DRAFT – NOT FOR QUOTATION

Exploring development offsets as a tool for conserving ecosystem services

Discussion Paper 2

Deciding on a policy approach – Why market-based instruments (MBIs) and which kind?

October 2005

CSIRO Sustainable Ecosystems

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This paper is the second paper in a series describing the impact of rural residential development on ecosystem services and outlining a market based approach to maintain and protect ecosystem services. Other papers in this series are:

- "Ecosystem services and rural residential development – a case study of the Murrindindi Shire of Victoria, Australia."
- "What are development offsets and how do they work – an introduction to development offsets."
- "Nesting in current institutions and frameworks – importance and issues."
- "Development offsets for Murrindindi Shire – challenges, opportunities and realities."
- "Development offsets for Murrindindi Shire – summary of research to date."

This paper is considered to be a work in progress. To provide comment or for more information on the issues discussed in this document please contact the following people:

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Acknowledgements:

The authors would like to thank Drew Collins of BDA group for important assistance in compiling this series including two background papers. The authors would also like to thank Russell Gorddard of CSIRO Sustainable Ecosystems and David Godden of NSW Department of Environment and Conservation for their valuable comment and review of this paper. Of course, any errors or omissions remain the full responsibility of the authors.

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Executive Summary

Current land use in the Murrindindi Shire is not supplying ecosystem services at the level desired by the community. Further, the development of the Murrindindi Shire for rural residential (RRD) and lifestyle housing, whilst possibly changing this trajectory of supply is not likely to see ecosystem services supplied at the desired and sustainable level. With no change in current land management and with an increase in RRD, the most likely net impact for ecosystem services is for an overall decline.

To address this decline in ecosystem services, the Goulburn Broken Catchment Management Authority (GBCMA) has set targets for the provision of ecosystem services at a regional level. The Murrindindi Shire supports the achievement of regional goals and what this means for the Murrindindi Shire. Further, it is recognised that with no action to manage this decrease, it is unlikely that ecosystem service targets will be achieved.

There are a number of ways that the supply of ecosystem services can be boosted to the target level. Each way has different equity, efficiency and effectiveness implications. The four prospective cases and their potential implications are:

1. Targets are met wholly by developers with no change required from non-developing landholders. This approach represents a tax relative to continuing current land-use. If rural residential development improves ecosystem service outcomes beyond current levels but less than the target levels in the absence of regulation then such a requirement would yield the perverse outcome of less development than desired *and* lower ecosystem services than desired. This approach is considered to be ineffective, inequitable and inefficient;
2. Developers and non-developers are required to meet similar ecosystem service targets within similar time horizons. This approach would be non-distortionary and therefore equitable and also effective. It is further identified that allowing some flexibility with how the targets are met could see some efficiency improvements within this approach.
3. Incentives are provided to non-developers alone to meet ecosystem service targets. This approach is likely to lead to slippage whereby prospective developers would seek to draw on incentives to achieve ecosystem service targets prior to undertaking development. This approach may be equitable and effective but may have some reduced efficiencies; and
4. Developers are taxed to fund the achievement of targets across the wider landscape. This approach would reduce the incentives to pursue rural residential development and see rural residential development reduced below a level that is socially optimal. This would impose costs on the wider community.

Whilst the second option is considered to be potentially the most effective and equitable approach to achieve targets, this paper investigates how the potential efficiencies can be achieved.

Historically ecosystem services have been freely and widely available. However, their significance is not being recognised in our current operating frameworks. 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 provide a good at the level that is socially optimal, we say that market failure has occurred. There are a range of market failures and these can occur due to a range of factors and/or interactions between factors – understanding these failures and causes is central to the design of any NRM policy to address environmental issues.

In theory, the problems arising from the absence of markets can be remedied through government intervention (Murtough *et al*, 2002). Here, intervention may be through facilitation, through incentives or through regulation. Whilst regulation and facilitation are important to achieving policy goals, the efficiency benefits from a market-based approach or market-based instruments (MBIs) are the focus of this paper. Good government intervention is that which addresses the market failure and does so such that the benefits of intervention outweigh the costs.

Market-based instruments (MBIs) operate through market signals rather than through explicit directives and primarily address the cause of market failure for a good (usually the lack of fully defined property rights). By changing the market forces faced by firms (or landholders), MBIs redefine the agenda for players such that improved environmental outcomes are in their own interest (Whitten *et al*, 2003a). MBIs have two efficiency advantages over the more traditionally used regulatory instruments. First, MBIs allow different firms to make different adjustments in response to their unique business structures and opportunities. Second, by not prescribing how firms are to achieve targets, MBIs give firms the incentive to be innovative and discover cheaper ways to achieve outcomes or even achieve beyond targets.

Whilst Murrindindi has a number of regulations to manage current landholder and RRD impacts on ecosystem services, the differences in costs and approaches to achieving targets faced by developers and non-developers could see a more efficient outcome through the application of an MBI. That is, an MBI could:

- Allow flexibility in the way participants choose to respond to targets and thus encouraging innovation;
- Encourage change amongst those who can achieve change most cheaply, as opposed to broadly levelling change requirements on all, thereby meeting targets more cost efficiently; and

- Place positive incentives on better NRM, as compared to the negative incentives evident in regulatory approaches, thus driving innovation and continual improvements in NRM management.

An MBI can be either price or quantity based or may simply involve 'lubricating' the market so that a current market works more effectively (eg eco labelling). The right MBI is specifically related to the goods being traded and the potential participants in the market.

When there is full information about the cost to perform an action, in this case to conserve ecosystem services, a price and a quantity based instrument will result in the same outcome at the same cost (Sterner 2003). However, for environmental goods such as ecosystem services, decision making with full information rarely occurs.

Policy makers, however, do have some level of information by which to guide their selection of an appropriate mechanism. Factors that are used to guide the choice of instrument in the Murrindindi context include:

- The allocation of current property rights and the extent of change required;
- The jurisdictional powers associated with the property rights and the power needed for change;
- The relative biophysical and economic efficiency of the different mechanisms;
- The existence and influence of thresholds in supply or demand;
- The length of time to produce outcomes from the mechanism and the timeframes required for outcomes in the Murrindindi;
- The number of landholders and the ability to reduce transaction costs at the point of change;
- The degree of change from the starting point; and
- The nature and certainty of the policy goals.

A quantity based MBI is recommended to achieve ecosystem services targets in the Murrindindi Shire. The reason for this recommendation is:

- Murrindindi Shire is required to comply with the ecosystem service targets for the upper Goulburn Broken catchment. Therefore quantity targets are known;
- Ecosystem services have long term time frames of ecosystem services so should be secured more cost effectively through a quantity based MBI;
- It is likely that the marginal benefit curve of ecosystem services is steep because the system is likely to be approaching thresholds. A quantity based policy gives a more secure outcome when operating with thresholds; and
- A quantity based mechanism can capitalise on current policy at the point of change. This will further reduce the transaction cost of policy implementation.

A once tradable development offset MBI is recommended to achieve ecosystem services targets for the Murrindindi.

Offset schemes require a target and allow agents (for example a polluter) to achieve this target (for example pollution abatement) either onsite or through sponsoring abatement effort from other sources. Because agents can choose to either take direct action or pay others to take action for them the targets are achieved more cost effectively compared to when the same actions are required by all agents. The once tradable nature of the offset scheme requires that desirable and non desirable actions are performed by the same party; or, the property right for the desirable action can only be exchanged once. That is, either the party doing the damaging also does the offsetting; or the damaging party pays another to undertake the offsetting activity. This exchange can only occur once.

The offset scheme and not a cap and trade (the other common quantity based MBI) is recommended for Murrindindi because the environmental goods being targeted for supply in the Murrindindi case are difficult to package into small, discrete and substitutable bundles as is required for a cap and trade mechanism. Further, the outcomes from actions occur over very long time frame which is very hard to measure and trade in a cap and trade approach. .

A once tradable development offset to achieve ecosystem services targets in the Murrindindi means:

- All landholders, whether they be non-developing or developers know what the end goal is and what this end goal means for their property and operation. That is, the developer knows that he/she must have no net impact and achieve higher ecosystem service targets. The non-developer knows that they must change land management to meet targets;
- But the actual action to meet targets for the catchment for each property is flexible, thereby allowing properties to choose the action of least cost. For example, RRD on the pristine property at the top of the catchment, whilst required to meet no net impact requirements from development and actions to meet targets, does not necessarily have to meet these on-site. Instead the developer may pay another landholder to undertake works to offset the impacts from the RRD and to meet the developer's targets. Of course there are rules about when an offset can be used, which mean that an entire pristine block will not be clear felled and offset. These rules are discussed in the relation to offset design in paper 3, "What are development offsets and how do they work – an introduction to development offsets and their issues".
- The provision of ecosystem services as an offset could become part of the production profile for both developers and non-developers. That is, once targets (and no net impact obligations are met) all landholders have the opportunity to provide services as offsets to others. An offset, by providing a property right to the ecosystem service, creates a value for the provision of the service.

Whilst the concept of the once tradable development offset is relatively straight forward, the ability of the scheme to achieve the environmental outcomes is highly dependant on the design of the scheme. Key design steps for the scheme for the Murrindindi Shire are worked through in report 3 "What are development offsets and how do they work – an introduction to development offsets and their issues".

