The Potential for Tree Crops To Sequester Carbon in Western Australia

Presentation by:

Dr Syd Shea

Executive Director

Department of Conservation and Land Management,

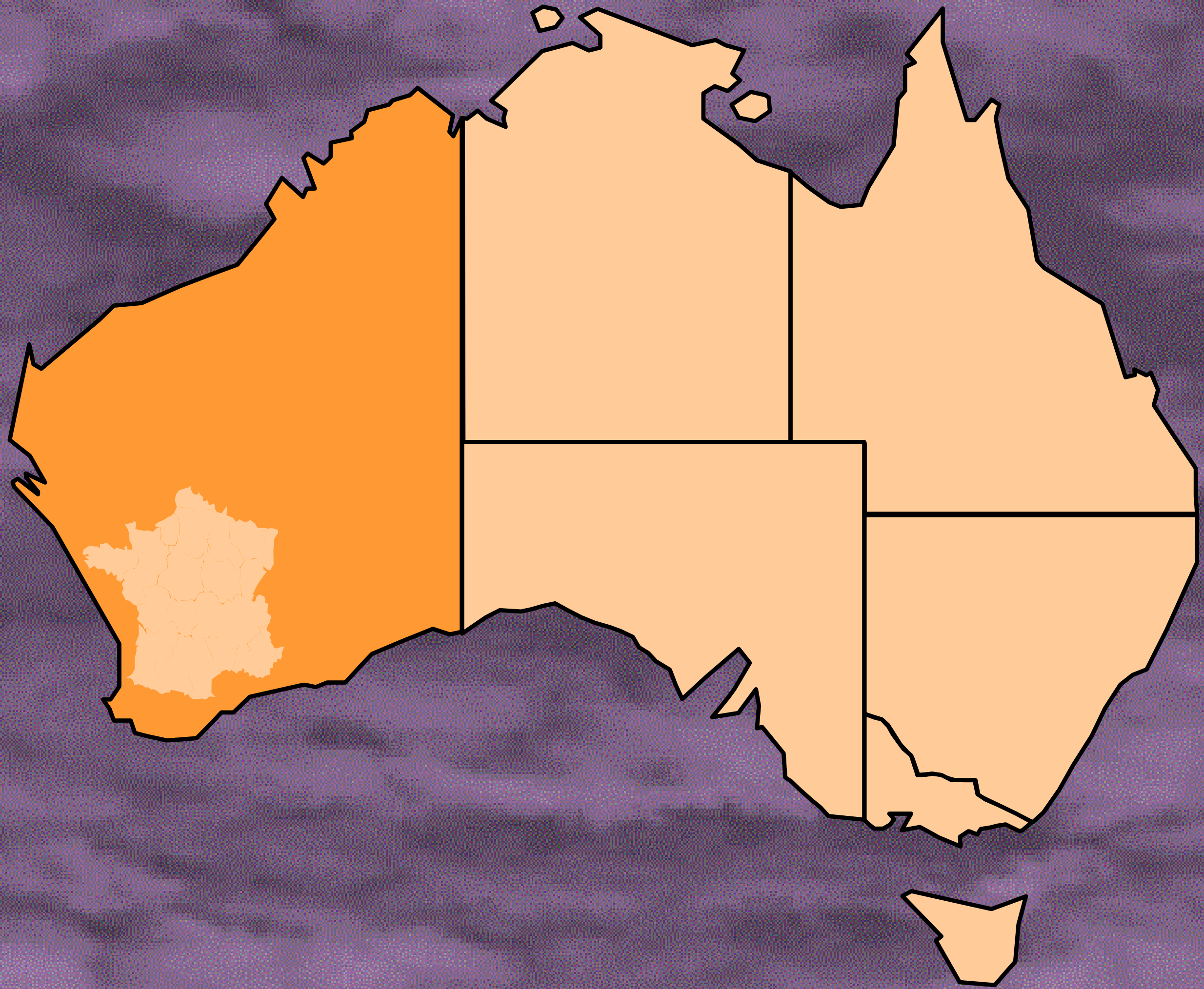
Western Australia

to

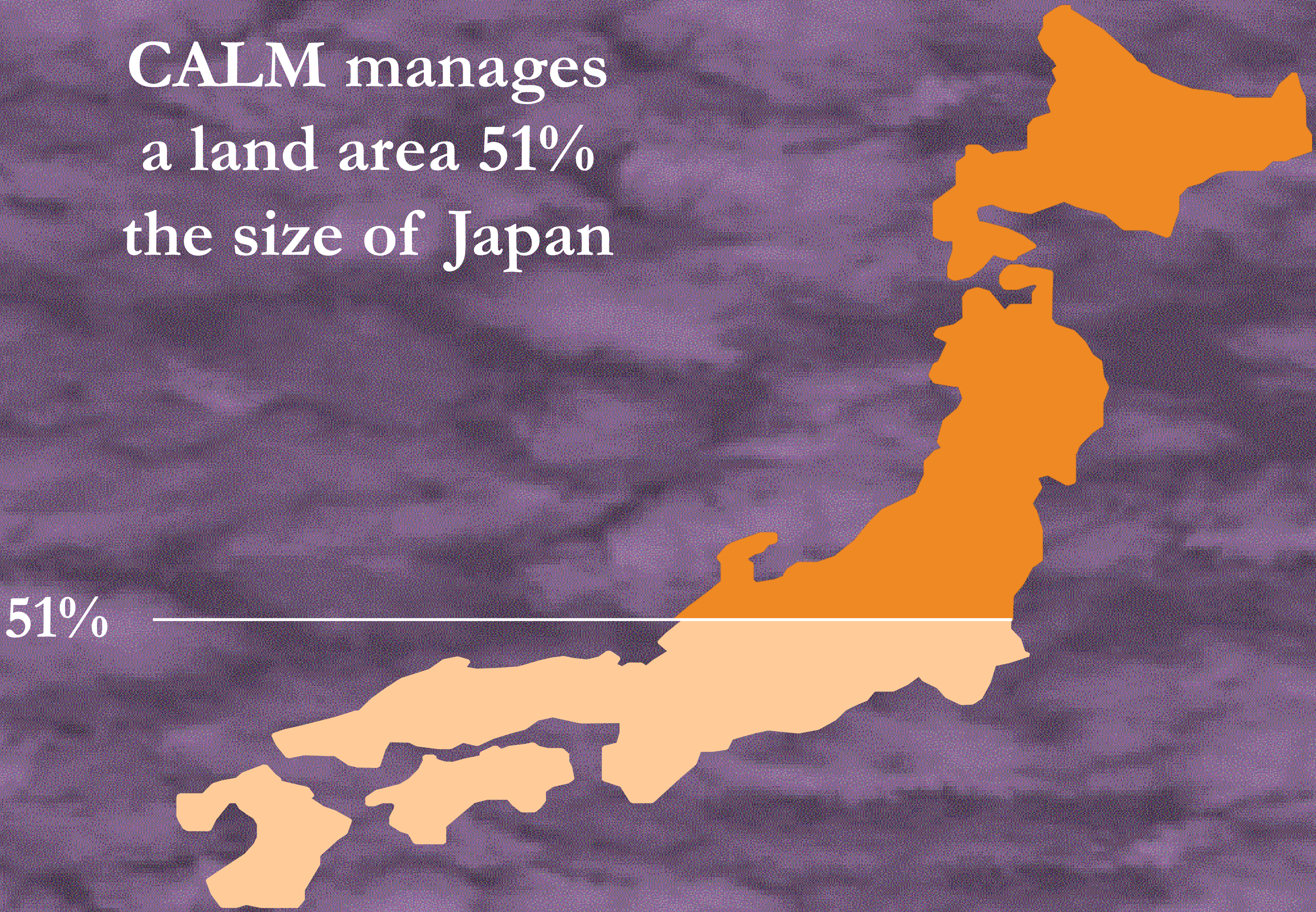
Gorgon Development

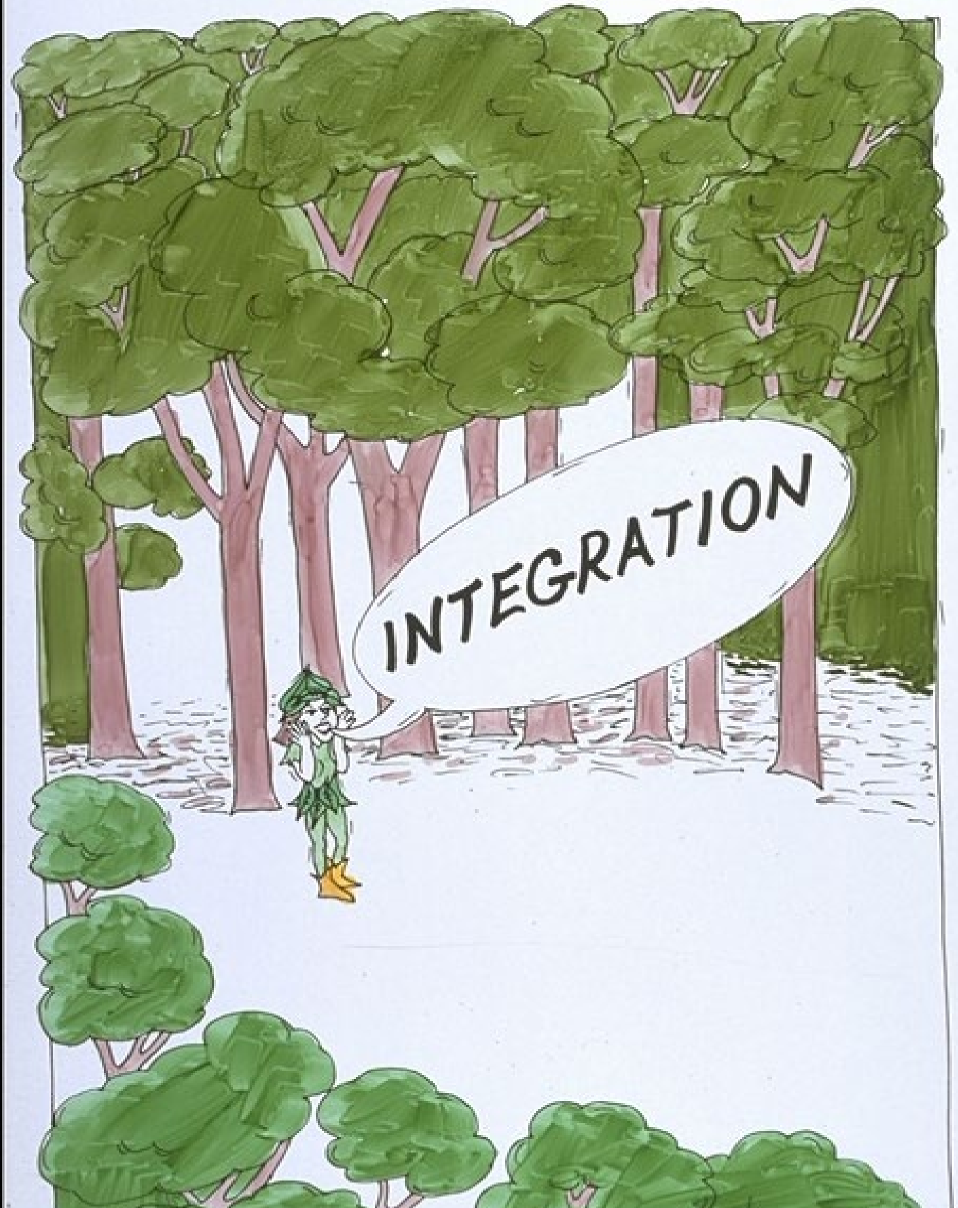
16 December 1998

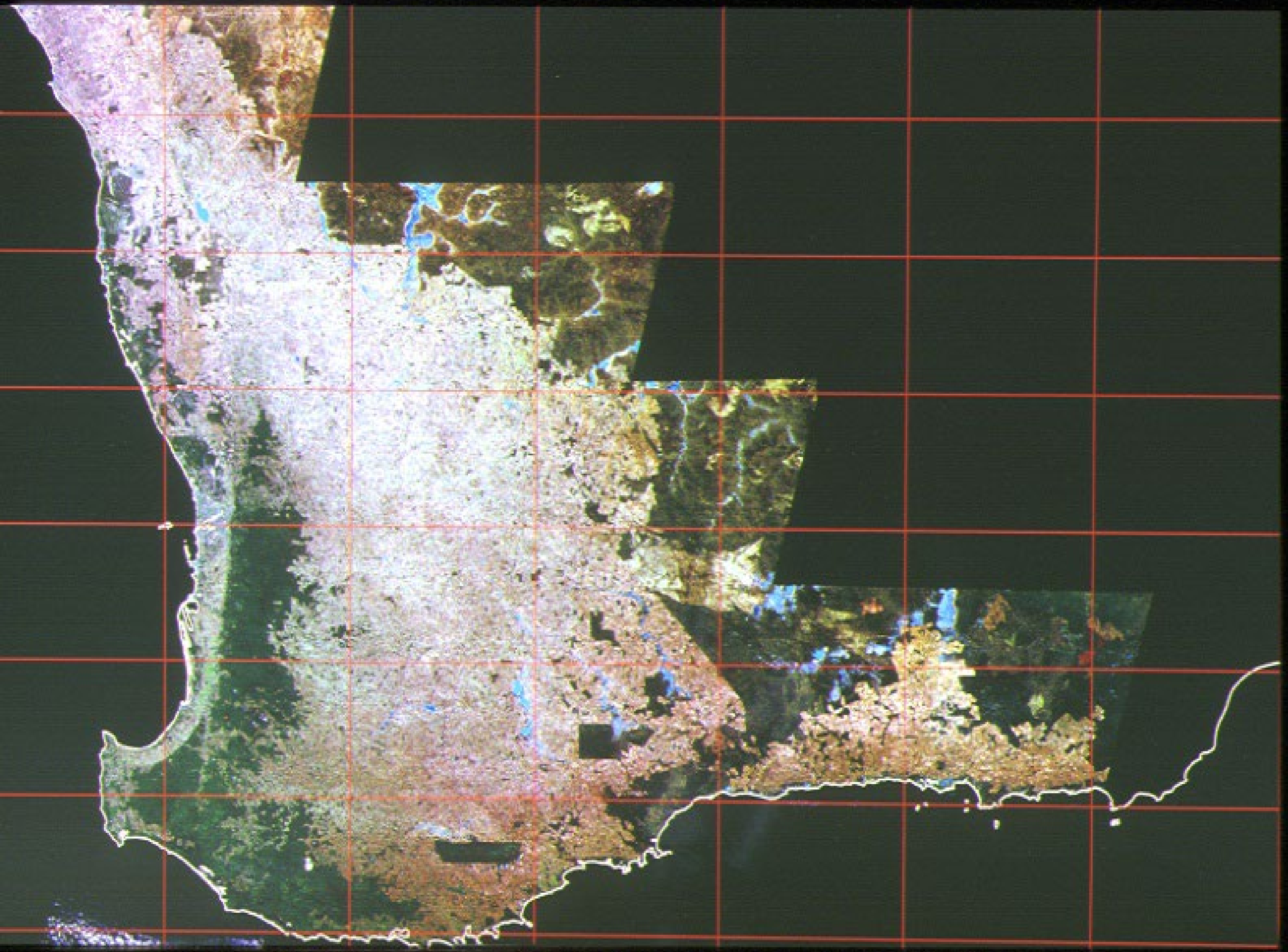
France occupies a land area about a quarter the size of Western Australia



CALM manages a land area 51% the size of Japan




INTEGRATION



Satellite imagery and salinity

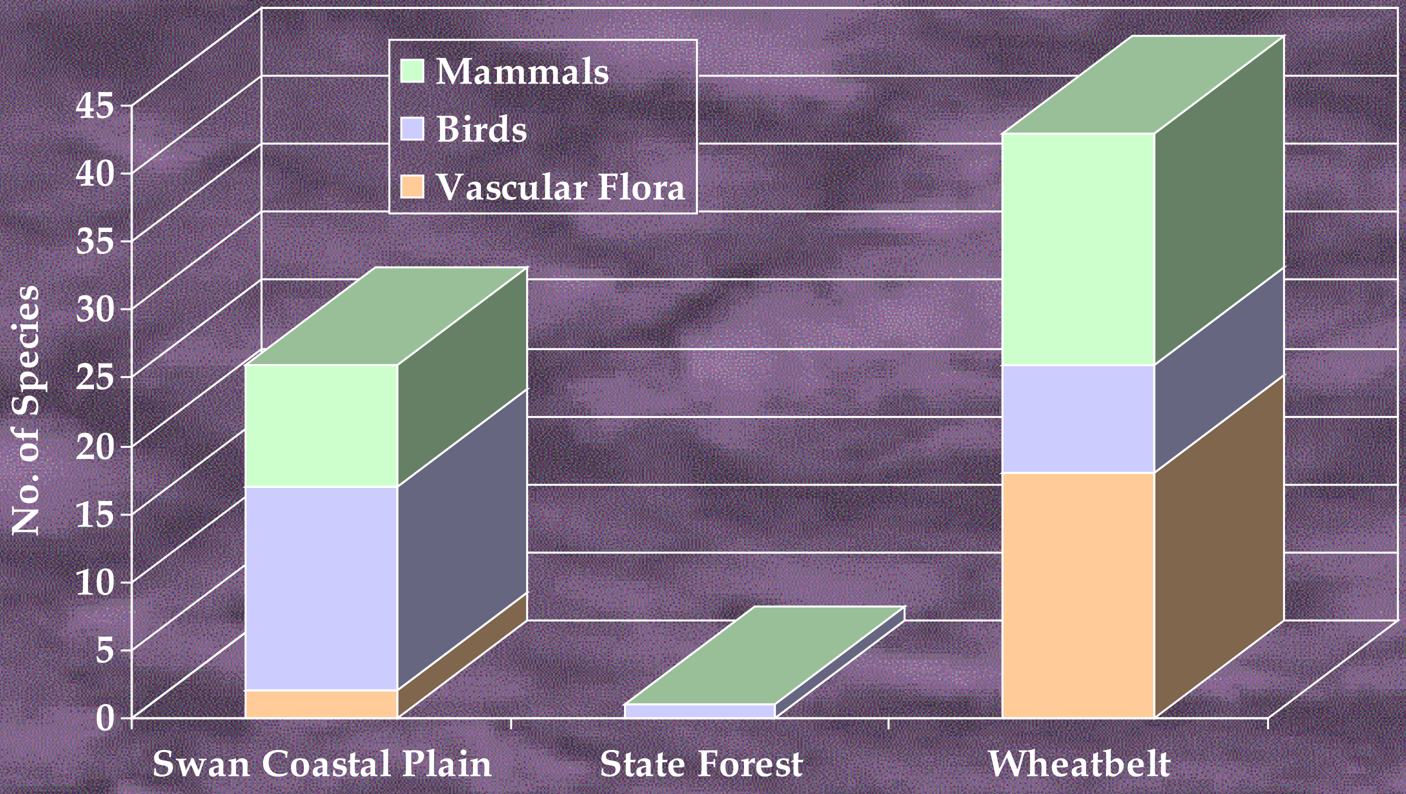
Estimated areas affected by salinity in 1994, 2020 and potential at full development

Region	Total Area	Salt affected 1994		Salt affected 2020		Potential area	
	000ha	000ha	%	000ha	%	000ha	%
South Coast	4 079	395	9.7	688	16.8	977	24.0
South West	3 310	274	8.3	596	18.0	820	24.8
Swan-Avon	7 591	759	10.0	1 290	17.0	3 035	40.0
Northern	4 252	376	8.8	723	17.0	1 276	30.0
Total	**19 231**	**1 805**	**9.4**	**3 296**	**17.1**	**6 111**	**31.8**

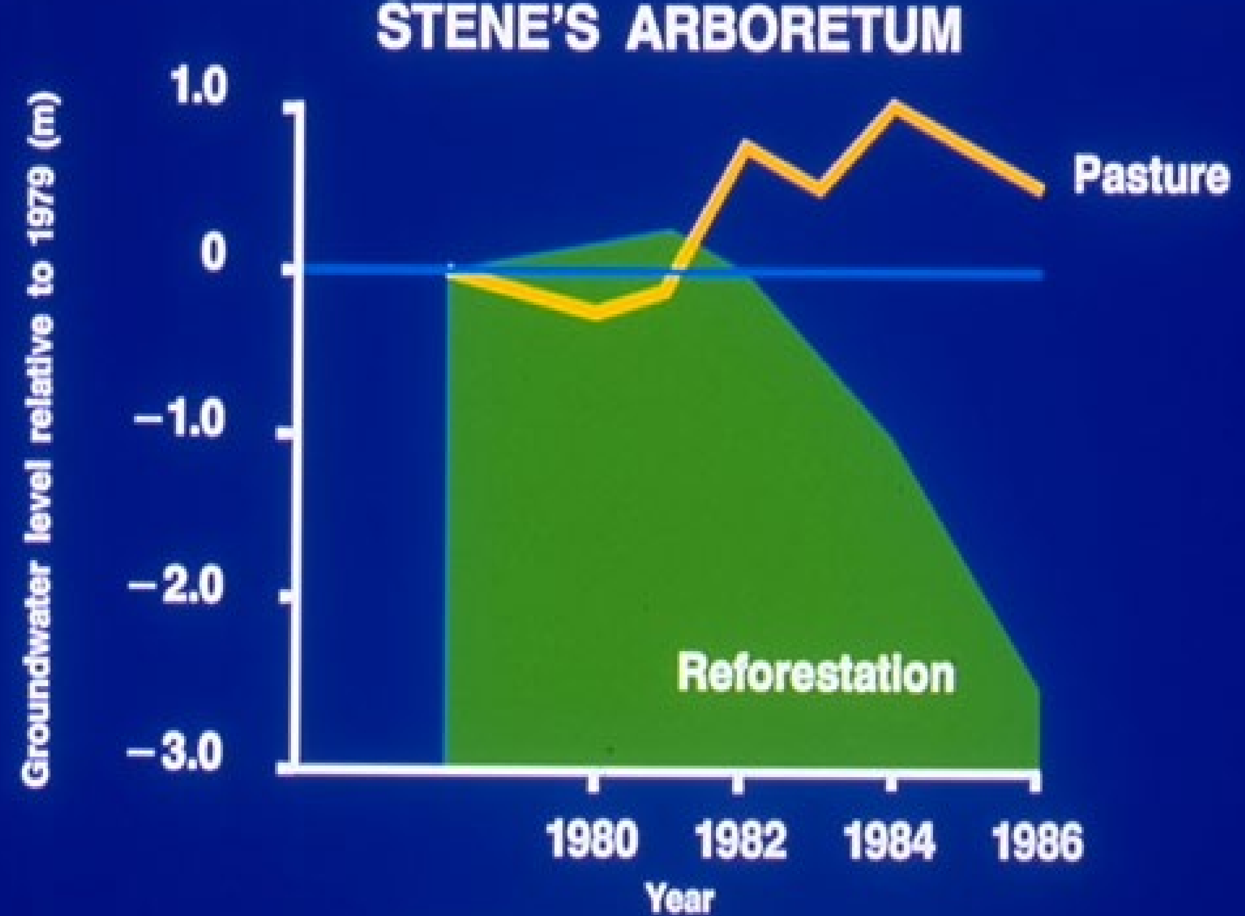
From Ferdowsian *et al*. 1996

Species extinctions since European settlement in 1829

(After Armstrong and Abbott, 1995)

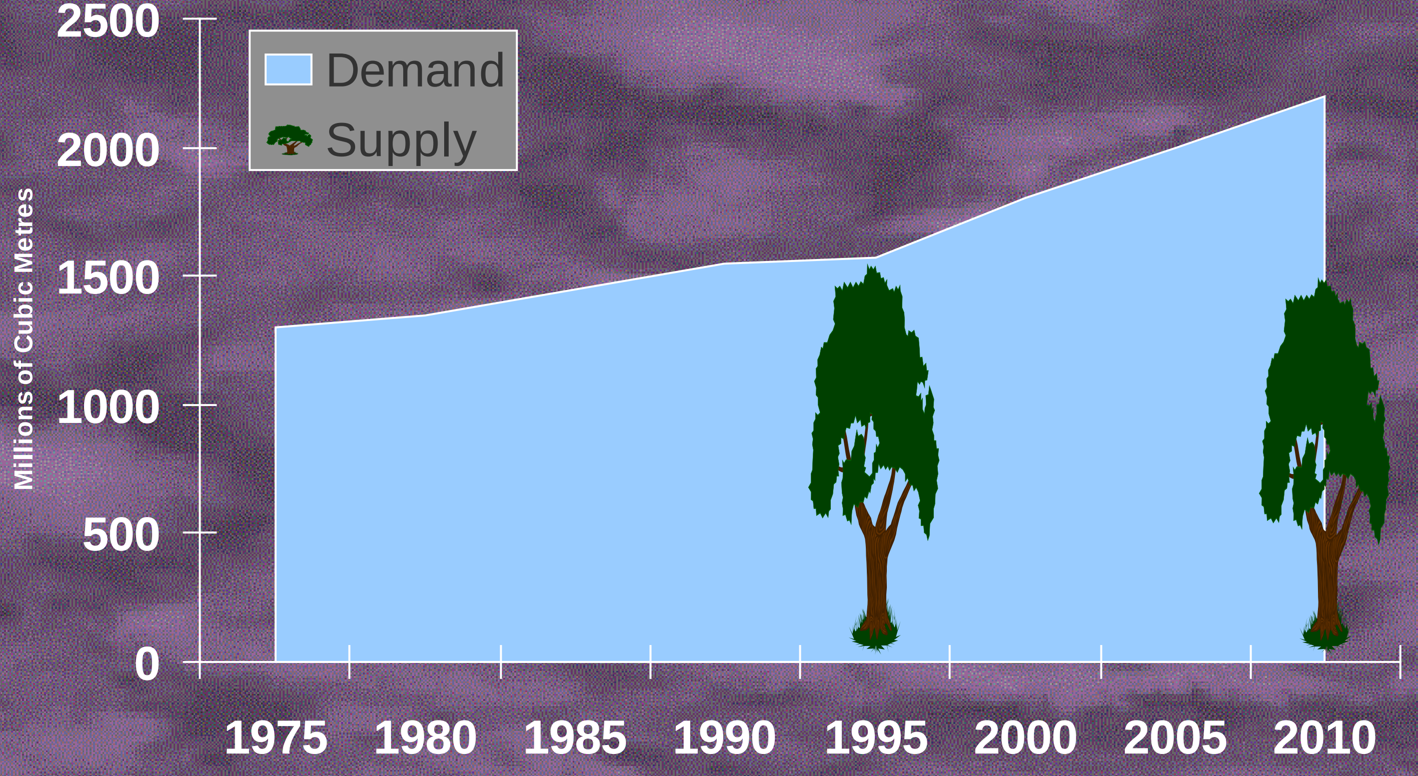


THE EFFECT OF TREE CROPS ON WATER TABLE LEVELS



Water Authority of Western Australia
July 1989
Report No. WS 33

Global wood demand rises as supply falls



Sources: D A Neilson,UN FAO, Apsey & Reed, Jaakko Poyry, Widmans World Wood Reveiw, Xylem Investments Inc

Farm forestry zones by area and rainfall

Farm forestry zone	Rainfall	Area (in million ha)
Traditional pine and new bluegum	> 600 mm	2
New maritime pine	400 – 600 mm	6
Wheatbelt	< 400 mm	10

- Carbon Sequestration - Science and Governance

Extract from Kyoto Protocol - Article 2

Each Party included in Annex 1 in achieving its quantified emission limitation and reduction commitments under Article 3, in order to promote sustainable development, shall:

(a) Implement and/or further elaborate policies and measures in accordance with its national circumstances, such as:

………

(ii) Protection and enhancement of sinks and reservoirs of greenhouse gases ….taking into account ….promotion of sustainable forest management practices, afforestation and reforestation.

High temperatures and lower rainfall could turn much of the Amazon rainforest into desert by the middle of next century

Rainforest will turn to desert, scientists warn

Our planet's lungs may collapse within 50 years, reports Nick Nuttall

[illegible]

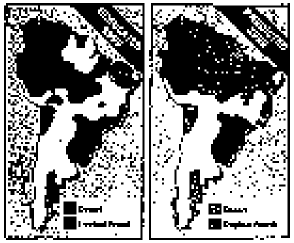
THE URGENT NEED FOR ACTION

[illegible]

[illegible]

' Global warming is already producing the risk of hunger '

[illegible]



Official: 1998 is the hottest for a thousand years

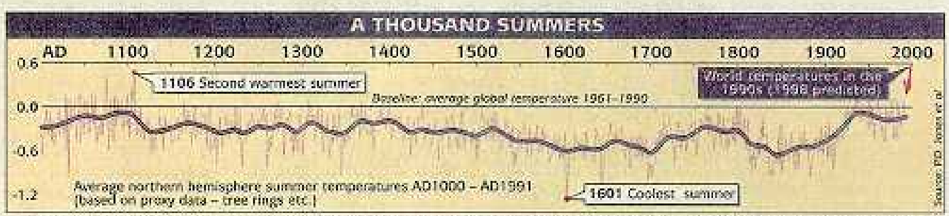
BRITAIN HAS experienced the hottest year in 1998 for the past 1,000 years, according to leading British scientists.

A team at the University of East Anglia has reconstructed the temperature peaks of every year in the last millennium, and these scientists are confident 1998 will be the warmest. Their research shows this year will have been hotter than 1106, the previous record summer in the northern hemisphere.

It is already certain to be the hottest year in the 140-year global temperature record that has been compiled from instrumental readings. In spite of Britain's own soggy summer, there have been record heat-waves and forest fires in many countries.

BY MICHAEL MCCARTHY
Environment Correspondent

But scientists at the university's Climatic Research Unit (CRU) are convinced that, as 2000 approaches, 1998 will also prove to have been the hottest year of this millennium.



The scientists have put together the annual average summer temperatures of the last 1,000 years from "proxy indicators" – measurements of tree-ring growth and analysis of ice cores, which give information about the meteorological conditions deep in the past.

The record, published in the scientific journal *The Holocene*, shows that the 1990s were the hottest decade since before William the Conqueror landed.

The research will add further credence to global warming being caused by industrial gases, such as carbon dioxide from vehicle exhausts and power station emissions.

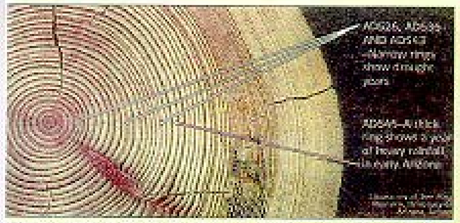
The research is published as ministers and officials from 180 countries begin a two-week conference in Buenos Aires to try to carry forward last year's Kyoto treaty aimed at countering climatic change.

The scientists at the CRU, led by Professor Phil Jones, are in a unique position to assess 1998 as the millennium's hottest year because they are also responsible for updating and maintaining the modern instrumental temperature record for the world, which goes back to 1856. Their data for this year already show that 1998 will beat the previous record – 1997 – by such a significant margin.

The five hottest years in the modern global temperature record are now all from this decade – in descending order: 1998, 1997, 1995, 1990 and 1991.

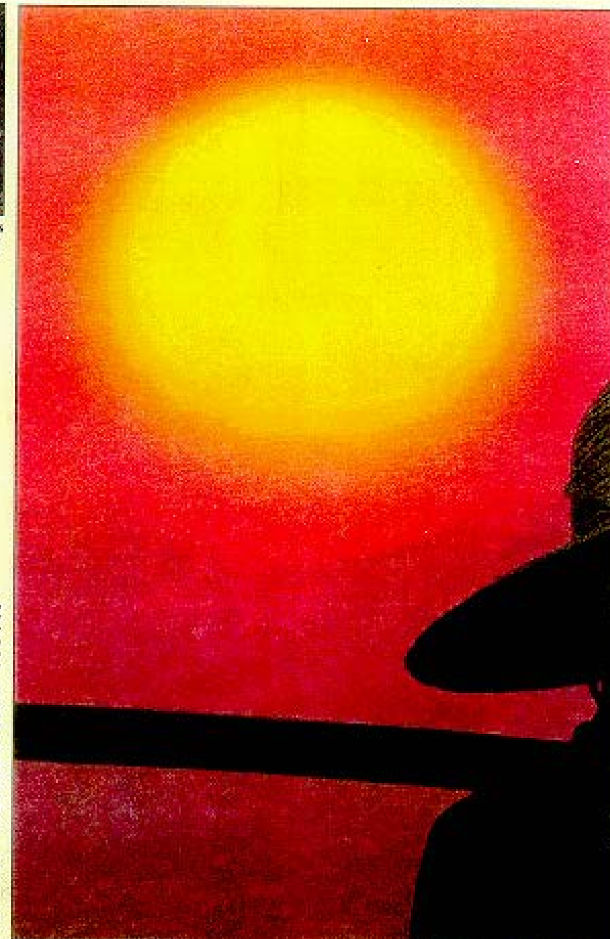
"The bottom line is that we believe the last three to four years have been the warmest of the millennium, and 1998 to have been the warmest of all," Professor Jones said.

