Centre for
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Goulburn Broken Dryland Regional Development Project

Land Use and Climatic Suitability Criteria

June 2000

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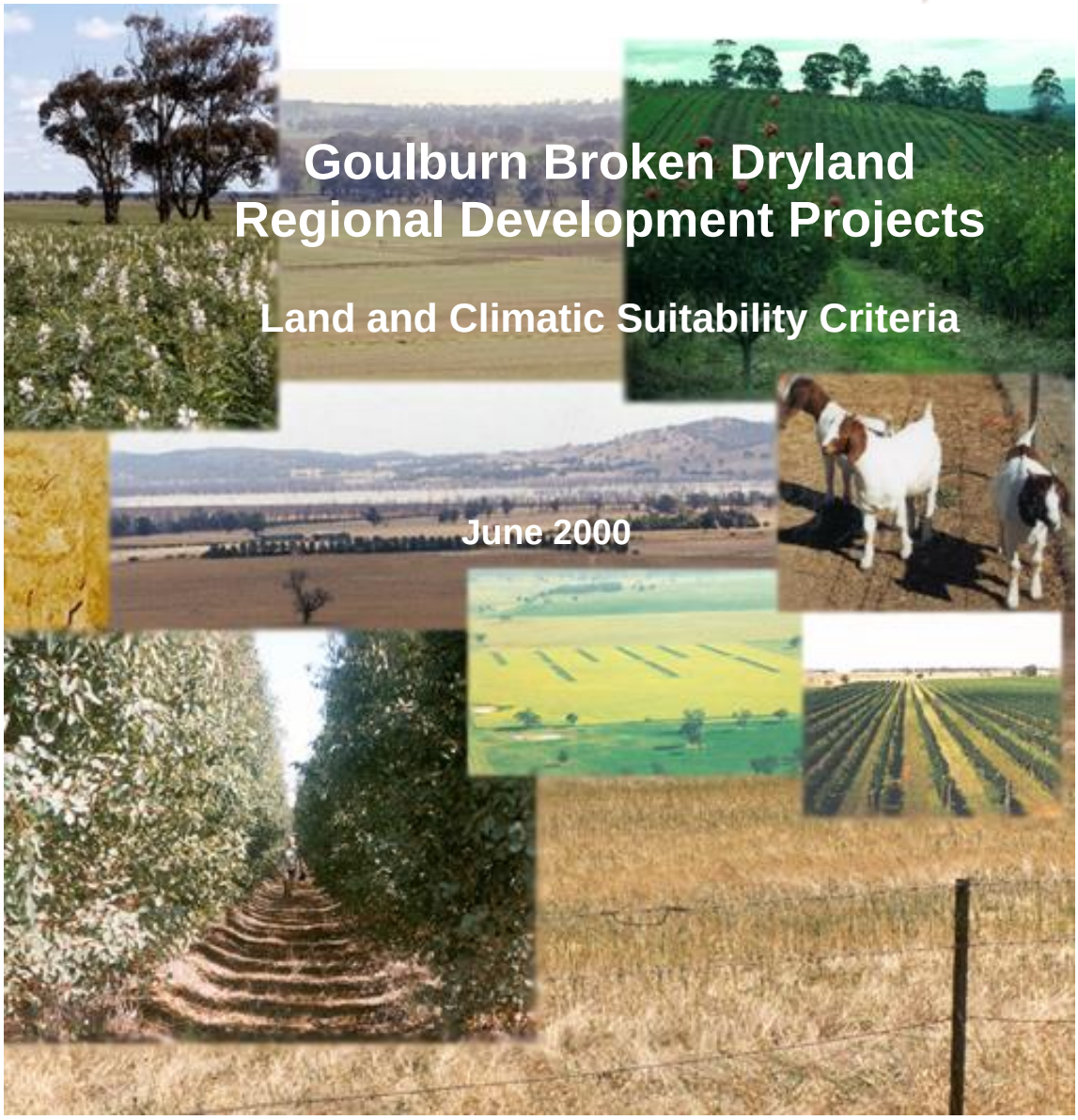

Goulburn Broken Dryland Regional Development Projects

Land and Climatic Suitability Criteria

June 2000

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Goulburn Broken Dryland Regional Development

Biophysical Suitability Analysis Using The MLF Method.