1 Introduction

Land use in the Murrindindi Shire is undergoing some major changes as a result of rural residential development (RRD). Whilst RRD will see some positive and negative impacts on ecosystem services, it is likely that the overall impact will be negative and result in a decline in ecosystem services.

Ecosystem services are not adequately conserved because markets do not exist for the provision of these goods. Whilst markets exist for some goods reliant on the supply of ecosystem services (for example wheat), no markets exist for many ecosystem services that are directly enjoyed or which contribute to public good outcomes. As a result, ecosystem services are largely left out of decision making processes and there are few incentives for landholders to provide these services.

The inability of the market to provide a good that is socially desirable is commonly referred to as market failure. Murtough *et al* (2002) suggest that the most prominent reasons why markets for ecosystem services rarely exist are due to uncertainty about ecosystem processes, an inability to define and enforce ownership (property rights), and asymmetric information.

In theory, the problems that arise due to market failure can be remedied by government intervention (Murtough *et al* 2002). This intervention may involve regulation, changing the incentive structures (through direct payments or through creating a market such as market-based instruments (MBIs)) or facilitation and the provision of better information. This paper assesses the policy options available to the Murrindindi Shire to achieve ecosystem services targets.

This is the second paper in a series of papers assessing and designing policy options for ecosystem service provision in areas undergoing rural residential development (RRD). In this paper the focus is on:

- Ecosystem service targets in the Murrindindi Shire and what these might mean for both developers and non-developers;
- The potential and various policy approaches to achieve the target level of ecosystem services;
- Gaining an understanding of the causes of the undersupply of ecosystem services in the current framework;
- The opportunities and advantages of a market based approach or market based instrument (MBI) to efficiently achieve the ecosystem service targets; and
- Determining which type of MBI is most appropriate in the Murrindindi context.

Background on the Murrindindi Shire and the nature of RRD and impacts on ecosystem services can be found in the first report from this project "Ecosystem services and rural residential development – a case study of the Murrindindi Shire of Victoria".

This paper is structured as follows. In section 2 a brief summary of the nature of RRD in the Murrindindi Shire is provided. In section 3 the biophysical issues facing the provision of ecosystem services in the Murrindindi Shire are presented. Here the concept of target levels of ecosystem services is introduced. In section 4 the policy issues for ecosystem services for Murrindindi Shire are presented through a discussion of the various approaches that could be taken to achieve ecosystem service targets. In section 4 the equity, efficiency and effectiveness considerations associated with each approach are discussed. In section 5 key steps in designing a policy solution by firstly understanding the problem with market failure is discussed. In section 6 methods for a market-based approach or market-based instrument (MBI) are given and the potential benefits of the market based approach are discussed. In section 7 the best type of MBI for Murrindindi is discussed with evidence to suggest that a quantity based MBI is pursued. In the final section, section 8, the key concluding comments from this paper are presented along with the critical issues related to MBI design that are addressed in next paper.

2 Background

2.1 Murrindindi Shire and rural residential development

The Murrindindi Shire is located on the north fall of the eastern section of the Victorian Highlands. Almost all of the Murrindindi Shire's area of 3,887 square km is located in the foothills of the Upper Goulburn section of the Goulburn Broken Catchment (GBC). The region is experiencing significant population growth with an increase in population of 1,327 to 13,779 between the 1996 and 2001 censuses (Municipal Strategic Statement (MSS), Murrindindi Shire Council 2001 and 2004).

To accommodate the growing population, the number of houses in the Shire is also rapidly growing. In 2001 there were 4,787 dwellings recorded for the Murrindindi Shire. The Victorian Government Department of Sustainability and Environment (DSE) projects that the total number of households in the Shire would increase to 7,915 over the period 2001 – 2021 (Habitat Planning, 2003). Given the recent high population growth[1] it is possible that actual housing growth will be greater than this projection.

Development for housing in the Murrindindi Shire is occurring on town blocks and in rural areas. Rural residential development is occurring on previously agricultural land including the rural zone and farming zone (lots greater than 40ha), environmental rural zone (lots greater than 40ha) and rural living zone (in general for lots greater than 4ha and with a second level of subdivision lot size of 20ha in Alexander and Yea). The focus of this series of papers is primarily on the rural living zone and environmental rural zone development because of their relatively greater potential impact on ecosystem services.

2.2 Ecosystem services important to the Murrindindi Shire

Ecosystems provide many services from which humans benefit. A common perception of ecosystem services is that they transform natural assets or natural capital such as soil, biota, air and water into things that we value. The benefits from

[1] also see paper 1 "Ecosystem services and rural residential development – A case study of the Murrindindi Shire".

ecosystem services important to the Murrindindi Shire and particularly RRD are explored in detail in the first report of this series, but can be summarised in the following groups:

- 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 pest animals and plants);
- Water quality (includes sediment and nutrients); and
- Soil quality (erosion and salinity).

These ecosystem service benefits include those that are important to the production of RRD and those that are important to downstream users, or users without any direct connection to RRD. Further, ecosystem services are valued by both current residents and those residents moving to the area for the rural lifestyle.

3 Setting out the issue

3.1 Ecosystem service targets

The current and future community expect and desire the ongoing provision of a certain level of ecosystem services. These happen to be above that is supplied at present and what is likely to be supplied in the future with RRD. As such, targets for the provision of ecosystem services have been set at a regional, state and national level. Whilst there are no specific local targets set for ecosystem services by the Murrindindi Shire, the Shire supports the achievement of regional goals for the upper GBC which are set out in the regional catchment strategy (RCS) (GBCMA, 2003)[2] . Further, the RCS targets are taken as the efficient level of ecosystem service targets for the Murrindindi Shire in this and other reports in this series.

Targets for the Goulburn Broken Catchment (GBC) incorporate goals for improvements in water quality, soil quality, the management of pest plants and animals, native vegetation and climate. A summary of targets from the RCS that are most likely to apply to the Murrindindi are set out in Table 1 below. For a full account of the targets see the regional catchment strategy GBCMA (2003).

[2] It is assumed that the GBCMA RCS targets are at or above the self sustaining level of ecosystem services. This paper does not discuss whether or not these targets are optimal.

Table 1: Summary of targets for the Goulburn Broken Catchment

Target	Potential actions
Water quality	
Maintain the quality of all reaches of rivers and streams as good or excellent	• riparian revegetation • improved wetland management
Pest plants and animals	
Individual landholders will take responsibility for pest plants and animals of their property	• 100% treatment of State declared prohibited weeds until eradicated • 100% increase in area declared rabbit free
Biodiversity	
Protect and enhance ecological processes and genetic diversity	• maintain extent of all native vegetation types at 1999 levels (this will see a net gain) • improve the quality of the 90% existing native vegetation by 10% by 2030 • increase the cover of all endangered and vulnerable EVC's to at least 15% of their pre European vegetation covers by 2030.

Source: GBCMA (2003)

It is important to note that targets apply to the whole catchment. Whilst catchment targets do mean that land management improvements will be required on a Shire wide and individual land manager basis, the targets do not indicate what the extent of these Shire and individual changes might be. That is, whilst most landholders will have to make management changes to meet targets, the targets will vary between different landholders.

3.2 Can targets be met with current management?

Continuing on with current management, that is, pursuing a 'do nothing' approach to targets would mean no change in land management requirements from non-developing landholders. Further, whilst developers are required to meet a number of impact mitigation measures (implemented by the Commonwealth, State and local governments) before development can take place; no additional impact mitigation from developers would be required under this scenario[3].

A 'do nothing' response to the target will see ecosystem services in the Murrindindi Shire provided at a level less than the target and continue to decline. This decline will occur for two main reasons.

First, current land management before RRD is already having a negative impact on ecosystem services. Although data is not available for the Shire, within the catchment, about 70% or 1.7 million ha of native vegetation has been cleared in the GBC as a whole since European settlement. The GBCMA also reports that a vast amount of the

[3] Urban and protected areas are not included in the discussion because protected areas are not likely to change such that there is a significant impact on ecosystem services; and, whilst there is significant development in urban areas, the nature of the urban areas is such that development here will not have a significant impact on ecosystem services.

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. The GBC contributes 33% of the Murray River water flow above the Murrumbidgee, but 58% of the turbidity (GBCMA, 2003). With no management change, this decline will continue.

Second, whilst the nature of the impacts on ecosystem services of RRD is largely unknown, it is likely that RRD, that complies with planning requirements but with no additional requirements to improve ecosystem services, will result in ecosystem services decline even though this decline may be at a faster or slower rate (see paper 1 of this series). This is because there is likely to be many impacts from RRD that fall outside these planning requirements. Impacts from RRD that fall outside of the planning requirements occur both at the site specific level and more broadly on a catchment or even broader scale.

Site specific impacts occur both directly through works such as construction of houses and associated works and indirectly through ongoing and residual changes associated with RRD (such as increasing the area of paved surfaces associated with an increase in houses and changes in land uses such as more or less livestock grazed and native vegetation conserved).

Individual impacts from RRD could also have impacts on broader ecosystem service supply beyond those impacts directly related to site specific activities of the development. For example, one impact may be as a result of the placement of the RRD in the landscape, particularly if RRD interrupts habitat corridors. In this example, whilst the individual site impacts alone may not be unmanageable, the total impact of the RRD on ecosystem services is far greater than the sum of the parts, as an ecosystem services threshold could be breached.

