Report to the Productivity Commission

Cost and stocking rate data for the Murweh Shire

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This report forms part of the consulting service provided to the Productivity Commission for its inquiry into the impacts of Native Vegetation and Biodiversity Regulation. The purpose of this report is to present stocking rate and cost data provided to the Commission and to explain the underlying assumptions and limitations of the data. The data in this report were used to generate returns estimates on cleared and uncleared land for Murweh (refer to 'Returns data' on the PC website (under 'Completed Projects') for the estimated returns data used in appendix K).

Stocking Rates

To remove the potential for confusion, it is necessary here to clarify the difference between 'stocking rate' and 'carrying capacity'. Our usage of these terms in the south west Queensland context is based on the following broad definitions:

Stocking Rate:
The number of stock on a given area of land at a particular point in time. Thus, the Stocking Rate of a given area can vary in accordance with management decisions (ie in response to varying availability of pasture with seasonal conditions).

Carrying Capacity:
Rather than a measure of livestock numbers at any given point in time, Carrying Capacity is used to describe the stock carrying capability of land over the longer term. One method of defining Carrying Capacity is as the average Stocking Rate which could be sustainably applied over a period of several years.

We *have* assumed that, despite the interchange of these terms, it is Carrying Capacities (ie the long term average sustainable stocking rates) which the commission is attempting to identify for the purposes of the case study, and the information provided here should be viewed as such.

What is a 'typical' farm:
In order to provide data for a typical farm it is necessary to first hypothesize what exactly a 'typical' farm consists of. In our initial modeling an assumption was made based on the distribution of isohyets within the shire, to adopt 500mm as the average annual rainfall across the shire (Kenny & Beale, 2003). Since rainfall (and solar radiation) is therefore assumed by our modeling as constant across the Murweh shire, the next largest contributor

to the variability of Carrying Capacity is land type. Differing land types are commonly described as Land Zones.

A Land Zone is a unit used to reduce the complexity of the landscape to more easily handled units of similar geology, soils, (native) vegetation, and ultimately, productive capacity. (ie with rainfall and radiation assumed constant, it is the *type* of land which is the major determinant of forage growth potential). For the purposes of this study we have hypothesized that a 'typical' farm in the Murweh shire is one which contains a mix of land zones representative of the type and relative abundance of the land zones found in the shire. This approach is reflected in the methodology used (Kenny & Beale 2003) to derive the average RUE (Rainfall Use Efficiency) applicable to the shire's woodlands, one of the co-efficients used by the Carrying Capacity model outlined in that report.

Estimating the Carrying Capacity for Uncleared Land.

Methodology:

- Safe carrying capacity for uncleared woodlands in Murweh was estimated using the Safe Carrying Capacity model (Johnston et. al. 1996) for an average farm. See Beale and Kenny (2003) for more information. Estimates from this model are lower than observed stocking rates in the shire.
- Our extensive knowledge of the shire gained through from our experience as scientist, consultant and grazier enable us to verify that the commonly accepted 'rule of thumb' for a typical, non-alluvial woodland of approximately 10 acres per DSE (0.247 DSE/Ha) is feasible.
- A common assessment of the alluvial woodlands which are more productive in their natural state is that they are up to twice as productive as the non-alluvial woodlands (Approx 0.5 DSE/Ha). Once again through our experience we are able to verify that this is a feasible assessment.
- These assessments were then reconciled to published information provided by Partridge, I. (1996) Managing Mulga Grasslands – a Grazier's Guide, which provides 'recommended broad stocking rates' by land zone (see page 12).
- Finally, this information was compared to the shire's 2003 woodland Carrying Capacity which we modeled using the widely accepted Safe Carrying Capacity model (Johnston et. al. 1996). This was undertaken for the purposes of projecting the effects of thickening, the second component of our original consultancy, with the methodology

described in the corresponding report (Kenny & Beale 2003). This assessment modeled the average Carrying Capacity for the shire's woodlands at 0.33 DSE/Ha. That the modeled Carrying Capacity is slightly lower than our subjective assessment is not surprising to us as the Safe Carrying Capacity model is known to tend toward more conservative (safer) assessments than those commonly adopted by graziers.