The MLF (Most Limiting Factor) Method as used in this study identifies biophysical factors that are critical for production or the protection of the environment. The biophysical factors are assessed in relation to the level at which they become limiting to plant growth or protection of the environment. The approach ultimately assigns a suitability rating based upon the most limiting factor.

The MLF methodology for the identification of horticultural biophysical suitability is based on the method for determining land capability developed by the United States Department of Agriculture. The land capability approach has been extensively used in Victoria over the last 30 years to facilitate land use planning at the local government level.

The MLF is a "rules combination" method. This approach deals with the interdependence of landscape factors (or *factor interdependence*) (Hopkins, 1977, pp. 394 - 395). The combination of landscape attributes (soil, vegetation, slope, drainage, etc.) that occur in the landscape unit is considered, and different units are given the same suitability rating if they have similar landscape attribute levels. The values derived for units are based upon expert knowledge of the key factors (attributes) and the level at which they become critical. *All factors are considered to have equal weight with respect to their impact upon growth or the environment*. The simplicity of the approach allows the technique to be applied via a GIS platform or manually.

Components, Factors and Critical Values.

The biophysical suitability for horticultural production has been determined based upon three ecosystem components:

1. *Climate* Is the crop in question suited to the rainfall, temperature and frost susceptibility within the land?
2. *Landscape* Will growing the crop result in unacceptable water erosion on the land? Will the natural landscape features of the land result in drainage problems, or impede machinery operations?
3. *Soil* Are the inherent soil conditions suitable for growing the crop/pasture?

The climate, land and soil components have each various elements or factors; and for each factor, critical values are identified and used to rate the suitability for different types of horticulture. The factors are rated for their limitation to plant growth, or potential for environmental degradation, according to a three class rating system (Table1). The most limiting factor determines the class.

Table 1 Class definitions used for the Most Limiting Factor biophysical suitability methodology.

Class	Description	Definition
1	*High*	High probability of the climate, land and soil being suitable for commercial horticulture production with respect to plant production and protection of the natural resource base.
2	*Moderate*	Moderate probability of the climate, land and soil being suitable for commercial horticulture production with respect to plant production and protection of the natural resource base.
3	*Low*	Low probability of the climate, land and soil being suitable for commercial horticulture production with respect to plant production and protection of the natural resource base.

The rationale for assigning critical values to each of the factors is based on: (a) plant production, and (b) protection of the natural resource base, with the aim of identifying economically and environmentally sustainable land use and management options.

Wine Grapes

Cabernet sauvignon is used as the benchmark variety for late maturing wine grape suitability.

Factors and critical values used for determining the biophysical suitability for late maturing wine grapes:

	Critical value		
Factor	**High probability of being suitable**	**Moderate probability of being suitable**	**Low probability of being suitable**
Climate			
Mean cumulative days of frost during spring (Sept, Oct and Nov)	< 10	10 - 15	> 15
Mean monthly rainfall during flowering (Nov and Dec)	< 75mm in Nov and < 75 mm in Dec	< 75mm in Nov or < 75 mm in Dec	> 75mm in Nov and > 75 mm in Dec
Mean monthly rainfall during ripening (Mar and Apr)	< 75mm in Mar and < 75 mm in April	< 75mm in Mar or < 75 mm in April	> 75mm in Mar and > 75 mm in April
Branas Index	< 5000	5000 - 6000	> 6000
Heat Degree Days	>1500	1350 - 1500	<1350
Landscape			
Slope (%)	0.5 - 15	< 0.5 and 15 - 25	> 25
Soil			
Surface pH	5.5 – 8.0	4.5 – 5.5 and 8.0 – 8.5	< 4.5 and > 8.5
Sub-surface pH	6.0 – 8.0	5.0 – 6.0 and 8.0 – 9	< 5.0 and > 9
Surface texture	Loam, Sandy Loam, Silty Loam, Sandy Clay Loam, Clayey Loam, Loamy Sand Clay Loam Sandy, Silty Clay Loam, Light Clay, Clayey Sand Light Medium Clay	Sand, Medium Clay, Medium Heavy Clay	Heavy Clay
Sub-surface texture	Loam, Sandy Loam, Silty Loam, Sandy Clay Loam, Clayey Loam, Loamy Sand Clay Loam Sandy, Silty Clay	Heavy Clay Sand	

