The Curtis Proprietary Method (CPM) of Environmental Valuation

Executive Summary

This prospectus is intended to give the reader a quick appreciation of the new method and includes the thesis abstract, the conceptual models, a valuation table for one tenure category in the Wet Tropics World Heritage Area, and 'frequently asked questions'.

A careful and thoughtful perusal of the material should satisfy the casual enquirer, however those interested in the background, supporting literature and discussion, could access the thesis through the Australian Digital Thesis network. Various papers and a book chapter have also been published. The references appear below.

Curtis, I. A. 2003. *Valuing Ecosystem Services in a Green Economy*. PhD Thesis. James Cook University, Cairns Campus, Australia.

Curtis, I. A. 2004. Valuing Ecosystem Services: A New Approach using a surrogate market and the combination of a multiple criteria analysis and a Delphi panel to assign weights to the attributes. *Ecological Economics.* 50:163-194

Curtis, I. A. 2006. Valuing the environmental impact of a transmission line corridor: A heuristic exercise in environmental valuation for the property profession*. Australian Property Journal*: June 2006 Vol 39 No.2, pp 87-96.

Thesis Abstract

Scope

Ecosystems are being degraded and destroyed worldwide at a rate unprecedented in human history. Accordingly a great deal of interest is currently being focussed on ecosystems, the role they play in planetary life support, and the need for a market mechanism to conserve these formerly regarded 'free' goods and services. This research project is concerned with the various divisions or branches within economics dealing with environmental valuation, including applied economics in the form of valuation practice, environmental science, and ecology. It is thus both multi-disciplinary and interdisciplinary and has as its central theme the use of a surrogate market to establish shadow prices for ecosystem services.

Methodology

Twenty ecosystem attributes were identified as being common to all ecosystems depending on the level of integrity, and ranked in order of importance on the basis of a range of criteria. This was achieved by a systematic analysis, namely a multiple criteria analysis, and a social study, in the form of a Delphi philosophical inquiry. These two methods incorporated many different perspectives: namely anthropocentric, utilitarian (economic), ecological, aesthetics, equity, risk and uncertainty. The weightings provided by the panellists were non-pecuniary, and as such were not subject to any bias or odium that may have been associated with putting monetary values on nature's gifts. The non-pecuniary weightings assigned by the panellists were converted to dollar values by empirically linking them to the surrogate market, namely the property market in the region, and calculating the value of a flow of benefits emanating from them (the economic rent). A valuation table was devised to assess the ecosystem integrity of individual ecosystems on private or public land and a conceptual model devised for landscapes. The case study area was the Wet Tropics World Heritage Area of northeast Queensland.

Results

The Delphi panel reached consensus in all three rounds of questionnaires, and the weights provided for the twenty attributes for all three models in the multiple criteria analysis showed a significant level of agreement between the disciplines represented on the panel. The ten ecosystem services ranked most important were: biodiversity; refugia; erosion control/soil and sediment retention; genetic resources; gas regulation; climate regulation; biological control; purification (clean air, water); disturbance regulation; and aesthetics, in that order. The total value of ecosystem goods and services in all the tenure categories in the Wet Tropics World Heritage Area (8,944 km^2) was determined to be in the range AUD$188 to $211 million $year^{-1}$, or AUD$210 to $236 $ha^{-1}yr^{-1}$ across tenure categories. The individual ecosystem services mentioned above ranged from AUD$18.6 to $20.9 million $year^{-1}$ for biodiversity down to AUD$10.2 to $11.4 million $year^{-1}$ for aesthetics. The value of individual ecosystem services constrained within a fully intact suite of ecosystem goods and services was found to be consistent with the value of all other uses to which land is put in a bioregion and with other avenues of investment in the economic system, and will increase proportionate to the human population density, and hence scarcity of ecosystem services.