1,000 summers, page 3



This cross-section of a Douglas Fir, which grew in Arizona between 322 and 683, shows how climate can be reconstructed from tree-rings. The three very thin rings are years of considerable drought. The fattest ring – year 546 – is a year of much rain

A thousand summers revealed in the trees



Harvest time under the scorching sun: a Chinese farmer in Shunyi, north of Peking — Will Burgess/Reuters

BY MICHAEL McCARTHY
Environment Correspondent

THE STUDY of ancient trees and ancient ice is providing dramatic evidence that the world is now growing notably warmer than it has been for at least the last thousand years.

These so-called "proxy" climate indicators have been used by the scientists at the Climatic Research Unit (CRU) at the University of East Anglia in Norwich to produce a remarkable annual record of summer temperatures of the last millennium. **

Examining the growth rings found inside the trees, and the snowfall and melt rings visible when a core is taken deep into the ice, they have been able to piece together what summer was like for every year since well before the Norman conquest.

They can indicate, for example, that in 1106, when Henry I was on the throne, it was sweelteringly hot, and in 1601, when Elizabeth I had only two more years left to reign, it was decidedly chilly.

But more important than any such annual detail is their discovery that the 1990s have been hotter than any period in the whole 1,000 years, and that 1998 is the warmest year of all.

This has been deduced because Professor Phil Jones and his colleagues at the CRU, who have compiled the 1,000-year "proxy" record, are the very people who are in charge of maintaining and updating the modern instrumental record (now taken by accurate thermometers) which goes back to 1855. Professor Jones, one of the world's leading experts on the global temperature record, does not equivocate. "The work we have done with various proxy climate indicators would indicate that 1998 will probably be the warmest year of the millennium," he says.

Much of data for the temperature reconstruction has been uncovered by his colleague, Dr Keith Briffa, whose academic interest is made clear by a notice on his office door: *Tree Rings Tell It Like It Was.*

Dr Briffa is one of the world's leading experts on deciphering climate signals from the concentric circles visible when a tree is cut across its trunk. Each ring represents a year's annual growth, and in general, the thicker and denser the ring, the more favourable that year's growing conditions.

In northern latitudes, warmth (or the lack of it) is usually the limiting factor: a wide ring means a hot summer. In drier regions, such as the south-western United States, the limiting factor is moisture, (as illustrated in the picture above).

Ice cores are analysed in two main ways: for their melt layers, which record how warm a summer was by how much ice melted and refroze; and by analysis of their oxygen isotopes – the heavy isotope O-18 is more present in years that were warm. The scientists at the CRU have used 17 separate sets of data to build up summer average temperatures for both hemispheres from 1000 to 1991, with 10 of them used to produce their northern hemisphere record.

Five of those are from tree rings, from northern Sweden, western Siberia, Alberta and Manitoba in Canada, and Idaho in the US.

Three data sets are from ice cores, one from Spitzbergen and two from Greenland, and the remaining two are written records of temperature compiled for central England and central Europe, which go back to the 17th and 16th centuries respectively.

The scientists are quick to point out that there are many uncertainties, especially in the earlier part of the record up to about 1500, which relies on only four data sets, three from tree rings and one from ice cores. But they have found that when they come to the more recent period, when temperatures were recorded accurately by scientific instruments, the "proxy" record corresponded closely with the "instrumental" one.

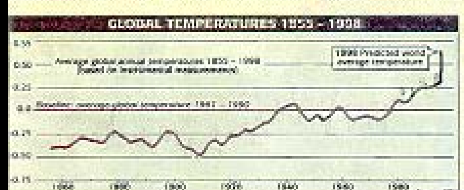
"We can learn an enormous amount about the climate of the past from proxy indicators," Dr Briffa said. "All the time there is an increasing sophistication of the methods by which we can interpret the data."

Another of the world's leading tree-ring experts, Professor Henri Grissino-Mayer from Valdosta State University, Georgia, is full of admiration for Professor Jones, Dr Briffa and their colleagues, and their thousand years of temperature history.

"They have uncovered a major modern disruption of the temperature record," he says. "By putting the tree-ring record alongside the modern instrumental record, these guys have discovered that the temperatures we are experiencing now are unprecedented for the last 1,000 years.

"It is a phenomenal discovery," said Professor Grissino-Mayer.

** *High-resolution palaeoclimatic records for the last millennium: interpretation, integration and comparison with General Circulation Model control-run temperatures.* PD Jones, KR Briffa (Climatic Research Unit, University of East Anglia) TP Barnett (Scripps Institution of Oceanography, La Jolla, California) and SFB Tett (Hadley Centre for Climate Prediction and Research, Bracknell Berkshire), *The Holocene* 8, (1998) pp455-471.



How the early swallow proves global warming

BY JOHN INGHAM
ENVIRONMENT CORRESPONDENT

Birds are yardstick for changes in climate

ONE swallow may not make a summer but it could help prove that global warming is taking place.

Ministers are considering using the arrival date of the summer's first swallow as a yardstick for climate change. The proposal is included in a report commissioned by the Department of the Environment as part of its quest to find "environmental indicators" — measures by which the Government and public can test Britain's green performance.

The latest research shows that swallows are arriving on average nearly two weeks earlier than in the 1950s. But the real acceleration has come in the 1990s with the birds being spotted a week earlier than ten years ago.

This coincides with a dramatic increase in temperatures worldwide. The seven warmest years since records began 150 years ago have all occurred in the past decade. Earlier this week scientists confirmed that 1998 will be the hottest year in the past 1,000 years, easily surpassing the previous record holder, 1997.

The man behind the swallow research, Tim Sparks of the Institute of Terrestrial Ecology, said: "Summer migrants are getting here earlier. Research in Surrey also shows that trees are coming into leaf 11 days earlier on average than in the 1980s.

"Global warming is playing a major role in this. These birds and trees are sensitive to temperature and this decade has been the warmest on record. For every one degree increase in spring temperatures, swallows arrive two to three days earlier. If we see the expected four degree increase by the year 2100, swallows could by be regularly getting here by mid-March."

Mr Sparks was backed by the authoritative British Trust for Ornithology whose newly-released Garden BirdWatch Handbook declares: "Our summer visitors do seem to be arriving earlier in many areas than they did in the 1940s and 1960s."

Details emerged as officials from 180 countries continued negotiations in Buenos Aires to tackle global warming by finding ways to reduce emissions of greenhouse gases such as carbon dioxide.

British ministers want a series of indicators to help them assess how rapidly global warming is advancing.

They commissioned a report which proposes 35 "barometers" from the natural world. Mr Sparks said: "Swallows are a good indicator because their arrival is sensitive to temperature."

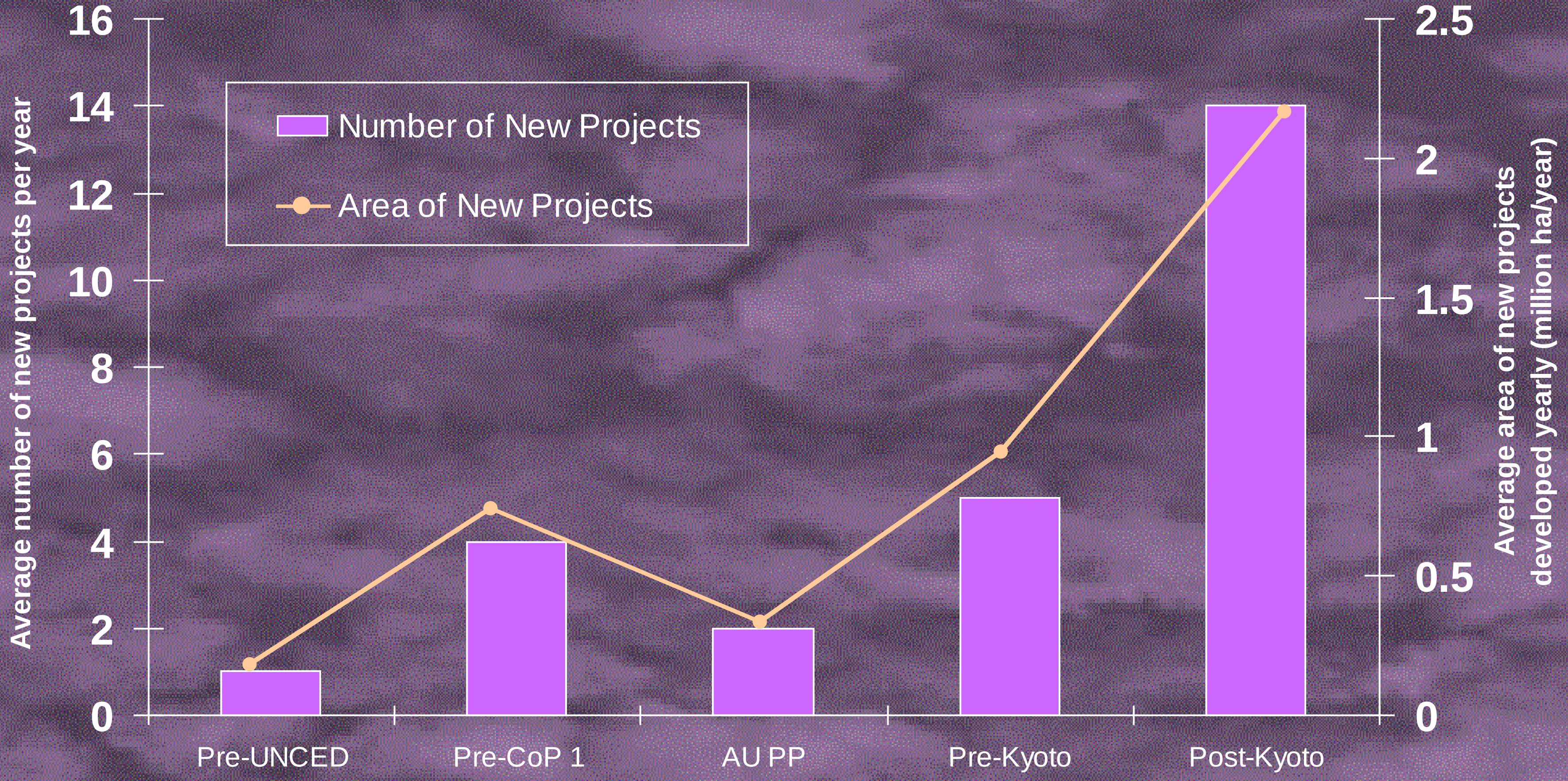
Other indicators include temperatures, river flows, potato yields, the health of beech trees, breeding success of garden birds such as robins as well as wren populations because the tiny bird is vulnerable to cold winters.

● Deadly tropical diseases such as dengue fever, malaria and cholera could spread to the West as a result of global warming, Harvard scientist Dr Paul Epstein warned yesterday in a report for the World Wide Fund for Nature.

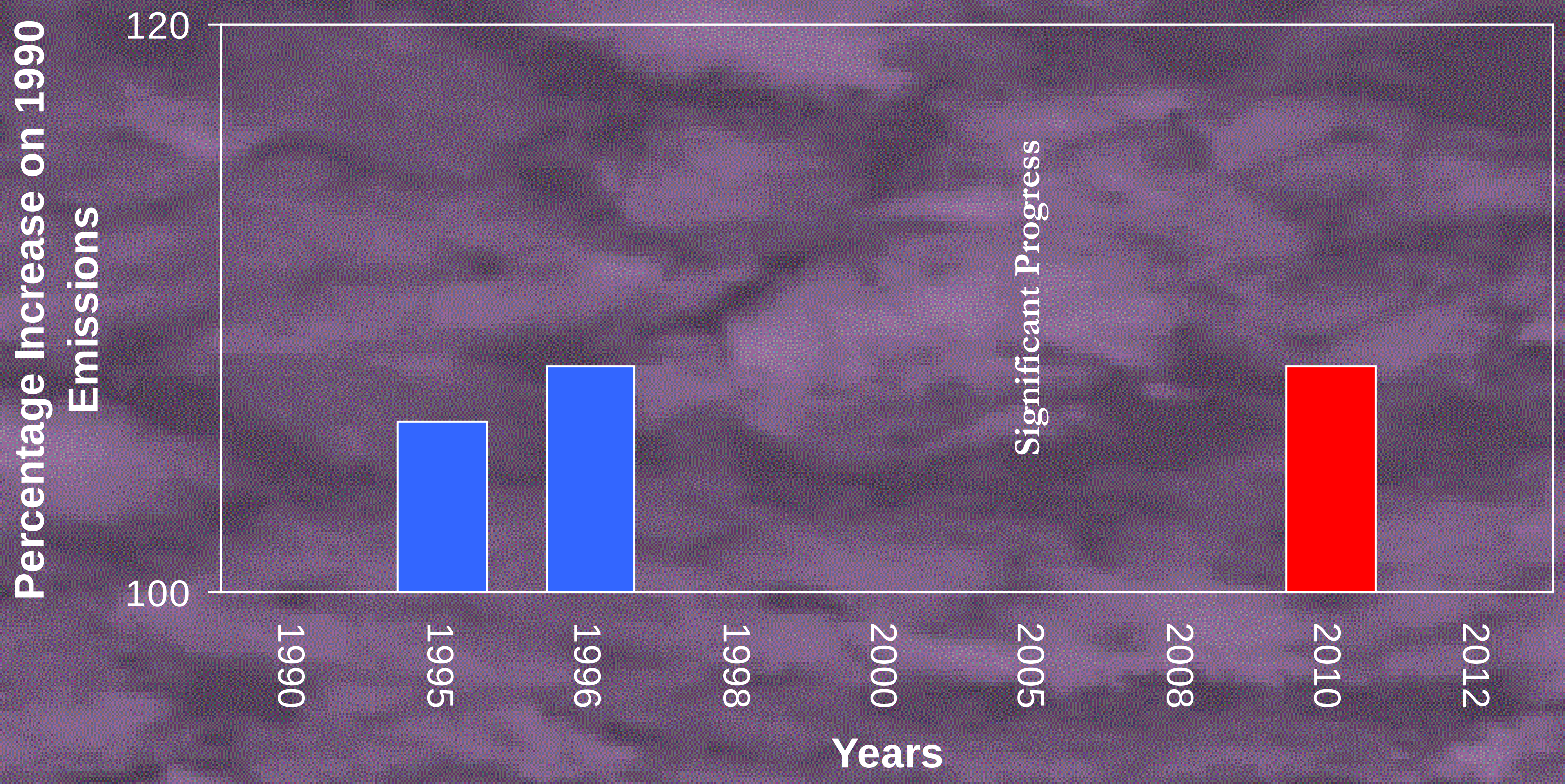
AVERAGE ARRIVAL DATES OF MIGRATING BIRDS IN HERTFORDSHIRE

	1890s	1990s
Swallow	April 8	March 26
Willow Warbler	April 9	March 28
Chiff Chaff	March 25	March 10
Garden Warbler	April 28	April 17
Blackcap	April 19	Overwinters
Swift	May 3	April 20

Carbon Sequestration Projects



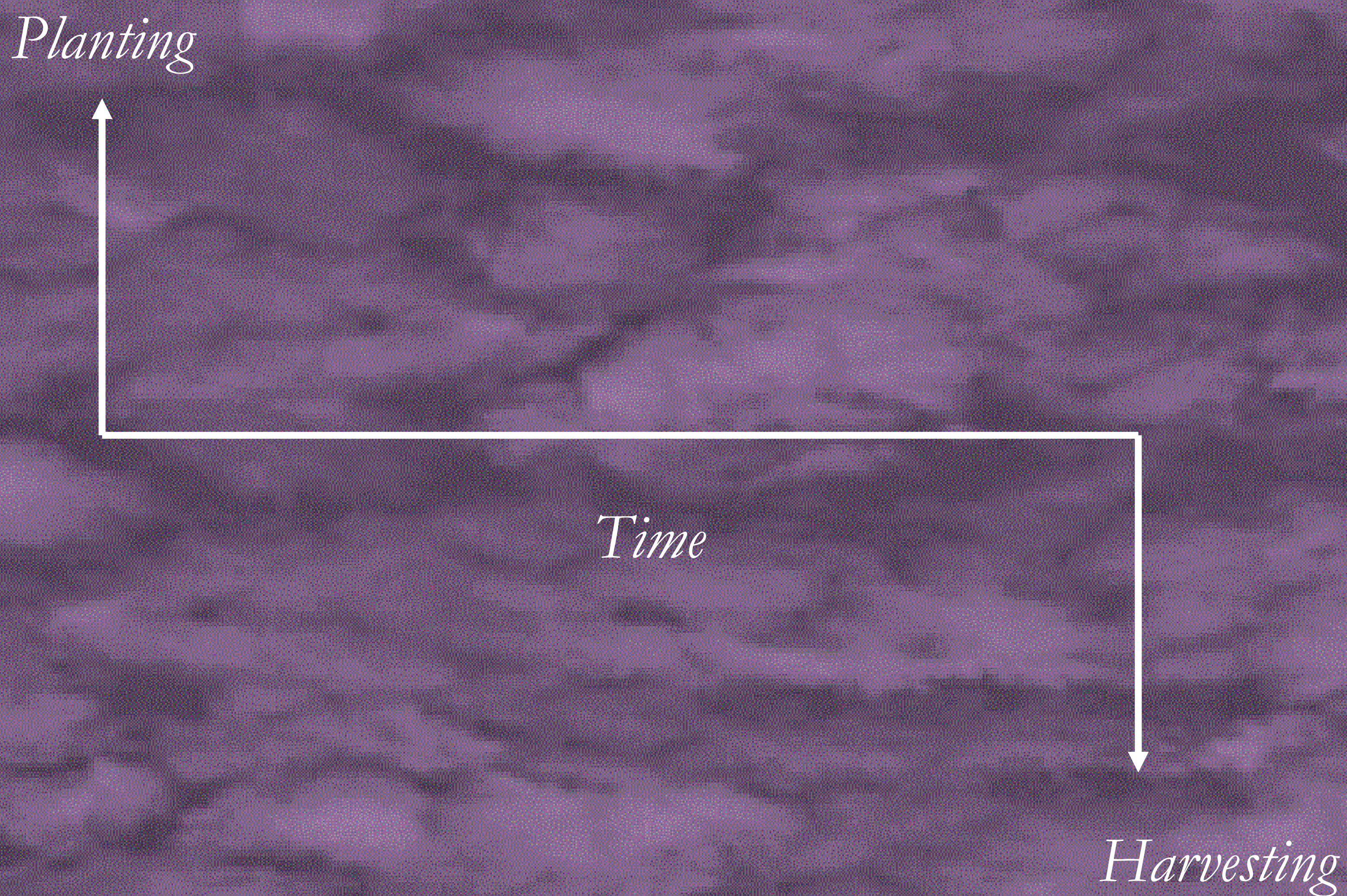
Australia’s Kyoto Targets



Australia's Kyoto Targets

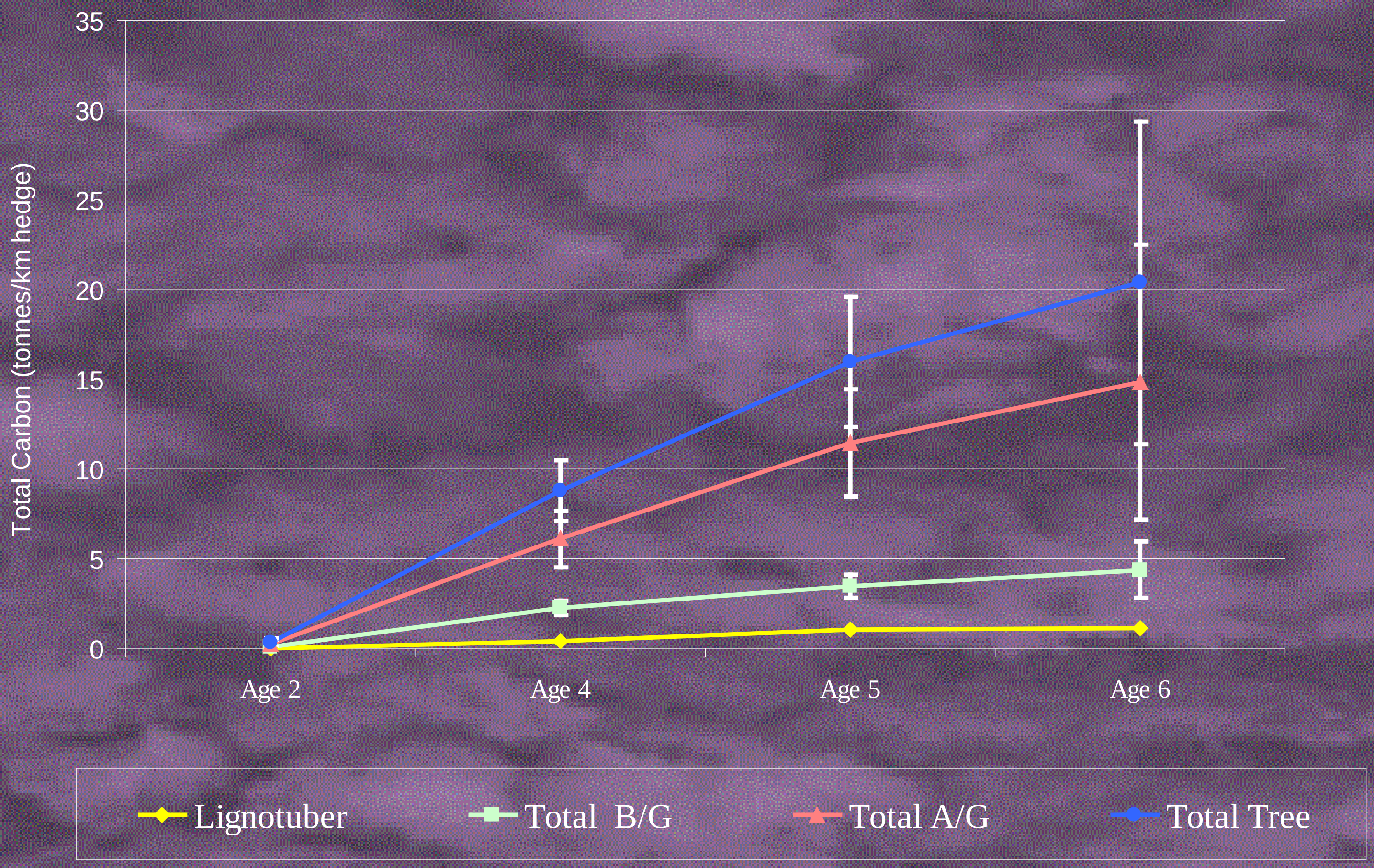
Current proposed resource projects in Western Australia could consume Australia's allowable growth in emissions of approximately 40 million tonnes of CO_2.

The Current Rules

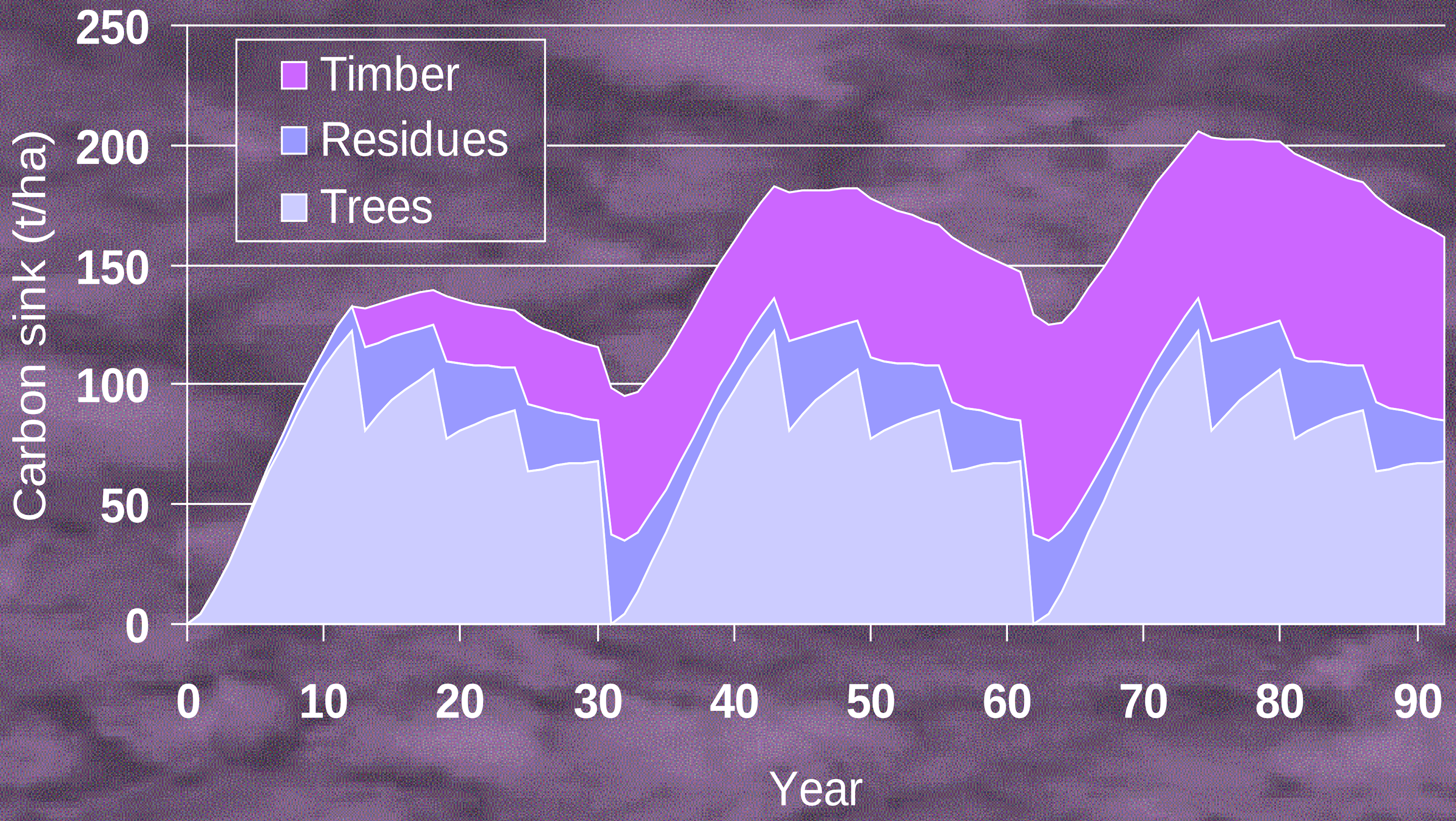


- Measuring Carbon Sinks -

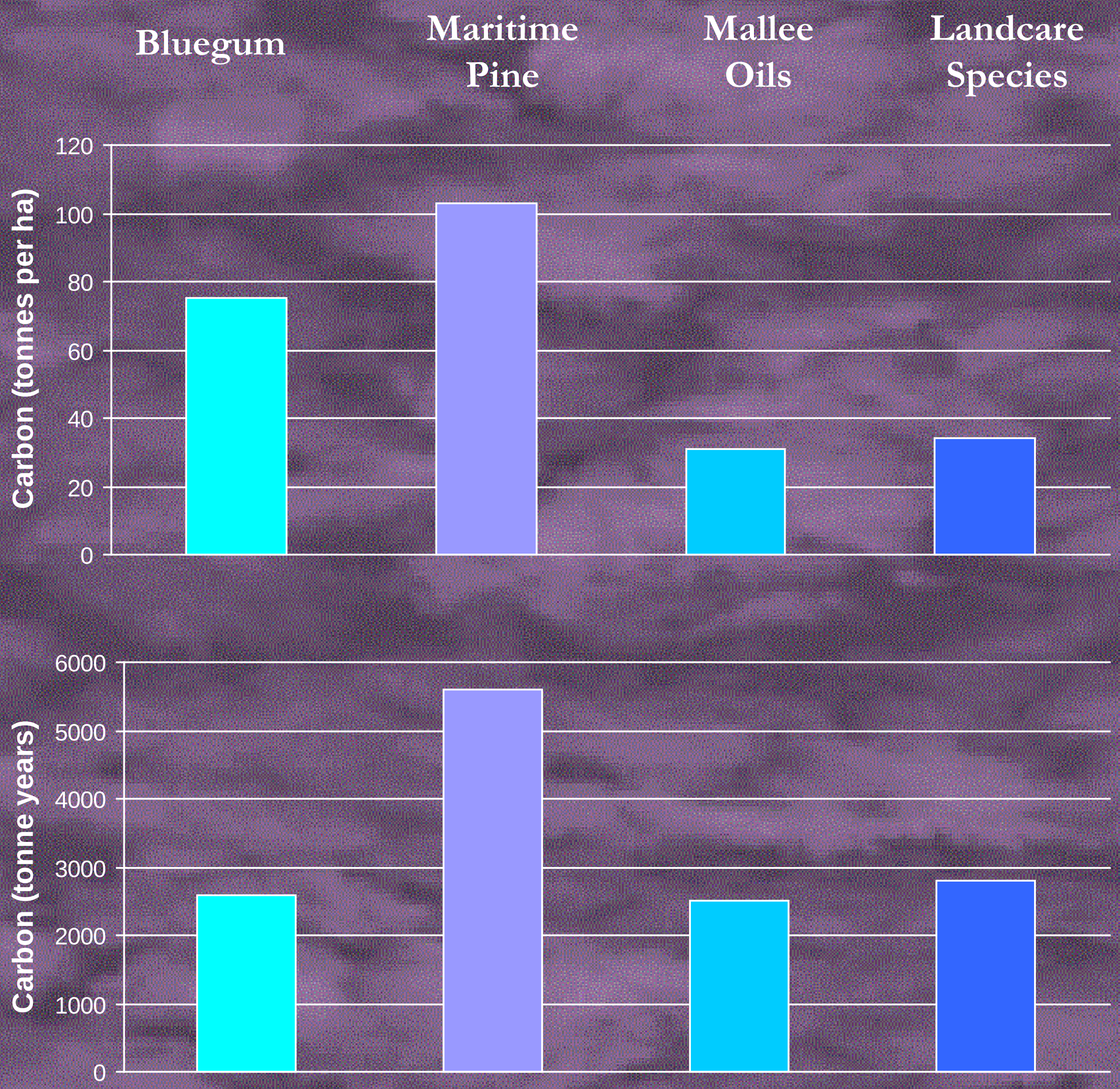
Total carbon per kilometre of hedge for *Eucalyptus plenissma* for different ages and tree components with standard deviation



