APPENDIX 1: LITERATURE REVIEW

Ref No.	Author/ Date/Source	Title	Regions	Species	Data lists used	Capability	Suitability	Economic analysis	Maps used	Envelopes	Notes
1	ABARE	Forest plantations on cleared agricultural land in Australia	National Plantation Inventory Regions	*Pinus radiata, P. pinaster, E. globulus, E. nitens, E. regnans, E. grandis, E. pilularis, Corymbia variegata, P. caribaea, P. elliottii, A. cunninghamii Acacia mangium*	BRS rainfall data, Margules Groome Pöyry plantation yield, costs, final market prices and timber processing data, AUSLIG road coverages, ABARE farm surveys	Rainfall	Cleared agr land, agr land value	Plantation costs, timber processing costs (fixed & variable, recovery rates & capacity), transport costs, market prices, value of agr land	Maps of each region of: Current agr land use and value, plantation productivity, potential land use	Varied depending on region and species	A national study looking only at rainfall for capability. Doesn't cover all the mills
2	Allen, R & Assoc. 1982. Prepared for Vic LCC	An investigation of private land suitable for softwood production in SW District 1	Green Triangle	*P. radiata*	Land sales	Cleared freehold land, rainfall, temperature, soils, topography	Land use	Land sales	N/A	N/A	Area statements by productivity zones
3	Beckhouse J.A. ,1996, SFNSW	South East Eucalypt Plantation Program	SE NSW	Tablelands: *E. nitens* Coastal: *E. botryoides E. saligna*	Covers MAI quoted in literature. Rough yield schedules.	Gives most promising species for Coastal & Tablelands	Assesses other reports.	Market discussion. Summarises previous market assessments & opportunities Presents IRRs.	None	N/A	Review of south coast plantation prospects, including species lists, MAIs, site preparation requirements & management. Also lists further research requirements.

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4	Bonny, L., 1991, FCNSW, Research Paper No. 12	Growth of a *E. grandis* plantation following intensive silvicultural treatments applied in the first 6 years.	Northern NSW	*E.grandis*	Growth rates as MAI to 6 years	Site preparation methods to obtain MAIs.	N/A	N/A	N/A	33^{o}S-25^{o}S, grows best on lower slopes, deep soils of at least moderate fertility, 1500mm rainfall	Possible use in determining growth rates.
5	Booth, T.H and Jovanovic, T., 1991, CSIRO Division of Forestry, Report to the National Plantations Advisory Committee.	Integrating farming and forestry. Commercial wood production on cleared agricultural land. Appendix B. B1 "Identification of land capable of private plantation development. "B4 "Environmental costs and benefits of establishing plantations on cleared agricultural land."	All Australia	*E.diversicolor* *E.globulus* *E.grandis* *E.nitens* *E.pilularis* *E.regnans* *E.saligna* *A.mangium* *A.mearnsii* *A.melanoxylon* *P.radiata* *P.elliottii* *P.caribaea* *Araucaria cunninghamii*	SPANS GIS ESOCLIM AUSLIG	Climate, *rainfall, temperature* Soil: *physical, chemical* Topography: Pests: Diseases: Potential for irrigated plantations. Potential for hardwood on cleared land.	Discusses environ-mental costs/ benefits. Discusses constraints of: *seed availability, frost, pests, pathogens, salinity, water-logging*	Tas, Vic, WA case studies. Costs and returns for farming and forestry.	Soil 1:5 million Veg^{n} 1:5 million Climate 1:5 million	Rainfall >600mm/yr Cleared Vegetation Dry season<=6 months	Comprehensive analysis of plantation capability. Includes environmental, harvesting and research constraints. Environmental benefits of hydrological, soil, biodiversity, climatological, Economic studies. National scale study

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6	Borschmann R. 1998. Prepared for Plantation Development Services for Plantations North East	DRAFT Plantation productivity potential of Blue Gum and Radiata Pine for NE Victoria	Victoria	*E. globulus, P. radiata*	Growth data derived from research trials and demo plantings	Cleared freehold land, rainfall, altitude, geology x rainfall classes	Distance from town centres	N/A	Plantation productivity potential for *P. radiata* & *E. globulus*	N/A	Area statements by productivity classes
7	Prepared by BRS under the Eden RFA process 1998	Identification of plantation expansion opportunities in NSW – Eden CRA region	Eden	*E. nitens, P. radiata*		Cleared private land. Climate (rainfall, temp, radiation & evaporation) Soil (geology, lithology, landscapes, depths, nutrient index). Topography. Site index	Land values, land tenure and use, productivity classes & buffer exclusions	NPV and productivity classes	Plantation potential maps for *P. radiata* & *E. nitens* Land tenure & use, NPV of Ag, NPV of plantations (baseline, high & low scenario)	N/A	Area statements

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8	Bush et al 1998 Central Highlands(Vic) Prepared by BRS for Central Highlands RFA process	Plantation potential analysis	Murray Valley Victoria	*E. nitens, E. regnans P. radiata, A. melanoxylon*	Topographic models, soil suitability classes	Temperature, soil types and slope	Relationship between land property size and land price	Relationship between land property size and land price. Socio-economic analysis	Rainfall, soil capab. Land cover & tenure, land suitab by parcel size. Potential for *E. globulus, E. nitens, E. regnans, P. radiata, A. melanoxylon*	N/A	A report with area statements by suitability classes
9	Bruskin S., SFNSW, research division, Coffs Harbour	Rainforest Plantings, material prepared for the joint venture plantation manager in response to a submission from the Big Scrub Landcare group	NSW North Coast	*various rainforest species*	Hoop pine log prices to 1994/95, NSW rainforest growth data, eucalyptus growth data, economic analysis,, climate/rainfall data	rainfall statistics, optimal growth rates for eucalypt and rainforest species, soil types for hoop and bunya pine, climate data	Market discussions, wood production schedules,	eucalypt, hoop pine, mixed rainforest plantations and cash flow summaries associated with varying ventures.	basic geology	N/A	detailed discussion of economics of rainforest species in plantations,