Conclusion

The combination of revealed preferences in a surrogate market as the empirical baseline for the whole suite of ecosystem services in a bioregion or Local Government Area, along with the expressed preferences of a group of experts as to the importance of each individual good or service, provides the theoretical and practical justification for the acceptance of the technique as a means of establishing opening prices in a future trading market. Being linked to the value of real property and hence population density in a region, it provides a key insight into the status and thus value of ecosystems services provided by public and private land, including scarcity. The most critical recommendation to policy and decision-makers emanating from this research is the requirement that environmental impacts arising from development projects, policies or proposals be properly identified, the magnitude of the impact properly assessed, and mitigation of the impacts strictly enforced. The same applies for environmental pollution, damage and degradation with legal liability apparent. Legislation is required to be enacted which will lead to the need for rigorous environmental valuation procedures that have empirical verification and will stand scrutiny in a court of law. The technique expounded in this thesis is such a procedure.

Frequently Asked Questions

Q: What is the central assumption of the Curtis Proprietary Method (CPM) of environmental valuation?

A: That land managed for conservation (ie. the maintenance of natural capital) is worth as least as much as the median value of all other land in a bioregion or catchment for the ecosystem goods and services it provides, which are essential for planetary life support.

Q: How is this justified?

A: Every use of land has an opportunity cost, that being the use foregone. In the case of conversion of naturally occurring ecosystems to human habitation or occupations, the provision of ecosystem goods and services can be considerably diminished. Australian valuation practice and accounting standards requires that virgin land be valued on the basis of comparable sales of adjoining land as if the improvements on the adjoining land did not and had never existed.

Q: Can the provision of ecosystem goods and services coexist with other uses?

A: Yes, depending on the level of development and the use to which the land is put. Indicators for ecosystem health, or the level of integrity of a full suite of ecosystem goods and services would include vegetation cover, species richness, tenure category, level of protection and land use characteristics.

Q: What is the '*Usus Fructus per annum (UFpa)*'?

A: The value of land at any point in time is dependent on the benefits or benefits stream that it is estimated can be derived from it in the future. The Oxford Dictionary defines *Usufruct* as: *Usus*~use, *fructus*~fruit. 1.Law. "The right of temporary possession, use, or enjoyment of the advantages of property belonging to another, so far as may be had without causing damage or prejudice to this. *Usufruct* is the power of disposal of the use and fruits, saving the substance of the thing". The *Usus Fructus* is thus the natural production function of land and can be conceptually extended to include all of the goods and services provided by land for planetary life support as well as for benefit of humans. The *UFpa* is the capitalised annual value of these services.

Q: So how are the value of a full suite of ecosystem goods and services in a given landscape derived?

A: The median unimproved land value (*MUV*) of rateable land in the region (obtained from local council records) is multiplied by an appropriate capitalisation rate, which is determined by a study of the market and the subject land relative to risk. For example, a National Park under strict protection would qualify for a capitalisation rate of say, 6.5%, while freehold land without restriction on clearing would warrant a much higher rate.

Q: That would mean that land with less ecosystem integrity and more risk would have a higher *UFpa*, ie. a higher value. Is this so and why?

A: Certainly, this reflects the economic concept of scarcity. For example, consider remnant vegetation, the *UFpa* is higher per hectare to reflect risk status, yet by definition there is less of it, so on a landscape scale where protected vegetation is included, they contribute in an equitable way to the overall provision of ecosystem goods and services in that landscape.

Q: How is the level of provision of ecosystem goods and services determined?

A: Ecosystem models are used based upon vegetation cover, species richness, the level of protection of the tenure categories in a landscape (national park, timber reserve etc.), and land use characteristics (tropical rainforest, dry sclerophyll forest, savannah, etc.), with capitalisation rates to determine *UFpa* increasing as the level of protection diminishes, and human and climate induced modifications increase. As there is a considerable degree of uncertainty to do with the level of provision of ecosystem goods and services, they are expressed as a range.

