the creeks and rivers of the region, increasing turbidity or resulting in stream deposition, does the cost become a true externality, either to other water users or as an environmental cost.

### 7.2.8 IMPACT ON SOCIAL COHESION

Wind farms, like many forms of industrial development, tend to evoke a polarisation of views and opinions within affected communities. While landholders' decisions to lease their land to developers is a private market transaction, the potential for considerable external impacts on other local residents means that communities can become highly divided by such developments. Such considerations are acknowledged by both industry and government as important considerations in the planning process (see discussion above). Some communities have been relatively welcoming of wind farms, however in other areas there is anecdotal evidence of landholders who lease their farms to developers being isolated from the local community. Given the significance of social cohesion to communities in rural areas, the ability for wind farms to create social division, while inherently difficult to quantify, is nonetheless an important consideration in the broader socio-economic analysis.

## 7.3 IMPACT ON LAND VALUES

The variable of land value impacts tends to capture many of the other impacts previously discussed. Put simply, land values tend to encompass people's perceptions of many of those previously discussed issues, and others, into the one unit – willingness to pay for land.

A review of the literature on the impact of wind farms on land values reveals no consistent conclusions. Some (e.g. Sterzinger, Beck, Kostiuk, 2003) argue that a wind farm has no impact and can, in some circumstances, enhance property values. This conclusion is based on an active wind farm in the area opening up another source of (non-agricultural) revenue to the farmer, creating an additional income stream from the land. Other studies (e.g. Inspiring Place Pty Ltd, 2002; Bunyan and Beckford, 2008) claim that wind farms do indeed have a detrimental impact.

The methodology and local area data used to support these conclusions across the various areas is unable to be verified, however one conclusion from the international and Australian evidence is clear: there is no universally agreed and applicable relationship between proximity to wind farms and land values. Critically, what matters is the specific characteristics of the region in which the wind farm is being located.

What can be concluded, and what is certainly consistent with land valuation theory, is that in areas where agricultural productivity is the dominant driver of land value, wind farms will have negligible effect. This is understandable, for there is little evidence that wind turbines undermine agricultural productivity and, as discussed, the presence of a wind operator in the region can open up another revenue stream to the land owner and enhance their overall revenue. This is not only beneficial as an additional revenue stream, but also minimises agricultural and seasonal risk to the farmer's income. Any loss of amenity due to the wind farm (such as noise or aesthetic impacts) will have minimal, if any, impact upon land values when amenity is not driving the land value. If the value of the land is tied to its income earning potential, then an additional income earning option is, all other variables remaining the same, likely to enhance property values or at least ensure that any impact is negligible.

However, there is a great deal of anecdotal evidence, often backed with the conclusions of real estate agents, that wind farms in some areas would and do undermine land values. This has been highlighted recently in Victoria, with one estimate placing the decline in land values

as high as one third, in the lifestyle coastal areas of Gippsland (Cuming and Skuthorp, 2008). The argument is generally based on the loss of amenity value, rather than any cost to agricultural productivity or revenue earning potential per se. Once again, these studies and their impacts on the local area property markets cannot be verified, however the perception that, in areas where amenity value is driving property prices, wind farms are not a desirable attribute of an area, can be confirmed.

Of course, some will argue against these perceptions, and passionately believe that wind farms do not detract from landscape values or cause local area nuisance issues such as noise pollution. Research by the Australian Wind Energy Association and Australian Council of National Trusts (2004) highlight the diversity of opinions on this. However, the important economic principle here is that, for a wind farm development to impact upon price by reducing demand for the land, not everyone has to share the view that the development is undesirable. Only some do.

This is because a property market, and the eventual price at which a buyer's willingness to pay meets a seller's willingness to sell, reflects the aggregated preferences of *all* potential buyers and sellers. Just because *some* do not feel that wind farms reduce amenity does not mean that the price will not be lower, even if the eventual buyer is one of them. So long as some potential buyers share the concern that a wind farm is not a positive asset to have nearby, the wind farm will be affecting price. Once again, we stress that the validity of people's concerns over issues such as noise, aesthetic impacts and impact of local roads, to the extent that they can be objectively assessed, is not relevant to the market price. These are often subjective opinions that cannot be proven or disproven. Their validity does not matter to the market price; the market responds to peoples' preferences, regardless of whether that preference is logical or rational in the eyes of others.