Estimating the Carrying Capacity for Cleared Land.

Treating vegetation by broadscale clearing reduces competition to grasses from woody species and enables the introduction of improved perennial grass species capable of producing higher yields of forage from a given quantity of rainfall (that is, a higher Rainfall Use Efficiency – RUE). Our assessment of 0.85 DSE / Ha for treated areas was determined via the following methodology:

- Adopted 'rules of thumb' for Carrying Capacities on improved buffel pastures include 2.5 DSE/Ha (7.5 acres / AE) in improved Aristida-Bothriochloa woodlands further east in slightly higher (though still semi-arid) rainfall zones, and 1.67 DSE/Ha (12 acres / AE) in the better quality brigalow and gidgee soil types extensively improved in the north west of the Murweh shire.
- In the more common 'red' country, or mulga based land systems which are now the focus of development efforts in the shire, Carrying Capacities comparable to those of the naturally open areas (Mitchell grass downs) are achievable with the introduction of a productive, perennial species (buffel) with similar characteristics, from a grazing perspective, to Mitchell grass. Carrying Capacities of approximately 1 DSE/Ha (20 acres / AE) are achievable in these areas under optimum development.
- The Safe Carrying Capacity model (Johnston et. al. 1996 a&b, as applied by Kenny & Beale 2003) predicts that the average carrying capacity of all of the shire's woodlands, in the absence of competition from woody species (ie when the woody index co-efficient WI = 1) equates to approximately 0.7 DSE/Ha.
- However the Safe Carrying Capacity Model does not allow for the improved Rainfall Use Efficiency (and subsequent pasture yields) achievable through the introduction of improved pasture species, and consequently tends to underestimate actual Carrying Capacities attainable with land development and improved pastures (Beale, 2004, pers. comm.).
- Additionally it is assumed that on any give 'typical' property under the 'business as usual' policy scenario there will be a portion of remnant timber retained, which will naturally

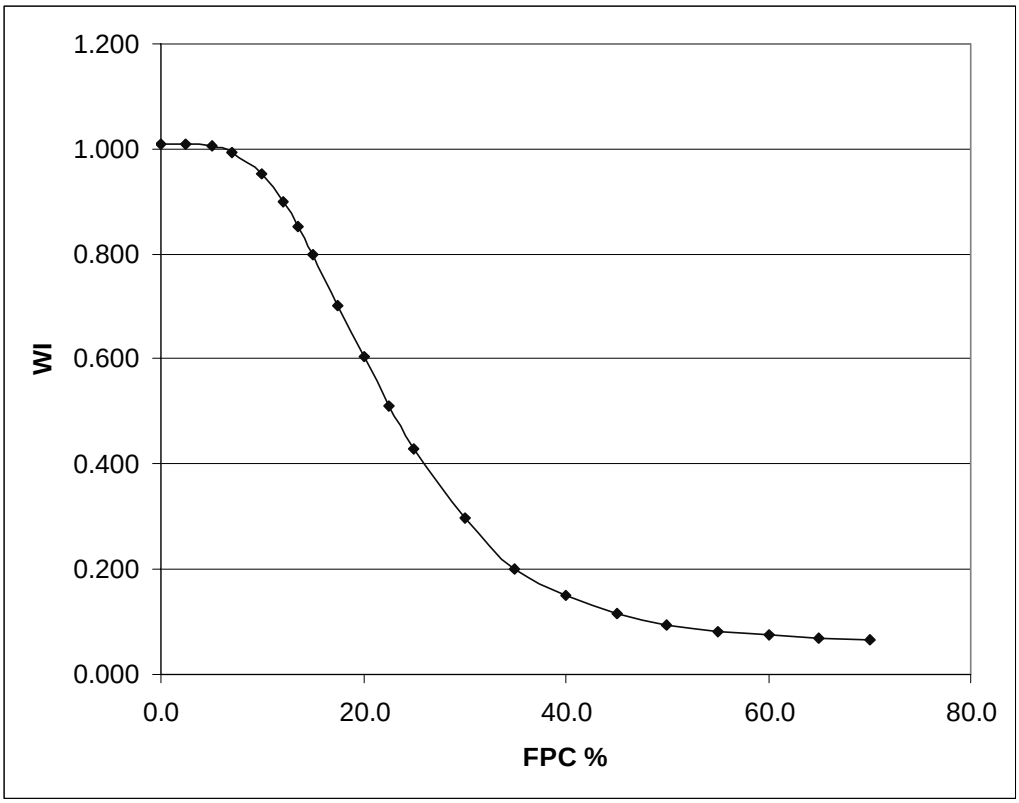
tend to be retained in those areas of lower Rainfall Use Efficiency, which would have the effect of increasing the average RUE for *cleared* lands above the average applicable for *all* lands.