Q: Is it possible to determine the value of an individual ecosystem good or service?

A: Yes, by the application of a weight determined by a panel of experts as to which ecosystem goods or services are most valuable to humans, to the maintenance of natural capital, and as having use or non use values including option, bequest and existence value. The weights can be sensitised to threats, risk, uncertainty, precaution and to the resistance and resilience of ecosystems.

Q: So there are a number of areas in the technique that express sensitivity to the results, namely the capitalisation rate varying with the level of protection and land use characteristics, the range of provision of ecosystem services based on the models, and the weights. Why then, is the median land value in the bioregion or catchment the appropriate measure of central tendency?

A: The median is the appropriate measure for highly skewed data, which is the case generally when a landscape includes more and less developed land, namely cities, suburban areas, rural communities, rangelands, and wilderness. There is a highly significant relationship between human population density and land values, which reflects the level of, or potential for, development. This relationship also reflects the scarcity of provision of ecosystem goods and services as a gradation from more to less developed land.

Q: Why is this technique better than other environmental economic approaches?

A: It is not necessarily better, as it also relies on human preferences. However the use of an available database of revealed preferences (what people pay for land), which is linked to human population density, level of development and thus scarcity of ecosystem services, removes a lot of the problems of bias inherent in expressed preference surveys. Moreover traditional environmental economics makes no attempt to assess the ecological integrity of the landscape being valued, nor does it attempt to weight or rank individual ecosystem goods and services.

Q: How are the final values determined?

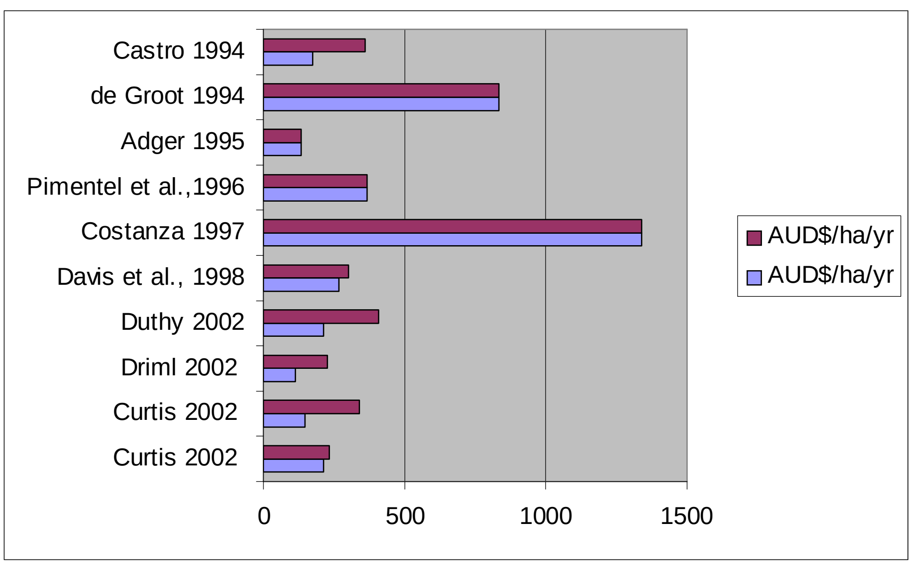
A: The results are calculated in a valuation table for each individual ecosystem good and service in each tenure category in a region and summed. Each tenure category has a different *UFpa* due to capitalisation rates varying with risk, and each tenure category has a different range of provision of ecosystem goods and services. However they can be expressed by a simple algorithm, where ***UFpa*** is the capitalised annual value of ***MUV***, ***esi*** is the extent to which ecosystem goods and services are intact (derived from the models), and ***wt*** is the weight assigned to the individual ecosystem good or service by the expert panel. It follows that:

Ufpa ($/ha) x area (ha) x esi** (%) **= TVw (the total annual value of a whole ecosystem on a landscape scale), and

Ufpa ($/ha) x area (ha) x esi (%) x wt (a decimal) = TVi (the total annual value of an individual ecosystem good or service).