Hence, the distinction between an area where land value is predominantly driven by agricultural productivity versus one where it is driven more by amenity value becomes an important local area characteristic.

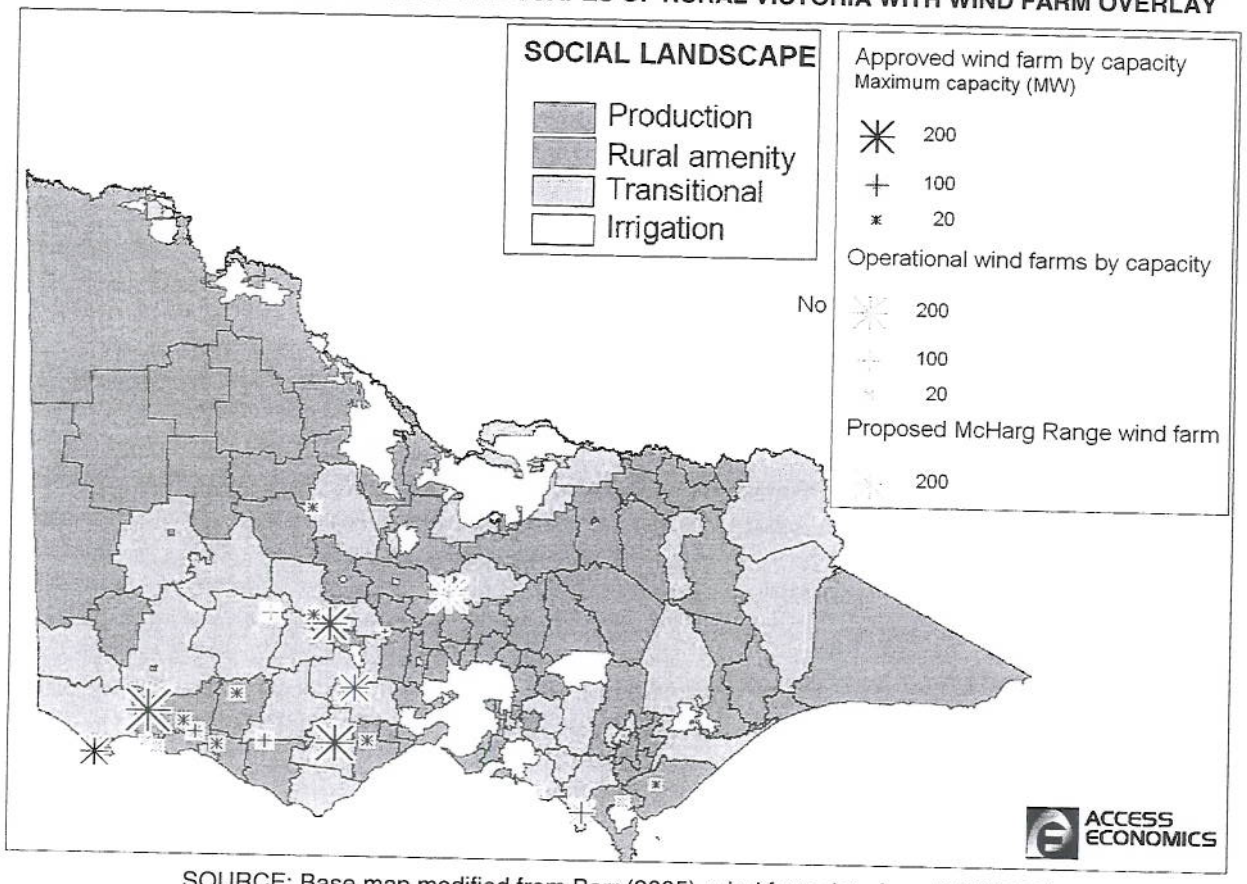
### 7.3.1 WIND FARMS IN RELATION TO LANDSCAPE ZONES OF VICTORIA

There are various ways to quantify the amenity value of an area. The Victorian Government publication *Understanding Rural Victoria* (Barr, 2005) disaggregates rural Victoria into four distinct zones:

- the agricultural production landscape;
- the rural amenity landscape;
- the rural transitional landscape; and
- the irrigation landscape.