Carbon sinks from Maritime Pine

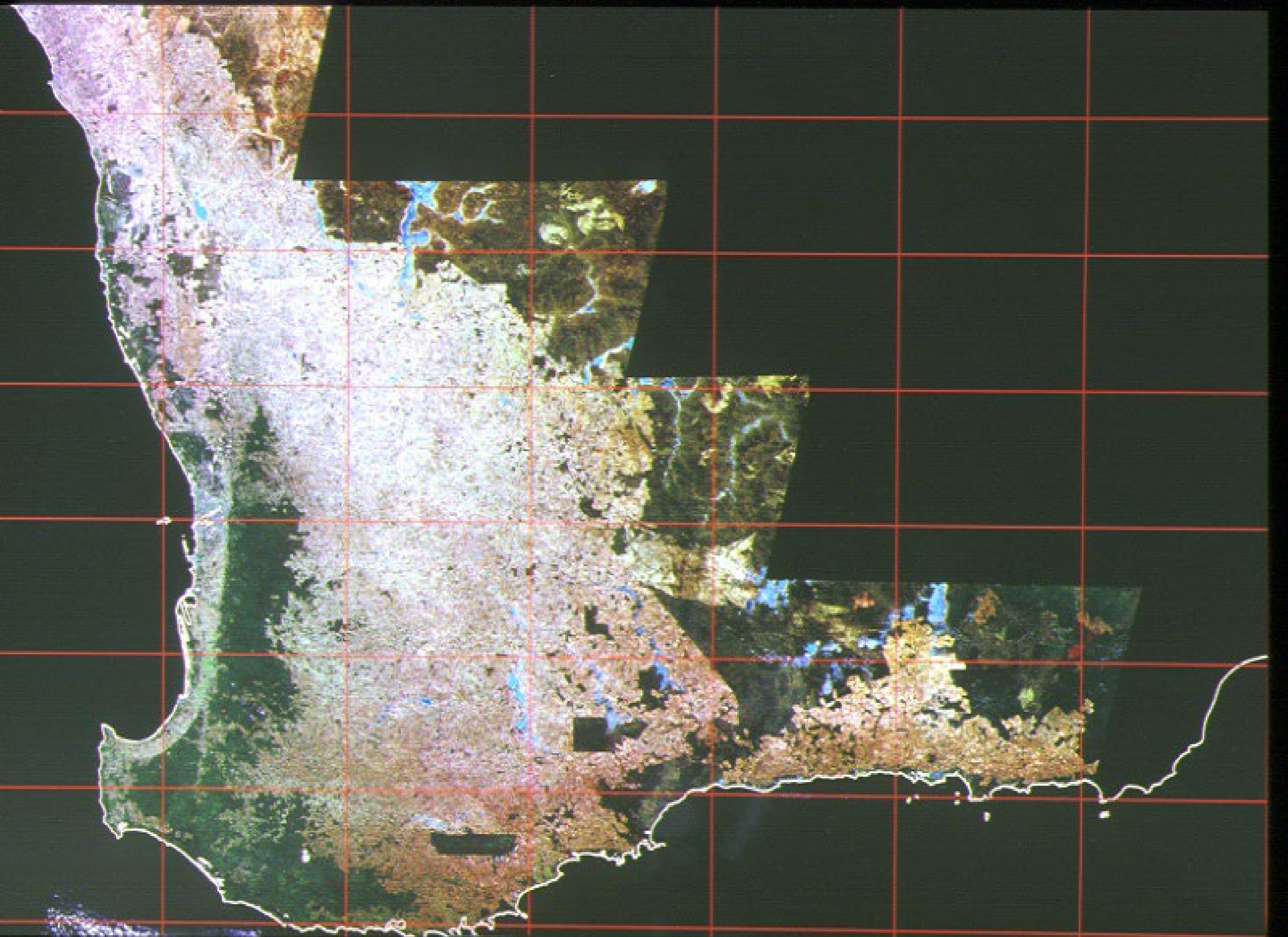


Carbon Sinks for Different Species

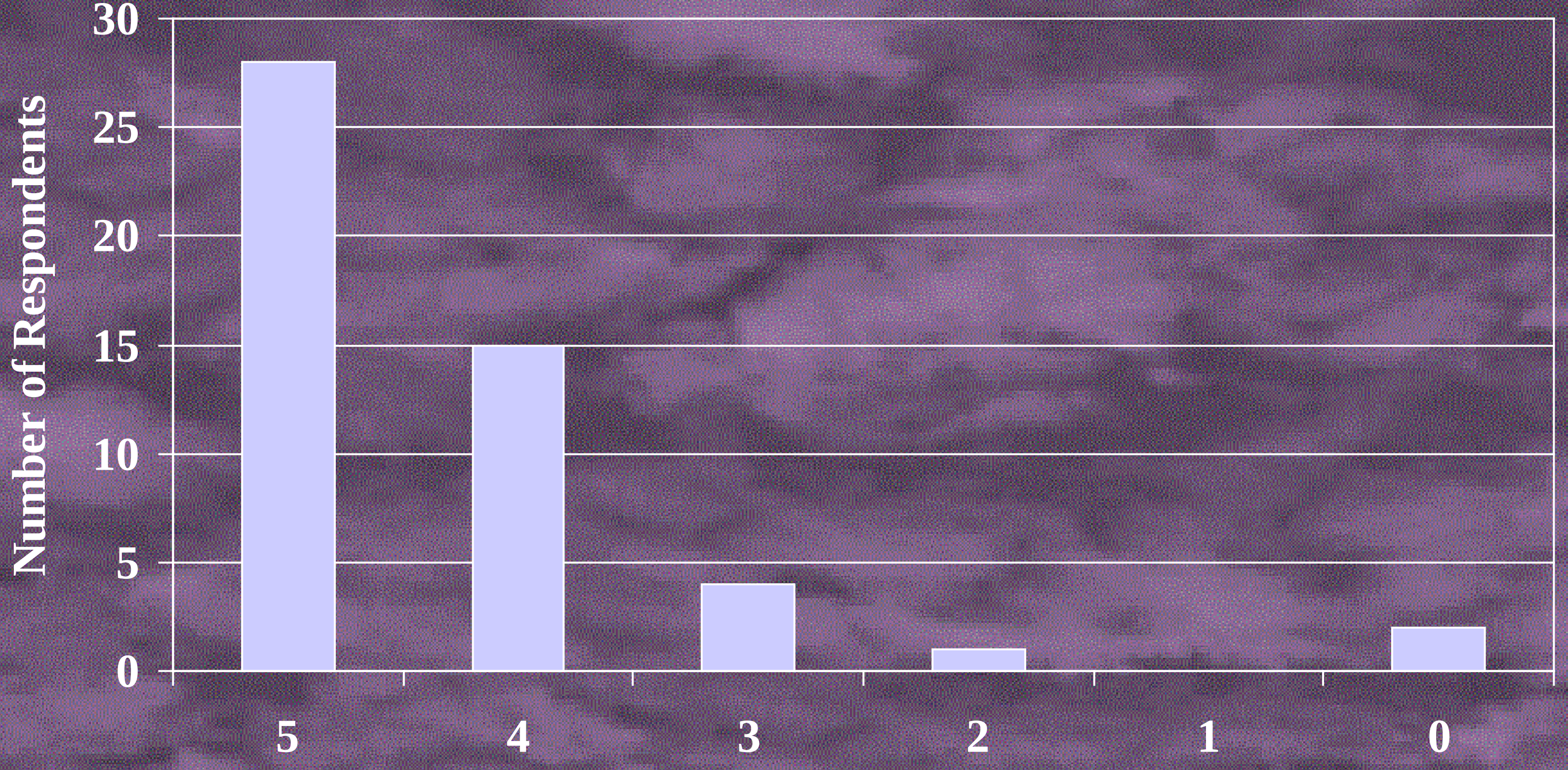


- Critical Elements of Carbon Sequestration Strategies -

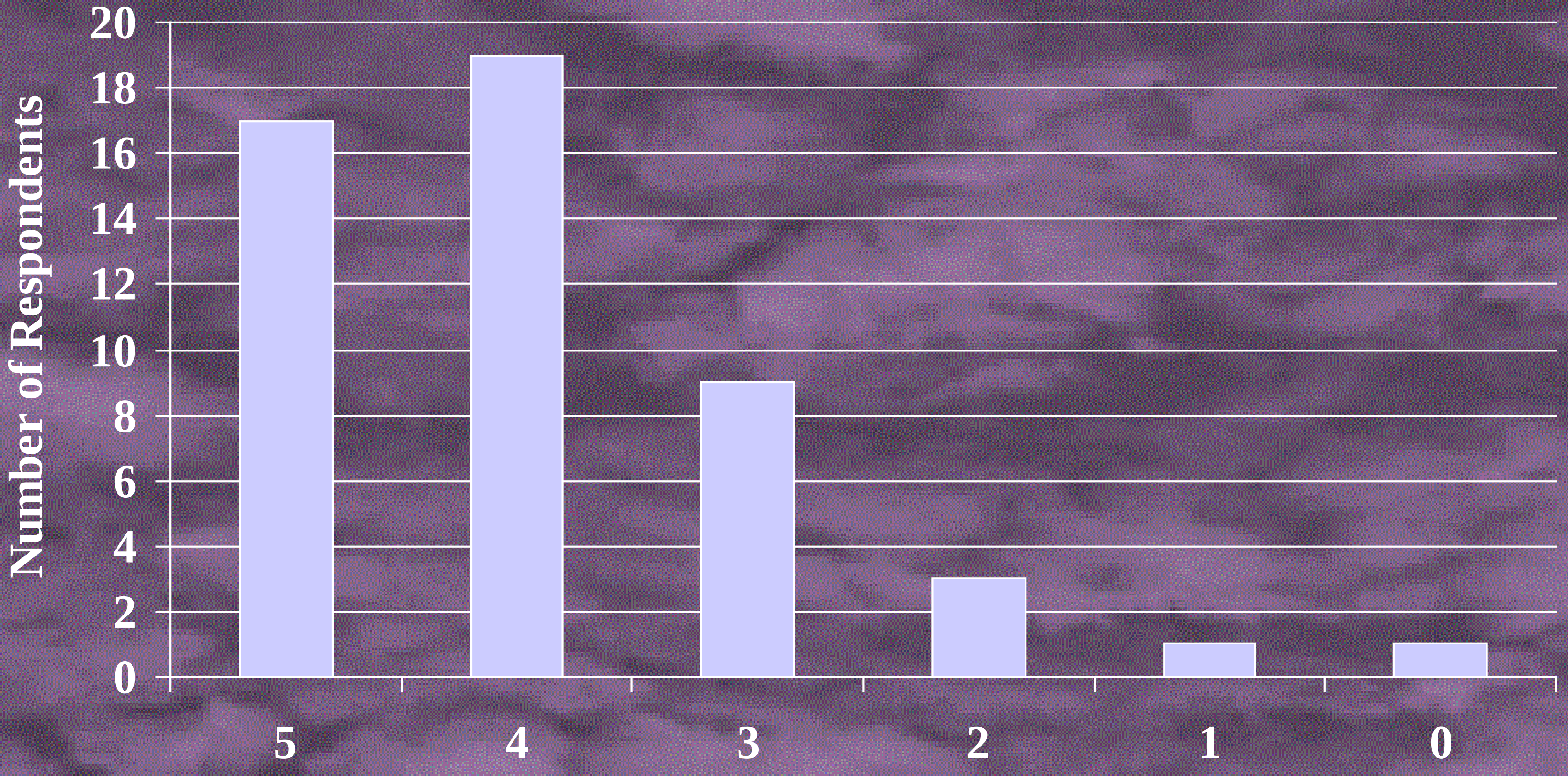
Land Availability



Attitude of establishing tree crops on farms



Importance of tree crops in increasing financial status of farming families

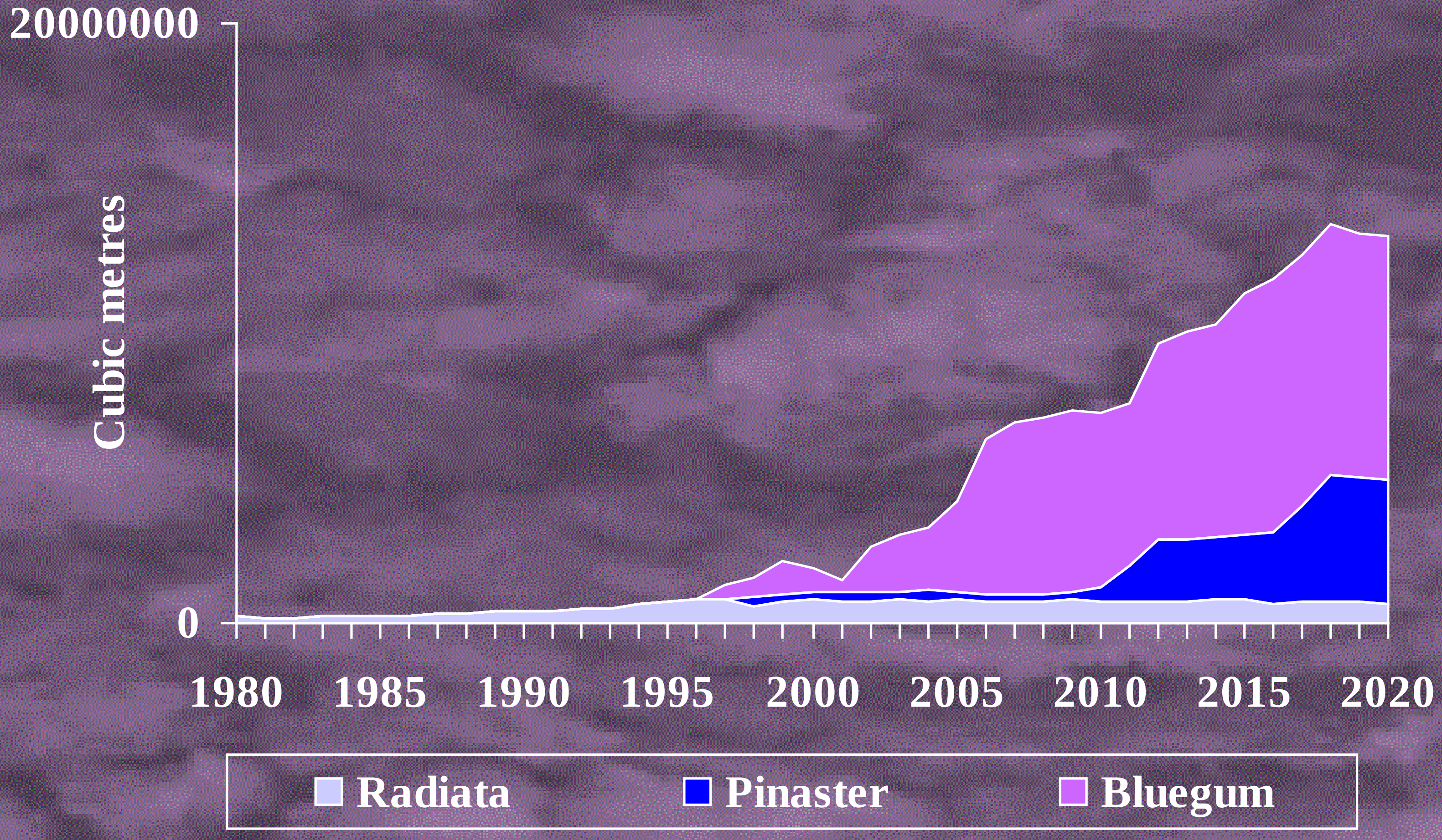


CALM has joint ventures with 1500 farmers

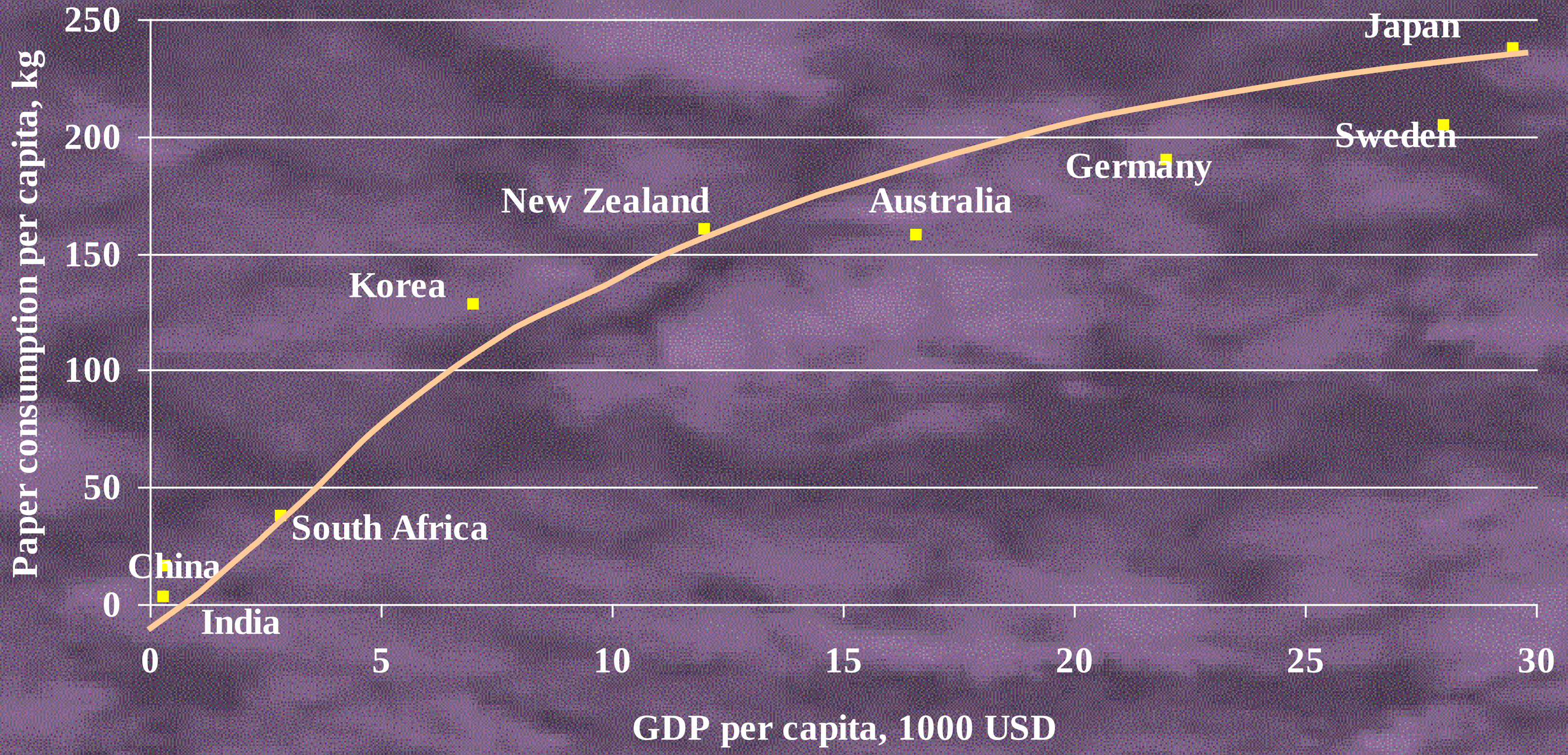
CALM has contracts with 84 land management contractors

Integration with Environmental and Economic Objectives

Current and predicted wood fibre production from tree crops and plantations in Western Australia

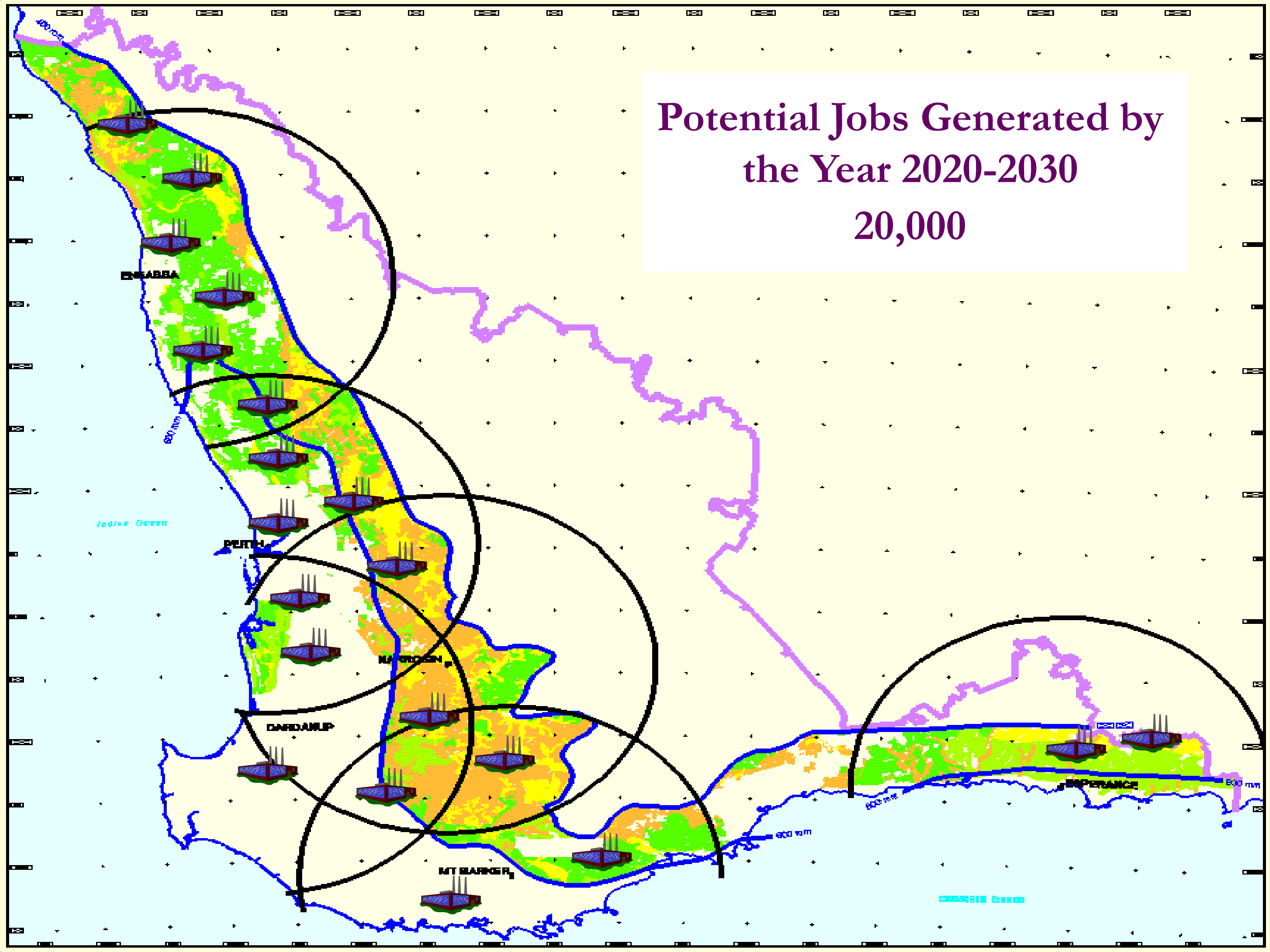


GDP and paper consumption (for selected countries in 1992)

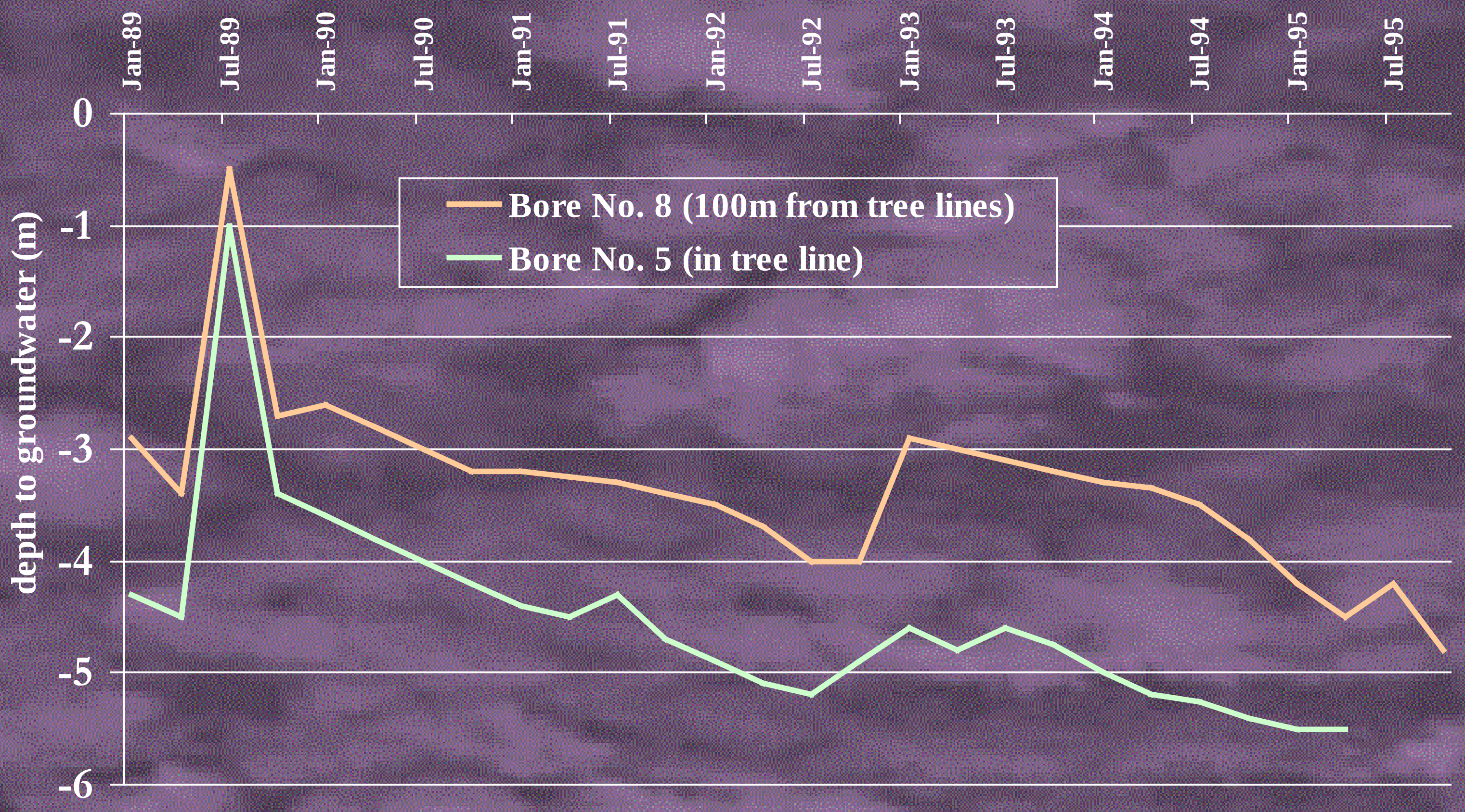


If growth 1990-96 (12% pa) continues, China will use the current world paper demand (279 million Mt) by 2015

Source: Jaakko Poyry Dana Ltd


Potential Jobs Generated by the Year 2020-2030
20,000
ENEABBA
PERTH
NARROGIN
DARDANUP
MT BARKER
ESPERANCE

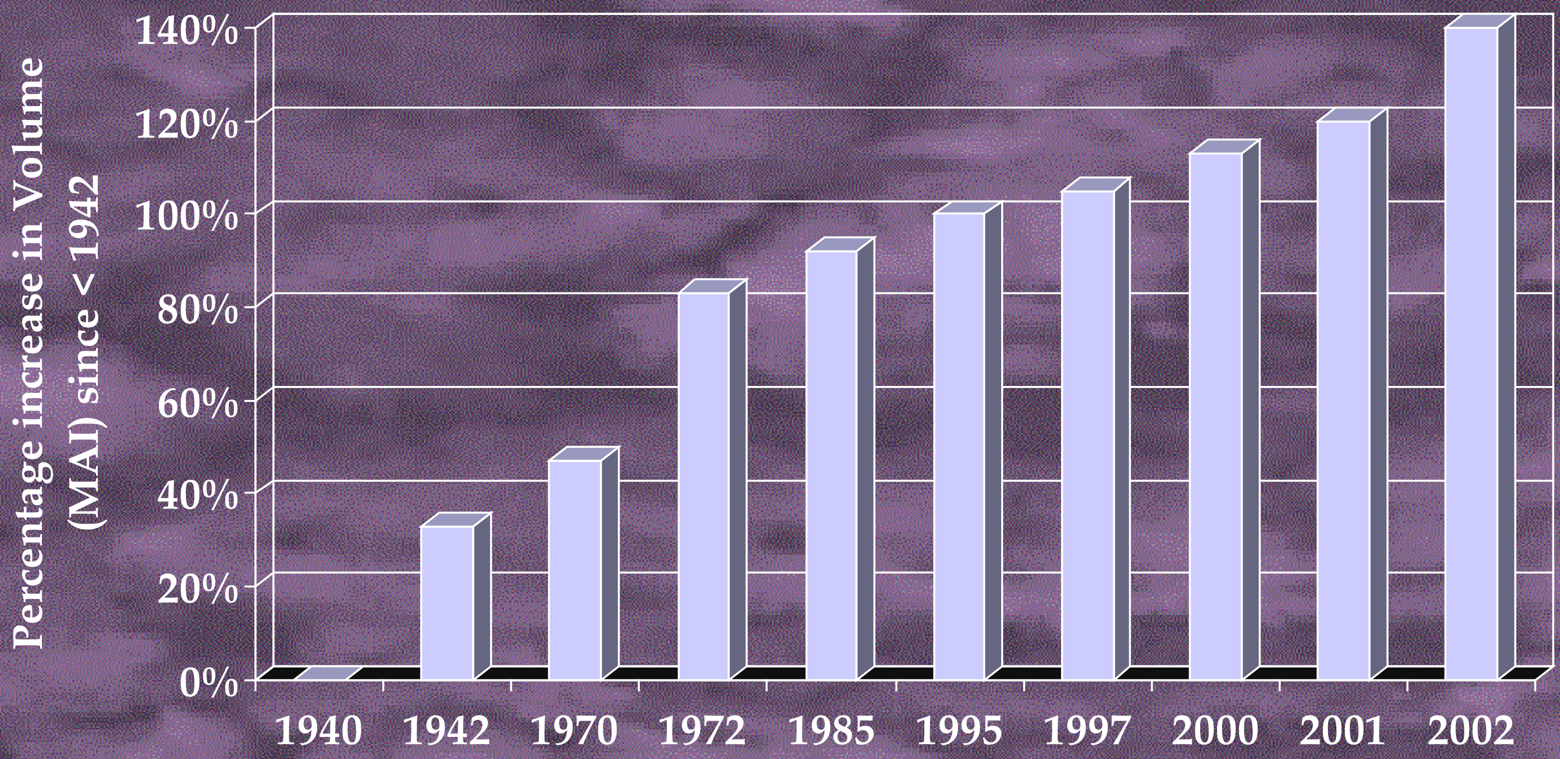
Hydrograph showing groundwater response to alley farming system (after Short and Skinner, 1996)



Quenda Response to Fox Control (Batalling Forest Block)