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10	Bureau of Transport & Commun-ication, 1996, Economics Working Paper 23.	Costs of carbon sequestration through afforestation: greenhouse gas emissions Australian Transport.	National	*P. radiata*	Carbon sequestration rates for plantations.	Uses CSIRO 1991 study. Ref 1.	N/A	Costs	N/A	N/A	Utilised work from Booth and Jovanovic 1991.
11	Centre for International Economics, 1994, Prepared for SFNSW.	Community and social benefits of eucalypt plantations	NSW	*not-specified*	Descriptive costs and benefits	N/A	N/A	N/A	None	None	Descriptive summary of costs and benefits to community of eucalypt plantations.
12	Chandler, Fraser, Keating, Forest Industry consultants New Zealand, 1994, for SFNSW.	A eucalypt plantation programme for NSW	All NSW	*Unspecified eucalypt*	Approx royalty	N/A	N/A	Australian markets and international demand.	None	None	A market discussion
13	Clark, R.V., 1995, SFNSW	Growing radiata pine sawlogs on farms in NSW. Plantations and agroforestry for profit.	NSW	*P.radiata*	Management regime	N/A	N/A	Costs of establishment, approximate returns, present values.	None	Soil depth 40-50 cm, < 18^{o} , most soils suitable except poorly drained or soils with poor water holding capacity	Guide to planning, assessment, maintenance and harvesting

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14	Clark, J., 1995, Environment Victoria. A report to the State Conservation Councils.	Australia's Plantations: industry, employment, environment.	Australia	*P.radiata*	MAI for softwood plantation regions. Projected softwood timber production. National area of plantation by region	None	None	Overall industry overview, markets, current volumes, employment, growth potential.	None	None	An overview of the plantation based industry inc.: employment, industry potential, and resource.
15	Cornish, P., 1989, Technical Paper No. 49, FCNSW.	The effects of radiata pine plantation establishment and management on water yields and water quality - a review	Australia, New Zealand, South Africa	*P.radiata*, and mentioned eucalypt usage.	Changes in streamflow with plantation age, downstream impacts.	N/A	N/A	N/A	N/A	N/A	Review of plantation effect on water quantity and quality.
16	Crevatin et al 1996. Undertaken by DPI forestry for Queensland Commodity Exports	South – east Queensland hardwood plantation land suitability study	SEQ	No particular hardwood species	Annual precip ANUCLIM, slope AUSLIG Land cover Landsat, statigraphic units, cadastral	Freehold cleared land, rainfall, slopes, soil type classes	Land use (not used for cropping), land size, distance from Brisbane	N/A	N/A	N/A	Assessing feasibility of amount of land suitably available for plantations around the Port of Brisbane

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17	Dwyer Leslie Pty Ltd, in association with Corporate Impacts P/L and Dr R.A Powell, 1990-1991/Dwyer Leslie Pty Ltd, in association with Dr R.A Powell, 1993-1995/, FCNSW/ SFNSW	Oberon: Rural Community Development Study, Years 1 to 5 and Final Report.	Oberon, Central Highlands	*P.radiata*	Employment industry economics, multipliers	N/A	N/A	Economic benefit to community and government	Road haulage network	None	Social and economic impacts of Forest Plantation establishment in Oberon.
18	Eucalypt and Forestry Services, 1995, Armidale.	An economic appraisal of the environmental and social effects of eucalypt plantations establishment under the joint venture program of State Forests of NSW.	All NSW	Unspecified eucalypts		N/A	N/A	Economic benefits on state scale	N/A	N/A	Covers range of social, environmental, economic costs/benefits, inc., hydrological, edaphic.
19	Furrer, B., 1993, Forest Planning and Environment Series, Vol. 3, SFNSW.	Eucalypt plantations in NSW	All NSW	Unspecified eucalypts	Approximate yield tables	N/A	N/A	IRR's	None	N/A	Outlines assistance measures, benefits, IRR's, and opportunities in NSW.

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20	Geddes Management 1998	Mt Lofty Ranges Farm Forestry Industry Plan	Mt Lofty SA	*P. radiata* *E. globulus,* *E. saligna* *C. maculata*	N/A	Cleared freehold land, rainfall, soils (fertility, water holding capacity), Slopes	Land use, property size Market potential, landholder attitudes	Socio-economic issues	N/A	N/A	A report of area statements and maps. Growth rate estimation
21	James, R.N, Florence, R.G, Mahendra-rajah, S and Turner, B.T, 1995, report to the Standing Committee on Forestry, Fisheries and Aquaculture, Department of Forestry, ANU, Canberra.	Forest Plantations of Australia - Their role in providing current and future wood supplies.	Australia wide	Unspecified	Production and consump-tion figures for hardwood and softwood	Not considered	Not considered	N/A	None	Not discussed	Discusses area reported to replace native forests
22	Johnson, I.G. & Stanton, R.R., 1993 FCNSW Research Division, Research Paper No. 20.	Thirty years of eucalypt species & provenance trials in NSW. Survival & growth in trials established from 1961-1990.	All NSW	Various	Show growth rates	N/A	N/A	N/A	Location of trials	NA	Useful for growth data