These regions are illustrated in Figure 7-6. Figure 7-6 also shows the location of Victoria's operational wind farms, and those that have been approved but are not yet operational.

**FIGURE 7-6: STYLIZED SOCIAL LANDSCAPES OF RURAL VICTORIA WITH WIND FARM OVERLAY**




SOURCE: Base map modified from Barr (2005), wind farm data from DPI (2008)

This figure highlights a key difference between a wind farm in the McHarg Ranges and almost all other approved wind farms. With the exception of two small facilities at Winchelsea (28 MW capacity) and at Leonard's Hill (4 MW capacity), all Victorian wind farms are located in either 'production' or 'transitional' landscapes. **However, the site of the McHarg Ranges proposal sits on the edge of a 'rural amenity' zone.**

Barr (2005) define a rural amenity zone as one where demand for land has been driven by amenity rather than production purposes. Such purposes include hobby farms, rural residential properties, weekenders or bush retreats. According to Barr (2005) these areas have a "more secure future ... the diminished capacity to maintain population through natural increase is more than offset by migration from Melbourne". However, they warn that "this bright future depends on protection of the amenity features and landscapes that attract migrants" and that the management of "planning schemes that enhance amenity values will be crucial for the future, lest the migrants it attracts help destroy the very features that draw them".

A further indication of the area's amenity value came recently through a review of the quality of life afforded by each of Australia's Local Government Areas (LGAs) by Bankwest (2008). This review, bringing together indicators comprising of income, employment levels, crime rates, internet access, health, education levels, home ownership, house size, proportion of empty homes and community involvement, found that Macedon Ranges had the highest ranking of all non-metropolitan LGAs in Australia. Of all 590 LGAs in Australia, it was ranked

13th, making it the fifth highest in Victoria and higher than any other LGA outside of the capital cities in Australia.

Of course, the four landscape zones are broad categories, and to explore the extent to which amenity value is driving land values in the McHarg Ranges region compared to agricultural productivity, we have independently calculated the ratio of land values to agricultural productivity around the state, using a variety of measures of 'agricultural productivity'. Firstly, an analysis of the agricultural productivity of the McHarg Ranges region reveals that it is significantly less than the agricultural productivity of the areas where operational wind farms are located (Table 7-2), or areas where wind farms have been approved but are not yet operational. We have quantified three measures of agricultural productivity, explained in the footnote below, and in all cases the McHarg Ranges is less productive than other wind farm (both operational and approved) areas.

**TABLE 7-2: AGRICULTURAL PRODUCTIVITY MEASURES, MCHARG RANGES COMPARED WITH OTHER PROPOSED AND OPERATIONAL WIND FARMS[16]**

| | NPP | YPP | Grazing $ per ha |
|---|---|---|---|
| McHarg Ranges | 3.19 | 4.85 | 241.20 |
| All Operational | 4.41 | 8.69 | 969.27 |
| All approved but not operational | 4.05 | 8.30 | 693.78 |
| Lodged with Minister | 3.71 | 8.44 | 487.52 |

Source: Access Economics calculations, using gridded GIS data from CSIRO land and water (Profit Function Surfaces for Five Year Mean and Mean annual and monthly Net Primary Production (tC ha-1) in the "Agric" (present day)and 2005/06 ABARE agricultural census data.

Despite the lower agricultural productivity of the McHarg Ranges region compared to other wind farm locations across the State, the rural land is considerably more expensive, almost double the value on a per hectare basis than regions where other Victorian wind farms have either been located or approved (Table 7-3).

16 Based on SLA level calculations. McHarg Ranges is the weighted average of the 'Macedon Ranges – Kyneton' and the 'Mitchell – North' SLAs.
NPP = Net Primary Productivity, a measure of the biomass growing potential of the area, reflecting soil, climatic and aspect variables.
YPP = Yield of Primary Production at full profit equity. Conceptually, this is a similar concept to the carrying capacity of the land as measures by units such as the dry sheep equivalent (DSE) per hectare for grazing land.
Grazing yield calculations based on data from the 2006 ABARE Agricultural Census.