A ‘do nothing’ approach is not considered to be an appropriate policy response to achieving ecosystem service targets.

4 Selecting a policy response to achieve targets

With targets set and a ‘do nothing’ approach unlikely to be successful in meeting the ecosystem service targets, a more proactive policy response is required. Whilst the policy approaches involve both developers and non-developers, the requirements of different approaches and therefore impacts could vary between the two. Policy impacts are often discussed in terms of effectiveness, efficiency and equity. Effectiveness relates to if the policy achieves the targets set; efficiency relates to whether the benefits can be achieved at a level greater than the costs and equity relates to how the benefits and costs of the policy are distributed amongst agents. The potential effectiveness, efficiency and equity impacts of the different approaches are discussed in this section. The following analysis is not empirical.

Policy responses considered in this section include:

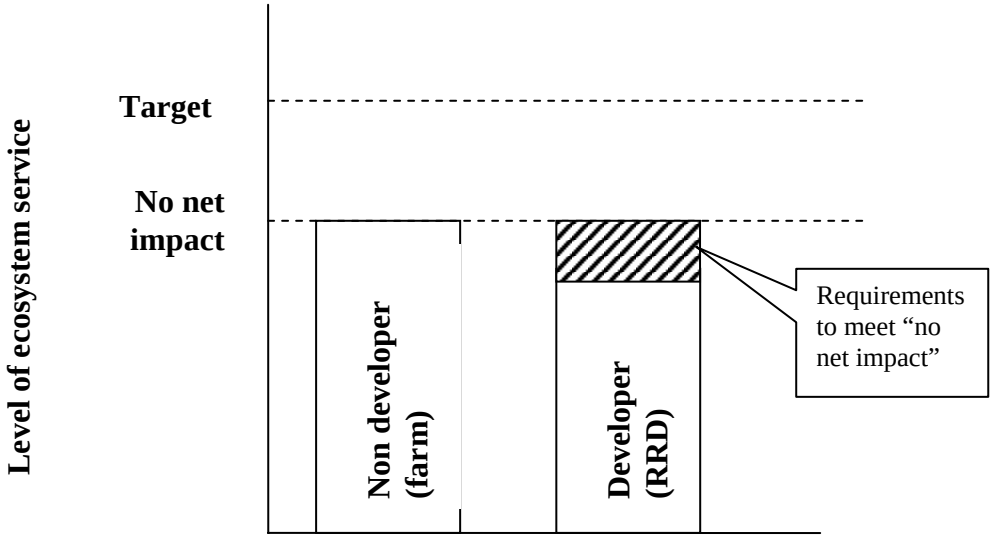
- Developers meeting no net impact on ecosystem services;
- Developers alone meeting individual on property ecosystem service targets;

- Developers and non-developers both meeting individual property targets; and
- A number of scenarios that provide incentives to non-developers to assist them in meeting targets.

4.1 Developers required to have no net impact

One policy to achieve the target level of ecosystem services may be to require developers to undertake development with a 'no net impact' on ecosystem services relative to current land use (hashed box in Figure 1). Because the targets mean different things for different landholders (see section 3.1), no net impact will result in a target supply of ecosystem services for some developers (e.g. those on a bush block that did not have to make any improvements to meet targets) but for those below the target, no net impact will see these properties remaining below the target. Overall, no net impact will result in the continued provision of ecosystem services below the target.

Figure 1: No net impact relative to existing land use



Only requiring developers to have a no net impact will not meet ecosystem services targets, this is not efficient, effective nor equitable therefore this alone is not considered to be an appropriate policy response.

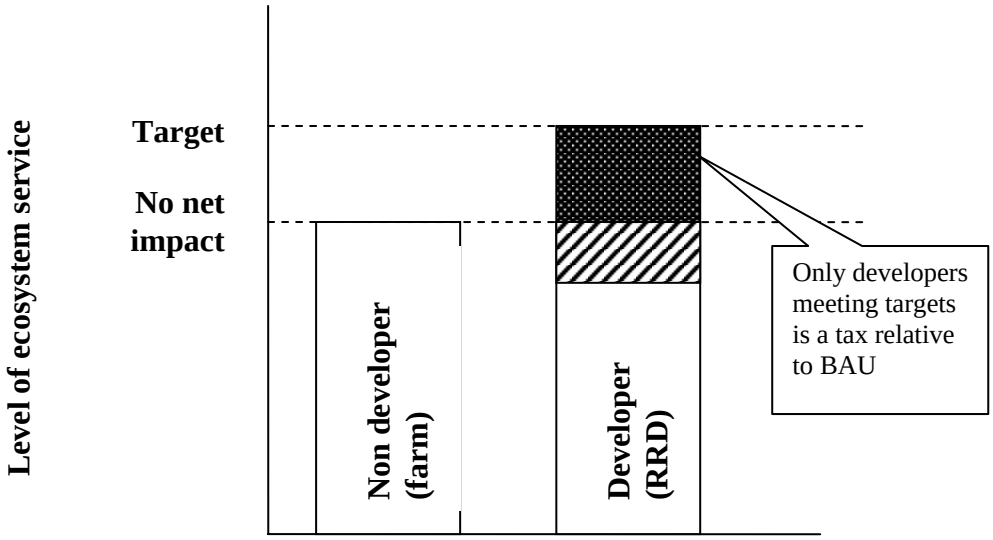
4.2 Developers alone required to meet a target ecosystem service level

Another response to achieving ecosystem service targets is requiring developers to operate above no net impact and achieve the appropriate target for each individual property undergoing development (spotted box in Figure 2). Under this scenario non-developing landholders continue on with business as usual (BAU) and are not required to meet the targets on their properties. The additional requirement on developers compared to BAU can be regarded as a tax *relative* to continuing current land use[4]. The tax in this case is equal to the spotted box in Figure 2. A tax on

[4]Certainly requiring one party and not the other to achieve outcomes over a target is a tax, but is requiring one party and not the other to achieve up to the target also a tax?

development such as this provides an explicit incentive to potential developers to stay at business as usual (non-developing). Further, the economic gains from development that the community desired from development are lost.

Figure 2: Developers alone required to meet target



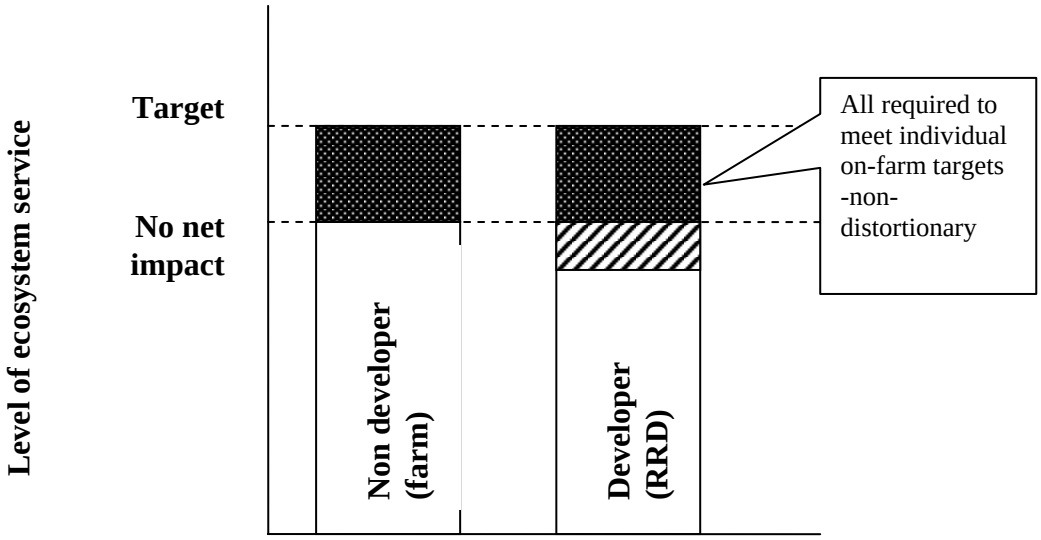
When only developers meet ecosystem service targets but current landholders do not, ecosystem services targets on the whole will not be met. This is not efficient, effective or equitable and therefore is not considered to be an appropriate policy approach.

4.3 All parties required to meet the higher ecosystem service target

Under this scenario both non-developing and developing landholders are required to meet the targets as they occur on their individual property(s). This approach is considered to be non-distortionary as all landholders who are currently supplying ecosystem services at a level under target are faced with some level of change (Figure 3). Further, because all landholders make the required changes (or at least have no net impact if they don't have to make changes) the targets are met. This policy approach is effective and equitable at meeting targets. The way in which the costs of achieving the target are spread across the developers and non developers could impact on the efficiency of this approach. How to maximise the efficiency of such an approach is the focus of later sections of this paper.

The opposite is also true. If farmers alone were required to supply the target ecosystem services and developers were not required to undertake any actions to achieving this level of ecosystem services. This is a tax on farmers. Significantly, if this approach was taken there would also be less land available to achieve the higher ecosystem services and the impacts of the inequity would be compounded (that is there would also be an added incentive to develop).