- Having consideration to the potential for improved pasture species to increase the average RUE of the shire's lands, having regard to the benchmarks outlined above and personal observations of the results of numerous development programs, our estimate of the average Carrying Capacity of the cleared component of a typical property under full development is 0.85 DSE/Ha.

Changes in carrying capacity due to regrowth on cleared land

The optimum timing of the treatment of regrowth is determined by extent of the deleterious effect on pasture growth being caused by (or about to be caused by) the increasing Foliage Projective Cover of regrowth. The safe carrying capacity model accounts for this relationship by calculating WI (Woody Index, or discount factor applicable to the total potential forage growth) as a function of FPC. Since Carrying Capacity is a major determinant of on farm cash operating surplus (Slaughter 2003), then a consideration of the relationship between WI and FPC (see figure 1) would suggest that regrowth control would normally be undertaken at or around the point of inflection in the graph, as Carrying Capacity is rapidly eroded by increasing FPC after this point.

Figure 1: Relationship of WI to FPC (source: Safe Carrying Capacity Model, Johnston et. al. 1996a&b)



Consideration of these factors leads to the estimate that on average Carrying Capacity at the time of treatment of regrowth would be reduced to *no less than* 80% of the original Carrying Capacity achieved following initial treatment. This estimate is consistent with our field observations which indicate that when treatment normally occurs, forage production levels are not overly diminished. This is also consistent with the observation that regrowth treatment typically occurs on an average cycle in the vicinity of ten years.

Importantly, a consideration of the overall effects over time of regrowth on Carrying Capacity should have regard to the shape of the WI / FPC curve, as this demonstrates that the loss of CC due to increasing FPC (regrowth), in the range from FPC=0 to when regrowth control typically occurs (FPC = 10%-15%) is not a 'straight line' relationship, but that such losses are incurred principally in the final years prior to treatment.

Ten years has been provided as an estimate of the required frequency of regrowth treatment. In our opinion this is feasible for the initial and perhaps second treatment of regrowth, however, in many land types the extent of regrowth will begin to reduce once

treatment has occurred two or three times, therefore the frequency with which it will require treatment will increase beyond ten years.

Variable Costs

Sheep - Uncleared

Our approach to recording cost data has tended to focus on recording costs on a per head basis rather than per hectare, as the variation in Carrying Capacity between individual properties (because of land type and proportion of development) makes cost comparisons (ie benchmarking exercises) on a per hectare basis of limited relevance. However per DSE data, which is more commonly recorded, can be readily translated to per Ha data by using the assumed average stocking rate. The data we have based our estimates for uncleared land on originated from a set of five broadly similar properties situated west of Charleville in the Murweh and Quilpie shires. Each of these properties contains only relatively small areas of limited development with little or no improved pastures and could reasonably be considered as 'undeveloped' with a production system based on grazing native pastures in woodlands.

Production data was benchmarked for 97-98 and 98-99, with the group's average direct costs / DSE for each year being $6.90 and $7.02 respectively. The 98-99 data are provided in the table below to assist in demonstrating the typical decomposition by type:

Table 1. Benchmarking Group Sheep Enterprise Direct Costs / DSE data for 98-99.