TABLE 7-3: RURAL LAND VALUE ($ PER HA)[17]

| Land Values | All rural land | Land wo buildings* |
|---|---|---|
| McHarg Ranges | $15,311.81 | $15,470.08 |
| Areas of operational wind farms | $8,287.24 | $10,125.35 |
| Areas of approved wind farms | $8,234.87 | $9,029.64 |
| Areas of wind farms lodged with minister | $7,284.85 | $7,420.17 |

Source: Access Economics calculations using LGA level data from Land Victoria, 2008, A Guide to property values, Data and analysis from the Valuer-General Victoria using 2007 property sales information for residential, commercial, industrial and rural property, Melbourne.

In terms of quantifying the extent to which amenity value, rather than agricultural productivity, is land value in an area, it is the ratio between land value and agricultural productivity that is most important. No single measure of this is conceptually perfect but, as revealed in Table 7-4, all ratio measures used show the same consistent trend; **that land in the McHarg Ranges is valued well above what it would be valued purely on the basis of agricultural productivity. This is strong evidence of a region of high amenity value, and confirms the findings from the Victorian Government report (Barr, 2005).**

TABLE 7-4: RATIO MEASURES OF LAND VALUE COMPARED TO AGRICULTURAL PRODUCTIVITY

| | All rural land value/NPP | Land value wo buildings/YPP |
|---|---|---|
| McHarg Ranges | $4,798.86 | $3,192.98 |
| Areas of operational wind farms | $1,878.86 | $1,164.50 |
| Areas of approved wind farms | $2,035.46 | $1,087.44 |
| Areas of wind farms lodged with minister | $1,965.21 | $879.32 |

Source: Access Economics calculations

On a more local area level, the McHarg Ranges region has a consistently higher ratio than all other wind farm regions in Victoria, including areas that are operational, approved or have been lodged before the Minister.

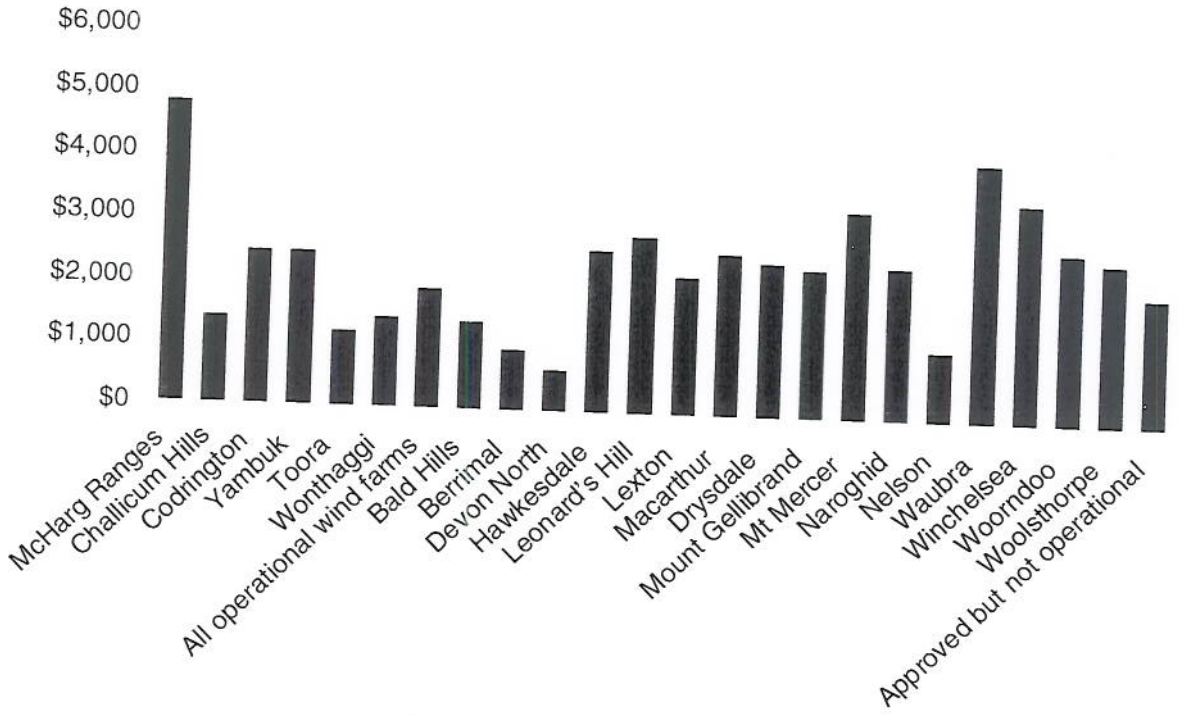
[17] NOTE: "Land wo buildings" refers to those categories of land for which there were no buildings involved, a more pure measure of the underlying unimproved value of the land. These categories are "Farm land (without buildings)" and "hobby farm land (vacant)". Such land may be more expensive, on an average per hectare basis, than other land which may have buildings (or other improvements such as vineyards or orchards), because they will typically be smaller allotments and, even though they may have no building, they may have building permits (or at least be large enough such that a planning permit would be provided).