Q: How do the values compare with other studies that have used a variety of approaches?

A: Quite well. Although weak commensurability of values is regarded as a foundation stone of ecological economics, most studies using a variety of methods fall within one order of magnitude. See Figure 13.1.



Note: The two ranges of values ascribed to Curtis are for 'within tenures' and 'across tenures'.

Figure 13.1 Comparison of the values derived for various suites of ecosystem services by various researchers (Source: Castro 1994; de Groot 1994; Adgers *et al.,* 1995; Costanza 1997a; Myers 1997; Curtis 2002; Driml 2002; Duthy 2002).

NB. The payment of US$100 $acre^{-1}$ yr^{-1} (AUD$350 ha^{-1} yr^{-1} as at June 2004) was actually negotiated for a period of 15 years by the City of New York in about 1997 with farmers in the Catskills/Delaware watershed in the State of New York, for maintenance or revegetation of riparian zones (in the interest of protecting NY City's water supply). This figure is again equivalent to many of the higher range figures of the above researchers.

About the author

Ian Curtis has been a practising land economist for the past thirty years, having been a principal, and a director or partner in a number of leading property consultancies in the City of Sydney. In the early to mid 1990s, he was becoming increasingly concerned about the impact of development on the coastal fringe in Australia, and subsequently in the process of project managing and co-authoring an environmental impact study for an island resort off the east coast of Cape York Peninsula, enrolled in a science degree at James Cook University in Cairns.

Completing his undergraduate degree in 1998, Ian went on to do an Honour's year, focusing on the environmental performance of hotels and resorts in North Queensland, including island resorts. Special emphasis was placed on greenhouse gas emissions due to electricity consumption, and recommendations made for renewable energy initiatives and carbon sequestration to offset the deleterious impact.

Not content with how the synergy between land economics and environmental science or ecology could be explained or rationalised, Ian then proceeded to undertake a 'research higher degree' that attempted to integrate economics and ecology by way of a completely original and pragmatic approach to valuing ecosystem goods and services. Completing his Doctor of Philosophy degree in 2003, Ian's work received highly complimentary comments from his examiners.

Ian Curtis is available for private consultancy to assist conservationists, environmental practitioners, catchment managers, natural resource managers, NGOs and Government, to **actually translate** the value and importance of ecosystem goods and services into the public domain.