Property Number	**1**	**2**	**3**	**4**	**5**	**Avg**
Freight & Selling	4.62	2.53	2.61	1.51	1.25	**2.50**
Supplements & Fodder	0.00	0.00	0.00	0.20	0.05	**0.05**
Animal Health	0.61	0.64	0.38	0.37	0.44	**0.49**
Contract Labour	3.68	3.33	3.95	4.20	4.75	**3.98**
Sundry Direct Costs	0.00	0.00	0.00	0.00	0.00	**0.00**
Total Direct Costs	**8.91**	**6.5**	**6.94**	**6.28**	**6.49**	**7.02**

Applying our estimated average stocking rate of 0.35 DSE / Ha the average 98-99 figure in the table above translates to **$2.45 / Ha**.

In addition, two of these properties have been the subject of further analyses in later years by our firm and their sheep enterprise direct cost decomposition is provided in table 2. Costs per Hectare have been calculated in these examples, it should be noted however that as both of these properties are mixed sheep and cattle, that hectares have been allocated to the sheep enterprise based on the relative weighting (in DSE terms) of the sheep and cattle enterprises.

Table 2. Sheep Enterprise Direct Cost Decomposition of two Murweh Shire Undeveloped Grazing Properties

Property	**Property A**				**Property B**	
Year	99-00		00-01		02-03*	
Direct Costs	$/Ha	$/DSE	$/Ha	$/DSE	$/Ha	$/DSE
Selling Costs & Levies – Sheep	0.11	0.29	0.04	0.14	0.12	0.43
Selling Costs & Levies – Wool	0.58	1.58	0.46	1.46	0.27	0.98
Freight –Sheep	0.23	0.63	0.20	0.62	0.00	0.00
Freight –Wool	0.17	0.48	0.11	0.35	0.10	0.38
Mustering	0.10	0.27	0.00	0.00	0.00	0.00
Wool Testing side sample	0.21	0.58	0.14	0.44	0.00	0.00
Shearing & crutching	1.01	2.75	0.75	2.36	1.01	3.66
Dips & Drenches	0.05	0.15	0.07	0.23	0.09	0.31
Shearing Requisites	0.18	0.50	0.33	1.05	0.05	0.20
Fodder & Supplements	0.00	0.00	0.00	0.00	0.88	3.20
Other	0.00	0.00	0.00	0.00	0.19	0.68
TOTAL	2.64	7.23	2.10	6.65	2.71	9.84

* Substantial drought feeding costs were incurred in 02-03

Cattle – Uncleared

Cost data for cattle on uncleared land (or at least, on substantially undeveloped properties) is available for four out of the five properties and for the same years as the data presented above for sheep direct costs (see Table 3):

Table 3. Benchmarking Group Cattle Enterprise Direct Costs / AE* data for 98-99.

Property Number	**1**	**2**	**3**	**4**	**Avg**
Freight & Selling	10.87	13.90	9.75	12.28	11.70
Supplements	3.97	2.20	6.44	4.45	4.27
Animal Health	0.34	3.76	2.09	0.69	1.72
Contract Labour	0.99	0.00	0.00	4.39	1.35
Sundry Direct Costs	0.19	0.00	0.00	0.00	0.05
Total Direct Costs	**16.36**	**19.86**	**18.28**	**21.81**	**19.08**

* DSE:AE ratio = 7

In the collation of this data a DSE : AE ratio of 7 was commonly used, which translates the average figure demonstrated by Table 3 to $2.73/DSE. By applying our estimated average stocking rate for woodlands of 0.35 DSE/Ha, this figure subsequently translates to **$0.95 / Ha**.

In addition, two of these properties, have been the subject of further analyses in later years by our firm and their cattle enterprise direct cost decomposition is provided in Table 4. Costs per Hectare have been calculated in these examples, it should be noted however that as both of these properties are mixed sheep and cattle, that hectares have been allocated to the cattle enterprise based on the relative weighting (in DSE terms) of the sheep and cattle enterprises.