**TABLE 7-5: ALL VICTORIAN WIND FARM RATIOS**

| | All rural land value/NPP | Land value wo buildings/DSE | Grazing income/DSE |
|---|---|---|---|
| McHarg Ranges | $4,798.9 | $3,193.0 | $64.1 |
| Challicum Hills | $1,363.0 | $484.2 | $16.2 |
| Codrington | $2,446.2 | $1,353.1 | $7.2 |
| Yambuk | $2,446.2 | $1,353.1 | $7.2 |
| Toora | $1,179.8 | $1,145.4 | $8.0 |
| Wonthaggi | $1,404.5 | $4,173.5 | $28.4 |
| All operational wind farms | $1,878.9 | $1,164.5 | $10.4 |
| Bald Hills | $1,363.5 | $1,144.7 | $8.6 |
| Berrimal | $946.1 | $463.3 | $12.0 |
| Devon North | $648.1 | $1,089.5 | $9.1 |
| Hawkesdale | $2,566.6 | $1,114.3 | $18.3 |
| Leonard's Hill | $2,806.2 | $4,034.1 | $49.6 |
| Lexton | $2,180.9 | $1,225.9 | $38.7 |
| Macarthur | $2,566.6 | $1,114.3 | $18.3 |
| Drysdale | $2,446.2 | $1,353.1 | $7.2 |
| Mount Gellibrand | $2,348.8 | $909.2 | $7.5 |
| Mt Mercer | $3,308.9 | $893.5 | $23.6 |
| Naroghid | $2,427.7 | $751.8 | $8.6 |
| Nelson | $1,086.5 | $906.7 | $9.7 |
| Waubra | $4,104.5 | $957.6 | $17.0 |
| Winchelsea | $3,487.7 | $2,020.3 | $24.8 |
| Woorndoo | $2,723.0 | $1,327.5 | $19.5 |
| Woolsthorpe | $2,566.6 | $1,114.3 | $18.3 |
| Approved but not operational | $2,035.5 | $1,087.4 | $13.0 |
| Ararat | $1,363.0 | $484.2 | $16.2 |
| Berrybank | $2,427.7 | $751.8 | $8.6 |
| Crowlands | $2,180.9 | $1,225.9 | $38.7 |
| Darlington | $2,427.7 | $751.8 | $8.6 |
| Glenthompson | $871.9 | $517.3 | $15.1 |
| LaL LaL | $2,987.9 | $1,328.9 | $23.8 |
| Mortlake | $2,723.0 | $1,327.5 | $19.5 |
| Morton's Lane | $871.9 | $517.3 | $15.1 |
| Ryan Corner | $2,446.2 | $1,353.1 | $7.2 |
| Sidonia Hills | $3,492.8 | $5,029.9 | $86.4 |
| All wind farms lodged with minister | $1,965.2 | $879.3 | $15.2 |

Source: Access Economics calculations

FIGURE 7-7: RURAL LAND VALUE/NPP FOR WIND FARM AREAS OF VICTORIA




Source: Access Economics

To appreciate how the specific McHarg Ranges area is different to either the Macedon Ranges – Kyneton or the Mitchell North SLAs[18], examples of recent property sales in the area have been sourced. The average rural land sales (without buildings) within a 5 km area of a signed wind farm property was approximately $11,000 a hectare, similar to the equivalent figure in the Mitchell North SLA but only about half of that of the Macedon Ranges – Kyneton SLA.