Availability of Suitable Species

Volume gains from the tree improvement program for Maritime Pine

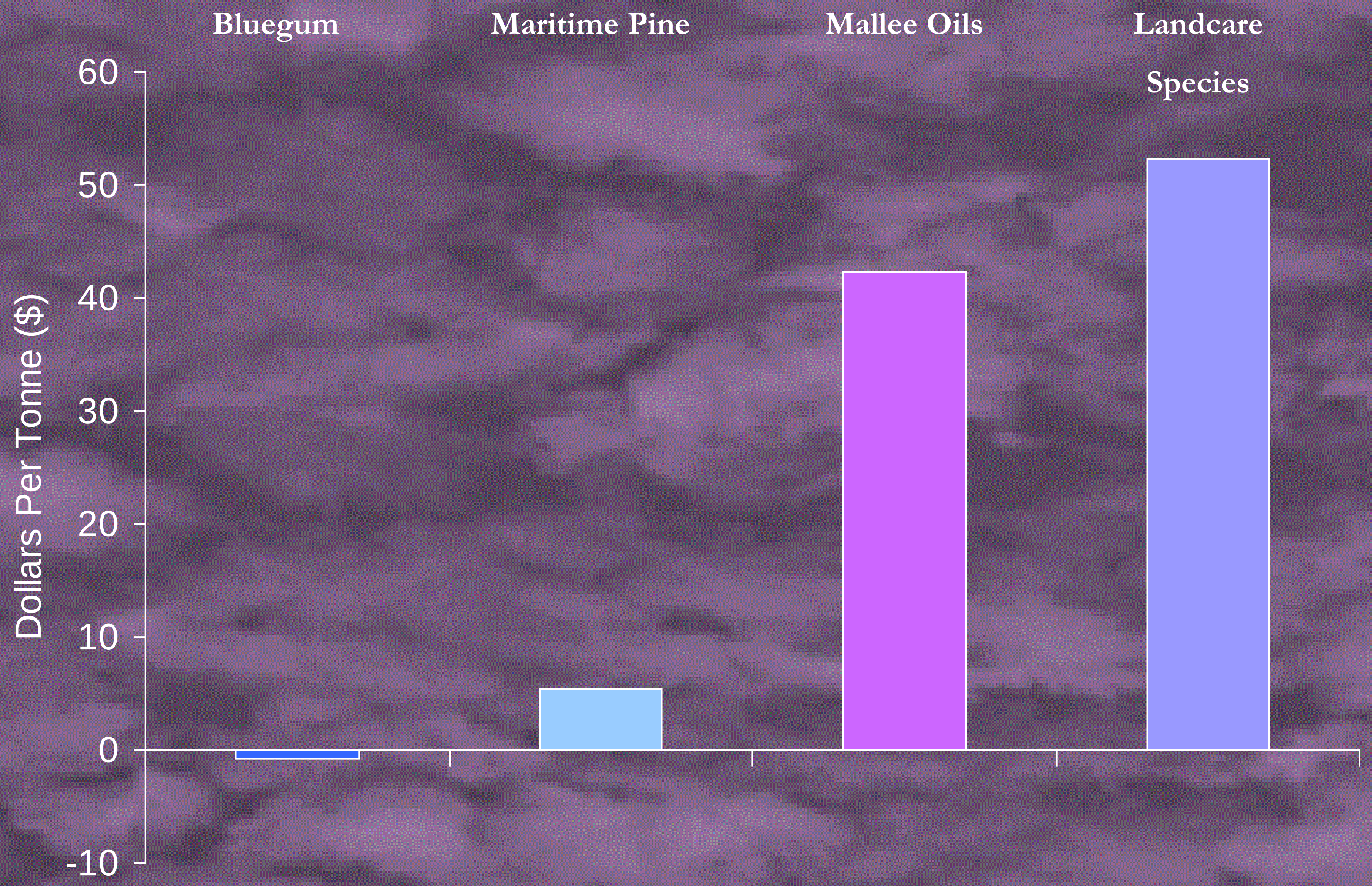


Trees are 2 years 8 months old

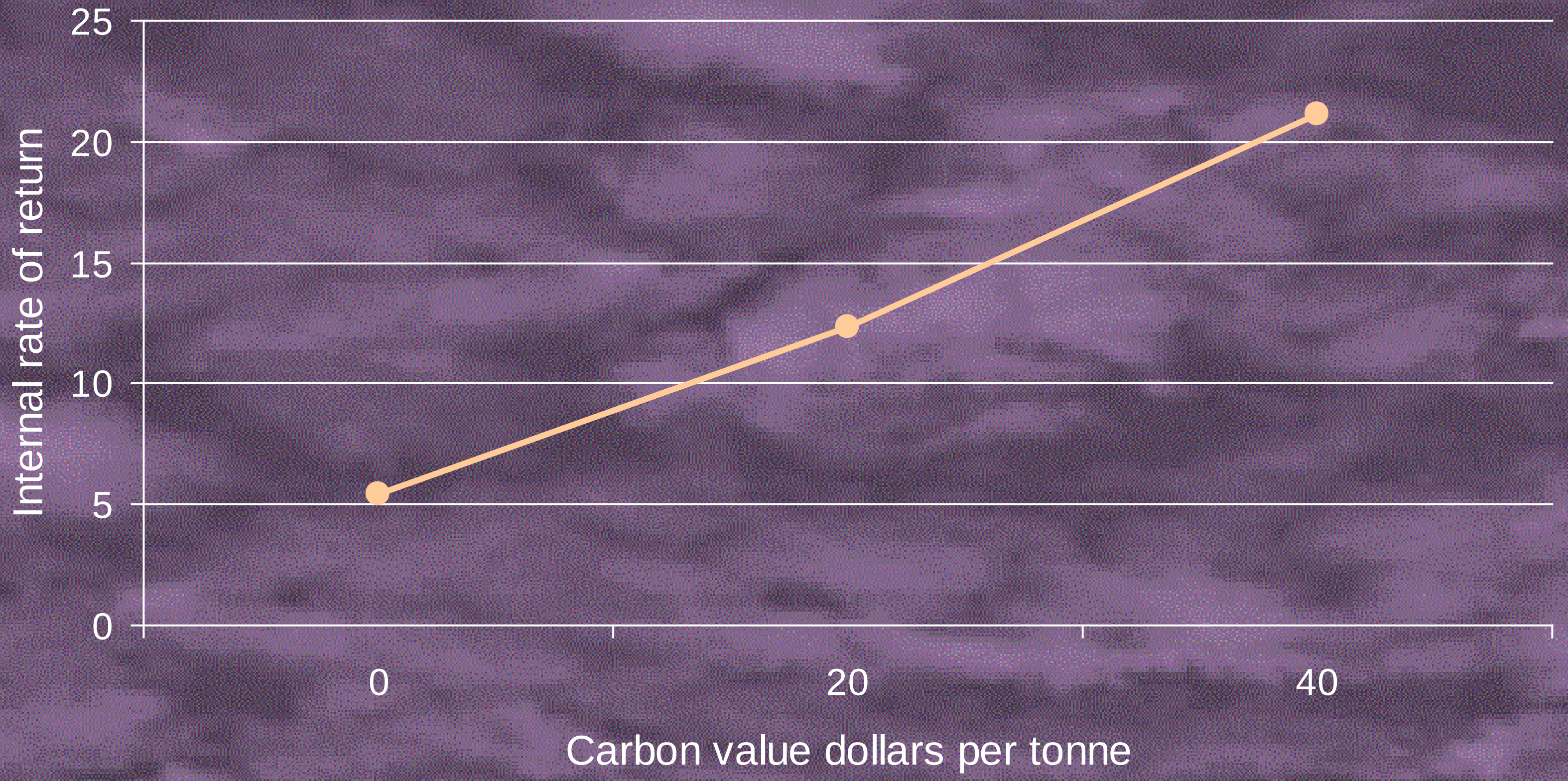
Infrastructure

Costs

Cost of Sequestering a Tonne of Carbon

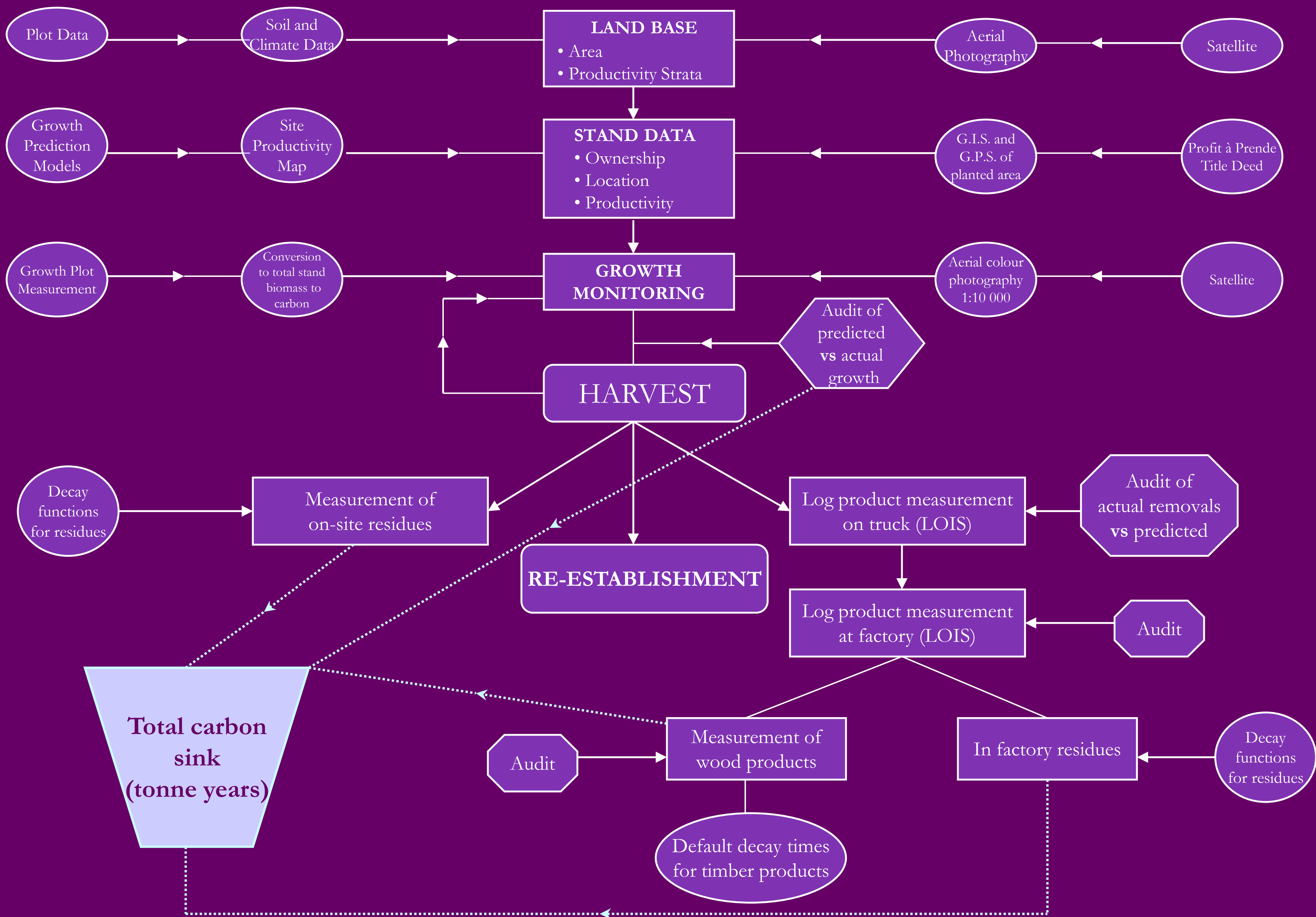


Return from Maritime Pine at Different Carbon Prices

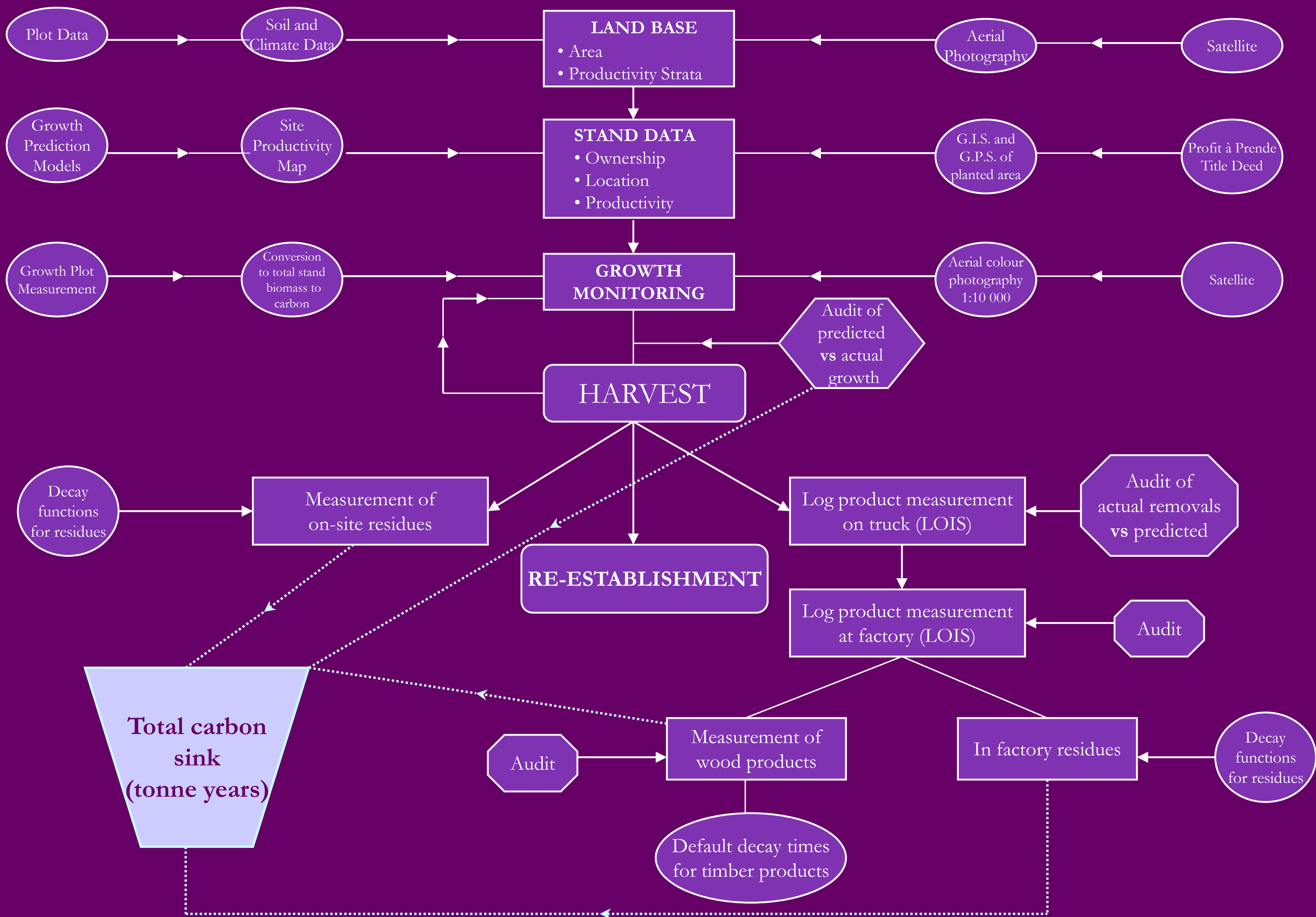


Measurement and Verification

Forecasting, Monitoring and Verification of Carbon Flows in Tree Crops from Establishment to Product Decay

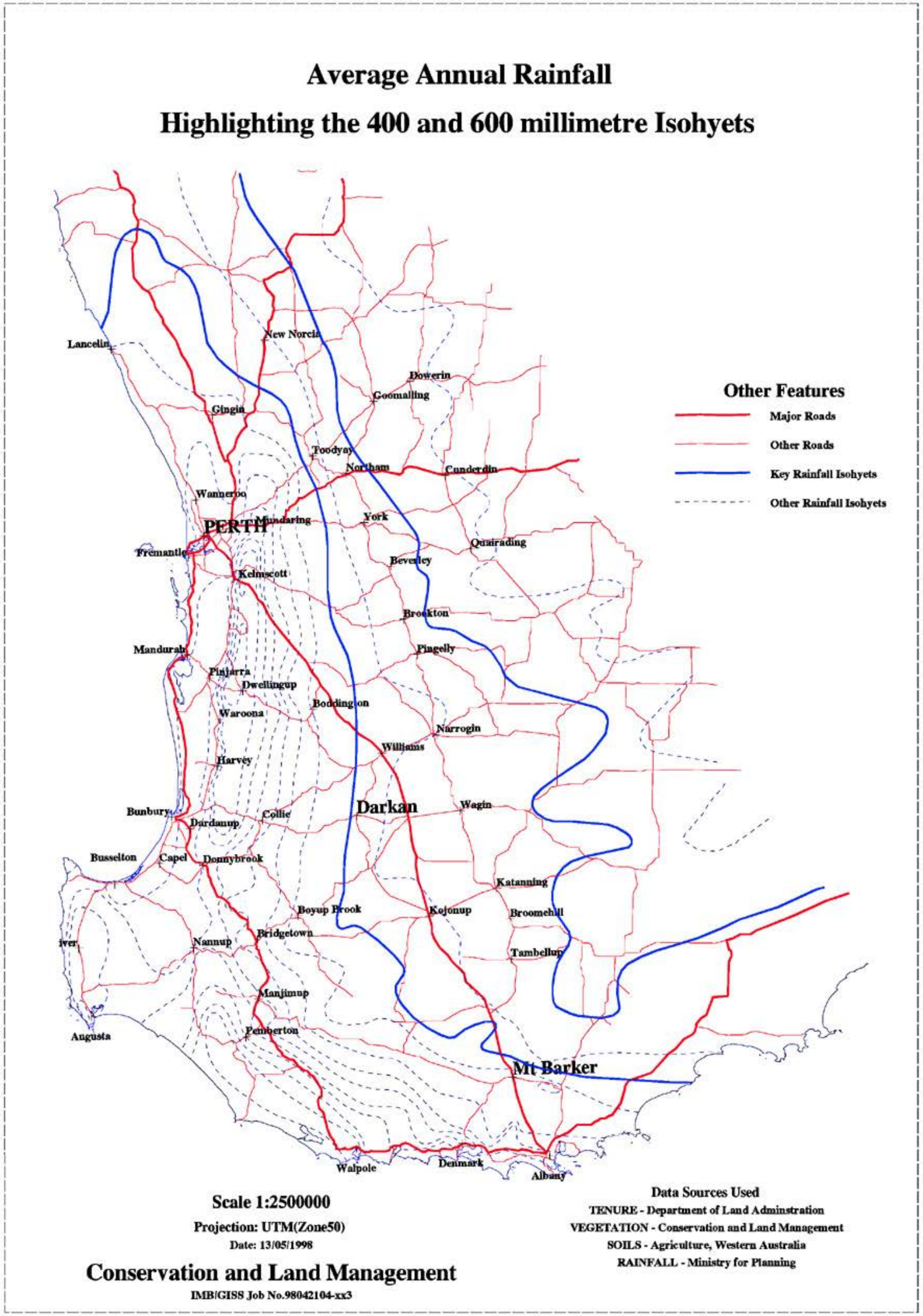


Forecasting, Monitoring and Verification of Carbon Flows in Tree Crops from Establishment to Product Decay

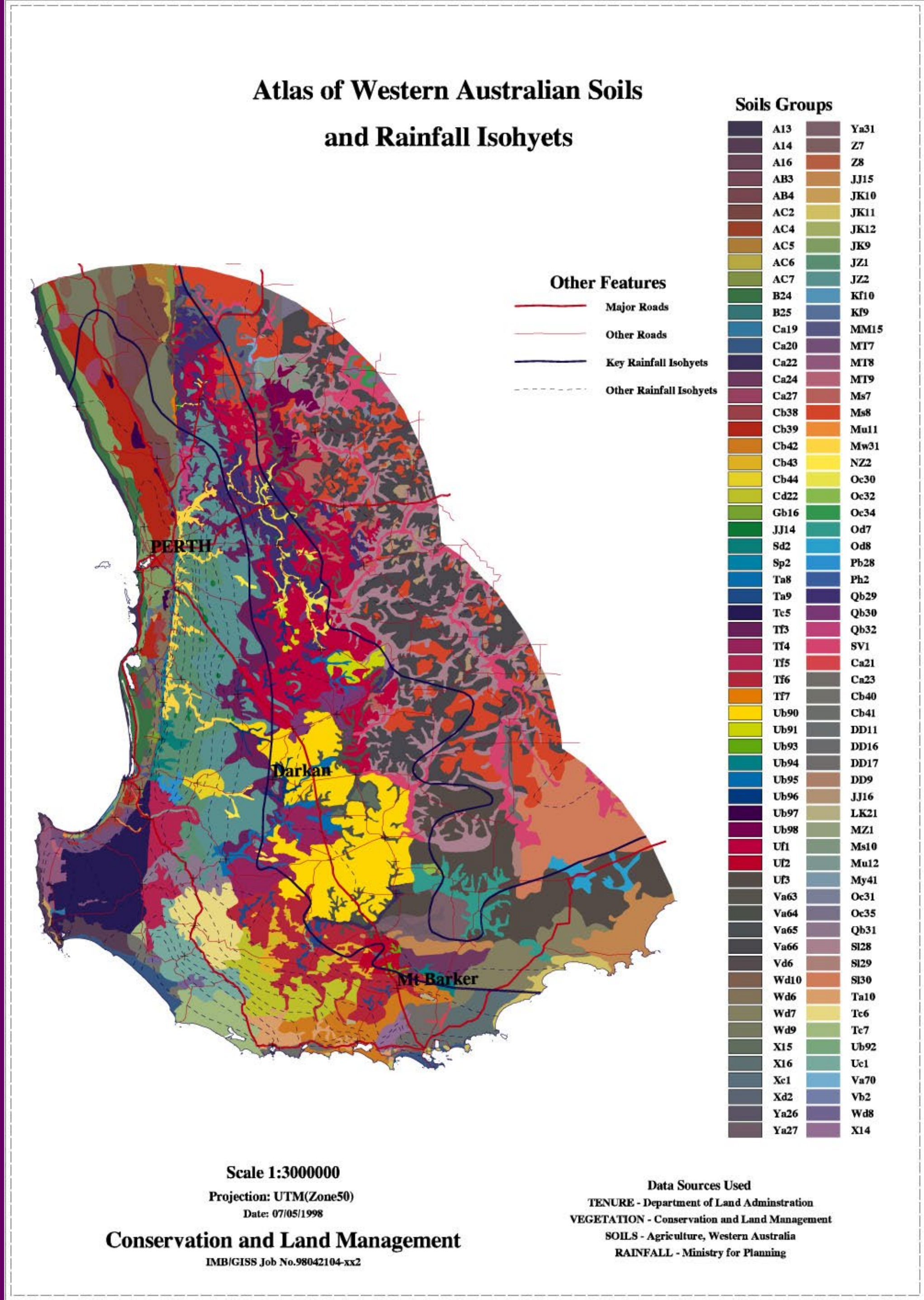


Forecasting, Monitoring and Verification of Carbon Flows in Tree Crops from Establishment to Product Decay

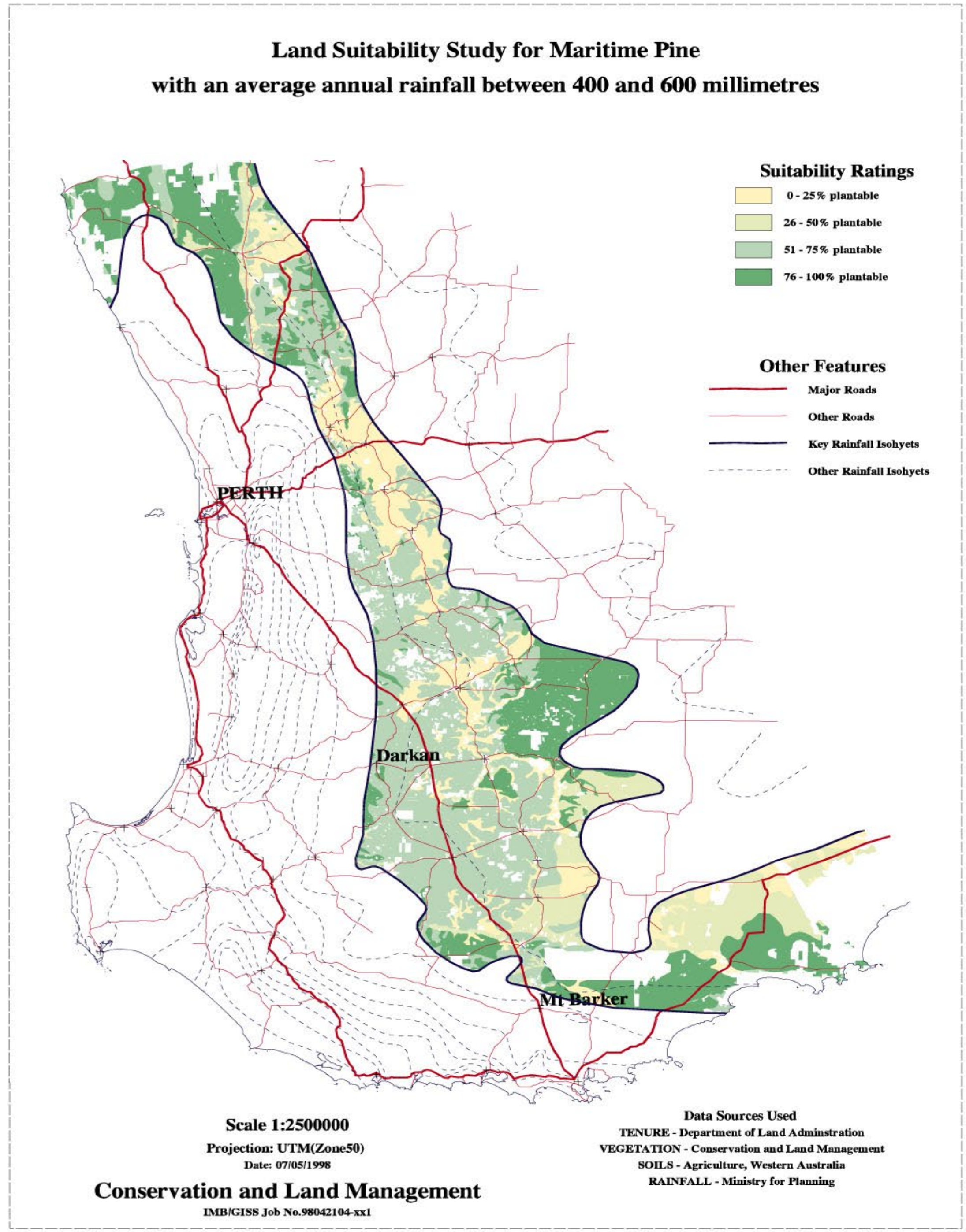
Rainfall Isohyets for South West of Western Australia



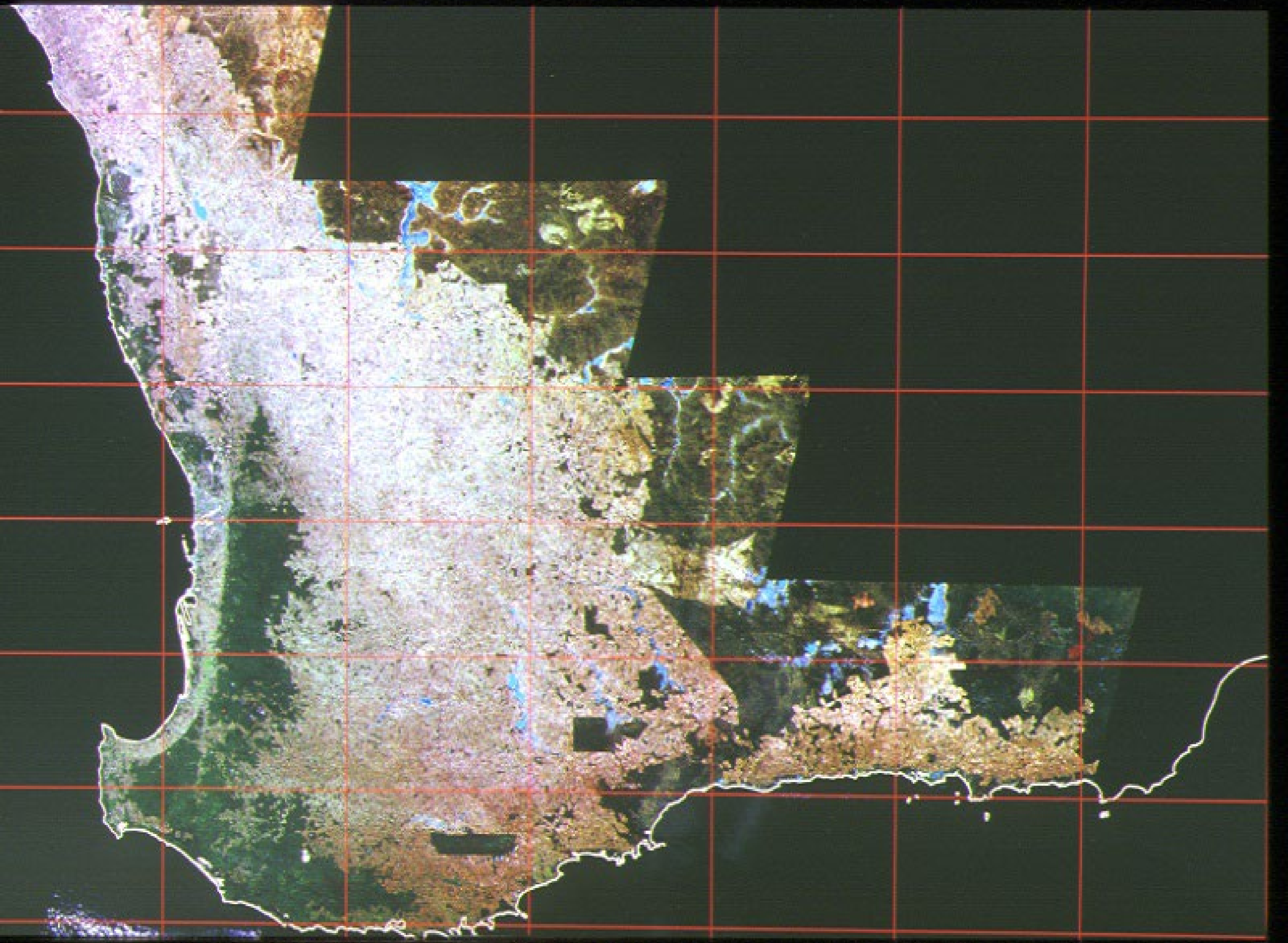
Atlas of Western Australian Soils

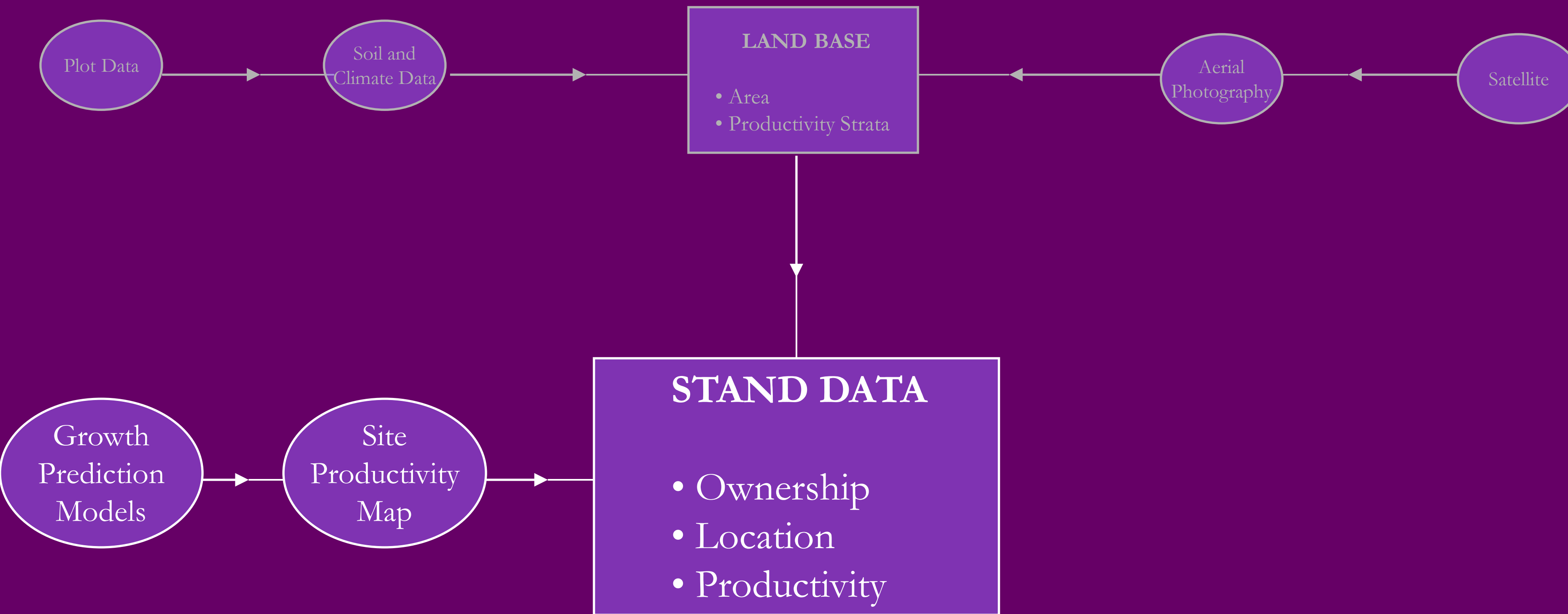


Land Suitability Study for Maritime Pine

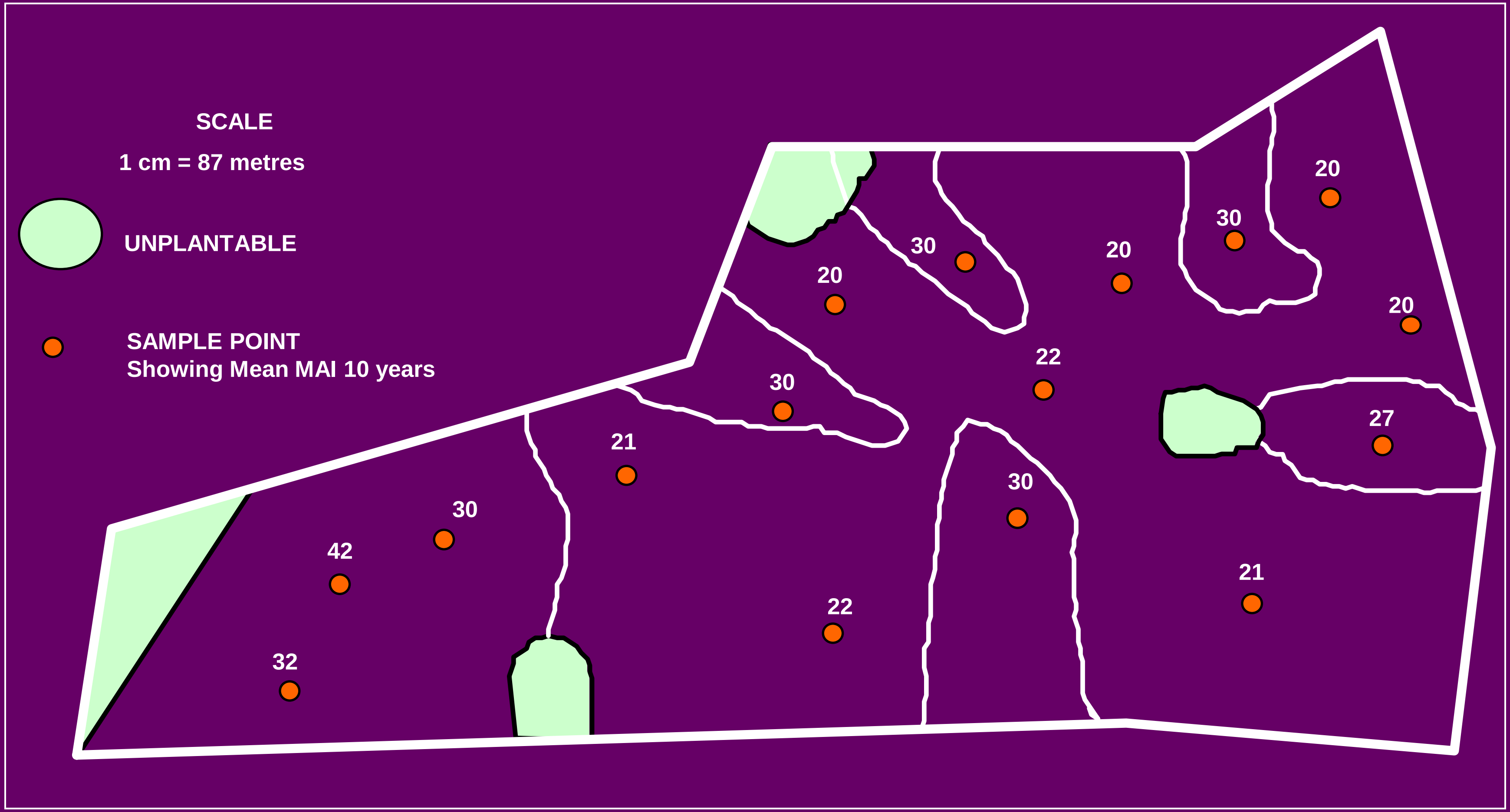


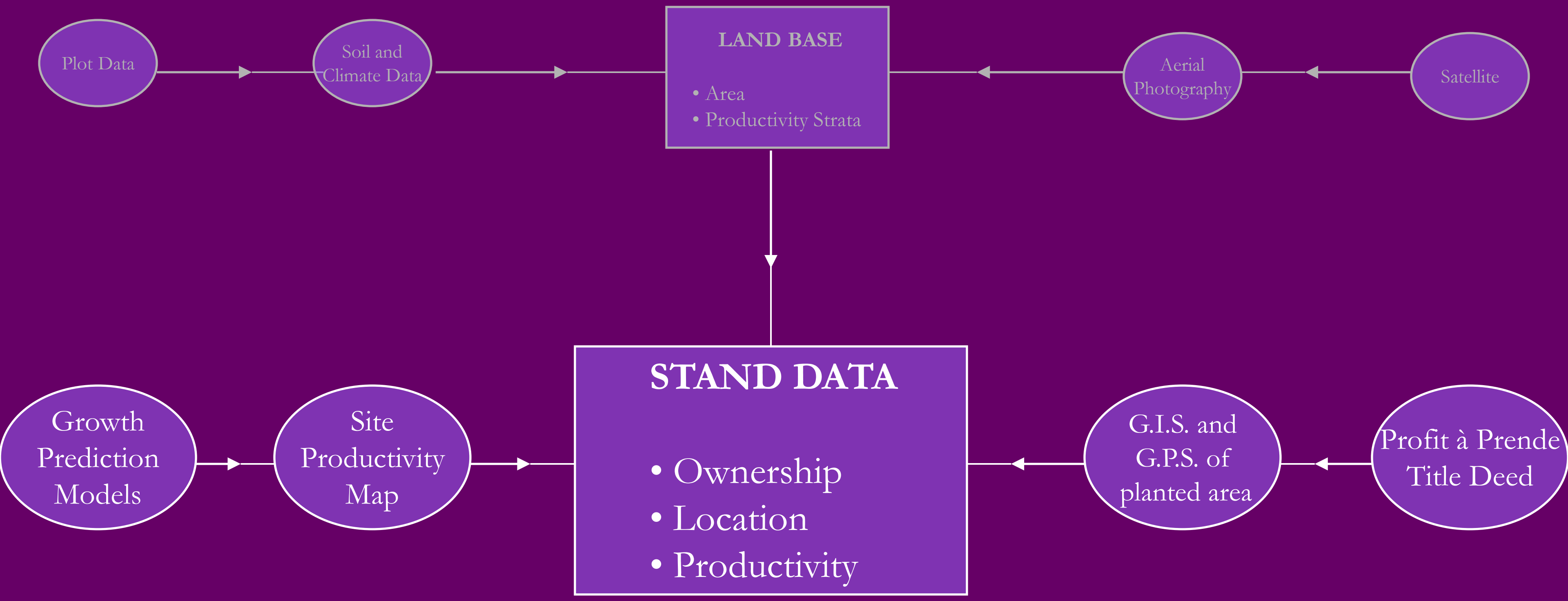

Plot Data
Soil and Climate Data
LAND BASE
• Area
• Productivity Strata
Aerial Photography
Satellite




Plot Data
Soil and Climate Data
LAND BASE
• Area
• Productivity Strata
Aerial Photography
Satellite
STAND DATA
• Ownership
• Location
• Productivity
Growth Prediction Models
Site Productivity Map

E. globulus site productivity assessment for a typical farm




Plot Data
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LAND BASE
• Area
• Productivity Strata
Aerial Photography
Satellite
STAND DATA
• Ownership
• Location
• Productivity
Growth Prediction Models
Site Productivity Map
G.I.S. and G.P.S. of planted area
Profit à Prende Title Deed

CALM SHAREFARMS LOWER WEST

JACKSON

Nelson Loc's 2868, 2869 & 2870.