Figure 3: Changing the rules for all landholders



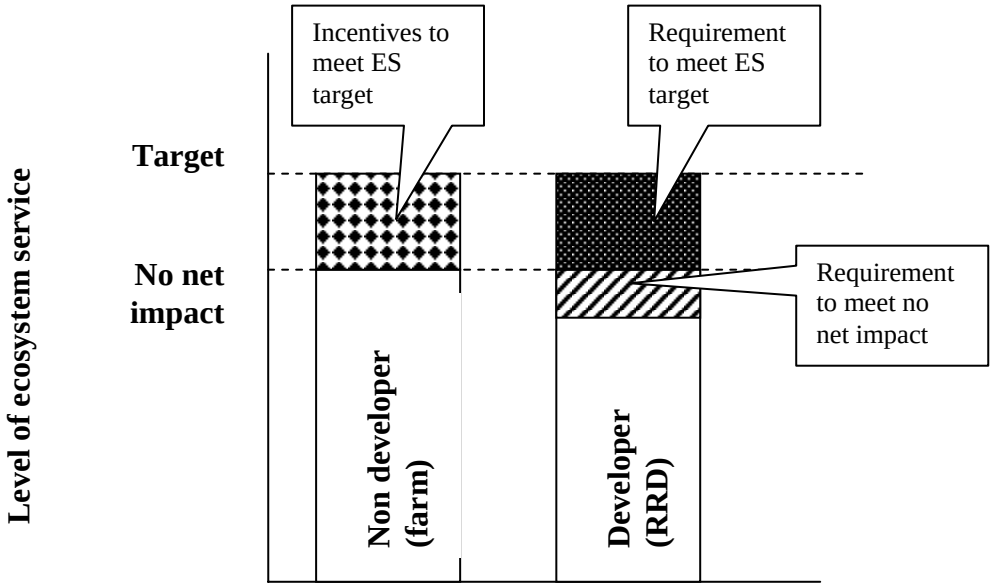
4.4 Provide an incentive to farmers to reach targets and no incentives to developers

Under this scenario both developers and non-developers are required to meet the target level of ecosystem services on their properties but only non-developers get incentives (diamond box in Figure 4). Through the incentives to non-developers, this option taxes developers relative to continuing BAU. As a result, only if the financial returns from development are greater than the incentive to stay non-developed and meet the target, would development occur. Under this option it is likely that, where possible, potential developers would take the incentive for the provision of ecosystem services first and then develop (whilst maintaining the ecosystem services at the target levels)[5]. That is, this approach is functionally similar to the approach that only placed target requirements on developers but with pressure to defer development in order to qualify for incentives to achieve ecosystem services targets.

This approach is equally effective as the previous but could be less equitable than the previous policy due to the incentives provided to non-developers. The incentive phase of this scheme could assist in the transition between current and target levels of management. This is discussed later in the paper.

[5] This incentive effect is also referred to as "slippage" and has been found in several incentive programs elsewhere (see for example Wu (2004).

Figure 4: Incentive to non developers

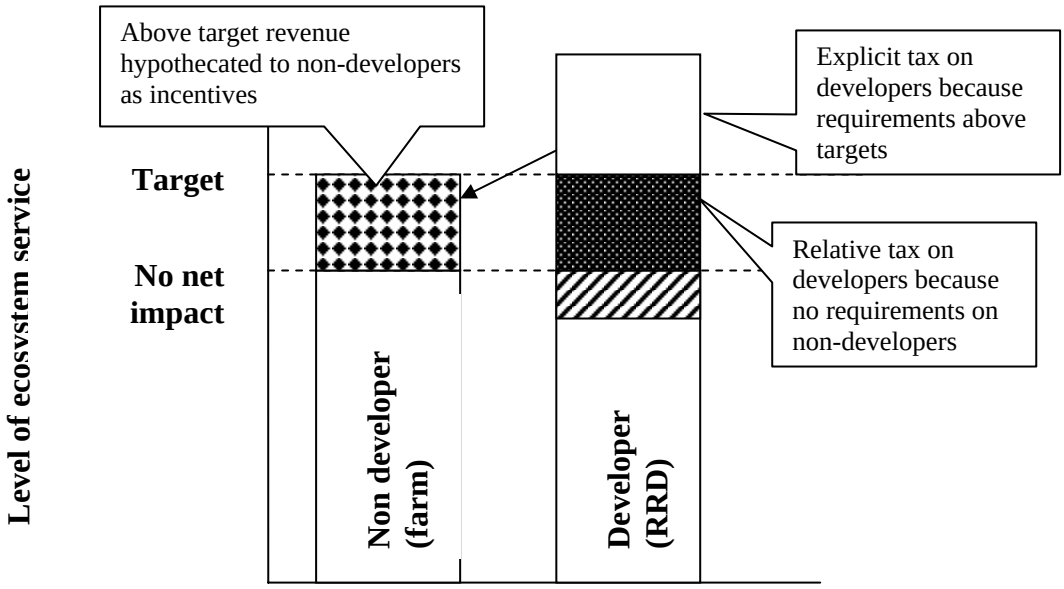


4.5 Developers required to provide ecosystem services over targets

In this approach developers are required to provide ecosystem services beyond the target or pay a fine for not over providing. Here non-developers do not have to meet targets. The distribution of negative impact from this approach occurs heavily on developers. Developers are firstly required to have a 'no net impact' from development (hashed box in Figure 5). Second, they are required to improve the supply of ecosystem services from the developed site to the averaged target level (spotted box in Figure 5). Third, developers are required to meet a higher level of ecosystem services to make up for non-developers not being required to achieve target levels. With no requirements on non-developers to meet targets, the developers are taxed both the spotted box and the clear box above (Figure 5). Often the area above the target is collected as a cash development tax that is hypothecated to incentives for landholders to improve ecosystem service provision.

It is important to note here that another version of this scenario would be to allow landholders to voluntarily over provide services whilst others under provide. The important distinction here is that landholders are encouraged to over provide, not forced, and those that do over provide are rewarded by those that under provide. This scenario can actually result in an equally effective policy but one that is more equitable and more efficient outcome than one where all landholders are required to provide up to the targets on their property (Figure 3) with no flexibility. This efficiency gain is particularly the case when landholders face different costs in the provision of the ecosystem services. This is discussed further in later sections of this report.

Figure 5: Taxing developers to pay non-developers to achieve targets



4.6 Section summary

The biophysical and policy issue can be summarised as follows:

1. Targets have been set by the GBCMA for ecosystem services across the GBC. These targets are used throughout this paper and other papers in this series;
2. The target level of ecosystem services will need to be reached at some point in the future by both developing and non-developing landholders across the landscape. The actions required to meet the targets vary across individual landholders;
3. Ecosystem services are less than target levels with current land management and likely to be in decline even before RRD takes place. Compared to the existing trajectory of ecosystem service provision, the impact of RRD could be positive or negative. Overall, however, with no change in requirements from developers, ecosystem services will continue to decline with RRD. Therefore 'do nothing' is not an appropriate policy approach to achieve ecosystem service targets;
4. Improving the provision of ecosystem services to target levels could be undertaken wholly by developers or non-developers or a mix of the two. Whilst increasing the supply to targets will be effective at achieving the required ecosystem services, the approach to achieve the targets will influence the distribution of the cost and as such the equity and efficiency of the policy outcome (Table 2).

Table 2: Summary of policy options

Policy Option	Impact		
	Effective	**Efficient**	**Equitable**
Developers meet no net impact	No, less than target	No, less than target	No, cost fully borne by developers
Developers meet no net impact and targets	No, target only met by developers. Without non developers total is less than target	No, less than target	No, cost fully borne by developers
All landholders meet targets	Yes, targets met.	Depends on flexibility to meet targets	Yes, all have to make changes. Affected by the flexibility.

For the purposes of the ensuing discussion in this and other papers in this series, it is put forward that both developers and non-developing landholders be required to meet 'no net impact' plus targets for ecosystem services. Given the heterogeneity of the landholders (developing and non-developing), the heterogeneity of the landscape and the fact that different landholders will face different targets, the remainder of this paper focuses on the design of a mechanism to achieve the effective target in the most equitable and efficient fashion.

5 Designing a policy solution

Now that the targets and players in the policy solution are clear, the next step to designing a good policy is to understand the impediments to the supply of the good in the first place. A good policy should address these impediments in its design.

5.1 Understanding the problem – market failure

Historically ecosystem services have been freely and widely available. However, their significance is not being recognised in current frameworks. 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, as is the case with ecosystem services impacted by RRD, market failure is said to occur. There are a range of market failures likely to contribute to poor ecosystem service production. These market failures can occur due to a range of factors and/or interactions between factors.

Market failure can be discussed as first and second order failures. First order market failures are those that are crucial to the functioning of the market. These can be categorised into three types:

Incomplete property rights – Individuals or other actors do not bear the full costs, or receive the full benefits, of their actions (often termed negative/positive externalities).

Public Goods – Public goods are characterised by two features. Firstly, one agents' consumption of the good does not diminish another agents consumption of the good (termed non-rival). Secondly, public goods are non-exclusive, that is, one agent can't prevent another from using the good. Many ecosystem services are either classic public goods, or exhibit public good attributes.

Information – This form of market failure is the result of a lack of important information such as knowledge about ecosystem services production processes, or the information needed for efficient management being held by only one party (termed asymmetric information).

Second order market failures can also result in no market or cause the current market framework to allocate ecosystem services at a level that is less than socially optimal. These second order conditions include the lack of a common market place, the emergence of market power, the time lags between actions and results and the difficulty in measuring the success of outcomes, barriers to market entry and the existence of multiple markets.