However, analysis of the gridded GIS data on net primary productivity reveals that agricultural productivity within the McHarg Ranges itself is lower than that of both the Macedon Ranges – Kyneton and the Mitchell North SLAs. This means the ratio between property prices and agricultural productivity is therefore broadly similar to that calculated for the Macedon Ranges – Kyneton and the Mitchell North SLAs as a whole.

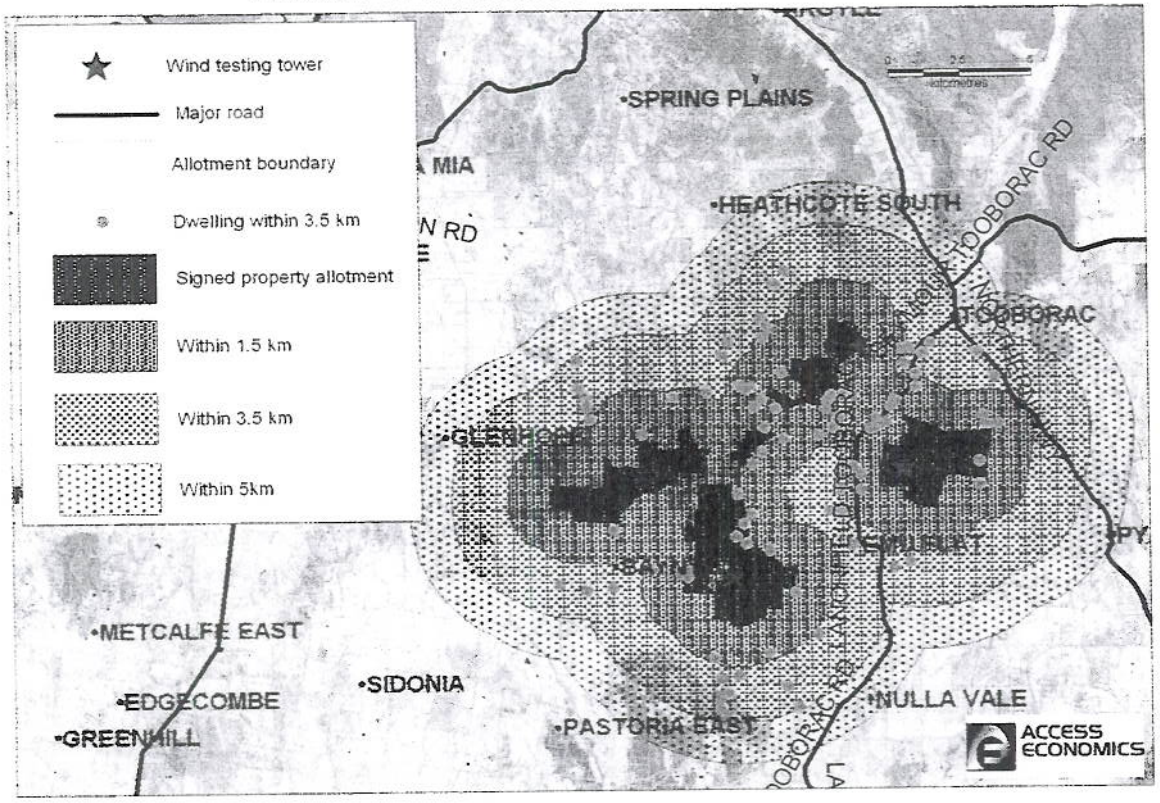
### 7.3.2 AREA AND PROPERTIES AFFECTED

As discussed, there is a lack of information available on the precise location and nature of the wind farm development and the turbines it will comprise. Nevertheless, some calculations on the areas and dwellings affected are possible based on the location of the properties who are understood to have signed to the wind farm agreements. As identified by Australian Wind Energy Association and Australian Council of National Trusts (2004), the scale of wind turbines and their contrasts to landscape character means that their impacts on scenic