Table 4. Cattle Enterprise Direct Cost Decomposition of two Murweh Shire Undeveloped Grazing Properties.

Property	Property A				Property B	
Year	99-00		00-01		02-03*	
Direct Costs	$/Ha	$/DSE	$/Ha	$/DSE	$/Ha	$/DSE
Selling Costs & Levies	0.44	1.19	0.41	1.30	0.18	0.66
Fodder & Supplements	0.13	0.36	0.11	0.36	1.44	5.24
Tags and EID	0.03	0.09	0.34	1.08	0.00	0.00
Veterinary Expenses	0.03	0.09	0.02	0.08	0.00	0.00
Dips & Drench	0.00	0.00	0.00	0.00	0.07	0.27
HGP's	0.00	0.00	0.00	0.00	0.01	0.05
Freight –Cattle	0.23	0.64	0.31	0.99	0.36	1.31
Other	0.00	0.00	0.00	0.00	0.01	0.05
TOTAL	0.86	2.37	1.19	3.81	2.07	7.53

* Substantial drought feeding costs incurred in 02-03

Sheep – Cleared

Clearing affects variable costs per hectare principally through the increase in carrying capacity. In addition, variable costs may be affected by clearing through; a) a change in the production system (ie sheep enterprises may tend toward breeding, cattle enterprises may tend away from breeding and toward finishing) and, b) adopting more intensive management practices that become available following land development and pasture improvement.

Data for sheep on cleared land is not readily available as developed properties in the shire are almost exclusively used for cattle production. As a surrogate measure some cost data is available to us for sheep properties on the Mitchell grass downs land systems in the north of the shire. Whilst the total costs structures for these properties would be significantly different to a developed property (ie no need for regrowth control) it is feasible to assume that direct costs per hectare on the naturally open downs would be comparable to those for 'unnaturally' open improved pastures of similar carrying capacity and nutritional value. In 1999-2000 direct costs for three of these properties averaged $10.70/Ha, which decomposed to; Freight & Selling Costs – $3.75/Ha, Animal Health – $0.72/Ha, Contract Labour (incl. shearing & crutching)- $6.23/Ha. Total direct costs per DSE for these three enterprises averaged approximately $9, as opposed to $6-7/DSE for the uncleared enterprises, which is probably a fair reflection of the more intensive management practices of the breeding flocks present on the downs.

Cattle – Cleared

Providing cost/Ha figures for cleared land requires some estimation, as actual data on hand has been measured on a property basis, and even well developed properties in the shire typically comprise a significant portion of uncleared, lightly stocked (or even unused) areas which have the effect of 'diluting' costs when expressed on a per hectare basis. Direct costs measured on a per head (AE) basis are generally more consistent, and appear to be reasonably independent of land type and level of development (ie. stocking rate). Our preferred methodology has therefore been to assess typical direct costs on a per AE basis, and then adjust this for the assumed average stocking rate under development.

Five reasonably well developed, average size properties measured in the late 90's revealed an average direct cost / AE value of $13.22, however this period coincided with one of poor cattle prices which may have had the effect of reducing expenditures. More recently, in 2000-2002 three studies revealed direct costs per AE values of $19.83, $24.22, and $20.77 which probably reflects the more buoyant position of the industry as compared to the late 1990's. In 2002-2003 anecdotal evidence suggests that direct costs will analyse significantly higher (perhaps up to $30 / AE) due to substantial investment in drought feeding during this period.

This data reconciles to the average direct costs per AE figure routinely adopted by our firm of $20. Applying our estimated carrying capacity of 0.85 DSE / Ha (0.106 AE / Ha) for the remaining woodlands under development, a figure of **$2.12/Ha** is returned.

If a direct cost average of $30 / AE is adopted the $/Ha figure is increased to $3.18. On reflection it may be prudent to allow for higher direct costs than our original estimate of $2.00 / Ha (suggest **$2.50/Ha**) as the more recent data suggests there has been an upward trend in recent years, possibly due to the continued uptake of new technology, such as Hormonal Growth Promotants, Livestock Identification Systems, more intensive handling and management, and reasonably good cash returns in the industry.