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23	Jurskis, V., 1996, SFNSW, Southern Research.	Plantation land suitability assessment - Southern Region	Southern region, South of Bowral	*P.radiata,* discussion of eucalypts	State Forest GIS	Rainfall, slope, cleared land. Secondary criteria of soil and site quality.	Some field checking of soil depth, and native vegetation.	No economic analysis attempted.	GIS maps produced showing potentially suitable land for softwood. 1:600 000	Annual mean rainfall INXS of 700mm pine 900mm eucalypts slopes<18^{o} Land essentially cleared secondary criteria, soil>1000mm, native veg^{n} >25m	Areas suitable for pine and eucalypt. Limitations include geology, detailed soil analysis, economics, species potential, and the coarse scale.
24	Keenan, R. 1998. Undertaken by Queensland Forest Research Institute	Farm forestry in the tropics: potential and pitfalls (prelim on plantation potential)	Northern Queensland, above 1000 mm only	*P. caribaea var. hondurensis, A. cunninghamii and various Euc and rainforest sp.*	BIOCLIM	Cleared land, rainfall, slopes, climate	Distance from Cairns, land use (not used for high value agriculture or farming)	Distance from Cairns	Map of capable land for a number of species	N/A	Map of capable land for a number of species
25	Lancefield Consultants, 1995	Farm Forestry Strategy Task Force Consultancy Report	SW WA	*P. radiata, E. globulus, P. pinaster*	MAIs,	Cleared freehold land, rainfall, soils, growth rates	Distance to centre	IRRs	Blue gum potential map	Rainfall >450mm/yr for pinaster, >600mm/yr for other sp.	Area statements by regional groups

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26	Landsberg, J.J., Jones, P.M. and Pryor, L.D., 1990, Report on a study undertaken for the Common-wealth Minister for Resources.	Development of a plantation strategy for the south-east forests of NSW.	SE NSW	*E.nitens* *E.grandis* *E.saligna* *E.globulus* others discussed	MAI for various eucalypts in varying areas economic analysis, inc RoR.	Lithography, rainfall	Doesn't account for land costs.	RoR's for varying yields and rotations based on establishment and maintenance costs.	None published	Rainfall 850-900mm rainfall 650-850mm rainfall>900mm slopes <15^{o} rateable land	Provides area based on capability, includes approx MAI's, doesn't include land value
27	Bonny, L, 1991, FCNSW, Research Paper No. 12.	Growth of an *E. grandis* plantation following intensive silvicultural treatments applied in the first six years.	Coffs Harbour	E. grandis	Provides MAI & CAI curves	N/A	N/A	None	None	N/A	Provides idea of growth rates with differing treatments.
28	Lewis, N. B and Ferguson, I.S., 1993.	Management of radiata pine.	Australia, New Zealand, Chile, South Africa	P.radiata	Growth and yield curves	N/A	N/A	Descriptive not specific	None	General requirements of radiata pine	Comprehensive book covering all aspects of radiata pine management
29	Lindenmeyer, Mackay, Nix, 1996, Aust For. 59 p74-89.	The bioclimatic domains of four species of commercially important eucalypts from South-Eastern Australia.	SE Aust	*E.regnans* *E.delegatensis* *E.fastigata* *E.nitens*	Bioclim Analysis for each species EUCALIST used for data source.	Elevation, rainfall, distribution, temp range and seasonal changes.	N/A	None	Very small scale potential maps	Elevation, rainfall, temperature.	Uses natural ranges of species and climatic requirements, matching them with bioclim analysis.

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30	Maclaren, J.P., 1993, FRI bulletin No. 184 NZ Forest Research Institute.	Radiata pine growers manual.	New Zealand	*P.radiata*	N/A	N/A	N/A	Basic analysis	None	Site selection requirements	An excellent non-technical practitioners guide on all aspects of radiata pine
31	Margules Groome Pöyry and Macquarie Corporate Finance, 1996, prepared for SFNSW.	Investor participation mechanisms in hardwood plantations in NSW	NSW	Unspecified hardwood	Investor mechanism	N/A	N/A	Capacity to pay calculations for pulpwood	None	None	Discusses potential investment in plantations and impediments
32	Margules Groome Pöyry Ltd Australia, DIST, DPIE, 1995.	Australian plantation bench-marking study.	National	N/A	Economic costs	N/A	None	Investor types, supply & demand factors, markets, government constraints. Minimum required IRR. Sources of information relating to forestry investment. International Land costs, prices, harvest & transport	None	None	Describes Australia's plantations industry, economics & industry locations.
33	Margules Groome Pöyry Ltd, 1993, prepared for Softwoods Working Party.	State softwoods strategic plan for NSW (draft)	All NSW	*P.radiata*	Markets, and potential, general management regime	N/A	N/A	Markets, and supply commitments	N/A	N/A	Discusses supply/demand, markets, constraints, environmental issues and proposes strategy.

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34	Margules Pöyry 1998. Prepared for Plantations North East	Regional Profile of North East Victoria	NE Vic	*P. radiata, E. globulus*	Large variety	Climate, soils, slope, growth rates	Tenure, land prices, infrastructure industry location,	Infrastructure, industry location, financial returns	Location of LGA, infrastructure, rainfall, tenure, current plantations radiata suitable land, blue gum suitable land, opp zones, wood vol, industry locations	N/A	It identifies areas within NE Vic that are physically suitable for plantation expansion using a combination of industrial and market information, and physical conditions
35	Margules Pöyry 1997. Prepared for Greening Australia & NT Forestry and Timber Products Network	Feasibility study – Farm forestry in the top end of the NT	Northern Territory	Various	Using existing information and GIS data	Temperature, rainfall, soils	Land size, land use, utilities, port infrastructure market demand	Financial analysis		N/A	Feasibility report for farm forestry in NT