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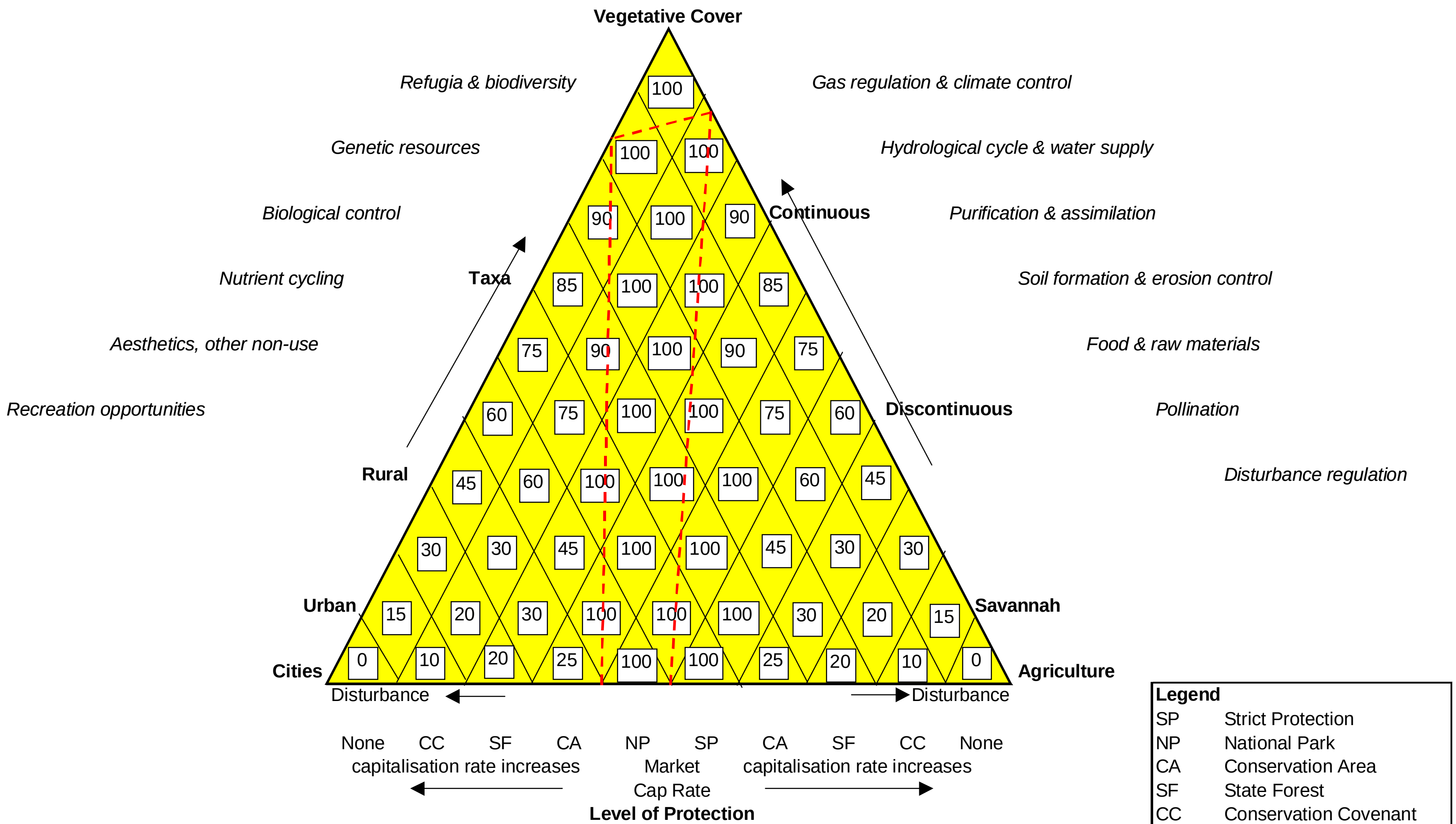

Figure 7.1. Triangulation model to assess extent of ecosystem services intact under a given level of protection or no protection

Scoring: Calculate the mean of the values within the diamonds included in the selection as well as those the dotted line passes through.