In theory, the problems arising from market failure may be remedied through government intervention (Murtough *et al.* 2002:1). However, good policy for government intervention should understand and address the cause of the market failure. The first and second order market failures for Murrindindi are discussed in the following sections

5.2 First order market failures for ecosystem services in the Murrindindi Shire.

5.2.1 Property rights – defined and well allocated

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 and Streit 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.

Rights define the relationship between a landowner and the ways in which they can use their resources.

The lack of a clear definition and allocation of rights is often cited as one of the main reasons why a market does not exist for ecosystem services (Murtough *et al* 2002; Whitten and Bennett 2005).

In the Murrindindi, some rights to a landholder's resource are clearly defined while others remain unclear. For example, the rights to the main activities associated with commercial agriculture or RRD are reasonably well defined in the Murrindindi Shire. At the same time, the rights to many valuable but non commercial benefits of a rural property such as the ecosystem services of healthy vegetation are not well defined. For goods such as ecosystem services one key cause of the lack of clearly defined rights is the bundling of conflicting and overlapping rights. For example, the rights to benefit from grazing stock in stands of native vegetation are held by the landholder whilst the rights to the benefits provided by the same native vegetation as habitat or through water filtration are held by the community. Here, the benefit streams of the rights are mutually exclusive but bundled together (you can have one but not the other at any one point in time). When a number of separate benefits desired by consumers are bundled together, signals in the market become distorted and the transaction costs of exchange become too high such that there are no benefits from trade.

Table 3 lists some, but not all of the main land use activities that affect key ecosystem services in the Murrindindi Shire and details how well rights are defined for these activities.

In Table 3 it is demonstrated that the rights to many commercial activities associated with the land in the Murrindindi Shire are well defined and allocated. At the same time, however, the rights to ecosystem service outcomes of this same land are not at all well defined and allocated. With the above described allocation of rights, agriculture will be produced at the expense of ecosystem services and some policy intervention is required to improve the definition and allocation of rights to ecosystem services.

Table 3: Allocation of rights to land use activities in the Murrindindi Shire

Impacting activity	Affected ecosystem service/s	Rights to ecosystem services are clear - defined and fully allocated			Comment
		Yes	No	Partially	
Building on ridgelines	Aesthetic			X	Building location is restricted through planning process but rights to the amenity value of views or emotional attachments to open space are not allocated
Conflicts between agriculture and residential neighbours	Aesthetics		?		Considered in planning process. Rights may be allocated to agriculture first because they were there first. Zoning may influence the allocation of rights. Planning requirements may manage rights conflicts here (i.e. development planning needs to consider agricultural neighbours)
Management of pest plants and animals	Aesthetics, Biodiversity	X			Rights allocated through a specified duty of care. However, management of these rights are not well enforced. No rights allocated to certain level of pest plant or animal. Also very difficult to exclude others from the costs of inappropriate management.
Tree clearing	Aesthetics, Biodiversity Water quality Soil quality			X	Don't have the right to clear, but can clear under certain circumstances. No rights specified for the provision of ecosystem services outcomes associated with trees. This affects decisions made in current land management and during RRD
Over grazing	Aesthetics, Biodiversity Water quality Soil quality			X	Grazing rights in place. No rights specified for the ecosystem services that are impacted on from grazing.
Grazing in riparian or sensitive areas (steep slopes or remnant vegetation)	Aesthetics, Biodiversity Water quality Soil quality		X		Rights to graze. No rights to ecosystem services impacted on by inappropriate grazing (remnant veg, riparian zones)
Management of domestic animals	Aesthetics, Biodiversity		X		Rights of ownership of domestic pets fully defined. But no rights allocated for the ecosystem services (habitat, population of fauna) impacted on by domestic animals

5.2.2 Public goods – non excludability and non rivalry of ecosystem services

When rights are well defined and well allocated they are also excludable. When a good is excludible, a reward such as a payment can be extracted from beneficiaries in exchange for the provision of the good. That is, there is an incentive to provide the good. Ecosystem services are both non rival and non exclusive. That is, one persons

consumption of an ecosystem service does not reduce another's (although the extent of non rival outcomes can depend on the nature of the ecosystem service); and it is extremely costly to identify and exclude all beneficiaries of ecosystem services.

Policy intervention is not likely to be able to make ecosystem services exclusive and rival. Rather, policy intervention should address the effect that the public good nature of ecosystem services has on supply by allocating rights such that some level of benefit is exclusive and non rival. An example of this is government purchasing the supply of ecosystem services from private landholders. Whilst the government can not exclude others from benefiting from the ecosystem service, the purchase provides the incentive to the landholder to provide the good as if the good was exclusive and rival.

5.2.3 Information failure

Efficient markets are predicated on the basis that full information is available to buyers and sellers. The full information criterion requires that producers and consumers both know all relevant information about the product, including factors such as quantity, quality, time and location of supply, price and so on.

For ecosystem services, information failure is both partial and complete and emerges as:

- Scientific uncertainty: Scientists know that ecosystem services are generated in different proportions depending on a range of biophysical and management inputs but don't know the exact relationship between these biophysical and landscape management inputs and the biodiversity outputs generated;
- Lag times: Ecosystem service benefits from actions occur over very long periods of time and space and are difficult to quantify whilst effort and cost is incurred up front. This results in weak incentives for collective action to prevent resource degradation (Hatfield Dodds 2005).
- Uncertainty about tools and techniques: Potential suppliers of ecosystem services don't know what tools and techniques to use to supply biodiversity: or
- Information asymmetry: one party (buyers or sellers) holds information that would normally be signalled in the market place, such as a price for changing management and the value of the ecosystem services that are produced (Stoneham *et al* 2002:4).

5.3 Second order market failures for ecosystem services in the Murrindindi Shire.

There are a range of other factors that can cause the market to fail even if the first order market failures are addressed. Once again, the market failures are context specific. That is, in any place and point in time, some but not all of these factors may occur to restrict the operation of a market.

For the Murrindindi the most likely second order causes of market failure are the potentially small numbers that will be engaged in the market; and, the level of scientific uncertainty around cause and effect relationships of actions and ecosystem services across space and time. A market works best because of heterogeneity of goods and participants (heterogeneity over time, space and type) and an ample number of each (Salzman and Ruhl 2000). A market for ecosystem services for just

Murrindindi may be efficiency compromised simply because of the restricted number of potential participants. Further, a market requires some level of certainty of measurement of cause and effects to manage trades. The nature of ecosystem services (the fact that they vary of time, type and space) makes measurement difficult and could therefore limit the effective functioning of the market.

5.4 Section summary

- In a market based framework for allocating scarce resources, ecosystem services are not provided at a level that is socially optimal. That is, the market fails to signal to landholders the level of ecosystem services that are demanded.
- The market fails due to a number of first and second order factors. The market may fail as a result of any one factor or because of the existence of a number of factors. For ecosystem services in the Murrindindi key market failures include the absence of fully defined and enforceable property rights, information failure (information between participants or the inability to measure cause and effect relationships) and market power from few market participants.
- Market failure is generally considered a precursor for government intervention. Analysing and addressing market failure results in good policy design.

6 A market based policy instrument for ecosystem services in Murrindindi.

6.1 Instruments available

In theory, the supply problems for goods arising from market failure may be remedied through some level of government intervention (Murtough *et al.* 2002). Intervention occurs to alter the incentives faced by landholders and can be divided into three categories:

- **Facilitative:** where measures are designed to improve the flow of information and corresponding signals and incentives without providing any direct incentive payments to landowners. For example, extension programs providing information about how to manage land to improve biodiversity conservation.
- **Market based/financial:** where measures are designed to directly alter the structure of pay-offs to land managers and is usually specifically intended to substitute for missing monetary signals that are generated within markets for other goods and services.
- **Coercive:** where non-voluntary measures are designed to compel management change using the coercive powers of government. Regulations designed to protect native vegetation are an example of coercive policies.

The key distinction between market based and coercive measures is the non-voluntary nature of coercive policy. The equivalent distinction between market based and facilitative measures is the direct provision of a monetary or non-monetary reward

rather than a reliance on existing rewards such as individual motivations or markets once facilitated. Despite the seemingly clear distinctions between different policy measures, practical applications seldom demonstrate such clarity. In practice, facilitative measures are often instrumental in the success of primarily incentive-based policies. Similarly, many so-called voluntary measures are backed up by strong regulations and incentives have often been used to assist in meeting new or more stringent regulations.

Traditionally, environmental impacts of ecosystem services have been addressed through facilitative and coercive instruments. Here, facilitative approaches have been used to encourage non-developing landholders to increase their provision of ecosystem services whilst coercive approaches have been used primarily with development to ensure a minimum standard of practise is complied with (see Box 1 for an overview of some of these non-development and development regulations).

Whilst regulation is one mechanism to approach achieving ecosystem service targets, discussion in section 4 suggested that whilst potentially effective, it is unlikely that regulation is the most equitable or efficient mechanism available. Section 4 presented discussion that a mechanism that required targets to be met by developing and non-developing landholders but that allowed flexibility on how these were met could potentially be as effective (or more effective if it actually increased the chance of the targets being met at all) but more equitable and efficient at achieving targets. A market based approach or instrument (MBI) could be the appropriate mechanism.