[18] These figures are based on Statistical Local Area calculation. SLAs are not homogenous landscapes. One SLA may encompass a number of landscapes, but this will be hidden by aggregation of data whereby one average for each SLA is presented.

character extend well beyond the site of the turbines themselves. Figure 7-8 illustrates the area likely to be most affected within 1.5 kilometre, 3.5 kilometre and 5 kilometre buffers around the properties that have signed wind agreements.

**FIGURE 7-8: AREAS MOST LIKELY TO BE IMPACTED**




The collective area of the properties for which wind agreements have been signed comprises 79 individual allotments and a land area of 2,987.8 hectares.

Not including area within the signed properties, within a 1.5 km radius of a signed property, there are:

- 313 individual title allotments
- 46 occupied addresses, mostly dwellings
- 10,276 hectares of land

Within a 3.5 km radius of a signed property there are:

- 887 individual title allotments
- 81 occupied addresses, mostly dwellings
- 22,635 hectares of land

To illustrate how declining property values can undermine the economics of the project as a whole, particularly the cost-effectiveness of the wind farm as a greenhouse abatement option, the following indicative examples are provided. In all cases we assume that land values decline only on land surrounding the signed properties, not on the signed properties themselves. We also assume that the costs of the wind farm do not change with different capacity factor assumptions:

- If land values within 1.5 km of the signed areas (not including the signed areas themselves) were to drop by 10%, the total cost to affected properties is approximately $15.7 million, increasing the cost of abatement over the project lifetime by $1.17 per tCO2e assuming a 35%capacity factor for the wind farm, and $1.37 with a capacity factor of 30%.
- If the land values within 1.5 km were to drop by 10%, areas within 3.5 km by 5%, within 5 km by 3%, and within 10 km by 1.5%, the total cost to affected properties is approximately $40.5 million, increasing the cost of abatement for the project by $3.02 per tCO2e assuming a 35% capacity factor for the wind farm, and $3.52 with a capacity factor of 30%.
- If land values within 10 km, in general, were to drop by 10%, the total cost to affected properties is $121.2 million, increasing the cost of abatement by approximately $9.04 per tCO2e assuming a 35% capacity factor, and $10.53 assuming a capacity factor of 30%.
- If land values within 5 km were to drop by 25%, and areas within 10 km by 10%, the total cost to affected properties is $196.5 million, increasing the cost of abatement by approximately $14.65 per tCO2e assuming a 35% capacity factor, and $17.07 assuming a 30% capacity factor.

An equivalent study into the areas of land affected by nearby non-renewable power plants, such as coal plant, would be less, simply because many hundreds of wind turbines are required to replace the power output of just one fossil-fuel fired facility. In any case, the addition of a 200 MW wind power facility is unlikely to, alone, result in any less fossil fuel powered facility. Indeed, the ability of many wind farms in aggregate to allow for a substitution of a fossil fuel power facility is limited, unless the spread of those wind farms allows for access to broadly different weather systems at any one time.

A fall of 25% in property values is high, and indeed the perception of wind farms as highly destructive features to a landscape must be very widespread and strong for this to occur. However, our previous analysis of the ratio of land values to agricultural productivity, as a way of inferring the role of amenity value in driving land values, suggests that a premium of up to 200% is being paid in the McHarg Ranges region. Of course, this premium would also be a function of accessibility (especially to Melbourne) as well as amenity. In effect, the land value premium in the McHarg Ranges is likely due to *accessible* amenity, as distinct from attractive landscapes more distant from the capital cities.

As a guide to the potential role of amenity per se, rather than accessibility, we can look at land values at other inland SLAs an equivalent distance from Melbourne as the McHarg Ranges. Some of these areas, such as Murrundindi, Strathbogie, Golden Plains and Baw Baw have unimproved rural land values of less than half of those of the McHarg Ranges area despite comparable or higher agricultural productivity. If neither agricultural productivity nor accessibility to Melbourne (or a major provincial city) can explain the difference in land values between these areas and the McHarg Ranges, only amenity value is left of the key drivers of rural land values[19].