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36	Meynink, R., 1990, prepared for Harris-Daishowa (Australia) Pty.Ltd.	An analysis of the Landsberg, Jones, Pryor 1990 "Develop-ment of a plantation strategy for the South-East Forests of NSW" report.	SE NSW	*Not specified*	Looks at haul distances, harvest costs, mill costs, MAI, land costs establish-ment and maintenance costs to determine IRR for plantations.	N/A	N/A	Detailed look at costs and IRR for varying land costs	None	Parameters for IRR	Reviews Landsberg report and provides economic analysis including land costs.
37	Mousa, A, And Keady E. July 1996, Resources Branch Department of Primary Industries, Queensland	plantation volume growth summaries from growth plots in Queensland	QLD	*Hoop pine, slash pine, radiata pine, Pinus taeda, Pinus patula, Pinus caribaea*	growth rates	not specified	not specified	N/A	9	not specified	growth summaries
38	Northern NSW Forestry Services, 1994, Study undertaken for the Mid North Coast Regional Development Board.	North Coast Forest and Plantation Resource Study.	North Coast NSW	*E.pilularis E.grandis E.saligna E.nitens*	Limited approx MAI for flooded gum and Blackbutt. Existing, and potential areas of hardwood plantations	Climatic and edaphic requirements	Includes some consideratio n of land value and survey of landowners	Develops IRR's for varying land costs, including establishment costs, and annual costs	Identifies broad areas as having the best potential.	Temp, rainfall, soil types, dry season length	Comprehensive look at hardwood potential and existing resource in N NSW. Potential areas based on landowners surveys, not capability criteria.

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39	Northern NSW Forestry Services, SFNSW, 1996, Study undertaken for the Mid North Coast Regional Development Board.	Mid-north Coast Forest and Plantation Resource study.	Mid North Coast NSW	*E.pilularis* *E.grandis* *E.agglomerata* *E.nitens* *E.saligna* *E.maculata* *E.dunnii* *E.laevopinea* *E.cloeziana*	Potentially suitable plantation area by local government area. Used (unspecified) GIS analysis Existing plantations Net Productive areas by forest type	Climate, soil, land tenure,	Excluded prime land for horticulture, steep slopes, uncleared land	Profitability based on costs, MAI and land costs.	1:600 000 maps. Includes existing and potential areas	>900mm, cleared private land, non-prime ag land, <18^{o} 10-20 hectares minimum size, well drained soils, access	Comprehensive analysis of region, including existing and potential, and covering economics. Does not cover exact CRA region, will be a good cross reference.
40	O'Hara,A.J., 1990, FCNSW, paper to Austis Conference, Tasmania.	Economics of growing eucalypt sawlogs in plantations.	NSW	Non-specific	Predominantly an economic analysis, includes basic yield tables	N/A	N/A	Detailed economic analysis based on establishment and management costs, returns, MAI, and sensitivity analysis.	None	N/A	Economic analysis looking at variables, and potential IRR. Not considering potential.
41	Private Forestry Tasmania farm forestry project	Tasmanian RFA background report Part D Social and Economic Report Vol II	Tasmania	*P. radiata,* *E. globulus* *E. nitens*	N/A	Cleared freehold land, rainfall, temperature, soils, productivity classes	Socio-economic study	Socio-economic study	N/A	N/A	Prepared as part of the CRA/RFA process

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42	Prosser, M., 1989, Honours thesis ANU Canberra.	The economics of eucalypt plantations- a case study: Blackbutt plantations of the New South Wales north coast.	Northern NSW	*E.pilularis*	MAI Blackbutt	Climate, soil, very basic analysis.	Cleared land, <120km from major town but >10km	Costs and returns	Unscaled map used for areas available	Cleared land, <120km from major town but >10km	Basic look at available areas, more detail on costings and economics.
43	Queensland RFA S/C 1998	Commercial plantation land suitability analysis of SE Queensland	SEQ	*Araucaria cunninghamii, P. elliottii x P. caribaea, E. argophloia, C. maculata E. pilularis, E. cloeziana E. grandis*	Climatic modelling	Cleared land Slopes, soil capability classes, climate, rainfall	N/A	N/A	N/A	Slopes <30º	Area statement and maps
44	Regional Analysis and strategies - prepared for SFNSW by Regional Analysis and Strategies, Armidale 1994	The impact of eucalypt forestry on the NSW economy	All NSW	Non-specific	Approximate prices for products	N/A	N/A.	State wide economic benefits.	None	None	Looks at economic benefits of a increase in NSW plantation estate
45	Reilly, J.J., Parkes, E.D., and Ferguson, I.S., 1975, Aust For. 37 p233-44.	The potential productivity of farmlands in the lower south coast region of NSW for radiata pine plantations.	Lower South coast NSW	*P.radiata*	Site index for *P.radiata* for various ages/areas. Approx areas suitable by district.	Land category determined by: soils, topography, geology. Site index by rainfall.	Not considered	Not considered	N/A	N/A	A report looking at categorising farmland potential for *P.radiata*

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46	Report of the National Plantations Advisory Committee. 1991	Integrating farming and forestry. Commercial wood production on cleared agricultural land. Appendix C. "Economics on farm forestry enterprises: a study approach"	All Australia	*E.diversicolor* *E.globulus* *E.grandis* *E.nitens* *E.pilularis* *E.regnans* *E.saligna* *A.mangium* *A.mearnsii* *A.melanoxylon* *P.radiata* *P.elliottii* *P.caribaea* *Araucaria cunninghamii*	N/A	Potential for hardwood on cleared land	Discusses economics	Tas, Vic, WA case studies. Costs and returns for farming and forestry.	N/A	Discusses farm conditions.	Analysis of plantation economics based on a number of case studies.
47	Furrer, B, 1994, SFNSW.	Eucalypt plantation joint venture site selection.	NSW	Various eucalypts	None	Growth capacity to achieve $20m^3$/ha/yr aim over 20 years. Economic capability	N/A	Specifications for obtaining timber with growing costs <\$20/m^3 after 20 years	Small scale suitability class map and rainfall map.	$<18^o$ 1m soil >100ppm total P rainfall>900mm <20% crown cover >25m dominant height	Outlines requirements for selection for joint venture program.
48	Centre for International Economics, 1994, prepared for SFNSW.	Community and social benefits of eucalypt plantations.	NSW	None	None	N/A	Talks about competing requirements for water	None	None	None	A very brief coverage of social benefits