Box 1: Some of the coercive instruments currently employed to manage non-developing and developer impacts on ecosystem services in the Murrindindi Shire

Regulation usually involves some command and control measures that dictate actions that individuals either must or must not take. In the Murrindindi case, government intervention through regulation does currently occur to manage some impacts on some ecosystem services in the non-developing and developing environment. These rules and regulations include but are not limited to:

For non-developers:

- Goulburn Broken Dryland Salinity Management Plan 1995-2001 Review Second Generation Salinity Management Plan
- Goulburn Broken Native Vegetation Plan Volume 1 & 2
- Native Vegetation Retention Controls Riverine Health Strategy 2002
- Goulburn Broken Catchment Water Quality Strategy. 1997 & 2002
- Floodplain Management Strategy 2002
- Goulburn Broken Recreation Strategy 2002
- Rabbit Management Action Plan 2001
- Weed Action Plan 2001

In addition for developers there are:

- EPA requirements and guidelines to reduce sediment runoff during construction.

- National and state policies to protect and enhance quantity and quality of native vegetation such as the native vegetation management framework – require any vegetation impacts to be offset.
- EPA regulations such as the Septic Tank Code of Practise to manage effluent in waterways.
- Zoning, overlays and permitting requirements
- Rural Living Development Guidelines. This also involves the submission and approval of a whole farm plan with subdivision application.

6.2 The market-based approach.

The market-based approach, or market-based instruments (MBIs) operate through market signals to change the incentives faced by landholders, rather than explicit directives. Significantly, MBIs address the cause of market failure for a good and by changing the market forces faced by participants (landholders in this case), MBIs redefine the agenda for players such that improved environmental outcomes are in their own interest (Whitten *et al,* 2003a).

6.2.1 Types of MBIs in Australia

MBIs in Australia are commonly categorised as either a price or quantity based instrument, although instruments aimed at improving the operation of existing markets, termed 'market-friction' instruments, are sometimes included as market instruments. Each manifestation of the instrument is illustrated (Figure 7).

Price based MBIs assign a price to environmental impacts within existing markets through the imposition of charges, taxes or subsidies[6]. Firms then respond to the modified market signals and adopt the resource use or management practice that offers them the greatest benefit and, if the policy is effective, it leads to a better resource management outcome. While these instruments cannot guarantee the *extent* of changes, they act to cap the *costs* incurred under the instrument. Price based instruments therefore rely primarily on price signals rather than scarcity to create incentives to potential participants.

Quantity based or 'tradeable rights' instruments create a market in the rights to engage in an activity associated with specified resource uses or environmental damage. They do this by restricting the total level of activity and allocating rights to participants. An efficient allocation of rights is then determined through market exchanges. Tradeable rights instruments tend to be used when it is important to get a

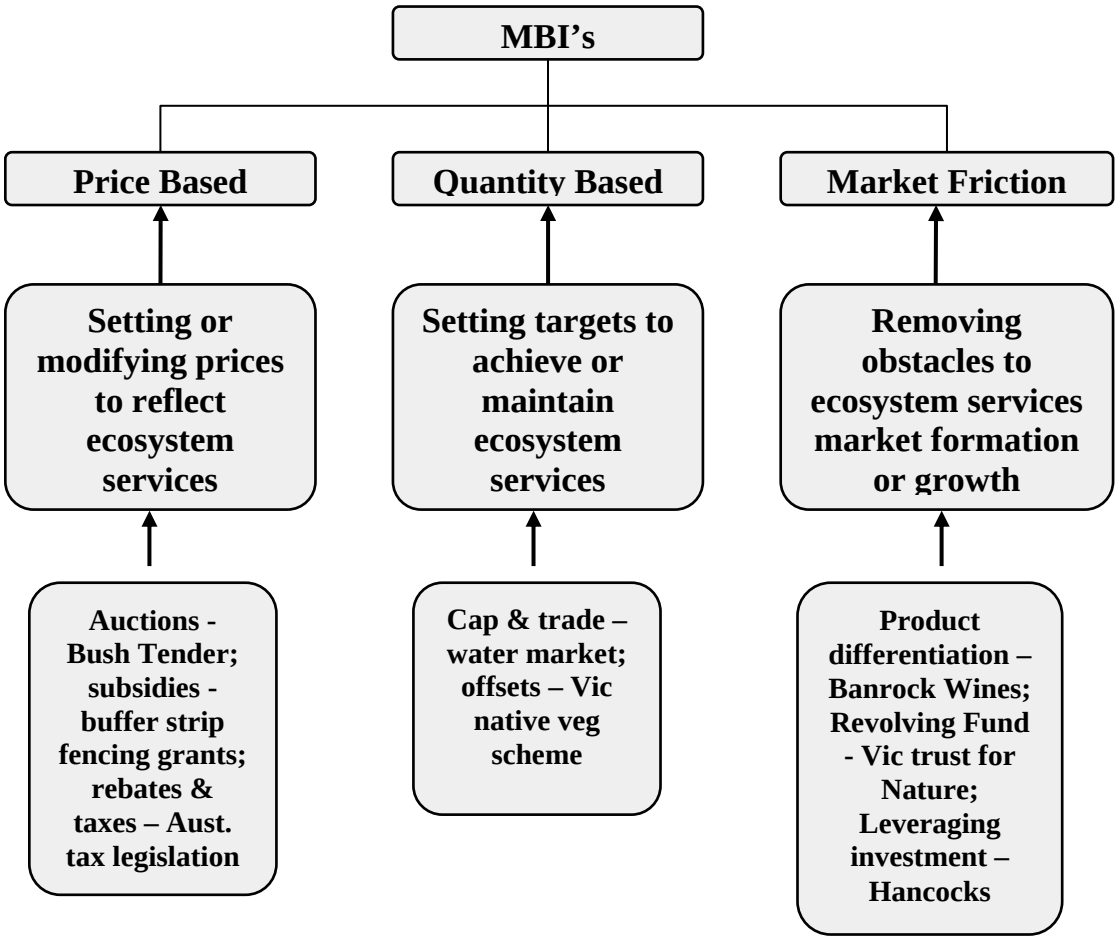
[6] It is important to be aware that many price based MBIs can also be called "market like" instruments. This argument is presented for two main reasons. First, many price based MBIs do not present with normal market characteristics such as many buyers and sellers. Instead there are more often than not one buyer and a few sellers (most auction MBIs are one buyer). Regardless, applications of a one buyer auction so far has tended to be more cost effective at purchasing environmental goods compared to a fixed price grant (BushTender reports cost effectiveness of auctioning as 7 times greater than alternative fixed grant approaches). Second, some schemes that are categorised as price based MBIs, such as subsidies and taxes do not take advantage of market characteristics such as heterogeneity in landscapes and management actions in their operation. These schemes, although providing a monetary incentive for the environmental good, provide the same monetary incentive or tax on all landholders once they get past a qualifying threshold (eg set $/km of fencing) – this is not really a market, but still changes the price incentives faced.

certain environmental outcome (for example, when pollution of a waterway is close to a level that may cause irreversible or unacceptable degradation). Quantity based MBIs need some level of regulation for effective operation. That is, Government or a designated authority must determine the total quantity of the good to be expressed in the rights, who can own the various rights, the initial allocation of rights, the conditions under which trade can take place, how rights will be monitored and enforced, etc (Murtough *et al* 2002).

Whilst quantity based MBIs tend to result in significant institutional change over time (unlike price based MBIs which often can only run for as long as the funding is available), quantity based MBIs need greater legislative backing.

Market friction mechanisms work to improve the way a current market functions. Market friction MBIs achieve this by providing more information to the market or reducing the transaction costs of the market. An example of a market friction MBI would be providing a designated broker or water exchange facility to improve water market outcomes.

Figure 6: Types of MBIs



6.2.2 Potential benefits of the market based approach.

MBIs applied in a natural resource management (NRM) context have received increasing attention recently as they have the potential to deliver improved NRM outcomes at lower costs than alternative instruments. MBIs achieve these efficiency gains in three ways:

1. Allowing flexibility in the way participants choose to respond to the instrument and thus encouraging innovation;
2. Encouraging change amongst those who can achieve change most cheaply, as opposed to broadly levelling change requirements on all; and
3. Placing positive incentives on better NRM, as compared to the negative incentives evident in regulatory approaches, thus driving innovation and continual improvements in NRM management.

Cost savings from MBIs are as a result of making the most of the heterogeneities in the market place. For example, if two neighbouring firms produce similar amounts of pollution but face widely differing costs to reduce their pollution (due to processes employed, input mixes, type of goods produced or other reasons) a regulatory instrument would lead to each reducing their pollution by an identical amount but with very different abatement costs incurred. Further, one firm may be able to carry out a lot more pollution abatement for a small cost but does not because it stops at the regulated amount, whilst another firm may become unviable due to the high costs that it incurs complying with the regulation.

A market-based approach to the same situation would be to set a target level of pollution to be achieved by all firms, and allow and encourage differential reductions in pollution as long as the overall target is met. This way, firms with high control costs undertake a smaller share of achieving environmental targets in a physical sense but a similar share in a monetary sense, whilst the firm facing the lower costs conducts most of the physical abatement at a cost subsidised by the high cost abatement firm (Whitten *et al* 2003a). That is, the differences in the market participants results in gains from trade realised by all players.