We are unable to collate the data necessary to provide an accurate picture of typical decomposition of these costs, however from memory freight costs often account for approximately 40% of the total direct costs, while selling costs account for approximately 15%, with the remainder being split between Fodder (particularly sensitive to drought years), Mustering, Animal Health Products, Veterinary, Tags, and HGP's.

Fixed Costs

Uncleared

The estimate of fixed costs (incl. depreciation) per hectare of $5.00 was attained following consideration of the data presented in table 5 for two case study properties in the Murweh Shire with limited development.

Much of the variation in cost / ha between Property A and Property B is in our opinion explained by scale, property A comprising approximately 32,400 hectares, (large) and Property B comprising approximately 20,400 hectares (small/average).

Table 5. Fixed cost data for two undeveloped case study properties over a five year period.

Property	Property A				Property B		Avg
Year	98-99	99-00	00-01	01-02	01-02	02-03	
Overhead Costs	$/Ha	$/Ha	$/Ha	$/Ha	$/Ha	$/Ha	$/Ha
Administration	0.41	0.36	0.40	0.41	0.52	0.51	0.44
Labour (paid)	0.93	0.92	1.23	0.75	0.71	0.63	0.86
Property Maintenance	0.34	0.34	0.24	0.34	0.17	1.27	0.45
Plant & Equipment	0.68	0.65	0.76	1.63	2.81	2.03	1.43
Finance	0.80	0.85	0.87	0.51	0.51	0.46	0.66
Depreciation	0.56	0.62	0.62	0.36	0.75	0.83	0.62
Labour (unpaid)	1.04	1.04	1.01	0.99	1.98	1.98	1.34
TOTAL	**4.76**	**4.80**	**5.13**	**4.99**	**7.45**	**7.71**	**5.80**
Add-back Finance	**3.96**	**3.95**	**4.26**	**4.48**	**6.94**	**7.25**	**5.14**

Cleared

Estimates for fixed costs on cleared land were based on the data presented in table 6. This data is taken from cattle properties with a significant portion of development. Per Ha indicators have not been used as the properties are part cleared / part uncleared, therefore fixed costs per Ha are highly variable and subject to dilution by the lightly grazed or unused areas. The approach has been to consider fixed costs per AE, which appear to be relatively independent of the proportion developed and then adjust this for the adopted average stocking rate assumed to be achievable for the remaining woodlands of the shire under full development.

Total fixed costs per AE will of course vary with scale (economies of size), however it is considered that the properties from which this data was sourced comprised a representative mix of herd sizes most commonly found in the shire, and would therefore provide sound indicators of average fixed costs / AE for well developed properties across the entire shire.

Table 6. Fixed cost data ($/AE) for a range of well developed cattle properties in the Murweh Shire

Property	Group Avg (n=6)		A		B		C	D	Avg $/AE
Year	97-98	98-99	99-00	00-01	00-01	01-02	01-02	01-02	
Fixed Cost	$/AE	$/AE	$/AE	$/AE	$/AE	$/AE	$/AE	$/AE	
Administration	3.21	3.38	18.34	14.52	7.11	19.33	5.49	4.08	9.43
Labour	4.32	11.67	14.12	18.77	13.33	19.84	10.01	21.39	14.18
Property Mntnce	5.81	8.94	15.66*	15.66	19.07	12.41	12.59	9.69	10.52
Plant & Equip.	14.48	17.23	9.11	18.26	22.88	21.81	9.27	20.29	16.67
Finance	na	na	23.38	38.01	12.94	15.57	20.87	20.97	16.47
Depreciation	10.87	8.76	12.59	13.67	6.79	17.60	10.83	27.41	13.57
Unpaid Labour	18.23	16.45	21.66	23.52	12.90	22.23	12.92	18.27	18.27
Total	56.92	66.43	99.20	142.41	95.02	128.79	81.98	122.10	99.11
Addback Finance	56.92	66.43	75.82	104.40	82.08	113.22	61.11	101.13	82.64