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49	SFNSW 1996	SFNSW Northern Region Softwoods Strategy, 1996	N NSW	*P.radiata*	National/ international supply/demand status MAI for varying areas	N/A	N/A	N/A	N/A	N/A	Predominantly a market analysis and outlining objectives and strategies for the Northern region softwoods
50	SFNSW, 1996	Land Potentially Suitable for Eucalypt Plantation - North Coast of NSW	North Coast NSW	*E.pilularis, E.maculata, E.dunnii*	Area statements, State Forest supply zones, management and harvesting schedules	Rainfall, soils, Land and Water Conservation capability classes	Looks at supply zones and distances to markets	Not analysed	SFNSW GIS produced map showing suitable areas	900 mm rainfall, cleared land, < 18^{o} slope, exclude prime agricultural land, west of Pacific Hwy., < in 700 m except Dorrigo	A very brief outline of methods used to determine areas suitable.
51	SFNSW, 1997	hardwood plantation strategic plan 1997/98	NSW	*E.pilularis, E.maculata, E.dunnii E.grandis*	area statements of current plantations, area summary by site class	area summary by site class,	area summary by supply zone,	financial overview, environmental and social benefits and costs	land potentially suitable for eucalypt plantations 1:700 000	900 mm rainfall, cleared land, < 18^{o} slope, exclude prime agricultural land, west of Pacific Hwy., < in 700 m except Dorrigo	An analysis of plan of action to establish 10 000 hectares of eucalypt plantations in 1997/98. Also outlines plan to establish 10 000 ha in 1998/99 and 10 000 hectares in 1999/2000.
52	SFNSW 1997 Central Tablelands Farm Forestry Project	An evaluation of forestry land capability for *Pinus radiata* in the Central Tablelands, NSW	Central Tableland of NSW	*P. radiata*	ESOCLIM, soil landscape sheets	Private cleared land Rainfall classes	Distance to markets	Distance to markets	Rainfall, soils, capability, suitability	700-850 mm rainfall	Area statements and maps for Central Highlands (Bathurst/Oberon)

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53	SFNSW & DLWC, 1997.	Erosion & sediment control strategy for eucalypt plantation establishment on the North Coast of NSW.	NE NSW	Eucalypts	Environ-mental constraints	N/A	N/A	N/A	N/A	N/A	Covers legislation, and environmental controls
54	Shea & Hewett, 1997 undertaken by CALM	*Pinus pinaster* project	SW WA	*P. pinaster*	GIS analysis	Rainfall, non waterlogged & non-saline soils	N/A	Discussion of socio-economic issues	Land availability for *P. pinaster*	400-600 mm rainfall	Looks at potential of *P. pinaster* in the intermediate rainfall areas of the state
55	South East Forest Foundation 1996	Esperance regional development strategy for farm forestry	SW WA, Esperance	*E. globulus, P. pinaster*		Cleared freehold land, soils, temperature	Distance to centres, land use, land acquisition strategies		Rainfall & soil types	Rainfall > 450mm	Area statements, Results of early growth plots
56	Spencer R.D. et al., 1999 undertaken by BRS & ABARE	Opportunities for hardwood plantation development in South East Queensland	SEQ	*E. pilularis, E. cloeziana, Corymbia citriodora, E. grandis*	AAGIS, ADIS, GRO	Soils, slope, rainfall	Land prices, private cleared land	Plantation yields, plantation costs & returns, land prices	Plantation capability, sawlog regimes (NPV), NPV as % of land value, highest economic suitability, sawmill allocation zones	Rainfall b/n 800-1000mm p/a for spotted gum. Rainfall over 1000mm p.a. for blackbutt, Gympie messmate, and rose gum	Plantation capability modelling for SEQ region, producing area statements and maps of potential areas for each species
57	Stanton, R., 1992, Research Paper No. 15 FCNSW.	Eucalyptus plantations in NSW	All NSW	Varied	NSW plantation areas to 1992	N/A	N/A	Not considered	Location of manageme nt areas	N/A	Description of NSW plantation estate to 1992.

Ref No.	Author/ Date/Source	Title	Regions	Species	Data lists used	Capability	Suitability	Economic analysis	Maps used	Envelopes	Notes
58	Stanton, R.R.J., 1990, Honours thesis, ANU, Canberra.	Land evaluations for eucalypt plantation purposes in the south-east region of NSW.	SE NSW	*E.agglomerata E.fastigata E.globulus E.nitens E.sieberi*	Basic species requirements.	Elevation, slope, total rain, seasonality, nutrient supply.	Divides into 4 classes	None	BIOCLIM GETCLIM SLPGRD (aspect) GRDAREA (area calculation)	Rainfall>850 mm where <600m elevation rainfall >750mm where >600m elevation slopes <15^{o} potential nutrient supply index >5 out of 10	Honours thesis using GIS and base environmental attributes to determine area available for plantations.
59	Stephens, N., Sun, D., and Tickle, P., 1998. Bureau of Rural Sciences	Plantation potential studies in Australia: an assessment of current status	All regions	*16 Eucalyptus sp., 3 Corymbia sp 5 Pinus sp. Acacia melanoxylon, Casuarina cunninghamiana, Grevillea robusta, Araucaria cunninghamii, Toona ciliata, Flindersia spp*	Questionnaire survey, literature review.	Rainfall, soil, geology attributes, temperature, altitude, slope. It varies depending which study was looked at.	Land size, land use, distance to mills, community attitudes. It varies depending which study was looked at.	socio-economic analysis, market potential, distance to mills, NPV, port infrastructure, market demand, financial analysis, impacts of legislation and scenario modelling. It varies depending which study was looked at.	N/A	N/A	A literature review undertaken on published studies relating to the identification of capable, suitable and available land for plantation development.