This example, National Park: 99%

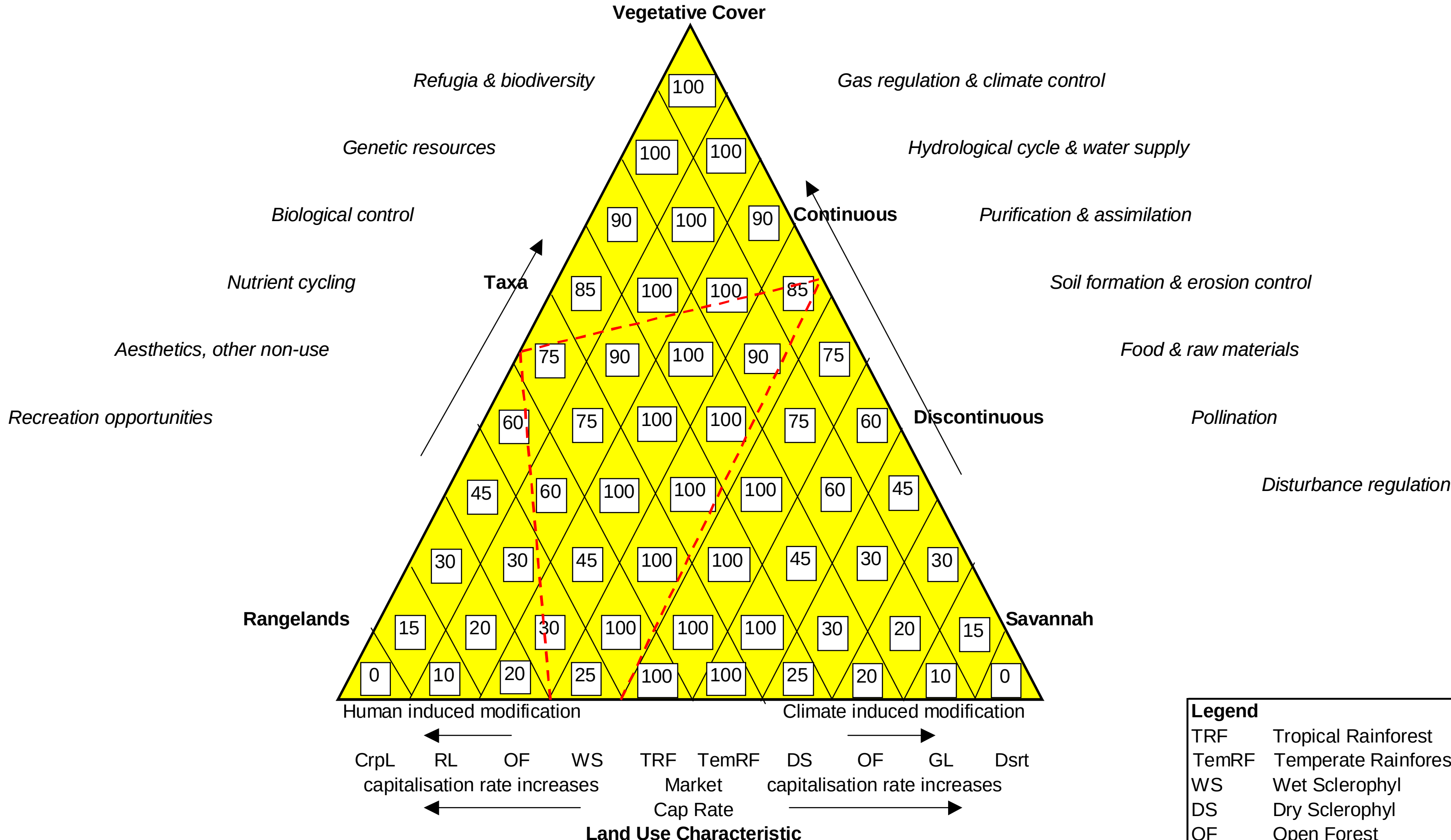

Figure 7.2. Triangulation model to assess extent of ecosystem services intact under a given land use characteristic

Scoring: Calculate the mean of the values within the diamonds included in the selection as well as those the dotted line passes through.

This example, Wet Sclerophyll Forest: 79%

Legend	
TRF	Tropical Rainforest
TemRF	Temperate Rainforest
WS	Wet Sclerophyl
DS	Dry Sclerophyl
OF	Open Forest
RL	Rangelands
GL	Grasslands
CL	Croplands
Dsrt	Desert

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TENURE CATEGORY: ~ TIMBER RESERVES CONSERVATION AREA WITHIN THE WET TROPICS OF QUEENSLAND WORLD HERITAGE AREA

The median unimproved value of all rateable land in the eleven Local Govt areas represented in the $3,810.02 per hectare