6.3 Section summary

- In theory, the supply problems for goods arising from market failure can be remedied through some level of government intervention (Murtough *et al.* 2002). Generally, government intervention seeks to alter the incentives faced by market participants such that the socially optimal supply of a good occurs. Effective and efficient government intervention is that which addresses the reason why the market does not supply the good in the first place, the market failure(s).
- Market based instruments (MBIs) address the cause of market failure for a good and by changing the market forces faced by participants (landholders in this case), redefine the agenda for players such that improved environmental outcomes are in their own interest.
- There are three main types of MBIs in Australia – quantity based, price based and market friction instruments. The next section of the paper steps through how to choose which MBI type is most appropriate for the Murrindindi Shire.

- MBIs have the potential to achieve significant efficiency gains particularly when compared with more traditional coercive and facilitative instruments. MBIs are particularly effective when there are heterogeneities between market participants and the costs faced to supply a good or outcome. This heterogeneity is likely to occur with non-developers and developers in meeting ecosystem service targets in the Murrindindi. MBIs achieve efficiency gains through:
    - Allowing flexibility in the way participants choose to respond to the instrument and thus encouraging innovation;
    - Encouraging change amongst those who can achieve change most cheaply, as opposed to broadly levelling change requirements on all; and
    - Placing positive incentives on better NRM, as compared to the negative incentives evident in regulatory approaches, thus driving innovation and continual improvements in NRM management.

7 A MBI for the Murrindindi

7.1 Which type of MBI is best for Murrindindi?

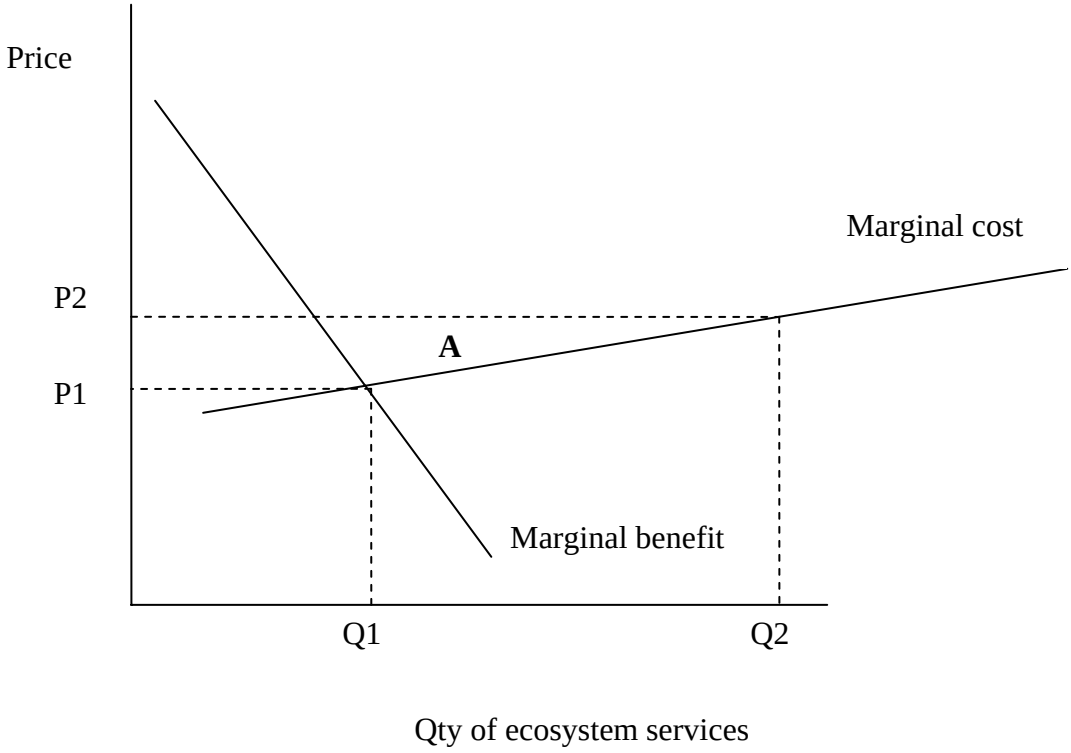
As discussed in the previous chapter there are three potential MBI approaches that could be used – price based, quantity based or that which lubricates the operation of a functioning market, market friction. For Murrindindi, the market friction instrument is not appropriate as no market currently exists for the ecosystem service product. Therefore only price and quantity based instruments are discussed in this section in relation to what type of instrument should be used.

7.1.1 A quantity or price based MBI

The selection and therefore the advantage of a price over a quantity based instrument (and vice versa) depend on the information available and the level of biophysical and institutional uncertainty (Weitzman 1974:480). When there is full information about the cost to perform an action, in this case to conserve ecosystem services, a price and a quantity based instrument will result in the same outcome at the same cost (Sterner 2003).

The main discussion for selecting between a price or quantity based mechanism has been presented by Weitzman (1974). Here, if for a good such as ecosystem services, the benefit function of having the good is steep or the cost function of supplying the good is flat a quantity based mechanism is recommended (Figure 7). The reason for this is the cost of getting the policy wrong (i.e. setting the wrong price) is very high. For example, with a flat marginal cost curve and steep marginal benefits curve, the wrong price will see a significant diversion from the required quantity (Q2 in Figure 7) which will result in a large policy efficiency loss (“A” in Figure 7). The opposite is also true. Quantity based mechanisms are also recommended when there are thresholds or kinks in the benefits attributed to a good. For example, if there is a critical point whereby pollution levels allow for safe swimming in a lake, it is more efficient to set a quantity policy at or below this threshold rather than trying to set the price to achieve this quantity.

Figure 7: Quantity or price based MBI



Whilst the slopes of the benefit and cost curves are essential in knowing what to choose, there are a number of circumstances and characteristics that can guide which approach to choose without establishing the shape of curves. Each of these for Murrindindi is discussed below.

Allocation of property rights: Securing an environmental outcome when property rights are fully allocated is often considered in terms of a polluter pays or beneficiary pays framework. Polluter pays is essentially a quantity based approach where quantity targets are set and polluters must meet targets at their own cost (or at no cost or even a benefit if trading is allowed). Beneficiary pays is like a price based mechanism where prices are paid to polluters to reach a target. The polluter pays approach is often used when the outcome is not far from the starting point whilst the beneficiary pays approach tends to be used when the outcome requires significant change by one sector (eg landholders) and when the public benefit is greater than the private benefit.

Determining a price or quantity based instrument with the guidance of whether the situation lends itself best to a beneficiary or polluter pays problem is straightforward if the property rights are not contested. For ecosystem services, however, this is not the case. Rights here are contested in three ways. First whilst property rights to ecosystem services are allocated by default to the landholder, the decline in ecosystem services indicates that the property rights to these services are not fully defined or enforced. Second, targets for ecosystem services impose on the rights of landholders to continue what they are doing; and finally, development laws further impact on the

landholder defacto rights. The fact that rights are contestable in the current and RRD framework, and the fact that there is a tendency for the polluter pays approach to apply in development situations suggest that a polluter pays, quantity based mechanism be used for Murrindindi.

Jurisdictional powers of the property rights: The choice of instrument is also influenced by the available legislative backing. For a quantity based instrument, a fair amount of legislative power is involved in determining the total quantity of the good to be expressed in the rights, who can own the various rights, the initial allocation of rights, the conditions under which trade can take place, how rights will be monitored and enforced, etc (Murtough *et al* 2002). Quantity based instruments tend to result in significant institutional change over time. The targets established by the GBCMA's RCS (2003) establish a legislative based that is essential for a quantity based mechanism

Time to produce outcomes: The time to produce outcomes depends on the nature of the impacting activity and the nature of the environmental good. A short impact outcome relationship is demonstrated by a firm that pumps pollution into a river. Here a change in management such as switching off the pumps can have an almost immediate impact on the quality of the water. This impact can occur as quickly as one hour, one day or one week. A medium impacting relationship can be demonstrated by most agricultural activities. A change in management such as cropping with buffer strips next to waterways could see a change in environmental outcomes over a period of months or a year. Ecosystem services such as biodiversity have significantly longer impact response relationships than the polluting firm or the agricultural cropping regime. It takes years or even decades to see an environmental change such as biodiversity after a management change such as one that stops land clearing.

Price based mechanisms tend to only achieve change for as long as the budget is available. Price based mechanisms are good at securing outcomes that have short response time horizons. Quantity based mechanisms, because they give a certainty of outcome are more appropriate to secure outcomes that have long time horizons. Therefore a quantity based mechanism would be better for ecosystem service outcomes.

Number of landholders and point of change: Transaction costs are the costs of coordinating people in the market. These costs arise because of uncertainty in the market place (Kasper 1998:133). Human interaction of any form inevitably leads to transaction costs (Kasper 1998:133) but too high transaction costs as a result of too high uncertainty will reduce the quantity and quality of interactions. Government interventions such as MBIs seek to reduce these transaction costs enough such that exchange can occur. However, in doing this, the MBI itself incurs transaction costs. Transaction costs associated with the MBI can be categorised as either institutional or bureaucratic. Institutional transaction costs are described by Whitten *et al* (2003) as those associated with the gathering of information, defining property right frameworks and designing exchange institutions or rules. Institutional transaction costs are those associated with establishing and trading property rights. Bureaucratic transaction costs are those associated with the setting up of structures to manage and monitor the market exchange.