Ref No.	Author/ Date/Source	Title	Regions	Species	Data lists used	Capability	Suitability	Economic analysis	Maps used	Envelopes	Notes
60	STFFN – Southern Tablelands Farm Forestry Network (1997) Kim Wells	Potential for commerical farm forestry on the NSW Southern Tablelands	Southern Tablelands NSW	*P. radiata*	Soil landscapes – topography & soils	Soil landscapes – topography & soils	N/A	Market potential based on a pers. Comm.	N/A	Excludes: <550mm rainfall, <50cm soil depth, >29 degrees slope	A very brief summary
61	Wareing K and Baker R. 1998. Prepared by BRS under the NE Vic RFA process	Opportunities for plantation expansion in the Victorian NE CRA/RFA region	NE Vic	*E. globulus, P. radiata*		N/A	Land value, land use, parcel size, farmers perceptions to farm forestry, community concerns	Scenario modelling	N/A	N/A	A report of area statements and maps
62	Wilson, S.M. Whitlam, JAH Bhati, U.N. Horvath, D Tran, U.D., ABARE 1996 Research Report 95.7.	Trees on Farms. Survey of trees on Australian farms 1993-1994.	National	Various	N/A	N/A	N/A	N/A	N/A	N/A	An overall outlook on farmers perceptions, costs & benefits & reasons for planting.

APPENDIX 2 – SUMMARY STATISTICS FOR CLIMATE SURFACES BY PRODUCTIVITY CLASSES

P. Radiata **productivity classes and values of rainfall and temperature.**

Total Annual Rainfall (mm) :	**min**	**mean**	**max**	**std**
Incapable	492	989	2709	443
Low potential	528	740	1570	87
Medium potential	629	947	1631	122
High potential	862	1195	1724	150

Maximum temperature (mean of 12 months, degrees C) :	**min**	**mean**	**max**	**std**
Incapable	5.6	17.5	23.0	3.6
Low potential	13.6	18.5	22.4	1.5
Medium potential	12.1	17.5	22.1	1.9
High potential	12.1	15.9	21.6	1.9

Maximum temperature (max of 12 months, degrees C) :	**min**	**mean**	**max**	**std**
Incapable	13.9	24.3	30.8	3.1
Low potential	21.3	26.5	30.6	1.9
Medium potential	19.8	25.1	29.9	1.9
High potential	19.4	23.6	27.5	1.5

Minimum temperature (mean of 12 months, degrees C) :	**min**	**mean**	**max**	**std**
Incapable	-0.7	5.9	13.0	3.6
Low potential	2.0	5.7	11.0	1.5
Medium potential	1.6	5.5	11.1	1.8
High potential	1.6	5.0	10.8	1.8

Minimum temperature (min of 12 months, degrees C) :	**min**	**mean**	**max**	**std**
Incapable	-5.5	0.6	8.5	3.6
Low potential	-3.0	0.1	5.8	1.3
Medium potential	-3.3	0.1	5.8	1.6
High potential	-3.2	-0.2	5.5	1.7

E. nitens **productivity classes and values of rainfall and temperature.**

Total Annual Rainfall (mm) :	**min**	**mean**	**max**	**std**
Incapable	492	767	2709	253
Low potential	850	969	2026	129
Medium potential	850	1094	1726	126
High potential	886	1289	2003	196

Maximum temperature (mean of 12 months, degrees C) :	**min**	**mean**	**max**	**std**
Incapable	5.6	17.8	23.0	2.3
Low potential	11.3	18.3	22.4	2.0
Medium potential	11.3	17.3	22.0	2.5
High potential	11.3	16.6	21.6	2.9

Maximum temperature (max of 12 months, degrees C) :	**min**	**mean**	**max**	**std**
Incapable	13.9	25.7	30.8	2.6
Low potential	19.0	25.8	30.2	2.1
Medium potential	19.0	24.2	29.1	1.7
High potential	19.0	23.4	27.1	1.7

Minimum temperature (mean of 12 months, degrees C) :	**min**	**mean**	**max**	**std**
Incapable	-0.7	5.2	13.0	1.9
Low potential	1.4	6.2	13.0	2.1
Medium potential	1.3	6.2	12.8	2.7
High potential	1.4	6.2	13.0	3.3

Minimum temperature (min of 12 months, degrees C) :	**min**	**mean**	**max**	**std**
Incapable	-5.5	-0.3	8.5	1.7
Low potential	-3.5	0.7	8.3	1.9
Medium potential	-3.5	0.9	8.3	2.6
High potential	-3.5	1.1	8.4	3.3

APPENDIX 3: MINUTES OF PLANTATION POTENTIAL WORKSHOP

TO:

Phil Tickle	BRS	02 6272 4689
Michael Ryan	BRS	02 6272 4937
Antti Roppola	BRS	02 6272 5980
Alison Pritchard	BRS	02 6272 4034
Mike Welch	SFNSW	02 6043 1007
Dave Cromarty	SFNSW	02 6043 1007
Tony O'Hara	SFNSW	02 9980 4164
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Hugh Dunchue	SFNSW	02 6043 1007
Don Hobson	SFNSW	02 6947 3911
		02 6947 2683 fax
Andy Sterling	SFNSW	
Ross Dickson	SFNSW	
Murray Brown	Murray Riverina Farm Forestry	02 6041 4808
John Scott	Murray Riverina Farm Forestry	03 5881 9340
		03 5881 9305 fax
Rob Kuiper	Softwoods Working Group	02 6921 6422
Melissa Green		02 6921 0780 fax
Emmo Willink	P.O.Box 99 Holbrook 2644	02 6036 3183
Niel Cooper	ACT Forests	02 6207 2486
		02 6207 2544 fax
Ian McArthur	ACT Forests	02 6207 2486
		02 6207 2544 fax
Chris Adams	Tumut Shire Council	02 6947 0500
		02 6947 2141 fax
Jim Grant	Department of State and Regional Development	02 6041 4808
		02 6041 4818 fax
Sophie Clayton	Tablelands Farm Forestry Network	02 6207 2486
		02 6207 2544 fax
Kenneth Epp	VISY Paper	02 6947 3714
		02 6947 9008 fax
Robin Reid	CSR Sawmilling	02 6941 1900
		02 6941 1909 fax
Chris Borough	Jaakko Pöyry Consulting	02 6295 2777
Angela Robinson	Jaakko Pöyry Consulting	02 6295 2803 fax
Mark Parsons	Fortech	02 6248 6900
		02 6248 6999 fax
Phil Ryan	CSIRO	02 6281 8331
		02 6281 8239 fax
Kevin Burns	ABARE	02 6272 2136
David Priem	DLWC	02-6947 0200

FROM: Michael Ryan Bureau of Rural Sciences 02- 6272 4937

02-6272 3882 fax

Date: 14 April, 1999

SUBJECT: ***NSW FARM FORESTRY WORKSHOP***

AND

CRA PLANTATION POTENTIAL WORKSHOP 23 FEBRUARY 1999

CONVENORS: (plantation potential)	Phil Tickle	Bureau of Rural Sciences	02 6272 4689
(farm forestry)	David Marston	Dames and Moore consulting	02 9955 7286

MINUTES FOR PLANTATION POTENTIAL WORKSHOP AND FARM FORESTRY WORKSHOP HELD AT TUMUT ON 23 FEBRUARY 1999.

David Marston-introduction to workshop, definitions of farm forestry and introduction of participants. Outline;

- why grow trees/history of Farm Forestry
- definition of farm forestry

Michael Ryan

plantation potential project aims:

- inform stakeholders
- incorporate stakeholder ideas
- determine species mix
- determine capability criteria
- establish site factors
- determine data gaps
- obtain input into market prospects
- determine suitability criteria
- agree to process

Phil Tickle

- explanation of plantation and expansion opportunities
- outline of project objectives
- outline of workshop objectives

David Marston and **Mark Parsons**

Strengths of Farm Forestry in Region

- government sponsored plantations
- Australian newsprint Mills at Albury (joint ventures)
- Total Catchment Management
- regional plantation committees
- new markets e.g. Visy Board Mill
- reopening of Junee rail line
- State Forest move towards plantations
- South West slope road study

- export markets-Port Kembla 1998
- privatisation plantations (+/-)

Weaknesses of farm Forestry in Region

- consent required for clearing
- taxation system
- inability to thin private plantations commercially
- Australian Newsprint Mills selling joint ventures
- lack of corporate sector support for farm forestry
- closure of rail lines
- species/site selection (700 mm boundary)
- and increased demand for road transport
- anti-pine sentiment from Councils
- Government domination of plantation sector
- disincentives to sustainable use of native forests

Issues for farm forestry to gain a vision

- balanced land use: water use, soil health, biodiversity, sustainable land use
- forestry as a normal land use
- reasonable incomes
- market driven
- regional co-ordination
- effective/efficient infrastructure
- healthy forests
- profitable enterprises
- integration of farm forestry within landscape

Policy goals for region

- 30,000 hectare planted by 2009
- 20 years CRA process targets
- appropriate marketing strategy for industry

Plantation Potential Workshop

CAPABILITY MODELLING

Phil Tickle -

Introduction into study, outline of capability and suitability factors,

- Eden as a case study-modelling of bio-physical factors, physical factors to establish growth relationships for *Pinus radiata* and *Eucalyptus nitens*.
- Outline of process models for determining capability

Species mix (rated by preference)	**Species issues**
1. *Pinus radiata*	snow range
2. *Pinus pinaster*	climate threshold
Psuedotsuga menziesii	high altitude species (Bob Eldridge CSIRO)

1.1.2 Pinus hallipensis

3. *Eucalyptus nitens*	provenance trials at Bago, little other data, check with Murray Brown regarding other trials
Eucalyptus delegatensis	provenance trials at Bago, high defect

1.1.3 Eucalyptus brutea

1.1.4 Eucalyptus machoryncha

4. *Eucalyptus globulus*	
Corymbia maculata	excellent potential in Northern New South Wales

1.1.5 Eucalyptus saligna

May want to use Treedat data base at CSIRO forests and forest products.

Existing plantations information

Action: SFNSW to complete all South West data including boundaries

Action: Sophie Clayton to MARVL all southern tablelands private plantations

Action: Antti Roppola to chase up Dave Jamieson on ACT soils

Action: Antti Roppola to chase up SFNSW regarding parent rock Code mapping and check with Phil Ryan and Col Wilkenson

Action: Antti Roppola to chase up ACT forests regarding site specific meteorological data

SUITABILITY MODELLING up–

Kevin Burns described the Wood and Paper Industry Strategy and the FORUM model. The description of how economic inputs and outputs are determined through end products, establishment and maintenance costs, and distance and cost of processing. Outputs from the modelling include potential plantation area, potential products, markets, gross value of product, employment.