[19] Quality of local infrastructure and other local area variables can also, of course, influence local area property prices, but these would have to be vastly different in those areas compared to the McHarg Ranges to explain such a large difference in price.

A doubling of land value due to the premium paid for amenity value places an upper bound on the possible land value impacts due to a wind farm, to the extent that wind farms only undermine amenity value of land. This means, for example, a total loss of the amenity value would have the effect of lowering land values by 50%. A loss of half of the amenity value would lead to a 25% decline in land values. Of course, this is a simplistic approach to what are vastly more complex land valuation issues, but it is one way of conceptualising the range of possible land value impacts from a wind farm development.

Although the aggregate land value costs under these scenarios run into the tens of millions of dollars, and over a hundred million under the most severe land value impact scenarios, it is clear that unless some highly speculative assumptions are made regarding land value impacts (themselves an aggregate of many of the local area impacts of wind farm developments), in aggregate the cost of declining land values will be small relative to the generic marginal cost of wind power over non renewables. In other words, the majority of the additional cost of wind power comes through its direct costs of construction, operation and decommissioning (specifically how much more expensive on a per MWh basis than the equivalents costs of non renewable options), rather than externality impacts on neighbouring properties. Specifically, it is the marginal direct cost of wind power over non renewables, the same cost that is met by Victorian power users or taxpayers, that is the major component of the cost. However, distributional issues and the burden of who pays is relevant here; whereas the marginal direct cost of wind power is met through millions of power users, the cost of declining land values on properties surrounding wind farms is met by the relatively few surrounding property owners. From their perspective, the impacts on land values only have to be proportionally very small for the absolute impact on them to be very large. From a policy perceptive, it is debatable whether the burden of paying for what is a genuine public good – greenhouse gas abatement – should fall so disproportionately on so few.

There is no legal precedent for compensation for declining land values as a result of a wind farm development in Victoria. Indeed, private property rights in Victoria do not extend to a right to protection from declining land values because of the activities on adjoining properties. Rather, the reverse is true; private property rights *protect* the right of the landholder to use their land as they see fit, within the existing legal and planning framework.

The Victorian planning process itself does not consider land value impacts. A recent Victoria wind farm panel report (Oakland Hill Wind Farm, Panel Report, 2008) highlights this.

> *Mr Power argued that effects on land values were not something that could be taken into account and drew our attention to the approach taken in previous panel reports. Some of the panel reports which address this matter are the Bald Hills Wind Farm, Waubra Wind Farm, Mt Gellibrand Wind Farm and Mt Mercer Wind Farm Panel Reports. Those reports adopt the view urged by Mr Power that land valuations are not a relevant matter in planning decisions and the Bald Hills report lists a number of legal cases in support of the proposition.*

The legal and planning case for consideration of land value impacts is unambiguous. Certainly from a planning perspective, it is generally the primary *drivers* of any impact on land values that are the focus, such as noise and aesthetic impacts, rather than the land value impacts themselves. To count these other impacts and land value impacts simultaneously would risk double counting the same impact.

However, from an overall economic welfare and public policy perspective, impacts on land values certainly should be considered so long as the broader public interest remains the

standard of policy. There is no universally agreed measure of 'the public interest', indeed strict definition of the term has proven elusive for centuries. One widely held 'test' of whether a policy or project is in the public interest or not is found in the concept of the Pareto efficiency or the related Kaldor-Hicks efficiency. In summary, as a widely used criterion for evaluating whether a change is in the public interest, this states that some change is in the public interest if the winners from the change could fully compensate the losers, and still be better off. The question of whether the compensation actually has to take place or not is debatable; what matters most from the public interest is that the compensation is at least hypothetically possible. This underlying concept that the sum of the benefits must outweigh (or be more than) the sum of the costs is also central to cost benefit analysis.

A failure to accommodate declining land values from a wind farm development is excluding the losers from the equation. From that flawed base, and by failing to accommodate impacts on one section of the 'public', one is in no position to determine whether a wind farm is enhancing the overall public interest or not.