Group and Type of Ecosystem Service (Attribute)	Present	*UFpa*	% Intact	% Intact	Weighting	Value per ha	Value per ha	TOTAL VALUE	TOTAL VALUE
		7.5%				66% intact	84% intact	Lower Range	Upper Range
Stabilisation Services									
Gas regulation (atmospheric composition)	Yes	$ 285.75	66	84	0.069	$ 13.01	$ 16.56	$ 965,092.26	$ 1,228,299.25
Climate regulation (temperature, rainfall)	Yes	$ 285.75	66	84	0.068	$ 12.82	$ 16.32	$ 951,105.42	$ 1,210,497.81
Disturbance regulation (ecosystem resilience)	Yes	$ 285.75	66	84	0.055	$ 10.37	$ 13.20	$ 769,276.44	$ 979,079.11
Water regulation (hydrological cycle)	Yes	$ 285.75	66	84	0.011	$ 2.07	$ 2.64	$ 153,855.29	$ 195,815.82
Erosion control and soil/sediment retention	Yes	$ 285.75	66	84	0.073	$ 13.77	$ 17.52	$ 1,021,039.64	$ 1,299,505.00
Biological control (populations, pest/disease control)	Yes	$ 285.75	66	84	0.063	$ 11.88	$ 15.12	$ 881,171.20	$ 1,121,490.62
Refugia (habitats for resident and transient populations)	Yes	$ 285.75	66	84	0.086	$ 16.22	$ 20.64	$ 1,202,868.62	$ 1,530,923.70
Regeneration Services									
Soil formation	Yes	$ 285.75	66	84	0.010	$ 1.89	$ 2.40	$ 139,868.44	$ 178,014.38
Nutrient cycling and storage	Yes	$ 285.75	66	84	0.039	$ 7.36	$ 9.36	$ 545,486.93	$ 694,256.10
Assimilation of waste and attenuation, detoxification	Yes	$ 285.75	66	84	0.051	$ 9.62	$ 12.24	$ 713,329.06	$ 907,873.36
Purification (clean water, air)	Yes	$ 285.75	66	84	0.058	$ 10.94	$ 13.92	$ 811,236.98	$ 1,032,483.42
Pollination (movement of floral gametes)	Yes	$ 285.75	66	84	0.036	$ 6.79	$ 8.64	$ 503,526.40	$ 640,851.78
Biodiversity	Yes	$ 285.75	66	84	0.099	$ 18.67	$ 23.76	$ 1,384,697.60	$ 1,762,342.40
Production of Goods									
Water supply (catchment)	Yes	$ 285.75	66	84	0.043	$ 8.11	$ 10.32	$ 601,434.31	$ 765,461.85
Food production (that sustainable portion of GPP)	Yes	$ 285.75	66	84	0.024	$ 4.53	$ 5.76	$ 335,684.27	$ 427,234.52
Raw materials (that sustainable portion of GPP, timber, fibre etc.)	Yes	$ 285.75	66	84	0.029	$ 5.47	$ 6.96	$ 405,618.49	$ 516,241.71
Genetic resources (medicines, scientific and technological resources	Yes	$ 285.75	66	84	0.073	$ 13.77	$ 17.52	$ 1,021,039.64	$ 1,299,505.00
Life Fulfilling Services									
Recreation opportunities (nature-based tourism)	Yes	$ 285.75	66	84	0.025	$ 4.71	$ 6.00	$ 349,671.11	$ 445,035.96
Aesthetic, cultural and spiritual, (existence values)	Yes	$ 285.75	66	84	0.054	$ 10.18	$ 12.96	$ 755,289.60	$ 961,277.67
Other non-use values (bequest, option and quasi option values)	Yes	$ 285.75	66	84	0.033	$ 6.22	$ 7.92	$ 461,565.87	$ 587,447.47
					0.999	$ 188.41	$ 239.79	$ 13,972,857.56	$ 17,783,636.90
						66% intact	84% intact		
	TEV ($AUDpa)			**Hectares**	**74,163**	**$ 13,972,857.56**	**$ 17,783,636.90**		
				(Ref WTMA GIS)					