	Loam, Light Clay, Clayey Sand Light Medium Clay, Medium Clay, Medium Heavy Clay		
Surface soil sodicity	No (ESP < 6%), Slight (ESP 6 - 15%)	Yes (ESP > 15%)	
Sub-surface soil sodicity	No (ESP < 6%), Slight (ESP 6 - 15%)	Yes (ESP > 15%)	
Useable soil depth (cm)	30 - 60	> 60, 10 - 30	< 10
Surface soil drainage	Moderately well drained (4), Well drained (5)	Rapidly drained (6), Imperfectly drained (3)	Poorly drained (2), Very poorly drained (1)
Sub-surface drainage	Moderately well drained (4), Well drained (5)	Rapidly drained (6), Imperfectly drained (3)	Poorly drained (2), Very poorly drained (1)

Wine Grapes

Pinot-Noir, Merlot, Chardonnay and Sauvignon Blanc are used as the benchmark varieties for early maturing wine grape suitability.

Factors and critical values used for determining the biophysical suitability for early maturing wine grapes:

	Critical value		
Factor	**High probability of being suitable**	**Moderate probability of being suitable**	**Low probability of being suitable**
Climate			
Mean cumulative days of frost during spring (Sept, Oct and Nov)	<10	10 - 15	>15
Mean monthly rainfall during flowering (Nov and Dec)	< 75mm in Nov and < 75 mm in Dec	< 75mm in Nov or < 75 mm in Dec	> 75mm in Nov and > 75 mm in Dec
Mean monthly rainfall during ripening (Mar and Apr)	< 75mm in Mar and < 75 mm in April	< 75mm in Mar or < 75 mm in April	> 75mm in Mar and > 75 mm in April
Branas Index	< 6500	6500 - 7000	> 7000
Heat Degree Days	1150 - 1600	1600 - 1900	< 1900 and > 1150
Landscape			
Slope (%)	0.5 - 15	< 0.5 and 15 - 25	> 25
Soil			
Surface pH	5.5 – 8.0	4.5 – 5.5 and 8.0 – 8.5	< 4.5 and > 8.5
Sub-surface pH	6.0 – 8.0	5.0 – 6.0 and 8.0 – 9	< 5.0 and > 9
Surface texture	Loam, Sandy Loam, Silty Loam, Sandy Clay Loam, Clayey Loam, Loamy Sand Clay Loam Sandy, Silty Clay Loam, Light Clay, Clayey Sand Light Medium Clay	Sand, Medium Clay, Medium Heavy Clay	Heavy Clay
Sub-surface texture	Loam, Sandy Loam, Silty Loam, Sandy Clay Loam, Clayey Loam, Loamy Sand Clay Loam	Heavy Clay Sand	

	Sandy, Silty Clay Loam, Light Clay, Clayey Sand Light Medium Clay, Medium Clay, Medium Heavy Clay		
Surface soil sodicity	No (ESP < 6%), Slight (ESP 6 - 15%)	Yes (ESP > 15%)	
Sub-surface soil sodicity	No (ESP < 6%), Slight (ESP 6 - 15%)	Yes (ESP > 15%)	
Useable soil depth (cm)	30 - 60	> 60, 10 - 30	< 10
Surface soil drainage	Moderately well drained (4), Well drained (5)	Rapidly drained (6), Imperfectly drained (3)	Poorly drained (2), Very poorly drained (1)
Sub-surface drainage	Moderately well drained (4), Well drained (5)	Rapidly drained (6), Imperfectly drained (3)	Poorly drained (2), Very poorly drained (1)

Vegetables

Assuming a rotation of broccoli, sweet corn, capsicums and leeks (warm climate).