PLANTATION PLAN LEGEND

- P.97 TREE CROP AREA E.globulus G.P.S. CAPTURE.
- P.96 TREE CROP AREA E.globulus G.P.S. CAPTURE.
- EXISTING BUSH G.P.S. Capture inside tree crop area only.
- SALT AFFECTED G.P.S. CAPTURE.
- PRIVATE PLANTING
- CALM PLANTING
- FENCE
- CADASTRAL BOUNDARY G.P.S. CAPTURE
- SEALED ROAD
- UNSEALED ROAD
- POWERLINE, PYLON
- SWAMP
- DAM
- WATER POINT
- BUILDINGS
- CADASTRAL BOUNDARY NON G.P.S. CAPTURE

STATISTICAL REPORT

Categories	Area (ha)
P.97 TREE CROP AREA	372.5
TOTAL AREA	372.5

SHIRE: BOYUP BROOK
MAIN ACCESS ROAD: CRAIGIE ROAD
FIRE CONTROL DETAILS
OWNER:
CONTACT:
FIRE CONTROL CONTACTS:
1.
2.
3.
FIREBREAKS
10m BOUNDARY
10m ADJOINING 1st CLASS ROADS
10m ADJOINING 2nd CLASS ROADS
6m INTERNAL BETWEEN COMPARTMENTS
6m INTERNAL

NB - The surrounding location boundaries have been determined using 50 series mapping and are for schematic purposes only, there may be inconsistencies between the G.P.S. plot and the Cadastral data. If this is important for the intended use then the matter must be resolved by reference to IMB.
DEPARTMENTAL PLAN FOR OPERATIONAL USE ONLY.

Part of CALM 1/50 000 map: 2230-4
Part of CALM 1/25 000 map: 2230-4SW & SE

G.P.S. (Global Positioning System).
The Global Positioning System used is a real time differential G.P.S. which obtains accuracy of +/-1.5m.

G.P.S. Surveyed By: JOHN MOSAJ	Date: MAY 97
Plan Compiled By: S. MOUNTFORD	Date: JULY 97
Plan Checked By:	Date:

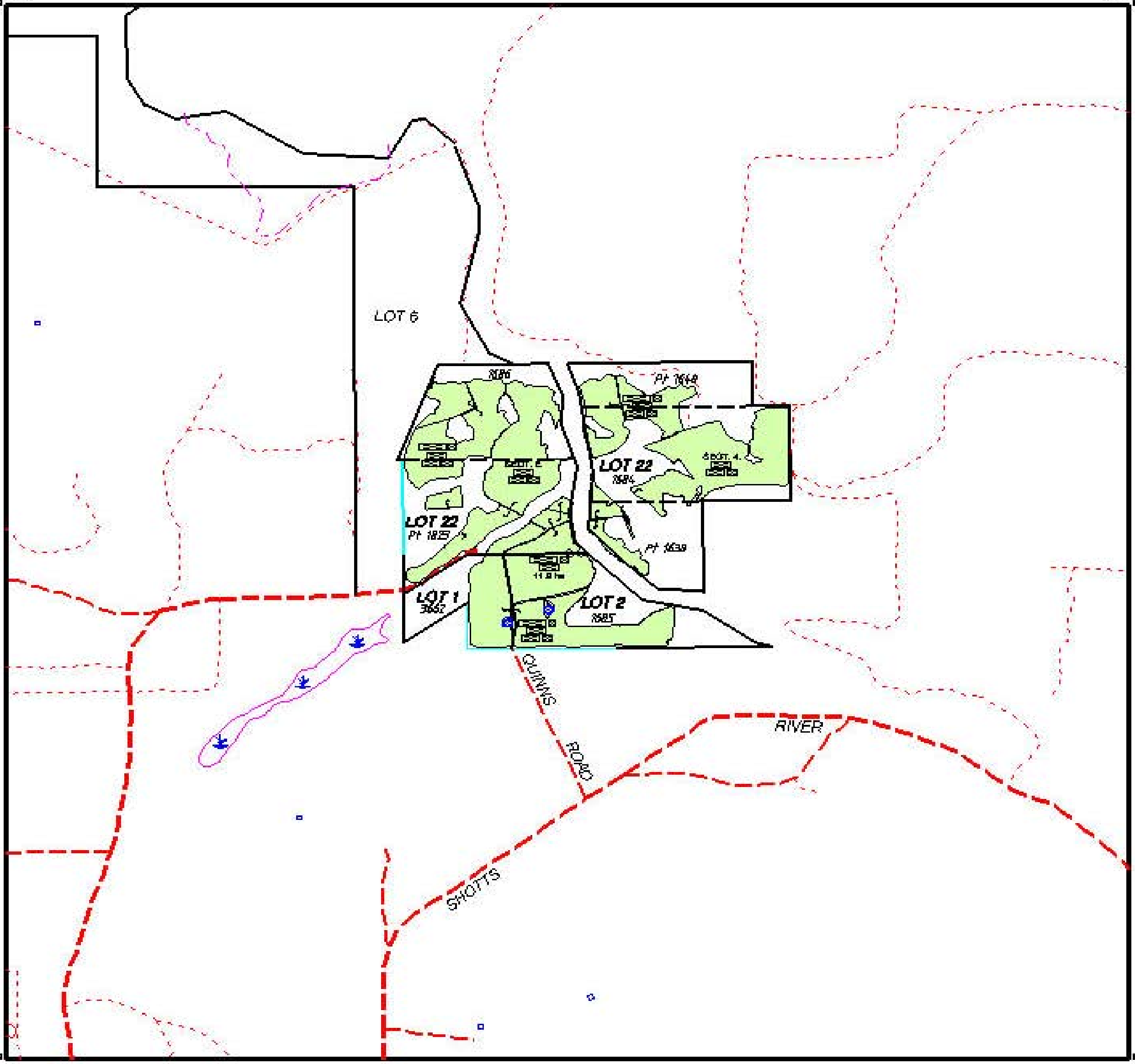
SCALE 1:25 000

1000 800 600 400 200 0 500 1000 metres

PROJECTION: TRANSVERSE MERCATOR C.M. 117 E
HORIZONTAL DATUM: AUSTRALIAN GEODETIC DATUM 1984
VERTICAL DATUM: AUSTRALIAN HEIGHT DATUM 1971

CALM
CONSERVATION AND LAND MANAGEMENT

PREPARED BY FOREST MANAGEMENT BRANCH UNDER THE DIRECTION OF DR. SYD SHEA, EXECUTIVE DIRECTOR OF THE DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT, WESTERN AUSTRALIA.



CALM SHAREFARMS LOWER WEST

FLEAYS

Wellington Loc 3662 & Pt. Loc 1685 being Lot 1, Pt Loc 1685 being Lot 2, Loc's 1684, 1686, 4090 & Pt Loc's 1638, 1640, 1823 being Lot 22.

PLANTATION PLAN LEGEND

G.P.S. CAPTURE

CADASTRAL BOUNDARY

STATISTICAL REPORT

Categories	Area (ha)
P.94 TREE CROP AREA	98.9
TOTAL AREA	98.9

SHIRE: COLLIE
MAIN ACCESS ROAD: QUINNS ROAD

OWNER
EXECUTIVE DIRECTOR, CALM
OWNERS INITIALS

Part of CALM map COLLIE
Part of DOLA map COLLIE

G.P.S. Surveyed By: S. MOUNTFORD	Date: DEC 97
Plan Compiled By: S. MOUNTFORD	Date: FEB 98
Plan Checked By:	Date:

SCALE 1:25 000
1000 800 600 400 200 0 500 1000 metres

CALM

FORM P2
APPROVAL NO. B1629
WESTERN AUSTRALIA

TRANSFER OF LAND ACT 1893 AS AMENDED

PROFIT A PRENDRE

[Under s.34B Conservation and Land Management Act 1984 as amended]

DESCRIPTION OF LAND (Note 1)	EXTENT	VOLUME	FOLIO
Firstly, that portion of Wellington Location 1685 as is Comprised in Lot 1 on Diagram 64908	Part	1651	353
Secondly, portion of Wellington Location 1685 and being Lot 2 on Diagram 64908	Whole	1651	354
Thirdly, Wellington Locations 1684 and 4090 and portion of each of Wellington Locations 1638, 1640, 1686 and 1823 the whole of the said land being Lot 22 on Plan 19273	Whole	1971	796

ESTATE AND INTEREST (Note 2)

Fees simple

ENCUMBRANCES (Note 3)

As the land firstly above described: Restricitve Covenant contained in Transfer F157963 and Profit à Prende G469575
As to the land secondly above described: Restrictive Convenant contained in Transfer F157963
As to the land thirdly above described: Restrictive Convenant contained in Transfer F302179 and Profit à Prende G469575

OWNER (Registered Proprietor) (Note 4)

THE EXECUTIVE DIRECTOR OF THE DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT of Hackett Drive Crawley

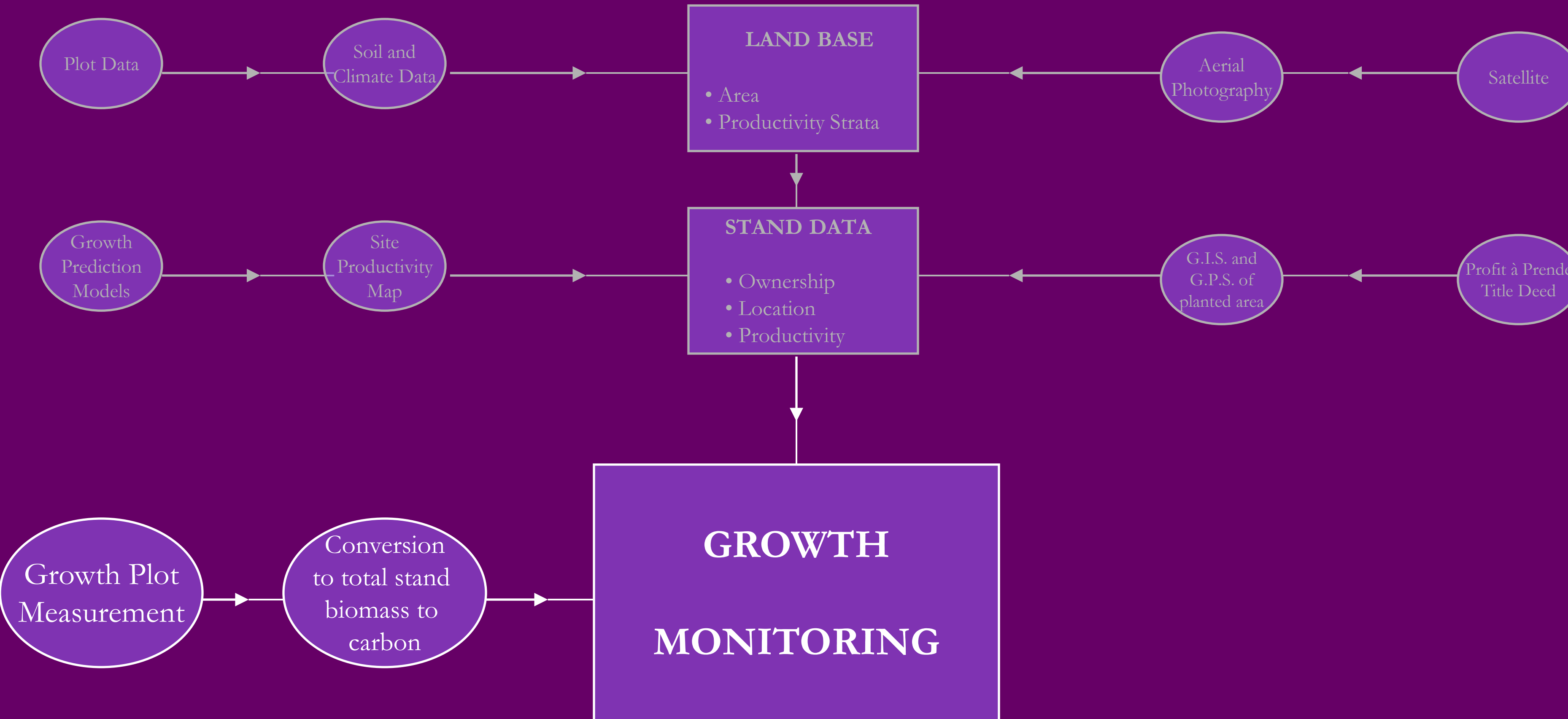
GRANTEE (Note 5)

HANSOL AUSTRALIA PTY. LTD. A.C.N. 061 693 856 of Suite 15, 64 Canning Highway Victoria Park

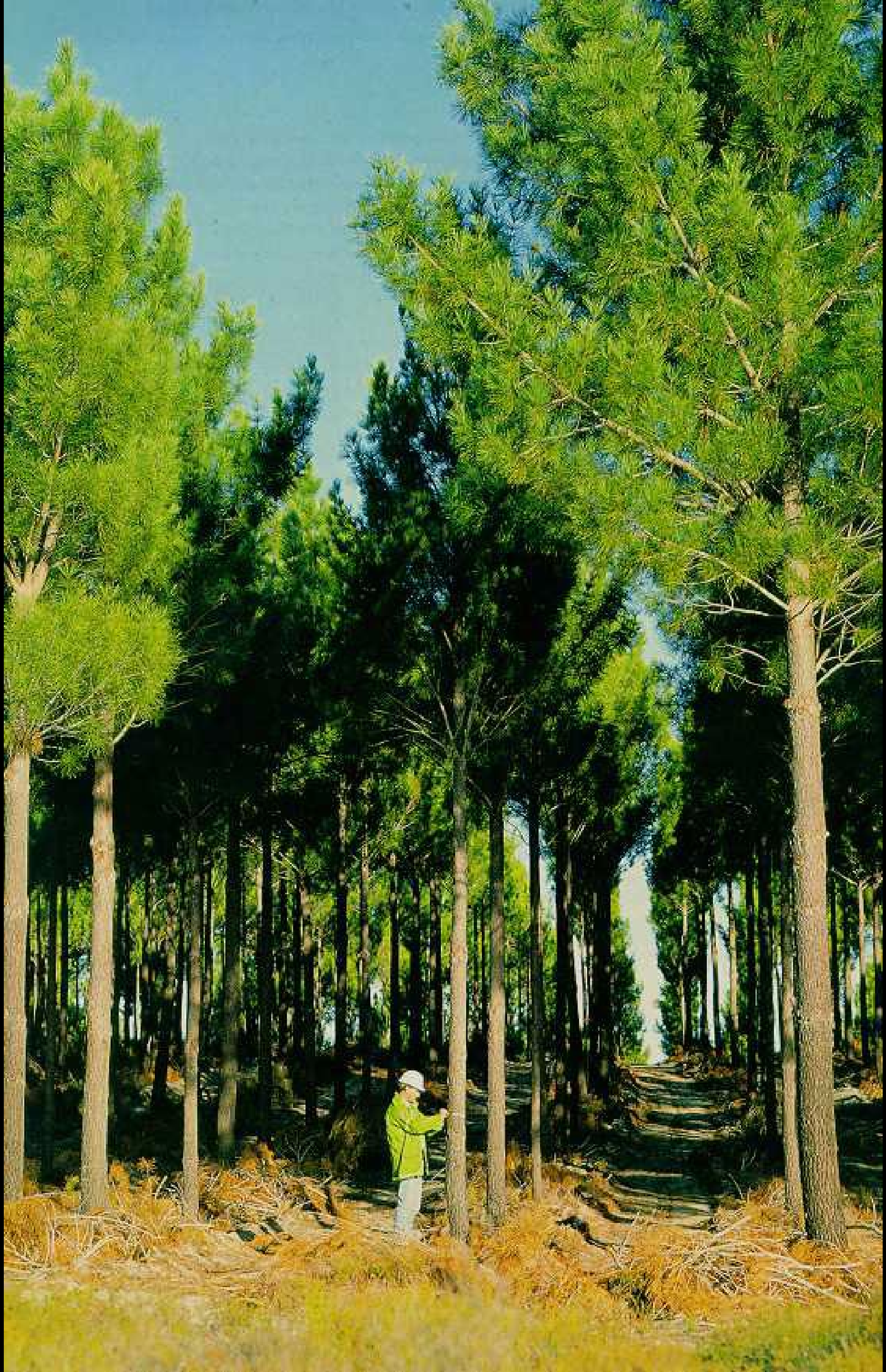
TERM OF PROFIT A PRENDRE (Note 6)

TWENTY EIGHT (28) YEARS, subject to earlier termination in accordance with clause 8, commencing on and including the First day of January 1999

The Owner hereby Grants a Profit a Prendre to the Grantee for the term specified above over the land described above subject to the encumbrances shown hereon in accordance with the terms and conditions contained in this Deed.

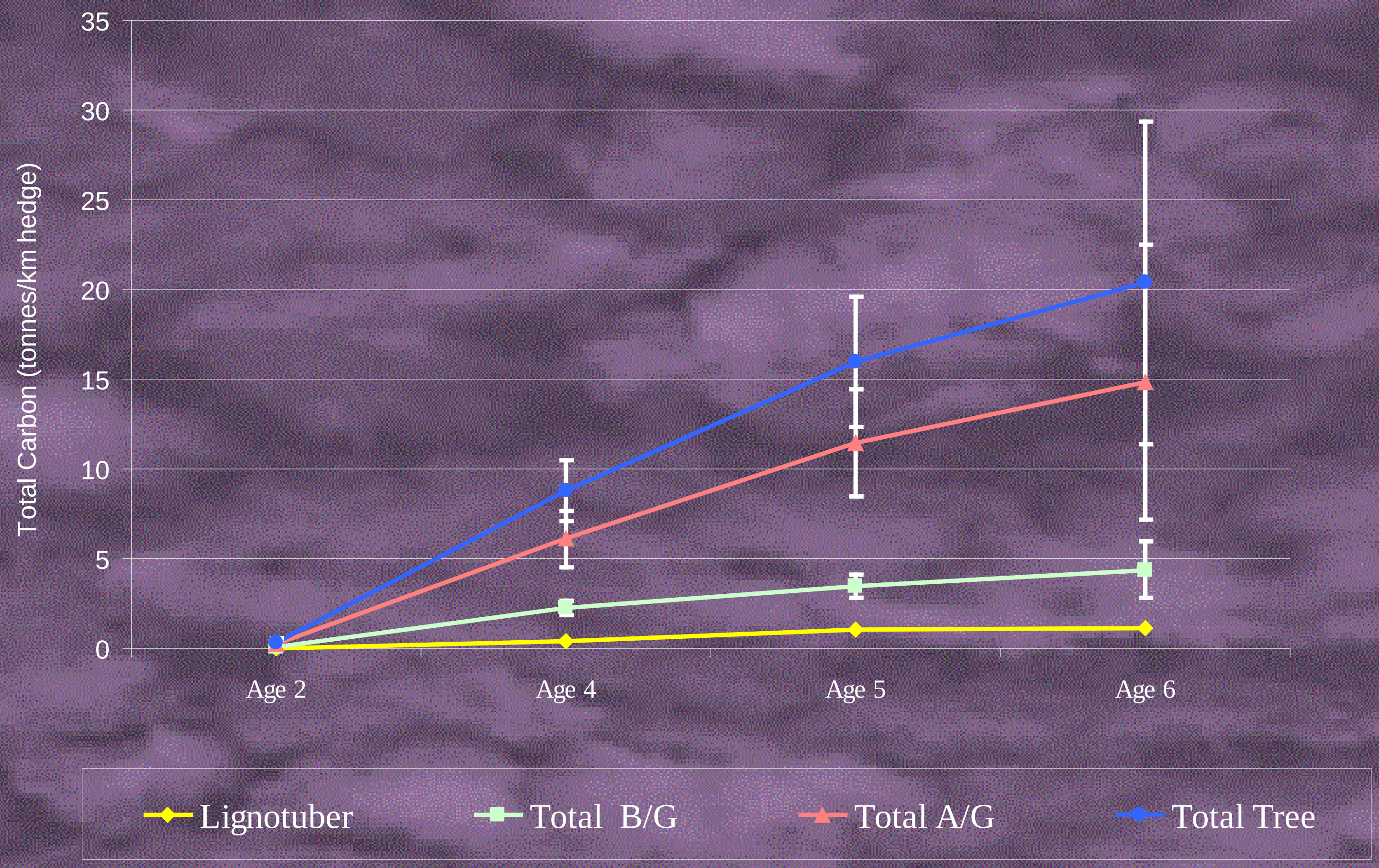


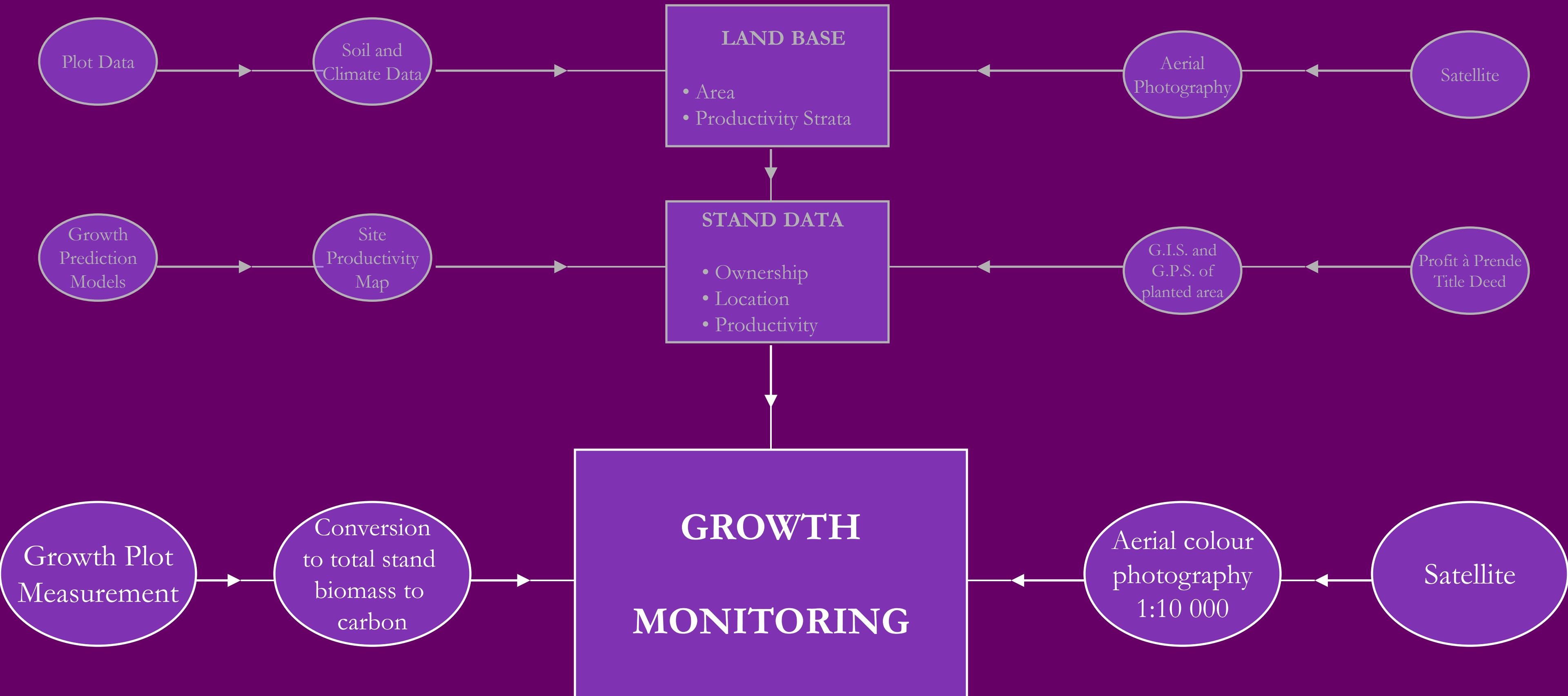
Plot Data
Soil and Climate Data
LAND BASE
• Area
• Productivity Strata
Aerial Photography
Satellite
Growth Prediction Models
Site Productivity Map
STAND DATA
• Ownership
• Location
• Productivity
G.I.S. and G.P.S. of planted area
Profit à Prende Title Deed
Growth Plot Measurement
Conversion to total stand biomass to carbon
GROWTH
MONITORING




100m

Total carbon per kilometre of hedge for *Eucalyptus plenissma* for different ages and tree components with standard deviation

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Conversion to total stand biomass to carbon
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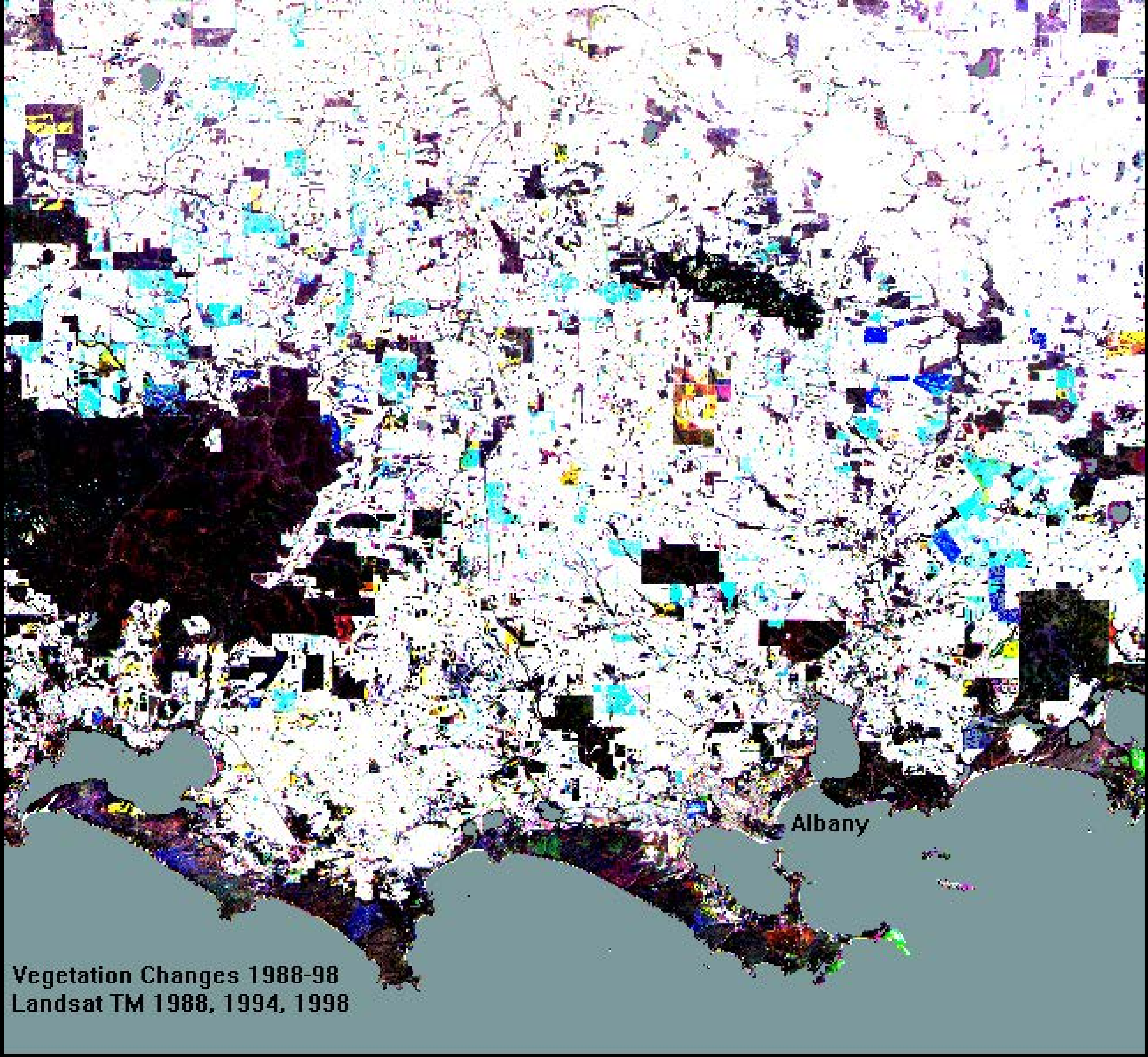
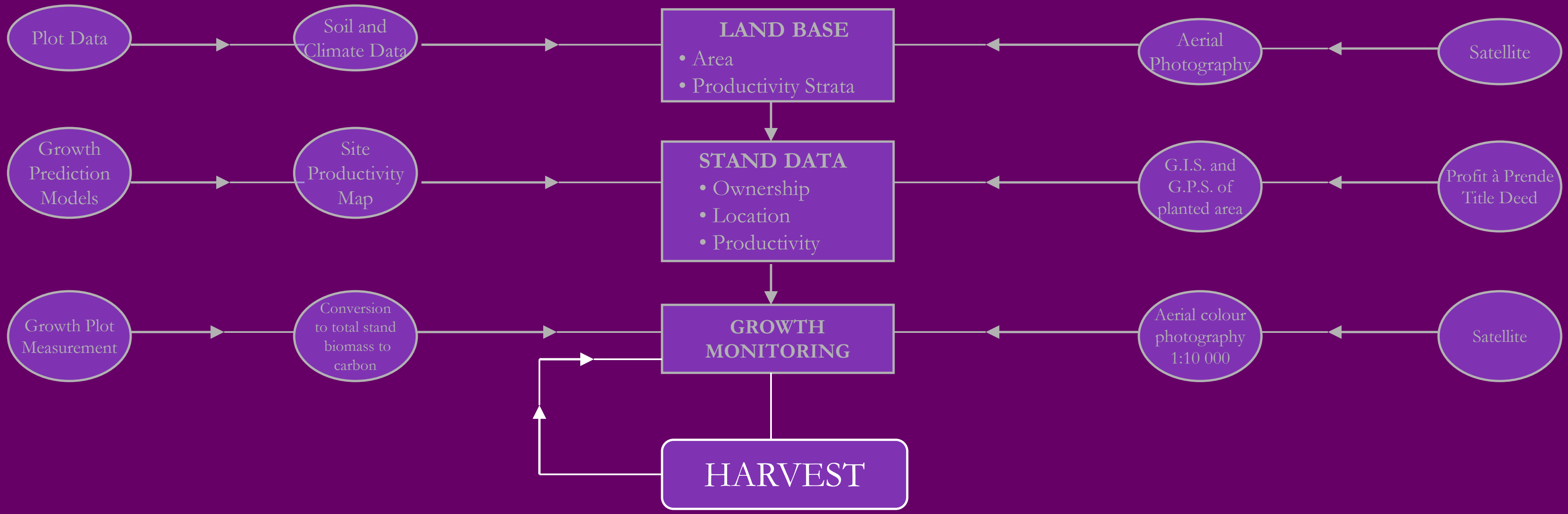
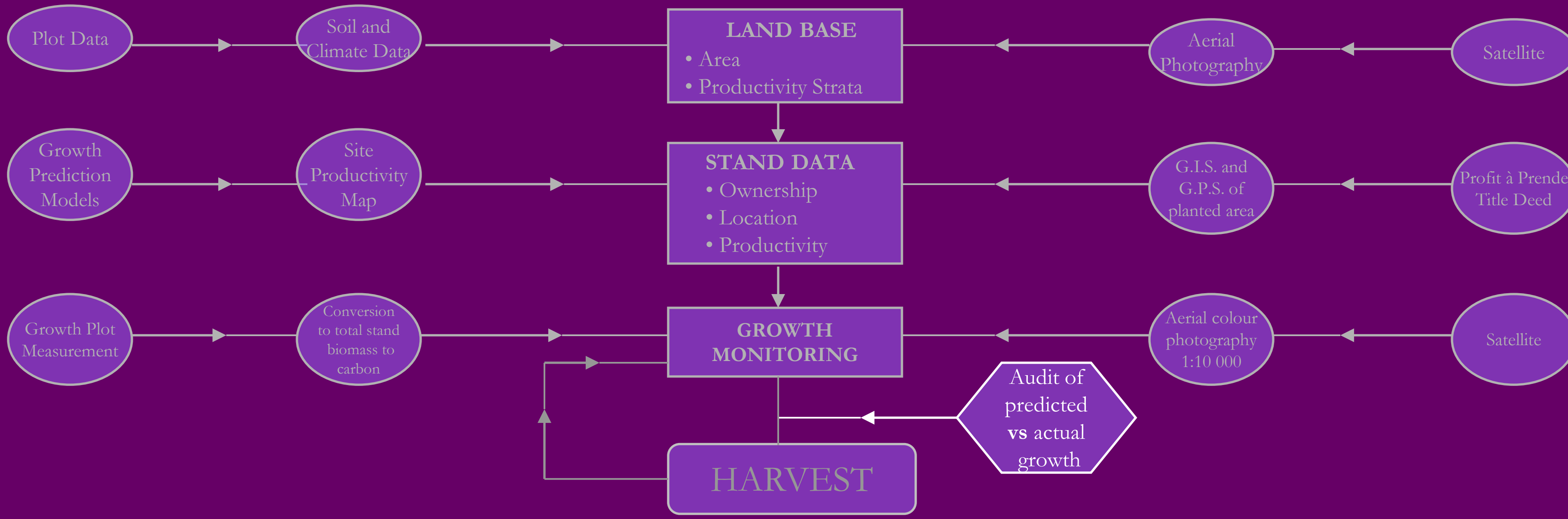
Aerial colour photography 1:10 000
Satellite