Policy transaction costs can be reduced if environmental change is achieved at the point of land ownership/use transition rather than after (that is, whilst a property is still 100 hectares rather than split into 5, 20 hectare blocks). There are two main reasons for this. Once land use has changed from agriculture to RRD there are many more landholders to deal with, increasing policy transaction costs such as negotiation, administration and monitoring. Second, a policy that operates at the point of change can capitalise on the processes already in place to manage the impacts of this change (eg zoning and development approvals etc) which can reduce the political and establishment costs of this new policy. A quantity based mechanism, by being more prescriptive on the actions that must be taken at the point of change than a price based instrument, can secure an outcomes at the point of change and therefore at a much lower transaction cost.

Degree of variation from the starting point: The transaction cost of a policy will also vary depending on how far the policy moves agents from their current operating framework. The further a policy moves agents from their current state, the higher the cost (bureaucratic and institutional). Quantity based instruments tend to be used when protecting outcomes that are similar to what is current or only requiring a small change. However, if the costs to change are large (even if the change is small) a hybrid instrument or staged approach may be appropriate. For Murrindindi this could involve the provision of incentives to assist non-developers to meet targets in the short term as suggested in section 4.4.

The nature and certainty of the goals: In some circumstances policy makers have full knowledge of the budget available to secure environmental outcomes. When budget is known with certainty a price based mechanism is commonly the approach used to secure environmental outcomes. The other certainty that may be known is the quantity of a good that may need to be obtained. Quantity targets may be especially important if a system is approaching a threshold. The nature of the budget or targets is commonly presented as the means by which to select a price or quantity based mechanism. As demonstrated in the above discussion there are many other issues to consider.

A quantity based MBI is recommended for ecosystem services in the Murrindindi Shire. The reason for this recommendation is:

- Murrindindi Shire is required to comply with the ecosystem service targets for the upper Goulburn Broken catchment. Therefore quantity targets are known;
- Ecosystem services have long term time frames of ecosystem services so should be secured more cost effectively through a quantity based MBI;
- It is likely that the marginal benefit curve of ecosystem services is steep because the system is likely to be approaching thresholds. A quantity based policy gives a more secure outcome when operating with thresholds; and
- A quantity based mechanism can capitalise on current policy at the point of change. This will further reduce the transaction cost of policy implementation.

7.1.2 Which quantity based MBI?

Whilst a quantity based instrument is recommended to be the most appropriate type of MBI for Murrindindi, the next task is to determine the most suitable quantity based instrument. Quantity based mechanisms can involve a cap and trade with or without offsets through to offsets without the cap and trade. A once tradable offset scheme is recommended as a mechanism solution for the Murrindindi case study. The reason for this recommendation is expanded below.

Offset schemes require a target and allow agents (for example a polluter) to achieve this target (for example pollution abatement) either onsite or through sponsoring abatement effort from other sources. Because agents can choose to either take direct action or pay others to take action for them the targets are achieved more cost effectively compared to when the same actions are required by all agents. An offset scheme is different to a cap and trade because an offset scheme allows the target (or cap) to be reached either on site or at an alternative site[7]. The once tradable nature of the offset scheme further differentiates this scheme from a cap and trade; here the offset can not be traded once achieved unlike a cap and trade. Murtough *et al* (2002) describe an offset scheme as non tradable if the desirable and non desirable actions are performed by the same party; or, the property right for the desirable action can only be exchanged once. That is, either the party doing the damaging also does the offsetting; or the damaging party pays another to undertake the offsetting activity.

There are a number of key criteria, mainly regarding the biophysical characteristics of the targeted good, which lead to the recommendation of a once tradable offset scheme and not a cap and trade MBI.

First, the environmental goods being targeted in the Murrindindi case are difficult to package into small discrete and substitutable bundles. To illustrate this concept, consider the operation of a cap and trade scheme. A cap and trade works best for environmental goods that are easily measurable and therefore relatively easy to package as a good that can be traded and substituted (for example a salinity cap and trade, caps allowable salinity emissions and allocates permits to emit). Salinity is one discrete environmental good that is the same package anywhere in the landscape – one unit Ec of salinity here is the same as one unit of Ec there (although the impacts may vary in different parts of the landscape). Ecosystem services, on the other hand, tend to be characterised by many environmental goods that interrelate across space and time, the biophysical characteristics of ecosystem services, therefore, make them very difficult to package into discrete and substitutable trading units.

Second, uncertainty and the long lag times associated with the cause and effect relationships of land management changes and outcomes for ecosystem services means that it is very difficult to know what land management changes will achieve relative to the goal or target. Consider again the cap and trade salinity example, here land management change brings about a fairly certain environmental outcome over a measurable period of time. As a result, land managers know what actions to employ to meet the cap, further, if they under or over achieve it is clear what number of additional permits they can buy and sell within the timeframe of the mechanism.

[7] Although cap and trade can include an offset whereby caps can be met with an offset.

7.2 What would a development offset MBI for ecosystem services in Murrindindi Shire look like?

In section 4 a number of scenarios were discussed that could bring about improved ecosystem services to the target levels. Section 4 highlighted that whilst there were a number of possible approaches, each approach had different equity, efficiency and effectiveness implications. Section 4 concluded that the best approach to reaching target ecosystem services was for both non-developing and developing landholders to be required to meet targets but to allow for flexibility in how these targets were met. This flexibility may enhance the potential efficiency gains. It has also been recommended in this paper that the achievement of targets by non developers may be enhanced in the short term through incentives.

A once tradable offsets scheme with targets set according to the GBCMA's RCS (2003) and to be met by both developing and non-developing landholders means the following for the Murrindindi:

- All landholders, whether they be non-developing or developers know what the end goal is and what this end goal means for their property and operation. That is, the developer knows that he/she must have no net impact and achieve higher ecosystem service targets. The non-developer knows that they must change land management to meet targets;
- But the actual action to meet targets for the catchment for each property is flexible, thereby allowing properties to choose the action of least cost. For example RRD on the pristine property at the top of the catchment, whilst required to meet no net impact requirements from development and actions to meet targets, does not necessarily have to meet these on-site. Instead the developer may pay another landholder to undertake works to offset the impacts from the RRD and to meet the developer targets. Of course there are rules about when an offset can be used, which mean that an entire pristine block will not be clear felled and offset. These rules are discussed in the relation to offset design in paper 3, "What are development offsets and how do they work – an introduction to development offsets and their issues".
- The provision of ecosystem services as an offset could become part of the production profile for both developers and non-developers. That is, once targets (and no net impact obligations are met) all landholders have the opportunity to provide services as offsets to others. An offset, by providing a property right to the ecosystem service, creates a value for the provision of the service.

Whilst the concept of the once tradable development offset is relatively straight forward, the ability of the scheme to achieve the environmental outcomes is highly dependant on the design of the scheme. Key design steps for the scheme for the Murrindindi Shire are worked through in report 3 "What are development offsets and how do they work – an introduction to development offsets and their issues".

8 Conclusion

Ecosystem services are affected by both current, non-developing land management and by RRD. RRD has both direct and indirect impacts on ecosystem services and whilst some impacts of RRD are positive for the provision of ecosystem services (for example, if RRD results in less intensive grazing), it is most likely that RRD overall will negatively impact on ecosystem services in the Murrindindi Shire.

In this report the catchment targets set by the Goulburn Broken Catchment Management Authority (GBCMA) are adopted as the desired ecosystem service targets for the region. Given that there are both non-developing and developing landholders there are a number of ways that ecosystem services at the target level can be achieved. Each option has different equity, efficiency and effectiveness outcomes.

In this paper it is recommended that an approach that requires both developers and non-developers to meet targets but allows flexibility with how the targets are met is the most effective, efficient and equitable approach to achieving targets. How this might be done is the focus of this paper.

To analyse potential policy approaches, this paper takes a step back to assess why ecosystem services are provided below the socially optimal level in both the non-developing and developing scenarios. A market failure analysis reveals that property rights for ecosystem services are not fully defined or allocated. Further, information asymmetry and information failure exists for ecosystem services both for potential sellers and buyers of these goods making transaction costs of exchange prohibitively high.

In theory, when market failure occurs, government intervention may be warranted to improve social welfare. This intervention can be facilitative (provide information to see the better operation of a current market), may see the provision of incentives (market based instruments) or be coercive (regulatory). Whilst some regulation is necessary to manage impacts, a market-based approach or market-based instrument (MBI) is put forward as the most cost effective policy to achieve targets especially when there is heterogeneity in the market place. MBI's applied in a NRM context have received increasing attention recently. This is because 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 many alternative instruments.

Because of the need to set a target level of ecosystem services to be supplied by non-developing and developing landholders, it is recommended in this paper that a quantity based MBI be designed for Murrindindi. The recommended MBI is a once tradable development offset MBI.

A once tradable development offset MBI can result in developing landholders being able to achieve no net impact requirements and targets by undertaking actions both on and/or offsite. By increasing the flexibility by which targets can be met could potentially see obligations and targets met more equitably and at a higher efficiency. Further, by allowing actions to occur offsite also creates a market for the provision of ecosystem services elsewhere in the landscape.

Whilst a development offset approach to achieving targets has many advantages over a more traditional regulatory approach, the ability of the scheme to achieve the environmental outcomes is highly dependant on the design of the scheme. Critical design steps for the scheme for the Murrindindi Shire are worked through in report 3 "What are development offsets and how do they work – an introduction to development offsets and their issues".

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