Factors and critical values used for determining the biophysical suitability for vegetables (warm climate):

	Critical value		
Factor	**High probability of being suitable**	**Moderate probability of being suitable**	**Low probability of being suitable**
Climate			
Average monthly maximum temperature (°C)(Nov to Mar inclusive)	> 25	20 - 25	< 20
Frost free days (Oct to Mar inclusive)	> 120		< 120
Landscape			
Slope (%)	< 6	6 – 10	> 10
Soil			
Surface pH	> 6.0	5.0 – 6.0	< 5.0
Sub-surface pH	> 6.0	5.0 – 6.0	< 5.0
Surface texture	Loam, Sandy Loam, Silty Loam, Sandy Clay Loam, Loamy Sand, Fine Sandy Loam, Loam Fine Sandy, Clay Loam	Clay Loam Sandy, Silty Clay Loam, Light Clay, Sand, Clayey Sand, Medium Clay, Heavy Clay	
Sub-surface texture	Loam, Sandy Loam, Silt Loam, Sandy Clay Loam, Clay Loam, Loamy Sand, Sandy Clay, Fine Sandy Loam, Light Clay, Loam Fine Sandy, Silty Clay Loam, Silty Clay	Sand, Heavy Clay, Heavy Medium Clay	
Surface soil sodicity	No (ESP < 6%)	Slight (ESP 6 - 15%)	Yes (ESP > 15%)
Sub-surface soil sodicity	No (ESP < 6%), Slight (ESP 6 - 15%)	Yes (ESP > 15%)	
Useable soil depth (cm)	> 50	45 – 50	< 45

Surface/Sub-surface drainage	Moderately well drained (4), Well drained (5), Rapidly drained (6)	Imperfectly drained (3)	Poorly drained (2), Very poorly drained (1)
Coarse fragments (%)	< 15	15 - 30	> 30

Vegetables

Assuming a rotation of Crucifiers (broccoli, cauliflower, chinese cabbage or bok choy), lettuce and leeks (cool climate).

Factors and critical values used for determining the biophysical suitability for vegetables (cool climate):

	Critical value		
Factor	**High probability of being suitable**	**Moderate probability of being suitable**	**Low probability of being suitable**
Climate			
Average monthly maximum temperature (°C)(Dec to Mar inclusive)	> 25	20 - 25	< 20
Average monthly maximum temperature (°C) (Nov)	> 21	18 - 21	< 18
Frost free days (Oct to Mar inclusive)	> 120		< 120
Landscape			
Slope (%)	< 6	6 – 10	> 10
Soil			
Surface pH	=> 5.5	5.3 – 5.5	< 5.3
Sub-surface pH	> 5.4	5.0 – 5.4	< 5.0
Surface texture	Loam, Sandy Loam, Silt Loam, Sandy Clay Loam, Loamy Sand, Fine Sandy Loam, Loam Fine Sandy	Clay Loam Sandy, Silty Clay Loam, Light Clay, Sand, Clayey Sand, Clay Loam, Medium Clay, Heavy Clay	
Sub-surface texture	Loam, Sandy Loam, Silt Loam, Sandy Clay Loam, Loamy Sand, Fine Sandy Clay Loam, Fine Sandy Loam, Loam Fine Sandy	Clay Loam Sandy, Silty Clay Loam, Loamy Clay, Sand, Clayey Sand, Clay Loam, Heavy Clay, Light Clay, Medium Clay, Silty Clay	
Surface soil sodicity	No (ESP < 6%)	Slight (ESP 6 - 15%)	Yes (ESP >15%)
Sub-surface soil sodicity	No (ESP < 6%), Slight (ESP 6 - 15%)	Yes (ESP >15%)	
Useable soil depth	> 50	45 – 50	< 45