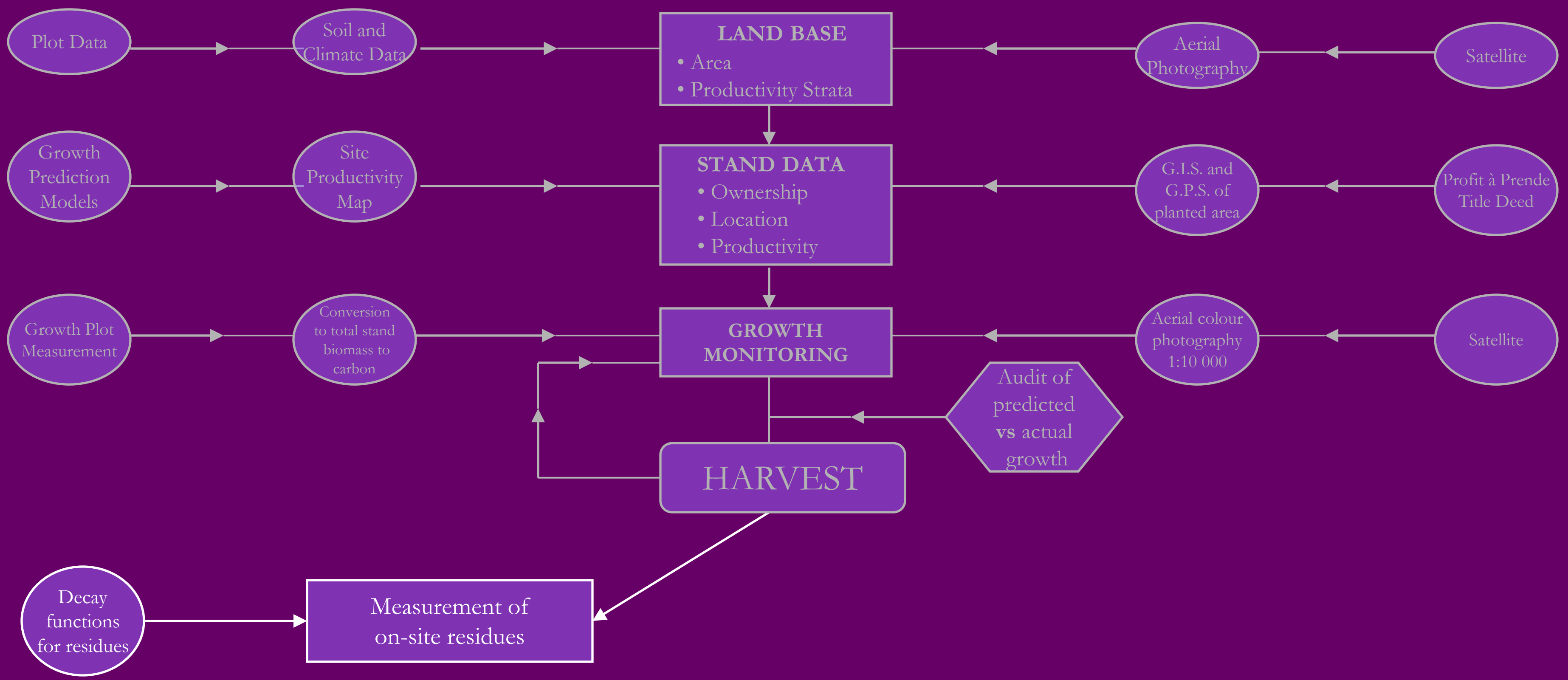

Albany
Vegetation Changes 1988-98
Landsat TM 1988, 1994, 1998

Forecasting, Monitoring and Verification of Carbon Flows in Tree Crops from Establishment to Product Decay



Forecasting, Monitoring and Verification of Carbon Flows in Tree Crops from Establishment to Product Decay

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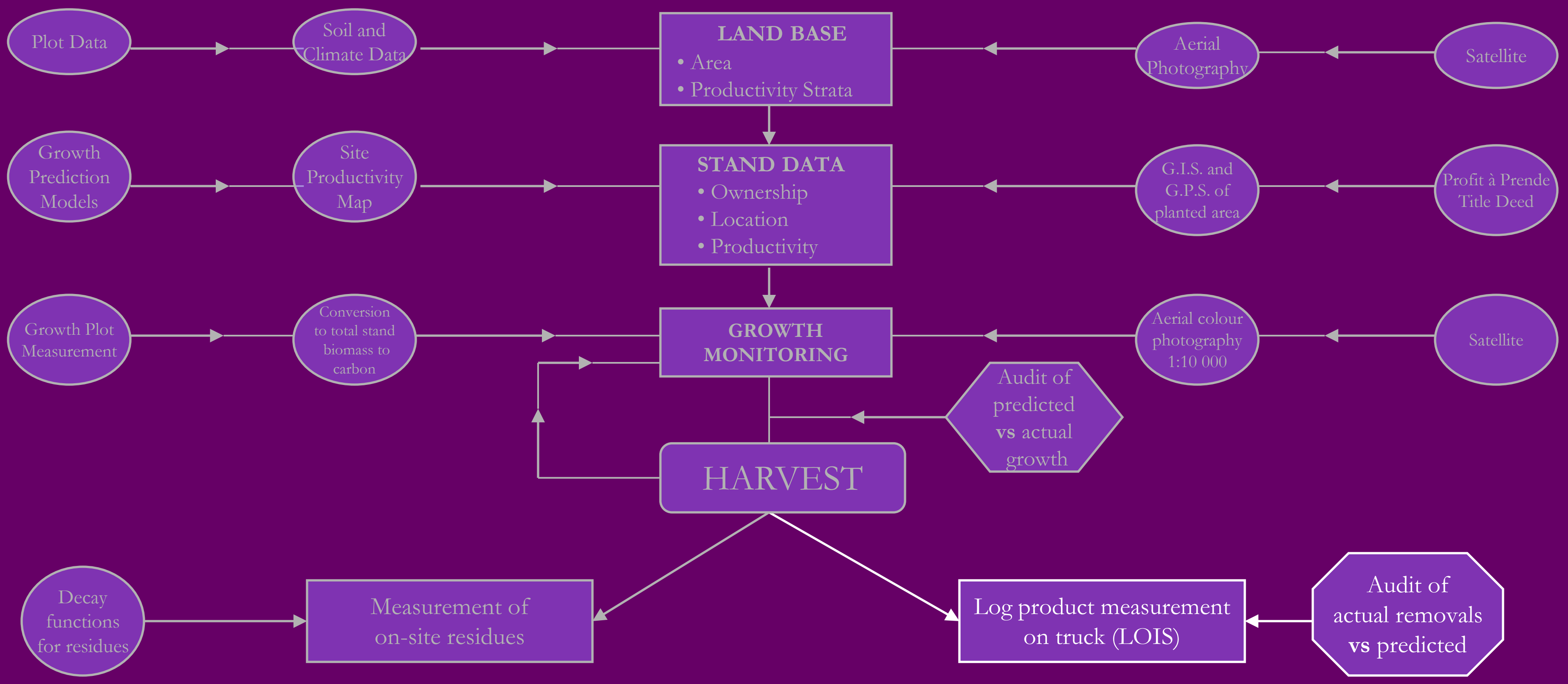
HARVEST
Decay functions for residues
Measurement of on-site residues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Log product measurement on truck (LOIS)
Audit of actual removals vs predicted


Timberjack

CLM 709 (1998)

LOGGING OPERATIONS INFORMATION SYSTEM (LOIS)

LOGGING OPERATION DETAILS

ACTION (√) ADD [✓] DELETE [ ] UPDATE [ ]

Operation Name — District: A | PERTH — Plantation /Block: PINJAR

Compartment: 09 — Coupe: — Operation: A | PJ | TPF2

Operation Type: FLAT — Description: T2

Operation Area: 10 ha — Supply Area: SWAN

Contractor(S)
- Name: SLS — Contract No.:
- Name: — Contract No.:
- Name: — Contract No.:

Start Date: 200498 — End Date: 300598 — Transition Dump: Y N

Private Prop. Owner: — FOCIS Mgt Area:

Silvicultural Type: S22 NEW / 2ND THN / 300 - 150 SPH

Contractor Payments To Be Printed At: PERTH

WEST SIDE AQUA RD
WESPINE THAL ORCHARD
STOCK PT1

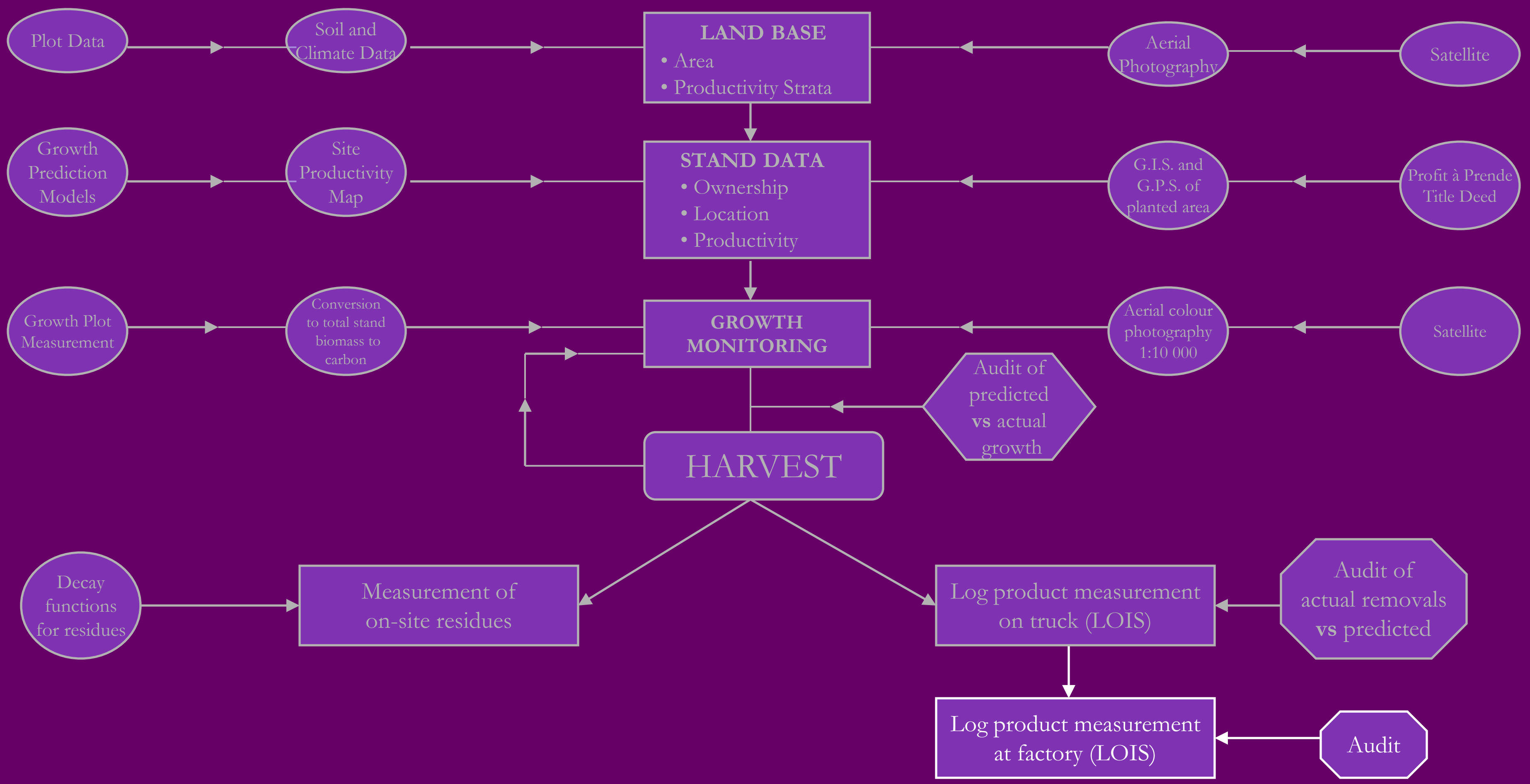
Delivery Location Distances
(and approved travel routes if applicable)

Delivery Location	Customer	Distance (km)	Approved Travel Route	Amendment (Date/Signature)
BASSENDEAN	PINEPAC	49	AQUA / PINJAR / WN / GN / ASHBURTON	
WELSHPOOL	WESFI	61	" " " " " "	
DARDANUP	WESPINE	242	" " " " " " / SW HWY	
OSB PK	W/COAST	45	" " " / OCEAN REEF / MITCH	

INPUT at STATE HEADQUARTERS 21 APR 1998 Date Operator

Completed By: C.J. SAUNDERS Date 20/4/98

Business Unit Manager: Date 20/4/98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Log product measurement at factory (LOIS)
Audit

Department of Conservation and Land Management

SOFTWOOD LOG DELIVERY NOTE

S 079859

Part A: Harvesting information - All shaded parts to be completed by Contractor before truck leaves bush landing

Date of loading: 10/9/98 Time of loading: 5-45 Date & time of delivery/unloading: 10/9/98 10-30

Truck registration no.: 9KT 041

Terrain = F (flat) S (steep)

Op type = 1(T1) 2(T2) 3(T3) C(clearfell)

Source of logs (Plantation): CLAYMORE

Logging operation: Dis K Plant CH Op No 8CF F/S 1/2/3/C 1

Product species: RADIATA.

Product type: SMALL SAW LOGS

Customer's name: D PINE-TEC.

Delivery location: BASSENDEAN.

CALM contractor (Production): PINE - HAULIERS.

Harvesting contract no.: 95/P1 Ref no. .... (Contractor use only)

Work description (√): Fall ☑ Extract ☑ Debark ☐ Prepare ☐ Measure ☐ Load ☑

CALM contractor (Delivery): " "

Harvesting contract no.: 95/P1 Ref no. .... (Contractor use only)

Work description (√): Load ☐ Cart ☑

Feller's ID code(s): S. BERGISON R. MORTON

If point of sale is bush landing, tick box ☐

Felling	Processing	Extracting
J. LODGE.		P. ALLAN.

(Contractor use only)

CONTRACT OF SALE NO: 2359 (CALM Use Only)

Part B: Signatures - All shaded parts to be completed by Contractor before truck leaves bush landing

Loader operator: [signature] Truck driver: [signature]

Customer: P. Lemma (Date 10/9/98 Time ....) Customer ref no. .... (Customer Use Only)

Forest Officer conducting field check .... (Date ....) ☐ Bush Landing ☐ On Road ☐ At Mill

Part C: Log Quantity - All shaded parts to be completed by Contractor before truck leaves bush landing (if measurement applicable)

(I) BIN MEASURE

Bin	Log Length (m)	Bin Width (m)	Bin Height (m)
1	2-4	2-3	1-7
2	2-4	2-3	1-8
3	2-4	2-3	2-0
4	2-4	2-3	2-0
5	2-4	2-3	1-8
6	2-4	2-3	1-8

Total Volume 2585.08. 37.988 m³

or (II) SCANNER MEASURE

Bin	Log Length (m)	Log Tally	No. of Logs
1			
2			
3			
4			
5			
6			

No of logs on load

or (III) WEIGHT (see details as printed by weighbridge printer on this D/Note or on attached weighbridge docket)

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT 14 SEP 1998 COMO, W.A.

RECEIVED 14 SEP 1998

INPUT AT STATE HEADQUARTERS Date 14 SEP 1998

Net Load Weight: Tonnes

Part D: Distribution: *(i) White original: CALM (via Customer) (ii) Pink duplicate: Customer (iii) Green triplicate: CALM Contractor (iv) Yellow quadruplicate: Remains in book at all times*

S079859

Department of Conservation and Land Management
Logging Operations Information System
INVOICE ATTACHMENT - ROYALTY & PRODUCTION

16-Sep-1998

Start: 01-SEP-1998 End: 15-SEP-1998

Customer: XXXXXXXXXXXXXX
XXXXXXXXXXXXXX
XXXXXXXXXXXXXX
XXXXXXXXXXXXXX

Debtor Code: XXXXX

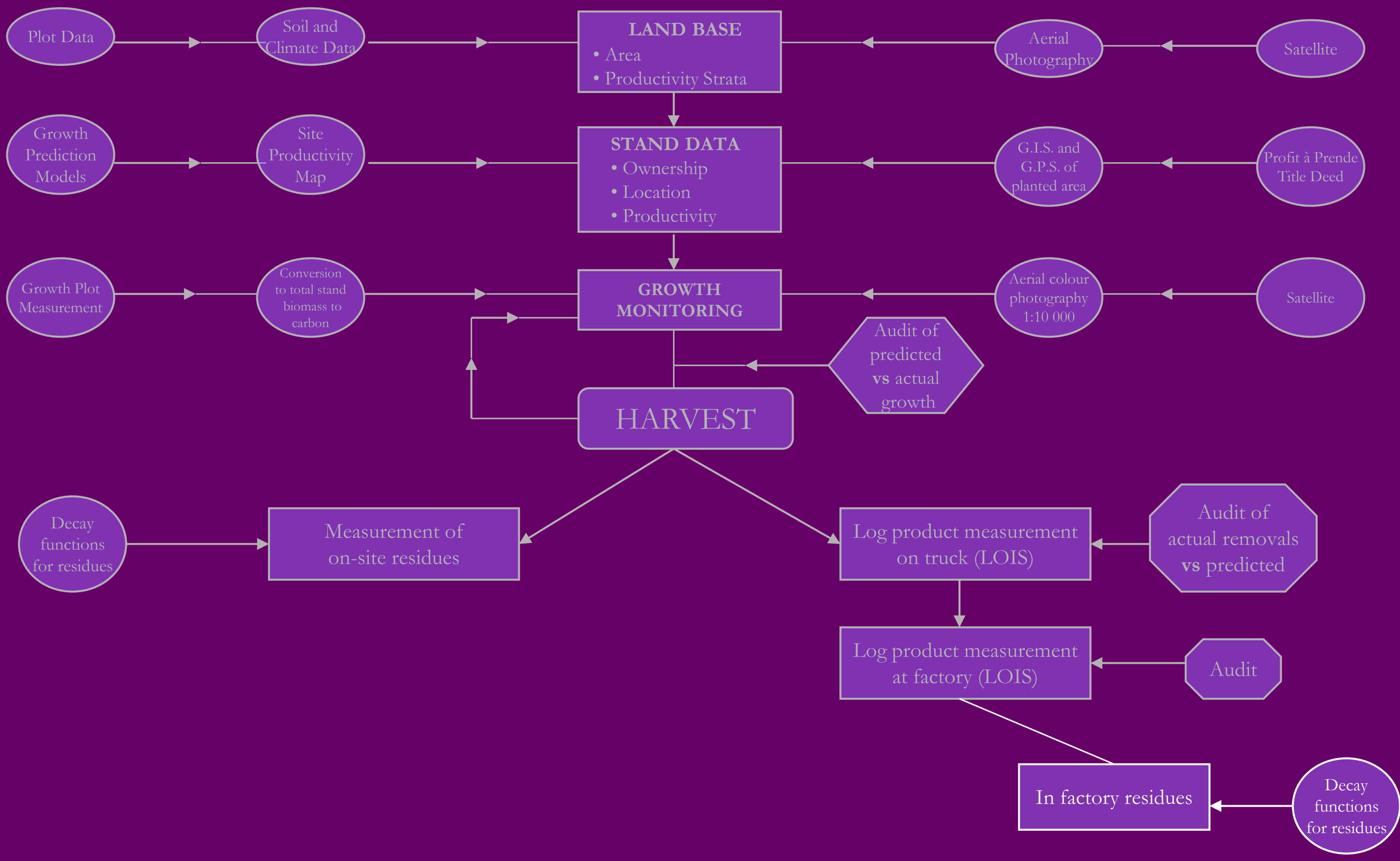
Location: YYYYYYYYYYYYYY
YYYYYYYYYYYYYY
YYYYYYYYYYYYYY
YYYYYYYYYYYYYY

Contract of Sale: 4444

Species/Product: PINASTER/SAWLOG (AUTO SCAN)

DNote	Date	Operatn	Logs	Volume	Tonnes	Dist	Prod	Cart	Royty/Stmp	Production	Cartage	Admin	Inforest	Roading	Other	Total
SOFTWOOD DELIVERIES																
S74130	02-Sep-98	ANN8CF3	79	33.468		208	95/P2	95/P2	1289.50	432.07	811.27	31.79	78.97	27.77	10.04	2681.41
S74135	04-Sep-98	ANN8CF3	20	11.726		208	95/P2	95/P2	468.02	151.39	284.24	11.14	27.68	9.74	3.52	955.73
S74136	07-Sep-98	ANN8CF3	42	20.822		208	95/P2	95/P2	871.69	268.81	504.71	19.78	49.14	17.28	6.24	1737.65
S74138	07-Sep-98	ANN8CF3	54	33.331		208	95/P2	95/P2	1449.26	430.30	807.94	31.64	78.66	27.66	9.99	2835.45
S74143	11-Sep-98	ANN8CF3	71	31.869		208	95/P2	95/P2	1320.71	411.43	772.50	30.28	75.22	26.45	9.57	2646.16
S74181	03-Sep-98	ANN8GFC	43	36.056		204	95/P2	95/P2	1863.87	465.48	873.99	34.25	85.09	29.94	10.82	3363.44
S79257	28-Aug-98	ANN8CF3	86	38.131		208	95/P2	95/P2	1431.11	492.27	924.30	36.22	90.01	31.64	11.44	3016.99
S79283	31-Aug-98	ANN8CF3	67	38.070		208	95/P2	95/P2	1496.22	491.49	922.82	36.16	89.85	31.59	11.43	3079.56
S79284	01-Sep-98	ANN8CF3	80	37.505		208	95/P2	95/P2	1480.11	484.20	909.12	35.63	88.51	31.12	11.26	3039.95
S79286	02-Sep-98	ANN8CF3	71	42.396		208	95/P2	95/P2	1708.56	547.33	1027.68	40.28	100.05	35.19	12.72	3471.81
S79288	03-Sep-98	ANN8GFC	53	39.318		204	95/P2	95/P2	1905.84	507.60	953.07	37.36	92.79	32.64	11.80	3541.10
S79290	04-Sep-98	ANN8CF3	77	38.194		208	95/P2	95/P2	1607.28	493.08	925.82	36.29	90.14	31.70	11.48	3195.79
S79294	08-Sep-98	ANN8CF3	92	38.373		208	95/P2	95/P2	1378.72	495.41	930.17	36.45	90.55	31.86	11.51	2974.67
S79296	09-Sep-98	ANN8CF3	88	38.001		208	95/P2	95/P2	1528.71	490.59	921.13	36.09	89.69	31.55	11.40	3109.16
S79298	10-Sep-98	ANN8CF3	84	37.031		208	95/P2	95/P2	1521.32	478.06	897.64	35.18	87.39	30.73	11.11	3061.43
S79300	11-Sep-98	ANN8CF3	63	38.054		208	95/P2	95/P2	1667.57	491.28	922.43	36.16	89.81	31.59	11.42	3250.26
S80702	14-Sep-98	ANN8CF3	59	41.114		208	95/P2	95/P2	1827.26	530.78	996.61	39.05	97.03	34.13	12.33	3537.19
S81601	01-Sep-98	ANN8CF3	90	34.367		208	95/P2	95/P2	1251.64	443.67	833.04	32.65	81.11	28.53	10.30	2680.94
S81611	04-Sep-98	ANN8CF3	82	37.939		208	95/P2	95/P2	1465.28	489.79	919.64	36.06	89.52	31.48	11.38	3043.15
S81614	08-Sep-98	ANN8CF3	56	34.848		208	95/P2	95/P2	1470.33	449.89	844.70	33.10	82.24	28.92	10.46	2919.64
S81621	11-Sep-98	ANN8CF3	69	34.135		208	95/P2	95/P2	1466.09	440.68	827.43	32.43	80.56	28.33	10.24	2885.76
S81623	14-Sep-98	ANN8CF3	53	34.436		208	95/P2	95/P2	1483.66	444.57	834.74	32.72	81.28	28.59	10.34	2915.90
S81651	02-Sep-98	ANN8CF3	82	35.244		208	95/P2	95/P2	1369.87	455.01	854.32	33.49	83.17	29.24	10.57	2835.67
S81653	03-Sep-98	ANN8CF3	70	34.862		208	95/P2	95/P2	1337.32	450.06	845.05	33.12	82.28	28.94	10.45	2787.22
S81655	07-Sep-98	ANN8CF3	71	35.769		208	95/P2	95/P2	1457.46	461.77	867.05	33.97	84.42	29.70	10.72	2945.09
S81656	09-Sep-98	ANN8CF3	51	35.752		208	95/P2	95/P2	1619.83	461.56	866.63	33.96	84.38	29.68	10.72	3106.76
S81658	10-Sep-98	ANN8CF3	52	35.218		208	95/P2	95/P2	1714.20	454.65	853.70	33.46	83.11	29.23	10.56	3178.91
S81659	14-Sep-98	ANN8AF3	61	37.739		206	95/P2	95/P2	1705.36	487.21	914.79	35.84	89.07	31.32	11.33	3274.92
S82093	31-Aug-98	ANN8CF3	86	33.226		208	95/P2	95/P2	1159.18	428.95	805.38	31.55	78.42	27.58	9.97	2541.03
S82095	04-Sep-98	ANN8CF3	64	35.383		208	95/P2	95/P2	1490.91	456.80	857.69	33.61	83.50	29.36	10.61	2962.48
S82097	07-Sep-98	ANN8CF3	80	37.295		208	95/P2	95/P2	1536.43	481.48	904.04	35.43	88.02	30.95	11.18	3087.53
S82099	08-Sep-98	ANN8CF3	61	35.260		208	95/P2	95/P2	1409.05	455.21	854.70	33.49	83.21	29.28	10.57	2875.51
S82124	31-Aug-98	ANN8CF3	84	34.779		208	95/P2	95/P2	1338.59	449.00	843.05	33.03	82.08	28.87	10.43	2785.05
Total PINASTER/SAWLOG (AU			****	1159.711	0.000				48090.95	14971.87	28111.39	1101.66	2736.95	962.58	347.91	96323.31

Species/Product: RADIATA/SAWLOG (AUTO SCAN)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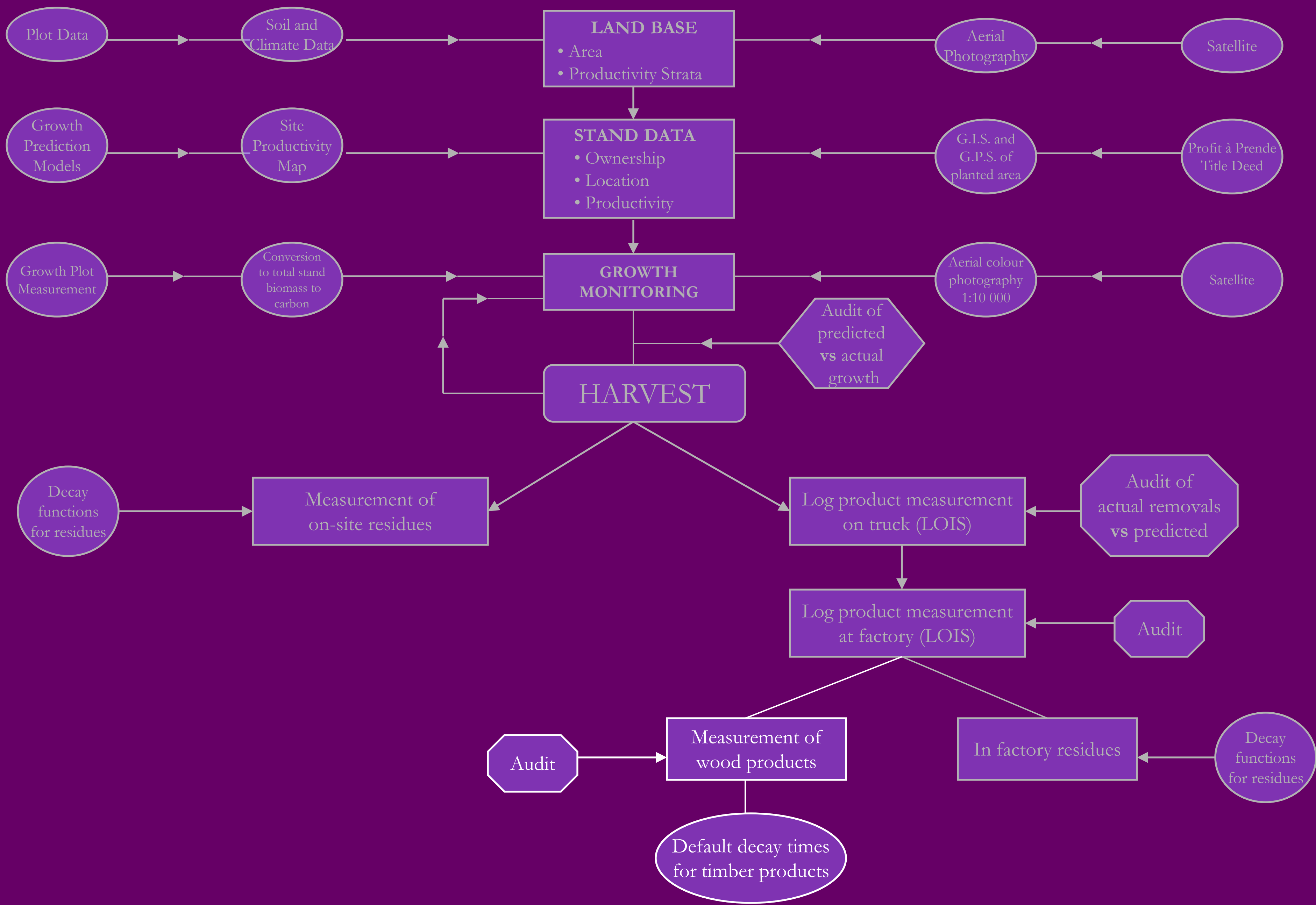
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Audit
Measurement of wood products
In factory residues
Decay functions for residues
Default decay times for timber products