At the assumed stocking rate for the remaining woodlands under full development of 0.85 DSE / Ha (0.1062 AE / Ha at 8:1 DSE:AE ratio) the average fixed costs / AE (net of finance costs) of $82.64 presented in the above table translates to **$8.78/Ha.**

Additional capital requirements on cleared land

Additional capital employed on a cleared property as opposed to an uncleared property (excepting the costs of clearing) would be predominantly utilised in additional livestock. The amount of additional capital required for livestock would presumably be proportional to the increase in carrying capacity attainable from clearing (eg if CC increases from 0.35 to 0.85 DSE / Ha, then the capital requirement for livestock would increase by 243%. It should be noted however that such capital is not in practice always supplied by the owner or his financiers, as in reality agistment cattle are often used to exploit increasing pasture reserves where the operators livestock capital is limited. Livestock values are notoriously volatile, however adopting a figure of $1.50 per Kg Liveweight then a 450kg (1 AE) animal will have a capital value of $675. Using a DSE : AE ratio of 8 the average stocking rates for cleared

and uncleared outlined above are 0.0437 AE / Ha and 0.1062 AE / Ha respectively. Capital requirements will consequently increase by $42.18 from $29.50 / Ha to $71.68 / Ha.

In respect to additional fencing and water requirements, such additional capital requirements would be entirely dependent upon the existing extent and quality of facilities on the subject property, which is of course highly variable. Most properties in the shire, because of the abundance of artesian and sub-artesian water enjoy reliable and abundant supplies of stock water, however with development typically comes the need to better distribute watering points, and reduce paddock size in order to better exploit the additional pasture supplies. Water reticulation (pumps and pipe) and fencing are therefore required. In our experience a substantial upgrade of the water infrastructure of an average size (say 20,000 Ha) property would typically be in the range of $25,000 - $50,000. New fencing is a lesser priority and is typically approached on an incremental basis over a period of some years, however 20 km of additional fencing (approximately$30,000) would be expected to improve most properties to adequate paddock size.

Costs of Clearing

Costs of undertaking land clearing and regrowth control operations were estimated as follows:

Chaining	$25 / Ha
Pasture Establishment	$10 / Ha
Regrowth Treatment	$20 / Ha / decade

Contractors which undertake land clearing normally charge according to the hourly rate of the plant used to undertake the work, which ranges depending upon the size of the plant. These costs are normally translated by graziers into per acre costs. Since the size of the plant also dictates the rate at which land is treated (ie the number of acres treated per hour) then clearing cost per acre/hectare tend to be relatively consistent despite differences in plant size and hourly rate. The rate does vary with the size and extent of vegetation, which is why regrowth control is typically less expensive than initial treatment. A contractor was consulted to provide estimates of land clearing costs with the following estimates being provided:

Costs to Control (2004):	$/acre	$/Ha
Average size timber	10	24.7
Regrowth (burnt)	4	9.9
Regrowth (unburnt)	8	19.8
Regrowth (2 ways* unburnt)	10	24.7

*chained, and then immediately re-treated by dragging the chain in the opposite direction to effect a better kill

The Queensland Department of Natural Resources uses cost data to analyse property sales in order to assess the *unimproved* value of land. Cost data used by the Department in 1997-1998 was as follows:

Costs to Control (1997-1998):	$/Ha
Sucker Regrowth - two-way pull (Brigalow)	$12-$17
Light Gidyea or Mulga	$20-$25
Mulga scrub with some timber or softwood scrub	$25-$30
Mixed red scrub, box/mulga country, Brigalow, Forest.	$30-$37
Aerial Seeding (pasture establishment)	
Plane Hire & Loading	$1.02
Seed @ 1.12kg/ha	$6.72
Total	$7.75

Source: Department of Natural Resources Cost Book, Charleville District, (1997-1998).

Having regard to the information provided above and our assessment of the relative distribution of woodland types which are the subject of this study, our initial assessments would appear to be reasonable indicators of development costs in Murweh shire's remaining woodlands.

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