(cm)			
Surface/Sub-surface drainage	Moderately well drained (4), Well drained (5), Rapidly drained (6)	Imperfectly drained (3)	Poorly drained (2), Very poorly drained (1)
Coarse fragments (%)	< 15	15 - 30	> 30

Wildflowers

Factors and critical values used for determining the biophysical suitability for wildflowers:

	Critical value		
Factor	**High probability of being suitable**	**Moderate probability of being suitable**	**Low probability of being suitable**
Climate			
Mean cumulative days of frost during spring (Sept, Oct and Nov)	< 10	10 - 15	> 15
Maximum temperature of hottest month (Feb)	< 40	> 40	
Soil			
Surface pH	5 - 7	4 - 5 and 7 - 8.5	< 4 and > 8.5
Salinity (discharge site)	absent	present	
Useable soil depth (cm)	> 50	< 50	
Soil drainage (surface & sub-surface)	Moderately well drained (4), Well drained (5), Rapidly drained (6)	Imperfectly drained (3)	Poorly drained (2), Very poorly drained (1)

Meat goats

Factors and critical values used for determining the biophysical suitability for meat goats (boer):

	Critical value		
Factor	**High probability of being suitable**	**Moderate probability of being suitable**	**Low probability of being suitable**
Climate			
Average annual rainfall	> 600	< 600	
Soil			
Salinity (discharge site)	absent	present	
Soil drainage (surface & sub-surface)	Moderately well drained (4), Well drained (5), Imperfectly drained (3), Rapidly drained (6)	Poorly drained (2)	Very poorly drained (1)

Sugar Gum (*Eucalyptus cladocalyx*)
Product: Wood **Use: Firewood**

Factors and critical values used for determining the biophysical suitability for sugar gum:

	Critical value		
Factor	**High probability of being suitable**	**Moderate probability of being suitable**	**Low probability of being suitable**
Climate			
Average number of frosts (Sept. - Dec.)	< 15	15 - 20	> 20
Average annual rainfall (mm)	600 - 1000	450 - 600	< 450
Average maximum temperature of hottest month (°C)	23 - 33	33 - 35	< 23 and > 35
Average minimum temperature of coldest month (°C)	> 3	2 - 3	< 2
Landscape			
Slope (%)	< 32	32 - 58	> 58
Site drainage	Moderately well drained (4), Well drained (5), Imperfectly drained (3)	Rapidly drained (6)	Poorly drained (2), Very poorly drained (1)
Soil			
Surface texture	Loam, silty loam, sandy clay loam, clayey loam, loamy sand clay, silty clay loam, light clay, clayey sand, light medium clay, medium clay, heavy clay		Fine sandy loam, Loam fine sandy, loamy sand, sand
Useable soil depth (cm)	> 45	35 - 45	< 35

Eurabbie (*Eucalyptus globulus ssp. Bicostata*)
Product: Wood Use: Firewood

Factors and critical values used for determining the biophysical suitability for eurabbie:

	Critical value		
Factor	**High probability of being suitable**	**Moderate probability of being suitable**	**Low probability of being suitable**
Climate			
Average annual number of frosts	< 25	25 - 70	> 70
Average annual rainfall (mm)	> 700	600 - 700	< 600
Average maximum temperature of hottest month (°C)	< 29	29 - 30	> 30
Average minimum temperature of coldest month (°C)	0 - 3	3 - 4	< 0 and > 5
Landscape			
Slope (%)	< 32	32 - 58	> 58
Elevation (ASL)	< 800	800 - 1050	> 1050
Soil			
Surface texture	Loam, silty loam, sandy clay loam, clayey loam, clay loam sandy, silty clay loam, light clay, light medium clay, medium clay	Heavy clay, Loamy sand, sandy loam	Sand, clayey sand
Useable soil depth (cm)	> 45	35 - 45	< 35

Mugga (*Eucalyptus sideroxylon s.s.*)
Product: Wood **Use: Firewood**

Factors and critical values used for determining the biophysical suitability for mugga:

	Critical value		
Factor	**High probability of being suitable**	**Moderate probability of being suitable**	**Low probability of being suitable**
Climate			
Average annual rainfall (mm)	> 700	550 - 700	< 550
Average maximum temperature of hottest month (°C)	29 - 31	27 - 29 and 31 - 33	< 27 and > 33
Average minimum temperature of coldest month (°C)	2 - 3	0 - 2 and 3 - 4	< 0 and > 4
Landscape			
Slope (%)	< 32	32 - 58	> 58
Soil			
Surface texture	Sand, loamy sand, sandy loam, fine sandy loam, light sandy clay loam, loam, loam fine sandy, silty loam, sandy clay loam, clay loam, silty clay loam, fine sandy clay, sandy clay, silty clay, light clay		Heavy clay, medium clay

Broombush (*Melaleuca uncinata*)
Product: Foliage & branches Use: Brush fencing

Factors and critical values used for determining the biophysical suitability for broombush:

	Critical value		
Factor	**High probability of being suitable**	**Moderate probability of being suitable**	**Low probability of being suitable**
Climate			
Average annual rainfall (mm)	450 - 550	550 - 600	< 450 and > 600
Average maximum temperature of hottest month (°C)	> 29	27 - 29	< 27
Average minimum temperature of coldest month (°C)	> 3	2 - 3	< 2
Landscape			
Slope (%)	< 34		> 34
Soil			
Surface texture	Sand, loamy sand, sandy loam, fine sandy loam, light sandy clay loam, loam, loam fine sandy, silty loam, sandy clay loam, clay loam, silty clay loam, fine sandy clay, sandy clay		Light clay, medium clay, heavy clay, silty loam, silty clay
Sub-surface texture	Light sandy clay loam, loam, loam fine sandy, clay loam, silty clay loam, fine sandy clay, sandy clay, light clay, medium clay, heavy clay, silty clay		Sandy clay loam, fine sandy loam, silty loam, loam fine sandy, sand, sandy loam, sand, loamy sand

Southern Blue Gum (*Eucalyptus globulus ssp. globulus*)
Product: Wood **Use: Firewood &/or pulp**

Factors and critical values used for determining the biophysical suitability for southern blue gum:

	Critical value		
Factor	**High probability of being suitable**	**Moderate probability of being suitable**	**Low probability of being suitable**
Climate			
Average annual number of frosts	< 25	25 - 40	> 40
Average annual rainfall (mm)	> 800	700 - 800	< 700
Average maximum temperature of hottest month (°C)	23 - 27	27 - 29	< 23 and > 29
Average minimum temperature of coldest month (°C)	> 3	2 - 3	< 2
Landscape			
Elevation (m) ASL	0 - 450	450 - 600	> 600
Slope (%)	< 32	32 - 38	> 58
Soil			
Useable soil depth (cm)	> 100	80 - 100	< 80

Red Ironbark (*Eucalyptus tricarpa*)
Product: Wood **Use: Firewood &/or pulp**

Factors and critical values used for determining the biophysical suitability for red ironbark:

	Critical value		
Factor	**High probability of being suitable**	**Moderate probability of being suitable**	**Low probability of being suitable**
Climate			
Average annual rainfall (mm)	500 - 600	700 - 1000 and 450 - 500	> 1000 and < 450
Average maximum temperature of hottest month (°C)	27 - 30	25 - 27	< 25
Average minimum temperature of coldest month (°C)	2.5 - 3.5	2 - 2.5	< 2
Landscape			
Slope (%)	< 32	32 - 38	> 58
Soil			
Surface texture	Sand, loamy sand, clayey sand, sandy loam, fine sandy loam, light sandy clay loam, loam, loam fine sandy, silt loam, sandy clay, light clay, medium clay, heavy clay	Sandy clay loam, clay loam, silty clay loam, fine sandy clay loam	

REFERENCES

Hopkins, L., (1977), “Methods for generating land suitability maps: a comparative evaluation”, *Journal of the American Institute of Planners*, Vol. 43, pp. 386 – 400.