LOG TIMBER RECEIVAL RECORD

(to be completed by Mill Owner/Manager and original forwarded to local CALM District office within 3 working day after end of calendar month)

Buyers Name Wesfi Pty Ltd

Month JUNE 19 98

Sawmill Welshpool

Delivery Date	Delivery Note No.	Product (species and type)	Quantity(✔) m³ ☐ No. of logs ☐ tonnes ☐	Delivery Date	Delivery Note No.	Product (species and type)	Quantity(✔) m³ ☐ No. of logs ☐ tonnes ☐
8/06/1998	S 073868	PinChip	✓ 29.00	10/06/1998	S 073702	PinChip	✓ 30.00
8/06/1998	S 073869	PinChip	✓ 28.30	10/06/1998	S 073703	PinChip	✓ 30.25
8/06/1998	S 073896	PinChip	✓ 30.25	10/06/1998	S 073704	PinChip	✓ 28.55
8/06/1998	S 073897	PinChip	✓ 28.05	10/06/1998	S 073754	PinChip	✓ 29.65
8/06/1998	S 073898	PinChip	✓ 29.30	10/06/1998	S 073755	PinChip	✓ 29.95
9/06/1998	S 073520	PinChip	✓ 30.05	10/06/1998	S 073756	PinChip	✓ 30.10
9/06/1998	S 073521	PinChip	✓ 32.50	10/06/1998	S 073757	PinChip	✓ 29.95
9/06/1998	S 073522	PinChip	✓ 27.65	10/06/1998	S 073785	PinChip	✓ 29.30
9/06/1998	S 073701	PinChip	✓ 30.55	10/06/1998	S 073786	PinChip	✓ 27.00
9/06/1998	S 073751	PinChip	✓ 28.35	10/06/1998	S 073787	PinChip	✓ 27.45
9/06/1998	S 073752	PinChip	✓ 29.30	10/06/1998	S 073873	PinChip	✓ 26.45
9/06/1998	S 073753	PinChip	✓ 29.80	10/06/1998	S 073874	PinChip	✓ 30.85
9/06/1998	S 073782	PinChip	✓ 29.50	10/06/1998	S 073875	PinChip	✓ 29.25
9/06/1998	S 073783	PinChip	✓ 32.05	11/06/1998	S 073677	PinChip	✓ 29.10
9/06/1998	S 073784	PinChip	✓ 29.85	11/06/1998	S 073678	PinChip	✓ 29.15
9/06/1998	S 073870	PinChip	✓ 29.25	11/06/1998	S 073679	RadChip	✓ 28.00
9/06/1998	S 073871	PinChip	✓ 30.80	11/06/1998	S 073705	PinChip	✓ 30.25
9/06/1998	S 073872	PinChip	✓ 28.70	11/06/1998	S 073706	PinChip	✓ 30.45
9/06/1998	S 073899	PinChip	✓ 29.20	11/06/1998	S 073707	PinChip	✓ 30.65
9/06/1998	S 073900	PinChip	✓ 29.90	11/06/1998	S 073758	RadChip	✓ 27.60
9/06/1998	S 073925	PinChip	✓ 31.60	11/06/1998	S 073759	RadChip	✓ 30.80
10/06/1998	S 073523	PinChip	✓ 25.90	11/06/1998	S 073760	RadChip	✓ 29.00
10/06/1998	S 073524	PinChip	✓ 31.90	11/06/1998	S 073788	PinChip	✓ 31.25
10/06/1998	S 073525	PinChip	✓ 32.30	11/06/1998	S 073789	PinChip	✓ 26.20
		Subtotal	714.05			Subtotal	701.20
						Monthly total	1415.25

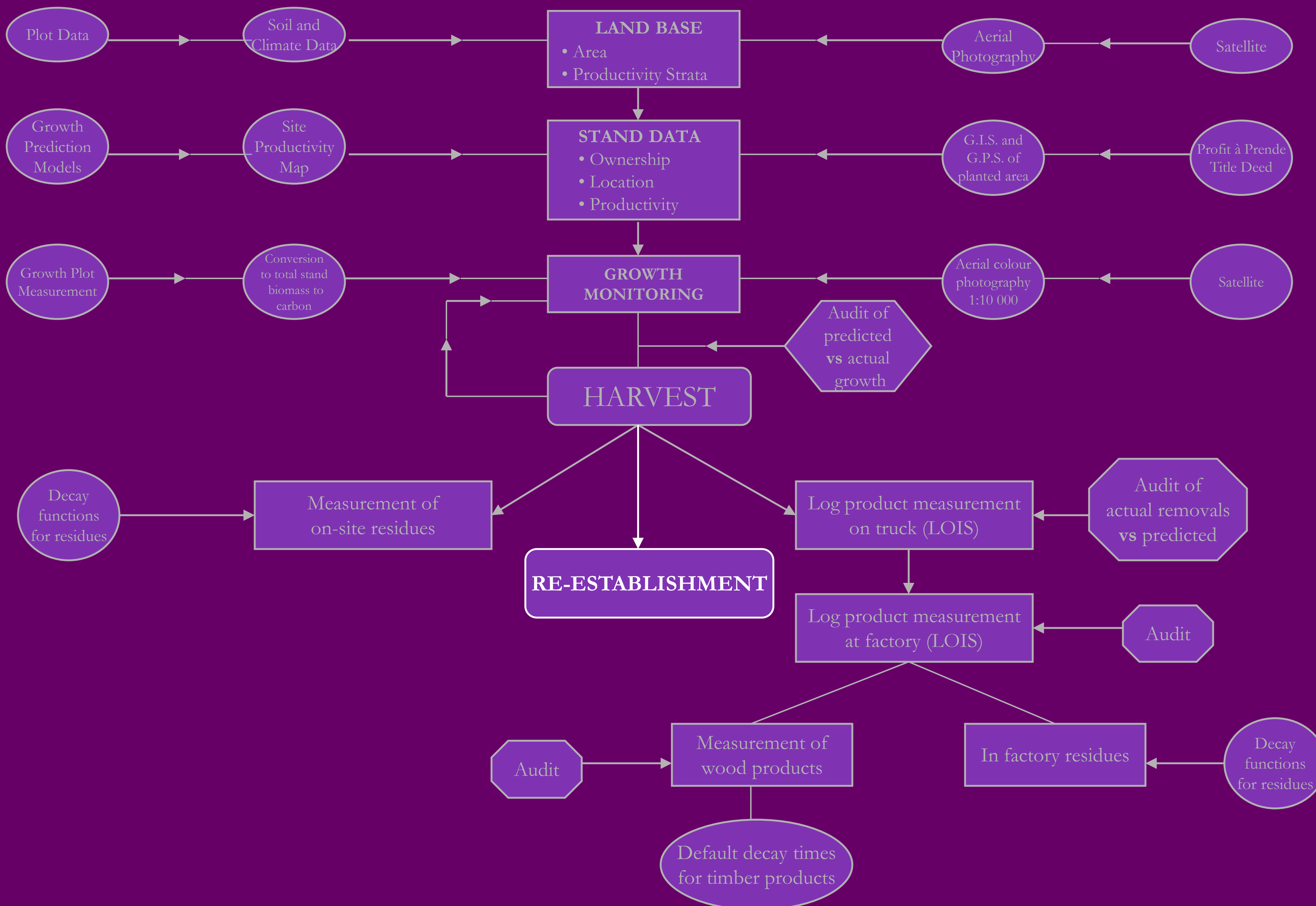
NOTE: Deliveries ex private property to be underlined in *red*

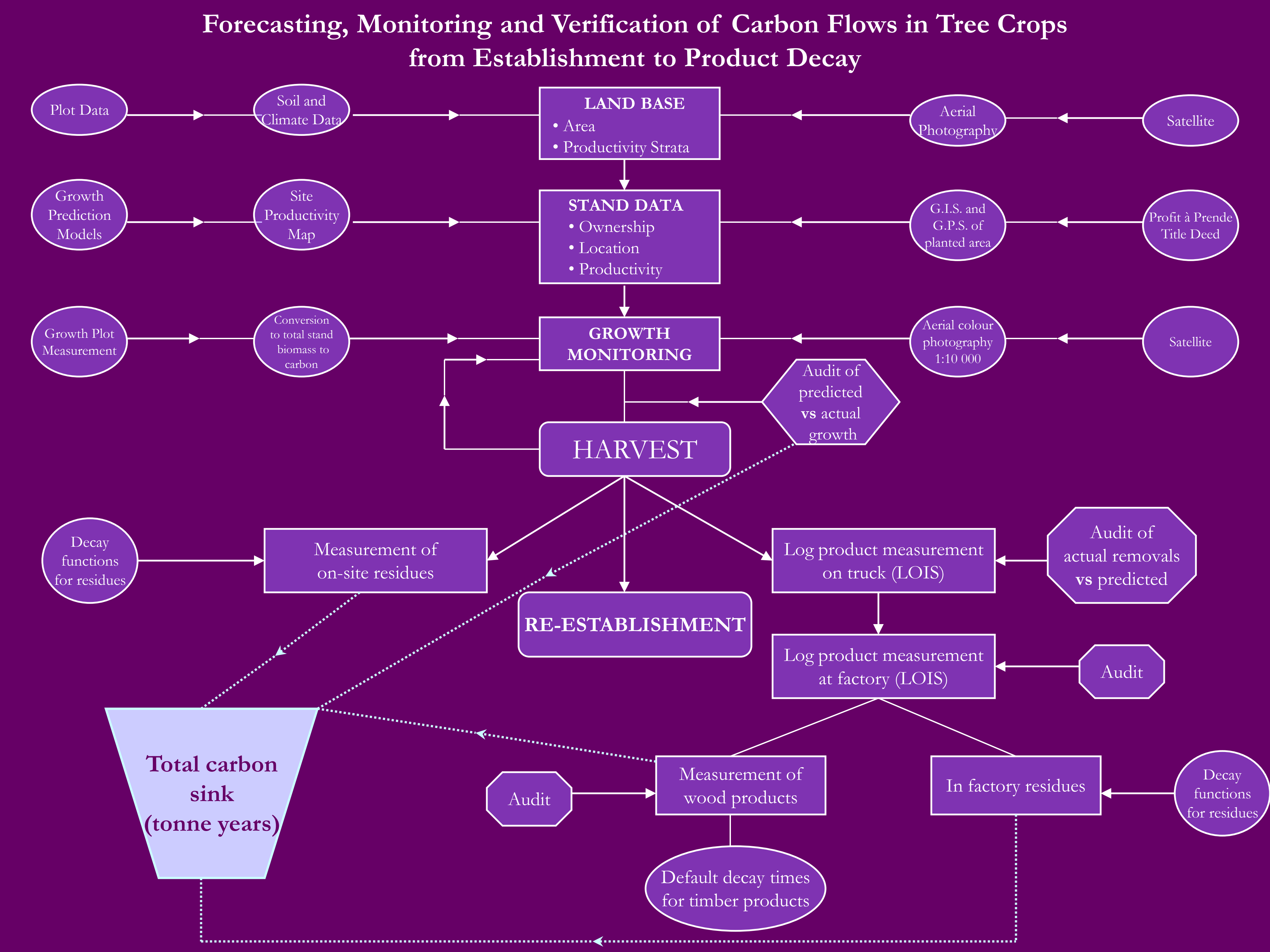
RECORD OF FOREST OFFICERS' INSPECTIONS

Date	Particulars of Inspection and Results	Action Required	Signatures: Forest Officer	Signatures: Mill Manager

THIS BOOK TO BE AVAILABLE FOR INSPECTION BY FOREST OFFICERS DURING MILL WORKING HOURS

04738/11/91—250 Bks—S/9625


Plot Data
Soil and Climate Data
LAND BASE
• Area
• Productivity Strata
Aerial Photography
Satellite
Growth Prediction Models
Site Productivity Map
STAND DATA
• Ownership
• Location
• Productivity
G.I.S. and G.P.S. of planted area
Profit à Prende Title Deed
Growth Plot Measurement
Conversion to total stand biomass to carbon
GROWTH MONITORING
Aerial colour photography 1:10 000
Satellite
Audit of predicted vs actual growth
HARVEST
Decay functions for residues
Measurement of on-site residues
RE-ESTABLISHMENT
Log product measurement on truck (LOIS)
Audit of actual removals vs predicted
Log product measurement at factory (LOIS)
Audit
Audit
Measurement of wood products
In factory residues
Decay functions for residues
Default decay times for timber products



Forecasting, Monitoring and Verification of Carbon Flows in Tree Crops from Establishment to Product Decay
Plot Data
Soil and Climate Data
LAND BASE
• Area
• Productivity Strata
Aerial Photography
Satellite
Growth Prediction Models
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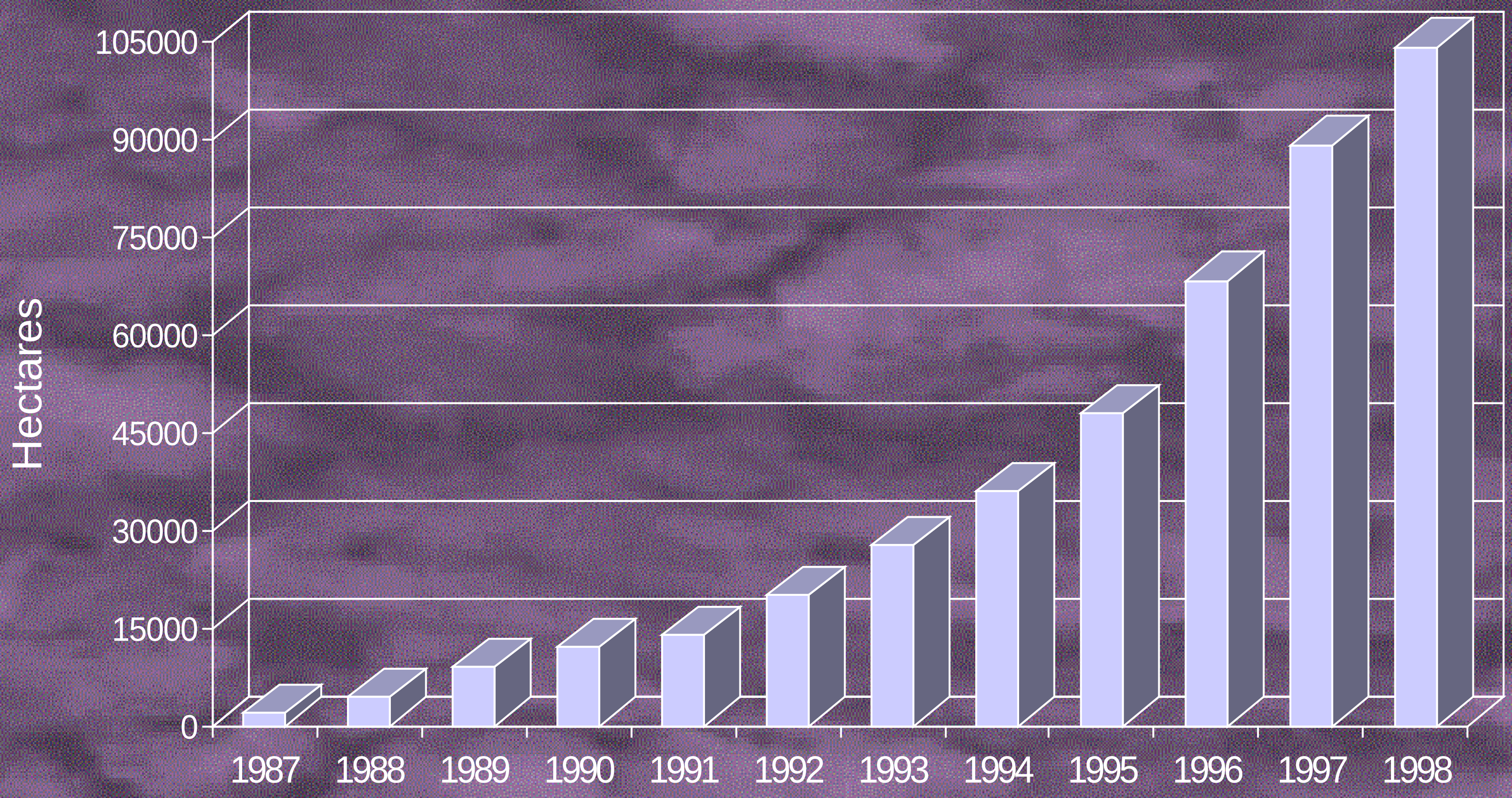
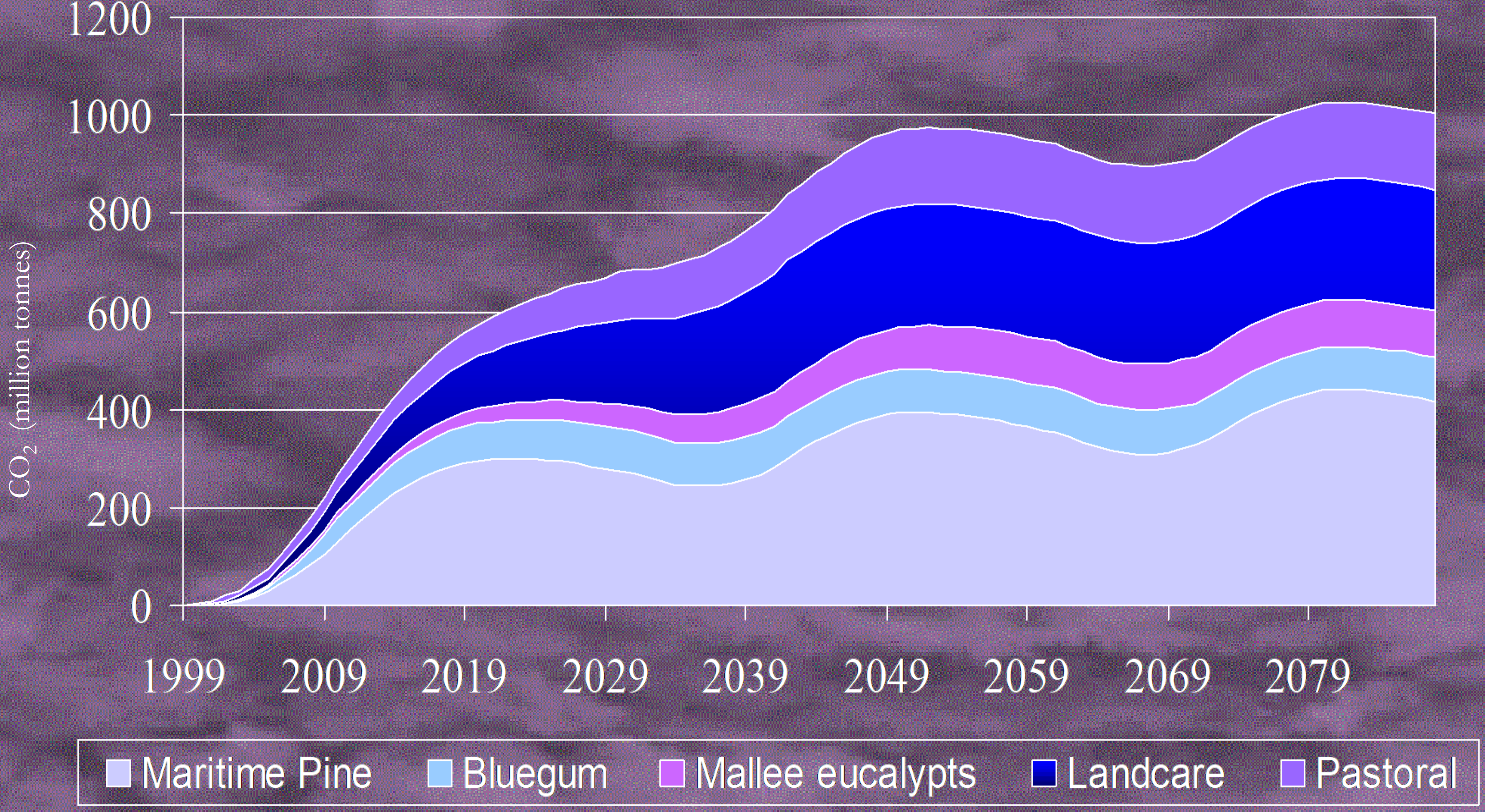
Log product measurement at factory (LOIS)
Audit
Total carbon sink (tonne years)
Audit
Measurement of wood products
In factory residues
Decay functions for residues
Default decay times for timber products

Implementation rate and scale

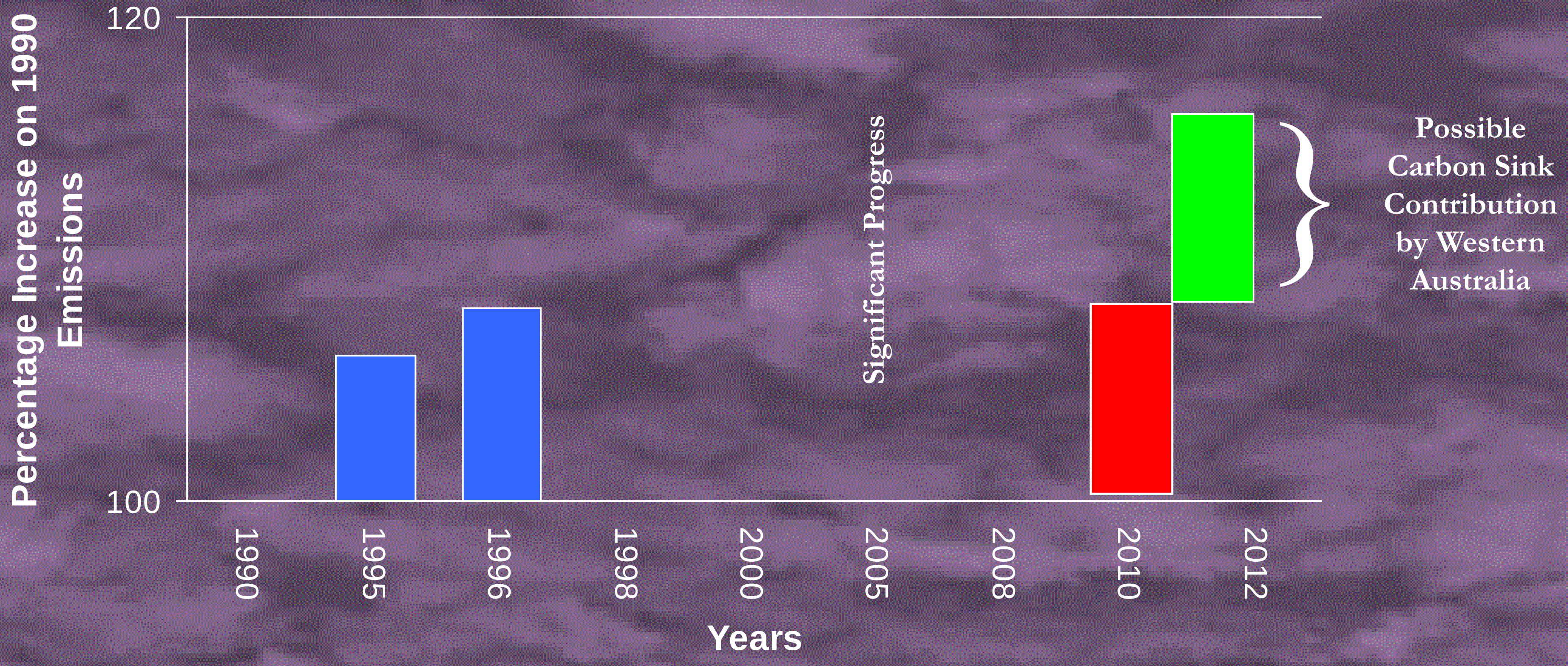
Total area of *E. globulus* in WA

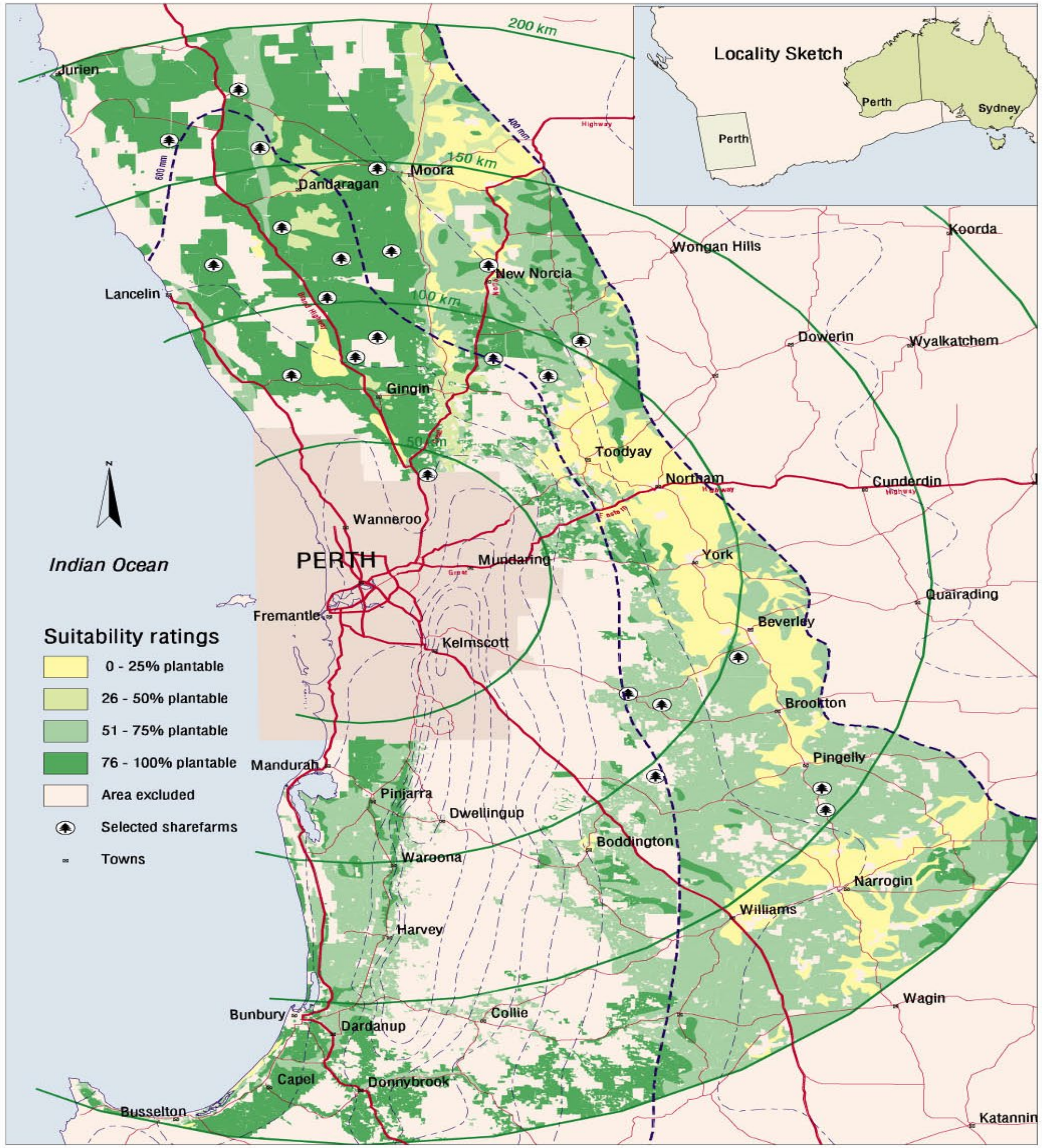


Cumulative CO_2 pool over 90 years



Australia's Kyoto Targets





Other features

- Major roads
- Proposed major roads
- Other roads
- Radiating buffers
- Key rainfall isohyets
- Other rainfall isohyets

Scale 1:1500000
Projection: AMG(Zone50)
Date: 6/11/1998

Conservation and Land Management
IMB/GISS Job No.98042104-pe2

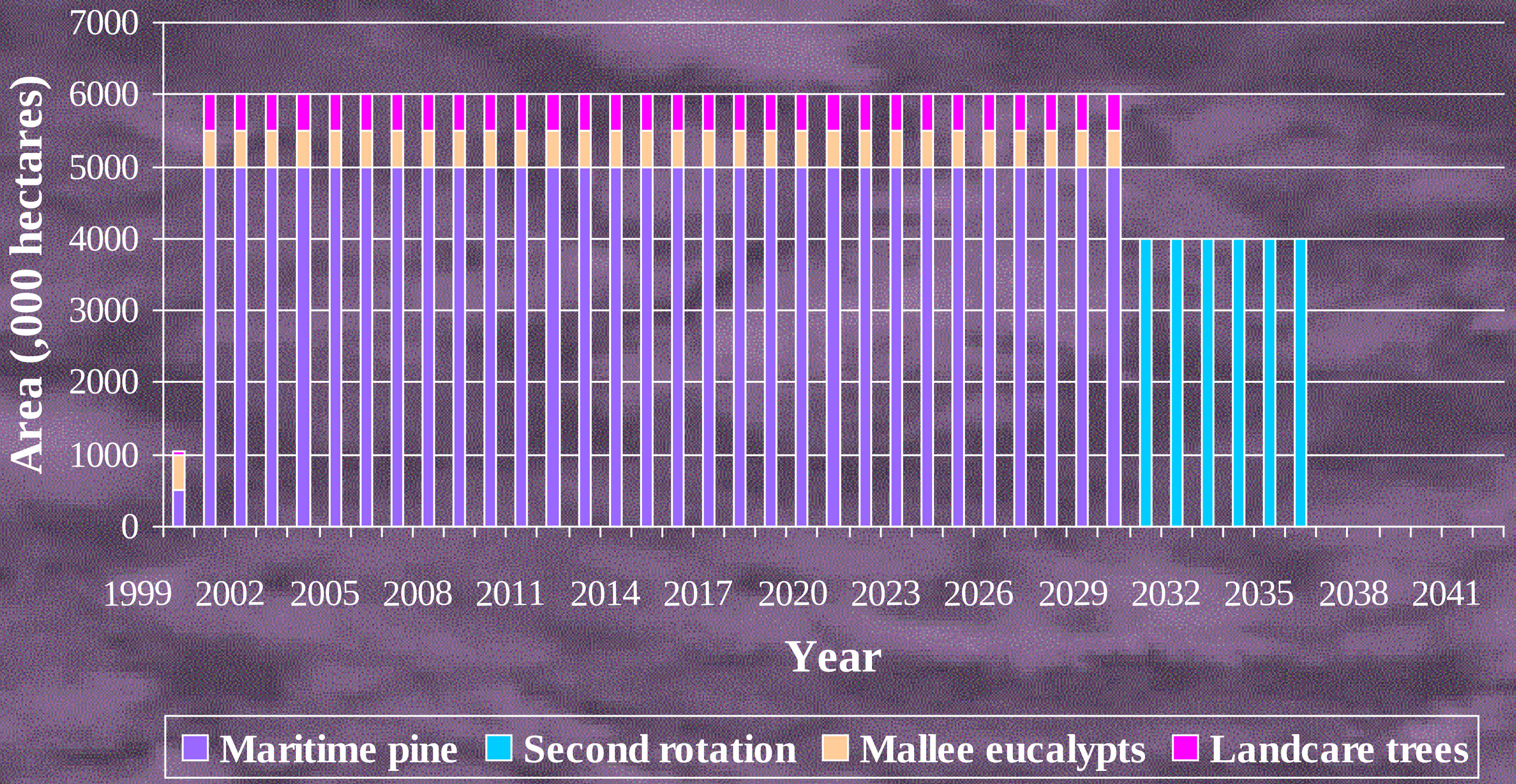
Data sources used

TENURE - Dept of Land Admin.
VEGETATION - Conserv. and Land Mgmt
SOILS - AgWest
RAINFALL - Min. for Planning

