomes. Finally, a bank can take some of the offset failure risk away from individual landholders which may also assist in the

generation of offset supply. It was recommended that a bank, operated by the MSC or outsourced be explored for the Murrindindi Shire. Borrowing allows developers to generate impacts before offset credits are purchased. This approach is less enthusiastically embraced than the banking concept due to the allocation of this risk placed entirely on environmental amenity if the developer does not fulfil their obligations.

The levels that enable exchange discussed here demonstrate that an offset scheme can often begin as a simple scheme with 'clunky' processes (assessments and verification on a case by case basis) but has the potential to evolve into something far more sophisticated. Good processes and rules as well as a science based metric established up front will be significant to the transition of the scheme into something streamlined and efficient.

5.4 Supporting and enforcing exchange.

To be effective at achieving environmental outcomes and to maintain the property right value, the offset credit must be enforceable both in law and practice over time. A good way of establishing a framework to enforce an offset is through the establishment of agreed measures and performance standards incorporated into a legally binding agreement. On going monitoring will then enable the scheme administrator to gauge performance against standards. Failure of a development based offset to meet performance standards will place a developer in breach of their development conditions and make the developer subject to the penalty provisions of the applicable planning legislation.

Offsets do tend to have a high risk of partial failure; because of this, a staged enforcement process may be most suitable. Non-performance provisions could provide a range of 'make good' opportunities ahead of punitive penalties. For example, minor infringements resulting from technical or unforseen factors rather than deliberately rorting the system per se, may simply require new offsets to make good for those that were not provided. An alternative approach may be for offset providers to prepare contingency plans in case of offset failure. This process could set out triggers that indicate the under performance of an offset. When these triggers are hit, contingency plans are activated. While the key goal of the offset is to manage the risks of losing environmental services, the level of penalties for offset failure must be considered with reference to the need to encourage market participation (penalties perceived as too harsh will discourage participation).

5.5 Administration costs

Any form of government intervention is only considered effective and efficient if the benefits gained are greater than the costs incurred in designing and implementing the intervention. Transaction costs of an MBI can be minimised if administration and implementation components optimise current institutions and structures (Coggan *et al* 2005). For the Murrindindi, transaction costs of the scheme can be minimised by nesting the offset process within the current development permit, verification, monitoring and enforcement process.

Efficiency considerations for the offset also mean that an important step in the design and implementation of the scheme is an ongoing analysis of the likely and actual benefits of an offset scheme relative to other policy approaches. Ongoing review of an

offset may mean that an offset administrator is required to provide information on scheme performance, compliance and benefits as well as costs of implementation and ongoing administration.

6. Conclusions and implications

The demand for RRD living is increasing in many localities and especially for those located a commutable distance from large employment centres. The Murrindindi Shire is one such locality. Whilst the impact of RRD on ecosystem services could be positive or negative, in the Murrindindi case the already low supply levels of ecosystem services on RRD properties coupled with inexperienced land managers leads us to suggest that the ecosystem service outcome is most likely to be negative.

With a lack of defined and allocated property rights for goods such as ecosystem services, current markets do not supply these services at the level that is socially optimal. When the market fails, theory suggests that it may be justifiable for governments to intervene. In this paper it is noted that there are already many layers of government intervention for ecosystem services in the GBC and the Murrindindi Shire. That said, however, there is a significant gap between the management of impacts on development sites such that there is site sustainability and what is required of developers to meet regional sustainability. Due to the efficiency gains that could be made through allowing flexibility in meeting regional sustainability targets, we investigate the issues associated with managing this gap using a development offset MBI. A development offset requires developers to meet regional sustainability targets but allows them the flexibility to do this on or offsite. By allowing developers to go off site for actions, this type of MBI can see targets achieved at a lower cost then on site regulation and creates a demand for the supply of ecosystem services across the landscape.

For an MBI to achieve its potential efficiency gains, the MBI must be well designed. A well designed MBI is one that addresses the causes of the market failure in the first place. In the case of ecosystem services the key market failure is the absence of defined and allocated property rights. Using Murtough *et al's* (2002) framework of seven desirable characteristics for property rights the key steps and issues associated with a development offset design are presented. Key steps and issues are those of:

1. Defining/measuring what is being exchanged;
2. Defining who can demand and supply an offset;
3. Enabling exchange; and
4. Supporting and enforcing exchange.

Stepping through the design issues for a development offset scheme highlights several key conclusions:

- The metric is critical to ensuring that what is exchanged in an offset is of equivalent type (in quantity and quality) to what is impacted by development. The metric can also ensure that the supply occurs in a reasonable time frame and is located within a reasonable distance to the impact zone. The nine principles for metric development presented in this paper also suggest ways to manage risk and uncertainty associated with management change effectiveness

and outcome success. In this paper we note that some of the metric principles can be included in the offset assessment rules. For example, 'refuse' conditions can occur in the assessment process if an application crosses a threshold or has too great spill over effects. We also note that the science required for the metric improves over time and with experience. Start up metric are often created with high scientific uncertainty with outcomes achieved through case by case processes. A metric that continually improves and evolves with science can see an offset scheme become much more efficient, with trades informed by the metrics and bounded by rules.

- The regulation framework is essential to specifying the boundaries within which offsets can occur. Through the regulation frameworks, policy makers need to specify what ecosystem services are valuable, how much needs to be produced and where this production is or needs to occur. The regulatory framework also needs to be clear on what impacts are substitutable and can be offset and the process that needs to be followed to do this. Through the regulatory framework those that can buy and sell offsets becomes clear.
- The transaction costs of buyer and seller interaction need to be minimised. High market information costs will see low participation in a market, this is likely to be the case for a new market such as one for offsets. In this paper we provide some suggestions of how the transaction costs could be minimised. This includes disclosing information on the characteristics of goods exchanged and the price received (to demonstrate the potential surplus available from the market), allowing brokers in the market to facilitate exchange and establishing banking provisions. While borrowing can also lubricate a market, the high risks associated with development and the unequal risk to the environment of offset failure leads us to discourage the use of borrowing for the Murrindindi.
- An offset MBI has a very strong possibility to evolve into a very sophisticated market. The initial design is important for the ability for this to occur. A deeper analysis on establishing the means of exchange demonstrates how an offset can start small with offsets assessed on a case by case basis and evolve into a sophisticated market structure. The initial institutions and structures and the management of the initial offset can be very influential over the evolution of the instrument.
- An offset market will operate and grow only if the value of the rights being exchanged is maintained. It is essential that compliance standards are set, monitored and enforced. Given the potential for a thin market (at least initially), a scheme administrator should explore the potential for flexible and staged enforcement.
- An MBI is only efficient if the benefits of the scheme outweigh the cost to design, implement and administer. Ongoing analysis of the benefits versus the costs needs to be conducted by the scheme administrator. It is also wise for an offset to be designed such that it optimises the current institutions and structures and therefore operates to a minimum transaction cost.

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