Enterprise scenarios potentially considered for softwood:

- high-grade structural sawlogs
- high-grade venue
- pulp and paper
- panels press into reservation
- by energy
- carbon

Enterprise scenarios potentially considered for hardwood:

- high and low grade sawn timber products
- export pulp logs
- bioenergy
- specialty timbers
- carbon
- fuel wood
- charcoal production
- oil

Action: Kevin Burns to look at Road haulage study in ACT (David Jamieson) and South-West slopes (Dave Chromarty)

Action: Phil Tickle to chase up with DLWC scoping project and costings for impact of vegetation clearance controls for plantation establishment .

Action: BRS to check with Charles Sturt University (Sandra Walpole), CRES (Victoria Mason), and CSIRO wildlife and ecology (Steve Morton) regarding land clearing impacts.

Action: BRS or ABARE to generate land access zoning coverage through Shire Council's.

Discussion on land use

- broad or land use zoning of region pressed into horticulture may be a problem
- Tumut Shire Council has GIS capabilities
- vineyards in Tumbarumba experiencing large expansion recently
- water use and harvesting may be a problem in the Murray Darling basin. SFNSW are doing studies on how much water radiata plantations use. Thought is that trees are good for catchments.

Summary and closing

Michael Ryan Summary of plantation potential discussions

David Marston Summary of farm forestry discussions

1. consent requirements:

- need uniform coordinated approval process
- best management practice/Code Forest Practice (ISO)
- training
- planning trees into farmland
- road use/who pays?

2. players

- local government, DLWC, Australian Forest Growers, CSIRO, Greening Australia, regional plantation committees, SFNSW, local councils, Murray Darling Basin Commission, private landowners, NSW agriculture, Sydney water, EPA.

3. Species/site selection

4. Marketing

- co-operative selling
- identify markets and grow accordingly
- harvesting flexibility
- non-timber markets: oils, nuts, biodiversity, honey
- valued adding

5. Natural resources inventory and databases

6. Regional plantation committees

- core funding (State and Commonwealth)
- technology transfer/networking
- impediments
- development opportunities
- roading

Vision for the region

- *Healthy landscapes with profitable use of trees on public and private land.*
- *Regional coordination community driven program of awareness, research and development, information transfer and actions.*

- *Clear market information and local value adding industries.*
- *The best management practice for tree crops in a balanced land use.*
- *Effective/efficient infrastructure.*
- *Investment opportunities for a range of purposes including forest products and environmental values.*

David Maston, Michael Ryan: Closing comments: thank you to all participants for their contributions into various aspects of this workshop.

Please call me if you have any queries regarding the workshop or these minutes

MICHAEL RYAN

APPENDIX 4: HARDWOOD ECONOMIC SCENARIOS TO BE UNDERTAKEN

VARIABLES TO BE ADJUSTED IN SCENARIOS

ESTABLISHMENT COSTS

SFNSW projected cost scenario (looks at SFNSW projected costs)

Projected SFNSW costs of $2000 per hectare

Annual costs of $90/year/hectare

Low cost scenario (looks at the ability to establish below projected SFNSW costs, using ABARE costings from WAPIS report)

establishment costs of $1400 per hectare year 1,

post establishment costs of $500/hectare

annual costs $80/year (regular maintenance)

ROYALTY RETURNS

Current return scenario

HQLSL $40/m3

HQSSL $20/m3v

pulp $10/m3

High returns scenario (looking at 25% increase on current royalties)

HQLSL $50/m3

HQSSL $25/m3

pulp $13/m3

YIELD TABLES

Current yield scenario

This yield table was developed using existing knowledge on Eucalyptus nitens growth and potential yields from existing plantations and SFNSW knowledge.

Table 1. Yield table for *Eucalyptus nitens* using relatively conservative yields

	INITIAL STOCK	SITE INDEX	T1 AGE	T1 STOCK	PULP	T2 AGE	T2 STOCK	HQLSL	HQSSL	PULP	Clearfell Age	HQLSL	HQSSL	PULP	Mai m3/ha/yr	TOTAL VOLUME
1	1000	30	25	350	140						45	70	110	130	10	450
2	1000	35	20	350	170						40	120	150	160	15	600
3	1000	40	15	500	130	25	250	10	40	60	35	150	150	160	20	700

High yield scenario (Using East Gippsland/Bombala WAPIS figures)

This scenario compares favourably with yield scenarios used within the WAPIS study.

They compare against the tables for Northern NSW and yields against existing Eucalyptus nitens plantations in terms of MAI predicted. The unknown is the quality of the sawlog component.

1.1.6 Table 3: Yield Table for Shining Gum using more optimistic yields

Class	Initial stock	Site index	T1 age	T1 Stock	PULP	T2 age	T2 Stock	HQLSL	HQSSL	pulp	Final clearfell	HQLSL	HQSSL	PULP	MAI m3/ha/yr	total volume
1	1000	30	25	350	170						40	124	62	124	12	480
2	1000	35	20	350	193						35	161	80	161	17	595
3	1000	40	15	500	140	25	250	12	43	68	32	176	88	176	22	704

APPENDIX 5: PINUS RADIATA YIELD TABLES

High:

Thin	Age	Pulp	Sawlog	Price $/m3
1	12	109	0	9.00
2	20	35	57	24.00
C/F	30	41	377	43.00

Medium

Thin	Age	Pulp	Sawlog	Price $/m3
1	14	110	0	9.00
2	22	50	60	24.00
C/F	32	40	316	43.00

Low

Thin	Age	Pulp	Sawlog	Price $/m3
1	15	100	0	9.00
2	21	40	60	22.00
3	28	25	75	35.00
C/F	35	25	250	43.00