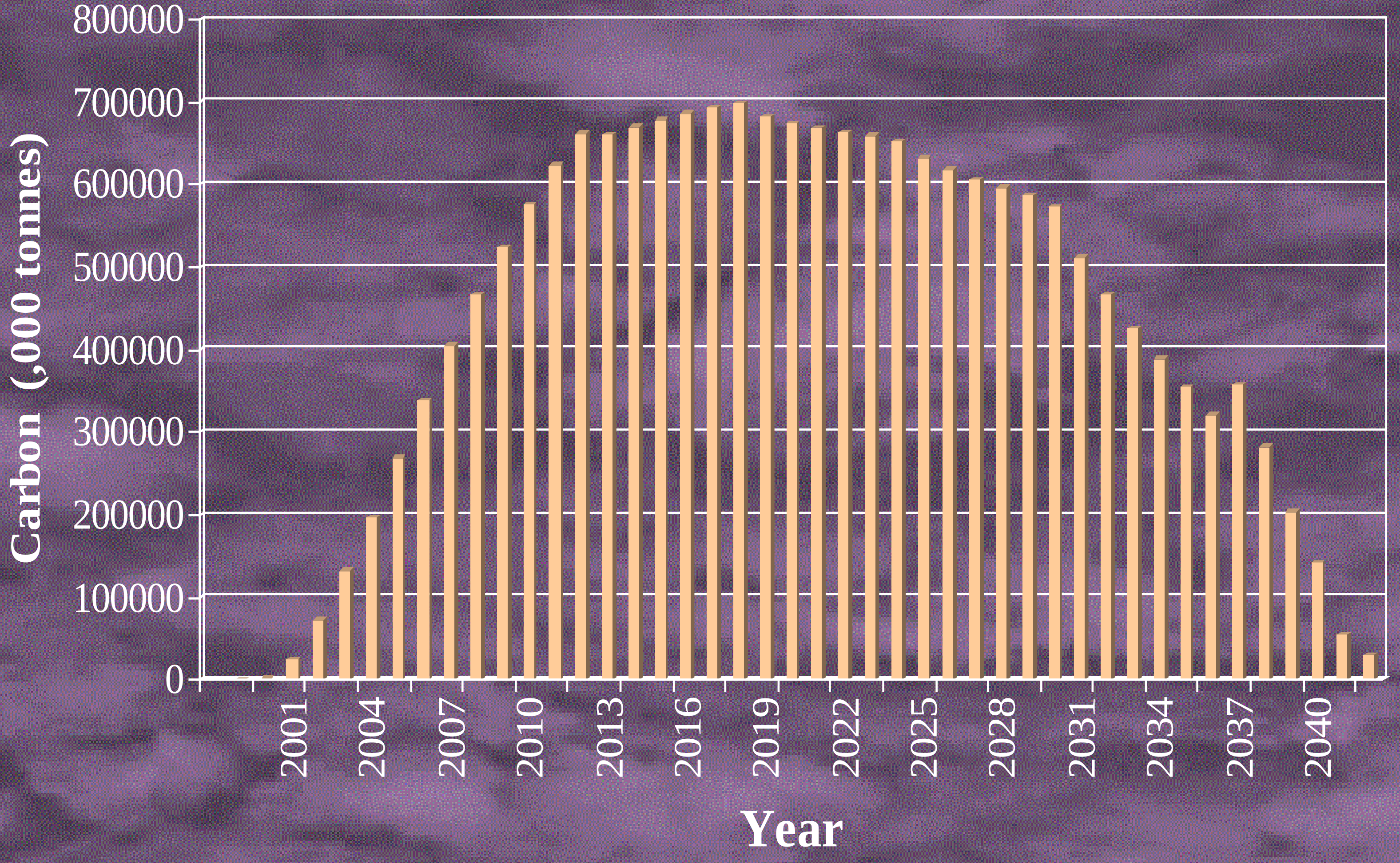
Area of Northern Sector: Available land: cleared agricultural land in the target area, by rainfall zone and distance from Perth

	Rainfall		Total
	400- 600	**> 600**	**ha**
Distance (km)	**Area (ha)**		
< 50	0	10, 696	10, 696
51-100	151,751	224, 814	376, 565
101-150	333, 920	170, 090	504, 010
151-200	362, 894	33, 059	395, 953
Total	**848, 565**	**438, 659**	**1, 287, 224**

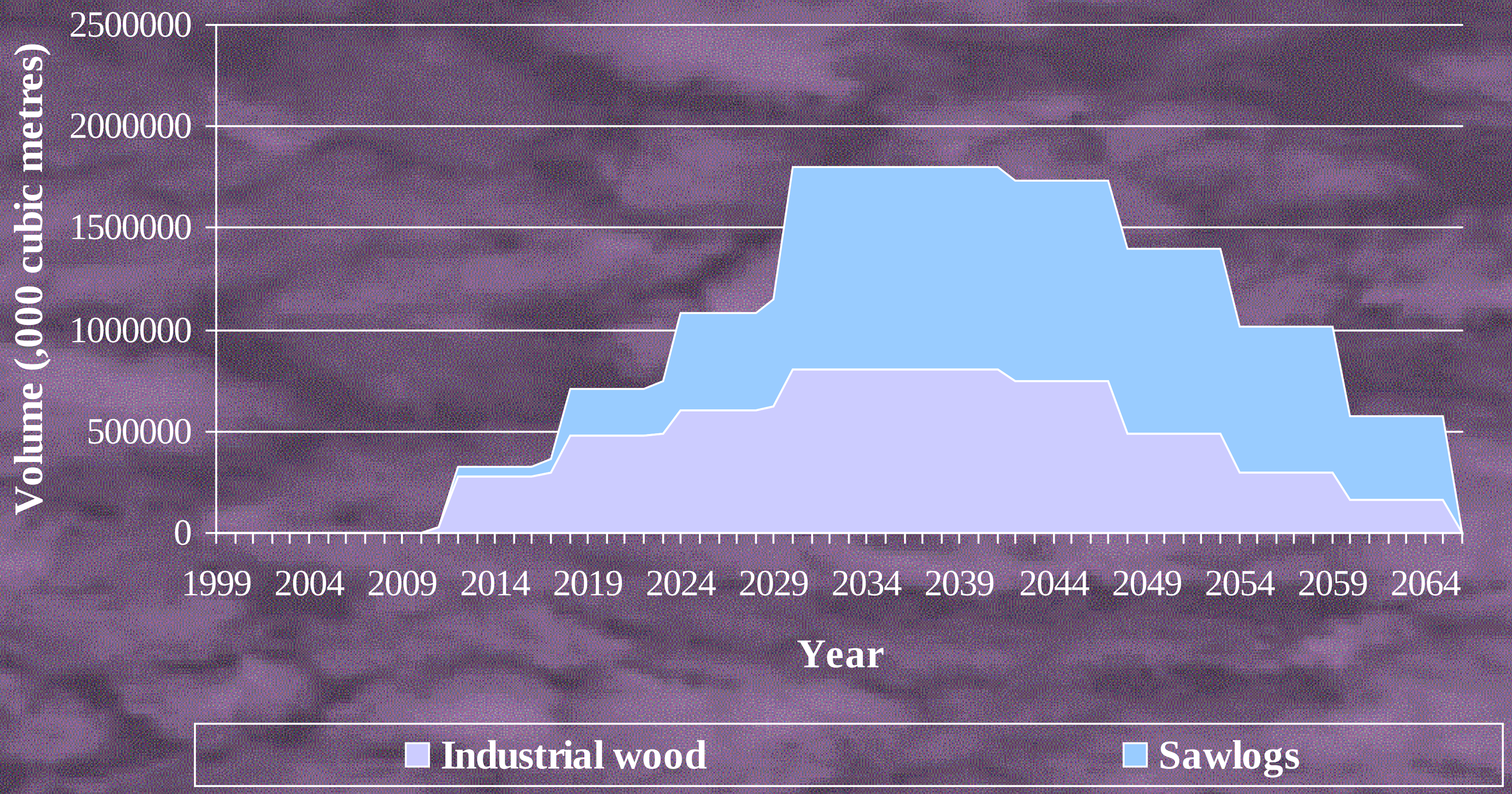
Proposed planting program for Strategy 1



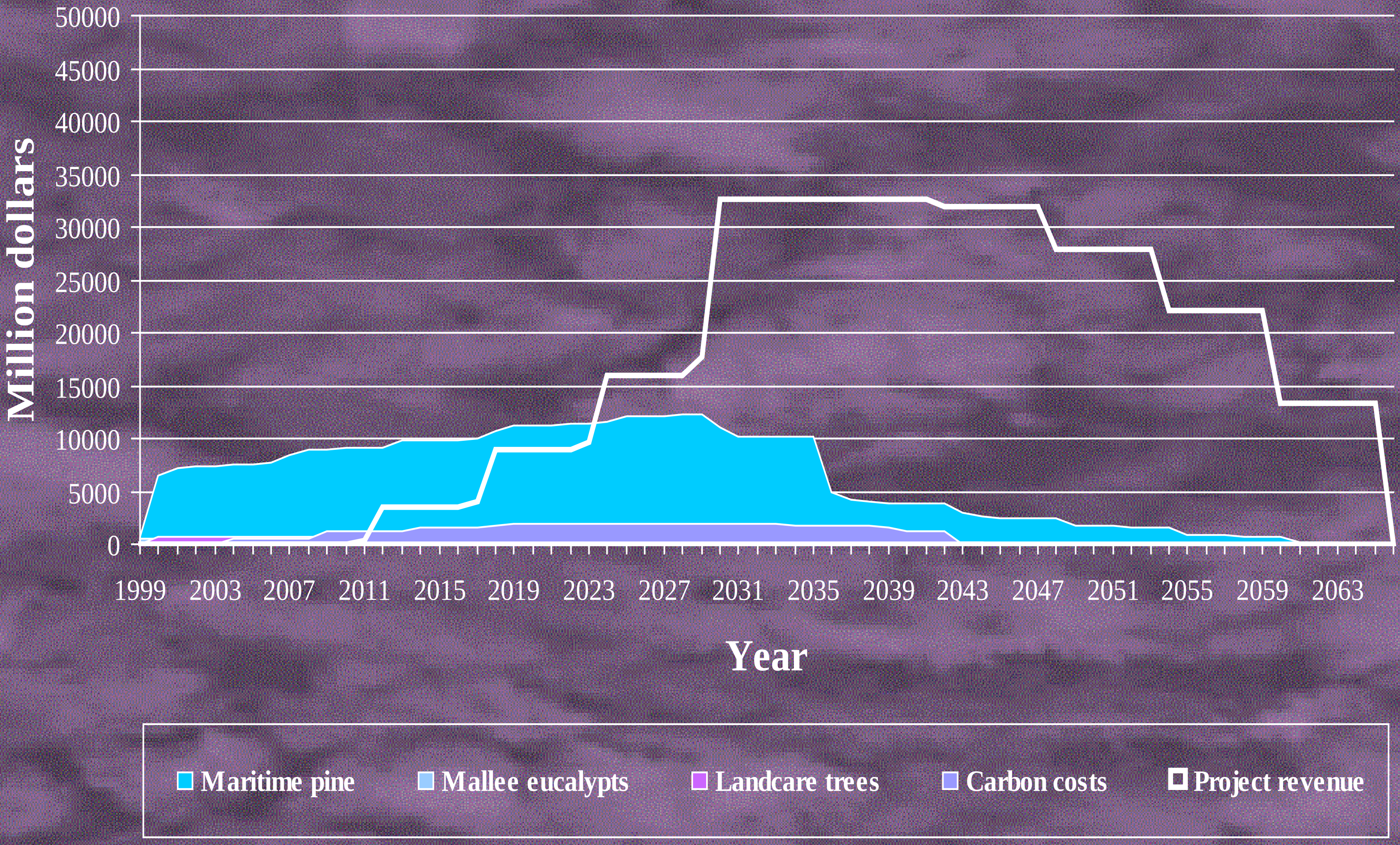
Annual sequestration for Strategy 1



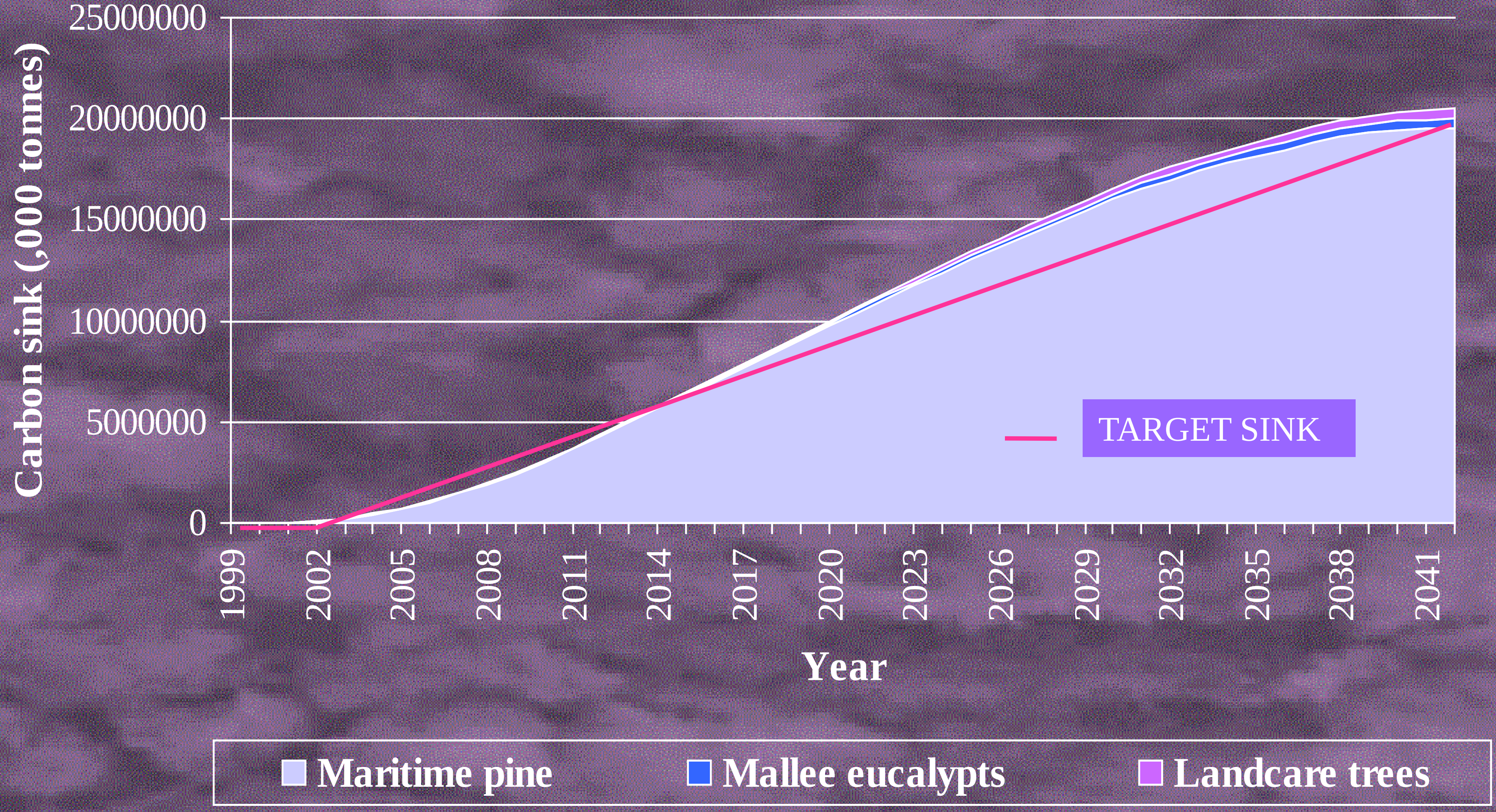
Projected woodflows: Strategy 1



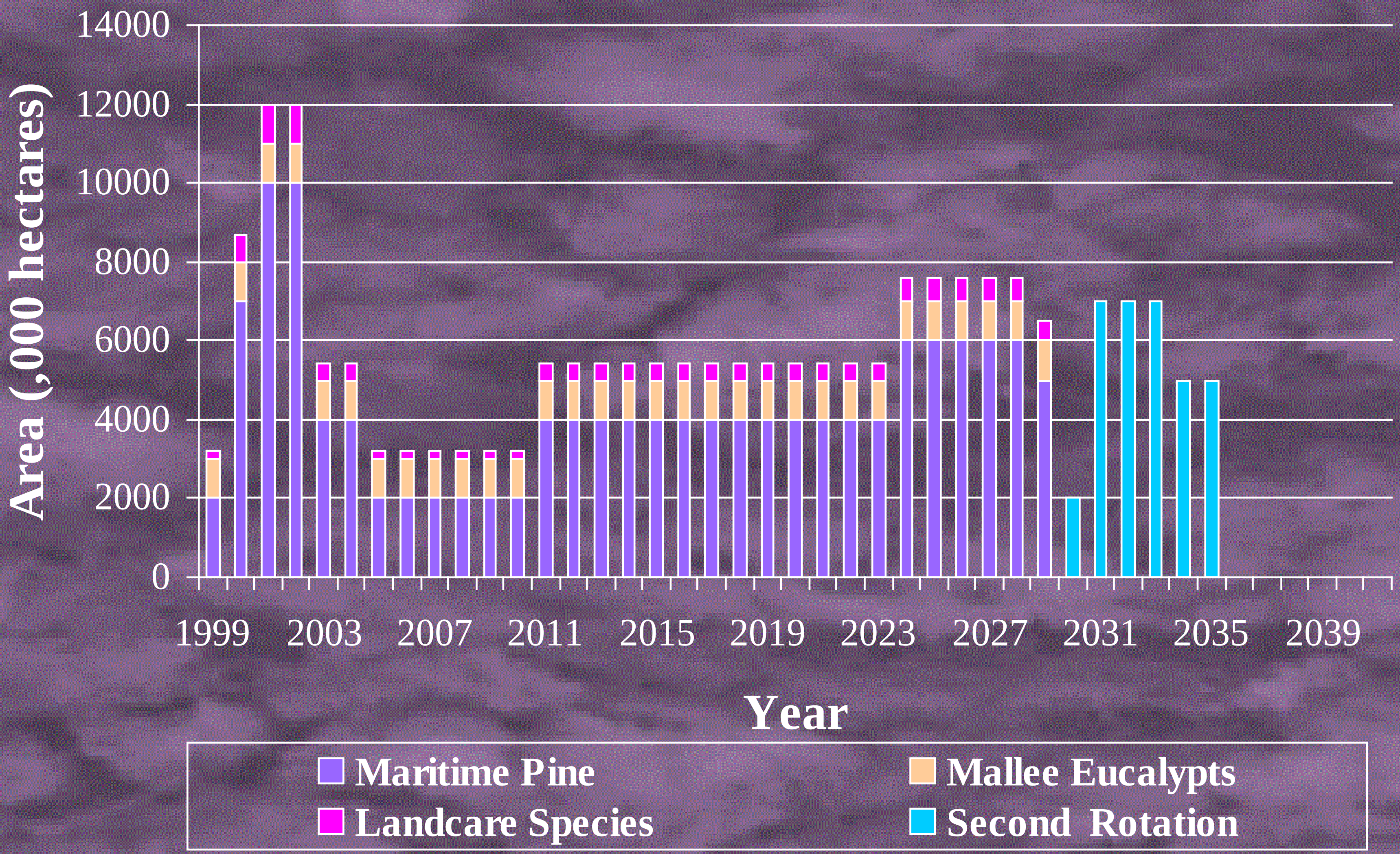
Project cost and revenue streams - Strategy 1



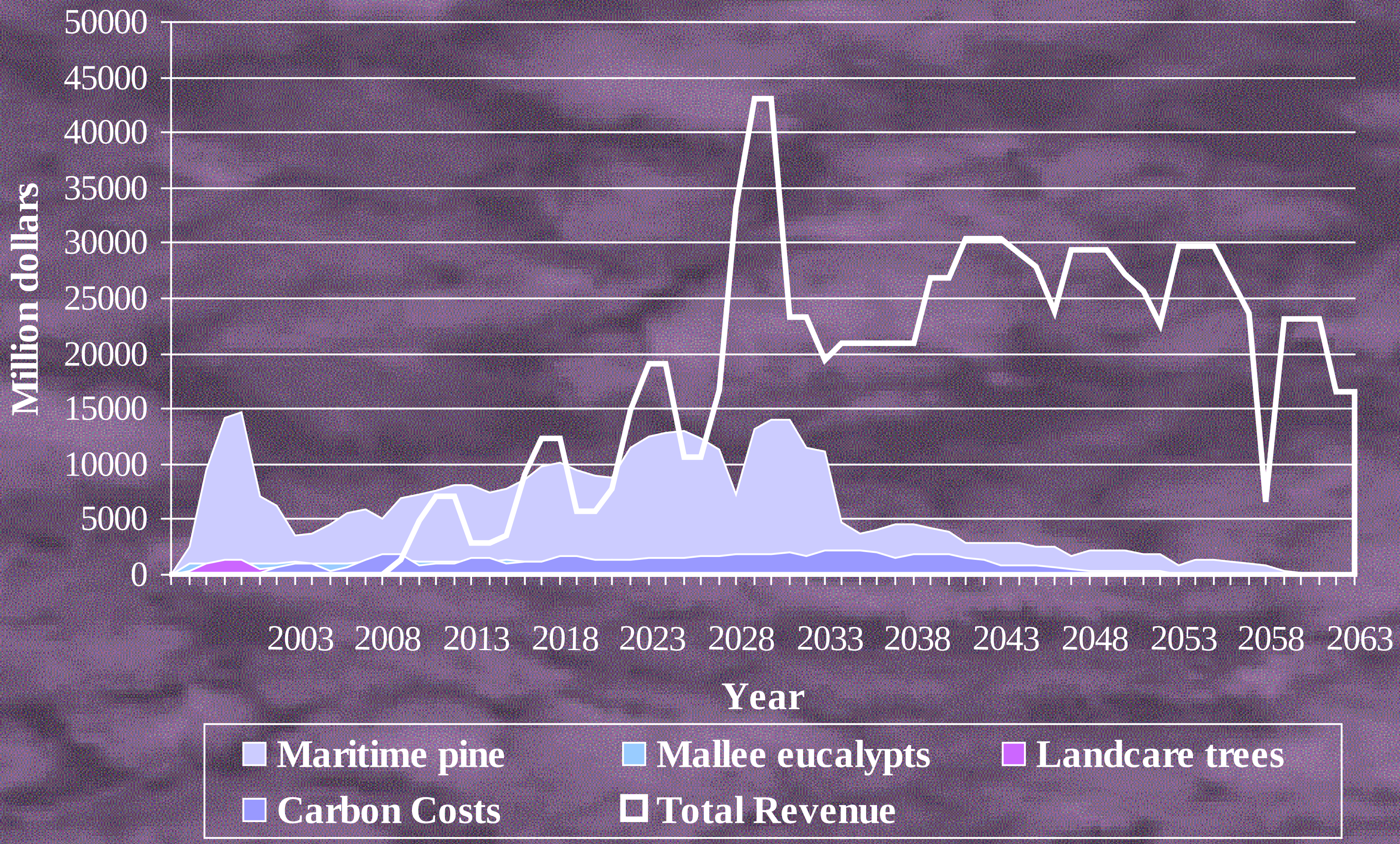
Carbon sink from Strategy 1



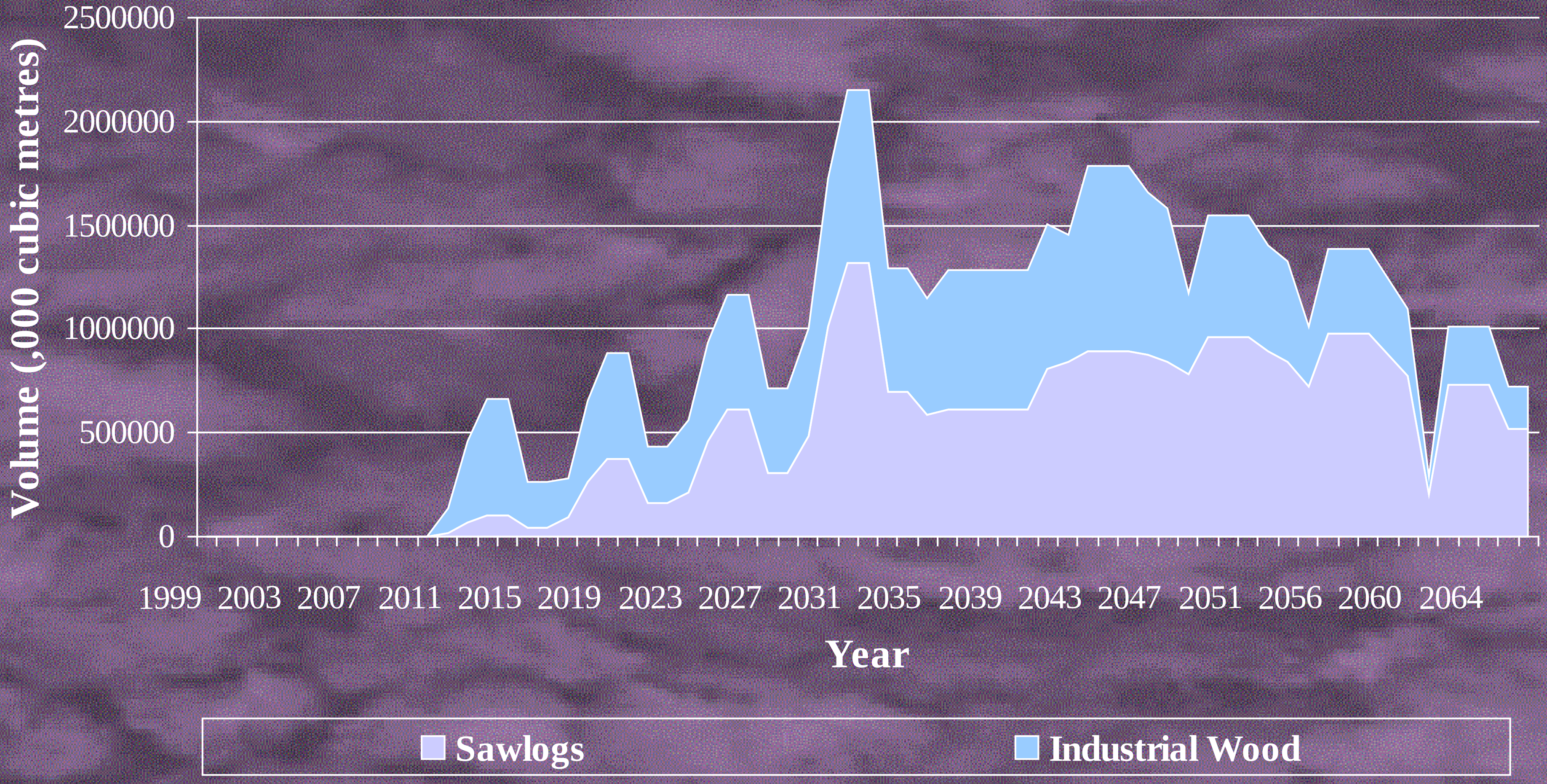
Proposed planting program for Strategy 2



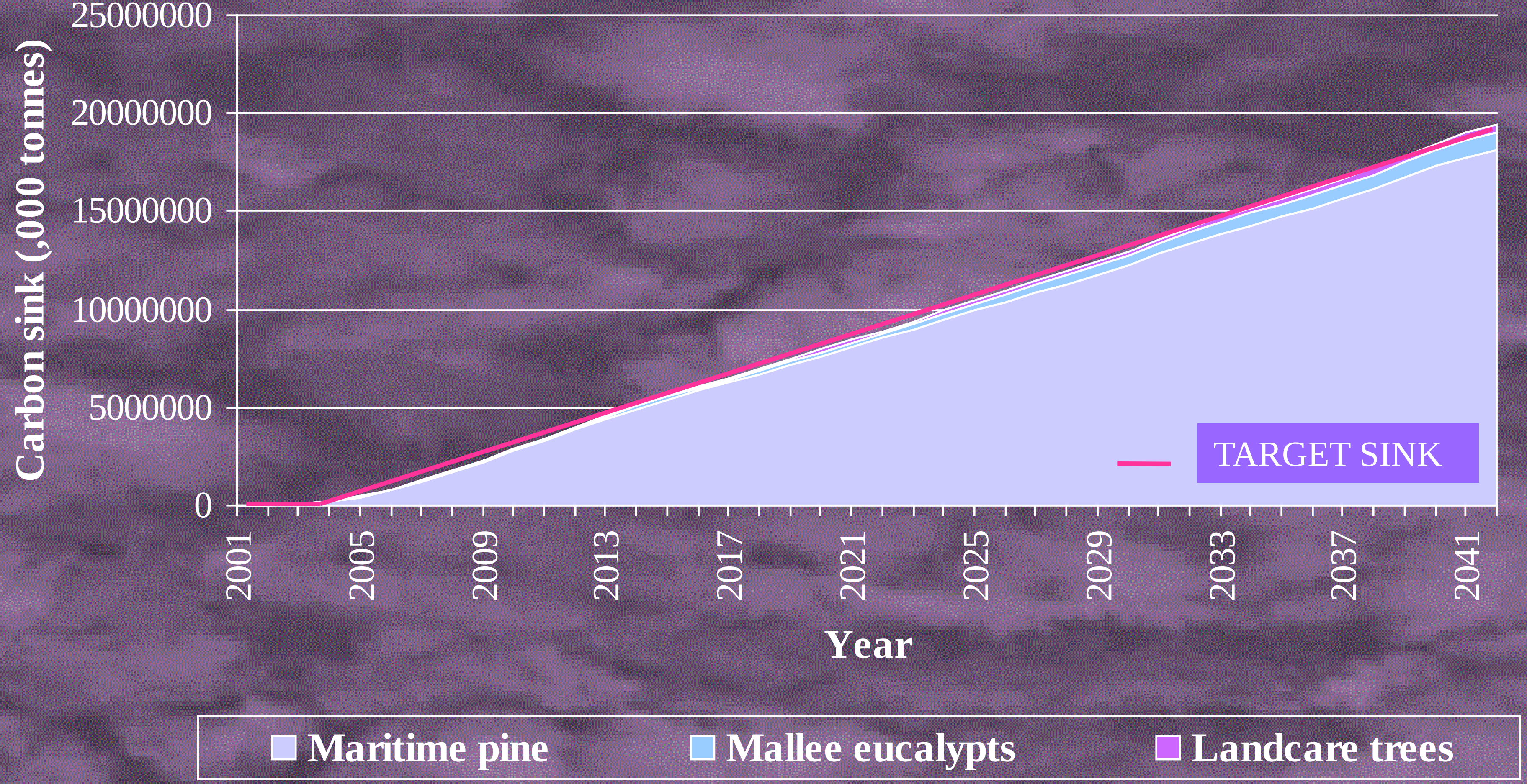
Project cost and revenue streams - Strategy 2



Projected woodflows: Strategy 2



Carbon sink from Strategy 2



The impact on cost per carbon tonne per hectare for each species type under high and low revenue scenerios

	Maritime Pine	Mallee eucalypts	Landcare species
High revenue			
Total revenue	$ 7, 170	$ 2, 250	$ 500
NPV	($ 484)	($ 235)	($ 1, 365)
NPV per average tonne	($ 4.70)	($ 7.59)	($ 40.15)
IRR (timber only)	5.9%	4.8%	-5.9%
Low revenue			
Total revenue	$ 5, 867	$ 0	$ 0
NPV	$ 737	($ 1, 076)	($ 1, 481)
NPV per average	($ 7.15)	($ 34.70)	($ 42. 68)
IRR (timber only)	4.8%	-	-

Financial summary of the Project

	Uniform planting strategy	Even sequestration strategy
Total cost ($ 000)	523, 626	533, 119
Total revenue ($ 000)	1, 137, 461	1, 191, 610
Discounted cost ($ 000)	142, 006	137, 540
Discounted revenue ($ 000)	82, 110	79, 443
Average carbon sink (000 tonnnes)	11, 180	10, 293
NPV ($ 000)	(58, 896)	(58, 098)
NPV per average tonne	($ 5.36)	($ 5.64)
IRR	4.1%	3.8%

Effect of timber revenue on carbon cost ($ per tonne)

Low Revenue (minus 10%)		
	Strategy 1	**Strategy 2**
NPV per average tonne	$ 6.09	$ 6.42
	3.5%	3.2%
High Revenue (plus 10% - includes oil and sandalwood)		
	Strategy 1	**Strategy 2**
NPV per average tonne	$ 4.08	$ 3.69
	4.9%	4.9%

Effect of carbon value on Project performance (internal rates of return)

Value of Carbon	Strategy 1	Strategy 2
$ 12	7.3%	6.8%
$ 20	10.5%	9.8%
$ 40	21.8%	20.8%

Australia's Kyoto Targets